ΕΛΛΗΝΙΚΗ
ΕΠΙΣΤΗΜΟΝΙΚΗ
ΕΤΑΙΡΕΙΑ
ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ
& ΓΕΩΤΕΧΝΙΚΗΣ
ΜΗΧΑΝΙΚΗΣ

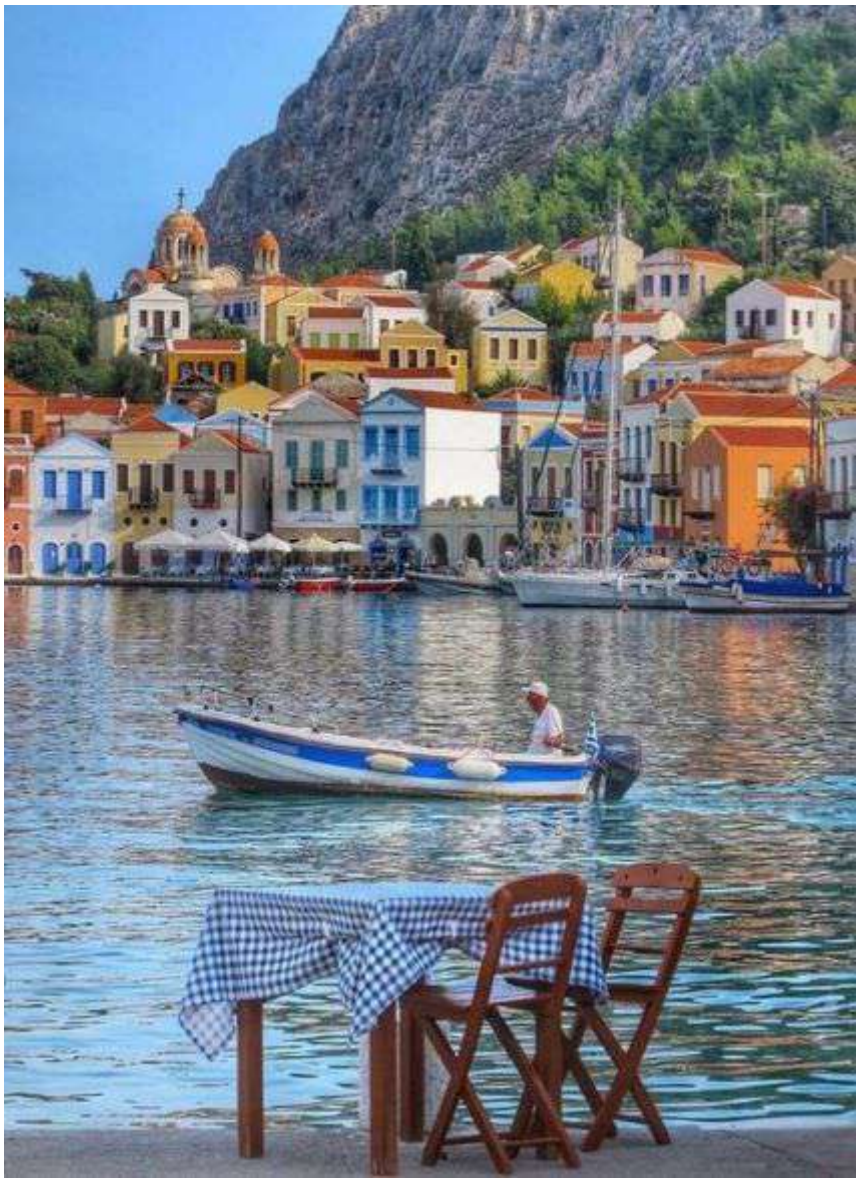
Τα Νέα της Ε Ε Ε Ε Γ Μ

150

Αρ. 150 – ΜΑΙΟΣ 2021

SIMSG ISSMGE

ISRM



Καστελλόριζο

Π Ε Ρ Ι Ε Χ Ο Μ Ε Ν Α

Εκδηλώσεις ΕΕΕΕΓΜ 3

- Σεισμικοί Γεωκίνδυνοι, Αντισεισμικός Σχεδιασμός και Διαχείριση της Διακινδύνευσης Ενεργειακών Έργων στην ευρύτερη Περιοχή της Μεσογείου 3
- Μετεωρίτες: η σημασία τους για τη κοινωνία και η αναζήτηση τους στην Ανταρκτική 3
- Θερμικός λυγισμός υπόγειων χαλύβδινων αγωγών φυσικού αερίου: αλληλεπίδραση εδάφους – αγωγού 4

Άρθρα 5

- The Design and Engineering Application of an Earthquake Strong -Motion Database 5

The Jesuit Contribution to Seismology 6

- 17 Equations That Changed the World 12

Νέα από τις Ελληνικές και Διεθνείς Γεωτεχνικές Ενώσεις 13

- International Society for Soil Mechanics and Geotechnical Engineering 13

ISSMGE News & Information Circular Ma7 2021 13

International Journal of Geoengineering Case Histories: 62,163 paper downloads in 2020 for the ISSMGE International Journal of Geoengineering Case Histories! 14

- International Society for Rock Mechanics and Rock Engineering 15

News 15

- International Tunnelling Association 15

LUNCHTIME LECTURE SERIES #5 "Automation in Tunnel Construction" 15

Scooped by ITA-AITES #43, 11 May 2021 15

Scooped by ITA-AITES #44, 25 May 2021 15

- British Tunnelling Society 16

Hinkley Point C Nuclear Power Station Tunnelling and Marine Project - TBMs, Primary/Secondary lining & the Heads 16

British Tunnelling Society Young Members Thames Tideway Tunnel - Victoria Embankment Foreshore - Using 3 techniques to sink a 55m deep Shaft in the Thames 16

- Institution of Civil Engineers Publishing 17

ICE Publishing Awards 17

- Industrial Fabrics Association International 18
- Geo-Institute of ASCE 18

The Ralph B. Peck Medal Lecture 18

- RockScience International Conference RIC 2021 - Lifetime Achievement Session Dr. Evert Hoek 18

Διακρίσεις Ελλήνων Γεωτεχνικών Μηχανικών 19

- International Journal of Geoengineering Case Histories - Β. Ξενάκη, Γ. Ντούλης & Γ. Αθανασόπουλος 2,235 downloads – 9,318 downloads since 2017 19

Προσφορές – Προκηρύξεις Θέσεων για Γεωτεχνικούς Μηχανικούς 20

- The LARAM 2021 school 20
- EKFB Eiffage Kier Ferrovial BAM: Geotechnical Engineer 20

Προσεχείς Γεωτεχνικές Εκδηλώσεις: 22

- INTERPRAEVENT 2021 – Norway Natural Hazards in a Changing World 22
- 4th Meeting of ICOLD EWG Dams and Earthquakes 22
- Keller Webinar Series: Groundwater Control 23
- ESC2021 - Session 31: When science meets industry: Advances in engineering seismology stemming from practice 24
- IAEG XIV Congress 2022 26
- 4th African Regional Conference on Geosynthetics – Geosynthetics in Sustainable Infrastructures and Mega Projects 27

Ενδιαφέροντα Γεωτεχνικά Νέα 29

- The mining-induced Jianshanying Landslide in Guizhou Province China 29

Deformation monitoring and failure mode research of mining-induced Jianshanying landslide in karst mountain area, China with ALOS/PALSAR-2 images 30

- Quick clay landslides: Slippery subject 30
- Northern Quebec landslide last month was a record-breaker 31
- Invited perspectives: Landslide populations – can they be predicted? 32
- Galapagos rock formation Darwin's Arch has collapsed 33
- The Pietrafitta landslide: can traffic vibration cause a landslide to move? 33

Clay landslide movement triggered by artificial vibrations: new insights from monitoring data 34

- Controls on the formation and size of potential landslide dams and dammed lakes in the Austrian Alps 34
- A big dam problem: The disaster in Michigan and solutions for the future 35
- Two huge earth cracks open up in Jalisco, Mexico 36
- 12 Tunnels That Will Blow Your Mind 36
- Norway's cruise ship tunnel plan explained 36

Ενδιαφέροντα – Σεισμοί & Αντισεισμικη Μηχανική 37

- Earthquake early warning milestones 37
- Earthquakes that talk to each other 42
- DeepShake spatiotemporal neural network improves early earthquake warnings 43
- Earthquakes and tsunamis from subduction zones more destructive than current estimates 44

Slip rate deficit and earthquake potential on shallow megathrusts 45

- New study reassesses strongest Mediterranean earthquake in history 45

Reassessing Eastern Mediterranean Tectonics and Earthquake Hazard From the 365 CE Earthquake 46

- HazMapper: a global open-source natural hazard mapping application in Google Earth Engine 46
- Scientists just dug the deepest ocean hole in history 47
- Electromagnetic anomalies occurring before large earthquakes 47

Laboratory investigation of coupled electrical interaction of fracturing rock with gases 48

- Study reveals inner workings of slow-slip earthquakes 48

Physical conditions and frictional properties in the source region of a slow-slip event 49

- Deep earthquakes in Texas driven by shallow wastewater injection 49

Widespread deep seismicity in the Delaware Basin, Texas, is mainly driven by shallow wastewater injection 50

- New paper on the M7.0 Samos earthquake 50
- Αρχαιότερες από όσο πιστεύαμε οι τεκτονικές πλάκες της Γης 51
- Capturing epistemic uncertainty in site response 51

Ενδιαφέροντα - Γεωλογία 52
- How geological processes affect the concentration of carbon dioxide in the atmosphere: The case study of Taiwan 52
  Co-variation of silicate, carbonate and sulfide weathering drives CO_2 release with erosion 52
Νέες Εκδόσεις στις Γεωτεχνικές Επιστήμες 53
Ηλεκτρονικά Περιοδικά 54

Εντυπωσιακές πτυχώσεις

ΕΚΔΗΛΩΣΕΙΣ ΕΕΕΕΓΜ

ΕΛΛΗΝΙΚΗ ΕΠΙΣΤΗΜΟΝΙΚΗ ΕΤΑΙΡΕΙΑ ΕΔΑΦΟΜΗΧΑΝΙΚΗΣ & ΓΕΩΤΕΧΝΙΚΗΣ ΜΗΧΑΝΙΚΗΣ

16 Ιουνίου 2021, 18:00
Διαδικτυακή Διάλεξη
Δρ. Πρόδρομου Ν. Ψαρρόπουλου

Σεισμικοί Γεωκίνδυνοι, Αντισεισμικός Σχεδιασμός και Διαχείριση της Διακινδύνευσης Ενεργειακών Έργων στην ευρύτερη Περιοχή της Μεσογείου

Περίληψη Διάλεξης

Τα τελευταία χρόνια παρατηρείται έντονο επενδυτικό ενδιαφέρον για την κατασκευή ενεργειακών έργων στην ευρύτερη περιοχή της Μεσογείου. Τα ενεργειακά έργα αποτελούν συνήθως μεγάλα και κρίσιμα έργα υποδομής, και, υπό προϋποθέσεις, η ασφάλειά τους ενδέχεται να κυμανθεί σε μη αποδεκτά επίπεδα, καθώς η συνολική διακινδύνευσή τους αποτελεί συνάρτηση (α) των εκάστοτε φυσικών ή/και ανθρωπογενών κινδύνων, (β) της δομικής τρωτότητας και (γ) των ενδεχόμενων απωλειών σε περίπτωση μερικής ή ολικής αστοχίας. Κατά τη φάση σχεδιασμού ενός νέου ενεργειακού έργου, οι μηχανικοί, με τη βοήθεια και άλλων επιστημόνων, είναι σε θέση να ποσοτικοποιήσουν τη διακινδύνευση με αρκετό ρεαλισμό (ανάλογα με την πληρότητα και την αξιοπιστία των διαθέσιμων δεδομένων) και να τη μειώσουν στα επιθυμητά επίπεδα (αν απαιτηθεί), ισορροπώντας μεταξύ ασφάλειας και οικονομίας. Παράλληλα, καθώς η τεχνολογία παρέχει πλέον τη δυνατότητα τηλε-παρακολούθησης σε πραγματικό χρόνο οποιουδήποτε κινδύνου ή/και της συνεπακόλουθης καταπόνησης νέων ή παλαιών ενεργειακών έργων, τα θέματα της ενόργανης παρακολούθησης, έγκαιρης προειδοποίησης και άμεσης απόκρισης έχουν αποκτήσει ιδιαίτερο ενδιαφέρον, καθώς μπορούν να συμβάλλουν στη μείωση της διακινδύνευσης κατά τις φάσεις κατασκευής και λειτουργίας ενός ενεργειακού έργου (μέσω πρόληψης αστοχιών ή/και ελαχιστοποίησης απωλειών στην περίπτωση διαπίστωσης κινδύνων ή/και δομικής τρωτότητας πέραν των προεκτιμηθέντων επιπέδων). Καθώς η ευρύτερη περιοχή της Μεσογείου χαρακτηρίζεται σε ξηρά και θάλασσα από έντονη γεωμορφολογία και σημαντικούς γεωκινδύνους που συνδέονται με την τεκτονική και τη σεισμικότητα, η συγκεκριμένη διάλεξη προσπαθεί, μέσω συγκεκριμένων περιστατικών και τεχνικών έργων, να «ρίξει φως» στα διεπιστημονικά ζητήματα του βέλτιστου αντισεισμικού σχεδιασμού και της αποτελεσματικής διαχείρισης της διακινδύνευσης χερσαίων, παράκτιων και υποθαλάσσιων ενεργειακών έργων που βρίσκονται ή θα βρεθούν εκτεθειμένα σε σεισμικούς γεωκινδύνους.

Σύντομο Βιογραφικό Σημείωμα Ομιλητή

Ο κ. Πρόδρομος Ψαρρόπουλος είναι Διδάκτωρ Πολιτικός Μηχανικός με ειδίκευση στη Γεωτεχνική Σεισμική Μηχανική. Διαθέτει 25ετή επιστημονική και επαγγελματική εμπειρία, η οποία εστιάζει κυρίως σε θέματα Υπολογιστικής Μηχανικής, Εδαφοδυναμικής, Αλληλεπίδρασης Εδάφους - Κατασκευής και Αντισεισμικής Τεχνολογίας. Έχει συγγράψει περί τις 30 δημοσιεύσεις σε διεθνή επιστημονικά περιοδικά, έχει δώσει ποικίλες διαλέξεις στην Ελλάδα και στο εξωτερικό ως προσκεκλημένος ομιλητής, και έχει διδάξει σε διάφορα εκπαιδευτικά ιδρύματα της χώρας (Σ.Ι., Σ.Τ.Ε.Α.ΜΧ., Γ.Υ.Σ., Α.Σ.ΠΑΙ.Τ.Ε., ΠΑ.Δ.Α.). Τα τελευταία χρόνια, όντας μέλος Ε.ΔΙ.Π. στο Εργαστήριο Δομικής Μηχανικής και Στοιχείων Τεχνικών Έργων της Σχολής Αγρονόμων Τοπογράφων Μηχανικών του Ε.Μ.Π., διδάσκει αυτοδύναμα τέσσερα μαθήματα Γεωτεχνικής Μηχανικής και Θεμελιώσεων, δύο εκ των οποίων είναι μεταπτυχιακά στο Διατμηματικό Μεταπτυχιακό Πρόγραμμα Σπουδών του Ε.Μ.Π. «Ναυτική και Θαλάσσια Τεχνολογία». Επαγγελματικά έχει ασχοληθεί με την ανάλυση και επισκευή μνημείων, το σχεδιασμό και την επίβλεψη υπέργειων και υπόγειων τεχνικών έργων, ενώ την τελευταία δεκαετία ασχολείται συστηματικά (ως σύμβουλος ελληνικών και ξένων εταιρειών) με τη μελέτη σημαντικών ενεργειακών έργων σε ξηρά και θάλασσα, με έμφαση στην ποσοτική εκτίμηση των γεωκινδύνων, στο σχεδιασμό θεμελιώσεων, στον αντισεισμικό σχεδιασμό ή/και στην ενόργανη παρακολούθηση. Είναι μέλος διάφορων επιστημονικών και επαγγελματικών ενώσεων, ενώ κατά το παρελθόν έχει διατελέσει επιστημονικός συνεργάτης του ΕΛ.Ο.Τ. και Γραμματέας των Τεχνικών Επιτροπών 341 (Geotechnical Investigation & Testing) της CEN και 301 (Preservation of Historic Sites) της ISSMGE.

30 Ιουνίου 2021, 18:00
Διαδικτυακή Διάλεξη
Δρ. Ιωάννη Μπαζιώτη
Επίκουρου Καθηγητή Ορυκτολογίας / Πετρολογίας
Γεωπονικού Πανεπιστημίου Αθηνών

Μετεωρίτες: η σημασία τους για τη κοινωνία και η αναζήτηση τους στην Ανταρκτική

Περίληψη Διάλεξης

Οι μετεωρίτες αποτελούν συστατικά του διαστήματος. Περιέχουν κόκκους ορυκτών που μπορεί να είναι παλαιότεροι όχι μόνο από τον πλανήτη Γη, αλλά ακόμα και από το ίδιο το ηλιακό μας σύστημα. Η διάκριση των μετεωριτών σε πολλούς τύπους εκφράζει την πολυπλοκότητα των διεργασιών που λαμβάνουν χώρα στο ηλιακό μας σύστημα. Διεργασιών που κατανέμονται στο χώρο και στο χρόνο. Θα παρουσιαστούν οι διαφορετικοί τύποι μετεωριτών με χαρακτηριστικά παραδείγματα. Επίσης, ιδιαίτερη μνεία θα δοθεί στο γιατί είναι σημαντικοί οι μετεωρίτες, και ποιος ο ρόλος τους στην εξέλιξη ουράνιων σωμάτων παρόμοιων με τη Γη. Επίσης, η κοινωνική διάσταση που συνδέεται με την ύπαρξη του ανθρώπου είναι ένα θέμα που θα αναπτυχθεί κατά τη διάρκεια της ομιλίας. Ποιες μπορεί να είναι οι συνέπειες πτώσης ενός μεγάλου ουράνιου σώματος στη Γη; Έχει συμβεί στο παρελθόν; Έχουμε αποδείξεις πτώσης αστεροειδών στη Γη, στη Σελήνη, στον Άρη; Υπάρχει πιθανότητα ένα σώμα να αφανίσει μεγάλο μέρος της ζωής στη Γη;

Το δεύτερο μέρος της ομιλίας ασχολείται με τις εμπειρίες του ομιλητή κατά τη διάρκεια της συμμετοχής του στην αποστολή Antarctic Search for Meteorites (ANSMET) η οποία χρηματοδοτείται από τη NASA, και χάρη σε αυτή έχουν ανακτηθεί περισσότεροι από 24.000 μετεωρίτες τα τελευταία 45 χρόνια. Γιατί όμως στην Ανταρκτική; Η αναζήτηση μετεωριτών στην Ανταρκτική βασίζεται στο γεγονός ότι η "παγωμένη" ήπειρος αποτελεί μία μοναδική περίπτωση του πλανήτη Γη. Εκεί, υφίσταται ένας φυσικός μηχανισμός συγκέντρωσης των μετεωριτών, εξαιτίας της σύγχρονης δράσης του ανέμου και της ηλιακής ακτινοβολίας. Η διάβρωση του πάγου -που περιέχει τους μετεωρίτες-, σε συνδυασμό με την κίνησή του, οδηγεί στο να αποκαλυφθούν οι μετεωρίτες πριν το εμπόδιο των Transantarctic Mountains. Επιπρόσθετα, οι μετεωρίτες που έχουν ανακτηθεί από την αποστολή ANSMET, έχουν δώσει πληθώρα νέων πληροφοριών σχετικά με την εξέλιξη πλανητικών σωμάτων (π.χ. Άρης, Σελήνη) και τη δυναμική σύγκρου-

σης μεταξύ αστεροειδών. Στη διάρκεια της ομιλίας θα παρουσιαστούν ερευνητικά δεδομένα από παραδείγματα μελέτης μετεωριτών με προέλευση την Ανταρκτική.

Σύντομο Βιογραφικό Σημείωμα Ομιλητή

Ο Ιωάννης Μπαζιώτης γεννήθηκε στην Αθήνα το 1980, αποφοίτησε από το Τμήμα Γεωλογίας του Πανεπιστημίου Αθηνών το 2002 (έτος εισαγωγής 1998), και έλαβε το διδακτορικό του από τη Σχολή Μηχανικών Μεταλλείων και Μεταλλουργών του Εθνικού Μετσόβιου Πολυτεχνείου (ΕΜΠ) το 2008. Εκπόνησε μεταδιδακτορική έρευνα στο ΕΜΠ τη διετία 2008-2010. Το 2012 μετέβη στην Αμερική όπου, υπό την καθοδήγηση του Larry Taylor, -ενός από τους καλύτερους Επιστήμονες στην Πλανητική Επιστήμη-, δημοσίευσε πόνημα για τον πιο σημαντικό μετεωρίτη με προέλευση τον πλανήτη Άρη, τον Tissint. Η έρευνα χρηματοδοτήθηκε από τη NASA. Ακολούθησε μεταδιδακτορική έρευνα σε μανδυακούς ξενολίθους, με σκοπό την κατανόηση της ετερογένειας του μανδύα σε μικρομετρική κλίμακα. Η έρευνα χρηματοδοτήθηκε από την Ελληνική Πολιτεία και την Ευρωπαϊκή Ένωση, και εκπονήθηκε συνεργατικά με το Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης, το California Institute of Technology, το Πανεπιστήμιο της Βιέννης και το Πανεπιστήμιο της Περούτζια. Η εν λόγω ερευνητική δουλειά συμπεριλήφθηκε στα έργα καλή πρακτικής του ΕΣΠΑ. Το 2014 προσλήφθηκε ως λέκτορας Ορυκτολογίας-Πετρολογίας στο Τμήμα Αξιοποίησης Φυσικών Πόρων και Γεωργικής Μηχανικής, του Γεωπονικού Πανεπιστημίου Αθηνών, ενώ από το 2016 είναι επίκουρος καθηγητής. Παρουσιάζει έντονη δράση σε διεθνές επίπεδο, με συμμετοχή σε συνέδρια ως προσκεκλημένος ομιλητής, σε Πανεπιστήμια, και ομιλίες για το ευρύτερο κοινό. Έχει πλούσιο επιστημονικό έργο, με πολλές από τις εργασίες του να έχουν δημοσιευθεί σε περιοδικά με υψηλό δείκτη εγκυρότητας. Έχει αναπτύξει εξαιρετικές συνεργασίες με πολυάριθμα Πανεπιστήμια (π.χ. California Institute of Technology, University of Tennessee, Open University of London, University of Muenster) και Οργανισμούς (π.χ. NASA, Jet Propulsion Laboratory, Natural History Museum of Vienna) του εξωτερικού, οι περισσότεροι εκ των οποίων στηρίζονται από Εθνικά ή Διεθνή –χρηματοδοτούμενα– προγράμματα. Είναι αξιολογητής επιστημονικών περιοδικών, και ερευνητικών προγραμμάτων για τη NASA.

14 Ιουλίου 2021, 18:00
Διαδικτυακή Διάλεξη
Δρ. Πάνου Ντακούλα
Καθηγητή Πανεπιστημίου Θεσσαλίας

Θερμικός λυγισμός υπόγειων χαλύβδινων αγωγών φυσικού αερίου: αλληλεπίδραση εδάφους – αγωγού

Περίληψη Διάλεξης

Οι αγωγοί που μεταφέρουν φυσικό αέριο είναι δυνατόν να υποστούν κατακόρυφο λυγισμό λόγω των σημαντικών θλιπτικών τάσεων που αναπτύσσονται εξαιτίας της υψηλής θερμοκρασίας και εσωτερικής πίεσης του μεταφερόμενου ρευστού. Η παρουσίαση διερευνά το φαινόμενο εμφάνισης θερμικού λυγισμού, λαμβάνοντας υπόψη την αλληλεπίδραση εδάφους-αγωγού. Το πρώτο τμήμα της έρευνας που εκπονήθηκε με συνεργασία του Π.Θ. και ΕΜΠ, αφορά οριζόντιους αγωγούς και βασίζεται σε αριθμητικές προσομοιώσεις και φυσικά πειράματα υπό κλίμακα. Αρχικά, εξετάζεται πειραματικά η αντίσταση του εδάφους σε ανύψωση υπόγειου αγωγού για διαφορετικές τιμές της διαμέτρου, του βάθους εγκιβωτισμού, και της σχετικής πυκνότητας της άμμου. Στην συνέχεια εξετάζεται πειραματικά η ανάπτυξη κατακόρυφου λυγισμού, για διαφορετικά βάθη εγκιβωτισμού. Παρουσιάζονται συγκρίσεις πειραματικών μετρήσεων και αριθμητικών προβλέψεων. Ακολουθεί λεπτομερής αριθμητική προσομοίωση του κατακόρυφου λυγισμού για αγωγούς εντός αργιλικών και αμμωδών εδαφών. Εξετάζεται η επίδραση αρχικών γεωμετρικών ατελειών, της αντοχής του εδάφους, και της εσωτερικής πίεσης στις κρίσιμες θερμοκρασίες ανάπτυξης λυγισμού. Στο δεύτερο τμήμα της παρουσίασης, διερευνάται η ανάπτυξη κατακόρυφου λυγισμού σε αγωγούς διερχόμενους από κεκλιμένο έδαφος για ένα ευρύ φάσμα κλίσεων πρανών. Παρουσιάζονται αντιπροσωπευτικά αποτελέσματα παραμετρικών αναλύσεων αναφορικά με την αντοχή του εδάφους, την εσωτερική πίεση, τα χαρακτηριστικά του αγωγού και το βάθος εγκιβωτισμού.

Σύντομο Βιογραφικό Σημείωμα Ομιλητή

Ο Δρ. Πάνος Ντακούλας είναι Καθηγητής στο Τμήμα Πολ. Μηχανικών του Παν. Θεσσαλίας. Έλαβε δίπλωμα Πολ. Μηχανικού από το ΕΜΠ (1980), και MSc και Διδακτορικό (1985) από το Rensselaer Polytechnic Institute (NY). Διατέλεσε Επίκουρος και Αναπληρωτής Καθηγητής (1987-2000) στο Πανεπιστήμιο Rice (Χιούστον), ενώ από το 2001 είναι μέλος ΔΕΠ του ΠΘ. Η έρευνά του επικεντρώνεται στην Εδαφοδυναμική και Γεωτεχνική Σεισμική Μηχανική, με εφαρμογές στην σεισμική συμπεριφορά φραγμάτων και λιμενικών συστημάτων, την πειραματική συμπεριφορά εδάφους σε ανακυκλική φόρτιση, την ρευστοποίηση, την δημιουργία καταστατικών προσομοιωμάτων εδάφους, την αλληλεπίδραση εδάφους-αγωγών και την προχωρημένη αριθμητική ανάλυση. Διατέλεσε πρόεδρος της Εθνικής Επιτροπής Σεισμικής Μηχανικής (Γεωτεχνικού Τομέα) του Συλλόγου Πολιτικών Μηχανικών των ΗΠΑ (1992-2000) και μέλος της Εκδοτικής Επιτροπής του περιοδικού Geotechnical and Geoenvironmental Engineering (ASCE). Για το ερευνητικό έργο του τιμήθηκε με το διεθνές βραβείο Prakash (1995) και με το βραβείο Hsieh (2009) του Συλλόγου Πολ. Μηχανικών της Μεγάλης Βρετανίας. Έχει δημοσιεύσει άνω των 120 επιστημονικών άρθρων σε διεθνή περιοδικά και πρακτικά συνεδρίων και διετέλεσε εκδότης σε πρακτικά συνεδρίων. Έχει συμμετάσχει σε ένα σημαντικό αριθμό ερευνητικών έργων και διατέλεσε σύμβουλος σε μεγάλα τεχνικά έργα.

ΑΡΘΡΑ

Το μέλος της ΕΕΕΕΓΜ Δρ. Κώστας Σουφλής εντόπισε και μου έστειλε αντίγραφο της διδακτορικής διατριβής του Prof. Julian Bommer, που εξεπόνησε υπό την επίβλεψη του Καθηγητού Νίκου Αμβράζη και του Dr. Sarada Sarma στο Imperial College και την υποστήριξε τον Ιούλιο 1991. Ζήτησα από τον Prof. Bommer την άδεια να περιλάβω στο περιοδικό μας την αφιέρωση AMDG και την περίληψη. Ο ίδιος απάντησε ως ακολούθως:

"Regarding the dedication and abstract, I am perfectly happy for you to include them in your newsletter, although I am not sure that the abstract is particularly interesting after 30 years of development in European strong-motion databases and ground-motion models. The dedication—*Ad Maiorem Dei Gloriam*—is perhaps more interesting."

Στη συνέχεια παρουσιάζονται τα αποσπάσματα από την Thesis του Prof. Julian Bommer, καθώς και άρθρο σχετικά με την συμβολή των Ιησουιτών στην Σεισμολογία.

The Design and Engineering Application of an Earthquake Strong -Motion Database

J. J. Bommer

A M D G

This thesis is dedicated to the Fathers and Brothers of the Society of Jesus who have made an enormous, although perhaps little recognized, contribution to the science of seismology.

