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To the determination of triggering factors of chalk cliff collapses in Upper Normandy

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The coastline of Upper Normandy (France) is made up of a 130 km long chalk cliff in the central part of the English Channel shoreline. For the last 30 years the average chalk cliff retreat rate is about 0.21 m/y. This cliff retreat is locally different and the rate can reach up to a metric value. Spatial variability of cliff recession occurs due to layers variations in local lithology or the influence of natural and man-made obstacles to the longshore drift. At the regional scale, chalk lithology seems to be homogeneous. But at the local scale, there are lithofacies differences and sedimentary discontinuities. These variations contain some subtle resistance contrasts that act on retreat modalities. Indeed, cliffs composed of the upper part of Senonian Chalk have a greater cliff recession rate than those composed of the lower Senonian Chalk and, equally of Turonian Chalk. An understanding of this rocky coast erosion is necessary because the decimetric retreat rate is threatening settlements that are too close to the coastline.

The main aim of this study is to determine the triggering factors of cliff retreat. We would like to contribute to scientific discussion about the predominance of marine processes and/or sub-aerial weathering processes in the trigger of cliff collapses. Human actions have to be taken into account because they modify longshore drift and can increase swell action at the cliff foot with the implementation of artificial structures.

This study is based on collaboration with the ESTRAN association. Since 2002, a special branch of this association, the “Service Littoral” has made a weekly inventory of cliff falls (location, volume and dating) along 12 km of coastline from Sainte-Marguerite-sur-Mer to Bracquemont. Thus, we have a considerable and unique database of cliff collapses. The originality of this database is in: 1) the length of period of observations, 2) the high periodicity of inventory and 3) the precise dating of discrete retreat events.

The analysis deals with the statistical definition of the relationships between processes and collapse and also with the understanding of the spatial organisation of collapse types (cliff foot collapse, central cliff collapse, top cliff collapse and whole cliff collapse). Cliff falls occur predominantly in winter but can also occur in summer.

Unsurprisingly, periods of intense rainfall (instantaneous or cumulative) and many frost/thaw cycles seem to generate the highest numbers of collapses. However, each process leads to specific modality and volumetric contribution. In view of these initial results, it is difficult to classify the processes that trigger the types of collapse. Indeed, numerous combinations of factors and the phenomena of process shifts or even hysteresis effects make the connection between triggering agents and cliff falls more complex.