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ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

Τα Νέα της Ε Ε Ε Ε Γ Μ

146

Κλιματική Αλλαγή και Κατολισθήσεις

Τα ακραία καιρικά φαινόμενα και οι εξ αυτών φυσικές καταστροφές σ' ολόκληρο τον πλανήτη επιβεβαιώνουν την κλιματική αλλαγή που συντελείται. Η Διακυβερνητική Επιτροπή για την Αλλαγή του Κλίματος (IPCC: Intergovernmental Panel on Climate Change) αναγνωρίζει ότι οι πλημμύρες, η ερημοποίηση, οι κατολισθήσεις, οι μετακινήσεις εδαφικών μαζών και οι δασικές πυρκαγιές είναι κάποια από τα φαινόμενα τα οποία ενισχύει η κλιματική αλλαγή. Το κόστος των φυσικών καταστροφών που έχουν σχέση με κλιματικούς παράγοντες αυξάνει τα τελευταία 40 χρόνια σε παγκόσμιο επίπεδο, ενώ παράλληλα αναγνωρίζεται ότι υπάρχει σαφής αύξηση της έκθεσης των ανθρωπίνων δραστηριοτήτων σε κίνδυνο.

(συνέχεια στην σελ.3)

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(συνέχεια από την πρώτη σελίδα)

Οι κατολισθήσεις είναι ένας από τους ο σημαντικώτερους τύπους φυσικών καταστροφών, επιφέροντας θανάτους και τραυματισμούς ανθρώπων αλλά και σημαντικές ζημιές σε περιουσίες και υποδομές, και δημιουργούν προβλήματα βιωσιμότητα οικισμών καθώς και στην ευημερία του ανθρώπινου πληθυσμού.

Σε ότι αφορά στο ρόλο των κλιματικών παραγόντων, αναγνωρίζεται ότι η βροχόπτωση είναι το πιο σημαντικό περιβαλλοντικό αίτιο κατολισθητικών συμβάντων. Ταυτόχρονα θεωρείται ότι η υψηλής έντασης βροχοπτώσεις αποτελούν την πιο σημαντική αιτία έναρξης ή το πιο καθοριστικό έναυσμα μιας κατολίσθησης.

Ιδιαίτερα στον ελληνικό χώρο, όπου οι εδαφικές κινήσεις και τα κατολισθητικά φαινόμενα αποτελούν συχνό φαινόμενο, καθώς η εκδήλωσή τους ευνοείται από το γεωτεκτονικό κάθεστώς του Ελληνικού χώρου, έχει εξαιρετικό ενδιαφέρον το είδος και η έκταση μιας τέτοιας αλλαγής.

Μία από τις πιο τραγικές περιπτώσεις κατολίσθησης στην Ελλάδα είναι αυτή που «έθαψε» το Μικρό Χωριό της Ευρυτανίας, στις 13 Ιανουαρίου 1963. Ένα τρομερό βουητό, που έβγαινε μέσα από το βουνό, ακούστηκε λίγο μετά τις 8 το πρωί ως έσχατη προειδοποίηση καθώς η πλαγιά κατρακύλησε καταπλακώνοντας μεγάλο μέρος του χωριού. Ένα τεράστιο κύμα λάσπης, παρασέρνοντας βράχια και δέντρα, σκέπασε τα μισά από τα 150 πέτρινα σπίτια του Μικρού Χωριού. Δεκατρείς άνθρωποι έχασαν τη ζωή τους. Η αιτία της δραματικής κατολίσθησης εντοπίστηκε, πέρα από το σαθρό του εδάφους, στις διαρκείς βροχοπτώσεις των προηγούμενων μηνών. Η κατολίσθηση, με μικρότερη ένταση, συνεχίστηκε για αρκετές ημέρες. Ένα νέο Μικρό Χωριό ανεγέρθηκε σε κοντινό ασφαλές σημείο, αν και μερικοί κάτοικοι έμειναν στον παλιό οικισμό. (https://www.kathimerini.gr/society/998006/o-efialtis-ton-katolisthiseon)

(https://tempo24.news/eidisi/114360/i-pio-katastrofiki-katolisthisi-stin-elliniki-istoria)

Έχοντας υπ' όψη τα παραπάνω θα πρέπει οι αρμόδιοι φορείς της Ελληνικής Πολιτείας να εκπονήσουν Εθνικό Πρόγραμμα Μείωσης Κινδύνων από Κατολισθήσεις, όπως το πρόσφατα θεσμοθετημένο "The US National Landslide Preparedness Act" (παρουσιάζεται στην σελίδα 51) με στόχο τη βελτίωση του εντοπισμού και της κατανόησης των κινδύνων κατολίσθησης, την προστασίας των οικισμών, την διάσωση ζωών, την μείωση των απωλειών περιουσίας και την βελτίωση της ετοιμότητας για καταστάσεις έκτακτης ανάγκης.

Ομιλία Εγκατάστασης
του Προέδρου της Ακαδημίας Αθηνών
ΛΟΥΚΑ Γ. ΧΡΙΣΤΟΦΟΡΟΥ

Θέμα: ΕΝΕΡΓΕΙΑ

1. ΠΡΟΛΟΓΟΣ

Πρώτος ο Αριστοτέλης εισήγαγε τη λέξη *ενέργεια* τον 4ο π.Χ. αιώνα [1]. Ωστόσο η λέξη *ενέργεια* δεν υπεισήλθε στην επιστήμη παρά τον 19ο αιώνα [2, 3] από τον Thomas Young. Έκτοτε η έννοια και η σημασία της ενέργειας αναγνωρίστηκαν σταδιακά, όπως και οι διάφορες μορφές της ενέργειας (λ.χ. κινητική, δυναμική, θερμική, ηλεκτρική). Όλα τα φαινόμενα που σχετίζονται με την εκτέλεση έργου συνδέονται μέσω της ενέργειας. Ταυτίστηκε έτσι η ενέργεια με την ικανότητα ενός συστήματος να εκτελεί έργον.

Από τον 19ο αιώνα άρχισε να αναγνωρίζεται η ενέργεια υπό τη σημερινή της έννοια, αν και οι νόμοι πάνω στους οποίους στηριζόταν τροποποιήθηκαν στα μέσα του 19ου αιώνα, όταν ανακαλύφθηκε ότι η μάζα είναι μία μορφή ενέργειας. Έκτοτε η κοινωνία στράφηκε προς την επιστήμη και την τεχνολογία της ενέργειας, και αυτή η στροφή άλλαξε ριζικά τη σχέση του ανθρώπου με την ενέργεια. Νέοι τρόποι μετασχηματισμού της ενέργειας από μια μορφή σε άλλη ανακαλύφθηκαν και νέες μηχανές εφευρέθηκαν για τις χρήσεις των νέων μορφών ενέργειας. Η επιστήμη και η τεχνολογία της ενέργειας συνεχίζουν έκτοτε ακατάπαυστα.

2. Η ΕΝΕΡΓΕΙΑ ΕΙΝΑΙ ΒΑΣΙΚΟ ΣΤΟΙΧΕΙΟ ΤΟΥ ΦΥΣΙΚΟΥ ΚΟΣΜΟΥ

Η ενέργεια επικρατεί στο σύμπαν από την αρχή του χρόνου. Η αρχή του χρόνου και του χώρου είναι και η αρχή της ενέργειας και της αλλαγής. Από την πρωταρχική ενέργεια προήλθε το καθετί που υπάρχει σήμερα – ο κόσμος, η Γη, η ζωή, εμείς. Ολόκληρο το φυσικό σύμπαν συνίσταται από τις διάφορες μορφές της ενέργειας, οι πλείστες των οποίων είναι ακόμη άγνωστες.

Όλες οι γνωστές μορφές ενέργειας είναι αναγκαίες για τη ζωή. Εμείς και η υπόλοιπη ζωή χρειαζόμαστε ενέργεια για ό,τι κάνουμε, και ό,τι κάνουμε συνδέεται με κάποιο μετασχηματισμό και ροή της ενέργειας. Στον φυσικό κόσμο της αλλαγής και της αποσύνθεσης που ζούμε, υπάρχει ταυτόχρονα και αύξηση της πολυπλοκότητας, της τάξης και της οργάνωσης. Η φυσική τάση αύξησης της εντροπίας (της αταξίας και της τελικής αποσύνθεσης) αντιστρέφεται με παροχή ενέργειας στον οργανισμό και ελάττωση της εντροπίας του (αύξηση της αρνητικής εντροπίας, negentropy [4]). Η ροή της ενέργειας σε ένα σύστημα δρα και οργανώνει το σύστημα, και η ζωή διατηρείται με παροχή και δαπάνη ενέργειας.

Τι γνωρίζουμε, λοιπόν, επιστημονικά για την ενέργεια; Γνωρίζουμε ότι στην αρχή του σύμπαντος όλα ήταν ενέργεια· ότι η ενέργεια υπάρχει σε πολλές μορφές· ότι οι μετασχηματισμοί της ενέργειας μεταξύ των μορφών της είναι οι φορείς της αέναης αλλαγής. Γνωρίζουμε ακόμη ότι η τάξη και η οργάνωση οδηγούν σε νέες μοριακές δομές, που διατηρούνται όταν παρέχεται ενέργεια στο σύστημα και κάνει δυνατή την κίνησή του ενάντια στην αύξηση της εντροπίας· γνωρίζουμε ότι οι ενεργειακοί μετασχηματισμοί οι οποίοι υποστηρίζουν τη ζωή συνιστούν απειροελάχιστο ποσοστό των ασύλληπτων ποσοτήτων ενέργειας στο Σύμπαν.

Προφανώς, υπάρχουν μορφές της ενέργειας που τα σημερινά όργανα της επιστήμης δεν μπορούν να ανιχνεύσουν. Και ίσως υπάρχουν, ακόμη, άλλες μορφές ενέργειας που σχετίζονται με τους ζώντες οργανισμούς για τις οποίες η επιστήμη δεν ομιλεί.

Κάθε μετασχηματισμός της ενέργειας απαιτεί ενέργεια. Για να πάρει κανείς την ενέργεια που επιθυμεί από ένα σύστημα, λ.χ. ηλεκτρική ενέργεια από ένα εργοστάσιο που καίει κάρβουνο, απαιτείται να δαπανήσει περισσότερη ενέργεια υπό μορφή χημικής ενέργειας που είναι αποθηκευμένη στο κάρβουνο, από την ηλεκτρική ενέργεια που παράγει. Για τη συγκεκριμένη μορφή ενέργειας που επιθυμεί κανείς να έχει, πληρώνει με άλλη μορφή ενέργειας. Το κατάλοιπο όλων των μετασχηματισμών της ενέργειας είναι «χαμηλής ποιότητας» ενέργεια, συνήθως υπό μορφή θερμότητας.

Σήμερα, σε κάθε χώρα, η ενέργεια είναι η βάση της επιστημονικής τεχνολογίας. Ιδιαίτερα η ηλεκτρική ενέργεια μπορεί να διαμορφωθεί καταλλήλως, ώστε να πάρει διάφορες ειδικά εξελιγμένες μορφές που απαιτούνται για τη λειτουργία σύγχρονων τεχνολογιών, για παράδειγμα, στους παλμικούς λέιζερ, στους υπολογιστές, στις επιστήμες της πληροφορικής και του διαδικτύου. Κάθε τεχνολογία βασίζεται στη διαθεσιμότητα ενέργειας ειδικής μορφής, και κάθε τεχνολογία που δύναται να επιτευχθεί θα επιτευχθεί *εφόσον υπάρχει ενέργεια στην κατάλληλη μορφή που απαιτείται.*

3. Η ΕΝΕΡΓΕΙΑ ΕΙΝΑΙ ΒΑΣΙΚΟ ΣΤΟΙΧΕΙΟ ΤΟΥ ΠΟΛΙΤΙΣΜΟΥ

Η ενέργεια έχει διαδραματίσει βασικό ρόλο στην εξέλιξη της κοινωνίας και την ανάπτυξη του πολιτισμού [5]. Ο άνθρωπος χρησιμοποίησε κάθε πηγή ενέργειας που ανακάλυψε, και ο σύγχρονος πολιτισμός ιδιαίτερα στηρίζεται στην ενέργεια. Μερικά από τα πλέον διακριτά χαρακτηριστικά του, όπως η ραγδαία αύξηση του πληθυσμού της Γης και του πληθυσμού των πόλεων, η υψηλή κατανάλωση ενέργειας, η ανθρωπογενής επίδραση στο περιβάλλον και το κλίμα, η κοινωνική πολυπλοκότητα και το χάσμα μεταξύ των πλούσιων και των φτωχών περιοχών του κόσμου, σχετίζονται όλα άμεσα με την ενέργεια [5, 6].

Η εξέλιξη της κοινωνίας και του πολιτισμού προσομοιάζουν την ικανότητα του ανθρώπου να ανακαλύψει και να χρησιμοποιήσει προς όφελός του νέες πηγές ενέργειας. Στο μέλλον ο πολιτισμός θα εξαρτάται ακόμη περισσότερο από την ενέργεια. Η αποκλίνουσα ανάγκη της κοινωνίας για περισσότερη ενέργεια δεν είναι εύκολο να ικανοποιηθεί. *Βιώσιμος πολιτισμός χρειάζεται βιώσιμη ανάπτυξη και βιώσιμη ανάπτυξη χρειάζεται βιώσιμες ενεργειακές πηγές — πηγές ενέργειας οι οποίες είναι περιβαλλοντικά φιλικές, οικονομικά προσιτές, επεκτείνονται στο μέλλον και στηρίζουν τη ζωή σε βάθος χρόνου.*

Είναι γεγονός ότι οι κύριες ενεργειακές πηγές στη διάθεση του ανθρώπου σήμερα –το κάρβουνο, το πετρέλαιο, το Φυσικό Αέριο (ΦΑ) και το ουράνιο– παρουσιάζουν σοβαρά περιβαλλοντικά και άλλα προβλήματα. Εντούτοις η χρήση των πηγών αυτών προβλέπεται να συνεχίσει στο μέλλον, λόγω κυρίως των ενεργειακών αναγκών των αναπτυσσόμενων χωρών. Το βασικό ερώτημα, επομένως, *παραμένει οξύ: πώς θα μπορέσει η ανθρωπότητα να ικανοποιήσει τις τεράστιες ενεργειακές της ανάγκες χωρίς να τεθεί σε κίνδυνο η υγεία του Πλανήτη; Πώς πρέπει να ενεργήσει ώστε η κλιματική αλλαγή να μην εξελιχθεί σε κλιματική κρίση;*

Είναι, κατά συνέπεια, προφανές ότι το μέλλον του πολιτισμού θα εξαρτηθεί όχι μόνον από τα συνολικά ποσά ενέργειας που θα έχει στη διάθεσή της η ανθρωπότητα, αλλά και από το πώς θα κατανέμεται αυτή η ενέργεια μεταξύ των λαών της Γης και από το πώς θα χρησιμοποιείται από αυτούς – η δεύτερη μάλιστα παράμετρος ίσως είναι σπουδαιότερη από την πρώτη. *Η πρόσβαση στην ενέργεια θα αναγνωρισθεί **σταδιακά** ως ανθρώπινο δικαίωμα και ως ηθική υποχρέωση του πολιτισμού.*

Πολλοί επιστήμονες υποστηρίζουν [7] ότι όσο περισσότερη ενέργεια έχει στη διάθεσή της και χρησιμοποιεί μια κοινωνία, τόσο πιο πολύπλοκη είναι. Επομένως, όταν η ποσότητα της ενέργειας που έχει στη διάθεσή της και χρησιμοποιεί μια κοινωνία ελαττωθεί, ή όταν η ποσότητα της ενέργειας που διαθέτει σταματήσει να αυξάνεται, ενώ οι ενεργειακές της ανάγκες εντείνονται, αυτή η κοινωνία θα βρεθεί σε κίνδυνο εάν

αποτύχει να εξασφαλίσει νέες πηγές ενέργειας, ή εάν δεν κατορθώσει να χρησιμοποιήσει πιο αποδοτικά την ενέργεια που διαθέτει.

Η αυξανόμενη πολυπλοκότητα του σύγχρονου πολιτισμού τον καθιστά εύθραυστο και λειτουργικά ευπρόσβλητο. Η λειτουργικότητά του εξαρτάται απολύτως από την ομαλή λειτουργία μιας πληθώρας σύνθετων/πολυδιάστατων και διασυνδεδεμένων συστημάτων που τον υποστηρίζουν *και που όλα βασίζονται στην ενέργεια.* Αρκεί η απενεργοποίηση μερικών από αυτά για να καταστραφεί η λειτουργία του όλου συστήματος. *Εύλογα, επομένως, συνάγεται το συμπέρασμα ότι η βιωσιμότητα του σύγχρονου πολιτισμού κινδυνεύει χωρίς νέες, τεράστιες ποσότητες ενέργειας.*

4. Η ΗΛΕΚΤΡΙΚΗ ΕΝΕΡΓΕΙΑ ΕΙΝΑΙ ΒΑΣΙΚΟ ΣΤΟΙΧΕΙΟ ΤΟΥ ΣΥΓΧΡΟΝΟΥ ΠΟΛΙΤΙΣΜΟΥ

Όπως ήδη ανέφερα, πάνω από κάθε άλλη μορφή ενέργειας βρίσκεται η ηλεκτρική, η οποία αποτελεί το θεμέλιο του σύγχρονου πολιτισμού. Κυρίως κατά τα τελευταία 70 χρόνια, υπάρχει σαφής και μονοσήμαντη σχέση μεταξύ της κατανάλωσης ηλεκτρικής ενέργειας και του Ακαθάριστου Εθνικού Προϊόντος (ΑΕΠ) μιας χώρας. Το ΑΕΠ μιας χώρας αυξάνεται ανάλογα με την κατανάλωση ηλεκτρικής ενέργειας από τη χώρα αυτή. Η συσχέτιση είναι ιδιαίτερα εντυπωσιακή για τις ΗΠΑ [8, 9]. Κατά συνέπεια, σήμερα η παγκόσμια κατανάλωση της ηλεκτρικής ενέργειας είναι περίπου πέντε (5) φορές μεγαλύτερη από ό,τι ήταν πριν από περίπου 70 χρόνια.

Σήμερα όλες οι χώρες αναζητούν συνεχώς περισσότερη ενέργεια, κυρίως ηλεκτρική. Αυτό απαιτεί η διατήρηση και η επέκταση του πολιτισμού. Ανάλογα με το είδος των ενεργειακών πηγών που χρησιμοποιούνται για την παραγωγή ηλεκτρικής ενέργειας, η παραγωγή της είναι *συνεχής* (από πηγές πάντοτε διαθέσιμες, όπως στην περίπτωση των ορυκτών και των πυρηνικών καυσίμων), *ελαστική* (από πηγές διαθέσιμες κατ' επιλογήν, όπως στους υδροηλεκτρικούς σταθμούς, ΥΗΣ), και *διεσπαρμένη και στοχαστική* όταν παράγεται από ηλιακά και κυρίως από αιολικά συστήματα Ανανεώσιμων Πηγών Ενέργειας (ΑΠΕ).

Για τις στοχαστικές ΑΠΕ χρειάζεται αποθήκευση ηλεκτρικής ενέργειας και έξυπνα δίκτυα, ώστε πάντοτε να παράγεται ενέργεια και να μεταφέρεται όπου χρειάζεται. Η αποθήκευση ηλεκτρικής ενέργειας στις περιπτώσεις αυτές καθίσταται βασική προϋπόθεση *αποτελεσματικής* χρήσης ΑΠΕ μεγάλης στοχαστικότητας. Μεγάλο ποσοστό στοχαστικής ηλεκτρικής ενέργειας (20%-30%) στο δίκτυο προκαλεί αστάθεια και περιορίζει το ποσοστό των ΑΠΕ στο δίκτυο. Η εκμετάλλευση και η επικράτηση των ΑΠΕ προϋποθέτει αξιόπιστες και οικονομικά προσιτές λύσεις στο πρόβλημα του συγχρονισμού της παραγωγής ηλεκτρικής ενέργειας από διεσπαρμένες και ασυνεχείς πηγές με τη μεταβλητή κατανάλωση.

Υπάρχουν πολλές επιλογές αποθήκευσης ηλεκτρικής ενέργειας, συμπεριλαμβανομένων συμβατικών μπαταριών και υδροηλεκτρικών έργων με αντλησιοταμίευση. Η αποθήκευση ηλεκτρικής ενέργειας με χρήση υδροηλεκτρικών έργων με αντλησιοταμίευση είναι σήμερα η επικρατέστερη παγκοσμίως.

Η ηλεκτρική ενέργεια μπορεί να αποθηκευτεί χωρίς μεγάλο κόστος ως θερμότητα, και η αφαλάτωση μπορεί να αποτελέσει έναν ακόμη τρόπο αποθήκευσης ενέργειας. *Ίσως η μέγιστη πρόκληση στις ΑΠΕ αφορά τη χρήση τους για παραγωγή αποθηκεύσιμων καυσίμων.* Ελπίζουμε ότι μέχρι το 2050 οι ΑΠΕ θα είναι οι επικρατέστερες πηγές ενέργειας σε μεγάλο μέρος του κόσμου. Αυτό ωστόσο δεν μπορεί να επιτευχθεί χωρίς τη δυνατότητα αποτελεσματικής αποθήκευσης ηλεκτρικής ενέργειας**.** Η επιπλέον ηλεκτρική ενέργεια από τις ΑΠΕ, αντί να απορρίπτεται, μπορεί να μετατραπεί σε άλλες μορφές ενέργειας για αποθήκευση και ακολούθως να μετατραπεί πάλι σε ηλεκτρική ενέργεια για την παραγωγή χρήσιμων προϊόντων, λ.χ. αμμωνίας, μεθανίου κ.ά.

Συνάγεται έτσι το συμπέρασμα ότι ένα σύστημα αποθήκευσης ενέργειας πρέπει να αποτελέσει αναπόσπαστο στοιχείο κάθε συστήματος ΑΠΕ.

5. ΠΗΓΕΣ ΕΝΕΡΓΕΙΑΣ

Η καθαρή, ασφαλής και οικονομικά προσιτή ενέργεια είναι μια από τις σημαντικότερες προκλήσεις για τη σημερινή κοινωνία. Κάθε πρωτογενής πηγή ενέργειας σήμερα –ορυκτά καύσιμα, *ΑΠΕ*, πυρηνικά καύσιμα– και κάθε αναδυόμενο ενεργειακό μείγμα των πηγών αυτών έχει τα πλεονεκτήματα και τα μειονεκτήματά του. Η κάθε μορφή πρωτογενούς ενέργειας έχει το κόστος και την επικινδυνότητά της. Η δυνατή συνεισφορά τους στις ενεργειακές ανάγκες της σύγχρονης κοινωνίας και οι αντίστοιχες περιβαλλοντικές/κλιματικές επιπτώσεις τους διαφέρουν. Όλες όμως παράγουν ανεπιθύμητα υποπροϊόντα και όλες στηρίζονται στη χρήση κατάλληλων υλικών για να γίνουν πιο αποτελεσματικές και λιγότερο επιβλαβείς. Η επιστημονική/τεχνολογική πρόκληση για την ανθρωπότητα είναι, επομένως, να εφεύρει τρόπους μείωσης των επιβλαβών υποπροϊόντων τους και, ακόμη, να τα χρησιμοποιήσει για να παραγάγει κάτι χρήσιμο.

Ορυκτά καύσιμα (κυρίως κάρβουνο, πετρέλαιο και ΦΑ): Το πλέον κρίσιμο στοιχείο σχετικά με τα ορυκτά καύσιμα σήμερα είναι το γεγονός ότι περίπου 80% των παγκόσμιων ενεργειακών αναγκών προέρχεται από τη χρήση ορυκτών καυσίμων. Η καύση των ορυκτών καυσίμων, κυρίως του κάρβουνου, είναι η πλέον επιβλαβής για το περιβάλλον και την υγεία. Εντούτοις η χρήση του κάρβουνου αναμένεται να συνεχιστεί, και μάλιστα ίσως και να αυξηθεί, λόγω της παγκόσμιας ζήτησης ηλεκτρικής ενέργειας και λόγω των τεράστιων αποθεμάτων και του χαμηλού κόστους του κάρβουνου σε σύγκριση με άλλα καύσιμα. *Η σημαντική χρήση του κάρβουνου στο μέλλον δεν συνάδει με τις προσπάθειες σταθεροποίησης των συγκεντρώσεων του CO_2 και των άλλων αερίων του θερμοκηπίου στην ατμόσφαιρα, και εγκυμονεί μη αποδεκτούς κινδύνους για την κλιματική αλλαγή.*

Είναι προφανές ότι απαιτούνται νέες, πιο αποτελεσματικές και πιο καθαρές τεχνολογίες για την καλύτερη καύση ορυκτών καυσίμων, αποτελεσματική σύλληψη, αποθήκευση και χρήση του CO_2, καθώς και αντικατάσταση του πετρελαίου με άλλες πηγές ενέργειας.

Ανανεώσιμες Πηγές Ενέργειας (ΑΠΕ) (κυρίως τα υδροηλεκτρικά, τα ηλιακά, τα αιολικά, τα γεωθερμικά συστήματα και η βιομάζα)*:* Οι πηγές αυτές είναι πιο καθαρές από τα ορυκτά καύσιμα, είναι όμως περισσότερο διεσπαρμένες και μερικές ιδιαίτερα στοχαστικές. Πρέπει να επεκταθούν σε μαζική κλίμακα διεθνώς, και αυτό απαιτεί οικονομικά εφικτούς τρόπους αποθήκευσης ηλεκτρικής ενέργειας από ΑΠΕ σε μεγάλη κλίμακα, και συχνά την αποτελεσματική μεταφορά της σε μεγάλες αποστάσεις. Τα Υ/Η έργα είναι η πλέον ουσιώδης ΑΠΕ και συνεισφέρει σήμερα ~ 16% της συνολικής παγκόσμιας ηλεκτρικής ενέργειας.

Το ενεργειακό μείγμα διαφέρει από χώρα σε χώρα και επίσης διαφέρει το ποσοστό των ΑΠΕ στο ενεργειακό μείγμα, καθώς και η ανάγκη αποθήκευσης ηλεκτρικής ενέργειας. Η συνεχώς αυξανόμενη χρήση των ΑΠΕ έχει ως αποτέλεσμα η οικονομία μιας χώρας να εξαρτάται ολοένα και περισσότερο από την ηλεκτρική ενέργεια, με τα ορυκτά καύσιμα να περνούν σε δεύτερη μοίρα. Η ανανεώσιμη ηλεκτρική ενέργεια σταδιακά αντικαθιστά τα υγρά και τα αέρια καύσιμα στις μεταφορές.

Η μεγαλύτερη όμως πρόκληση στις ΑΠΕ παραμένει η παραγωγή αποθηκεύσιμων καυσίμων.

Υπογραμμίζεται ότι οι μεγάλες αιολικές εγκαταστάσεις έχουν εξαιρετικά υψηλές ανάγκες χώρου, η βιομάζα είναι χαμηλής αποδοτικότητας ΑΠΕ, παρά το ότι τα βιοκαύσιμα είναι σημαντικά στη σύγχρονη κοινωνία, κυρίως στις μεταφορές, η γεωθερμική ενέργεια είναι σημαντική και συνεχώς διαθέσιμη ΑΠΕ, και το φως του ήλιου είναι η σημαντικότερη πηγή ενέργειας

ελεύθερη από άνθρακα, στην οποία στηρίζονται πολλές τεχνολογίες ΑΠΕ.

Πυρηνική ενέργεια από την πυρηνική σχάση: Η ηλεκτρική ενέργεια από τους πυρηνικούς αντιδραστήρες προέρχεται σχεδόν εξ ολοκλήρου από τη σχάση του πυρήνα του ουρανίου, και ένα πολύ μικρό ποσοστό από τη χρήση του πλουτωνίου και του θορίου *Th232*. Το 2010 τα πυρηνικά εργοστάσια παρήγαγαν 13% της συνολικής παγκόσμιας ηλεκτρικής ενέργειας, ποσοστό χαμηλότερο από το 18% το 1996.

Η ηλεκτρική ενέργεια από την πυρηνική σχάση είναι μέρος του ενεργειακού μείγματος πολλών χωρών· είναι σημαντική και λόγω της χαμηλής εκπομπής αερίων του θερμοκηπίου. Η παραγωγή ηλεκτρικής ενέργειας από την πυρηνική σχάση ***όμως*** δεν έγινε ευρύτερα αποδεκτή από την κοινωνία, της οποίας οι κύριοι φόβοι συνδέονται με την ασφάλεια των πυρηνικών αντιδραστήρων, την ασφαλή διαχείριση των πυρηνικών καταλοίπων, και τον κίνδυνο διασποράς πυρηνικών υλικών και όπλων.

Δέον να σημειωθεί ότι η ασφάλεια της τελευταίας γενιάς πυρηνικών αντιδραστήρων βελτιώθηκε σημαντικά, ο διεθνής έλεγχος όλων των πυρηνικών αντιδραστήρων ισχύος έχει αυξηθεί και η διαχείριση των πυρηνικών καταλοίπων έγινε καλύτερη· παραμένει όμως το πρόβλημα της μόνιμης εναπόθεσης των πυρηνικών αποβλήτων. Επίσης, μελετώνται εναλλακτικά πυρηνικά καύσιμα για τη μείωση της παραγωγής πλουτωνίου, επί παραδείγματι με αναγεννητικούς πυρηνικούς αντιδραστήρες που χρησιμοποιούν φυσικό μη σχάσιμο θόριο *Th*232. Δεκάδες νέοι πυρηνικοί αντιδραστήρες είναι υπό κατασκευή σε διάφορες χώρες του κόσμου (λ.χ. στην Ινδία, την Κίνα και τη Ρωσία) [10].

Δεν υπάρχουν σε λειτουργία σήμερα αναγεννητικοί αντιδραστήρες σε καμία χώρα.

Πυρηνική ενέργεια από πυρηνική σύντηξη. Δυστυχώς, ***ελεγχόμενη*** πυρηνική σύντηξη ως χρήσιμη πηγή ηλεκτρικής ενέργειας δεν έχει ακόμη επιτευχθεί. Η πυρηνική ενέργεια από τη σύντηξη ισοτόπων του ατόμου του υδρογόνου, για παράδειγμα του δευτέριου και του τρίτιου, είναι πρακτικά ανεξάντλητη. Παρά τις τεχνολογικές δυσκολίες [5], πιστεύεται ότι η παραγωγή ηλεκτρικής ενέργειας από ελεγχόμενη πυρηνική σύνταξη θα καταστεί πραγματικότητα μια μέρα και ενέχει όλα τα χαρακτηριστικά μιας βιώσιμης πηγής ενέργειας, ικανής να ανταποκριθεί στις ενεργειακές ανάγκες της διευρυνόμενης παγκόσμιας βιομηχανικής βάσης του σύγχρονου πολιτισμού.

***Πέραν από τις σημερινές πηγές ενέργειας*:** Στο μέλλον, η ανθρωπότητα ίσως *ανακαλύψει νέες μορφές ενέργειας και νέες πηγές ενέργειας, νέες πηγές των γνωστών μορφών ενέργειας, και νέες τεχνολογίες πρόσβασης στις υπάρχουσες μορφές ενέργειας.*

Πολλοί έχουν υποστηρίξει ότι στο μέλλον οι έρημες περιοχές της Γης ίσως αντικαταστήσουν τις πετρελαιοπηγές της ανθρωπότητας. Ίσως ακόμη η ανθρωπότητα επιχειρήσει να διαχειριστεί την ηλιακή ακτινοβολία στο διάστημα πριν φθάσει στην επιφάνεια της Γης [11], και ίσως, επί πλέον, επιχειρήσει να αναπτύξει άλλου είδους ανανεώσιμες πηγές ενέργειας [12], καλλιεργώντας, π.χ., βιομάζα σε άγονες περιοχές με την αξιοποίηση θαλασσινού νερού. Και ο ωκεανός παραμένει μια τεράστια δεξαμενή ενέργειας. Όντως, ποιος θα μπορούσε να αποκλείσει την ανακάλυψη νέων μορφών και πηγών ενέργειας, ή νέων τεχνολογιών αποτελεσματικότερης χρήσης της ενέργειας;

Όσο ο πολιτισμός εξελίσσεται, τόσο θα στηρίζεται στην ενέργεια και θα εξαρτάται σε κρίσιμο βαθμό από τη λειτουργικότητα *της βιομηχανικής του βάσης.* Πιστεύω, λοιπόν, ότι στο μέλλον η αντίληψή μας για την ενέργεια θα είναι πολύ διαφορετική από ό,τι σήμερα. Θα μάθουμε να καταναλώνουμε ενέργεια φειδωλά και διαφορετικά, να ταξιδεύουμε διαφορετικά, να παράγουμε τρόφιμα διαφορετικά, να σχεδιάζουμε τις οικονομίες μας διαφορετικά, να κτίζουμε τις πόλεις μας διαφορετικά, να μεταφέρουμε και να διανέμουμε την ηλεκτρική ενέργεια διαφορετικά, κατά τρόπο ανάλογο εκείνου του Διαδικτύου, και να έχουμε διαφορετική αντίληψη για το μέγεθος του πληθυσμού της Γης και τις καταναλωτικές ανάγκες του.

Στο μέλλον, κυρίες και κύριοι, η ισορροπία μεταξύ των ενεργειακών αναγκών της κοινωνίας και της υπεύθυνης διαχείρισης των συνεπειών της παραγωγής και της χρήσης της ενέργειας θα καταστεί πολυδιάστατη κοινή ευθύνη.