The Jesuits have made their most notable contribution in the field of instrumental observations. As early as 1869, Frederico Faura SJ began seismological observations at the Manila Observatory, and in 1884 regional seismic observations began under Father Sadero Masö SJ. The Manila Observatory is still operated by Jesuits today.

In 1899, French Jesuits founded a seismological observatory in Madagascar and in 1903 Jesuits established the seismic station of the Zikawei observatory in China. In Spain, Father M. Sanchez Navarro-Newmann SJ founded a seismic station at Cartuja near Granada in 1902, and the Ebro Observatory was founded in 1904 by Ricardo Cirero Salse SJ, who had been sub-director of the Manila Observatory. A seismic station was established by Jesuits at Tortosa in 1905, and in the same year, Simon Sarasola SJ began seismic measurements at the Belen Observatory which had been founded in Havana in 1870 by Benito Vines SJ.

Irish Jesuits founded the seismic station at Riverview in Australia in 1909, and it is still an active centre of seismological research under Larry Duke SJ. Jesuits from the same province founded another observatory at Rathfarnham Castle, Ireland, in 1916. In 1910 Father Bonaventure Bertoly SJ founded the seismic station at Ksara in the Bekka Valley of Lebanon, which was subsequently operated by Jacques Plassard Si.

The Jesuit contribution to seismology was recognized in 1911 when a meeting of the Association of Seismology, of what is now the International Union of Geodesy and Geophysics, recommended that the Society of Jesus establish a seismological observatory in Bolivia. In 1913, Father Pierre Descotes SJ founded the San Calixto Observatory in La Paz, which is today operated by Ramon Cabrio SJ.

In 1923, after the Colombian government had requested the Jesuits to take over the Weather Service, seismological observations were begun at the Colegio San Bartolome in Bogota by Simon Sarasola SJ, who had previously been in Cuba. The Geophysical Institute of the Andes, still operated by Jesuits today, was founded in 1943 by Father J. E. Ramirez SJ.

In the United States, the Jesuit involvement in seismology had begun in 1900 when Frederick L. Odenbach SJ started observations in Cleveland, Ohio. Father Odenbach established the Jesuit Seismological Service in 1911, which operated 11 stations in the United States and Canada. The Service was later disbanded but some of the stations continued to operate and in 1925 James B. McElwane SJ founded the Jesuit Seismological Association at St. Louis, Missouri. The Association was later headed by Fathers J. Lynch SJ, D. Lineham SJ and William Stauder SJ, and although some of the stations have ceased operation, it remains very active, particularly at St. Louis and at Weston in Boston.

In 1952, Maurice Buist SJ began an observatory at the College Jean-de-Brebeuf in Montreal, Canada. In 1957 Pierre Gouin SJ, of the same province, established a seismic station at the Geophysical Observatory of Addis Ababa, Ethiopia. Jesuits also founded seismic stations in Jamaica and Venezuela, and at Stonyhurst in England, Antofagasta in Chile, San Miguel in Argentina, Kalosca in Hungary and at Sucre in Bolivia. Amongst other Jesuit academics, Augustin Udias Vallina SJ, Professor of Geophysics at the Universidad Complutense of Madrid, has made significant contributions in seismology and tectonics.

Abstract

Records of strong ground-motion produced by earthquakes provide engineers with the most complete and dependable information available about the nature of seismic loads. Reliable digitized strong-motion records from around the world have been collected into a databank for use by engineers. In order to provide an efficient means of selecting appropriate records, a relational database of associated seismological and geophysical parameters has been developed. The continually expanding database is shown to be a useful resource to engineers involved in seismic risk reduction which obviates the use of synthetic time-histories which are associated with many uncertainties.

Since the facility is aimed at European engineers, emphasis has been placed on retrieving strong-motion records from this and adjacent regions. More than 700 earthquakes have been identified as generating strong-motion records in the area, and their focal depths, fault mechanisms, local, surface- and body-wave magnitudes and seismic moments have been uniformly re-evaluated. For 863 strong-motion records, generated by 442 shallow earthquakes, distances of the site from the earthquake source and the nature of the superficial site geology have been consistently determined.

To provide simple attenuation relationships for Europe, the data have been used to derive predictive equations for peak horizontal and vertical acceleration, for magnitudes between 4.0 and 7.3 and distances up to 310 km. The prediction of horizontal acceleration is improved by introducing the focal depth. The mean ratio of vertical to horizontal peak acceleration is found to be independent of magnitude and distance and equal to 0.5, with the 84-percentile value being 0.8.

Thesis submitted to THE UNIVERSITY OF LONDON for the Degree of Doctor of Philosophy, July 1991

Engineering Seismology and Earthquake Engineering, Department of Civil Engineering, Imperial College of Science Technology and Medicine, LONDON SW7 2BU

A M D G

Ad maiorem Dei gloriam or *Ad majórem Dei glóriam*, also rendered as the abbreviation **AMDG**, is the Latin motto of the Society of Jesus (Jesuits), an order of the Catholic Church. It means "For the greater glory of God" (Wikipedia).

Professor Julian J Bommer

Professional Activities:

I served on the full-time academic staff at Imperial College from 1994 until 2011, promoted to the position of Professor of Earthquake Risk Assessment in 2006. During my 17 years on the academic staff I supervised to successful completion 15 PhD students, and taught subjects related to Engineering Seismoloy, Risk Analysis, Professional Engineering Practice, and Energy, at undergraduate and Masters level. I also held a number of departmental posts, including Postgraduate Tutor (1996-2000), Senior Tutor (2001-2003) and Director of Undergraduate Studies (2004-2010). In the last role I coordinated the introduction of new 4-year MEng curriculum in Civil Engineeing.

In August 2013 I rejoined the academic staff on a part-time basis as a Senior Research Investigator and am engaged with some research in the Department and continue to publish (Web of Science h-index currently 44) as well as contributing to some teaching modules, I am mainly engaged in seismic hazard projects around the world, primarily for nuclear applications but also related to large dams, bridges and other major infrastructure projects, including the Panama Canal expansion. I am also working on some projects related to the hazard and risk due to induced seismicity. Details of these projects are in my CV.

Areas of Expertise:

Engineering Seismology: earthquake ground-motion characterisation and prediction; definition of earthquake actions for seismic design; seismic hazard assessment for natural and induced seismicity; earthquake loss estimation and risk analysis.

(https://www.imperial.ac.uk/people/j.bommer)

The Jesuit Contribution to Seismology

Agustin Udias & William Stauder

INTRODUCTION

The contribution to seismology of the Society of Jesus as an institution through its colleges and universities, and its members as individual scientists, forms an important chapter in the history of this science. This is especially so in the early years of its development. Several papers have described in part the work of Jesuits in seismology: Sánchez Navarro-Neumann (1928, 1937), Heck (1944), who limits himself to American Jesuits, and the interesting but short summaries of Linehan (1970, 1984). No recent or comprehensive work, however, exists on the topic. Recently, moreover, many Jesuit seismographic stations have been closed and the number of Jesuits actually working in seismology has been greatly reduced. To a certain extent, apart from a very few academic departments and research institutes associated with Jesuit universities, it can be said that this is a chapter which is coming to a close. The interest of Jesuits has moved in other directions and it is not likely that seismology will become again an important aspect of the work of individual Jesuits as it was in the past. For this reason we feel that it will be of interest to present an overall picture of the extent of the Jesuit involvement in seismology.

It may be intriguing to some that a religious order dedicated so much effort to a science like seismology. From the very early years of the its foundation in the 16th century by Ignacio de Loyola, the Society of Jesus dedicated itself primarily to educational work through its many colleges and universities. From the beginning of these institutions science was an important subject in the curriculum. A key figure in this development was Christopher Clavius (1537-1612), Professor of Mathematics in the Collegio Romano. Clavius was instrumental in incorporating a serious program of mathematics, astronomy, and natural sciences not only in his own college but also in all Jesuit colleges and universities (MacDonnell, 1989). Secondly, in the 17th and 18th centuries a number of astronomical observatories were established in these institutions. In a number of these, meteorological observations also were made. Finally, in a particularly notable page of this history, Jesuits were appointed Directors of the Astronomical Observatory in Beijing, China (Udfas, 1994). This tradition forms the background of modern Jesuit scientific work. Since the middle of the 19th century, as many as 40 geophysical observatories were created by Jesuits around the world and in many of these, seismological stations were installed (Udfas and Stauder, 1991).

As a science, seismology is relatively young. Davison (1927) dates its beginning to 1750 with the Lisbon earthquake and the work of John Michell (1724-1793). Although pendulums were used to detect the ground motion due to earthquakes at the beginning of the 19th century, the earliest seismographs were those developed in Italy by Luigi Palmieri (1807-1896) in 1855 and Timoto Bertelli (1826-1905) in 1872. Seismographs with continuous recording were developed in Japan from 1881 to 1882 by John Milne (1850-1913) and Thomas Gray (1850-1908). One of the first studies of earthquakes is that of Robert Mallet (1810-1881), who investigated the Naples earthquake of 1857 (Davison, 1927). The first record of a long-distance earthquake is a fortuitous recording of an earthquake in Japan by pendulums set up in Potsdam in 1889 by E. A. von Reuber-Paschwitz (1861-1895). From these dates and events seismology began to develop not only as a study of the nature of earthquakes but also, through the analysis of the seismic waves, as a method to investigate the structure of the interior of the earth.

A series of circumstances and interests involved Jesuits in the development of this new science from its inception. This interest, certainly, was consonant with the tradition of Jesuits in science dating from the 16th century, which developed, as has been mentioned, out of their work in colleges and universities. The character of seismology as a public service to mitigate the destructive effects of earthquakes was another influential factor. Especially in undeveloped countries, Jesuits were in many instances the first to install seismographic stations and to carry out seismicity and seismic risk studies.

Two trends may be distinguished in this involvement of Jesuits in seismology. In the United States, emphasis was on the cooperation of Jesuit institutions in the establishment of seismographic stations organized first as the Jesuit Seismological Service and subsequently as the Jesuit Seismological Association. In other countries, especially in mission lands, the

movement developed out of the activity of individual institutions in establishing seismic observatories, usually as a complement to the recording of other geophysical data.

JESUIT SEISMOGRAPHIC STATIONS

Table 1 presents a list of 38 seismographic stations installed and maintained by Jesuits. In each case dates of the installation of different types of seismographs are given *(OM* indicates "own manufacture"). The distribution by continents (see Figure 1) is as follows: Europe 6, Asia 4, Africa 2, Australia 1, North America 18, and South America 7. Most of these stations were founded before 1920, and many ceased operation in the 1960s and 1970s. At present, there are only eight functioning regularly. Initially, the preferred instruments were Wiechert and Mainka mechanical seismographs, and later, Galitzin-Wilip and Sprengnether electro-magnetic instruments. In 1962, 10 Jesuit stations became part of the 125 global WWSSN network (World Wide Standard Seismographic Network) supported by the U.S. Government. Of these, two, one in Colombia and the other in Bolivia, were later upgraded to become SRO (Seismological Research Observatory) and HGLP-ASRO (High Gain Long Period Adapted Seismological Research Observatory) stations, respectively.

TABLE 1 JESUIT SEISMOGRAPHIC STATIONS

Station	Dates	Instruments
Manila, Philippines	1868– ——	1868: OM Seismoscopes Z, H 1882: Cecchi, Bertelli, Rossi 1889: Gray-Milne, Ewing 1911: Wiechert, NE, 1000 kg
Baguio		1911: Vicentini, Omori 1951: Sprengnether SP ZNE 1962: WWSSN
Guam y Butuam		1912: Wiechert NE 200 kg
Ambulong		1912: Vicentini, Agamennone 1930: Galitzin-Wilip, ZNE
Tagaytay		1930: Wiechert NE
Davao		1962: WWSSN
Manila		1962: Sprengnether SP ZNE
Tuscalano Frascati, Italy	1888–1920	1888: OM Seismoscope (Egidi) 1908: Cancani, Agammenone
Tanarive, Madascar	1899–1992	1899: Cecchi, Bertelli 1927: Mainka ZNE 460 kg
John Carroll, Cleveland, Ohio, JSA	1900–1992	1900: OM Seismoscope (Odenbach) 1908: Wiechert NE 80 kg 1946: Sprengnether LP-ZNE, SP Z
Cartuja, Granada, Spain	1902–1971	1902: Vincentini NE 305 kg, Z 245 kg; Stiattesi NE 1908: OM Z 208 kg, NE (Cartuja) 1920: OM NE 3000 kg (Cartuja) 1924: OM ZNE Elctrmag (Neumann)
Ebro, Tarragona, Spain	1904– ——	1904: Vicentini ZNE, Grablowitz 1914: Mainka Z 1500 kg, NE 300 kg 1965: Benioff SP ZNE 1969: Sprengnether LP ZNE
Zikawei, Shanghai, China	1904–1949	1904: Omori 1909: Welchert NE 1200 kg 1913: Galitzin Z 1932: Galitzin-Wilip ZNE
Belen, Havana, Cuba	1907–1920	1907: Bosch-Omori NE
Santa Clara, California	1907–1958	1907: OM seismograph 1909: Wiechert ZNE 80 kg 1930: Galitzin-Wilip ZNE 1931: Wood Anderson NE
Stonyhurst, Lancashire, Eng.	1908–1947	1908: Milne NE 1924: Milne-Shaw NE
Mungret, Limerick, Ireland	1908–1915	1908: OM (O'Leary, inv. pend.)
Riverview, Australia	1909–1985	1909: Wiechert ZNE 1910: Mainka NE 1941: Galitzin-Wilip ZNE 1953: Sprengnether SP-Z 1962: WWSSN
Regis, Denver, Colorado, JSA	1909–1988	1909: Wiechert NE 80 kg 1946: Sprengnether LP-NE, SP-Z 1962: Sprengnether SP-ZNE
Gonzaga, Spokane, Washington, JSA	1909–1970	1909: Wiechert NE 80 kg 1946: Wood Anderson NE
Holy Cross, Worcester, MA	1909–1934	1909: Wiechert NE 80 kg
Marquette, Milwaukee, Wis., JSA	1909–1951	1909: Wiechert NE 80 kg

The first seismographic station was installed by Jesuits about 1868 in the Observatory of Manila. This consisted of two pendulums, one vertical the other horizontal, and were what we would today call seismoscopes. They were designed by Juan Ricart, Professor of Sciences at the Manila Jesuit College. They functioned intermittently until 1877 when regular, continuous-recording instruments were installed. After the Manila earthquakes of 1880, which were recorded on the old seismographs and studied by Federico Faura (1847-1897), the station was better equipped with Cecchi, Bertelli and Rossi seismographs made in Italy. Additional stations were installed at other points of the Philippines, namely at Baguio, Ambulong, Butuam, Tagaytay, and the island of Guam (Saderra-Masó, 1895 and 1915; Su, 1988). Unfortunately, all seismographic records were lost in the destruction of the observatory during World War II. The continuous catalog of Philippine earthquakes, however, was salvaged and was published shortly after the war by Repetti (1946). After the war, new seismographs were installed in Manila, Baguio, and Davao. The last two sites became WWSSN stations in 1962.

TABLE 1 JESUIT SEISMOGRAPHIC STATIONS (CONTINUED)

Station	Dates	Instruments
Georgetown, Washington, DC, JSA	1910–1972	1910: Wiechert NE 80 kg 1912: Bosch-Omori NE 25 kg 1912: Bosch photog. NE 200 kg 1912: Wiechert ZNE 200 kg 1912: Mainka NE 135 kg 1923: Galitzin ZNE 1962: WWSSN
Canisius, Buffalo, NY, JSA	1910– ——	1910: Wiechert ZNE 80 kg 1932: Galitzin-Wilip Z 1946: Sprengnether LP-NE, SP-Z
Saint Louis, St. Louis, MO, JSA	1910– ——	1910: Wiechert NE 80 kg 1928: Wood Anderson NE 1946: Sprengnether LP-NE, SP-Z 1960: Benioff SP-Z 1963: Sprengnether LP ZNE, Benioff SP NE
Florissant	1928–1974	1928: Galitzin ZNE 1928: Wood Anderson NE 1962: WWSSN
French Village	1974– ——	1972: WWSSN
Cape Girardeau, MO	1938– ——	1938: Wood Anderson NE 1980: Benioff SP-ZNE,
Little Rock, AR	1930–1958	1930: Wood Anderson NE
Cathedral Cave, Onandago State Pk	1991– ——	1991: IRIS Station
Saint Boniface, Manitoba, Canada	1910–1922	1910: Wiechert NE 80 kg
Fordham, New York, NY, JSA	1910–1977	1910: Wiechert NE 80 kg 1924: Milne-Shaw NE 1927: Galitzin-Wilip ZNE 1932: Wood Anderson NE 1936: Benioff SP-Z 1950: Sprengnether SP-ZNE
Loyola, New Orleans, LA, JSA	1910–1960	1910: Wiechert NE 80 kg 1946: Sprengnether LP-NE, SP-Z
Spring Hill, Mobile, AL, JSA	1910–1989	1910: Wiechert NE 80 kg 1941: McComb-Romberg NE 1962: WWSSN
Ksara, Bekka, Lebanon	1910–1979	1910: Mainka NE 135 kg 1921: Mainka NE 460 kg 1933: Galitzin-Wilip ZNE 1957: APX SP-ZNE (Grenet Coulomb)
Loyola, Chicago, IL, JSA	1913–1960	1912: Wiechert NE 80 kg 1957: Sprengnether ZNE 1983: Kinemetrics SP-Z
San Calixto, La Paz, Bolivia	1913– ——	1913: OM Z 1500 kg, NE 2000 kg 1930: Galitzin-Wilip ZNE 1962: WWSSN 1972: HGLP-ASRO
Sucre, Bolivia	1915–1948	1915: OM Z 1500 kg, NE 3000 kg
Rathfarnham Castle, Ireland	1916–1961	1916: OM Z (O'Leary) 1500 kg 1932: Milne-Shaw NE
San Bartolome, Bogotá, Colombia	1923–1940	1923: OM NE 2000 kg (Cartuja) 1926: Wiechert NE 2000 kg 1930: OM NE 1000 kg (Cartuja)

TABLE 1 JESUIT SEISMOGRAPHIC STATIONS (CONTINUED)

Station	Dates	Instruments
Xavier, Cincinnati, OH, JSA	1927–1986	1927: Galitzin-Wilip ZNE 1949: OM ZNE (electromag)
Weston, Boston, MA, JSA	1928– ——	1930: Bosch-Omori NE 1934: Wiechert NE 2000 kg 1936: Benioff SP-ZNE 1962: WWSSN
Saint Louis, Island of Jersey	1936–1979	1936: Mainka NE 1000 kg
Saint George's, Kingston, Jamaica	1940–1975	1940:
Instituto Geofisico, Bogotá, Colombia	1941– ——	1941: Benioff SP-Z 1943: Wiechert NE 1946: Sprengnether NE 1962: WWSSN 1973: ASRO
Galerazamba		1949: Sprengnether ZNE
Chinchina		1949: Sprengnether ZNE
San Luis, Antofagasto, Chile	1949–1965	1949: Bosch Omori 1960: Wilson-Lamison
San Francisco, California	1950–1964	1960: Sprengnether LP-NE, SP-Z
S. Jean De Brebeuf, Montreal, Canada	1952– ——	1952: Wilmore 1952: Benioff SP-ZNE 1961: Press-Ewing LP-ZNE 1961: Geotech SP-Z
Addis Ababa, Ethiopia	1957–1978	1957: 1962: WWSSN

The first seismograph installed by Jesuits in Europe was a seismoscope made by Giovanni Egidi (1835-1897) and installed in the meteorological observatory Tuscolano, Frascati, Italy, founded in 1868 (Egidi, 1888). An important station was installed in 1902 in Granada, the most seismically active region of Spain. Due to a lack of funds most seismographs were made patiently under the direction of Manuel Sánchez Navarro-Neumann (1867-1941), who reproduced with some

improvements the Omori, Wiechert and Galitzin seismographs (Sánchez Navarro-Neumann, 1928). In Ireland, William J. O'Leary installed the first seismograph, also of local design, at Mungret College in 1908. In 1916 it was moved to Rathfarnham Castle, where it was in operation until 1961. This was an inverted pendulum suspended by steel wires with a mass of 600 kg recording on smoked paper on two drums (Murphy, 1995). In the Ebro Observatory, Spain, a seismological station has functioned continuously from 1904 to the present. At Stonyhurst, England, the station operated from 1908 to 1947. A seismographic station was also established by Jesuits on the Island of Jersey, operating from 1936 to 1979.

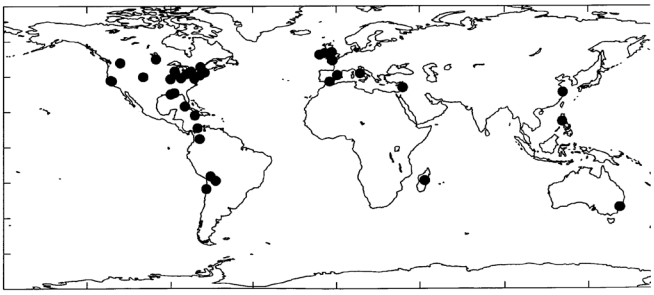


Figure 1. Map showing the location of Jesuit seismographic stations.

Very early, in 1899, Jesuits installed a seismographic station in Madagascar using instruments of Italian design. In 1927 a three-component Mainka seismograph was installed. This station operated under Jesuit supervision until 1967 and may have been one of the earliest seismographic stations in Africa. In 1904 Jesuits installed an Omori seismograph donated by the Japanese government in the observatory of Zikawei. This may have been the first such station in China. Updated with Wiechert and Galitzin-Wilip instruments in 1909 and 1932, respectively, Zikawei continued as a firstclass station up to the time the Jesuits were expelled from China in 1949 (Gherzi, 1950). In Ksara, Lebanon, seismographs were installed in 1910. This was an important station due to lack of stations in the Middle East. It operated uninterruptedly until 1979 with Wiechert instruments. In Australia, the Jesuit seismographic station of Riverview was initiated in 1909 with Wiechert instruments. In 1962, it became a WWSSN station and operated until 1985. For many years this was the best known and best equipped station in Australia (Drake, 1980; Doyle and Underwood, 1965).

At the 2nd General Assembly of the International Seismological Association, Manchester, 1911, a resolution was passed recommending that the Jesuits install a seismic station in the central part of South America. In response to this recommendation a seismological station was installed in 1913 at La Paz, Bolivia, with the name of Observatory de S. Calixto, by Pierre M. Descotes (1877-1964), with instruments of local design. In 1930, the station was upgraded with Galitzin-Wilip seismographs. From 1964 to 1993, the station was directed by Ramón Cabré. The Observatory of S. Calixto has been one of the most reliable stations in South America (Cabrd, 1991; Coenraads, 1993). The first seismograph in Colombia was installed by Jesuits in 1923 in Bogotá. In 1941 the Instituto Geofisico de los Andes Colombianos (today the Instituto Geofisico, Universidad Javeriana) was founded by Jesus E. Ramirez (1904-1983). This soon became one of the best seismological research institutions in South America (Ramirez, 1977; Goberna, 1988). In *1962,* the stations of La Paz and Bogotá became WWSSN stations. Later La Paz became an HGLP-ASRO station (1972) and Bogotá became an SRO station (1973). This upgrade is a clear recognition of the work done by Jesuits in these two stations.

Other Jesuit seismographic stations in Cuba and Chile functioned only a few years. In 1940 a seismographic station was installed in St. George's College, Kingston, Jamaica, dependent on Weston Observatory. In Montreal, Canada, a seismographic station was installed in 1952 (Buist, 1983). The Montreal station was a modern station with WWSSN type instruments. It was the last new station installed under direct Jesuit auspices. Maurice Buist was its Director for 31 years until his retirement in 1983. In Ethiopia Haile Salassie invited the Jesuits to undertake the administration of the National University in Addis Ababa. Although not a Jesuit station in the strict sense, the associated Geophysical Observatory of Addis Ababa was directed by the Canadian Jesuit Pierre Gouin from 1957 to 1978. In 1962, a WWSSN seismographic station was installed.

THE JESUIT SEISMOLOGICAL ASSOCIATION

The history of the work of Jesuits in seismology in the United States is linked to the Jesuit Seismological Association (Macelwane, 1926, 1950). The first Jesuit to install a seismograph in the U.S. was Frederik L. Odenbach (1857-1933) in 1900 at John Carroll University, Cleveland, Ohio, with two seismoscopes of his own design. In 1908 Odenbach conceived the notion that the system of Jesuit colleges and universities distributed throughout the United States offered an opportunity to establish a network of similar seismographic stations. In 1906 the International Seismological Center had been established in Strasbourg, France, where data were centrally reported and epicenters determined. Odenbach envisioned a network of Jesuit stations that could contribute significant data to this international enterprise.

Odenbach sold the Presidents of the colleges and universities and the American Jesuit Provincial Superiors on the idea. In 1909 sixteen identical horizontal Wiechert seismographs of 80 kg mass were purchased in Germany and were distributed to fifteen colleges in the United States and one in Canada. A typical station was that of Georgetown (see Figure 2). These stations formed the Jesuit Seismological Service. Individual stations were to process their own seismograms and send the readings to the Central Station in Cleveland. The data would then be collated and forwarded to the International Seismological Center in Strasbourg. These stations, in effect, constituted the first seismological network of continental scale with uniform instrumentation.

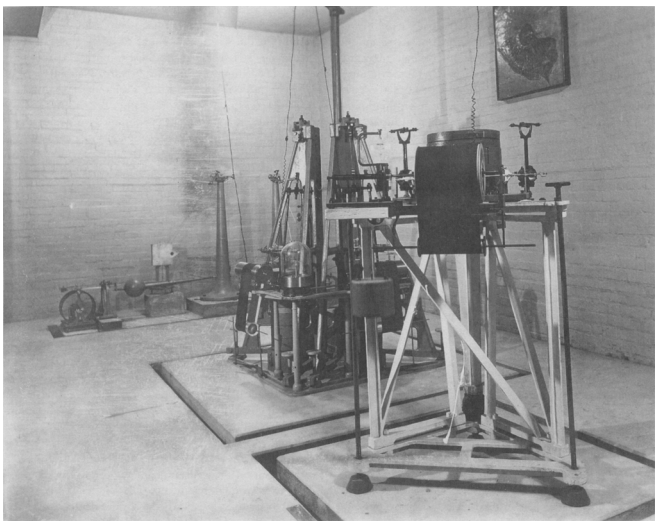


Figure 2. Instruments of the Georgetown seismographic station, about 1920. The Wiechert is on the right.

Many of the first stations, for a variety of reasons, floundered early, and the cooperative effort was never fully established. In 1925 James B. Macelwane (1883-1956) returned to Saint Louis University after completing his doctoral studies at the University of California. One of Macelwane's early efforts was to revitalize the Jesuit seismographic network. The impetus

to this came not only from his own interest but also from the urging of scientists of the National Research Council and the Carnegie Institution in Washington, and with the further encouragement of Sánchez Navarro-Neumann of the Spanish Observatory at Cartuja.

Thus, in the summer of 1925 the stations were reorganized into the Jesuit Seismological Association. The 14 member stations are indicated as JSA in Table 1. The Presidents of the Association have been J. B. Macelwane of Saint Louis University, 1925-1956; J. J. Lynch of Fordham University, 1957-1970; and D. Linehan of Weston Observatory, 1970-1986. W. Stauder of Saint Louis University has been President from 1986 to the present.

Saint Louis University became the Central Station in 1925. Through its recently established Department of Geophysics it became a resource for graduate education in seismology for a number of Jesuits who then returned as directors to their own institutions. The Central Station assumed as well the responsibility on behalf of the JSA of collecting data from member stations and from other stations around the world and of locating earthquake epicenters and publishing these to the worldwide seismological community. The Central Station continued this service until the early 1960s when, with the advent of computer determination of epicenters, it was discontinued as an unnecessary duplication of the determinations by the U.S. Coast and Geodetic Survey (later by the U.S. Geological Survey) in the United States and by other international agencies.

Most of the JSA seismographic stations continued in regular operation until relatively recent time. Florissant (Saint Louis), Weston, Georgetown, and Spring Hill became WWSSN stations in 1962. At present only Saint Louis and Weston continue as seismological research institutes. Both conduct active research programs and operate regional networks, and are members of IRIS, the Incorporated Research Institutes for Seismology. Saint Louis has installed a broadband station of the IRIS system at Cathedral Cave, Missouri and is deploying other similar broadband stations in the Midwest.

JESUIT SEISMOLOGISTS

From 1868, the approximate date of the installation of the first seismograph by the Jesuits in Manila, to the present many members of this religious order have dedicated their time and efforts to seismology. In this short article it is hardly possible to do more than mention even the most important of them. However, a few words must be said about those that occupy an important place in the history of seismology. We will mention only the work of past Jesuits, although at present there are still Jesuits actively working in seismology (e.g., L. Drake, presently at La Paz, P. Gouin in Montreal, W. Stauder in St. Louis, S. Su in Manila, R. Van Hissenhoven in Bogotá, and A. Udfas in Madrid).

