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The contribution of the CAM fibre optic submarine cable telecom ring to the early warning of tsunami and earthquakes

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CAM is the acronym of the submarine telecommunication fibre optic cables that interconnect in a ring Portugal mainland, Azores and Madeira archipelagos. The current cables will cease their operation by 2024 (due to the end of cable lifetime), and the process of their replacement by a new set of cables is now under consideration by the Portuguese authorities with the technical requirements to be defined until mid-2020.

The CAM cables span along the plate boundary between Eurasia and Nubia, an offshore domain prone to generate destructive earthquakes and tsunamis. The impacts caused by these natural hazards can be mitigated by effective tsunami (TWS) and earthquake (EEWS) early warning systems that would benefit (but not only) Portugal, Spain and Morocco. In TWS, a confirmation that a tsunami was generated, and an evaluation of its amplitude, are only obtained after the recordings from the closest coastal tide-gauge are analysed. Hence, this information will not benefit large stretches of coastline. EEWS that rely on land station observations of strong motion will not profit the regions closest to the epicentre. Furthermore, the quality of the offshore earthquake parameters computed by the operational centres is less than optimal when land stations only are used.

All these difficulties can be overcome by deploying sensors integrated in the commercial telecom submarine cables to be installed in the future, without reduction of the reliability, lifetime, operational and functional requirements demanded by operators. Being closer to the tectonic sources, such sensors (and the cable itself) will record the geophysical parameters and transmit them to land much faster than the speed of destructive waves, providing the processing centres with critical lead time. This is the approach that has been advocated by the Joint Task Force led by three U.N. agencies (ITU, WMO and UNESCO-IOC) (Howe et al., Front. Mar. Sci. 6:424, 2019). Such initiative was given the name of SMART, for Science Monitoring and Reliable Telecommunications.

In this work we evaluate the contribution of a SMART CAM fibre optic ring of cables, with repeaters equipped with geophysical sensors, to three critical aspects of TWS and EEWS: 1) quality of fast earthquake parameters; 2) earthquake early warning lead time; 3) tsunami confirmation warning time. The performance parameters selected where: i) azimuthal gap between the minimum set of stations required for an earthquake location to be accepted; ii) size of the estimated location error ellipse; iii) error on the focal depth estimation; iv) gain in P-wave advance time for the minimum set of stations required by the EEWS; v) gain in tsunami travel time to the closest tide-gauge or pressure sensor.

The methodology and results obtained are valuable to encourage national authorities to implement the SMART cable concept in the technical specifications for future telecommunication submarine cables. This has been recently suggested by the ANACOM President (the Portuguese regulator for telecommunications advising the national authorities) for the CAM cables that must be operational in early 2024. The first author would like to acknowledge the financial support from FCT through project UIDB/50019/2020-IDL.