Title of the project:
Aeolian Sediment Transport from the Beach to the Dunes: From grain scale toward bulk scale sediment transport

Assignment no.: ##	**Internal/external:** Internal
Head graduation committee: Prof.dr.ir. S. Luding	**Daily advisor:** Staff/PhD Multi Scale Mechanics, Dr.ir. G.H.P. Campmans, …
Name(s) of participating companies or institutes:	**Start of the project:** November 2019/when possible

Required courses:
Either courses related to numerical techniques, or experimental techniques.

Short description and objective of the project:

Background/context Many of the world's coastlines, including those in the Netherlands, are sandy and consist of beaches and dune fields, forming the interface between water and land. Coastal dunes play an important role in the safety of coastal regions by offering protection against flooding. Understanding the dynamics of the coastal system, especially the recovery of the dunes after storm erosion and the long–term growth rate of dunes (to meet the rate of sea level rise and keep providing sufficient levels of flood protection), requires knowledge on Aeolian (wind-blown) sediment transport.

For predicting morphologic (topographic) changes of the dunes, accurate predictions of sediment transport rates from the beach to the dunes are required, especially the amount of sand that can be blown out of the more moist part of the beach that falls dry during low tide, because this is the zone where waves can deposit new sand during flood tide and by wave run-up. However, the current transport models used for such predictive applications are far from accurate. Predicted transport rates may even deviate up to an order of magnitude from observed transport rates. Obviously, these errors make current transport models of limited value to predictively address the temporal scales relevant to coastal engineering, which are in the order months-years up to decades.

One of the possible sources for error is the fact that current transport formulations may use an erroneous representation of the initiation of grain motion on moist beaches. This also contributes to the so-called 'fetch effect', the downwind distance over which the wind has to blow to develop fully saturated sand transport, starting from zero sand transport at the waterline. Furthermore, errors may be related to the space-time varying structure in sediment concentration as observed in aeolian streamers (fig) and how such clouds form and behave. The idea for this project is to start from a fundamental understanding of sand grain behavior under airflow over moist sand beds and translating this towards a larger scale sediment transport formulation

Aim/Goal The aim of this project is to study sand grain behavior at level of small scale particle dynamics and translate these dynamics, or contribute to such translation, into a

larger scale sediment transport formulation in the context of coastal engineering (sand from the beach to the dunes by wind).

Methods This is still open, it can be done using numerical modeling techniques or possibly also via experimental techniques.

Figure: Aeolian streamers, varying in space and time (a movie can be found here).