The first Jesuit to be mentioned is Federico Faura, who published a study about the destructive Manila earthquakes of 1880 (Faura, 1880). In the paper he reproduced the records obtained by the instruments (seismoscopes) in the Observatory of Manila. Faura continued his interest in seismology, improving the seismological instrumentation of the Observatory and publishing a seismological bulletin. Beginning in 1877, Giovanni Egidi, director of the Observatory Tuscolano in Italy, collaborated with M. S. De Rossi in the seismological observations that were published in *Bullettinodel Vulcanismo Italiano* (Davison, 1927, p. 100).

Two Jesuits contributed very early to the study of the seismicity and seismotectonics of the Philippines and Spain. Manuel Saderra-Masó dedicated himself to the study of the seismicity of the Philippines, interpreting it in terms ofseismotectonic lines and relating it to the geological structure of the archipelago in a very early work of this type (Saderra-Masó, 1895). M. Sánchez Navarro-Neumann, Director of the Observatory of Cartuja, Spain, compiled the first modern earthquake catalogue of Spain and published numerous studies on the seismicity of that region (Sánchez Navarro-Neumann, 1917). He also published an early paper on the energy in earthquakes (Sánchez Navarro-Neumann, 1915).

The most renowned Jesuit seismologist (Figure 3; see front cover) was without doubt James B. Macelwane (Byerly and Stauder, 1958). Macelwane obtained his doctoral degree at the University of California, Berkeley, in 1923, with the first dissertation on a seismological topic in the United States. In 1925 he became the first Director of the Department of Geophysics at Saint Louis University and reorganized the Jesuit Seismological Association. Travel times of seismic waves, the constitution of the interior of the earth, and the nature of microseisms and their relation to atmospheric storms were a few of the topics of his research papers (e.g., Macelwane and Dahm, 1937; Macelwane, 1939; 1946). In 1936 he published the first textbook on seismology in America (Macelwane, 1936). In 1928-29 he was President of the Seismological Society of America and in 1953-56 of the American Geophysical Union. In 1944 he was elected to the National Academy of Sciences. Throughout his career Macelwane took an active part in the committees and commissions of these societies, as well as in projects of the National Research Council and the International Union of Geodesy and Geophysics. He was also always interested in promoting educational programs and in encouraging young geophysicists. For the latter reason, in 1962 the American Geophysical Union created a medal in his honor for recognition of significant contribution to the geophysical sciences by a young scientist of outstanding ability.

Two Jesuit students of Macelwane deserve to be mentioned. William C. Repetti (1884-1966) studied the interior of the earth from the travel times of body waves, inferring the existence of several discontinuities in its interior. In 1928 he joined the staff of the Manila Observatory where he assumed charge of the seismological section. Among other contributions he compiled a catalogue of earthquakes of the Philippines (Repetti, 1946). Jesus E. Ramirez (1904-1983) worked on the problem of microseisms and storms, designing a tripartite station system to track the center of tropical hurricanes. In 1941 he founded in Bogotá the Instituto Geofisico de los Colombianos, where he conducted and published a large number of studies of Colombian seismicity (Ramirez, 1967). He was a leading figure in the seismicity of South America.

J. Joseph Lynch (1894-1987) became Director of the Seismographic Station of Fordham University in 1920. This was the beginning of a long career as a seismologist that led to a variety of seismological studies, among them a field study of the Dominican Republic earthquake of 1946. He has left us a lively account of his involvement in seismology over a period of 50 years (Lynch, 1970). Daniel Linehan (1904-1987) was Professor of Geophysics and Director of Weston Observatory for 32 years. A prolific writer in many aspects of seismology, he dedicated himself especially to seismic exploration. In 1950 he carried out, accompanied by Lynch, a shallow seismic exploration survey under St. Peter's Basilica in Rome for archeological purposes. He participated in three expeditions to the Antarctic, one to the Arctic, and several UNESCO seismological missions in Africa, Asia and South America. Two other Jesuits participated in separate expeditions to the Antarctic during the International Geophysical Year: Edward Bradley of Xavier University, Cincinnati, and Henry Birkenhauer of John Carroll University, Cleveland.

Of European Jesuit seismologists, Richard E. Ingram (1916-1967), Director of Rathfarnham Castle, Ireland merits mention for his theoretical papers (Ingram, 1963).

Among the different topics in seismology, the study of microseisms attracted the special interest of Jesuit seismologists. We have already mentioned the work of Macelwane and Ramirez, with a first paper in 1935. Probably the first suggestion of the relation between microseisms and storms was made by Josd Algue (1859-1930), Director of Manila Observatory, as early as 1894 in his study of Philippine Islands typhoons (Deppermann, 1951). Ernesto Gherzi (1886-1976), Director of Zikawei Observatory, published several papers on the relation between microseisms and atmospheric conditions (Gherzi, 1924). In 1952 a seminar was organized by the Pontifical Academy of Sciences on the problem of microseisms in which Gherzi, Macelwane, and Due-Rojo (Cartuja) participated, along with a select group of other specialists (Pontifical Academy of Sciences publication, 1952).

Jesuits participated in the early stages of the organization of seismological associations. R. Cirera (1864-1932), first Director of Ebro Observatory represented Spain as one of two delegates in the second meeting of the International Seismological Conference in 1903 in Strasbourg (Rothe, 1981). Three Jesuits, Berloty (Ksara), Sfinchez Navarro-Neumann (Cartuja) and Stein (Vatican) were present at the first General Assembly of the International Association of Seismology in the Hague in 1907. Jesuits have participated actively in the International Association of Seismology and the Physics of the Earth's Interior since its establishment in 1922 as part of the International Union of Geodesy and Geophysics (IUGG).

Jesuits have had a special relation with the Seismological Society of America. One of the 13 participants at the first meeting for its founding in 1906 was Jerome S. Ricard (1850-1930), Director of Santa Clara Observatory, who was elected a member of the first Board of Directors (Byerly, 1964). J. B. Macelwane also served on the Board from 1925 to 1956 and was elected President of the Society in 1928. W. Stauder served on the Board from 1962 to 1967 and was President in 1966. Several Jesuits have been Chairman of the Eastern Section of the Seismological Society of America: J.B. Macelwane, *1926* (first Chairman); J.J. Lynch, 1930; V.C. Stechschulte, 1933; D. Linehan, 1954; V. Blum, 1955; H. Birkenhauer, 1956; and W. Stauder, *1963.* For many years the Jesuit Seismological Association met jointly with the Eastern Section. In 1937, for example, at the joint meeting in St. Louis, of 22 participants 9 were Jesuits (see Figure 4), in 1948 at the meeting in Cleveland of 29 participants 8 were Jesuits, and in 1961 at the joint meeting in Cincinnati, of more than 80 participants 9 were Jesuits.

CONCLUSION

As we have seen, Jesuits contributed to organizational, experimental, and theoretical aspects of seismology. Their principal contribution has been providing seismological data for research into the constitution of the earth and the processes of generation of earthquakes. To accomplish this more effectively, Jesuit stations regularly endeavored to update the quality of their instrumentation (Table 1). This was particularly of significance in the early times, between 1910 and 1960, when the number and quality of seismological stations worldwide was rather limited. Jesuit stations in South America, Africa and Asia were particularly important in those early times. In some instances, they were the only reliable stations in a region for many years. Establishment of modern national seismological networks and research institutions has made their work no longer necessary and explains the closing of many Jesuit stations.

The reporting of data has been a service of Jesuit observatories. Although many of the stations have been closed, those still active keep up this tradition. But more and more, the contributions of Jesuits to this now very modern and developed science are through the research centers, principally Saint Louis University, Weston Observatory, Instituto Geofisico (Bogota), Observatorio de S. Calixto (La Paz) and Manila Observatory. There are also contributions by individual Jesuits associated with Jesuit stations or working in or with other institutions or associations. They have continued to play an important part in the development of the theory of plate tectonics, the study of the deep constitution of the earth, the mechanism of earthquakes and in the earthquake hazard reduction programs of their various national efforts and cooperative international initiatives. They do indeed, stand even today, in the tradition of the early Jesuit pioneers.

Figure 4. Participants in the joint meeting of the Eastern Section of the Seismological Society of America and the Jesuit Seismological Association held in St. Louis, 1937. Left to right, *First row.* Anthony J. Westland, S.J., Archie Blake, Ernest A. Hodgson, Capt. Nicholas H. Heck, James B. Macelwane, S.J., J. Joseph Lynch, S.J. *Second row."* J. Emilio Ramirez, S.J., Alphonse R. Schmitt, S.J., Louis B. Schlichter, Alton C. Chick. *Third row.* H. M. Rutherford, Florence Robertson, Paul Weaver, ?, Victor C. Stechschulte, S.J., Theodore Zegers, S.J. *Fourth row:* Daniel Linehan, S.J., Albert J. Frank, Arthur C. Ruge, Msgr. Joseph A. Murray, John P. Delaney, S.J., Ross Heinrich.

In order to preserve a recognition of the contribution of Jesuits to this science, in 1989 the Jesuit Seismological Association approached the Eastern Section of the Seismological Society of America with the offer to fund the establishment of an award to honor an individual who has contributed notably to observational seismology. The Eastern Section accepted the proposal in 1991. The award is now conferred annually and bears with it a plaque and a small monetary prize.

REFERENCES

Buist, M. (1983). L'Observatoire de Geophysique, *Bulletin de Geo-physique,* College Jean de Brebeuf, Montreal.

Byerly, E (1964). History of the Seismological Society of America, *Bull. Seism. Soc. Am.,* 54, 1,723-1,741.

Byerly, E and W. Stauder (1958). James B. Macelwane, S.J., *Biograph. Memoirs Nat. Acad. of Sciences,* 31,254-281.

Cabrd, R. (1988). 75 afios en la vanguardia de la sismologia, *Revista Geoflsica,* 29, 1-3.

Coenraads, R. R. (1993). The San Calixto Observatory in La Paz, Bolivia, eighty years of operation, Director Dr. L. Drake, S.J., *Jour. and Proceed. Roy. Soc. of New South Wales,* 126, 191-198.

Davison, C. (1927). *The Founders of Seismolog~* Cambridge University Press.

Deppermann, C. E. (1951). Father José Algué and microseisms, *Bull. Seism. Soc. Am.,* 41,301-302.

Doyle, H. and R. Underwood (1965). Seismological stations in Australia, *Australian Jour. of Science,* 28, 40-43.

Drake, L. A. (1980). Riverview Observatory, in *St. Ignatius" Centennial 1880-1980* (C. Fracer and E. Lea Scarlett, eds.), St. Ignatius College, Lane-Cove NSW, 210-214.

Egidi, G. (1888). *Applicazioni delle asta vibranti e oscillanti alle osservazioni dei moti sismici,* Roma.

Gherzi, E. (1950). Etude sur les microsdismes, *Observatory of Zikawei, Notes Seismologiques,* 5, 1-16.

Gherzi, E. (1950). The scientific work of the Catholic Church at the Zikawei Observatory in Shanghai, *Int. Portugues de Hongkong, 3,* 435-57.

Goberna, R. (1988). The historical seismograms of Columbia, in *Historical Seismograms and Earthquakes of the World* (W. K. Lee, H. Meyers and R. Shimazaki, eds.), Academic Press, N.Y., 467-473.

Heck, N. H. (1944). The Jesuit contribution to seismology in the U.S.A., *Thought,* 19, 221-228.

Ingram, R. E. (1963). Focal mechanism of couples without moment, *Bull. Seism. Soc. Am.,* 53, 817-820.

Linehan, D. (1970). Jesuits in seismology, *Earthquake Information Bull.,* 2, 14-17.

Linehan, D. (1984). Jesuits in seismology, *Earthquake Information Bull.,* 16, 156-165.

Lynch, J. J. (1970). *Watching our Tembling Earth for 50 Years,* Dodd, Mead and Co., New York.

Macelwane, J. B. (1926). The Jesuit seismographic stations in the United States and Canada, a retrospect, *Bull. Seism. Soc. Am.,* 16, 187-193.

Macelwane, J. B. (1936). *Introduction to Theoretical Seismology Part L Geodynamics,* Wiley, New York, 336 pp.

Macelwane, J. B. (1939). Evidence of the interior of the earth derived from seismic sources, in *Internal Constitution of the Earth,* McGraw Hill, New York, 219-290.

Macelwane, J. B. (1946). Storms and the origin of microseisms, *Annales de Geophysique,* 2, 281-289.

Macelwane, J. B. (Ed., 1950). *Jesuit Seismological Association, 1925-1950, Twenty-fifth Anniversary Commemorative Volume,* Saint Louis University, 347 pp.

Macelwane J. B., and C. G. Dahm (1937). Revised travel-time tables, *Publ. Bureau Central Seism. Int. Series A, Trav. Scientifique,* 15, 38.

Murphy, T. (1995). *A Treatise on the Seismology Observatories of Mungret and Rathfarnham,* (MS), Ireland.

Ramirez, J. E. (1967). Historia de los terremotos en Colombia, *Bol. Bibl. de Geof. y Ocean. Am.,* 4, 1-146.

Ramirez, J. E. (1977). *Historia del Instituto Geofisico al Conmemorar sus 35 anos,* Universidad Javeriana, Bogotá.

Repetti, W. C. (1946). Catalogue of Philippine earthquakes, *Bull. Seism. Soc. Am.,* 36, 133-322.

Rothé, J. P. (1981). Fifty years of history of the International Association of Seismology (1901-1951), *Bull. Seism. Soc. Am.,* 71,905-923.

Saderra-Mas6, M. (1895). *La Sismologia en Filipinas,* Imp. Ramirez, McCullough, Manila.

Saderra-Mas6, M. (1915). *Historia del Observatorio de Manila, 1865-1915,* McCullough, Manila.

Saderra-Masó, M. and W. D. Smith (1913). The relation of seismic disturbances in the Philippines to the geological structure, *Bull. Seism. Soc. Am.,* 3, 151-186.

Sánchez Navarro-Neumann, M. N. (1915). Travail produit par un tremblement de terre, *Boll. della Soc. Sism. Italiana,* 34, 87-89.

Sánchez Navarro-Neumann, M. N. (1919). Ensayo sobre la sismicidad del suelo espafiol, *Bol. R. Soc. Historia Natural,* 13, 83-108.

Sánchez Navarro-Neumann, M. N. (1928). La estacion sismologica de Cartuja y su labor cientifica, 1903-1928, *Razon y Fe,* 27, 115.

Sánchez Navarro-Neumann, M. N. (1928). Actual cooperación de la Compafiia de Jesus a los estudios sismológicos, *Iberica,* 15, 58-62.

Sáchez Navarro-Neumann, M. N. (1937). Os Jesuitas e a sismologia, *Broteria,* 24, 145-151.

Su, S. (1988). Historical seismograms of the Manila Observatory, in *Historical Seismograms and Earthquakes of the World* (W. K. Lee, H. Meyers, and K. Shimazaki, eds.), Academic Press, New York, 490-496.

Geophysics Department
Physical Sciences Faculty
Universidad Complutense
2804 Madrid
Spain
(A.U.)

St. Louis University
Office of the Academic Vice President
221 North Grand Boulevard
St. Louis, MO 63103
(W.S.)


ΑΣΚΗΣΕΙΣ
ΓΕΩΜΕΤΡΙΑΣ
EXERCICES
DE GEOMETRIE

(σ.εκδ. Οι παλαιοί θα θυμούνται τις ασκήσεις Γεωμετρίας των Ιησουιτών, που διαβάζαμε για τις εισαγωγικές στο Πολυτεχνείο)

17 Equations That Changed the World
by Ian Stewart

1.	**Pythagoras's Theorem**	$a^2 + b^2 = c^2$	Pythagoras,530 BC
2.	**Logarithms**	$\log xy = \log x + \log y$	John Napier, 1610
3.	**Calculus**	$\frac{\mathrm{d}f}{\mathrm{d}t} = \lim_{h \to 0} = \frac{f(t+h) - f(t)}{h}$	Newton, 1668
4.	**Law of Gravity**	$F = G\frac{m_1 m_2}{r^2}$	Newton, 1687
5.	**The Square Root of Minus One**	$i^2 = -1$	Euler, 1750
6.	**Euler's Formula for Polyhedra**	$V - E + F = 2$	Euler, 1751
7.	**Normal Distribution**	$\Phi(x) = \frac{1}{\sqrt{2\pi\rho}} e^{\frac{(x-\mu)^2}{2\rho^2}}$	C.F. Gauss, 1810
8.	**Wave Equation**	$\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$	J. d'Almbert, 1746
9.	**Fourier Transform**	$f(\omega) = \int_{\infty}^{\infty} f(x) e^{-2\pi i x \omega} \mathrm{d}\,x$	J. Fourier, 1822
10.	**Navier-Stokes Equation**	$\rho\left(\frac{\partial \mathbf{v}}{\partial t} + \mathbf{v} \cdot \nabla \mathbf{v}\right) = -\nabla p + \nabla \cdot \mathbf{T} + \mathbf{f}$	C. Navier, G. Stokes, 1845
11.	**Maxwell's Equations**	$\nabla \cdot \mathbf{E} = 0$ $\quad \nabla \cdot \mathbf{H} = 0$ $\nabla \times \mathbf{E} = -\frac{1}{c}\frac{\partial \mathbf{H}}{\partial t}$ $\quad \nabla \times \mathbf{H} = \frac{1}{c}\frac{\partial E}{\partial t}$	J.C. Maxwell, 1865
12.	**Second Law of Thermodynamics**	$\mathrm{d}S \geq 0$	L. Boltzmann, 1874
13.	**Relativity**	$E = mc^2$	Einstein, 1905
14.	**Schrodinger's Equation**	$ih\frac{\partial}{\partial t}\Psi = H\Psi$	E. Schrodinger, 1927
15.	**Information Theory**	$H = -\sum p(x) \log p(x)$	C. Shannon, 1949
16.	**Chaos Theory**	$x_{t+1} = kx_t(1 - x_t)$	Robert May, 1975
17.	**Black-Scholes Equation**	$\frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} + \frac{\partial V}{\partial t} - rV = 0$	F. Black, M. Scholes, 1990

ΝΕΑ ΑΠΟ ΤΙΣ ΕΛΛΗΝΙΚΕΣ ΚΑΙ ΔΙΕΘΝΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΝΩΣΕΙΣ

International Society for Soil Mechanics and Geotechnical Engineering

ISSMGE News & Information Circular May 2021
www.issmge.org/news/news-and-information-circular-may-2021

1. ISSMGE REGIONAL VICE-PRESIDENTS 2022-2026

The ISSMGE is pleased to announce the names of the regional vice-presidents for the next term (2022 -2026). They are:

Africa: Dr Marawan Shahin (Egypt)
Asia: Professor Keh-Jian Shou (Chinese Taipei)
Australasia: Mr Graham Scholey (Australia)
Europe: Professor Lyesse Laloui (Switzerland)
North America: Mr Walter Paniagua (Mexico)
South America: Professor André Pacheco de Assis (Brazil)

2. 20ICSMGE / 7iYGEC NEW DATES MAY 2022

New dates have been confirmed for the conferences in Sydney as follows;

7iYGEC - Friday 29 April-Sunday 1 May 2022
20ICSMGE Sunday 1 May Thursday 5 May 2022.

For more information, please visit the conference website (https://icsmge2021.org/) which is in the process of being updated.

3. CORPORATE ASSOCIATES PRESIDENTIAL GROUP

The March 2021 CAPG update (https://www.issmge.org/corporate-associates/corporate-associates-presidential-group) has important information on the soon upcoming CAPG speciality session at the International Foundations Conference and Equipment Expo (IFCEE), in Dallas, USA, May 10 -14, 2021, the CAPG sessions at the 20th ICSMGE in Sydney (May 2022), the successful completion of the world wide online sessions for the ISSMGE Overdesign Survey, planning of CAPG contributions to the ISSMGE virtual Time Capsule project and other important areas.

4. NEW WEBINAR

Experiences in Sustainable Geotechnics, delivered by Prof. Nilo Consoli, is a new webinar now available from the ISSMGE website.

5. ISSMGE TC217 LAND RECLAMATION SEMINAR SERIES

The committee of TC217 is hosting a trilogy of online seminars on topics relating to land reclamation from consultant, specialist contractor and academic perspectives. Please register your interest to attend these seminars here: https://forms.gle/QLPkWYzFquxbqJPz7

Seminar Programme:

- Land Reclamation using Soft Clay by Prof. Chu Jian - 20 May 2021, 7pm (GMT+8)

- Application of Machine Learning in Cement Stabilisation in Land Reclamation by Assoc. Prof. Darren Siau Chen Chian - 20 May 2021, 7:30pm (GMT+8)

6. 3rd HUTCHINSON LECTURE - 3rd JTC WORKSHOP NORWAY, 2022 CALL FOR PROPOSALS

The Joint Technical Committee (JTC1) on Natural Slopes and Landslides of the Federation of the International Geo-engineering Societies (FedIGS) is organizing the 3rd JTC1 workshop, which will be held in Norway in Spring, 2022; the provisional title of the event is Landslide initiation, prediction and risk mitigation.

The workshop will host the 3rd Hutchinson Lecture, which has been established by the same JTC1 to award a scholar, aged 42 or less at the time of the event, who has significantly contributed to the development of knowledge in the field of slope stability and landslides. The Hutchinson Lecture should deal with a subject consistent with the workshop issues. The lecture will be published in an international journal.

The Hutchinson lecturer, who should have a disciplinary background from one or more of the domains of the geosciences, will be chosen - by vote of JTC1 Committee members - among candidates proposed by national societies. All countries are then asked to propose their own candidate. The proposals, accompanied by the candidate CV, should be submitted to the JTC1 chairman, Luciano Picarelli, by September 15th 2021 (luciano.picarelli@unicampania.it) .

7. BULLETIN

The latest edition of the ISSMGE Bulletin (Volume 15, Issue 2, April 2021) is available from the website https://www.issmge.org/publications/issmge-bulletin/vol-15-issue-2-april-2021

8. ISSMGE FOUNDATION

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

9. 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 events 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 previous Circular:

ISSMGE Events

THE SECOND INTERNATIONAL CONFERENCE ON PRESS-IN ENGINEERING 2021, ONLINE - 19-06-2021 - 20-06-2021 ONLINE, Japan; Languages: English and Japanese; Organiser: International Press-in Association (IPA); Contact person: ICPE2021 Organizing Committee; 5F, Sanwa Konan Bldg, 2-4-3 Konan, 2-4-3 Konan, Minato-ku, Phone: +81-(0)3-5461-1191, Fax: +81-(0)3-5461-1192, Email: tokyo@press-in.org; Website: http://icpe-ipa.org; Email: icpe2021@gmail.com

ASIAFUGE 2021 SINGAPORE - 18-11-2021 - 19-11-2021 NUS UTown Campus, Singapore; Language: English; Organiser: Geotechnical Society of Singapore (GeoSS) & National University of Singapore (NUS); Contact person: Assoc Prof Darren Chian, Address: National University of Singapore, Email: sc.chian@nus.edu.sg, Website: https://www.asiafuge-sg.com/

FIFTH INTERNATIONAL CONFERENCE ON NEW DEVELOPMENTS IN SOIL MECHANICS AND GEOTECHNICAL ENGINEERING 30-06-2022 - 02-07-2022 Atatürk Cultural and Congress Center Near East University, Nicosia, Cyprus; Language: English; Organiser: Turkish Society of Soil Mechanics and Geotechnical Engineering and Near East University; Contact person: Cavit ATALAR; Address: Near East Boulevard; Phone: 05338342829; Fax: 00903922236461; Email: cavit.atalar@neu.edu.tr; Website: http://zm2020.neu.edu.tr;

17TH ASIAN REGIONAL GEOTECHNICAL ENGINEERING CONFERENCE - 14-08-2023 - 18-08-2023 Nur-Sultan, Kazakhstan; Language: English; Organiser: Kazakhstan Geotechnical Society; Contact person: Ms. Bibigul Abdrakhmanova, Address: 2, Satpayev Street, Eurasian National University, Geotechnical Institute, Phone: +7-7172- 344796, Fax: +7-7172-353740, Email: bibakgs@gmail.com; Email: milanbi@mail.ru

NON-ISSMGE Events

LECTURE-1 ON MSE WALLS (2ND EDITION OF AGERP LECTURE SERIES) - 16-04-2021 - 31-12-2021 Online (Zoom), Brisbane, Australia; Language: English; Organiser: AGERP Lecture Series; Contact person: Dr. Partha Mishra and Professor Sarat Das, Convenor, AGERP Lecture Series; Email: hello.agerp@gmail.com; Website: http://www.age-rp.com

DFI DEEP MIXING CONFERENCE 2021 AN ONLINE CONFERENCE - 01-06-2021 - 17-06-2021 Online, United States; Language: English; Organiser: Deep Foundations Institute; Contact person: Angie Gibble, Address: 326 Lafayette Ave, Phone: 9734234030, Email: agibble@dfi.org, Website; http://www.dfi.org/DM2021; Email: events@dfi.org

16TH INTERNATIONAL CONFERENCE OF THE INTERNATIONAL ASSOCIATION FOR COMPUTER METHODS AND ADVANCES IN GEOMECHANICS IACMAG - 30-08-2022 - 02-09-2022 Politecnico di Torino Conference Centre, Italy; Language: English; Organiser: Politecnico di Torino; Contact person: Symposium srl, Address: via Gozzano 14; Phone: +390119211467; Email: info@symposium.it; Email: marco.barla@polito.it;

International Journal of Geoengineering Case Histories

62,163 paper downloads in 2020 for the ISSMGE International Journal of Geoengineering Case Histories!

The ISSMGE International Journal of Geoengineering CaseHistories is proud to announce that 62,163 papers were downloaded in 2020.

The International Journal of Geoengineering Case Histories is an official journal of the International Society for Soil Mechanics and Geotechnical Engineering, the premier scientific organization for geotechnical engineering worldwide. The Case Histories Journal covers the broad area of practice in geotechnical engineering (soils and rocks), including geotechnical earthquake engineering, environmental geotechnics and engineering geology, and energy geo-construction with a focus on careful documentation of case histories and emphasis on observations and data collected during and after project construction.

Papers published in this refereed journal are freely available in color and are accompanied by databases that include the electronic data presented in the paper as well as additional figures (as necessary). The locations of the case histories are also positioned in the IJGCH Geographic Database.

The open access vision of the journal is aimed to better serve the professional community. All papers are immediately downloadable by visitors and accessed through Google Scholar and Georef index index databases. The more than 62,000+ paper downloads in 2020 speaks volumes about the impact of the journal.

Below, you can find the list of the top 10 papers downloaded from the International Journal of Geoengineering Case Histories in 2020:

1. Xenaki, V., Doulis, G., Athanasopoulos, G. (2016). Geotechnical Design of Embankment: Slope Stability Analyses and Settlement Calculations. International Journal of Geoengineering Case Histories, Vol. 3, Issue 4, p.246-261. (2,235 downloads – 9,318 downloads since 2017)

2. Jafari, N. H., Stark, T. D., and Merry, S. (2013). The July 10 2000 Payatas Landfill Slope Failure. International Journal of Geoengineering Case Histories, Vol.2, Issue 3, p.208-228. (2,046 downloads – 7,954 downloads since 2017)

3. Rutherford C.J., Biscontin G., Koutsoftas D., Briaud J.L. (2007). Design Process of Deep Soil Mixed Walls for Excavation Support. International Journal of Geoengineering Case Histories, Vol.1, Issue 2, p.56-72. (1,971 downloads – 8,205 downloads since 2017)

4. Burland J.B., Jamiolkowski M.B., Viggiani C., (2009). Leaning Tower of Pisa: Behaviour after Stabilization Operations. International Journal of Geoengineering Case Histories, Vol.1, Issue 3, p.156-169. (1,704 downloads – 9,619 downloads since 2017)

5. Dhar, A. S., Siddique, A., Ameen, S. F. (2011). Ground Improvement using Pre-loading with Prefabricated Vertical Drains. International Journal of Geoengineering Case Histories, Vol. 2, Issue 2, p.86-104. (1,475 downloads – 6,710 downloads since 2017)

6. Briaud J-L., Smith B., Rhee K-Y., Lacy H., Nicks J., (2009) The Washington Monument Case History. International Journal of Geoengineering Case Histories, Vol.1, Issue 3, p.170-188. (1,464 downloads – 6,302 downloads since 2017)

7. Shirode, N. P., Birid, K. C., Gandhi, S. R., Nair, R. (2017). Uplift of an Underground Tank in Northern Malabar Region, India. International Journal of Geoengineering Case Histories, Vol. 4, Issue 2, p.134-146. (1,248 down-loads – 3,816 downloads since 2017)

8. Goh, K.H., Ng, S.S.G., and Wong, K.C. (2016). Case Histories of Bored Tunnelling Below Buildings in Singa-pore Downtown Line. International Journal of Geoengineering Case Histories, Vol.3, Issue 3, p.149-161. (1,197 down-loads – 5,629 downloads since 2017)

9. Mayne, P. W. (2005). Unexpected but foreseeable mat settlements on Piedmont residuum. International Journal

of Geoengineering Case histories, Vol.1, Issue 1, p.5-17. (1,159 downloads – 5,805 downloads since 2017)

10. Cham, W. M. (2016). Singapore Case Histories on Performance of Piles Subjected to Tunnelling-Induced Soil Movement. International Journal of Geoengineering Case histories, Vol. 3, Issue 3, p.128-148. (1,142 downloads – 5,099 downloads since 2017)

The open access scope of the Journal is supported by the following forward-looking organizations: Shamsher Prakash Foundation, DarGroup, Geosyntec Consultants and ConeTec. Our sponsors make possible the circulation of the journal to thousands of readers at no cost.

