SUMMARY OF IGCP 2017

IN GEOHAZARDS THEME

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IGCP project 640: Significance of Modern and Ancient Subaqueous Slope Landslides (S4LIDE)

Duration: 2015-2020

Aims: Submarine landslides pose a risk to coastal communities and offshore infrastructure. However, our lack of understanding of the causal mechanisms and timing of submarine landslides has hampered progress in the prediction effort, which is essential to implement appropriate mitigation measures. This project seeks to create an international and multidisciplinary platform allowing geoscientists from academia and industry to sustain a dialogue conducive to the integration of findings from different fields into a more cohesive understanding of submarine landslides.

Related UN SDGs: This project contributes to the following sub-goals of the UN SDGs:

Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture
2.4. By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality.

Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable
11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

Countries involved, approximate number of total 2017 participants

Representatives of 30 countries collaborate in the IGCP project: Australia, Austria, Belgium, Brazil, Canada, Colombia, China, Czech Republic, Egypt, France, Germany, India, Ireland, Israel, Italy, Japan, Republic of South Korea, Russia, Netherlands, New Zealand, New Caledonia, Nigeria, Norway, Peru, Spain, Switzerland, Thailand, United Kingdom, USA, and Venezuela. About 250 people are involved in the project.

Scientific activities (meetings, workshops, training sessions)

Six main scientific meetings and workshops in 2017 have been organizes in London, Houston, Vienna, Washington, New Delhi and New Orleans as well as two main main training events.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.)

S4SLIDE Morphometric Database. Several steps in the right direction. The S4SLIDE community works on advancing the understanding of subaqueous landslides with special emphasis on the collection of morphometric parameters and their potential relationship with pre-conditioning factors and triggering mechanisms.

Development of Rapid Response Monitoring of Submarine Landslides. The 14 November 2016, Kaikoura (New Zealand) Mw7.8 earthquake triggered widespread landslides offshore. The earthquake-triggered landslides evolved into a full canyon flushing turbidity current that travelled at least 680 km along the deep sea Hikurangi Channel and most likely reached the terminal fan – 1500 km from the initial landslides. The event has reshaped much of the canyon and decimated one of the highest biomass benthic ecosystems documented in the deep sea. Although canyon flushing events like this have been recognized from the geological record and submarine cable breaks, this was the first direct documentation of the consequences of canyon flushing events on seafloor geomorphology and ecosystem structure.

Tsunamigenic Hazard Assessment in Lakes. Tsunami in lakes may pose a significant threat to lakeshore settlements and infrastructure but globally remain a relatively unknown hazard. A pilot study has been carried out in New Zealand's Lake Tekapo to assess the magnitude and frequency of landslide-generated tsunamis. Lake Tekapo is a 120 m deep glacial formed lake that attracts large numbers of tourists and is part of New Zealand's large hydroelectric power network. Analysis of seismic data indicate that some delta systems have collapsed repeatedly throughout the ~17,000 years following glacial retreat. Tsunami modelling indicates that landslides can cause tsunami up to 5 m at the southern shoreline where tourism and infrastructure is located. Modelling concurrent failures shows amplification of the generated waves indicting that basin-wide failure events could

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result in significant tsunami in this lake. These results are being used to determine the probability of landslide-generated tsunami and subsequently the hazard at the southern shoreline.
Other achievements:

- IODP Expedition 372 Creeping Gas Hydrate Slides and Hikurangi LWD, starting in November, will certainly be a milestone for submarine landslide research;
- The European Union Funded International Student Training Network SLATE started in 2017 and will foster student training and research on submarine landslides over the next 4 years.
- Successful submission of new IODP Proposal 922 "Pre Slope failure and stability of the Cenozoic western Atlantic: Causes and history" (SASCWATCH) by Hugh Daigle et al.

Project team members published 49 papers in 2017.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)

Scientists working on the IGCP project 640 "Significance of Modern and Ancient Subaqueous Slope Landslides (S4LIDE)" consider that the remains of landslide masses lie on the bed of many lakes (for example, Lake Tekapo). They conduct the research collecting data and analyzing them using mathematical and numerical models to find out what sort of tsunamis could occur if there was big landslide. If that happened, it could endanger local residents, tourists, and surrounding infrastructure. The observation and modeling help scientists seeing how big the landslides have been in the past and making forecasting on what can happen in the future. The S4LIDE project participants disseminate the gained scientific knowledge on landslides and tsunamis via scientific meetings, workshops and training courses co-sponsored by the UNESCO-IUGS International Geoscience Program.

