Title of the project:
Deriving beach surface properties from Sentinel-1 satellite imagery

Assignment no.: 33.16	**Internal/external:** Internal
Head graduation committee: dr. K.M. Wijnberg	**Daily advisor:** Dr. J. Ndungu Dr.ir. R. van der Velde (ITC) MSc I.A. Williams
Name(s) of participating companies or institutes:	**Start of the project:** a.s.a.p.

Required courses:
Morphology
Data analysis in WEM

Short description and objective of the project:

Motivation: For the design of Building with Nature solutions along sandy shores, such as the Sand Motor (Figure 1a), we need to be able to predict the long term effect of these projects on dune formation. Currently, proper well-tested models to do so are lacking. One of the main problems is the currently inadequate modelling of the amount of sand transport by wind occurring on beaches and beach plains. On the process scale, the transport rate is sensitive to variation in various beach surface properties, such as moisture content and surface roughness. To understand the importance of the short term variation in moisture content and surface roughness for the long-term wind driven sand supply, we first want to know whether, and how variable these properties actually are on beach plains, both in time and space. The Sentinel1 SAR imagery (Synthetic Aperture Radar) potentially offers a vast amount of data to study this variability, as the reflection of the radar signal is sensitive to soil moisture content and surface roughness. At present, however, it is not yet clear how well available algorithms perform on beaches/beach plains, nor whether coherent patterns in reflection occur over beach plains. Figure 1(b,d) shows two example SAR images for the Sand Motor (artificial beach plain) and SW-Texel (natural beach plain) respectively, which both show spatial variation in reflection.

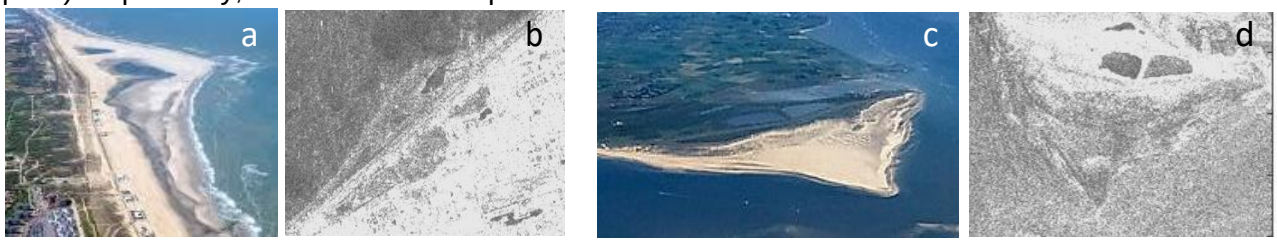

Figure 1: Example Sentinel-1 imagery of beach plains, both artificial (a,b;, the Sand Motor) and natural (c,d; Texel)

Objectives
The objective of this research project is to assess to what extent Sentinel-1 imagery is suitable to map time-varying spatial patterns in surface moisture content and/or surface roughness on beach plains, and, if suitable, explore the variability of these properties in time and space.

The research will involve, amongst others, a literature review, SAR image pre-processing (e.g. noise reduction), collection of ground truth data on surface moisture content at the Sand Motor and Texel, testing of existing algorithms for suitability on beach plains, and analysis of imagery regarding temporal variation of spatially coherent patterns in radar reflection.

Links for some background reading

Sentinel-1 SAR: https://sentinel.esa.int/web/sentinel/user-guides/sentinel-1-sar

Wagner et al., The potential of Sentinel-1 for monitoring soil moisture with a high spatial resolution at global scale (http://rs.geo.tuwien.ac.at/share/publications/publ/0048.pdf)

Van der Weerd and Wijnberg (2016). Aeolian sediment flux derived from a natural sand trap (http://www.bioone.org/doi/pdf/10.2112/SI75-068.1)