Geophysical Research Abstracts
Vol. 21, EGU2019-18540, 2019
EGU General Assembly 2019

Non-Linear modelling of Extreme High-Angle Waves Instability

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Sandy coastlines with very oblique wave incidence often exhibit alongshore morphological features such as sand waves (Zenkovitz, 1959; Ashton et al., 2001; Arriaga et al., 2018). Their origin and dynamics has been explained from a morphodynamic instability under wave-driven alongshore sediment transport. Zenkovitz (1959) showed that an incidence angle at breaking above 45 ° caused shoreline instability. However, wave angle at breaking is rarely larger than 45° so that the occurrence of such instability in nature would be very limited. More recently, Ashton et al. (2001) investigated shoreline instability in terms of the wave angle in deep water and found that the shoreline is unstable for an angle above 42° no matter the angle at breaking. The corresponding feedback mechanisms are different as they involve bathymetric perturbations a) only in the surf zone in case of Zenkovitz (1959) or b) in both the surf and the shoaling zones in case of Ashton et al. (2001). The latter mechanism has been extensively investigated in recent years (e.g., van den Berg et al, 2014) and is called HAWI (High Angle Wave Instability). The aim of this present contribution is the former mechanism that is called Extreme High Angle Wave Instability (EHAWI).

The instabilities associated with high-angle waves have been studied with a one-line approximation (or similar). However, this is not appropriate for EHAWI and Falques et al. (2018) investigated this instability with a fully 2DH linear stability model. They found an instability mode confined within the surf-zone with a maximum growth rate for offshore angle $\sim$ 70 ° that was associated to EHAWI.

The aim of the present contribution is an extension of Falques et al (2018)'s work by using a 2DH nonlinear morphodynamic model which has been developed with a new numerical scheme that is adequate for very large scales. The shoreline treatment includes flooding and drying with sediment transport in both wet and dry regions. The effects of wave rollers are also incorporated. The model is now being tested and applied to further explore in the nonlinear regime the EHAWI instability mode found by Falques et al. (2018). Typical nonlinear effects as saturation or merging of patterns is being regarded. More importantly, the coupling between the shoreline and the surfzone bathymetric features can be now investigated.

References

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