The ISSMGE International Journal of Geoengineering Case Histories is a great place to publish case histories and make sure professionals globally read them! Please consider the ISSMGE International Journal of Geoengineering Case Histories as a high impact means to disseminate your work.

https://www.geocasehistoriesjournal.org/announcements/62163-paper-downloads-in-2020-for-the-issmge-international-journal-of-geoengineering-case-histories/

ISRM International Society for Rock Mechanics and Rock Engineering

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

New ISRM course on Rock Mass Characterization and Monitoring based on Advanced Remote Sensing Techniques on the ISRM website 2021-05-03

The new ISRM course on "Rock Mass Characterization and Monitoring based on Advanced Remote Sensing Techniques" coordinated by Prof. Leandro Alejano is available on the ISRM website in open access.

New ISRM Suggested Method Video 2021-05-10

A video of the Suggested Methods for Determining Direct Tensile Strength of Rock Materials (Part 1) was published.

ASSOCIATION INTERNATIONALE DES TUNNELS ET DE L'ESPACE SOUTERRAIN ITA AITES INTERNATIONAL TUNNELLING AND UNDERGROUND SPACE ASSOCIATION

LUNCHTIME LECTURE SERIES #5

As part of our lunchtime lecture series, we are pleased to announce that the fifth instalment will be on "**Automation in Tunnel Construction**".

Tue, June 8, 2021, 13:00 - 14:30 (CET)

This episode will be an introduction to automation in tunnel construction and will feature 3 lectures:

- An overview of automation in tunnel construction - Mike Mooney (Colorado School of Mines)
- Automation in conventional tunnelling - Tom Frode Hansen (NGI)
- Automation in mechanised tunnelling, an example from Kuala Lumpur - Ng Hau Wei (Gamuda)

The session will finish with a Q&A involving all speakers.

We will also be joined by an ITA Young Member for this session who will be co-hosting the session.

To sign up for a free subscription, please click on https://www.itacet.org/session/lunchtime-lecture-series-5

Scooped by ITA-AITES #43, 11 May 2021

Tunnel boring machine launched at City Rail Link in Auckland | New Zealand

Strait of Gibraltar underwater railway tunnel project coming back to life | Spain & Morocco

'331 km tunnel projects to be finished by 2026'| India

Construction of 180-ft. long tunnel underneath Temple Square reaches end | United States of America

Work starts on first disposal tunnel at Finnish repository

Plans for Australia's massive tunnel project | Australia

Pune metro rail completes underground tunnel across Mutha river | India

Third Line of Sofia Underground Extended to Gorna Banya | Bulgaria

Blue Mountains may set road tunnel record | Australia

Advance record at the Brenner Base Tunnel | Italy

ITA launches survey into precast concrete segmental lining damage

Study shows best route for Del Mar train tunnel | United States of America

Scooped by ITA-AITES #44, 25 May 2021

Boring machines finish digging Melbourne's Metro Tunnel | Australia

Construction of mountain tunnel starts in July | The Philippines

[Work on 14.15 km Zojila tunnel going on smoothly | India]

[How To Dig A Tunnel]

[New milestone achieved for Brisbane's Cross River Rail tunnel | Australia]

[Obituary - Niko Kleuters 1954 - 2021]

[Micro Tunnel Boring Machine lowers into shaft to begin first tunnelling for Watercare's groundbreaking Central Interceptor project | New Zealand]

[Investment in Delta tunnel, Sites Reservoir will ensure water supply | United States of America]

[ITA launches its seventh tunnelling awards]

[National Grid begins 32.5km tunnelling project under London | UK]

[Quebec City tunnel beneath St. Lawrence River to cost $7B, take 10 years to build | Canada]

[Florence the Machine! HS2 tunnelling monster named after famous nurse begins 10-mile burrow | UK]

www.britishtunnelling.org.uk

Hinkley Point C Nuclear Power Station Tunnelling and Marine Project

TBMs, Primary/Secondary lining & the Heads

Lecture will be broadcasted live on YouTube
Thursday 17th June 2021 at 18:00 hrs [UTC+1]
https://youtu.be/z0Ex7ZdAv

Speakers

Patrick Brady - Temporary Works Manager, Balfour Beatty
Matt Fowler - Site Agent, Balfour Beatty

The main cooling water supply for the Hinkley Point C nuclear power station will be fed from four intake head's which will be located on the seabed of the Bristol Channel. The water will travel along long 2 separate segmentally lined tunnels into the power plant completing its loop by returning to sea via a third tunnel. Onshore, the tunnelling construction works include 3 shafts, 8 primary lined tunnels and a number of complex secondary lined structures.

In this lecture, Pat & Matt will discuss the many engineering challenges faced in the construction of these works and how the team overcame unique logistical challenges, difficult ground conditions and challenging weather to build the Head's and the tunnels to nuclear standards throughout the global pandemic.

Thames Tideway Tunnel
Victoria Embankment Foreshore
Using 3 techniques to sink a 55m deep Shaft in the Thames

Lecture will be broadcasted live on YouTube
Thursday 10th June 2021 at 12:00 hrs [UTC+1]
https://youtu.be/nEraYOwb9AY

Speakers

Florin Edu – Site Agent, Barhale

Ala Hammad – Sub-Agent, Strabag (Previously: Construction Engineer, Tideway)

The overall Tideway scheme is a significant new combined sewage storage and transfer system that shall help protect the River Thames by tackling the problem of overflows from the capital's Victorian sewers. The main tunnel, a major component of the system, shall run from Acton in west London to Abbey Mills Pumping Station in east London; controlling the most polluting combined sewer overflows (CSOs) by intercepting, storing and conveying the discharges, which currently flow into the river. Victoria Embankment Foreshore site is one of 27 Thames Tideway Tunnel sites. Located in the heart of London on the River Thames, it is one of the most

visible sites creating a vital connection to our new 25km tunnel.

The presentation will detail the methodology used to sink the 55m deep 15m diameter drop shaft using pre-cast concrete segments, including caisson & underpinning sinking methodologies, followed by sprayed concrete lining (SCL) to formation level.

The presenters will also briefly highlight the subsequent shaft activities including the installation of the shaft permanent base slab, waterproofing and cast-insitu concrete shaft secondary lining hydraulic jumpform system.

Each year the ICE Publishing Awards celebrate authors from both industry and academia who have produced work judged by their peers to be of exceptional quality and benefit to the civil engineering, construction and materials science community.

This year's authors come from around the world and in their papers discuss problems civil engineers are working on to ensure sustainable development including renewable energy, low emission transport, resource management and safety.

Each paper is free to view on ICE Virtual Library in perpetuity as part of our commitment to furthering knowledge and best practice.

Each year a few papers are chosen to be part of our Thomas Telford Prestige Paper Lecture Series. 2020 winners were presented online in 2021, recordings are available to view on our YouTube channel.

Telford Gold Medal - Best paper overall An effective stress analysis for predicting the evolution of SCR–seabed stiffness accounting for consolidation; Zefeng Zhou, Conleth D. O'Loughlin and David J. White, *Géotechnique*

Overseas Prizes (Mokshagundam Visvesvaraya Award) – Best papers written by overseas authors or covering an overseas project

Howrah Bridge: icon of a 330-year-old city in India – part I: history, planning and design; Amitabha Ghoshal, *Engineering History and Heritage*

Manby Prize – Best paper that covers ICT/GIS/BIM in its broadest sense

Great Western railway electrification, UK: the key role of building information modelling; John Nolan, *Civil Engineering*

David Hislop Award (also known as the Offshore award)

Full-scale observations of dynamic and static axial responses of offshore piles driven in chalk and tills; Roisin M. Buckley, Richard J. Jardine, Stavroula Kontoe, Pedro Barbosa and Felix C. Schroeder, *Géotechnique*

Telford Premium

A reformulated hardening soil model; Thomas A. Bower, Anthony D. Jefferson and Peter J. Cleall, *Engineering and Computational Mechanics*

The Ordsall Chord, UK: conservation architecture and engineering – part 1: project overview; Brian Duguid, Bernadette Bone and Jutinder Birdi, *Engineering History and Heritage*

Bank Buildings, Belfast, UK: making safe after a fire; Tim Lohmann and John McClafferty, *Forensic Engineering*

Wheel tracker testing of recycled concrete and tyre aggregates in Australia; Arul Arulrajah, Farshid Maghool, Alireza Mohammadinia, Mehdi Mirzababaei and Suksun Horpibulsuk, *Geotechnical Research*

Development of inter-particle friction in a railway ballast; C. P. Y. Wong and M. R. Coop, *Géotechnique Letters*

Site investigation and performance of radial deep consolidation grouting in soft soil; Mario Vicente Riccio Filho, Alessando Cirone, Marcio de Souza Soares de Almeida, Tatiana Tavares Rodriguez and Daniel de Andrade Faria, *Ground Improvement*

Development of a fault simulator for soils under large vertical stress in a centrifuge; Jiro Takemura, Chaofan Yao and Osamu Kusakabe, *International Journal of Physical Modelling in Geotechnic*

Listening for deterioration and failure: towards smart geotechnical infrastructure; Alister Smith and Neil Dixon, *Smart Infrastructure and Construction*

Assessing the impact of resource efficiency on selected case studies in Ireland; Jan Göttsche and Mark Kelly, *Waste and Resource Management*

Coopers Hill War Memorial Prize

Temporary works for demolition of Earls Court Exhibition Centre in London, UK; Tomasz Mochol and Stuart Vaughan, *Civil Engineering*

Crampton Prize

Influence of the features of the unsaturated zone on the air injection method in a slope; Wei Xie, Hongyue Sun, Zhenlei Wei, Yuequan Shang and Xin Yan, *Geotechnical Engineering*

Environmental Engineering and Science Prize

Reclaiming historic landfill sites for residential development: a UK case study; Duncan I Scott, Michael Longman and Steve Wilson, *Journal of Environmental Engineering and Science*

Environmental Geotechnics Prize

State of the in situ Febex test (GTS, Switzerland) after 18 years: a heterogeneous bentonite barrier; María Victoria Villar, Rubén J Iglesias and José Luis García-Siñeriz, *Environmental Geotechnics*

Geotechnical Research Medal

Adhesion-force micro-scale study of desiccating granular material; Tomasz Hueckel, Boleslaw Mielniczuk and Moulay Said El Youssoufi, *Géotechnique*

James Hill Prize

Improved underground utilities asset management – assessing the impact of the UK utility survey standard (PAS128); Nicole Metje, Aryan Hojjati, Anthony Beck, Christopher D. F. Rogers, *Municipal Engineer*

Rees Jeffreys Award (Highways Prize)

West Anglia main line upgrade – a geotechnical perspective; Vincent Nyambayo, Naveena Chandrashekharaiah, Chris Gray, Danielle Allum, Evans Koka and Michael Asare, *Transport*

(https://www.icevirtuallibrary.com/page/authors/awards-2021)

(παρουσιάζονται μόνο τα άρθρα με γεωτεχνικό περιεχόμενο)

Industrial Fabrics Association International

Industrial Fabrics Association International is excited to announce that the Geosynthetics Conference Proceedings Archive is now available. The Proceedings Archive contains the proceedings from 19 different geosynthetics conferences published by IFAI over the years - **all for FREE**.

Geotechnical engineering practitioners and members of the academia (including students) are invited to take advantage of this expanded resource featuring technical content including everything from Geosynthetics 2021 all the way back to the 1982 Second International Conference on Geotextiles.

Explore a vast array of geosynthetic knowledge and see how applications have changed over the years by downloading/printing the complete conference proceedings from selected years at https://geosyntheticsconference.com/proceedings-archive/.

Geo-Institute of ASCE

The Ralph B. Peck Medal Lecture

The Ralph B. Peck Medal Lecture is presented annually by a geotechnical engineer recognized by the Geo-Institute for outstanding contributions to the profession through the analysis and publication of case histories. The 2021 Peck Lecturer was Lelio Mejia of Geosyntec.

Lelio H. Mejia delivered the lecture on Earthquake Cracking of Embankment Dams on May 11, 2021. The lecture can be viewed using the following link: https://youtu.be/33cMm8THHtg

RIC 2021 - Lifetime Achievement Session
Dr. Evert Hoek

Recently at the Rocscience International Conference 2021, Dr. Evert Hoek received the Lifetime Achievement Medal for his contributions in the field of Rock Engineering. Now watch the special session in which Dr. Hoek takes you through the **Developments in Rock Engineering from 1958 to 2020**.

https://www.youtube.com/watch?v=dy83dYaXHVY

The fantastic presentation was followed by a Q&A period where Dr. Evert Hoek answered questions asked by the conference attendees. Click below to read Dr. Hoek's answers to all the questions from the session.

Read Dr. Hoek's extended Q&A

ΔΙΑΚΡΙΣΕΙΣ ΕΛΛΗΝΩΝ ΓΕΩΤΕΧΝΙΚΩΝ ΜΗΧΑΝΙΚΩΝ

International Journal of Geoengineering Case Histories

Β. Ξενάκη, Γ. Ντούλης & Γ. Αθανασόπουλος
2,235 downloads – 9,318 downloads since 2017

Το άρθρο των συναδέλφων Βάλιας Ξενάκη, Γιώργου Ντούλη και Γιώργου Αθανασόπουλου «Xenaki, V., Doulis, G., Athanasopoulos, G. (2016) Geotechnical Design of Embankment: Slope Stability Analyses and Settlement Calculations», International Journal of Geoengineering Case Histories, Vol. 3, Issue 4, p.246-261 είχε τα περισσότερα «κατεβάσματα» (downloads) εντός του 2020 απ' όλα τα δημοσιευθέντα άρθρα στο περιοδικό (2,235 downloads – 9,318 downloads since 2017).

https://www.geocasehistoriesjournal.org/announcements/62163-paper-downloads-in-2020-for-the-issmge-international-journal-of-geoengineering-case-histories/

ΠΡΟΣΦΟΡΕΣ - ΠΡΟΚΗΡΥΞΕΙΣ ΘΕΣΕΩΝ ΓΙΑ ΓΕΩΤΕΧΝΙΚΟΥΣ ΜΗΧΑΝΙΚΟΥΣ

The LARAM 2021 school

LARAM ("LAndslide Risk Assessment and Mitigation") is an international training programme run by the Geotechnical Engineering Group (GEG) of the University of Salerno. This is a long running training scheme that brings together early career professionals for a two week intense period. The course is taught by eminent landslide scientists. It serves two key purposes:

1. It equips cadres of early career researchers with the skills that the need to make a substantial contribution to landslide science;

2. It creates international cohorts of researchers, enabling collaboration.

The LARAM organisers describe the school as follows:

For each edition of the school, 40 PhD students are selected to attend the residential courses, selected among applicants working in civil engineering, environmental engineering, engineering geology or related fields. The School can be also attended by some Young Doctors who defended their PhD thesis in the previous 5 years.

The courses include formal lessons, tutorials and field training.

The 2021 version of LARAM will run from 6 to 17 September 2021. Unfortunately, in these pandemic times it is having to run in online format. However, there is no doubt that it will be an exceptionally worthwhile event.

Details of the 2021 programme are now available. Applications are also invited from both PhD students and those recently graduated with a doctoral degree:

- Application for PhD students: https://www.laram.unisa.it/school/2021online/application_phd_students

- Registration PhD graduates: https://www.laram.unisa.it/school/2021online/registration_young_doctors

Whilst the LARAM school was not available when I was early in my career (to my deep regret), many of my post doctoral researchers have attended over the years. They have found it to be an invaluable experience. I thoroughly recommend it.

Previous cohorts of students and lecturers on the LARAM programme. Image from Cascini *et al.* (2020).

Reference

Cascini, L., Calvello, M., Cuomo, S. *et al.* 2020. LARAM School 2020 goes online: the 15th doctoral school on "LAndslide Risk Assessment and Mitigation". *Landslides* **17,** 1997–1999. https://doi.org/10.1007/s10346-020-01456-w

(Dave Petley, 14 May 2021, https://blogs.agu.org/landslideblog/2021/05/14/laram)

Eiffage Kier Ferrovial BAM

Geotechnical Engineer

EKFB is a joint venture that brings together international, market leading expertise from four leading civil engineering and construction companies: Eiffage, Kier, Ferrovial Construction and BAM Nuttall. All four partners have specialist expertise in the design, construction, operation, financing and maintenance of railway networks, including the construction of one of Europe's latest high speed rail projects.

We're looking for an Geotechnical Engineer to support the Design and Engineering team, in managing and delivering the optimized Design for Geotechnical discipline in accordance with the Programme and the Client's requirements. You will be reporting directly to the Engineering Discipline Manager/Lead- Geotechnical.

We'll need you to provide support to the Geotechnical Discipline Manager route wide (across all sectors). You'll also need to help in leading the design development within the IDMT. Close liaison with the D&E Section Lead to ensure the delivery

on time, optimized and in accordance with the Client's requirements is a key part of this role.

Supporting the study of optimisation/assumptions and liaison with the commercial, planning, design delivery teams, and designers. You'll need to link and coordinate with Construction for management of topics such as GI, topographical surveys, and all other issues related with the design development for the geotechnical design. As well as assist in driving the expertise within EKFB Design and Engineering team.

You will be responsible for coordination of the Geotechnical Design route wide. You will need to ensure coordination of all design and assurance deliverables with interfacing organisations.

…

(https://www.linkedin.com/company/ekfb/jobs/)

ΠΡΟΣΕΧΕΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΚΔΗΛΩΣΕΙΣ

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

INTERPRAEVENT
2021 – Norway

Natural hazards in a changing world
May 31st - June 2nd 2021 - Virtual Congress
www.interpraevent2020.no

THE INTERPRAEVENT RESEARCH ASSOCIATION

In 1965 and 1966, Europe was hit by several flood disasters. The devastating effects led to regular meetings of well-known experts in Klagenfurt in 1967, to discuss the causes of these natural occurrences, as well as preventive measures for protection and damage limitation. The meetings unified researchers and engineers from different fields and countries to cope with severe sediment-related disasters that hit the European Alps countries successively. As a result from these meetings the association Interpraevent was founded.

THE INTERPRAEVENT CONGRESS

The purpose of the Research Society is to set up preventive protection against disasters, and to further interdisciplinary research to protect human living space against flooding, debris flow, landslides, avalanches and rockfall, as well as anthropogenic (man-made) influences and destruction. As the Society's name implies, the intention is also to carry out research and pass on information concerning the causes of these events.

One of the tasks of Interpraevent is therefore to plan and conduct international interdisciplinary events. Up to now, 13 international congresses have been organized on the topic of preventive protection against natural hazards. Due to the COVID-19 Coronavirus pandemic, the 14th Interpraevent Congress will be held as a virtual meeting in May-June 2021

CONGRESS AIMS

The congress aims to be a meeting point for practitioners, scientist and decision makers working in the fields of the congress themes. The focus will be on all fields of natural hazard risk reduction – from integrated management and causes of disasters, to mitigation measures, preparedness and effects of climate and social changes. We welcome contributions from research to practical applications, as well as policy making, insurance and economic aspects.

FOR REGISTRATION INQUIRIES : interpraevent@gyro.no
CONTACT ORGANIZING COMMITTEE: interpraevent2020@nve.no

2021 ICOLD MARSEILLE - ICOLD 27th Congress - 89th Annual Meeting Sharing Water: Multipurpose of Reservoirs and Innovations, 4 - 11 June 2021, Marseille, France, https://ciqb-icold2021.fr/en/

International Airfield and Highway Pavements Conference, June 6-9, 2021, Austin, Texas, USA, www.pavementsconference.org

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

6th Rock Mechanics& Tunneling Day - Rock mechanical aspects of the Railway Project Stuttgart –Ulm and other national and international projects, 10.06.2021, Rosengarten, Mannheim, Germany, www.felsmechanik.eu

5th Symposium of the Macedonian Association for Geotechnics "The problems associated with soft rocks in rock engineering", an ISRM Specialized Conference, 10-12.06.2021, Ohrid, North Macedonia, https://mag.net.mk/v-mag-symposium-28-30-5-2020

9th International Conference on Computational Methods for Coupled Problems in Science and Engineering (COUPLED PROBLEMS 2021), 13-16 June 2021, Sardinia, Italy, coupledproblems_sec@cimne.upc.edu

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

International Scientific Conference Doctrinal texts – achievements, importance and future in the protection of heritage /90th anniversary of the Athens Charter/ 12th edition, June 14-15, 2021, Florence. Italy, www.lifebeyondtourism.org/events/icomos-isctheory-florence-2021

We are approximately one month away from our next meeting of the EWG "Dams and Earthquakes" which will take place

on **June 15th, 2021 between 13.30 and 18.30 Paris Time (GMT + 2)**.

You will find attached a tentative program whose schedules have been adapted so that the majority of participants and speakers can participate (time zones spread from GMT-8 to GMT+6). This program is likely to evolve if new intervention proposals reach me. I already invite the speakers planned to let me know about any time constraints.

The link and login details are the following:
https://inrae-fr.zoom.us/j/6931211406?pwd=a0lFbUtH-RHlmbFMxMGhud2hYOE8xUT09

Password: Ewgd&e2021

guillaume.veylon@inrae.fr

Tentative Programme

13.30-14.00
Welcome of the Participants

14.00-14.10
Opening Speech
Guillaume Veylon (INRAE, FRA)

Session A - INPUT GROUND MOTION

14.10-14.30
Revision of the seismic hazard in Europe and the implication to the seismic design and safety assessment of dams at European scale.
Pr. Kyriazis Pitilakis (Aristotle University, GR)

14.30-14.50
Principles and methodology for the selection of input ground motions for the dynamic analysis of dams.
Dr. Pierre-Yves Bard (Grenoble Alpes University, FRA)

14.50-15.10
Floor response spectrum calculation at Hydro-Québec for the design of spillway superstructures.
Dr. Benjamin Miquel (Hydroquebec, CAN)

15.10-15.30
Optimal Seismic Intensity Measure Selection for Concrete Dams.
Dr. M. Amin Hariri-Ardebili (University of Colorado, USA)

15.30-16.00
PAUSE

Session B - STRUCTURAL MODELING

16.00-16.20
A SEM-FEM analysis procedure for rupture-to-dam earthquake simulation.
Pr. Jin-Ting (Tsinghua University, CN)

16.20 - 16.40
Examples of holistic approaches dealing with the structural assessment of concrete dams in seismic areas.
Dr. Luca Furgani (Mott McDonald, UK)

16.40 - 17.00
Seismic safety assessment framework for large arch-gravity dams according to Swiss guidelines applied to Lago Bianco South masonry-multi-stage-constructed Dam.
Dr. Sven-Peter Teodori (AFRY, CH)

17.00 - 17.20
Pushover analysis for dams - method/ limits and developments.
Nicolas Humbert (EDF, FRA)

17.20 - 17.40
Qualification of a simplified method to evaluate the sliding of gravity dams under earthquake.
Emmanuel Robbe (EDF, FRA)

17.40-18.00
Seismic bahavior of hardfill dams.
Pr. Panos Dakoulas (University of Thessaly, GR)

18.000-18.30
Discussions & conclusion
Guillaume Veylon (INRAE, FRA)

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 Pressin 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/#

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

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

Join Keller for the second webinar in their series highlighting Keller's solutions to a wide range of geotechnical challenges.

About this event

This webinar will focus on groundwater control. Groundwater control can be provided with dewatering, ground improvement, or the installation of barriers in soil, rock, or below-grade structures to restrict the movement of water. Keller provides the optimal solution to tackle each difficult groundwater control challenge.

Learning objectives

Be able to understand the vast array of available groundwater control methods and be able to select the relevant technique or combination of techniques for any particular application or ground condition.

About our presenter

Paul C. Schmall, Ph.D., P.E., D.GE

Paul is Vice President of Business Development for Keller and was previously the Chief Groundwater Control Engineer for Moretrench, where he worked for 31 years prior to their acquisition by Keller in 2019. He has extensive experience with the company's complex groundwater control, grouting, and ground freezing projects for underground construction as well as forensic investigation and remediation of geotechnical "failures" related to groundwater. Paul is the recipient of the 2015 Wallace Hayward Baker Award, the 2014 Engineer/ Constructor Award of the New Jersey Society of Professional Engineers in Construction, and the incoming President of the Moles. He has authored more than 40 technical papers/articles and co-authored the third edition of Construction Dewatering and Groundwater Control. He holds degrees from Bucknell University and the University of Nottingham.

https://www.keller-na.com/events/keller-webinar-series-groundwater-control

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

7th International Conference on Industrial and Hazardous Waste Management 27-30 July 2021, Chania, Crete, Greece, http://hwm-conferences.tuc.gr (online participation available)

ACE 2020 14th International Congress on Advances in Civil Engineering, 6-8 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

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

EUROGEO WARSAW 2020 7th European Geosynthetics Congress, 19-22 September 2021, Warsaw, Poland, www.eurogeo7.org

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

My co-conveners and I would like to invite you to a special session dedicated to the output of high-end national and international industry projects from around the world. It's a session in the coming European Seismological Commission (ESC) meeting to be held this fall, as you may know, not in Corfu anymore, but online (Sep. 19-24, 2021 - https://www.erasmus.gr/microsites/1193).

Our session is (somewhat romantically) called "When science meets industry: **Advances in engineering seismology stemming from practice**". People who work in this **industry-academia interface** have long shaped / are shaping the state of the art by making impactful advances through solving real-life problems. I thought it would be great to get such folks from companies, organisations, research agencies, universities etc. all together and showcase/foster such fruitful collaborations.

We hope to "see" you in September, and walk the science-industry line together!

Best wishes,

Olga, Iain and Luis-Angel

Session 31

When science meets industry: Advances in engineering seismology stemming from practice

Conveners:

Olga-Joan Ktenidou, Iain Tromans, Luis A. Dalguer3

In recent years, the challenges faced in major industrial projects have provided a springboard for research and innovation that have brought about numerous advances in the Engineering and Seismological communities. In the US, it has been the case for a long time that cutting-edge research in engineering seismology does not only originate in a purely academic context but also from practice in large-scale projects between academia and industry aimed at solving real casespecific challenges, not least in the domain of seismic hazard assessment. In more recent years, large national and international industrial projects in Europe have also begun to shape the state-ofthe-art in science, technology and practice, developing new approaches and innovative techniques in several topics, including ground motion models, uncertainty quantification, site-specific hazard assessment, site characterisation, site effects and attenuation, but also seismic hazard of low seismicity regions, induced seismicity, and more.

This session aims to bring together the Engineering and Seismological communities and create a platform for discussion and exchange concerning recent advances in any aspect of engineering seismology where innovation in data, models or methods has been driven by the needs of industry. We wel-

come contributions from academics and practitioners, national bureau rendering expert services, organisations from the energy and other sectors, leading companies that practice research-led consulting. We also seek to hear from those developing new products, sensors, or software that are changing the state-of-the-art and to discuss exciting new possibilities for applications.

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

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

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/

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

2022 GEOASIA7 - 7th Asian Regional Conference on International Geosynthetics Society, April 11 - 15, 2022, Taipei, Taiwan, www.geoasia7.org

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

SYDNEY 7iYGEC 2021 7th International Young Geotechnical Engineers Conference A Geotechnical Discovery Down Under, 29 April - 1 May 2022, Sydney, Australia, http://icsmge2021.org/7iygec

SYDNEY ICSMGE 2021 20th International Conference on Soil Mechanics and Geotechnical Engineering, 1–5 May 2022, Sydney, Australia, www.icsgme2021.org

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, http://cpt22.org

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

3rd International Symposium on Geotechnical Engineering for the Preservation of Monuments and Historic Sites 22-24 June 2022, Napoli, Italy, https://tc301-napoli.org

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

ICONHIC2022: THE STEP FORWARD - 3rd International Conference on Natural Hazards & Infrastructure, 5 – 7 July 2022, Athens, GREECE, https://iconhic.com/2021

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

IAEG XIV Congress 2022

Chengdu, China September 14-20, 2022

As a quadrennial global academic event initiated by the International Association for Engineering Geology and the Environment (IAEG), the IAEG Congress has been successfully held for 13 sessions, which aims to propagate the latest research results in the field of engineering geology and the environment, facilitate international academic exchanges and interdisciplinary integration, and promote the disciplinary construction of engineering geology and the environment. To further strengthen theoretical innovation, technological breakthrough and international cooperation in the field of engineering geology and the environment.

The XIV Congress of the International Association for Engineering Geology and the Environment will be held in **Chengdu Century City New International Convention and Exhibition Center**, Chengdu, China from **September 14 to 20, 2022**. Based on the theme of "**Engineering Geology for a Habitable Earth**", the congress is expected to enhance the disciplinary and research development of international engineering geology and the environment, and contribute to the advancement of major projects, ecological progress, and habitable earth with research and discussion in the engineering geology and global climate change, geological hazard assessment and prevention, geotechnical properties of rock and soil mass, engineering geology and the environmental issues concerning marine, transportation, urban and ecological environment protection in major projects, engineering geology and resilience engineering construction, intelligent engineering geology, and new theories, methods, and techniques in engineering geology, etc.