6. ΕΝΕΡΓΕΙΑ ΚΑΙ ΦΤΩΧΕΙΑ – Η ΗΘΙΚΗ ΔΙΑΣΤΑΣΗ ΤΗΣ ΕΝΕΡΓΕΙΑΣ

Η διεύρυνση του χάσματος μεταξύ των πλούσιων και των φτωχών περιοχών της Γης αντανακλά τη μεταξύ τους υφιστάμενη διαφορά κατανάλωσης ενέργειας και την έλλειψη πρόσβασης από τους λαούς των φτωχών περιοχών της Γης σε σύγχρονες μορφές ενεργειακών υπηρεσιών και μορφών ενέργειας, ιδιαίτερα ηλεκτρικής ενέργειας. *Η φτώχεια των ανθρώπων στις φτωχές περιοχές της Γης είναι βασικά* ***ενεργειακή φτώχεια.***

Σχεδόν όλα τα προβλήματα των φτωχών περιοχών της Γης σχετίζονται άμεσα ή έμμεσα με την ενέργεια. Για την εξαφάνιση της ενεργειακής φτώχειας και την εξασφάλιση αξιοπρεπούς ζωής για δισεκατομμύρια συνανθρώπους μας, πρέπει να εξαλείψουμε την ενεργειακή τους ανέχεια – και αυτό απαιτεί περισσότερη κατανάλωση ενέργειας.

Σήμερα υπολογίζεται [13] ότι 1,5 δισεκατομμύριο άνθρωποι δεν έχουν πρόσβαση στην ηλεκτρική ενέργεια και περίπου 2,5 δισεκατομμύρια στηρίζονται στην παραδοσιακή βιομάζα για μαγείρεμα και θέρμανση και έχουν εισοδήματα χαμηλότερα από $2 τη μέρα. Γι' αυτόν ακριβώς τον λόγο η Γενική Συνέλευση των Ηνωμένων Εθνών όρισε το έτος 2012 ως «*Διεθνές Έτος για Βιώσιμη Ενέργεια για Όλους*» (as the "International Year of Sustainable Energy for All" [14]) και άλλοι διεθνείς οργανισμοί, μεταξύ των οποίων η EU και η World Bank, εστίασαν την προσοχή τους στην ενεργειακή φτώχεια.

Η παροχή ηλεκτρισμού στις ενεργειακά φτωχές περιοχές της Γης είναι βασική πρόκληση του σύγχρονου πολιτισμού.

Πέρα από εκεί όπου φθάνουν τα συνηθισμένα ηλεκτρικά δίκτυα, υπάρχουν ευκαιρίες για παραγωγή ηλεκτρικής ενέργειας από ΑΠΕ (με μικρά υδροηλεκτρικά, αιολικά, γεωθερμία, βιομάζα, και ιδιαίτερα ηλιακά συστήματα) και τη μεταφορά της με μικρά, αυτόνομα τοπικά δίκτυα. Οι μικρής κλίμακας ΑΠΕ συνιστούν την καλύτερη ευκαιρία για την εξάλειψη της ενεργειακής φτώχειας με την παροχή καθαρής ενέργειας απαλλαγμένης από αέρια του θερμοκηπίου.

Είναι, επομένως, μεγίστης σημασίας να μειωθεί το κόστος των Φωτοβολταϊκών (Φ/Β), των θερμικών ηλιακών, των ανεμογεννητριών και να αναπτυχθούν καλύτερες και οικονομικότερες τεχνολογίες παραγωγής και αποθήκευσης ενέργειας. Το Πρόγραμμα «Έξυπνα Χωριά» ("The Smart Villages Initiative") σε περιοχές της Αφρικής, της Λατινικής Αμερικής και της Ασίας αποβλέπει στη δυνατότητα μικρών και απομακρυσμένων «έξυπνων» χωριών (Smart Villages), όπου οι άνθρωποι αγωνίζονται να έχουν πρόσβαση σε οικονομικά προσιτές, ασφαλείς και σύγχρονες μορφές και πηγές ενέργειας ***για όλους*** [15].

Η βασική πρόκληση, επομένως, είναι να εξασφαλιστεί οικονομικά προσιτή πρόσβαση σε αξιόπιστες σύγχρονες μορφές ενέργειας για όλους τους λαούς, και να επιτευχθεί αυτό σ' έναν κόσμο μεγάλης και αυξανόμενης κατανάλωσης ενέργειας και υψηλού κόστους. Η φτώχεια, κυρίες και κύριοι, στερεί από τον άνθρωπο την ελπίδα – και ο άνθρωπος πρέπει να έχει ελπίδα για να ζήσει ειρηνικά με τον συνάνθρωπό του.

7. ΣΥΝΘΗΚΕΣ ΓΙΑ ΕΝΑΝ ΒΙΩΣΙΜΟ ΣΥΓΧΡΟΝΟ ΠΟΛΙΤΙΣΜΟ

Η ευημερία μιας κοινωνίας στο μέλλον θα εξαρτηθεί κατά κύριο λόγο από το πόσο επιτυχώς αντιμετωπίζει σήμερα δύο κεντρικές προκλήσεις:

α) τη διασφάλιση του εφοδιασμού με αξιόπιστες και οικονομικά προσιτές πηγές ενέργειας, και

β) την επιτάχυνση σε ενεργειακά μείγματα χαμηλής περιεκτικότητας άνθρακα.

Στο μέλλον, ο άνθρωπος θα χρειαστεί σοφία και θάρρος για να επιτύχει την πολύτιμη ισορροπία μεταξύ των περιορισμών που θα του επιβάλλει η κοινωνία προκειμένου να του εξασφαλίζει επαρκή ποσότητα ενέργειας. Θα χρειαστεί, επίσης, να επιδείξει σοφία και θάρρος και η Πολιτεία προκειμένου να σεβαστεί τα ανθρώπινα δικαιώματα, κυρίως την ελευθερία του ανθρώπου, χωρίς την οποία δεν νοείται πολιτισμός.

***Ο σύγχρονος πολιτισμός, επομένως, πρέπει να αλλάξει για να επιζήσει. Δύο βασικά στοιχεία αυτής της αλλαγής είναι*:**

α) η αποτελεσματική χρήση της επιστήμης και της τεχνολογίας για να ικανοποιηθούν οι ενεργειακές ανάγκες της κοινωνίας, και

β) η καθοδήγηση από τις πανανθρώπινες αξίες, για να διασφαλισθεί η ειρηνική συμβίωση των λαών της Γης κάτω από συνθήκες περιορισμένων πηγών ενέργειας.

8. ΕΞΟΙΚΟΝΟΜΗΣΗ ΕΝΕΡΓΕΙΑΣ ΚΑΙ ΕΝΕΡΓΕΙΑΚΗ ΑΠΟΔΟΤΙΚΟΤΗΤΑ

Πρέπει, ακόμη, να δώσουμε τη δέουσα προσοχή στην αύξηση της εξοικονόμησης ενέργειας και της ενεργειακής αποδοτικότητας. Είναι ανάγκη να βρούμε νέους τρόπους εξοικονόμησης ενέργειας.

Κυρίες και κύριοι, ***υπάρχει ενέργεια*!** Το πρόβλημα είναι ***πώς θα την μετατρέψουμε σε χρήσιμες μορφές.*** Η μετατροπή αυτή καθαυτήν χρειάζεται ενέργεια και γνώση. Χρειαζόμαστε:

- ***νέους, καλύτερους ενεργειακούς φορείς****, λ.χ., εκτός από τα ηλεκτρόνια, φωτόνια, υδρογόνο, κυψέλες καυσίμων, κ.ά.,*
- ***νέες μορφές ενέργειας****, η χρήση των οποίων να παράγει προϊόντα υψηλής αξίας,*
- ***νέες πηγές ενέργειας***, συμπεριλαμβανομένων εκείνων από τη χρήση των αποβλήτων και της χαμηλής ποιότητας/«άχρηστης θερμότητας», και
- ***νέα υλικά και νέες τεχνολογίες*** για αποτελεσματικότερη εξοικονόμηση ενέργειας και ενεργειακή αποδοτικότητα.

9. ΑΝΑΔΥΟΜΕΝΕΣ ΕΝΕΡΓΕΙΑΚΕΣ ΤΑΣΕΙΣ ΚΑΙ ΠΡΟΚΛΗΣΕΙΣ ΠΑΓΚΟΣΜΙΩΣ

Η ανθρωπότητα σήμερα εστιάζει τις προσπάθειές της στην «***απανθρακοποίηση***» των πηγών ενέργειας και επικεντρώνεται στη μετάβαση σε «***καθαρή ενέργεια***». Η πρόκληση αυτή είναι αδιάρρηκτα συνδεδεμένη με τη μείωση της επίδρασης της παραγωγής και της χρήσης της ενέργειας στο κλίμα και την ενεργειακή φτώχεια.

Η συνολική χρήση της ενέργειας παγκοσμίως αυξάνεται και ***το παγκόσμιο ενεργειακό μείγμα συνεχώς αλλάζει. Τα αποκεντρωμένα ηλεκτρικά συστήματα χαρακτηρίζονται σταδιακά από διεσπαρμένες μονάδες ΑΠΕ***.

Ο ηλεκτρισμός και το ΦΑ θα επηρεαστούν από τις προκλήσεις στον τομέα των μεταφορών.

Ανεξαρτήτως από αυτές τις αλλαγές στο παγκόσμιο ενεργειακό μείγμα, στις επόμενες δεκαετίες ***θα συνεχιστεί η χρήση των ορυκτών καυσίμων κάρβουνου, πετρελαίου και ΦΑ, και εδώ ακριβώς έγκεινται το πρόβλημα και οι προκλήσεις.***

10. ΑΝΑΔΥΟΜΕΝΕΣ ΕΝΕΡΓΕΙΑΚΕΣ ΤΑΣΕΙΣ ΚΑΙ ΠΡΟΚΛΗΣΕΙΣ ΣΤΗΝ ΕΛΛΑΔΑ

Οι κύριες ενεργειακές πηγές της Ελλάδος σήμερα είναι ο λιγνίτης, οι ΑΠΕ και η εξοικονόμηση ενέργειας. Στο ενεργειακό μείγμα της Ελλάδος, η χρήση του λιγνίτη ελαττώνεται, εκείνη των ΑΠΕ και του ΦΑ αυξάνεται, και του εισαγόμενου πετρελαίου συνεχίζει σε υψηλά επίπεδα.

Το ενεργειακό μείγμα της Ελλάδος αλλάζει: ***Απανθρακοποιείται.*** Ως εκ τούτου, αυξάνονται οι ΑΠΕ στο ενεργειακό μείγμα ***και γίνεται αποτελεσματική χρήση του ενεργειακού τομέα για να αποκτήσει η Ελλάδα τις αναγκαίες υποδομές,*** όπως την αποθήκευση ενέργειας και τα έξυπνα δίκτυα.

Μεγάλες ποσότητες καυσαερίων εκπέμπονται στο περιβάλλον, λόγω κυρίως της χρήσης ορυκτών καυσίμων στις μεταφορές, και αυτό απαιτεί χρήση εναλλακτικών καυσίμων και ηλεκτρικής ενέργειας από ΑΠΕ στις μεταφορές.

Η χώρα μας πρέπει ακόμη να μειώσει σημαντικά το κόστος της ηλεκτρικής ενέργειας. Είναι περίπου δύο φορές υψηλότερο του μέσου όρου του κόστους των χωρών μελών της ΕΕ.

Η χώρα μας, κυρίες και κύριοι, έχει, επίσης, καθήκον να καταβάλει κάθε δυνατή προσπάθεια να αξιοποιήσει υπεύθυνα και δυναμικά τα δικά της πλούσια κοιτάσματα Υ/Α, κυρίως του ΦΑ.

11. ΕΠΙΛΟΓΟΣ – ΠΡΩΤΟΒΟΥΛΙΕΣ ΤΗΣ ΠΡΟΕΔΡΙΑΣ ΤΟ 2021

Κλείνοντας, επιθυμώ να αναφέρω τα εξής:

α. Η Επιτροπή Ενέργειας της Ακαδημίας Αθηνών, εδώ και 17 ίχρόνια, ασχολείται συστηματικά, εντατικά και ανιδιοτελώς με τα ενεργειακά θέματα της Ελλάδος και πληροφορεί τον Έλληνα πολίτη και την Ηγεσία της χώρας για πλήθος ενεργειακών ζητημάτων και αναγκών της χώρας μας. Πρόσφατα, η Επιτροπή Ενέργειας δημοσιοποίησε τις απόψεις και τις θέσεις της για την απολιγνιτοποίηση της Ελλάδος, έργο για το οποίο η Ακαδημία την ευχαριστεί ιδιαίτερα.

β. Σε ό,τι αφορά τα θεμελιακά επιστημονικά ερωτήματα που σχετίζονται με την ενέργεια, όπως περιληπτικά τα εξέθεσα στην αρχή της ομιλίας μου, αυτά αναμφισβήτητα θα συνεχίσουν να υφίστανται. Ίσως μάλιστα να επεκταθούν και πέραν του φυσικού κόσμου της ενέργειας, σε ερωτήματα που σχετίζονται μεν με την ενέργεια, στα οποία όμως η επαγωγική μέθοδος της Φυσικής επιστήμης αδυνατεί προς το παρόν να ανταποκριθεί ικανοποιητικά.

γ. Μερικές από τις Πρωτοβουλίες της Προεδρίας το 2021

i. <u>Ημερίδες</u>

- «Ενεργειακή Αυτοδυναμία της Ελλάδος».
- «Απόδημος Ελληνισμός (Η ιστορία, το έργο και η προφορά του στην Ελλάδα)».
- «Διάλογοι μεταξύ των Θετικών και των Ανθρωπιστικών Επιστημών και της Κοινωνίας».

- «Θέματα Δημόσιας Υγείας (Μαθήματα από την πανδημία του COVID-19)».

ii. <u>Άνοιγμα της Ακαδημίας προς την Ελληνική Κοινωνία</u>

- *Ενεργός συμμετοχή της Ακαδημίας σε κοινωνικά θέματα.*

- *Εορτασμός για τα 200 χρόνια από την έναρξη της Ελληνικής Επανάστασης.*

- *Επαναφορά των «Διαλέξεων της Τρίτης».*

iii. <u>Σεβασμός στην εφαρμογή των νόμων, των κανονισμών και του έθους της Ακαδημίας</u>

iv. <u>Πρωταρχικό καθήκον ΟΛΩΝ: η εξομάλυνση της λειτουργίας της Ακαδημίας και η προβολή του έργου του Ανώτατου Πνευματικού Ιδρύματος της Ελλάδος</u>

Κυρίες και κύριοι Συνάδελφοι,

Έχουμε όλοι καθήκον να εργαστούμε μαζί, ενωμένοι, και να συνεργαστούμε παρά τις όποιες τυχόν διαφορές μας. Αυτό ζητά από όλους μας το Ανώτατο Πνευματικό Ίδρυμα της Ελλάδος.

Σας ευχαριστώ.

12. ΠΑΡΑΠΟΜΠΕΣ ΚΑΙ ΣΗΜΕΙΩΣΕΙΣ

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Η Διαδικτυακή Συνεδρία της Εγκατάστασης Νέων Αρχών της Ακαδημίας Αθηνών για το έτος 2021 έγινε την Τρίτη 12 Ιανουαρίου 2021 και ώρα 18:00. http://www.academyofathens.gr/el/live/20210112

ΣΕΙΣΜΟΣ ΣΑΜΟΥ - ΣΜΥΡΝΗΣ

Διεθνής Τεχνική Έκθεση για τον Σεισμό της Σάμου

Το Ελληνικό Τμήμα Αντισεισμικής Μηχανικής εύχεται **Καλή και Δημιουργική Χρονιά** ανακοινώνοντας τη δημοσίευση της διεθνούς Τεχνικής Έκθεσης για τον Σεισμό της Σάμου, ο οποίος είχε σημαντικές επιπτώσεις στο νησί καθώς και στα Τουρκικά παράλια, ιδιαίτερα στην περιοχή της Σμύρνης. Η έκθεση είναι απότοκο της συνεργασίας του ΕΤΑΜ με τα δύο Τουρκικά Τμήματα Αντισεισμικής Μηχανικής καθώς και το Geotechnical Extreme Events Reconnaissance (GEER) και το Earthquake Engineering Research Institute των ΗΠΑ. Η άριστη συνεργασία 113 συγγραφέων και 18 κριτών από τις τρεις χώρες αποτελεί ένα σημαντικό παράδειγμα συνέργειας και διεπιστημονικότητας, επιστημονικές αρχές που αποτελούν προαπαιτούμενο για την καλύτερη κατανόηση τόσο του σεισμικού φαινομένου όσο και των γεωτεχνικών και δομικών του επιπτώσεων.

Λήψη Έκθεσης:
http://geerassociation.org/component/geer_reports/?view=geerreports&id=96&layout=build

Webinar for the M7.0 Samos island (Aegean Sea) earthquake

Το Ελληνικό Τμήμα Αντισεισμικής Μηχανικής σε συνεργασία με τα δύο Τμήματα Αντισεισμικής Μηχανικής της Τουρκίας, το **Geotechnical Extreme Events Reconnaissance (GEER)** και το **Earthquake Engineering Research Institute (EERI)** των ΗΠΑ διοργανώνει διαδικτυακή ημερίδα το **Σάββατο 30 Ιανουαρίου** και ώρα **13:00** σχετικά με τον σεισμό της 30/10/2020 και τις επιπτώσεις του στην Ελλάδα και την Τουρκία και ειδικότερα στο νησί της Σάμου και στα παράλια της Σμύρνης.

Οι παρουσιάσεις θα πραγματοποιηθούν στην αγγλική γλώσσα.

Δωρεάν Εγγραφή

The Increasing Importance of BIM for Civil Engineering

Every building project, no matter how small, comes with many aspects to consider and disciplines to reconcile. Sometimes, that's the hardest part — having everyone work together without getting in each other's way. For decades now, architects, engineers, and building contractors have looked for ways to resolve this problem, as well as cut project costs and increase efficiency. Finally, it seems that the solution is here, in the form of BIM.

What Is BIM?

BIM stands for building information modeling, and it can be understood in two ways: as a process and as software. In both cases, BIM helps coordinate all aspects of the building project and allows the team to collaborate. Aside from that, it lets civil engineers troubleshoot the building before it's even built and explore different options for project completion.

Building information modeling software creates an accurate virtual 3D model of the building that shows all aspects needed for construction. That includes not only the building's geometry and spatial relationships, but also its cost estimates, materials, project schedules, and sustainability. All this information updates regularly as the project unfolds, so the team members always have the latest details.

On the other hand, as a process, BIM is a paradigm in construction that encourages the whole team to improve their workflow. According to BIM, harmony is the key; all disciplines and aspects will flow together, increasing efficiency and reducing waste.

Similarly, all construction documents are integrated and available to everyone as a single source of truth. That way, team members are always on the same page, and there's less opportunity for confusion and litigation that take the focus away from the project.

What You Can Use BIM For:

If you're working in construction, BIM is surely one of the best tools you'll encounter. But you may be wondering what some of its more specific uses are. Well, let's take a look at a few common ones:

Visualization and Troubleshooting

Using BIM, you can easily create accurate 3D models of a building in construction. That way, you can see exactly what your project will look like after its completion, as well as spot any potential problems. That allows you to make more informed decisions and necessary changes while you're still in the project's early stages.

Cost Estimation

Cost estimation is by no means a new concept introduced exclusively by BIM. Even before any software existed, people needed to calculate how much money to set aside for a construction project. But the right BIM software can organize complex tasks that previously needed to cross various applications and formats.

BIM's cost estimating features are quite accurate. When any features of the model change, the estimates will update as well. This process is fully automated, so you don't have to worry about fixing any numbers by hand.

Exploring Different Solutions

Why wouldn't you try out different solutions or designs before settling on the perfect one? Of course, in the past, you couldn't. There was no way to visualize and further explore all possible options. But with the right BIM software, that's quite easy. All you have to do is alter a few parameters, and your model will change too. The industry describes this as bi-directional associativity. A change in the model anywhere is a change everywhere.

So feel free to explore various solutions for problems you encounter or play around with the design. You might find something that works better than your original plan and cuts the costs down as well!

Facility Management

BIM's importance doesn't end once the construction is over. The owner can use the model for the operation and maintenance of the new building. After all, BIM contains all the data about the building, including floor plans, sections, and details as well as materials and costs. Of course, all that can come in handy even years after the building has been completed.

Project Coordination

No more browsing through hundreds of files in search of a document you need — BIM puts all the details in one place. When the model is saved in the cloud, it is easily accessible; every team member can look at the model and update it anytime. As soon as the changes are made, all other members can see them and continue working with this new information.

BIM Use on the Rise in Civil Engineering

BIM is taking hold in the design and architectural engineering and construction industry. For instance, civil engineers are contributing to cloud projects such as BIM 360 Docs more and more. This software helps them organize their project documents and coordinate work with other team members. The single source of truth is as valuable to civil engineers as it is to the owner and the design team.

And the trend is unlikely to change anytime soon. According to a study from 2012, we were using BIM even back then! This number is surely higher now, and it will continue to rise unless some other, even more sophisticated model appears.

But are civil engineers happy with this model, or does it leave much to be desired? As it happens, believe that technology improves their project outcomes, and 82% claim that their company is more efficient than ever! Looking at such high numbers, it becomes obvious that BIM is doing something right.

In Conclusion

BIM is already taking over the AEC industry, and there's no doubt it will continue to do so. That comes as no surprise,

though — after all, it's a building information model that increases efficiency and reduces costs and time needed to complete a project. And what more could a civil engineer ask for?

About the Author

Roger Liucci is the senior BIM Specialist at Microsol Resources, an Autodesk Platinum Partner, in their New York office. He is particularly interested in the interaction between design and technology as it relates to construction and cloud computing, where one can work anytime, anywhere, and optimize designs with virtually infinite, mobile cloud computing power.

(Roger Liucci / EMI, January 4, 2021, https://engineering-managementinstitute.org/increasing-importance-bim-civil-engineering)

Artificial Intelligence detects hidden earthquakes

Tiny movements in Earth's outermost layer may provide a Rosetta Stone for deciphering the physics and warning signs of big quakes. New algorithms that work a little like human vision are now detecting these long-hidden microquakes in the growing mountain of seismic data.

The researchers tested a new model using data recorded 20 years ago in the region of Japan shaken by the magnitude-6.6 Tottori earthquake and its aftershocks.

Measures of Earth's vibrations zigged and zagged across Mostafa Mousavi's screen one morning in Memphis, Tenn. As part of his PhD studies in geophysics, he sat scanning earthquake signals recorded the night before, verifying that decades-old algorithms had detected true earthquakes rather than tremors generated by ordinary things like crashing waves, passing trucks or stomping football fans.

"I did all this tedious work for six months, looking at continuous data," Mousavi, now a research scientist at Stanford's School of Earth, Energy & Environmental Sciences (Stanford Earth), recalled recently. "That was the point I thought, 'There has to be a much better way to do this stuff.'"

The Loma Prieta earthquake, which severely shook the San Francisco and Monterey Bay regions in October 1989, occurred mostly on a previously unknown fault.

This was in 2013. Handheld smartphones were already loaded with algorithms that could break down speech into sound waves and come up with the most likely words in those patterns. Using artificial intelligence, they could even learn from past recordings to become more accurate over time.

Seismic waves and sound waves aren't so different. One moves through rock and fluid, the other through air. Yet while machine learning had transformed the way personal computers process and interact with voice and sound, the algorithms used to detect earthquakes in streams of seismic data have hardly changed since the 1980s.

That has left a lot of earthquakes undetected.

Big quakes are hard to miss, but they're rare. Meanwhile, imperceptibly small quakes happen all the time. Occurring on the same faults as bigger earthquakes – and involving the same physics and the same mechanisms – these "microquakes" represent a cache of untapped information about how earthquakes evolve – but only if scientists can find them.

In a recent paper published in *Nature Communications*, Mousavi and co-authors describe a new method for using artificial intelligence to bring into focus millions of these subtle shifts of the Earth. "By improving our ability to detect and locate these very small earthquakes, we can get a clearer view of how earthquakes interact or spread out along the fault, how they get started, even how they stop," said Stanford geophysicist Gregory Beroza, one of the paper's authors.

Focusing on what matters

Mousavi began working on technology to automate earthquake detection soon after his stint examining daily seismograms in Memphis, but his models struggled to tune out the noise inherent to seismic data. A few years later, after joining Beroza's lab at Stanford in 2017, he started to think about how to solve this problem using machine learning.

The group has produced a series of increasingly powerful detectors. A 2018 model called PhaseNet, developed by Beroza and graduate student Weiqiang Zhu, adapted algorithms from medical image processing to excel at phase-picking, which involves identifying the precise start of two different types of seismic waves. Another machine learning model, released in 2019 and dubbed CRED, was inspired by voice-trigger algorithms in virtual assistant systems and proved effective at detection. Both models learned the fundamental patterns of earthquake sequences from a relatively small set of seismograms recorded only in northern California.

In the *Nature Communications* paper, the authors report they've developed a new model to detect very small earthquakes with weak signals that current methods usually overlook, and to pick out the precise timing of the seismic phases using earthquake data from around the world. They call it Earthquake Transformer.

According to Mousavi, the model builds on PhaseNet and CRED, and "embeds those insights I got from the time I was doing all of this manually." Specifically, Earthquake Transformer mimics the way human analysts look at the set of wiggles as a whole and then hone in on a small section of interest.

People do this intuitively in daily life – tuning out less important details to focus more intently on what matters. Computer scientists call it an "attention mechanism" and frequently use it to improve text translations. But it's new to the field of automated earthquake detection, Mousavi said. "I envision that this new generation of detectors and phase-pickers will be the norm for earthquake monitoring within the next year or two," he said.

The technology could allow analysts to focus on extracting insights from a more complete catalog of earthquakes, freeing up their time to think more about what the pattern of earthquakes means, said Beroza, the Wayne Loel Professor of Earth Science at Stanford Earth.

Hidden faults

Understanding patterns in the accumulation of small tremors over decades or centuries could be key to minimizing surprises – and damage – when a larger quake strikes.

The 1989 Loma Prieta quake ranks as one of the most destructive earthquake disasters in U.S. history, and as one of the largest to hit northern California in the past century. It's a distinction that speaks less to extraordinary power in the

case of Loma Prieta than to gaps in earthquake preparedness, hazard mapping and building codes – and to the extreme rarity of large earthquakes.

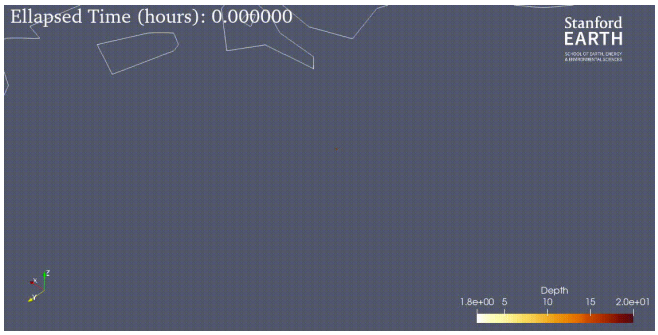
https://www.youtube.com/watch?v=c93nUNkbpH0&feature=emb_logo

Only about one in five of the approximately 500,000 earthquakes detected globally by seismic sensors every year produce shaking strong enough for people to notice. In a typical year, perhaps 100 quakes will cause damage.

In the late 1980s, computers were already at work analyzing digitally recorded seismic data, and they determined the occurrence and location of earthquakes like Loma Prieta within minutes. Limitations in both the computers and the waveform data, however, left many small earthquakes undetected and many larger earthquakes only partially measured.

After the harsh lesson of Loma Prieta, many California communities have come to rely on maps showing fault zones and the areas where quakes are likely to do the most damage. Fleshing out the record of past earthquakes with Earthquake Transformer and other tools could make those maps more accurate and help to reveal faults that might otherwise come to light only in the wake of destruction from a larger quake, as happened with Loma Prieta in 1989, and with the magnitude-6.7 Northridge earthquake in Los Angeles five years later.

"The more information we can get on the deep, three-dimensional fault structure through improved monitoring of small earthquakes, the better we can anticipate earthquakes that lurk in the future," Beroza said.



Earthquakes detected and located by EarthquakeTransformer in the Tottori area.

Earthquake Transformer

To determine an earthquake's location and magnitude, existing algorithms and human experts alike look for the arrival time of two types of waves. The first set, known as primary or P waves, advance quickly – pushing, pulling and compressing the ground like a Slinky as they move through it. Next come shear or S waves, which travel more slowly but can be more destructive as they move the Earth side to side or up and down.

To test Earthquake Transformer, the team wanted to see how it worked with earthquakes not included in training data that are used to teach the algorithms what a true earthquake and its seismic phases look like. The training data included one million hand-labeled seismograms recorded mostly over the past two decades where earthquakes happen globally, excluding Japan. For the test, they selected five weeks of continuous data recorded in the region of Japan shaken 20 years ago by the magnitude-6.6 Tottori earthquake and its aftershocks.

The model detected and located 21,092 events – more than two and a half times the number of earthquakes picked out by hand, using data from only 18 of the 57 stations that Japanese scientists originally used to study the sequence. Earthquake Transformer proved particularly effective for the tiny earthquakes that are harder for humans to pick out and being recorded in overwhelming numbers as seismic sensors multiply.

"Previously, people had designed algorithms to say, find the P wave. That's a relatively simple problem," explained co-author William Ellsworth, a research professor in geophysics at Stanford. Pinpointing the start of the S wave is more difficult, he said, because it emerges from the erratic last gasps of the fast-moving P waves. Other algorithms have been able to produce extremely detailed earthquake catalogs, including huge numbers of small earthquakes missed by analysts – but their pattern-matching algorithms work only in the region supplying the training data.

With Earthquake Transformer running on a simple computer, analysis that would ordinarily take months of expert labor was completed within 20 minutes. That speed is made possible by algorithms that search for the existence of an earthquake and the timing of the seismic phases in tandem, using information gleaned from each search to narrow down the solution for the others.

"Earthquake Transformer gets many more earthquakes than other methods, whether it's people sitting and trying to analyze things by looking at the waveforms, or older computer methods," Ellsworth said. "We're getting a much deeper look at the earthquake process, and we're doing it more efficiently and accurately."

The researchers trained and tested Earthquake Transformer on historic data, but the technology is ready to flag tiny earthquakes almost as soon as they happen. According to Beroza, "Earthquake monitoring using machine learning in near real-time is coming very soon."

Beroza is Deputy Director of the Southern California Earthquake Center (SCEC) and a co-director of the Stanford Center for Induced and Triggered Seismicity (SCITS). Ellsworth is also a SCITS co-director. Co-author Weiqiang Zhu is a graduate student in Geophysics at Stanford Earth. Co-author Lindsay Chuang is affiliated with the Georgia Institute of Technology.

The research was supported by SCITS.

(Josie Garthwaite, October 21, 2020, https://earth.stanford.edu/news/ai-detects-hidden-earthquakes#gs.pljr53)

Earthquake transformer—an attentive deep-learning model for simultaneous earthquake detection and phase picking

S. Mostafa Mousavi, William L. Ellsworth, Weiqiang Zhu, Lindsay Y. Chuang & Gregory C. Beroza

Abstract

Earthquake signal detection and seismic phase picking are challenging tasks in the processing of noisy data and the monitoring of microearthquakes. Here we present a global deep-learning model for simultaneous earthquake detection and phase picking. Performing these two related tasks in tandem improves model performance in each individual task by combining information in phases and in the full waveform of earthquake signals by using a hierarchical attention mechanism. We show that our model outperforms previous deep-learning and traditional phase-picking and detection algorithms. Applying our model to 5 weeks of continuous data recorded during 2000 Tottori earthquakes in Japan, we were able to detect and locate two times more earthquakes using only a portion (less than 1/3) of seismic stations. Our model picks P and S phases with precision close to manual picks by human analysts; however, its high efficiency and higher sensitivity can result in detecting and characterizing more and smaller events.

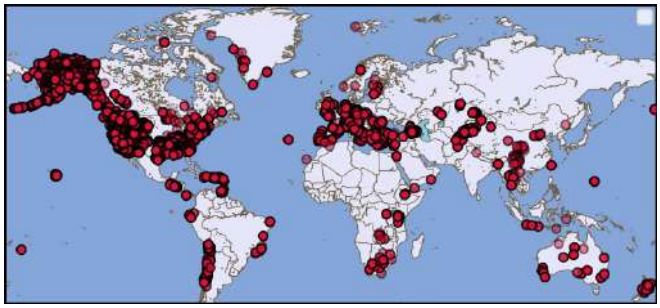


Fig. 2: The training and test dataset.

Mousavi, S.M., Ellsworth, W.L., Zhu, W. *et al.* Earthquake transformer—an attentive deep-learning model for simultaneous earthquake detection and phase picking. *Nat Commun* **11,** 3952 (2020). https://doi.org/10.1038/s41467-020-17591-w

Nature Communications **volume 11**, Article number: 3952 (2020)

(https://www.nature.com/articles/s41467-020-17591-w#citeas)

Geology is at a Crossroads

Geology is changing, but have colleges and universities caught up with that change?

Earthquake damage to Glenn Highway at Mirror Lake in Alaska on November 30, 2018.

Newsletter

Geology was a discipline built to find the resources of our planet. The first real geologic map, crafted by William Smith in 1815, was part of a quest to find the fuel for the Industrial Revolution. Smith used his work as a springboard to develop ideas that are essential to our understanding of geologic time. However, at its roots, the study of the Earth was linked to the search for resources.

Things have changed a lot over the past 200 years. The study of our planet, better described as Earth Sciences these days, has evolved to be more than just the search for oil, metals, coal. We study the planet to better understand natural hazards, to map out the Earth's climate history and future, to examine the intersection between life and the solid planet, to hypothesize about the origin of life and to really just learn more about where we live.

