

HOW TIDES AND WAVES ENHANCE AEOLIAN SEDIMENT TRANSPORT AT THE SAND MOTOR MEGA NOURISHMENT.

By:
Bas Hoonhout
Arjen Luijendijk
Sierd de Vries
Sierd.deVries@tudelft.nl

With contributions of:
Thijs van het Hoofft
















Mega nourishments require new predictive tools.

- Time scales of interest (decades).
- Development of marine and aeolian domains.

Dune growth receives specific interests at the Sand Motor.

- Actual dune growth is much less than anticipated.
- **How are marine processes influencing aeolian sediment transport processes?**



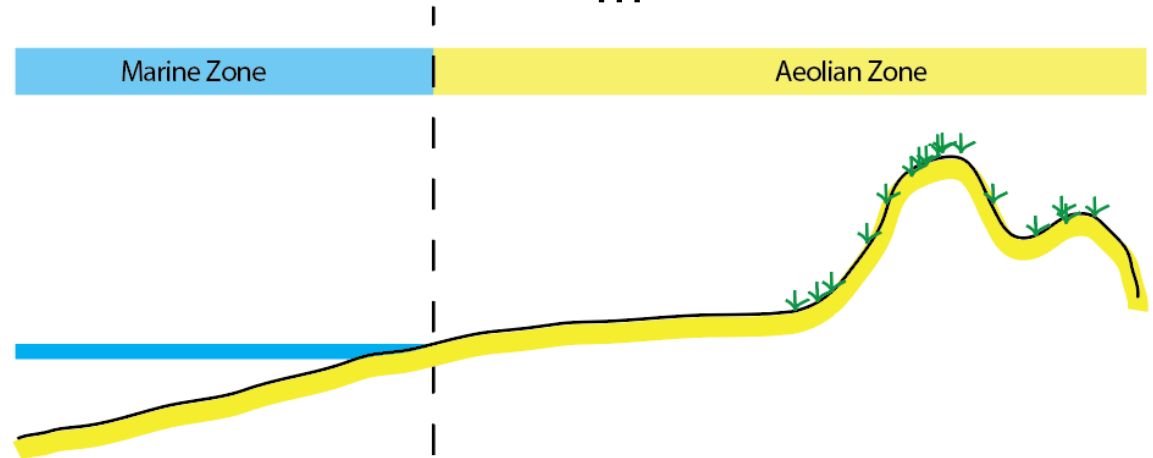
Existing state of the art of morphodynamic modelling is segregated

Marine Morphodynamics

- Delft3D
- Telemac
- Mike
- XBeach
- Swan
- ...

Aeolian Morphodynamics

- AEOLIS
- DuBeVeg
- CDM
- ...



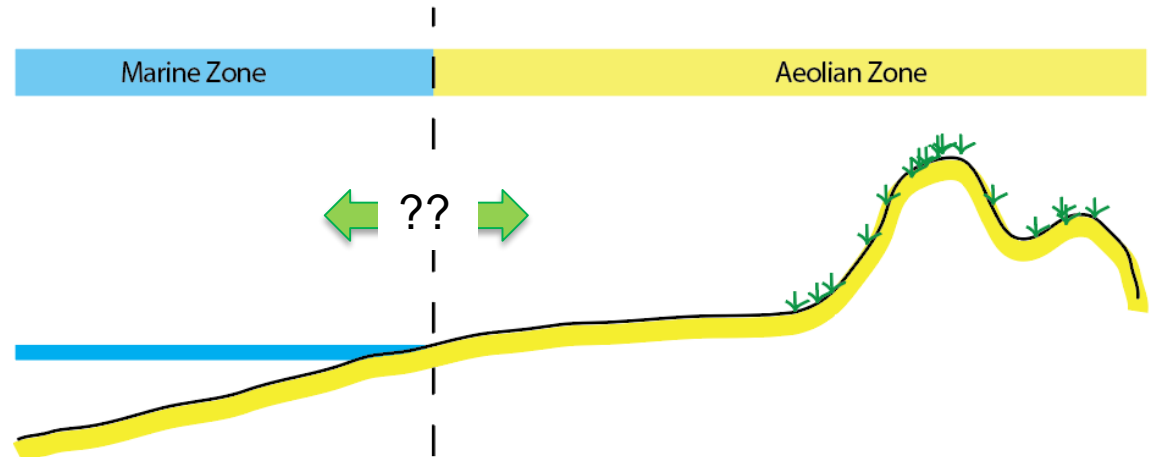
Existing state of the art of morphodynamic modelling are segregated