We warmly welcome the worldwide engineering geological community to come to Chengdu to participate in this academic event.

General scientific themes

- Climate Change Mitigation and Adaption
- Engineering Geology and Sustainable Development
- Mechanism, Monitoring and Early Warning, Prevention and Assessment of Geological Disasters
- Environmental Engineering Geology and Ecosystem Protection
- Geotechnical Properties of Rock and Soil Mass
- Traffic Engineering Geology and Sichuan-Tibet Railway Construction
- Energy Engineering Geology and Deep Earth Resource Exploitation
- Urban Engineering Geology and Underground Space Utilization

- Marine Engineering Geology and Coastal Development
- Polar, Planetary Engineering Geology and Disasters
- Artificial Intelligence, Big Data and Engineering Geology
- New Theory and Technology of Engineering Geology
- Preservation of Cultural Heritage and Engineering Geology
- Education and Disciplinary Development of Engineering Geology

Contacts

Session and Field Course:
Dongpo Wang: wangdongpo@cdut.edu.cn
Peng Zeng: zengpeng15@cdut.edu.cn
Address: No. 1 Dongsan Road, Erxianqiao, Chenghua District, Chengdu, Sichuan, China
Tel : 028-84073193
Email Address: sklgp_cdut@126.com

ଓ ଌ

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

ଓ ଌ

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

ଓ ଌ

LARMS 2022

IX Latin American Congress on Rock Mechanics, Rock Testing and Site Characterization
an ISRM International Symposium
16-19 October 2022, Asuncion, Paraguay

Symposium Themes

- Site characterization,
- Rock mass properties,
- Rock mass classification,
- Foundations,
- Slopes,
- Tunnels,
- Soft Rock,
- Shotcrete

Contact Person: Jose Pavon Mendoza
Address: Espana 959, casi Washington
Telephone: +595 971 909165
E-mail: jose.pavonm@gmail.com

ଓ ଌ

AusRock 2022

6th Australasian Ground Control in Mining Conference –an ISRM Regional Symposium
07 -09 November 2022, Melbourne, Australia

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

ଓ ଌ

Geoafrica – February 2023
4th African Regional Conference on Geosynthetics – Geosynthetics in Sustainable Infrastructures and Mega Projects
February 2023, Cairo, Egypt
www.geoafrica2023.org

The International Geosynthetic Society in Egypt (IGSE) is pleased to announce that the 4th African Regional Conference on Geosynthetics shall take place in Cairo, Egypt in 2023. As a newly formed chapter of IGS, we are excited to initiate our activities with this important regional conference as a seed for future activities of IGSE. We are eager to host this event and look forward to regional and international participation from academics, consultants, producers, contractors, and project owners. The main aim of the conference is to engage regional and international experts to raise awareness of technical advances, participate in joint activities, exchange experiences, and build bridges. The event shall be held at one of the most inviting locations along the river Nile in Cairo. Due to the COVID 19 pandemic, the conference dates have been postponed from the original dates in October 2021 to 20-23 February 2023.

The use of geosynthetics in infrastructures and mega projects has immensely increased in Egypt and the region in recent years. Projects including major expansions of highways and railroads in challenging soil conditions, new cities and urban centers, industrial and commercial zones, ports, tank farms, landfills, mine tailings, and major utilities have seen extensive use of geosynthetic products in various applications. We have therefore chosen a conference theme to be "Geosynthetics in Sustainable Infrastructures and Mega Projects".

Technical Themes

- Geosynthetics in sustainable infrastructures and mega projects
- Reinforced soil walls and slopes
- Drainage and filtration
- Geosynthetics in transportation applications
- Geosynthetic barriers
- Hydraulic and coastal applications
- Innovation in geosynthetic products and applications
- Design and numerical modeling
- Durability and long-term performance

Contact Us

info@geoafrica2023.org

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

XII ICG - 12th International Conference on Geosynthetics, September 17 – 21, 2023, Rome, Italy, www.12icg-roma.org

15th ISRM

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

Organizer: Austrian Society for Geomechanics
Contact Person: Prof. Wulf Schubert
E-mail: salzburg@oegg.at

ΕΝΔΙΑΦΕΡΟΝΤΑ ΓΕΩΤΕΧΝΙΚΑ ΝΕΑ

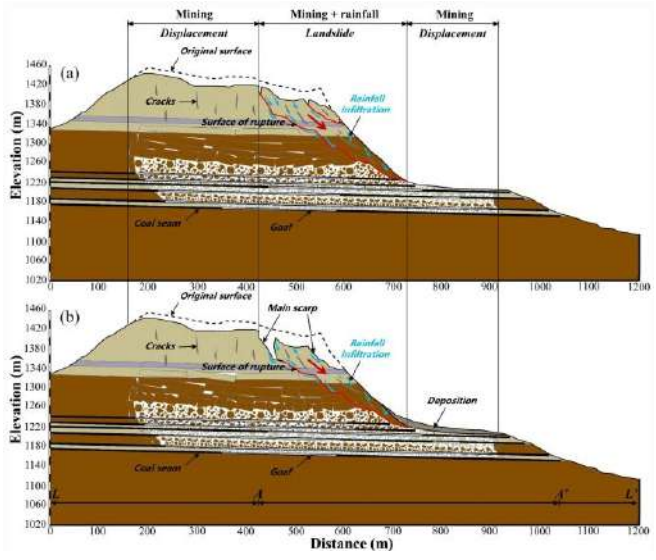
The mining-induced Jianshanying Landslide in Guizhou Province China

I have frequently written about mining-induced landslides. A paper just published in the journal *Landslides* (Chen *et al.* 2021) highlights an extraordinary example, the Jianshanying Landslide, which is located in Guizhou Province in China. The landslide, which has been triggered by coal mining beneath a mountain, is located at 26.308676°, 104.734385°. It is easily seen in Google Earth imagery:

This is a very large, very active failure. Note that the toe of the landslide is engulfing inhabited areas in two different locations. Chen *et al.* (2021) focuses on the evolution of movement of the landslide, and does a good job. They demonstrate that the landslide has rapidly evolved with time – this is also evident from the Google Earth images. The image below was collected in November 2018:

You should be able to compare these two images using the slider below. This evolution has occurred in just two years:

Chen et al. (2021) have provided this very beautiful and very clear diagram to illustrate the form and evolution of the landslide:



Cross-sections illustrating the form and evolution of the Jianshanying landslide in China. Figure from Chen et al. (2021).

As the cross-section shows, mining of a thick set of coal seams has induced subsidence across the whole of the mountain top, and has induced a very deep-seated failure of the flank. Movement rates accelerates in periods of heavy rainfall. The diagram infers that considerably more deformation of the landslide is yet to occur.

The crown to toe distance of this landslide is about 1,150 metres. It is about 450 metres wide. If we assume that the average depth is 25 metres (and this might be conservative) then the volume is in the order of 25 million cubic metres. As such it is one of the largest landslides triggered by mining.

Reference

Chen, L., Zhao, C., Li, B. *et al.* 2021. Deformation monitoring and failure mode research of mining-induced Jianshanying landslide in karst mountain area, China with ALOS/PALSAR-2 images. *Landslides* (2021). https://doi.org/10.1007/s10346-021-01678-6

(Dave Petley / THE LANDSLIDE BLOG, 29 April 2021, https://blogs.agu.org/landslideblog/2021/04/29/jianshanying-landslide)

Deformation monitoring and failure mode research of mining-induced Jianshanying landslide in karst mountain area, China with ALOS/PALSAR-2 images

Liquan Chen, Chaoying Zhao, Bin Li, Kai He, Chaofeng Ren, Xiaojie Liu & Donglie Liu

Abstract

The Jianshanying landslide in Guizhou province, China, is a typical mining-induced landslide with its complex formation in karst mountainous area. However, the spatiotemporal deformation characteristics and failure mechanism are still unknown. In this paper, the surface deformation time series from 2017 to 2020 is firstly estimated by combining multi-temporal synthetic aperture radar (SAR) interferometry and improved offset-tracking methods to overcome the difficulties caused by the large gradient surface deformation and surface material changes. Then, the spatiotemporal characteristics of Jianshanying landslide is analyzed in terms of line-of-sight (LOS) deformation with stacking InSAR method and two-dimensional (2D) deformation with improved SAR offset-tracking method. And the different deformation features between sliding body and surrounding areas are uncovered. Accordingly, we point out the "three-section" surface deformation model. We further analyze the deformation time series by considering the joint effects of rainfall and underground mining. Finally, we conceptualize the landslide failure mode for the Jianshanying landslide, which can be extended to the similar landslide in karst mountainous areas of southwestern China.

https://link.springer.com/article/10.1007/s10346-021-01678-6

Quick clay landslides: Slippery subject

The fatal landslide in Gjerdrum, near Oslo on 30 December 2020, in which 10 people died, was a reminder of the problems sensitive clays pose in Norway, Sweden and parts of North America. NGI technical expert **Anders Solheim** discusses.

Quick clay is a highly sensitive marine clay, whose remoulded shear strength is very low. It has a remoulded strength of less than 0.5kPa, but in Norway materials with remoulded strengths up to 2kPa are treated as quick clay with respect to requirements in construction projects. The geological background for these clays is found in the isostatic depression of the Scandinavian crust from the load of the ice sheet during the last glaciation

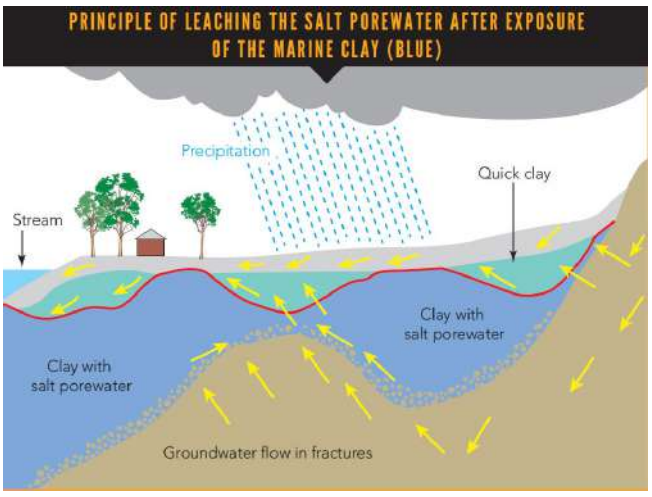
Following deglaciation, some 10,000 years ago, the sea followed the retreating ice front inland, until isostatic rebound exposed the land again and the sea retreated back to where today's beachline is found. During the period when land areas were covered by the sea, clays were deposited in relatively deep waters, and these marine clays were subsequently exposed. The salt porewater has then in some areas been gradually leached by percolating fresh groundwater.

Clay minerals are small – less than 0.002mm – platelets that deposit with a very open but stable house-of-cards-like structure in seawater due to electrical charges on the clay minerals.

However, when the porewater becomes fresh after thousands of years of leaching, this structure is no longer stable, and upon disturbance, this very open, porous structure collapses, and the clay platelets float in excess porewater.

This is why a relatively firm clay can turn into a "soup", which is why quick clay landslides occur.

Of course, there are also particularly vulnerable areas where one should not build at all, but these are relatively few, and will also be detected by proper geotechnical investigations and analyses.



Quick clay landslides

Many devastating and fatal quick clay landslides have occurred throughout Norway's history.

The most serious in modern times happened in Verdal, north of Trondheim, in 1893, with 116 fatalities. This landslide, and many others, have been released by natural triggers, of which river and stream erosion are the most important.

If erosion exposes quick clay, it may lead to an initial, often small failure, which then progresses rapidly backwards in the retrogressive development of a large landslide

During the last 70 years, more than 50% of large quick clay landslides in Norway have been triggered by human activity, of which various construction activities have been the main cause. In fact, since 2008, about 90% have been triggered this way, according to a survey by L'Heureaux *et al* (2018).

The latest fatal example of a human-induced quick clay landslide was in November 2016, in Sørum municipality, not far from Gjerdrum, where too much mass was added to the top of a slope during the levelling of farmland. This triggered a large landslide in which three people died.

Quick clay also creates huge challenges for infrastructure development in Norway, as areas with marine clay deposits are also among the heaviest populated in the country, such as the region north of Oslo, Oslo city, the areas on both sides of the Oslo Fjord, Trondheim, and several others.

Roughly 100,000 people live in mapped quick clay areas in Norway, and many more in live areas where quick clay can potentially occur. Since quick clay landslides affect large areas with regards to release and to run-out and can occur in quite flat terrain, extensive mitigation measures are required to ensure the required area's stability.

As Norwegian authorities are aware of these problems, detailed guidelines and handbooks on how to act in areas of potential quick clay are published.

Detailed geotechnical investigations are required for all development projects with requirements somewhat connected to the scale and type of infrastructure to be built.

Mitigation measures

At present there are no early warning systems for quick clay landslides, but there are several mitigation measures which will stabilise an area and increase the stability to the required levels. Erosion control in streams and rivers is a very widely used method to avoid landslides triggered by erosion.

Other commonly used measures are terrain modifications often in combination with various drainage methods. Typically, this involves the removal of mass on top of a slope to reduce driving forces; and adding mass to the base of the slope to increase resisting forces. This measure is designed after detailed geotechnical investigations and stability analysis.

Soil reinforcement by chalk-cement piling is also a commonly used mitigation measure. A slurry of chalk and cement is mixed down a borehole, which can be from 0.5m to 1m in diameter, and forms a pile when the string with the mixer is pulled back up. These chalk-cement piles can be inserted in a variety of patterns, again with a design determined after careful geotechnical analyses.

After events like the 2020 Gjerdrum landslide it is natural that regulations and guidelines are reviewed and, if necessary, revised. A commission was recently established in Norway to analyse the causes of the fatal event and to review national regulations and practices.

It is, however, unrealistic and also unwanted to ban all development in possible quick clay areas in Norway.

Therefore, what matters is to be aware of the ground conditions on the site one operates, and if in an area with a potential for marine clays, always consult geotechnical expertise and follow "the book" carefully.

Of course, there are also particularly vulnerable areas where one should not build at all, but these are relatively few, and will also be detected by proper geotechnical investigations and analyses.

L'Heureux, J.S., Høydal, Ø.A., Paniagua Lopez, A.P. & Lacasse, S., 2018: Impact of climate change and human activity on quick clay landslide occurrence in Norway. Second JTC1 Workshop on Triggering and Propagation of Rapid Flow-like Landslides, Hong Kong 2018Nor

Jørgensen, P., Sørensen, R. og Prestvik, O. 2013. Norske Jordarter ('Norwegian Soils') Norsk Jordforening. (In Norwegian)

(26 April, 2021 / Ground Engineering Editorial, https://www.geplus.co.uk/features/quick-clay-landslides-slippery-subject-26-04-2021)

Northern Quebec landslide last month was a record-breaker

At 1.8 kilometre-long landslide sent 45 million cubic metres of debris into Great Whale River

The landslide was located approximately eight kilometres upstream from the side-by-side Cree and Inuit villages of Whapmagoostui and Kuujjuarapik, located 1,700 kilometres north of Montreal on Hudson's Bay. (Kativik Regional Government/ Cree Nation Government)

A huge landslide last month in northern Quebec is the longest on record and the second largest, according to officials with Kativik Regional Government, Cree Nation Government, along with local leaders from Whapmagoostui and Kuujjuarapik.

"The landslide covers a span of 1.8 kilometres in length and 500 metres in width along the riverbank — the longest landslide ever recorded," according to a joint new release.

With over 45 million cubic metres of debris spilling into the Great Whale River, it is also the second largest one in 150 years of keeping records.

The earth gave way on the morning of April 22, approximately eight kilometres upstream from the side-by-side Cree and Inuit villages of Whapmagoostui and Kuujjuarapik, which are 1,700 kilometres north of Montreal on Hudson's Bay.

The area remains under close observation, but local elder advisor George Kawapit said there is no immediate concern.

Denis Demers, a Quebec Ministry of Transportation landslide expert, also spoke at the meeting.

"The worst is over. The major part of the debris from the landslide has spilled into the river," said Demers.

"It may take months, if not years, for the river to return to its normal course."

Provincial experts are expected to travel to the area sometime this week once they have a chance to study topographic data from the site, according to local officials.

Local leaders will create a safety buffer zone around the landslide to warn residents of both communities to the potential dangers in the area.

Further updates are expected after the experts complete their assessment of the soil and riverbanks near the landslide.

(CBC North Cree Unit, May 03, 2021, https://www.cbc.ca/news/canada/cree-inuit-landslide-northern-quebec-1.6012487)

Invited perspectives: Landslide populations – can they be predicted?

Fausto Guzzetti

Landslides are different from other natural hazards. Unlike volcanoes, they do not threaten human civilization (Papale and Marzocchi, 2019). Unlike tsunamis, they do not affect simultaneously several thousands of kilometres of coastline – although a submarine landslide in Norway caused a tsunami to hit Scotland (Dawson et al., 1988). Unlike floods and earthquakes, they do not cause hundreds of thousands of casualties in a single event – although a landslide killed thousands in Peru (Evans et al., 2009) and debris flows tens of thousands in Colombia (Wieczorek et al., 2001). But the human toll of landslides is high (Froude and Petley, 2018), and their economic and societal consequences are largely undetermined. Compared to other hazards, landslides are subtle, often go unnoticed, and their consequences are underestimated.

As with other hazards, the design and implementation of effective risk reduction strategies depend on the ability to predict (forecast, project, anticipate) landslides. I have argued that "our ability to predict landslides and their consequences measures our ability to understand the underlying […] processes that control or condition landslides, as well as their spatial and temporal occurrence" (Guzzetti, 2021). This assumes that landslide prediction is possible, something that has not been demonstrated (or disproved), theoretically. Yet, there is nothing in the literature that prevents landslide prediction, provided that one clarifies the meaning of "prediction" (Guzzetti, 2021), that the prediction is scientifically based (Guzzetti, 2015), and that we understand the limits of the prediction (Wolpert, 2001). Efforts are needed to determine the limits of landslide predictions, for all landslide types (Hungr et al., 2014) and at all geographic and temporal scales (Fig. 1).

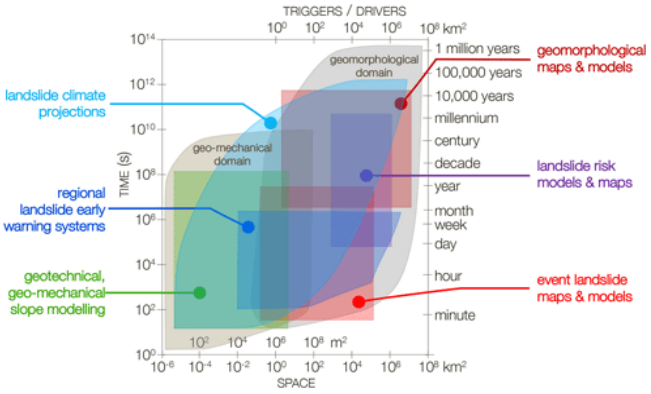


Figure 1 Space (lower *x* axis)–time (*y* axes) chart showing main geomorphological and geo-mechanical landslide domains, and typical length scale of main meteorological and geophysical triggers and drivers of populations of landslides. Coloured polygons show approximate sub-domains for typical landslide hazards and risk mapping and modelling efforts. Modified after Guzzetti (2021).

Here, I outline what I consider to be the main problems that need to be addressed in order to advance our ability to predict landslide hazards and risk. The field is vast, and I limit my perspective to populations of landslides – that is, the hazards and risk posed by many landslides caused by one triggering event or by multiple events in a short period. In this context, predicting landslide hazard means anticipating *where*, *when*, *how frequently*, *how many*, and *how large* populations of landslides are expected (Guzzetti et al., 2005; Lombardo et al., 2020; Guzzetti, 2021). Predicting landslide risk is about anticipating the consequences of landslide populations to different vulnerable elements (Alexander, 2005; Glade et al., 2005; Galli and Guzzetti, 2007; Salvati et al., 2018).

Guzzetti, F.: Invited perspectives: Landslide populations – can they be predicted?, Nat. Hazards Earth Syst. Sci., 21,

1467–1471, https://doi.org/10.5194/nhess-21-1467-2021, 2021. https://nhess.copernicus.org/articles/21/1467/2021/

ଔ ଌ

Galapagos rock formation Darwin's Arch has collapsed

One of the most famous rock formations in the Galapagos Islands has collapsed into the sea.

The top of Darwin's Arch, located in the northern part of the archipelago, fell as "a consequence of natural erosion," according to the Ministry of Environment for Ecuador.

Images of the structure, which now consists of just two pillars, were posted on the social media accounts for the ministry on Monday alongside a statement confirming the news.

"The collapse of Darwin's Arch, the attractive natural bridge found less than a kilometer from the main area of Darwin Island, was reported," the ministry said in the statement.

"Darwin's Arch is made of natural stone that at one time would have been part of Darwin Island, which is not open to visits by land."

Named after English biologist Charles Darwin, the arch is considered one of the best diving spots in the Pacific Ocean archipelago that's part of Ecuador and located hundreds of miles off the country's coast.

Iconic site

The UNESCO World Heritage site, known for its many endemic animal and plant species, famously inspired Darwin's theory of evolution.

Tour company Aggressor Adventures, which organizes group trips to various destinations around the world, indicated in a post shared on Facebook that one of its tour groups witnessed the incident take place.

"Unfortunately today, our guests of the Galapagos Aggressor III experienced a once in a lifetime event," the company shared.

"This morning at 11:20 a.m. local time, the world famous Darwin's Arch collapsed in front of their eyes.

"Some in the dive & travel industry are already referring to this now as 'The Pillars of Evolution'. We will miss this iconic site."

(Tamara Hardingham-Gill / CNN, 18th May 2021, https://edition.cnn.com/travel/article/galapagos-darwins-arch-collapses/index.html)

ଔ ଌ

The Pietrafitta landslide: can traffic vibration cause a landslide to move?

Over the years I have frequently heard discussions about the triggers for landslide movement. Many of these are obvious – rainfall, seismic shaking, snowmelt, construction, for example. Sometimes people have also described vibration from traffic or trains as being a potential trigger. I have always wondered how strong the evidence is to support this assertion.

There is an interesting paper in the journal *Landslides* (Guerriero *et al.* 2021) that has investigated this for a clay landslide in Italy. The site, the Pietrafitta landslide in southern Italy, is located alongside an important road, SS87. In 2016 movement of the landslide was causing periodic closure of the road to traffic. The authors have included this image of the landslide:

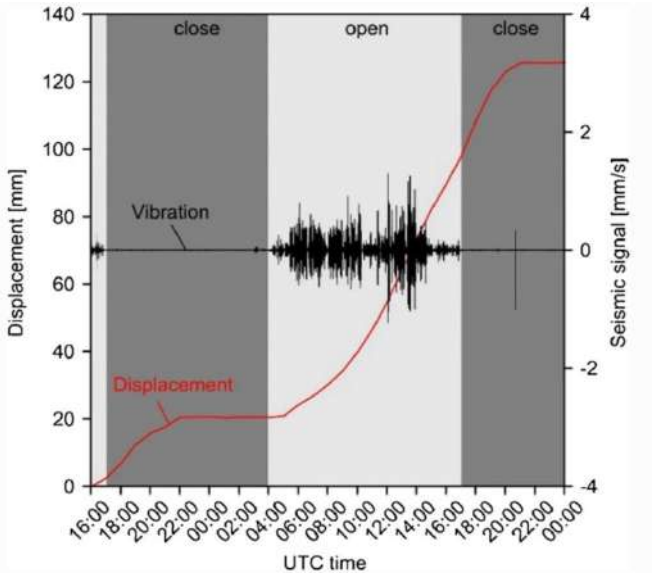
The Pietrafitta landslide. Image from Guerriero *et al.* (2021)

This is probably best described as a retrogressive earthflow. The scale of the landslide is indicated by the truck located on the right side of the landslide toe.

The authors installed a broadband seismic station to measure the traffic vibration and an extensometer to measure land-

slide movement. In the period of the study traffic flow on the road occurred for only a part of the day, giving a period of no traffic vibrations to compare with a period in which traffic was occurring.

The graph below shows the startling results:



Traffic vibrations and displacement of the Pietrafitta landslide. Image from Guerriero *et al.* (2021).

When the road was closed (the dark grey periods) no traffic vibrations were recorded. Movement of the landslide typically slowed and stopped. In the period in which traffic was flowing (the light grey periods) the landslide commenced movement, with a period of acceleration. After the traffic ceased the landslide continued to move for some hours before slowing and eventually stopping.

Guerriero *et al.* (2021) hypothesise that the landslide was probably on the very margin of instability in its natural state (i.e. the factor of safety was very close to one). The traffic vibration generated higher pore water pressures on the shear surface, which were enough to lower the factor of safety below one, allowing movement to start. Once the traffic ceased the higher pore water pressures took a few hours to dissipate, such that the landslide continued to move for a while, but then stopped.

The conditions in the Pietrafitta landslide are perhaps unusual, being both fully weakened and marginally stable. I'm reminded of the Slumgullion landslide (also an earthflow), which moves in response to atmospheric tides. But Guerriero *et al.* (2021) have demonstrated that landslides can indeed move in response to traffic vibrations.

Reference

Guerriero, L., Ruzza, G., Maresca, R. *et al.* 2021. Clay landslide movement triggered by artificial vibrations: new insights from monitoring data. *Landslides*. https://doi.org/10.1007/s10346-021-01685-7

(Dave Petley / THE LANDSLIDE BLOG, 21 May 2021, https://blogs.agu.org/landslideblog/2021/05/21/pietrafitta-landslide-1)

Clay landslide movement triggered by artificial vibrations: new insights from monitoring data

Luigi Guerriero, Giuseppe Ruzza, Rosalba Maresca, Francesco M. Guadagno & Paola Revellino

Abstract

Slope stability is influenced by a number of factors that modify the resisting/acting force ratio control landslide initiation and movement velocity. Among these, artificial vibrations have been identified as an important degrading factor for soil strength, but it is not fully clear if they can trigger or modulate movements of clay landslides. To contribute to a better understanding of the potential effect of vibrations on landslide movement, also in terms of boundary conditions, we analyzed monitoring data acquired at the toe of the Pietrafitta landslide in southern Italy. This landslide adjoins the SS87 national road that suffered periodic closure due to landslide activity and in April 2016 operates daytime only for risk mitigation purpose. This condition promoted a better identification of a potential cause-effect relation between traffic vibration and landslide movement. Results from data analysis and landslide modeling suggest that in condition of incipient movement, artificial vibrations, also of limited amplitude, are able to directly initiate clay landslide movement that due to the viscous nature of the involved material exhibit a specific displacement pattern that is not consistent with a sliding block model.

Springer Link / Technical Note, https://link.springer.com/article/10.1007/s10346-021-01685-7

Controls on the formation and size of potential landslide dams and dammed lakes in the Austrian Alps

Anne-Laure Argentin, Jörg Robl, Günther Prasicek, Stefan Hergarten, Daniel Hölbling, Lorena Abad, and Zahra Dabiri

Abstract

Controls on landsliding have long been studied, but the potential for landslide-induced dam and lake formation has received less attention. Here, we model possible landslides and the formation of landslide dams and lakes in the Austrian Alps. We combine a slope criterion with a probabilistic approach to determine landslide release areas and volumes. We then simulate the progression and deposition of the landslides with a fluid dynamic model. We characterize the resulting landslide deposits with commonly used metrics, investigate their relation to glacial land-forming and tectonic units, and discuss the roles of the drainage system and valley shape. We discover that modeled landslide dams and lakes cover a wide volume range. In line with real-world inventories, we further found that lake volume increases linearly with landslide volume in the case of efficient damming – when an exceptionally large lake is dammed by a relatively small landslide deposit. The distribution and size of potential landslide dams and lakes depends strongly on local topographic relief. For a given landslide volume, lake size depends on drainage area and valley geometry. The largest lakes form in glacial troughs, while the most efficient damming occurs where landslides block a gorge downstream of a wide valley, a situation preferentially encountered at the transition between two different tectonic units. Our results also contain inefficient damming events, a damming type that exhibits different scaling of landslide and lake metrics than efficient damming and is hardly reported in inventories. We assume that such events also occur in the real world and emphasize that their documentation is needed to better understand the effects of landsliding on the drainage system.

Argentin, A.-L., Robl, J., Prasicek, G., Hergarten, S., Hölbling, D., Abad, L., and Dabiri, Z.: Controls on the formation and size of potential landslide dams and dammed lakes in the Austrian Alps, Nat. Hazards Earth Syst. Sci., 21, 1615–1637, https://doi.org/10.5194/nhess-21-1615-2021,2021.

https://nhess.copernicus.org/articles/21/1615/2021/

A big dam problem: The disaster in Michigan and solutions for the future

A dam failure and a flood, in the middle of a global pandemic: it's a worst-case scenario.

Edenville Dam, MI

A dam failed in Michigan yesterday, forcing thousands of residents to evacuate their homes. The Edenville Dam, which failed, and the Sanford Dam, which was compromised, are on the Tittabawassee River, a tributary of the Saginaw River. The failures followed days of heavy rainfall and sent floodwaters into downstream communities. Residents of Edenville, Midland and Sanford were evacuated.

