Sylvain Chaverot's Ph.D. thesis "Impact des variations récentes des conditions météo-marines sur les littoraux meubles du Nord-Pas-de-Calais"

Abstract:
The aim of this doctoral dissertation is to analyse the response of low-lying sandy coasts of Nord-Pas-de-Calais to high energy events at various spatial and temporal scales.
First, the evolution of the shoreline was determined by comparison of geometrically rectified aerial photographs from the second half of the XXth century. This was followed by an analysis of meteorological and tide-gauge data from three stations along the Côte d'Opale (Boulogne-sur-Mer, Calais, Dunkirk). This analysis focuses on high magnitude events (in terms of wind velocity and surge height), which likely have the most significant impacts on shorelines. The study of high energy events reveals an important interannual variability. At Dunkerque, two high wind velocity periods ($\geq$ 16 $m.s^{-1}$) dominated by winds from the north and north-west, and high surges ($\geq$ 100 cm) are observed between 1956-1962 and 1972-1977. At Boulogne-sur-Mer, a stormy period is also observed between the mid 80's and mid 90's.
To assess the potential impact of high water levels during high energy periods, on sandy shorelines at a short time-scale (event) and at a medium time-scale (several years) on macrotidal environments, meteorological and geomorphologic data have been integrated into a storm erosion susceptibility index using different parameters (water level above dune toe, event duration, height of the waves). At a short time-scale, the storm index reveals that the geomorphologic response of the coastline to high water events is mainly controlled by storm-induced processes. But at a longer time-scales (several years), there is no clear relationship between storm index and shoreline evolution. Thus, shoreline response is probably controlled by variations in sediment supply.
Finally, this study includes an evaluation of the possible impacts of climate change on the evolution of unconsolidated shorelines. Some of the expected consequences on coasts include sea-level rise and an increase in storm intensity and frequency. Such scenarios would result in an acceleration of coastal erosion and more frequent flooding of low-lying sandy coastlines, which are highly vulnerable. Zones at risk of marine flooding in a vulnerable area of the Côte d'Opale are mapped.