Effective management of European coastal erosion is one of the major stakes of the 21st century. The EU EUROSION report (2004) underlines that all European coastal states are to some extent affected by coastal erosion. Erosion of sandy beaches is exemplified by the displacement of the shoreline, which is located on a relatively steep section of the beach profile, extending shoreward from the low tide level to the berm, called the beachface. Since the 1990s, methods to fight coastal erosion have largely shifted from "hard engineering" to "soft engineering". One potential soft-engineering measure to promote beachface sedimentation is known as the Beach Dewatering System (BDS), based on the artificial regression of the beach groundwater. The applied-research question underlying the NATARISE project is why a BDS leads to sedimentation. It was envisaged that an improved understanding of the interaction between swash motion and groundwater was crucial to answer this question. As the groundwater in a beach is actively drained, this will alter infiltration/exfiltration speeds of water into/out of the beach. This, in turn, will affect sediment transport processes, possibly leading to beach sedimentation.

Within this context, the NATARISE project was based on two major objectives:

1. to investigate swash/groundwater interactions between contrasting European beaches, and
2. to understand how BDS promotes beachface sedimentation, while investigating the instantaneous effects of the drainage influence over swash in/exfiltration speeds and volumes.

To reach these objectives, NATARISE was separated into 4 work-packages:

1. influence of tide over beachface morphodynamics of meso-macrotidal beaches
2. influence of short waves / long waves over beachface morphodynamic of microtidal beaches
3. impact of beach dewatering systems over instantaneous beachface morphodynamics of a microtidal reflective beach
4. modelling of natural and artificially influenced beachface morphodynamics of contrasting beaches.

During the actual project, the researcher placed considerable effort on work-packages 1 and 2 (i.e., objective 1). The field measurements belonging to work-package 2 required far more preparation time than originally anticipated. Also, the data was more noisy that envisaged and thus more work had to be spent on data validation. As a result, work on packages 3 and 4 (i.e. objective 2) was not carried out.

The main results of workpackages 1 and 2 are as follows:

- (work-package 1) A gently sloping, meso-macro-tidal beach with medium-size (350 μm) sand acts as a damping medium. Well shoreward of the swash zone the groundwater is clearly elevated above the sea level and does not show noteworthy variations. Closer to the swash zone, temporal variations in groundwater level at tidal and long-wave (20 – 200 s) periods become increasingly obvious.

Fluctuations at periods of the sea and swell ('short') waves are essentially non-existent.

- (work-package 1) For the same beach, the beach fills up faster than it drains. During falling tide, the water table and the mean sea level decouple. During rising tide, a local super-elevation of the groundwater level is present in the swash zone due to infiltration.
- (work-package 2) A new data set on swash – groundwater interaction was collected on a rather steep, low-energy, micro-tidal beach in the south of France (photo 1). A unique aspect of the campaign was the instantaneous measurement of bed elevation change with ultrasonic devices.
- (work-package 2) An individual swash on a microtidal beach may cause sedimentation or erosion of the beachface by several millimeters during low-energy conditions. Similar swash motions may result in opposite bed-level change, causing the tide-averaged accretion or erosion of the beachface to be small and to be of the same order as that of an individual swash. Thus, the amounts of sand transported during individual swashes may be huge, but the resulting tide-averaged bed-level change is only small. This highlights the complexity if we wish to reliably predict beach evolution with wave-resolving models.

The next steps, in the post-NATARISE stage of the project, will be to more fully analyze the data, with a focus on water in/exfiltration. The existing and new results then need to be compared to results that are obtained at an artificially drained beach. This comparison will show if and why active dewatering promotes beachface sedimentation. Furthermore, it will help in designing the characteristics of BDSs to most efficiently combat beach erosion. The NATARISE data set is actually worked on by our French partner at LSEET, Université de Toulon, France.

Photograph 1 Cross-shore array of pressure sensors, velocimeters and ultrasonic devices deployed as part of work package 2 to study swash – groundwater interactions on a low-energy, microtidal beach. The ultrasonic devices have provided a unique insight into the response of the bed level to individual swash events.