Of course, the search for resources hasn't ended either. Some of the largest companies on the globe today are ones built on resource extraction: ExxonMobil, BP, BHP, Newmont, Chevron and more. In total, they are worth trillions of dollars and it is through the work of generations of geologists that the world is what is it today: *industrialized, swimming in cheap energy and technologically advanced*.

Changing Resources

That is not without consequence. Quite obviously, climate change is the biggest. The extraction and use of petroleum, coal and natural gas have lead to humans radically changing the Earth's climate to our detriment. Mining has done irreparable (on human timescales) harm to delicate ecosystems. They have also lead to exploitations of people and nations for the sake of the enrichment of others. These are crosses that modern Earth Sciences must bear.

Yet, even today, we need these resources ... and we need people to find new sources of oil, copper, gold, aluminum, rare earth elements and more. This is now balanced with the dire necessity to change what resources we use. Hydrocarbons like petroleum, coal and natural gas will have to be phased out as much as possible in order to stop the hurtling subway of climate change. Those lucrative jobs in the oil industry that has sustained many geology programs at colleges and universities are going away.

Oil Rig

The New York Times recently threw a spotlight on this. For many geology students, the idea of a very lucrative and (somewhat) stable career in the oil industry had significant appeal. In how many industries can undergraduates and Masters' students can realistically get hired at starting wages close to or over $100,000? You can see the appeal when you are 23 trying to make your way in the world.

Like any industry, oil had ups and downs. When oil prices are high, there was the tendency to see more students gravitate towards geology degrees. When prices dropped, they didn't. Oil companies would let the most recent hires go during those downturns but scoop up many new graduates once the price rebounded.

Oil Dries Up

Suddenly (or maybe not so suddenly), the landscape has changed. Instead of having the backstop of the oil industry for geology graduates, the double whammy of extended low oil prices and the need to move away from petroleum has meant that jobs in "the industry" have gone away. Unfortunately, the academic ranks have not really caught up with this sea change.

...And I find this perplexing. I would venture to say that when most high school students are asked about geology, many think the only jobs that you can get with such a degree are in oil or mining. That's because that is likely all they really hear about in their pre-college experience. It most of it isn't good (and likely rightly so).

That's why the whole field is at a crossroads -- and not only in what we call ourselves. In many ways, geology has become a bit of a dirty word with its close link to resource extraction. It also doesn't really reflect what an education and career studying the Earth does anymore ... or what it should be doing.

Many faculty and institution still cling to the ideas that have been central to geology for at least a century. This is in content, skills and job advice we offer our students. Most of this is centered on careers that are resource focused because, as many a geology faculty has said, "*you can always get a job in oil.*"

The New, Old Study of the Earth

This isn't the case, both practically and ethically. Instead, we need to rebrand and retool.

"**Earth Sciences**" is much closer to what people who study the Earth do today. It is about linking all the processes happening above, on and within our planet. It is about revealing how we can better realize the repercussions of resource use.

It is about understanding and protecting people from the consequences of climate change and natural hazards. It is about finding the resources we need to drive the planet on green energy.

Mountains in Mongolia

The skills students need to do this are different, yet also very similar to what a geologist 50 years ago might learn. You still need to know about rocks and minerals. You still need to know how the interior of the Earth works and plate tectonics. You still need to understand how rocks are made and destroyed. You very much still need to see rocks in the field and realize what they are telling you.

However, you also need to know how to interpret the planet in new ways. Earth scientists need to be comfortable with big data and with geographic information on a global scale. We need to know how to do lab analyses and how to interpret whether data collected is robust and reliable. Gone are the days where you can make a career from merely mapping the Earth's surface.

On top of this, we need to humanize the Earth Sciences. More students in the field need to understand the economic, anthropologic and social ramifications of Earth processes (natural and human-driven) past and present. We need to realize that there are different ways to understand the planet than a resource-focused objective. We need to understand how the Earth impacts lives.

This means that many departments at colleges and universities, both graduate and undergraduate, need to rethink their focus and curriculum. Sometimes disciplines tend to stagnate, especially when so much money was coming from such specific part of the field. Universities are eliminating geoscience/geology programs due to low enrollment -- and some (or maybe a lot?) of that drop in enrollment reflects how the discipline isn't in synch with what students want from the Earth Sciences.

Our students want to go into careers about sustainability, renewable energy, climate change resilience, natural disaster preparedness, human interactions with the planet. Our curriculum should begin to reflect these changes. I'm not saying we abandon the central tenets of an Earth Science (geologic) education, but rather critically consider what it means to be an **Earth Scientist in 2021**.

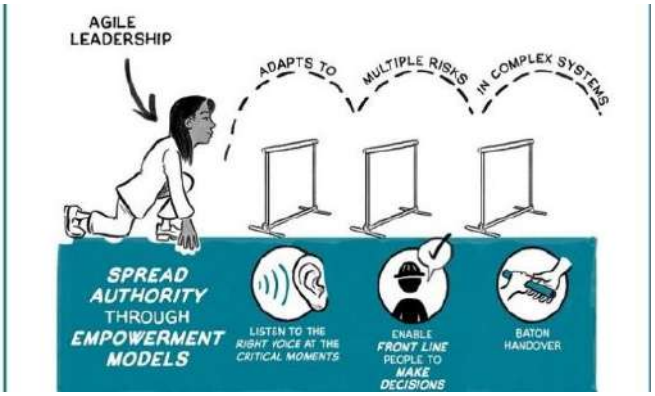
It is hard to pick a new path. We've reached that crossroads. If the discipline doesn't adapt, it will quickly follow the path that leads it to the same place as the dinosaur.

(Erik Klemetti / Rocky Planet / DISCOVER, January 4, 2021, https://www.discovermagazine.com/planet-earth/geology-is-at-a-crossroads)

Developing a career development pathway for leaders of complex infrastructure projects

Recommendations to radically change the way infrastructure is delivered call on ICE to develop a pipeline of leaders with the "breadth and adaptability" to thrive in a complex and technology-driven project environment.

Mark Hansford, Director of Engineering Knowledge



A Systems Approach to Infrastructure Delivery is an eight-step model which places emphasis on agile, adaptable leadership

In March 2020, ICE launched a review into why a number of recent signature projects have been delivered behind schedule and over budget and to explore whether a more systems-focused approach could help. The review steering group, made up of key industry thought-leaders, was asked to assess the impact of accelerating technological change and the different approaches taken in adjacent industries to address these changes.

Between April and October 2020, ICE carried out more than 30 interviews with project practitioners from the infrastructure, aerospace, defense, oil and gas, and technology sectors. A detailed literature review was also conducted with the help of Professor Andrew Davies, one of the UK's leading academic specialists in systems integration and complex projects.

It quickly became abundantly clear that continuing as we are is not an option. Big generational challenges, such as the UK's commitment to a net-zero carbon economy, are adding further layers of complexity to what we do. Technology in areas such as communications, transportation and power generation, distribution and storage is evolving at such a pace that it's forcing a change in how we design, integrate and commission infrastructure systems.

It also quickly became clear that increasingly the functionality of infrastructure is sitting in this technology suite and in the digital twin of the physical asset.

The review concluded that, quite simply, the dominant leadership and delivery model for infrastructure projects has not evolved to reflect these profound changes.

Delivery remains in the hands of traditionally trained engineers working within organisations using long-established construction industry methods. The review concluded it's this conservatism that's driven the increasing number of signature project failures.

A Systems Approach to Infrastructure Delivery

The main output from this review was, therefore, a new model, "A Systems Approach to Infrastructure Delivery" (SAID).

SAID is an eight-step model for applying systems thinking to project delivery, with each step made deliberately easy to visualise, with catchy descriptors such as "Think Outcomes not Edifices"; " "Think Shovel-Worthy not Shovel-Ready"; and "Data Oils your Projects".

It's already been welcomed enthusiastically by industry leaders, and a second phase of the review will now work with industry clients and bodies to develop and test the model. This is clearly a crucial next step.

Developing a new career development pathway

But in parallel with this work something equally crucial will begin. ICE's knowledge team will begin devising a career development pathway for leaders of complex infrastructure projects: a key recommendation of the review.

The review makes clear that the infrastructure sector needs to develop a pipeline of leaders with the breadth and adaptability to thrive in an ever more complex, technology-driven project environment.

It also makes clear that leaders of these projects need capabilities that are over and above those gained through formation in any one of the individual professions that make up the UK infrastructure workforce, and to that end ICE will be engaging with other relevant professions in developing this career pathway. It must be targeted at talented individuals from all professional backgrounds.

This is a hugely important programme and will be developed alongside other programmes in formation, such as ICE's Carbon Champions programme, and a programme to ensure ICE can support civil engineers wishing to become project Design Champions, as now mandated by government in its recently published National Infrastructure Plan.

There's clearly much to do. But it's truly exciting. If you're inspired and interested in getting involved and connecting with ICE's growing network of civil engineers and professionals collaborating to build on our project leadership skills, please contact: knowledge@ice.org.uk.

Read more about a Systems Approach to Infrastructure Delivery.

(INSTITUTION OF CIVIL ENGINEERS, 11 January, 2021, https://dev.ice.org.uk/news-and-insight/the-civil-engineer/january-2021/career-path-complex-infrastructure-leaders)

A Systems Approach to Infrastructure Delivery: ICE report calls for technological focus

A new ICE report explores the benefits of a systems approach in delivering infrastructure projects and features eight guiding principles to deliver better outcomes for owners and users

Matthew Rogerson

A new ICE report explores the benefits of a systems approach in delivering infrastructure projects

Infrastructure needs to catch up with more technologically advanced sectors and capitalise on its increased role in the UK's short and long-term plans, according to a new ICE-commissioned report, A Systems Approach to Infrastructure Delivery (SAID).

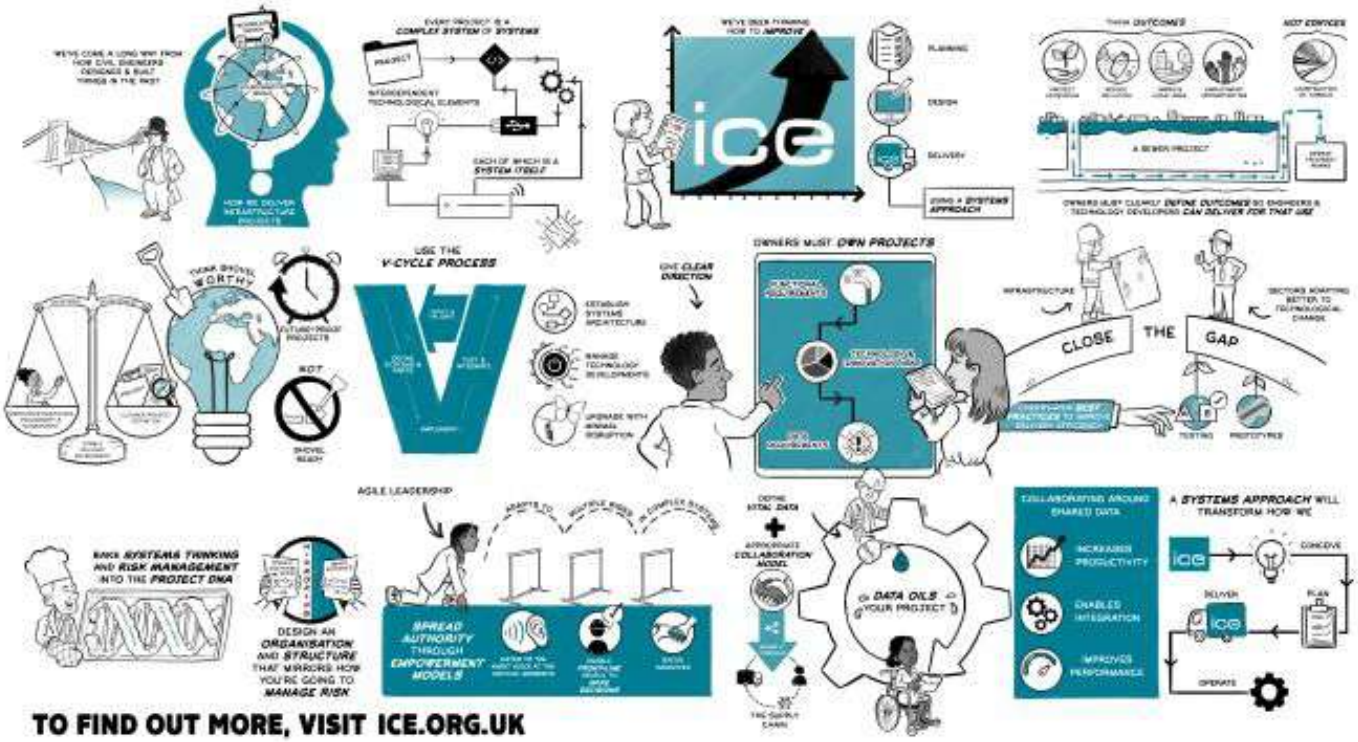
Following the Government's announcement of a National Infrastructure Strategy and against a backdrop of costly, high-profile infrastructure failures, the report provides guiding principles and other recommendations, regarding the leadership, culture and organisation of infrastructure projects.

Among them is a call for infrastructure to close the gap with sectors that have adapted better to growing complexity and technological change, including oil, gas and aerospace. The report recommends cherry-picking best practices in order to improve efficiency and effectiveness.

With infrastructure at the heart of the UK's proposed economic recovery plan from Covid-19, and central to the target of net-zero carbon emissions by 2050, the report also calls on owners to clearly define a project's outcomes and provide direction across the board.

This ranges from functional needs for the operational system to data requirements and gauging appetite for technological and innovation risk.

Ahead of his appearance at the report's accompanying Strategy Session tomorrow, Andrew McNaughton, steering group chair and former SYSTRA Group Chief Operating Officer, said: "Huge generational challenges, such as Covid-19 and the UK's commitment to a net-zero carbon economy, are adding further layers of complexity to what we as civil engineers do.



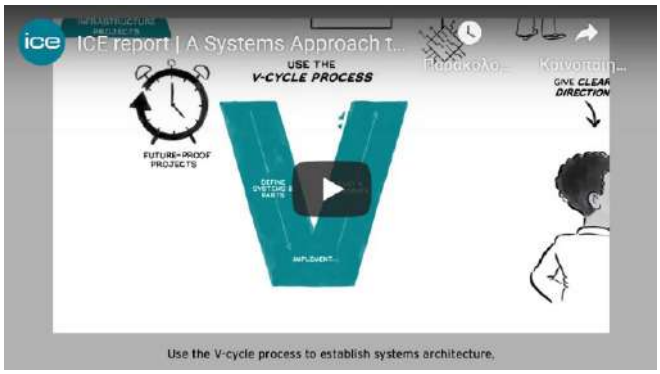
"Technology, in areas such as communications, transportation and power generation, distribution and storage, is also evolving at a pace that is forcing change in the design, integration and commissioning of infrastructure systems. The industry has fallen behind, and it has the responsibility now to catch up and provide the infrastructure that the public deserve."

The report's steering group features representatives from BAE Systems, the Environment Agency and Heathrow Airport and makes wider recommendations to Government and industry bodies.

These include the development of a construction readiness standard, a post-professional qualification career develop-

ment pathway for leaders of complex projects and a common approach to data management.

Watch our ICE video on a systems approach to infrastructure delivery below.



https://www.youtube.com/watch?v=9ueVayHrmNo&feature=emb_logo

ICE has begun working through the practicalities of implementing the SAID model and will support a second phase of work to further develop and test its application.

Download A Systems Approach to Infrastructure Delivery

Find out more about the SAID report and model by joining the latest ICE Strategy Session: A systems approach to infrastructure delivery on Tuesday 15 December.

(INSTITUTION OF CIVIL ENGINEERS, 14 December, 2020, https://www.ice.org.uk/news-and-insight/latest-ice-news/ice-report-calls-for-technological-focus)

HazBlog-007: Landslide generated tsunami – the 2007 Chehalis Lake, B.C. Canada Example

Karl Wegmann

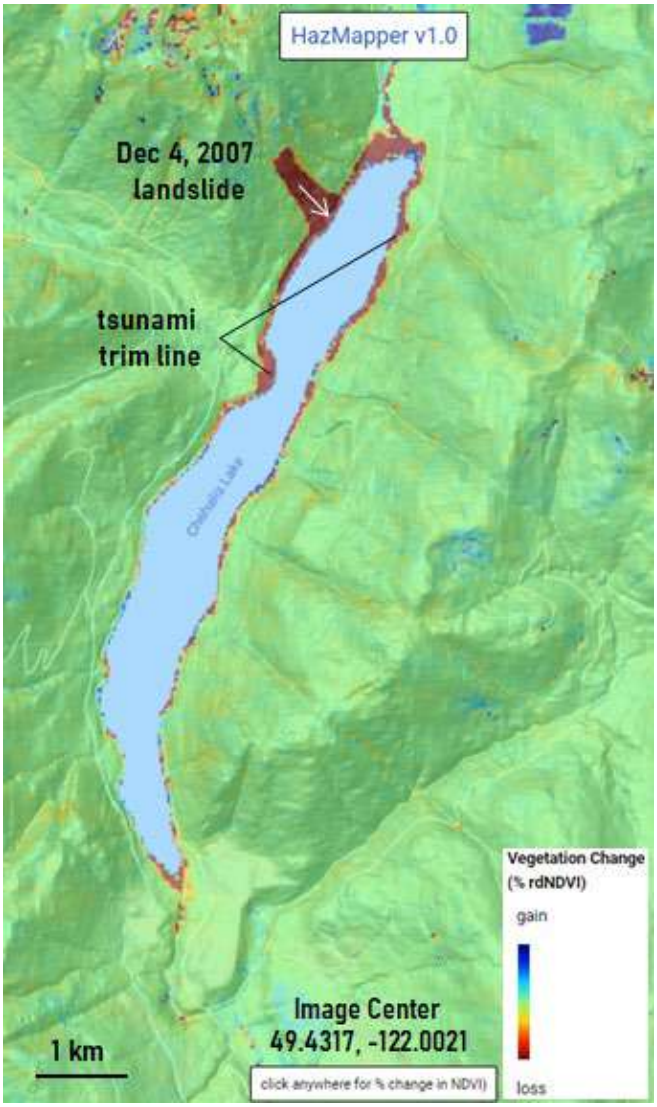
Glacial trough lakes and fjords – deep, blue, beautiful, inviting. Several weeks ago, while developing materials for a new course on geology through the movies, we watched the 2015 Norwegian disaster/action-thriller ***The Wave***, in which a rockfall high above the Geiranger Fjord creates a displacement wave (landslide-generated tsunami) up to 80 m high that destroys the town of Geiranger and quite a few movie-lives along with it. This future-fictional event is based upon a real happening in 1934 when a landslide-generated wave in nearby Tafjorden killed 40 people. While the 1934 event is way too far back in time to investigate with satellite imagery, the 2007 Chehalis Lake, British Columbia event is worth looking at with HazMapper and the 30 m Landsat 7 data set.

On December 4, 2007, a 3 million m^3 rock slide – debris avalanche initiated on the east face of 1,563 m high Mount Orrock, British Columbia. The debris avalanche descended 550 m before entering into 175 m-deep water of Chehalis Lake, a glacial-trough lake formed in the Pleistocene by advance and retreat of the Cordilleran Ice Sheet.

Location and 2008 satellite image map of Chehalis Lake as published by Wang et al. (2015). The Chehalis Lake landslide area is identified by the red polygon, while the yellow line indicates the wave-impacted area between the lake's shoreline and the upper-limit of tsunami wave scour and vegetation removal. Select tsunami run-up height measurements are shown. The inset oblique aerial photograph shows the zones of the rock slide – debris avalanche on the east side of Mount Orrock (Brideau et al. 2012).

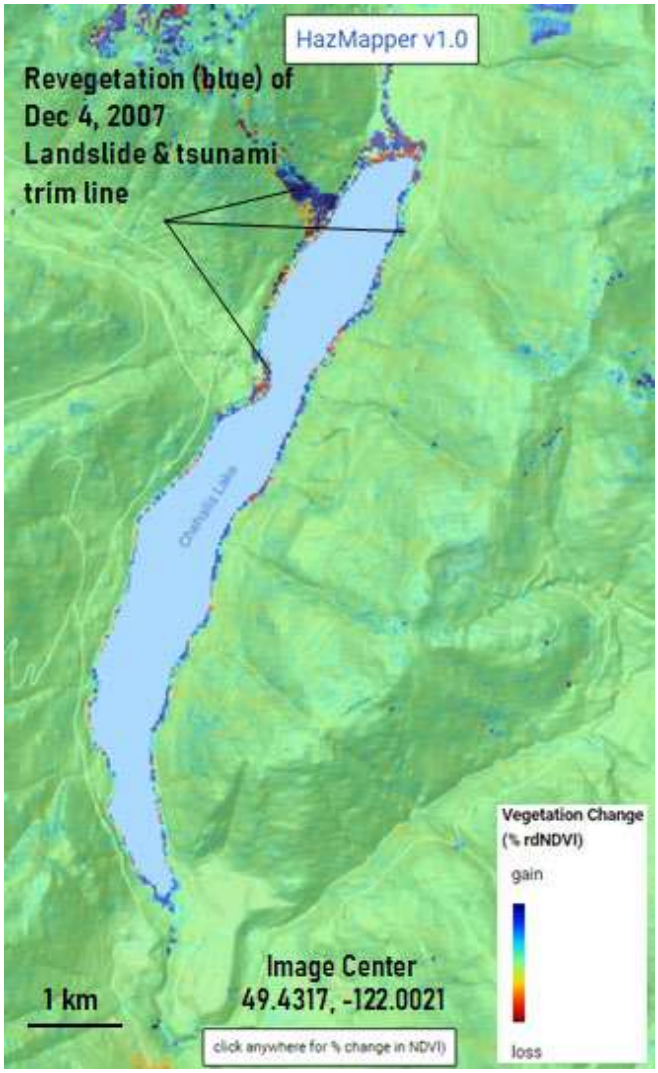
Upon entry into the lake, the debris avalanche generated a destructive tsunami that traveled the lake's length and continued down the Chehalis River for at least 15 km (Roberts et al., 2013). The tsunami had a maximum run-up height of 37.8 m (124 ft) above lake level directly across from the debris avalanche entry point and 6.3 m (20.7 ft) at the lake's exit, 7.5 km away. Because the event occurred in winter and in a fairly remote location, there were no eye-witnesses or casualties. In the summer, the lake is a popular location for camping, hiking, and fishing. All three of the campgrounds at the lake were damaged by the tsunami. Steve Ward, an emeritus professor at UC Santa Cruz, has posted a YouTube video with model simulations of the 2007 Chehalis Lake landslide and tsunami that are worth a look.

Using the 30 m Landsat 7 imagery, the rockslide-debris avalanche footprint and the trim line around the lake are quite visible via HazMapper. In the rdNDVI (pre-post relative difference in Normalized Difference Vegetation Index) image below, we choose to use an 18-month pre and post-event analysis window. We did this for two reasons. First, the event happened in winter at 49.4° N, so there are seasonal differences in vegetation and often snow on the ground. If we were using Landsat 8 or Sentinel-2 data, for example, we likely could have decreased the analysis window to 6 months pre/post-event to capture the rdNDVI signal successfully. However, because of the Landsat-7 instrument failure in 2003 resulting in the scan line error, increasing the analysis window to 18-months in both directions results in a reasonably clean rdNDVI change image, as can be seen below. Here is the direct HazMapper link for the analysis image presented below. It is fun and useful to experiment within HazMapper to get a feeling for how changing the Pre-and-Post Event Windows' duration impacts the results when using Landsat-7 data after the May 31, 2003 failure of the Scan Line Corrector.



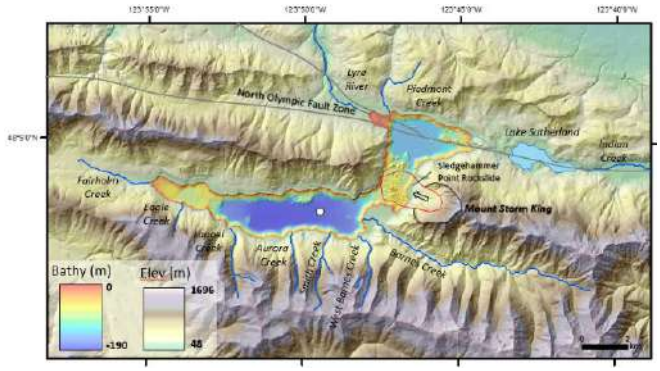
Chehalis Lake landslide and tsunami. The HazMapper URL for this analysis is available here, and uses a 18-month pre-post analysis window and a slope threshold of 0.01° to avoid analyses over water.

As we have seen with earlier posts, HazMapper is useful for identifying areas where vegetation has been lost and where vegetation is returning to previously disturbed parts of the landscape. The HazMapper rdNDVI result below shows the revegetation of the landslide mass and areas below the tsunami trim line in blue colors across an 18-month pre-post analysis window centered on June 4, 2009, again using Landsat-7 data.



URL available here.

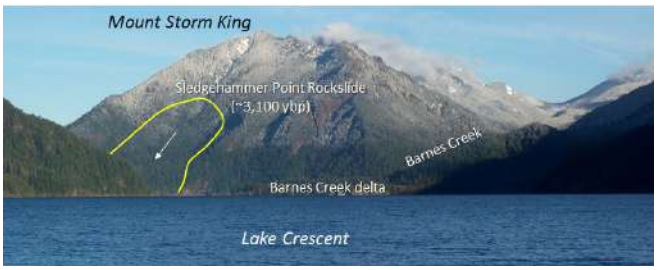
We know that rapid-moving landslides entering into deep bodies of water can generate displacement waves. Is there evidence in the sediments of lakes for such events? Indeed there is. To our knowledge, the sediments in Chehalis lake have not been cored (recovered) yet to evaluate the sedimentary characteristics of the deposit associated with the 2007 event. Not too far away, however, on the north side of the Olympic Peninsula of Washington State, Lake Crescent's sediments have been cored. The sediments from Lake Crescent record spectacular evidence for past landslide disturbance, as reported in a 2019 article in the Geological Society of America Bulletin by Dr. Elana Leithold and colleagues.



Bathymetric map for Lake Crescent, WA. The Sledgehammer Point Rockslide (SPL) occurred about 3,100 years ago and deposited about 7.2 million m3 of rock and debris onto the floor of Lake Crescent (Leithold et al., 2019). The rapid entry of the landslide debris likely created a displacement wave in the lake that led to the redistribution of sediments from the shallow margins of the lake towards the deeper depositional basins. The sedimentary deposit resulting from the 3,100 year event is known as megaturbidite-A (MTA). The white circles is the location of the core photograph shown below.

Leithold's team identified four 'megaturbidite' layers in the past ~7200 years (see below), each of which may have been caused when large landslides, likely triggered by local earthquakes, entered into the lake. The most recent megaturbidite was deposited about 3,100 years ago and recorded both an earthquake on the along the North Olympic Fault Zone, that trends beneath the northern part of the lake, and the triggering of a landslide from the west slope of Mount Storm King, known as the Sledgehammer Point rockslide.

The Sledgehammer Point slide entered waters that were at least 140 m deep, and is estimated to have rapidly deposited about 7.2 million m^3 of rock and debris into Lake Crescent in a matter of seconds.



Photograph of Mount Storm King as seen from the west and the location of the 3,100 year old Sledgehammer Point Rock slide. Photo from Jefftaylor@xwb.com

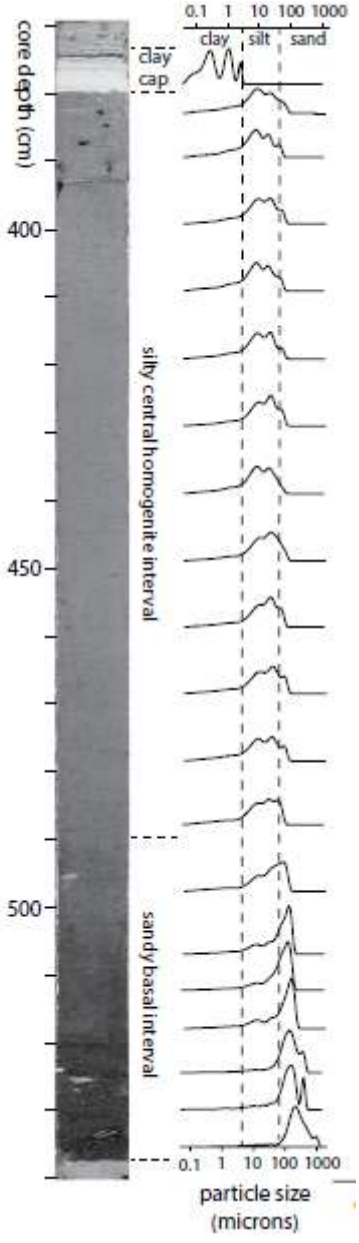
The megaturbidite deposited in response to the Sledgehammer Point Rockslide is over 165 cm thick. The average sedimentation rate at Lake Crescent is closer to 0.1 cm per year (Leithold et al., 2019). Therefore, the megaturbidite represents a ~1,650 times increase in lake-bottom sediment accumulation compared to the background rate. The figure below shows a photograph and the grain size distribution of a portion of one of the sediment cores recovered from the deep basin to the west of the rockslide deposit.

Clark and colleagues (2015) used data on the maximum observed height of landslide-generated tsunami waves worldwide as a function of the landslide volume to derive a regression equation relating the two parameters. Leithold et al. (2019) updated this database and used it to estimate the range of maximum run-up heights for the Sledgehammer Peak rockslide into Lake Crescent 3,100 years ago. The maximum wave run-up height on the opposite shore to the rockslide entry point is estimated to be somewhere between 82 to 104 m above lake level!

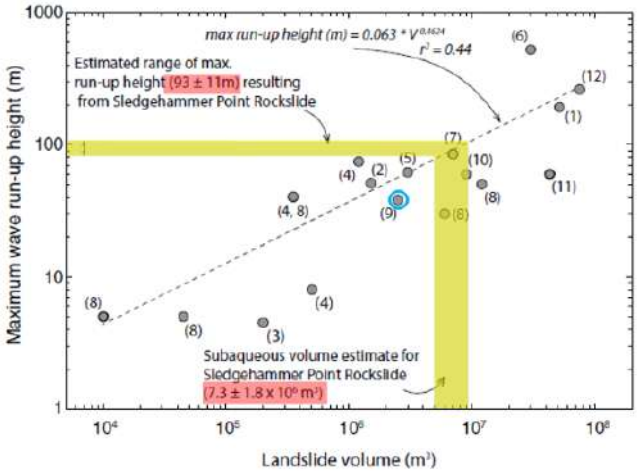
At Chehalis Lake in 2007, the maximum observed tsunami run-up was 38.6 m. Applying the regression equation reported in Leithold et al. (2019) results in a predicted run-up height of 62 m at Chehalis Lake. However, what is not well constrained is the slide that entered the lake. Perhaps the volume of rock and debris that entered into Chehalis Lake is closer to about 1 million m^3, which using the regression equation, would result in an estimated maximum opposite shore displacement wave of around 37 m, close to the observed value. Of course, variations in bathymetry or the volume of entering rock and debris will lead to real-world deviations from a simplified prediction.

Let us bring this post back full-circle to the Norwegian disaster-thriller The Wave. The geologists' job in the movie is to

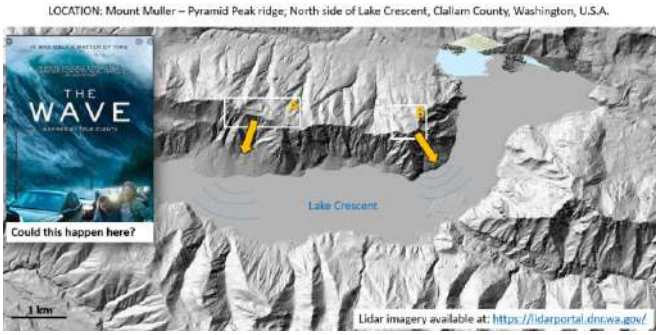
monitor a large crack in the mountainside high above the fjord. This crack fails catastrophically, leading to the rock avalanche that descends into the fjord and causes the tsunami. The State of Washington maintains a public-facing lidar portal, where anyone can view the most up-to-date high-resolution topographic data. Recently, they posted the *Olympics North Opsw 2018 data set*, which includes the high terrain on the north side of Lake Crescent. Low and behold, look at these lake-facing scarps (cracks) that sure look like they might be caused by slow, incremental rock mass movement above where we know older rockslides into the lake occurred (Leithold et al., 2019). See locations A & B on the figures below. Could they fail catastrophically? Will a future landslide-lake tsunami-megaturbidite event happen again at Lake Crescent? My bet is on 'yes.' The question then is when?



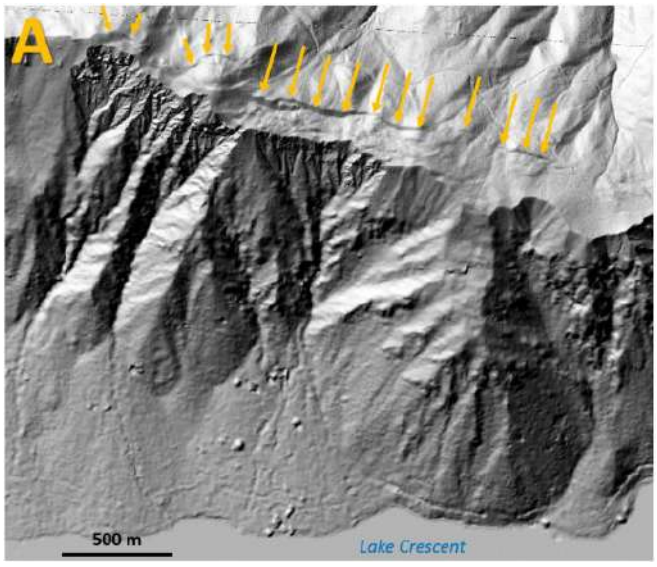
Megaturbidite-A from core 6 at Lake Crescent, WA. Particle size distribution shows normal grading in the sandy basal interval, the homogeneous nature of the thick, silty central interval, and the abrupt basal contact of the upper clay cap, which is interpreted to represent the slow, weeks-to-months long settling of the finest, clay-sized particles resuspended during the landslide disturbance event (from Leithold et al., 2019).



