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Modelling coastal dune development under climate change

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The balance between positive and negative sediment fluxes for coastal dunes determines their volume and morphology. Important controls on coastal dune development are climate, vegetation, sediment budget and management. Changes in climate and environmental conditions may lead to a shift in the balance between dune growth and erosion. To answer the question whether coastal dunes will be able to provide a natural defence against the sea in a changing climate, a model of the beach-foredune system is needed that includes the important controls.

Although several models have been developed that simulate the interactions between vegetation and aeolian transport in dune development, none of these incorporates the coupling between dune and beach. Therefore, a new tool will be developed to simulate the dynamics of the beach-foredune system and to study coastal dune development under changing conditions.

The DECAL algorithm (Baas, 2002) will form the basis of the model development. It uses a cellular automata approach and is capable of producing realistic landforms resulting from interaction between vegetation and aeolian transport. It will be extend with a wind erosion component that calculates aeolian sediment fluxes as a function of wind and surface conditions, to simulate the irregular sediment supply from the beach to the dunes. Finally, the vegetation's growth functions will be refined with a more sophisticated vegetation growth model. Field work will be carried out to measure aeolian sediment fluxes and to monitor elevation changes in relation to vegetation patterns.

The new beach-dune model will be used to simulate coastal dune development under a set of scenarios on environmental change. The results will indicate the system's sensitivities to climate parameters, show possible directions of dune development and aid in developing adequate adaptation strategies.