PhD or Postdoctoral position in IPGP (Paris)

# Modelling dune morphodynamics in presence of vegetation

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**Summary:** The long-term objective is to provide new numerical methods for the quantitative analysis of vegetated dune fields. Dealing with such a complex system, the naive, brute force approach would be to set up a mathematical model that accounts for all the involved physical/biological mechanisms and their appropriate length scales. This type of modeling is unrealistic because of the number of parameters and the uncertainties about the underlying processes. Our strategy of model building is to work at an intermediate length scale of 1 meter with a coherent dune model, which can incorporate different physical/biological compartments and their subsequent sets of interaction. The ReSCAL dune model, a software package constructed on a modular basis for simulating systems in which multiple processes are combined, is particularly well-adapted for this purpose *(Rozier et al., 2014)*.
We will start working on vegetation following the same methodology as for the analysis of different grain sizes *(Gao et al., 2015)*. We will first introduce a new field into the structure associated with sedimentary cells to account for the role of plants on transport, erosion and deposition. Thus, immobile sedimentary cells will be either in a vegetated or non-vegetated substates. As for granular mixtures, these substates will have different threshold shear stress for motion inception and a different impact on deposition when the interact with other sedimentary cells. In addition, biological processes associated with seeding and vegetation growth can be easily incorporated into the 3D structure of the model. It takes the form of new transitions between the vegetated and the non-vegetated substates in order to account for changes in surface and subsurface properties. As a result, spatial heterogeneities associated with vegetation may dynamically evolve over time even without transport. Obviously, when considering transport, it will generate a new level of complexity in the model, which will have without any doubt a strong impact on both sand flux and dune morphodynamics. Specific attention will be given to the formation of blowout, an erosion pattern rarely observed on dunes in arid desert and common in coastal areas or in semi-arid environments.

**Required skills:**

Geomorphology, granular physics, numerical modelling (C, Matlab, python), Linux.

**Grant:**

French National Research Agency, ANR SONO
Marrying coastal safety objectives with natural development of sand dunes.

**Salary:** 1430 euros/month for a PhD of 3 years.
2000 euros/month for a Postdoc of 2 years.

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