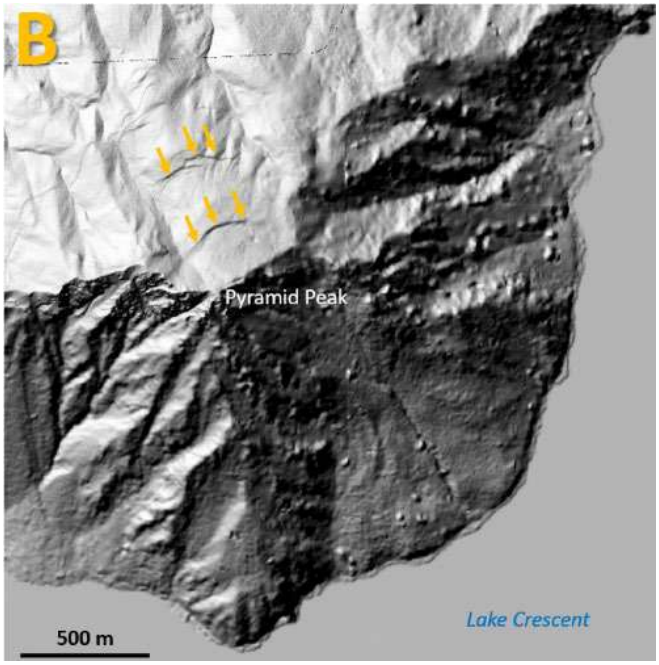
Relationship between submerged rockslide volume and observed maximum displacement wave run0up height for historic events, updated from Clarke et al. (2015) by Leithold et al. (2019). The estimated range of maximum tsunami run-up heights for the Sledgehammer Point Rockslide at Lake Crescent, WA is shown by the yellow bars. The 2007 Lake Chehalis event is circled in blue. Figure modified from Leithold et al. (2019).



Lidar hillshade of the Lake Crescent area . Note the lake-facing scarps that have formed along the ridge above the north side of the lake. Detail areas A and B are expanded upon in the next two figures.



Lidar hillshade image of Area A detail from previous figure. The orange arrows identify lake-facing scarps. Perhaps these are incipient head-scarps of future rock slides? Lidar topographic data is available from Washington State Lidar Portal.



Lidar hillshade image of Area B detail from penultimate figure. The orange arrows identify lake-facing scarps. Perhaps these are incipient head-scarps of future rock slides that will usher in the demise of Pyramid Peak, a prominent landmark above Lake Crescent. Lidar topographic data is available from Washington State Lidar Portal.

Lake Crescent is a beautiful spot on the northern Olympic Peninsula. Plan your visit today, for if you don't, you will be one year older when you do. But when you are there, don't forget to consider the landslide-tsunami story that is partially masked by the flanking forests and submerged beneath the lake's azure-blue waters.

View to the WNW across Lake Crescent as seen from the slopes of the Mount Storm King Trail. Lake Crescent is one of the jewels of Olympic National Park. The Strait of Juan de Fuca and Vancouver Island, British Columbia are visible at the top-right. Photo available at https://www.hikingproject.com/photo/7018563.

References:

Brideau, M.-A., Sturzenegger, M., Stead, D., Jaboyedoff, M., Lawrence, M., Roberts, N.J., Ward, B.C., Millard, T.H., and Clague, J.J., 2012, Stability analysis of the 2007 Chehalis lake landslide based on long-range terrestrial photogrammetry and airborne LiDAR data: Landslides, v. 9, p. 75–91.

Clark, K.J., Upton, P., Carey, J., Rosser, B., and Strong, D., 2015, Tsunami and seiche hazard scoping study of lakes Tekapo, Pukaki, Ohau, Alexandrina, and Ruataniwha: Geological and Nuclear Sciences Limited (GNS Science) Consultancy Report 2014/227, 82 p.

Leithold, E.L., Wegmann, K.W., Bohnenstiehl, D.R., Joyner, C.N., and Pollen, A.F., 2019, Repeated megaturbidite deposition in Lake Crescent, Washington triggered by Holocene ruptures of the Lake Creek-Boundary Creek fault system: Geological Society of America Bulletin, v. 131, p. 2039–2055.

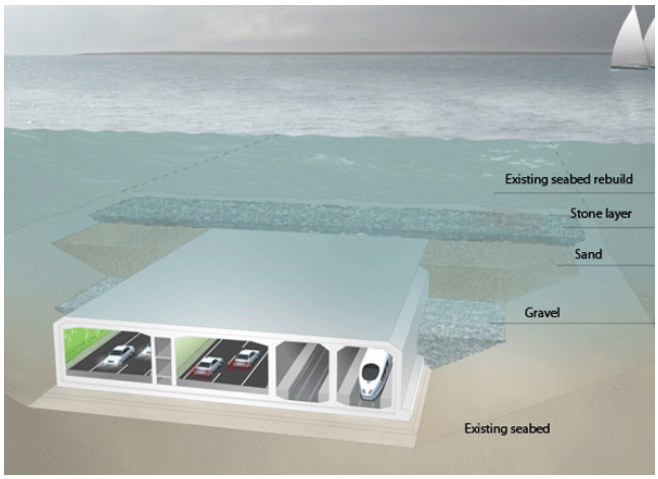
Roberts, N.J., McKillop, R.J., Lawrence, M.S., Psutka, J.F., Clague, J.J., Brideau, M.-A., and Ward, B.C., 2013, Impacts of the 2007 landslide-generated tsunami in Chehalis Lake, Canada, *in* Landslide science and practice, Springer, p. 133–140.

Viard, T., 2017, Hydraulic 2D Model of Landslide Generated Wave–Cases of Chehalis Lake and Chambon Lake, *in* Proceedings of the XXIVth TELEMAC-MASCARET User Conference, 17 to 20 October 2017, Graz University of Technology, Austria, p. 113–118.

Wang, J., Ward, S.N., and Xiao, L., 2015, Numerical simulation of the December 4, 2007 landslide-generated tsunami in Chehalis Lake, Canada: Geophysical Journal International, v. 201, p. 372–376.

(HazMapper, January 12, 2021, https://hazmapper.org/2021/01/12/hazblog-007-landslide-generated-tsunami-the-2007-chehalis-lake-b-c-canada-example/)

This is how the Fehmarnbelt tunnel will be constructed



Construction is underway for the Fehmarnbelt tunnel, which will connect Germany and Denmark. At 18.2 km, the Fehmarnbelt tunnel will be the world's longest immersed tunnel for both vehicles and trains. It will take only ten minutes to travel from Denmark to Germany by car and seven minutes by train. The tunnel will be finished in 2029.

The construction consortium Femern Link Contractors started construction work on the 18 kilometre long tunnel under the Fehmarnbelt on 1 January 2021 with a virtual ground breaking ceremony. This marked the start of the construction of the immersed tunnel itself as well as the associated tunnel portal and ramps.

2 hour shorter journey

The Fehmarnbelt tunnel will comprise a four lane motorway and two electrified rail tracks. It currently takes four and a half hours by train from Hamburg to Copenhagen and ten hours by train between Stockholm and Hamburg. When the Fehmarnbelt tunnel and the upgrading of the rail infrastructure on both sides of the link are completed, the journey time will be cut by two hours. There will also be far more frequent departures on the route.

After 25 years of planning, the day has come when the many thousands of pages of analysis and reports become a construction site. "One of the largest construction works in Danish history can now start", said Denmark's Minister of Transport Benny Engelbrecht at the start of the construction works. "Many thousands of employees will have their permanent workplace in Rødbyhavn for the next 8 and a half years."

The Fehmarnbelt tunnel on the map, connecting Germany and Denmark

Tunnel elements

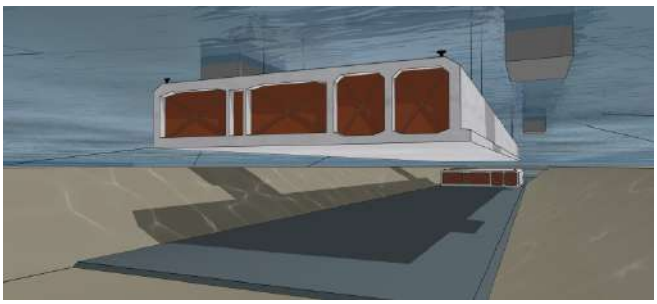
One of the first steps is the establishing of, the tunnel element factory at Rødby for the manufacture of the 89 steel-reinforced concrete elements and the tunnel portal on Lolland. There are two types of tunnel elements: 79 standard elements and 10 special elements. The special elements will have a special 'basement' for machinery, which will make the construction process and maintenance of the finished tunnel easier. The tunnel elements will be manufactured using industrial batch production, which will streamline the process considerably.

In the spring of 2020, Fehmarn Belt Contractors (FBC), consisting of the Dutch construction companies Boskalis and Van Oord, already began construction of the working harbour at Rødby. The harbour will be used for shipping in the large quantities of building materials to be used for the construction, as well as to tow the finished tunnel elements out to the Fehmarnbelt. During 2021, FBC will be able to start construction of a working harbor at Puttgarden on the German side and excavation of the tunnel gutter for the tunnel elements under the seabed in the Fehmarnbelt.

In the seabed

The immersed tunnel will be securely sited below the sea bed, protected against ships' anchors and collisions. Each finished tunnel element is suspended from sophisticated immersion pontoons and will be sealed with watertight steel bulkheads at each end to keep the inside of the element completely dry. They also ensure that its approximately 73,000 thousand tonnes will float, even with its enormous weight. In principle, each floating element is like a large, hollow, air-filled ship's hull.

The prepared tunnel elements are then pushed into a specially designed basin near the factory. From here, the element will be towed out by four tugboats to the Fehmarnbelt and placed into position. Here, the element will be carefully lowered into a dredged trench on the seabed. From the navigation bridge of the pontoons it is possible to fine-tune the element's position in the water and control the immersion.



A tunnel element during immersion: cables, winches and advanced measuring equipment guide the element to its exact position.

The first tunnel element on each side of the belt will be connected to the portal facility which will connect the coast and sea. The new elements will then be linked together until the tunnel can be assembled with a special element in the middle of the Fehmarnbelt. The elements will be covered with gravel, sand and stone as they are linked together. The top layer of stone will be more or less level with the existing seabed.

Beginning of the project

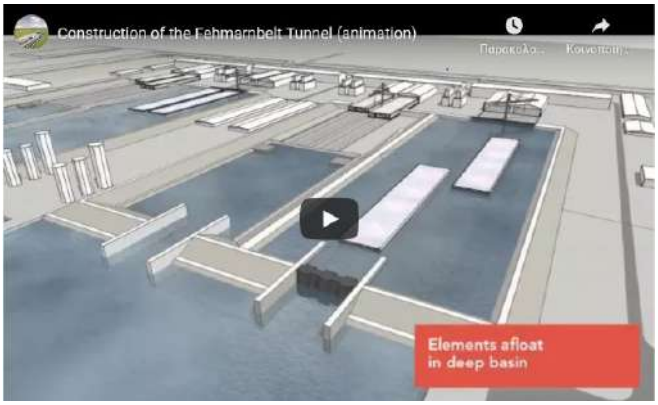
The Fehmarnbelt Fixed Link appeared on the agenda of the Danish Parliament for the first time in March 1991. The tunnel was approved by a Construction Act passed by the Danish parliament in 2015. In 2016, conditional civil works contracts

were concluded with two major international contractor consortia consisting of Danish, German, French and Dutch companies. The contracts encompass approximately 75 percent of the construction.

Denmark will build and operate the tunnel at its own cost, estimated at 7.1 billion euros. The EU provides funds, as the tunnel link is one of the European Commissions nine high priority infrastructure projects that will link cities, ports and production areas from northern Finland across Denmark and Germany to southern Italy.

The tunnel is user-financed according to the same model for the fixed links of the Great Belt Fixed Link and the Øresund Bridge. The project has a repayment period of 36 years, including upgrades to the railway between Ringsted and Rødby, which will also be funded by the profit from the tunnel.

In the video below from Femern A/S the construction of the tunnel is animated:



https://www.youtube.com/watch?v=30RECLGlTOg&feature=emb_logo

(RailFreight, 14-01-2021, https://www.railfreight.com/railfreight/2021/01/14/this-is-how-the-fehmarnbelt-tunnel-will-be-constructed)

Σύντομη περιγραφή του έργου παρουσιάζεται και στο Τεύχος 138, Μαΐου 2020, σελ. 4.

Ageing Dams Pose Growing Threat

By 2050, most people on Earth will live downstream of tens of thousands of large dams built in the 20th century, many of them already operating at or beyond their design life, according to a United Nations University analysis.

The report, "**Ageing Water Infrastructure: An Emerging Global Risk**", by the Canada-based UNU Institute for Water, Environment and Health (UNU-INWEH), says most of the 58,700 large dams worldwide were constructed between 1930 and 1970 with a design life of 50 to 100 years, adding that at 50 years a large concrete dam "would most probably begin to express signs of aging."

Ageing signs include increasing cases of dam failures, progressively increasing costs of dam repair and maintenance, increasing reservoir sedimentation, and loss of a dam's functionality and effectiveness — "strongly interconnected" manifestations, the paper says.

The report says dams that are well-designed, constructed, and maintained can "easily" reach 100 years of service but predicts an increase in "decommissioning" — a phenomenon gaining pace in the USA and Europe — as economic and practical limitations prevent ageing dams from being upgraded or if their original use is now obsolete.

Worldwide, the huge volume of water stored behind large dams is estimated at 7,000 to 8,300 cubic kilometers — enough to cover about 80% of Canada's landmass under a meter of water.

The report provides an overview of dam ageing by world region and primary function — water supply, irrigation, flood control, hydropower, and recreation.

It also details the increasing risk of older dams, the rising maintenance expense, the declining functionality due to sedimentation, the benefits of restoring or redesigning natural environments, and the societal impacts — pro and con — that need to be weighed by policymakers deciding what to do. Notably, "the nature of these impacts varies significantly between low- and high-income countries".

The analysis also includes dam decommissioning or ageing case studies from the USA, France, Canada, India, Japan, Zambia, and Zimbabwe.

Climate change will accelerate the dam ageing process

"This report aims to attract global attention to the creeping issue of ageing water storage infrastructure and stimulate international efforts to deal with this emerging, rising water risk," says co-author Vladimir Smakhtin, Director of UNU-INWEH.

"Underlined is the fact that the rising frequency and severity of flooding and other extreme environmental events can overwhelm a dam's design limits and accelerate a dam's ageing process. Decisions about decommissioning, therefore, need to be taken in the context of a changing climate."

Notes lead author and UNU-INWEH Senior Researcher Duminda Perera: "This problem of ageing large dams today confronts a relatively small number of countries — 93% of all the world's large dams are located in just 25 nations."

"Large dam construction surged in the mid-20th century and peaked in the 1960s–1970s," he says, "especially in Asia, Europe and North America, while in Africa the peak occurred in the 1980s. The number of newly-constructed large dams after that continuously and progressively declined."

According to the report, the world is unlikely to witness another large dam building revolution as in the mid-20th century, but dams constructed then will inevitably be showing their age.

China has 23,841 large dams (40% of the world's total). And 32,716 large dams (55% of the world's total) are found in just four Asian countries: China, India, Japan, and the Republic of Korea — a majority of which will reach the 50-year threshold relatively soon. The same is true of many large dams in Africa, South America, and Eastern Europe.

The pace of large dam construction has dropped dramatically in the last four decades and continues to decline in part because "the best locations for such dams globally have been progressively diminishing as nearly 50% of global river volume is already fragmented or regulated by dams," the report says.

As well, there are strong concerns regarding the environmental and social impacts of dams, and large dams in particular, as well as emerging ideas and practices on the alternative types of water storage, nature-based solutions, and types of energy production beyond hydropower.

Drivers of dam decommissioning

Public safety, escalating maintenance costs, reservoir sedimentation, and restoration of a natural river ecosystem are among the reasons driving dam decommissioning.

However, most dams removed to date have been small; decommissioning large dams (defined by ICOLD as 15 or more metres from lowest foundation to crest, or 5 to 15 metres impounding more than 3 million cubic metres) is "still in its infancy, with only a few known cases in the last decade."

"A few case studies of ageing and decommissioned large dams illustrate the complexity and length of the process that is often necessary to orchestrate the dam removal safely," adds co-author and UNU-INWEH Adjunct Professor R. Allen Curry, based at the University of New Brunswick.

"Even removing a small dam requires years (often decades) of continuous expert and public involvement, and lengthy regulatory reviews. With the mass ageing of dams well underway, it is important to develop a framework of protocols that will guide and accelerate the dam removal process."

Decommissioning will also have various positive and negative economic, social, and ecological impacts to be considered in a local and regional social, economic, and geographic context that is "critical to protect the broader, sustainable development objectives for a region," the report says.

"Overall, dam decommissioning should be seen as equally important as dam building in the overall planning process on water storage infrastructure developments."

"Ultimately, value judgments will determine the fate of many of these large water storage structures. It is not an easy process, and thus distilling lessons from and sharing dam decommissioning experiences should be a common global goal. Lack of such knowledge and lack of its reflection in relevant regional/national policies/practices may progressively and adversely affect the ability to manage water storage infrastructure properly as it is ageing."

In addition to the three UNU-INWEH experts, the report was co-authored by Spencer Williams, Graduate Institute of International and Development Studies, Geneva, Switzerland. and Taylor North of McMaster University, Hamilton, Canada.

By the numbers

General

- 58,700: large dams registered in the International Commission on Large Dams (ICOLD) database, a large dam is defined as 15+ metres in height, measured from lowest foundation to crest, or 5 to 15 metres high impounding more than 3 million cubic metres (0.003 km3). Within the 58,700 large dam total, roughly one in eight has a 100 million cubic metre (0.1 km3) capacity.
- 7,000 to 8,300 km3: volume of water stored behind large dams worldwide — about one-sixth of all river discharge worldwide each year — enough to cover roughly 80% of Canada's land mass under a meter of water
- 50 to 100 years: design life of dams constructed between 1930 and 1970 (when most existing large dams were built). Average life expectancy: 50 years
- ~16,000: large dams 50 to 100 years old in North America and Asia
- ~2,300: large dams 100+ years old in North America and Asia

USA / Canada

- 56: average age of 90,580 US dams (all sizes)
- 85%+: US dams in 2020 operating at or beyond their life expectancy
- 75%: US dam failures that occurred after 50 years of age
- US$ 64 billion: estimated cost to refurbish US dams
- 1,275: dams removed in 21 US states in the last 30 years; 80 removed in 2017 alone
- 50%+: large dams in Canada over 50 years old

China

- 56%: proportion of the world's large dams located in China and the US (the top 25 countries account for more than ~93%)
- 23,841: large dams in China (the most of any country, and 40% of the world's total)
- 60%: proportion of the world's large dams in Asia
- 55%: proportion of the world's large dams in just four countries — China, India, Japan, and Republic of Korea — the majority of which will soon reach 50 years of age

India

- 1,115+: large dams in India that will be roughly 50 years old in 2025
- 4,250+: large dams in India that will be 50+ years old in 2050
- 64: large dams in India that will be 150+ years old in 2050
- 3.5 million: the approximate number of people at risk if India's Mullaperiyar Dam, built 100+ years ago, were to fail. The dam, in a seismically active area, shows significant structural flaws and its management is a contentious issue between Kerala and Tamil Nadu States

Japan

- 100+ years: average age of large dams in Japan

Australia

- 650: large dams in Australia, half of them 50+ years old; 50+ have been in operation for 100+ years. Portion of Australia's electricity generation from hydropower: 65%

UK / Europe

- 100+ years: average age of large dams in the UK
- ~10%: large dams in Europe 100+ years old

Africa

- 2,000: large dams in Africa (¼ of them in South Africa), the fewest of any continent; mostly used for irrigation

Link to the full report: http://bit.ly/UNU-dams

(United Nations University / Institute in Hamilton, Canada, 22.01.2021, https://unu.edu/media-relations/releases/ageing-dams-pose-growing-threat.html)

Ageing Water Storage Infrastructure: An Emerging Global Risk

Perera, D., Smakhtin, V., Williams, S., North, T., Curry, A., 2021. Ageing Water Storage Infrastructure: An Emerging Global Risk.UNU-INWEH Report Series, Issue 11. United Nations University Institute for Water, Environment and Health, Hamilton, Canada.

The Report provides an overview of the current state of knowledge on the ageing of large dams –an emerging global development issue as tens of thousands of existing large dams have reached or exceeded an "alert" age threshold of 50 years, and many others will soon approach 100 years. These aged structures incur rapidly rising maintenance needs and costs while simultaneously declining their effectiveness and posing potential threats to human safety and the environment.

The Report analyzes large dam construction trends across major geographical regions and primary dam functions, such as water supply, irrigation, flood control, hydropower, and recreation. Analysis of existing global datasets indicates that despite plans in some regions and countries to build more water storage dams, particularly for hydropower generation, there will not be another "dam revolution" to match the scale of the high-intensity dam construction experienced in the early to middle, 20th century. At the same time, many of the large dams constructed then are aging, and hence we are already experiencing a "mass ageing" of water storage infrastructure.

The Report further explores the emerging practice of decommissioning ageing dams, which can be removal or re-operation, to address issues of ensuring public safety, escalating maintenance costs, reservoir sedimentation, and restoration

of a natural river ecosystem. Decommissioning becomes the option if economic and practical limitations prevent a dam from being upgraded or if its original use has become obsolete. The cost of dam removal is estimated to be an order of magnitude less than that of repairing.

The Report also gives an overview of dam decommissioning's socio-economic impacts, including those on local livelihoods, heritage, property value, recreation, and aesthetics. Notably, the nature of these impacts varies significantly between low- and high-income countries.

The Report shows that while dam decommissioning is a relatively recent phenomenon, it is gaining pace in the USA and Europe, where many dams are older. However, it is primarily small dams that have been removed to date, and the decommissioning of large dams is still in its infancy, with only a few known cases in the last decade.

A few case studies of ageing and decommissioned large dams illustrate the complexity and length of the process that is often necessary to orchestrate the dam removal safely. Even removing a small dam requires years (often decades), continuous expert and public involvement, and lengthy regulatory reviews. With the mass ageing of dams well underway, it is important to develop a framework of protocols that will guide and accelerate the process of dam removal.

Overall, the Report aims to attract global attention to the creeping issue of ageing water storage infrastructure and stimulate international efforts to deal with this emerging water risk. This Report's primary target audiences are governments and their partners responsible for planning and implementing water infrastructure development and management, emphasizing adaptation to a changing climate and sustainable development.

(admin in UNU-INWEH Reports, 22 Jan 2021, https://inweh.unu.edu/ageing-water-storage-infrastructure-an-emerging-global-risk)

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular January 2021
https://www.issmge.org/news/issmge-news-and-information-circular-january-2021

1. 20ICSMGE- IMPORTANT NOTICE

Due to the ongoing pandemic, the conference organisers have taken the difficult decision to postpone the conference until Feb-April 2022. We hope to confirm the final date in the next circular.

2. TERZAGHI ORATION – News from the ISSMGE President Charles Ng

I am very pleased to announce that Professor Antonio Gens from the Universitat Politècnica de Catalunya in Spain has been selected to deliver the Terzaghi Oration at the 20ICSMGE in Sydney. Professor Gens was selected from a pool of 16 outstanding nominations including 5 former Rankine Lecturers. After reviewing the abstracts of proposed case histories including photographs submitted by 6 finalists and consultation among some distinguished peers in our Society, I had the privilege to select Professor Gens to be our next Orator although the decision was extremely difficult since we had so many outstanding candidates. I am absolutely confident that Professor Gens will deliver an excellent lecture in Sydney. Please join me in congratulating Professor Gens**.**

3. BRIGHT SPARK LECTURES - 20ICSMGE

The YMPG in collaboration with the Local Organising Committee for the ICSMGE would like to announce the winners of the Bright Spark Lecture Award to two very distinguished engineers: Dr. Ashani Ranathunga (Sri Lanka) and Dr. Brendon Bradley (New Zealand). They are both invited to give keynote lectures at the 20ICSMGE in Sydney.

For the full article, please refer to the News Bulletin, October 2020, page 30 (https://www.issmge.org/publications/issmge-bulletin/vol-14-issue-5-october-2020)

4. TC - NOMINATIONS

These TCs are actively seeking nominations for members from the Member Societies. Please make sure that your Member Society representative is aware of your interest in joining either of these Committees.

TC107 – Tropical Residual Soils

TC214 - Foundation Engineering for Difficult Soft Soil Conditions.

5. WEBINARS

The following webinar was recently added to the ISSMGE educational resources available from the website:

- Prof. Pijusch Samui: "Machine Learning in Geotechnical Engineering

6. ISFOG 2020 – Proceedings now available

The proceedings for ISFOG 2020 (a specialist conference on offshore geotechnics held under the auspices of TC209) have just been released. The conference itself has been postponed to late 2021, but the decision was taken to make the proceedings available this time - to ensure the material comes out in a timely fashion, and to honour the commitment of authors to the conference. The link to purchase the proceedings is at https://www.isfog2020.org/proceedings. The cost is USD150.00 and will be deducted from the cost of your conference registration. Registration will open to the public in June 2021. Registrants will be contacted closer to that date and given instructions on how to obtain credit for the purchase of the proceedings.

7. BULLETIN

The latest edition of the ISSMGE Bulletin (Volume 14, Issue 6, December 2020) is available from the website https://www.issmge.org/publications/issmge-bulletin/vol-14-issue-6-december-20200

8. ISSMGE ONLINE LIBRARY – OPEN ACCESS

The ISSMGE Online library (https://www.issmge.org/publications/online-library) is in continuous development – please note the following additions/updates:

- All Proceedings from Australia New Zealand Conferences on Geomechanics

9. ISSMGE FOUNDATION

The next deadline for receipt of applications for awards from the ISSMGE Foundation is the 31st January 2021. Click **here** for further information on the ISSMGE Foundation.

10. NEWS FROM GI-ASCE

GI-ASCE would like to encourage visitors to its site (https://www.geoinstitute.org/) for a wealth of resources and news available to all, including award lectures from the 2020 Geo-Congress (Geo-Institute of ASCE - YouTube) and updates regarding deadlines for paper submissions to relevant conferences (https://www.geoinstitute.org/events)

11. CONFERENCES

For a listing of all ISSMGE and ISSMGE supported conferences, and full information on all events, including deadlines, please go to the Events page at https://www.issmge.org/events. However, for updated information concerning possible changes due to the coronavirus outbreak (ie. postponements, cancellations, change of deadlines, etc), please refer to that specific event's website.

As might be expected, many events have been rescheduled and we update the Events page whenever we are advised of changes.

The following are events that have been added since the pre-

vious Circular:

ISSMGE Events

17th Danube-European Conference on Geotechnical Engineering - 05-09-2022 - 07-09-2022

Ramada Parc, Bucharest, Romania; Language: English; Organiser: Romanian Society for Geotechnical and Foundation Engineering; Contact person: Ernest Olinic, Address: Bvd. Lacul Tei 124; Email: srgf@utcb.ro; Website: http://www.17decge.ro

ISRM International Society for Rock Mechanics and Rock Engineering

Access to ISRM Online Library updated

Dear ISRM member

As you know, the ISRM Online Library is hosted by OnePetro. In the ISRM Online library you can find the proceedings of ISRM Congresses and sponsored Symposia and download freely up 100 papers per year.

OnePetro has updated its website and, if you were previously registered there you may have received an email with your new access credentials. If you are not registered yet, now is a good opportunity. Just go to onepetro.org and either:

- If already have an OnePetro username, login with the password received by email, or ask to reset your password.
- If you never registered with OnePetro, create a OnePetro account.

In both situations, remember that the OnePetro and ISRM username/passwords are not the same. After logging at OnePetro, make sure to visit your Account, choose My Memberships, and enter the Sign In credentials you use with ISRM. Now and in the future, you will need to annually redeem your membership details to receive your membership benefits on OnePetro. If you don't remember the ISRM username and password, you may get them at https://www.isrm.net/.

Contact the ISRM Secretariat at secretariat@isrm.net if you need any additional help.

Dr. Luis Lamas
Secretary General, ISRM

News
www.isrm.net/noticias/?tipo=1&todas=1&show=info

1st International Young Scientists Forum for DDA was held on 9 January 2021-01-13

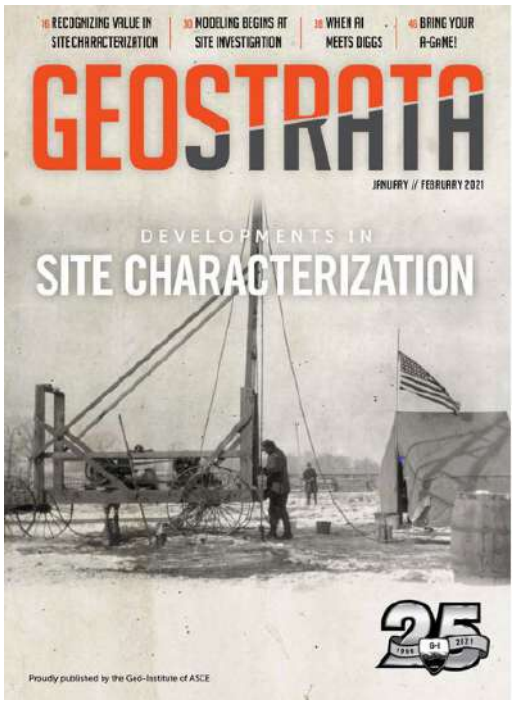
11th Asian Rock Mechanics Symposium ARMS11 - call for abstracts 2021-01-11

New ISRM course on "Prevention methods for Landslides in Rock Masses" 2021-01-10

Complete ISRM course on "Prevention methods for Landslides in Rock Masses" now available on the ISRM website

EUROCK 2021 - full paper submission deadline is 28 February 2021-01-09

Geo-Institute of ASCE



Κυκλοφόρησε το τεύχος Ιανουαρίου // Φεβρουαρίου 2021 του περιοδικού GEOSTRATA του Geo-Institute της American Society of Civil Engineers, αφιερωμένο στο θέμα "Developments in Site Characterization", με τα παρακάτω περιεχόμενα:

- From The President: A New Year — A New Decade
- GeoCartoon
- From the Editorial Board
- Board of Governors Update
- Technical Activities Update
- For Who the Bell Tolls
- Recognizing Value in Site Characterization — How Cool Would That Be?
- Lessons Learned From Geolegends - Richard J. Finno, PhD, PE, D.GE, Life.M.ASCE

- Jan/Feb 2021 Developments In Site Characterization - Your Numerical Model Begins at the Site Investigation Phase
- Jan/Feb 2021 Developments In Site Characterization - When AI Meets DIGGS
- Jan/Feb 2021 Developments In Site Characterization - Bring Your A-GaME! and Dominate the Field [Investigation]
- Jan/Feb 2021 Developments In Site Characterization - Practical Aspects Of Routine Geotechnical Site Investigations
- Jan/Feb 2021 Developments In Site Characterization - Pay Now, Or Pay Later
- Look Who's a D.GE - Joseph J. Lifrieri, PhD, PE, D.GE, CPG, PMP, PP, F.ASCE
- New Faces In G-I - Kirk Carr Ellison, PhD, PE, GE, M.ASCE
- G-I Organizational Member News
- Corebits News
- Corebits Chapters
- ASCE EDUCATION and CAREERS
- Geostrata
- Industry Calendar
- Ode to a Split Spoon

https://www.readgeo.com/geostrata/january_february_2021/MobilePagedArticle.action?articleId=1651730#articleId1651730

BTS January Live Webinar
Three Great Challenges:
Experiences from TBM Tunnelling in Difficult Ground
http://www.britishtunnelling.org.uk

Speaker: Lok Home – President, The Robbins Company

When boring through the earth, even extensive Geotechnical Baseline Reports can miss fault lines, water inflows, squeezing ground, mixed face conditions, rock bursting and other geological challenges. That reality is compounded when tunnels are extremely long, in remote locations, or under high cover.

In this lecture, Robbins' President Lok Home will discuss three of the most challenging projects in recent memory: The 43.5 km long AMR Water Tunnel, the geologically diverse Sleemanabad Carrier Canal (both in India), and China's Yin Han Ji Wei project in challenging rock bursting conditions.

Lecture and the Q&A broadcasted live on YouTube **Thursday 21st January 2021 at 18:00 hrs [GMT]** Online at: https://youtu.be/SN3htCiU3FA

Joint BTS/ MinSouth Meeting
North Yorks Polyhalite Project
Mineral Transport System

Speakers: Craig Sewell & Jason Fawcett – Strabag

Since 2019, Strabag have been undertaking construction of the Mineral Transport System for the North Yorks Polyhalite Project. This includes a 37km long segmentally lined tunnel and a 370m deep shaft at Lockwood Beck.

The presentation will cover the extensive work being undertaken on the project and an update on the progress of the project to date.

Note: Lecture and the Q&A will be broadcasted live on YouTube **Thursday 11th February 2021 at 18:00 hrs GMT** Online at: https://youtu.be/K6jky336ooA

Landslides and rainfall

BGS Research — Landslides

The graphs on this page are updated monthly using rainfall statistics released by the Met Office and data from our National Landslide Database. The BGS began to release these monthly statistical graphs as research into recent landslide event periods increased.

