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Undular bore formation and extreme runup on reef-lined coasts

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A number of studies has qualitatively described the development of undular bores over fringing coral reefs but the importance of this phenomenon for reef hydrodynamics, and in particular flooding, has never been studied. Yet, the transformation of a long wave (e.g., swell or infragravity wave) into an undular bore leads to significant modifications of the wave field. The formation of undulations is for example associated to a significant increase of the leading bore height that could increase wave run-up, especially if the reef is wide enough to allow the splitting of the initial long wave into a solitary wave-train. As reef-fronted coastlines are often low-lying and therefore extremely vulnerable to flooding, a good understanding of long wave transformation over the reef flat, including their possible transformation into undular bores, is crucial.
During this talk, we will present the results of a series of laboratory experiments specifically designed to analyse the consequences of undular bore development on run-up over reef-lined coasts. These experiments were conducted in the 40m-long wave flume of the Water Laboratory at Delft University of Technology. Both regular and bichromatic wave conditions were generated and measured during their propagation across a schematized smooth fringing reef (1:20 geometric scaling factor). Our data reveals that both swell and infragravity waves are likely to steepen and transform into undular bores over the reef flat. For our regular wave experiments, well-developed undular bores were observed at the most onshore part of the reef for most cases. The first undulation had generally enough time to evolve into a solitary wave before reaching the beach for most cases considered and was observed to control the maximum run-up.