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Eects of sea level rise on the formation and long-term evolution of shoreface-connected sand ridges, a model study

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Shoreface-connected sand ridges occur on many storm-dominated inner shelves. These rhythmic bedforms have an along-shelf spacing of 2-10 km, a height of 1- 6 m, they evolve on timescales of centuries and they migrate several meters per year. An idealised model is used to study the impact of sea level rise on the characteristics of the sand ridges during their initial and long-term evolution. Different scenarios (rates of sea level rise, geometry of inner shelf) are examined.

Results show that with increasing sea level the height of sand ridges increases and their migration decreases until they eventually become inactive. This latter occurs when the near-bed wave orbital velocity drops below the critical velocity for erosion of sediment. The sand ridges undergo different stages of growth in case of small rates of sea level rise($R \sim 1$ mm/yr). First, they grow exponentially, after which a rapid decrease of the growth occurs. Ultimately, an accelerated growth of the sand ridges is observed until they drown. In contrast, in absence of sea level rise, the model simulates shoreface-connected sand ridges with constant heights and migration rates.

Model results furthermore indicate that sand ridges do not form if the rate of sea level rise is too high, or if the initial depth of the inner shelf is too small. A larger transverse bottom slope enhances growth and height of sand ridges and it shortens their active time period. Sea level rise reduces merging of ridges such that multiple ridges occur in the end state. Model results fairly agree with field data.