Directional spreading effect on wave transformation and wave overtopping in a shallow foreshore

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For the actual designs for coastal defenses such as construction of storm walls and implementation of beach nourishment, an appropriate estimation of wave boundary condition is necessary. The wave boundary conditions are typically estimated at toe of dike using numerical models (e.g. SWAN). However these approaches do not always represent wave transformation in the field, especially in shallow foreshores where low-frequency waves would be generated due to wave breaking and wave-wave interaction. These processes are key issues to understand for the appropriate estimation of wave overtopping.

In general, more low-frequency energy is generated when directional spreading is small and the generated low-frequency waves give more flux landwards. For example, Guza and Feddersen (2012) shows that the directional spreading effect influences wave run-up significantly. It indicates that the directional spreading effect would influence wave overtopping discharge as well.

In this study, the influence of the directional spreading on the wave transformation in shallow foreshore and wave overtopping over a dike are investigated by the SWASH model (Zijlema et al., 2011), which shows a good representation of wave transformation in a shallow foreshore and wave overtopping over the dike (Suzuki et al., 2011;2012). The SWASH model is based on the non-linear shallow water equations with a non-hydrostatic pressure model developed at the Delft University of Technology. The computational time is not demanding due to the depth averaged assumption and the parallel computation capability.

The result of the wave overtopping discharge estimated by the SWASH model shows that the wave overtopping discharge reduces significantly by changing the directional spreading.

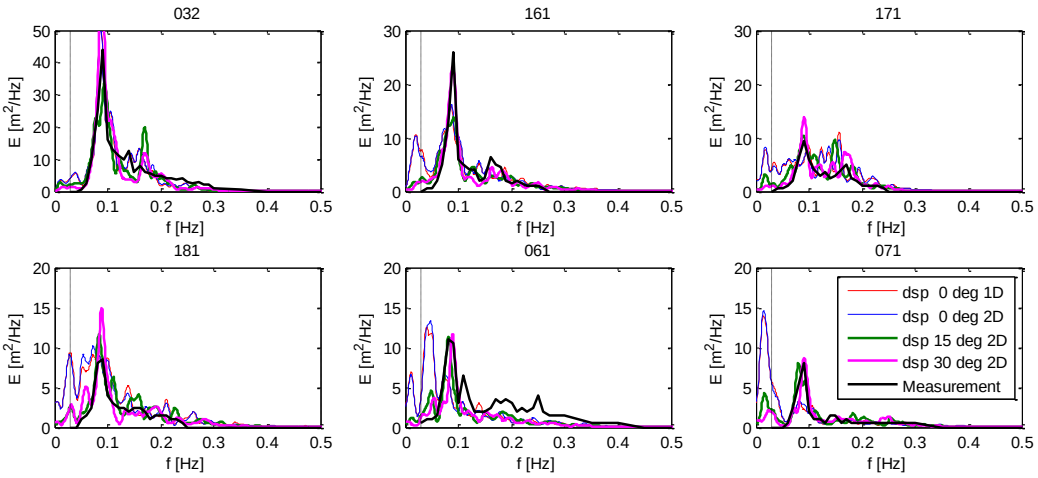

Figure. Wave spectrum estimated by SWASH using different directional spreading