

**ECSA 58 & EMECS 13**

**Estuaries and coastal seas in the Anthropocene**

Structure, functions, services and management



6–9 September 2021  
ONLINE Live and On-demand

# Book of Abstracts



## O35.5

### The influence of the estuarine circulation on estuarine sand dune formation: an idealized modeling approach

Wessel M. van der Sande<sup>1</sup>, Pieter C. Roos<sup>1</sup>, Theo Gerkema<sup>2</sup>, Suzanne J.M.H. Hulscher<sup>1</sup>

<sup>1</sup>University of Twente, The Netherlands. <sup>2</sup>Royal Netherlands Institute for Sea Research, The Netherlands

#### Abstract

In many estuaries, sand dunes can be found; these are large-scale rhythmic bedforms. They have wavelengths on the order of tens to hundreds of meters, and heights of up to one-third of the water depth. An observational study in the Gironde Estuary, France, showed that sand dunes may migrate upstream – against the river flow (Berné et al., 1993). Our aim is to explain the influence of estuarine circulation on this phenomenon.

To this end, we develop an idealized process-based model which captures the motion of water and sediment within a local section of a generic estuary. The schematized nature of idealized models makes them computationally cheap, and allows for qualitative physical insights. Our model includes, in addition to tidal and river flow, a horizontal baroclinic pressure gradient (leading to gravitational circulation) and time-dependent eddy viscosity which follows from stratification (and which also induces circulation). We do so by imposing the along-estuarine salinity gradient and time dependence of the eddy viscosity (i.e. a diagnostic approach).

The model results provide generic insights into the influence of estuarine circulation on bedform dimensions and dynamics. In particular, they reveal the dominant wavelength and the corresponding growth and migration rates. The migration rate is directed opposite to the river discharge for a portion of the parameter space – part of which is representative for the Gironde estuary. The presented study is a first attempted to quantify the effect of estuarine circulation on sand dune dynamics, thus contributing to our knowledge of estuarine morphodynamics.

#### References

Berné, S., Castaing, P., le Drezen, E., & Lericolais, G. (1993). Morphology, Internal Structure, and Reversal of Asymmetry of Large Subtidal Dunes in the Entrance to Gironde Estuary (France). *Journal of Sedimentary Petrology*, 63(5), 780–793. <https://doi.org/10.1306/d4267c03-2b26-11d7-8648000102c1865d>

#### Keywords

Estuarine sand dunes, Morphodynamic modeling, Estuarine circulation