A dam failure and a flood, in the middle of a global pandemic: it's a worst-case scenario. The immediate focus needs to be protecting public health and safety. Governor Whitmer encouraged people to seek shelter with friends or relatives, and to take precautions to prevent the spread of coronavirus.

How did this happen?

Why did these particular dams fail? Was it because of heavy rains? Climate change? Faulty, aging infrastructure? Lack of action by the dam owner? Right now, we know the following:

- The Edenville Dam was plagued by concerns and safety violations. The Federal Energy Regulatory Commission revoked its hydropower license in 2018 due to concerns that the dam could not withstand a significant flood. FERC flagged problems for the dam's owner starting in 1999. https://www.facebook.com/rkaleto/videos/10100276786854416/

- Climate change is bringing more severe and frequent flooding at a time when our nation's infrastructure is aging and outdated.

- The American Society of Civil Engineers has repeatedly given our nation's dams a grade of D in their "Report Card for America's Infrastructure" – citing age, downstream development, dam abandonment and lack of funding for dam safety programs. More dams will fail, endangering people and property, unless we act to repair essential infrastructure and remove dams that no longer make sense. The Association of State Dam Safety Officials estimates there are more than 2,000 high-hazard dams nationwide in deficient condition.

- The dam failure in Michigan isn't the first "wake up call" when it comes to the need to address aging infrastructure. Dozens of dams failed in the Carolinas five years ago; thousands of residents were evacuated due to the partial failure of nation's tallest dam, Oroville Dam on the Feather River, three years ago; and last year the Spencer Dam failed in Nebraska forcing evacuations. These disasters aren't specific to one region, they are impacting communities nationwide.

Oroville Dam spillway debris in Feather River

While we're still learning about the specifics of this disaster which is still unfolding in Michigan, the following three actions are necessary to protect communities in the future:

1. **Increase, don't decrease, public safety and environmental safeguards** – The safety of federally licensed hydropower dams is overseen by FERC. While FERC revoked the dam's license in 2018 due to safety concerns, that clearly was not enough to prevent this week's catastrophe. Moreover, on the same day the dams failed, President Trump signed a new executive order to roll back more regulations under the guise of restarting the economy. Further gutting the regulations that safeguard human lives and safety and protect the environment is the wrong way to produce a sustainable economic recovery.

2. **Strengthen evaluation and enforcement** – Michigan has a working dam safety program. Even so, state dam safety offices are historically underfunded with a limited number of staff responsible for inspecting thousands of dams. We must improve these efforts by making it the responsibility of dam owners to inspect and maintain their dams; requiring more frequent, detailed inspections of deficient dams and increasing penalties for unsafe dams and violations; and, requiring dam owners to ensure that funds are available to repair or remove dams in the event they can't or won't meet safety standards. As communities continue to grow and development expands, many dams may also be misclassified as infrastructure and development increases downstream.

3. **Increase funding for dam removal and water infrastructure** – Dam removal can be the best way to address a dam that poses a safety risk. There are tens of thousands of dams across the country that no longer serve the purpose they were built to provide and whose removal could eliminate the cost and liability associated with owning a dam. Unless they are well maintained, their condi-

tion only gets worse every year. The most cost-effective and permanent way to deal with obsolete, unsafe dams is to remove them.

Healthy rivers are the lifeblood of our communities and our environment, and we depend on essential infrastructure to provide water, power and other services. It's time to prioritize river protection, and investment in smart infrastructure. Our communities, our economy and our lives depend on it.

(Brian Graber | American Rivers, May 20, 2020, https://www.americanrivers.org/2020/05/a-big-dam-problem-the-disaster-in-michigan-and-solutions-for-the-future/)

Two huge earth cracks open up in Jalisco, Mexico

The Municipal Unit of Civil Protection and Firefighters of Sayula reported two giant fissures extending from the Sayula lagoon to the Guadalajara-Colima Freeway in Jalisco, Mexico on May 10, 2021.

The Civil Protection staff and firefighters went to the scene to inspect the rift and reported that the cracks were possibly due to a hydro-geologic failure.

Images posted by authorities suggest that the cracks also affected buildings and gardens

"Due to the effect of geological risk, two cracks affecting the roads to Usmajac and the free road to Ciudad Guzmán are kept under surveillance, in which personnel from the Highway Administration, Public Works, and the State and Municipal Civil Protection Units already work," the Civil Protection said in a statement.

Authorities said despite the work on the highway, it remained open to road traffic, but warned motorists to practice extreme precaution.

https://www.youtube.com/watch?v=-k7_EnBDRT0

(Julie Celestial / THE WATCHERS, May 17, 2021, https://watchers.news/2021/05/17/two-huge-earth-cracks-open-up-in-jalisco-mexico/)

12 Tunnels That Will Blow Your Mind

These are the longest and most impressive tunnels ever made.

https://www.youtube.com/watch?v=7xsGGxvS5AE

Norway's cruise ship tunnel plan explained

Norway's grand plan to build the world's first full-scale ship tunnel is finally going ahead. This is how it'll be done.

https://www.youtube.com/watch?v=Sfv0-WWxYNk

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΣΕΙΣΜΟΙ & ΑΝΤΙΣΕΙΣΜΙΚΗ ΜΗΧΑΝΙΚΗ

Earthquake early warning milestones

Earthquake alerts are rapidly becoming available to more people around the globe thanks to partnerships among scientists, policy makers and industry. UC Berkeley's role in the scientific development of earthquake early warning is recorded in our academic publications. Here, we detail some of the other milesones towards our goal of global earthquake alerts.

For information on how the earthquake early warning works, visit our Berkeley Seismo Lab Earthquake Early Warning pages.

2020

Google launches the Android Earthquake Alerts System

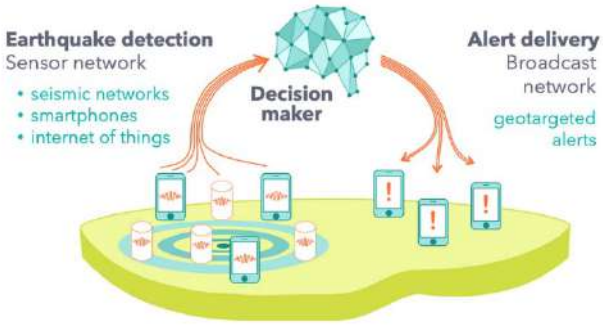
On August 11, 2020 Google announced that it was bringing global earthquake detection, earthquake information and alerting into the Android ecosystem. Adapting the MyShake concept, Android phones around the globe are now mini-seismometers able to detect earthquake shaking. Initially, the earthquake detections will feed information to people through Google Search, but the goal is to use the Android network to deliver alerts around the globe.

As part of the same announcement, earthquake alerts generated by the ShakeAlert early warning system will immediately be available on all Android phones in California. This provides another channel for people to receive these critical alerts. They are now available natively within Android, by downloading the MyShake app (iOS and Android), or through WEA.

Earthquake alerts, now part of Android. Yes, this looks a lot like Richard Allen with his Berkeley Golden Bear mug. (Video courtesy of Google)

Publications and IP

The MyShake Platform: A Global Vision for Earthquake Early Warning by published in Pure Appl. Geophys. by Allen et al published in **Pure Appl. Geophys.**.



Toward Global Earthquake Early Warning with the MyShake Smartphone Seismic Network. Part 1 and Part 2 by Kong et al published in **Seismo. Res. Lett.**

Richard Allen and Qingkai Kong at Google Android during their collaboration

2019

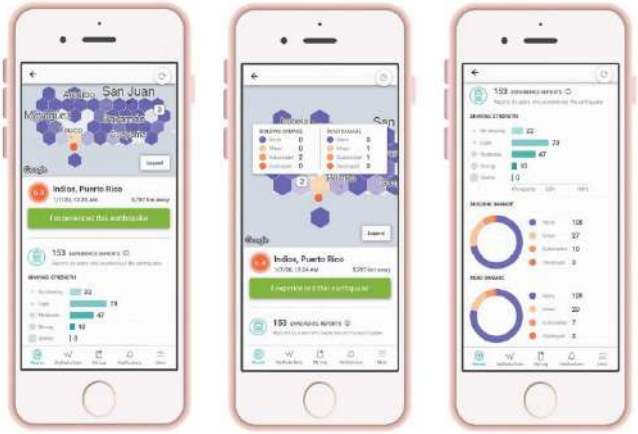
MyShake 2.0 launches and delivers public earthquake alerts across California

On October 17, 2019, California Governor Gavin Newsom announced that earthquake early warnings would now be available to the public across California using UC Berkeley's MyShake app. Sponsored by the Governor's Office of Emergency Services, a new version of MyShake was released with the capacity to deliver ShakeAlert warnings to the public. Overnight, MyShake was downloaded by hundreds of thousands of people across California on both Android and iOS platforms.

The press conference was on the 30th anniversary of the Loma Prieta earthquake and at the foot of the old Bay Bridge which collapsed in the quake. Left to right: Berkeley Seismology Lab Director Richard Allen, State Senator Jerry Hill, CalOES Director Mark Ghilarducci, and Governor Newsom. Oakland Mayor Libby Schaaf hosted the event (just out of shot).

Publications and IP

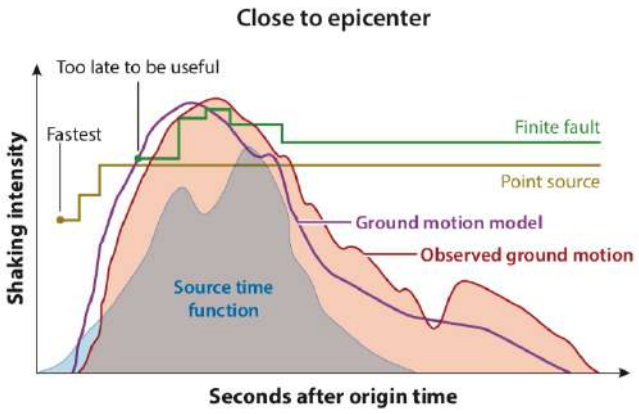
Google licences the MyShake IP from UC Berkeley



MyShake Citizen Seismologists help launch dual-use seismic network in California by Strauss et al published in **Frontiers**

join the community
MyShake.berkeley.edu

Earthquake Early Warning: Advances, Scientific Challenges, and Societal Needs by Allen and Melgar in **Annu. Rev. Earth Planet. Sci.**



2018

ShakeAlert is "open for business"

In a press conference at the Downtown Berkeley BART station on October 8, 2018, the ShakeAlert partners announced that ShakeAlert was available to deliver earthquake alerts across California, Oregon and Washington. The BART train system in the Bay Area was one of the first test users of the warning system and demonstrated how the alerts could slow and stop the trains. But, there was no mechanism to deliver alerts to the public, yet.

Following the press conference, VIPs and the media took a ride on a new BART train to demonstrate how the system works. From left to right: Oakland Mayor Libby Schaaf, BART Board of Directors President Robert Raburn, Congressman Adam Schiff, State Senator Jerry Hill, Berkeley Seismology Lab Director Richard Allen and CalOES's Ryan Arbor.

Publications

Optimizing Earthquake Early Warning Performance: ElarmS-3 by Chung, Henson and Allen published in **Seismo. Res. Lett**.

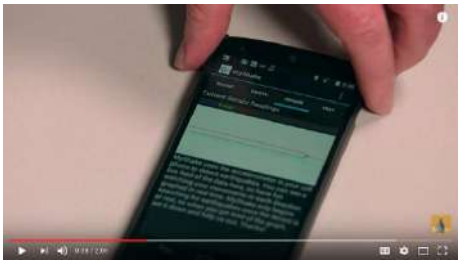
Revised technical implementation plan for the ShakeAlert system — An earthquake early warning system for the West Coast of the United States by Given et al, a **USGS Open File Report**.

2016

MyShake citizen science smartphone app launches

The Berkeley Seismology Lab announced the launch of its MyShake app at the annual meeting of the American Association for the Advancement of Science. Funded by the Moore Foundation, the freely available smartphone app turnes personal smartphones into a network of earthquake sensors. Global press coverage led to some 100,000 downloads within a few weeks, and MyShake became the largest seismic network with sensors distributed around the world.

MyShake: Detecting earthquakes with smartphones - from February 2016 (Play Video)



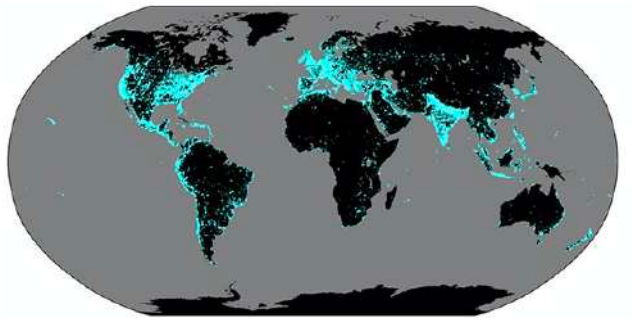
White House summit on Earthquake Early Warning

In February 2016, the White House hosted a summit on earthquake resilience to promote the concept of earthquake early warning. UC Berkeley and other scientists, legislators, and users of the prototype system all spoke to the value ShakeAlert could provide in future earthquakes.

Earthquake Early Warning at the White House

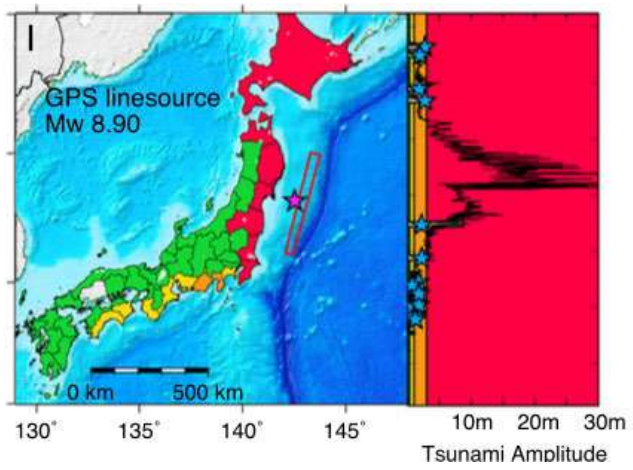
Publications

MyShake: Initial Observations from a Global Smartphone Seismic Network by Kong, Allen and Schreier published in **Geophys. Res. Lett.**.

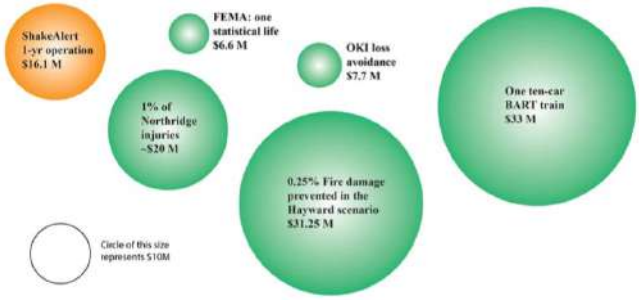


MyShake: A smartphone seismic network for earthquake early warning and beyond by Kong, Allen, Schreier, and Kwon published in **Science Advances**.

The T-larmS algorithm extends earthquake early warning to provide rapid local tsunami warning. The approach is described in *Local tsunami warnings: Perspectives from recent large events* by Melgar et al published in **Geophys. Res. Lett.**.



Benefits and Costs of Earthquake Early Warning by Strauss and Allen, published in **Seismo. Res. Lett.**.



2014

Federal funding to start construction of ShakeAlert

In December 2014, the US Congress provided the first funding specifically to build ShakeAlert with a $5M appropriation of federal funding via USGS's budget. Congressional champions included US Senator Dianne Feinstein (D-CA), Congressman Adam Schiff (D-CA) Congressman Ken Calvert (R-CA) and Congresswoman Barbara Lee (D-CA.)

Berkeley hosts International Meeting on Earthquake Early Warning

The opening session (pictured above) included (from left to right) Prof. Richard Allen, State Sen. Jerry Hill, then Lt. Gov. Gavin Newsom, then State Sen. Alex Padilla, Office of Emergency Services Director Mark Ghilarducci, San Francisco Mayor Ed Lee and USGS Acting Director Suzette Kimball.

Two weeks after the M6.0 Napa earthquake, the Berkeley Seismology Lab hosted an international meeting on earthquake early warning. Attended by scientists, industry partners and politicians, the meeting led to federal funding for ShakeAlert. During the summit, then Lieutenant Governor Gavin Newsom announced, "Disaster Preparedness is now my top priority. Whether through public education and out-

reach, advance warning systems, or protecting our infrastructure, we must leverage technology, innovation and the public will to revive our woefully inadequate disaster preparedness structure."

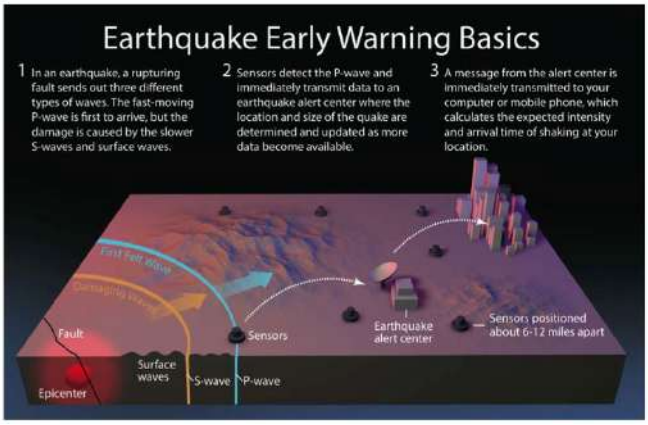
ShakeAlert provides warning in M6.0 Napa earthquake

Earthquake early warning featured on MSNBC's Rachel Maddow - Moment of Geek: Quake warning provides extra life-saving seconds (screenshot)

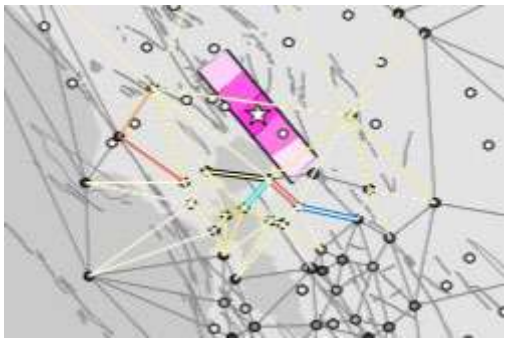
The M6 Napa earthquake at 3:20 am on August 24, 2014, rattled the entire San Francisco Bay Area. Damage was mostly confined to the Napa area, but the entire region was reminded of the earthquake threat. ShakeAlert issued a warning to test users in the Bay Area, including BART, San Francisco Emergency Management, UC Police, and Google. The alert came from Berkeley's ElarmS algorithm.

Publications

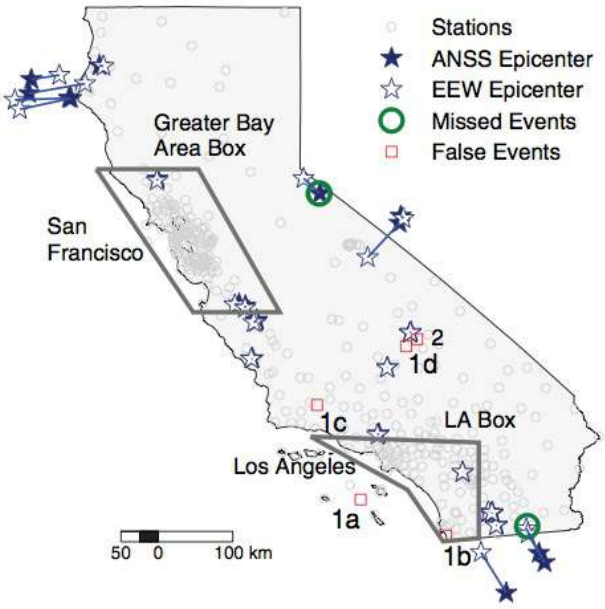
Technical Implementation Plan for the ShakeAlert Production System—An Earthquake Early Warning System for the West Coast of the United States by Given et al published by the US Geological Survey



The 2014 Mw 6.0 Napa earthquake, California: Observations from real-time GPS-enhanced earthquake early warning by Grapenthin, Johanson and Allen published in **Geophys. Res. Lett.**



Designing a Network-Based Earthquake Early Warning Algorithm for California: ElarmS-2 by Kuyuk and Allen published in **Bull. Seismo. Soc. Am.**



CISN ShakeAlert – An Earthquake Early Warning Demonstration System for California by Boese et al published in **Early Warning for Geological Disasters - Scientific Methods and Current Practice**

2013

California passes earthquake early warning legislation

From left to right: Then State Senator Alex Padilla and the USGS EEW coordinator, Doug Given, as a press briefing about the legislation. Richard Allen and Peggy Hellweg of the Berkeley Seismology Lab giving testimony at the various Senate committee hearings.

Sponsored by then State Senator Alex Padilla, California passed legislation to develop a public earthquake early warning system. The bill was later carried by State Senator Jerry Hill, when Padilla became Secretary of State.

Publications

Seconds Count: The United States should install an earthquake early-warning system now — and before the next big one hits by Allen was published in **Nature**

2011

Earthquake Early Warning Summit following M9 Tohoku-Oki earthquake

Summit participants at the press briefing that followed. From left to right: John McPartland (BART), Doug Given (USGS), Tom Heaton (Caltech), John Vidale (then University of Washington), and Richard Allen (Berkeley).

In the devastating M9 earthquake in Japan an alert was issued across Japan before the shaking. Only weeks after this event, the Berkeley Seismology Lab hosted a summit with scientists, legislators, foundations and the private sector. At the summit, a plan was developed to implement a prototype early warning system in the short-term, with a long-term goal of delivering open public alerts in California, Oregon and Washington. The Universities of Washington and Oregon joined UC Berkeley and Caltech in the cooperative agreement with the US Geological Survey, and the Gordon and Betty Moore Foundation made a $6.5M investment in the project to complete the development of the system. This summit was also the beginning of the development of legislation in California to provide early warning.

Publications

Seconds before the big one by Allen and published in **Scientific American** detailed how a U.S. warning system would work.

2007

First real-time generation of an earthquake alert in California

The Berkeley Seismology Lab's prototype ElarmS algorithm was up and running when the M5.4 Alum Rock earthquake rattled the San Francisco Bay Area on Oct. 30, 2007. ElarmS detected the earthquake in real time and generated an alert.

In 2006, the US Geological Survey (USGS) began funding the ShakeAlert cooperative research agreement between UC Berkeley, Caltech and the USGS. This collaborative project was the beginning of the partnership that developed ShakeAlert and continues to operate the system today. The Alum Rock earthquake was the first proof-of-concept event for the ShakeAlert partnership, demonstrating the technical feasibility of rapid earthquake detection and alerting. More details about the quake detection are here.

Publications

The ElarmS earthquake early warning methodology and its application across California by Allen was published in the special volume **Earthquake Early Warning Systems**. This publication detailed the methodology now at the heart of ShakeAlert.

2003

The potential for earthquake early warning in California

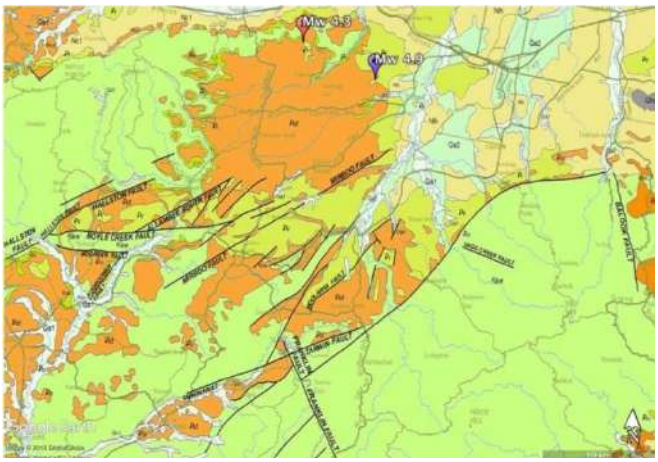
Published in Science, this manuscript authored by Richard Allen and Hiroo Kanamori detailed the scientific foundations and the methodolgy for the development of an early warning system in Southern California. It catalyzed research and development efforts in the United States, Europe and across Asia. The ElarmS alerting algorithm described in this manuscript has since been operationalized in Chile, South Korea, Italy and Israel, and now provides ShakeAlerts across California, Oregon and Washington.

Publications

The potential for earthquake early warning in southern California by Allen and Kanamori, was published in **Science**

Earthquakes that talk to each other

On 19th June 2012 at 8:53 pm local time, a moment magnitude-4.9 earthquake rattled the residents in and around the small town of Thorpdale in eastern Victoria. Moment magnitude measures the size or strength of an earthquake based on how much energy is released, which differs from the better known Richter scale.



The quake was felt more than 100 kilometers away in Melbourne's CBD and in other parts of the state.

Then, nearly a month later, on 20th July at 7:11 pm, another magnitude-4.3 seismic shock jolted the region.

A second earthquake like this is normal because, usually, the release of residue stress on a fault produces smaller aftershocks in the days following a mainshock.

But, in fact, our new research suggests that these earthquakes broke not one, but two adjacent faults. And it's likely that the seismic slip on the first fault activated the second one; which means that the first earthquake communicated with the second one in a language that only the Earth understands.

A quake conversation

Two days after the first quake, the University of Melbourne seismology group deployed 13 temporary seismic stations on a rolling basis in Thorpdale.

These stations are designed to pick up any distinct signals of seismic waves emanating from tiny aftershocks following the first earthquake.

But the stations then picked up signals from the second earthquake that people felt along with the aftershocks.

Because the first earthquake was of reasonable size, permanent—more distant seismic stations maintained by the University of Melbourne along with other agencies like Geoscience Australia and the Seismology Research Centre—picked up its seismic signals.

These signals consist of three main types:

Primary (or P) waves are the fastest seismic waves and will be picked up by a station first

The Secondary (S) waves travel at a slower speed than the P waves. Both these wave types are called body waves because they travel inside the Earth. In Victoria, P and S waves travel at speeds, respectively, of about 20,000 kilometers an hour and 12,600 kilometers an hour.

Surface waves, on the other hand, travel along the surface of the Earth and are the slowest, traveling at around 10,000 kilometers per hour but produce the most shaking. To give you an idea of how fast this is, the speed of sound sits at around 1200 kilometers per hour.

Using these P waveforms, our research team accurately estimated the first earthquake as 4.9 magnitude and the second July one to be 4.3.

The energy released in the first earthquake was about 27 petajoules (PJ) and it released eight times more energy than the second one. In terms of strength, 27 PJ could power the state of Victoria for an entire week.

By accurately timing the arrival of P and S waves at the stations, our team then worked to precisely triangulate the locations of the earthquakes in Thorpdale.

And this is when things got interesting.

More than a single fault

If these earthquakes (including aftershocks) occurred on a single fault, all the earthquakes should have clustered in one place.

But, the two earthquakes had their own separate clusters, and the second earthquake was located roughly seven kilometers to the northwest of the first one. So, it became clear that these earthquakes were two separate mainshocks—which was confirmed by additional projections of fault plane analysis.

There were forty-four aftershocks in the first 24 hours following the first mainshock.

A week later, the aftershock rate diminished to about one a day, and after 18 days, none were recorded. Then, five days before the second mainshock, that aftershock rate picked up.

Three days prior to the second main event, four aftershocks were recorded, and a day after that, another twelve occurred.

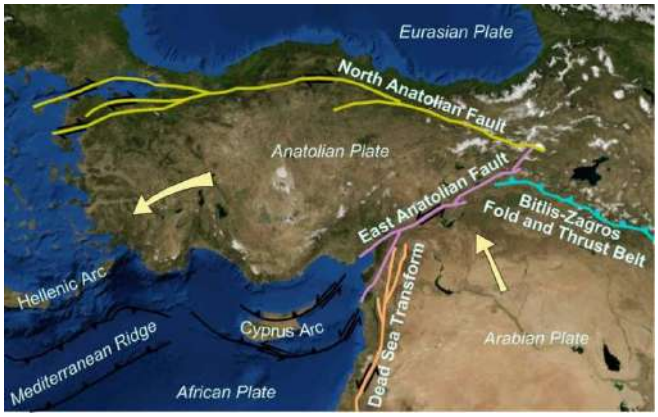
A day before the second mainshock, six aftershocks were detected. It appears that the aftershocks—or the geologic conditions that produce them—were gradually moving towards the location of the second, magnitude 4.3 earthquake.

And on the day of the second mainshock, forty-one aftershocks occurred.

Stress transfer

One way that an earthquake can trigger another is as a result of a mechanism known as Coulomb stress transfer. That is,

an earthquake can change stress conditions in the surrounding Earth's crust in a way that could bring nearby faults either closer to or away from failure.



Testing this condition showed us that the first mainshock slightly relieved stress at the location of the second mainshock. This may have contributed to the nearly 30-day delay in the second mainshock.

In addition, any water trapped in the crust's pores under high compression near the second mainshock may have played a role. It's possible that this water seeped into the fault plane, triggering the second mainshock, as a result of shaking and aftershocks from the first quake.