Analysis carried out by the Met Office shows that the UK is experiencing more extreme rainfall events and that this is likely to be linked to climate change. The UK experienced several months of above-average rainfall from April to December 2012, making it one of the wettest periods of time for most of the country since meteorological records began.

Throughout this period, and into early 2013, a marked increase in the number of landslides was widely reported and captured in our National Landslide Database. Further well-publicised storm events in the winter of 2015 caused another peak in the landslide graph.

Landslides occurring after periods of intense, heavy rainfall are likely to result from one or more of the following:

- water loading of the slope
- reduction in soil strength
- removal of soil particles
- other material changes in the slope

Data collection, communication and social media

As well as routinely collecting data from ongoing regional geological surveys (600 KB pdf) and the published scientific literature, the online press has been monitored for information about landslides through various internet search engines since 2006.

In August 2012, social media were incorporated into this search. Twitter has proved to be the most prolific source of information, as it has for other geohazards such as earthquakes and tsunamis, as well as an early warning system around the world.

Tweets are mainly in response to events that have an immediate impact on society, such as travel disruption, which are often small slope failures. Previously, these small events would not be as visible in the regional and national media and would therefore have a much lower likelihood of being recorded in the National Landslide Database.

Read more about how we use social media and how you can contribute.

Have you seen a landslide?

Please tell us about any landslides you may have seen in the UK — use the report a landslide form or use the contact details at the end of this page.

There are many different ways to classify landslides. Those that occur in response to the extreme rainfall events are mostly likely shallow failures on artificial, engineered slopes; deeper-seated landslides have a longer response time, reflecting the time taken for infiltrating water to reach the groundwater table.

Contact the Landslide Response Team

Tel: 0115 936 3143 Email: landslides@bgs.ac.uk

https://www.bgs.ac.uk/geology-projects/landslides/landslides-and-rainfall/

Institution of Civil Engineers

Geotechnical engineering update

NEWS

Most downloaded of 2020

We take a look at the most downloaded journal papers and eBooks of 2020 to see what you've been reading. The journal papers are all free to read, and the lists showcase the big global issues civil engineers are tackling.

Read the full list now

Challenges for sustainable management of soil resources

Sustainable management of soil resources is an essential part of sustainable development, *Environmental Geotechnics* editorial board members cover this important topic.

Read more

Most talked about of 2020

We've used Altmetric to see which of our books and journal papers started the most conversations online last year. Have you read them all?

View the full list

Predatory publishing

Pressure to publish has led to an increase in publishing venues which seemingly offer a quick and easy service. In reality, many don't provide the services you might expect...

Find out more

We will be changing to a new article-tracking system in Spring 2021. Look out for more news from the journals team soon.

FREE TO READ

Open access: Episodic direct simple shear tests to measure changing strength for whole-life geotechnical design

Experimental determination of the shear strength of peat from standard undrained triaxial tests: correcting for the effects of end restraint

Improving expansive clay beds with granular pile anchors (GPAs) and geogrid-encased GPAs

Open access: Mechanical and deformation characteristics of composite assembled supporting structure

Optimal ranges of soil index properties for diesel containment using compacted barriers

Performance and mechanism of bolt and slurry bonds in anchor systems for earthen sites

Scaled model tests on segmental linings of shield tunnels under earth and water pressures

X-ray computed tomography imaging of fibre-reinforced clay subjected to triaxial loading

Search all our content

EVENTS

ICE Training: Foundation Design

11-12 February 2021, online

Delivered over two days this Eurocode compliant course uses a range of tools to address the key geotechnical and structural criteria for the design of a range of foundation types commonly used for building and civil engineering structures.

Register now

A free webinar on excavation support in dense urban environments is organized by Bentley Geotechnical Engineering and ASCE.

The event will take place on Tuesday, February 9, 2021, at 01:00 PM in Eastern Time (US and Canada). The attendees of the live event will receive a certificate of completion from Bentley.

The webinar will focus on subsurface behavior and is addressed to geotechnical, structural or civil engineering occupations. Lectures will provide comprehensive solutions for the design and analysis of soils, rocks and associated structures including:

- Capture model sensitivity to input parameters and design
- Model in real-time for project stakeholder collaboration
- Discuss where 3D analysis is making a difference
- Consider advancements in geotechnical analysis for seismic regions

Francisco Diego and Brice Exley will speak with developers, engineers and Haley & Aldrich (previously Hart Crowser) for a lively discussion about real-world examples, like safely excavating under Rainier Tower, using innovation coupled with fast and reliable analysis.

(https://www.geoengineer.org/events/excavation-support-in-dense-urban-environments)

ΕΛΛΗΝΙΚΟΣ ΣΥΝΔΕΣΜΟΣ ΓΕΩΣΥΝΘΕΤΙΚΩΝ ΥΛΙΚΩΝ

Hellenic Geosynthetics Society HGS - New Council

Dear Madam, dear Mr. Ziegler, dear Mr. Braeu

Please be informed and consider a change of the composition of our Council, as issued after a meeting held on 28/1/2021 following the resignation of our secretary- Mrs Stella Karavasili from the council. Based on the results of the latest Council meeting (teleconference 28/01/2021) and according to our by-laws, Prof. G.Athanasopoulos is the new Council member and Mr Ch. Stratakos has overtaken the tasks of our Secretariate. Therefore the new HGS Council composition up to the next General Assembly (planned for February 2022) and new elections is the following:

President : Mr ANASTASIOS KOLLIOS

Vice-President : Prof. IOANNIS MARKOU

Treasurer : Mr. NIKOLAOS TSATSOS

Secretary : Mr. CHRISTOS STRATACOS

Regular Members : Mr. IOANNIS FIKIRIS
Mr. APOSTOLOS RITSOS
Prof. GEORGE ATHANASOPOULOS

Kind regards

PRESIDENT OF HGS-member of EAC

Kollios Anastasios
Dr. Civil Engineer

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΤΕΧΝΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

ΑΚΑΔΗΜΙΑ ΑΘΗΝΩΝ

Τον Δεκέμβριο του 2020 απονεμήθηκε από την Ακαδημία Αθηνών το *Βραβείο της Οικογενείας Λουκά Μούσουλου*, για ερευνητική εργασία στον κλάδο της Μεταλλειολογίας – Ορυκτών Πόρων στους κ.κ. **Μιχάλη Λοτίδη** (Δρ. Μηχανικό ΕΜΠ), **Παύλο Νομικό** (Αναπληρωτή Καθηγητή ΕΜΠ) και **Αλέξανδρο Σοφιανό** (Ομότιμο Καθηγητή ΕΜΠ). Το βραβείο αφορά στην εργασία τους «Numerical study of the fracturing process in marble and plaster hollow plate specimens subjected to uniaxial compression» που δημοσιεύθηκε στο περιοδικό Rock Mechanics and Rock Engineering (2019, 52:4361–4386, https://doi.org/10.1007/s00603-019-01884-8). Το βραβείο έχει θεσπισθεί στη μνήμη του ακαδημαϊκού Λ. Μούσουλου και συνοδεύεται από χρηματικό έπαθλο 3.000 ευρώ.

Numerical Study of the Fracturing Process in Marble and Plaster Hollow Plate Specimens Subjected to Uniaxial Compression

Michail A. Lotidis, Pavlos P. Nomikos & Alexandros I. Sofianos

Abstract

Physical models of plaster, calcitic and dolomitic marbles from greek quarries with a single pre-existing cylindrical hole of various diameters, subjected in uniaxial compression are simulated numerically with a bonded particle model by employing the two- and the three-dimensional versions of the Particle Flow Code. The linear parallel bond model is employed for the plaster's simulation, and respectively the flat-joint model for the marbles. The calibration procedure and results are presented, as well as the simulation results of the hollow specimens. The micro-cracking, the fracturing process and the sequence of their appearance during the numerical tests of the hollow plates are in good agreement with the laboratory tested physical models. Each fracture pattern is similar to the one of the physical models. Also, the regions of micro-cracking in the numerical models is quite similar to the regions of intense deformation observed from digital image correlation analysis on the respective physical models. The followed methodology for the determination of the phenomena's onset is presented as well. A comparison between the peak strength and the required applied axial stress for the primary fracture and spalling initiation of the numerical and the physical models is presented along with the accompanied scale effect. Additional numerical investigation is performed, quantifying the stress distribution along and normal to the primary fracture's path during the numerical test. The current study reveals the potential of the bonded particle model to reliably simulate laboratory and field structures, at least for the studied materials.

Lotidis, M.A., Nomikos, P.P. & Sofianos, A.I. Numerical Study of the Fracturing Process in Marble and Plaster Hollow Plate Specimens Subjected to Uniaxial Compression. *Rock Mech Rock Eng* **52,** 4361–4386 (2019). https://doi.org/10.1007/s00603-019-01884-8

(https://link.springer.com/article/10.1007/s00603-019-01884-8#citeas)

Prof. Katerina Ziotopoulou

(https://twitter.com/ucdaviscee/status/1353757069371789312)

ΠΡΟΣΦΟΡΕΣ - ΠΡΟΚΗΡΥΞΕΙΣ ΘΕΣΕΩΝ ΓΙΑ ΓΕΩΤΕΧΝΙΚΟΥΣ ΜΗΧΑΝΙΚΟΥΣ

STARS

PhD position in soil mechanics in Prague!

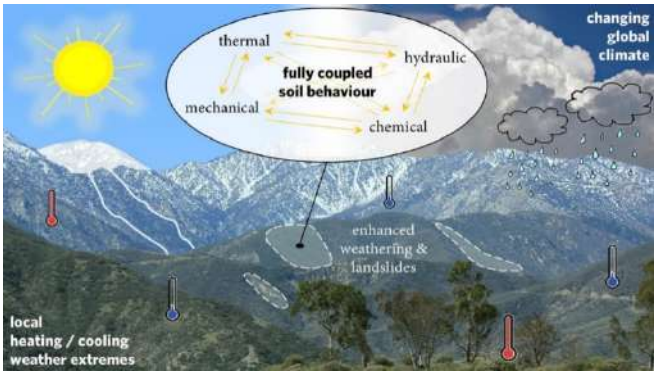
The STARS program provides fully funded PhD positions to ensure an excellent education and an adequate income to PhD students of the Faculty of Science. The STARS program aims to attract the best students from abroad, as well as from the Czech Republic.

The STARS program guarantees that the student will receive at least 20500 CZK/month (equivalent of cca 800 EUR/ month). The actual income may exceed this amount, depending on the specific funding of each individual project.

I am pleased to announce the opening of a new PhD position with a focus on the **thermo-hydro-mechanical characterisation of the residual shear strength of clays** within a recently funded project aimed at understanding the direct role of temperature in controlling slope stability and landslide kinematics.

The PhD scholarship is funded for up to four years within the STARS programme of the Faculty of Science of Charles University and is based at the Institute of Hydrogeology, Engineering Geology and Applied Geophysics. The successful candidate will receive a state-guaranteed scholarship plus a STARS scholarship subject to obtaining a grade "A" (excellent) during each-year evaluations.

The candidate is expected to perform an extensive experimental study which will be complemented by multi-scale constitutive and numerical modelling, scientific writing, attendance to selected university courses, and participation in conferences and seminars. The candidate will join a young and stimulating environment and will be expected to provide critical and creative thinking and, with time, propose spin-off research activities and collaborations.



Landslides in a changing climate.

Applications are open until 11th March and can only be submitted online on the STARS website: https://stars-natur.cz/. The candidate can apply to up to three positions. The expected starting date is **1st October 2021** but an earlier start is encouraged.

Further information on the position can be found at the following link https://stars-natur.cz/phd-positions/geology/thermo-hydro-chemo-mechanical-characterisation-of-the-residual-shear-strength-of-an-expansive-clay?back=wr7fm. Feel free to contact me for informal discussion by email at gianvito.scaringi(at)natur.cuni.cz.

(https://unstablegrounds.wordpress.com/2021/01/12/phd-position-in-prague)

NYU TANDON SCHOOL OF ENGINEERING

Ceferino Research Group
Department of Civil and Urban Engineering
New York University

Ph.D. Position Opening in the area of Disaster Risk Analysis for Urban Resilience starting Fall 2021

We seek highly motivated candidates with a degree in civil engineering, statistics, or computer science with a strong background in the fields of disaster risk, urban resilience, and earthquake and wind engineering. Only in 2020, disasters caused more than $200 billion in losses, highlighting the growing cost of climate change. As these catastrophes impact multiple urban systems components, interdisciplinary research brings invaluable potential for developing a unique understanding of disaster risk, urban vulnerabilities, and natural hazards. Successful candidates will work with Prof. Ceferino on interdisciplinary research to elucidate the impact of extreme natural hazards on complex urban systems and provide technical support for policymakers to develop solutions for enhancing cities' disaster resilience. Successful candidates will work in a collaborative, supportive, and inclusive environment suitable for conducting interdisciplinary research.

Candidates with a master's degree and relevant professional experience and research skills are further encouraged to apply. If you are interested, please email ceferino@nyu.edu and

provide the following three documents in a single pdf. Please title your email "Ph.D. in Urban Resilience Fall 2021".

- 1-page cover letter describing your research experience and interests. Please include a brief statement about your future academic or professional goals and any previous experience demonstrating working as a team.

- CV (including a list of publications, academic/professional backgrounds, skills, GPA, language scores)

- Contact names and information of 2 references.

Candidates with outstanding promise will be encouraged to submit a formal application to graduate school. Candidates will be asked for additional material to officially apply to the Ph.D. Program in Civil Engineering according to the Tandon School of Engineering requirements. Please, visit the Tandon School of Engineering website for more information (https://engineering.nyu.edu/academics/programs/civil-engineering-phd). Please notice that encouragement to apply does not guarantee admission.

Luis Ceferino
Assistant Professor
Department of Civil and Urban Engineering
New York University
Email: ceferino@nyu.edu
Website: https://.luisceferino.com

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

Για τις παλαιότερες καταχωρήσεις περισσότερες πληροφορίες μπορούν να αναζητηθούν στα προηγούμενα τεύχη του «περιοδικού» και στις παρατιθέμενες ιστοσελίδες.

Λόγω της πανδημίας του κορωνοϊού, υπάρχουν αλλαγές είτε στον τρόπο διεξαγωγής των συνεδρίων (με φυσική παρουσία ή virtual), είτε των ημερομηνιών διεξαγωγής κάποιων συνεδρίων. Συνιστάται να ελέγχετε την ημερομηνία διεξαγωγής απ' ευθείας στον ιστότοπο του συνεδρίου.

Postponed ISGPEG 2020 International Conference on Innovative Solutions for Geotechnical Problems in Honour of Prof. Erol Guler, 2021, Istanbul, Turkey, www.isgpeg2020.org/en

Virtual 17th World Conference ACUUS2020 Deep Inspirations, 3-4 February 2021, www.ril.fi/en/events/acuus-2020.html

3rd International Tunnelling Forum, 3.02.2021 - 4.02.2021, Poland, On-line, https://en.kongresdrogowy.pl/konferencja/115-3rd-international-tunneling-forum

Virtual XIII International Symposium on Landslides - Landslides and Sustainable Development, 22-26 February 2021, Colombia, www.scg.org.co/xiii-isl

ICOLD-CIGB 2020 NEW DELHI Sustainable Development of Dams and River Basins, 24-27th February 2021, New Delhi, India, https://icold2020.org (physical and virtual)

International Conference on Challenges and Achievements in Geotechnical Engineering, 31.03.2021 – 02.04.2021, Tirana, Albania, Erdi Myftaraga, emy@greengeotechnics.com

Second International Conference on Geotechnical Engineering - Iraq 2021, 5-6 April 2021, Akre (Aqrah), Duhok, Iraq, http://ocs.uobaghdad.edu.iq/index.php/icgeotecheng/icgte

Virtual Rocscience International Conference on Numerical Modelling "The Evolution of Geotech: 25 Years of Innovation", April 20th - 21st, 2021, www.rocscience.com/learning/rocscience-conference

2nd Vietnam Symposium on Advances in Offshore Engineering – Sustsainable Energy & Marine Planning, 22-24 April 2021, Ho Chi Minh City, Vietnam, https://vsoe2021.sciences-conf.org

16th International Conference of the International Association for Computer Methods and Advances in Geomechanics – IACMAG - CHALLENGES and INNOVATIONS in GEOMECHANICS, 03-05-2021, Torino, Italy, www.symposium.it/en/events/2020/16th-international-conference-of-iacmag?navbar=1

9th International Symposium on Geomechanics
3 - 6 May, 2021, Medellin, Colombia

Organizer: Sociedad Colombiana de Geotecnia and Universidad Nacional de Colombia

Telephone: + 57 4 425 5146

E-mail: gaalzate@unal.edu.co

ATS 2020 AUSTRALASIA TUNNELLING CONFERENCE, 10th – 13th May 2021, Melbourne, Australia, www.ats2020.com.au

EUROGEO WARSAW 2020 7th European Geosynthetics Congress, 16-19 May 2021, Warsaw, Poland, www.eurogeo7.org

TISOLS Tenth International Symposium on Land Subsidence, Living with Subsidence, 17-21 May 2021, Delft - Gouda, the Netherlands, www.tisols2020.org/tisols2020

7th International Conference on Industrial and Hazardous Waste Management 18 - 21 May, 2021, Chania, Crete, Greece, http://hwm-conferences.tuc.gr

Virtual 2020 CHICAGO ICTG International Conference on Transportation Geotechnics, May 23 - 26, 2021, Chicago, Illinois, USA, http://conferences.illinois.edu/ICTG2020

Fifth International Conference on New Developments in Soil Mechanics and Geotechnical Engineering, 27 – 29 May 2021, Nicosia, Northern Cyprus https://zm2020.neu.edu.tr/

MSL 2021 The 1st Mediterranean Symposium on Landslides SLOPE STABILITY PROBLEMS IN STIFF CLAYS AND FLYSCH FORMATIONS, 7-9 June 2021, Naples, Italy, https://medsymplandslides.wixsite.com/msl2021

International Airfield and Highway Pavements Conference, June 8-10, 2021, Austin, Texas, USA, www.pavementsconference.org

9th International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2021), 13-16 June 2021, Sardinia, Italy, https://congress.cimne.com/Coupled2021/frontal/Objectives.asp

Rapid Excavation and Tunneling Conference RETC2021, June 13-16, 2021, Las Vegas, Nevada, USA, www.retc.org

Cities on Volcanoes 11 - Volcanoes and Society: environment, health and hazards, 14-18 June 2021, Heraklion, Crete, https://pcoconvin.eventsair.com/volcanoes11

Joint meeting of ISSMGE TC201 and TC210, ICOLD TC E and TC LE "Dams and Levees: Particle Movements – Case Studies, Experiments, Theory", June 16-19, 2021, Budapest, Hungary, www.isc6-budapest.com

6th International Conference on Geotechnical and Geophysical Site Characterization "Toward synergy at site characterisation", June 16-19, 2021, Budapest, Hungary, www.isc6-budapest.com

EGRWSE 2020 - 3rd International Conference on Environmental Geotechnology, Recycled Waste Materials and Sustainable Engineering, 17-19 June 2021, Izmir, Turkey, www.egrwse2020.com

2nd ICPE 2021 The Second International Conference on Press-in Engineering, 19-21 June 2021, Kochi, Japan, https://icpe-ipa.org/

DFNE 2021 3rd International Conference on Discrete Fracture Network Engineering (in conjunction with ARMA 2021), June 23-25, Houston, Texas, USA, www.dfne2021.org

1st International Conference on Sustainability in Geotechnical Engineering, ICSGE, 27-30 June 2021, Lisboa, Portugal, http://icsge.lnec.pt/#

ICONHIC2021: THE STEP FORWARD - 3rd International Conference on Natural Hazards & Infrastructure, 22 – 24 June 2021, Athens, GREECE, https://iconhic.com/2021

DFI Deep Mixing, 5-8 July 2020, TBD, Gdansk, Poland, www.dfi.org/DM2020

II International Seminar "Tailings and Waste Rock Disposal", July 12 – 14, 2021, Lima, Peru, www.geoingenieria.org.pe

7th ICRAGEE International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, 12-17 July 2021, Bengaluru, India, http://7icragee.org

AFRICA 2021 Water Storage and Hydropower Development for Africa, 13-15 July 2021, Lake Victoria, Uganda, www.hydropower-dams.com/africa-2021

GEOCHINA 2021 - 6th GeoChina International Conference Civil & Transportation Infrastructures: From Engineering to Smart & Green Life Cycle Solution, July 19 to 21, 2021, Nan-Chang, China, http://geochina2021.geoconf.org

PanAm Unsat 2021 3rd Pan-American Conference on Unsaturated Soils, 25-28 July 2021, Rio de Janeiro, Brazil, https://panamunsat2021.com

ACE 2020 14th International Congress on Advances in Civil Engineering, September 2021, Istanbul, Turkey, www.ace2020.org/en

XVIth International Congress AFTES 2021 Underground, a space for innovation, 6 to 8 September 2021, www.aftes2020.com

COMPLAS 2021 XVI International Conference on Computational Plasticity, Fundamentals and Applications, 7-10 September 2021, Barcelona, Spain, https://congress.cimne.com/complas2021/frontal/default.asp

RMEGV 2021 - 5th International Workshop on Rock Mechanics and Engineering Geology in Volcanic Fields, 9÷11 September 2021, Fukuoka, Japan, https://ec-convention.com/rmegv2021

SYDNEY 7iYGEC 2021 7th International Young Geotechnical Engineers Conference A Geotechnical Discovery Down Under, 10-12 September 2021, Sydney, Australia, http://icsmge2021.org/7iygec

SYDNEY ICSMGE 2021 20th International Conference on Soil Mechanics and Geotechnical Engineering, 12-17 September 2021, Sydney, Australia, www.icsgme2021.org

International Conference on Textile Composites and Inflatable Structures (MEMBRANES 2021), 13-15 September 2021, Munich, Germany, https://congress.cimne.com/membranes2021/frontal/default.asp

37th General Assembly of the European Seismological Commission, 19-24 September 2021, Corfu, Greece, www.escgreece2020.eu

EUROCK TORINO 2021 - ISRM European Rock Mechanics Symposium Rock Mechanics and Rock Engineering from theory to practice, 20-25 September 2021, Torino, Italy, http://eurock2021.com

This British Tunnelling Society "BTS 2020" Conference and Exhibition, Sept 30th - Oct 1st, 2021, London, United Kingdom, www.btsconference.com

Virtual EUROENGEO 3RD EUROPEAN REGIONAL CONFERENCE OF IAEG, 7 - 10 October 2021, Athens, Greece, www.euroengeo2020.org

10th International Conference on Scour and Erosion (ICSE-10), October 17-20, 2021, Arlington, Virginia, USA, www.engr.psu.edu/xiao/ICSE-10 Call for abstract.pdf

3rd International Symposium on Coupled Phenomena in Environmental Geotechnics, 20-22 October 2021, Kyoto, Japan, https://cpeg2020.org

ARMS11 11th Asian Rock Mechanics Symposium, Challenges and Opportunities in Rock Mechanics, 21-25 October 2021, Beijing, China, www.arms11.com

HYDRO 2021 Roles of hydro in the global recovery, 25-27 October 2021, Strasbourg, France, www.hydropower-dams.com/hydro-2021

EURO:TUN 2021 Computational Methods and Information Models in Tunneling, October 27th - 29th, 2021, Bochum, Germany, http://eurotun2021.rub.de

GFAC 2021

International Conference
"Geotechnics fundamentals and applications in construction:
investigations, design, technologies"
October 27–29, 2021, Saint Petersburg, Russia
https://gfac.spbgasu.ru

We are pleased to invite you to take part in the GFAC 2021 conference on geotechnics hosted by Saint Petersburg State University of Architecture and Civil Engineering. Traditionally, the conference will bring together representatives of Russia's leading universities, research institutes, design and manufacturing companies as well as scientists from many foreign countries (Belarus, Ukraine, Kazakhstan, USA, South Korea, Japan, India, etc.).

The main aim of the conference is the exchange of latest research findings in geotechnics and modern geotechnical engineering, soil mechanics, basements and foundations, engineering geology as well as sharing experience in the design of complex geotechnical objects under different geological conditions.

GFAC topics

- Special field and laboratory methods of investigating physical and mechanical properties of soils
- Theoretical and practical aspects of soil mechanics
- Models of soil bases and their application in design

- Geotechnical justification, scientific and technical support for engineering survey, design, construction and operation of foundations, underground and earth structures
- Numerical modelling of the "base–foundation–structure" system in software complexes
- Innovative technological solutions in the construction of bases, foundations, underground structures and high-rise buildings
- New construction and reconstruction of buildings and structures in dense urban development and on structurally unstable soils
- Exploring the properties of frozen and thawing soils, foundation constructions and applicable engineering methods
- Geotechnical monitoring in the construction and operation of buildings and structures
- Analysis of the causes of accidents and emergency situations in the design and construction of foundations for buildings and structures

Contacts

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Emerging Technologies and Applications for Green Infrastructure, 28-29 October 2021, Ha Long, Vietnam, https://cigos2021.sciencesconf.org

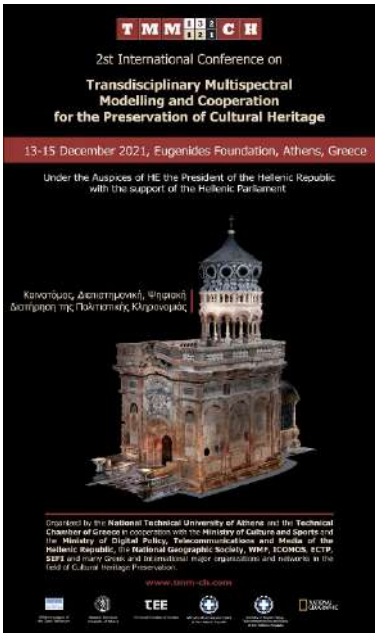
5TH World Landslide Forum Implementation and Monitoring the USDR-ICL Sendai Partnerships 2015-2015, 2-6 November 2021, Kyoto, Japan, http://wlf5.iplhq.org

ISFOG 2020 4th International Symposium on Frontiers in Offshore Geotechnics, 8 – 11 November 2021, Austin, United States, www.isfog2020.org

2021 ICOLD MARSEILLE - ICOLD 27th Congress - 89th Annual Meeting Sharing Water: Multipurpose of Reservoirs and Innovations, 12 - 19 November 2021, Marseille, France, https://cigb-icold2021.fr/en/

2021 GEOASIA7 - 7th Asian Regional Conference on International Geosynthetics Society, November 22-26, 2021, Taipei, Taiwan, www.geoasia7.org

ICGE – Colombo – 2020 3rd International Conference in Geotechnical Engineering, 6-7 December 2021, Colombo, Sri Lanka, http://icgecolombo.org/2020/index.php



2nd International Conference TMM-CH Transdisciplinary Multispectral Modelling and Cooperation for the Preservation of Cultural Heritage
Rebranding The World In Crisis Through Culture
12-15 December, 2021 Athens, Greece
https://tmm-ch.com/

Innovative scientific methodologies and challenging projects marking future trends in the protection of cultural heritage, have initiated a universal conversation within a holistic approach, merging competence from the scientific fields of architecture, civil engineering, surveying engineering, materials science and engineering, information technology and archaeology, as well as heritage professionals on restoration and conservation, stakeholders, industry representatives and policy makers. The combined utilization of digital documentation technologies with innovative analytical and non-destructive techniques, numerical, computational and 3D techniques, archaeometric and archaeogene methods, supports the creation of a transdisciplinary multispectral modeling towards the sustainable preservation of cultural heritage. Innovation is enhancing and revealing a critical dimension of the preservation of cultural heritage along with social participation and communication.

The National Technical University of Athens interdisciplinary team "Protection of monuments" [Prof. A. Moropoulou, Prof. Emer. M. Korres, Prof. A. Georgopoulos, Prof. C. Spyrakos, Ass. Prof. C. Mouzakis], scientific responsible for the Holy Aedicule's rehabilitation of the Holy Sepulchre in Jerusalem, and the Technical Chamber of Greece, in collaboration with international and Greek Authorities, organize the **2nd TMM_ CH International Conference on "Transdisciplinary Multispectral Modelling and Cooperation for the Preservation of Cultural Heritage: Rebranding the World in Crisis through Culture",** on 12-15 December 2021, in Athens, Greece, discussing modern trends in the original agora of our technological and democratic roots.

The Conference is organized under the auspices of H.E. the President of the Hellenic Republic, with the support of the Hellenic Parliament, in cooperation with the National Geographic Society, the World Monuments Fund, the Cultural Heritage Finance Alliance, the International Council of Monuments and Sites ICOMOS, the Organization of World Heritage Cities OWHC, the European Society for Engineering Education SEFI, the European Construction Technology Platform ECTP, the International Federation of Surveyors FIG, the Heritage

Documentation CIPA, and other major international and European organizations, associations and networks in the field of cultural heritage preservation, which had successfully organized the 1st TMM_CH Conference.

The conference will be held at the Eugenides Foundation. Scientific walk and talk visits on 12 December 2021 to Acropolis Monuments and Museum [in the footsteps of the Greek Peripatetic Philosophical School] and other visits planned upon demand.

At the 1st TMM_CH Conference, which was held with great success in October 2018 at the Eugenides Foundation in Athens, with the presence of 350 delegates from 22 countries from all continents, the emblematic rehabilitation of the Holy Aedicule of the Holy Sepulchre in Jerusalem was presented as an exemplary application, in the field of monuments protection, of interdisciplinary and multispectral collaboration, as an outcome of innovation, not only on Research, but in the implementation process as well, with emphasis on technological advancements, not only intersecting all the scientific fields of engineers and natural scientists, but also initiating an ongoing dialogue with humanities, such as Archaeology, Theology, Sociology, Diplomacy and Tourism.

The **scope** of the 2nd TMM_CH Conference is to present the latest developments in research and innovation that identify novel trends to build an interdisciplinary approach to conservation and holistic digital documentation of cultural heritage. The utilization and reuse of monuments, historic cities and sites, forms the framework of a sustainable preservation of cultural heritage, in accordance with the principles of circular economy; in terms of respect and protection of values, materials, structures, architecture and landscape; with an informed society, able to participate effectively in the policies that will design and implement the new strategies required.

Sharing knowledge, experiences, and recommendations about sustainable cultural heritage approaches and practices at a moment of great risk and a time of renewed possibilities, will reorientate conversation to explore the current conditions and contours of the World in crisis rebranding itself through Culture, and relaunching development.

The International Steering Committee and the International Scientific Committee welcome research contributions for oral and poster presentations in English. The submitted abstracts and papers will be peer reviewed. Accepted papers will be divided into sessions. Plenary lectures [after invitation] will cover major accomplishments, trends and technical challenges. Please check important dates for submission deadlines.

Selected papers will be published, as at the 1st TMM_CH Conference, in Springer Computer Science Proceedings, available in 2022 following the Conference, and Scientific Journals in the field of Cultural Heritage Preservation.

TOPICS

- Multispectral, Multidimensional, Novel Approach through Transdisciplinarity and Cooperation in the Protection of Cultural Heritage: Exemplary Projects (The Project of the Rehabilitation of the Holy Sepulchre's Holy Aedicule, EDICULA Erasmus+ Strategic Partnership, et als)
- Digital Heritage
- Heritage at Risk
- Resilience to Climate Change, Natural Hazards and Pandemic Risks
- Advanced Non Destructive and Structural Techniques for Diagnosis, Redesign and Health Monitoring
- Conserving Compatibility, the Materiality of Structures and Architectural Authenticity
- Cross-Discipline Earthquake Protection and Structural Assessment of Monuments
- Transdisciplinary Dialogue among Architecture, Engineering and Natural Sciences with Humanities and Diplomacy
- Bridging Heritage Stakeholders, Science and Industry
- Sustainable Preservation and Management of Cultural Heritage
- Historical / Architectural Sites, Monuments and Complexes as Open Labs of Innovation and Sustainable Socioeconomic Development
- Historic Cities and Centers: New Preservation Strategies by Reuse for Development
- The Reuse of Cultural Heritage through Circular Economy and Social Participation as Key Contribution to Local and Regional Development
- Cultural Heritage and Tourism
- Revealing and Protection of Cultural and Natural Assets through Cultural Routes for Integrated Development of Isolated Areas (Islands, Mountain areas, et als)
- Novel Educational Approach for the Preservation of Cultural Heritage
- From Research and Innovation to Policy for Cultural Heritage Preservation
- Rebranding the World in Crisis through Culture

GeoAfrica 2021 - 4th African Regional Conference on Geosynthetics Geosynthetics in Sustainable Infrastructures and Mega Projects, 21-24 February 2022, Cairo, Egypt, https://geoafrica2021.org

ICEGT-2020 2nd International Conference on Energy Geotechnics, 10-13 April 2022, La Jolla, California, USA, https://icegt-2020.eng.ucsd.edu/home

WTC 2022 World Tunnel Congress 2022 - Underground solutions for a world in change, 22-28 April 2022, Copenhagen, Denmark, www.wtc2021.dk

LARMS 2021 – IX Latin American Rock Mechanics Symposium Challenges in rock mechanics: towards a sustainable development of infrastructure, 15 – 18 May 2022, Asuncion, Paraguay, https://larms2021.com

CPT'22

5th International Symposium on Cone Penetration Testing

8-10 June 2022, Bologna, Italy

The Italian Geotechnical Society (AGI) and the University of Bologna are pleased to announce the 5th International Symposium on Cone Penetration Testing, CPT'22, to be held in Bologna, Italy, on June 8-10, 2022. CPT'22, organized under the auspices of the ISSMGE Technical Committee TC102, follows the successful symposia held in Delft, The Netherlands

(2018), Las Vegas, Nevada USA (2014), Huntington Beach, California USA (2010) and Linköping, Sweden (1995).

