Interaction dynamics of sand dunes in numerical simulation

Atsunari Katsuki[1]; Macoto Kikuchi[2]; Noritaka Endo[3]; Hiraku Nishimori[4]

[1] Phys. sci., Osaka University & Cyber media center, Osaka University; [2] Cyber media center, Osaka University; [3] Earth and Space Sci., Osaka Univ.; [4] Graduate school of Engineering,

Osaka Pref. Univ.

http://www.cp.cmc.osaka-u.ac.jp/~katsuki/indexJ.html

Dunes has been studied by a lot of geologist and physicists. They mainly has focused on a single dune. However, dunes are observed usually as a group. Thus we think that there should be some interaction between dunes. In this thesis, the interaction dynamics between dunes,
especially crescentic dune called barchan, is studied by using a water tank experiment and numerical simulations.

First, we propose a minimal model which
can describes essentials of dune dynamics and can reproduce a barchan. The model includes only two processes: sand transport in the flow-direction and avalanche. In spite of its simplicity, the model reproduces morphologic features of a barchan and of a dune field.

Next, we investigate a collision process of two barchans as the simplest case of interaction.

Four types of collision processes are observed in
water tank experiments. Numerical simulations reproduce these patterns successfully and clarify their difference in detail. In addition, we propose a set of phenomenological equations which expresses the collision dynamics of two barchans.

Lastly, formation dynamics of a dune field is investigated. A water tank experiment and numerical simulation show pattern transition of dunes in the course of formation of
the barchan field. The initial sand bed changes its form into transverse ripples, that is, dunes with straight crest lines perpendicular to the flow direction. After that, barchans emerge from transverse ripples.