Seeping water can act as a lubricant for an otherwise locked fault interface, reducing the frictional strength that holds a fault together.

This process is similar to the way in which man-made earthquakes (known as induced seismicity) are triggered from reservoir impoundment and waste water injections.

Victoria's Thomson Reservoir, which sits about 200 kilometers east of Melbourne, is one example of seeping fluid triggering an earthquake.

In this instance, a swarm of earthquakes occurred, that included one in 1996 with a local magnitude of five.

Predicting quakes?

One of the most famous examples of "communicating earthquakes" are the ones that occurred along the 1500-kilometer-long North Anatolian Fault, which sits in modern-day Turkey.

This fault separates two tectonic plates—the Eurasian plate to the north and the Anatolian plate to the south. From 1939 until around 1999, twelve earthquakes with magnitudes exceeding 6.7 have marched westward along the fault line.

So, does this information help us predict earthquakes? Does it help us foretell the size, location and the time of an earthquake?

The short answer is no.

Professor Charles Richter, who developed the Richter magnitude scale which quantifies the size of earthquakes, once famously said: "Journalists and the general public rush to any suggestion of earthquake prediction like hogs toward a full trough, [prediction] provides a happy hunting ground for amateurs, cranks, and outright-publicity seeking fakers."

All that is possible is an earthquake forecast that gives a probability of occurrence of an earthquake with a certain size in a region over decadal time-scales.

Even this process has large uncertainties especially in places like Australia where our historical earthquake record is poor.

But what these two earthquakes talking to each other does tell us, is that earthquakes are not isolated events. Instead, they can interact with each other and increase damage by prolonging earthquake activity in a region.

Provided by **University of Melbourne**.

(Geology Science, April 15, 2021, https://geology-science.info/earthquakes-that-talk-to-each-other)

DeepShake spatiotemporal neural network improves early earthquake warnings

DeepShake, a spatiotemporal neural network trained on more than 36 000 earthquakes, provides a new way of forecasting ground shaking intensity prior to an earthquake, researchers reported at the Seismological Society of America's 2021 Annual Meeting.

The network, developed by researchers Daniel J. Wu, Avoy Datta, Weiqiang Zhu, and William Ellsworth at Stanford University, analyzes seismic signals in real-time. It also issues advanced warning of powerful trembling based on the traits of the earliest detected waves from an earthquake.

The data used to train DeepShake came from seismic recordings of the Ridgecrest sequence in California in 2019. When the researchers tested an M7.1 quake, the neural network sent simulated alerts between 7 and 13 seconds before high-intensity ground shaking occurred in areas in Ridgecrest.

"DeepShake is able to pick up signals in seismic waveforms across dimensions of space and time," said Datta, noting the novelty of using deep learning for quick early warning and predicting directly from seismic records alone.

The network shows the potential of machine learning models to enhance the speed and precision of earthquake alert systems, he added.

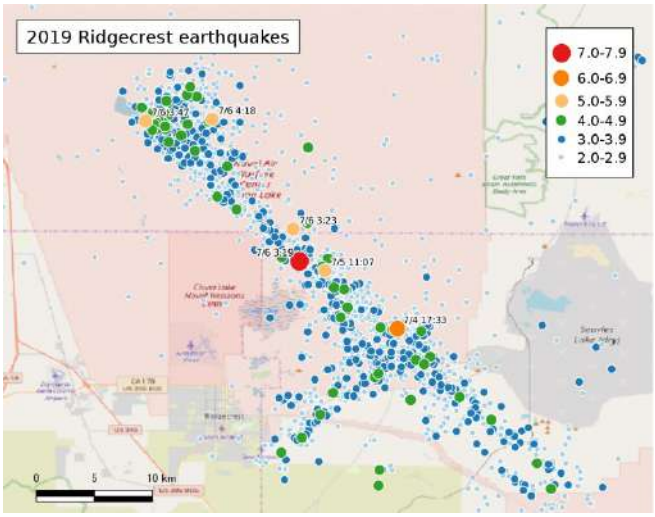
"DeepShake aims to improve on earthquake early warnings by making its shaking estimates directly from ground motion observations, cutting out some of the intermediate steps used by more traditional warning systems," explained Wu.

Many early warning systems first identify the quake's location and magnitude, then calculate ground motion for an area based on ground motion prediction equations.

"Each of these steps can introduce an error that can degrade the ground shaking forecast," Wu added.

To address this, the team went for a neural network approach. The algorithms are trained without the researcher pointing out which signals are vital for the network to use in

its predictions. The network then learned which features optimally predict the intensity of future tremors directly from the data.



"We've noticed from building other neural networks for use in seismology that they can learn all sorts of interesting things, and so they might not need the epicenter and magnitude of the earthquake to make a good forecast," Wu said.

"DeepShake is trained on a preselected network of seismic stations so that the local characteristics of those stations become part of the training data."

"When training a machine learning model end to end, we really think that these models are able to leverage this additional information to improve accuracy."

The team sees DeepShake as complementary to California's ShakeAlert, adding to the tools for early earthquake warning systems.

Datta added, "We're really excited about expanding DeepShake beyond Ridgecrest, and fortifying our work for the real world, including fail-cases such as downed stations and high network latency."

(Julie Celestial / THE WATCHERS, May 5, 2021, https://watchers.news/2021/05/05/deepshake-neural-network-improves-early-earthquake-warnings)

Earthquakes and tsunamis from subduction zones more destructive than current estimates

Earthquakes and tsunamis from subduction zones might be more hazardous than current estimates, a new study suggests. Researchers from the University of New Mexico and the Nanyang Technological University developed a new method to assess the dangers represented by the most distant part of offshore subduction zones. The findings show that the hazard might have been underestimated in some areas, indicating that risk assessments should be redone.

Megathrust earthquakes are among the strongest quakes in the world and occur in subduction zones, where two tectonic plates collide and one slides under the other. If the fault between them is stuck, a slip deficit builds up over time. When such earthquakes impact the shallowest part of the fault near the ocean floor, they could shift the seafloor upward, triggering devastating tsunamis.

Therefore, understanding the potential rupture behavior of megathrusts is a crucial task for geoscientists predicting seismic and tsunami hazards. The possibility of seismic behavior is often believed to be somewhat low in the shallow area of the fault, based on laboratory studies of recovered fault zone material.

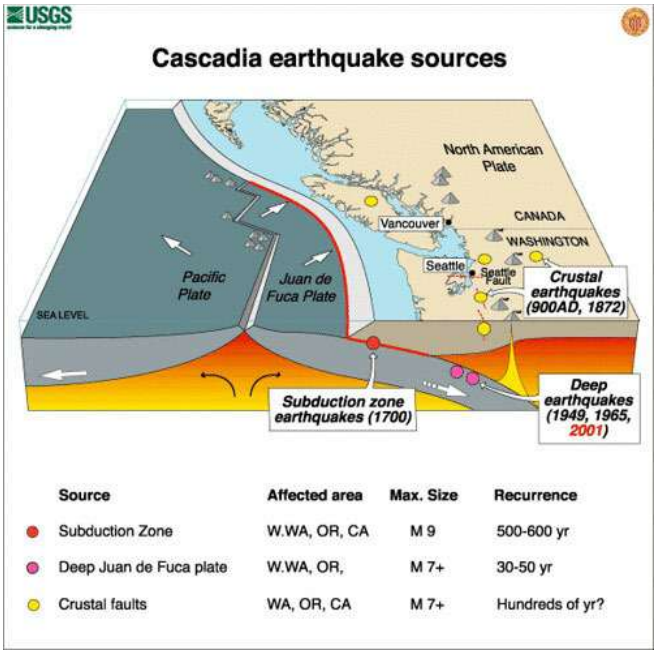
The fault's slip deficit buildup rate can also be calculated with the use of geodetic observations that monitor how the Earth's surface moves over time, as well as a model that relates how slip on the fault impacts the movement of these stations.

However, researchers were having difficulties using this technique to track what is going on in the shallowest part of the fault as it is far from land and underwater, where traditional GPS tools cannot operate.

Now, the researchers in the study have developed a new geodetic method for deducing this value, which accounts for the interaction between various parts of the fault that results in a much more physically accurate result.

Previous models have failed to take into consideration the fact that if the deep part of the fault is stuck between earthquakes, the shallow part can't move as well, in what they call a stress shadow. There is no buildup of energy to cause it to slip.

By taking this into account, the team was able to develop a technique that uses the same land-based data but results in an improvement in their ability to track the fault slip in the areas that are farthest from the shore. This allowed the researchers to reassess the hazard posed by the offshore parts of subduction zones most prone to a tsunami.



"We applied this technique to the Cascadia and Japan subduction zones and found that wherever deeper locked patches are present, the shallow fault must also have a high slip deficit, regardless of its own frictional properties," said Eric Lindsey, an assistant professor in the UNM Department of Earth and Planetary Sciences.

"If these areas can slip seismically, global tsunami hazard could be higher than currently recognized. Our method identifies critical locations where seafloor observations could yield information about frictional properties of these faults in order to better understand their slip behavior."

The study highlights the importance of calling for a reassessment of previous models of tsunami and megathrust hazards worldwide. The team hopes that this will lead to better preparedness among coastal communities.

Reference

"Slip rate deficit and earthquake potential on shallow megathrusts" - Lindsey, E. O., et al. - Nature Geoscience - https://doi.org/10.1038/s41561-021-00736-x

(Julie Celestial / THE WATCHERS, May 5, 2021, https://watchers.news/2021/05/05/earthquakes-and-tsunamis-from-subduction-zones-more-destructive-than-current-estimates)

Slip rate deficit and earthquake potential on shallow megathrusts

Eric O. Lindsey, Rishav Mallick, Judith A. Hubbard, Kyle E. Bradley, Rafael V. Almeida, James D. P. Moore, Roland Bürgmann & Emma M. Hill

Abstract

Most destructive tsunamis are caused by seismic slip on the shallow part of offshore megathrusts. The likelihood of this behaviour is partly determined by the interseismic slip rate deficit, which is often assumed to be low based on frictional studies of shallow fault material. Here, we present a new method for inferring the slip rate deficit from geodetic data that accounts for the stress shadow cast by frictionally locked patches, and show that this approach greatly improves our offshore resolution. We apply this technique to the Cascadia and Japan Trench megathrusts and find that, wherever locked patches are present, the shallow fault generally has a slip rate deficit between 80 and 100% of the plate convergence rate, irrespective of its frictional properties. This finding rules out areas of low kinematic coupling at the trench considered by previous studies. If these areas of the shallow fault can slip seismically, the global tsunami hazard could be higher than currently recognized. Our method identifies critical locations where seafloor observations could yield information about frictional properties of these faults so as to better understand their slip behaviour.

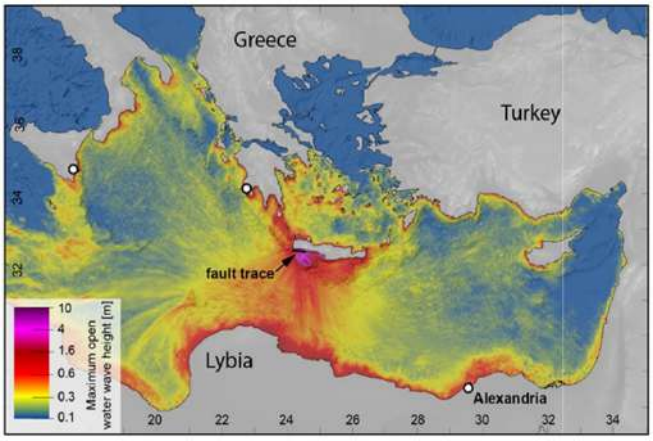
Lindsey, E.O., Mallick, R., Hubbard, J.A. *et al.* Slip rate deficit and earthquake potential on shallow megathrusts. *Nat. Geosci.* (2021). https://doi.org/10.1038/s41561-021-00736-x

(May 3, 2021, https://www.nature.com/articles/s41561-021-00736-x#citeas)

New study reassesses strongest Mediterranean earthquake in history

A new study published in AGU Advances highlighted and reassessed the Crete Earthquake-- believed to be the strongest recorded earthquake in the Mediterranean, which occurred in AD 365. Using new radiocarbon dates and historical records, the researchers showed how much of the shorelines on the Greek island were uplifted during the quake. The findings pinpoint the importance of considering normal-fault earthquake sources in regions where tectonic plates collide and determine future research directions for more hazard characterization.

On July 21, 365 CE, an enormous earthquake occurred around the Mediterranean, so strong that it generated a tsunami that radiated throughout the Eastern Mediterranean basin. As a result, cities were destroyed and there were numerous fatalities. In Alexandria, the tsunami was so severe that the event was commemorated as the "day of horror" for centuries.



Map showing the modeled wave heights of the tsunamis triggered by the 365 Crete Earthquake.

The 365 Crete Earthquake is generally believed to be the largest recorded earthquake in the Mediterranean, powerful enough to lift parts of Crete Island by several meters. This upheaval left behind fossil shorelines, which the researchers studied to reassess the event.

Richard Ott, a scientist at the GFZ German Research Center for Geosciences and lead author of the study, along with his colleagues, refined the dating of the fossil shoreline and compared the information from many samples to ancient records of earthquakes by historic writers.

Radiocarbon analysis of fossils below the shoreline helped to identify when the upheaval took place. The team gathered fossil samples of vermetids and corals from the Krios paleoshoreline at eight different sites. Shells and skeletons from these dead organisms mark when the event happened because they died when the quake lifted them above sea level.

The findings showed that the fossil shoreline was likely not uplifted in one big quake, but rather by a series of powerful earthquakes around the island in the first centuries AD. This result is consistent with archaeological investigations suggesting the ancient harbor in Phalasarna was already abandoned following an earthquake in AD 66.

Compared to previous studies, the findings showed that normal faults are possibly behind this earthquake sequence. Normal faults are a particular type of fracture in the crust that occurs when it is being pulled apart. The researchers model the propagation of tsunamis from earthquakes on

these faults and find that their new type of model can explain well the tsunami report from Alexandria by historic writer Ammianus Marcellinus.

The ruins of the ancient harbor town in Phalasarna.

The findings also suggest that earthquakes on such normal faults are possibly a common tsunami trigger in the Mediterranean. The 365 Crete Earthquake is estimated to be below M_w8, which is lower than previous M8.3 - 8.5 estimates.

However, the researchers pointed out that there is a risk of strong earthquakes in the Eastern Mediterranean, stressing the importance of educating locals on how to act in the event of such a calamity.

"Based on these findings and the better consistency with the long-term record of crustal extension in the region, we favor a normal faulting origin for the 365 CE and earlier earthquakes," the team wrote.

"However, we note that more research, and especially geophysical imaging, is required to adequately understand the tectonics and seismic hazard of the Hellenic Subduction Zone."

Fossil shorelines left behind by the upheaval.

Reference

"Reassessing Eastern Mediterranean Tectonics and Earthquake Hazard From the 365 CE Earthquake" - Ott, R. F., et al. - AGU Advances - https://doi.org/10.1029/2020AV000315

(Julie Celestial / THE WATCHERS, May 11, 2021, https://watchers.news/2021/05/11/largest-recorded-mediterranean-earthquake)

Reassessing Eastern Mediterranean Tectonics and Earthquake Hazard From the 365 CE Earthquake

Richard F. Ott, Karl W. Wegmann, Sean F. Gallen, Frank J. Pazzaglia, Mark T. Brandon, Kosuke Ueda, Charalampos Fassoulas

Abstract

The hallmark of great earthquakes in the Mediterranean is the 21 July 365 CE earthquake and tsunami that destroyed cities and killed thousands of people throughout the Eastern Mediterranean. This event is intriguing because most Mediterranean subduction forearcs exhibit pervasive crustal extension and minimal definitive evidence exists for great subduction megathrust earthquakes, consistent with weak seismic coupling. This conundrum has led many to favor rupture of a previously unrecognized upper plate splay fault south of Crete in an M w 8.3–8.5 earthquake, uplifting a Cretan Holocene paleoshoreline by up to 9 m. Similar source mechanisms have been adapted for the region, which are commonly used for seismic and tsunami hazard estimation. We present an alternative model for Holocene paleoshoreline uplift and the 365 CE tsunami that centers on known active normal fault systems offshore of western and southwestern Crete. We use new and published radiocarbon dates and historical records to show that uplift of the Cretan paleoshoreline likely occurred during two or more earthquakes within 2–3 centuries. Visco-elastic dislocation modeling demonstrates that the rupture of these normal faults fits observed data as well as reverse fault models but requires reduced slip and lower cumulative earthquake energy release (~M w 7.9). Tsunami modeling shows that normal-fault ruptures produce strong tsunamis that better match historical reports than a hypothetical reverse fault. Our findings collectively favor the interpretation that damaging earthquakes and tsunamis in the Eastern Mediterranean can originate on normal faults, highlighting the potential hazard from tsunamigenic upper plate normal fault earthquakes.

AGU Advances, https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2020AV000315

HazMapper: a global open-source natural hazard mapping application in Google Earth Engine

Corey M. Scheip and Karl W. Wegmann

Abstract

Modern satellite networks with rapid image acquisition cycles allow for near-real-time imaging of areas impacted by natural hazards such as mass wasting, flooding, and volcanic eruptions. Publicly accessible multi-spectral datasets (e.g., Landsat, Sentinel-2) are particularly helpful in analyzing the spatial extent of disturbances, however, the datasets are large and require intensive processing on high-powered computers by trained analysts. HazMapper is an open-access hazard mapping application developed in Google Earth Engine that allows users to derive map and GIS-based products from Sentinel or Landsat datasets without the time- and cost-intensive resources required for traditional analysis. The first iteration of HazMapper relies on a vegetation-based metric, the relative difference in the normalized difference vegetation index (rdNDVI), to identify areas on the landscape where

vegetation was removed following a natural disaster. Because of the vegetation-based metric, the tool is typically not suitable for use in desert or polar regions. HazMapper is not a semi-automated routine but makes rapid and repeatable analysis and visualization feasible for both recent and historical natural disasters. Case studies are included for the identification of landslides and debris flows, wildfires, pyroclastic flows, and lava flow inundation. HazMapper is intended for use by both scientists and non-scientists, such as emergency managers and public safety decision-makers.

Scheip, C. M. and Wegmann, K. W.: HazMapper: a global open-source natural hazard mapping application in Google Earth Engine, Nat. Hazards Earth Syst. Sci., 21, 1495–1511, https://doi.org/10.5194/nhess-21-1495-2021, 2021.

https://nhess.copernicus.org/articles/21/1495/2021/

Scientists just dug the deepest ocean hole in history

The team drilled a hole nearly 5 miles (8,000 m) below the Pacific Ocean's surface to study the region's earthquake history.

A team of researchers working off the coast of Japan just drilled a hole in the Pacific seabed deeper than any hole in any ocean before it.

On May 14, scientists aboard the research vessel Kaimei lowered a long, thin drill called a giant piston corer nearly 5 miles (8,000 meters) through the Pacific Ocean — waiting two hours and 40 minutes until the drill finally reached the bottom of the Japan Trench, according to a statement. There, the team extracted a 120-foot-long (37 m) sediment core from the bottom of the sea before slowly hauling the corer up again.

The research vessel Kaimei cruises the Pacific Ocean near the Japan Trench.

The drill site is located very close to the epicenter of the magnitude-9.1 Tohoku-oki earthquake, which battered the region in 2011 and produced a gargantuan tsunami that smashed into the Fukushima Daiichi nuclear power plant, triggering a devastating meltdown. By studying sediment from this area, the researchers hope to learn more about the trench's ancient earthquake history.

This deep drilling operation blows the previous ocean drilling record holder out of the water. For nearly 50 years, that record has belonged to the research vessel Glomar Challenger, which sunk a drill into the Mariana Trench in 1978. That operation recovered a sediment core from about 4.3 miles (7,000 m) below the surface — or about 1,000 m closer to fresh air than the recent RV Kaimei expedition, the team said.

As for the deepest hole ever dug, on land or sea? That title goes to the Kola Superdeep Borehole, created by Russian scientists in the country's far northern Kola Peninsula in 1989. Drilling for the project began in 1970; nearly two decades later, the hole reached a maximum depth of 7.6 miles (12,200 m) below the surface.

The Kola project turned up many geological samples from the continental crust — but, sadly, no buried treasure. No big loss, in the end; sometimes in Siberia, gold just falls from the sky.

(Brandon Specktor - Senior Writer / LIVESCIENCE , 21 May 2021, https://www.livescience.com/deepest-borehole-ever-pacific-ocean-2021.html)

Electromagnetic anomalies occurring before large earthquakes

A new study published in Earth, Planets and Space sheds new light on the electromagnetic anomalies occurring before large earthquakes. The research supports the hypothesis that fault rupture progresses just before an earthquake, and the invading gas is charged and forms a large current, causing various electromagnetic anomalies.

It has been documented over hundreds of years that various electromagnetic anomalies occur a few weeks before the occurrence of a large earthquake. These electromagnetic anomalies are variations that appear in telluric current, geomagnetism, electromagnetic waves, etc. before the earthquake, authors of the new study say.

Although there are various models to explain the mechanism, the large current generated at the source was not fully explained.

For example, many researchers thought that the stress applied to the fault produced an electric current, but the stress applied to the fault takes place over hundreds or thousands of years before the occurrence of the earthquake.

It is a common belief among seismologists that it is impossible for the stress to suddenly increase and generate a large current just before the earthquake, and therefore the mechanism had not yet been explained.

To resolve this mystery, Shinshu University and Genesis Research Institute, Inc. conducted a joint research project on earthquake-preceding phenomena under the leadership of Professor Emeritus of Shinshu University, Dr. Yuji Enomoto. The research group made the following hypothesis and con-

ducted laboratory experiments on indoor rock fracture and gas-electric interactions to solve the mystery of electromagnetic anomalies.

In the area that is at the epicenter of a seismic fault, a fault-valve forms before the next earthquake occurs. It is believed that dense layers in the crust are formed over time. The fluid, including some gases such as water that springs up from the vicinity is trapped by the fault valve and stays there. When the shear stress applied to the fault or the pressure of the stagnant reserved fluid reaches criticality, the fault valve cracks, the high-pressure fluid rises along the fault, and the pressure gradually decreases.

As the pressure decreases, carbon dioxide or methane that are now dissolved in the fluid are degassed at once, expanding in volume and expanding the cracks. The model considers the fault becomes fragile and the rupture accelerates, leading to an earthquake. The gas becomes electrified in the process. That is, it is charged with electricity. The trapped electrons in the defects are suddenly released due to the thermal stimulus and attached to gas molecules. Because it is negatively charged, a current is generated as the gas moves.

In the lab, several types of rock, including granite, gabbro, quartz diorite and basalt were tested. A simple estimation found that there is a high possibility that a large current will be generated immediately before the earthquake, depending on the earthquake magnitude.

This supports the above-mentioned hypothesis that fault rupture progresses just before an earthquake, and the invading gas is charged and forms a large current, causing various electromagnetic anomalies. In the future, the group plan to carry out field observations to verify this model.

Reference

"Laboratory investigation of coupled electrical interaction of fracturing rock with gases" - Yuji Enomoto et al. - Earth, Planets and Space - April 15, 2021 - http://dx.doi.org/10.1186/s40623-021-01416-1 - OPEN ACCESS

(Teo Blašković / THE WATCERS, May 24, 2021, https://watchers.news/2021/05/24/electromagnetic-anomalies-occurring-before-large-earthquakes)

Laboratory investigation of coupled electrical interaction of fracturing rock with gases

Yuji Enomoto, Tsuneaki Yamabe, Shigeki Sugiura & Hitoshi Kondo

Abstract

In the coupled electric interaction of rock fractures and gas invasion, that is, when gases interact with newly created crack surfaces, the unpaired electrons within the rock crystal defects are thermally stimulated, released into the crack due to the temperature rise at the crack tip via plastic work, and attached to ambient gas molecules to electrify them in a negative state. Using a working hypothesis that this mechanism is the source mechanism of seismo-electromagnetic phenomena, we conducted laboratory experiments in which rocks were fractured with pressurized N2, CO2, CH4, and hot water vapour. Fractures were induced by a flat-ended indenter equipped with a flow channel, which was loaded against blocks of quartz diorite, gabbro, basalt, and granite. Fracture-induced negatively electrified gas currents at ~ 25 °C and ~ 160 °C were successfully measured for ~ ≥ 100 μs after full development of the crack. The peak electric currents were as high as 0.05–3 μA, depending on the rock species and interaction area of fractured rock and gas and to a lesser extent on the gas species and temperature. The peak current from fracturing granite, which showed higher γ-ray activity, was at least 10 times higher than that from fracturing gabbro, quartz diorite, and basalt. The results supported the validity of the present working hypothesis, that coupled interaction of fracturing rock with deep Earth gases during quasi-static rupture of rocks in the focal zone of a fault might play an important role in the generation of pre- and co-seismic electromagnetic phenomena.

Earth, Planets and Space **volume 73**, Article number: 90 (2021), https://earth-planets-space.springeropen.com/articles/10.1186/s40623-021-01416-1

Study reveals inner workings of slow-slip earthquakes

Slow-slip earthquakes have been detected at many earthquake hotspots in the world, including areas around the Pacific Ring of Fire, but it remains unclear as to how they are linked to the damaging quakes that take place there. In a new study, researchers at The University of Texas at Austin have revealed its inner workings by studying a region off the coast of New Zealand known to generate slow-slip events.

"Subduction zones are the biggest earthquake and tsunami factories on the planet," said co-author Laura Wallace, a research scientist at GNS Science in New Zealand and at UT Austin's Institute for Geophysics (UTIG).

"With more research like this, we can really begin to understand the origin of different types of [earthquake] behavior at subduction zones."

The team used novel image processing techniques and computer modeling to analyze several proposed mechanisms about how slow-slip quakes happen, revealing the ones that worked best.

According to UTIG research scientist Adrien Arnulf, the study's lead author, this line of research is important because knowing and understanding where and when large subduction zone earthquakes could hit can happen only by determining the inner workings of a slow slip.

Image: Seismic imaging in the Pacific Ocean.

"If you ignore slow slip, you will miscalculate how much energy is stored and released as tectonic plates move around the planet," he said.

Slow-slip events are an important part of an earthquake cycle because they take place in similar places and can emit as much tectonic energy as a high magnitude earthquake without sudden seismic shaking.

For the study, the researchers examined New Zealand's Hikurangi subduction zone, an ideal site to learn more about slow-slip quakes. These events can be traced either by listening to the internal rumblings of the Earth or sending artificial seismic waves and recording the echo.

The team was able to extract more information by programming algorithms on a supercomputer called Lonestar5 to look for patterns in the data. The findings show how weak the fault had become, and where pressure was present within the Earth's joints.

The simulation showed tectonic forces building in the crust then releasing through a series of slow-motion tremors, just like the slow-slip earthquakes at Hikurangi over the past 20 years.

"We don't necessarily have the nail-in-the-coffin of how exactly shallow slow slip occurs, but we tested one of the standard nails (rate-state friction) and found it doesn't work as well as you'd expect," said James Biemiller, a graduate student at the UT Jackson School of Geosciences.

"That means we can probably assume there are other processes involved in modulating slow slip, like cycles of fluid pressurization and release."

The insights will help other scientists point out why tectonic energy at subduction zones is released gently as slow-slip quakes and other times damaging, high-magnitude earthquakes.

Reference

"Physical conditions and frictional properties in the source region of a slow-slip event" - Arnulf, A. F., et al. - Nature Geoscience - https://doi.org/10.1038/s41561-021-00741-0

(Julie Celestial / THE WATCHERS, May 26, 2021, https://watchers.news/2021/05/26/study-reveals-inner-workings-of-slow-slip-earthquakes)

Physical conditions and frictional properties in the source region of a slow-slip event

Adrien F. Arnulf, James Biemiller, Luc Lavier, Laura M. Wallace, Dan Bassett, Stuart Henrys, Ingo Pecher, Gareth Crutchley & Andreia Plaza Faverola

Abstract

Recent geodetic studies have shown that slow-slip events can occur on subduction faults, including their shallow (<15 km depth) parts where tsunamis are also generated. Although observations of such events are now widespread, the physical conditions promoting shallow slow-slip events remain poorly understood. Here we use full waveform inversion of controlled-source seismic data from the central Hikurangi (New Zealand) subduction margin to constrain the physical conditions in a region hosting slow slip. We find that the subduction fault is characterized by compliant, overpressured and mechanically weak material. We identify sharp lateral variations in pore pressure, which reflect focused fluid flow along thrust faults and have a fundamental influence on the distribution of mechanical properties and frictional stability along the subduction fault. We then use high-resolution data-derived mechanical properties to underpin rate–state friction models of slow slip. These models show that shallow subduction fault rocks must be nearly velocity neutral to generate shallow frictional slow slip. Our results have implications for understanding fault-loading processes and slow transient fault slip along megathrust faults.

Nature Geoscience **volume 14**, pages 334–340 (2021), https://www.nature.com/articles/s41561-021-00741-0

Deep earthquakes in Texas driven by shallow wastewater injection

Virginia Tech geoscientists have found that shallow wastewater injections can drive widespread deep earthquake activity in oil and gas production fields. The team came up with the finding after studying the Delaware Basin in western Texas, one of the most productive and unconventional hydrocarbon fields in the United States.