As tradition of the CPT events, which foster a lively debate on recent advancements on cone penetration testing, the Symposium aims at providing Researchers, Practitioners and Contractors with a unique opportunity of sharing up-to-date knowledge in equipment, testing procedures, data interpretation and related applications, as well as discussing emerging solutions and new ideas with the largest gathering of world's experts, academics and non-academics, working in the broad and dynamic area of CPTs.

Organizer

Italian Geotechnical Society (AGI) and University of Bologna (endorsed by TC102)

Contact Information

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3rd European Conference on Earthquake Engineering and Seismology (3ECEES), 19-24 June 2022, Bucharest, Romania, https://3ecees.ro

9th International Congress on Environmental Geotechnics
Highlighting the role of Environmental Geotechnics in Addressing Global Grand Challenges
26-29 June 2022, Chania, Crete island, Greece
www.iceg2022.org

The 9th International Congress on Environmental Geotechnics is part of the well established series of ICEG. This conference will be held on an outstanding resort in the town of Chania of the island of Crete in Greece. The theme of the conference is "Highlighting the role of Environmental Geotechnics in Addressing Global Grand Challenges" and will highlight the leadership role of Geoenvironmental Engineers play on tackling our society's grand challenges.

Contact Information

- Contact person: Dr. Rallis Kourkoulis
- Email: rallisko@grid-engineers.com

IS-Cambridge 2020 10th International Symposium on Geotechnical Aspects of Underground Construction in Soft Ground, 27 - 29 June 2022, Cambridge, United Kingdom, www.is-cambridge2020.eng.cam.ac.uk

UNSAT2022
8th International Conference on Unsaturated Soils
June or September 2022, Milos island, Greece

Eurock 2022

Rock and Fracture Mechanics in Rock Engineering and Mining
12÷15 September 2022, Helsinki, Finland
www.ril.fi/en/events/eurock-2022.html

Themes

- Rock mass Characterization
- Geophysics in rock mechanics
- Mechanics of rock joints
- Jointed rock mass behaviour
- Rock support, probability based design
- Rock stress measurements
- Constitutive modelling of rock
- Rock drilling
- Blast induced fractures
- Rock engineering and mining education
- Geological disposal of spent nuclear fuel
- Recent advances in rock mechanics research
- Field and laboratory investigations
- Case studies

Contact Person: Lauri Uotinen
E-mail: lauri.uotinen@aalto.fi

6th Australasian Ground Control in Mining Conference – AusRock 2022
17 – 19 September 2022, Melbourne, Australia

Organizer: UNSW Sydney, AusIMM
Contact Person: Ismet Cambulat
E-mail: icambulat@unsw.edu.au

XII ICG - 12th International Conference on Geosynthetics, September 18 – 22, 2022, Rome, Italy, www.12icg-roma.org

28th European Young Geotechnical Engineers Conference and Geogames, 17 – 19 September 2022, Moscow, Russia, https://www.eygec28.com/?

11th International Conference on Stress Wave Theory and Design and Testing Methods for Deep Foundations, 20 - 23 september 2022, De Doelen, Rotterdam, The Netherlands, https://www.kivi.nl/afdelingen/geotechniek/stress-wave-conference-2022

88th ICOLD Annual Meeting & Symposium on Sustainable Development of Dams and River Basins, April 2023, New Delhi, India, https://www.icold2020.org

15th ISRM

International Congress in Rock Mechanics
9÷14 October 2023, Salzburg, Austria

Contact Person: Prof. Wulf Schubert
E-mail: salzburg@oegg.at

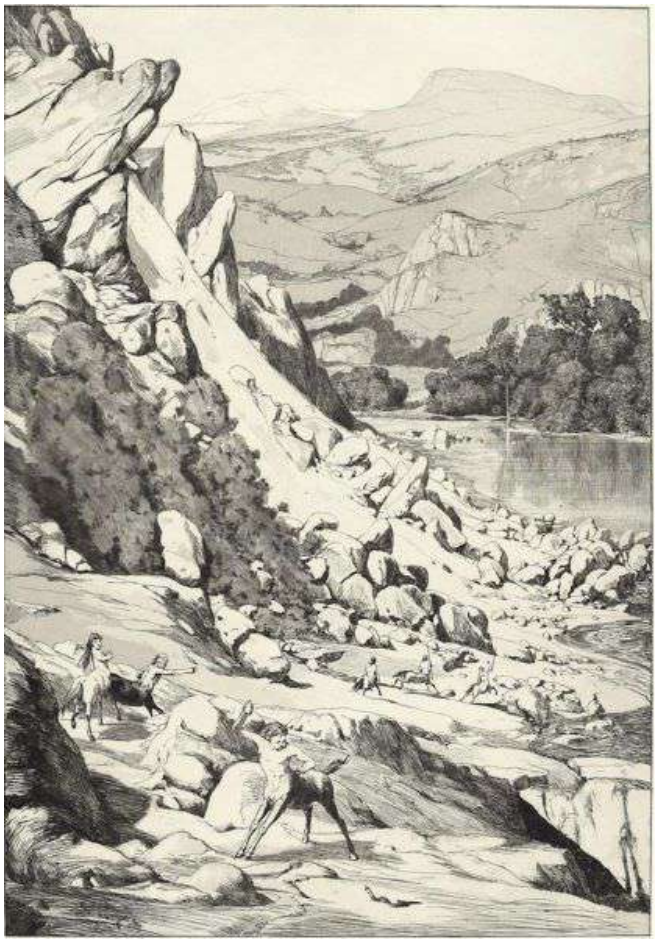
ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

Landslides in Art Part 34: Landslide (Bergsturz) from Intermezzi, Opus IV by Max Klinger

Max Klinger (1857 – 1920) was a German artist renowned for his paintings, sculptures, prints and graphgics, as well as extensive writings on art and graphics.

In 1881 he produced a folio, published as *Intermezzi, Opus IV*, comprising of seven etchings and aquatints with chine collé and five etchings with chine collé. There is a copy in the Museum of Modern Art in New York.

Intermezzi, Opus IV provides a series of whimsical snapshots, arranged in sets of four works. One set of four etchings features the mythological lives of centaurs , and one of these is named *Landslide (Bergstrutz)*:



Landslide (Bergstruz), an etching by Max Klinger produced in 1881.

The etching shows a simple but very beautiful landscape – Max Klinger had studied Japanese art, including the depiction of landscapes. The influences are clear in the work – look in particular at the representation of the mountains in the distance. But the main depiction is of a landslide in the centre of the etching. The landslide looks quite recent – note the smooth, unweathered topography of the landslide source and scar, and no track has yet been created across the deposit. On the edge of the lake is a boulder-rich landslide deposit – this was a rapid and energetic slide, which bifurcated to leave a bouldery heap on the lower part of the hillside.

Max Klinger has included in the etching six centaurs, three of whom are approaching the landslide with aplomb. One is distracted by a snake, to the evident frustration of the team leader. Clearly the centaurs are a team of engineering geologists, dispached to investigate the landslide – indeed two are carrying ranging poles. Presumably the third is transporting a theodolite, out of sight. These centaurs are the ideal field geologists, with a human upper body but the stability and energy of a quadruped.

I imagine the centaurs will be quickly able to evaluate the landslide (once they have stopped being distracted by the snake); I wonder what they made of that fractured outcrop on the nearside of the landslide. I sense that there is a high risk of a toppling failure there, and there is a similarly precarious outcrop on the far side. The services of a roped access team might be required.

(Dave Petley / THE LANDSLIDE BLOG, 3 January 2021, https://blogs.agu.org/landslideblog/2021/01/03/max-klinger)

Large clay landslide leaves 26 people missing, 10 injured in Gjerdrum, Norway

A large clay landslide struck Gjerdrum, Norway, on Wednesday, December 30, 2020, leaving 26 people missing and at least 10 others injured. Some 500 residents have been evacuated amid fears of further mudslides.

The landslide occurred on Wednesday morning in a residential area in Gjerdrum, around 30 km (19 miles) north of Oslo. More than a dozen buildings have been swept away, according to the police.

At least 10 people sustained injuries, one of them critically, while 26 remain unaccounted for. The missing victims were from homes in the innermost area of the slide, but it was not clear yet whether they were away at the time of the incident or had been trapped in their houses, the police added.

The affected area remains unstable and can only be accessed by helicopter, according to the head of the police operation, Roger Pettersen.

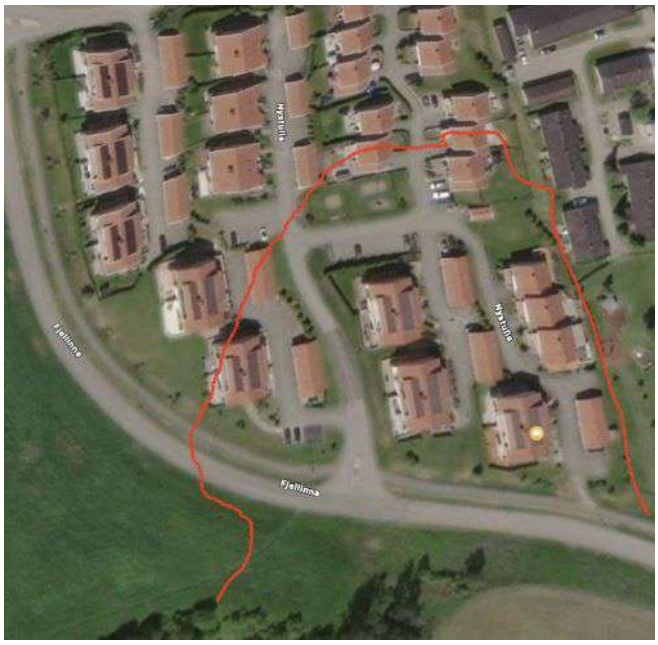
Gjerdrum mayor Anders Oestensen told local media NTB that around 500 people have been evacuated from the area and the numbers may rise further amid fears of more landslides.

Meanwhile, broadcaster NRK highlighted that large amounts of precipitation hit southern Norway in the past few days, which may have caused the clay soil to shift.

In an analysis by Dr. Dave Petley of The Landslide Blog, he stated that while it is not clear how far downslope the landslide extends, images indicate that it was "a very substantial failure," adding that Gjerdrum has been hit by quick clay landslides before.

"The area that has failed is described as being Low hazard but a loosening area (I am not sure what this means yet). However, it is immediately adjacent to an area described as a medium hazard," Dr. Petley wrote.

Norwegian Prime Minister Erna Solberg told broadcaster TV2, "This should have been a New Year's weekend where we should have had peace and quiet and maybe should have worried most about COVID-19 and not whether we have missing persons from a landslide."



The landslide on Ask: At least 17 buildings affected show images from rescue helicopters compared to aerial photos from TOMTOM maps. #gjerdrum

UPDATE [30.12-12:40] #Ask #Gjerdrum #Norvegia #frana su edifici +1 morto #feriti – In corso ricerche possibili #dispersi (Emergenza24 @Emergenza24)

(Julie Celestial / THE WATCHERS, December 30, 2020, https://watchers.news/2020/12/30/landslide-gjerdrum-norway-december-2020)

The scale of the Gjerdrum landslide: a helicopter video

Tonight there is news that a body has been recovered from the site of the Gjerdrum landslide in Norway. This comes after search teams were able to access the site today to undertake the search for the missing people. With the discovery of a victim the number of missing people is now nine; there is still some hope that they might find survivors, but hopes are clearly fading given the combination of the weather and time.

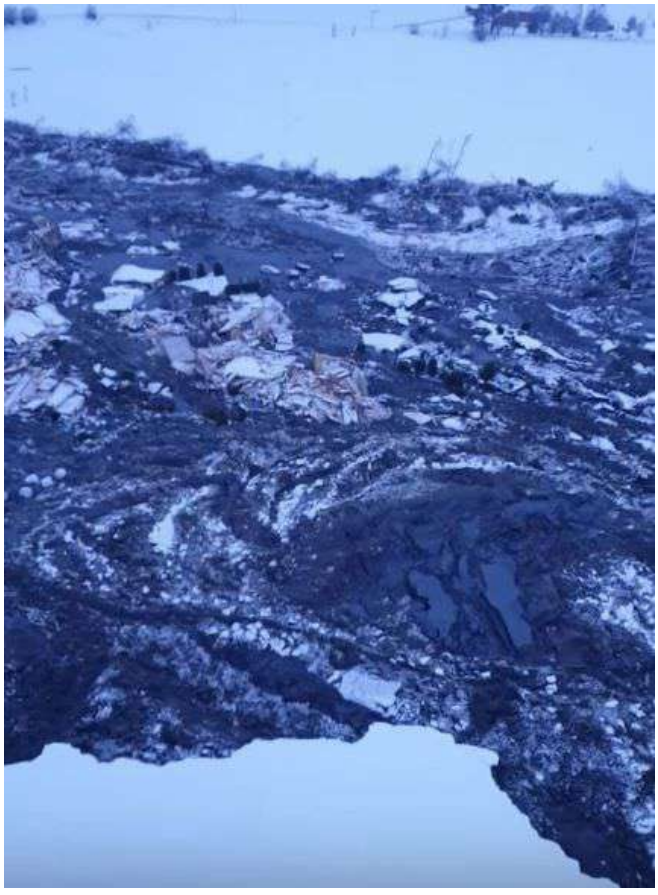
I have often noted that people who have not been involved in these sorts of accidents find it hard to understand why rescues cannot occur more quickly. In part this is of course the need to protect the rescuers – there are many documented examples in which secondary landslides have cost lives, sometimes of those brave people involved in the rescue operations. But this is also because the scale of the affected area can be very large, meaning that the search process is

difficult.

Both of these issues are in play here. This landslide site is very big indeed. Yesterday, NGI released a helicopter video taken of the landslide site. The video is quite long, but I recommend watching the whole thing. You will see that the landslide extends over a large distance, and is wide as well:-

https://www.youtube.com/watch?v=nTDw8PLo_5U&feature=emb_logo

The image below shows just a small part of the landslide mass that needs to be searched. Bear in mind too that the material is extremely weak, so moving around it will be very challenging. And of course at this time of year daylight in Norway is fleeting:-



A small part of the Gjerdrum landslide in Norway. Still from a video posted to Youtube by NGI.

Meanwhile, in other news:

- The search, which is being assisted by experts from Sweden, has been suspended for the night as it is too dangerous to work on the site in the dark;
- Small landslides are continuing to occur on the margins of the failure, with more properties likely to be lost;
- There are some reports that a second dog has been rescued from the site

Of course on these occasions our thoughts must go to those who are missing, and to their families – for them this will be unbearable. But also spare a thought for the rescue teams and for the technical experts who are working with them. They will be under immense pressure as this continues, in the full glare of the media. There are many victims of these events, some less obvious than others.

(Dave Petley / THE LANDSLIDE BLOG, 1 January 2021, https://blogs.agu.org/landslideblog/2021/01/01/the-scale-of-the-gjerdrum-landslide-a-helicopter-video)

Several warnings about the creek in the avalanche area

Neither Gjerdrum municipality nor NGI can now say whether the main part of the avalanche area was mapped and secured in connection with the development of the housing estate. They also cannot say whether a stream that came to several concerns about was secured.

The avalanche area at Nystulia in Gjerdrum has caused major damage to the housing estate, but the largest parts of the avalanche are on the field south of the settlement.

(Fredrik Kampevoll, Line Tomter, Julia Kirsebom Thommessen, Ingerid Stenvold / NRK, 5 Jan. 2021, https://www.nrk.no/norge/flere-varsler-om-bekken-i-skredomradet-1.15311870)

Planet Labs high resolution satellite image of the Gjerdrum landslide in Norway

Operations continue with some intensity of the site of the Gjerdrum landslide in the village of Ask in Norway. Sadly, the focus has now changed from rescue to recovery, with an acceptance that there are no more survivors. To date the remains of seven victims have been recovered, leaving three people missing. Operations have been made easier by an improvement in the conditions on the landslide, but finding those still missing will be a difficult task.

My friends at Planet Labs have now managed to capture an excellent SkySat high resolution satellite image of the site – once again can I note my thanks to them, and in particular to Rob Simmon, for their support. This is the first image that I have seen of the entirety of the site.

The crown of the landslide is of course where the losses occurred. The image below shows this area:

A high resolution SkySat satellite image of the Gjerdrum landslide in Norway. Image Copyright Planet Labs, used with permission.

The form of this landslide is interesting, with a large main source area, and a smaller area to the north that has affected the houses with such catastrophic consequences. The reason for that morphology is not clear to me – on first inspection it appears that this was a retrogression from the main landslide bowl. If so, it will be important to understand why this happened at this particular location. Others will be better placed to comment on this than me, and I'm sure that the official investigation will provide an explanation.

The Planet Labs image also captured the whole of the landslide, which is very large. This is the image:-

A high resolution SkySat satellite image of the Gjerdrum landslide in Norway. Image Copyright Planet Labs, used with permission.

Note the main source on the western side of the image. The main slide moved roughly towards the south, and then followed a very subtle channel towards the east. Mobility was high – the choked channel on the eastern side of the image demonstrates that the landslide moved over 2 2 km. In one location the slide has bifurcated, as seen on the helicopter image. There is a very substantial amount of debris at the toe of the landslide.

There is a great deal of speculation about the trigger of the Gjerdrum landslide. In the past, for example at Rissa, quick clay landslides have been triggered by excavations lower on the slope, which induced rapid liquefaction and expansion of the landslide. There is also some discussion about the role of modification of the topography too – the slope included both a golf course and the housing development. I am not in a position to comment on this, but the Wikipedia article on the Gjerdrum landslide has some details.

Reference

Planet Team (2020). Planet Application Program Interface: In Space for Life on Earth. San Francisco, CA. https://www.planet.com/

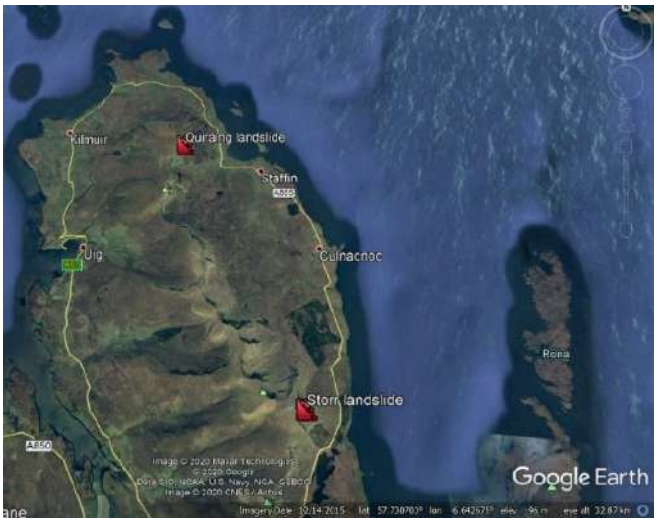
(Dave Petley / THE LANDSLIDE BLOG, 5 January 2021, https://blogs.agu.org/landslideblog/2021/01/05/planet-labs-gjerdrum-landslide)

The Trotternish landslide complex on the Isle of Skye in Scotland

A few years ago I posted briefly about the Quiraing landslide (also sometimes spelt Quirang) on the Isle of Skye in Scotland, suggesting that it is the most beautiful landslide complex in the world. I stand by my view (but would welcome alternative suggestions of course). It is hard to beat this in my views:-

The Quiraing, part of the Trotternish landslide complex on the Isle of Skye.

In fact the Quiraing is one part of a huge, ancient landslide complex located on the east side of the Trotternish peninsula in the northern part of the Isle of Skye. This landslide complex should be better known, but it is a long trip to visit it even from the major cities of Scotland. The complex, which is not active, dates from the period after the last glaciation, between about 13,000 and 5,000 years before present. The Google Earth image below shows the Trotternish peninsula and the location of the two best known landslides, the Quirang and the Storr:-

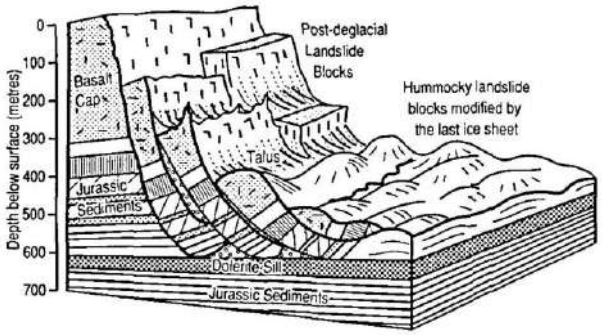


Googe Earth image of the Trotternish peninsula, showing the Storr and Quiraing landslides.

As the image shows, the Trotternish peninsula is dominated

by a large escarpment running apprixmately north-south, formed from Tertiary basalts. At the Storr this has an elevation of about 720 metres. This escarpment, which extends for 23 km, has ancient landslides along its whole length. This is the complex known as the Trotternish landslides – it is the largest landslide complex in the UK by far.

Colin Ballantyne of the University of St Andrews wrote an excellent summary of this complex (Ballantyne 2008), which was published in the Scottish Geographical Magazine. He included this very nice summary of the general structure of the landslides at Trotternish:



The general form of the landslides on the Trotternish peninsula. Diagram from Ballantyne (2008).

As the diagram shows, these landslides consist of rotational failure through the basalt escarpment and the underlying Jurassic sediments, with the basal shear surface being defined by a resistant dolerite sill within the Jurassice rocks. There are multiple failures at the various sites, with the blocks buttressing those upslope. The rotated blocks become more degraded downslope.

This is a classic rotational landslide system, on a very large scale.

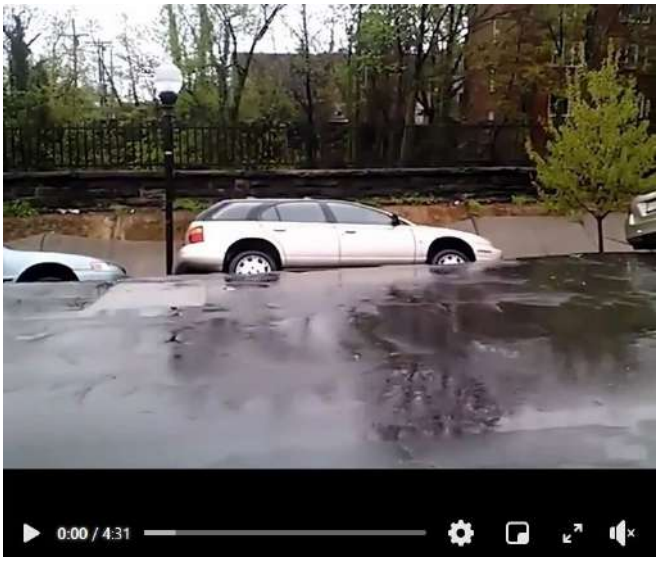
Reference

Ballantyne, C.K. 2008. Scottish landform examples — 2: The landslides of Trotternish, Isle of Skye, *Scottish Geographical Magazine*, **107** (2), 130-135. DOI: 10.1080/00369229118736821

(Dave Petley / THE LANDSLIDE BLOG, 4 January 2021,https://blogs.agu.org/landslideblog/2021/01/04/trotternish-landslide-complex)

https://twitter.com/Mo_Heidarzadeh/status/1344338455615172609

The moment of recording some natural events



https://www.facebook.com/permalink.php?story_fbid=2639655689698518&id=1571714746492623

Destructive massive landslide in a copper mine in Toledocity in Cebu, Philippines

This is a destructive massive landslide in a copper mine in Toledocity in Cebu Philippines on Dec 21 which left several casualties. A small tsunami was generated by the landslide (from YouTube: Adeena Sofia).

The landslide appears to be triggered by heavy rainfall in the area #landslide #Philippines

(Dr Mohammad Heidarzadeh, Dec 30, 2020)

A Slippery Slope: Could Climate Change Lead to More Landslides?

Scientists investigate whether warming temperatures and changing rainfall patterns could be triggering more landslides in mountainous areas.

On 10 August 2020, the Grizzly Creek Fire started to sweep through the steep, wooded slopes of Glenwood Canyon in Colorado. Sparks from a vehicle traveling along Interstate 70 are believed to be the cause of the raging forest fire.

The fire blazed into October, shutting down the major interstate through the Rocky Mountains for 13 days. The flames

left scarred, barren hillsides in their wake and a deadly calling card for the months ahead: landslides.

The Grizzly Creek Fire blazes through Glenwood Canyon in Colorado, days after it started.

Months later, with no trees or vegetation to stabilize the slopes, rocks started falling down them and onto the interstate. "The tree roots hold rocks in place a bit—they are a little like a web," said Paul Santi, a professor of geology and geological engineering at the Colorado School of Mines in Golden. "You remove those and the stability they are providing, and you are going to see the movement of particles, from sand-grain size to boulder size, after a wildfire."

Burned hillslopes are especially vulnerable when rain begins to fall. In Glenwood Canyon and many other burned areas, the main concern is giant debris flows, which are a mix of soil, rock, and other debris saturated with water. After the 2018 wildfires near Montecito, Calif., a series of debris flows killed 23 people, injured 167 more, and damaged 408 homes. In Glenwood Canyon, mudslides could close a major transportation corridor for days, or more. And the potential for such risks might stretch for years, depending on how long it takes for vegetation to regrow and restore slope stability. "Typically, the increased risk for debris flows is usually something on the order of 1–3 years after a fire," Santi said.

This aerial view shows massive landslide damage in the mountains of Puerto Rico after the extreme rainfall from Hurricane Maria in 2017.

A Climate Connection

Colorado has seen temperatures rise by about 1°C since the early 20th century, and the hotter temperatures have been associated with droughts and extreme wildfire seasons. Because much of the state is mountainous, this change in climate could also lead to more landslides.

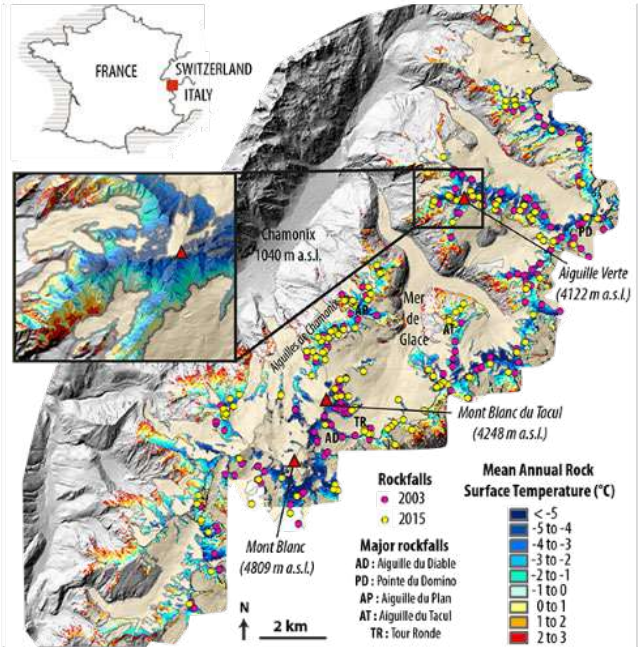
"The connection between climate change and landslides is something that's been talked about for a long, long period of time.""As we have more fires—and longer, more intense fires—and then we couple this with more intense weather events, we are going to see a higher frequency of debris flows," Santi said.

Scientists are also starting to discover other ways in which climate change is leading to changes in certain types of landslide activity, including debris flows, earthflows (rapidly descending earth), and rockfalls. In certain mountainous areas of Europe and Alaska, researchers have recorded a higher incidence of rockfalls as average temperatures rise from one year to the next. In other locations, an increase in extreme rainfall events and/or stronger hurricanes—both linked to climate change—can trigger debris flows.

"The connection between climate change and landslides is something that's been talked about for a long, long period of time," said David Petley, an Earth scientist at the University of Sheffield in the United Kingdom. "There is a kind of inevitability that there will be a signal there."

Consequently, in the past 2 decades, scientists have begun to probe how different aspects of climate change are affecting the stability of slopes in North America, Asia, Europe, and Oceania. The results could help people know whether the ground beneath their feet, or the slopes above their houses, might pose a threat in the decades to come.

From Rock Climbs to Rockfalls



During the extremely hot summers of 2003 and 2015, multiple rockfalls occurred in the Mont Blanc massif. The map shows the locations of these rockfalls imposed on the permafrost distribution for the region. The abbreviation masl = meters above sea level. Credit: Deline et al., 2017, https://doi.org/10.1016/j.scitotenv.2017.07.055

In 2005, a series of huge rockfalls in the Mont Blanc massif in the French Alps swept away the Bonatti pillar, a classic climbing route on the Drus, at 2,754 meters above sea level. For scientists Philip Deline and Ludovic Ravanel at the Université Savoie Mont Blanc/French National Center for Scien-

tific Research in Chambéry, the rockfalls were troubling but unsurprising. For years, they'd been tracking rockfalls and the rising risks for the climbing community in the region.

Using reports from mountaineers and a large database of old and new photographs, Ravanel has created an inventory of rockfalls in two areas of the Mont Blanc massif from the end of the 1800s to current times. Nearly 80% of the rockfalls occurred between 1990 and 2015, as air temperature increased. Nearly a third of all the rockfalls have occurred in the past 5 years, Deline said. "We have shown there is a clear connection between the warming temperature and rockfall frequency," Deline said.

The scientists believe that warming temperature is heating permafrost, ground that has remained permanently frozen for at least 2 years. In mountainous areas, permafrost zones typically exist above a certain altitude. In permafrost zones, rocks are glued together by ice fillings in their cracks and crevices. As the air temperature increases each year, scientists believe that the warming, and even thawing, permafrost is weakening rock faces and leading to rockfalls. The theory is difficult to prove: "The permafrost is not something visible like a glacier," Deline said.

"We are becoming even more convinced that thawing permafrost is the trigger of this kind of event."When the scientists analyzed their inventory of rockfalls, they found that all of the rockfalls stemmed from areas in permafrost zones and that rockfalls were more likely in regions of temperate permafrost (close to 0°C). They also found that the frequency of rockfalls increased during the hottest summers, with significant rockfalls seen in the extremely hot summers of 2003 and 2015.

In a relatively recent rockfall from their inventory, approximately 50,000 cubic meters of rock crashed down a mountainside. Some of the large sections of rock contained ice. Deline and Ravanel used carbon dating to estimate the age of the ice and found it was several thousand years old. This shows that the permafrost hadn't thawed in that time, Ravanel said.

"So this is one more element in order to show that we are in [a] period of the degradation of the permafrost," Deline said. "We are becoming even more convinced that thawing permafrost is the trigger of this kind of event."

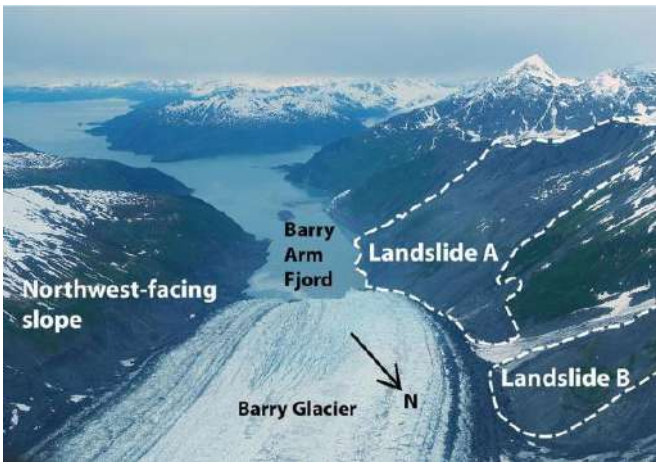
The Tour Ronde rockfall in Chamonix, France, occurred during the extremely hot summer of 2015.

From Rockfalls to Tsunamis

The connection between warming temperatures and rockfalls has been observed at high altitudes in other regions as well. When scientists used Landsat satellite imagery to analyze rockfalls in Glacier Bay National Park and Preserve in Alaska, they found that a cluster of large rock avalanches had occurred between 2012 and 2016, a period of record-breaking warm winter and spring temperatures.

Researchers hypothesized that thawing permafrost may be playing a role in these events and expressed concerns that a landslide into Glacier Bay could trigger a tsunami. "It would be a low-probability, high-consequence type of event," said geologist Gabriel Wolken of the Geological and Geophysical Surveys Division of the Alaska Department of Natural Resources.

More recently, however, scientists have become concerned about a "higher-probability event with very large consequences," Wolken said. As the climate has warmed in Alaska, Barry Glacier, on the edge of Prince William Sound, has retreated. Previously supported slopes are now weakened and have the potential to fail.



Subaerial landslides could generate tsunamis if they rapidly failed into Barry Arm Fjord in southern Alaska.

A small landslide from this slope into Barry Arm Fjord has the potential to generate a tsunami that could affect fishers and tourists in the immediate area. A full-slope failure would be like dropping about 500 Empire State Buildings into the ocean at one time, Wolken said, on the basis of the scientists' current best estimates of the possible maximum volume.

A tsunami from such a major landslide would be devastating for the local community. The town of Whittier, 50 kilometers southwest of the slope, could be struck by a wave 10 meters high within 20 minutes. During the summer, as many as 500 people—fishers, recreational boaters, and campers—may be in the area and at risk, according to the Alaska Department of Fish and Game. Consequently, Alaskan officials have strongly recommended that people avoid the identified danger zones until scientists better understand the hazards involved.

Concerned about this risk, a group of scientists, including Wolken, issued a statement in May 2020 calling attention to the large, creeping rock slope above the fjord and the potential for a hazardous tsunami. For Wolken, the connection to climate change is clear.

"Fundamentally, this landslide probably wouldn't happen, and the tsunami hazard associated with it wouldn't exist, if the glacier [were] positioned where it used to be," Wolken said. "We have all of these changes in cryospheric variables…such as glacial retreat and permafrost thaw and degradation, that are independently clearly linked to a change in climate."

