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Effect of sea level rise and tidal current variation on the long-term evolution of tidal sand ridges

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Tidal sand ridges are large-scale bedforms that occur on outer shelves of coastal seas. They evolve due to tide-topography interactions on a timescale of centuries, during which sea level, strength and direction of the tidal current generally change. According to their present-day behaviour, they are classified as ‘active’, ‘quasi- active’ and ‘moribund’ ridges. Active ridges occur in relatively shallow waters with strong tidal currents, while moribund ridges occur in relatively deep waters with weak tidal currents.

Using a nonlinear morphodynamic model, the present study extends earlier work by investigating the effect of sea level rise and change in the amplitude and principal direction of the tidal current on the growth time and height evolution of tidal sand ridges. Generally, active tidal sand ridges occur if the tidal current is strong (above approximately 0.5 m/s), if sufficient sand is available and if sea level rates are not too high. These conditions are typically met in e.g. the North Sea. With increasing rates of sea level rise, the growth time of these ridges becomes longer and their spacing and orientation might change. Tidal sand ridges turn out to become moribound if in the course of time the tidal velocity amplitude decreases, as occurred in the Celtic Sea, or when accelerated sea level rise occurs.