Well drillers dispose of large volumes of brine --a toxic wastewater byproduct of oil and gas production-- by injecting them into subsurface formations where it can drive earthquakes.

Since 2010, the Delaware Basin has seen a major increase in shallow wastewater injection and widespread deep seismicity, including the recent M5.0 event near Mentone. Most of the tremors were relatively small, but some were large and widely felt.

"It is quite interesting that injection above the thick, overall low-permeability shale reservoir can induce an earthquake within the deep basement, despite a minimal hydraulic connection," said lead author Guang Zhai, a postdoctoral research scientist in the Department of Geosciences, who is also part of the Virginia Tech College of Science and a visiting assistant researcher at the University of California, Berkeley.

"What we have found is that the so-called poroelastic stresses can activate basement faults, which is originated from the fluid injection causing rock deformation."

Study co-author Manoochehr Shirzaei, an affiliated faculty member of the Virginia Tech Global Change Center, added, "This finding is significant because it puts poroelastic stresses in the spotlight as the main driver for basinwide earthquakes in the Basin."

Predicting the amount of seismic activity from wastewater injection is troublesome, said Zhai, because it involves numerous variables, including injection depth. Although deep injection is known to be the dominant reason behind fluid pressure increase, it is still questionable how shallow injections cause earthquakes.

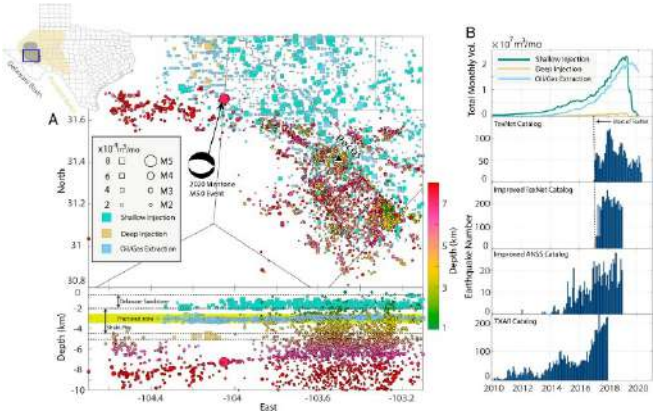


Image: Industrial and seismic activities within the Delaware Basin. Credit: Zhai, et al.

The team looked at how varying amounts of injected brine disturbed the crustal stresses deep under the Delaware Basin and how the disturbances lead to earthquakes.

"Fluids such as brine and natural groundwater can both be stored and move through rocks that are porous," Zhai explained.

The researchers used data analytics and computer modeling to imitate the large volume of fluid extraction from shale reservoirs from more than 1 500 shale production wells from 1993 to 2020, with 400 wells injecting brine in sandstone formations from 2010 to 2020.

They found that the basinwide earthquakes mainly take place where the deep stress increases due to shallow injection. This indicates that there is a causal link between deep earthquakes and shallow fluid injection via elastic stress transfer.

"The deep stress change is sensitive to shallow aquifer properties, especially the hydraulic diffusivity, which describes the ease of fluid flow in porous medium," said co-author Michael Manga.

"One question to ask is why some areas that host lots of shallow injection lack seismicity. Our approach offers a way to investigate other significant factors that control induced earthquake."

Shirzaei added that tectonic settings also help predetermine the magnitude and likelihood of the earthquake.

"We hope the mechanism we find in this study can help people rethink the ways induced earthquakes are caused, eventually helping with better understanding them and mitigating their hazards," Zhai concluded.

Reference

"Widespread deep seismicity in the Delaware Basin, Texas, is mainly driven by shallow wastewater injection" - Zhai, G., et al. - Proceedings of the National Academy of Sciences of the United States of America - https://doi.org/10.1073/pnas.2102338118

(Julie Celestial / THE WATCHERS, May 16, 2021, https://watchers.news/2021/05/16/deep-earthquakes-in-texas-driven-by-shallow-wastewater-injection/)

Widespread deep seismicity in the Delaware Basin, Texas, is mainly driven by shallow wastewater injection

Guang Zhai, Manoochehr Shirzaei, and Michael Manga

Significance

The Delaware Basin, western Texas, has experienced a surge in the number of earthquakes. We investigate basin-wide earthquake, hydrogeologic, industrial, and geodetic data spanning 1993–2020 to identify the reasons for the increase. We use these data and models to quantify the stress changes from wastewater injection and hydrocarbon extraction. We demonstrate that the basin-wide seismicity is dominated by the stresses caused by shallow injection that are transmitted vertically by deforming the underlying crust. We analyze both injection and production data to understand how subsurface properties control earthquake locations and timings. We suggest that injecting wastewater into porous formations will minimize seismic hazard. We establish a framework explaining why earthquakes sometimes occur and sometimes do not occur within human activity-impacted areas.

Abstract

Industrial activity away from plate boundaries can induce earthquakes and has evolved into a global issue. Much of the induced seismicity in the United States' midcontinent is attributed to a direct pressure increase from deep wastewater disposal. This mechanism is not applicable where deep basement faults are hydraulically isolated from shallow injection aquifers, leading to a debate about the mechanisms for induced seismicity. Here, we compile industrial, seismic, geodetic, and geological data within the Delaware Basin, western Texas, and calculate stress and pressure changes at seismogenic depth using a coupled poroelastic model. We show that the widespread deep seismicity is mainly driven by shallow wastewater injection through the transmission of poroelastic stresses assuming that unfractured shales are hydraulic barriers over decadal time scales. A zone of seismic quiescence to the north, where injection-induced stress changes would promote seismicity, suggests a regional tectonic control on the occurrence of induced earthquakes. Comparing the poroelastic responses from injection and extraction operations, we find that the basement stress is most sensitive to shallow reservoir hydrogeological parameters, particularly hydraulic diffusivity. These results demonstrate that intraplate seismicity can be caused by shallow human activities that poroelastically perturb stresses at hydraulically isolated seismogenic depths, with impacts on seismicity that are preconditioned by regional tectonics.

Proceedings of the National Academy of Sciences of the United States of America, PNAS May 18, 2021 118 (20) e2102338118; https://doi.org/10.1073/pnas.2102338118

https://www.pnas.org/content/118/20/e2102338118

New paper on the M7.0 Samos earthquake

I send the link to the paper "Co-seismic and post-seismic deformation, field observations and fault model of the 30 October 2020 $M_w = 7.0$ Samos earthquake, Aegean Sea"

https://link.springer.com/article/10.1007/s11600-021-00599-1

There is also a link to the supplementary material (DOCX file).

Dr Athanassios Ganas

Research Director
Institute of Geodynamics
National Observatory of Athens
Web Page: http://www.gein.noa.gr/Ganas/resume.html

Αρχαιότερες από όσο πιστεύαμε οι τεκτονικές πλάκες της Γης

Η Γη δημιουργήθηκε πριν από περίπου 4,5 δισ. έτη εκατό εκατ. έτη μετά την γέννηση του Ήλιου. Οι τεκτονικές πλάκες, τα τμήματα από τα οποία απαρτίζεται ο στερεός φλοιός, σύμφωνα με την κρατούσα θεωρία σχηματίστηκαν πριν από 3-3,5 δισ. έτη. Χωρίς την παρουσία των τεκτονικών πλακών και μάλιστα με τον τρόπο που αυτές λειτουργούν ο πλανήτης μας θα ήταν εντελώς διαφορετικός και πιθανότατα αφιλόξενος τουλάχιστον για την παρουσία σύνθετων μορφών ζωής.

Μελετώντας αρχαίους κρυστάλλους ζιρκονίου ομάδα διεθνής ερευνητών κατέληξε στο συμπέρασμα ότι οι τεκτονικές πλάκες εμφανίστηκαν τουλάχιστον 200 εκατ. έτη νωρίτερα από την ημερομηνία που αναφέρει η κρατούσα θεωρία.

«Ανασυνθέτουμε τον τρόπο με τον οποίο η Γη μετατράπηκε από μια μπάλα λιωμένων πετρωμάτων και μετάλλων στον πλανήτη που γνωρίζουμε σήμερα» αναφέρει ο Μάικλ Άντερσον, γεωλόγος στο Εθνικό Μουσείο Φυσικής Ιστορίας Smithsonian στην Ουάσινγκτον που ήταν επικεφαλής της έρευνας.

Η μελέτη των τεκτονικών πλακών και ο εντοπισμός ευρημάτων που να αποκαλύπτουν την ιστορία και εξέλιξη τους είναι ένα εξαιρετικά δύσκολο εγχείρημα επειδή οι αρχικές πλάκες έχουν καλυφθεί από νεότερες ενώ παράλληλα έχουν υπάρξει διαδικασίες ανακύκλωσης τους στο πέρας των αιώνων. Αναλύοντας την χημική σύσταση 3,500 πανάρχαιων ζιρκονίων εντόπισαν διάφορα χημικά και ραδιενεργά στοιχεία η παρουσία των οποίων συνδέεται με την ύπαρξη τεκτονικών πλακών. Η χρονολόγηση αυτών των στοιχείων υπέδειξε όχι μόνο την δική τους ηλικία αλλά και αυτή των τεκτονικών πλακών.

http://www.kerdos.gr/επιστήμη-τεχνολογία/389661-αρχαιότερες-από-όσο-πιστεύαμε-οι-τεκτονικές-πλάκες-της-γης

Capturing epistemic uncertainty in site response

Adrian Rodriguez-Marek, Julian J Bommer, Robert RYoungs, Maria J Crespo, Peter J Stafford, and Mahdi Bahrampouri

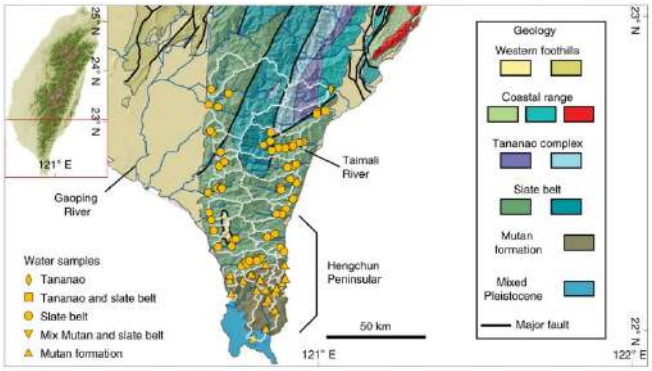
Abstract

The incorporation of local amplification factors (AFs) determined through site response analyses has become standard practice in site-specific probabilistic seismic hazard analysis (PSHA). Another indispensable feature of the current state of practice in site-specific PSHA is the identification and quantification of all epistemic uncertainties that influence the final hazard estimates. Consequently, logic trees are constructed not only for seismic source characteristics and ground-motion models (GMMs) but also for the site AFs, the latter generally characterized by branches for alternative shear-wave velocity (V_S) profiles. However, in the same way that branch weights on alternative GMMs can give rise to unintentionally narrow distributions of predicted ground-motion amplitudes, the distribution of AFs obtained from a small number of weighted V_S profiles will often be quite narrow at some oscillator frequencies. We propose an alternative approach to capturing epistemic uncertainty in site response in order to avoid such unintentionally constricted distributions of AFs using more complete logic trees for site response analyses. Nodes are included for all the factors that influence the calculated AFs, which may include shallow V_S profiles, deeper V_S profiles, depth of impedance contrasts, low-strain soil damping, and choice of modulus reduction and damping curves. Site response analyses are then executed for all branch combinations to generate a large number of frequency-dependent AFs. Finally, these are re-sampled as a discrete distribution with enough branches to capture the underlying distribution of AFs. While this approach improves the representation of epistemic uncertainty in the dynamic site response characteristics, modeling uncertainty in the AFs is not automatically captured in this way, for which reason it is also proposed that a minimum level of epistemic uncertainty should be imposed on the final distribution.

Earthquake Spectra 2021, Vol. 37(2) 921–936,
https://doi.org/10.1177/8755293020970975, https://journals.sagepub.com/doi/abs/10.1177/8755293020970975

ΕΝΔΙΑΦΕΡΟΝΤΑ - ΓΕΩΛΟΓΙΑ

How geological processes affect the concentration of carbon dioxide in the atmosphere: The case study of Taiwan



Lithologic map of southern Taiwan and sampling locations. (Bufe et al., 2021)

A new study, recently published in Nature Geoscience, focuses on the concentration of carbon dioxide in the Earth's atmosphere controlled by geological processes such as erosion and weathering of rocks.

It is already known that certain geological processes produce or store CO_2. In particular, when new rocky formations come to the surface of the ground as a result of tectonics and/or erosion of overlying formations, they are exposed to acidic water and are, in turn, eroded.

The type of the rock affects the chemical processes of the erosion procedure and, eventually, controls the amount of CO_2 that is stored or generated. For instance, if the water comes together with silicate minerals, limestones are formed via direct chemical precipitation. Travertines are common formations of such direct calcium carbonate precipitation. In that case, CO_2 is trapped inside the formations for a long time period. However, if the acidic water contacts sulfurous minerals (e.g., cinnabar, pyrite, sphalerite, stibnite, galena), limestones dissolve and CO_2 is produced. Nevertheless, quantitative data on determining which of those processes prevails in nature have not been derived yet and the new study comes to shed light on this issue.

To find answers, the research team focuses on Taiwan, an island with unique geological features. Taiwan is an earthquake-prone zone where powerful seismic shocks occur on a regular basis shifting the landscape. The southern part of Taiwan has recently emerged from the sea and its mountains are relatively lower and erode at a smaller rate compared to those of its central part. In both parts, silicate and sulfurous minerals exist. Moreover, the island is also frequently hit by typhoons, a fact that accelerates weathering and erosion processes. In addition, it is estimated that those erosion processes occur at a much higher rate in the center of the island compared to those on its southern section. Hence, the island is ideal to study the long-term CO_2 balance.

The team collected water samples from rivers in the mountains of the 2 aforementioned regions in Taiwan and studied the concentration of silicate, sulfide and carbonate minerals in order to derive the amounts of CO_2 produced or stored. They found that carbon dioxide is bound in the southern part of Taiwan. Nevertheless, in the central part where erosion processes are much faster and sulfide weathering prevails, CO_2 is produced. In fact, the release processes that occur in the central part dominate and thus, **Taiwan is an emitter of CO_2.**

The authors of the study emphasize that this may not always be the case. In different environments (e.g., the Alps, the Himalayas etc.) there are various geological features (such as sedimentation in alluvial plains that are rich in silicates) that may impact the carbon dioxide equilibrium. Therefore, there is a lot of research to be conducted in that direction before the effect of geological processes on CO_2 concentration worldwide is comprehensively assessed.

Sources: GFZ-potsdam, Bufe et al., 2021

(Geoengineer.org, Apr, 07, 2021, https://www.geoengineer.org/news/how-geological-processes-affect-the-concentration-of-carbon-dioxide-in-the-atmosphere-taiwan-case-study?utm_source=twitter&utm_medium=social&utm_campaign=page_post)

Co-variation of silicate, carbonate and sulfide weathering drives CO_2 release with erosion

Aaron Bufe, Niels Hovius, Robert Emberson, Jeremy K. C. Rugenstein, Albert Galy, Hima J. Hassenruck-Gudipati & Jui-Ming Chang

Abstract

Global climate is thought to be modulated by the supply of minerals to Earth's surface. Whereas silicate weathering removes carbon dioxide (CO_2) from the atmosphere, weathering of accessory carbonate and sulfide minerals is a geologically relevant source of CO_2. Although these weathering pathways commonly operate side by side, we lack quantitative constraints on their co-variation across erosion rate gradients. Here we use stream-water chemistry across an erosion rate gradient of three orders of magnitude in shales and sandstones of southern Taiwan, and find that sulfide and carbonate weathering rates rise with increasing erosion, while silicate weathering rates remain steady. As a result, on timescales shorter than marine sulfide compensation (approximately 10^6–10^7 years), weathering in rapidly eroding terrain leads to net CO_2 emission rates that are at least twice as fast as CO_2 sequestration rates in slow-eroding terrain. We propose that these weathering reactions are linked and that sulfuric acid generated from sulfide oxidation boosts carbonate solubility, whereas silicate weathering kinetics remain unaffected, possibly due to efficient buffering of the pH. We expect that these patterns are broadly applicable to many Cenozoic mountain ranges that expose marine metasediments.

Bufe, A., Hovius, N., Emberson, R. *et al.* Co-variation of silicate, carbonate and sulfide weathering drives CO_2 release with erosion. *Nat. Geosci.* **14,** 211–216 (2021). https://doi.org/10.1038/s41561-021-00714-3

https://www.nature.com/articles/s41561-021-00714-3#citeas

ΝΕΕΣ ΕΚΔΟΣΕΙΣ ΣΤΙΣ ΓΕΩΤΕΧΝΙΚΕΣ ΕΠΙΣΤΗΜΕΣ

Contractual framework checklist for subsurface construction contracts

ITA Working Ggroup 3

This 2nd edition of the Contractual Framework Checklist builds upon the 1st edition by identifying and clarifying key contractual practice subject areas that ITA believes are fundamental for the success of subsurface construction projects independently of the form of contract and risk apportionment used. This 2nd edition also endorses third party documents that ITA considers to have special subject matter or geographic significance and will further assist formulation of contractual practices for improved project performance.

ITA believes most existing standard forms of construction guidelines and contracts could deal better with the variabilities inherent in subsurface environments, and the impact of those variabilities when an Employer seeks to have an underground facility constructed in this variable environment. Application of this Contractual Framework Checklist will help all parties achieve the ultimate objectives of on-time, on-budget and fitness for purpose delivery of the subsurface (below the surface of the earth, be it water or land) infrastructure.

Download document ITA REPORT #25.pdf

(ITA, 2021)

Use of Recycled Materials in Pavements

PIARC Literature Review

PIARC Technical Committee 4.1 Pavements

Back in 2003, PIARC published a report from Technical Committee C7/8 on "Pavement Recycling". This report contains guidelines for in-place recycling with cement, emulsion or foamed bitumen and hot mix recycling in a plant.

The current literature review is part of a set of three publications on the "Use of Recycled Materials in Pavements" expected for the 2020-2023 cycle.

This literature review describes:

- recycling in-place using hydraulic and/or bituminous binders, it also addresses the preliminary investigations of the existing pavement prior to recycling it;
- recycling or re-using in-plant where the recycled materials are mixed in plant, adding hydraulic or bituminous binders, to produce a mix for asphalt or concrete pavements, or for road base layers.

A second publication will be a collection of case studies.

This literature review does not contain any conclusions or recommendations on recycling pavement materials. They will be part of a third publication, which is a briefing note

(PRIARC, 2021)

ΗΛΕΚΤΡΟΝΙΚΑ ΠΕΡΙΟΔΙΚΑ

Τεύχος 1, Μάιος 2021
2021_ΤΕΥΧΟΣ_1ο.pdf Download File

Κυκλοφόρησε το 1ο Τεύχος του 2021 του ηλεκτρονικού περιοδικού της Ελληνικής Επιτροπής Σηράγγων & Υπογείων Έργων (Ε.Ε.Σ.Υ.Ε.) Μαΐου 2021με τα ακόλουθα περιεχόμενα:

Τα Νέα & οι Εκδηλώσεις μας

- Ραντεβου Το 2023 Στην Αθήνα!
- Εκλογές ΕΕΕΣΥΕ
- Γυναίκες στη Σηραγγοποιία – Ελλάδα

Τα Νέα της ΙΤΑ

- 2021 Lunchtime Lecture Series

Ενδιαφέρουσες Εξελίξεις

- Σήραγγα στη Βαλτική: Φινλανδία - Εσθονία
- Υποθαλάσσια Σήραγγα Γιβραλτάρ

Εκδηλώσεις Σχετικές (και) με Υπόγεια Έργα

- WTC 2022
- Euroengeo 2021

Νέες Εκδόσεις / Κυκλοφορίες

www.issmge.org/publications/issmge-bulletin/vol-15-issue-2-april-2021

Κυκλοφόρησε το Τεύχος #2 του Τόμου 15 (Απριλίου 2021) του Bulletin της ISSMGE με τα παρακάτω περιεχόμενα:

- **TC Corner**
  - TC304: State-of-the-at review of inherent variability and uncertainty in ge-otechnical properties and models
  - TC211 & 202: Inaugural HDR workshop by the Transport Research Centre, UTS
- **Major project**
  - Seismic site classification proposed by Chile
- **How news**
  - Grishmanov Award 2020
- **ISSMGE Foundation**
- **Event Diary**
- **Corporate Associates**
- **Foundation Donors**

International Journal of Geoengineering Case Histories

An official journal of the International Society for Soil Mechanics and Geotechnical Engineering

Volume 6, Issue #1, https://www.geocasehistoriesjournal.org/pub/issue/view/47

The Case Histories Journal is a peer-review journal on the geotechnical engineering practice with a focus on careful documentation of case histories with an **emphasis on observations and data collected during and after project construction.** Papers are reviewed by a distinguished international Editorial Board and a selected number of reviewers. All papers published in the journal are accompanied by electronic data for better documentation of each case history.

We are pleased to announce the publication of a new special issue on Case Histories from Turkey. This is a special issue organized by the Turkish Geotechnical Society. We thank Prof. Dr. S. Feyza Cinicioglu, President of the Turkish Geotechnical Society for ISSMGE, who served as a Guest Editor for this Special Issue.

On behalf of the Case Histories Journal,

Dimitrios Zekkos, University of California at Berkeley, Editor-in-Chief
Jean-Louis Briaud, Texas A&M, Co-Editor-in Chief

Table of Contents

Editorial by Feyza Cinicioglu

The Multi-Purpose Bottom Plug for the Galataport Project by Salvatore Miranda

Performance Monitoring of Rammed Aggregate Piers® (RAPs) by Ece Kurt Bal, Lale Oner, Kutay Ozaydin

A Constructability Problem in a Deep Shoring System by Hakan Köpüklü, Onur Ekli, Önder Akçakal, Hilmi Turan DurgunoÄŸlu

View Issue

GeoWorld

Geo-Trends Review

A Crowdsourcing Magazine for the Geotechnical Engineering Community
Issue #15 - May 2021
www.mygeoworld.com/geotrends/issues/15-may-2021

If you want to be part of the first interactive geotechnical magazine start blogging, posting, updating your profile, asking and replying to questions, today!

You can also interact and add value to the news that interest you by using the share and like buttons under each story, event or discussion.

Through Geo-Trends, YOU are the author and YOUR message reaches directly thousands of geo-professionals!

International Geosynthetics Society

Κυκλοφόρησε το IGS Newsletter της International Geosynthetics Society με τα παρακάτω περιεχόμενα:

IGS NEWSLETTER – May 2021

Helping the world understand the appropriate value and use of geosynthetics

httpwww.geosyntheticssociety.org/newsletters

- 12 ICG Postponed to September 2023 READ MORE
- New Dates for GeoAsia 7 READ MORE
- IGS Foundation Annual Report Out Now READ MORE
- Sustainable Dams With IGS India READ MORE
- My Engineer Life With… Tondani Nevhutalu READ MORE
- Social Media – IGS Brazil Experience READ MORE
- IGS Sustainability Paper Features In Special Edition READ MORE
- Upcoming Webinars
  Ingenuity with Geosynthetics REGISTRATION INFORMATION
  Gas Geomembrane Webinar REGISTRATION INFORMATION
  Geosynthetics CQA in Barrier and Floating Covers
  Geomembrane Behavior In Mining
  REGISTRATION INFORMATION
- Calendar of Events

www.icevirtuallibrary.com/toc/jgein/28/2

Κυκλοφόρησε το Τεύχος 2 του Τόμου 28 (Απριλίου 2021) του Geosynthetics International της International Geo-synthetics Society με τα παρακάτω περιεχόμενα:

Repeated loading of soilbag-reinforced road subgrade, S. H. Liu, J. Liao, T. T. Bong, K. W. Fan, 28(2), pp. 113–124

Performance and design of modified geotextile tubes during filling and consolidation, H. J. Kim, T. W. Park, P. R. Dinoy, H.S. Kim, 28(2), pp. 125–143

Water characteristic curves of geosynthetic clay liners hydrated by a saline solution, B. Yu, A. El-Zein, 28(2), pp. 144–157

Effect of aperture ratio on the cyclic shear behaviour of aggregate-geogrid interfaces, J. Wang, F. Y. Liu, Q. T. Zheng, Y. Q. Cai, C. F. Gou, 28(2), pp. 158–173

Modeling the WRC and volume change behavior of GCLs considering net stress and temperature, S. Rajesh, S. Roy, V. Khan, 28(2), pp. 174–185

Thermal conductivity of nonwoven needle-punched geotextiles: effect of stress and moisture, M. Lahoori, S. Rosin-Paumier, G. Stoltz, Y. Jannot, 28(2), pp. 186–194

Effect of fiber reinforcement on the mechanical behavior of bio-cemented sand, C. Lv, C. Zhu, C.-S. Tang, Q. Cheng, L.-Y. Yin, B. Shi, 28(2), pp. 195–205

Compatibility of tailings–nonwoven geotextile under stress and the effect of sand filter, S. Liu, Y. Wang, D. Feng, 28(2), pp. 206–213

Interaction between PFASs and geosynthetic liners: current status and the way forward, A. Bouazza, 28(2), pp. 214–223

ΕΚΤΕΛΕΣΤΙΚΗ ΕΠΙΤΡΟΠΗ ΕΕΕΕΓΜ (2019 – 2022)

Πρόεδρος	:	Μιχάλης ΜΠΑΡΔΑΝΗΣ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΣ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Α.Ε. mbardanis@edafos.gr, lab@edafos.gr
Α' Αντιπρόεδρος	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr
Β' Αντιπρόεδρος	:	Μιχάλης ΠΑΧΑΚΗΣ, Πολιτικός Μηχανικός mpax46@otenet.gr
Γενικός Γραμματέας	:	Γιώργος ΜΠΕΛΟΚΑΣ, Δρ. Πολιτικός Μηχανικός, Επίκουρος Καθηγητής ΤΕΙ Αθήνας gbelokas@teiath.gr, gbelokas@gmail.com
Ταμίας	:	Γιώργος ΝΤΟΥΛΗΣ, Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε.- ΓΕΩΤΕΧΝΙΚΕΣ ΜΕΛΕΤΕΣ Α.Ε. gdoulis@edafomichaniki.gr
Έφορος	:	Γεώργιος ΓΚΑΖΕΤΑΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής Ε.Μ.Π. gazetas@central.ntua.gr, gazetas50@gmail.com
Μέλη	:	Ανδρέας ΑΝΑΓΝΩΣΤΟΠΟΥΛΟΣ, Δρ. Πολιτικός Μηχανικός, Ομότιμος Καθηγητής ΕΜΠ aanagn@central.ntua.gr
		Παναγιώτης ΒΕΤΤΑΣ, Πολιτικός Μηχανικός, ΟΜΙΛΟΣ ΤΕΧΝΙΚΩΝ ΜΕΛΕΤΩΝ Α.Ε. otmate@otenet.gr
		Μαρίνα ΠΑΝΤΑΖΙΔΟΥ, Δρ. Πολιτικός Μηχανικός, Αναπληρώτρια Καθηγήτρια Ε.Μ.Π. mpanta@central.ntua.gr
Αναπληρωματικά Μέλη	:	Χρήστος ΣΤΡΑΤΑΚΟΣ, Πολιτικός Μηχανικός, ΝΑΜΑ Α.Ε. stratakos@namalab.gr
		Βάλια ΞΕΝΑΚΗ, Δρ. Πολιτικός Μηχανικός, ΕΔΑΦΟΜΗΧΑΝΙΚΗ Α.Ε. vxenaki@edafomichaniki.gr
Εκδότης	:	Χρήστος ΤΣΑΤΣΑΝΙΦΟΣ, Δρ. Πολιτικός Μηχανικός, ΠΑΝΓΑΙΑ ΣΥΜΒΟΥΛΟΙ ΜΗΧΑΝΙΚΟΙ Ε.Π.Ε. editor@hssmge.gr, ctsatsanifos@pangaea.gr

ΕΕΕΕΓΜ

Τομέας Γεωτεχνικής
ΣΧΟΛΗ ΠΟΛΙΤΙΚΩΝ ΜΗΧΑΝΙΚΩΝ
ΕΘΝΙΚΟΥ ΜΕΤΣΟΒΙΟΥ ΠΟΛΥΤΕΧΝΕΙΟΥ
Πολυτεχνειούπολη Ζωγράφου
15780 ΖΩΓΡΑΦΟΥ

Τηλ. 210.7723434
Τοτ. 210.7723428
Ηλ-Δι. secretariat@hssmge.gr ,
geotech@central.ntua.gr
Ιστοσελίδα www.hssmge.org (υπό κατασκευή)

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» Εκδότης: Χρήστος Τσατσανίφος, τηλ. 210.6929484, τοτ. 210.6928137, ηλ-δι. ctsatsanifos@pangaea.gr, editor@hssmge.gr, info@pangaea.gr

«ΤΑ ΝΕΑ ΤΗΣ ΕΕΕΕΓΜ» «αναρτώνται» και στην ιστοσελίδα www.hssmge.gr