Rainy Day Slides

Although the connection between rising temperatures and landslides in permafrost zones is becoming clearer, most of the world's landslides are triggered by rainfall. Discovering whether changes in rainfall patterns could lead to more, or fewer, landslides is proving tricky.

"The nature of the interaction between rainfall and ground movement is harder to pin down, as there are lots of variables to be considered simultaneously," Petley said.

To determine how changing rainfall patterns might affect landslide activity in the Calabria region of southern Italy, for example, scientists analyzed a catalog of rainfall events related to landslide occurrences in the region between 1921 and 2010. The researchers then used the rainfall events from the past 30 years and a model of anticipated changes in rainfall patterns based on different greenhouse gas emissions scenarios to anticipate how landslide activity might change across Calabria in the future.

Research also predicted that there would be a greater number of rainfall events capable of triggering landslides.Using this approach and assuming that emissions keep rising through the 21st century and temperatures rise by 4.5°C in the next 80 years, the researchers' methodology predicted a 45.7% average increase of rainfall-induced landslides in the region. "We expected an increasing trend, and we managed to quantify it," said Stefano Luigi Gariano at the Research Institute for Geo-hydrological Protection in Perugia, Italy.

The scientists' research—among the first to quantify the impacts of changing rainfall patterns on a regional scale—also predicted that there would be a greater number of rainfall events capable of triggering landslides. And those high-intensity rainfall events would be concentrated into certain months of the year. "There will be more rainfall in less time, which will produce more intense events," Gariano said.

Warming temperatures can also have an impact on the intensity of hurricanes. "We're seeing from our data that the strongest storms are in fact getting stronger," said climatologist James B. Elsner at Florida State University.

Although more intense storms don't necessarily cause more rainfall, scientists have determined that long-term climate trends contributed to the record-breaking rainfall of Hurricane Maria, which slammed Puerto Rico in 2017. This extreme rainfall led to 40,000 landslides on the island.

A Model Approach

To look at how changing rainfall patterns might be affecting landslide activity in High Mountain Asia, a team of scientists recently used two models: one that projects changes in precipitation coupled with another that determines whether landslide activity is likely due to the intensity of the rainfall and the surface conditions.

"It's a simple decision tree model that considers if it is raining hard," said research scientist Dalia Kirschbaum of the NASA Goddard Space Flight Center in Greenbelt, Md. "If the answer is yes, it goes on to see if the area is susceptible to a landslide."

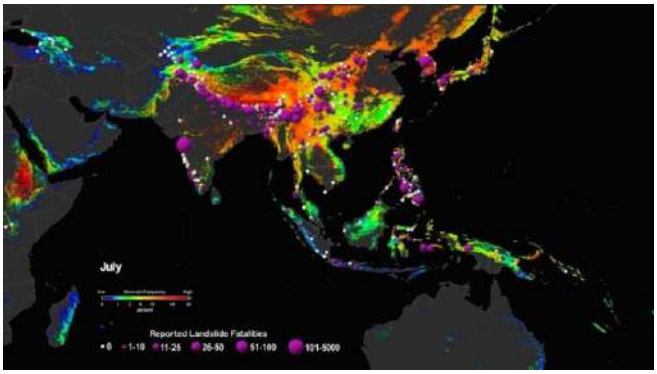
The scientists used outputs from their Global Climate Change model to anticipate changing rainfall patterns between 2060 and 2100 in High Mountain Asia to produce a representation of how rainfall might vary seasonally in the future.

The researchers then fed the rainfall data into their Landslide Hazard Assessment for Situational Awareness model, which assesses the potential for landslides in a region on the basis of detailed information about slope steepness, bedrock, tectonic faults, and tree cover within a given area.

Thousands of rainfall-induced landslides blocked roads in Puerto Rico after Hurricane Maria in 2017.

The combination of models predicted that the border region of China and Nepal could see a 30%–70% increase in possible landslide activity at the end of the century compared with that seen between 1961 and 2000.

Currently, the scientists' model is focused only on the rainfall impacts. "There are many studies that have shown that rainfall is the most predominant trigger of landslides," Kirschbaum said. "And in a changing climate, we anticipate that landslide impacts could be even more exacerbated in areas where you have more extreme rainfall and susceptible slopes."



Scientists evaluated the potential landslide activity in July 2020 in Southeast Asia using NASA's Landslide Hazard Assessment for Situational Awareness model. Overlaid are reported landslide fatalities dating back to 2007.

A Tangled Web

Despite the progress that has been made in assessing how climate change affects landslides, the picture remains a complex one. Climate change can lead to more landslides, but in some regions, it can lead to droughts or more vegetation, which can make landslides less likely.

"The actual way that a landslide manifests is really quite complex and unfortunately keeps us in business."'"The mechanics of landslides are actually pretty straightforward, and we've

understood them for a long time," Petley said. But he added that deciphering when a landslide will happen, or how, is tricky. Often, landslides are simply the end point, or middle point, in a cascade of events, muddying the picture even further. Wildfires followed by rain can cause landslides, earthquakes can cause landslides, and even one landslide can lead to another.

"The actual way that a landslide manifests is really quite complex and unfortunately keeps us in business," Petley said. "Prediction methods might be able to predict the first landslide, but can they predict immediately what happens after the first one?"

A Paucity of Data

In Alaska, many of the areas prone to landslides are remote and unpopulated, and their conditions are harsh. Consequently, scientists have faced challenges in seeing how changes in climate affect the potential for landslides. "It's logistically challenging and costly to study the changes impacting slope stability in such a vast area," Wolken said. "So we have a data gap."

"Nowhere in the world do we have a 30-year record of landslide activity that has enough landslides in it so that we would genuinely know that change is occurring."Data scarcity also exists in the long-term record of landslide activity. "If you talk to climate scientists, they say you can't pick up a trend in a data set that is less than 30 years," Petley said. "And the problem is that pretty much nowhere in the world do we have a 30-year record of landslide activity that has enough landslides in it so that we would genuinely know that change is occurring."

Consequently, the lack of data is the key challenge facing scientists in trying to determine what impact changing weather patterns might be having on landslide activity. "Without more information, we can't draw that line directly yet," Wolken said.

Closing the Gap

Although current landslide inventories might lack the number of landslide incidents required to draw any meaningful conclusions about changing patterns, scientists are investigating both practical and inventive approaches to close the data gap.

Cell phone videos and high-resolution remote sensing provide much greater documentation of modern landslides than was possible in the past. Petley takes advantage of these in his *Landslide Blog*, which highlights significant landslide events from around the globe and provides commentary on their causes.

In 2013, geophysicists at Columbia University pioneered a new method to detect the unique signature of landslides in seismic waves, the vibrations caused by sudden movements of rock, ice, magma, or debris. Using this technique, scientists were able to find a series of seven previously undocumented massive landslides associated with Siachen Glacier in the Himalayas.

Such a technique could be used to search back through the historical seismic data and, with the help of artificial intelligence, pick out previously undetected landslide events, Petley said. "It does seem that although we don't have comprehensive data sets yet, there is the prospect that through possible new techniques we may be able to project backward, which is really exciting," he said.

"We're really at the cusp of greatly expanding landslide inventories as a community."Kirschbaum believes that the combination of high-resolution satellite imagery and machine learning algorithms will drastically enhance opportunities to increase the amount of landslide data available. "We're really at the cusp of greatly expanding landslide inventories as a community," Kirschbaum said. "With better knowledge of events today, we can build models that help take us into the past and understand the patterns between landslide activity and climate."

In July 2020, Kirschbaum and her colleagues published a study demonstrating how they had used a model to reconstruct the patterns of landslide hazard in the Pacific Northwest using a machine learning model. The model was able to replicate well-documented landslide events and then apply what was learned to represent long-term patterns in potential landslide hazards. "While this model was over a fairly small study area, it shows the potential for doing this on a much larger scale," Kirschbaum said.

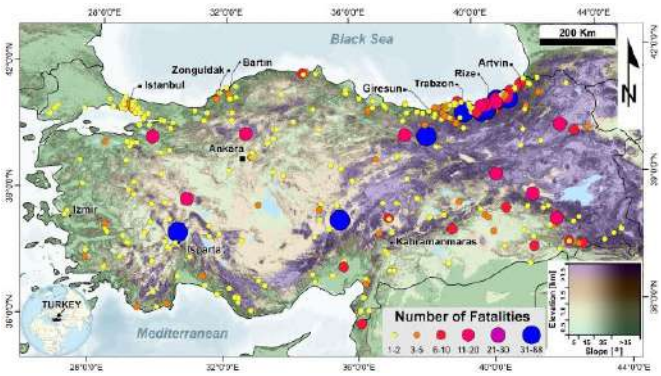
Kirschbaum is confident that researchers are going to be able to build models that can look back into the past to understand patterns in landslide activity and that can also project into the future to anticipate how climate change may modulate landslide activity and impacts. "It's a complex problem, but I think with new modeling techniques and new data sources, there is real potential to move our understanding of landslide processes and impacts forward," Kirschbaum said. "So it is a positive picture moving forward."

Citation: Palmer, J. (2020), A slippery slope: Could climate change lead to more landslides?, *Eos, 101,* https://doi.org/10.1029/2020EO151418. Published on 23 November 2020.

(Jane Palmer, Science Writer / Eos Science News by AGU, 23 November 2020, https://eos.org/features/a-slippery-slope-could-climate-change-lead-to-more-landslides)

Spatiotemporal variations of fatal landslides in Turkey

Tolga Görüm and Seçkin Fidan



Abstract Landslides are one of the devastating geohazards that cause extensive socio-economic and environmental damages on local, regional, and global scales. Previous studies based on digital media sources have attracted attention to the high fatal landslide rate in Turkey, at a continental or global scale; however, the preparation of a comprehensive and long-term database for Turkey has been neglected until today. To examine this data gap, we present a new database of fatal landslide events resulting in fatalities from 1929 to 2019, which has been compiled using Turkish national and

local printed and digital media reports, academic papers, disaster, and city annual reports. The fatal database of Turkey (FATALDOT) shows that, in total, 1343 people were killed in 389 fatal landslide events. The spatiotemporal distribution of the fatal landslides highlighted increasing trends with reference to two distinct hotspot zones through-out the Eastern Black Sea and Marmara Region, mostly around Istanbul megacity. Our results show that there has been a significant uniformity between the number of fatalities and fatal landslides triggered by anthropogenic and natural factors over the past decade, indicating an increasing dominance of human activities in fatality rates. Our findings also, for the first time, remarked the potential signatures of the economic crisis and political steadiness on fatal landslide trends. Nevertheless, we conclude that the increasing rate of anthropogenic disturbances in urban and mountainous areas, together with regional variances in topography and climatic setting, is essential in governing the pattern of fatal landslides.

https://link.springer.com/epdf/10.1007/s10346-020-01580-7

Protecting the rescuers – a disastrous double landslide at Cihanjuang in Indonesia and a lucky escape in Italy

I have noted previously that one of the great challenges in the aftermath of major landslide accidents is protecting the rescuers. In the recent Gjerdrum quick clay landslide the rescue proceeded slowly for this reason – in the immediate aftermath it was considered too risky to deploy rescue staff into an area in which another landslide might occur.

his problem has been brought home in vivid form through a disastrous double landslide in Indonesia on 9 January 2021. The events occurred in the village of Cihanjuang in West Java. The image below shows the aftermath of the landslide:-

The 9 January 2021 landslide at Cihanjuang in Indonesia.

Reports indicate that the first failure happened at 4 pm local time. Rescue operations were immediately undertaken, and evacuations were underway. A second landslide then struck the same location a little over three hours later. This is believed to have buried a number of rescue personnel.

At the time of writing the BBC is reporting that 12 people have been killed. Reuters is reporting that 18 people were injured. Unfortunately though the BBC is also reporting that a further 27 people are missing, although there will be considerable uncertainty in this figure.

Protecting the rescuers is a really challenging task, balancing the rapidly diminishing chances of trapped victims being able to survive against the likelihood of further landslides burying the rescue personnel. Decisions have to be made quickly on the ground, often in poor weather, and with inadequate information about what is happening. As the many landslide videos that are now available on Youtube illustrate so vividly. Landslides often strike two or more times at the same location in a short period of time.

Quickslide: a tragedy averted in Italy

Meanwhile, there was a remarkable escape in the Italian town of Bolzano on 5 January 2021 when a rock slope failure demolished a large part of Hotel Eberle, located on the hill of Santa Maddalena above the town of Bolzano. Fortunately the hotel was closed due to Covid-19 restrictions, so no-one was killed. The impact of the landslide was dramatic:-

The landslide that struck Hotel Eberle, located on the hill of Santa Maddalena above the town of Bolzano on 5 January 2021.

The image below, from Tripadvisor, shows the hotel before the landslide. This was an extremely fortunate escape:-

Hotel Eberle in Bolzano before the landslide.

(Dave Petley / THE LANDSLIDE BLOG, 10 January 2021, https://blogs.agu.org/landslideblog/2021/01/10/cihanjuang

Satellite radar technique developed to predict dam collapse

A new study by Nottingham and Durham Universities claims that the 2019 Brazilian dam collapse could have been foreseen with the right monitoring technology.

The collapse in south-east Brazil, which took place on 25 January 2019 at a tailings dam near the Corrégo do Feijão iron ore mine in Minas Gerais state, was one of Brazil's worst environmental disasters, killing over 200 people.

Owned by Vale, Brazil's largest mining company, the dam was used for more than 40 years to hold waste from the mine. Its collapse caused a torrent of sludge to cover surrounding land, destroying homes and polluting rivers with toxic material.

The study's lead author, Dr. Stephen Grebby from the Nottingham Geospatial Institute at the University, said that a significant number of these types of dam need enhanced monitoring.

"Most mining companies currently rely upon ground-based sensors to monitor the stability of dams," Grebby explained. "However, these typically offer an inadequate coverage of measurements across the whole of the dam, which can make it difficult to detect movement or other signs of distress."

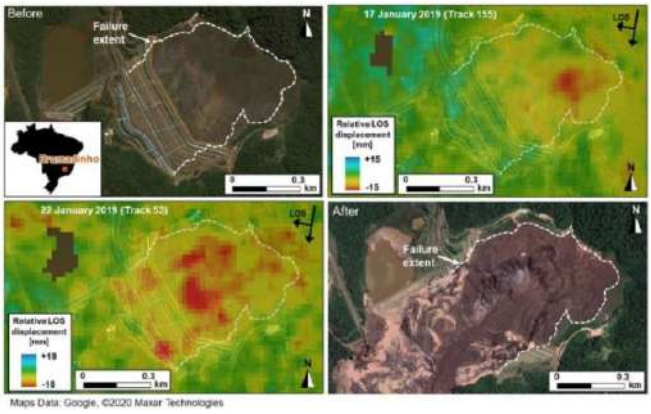
Grebby said he would like to see InSAR (satellite radar imaging) become standard practice to check for small ground movements in and around dams. In collaboration with Durham University and Nottingham spin-out company Terra Motion Ltd, he investigated whether the failure in Brazil could have been foreseen.

The researchers said they used an advanced InSAR technique called Intermittent Small Baseline Subset (ISBAS), developed by Nottingham University and Terra Motion, to help overcome the limitations faced when using some of the more conventional InSAR techniques over vegetated terrain.

This technology looks down from above, offering a more complete picture of ground movements with 'millimetre-level accuracy', according to the team.

Dr Grebby explained how their results revealed that different areas of the dam were moving at different rates, with some being seen to accelerate suddenly during the two months preceding the collapse.

"If monitored correctly, using the ISBAS InSAR technique, the failure date could have been predicted to within a week of it happening. Crucially, this prediction would have been possible around 40 days prior to the collapse, allowing time for a warning to be raised that the dam was becoming unstable.



Top left and bottom right are Google Earth satellite images of the Brumadinho tailings dam taken before and after the collapse on 25 January 2019. Top right and bottom left show precursory movement across the dam (red and yellow colours), which the researchers analysed to find that the collapse could have been predicted.

"This could have led to more in-depth monitoring or other mitigation measures to avert the loss of life and environmental disaster that tragically unfolded."

Dr Andrew Sowter, CTO of Terra Motion Limited and inventor of the ISBAS InSAR technique, added: "This work would not have been possible without the availability of free satellite data from the Sentinel-1 mission which has global reach and is sustainable for the foreseeable future.

"Along with the innovative approach described in this paper and our unique InSAR products, this means that a low-cost operational remote tailings monitoring system is within reach at local, regional and even national scales anywhere in the world."

Researchers are now looking to develop the technology as software that can be offered to the mining industry, looking out for a reliable, early warning system to predict the risk of imminent collapse at tailing dams. The study is published in the journal *Communications Earth & Environment.*

(THE ENGINEER, 20th January 2021, https://www.theengineer.co.uk/satellite-radar-technique-developed-to-predict-dam-collapse)

Advanced analysis of satellite data reveals ground deformation precursors to the Brumadinho Tailings Dam collapse

Stephen Grebby, Andrew Sowter, Jon Gluyas, David Toll, David Gee, Ahmed Athab & Renoy Girindran

Abstract

Catastrophic failure of a tailings dam at an iron ore mine complex in Brumadinho, Brazil, on 25th January 2019 released 11.7 million m^3 of tailings downstream. Although reportedly monitored using an array of geotechnical techniques, the collapse occurred without any apparent warning. It claimed more than 200 lives and caused considerable environmental damage. Here we present the Intermittent Small Baseline Subset (ISBAS) technique on satellite-based interferometric synthetic aperture radar (InSAR) data to assess the course of events. We find that parts of the dam wall and tailings were experiencing deformation not consistent with consolidation settlement preceding the collapse. Furthermore, we show that the timing of the dam collapse would have been foreseeable based on this observed precursory deformation.

We conclude that satellite-based monitoring techniques may help mitigate similar catastrophes in the future.

Communications Earth & Environment **volume 2**, Article number: 2 (2021)

(https://www.nature.com/articles/s43247-020-00079-2#citeas)

Duke researchers ask: Can soil temperature predict a landslide?

On satellite images of the Andorra principality, left, and the El Forn landslide, outlined in red, right, an arrow shows the direction of the sliding mass. The purple outline indicates a faster-moving area. S10 marks the instrumented borehole for the Duke University analysis, while S9 marks another, earlier borehole.

Researchers in Duke University's Department of Civil and Environmental Engineering have developed a new mathematical model that uses temperatures within a deep-seated landslide to help predict the sudden, catastrophic failure of the moving land mass. A deep-seated landslide is one in which the sliding surface of rock is deep underground, roughly 30 m or even much deeper, notes Manolis Veveakis, Ph.D., an assistant professor of civil and environmental engineering at Duke.

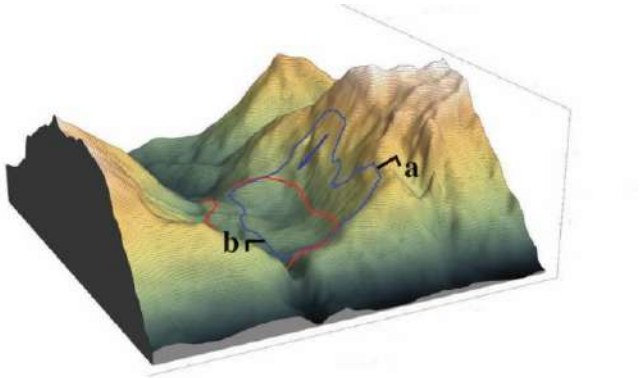
Although deep-seated landslides are less common than shallow landslides - which involve material located closer to the surface, often in a slurrylike state - the deep-seated events involve massive amounts of rock, often moving as rigid blocks, that generally cause greater damage, Veveakis says. Deep-seated landslides can move slowly for decades or longer, creeping just a few inches each year, before suddenly accelerating and collapsing without warning. "When (a deep-seated landslide) moves, it takes the entire mountain with it - all the infrastructure, the people living there," Veveakis explains.

One such landslide struck northern Italy in 1963 at the Vajont Dam (or Vaiont Dam), at the base of the Monte Toc mountain. The dam operators had tried for several years to mitigate the slow-moving event, located farther up the mountain, by lowering the water level of the lake behind the dam. Although these efforts initially seemed to help slow the landslide, in the end it collapsed anyway, suddenly sending approximately 10 billion cu ft of material plummeting into the lake at nearly 70 mph. The failure of the landslide generated a tsunami more than 800 ft tall that crashed over the dam, destroying several small towns and killing nearly 2,000 people, accord-ing to a Duke press release on Veveakis' research.

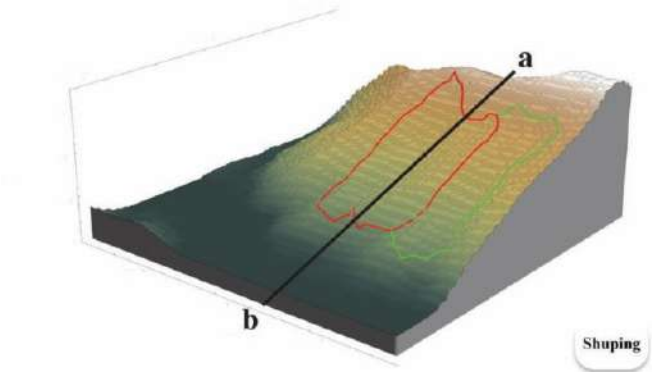
Carolina Seguí, Ph.D., a geological engineer at Duke, and Hadrien Rattez, a postdoctoral researcher, applied the new temperature-based model to the Vajont Dam scenario in a paper, written with Veveakis, that was published online in June in the *Journal of Geophysical Research: Earth Surface*. The model accurately recreated the movements of the Vajont landslide and explained the mechanisms underpinning its motion over a period of more than two years, Duke reported in a June 15 press release.

That paper also applied the model to the Shuping landslide, an ongoing, active, deep-seated landslide near the Three Gorges Dam in China, and again accurately reproduced that landslide's movement over a period of more than a decade. The research was funded by the National Science Foundation.

The Shuping landslide is also associated with a dam and a lake. But its behavior is the opposite of what happened at the Vajont Dam: The Shuping landslide accelerates when the level of the nearby lake is lowered, Veveakis notes. Every landslide is different, he explains, and so "we wanted to see how the model would perform in two opposite scenarios."



A model of the Vajont landslide indicates the initial configuration of the sliding mass, circled in blue, and the postcollapse configuration, circled in red. The letters a and b indicate sections of the landslide that were analyzed.



In this model of the Shuping landslide, the red outline shows the contour of the active sector of the landslide; the green outline indicates a dormant sector. The letters a and b and the black line indicate sections of the landslide that were analyzed.

The model works by taking temperature readings in a relatively thin layer of soft rock known as the shear band, which is generally found at the base of a landslide. Although the model specifically examined clay in the Vajont and Shuping examples, the approach "is generic for rocks that are sensitive to shearing, creeping, and temperature variations," Veveakis says. Because actual measurements from the shear bands in the Vajont and Shuping landslides were not available, the researchers estimated the friction and internal temperatures, Duke noted in the same release.

Veveakis and Seguí are applying the model to an active landslide in Andorra known as El Forn, which is being closely monitored by the Andorran government. Movement of the El Forn landslide is not associated with a dam and lake, but rather it is affected by snowmelt, precipitation, and ground-water levels, says Seguí. A bore hole drilled into the El Forn site provided access for a thermometer to measure temper-ature as well as piezometers to record water pressure and an extensometer to measure horizontal displacement. Core samples were also extracted, which means the Duke team now has several years' worth of site-specific data and mate-rial to work with. Because each landslide is unique, even the changes in temperature that the researchers are studying are subjective rather than absolute.

"You have to test the material in a laboratory and see its (thermal) sensitivity," explains Seguí. "You take months or years of data to train the model, and then see the evolution of, say, the velocity or the water pressure linked to the response of the temperature of the material. Then you can see that, say, a 0.2-degree change in temperature is a lot for that material, or maybe you need a change of 10 degrees."

So far, the results are promising. In a paper scheduled for an upcoming issue of the journal *Geophysical Research Letters*, Seguí and Veveakis conclude that the combined data offer "favorable results of the mathematical model. This will allow scientists to "forecast… the behavior (i.e., displacement) of a deep-seated landslide."

The goal is to provide advance warning of an imminent collapse as well as a stability threshold, Veveakis says, "so that we can tell the engineer in the field not only when the landslide will fail but also at what point it is still susceptible to human intervention." If the model's calculations are correct, Veveakis adds, it could have predicted the Vajont collapse a few weeks in advance. In other cases, the model could predict a collapse as much as a year or more ahead of the event. That would give engineers time to increase or lower reservoir levels, dig wells to pump out groundwater, evacuate populations, or take other actions "before the landslide reaches the point of no return," Seguí says.

This article first appeared in the December 2020 issue of Civil Engineering *as "Duke Researchers Test Landslide Temperatures To Predict Collapses."*

(December 1, 2020, https://source.asce.org/duke-researchers-ask-can-soil-temperature-predict-a-landslide)

On the Stability of Deep-Seated Landslides. The Cases of Vaiont (Italy) and Shuping (Three Gorges Dam, China)

Carolina Seguí, Hadrien Rattez, Manolis Veveakis

Abstract

Deep-seated landslides can have catastrophic impacts on human life and infrastructure when they suddenly fail. These events are devastating because of the large volumes of soil and rock masses involved and their often long runout. The present study suggests an energy-based method to determine when a landslide becomes unstable, giving critical values for measurable variables (velocity and basal temperature) up to which remediation actions can be deployed. This work focuses on large ancient landslides reactivated by dam-related water table variations that modify landslide stability. The main hypothesis of this work is that most of the deformation of deep-seated landslides is concentrated on a thin, basal shear band forming the sliding surface. In particular, this assumption allows an approximation of deep-seated landslides as elastic/rigid blocks sliding over a viscoplastic shear band, featuring weak phases like expansive clays. When the landslide moves, it causes friction in the shear band that raises the temperature of the clays until they become unstable and collapse catastrophically through a thermal runaway instability. The model is applied to the Vaiont landslide in Northern Italy and the Shuping landslide next to the Three Gorges Dam in China. The results of the model reproduce the sliding behavior of both landslides and provide constraints on the critical points of stability.

(Robert L. Reid, 15 June 2020, https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019JF005203)

Gravity always wins: in New Zealand landslides are more deadly than earthquakes

New Zealand is a country with an abundance of natural hazards – earthquakes, volcanoes, floods, tsunami, cyclonic storms and landslides, amongst others. Of the geophysical hazards, it is earthquakes and volcanoes that attract most of the attention, driven by large events such as the Christchurch earthquake sequence, the Kaikoura earthquake and the Whakaari / White Island eruption. Landslides are generally not considered to be such a major issue around the world, and are often dismissed as a secondary hazard.

Interestingly though, my colleagues at GNS Science have been looking the comparative impact of landslides and earthquakes through time in New Zealand. The online news service Stuff has a good article about this work today. The simple conclusion is startling:

Landslides are significantly more dangerous than earthquakes, according to an analysis by GNS Science.

Gravity always wins – the aftermath of landslides in Christchurch, New Zealand

Interestingly the article provides some detail to this through some words from Jo Horrocks, the chief resilience and research officer of the Earthquake Commission (EQC), the national insurer against earthquakes (and landslides). She noted that landslides cost the country an average of NZ$250 to 300 million (about £125-150 million) and that over the last 160 years they have claimed about 1800 lives. This is considerably higher than the toll from earthquakes.

The reasons that they are under appreciated is that landslides tend to happen as frequent events from which the losses accumulate. Huge clusters of landslides do occur – the Kaikoura earthquake was a fine example – but of course these are usually triggered by another event, such as an earthquake or a cyclone. Very often it is the landslides that cause the losses.

I am sure that this effect is seen in many other countries as well. The article in Stuff has a nice quote, taken from an article in the *Te Ara Encyclopaedia of NZ*:

Gravity always wins

(Dave Petley / THE LANDSLIDE BLOG, 18 January 2021, https://blogs.agu.org/landslideblog/2021/01/18/gravity-always-wins)

NZ landslides more dangerous than quakes

This landslide in January 2019 at Cape Kidnappers in Hawke's Bay injured two tourists.

Landslides are significantly more dangerous than earthquakes, according to an analysis by GNS Science.

It had identified 1800 fatalities over the past 160 years caused by landslides or slips, which is significantly more than earthquake casualties over the same period, said Jo Horrocks, the Earthquake Commission's chief resilience and research officer.

The two deadliest earthquakes since 1860 – the Christchurch and Napier quakes – killed about 440 people between them.

Landslides cost the country an average of $250 million to $300m each year, she said.

Videographic on landslides. Severe flooding forced thousands of residents in New Zealand's South Island to flee their homes on Wednesday and left hundreds of tourists stranded at the remote Milford Sound beauty spot.

The cost of landslides and slips often get rolled into damage caused by storms or floods. A weather event in Napier on November 9-10 last year for example, is listed by the Insurance Council as a "flood", even though several homes were hit by landslides.

"The whole bank just came down," said Napier artist Freeman White. The landslide stoved in a wall of his house, shunted his woodburner and damaged a bathroom wall.

He was on his roof clearing gutters and had to flee. Then a second slip came down. "If I'd been in the wrong place, I'd have been dead," he said. "It was so touch and go. My wife thought I was dead."

Napier artist Freeman White and the landslide damage to his home.

"The landslides in Napier demonstrated again that landslips are a major risk to people and property in New Zealand, which we need to understand and manage," said Horrocks.

And not all of them are triggered by floods or earthquakes. A January 23, 2019, "debris avalanche" on the coastal cliffs at Cape Kidnappers, Hawke's Bay, seriously injured two tourists and was witnessed by many people.

"I could see a big part of the cliff start to part … and start sliding down and I thought, 'Oh, s..., it's really collapsing,"' said Jungho Son of South Korea.

"In the ocean, I still could hear the rumbling sound, because it was still going ... I literally thought I couldn't make it … because I was [getting hit] by rocks ... but it stopped."

"There was no discernible trigger for the debris avalanche, with no seismicity and limited rainfall recorded in the week prior," concluded a GNS report on the incident. Blame was laid on "cliff material weakening through time".

The Department of Conservation now actively discourages people from walking near the sea cliffs.

"Gravity always wins," warns a 2006 *Te Ara Encyclopaedia of NZ* article on landslides (https://teara.govt.nz/en/landslides/page-1). "Compared to many other countries, New Zealand has a high number of landslides."

Mountain ranges are still being uplifted and feature steep slopes. Rock is weakened by folding and faulting. Elsewhere, much of the land is hill country formed by rivers cutting into soft and clay rock. The soils are weak because they are derived from volcanic ash or loess. Throw in high rainfall and earthquakes and the risks increase.

To address these dangers, a National Landslide Database is being created to "capture all current and future landslide information from local and regional councils, Crown entities and geotechnical consultants".

About 30 people were in Howden Hut on the Routeburn Track when it was hit by a landslide in February last year.

Many organisations –including GNS, EQC, NZ Transport Agency, KiwiRail and local councils – hold valuable information on landslides, but no single entity has had overall responsibility for managing this information.

It will become an "asset for any organisation involved in planning housing and infrastructure in New Zealand", said EQC's Horrocks.

(Will Harvie / suff, Jan 18 2021, https://www.stuff.co.nz/science/123927961/nz-landslides-more-dangerous-than-quakes)

Mapping Displacement and Subsidence with Time-series Radar

In this webinar, experts from Hexagon and the Arizona Department of Water Resources will discuss the use of time-series displacement maps with a high point density for monitoring and mitigating subsidence due to subsurface extraction of resources such as water or hydrocarbons.

Video of Mapping Displacement and Subsidence: Displacement Mapping https://www.youtube.com/watch?v=7li-YNQ1pgAU&feature=emb_logo

Video of Mapping Displacement and Subsidence: ADWR Land Subsidence Monitoring Program Using INSAR Data https://www.youtube.com/watch?v=x9njQKgm388&list=PLTBBygdCOWWdcLZcFKwQrbU84IUTt4sE1

Background

Two related developments have moved the use of radar imagery into the operational realm. The supply of available data has increased greatly, especially with the freely-available Sentinel-1 satellites. And the analysis algorithms are now tested and established, producing reliable and standardized Information Products. One application in particular has benefited greatly from these synergistic developments; centimeter-scale measurement of surface motion on a regional scale. The ability to produce time-series displacement maps with a high point density has revolutionized the monitoring, and mitigation, of subsidence due to subsurface extraction of resources such as water or hydrocarbons.

Our speakers are:

- Derrold Holcomb, Product Manager, Advanced Sensor Software, Hexagon Geospatial | **Slides** | **Video** | **Application Demo**
- Brian Conway, Geophysics Unit Supervisor, Arizona Department of Water Resources | **Slides** | **Video**

Additional Resources

- View this webinar's Question & Answer session
- Answers to Additional Questions from Webinar Attendees

(AGI Webinars, Wednesday, April 15, 2020, https://www.americangeosciences.org/webinars/mapping-displacement-and-subsidence-time-series-radar)

Large landslide image island of Hokkaido, Japan

Geology Science, @GeologyyScience

Jan 20, 2021, https://twitter.com/GeologyyScience/status/1351977613410054146

Civil Engineering Discoveries, @CivilEngDis

Jan 20, 2021, https://twitter.com/CivilEngDis/status/1351955089511116802

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The US National Landslide Preparedness Act

Amongst the remarkable political shenanigans in the United States in recent weeks, in which the term landslide has been used in an entirely different context, there has been one piece of good news. Earlier this week the President signed into law H.R. 8810, the National Landslide Preparedness Act.

