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SHALLOW GEOPHYSICS APPLIED IN A TIDAL FLAT AREA

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In order to validate 3D models of sedimentation in active sedimentary environments, detailed stratigraphic information from both the land and the sea is indispensable. However, this land-sea-boundary often remains a blank spot, as it presents serious technological challenges. In the present study land- and sea-based shallow geophysics were tested in a tidal estuary environment with the aim to assess the validity, consistency and vertical resolution of each method.

The test site is located in the Verdronken land van Saeftinghe, at the southern rim of the Westerschelde estuary, The Netherlands. It consists of some 3000ha of salt marshes, intertidal mudflats and sandy shoals, cut by numerous creeks and gully systems. The shallow subsurface is made up of alternating sand, clay and peat layers. Data acquisition focussed on the top 10-20m. During high tide marine data were obtained from the major creeks; at low tide land data were obtained from exposed sand bars and salt marshes. Applied techniques included VHR land and marine seismics, geo-electrical & electromagnetic methods (land + marine), CPT and shallow coring on land. Lightweight equipment and small boats provided a fast and effective survey means, crucial in difficult terrain conditions.

Marine seismic profiling involved different sources (Parametric Echosounder, Seistec, 3.5kHz Echosounder, Boomer). The first two yielded excellent images (vertical resolution 15-25cm); the latter two proved inadequate in very shallow water. Land seismic trials included S- & P-wave vibrator, (sledge-) hammer, and drop weight (geophone spacing 25cm). DC resistivity tests on land involved inverse Schlumberger and dipole-

dipole arrays with 1-2m electrode spacing. Transient electromagnetic (TEM) trials were done using 3 different loop sizes were tested (6.25-12.5-25m). Marine resistivity profiling involved a dipole-dipole array (9 electrodes, 6m spacing). CPT measurements were carried with a small 50kN device (36mm cone). Manual drilling was done using so-called van der Staaij cores.

The seismic data provided by far the best subsurface image. Marine profiles revealed the internal structure of lateral accretion surfaces in shifting palaeo-gullies in very high detail. Penetration however was often limited to a few m, probably due to shallow gas. Some gassy patches appeared to shift laterally over time. Land seismic profiles showed different reflectors in the upper 10m. The best resolution was obtained with the S-wave vibrator (30-40cm). The resistivity methods suffered from the effect of tidal action and (salt/brackish) water intrusion, and mostly did not allow a clear identification of the shallow stratification. Some weak internal layering could be observed on the shallow TEM data, but with a much lower resolution compared to the acoustic data. Furthermore the application of resistivity techniques on land proved very strenuous.

Shallow cores and CPT's revealed a sequence of sandy to clayey deposits and a marked peat layer. Correlation with the shallow seismic reflections was generally very good. The high resolution of the terrestrial S-wave data, and their high sensitivity to small changes in soil type, allowed observation of subtle transitions from sandy to sandy clay. However, the high lateral variability of the sediments (even for distances on m-scale) often complicated precise correlation between the different data sets. Nevertheless, these first results indicate that the integrated use of well-tuned acoustic techniques (both marine & land) and strategically located ground-truth information (from cores & CPT) will provide a better understanding of complex estuarine sedimentary environment.