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Testing the potential of a submarine fibre optic cable to detect sediment gravity flows using laser interferometry

Irena Schulten[1], Cecilia Clivati[2], Aaron Micallef[1], Simone Donadello[2], Davide Calonico[2], André Xuereb[2], Alberto Mura[2], and Filippo Levi[2]
[1]University of Malta, Geosciences, Msida, Malta (irena.schulten@um.edu.mt)
[2]Istituto Nazionale di Ricerca Metrologica – INRIM, Turin, Italy

Sediment gravity flows are common processes in the submarine environment. They are important for the global sediment transport, but can destroy offshore infrastructure and may even contribute to tsunami generation. These flows, however, remain poorly understood. There is a lack of direct observations due to difficulties with deploying appropriate instruments and predicting the occurrence and route of these flows, especially on open continental slopes. Deployed instruments are further often destroyed as a result of the gravity flows. Submarine fibre cables are present along almost all continental margins worldwide. They are economically important for telecommunication and internet data transfer. Historic records, however, have shown that submarine gravity flows affect and even severe these cables.

Recent studies successfully tested the usage of fibre optic cables to detect earthquakes and other processes such changes in the wave height associated with storm events. The aim of this study will be to test whether fibre optic cables can also detect submarine gravity flows using laser interferometry. The study is based on a cooperation between the University of Malta and the Istituto Nazionale di Ricerca Metrologica (INRiM) in Italy and is part of the European funded project "Modern and recent sediment gravity flows offshore eastern Sicily, western Ionian Basin (MARGRAF, ID 101038070)". The University of Malta has been granted permission to collect data from a 260-km long optical fibre cable that connects Malta and Sicily through the western Ionian Basin. INRiM provided the measurement system and technical support needed to carry out the experiment. The western Ionian Basin is an ideal study site, as it is characterised by many earthquakes, tsunamis and submarine sediment gravity flows. The cable crosses known pathways of these gravity flows and thus provides a high possibility to detect modern sediment flows. The laser interferometry data will be analysed to detect disturbances (e.g., twists, expansions, contractions) on the cable. Any detected disturbances will be compared with oceanographic and seismometer data, both from onshore stations and Ocean Bottom Seismometers (OBS). This comparison will allow us to infer the source of the cable disturbance. In addition, we plan to collect gravity cores in vicinity of the event to assess whether the event was based on a gravity flow or not. Initial results showed earthquakes and various storm events recorded by the cable.

The findings are expected to improve our current understanding of gravity flows in the region in terms of potential trigger mechanisms and reoccurrence rate. Eastern Sicily is densely populated and hosts touristic and industrial infrastructure, which makes it important to constrain the geohazard implication of these flows. A successful test will further allow to use this application on cables in other regions worldwide.