This piece of legislation, initially proposed by Representative Suzan DelBene (D-WA), establishing a National Landslide Hazards Reduction Program in the USGS, with the aim of improving identification and understanding of landslide risks; of protecting communities; of saving lives and reducing property losses; and of improving emergency preparedness. This is a tremendous and very important step forwards, finally recognising at a federal level landslides as a significant hazard and establishing the means to start to improve their management.

The congress.gov website has a nice summary of the key provisions of the National Landslide Preparedness Act:-

The USGS shall, among other things

- *develop and publish a national strategy for landslide hazards, risk reduction, and response in the United States (including territories);*
- *develop and maintain a publicly accessible national landslide hazard and risk inventory database;*
- *expand the early warning system for debris flow; and*
- *establish emergency response procedures for the rapid deployment of federal scientists, equipment, and services to areas impacted by a significant landslide event.*

The USGS may provide grants to research, map, assess, and collect data on landslide hazards.

The National Science Foundation may provide grants to eligible entities for landslide research.

The USGS shall establish the 3D Elevation Program and the 3D Elevation Federal Interagency Coordinating Committee, and (2) may make grants and enter into cooperative agreements to facilitate the improvement of nationwide coverage of 3D elevation data.

There is a host of good things about this, including the development of a national strategy and the establishment of a LIDAR based programme to generate digital elevation data.

The timing is very pertinent, as earlier this week a really significant rainfall event occurred in the Pacific Northwest, triggering many landslides. The most significant appears to have occurred close to Dodson in Oregon, where a large debris flow killed a motorist, Jennifer Moore. A search is underway to try to recover her remains. Multnomah County Sheriff's Office has tweeted this image of the site:-

The fatal landslide in Dodson County, Oregon, which illustrates the need for the National Landslide Preparedness Act.

(Dave Petley / THE LANDSLIDE BLOG, 15 January 2021, https://blogs.agu.org/landslideblog/2021/01/15/us-national-landslide-preparedness-act)

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ

World's Largest Earthquake Test

Simpson Strong-Tie participated in an unprecedented test to highlight the importance of earthquake-resistant construction and, ultimately, improve the construction safety of wood buildings in the U.S.

https://www.youtube.com/watch?v=9X-js9gXSME

Study suggests that smaller earthquakes generate most strong ground motions

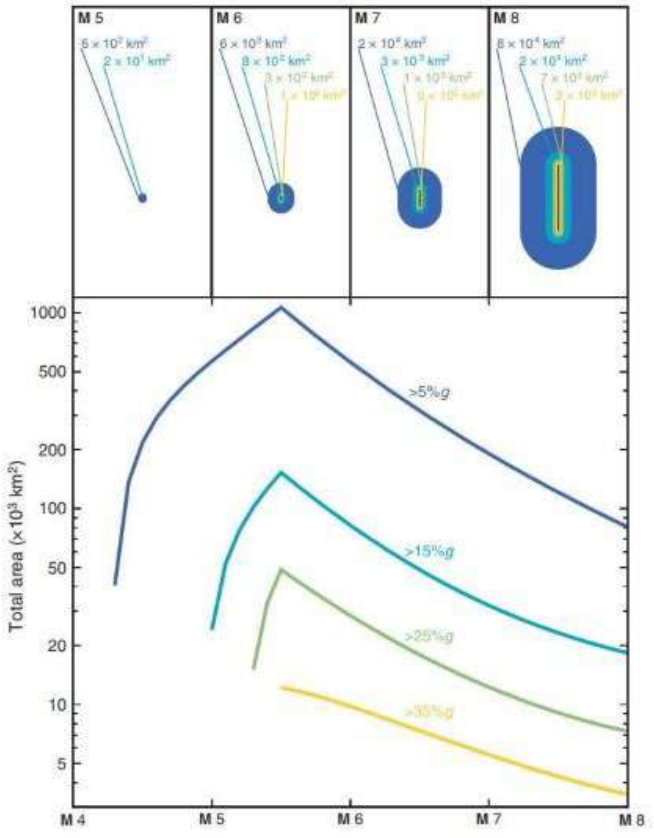
According to a new study, smaller earthquakes have caused the strongest shaking incidents in the vicinity of the epicentral areas.

The study was recently published in Seismological Research Letters by scientists from the United States Geological Survey (USGS) and the University of Southern California in Los Angeles.

The team focused on large datasets of earthquakes ranging from M 0.5 to M 8.0 to correlate the intensity of the seismic shocks with the generated strong ground motions. The researchers calculated the expected strong motions triggered from an earthquake of a specific magnitude at certain distances taking into consideration the Gutenberg-Richter magnitude-frequency law (the probabilistic frequency of an earthquake decreases as its magnitude increases). The findings show that, while small earthquakes generally produce weaker shaking, the correlation between the two parameters is highly variable and there are many cases in which a greater shaking than expected was detected.

The study suggests that those observations of small-magnitude seismic shocks and strong shaking are indeed a source of seismic hazard. Scientists have developed a theo-retical model showing that the seismic hazard curves are pos-itively skewed with respect to magnitude. This is a combina-tional outcome that derives from both the aforementioned variability and the high number of smaller earthquakes that generally occur.

Moreover, the findings show that a greater earthquake will not necessarily generate stronger ground motions than a smaller one but its impact will affect a wider area. Therefore, engineering projects could be more affected by medium earthquakes that also have a greater occurrence probability than by a massive seismic shock that seldom occurs. Examples include the M5.7 earthquake that occurred in Santa Rosa, California (1969) and caused the equivalent of today's $50 million in infrastructure damage and the M 5.7 Salt Lake City earthquake in 2020 that resulted in severe damage to several buildings. "For a lot of us, if we do look back over our personal experiences, the earthquake that we had the greatest amount of damage from is not the largest magnitude earthquake that we've felt at all," Dr. Sarah Minson, lead author of the study and a Research Geophysicist at the USGS, stated.



Total area expected to experience shaking above each PGA threshold from all earthquakes assuming Gutenberg–Richter magnitude–frequency distribution. Credits: Minson et al., 2020

The team acknowledges that there is no need for changes in Ground Motion Prediction Equations (GMPEs) or Probabilistic Seismic Hazard Assessment (PSHA) since the variation of the expected strong motions and the variability of different potential earthquakes are taken into consideration. Therefore, eventually, seismic hazard models do not account for the magnitude of an earthquake. Nevertheless, the findings could have a significant impact on Earthquake Warning Systems (EEW) which currently function better for major earthquakes (>M7.0). Hence, many EEW systems will not provide reliable warning alerts during a medium earthquake.

In terms of human psychology regarding earthquake awareness, the authors suggest that it is more efficient for people to prepare for smaller earthquakes than focusing on the impact of a vast seismic shock.

* The chart above shows the total area expected to experience shaking above a certain Peak Ground Acceleration (PGA) threshold. Despite the total area per occurrence of a

single event is wider in larger earthquakes, given the Gutenberg–Richter law, a greater area will eventually be affected due to the number of medium earthquakes.

Sources: SeismologicalResearchLetters, SeismologicalSocietyofAmerica

(Geoengineer.org, Jan, 04, 2021, https://www.geoengineer.org/news/study-suggests-that-smaller-earthquakes-generate-higher-strong-ground-motions)

Shaking is Almost Always a Surprise: The Earthquakes That Produce Significant Ground Motion

Sarah E. Minson, Annemarie S. Baltay, Elizabeth S. Cochran, Sara K. McBride, Kevin R. Milner

Abstract

Although small earthquakes are expected to produce weak shaking, ground motion is highly variable and there are outlier earthquakes that generate more shaking than expected—sometimes significantly more. We explore datasets of **M** 0.5–8.3 earthquakes to determine the relative impact of frequent, smaller-magnitude earthquakes that rarely produce strong ground motion, to rare, large earthquakes that always cause strong shaking. We find that the natural variability of ground motion, combined with the Gutenberg–Richter mag-nitude–frequency relationship, ensures that most occur-rences of any ground motion come from earthquakes of smaller magnitude than expected, often >2 magnitude units smaller. This holds even for very strong shaking (>20%*g*), suggesting that **M**<7 earthquakes could be a significant source of damage.

Seismological Research Letters (2021) 92 (1): 460–468, https://doi.org/10.1785/0220200165, https://pubs.geoscienceworld.org/ssa/srl/article-abstract/92/1/460/592408/Shaking-is-Almost-Always-a-Surprise-The

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

10 geological discoveries that absolutely rocked 2020

This year, scientists uncovered some of the Earth's most well-kept secrets. They found hidden rivers, chunks of lost continents and remnants of ancient rainforests, and they delved into the planet's ancient history using cutting-edge technologies. Who knows what they'll unearth next! While we wait to find out, here are 10 of the geological discoveries that rocked our world in 2020.

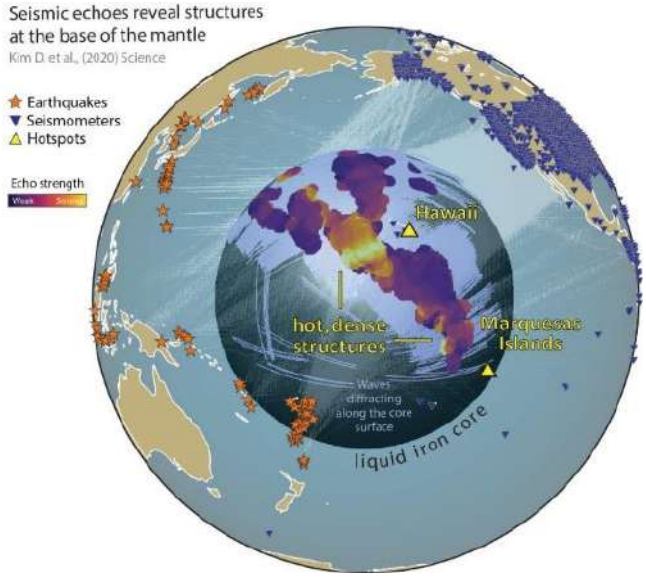
Historic supereruption at Yellowstone

The Yellowstone hotspot lurks beneath the national park's geysers and hot springs, and about 9 million years ago, the volcano exploded in two historic supereruptions, scientists found. After analyzing ancient volcanic rock tracts and volcanic deposits in the region, the team uncovered evidence of two previously unknown eruptions, which they named the McMullen Creek supereruption and the Grey's Landing supereruption. The Grey's Landing eruption shattered rec-ords as the largest eruption of the Yellowstone hotspot ever detected; about 8.72 million years ago, the eruption covered roughly 8,900 square miles (23,000 square kilometers) of what is now southern Idaho and northern Nevada with volcanic debris.

Lost islands in the North Sea withstood massive tsunami

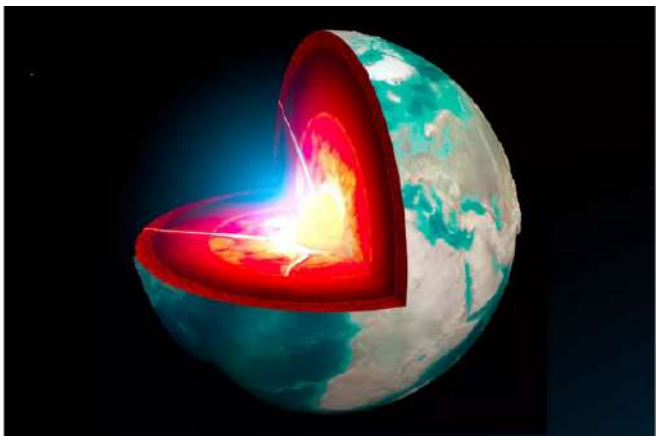
Roughly 8,000 years ago, a tsunami struck a plain between Great Britain and the Netherlands, submerging most of the region. But research suggests that some islands may have withstood the tsunami, providing a home to Stone Age humans for thousands of years. Though they remained above water for some time after the tsunami, rising sea levels eventually submerged the islands about 1,000 years later. Scientists learned the lost islands had survived the tsunami only after collecting sediment from the seafloor near the eastern English estuary of the River Ouse.

Monstrous blobs near Earth's core are bigger than we thought



Continent-size blobs of rock sit at the boundary of Earth's solid mantle and liquid outer core, and now, scientists think they might be bigger than we ever imagined. By previous estimates, the two largest blobs would measure 100 times taller than Mount Everest if pulled to the planet's surface. But after studying decades of seismic data from earthquakes, scientists now estimate that the big blob beneath the Pacific Ocean may actually be far more monstrous. For instance, one newfound structure along the edge of the blob measured more than 620 miles (1,000 kilometers) across.

Earth's core is a billion years old



The Earth's solid inner core — a 1,500-mile-wide (2,442 kms) ball of iron — likely formed about 1 billion to 1.3 billion years ago, scientists estimate. By recreating the conditions found in the core on a teeny, tiny scale, the team was able to calculate how long it would take for a blob of molten iron to build up to the core's current size. The time window of roughly 1 billion years lines up nicely with historic fluctuations in the planet's magnetic field, which grew significantly stronger between 1 billion and 1.5 billion years ago. The crystallization of the inner core may have provided this boost of magnetism,

since the process would have released heat into the liquid outer core; heat drives a churning motion in the liquid that then powers the magnetic field.

Related: **Changing Earth: 7 ideas to geoengineer our planet**

Piece of a lost continent found under Canada

About 150 million years ago, a now-lost continent broke up into enormous fragments — and one big chunk was recently discovered lurking under Canada. Scientists made the discovery while studying a type of diamond-bearing volcanic rock called kimberlite, which had been collected from nearly 250 miles (400 km) beneath Baffin Island in northern Canada. The mineral chemistry of the kimberlite matched that of the long-lost continent, making the sample location the deepest point where evidence of the continent had ever been found.

Related: **Piece of lost continent discovered beneath Canada**

Underwater rivers found near Australia

This year, scientists discovered massive rivers of cold, salty water that flow from the Australian coast out into the deep ocean. The rivers, which researchers found using autonomous underwater vehicles, form when shallow waters near the coast lose heat during the winter. Evaporation during the summer months makes this shallow water saltier than deep water, so when it cools, the dense, salty water sinks and snakes through the ocean as an underwater river. These rivers span thousands of miles and carry nutrients, plant and animal matter and pollutants out into the ocean.

Related: **Massive underwater rivers were discovered off the coast of Australia**

Ancient rainforest found under Antarctic ice

Antarctica might be the last place you'd expect to find remnants of an ancient rainforest, but that's exactly what scientists found under the western side of the continent. The forest's remains were discovered in a sediment core drilled from a seabed near Pine Island Glacier. A layer of sediment within the core stood out from the rest, as its color clearly differed from those around it; upon closer inspection, scientists found ancient pollen, spores, bits of flowering plants and a network of roots within the layer. The sample dated back 90 million years, to the mid-Cretaceous period, when the now-frozen Antarctic had a much milder climate.

Related: **Remains of 90 million-year-old rainforest discovered under Antarctic ice**

Ancient seabed buried 400 miles beneath China

A seabed that once lined the bottom of the Pacific Ocean was found buried hundreds of miles beneath China, where it continues to descend toward the Earth's mantle transition zone. The slab of rock once sat atop the oceanic lithosphere, the outermost layer of Earth's surface, but was pushed downward when it collided with a neighboring tectonic plate, in what's called a subduction event. Scientists had never detected a subduction event so deep beneath the planet surface, at depths ranging between 254 to 410 miles (410 to 660 km) underground.

Related: **Ancient fragment of the Pacific Ocean found buried 400 miles below China**

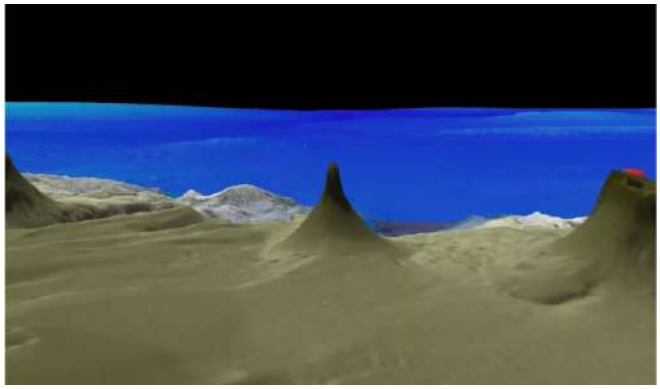
Lost tectonic plate gets resurrected?

Scientists digitally reconstructed a tectonic plate and showed that its movement likely gave rise to an arc of volcanoes in

the Pacific Ocean some 60 million years ago. In the past, some geophysicists argued that the plate, known as Resurrection, never existed. But if it did exist, the plate would have been pushed beneath Earth's crust tens of millions of years ago; so using computer reconstruction, scientists reversed that motion, virtually pulling it and other ancient plates back to the surface. They found that Resurrection would have fit in like a perfect puzzle piece, just east of two plates called Kula and Farallon, and that its edge matches up with ancient volcanic belts in Washington State and Alaska.

Related: **'Lost' tectonic plate called Resurrection hidden under the Pacific**

Towering coral structure dwarfs Empire State Building



The first detached coral reef discovered in more than 100 years stands taller than the Empire State Building. Measuring 1,640 feet (500 meters) high from base to tip, the tower of coral stands freely near the rest of the Great Barrier Reef off the coast of Australia. The blade-like structure measures 1 mile (1.5 km) wide at its base and its peak sits about 130 feet (40 m) below the sea's surface.

Related: **Coral 'tower' taller than the Empire State Building discovered off Australian coast**

(Nicoletta Lanese - Staff Writer / LIVESCIENCE, 27 dec 2020, https://www.livescience.com/geological-discoveries-2020.html)

Marie Tharp's groundbreaking maps brought the seafloor to the world

Her deep understanding of geology made for gorgeous and insightful views

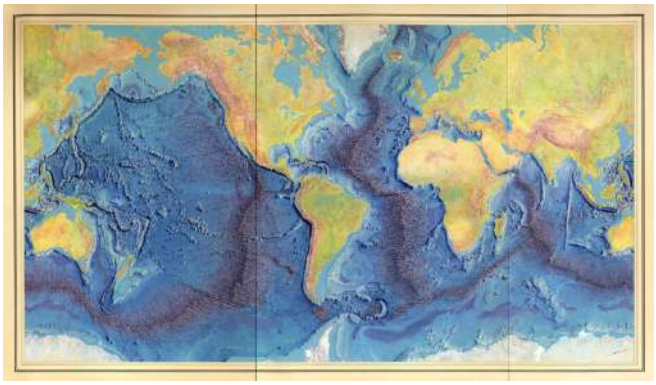
Barred from ocean expeditions for most of her career, Marie Tharp poured all of her energy into mapping the seafloor — creating the most comprehensive views available.

Walk the halls of an academic earth sciences department, and you'll likely find displayed on a wall somewhere a strikingly beautiful map of the world's ocean floors. Com-pleted in 1977, the map represents the culmination of the unlikely, and underappreciated, career of Marie Tharp. Her three decades of work as a geologist and cartographer at Co-lumbia University gave scientists and the public alike their first glimpse of what the seafloor looks like.

In the middle of the 20th century, when many American scientists were in revolt against continental drift — the controversial idea that the continents are not fixed in place — Tharp's groundbreaking maps helped tilt the scientific view toward acceptance and clear a path for the emerging theory of plate tectonics.

Tharp was the right person in the right place at the right time to make the first detailed maps of the seafloor. Specifically, she was the right *woman*. Her gender meant certain professional avenues were essentially off-limits. But she was able to take advantage of doors cracked open by historical circumstances, becoming uniquely qualified to make significant contributions to both science and cartography. Without her, the maps may never have come to be.

"It was a once-in-a-lifetime — a once-in-the-history-of-the-world — opportunity for anyone, but especially for a woman in the 1940s," Tharp recalled in a 1999 perspective. "The nature of the times, the state of the science, and events large and small, logical and illogical, combined to make it all happen."



With funding from the U.S. Navy, Marie Tharp and Bruce Heezen produced this 1977 map with Austrian painter Heinrich Berann. It has become iconic among cartographers and earth scientists.

Tharp's cartographic roots ran deep. She was born in Michigan in 1920 and as a young girl would accompany her father on field trips to survey land and make maps for the U.S. Department of Agriculture's Bureau of Soils, a job that kept the family on the move. "By the time I finished high school I had attended nearly two dozen schools and I had seen a lot of different landscapes," Tharp recalled. "I guess I had map-making in my blood, though I hadn't planned to follow in my father's footsteps."

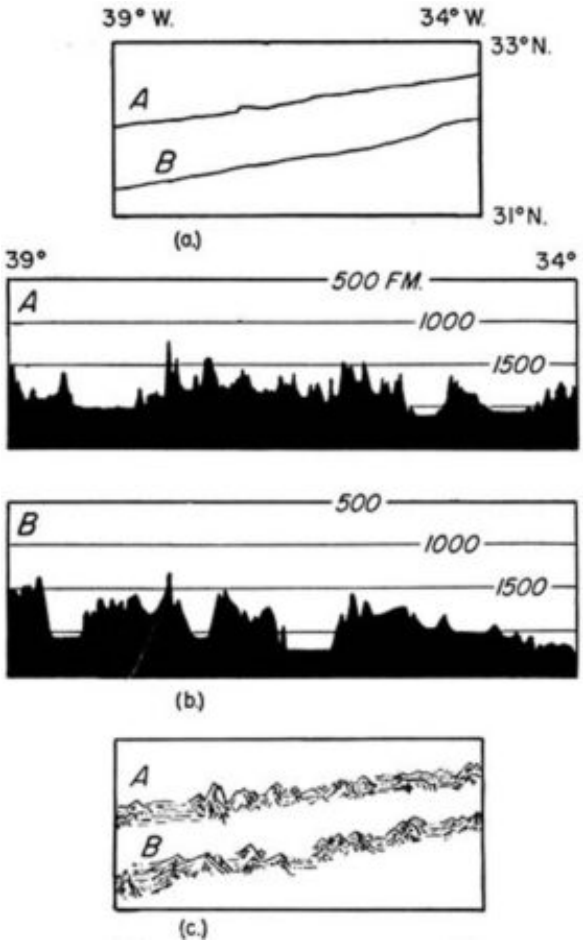
Tharp was a student at the University of Ohio in 1941 when the attack on Pearl Harbor emptied campuses of young men, who were joining the military in droves. This sudden scarcity of male students prompted the University of Michigan's geology department to open its doors to women. Tharp had taken a couple of geology classes and jumped at the opportunity. "There were 10 or 12 of us that appeared from all over the United States, girls. With a sense of adventure," she recalled in an oral history interview in 1994. Tharp earned a master's degree in 1943, completing a summer field course in geologic mapping and working as a part-time draftsperson for the U.S. Geological Survey along the way. Upon graduating she took

a job with an oil company in Oklahoma but was bored by work that involved neither fieldwork nor research. So she enrolled in night classes to earn a second master's degree in mathematics from the University of Tulsa.

Looking for more excitement, she moved to New York City in 1948. When she walked into the Columbia University geology department looking for a job, her advanced degrees got her an interview, but the only position available to a woman was that of a draftsperson assisting male graduate students working toward a degree in geology that she had already earned. Still, it seemed more promising than the other job she had inquired about — studying fossils at the American Museum of Natural History — so she took it.

The following year Tharp became one of the first women employed by Columbia's newly founded Lamont Geological Observatory and soon was working exclusively with geologist Bruce Heezen, a newly minted Ph.D. Like many of the male scientists at Lamont, Heezen was primarily occupied with collecting ocean data, which Tharp would then analyze, plot and map — work she was more than qualified to do.

"These men considered it glamorous and pleasurable to go to sea, far more so than staying at home to analyze [the data]," writes science historian Naomi Oreskes of Harvard University in her forthcoming book *Science on a Mission: How Military Funding Shaped What We Do and Don't Know About the Ocean*. "This is one reason data analysis was often left to women." In fact, women often weren't allowed on the research ships at all.



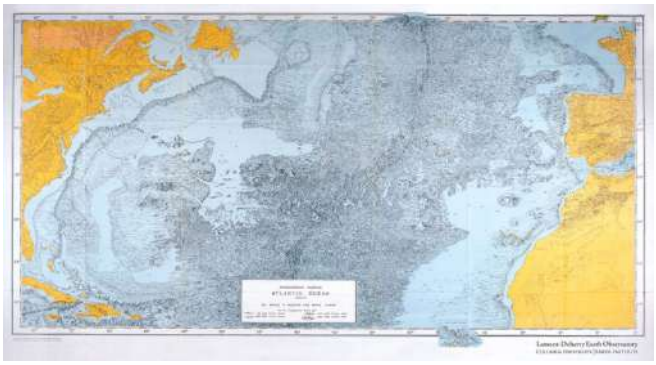
To generate the seafloor maps, Marie Tharp started with two-dimensional ocean profiles (top) and then used her extensive geologic knowledge to decipher landforms and fill in the blank spaces (bottom). B.C. Heezen, M. Tharp, and M. Ewing/Lamont-Doherty Earth Observatory/Geological Society of America Special Paper 1965

Barred from ocean expeditions, Tharp poured all of her energy into mapping the seafloor starting with the North Atlantic, work that would lead to two important discoveries. To make a map, she first translated the echo soundings gathered by ships crossing the ocean into depths and then created two-dimensional vertical slices of the terrain beneath the ships' tracks. These ocean-floor profiles showed a broad ridge running down the middle of the Atlantic. Though the feature had been roughly mapped in the 19th century, Tharp noticed a notch near the top of the ridge in each of the profiles. She believed the notches represented a continuous, deep valley running down the center of the mid-ocean ridge. If she was right, the valley might be a rift where molten material came up from below, forming new crust and pushing the ocean floor apart — evidence that could support continental drift.

The idea that the continents were not fixed in place had gained traction in Europe, but Heezen, like most U.S. scientists at the time, "considered it to be almost a form of scientific heresy," Tharp later wrote in *Natural History* magazine. It took her a year or so to convince Heezen that the rift was real, and it took the two several more years to finish their first map of the North Atlantic in 1957.

In order to publish that first map and share their work with other scientists, Tharp and Heezen had to get around the U.S. Navy's Cold War–inspired decision to classify detailed topographic maps that used contour lines to indicate depths. This was one of the reasons the pair chose to adapt a relatively new cartographic style known as a physiographic diagram, a sort of three-dimensional sketch of terrain as if seen from an airplane window. To do this, Tharp had to use her training as a geologist and experience with mapping on land — knowledge and skills that a typical research assistant or draftsperson wouldn't have had.

Physiographic maps had previously been used to represent continental landforms with standardized symbols. Each type of mountain, valley, plain and desert was sketched in a specific way. Tharp and Heezen were the first to use the technique to show what unknown, unseeable terrain might look like. Tharp first sketched a strip of seafloor along each profile, deciphering what type of landform each bump and dip was likely to be. Then she identified patterns to fill in the blank spaces between the profiles.



Bruce Heezen and Marie Tharp's physiographic maps, this one of the North Atlantic first published in 1957 and again in 1959, gave scientists a compelling visual comparison to continental landforms they understood. Physiographic Diagram of the North Atlantic Ocean (1959) by Heezen and Tharp; reproduced by permission of Marie Tharp Maps LLC and the Lamont-Doherty Earth Observatory

"The amount of work involved in taking it from just from those soundings and being able to create that is just amazing," says historian Judith Tyner, author of *Women in American Cartography*.

As Tharp was creating her map, an unrelated project was taking shape on the drafting table next to hers. Heezen had hired a recent art school graduate to plot thousands of earthquake epicenters in the Atlantic Ocean to help Bell Labs find the safest places to lay transoceanic cables. The epicenters he was plotting lined up with Tharp's rift valley. The correlation lent weight to the idea that the rift was where the crust was pulling apart, and gave Tharp a way to accurately locate the rift between the ship tracks.

Heezen and Tharp's 1957 diagram of the north Atlantic Ocean was by far the most exhaustive seafloor map ever produced.

"The marvelous thing about that map is how comprehensive it looked on rather limited data," says science historian Ronald Doel of Florida State University in Tallahassee. "But the earthquake data also helped to make clear just where the ridges are oriented and where the associated geological features are."

The American scientific community was initially skeptical, wary of the speculative nature of their map. But as the pair continued mapping the rest of the Atlantic and moved on to other oceans, evidence accumulated for a continuous ridge, with a rift valley at its center, stretching for some 60,000 kilometers across the globe.

Tharp and Heezen's innovative use of the physiographic method gave scientists a compelling visual comparison to continental landforms they understood. This helped convince them that just as the East African Rift was splitting that continent, the submarine rift valley marked where the continents on either side of the Atlantic had pulled away from each other.

"That's why her map is so powerful," says historian of geology David Spanagel of Worcester Polytechnic Institute in Worcester, Mass. "It allows people to see the bottom of the ocean as if it were a piece of land, and then reason about it. That's a transformative thing that she's able to accomplish."

National Geographic also took notice of the maps and invited Heezen and Tharp to collaborate on some ocean illustrations with the Austrian painter Heinrich Berann, who would become famous for his mountain panoramas. The gorgeous ocean-floor depictions were included as poster-sized supplements in issues of *National Geographic* magazine between 1967 and 1971. The magazine had a circulation of 6 million or 7 million at the time, giving a sizable swathe of the public a window into the ocean.

In 1973, Heezen and Tharp received a grant from the U.S. Navy to work with Berann on a complete map of the world's ocean floors. It took the trio four years to create their iconic cartographic masterpiece, an unparalleled, panoramic visualization that continues to shape how both scientists and the public think about the seafloor.

The map was finished just weeks before Heezen died of a heart attack at age 53, while in a submarine exploring the mid-ocean ridge near Iceland. His death left Tharp without a source of funding and data, essentially ending her remarkable career. It would be decades before her contributions were fully recognized. But unlike many other unsung figures in the history of science, the accolades began rolling in before she died of cancer in 2006. During the last decade of her life, Tharp received prestigious awards from several institutions including Lamont — now known as the Lamont-Doherty Earth Observatory — and the Library of Congress, which named her one of the four greatest cartographers of the 20th century.

"Can you imagine what heights she would have risen to in her profession," says Tyner, "if she'd been a man?"

Though hers was always the second name, after Heezen's, on the maps they made, and doesn't appear at all on many of the papers her work contributed to, Tharp never expressed any regrets about her path. "I thought I was lucky to have a job that was so interesting," she recalled in 1999. "Establishing the rift valley and the mid-ocean ridge that went all the way around the world for 40,000 miles — that was something important… You can't find anything bigger than that, at least on this planet."

(Betsy Mason / Science News, January 13, 2021, https://www.sciencenews.org/article/marie-tharp-maps-plate-tectonics-seafloor-cartography)

Στο Τεύχος 100, Μαρτίου 2017, σελ. 36 υπάρχει αναφορά σε video του National Geographic σχετικό με την ζωή και το έργο της Marie Tharp).

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΛΟΙΠΑ

San Shan Bridge, Beijing (2022)

The San Shan Bridge spans across the Gui River and will be an integral part of the infrastructure program for the Olympic Winter Games 2022 in Beijing and connects the city center with Zhangjiakou. The english translation of "San Shan is 3 Mountains and describes the form of the bridge seen from the side with its 3 arches connecting to its hilly backdrop.

https://www.linkedin.com/company/civilengineeringdiscov-eries/

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

https://www.issmge.org/publications/issmge-bulletin/vol-14-issue-6-december-20200

Κυκλοφόρησε το Τεύχος #4 του Τόμου 14 (Δεκεμβρίου 2020) του Bulletin της ISSMGE με τα παρακάτω περιεχόμενα:

TC Corner

- Inauguration of the TC107 symposium "Laterites and lateritic soils"

Conference reports

- XXX Italian National Conference on Geo-synthetics Engineering, Italy
- 1st Indo-Japan Webinar Series :Geotech-nics for Disaster Mitigation"
- Geotechnical Challenges of Mega Pro-jects

Obituary

- Prof. Dong-Soo Kim
- Prof. Gavin John Alexander

Event Diary

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www.isrm.net/adm/newsletter/ver_html.php?id_newsletter=198

Κυκλοφόρησε το Τεύχος #52 (Δεκεμβρίου 2020) του Newsletter της ISRM με τα παρακάτω περιεχόμενα:

- President's New Year Message
- 32nd Online Lecture by Prof. Antonio Samaniego
- EUROCK 2021 - work in progress
- The ISRM 2020 online Council meeting took place on 28 October
- The 2020 ISRM Board online meeting took place on 20-22 October
- Rock Engineering Practice, a complete video course by Professor Jian Zhao
- New ISRM course on "Prevention methods for Landslides in Rock Masses" by Prof. Zhong-qi YUE
- New ISRM Young Rock Engineer Award
- New ISRM Suggested Method video available on the web-site - triaxial compression tests
- Indonesian was added to the ISRM technical glossary
- Prof. Manuel Romana passed away
- 1st International Youth Scientists Forum for Discontinuous Deformation Analysis (IYSF-DDA)
- Rocha Medal 2021 winner and runners-up were announced
- ISRM Specialized Conference CouFrac2020 was held online from Seoul
- ISRM Sponsored Conferences

Κυκλοφόρησε το IGS Newsletter της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

IGS NEWSLETTER – January 2021

Helping the world understand the appropriate value and use of geosynthetics

https://www.geosyntheticssociety.org/newsletters/

- Launch Of IGS Sustainability Committee READ MORE
- The Global Database On Geosynthetic Barrier Regulations READ MORE
- Honorary Membership For ACigs Founders READ MORE
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- Holiday Message From The IGS President READ MORE
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- Italy Chapter At Green Event 'Ecomondo' READ MORE
- Iran Chapter Technical Webinar READ MORE
- IGS UK Smashes Stereotypes In Soil Structures READ MORE
- IGS-NA Highlights Geosynthetics at Mine Tailings Event READ MORE
- IGS-ICE Webinar Shares Insight On Landslide READ MORE
- Calendar of Events

READ MORE AT GEOSYNTHETICSSOCIETY.ORG

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