

# A Numerical Simulation of the Temporal Evolution of a Three Dimensional Barchanoid Dune and the Corresponding Sediment Dynamics

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## Abstract

Current driven sediment transport causes the evolution of bedforms like ripples, scour marks, or dunes. Here the interaction of a fluid with an underlying sediment bed is the driving force. Therefore two phenomena have to be covered by the modeling as well as in the implementation. In this study we use NaSt3D as fluid solver for incompressible flow problems in three dimensions and apply this fluid solver to the problem of sediment transport processes during the evolution of a dune. The main parts in sediment transport are bed load and suspension load, which are both calculated from the fluid velocities by empirical models. In detail, the transport of the suspended material is modeled by a modified advection diffusion equation. Furthermore a continuity equation describes the temporal evolution of the sediment surface and its morphological change. Additionally to the sediment models, the slope stability of the sediment is treated by a slope limiting algorithm, which ensures the angle of repose. Both sediment models and the slope limiter are fully coupled to the Navier Stokes solver by a loosely partitioned approach. With this approach a robust coupled system is available to simulate various erosion and deposition problems. The code is tested at single phase examples like the simulation of a barchanoid dune. In this experiment the bed and suspension load transport as well as the morphological change of the sediment surface are well covered and show the capability of the simulation.

## References

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