Post-Doc offer

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Vegetated dunes in a real-space cellular automaton

The long-term objective is to provide new numerical methods for the quantitative analysis of vegetated dune fields under multidirectional wind regimes. Dealing with such a complex system, the brute force approach would be to set up a mathematical model that accounts for all the involved physical/biological mechanisms. This type of modelling 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 *(see source codes and papers on http://www.ipgp.fr/rescal)*.

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), Linux.

Salary: The salary grid of the IPGP will be applied according to experience. The grant is provided by the French National Agency, ANR SONO (Combine coastal defence and protection of the natural environment through sand dunes).

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