PhD project (2023-2026) – Université de Toulouse

Modelling out-of-equilibrium beach profiles

Departments	Institut de Mécanique des Fluides de Toulouse (IMFT - UMR5502) Laboratoire d'Etudes en Géophysique et Océanographie Spatiales (LEGOS - UMR5566)
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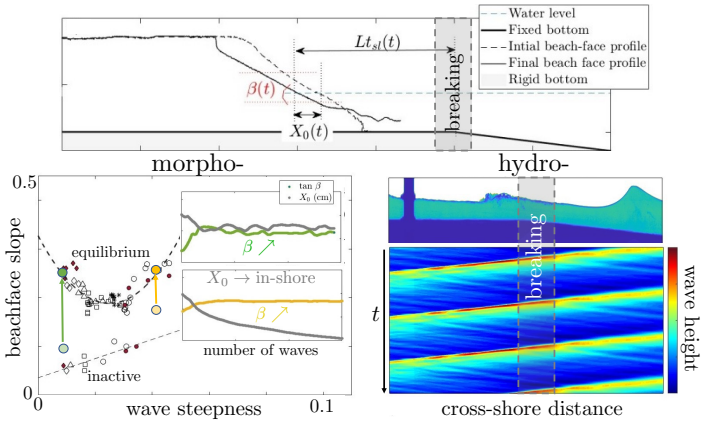
Context and objectives : Due to an increase of the occurrence of extreme events, associated with climate change, and a sediment budget deficit, accentuated by human activities, it is necessary to better understand the evolution of coastal zones towards new equilibrium states. How will coastal zones adapt to these changes to come ? The objective of this project is part of this environmental context using a combined approach of laboratory experimental models and in-situ measurements. The project deals with the concept of equilibrium beach states, under wave forcing, and their transition towards new states due to sediment deficit or wave forcing variation. **The objective of the project** is then to **understand and characterize the influence of the available volume of sand** (induced by a long-shore current in natural situations) on the **transient evolution from one-equilibrium to another** (induced by a modification of wave forcing associated with a storm or seasonal variation in natural situations). For that purpose an original physical model at the laboratory scale has been designed at IMFT, allowing a constant input of sand into a cross-shore-model wave flume. This allows to mimic and control the sand input from longshore current in natural situations, while the wave maker allows to control the wave forcing.

In-situ deployment of metrological techinques. a) extraction of cross-shore profil using a measurement stick, b) GPS localisation, c) HD camera and d) LIDAR.

Methods : **The originality of the project is to provide and to characterize useful semi-empirical models containing the physical ingredients at the origin of the morphodynamics transitions**, mentioned previously, and **to confront the extracted models from laboratory scale to real situations**. For this purpose, laboratory experiments will be achieved in the wave flume at IMFT. Models based on the pertinent physical processes will be developed thanks to accurate measurements of the morphodynamics when varying the dimensionless parameters controlling the dynamics of the system. In particular, experimental campaigns consist of varying (i) the frequency and/or the amplitude of the wave forcing using control of the wave-maker and (ii) local volume of sediment on the beach face. Models based one the relevant dimensionless parameters controlling the dynamics of the system (wave steepness, Rouse number, Dean number, among others) and obtained from these laboratory campaigns will be tested and validated on available field data.



Physical model of beachface evolution under monochromatic wave forcing. Rigid topography imposes the breaking point and the inner-surf dissipation length. Case of a sediment budget deficit.

Candidate : The study is mostly based onto laboratory experimental models, with a substantial part of physical analyses and modeling. The candidate should have a background in fluid mechanics or physics, with an interest in experimental research and geophysical fluid mechanics and/or applications to natural flows.

Deadline for application is end of May 2023.