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Salt marsh stability modelled in relation to sea level rise

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Accretion on a natural backbarrier salt marsh was modeled as a function of high tide level, initial salt marsh level and distance to the source. Calibration of the model was based on up to ca 80 year old marker horizons, supplemented by ^{210}Pb/^{137}Cs datings and subsequent measurements of clay thickness. Autocompaction was incorporated in the model, and shown to play a major role for the translation of accretion rates measured as length per unit time to accumulation rates measured as mass per area per unit time. This is important, even for shallow salt marsh deposits for which it is demonstrated that mass depth down core can be directly related to the bulk dry density of the surface layer by means of a logarithmic function. The results allow for an evaluation of the use of marker horizons in the topmost layers and show that it is important to know the level of the marker in relation to the salt marsh base. In general, deeper located markers will indicate successively smaller accretion rates with the same sediment input. Thus, stability analysis made on the basis of newly established marker horizons will be biased and indicate salt marsh stabilities far above the correct level. Running the model with a constant sea level revealed that balance between the inner and the outer salt marsh deposition can not be achieved within a reasonable time scale. Likewise it is shown that only one specific sea level rise provides equilibrium for a given location on the salt marsh. With a higher sea level rise, the marsh at the specific location will eventually drown, whereas - with a sea level rise below this level – it will grow towards the top of the rising tidal frame. The short term variation of salt marsh accretion was found to correlate well with variations in the North Atlantic Oscillation - the NAO winter index. Comparisons between the geomorphological development of wind tide affected salt marshes, like those present on the Danish North Sea coasts, and primary astronomically controlled tidal marshes like those in the Georgian Bight, USA showed that the former - when first established - relatively quickly grow above the level of the highest astronomical tide, whereas this - in practice - will never happen for the latter.