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Slope instability as a proxy of Cantabrian Coast retreat (N Iberia): a multidisciplinary approach

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Coast retreat is linked to global changes and it affects large population, therefore it is one of the great challenges of the future. The Asturian sector of the Cantabrian Coast (N Iberia) shows more than 660 km of rugged morphology developing cliffs (more than 50% of the coastline) where slope instabilities are very frequent. Moreover, the coastal municipalities are exposed to risk as well as great social and economic vulnerability. Taking into account the above, in January 2018 we started the research project: "Slope instability as a proxy of Cantabrian Coast retreat: a multidisciplinary approach. COSINES" to study the Asturian rocky coast evolution during the period 2018-2020. This project aims to characterize the retreat of the Asturian Coast using cliffs instability as a geomorphological indicator. The specific objectives are: 1) Establish the spatial distribution of slope movements in multiple cliffs; 2) determine their typology; 3) identify the role of both conditioning factors (lithology and geological structure) and triggers (meteorological phenomena including maritime storms); 4) develop conceptual models of coastal evolution; 5) establish the spatial and temporal evolution; and 6) quantify the contribution of cliff instabilities to the coastline retreat.

Lithologically, the Asturian Coast can be divided into three zones: i) the western zone, with a predominance of Paleozoic siliceous rocks (sandstone, quartzite and slate); ii) the central zone, of mixed lithology, with an alternation of calcareous (limestone and marl) and siliceous (mostly shale, sandstone, conglomerate) rocks with ages ranging from Paleozoic to Permian-Triassic; and iii) the eastern zone, with a predominance of calcareous materials (limestone and marl) dated from Carboniferous to Jurassic. Three pilot areas representative of each of the three previously mentioned zones have been considered in our project. The study sectors, from West to East, are: 1) Luarca sector, with 10.4 km; 2) Cabo Peñas sector, with 36.9 km and 3) Tazones sector, with 13.5 km.

Meteorologically, the Asturian Coast is a temperate and rainy coastline with significant precipitations above 1000 mm/year. NW incoming wave component is the main dynamic factor of this mesotidal coast, frequently affected by strong Atlantic storms, especially in winter, being the range greater than 4.0 m the 10% of the time.

At a regional scale, the multidisciplinary methodology comprises: 1) Collection of digital topographic bases, sequential aerial photographs and geological maps; 2) compilation of slope instability data, meteorological records and marine dynamics information; 3) geological, geomorphological and hydrogeological mapping at 1:10,000 scale. Three selected cliffs (one in each pilot area) were selected to develop more detailed studies, involving: 1) Photogrammetric surveys by Remotely Piloted Aircraft, as well as geophysical and topographical surveys; 2) detailed geological, geomorphological and hydrogeological mapping at 1:1,000 scale; 3) geomechanical characterization of the cliffs' rock mass; and 4) development of stability models using finite element and limit equilibrium methods. The development of a spatial database in GIS allows storing and managing spatial data at regional and detailed scale.

Here we present our research progress and a synthesis of the work already done in the COSINES project framework.