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3D modelling of mechanical peat properties in the Holocene coastal-deltaic sequence of the Netherlands

Kay Koster (1,2), Esther Stouthamer (1), Kim Cohen (1,2,3), Jan Stafleu (2), Freek Busschers (2), and Hans Middelkoop (1)

(1) Utrecht University, Faculty of Geosciences, Department of Physical Geography, Netherlands (k.koster1@uu.nl), (2) TNO - Geological Survey of the Netherlands, (3) Deltares, Department of Applied Geology and Geophysics

Peat is abundantly present within the Holocene coastal-deltaic sequence of the Netherlands, where it is alternating with clastic fluvial, estuarine and lagoonal deposits. The areas that are rich in peat are vulnerable to land subsidence, resulting from consolidation and oxidation, due to loading by overlying deposits, infrastructure and buildings, as well as excessive artificial drainage. The physical properties of the peat are very heterogeneous, with variable clastic admixture up to 80% of its mass and rapid decrease in porosity with increasing effective stress.
Mapping the spatial distribution of the peat properties is essential for identifying areas most susceptible to future land subsidence, as mineral content determines volume loss by oxidation, and porosity influences the rate of consolidation. Here we present the outline of a study focusing on mapping mechanical peat properties in relation to density and amount of admixed clastic constituents of Holocene peat layers (in 3D). In this study we use a staged approach:
1) Identifying soil mechanical properties in two large datasets that are managed by Utrecht University and the Geological Survey.
2) Determining relations between these properties and palaeogeographical development of the area by evaluating these properties against known geological concepts such as distance to clastic source (river, estuary etc.).
3) Implementing the obtained relations in GeoTOP, which is a 3D geological subsurface model of the Netherlands developed by the Geological Survey. The model will be used, among others, to assess the susceptibility of different areas to peat related land subsidence and load bearing capacity of the subsurface.
So far, our analysis has focused stage 1, by establishing empirical relations between mechanical peat properties in $\sim$70 paired (piezometer) cone penetration tests and continuously cored boreholes with LOI measurements. Results show strong correlations between net cone resistance (qn), excess pore water (u1-u0), and total vertical stress (σvo), suggesting that the overburden strongly controls the vertical differential susceptibility of peat layers to consolidation.