

The Impact of Wind on Tidal Flats: Temporal and Spatial Differences

Bram van Prooijen, TU Delft, B.C.vanProoijen@TUDelft.nl
Lodewijk de Vet, Deltares & TU Delft
Irene Colosimo, TU Delft

Abstract

The morphodynamics of tidal flats are forced by flow and waves under influence of water depth variations. Local wind affects this interaction, as it leads to enhanced waves, water level set up/down and wind-driven flow. Duran-Matute et al. (2014) explored the effects of wind in the Wadden Sea by numerical modelling and showed its importance. In this contribution, we explore the impact of wind events on tidal flats in three different systems. Measurements are carried out on tidal flats in the Wadden Sea, Eastern Scheldt and Western Scheldt. In the Western Scheldt, bed degradation is found during events in which the conditions for erosion are locally favorable. These conditions are characterized by the “perfect” combination of a sufficiently long period (hours) of very shallow water, depth-limited waves and relatively strong wind-driven currents (de Vet et al, 2020). Measurements in the Wadden Sea indicate that wind-driven flow can dominate over tidal flow, leading to significant (net) sediment fluxes (Colosimo et al, 2020). Long-term bed level measurements in the Eastern Scheldt show a major local response of the bed level to the severe 1990 storm, while other nearby locations hardly responded. In all these studies, the major spatial variation in the importance of wind is acknowledged.

The temporal and spatial variety in response of the tidal flats makes it difficult to define “representative” conditions for an estuary or even a tidal flat. Instead of trying to classify estuaries (or its subsystems) as tide-dominated or wave-dominated systems, we have to acknowledge the diversity in time and space. How to include this in forecasting the morphodynamics of estuaries is open for further exploration.

Duran-Matute, M., Gerkema, T., De Boer, G. J., Nauw, J. J., & Gräwe, U. (2014). Residual circulation and freshwater transport in the Dutch Wadden Sea: a numerical modelling study. *Ocean Science*, 10(4), 611-632.

de Vet, P. L. M., van Prooijen, B. C., Colosimo, I., Steiner, N., Ysebaert, T., Herman, P. M. J., & Wang, Z. B. (2020). Variations in storm-induced bed level dynamics across intertidal flats. *Scientific Reports*, 10(1), 1-15.

Colosimo, I., de Vet, P. L., van Maren, D. S., Reniers, A. J., Winterwerp, J. C., & van Prooijen, B. C. (2020). The impact of wind on flow and sediment transport over intertidal flats. *Journal of Marine Science and Engineering*, 8(11), 910.