The IGCP project URL: https://sites.google.com/a/utexas.edu/s4slide/

IGCP project 641: Deformation and fissuring caused by exploitation of subsurface fluids (M3EF3)

Duration: 2015-2018

Aims: Ground response to subsurface fluid extraction in terms of land subsidence is one of the classical issues in geosciences, bearing wide implications from a societal point of view, e.g. increasing flood risks, damaging buildings and infrastructures, reducing water availability, etc.. M3EF3 project aims to: (i) map the distribution of ground failure caused by subsurface fluid extraction at the world scale, with strong emphasis given to Africa where there are very few reports of systematic studies on subsidence and related processes; (ii) characterize the major features of the detected fissure systems and identify the factors that interact for their occurrence; (iii) appropriately integrate geo-mechanical analyses, effective and economic monitoring methodologies, and modeling techniques to investigate the generation/propagation of earth fissure and fault activation; (iv) understand the process of ground failure by focusing on a few sites (in Mexico, China, Arizona); (v) develop a procedure of risk assessment for determining the most probable conditions (from both the geological point of view and also in terms of human activities) of ground failure; (vi) identify effective management and mitigation strategies that have been used to reduce this geologic risk; (vii) promote the integration between scientists from different disciplines and experts from developed/developing countries; and (viii) disseminate the M3EF3 outcomes through workshops, a project website, guidelines for laboratory, monitoring, and modeling investigations, risk analyses applied to ground failure, and non-technical fact sheets for policy makers and citizens.

Related UN SDGs

This project contributes to Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable of the UN SDGs. Namely, "11.5. By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations."

Countries involved, approximate number of total 2017 participants

Representatives of 15 countries collaborate within this project: Australia, Canada, Colombia, China, Germany, Iran, Italy, Mexico, Pakistan, Philippines, Poland, Spain, the Netherlands, UK, and USA. 65 people are involved in the project.

Scientific activities (meetings, workshops, training sessions)

Main scientific meeting of the project was held in Alicante, Spain including a training session with 35 attendants from Spain, Mexico, USA, Italy, China, Japan, The Netherlands, Egypt, Pakistan, Poland, Colombia.

Scientific achievements/ results (papers, new findings, new models, new data, new map etc.)

Mechanisms: The main 3-4 mechanisms responsible for ground rupture development in subsiding basins were defined. Appropriate new material was been added to the project website. A theoretical modelling study was begun and the ongoing study seeks to quantify the main drivers/conditions causing earth fissures and fractures development (preliminary results will be presented at the international conference MODSIM 2017).

Monitoring: Specific in-situ and remote-sensing methodologies were developed, tested and established: fiber-optics horizontal extensometers were established in Wuxi (China); advanced FFT analyses of InSAR-based displacement maps and time series were applied to Mexico City; a novel 3D reconstruction of fissure geometries from drone acquisitions were developed in Spain and tested on specific study cases, ground-mapped fissures in Arizona. Furthermore, a first map of ground fractures was developed for Mexico City and a first world map of the ground ruptures occurrence has been released (http://www.igcp641.org/?page_id=45).

Modelling: To understand the geomechanical processes caused by groundwater pumping in a sedimentary basin they developed an integrative analysis using 3D numerical models with an accurate geological framework. A new methodology integrating regional and local models allows scientists (for the first time) to account for the development and motion on fissures as features in the propagation of deformation in sedimentary basins. A first example was published in the framework of the collaboration Italy-China (Ye et al., *submitted*). They published one map, one paper and one book chapter related to the project in 2017.

Societal/educational results/highlights (media coverage, science, education, cultural and informal) related to the Climate Change (Paris COP21), Disaster risk reduction (Sendai framework) and SDGs (New York 2015)

Several articles in Mexican local newspapers on the topic of the project.

The IGCP project URL: http://www.igcp641.org