



Sea-level rise and tides: to flood or not to flood

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It has been suggested that sea level rise (SLR) may have significant and unexpected effects on the regional tidal dynamics of the European Shelf, but the response varies significantly between different studies. Here it is shown that previous differences between studies are due to the way SLR has been implemented in the models simulations. Introducing a vertical wall around the present day coast line and the raising sea-level gives a profoundly different response to if new wet grid cells are generated by flooding new land. It is shown here that the flooding of low-lying land is the main controller of the previously reported non-linear aspect of the response, and further mechanistic explanations are provided using sensitivity simulations and analytical tidal theory. The response of the Irish Sea to SLR is controlled by the near-resonant state of the basin, with flooding of new cells drawing the basin closer to resonance. This is not the case in the North Sea, where the response to flooding is induced by shifts towards to east of the locations of the amphidromic points induced by changes in the location of the tidal dissipation. Conversely, without flooding, the main changes – especially in the North Sea – are due to altered propagation properties of the tidal wave which shifts the amphidromes westwards or not at all. Identifying the processes which control the responses of shelf sea tides to SLR not only teaches us about the system itself, but also aids predictions of how other shelf sea systems will respond to future changes.