Marine Morphodynamics

- **Delft3D-FM** (FLOW)
- **SWAN** (WAVES)
Luijendijk et. al., 2017

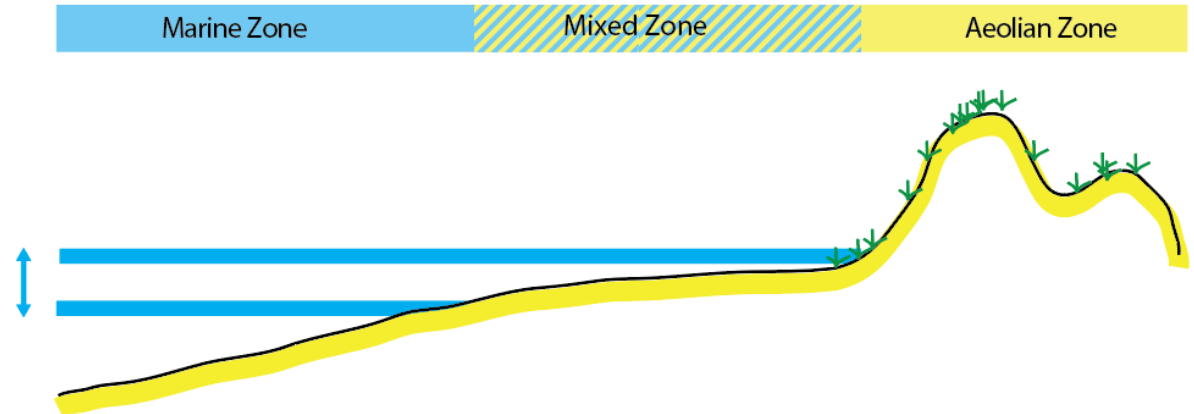
Aeolian Morphodynamics

- **AEOLIS**
(supply limited transport)
Hoonhout & De Vries, 2016



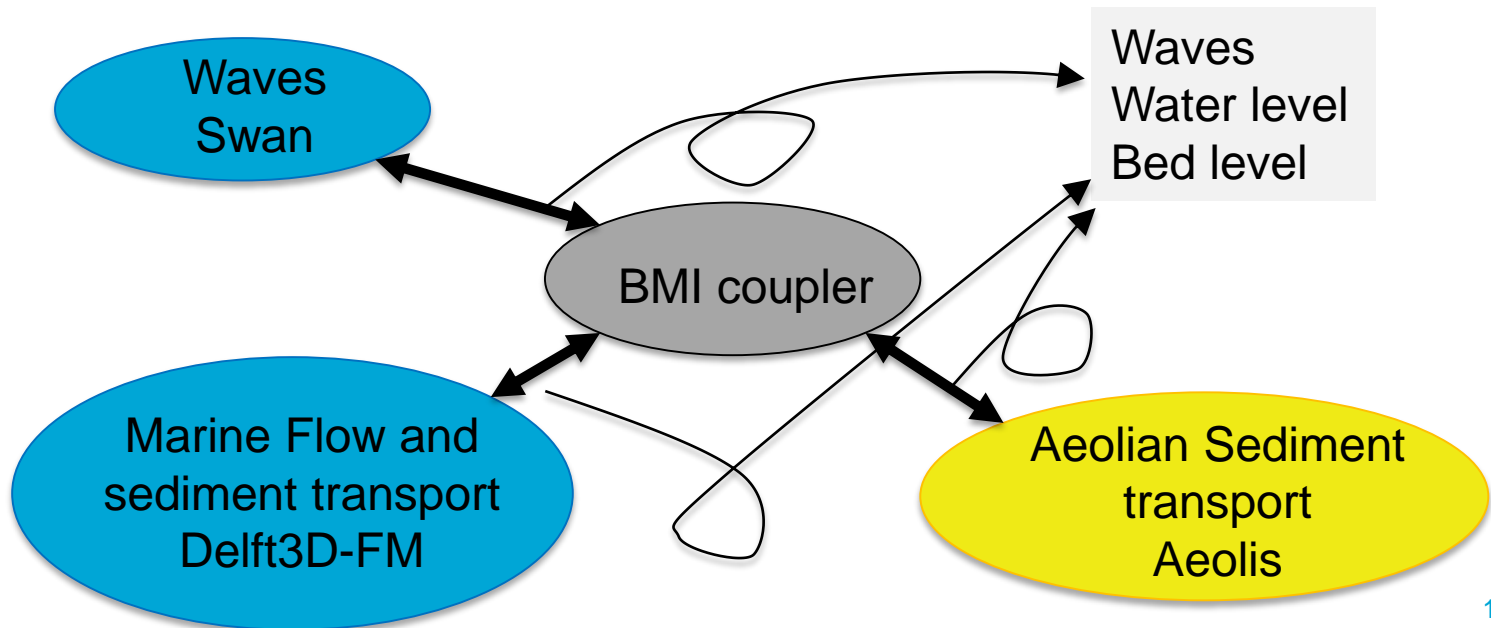
Existing state of the art of morphodynamic modelling are segregated

- Spatial domains overlap
 - No model for mixed zone exist
- Time scales differ

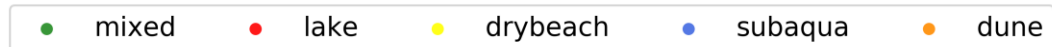
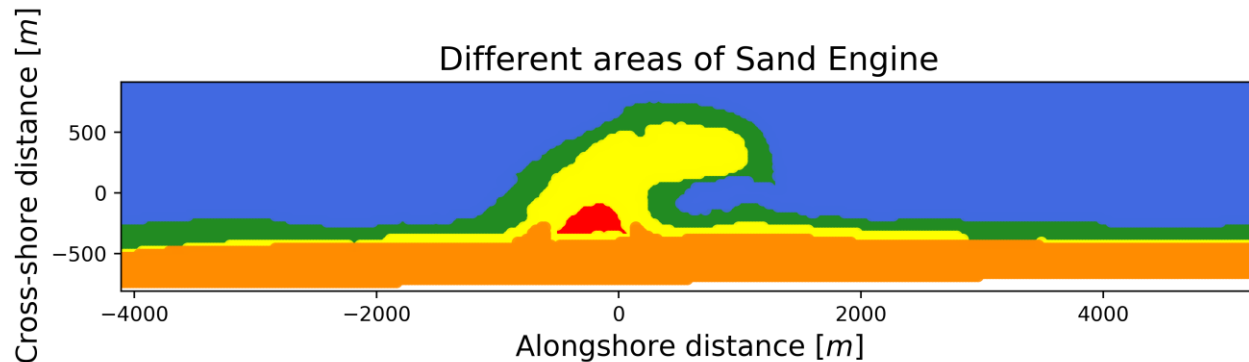


Basic Model Interface (BMI) Coupling framework

Non invasive model coupling (*Peckham et. al., 2013*)

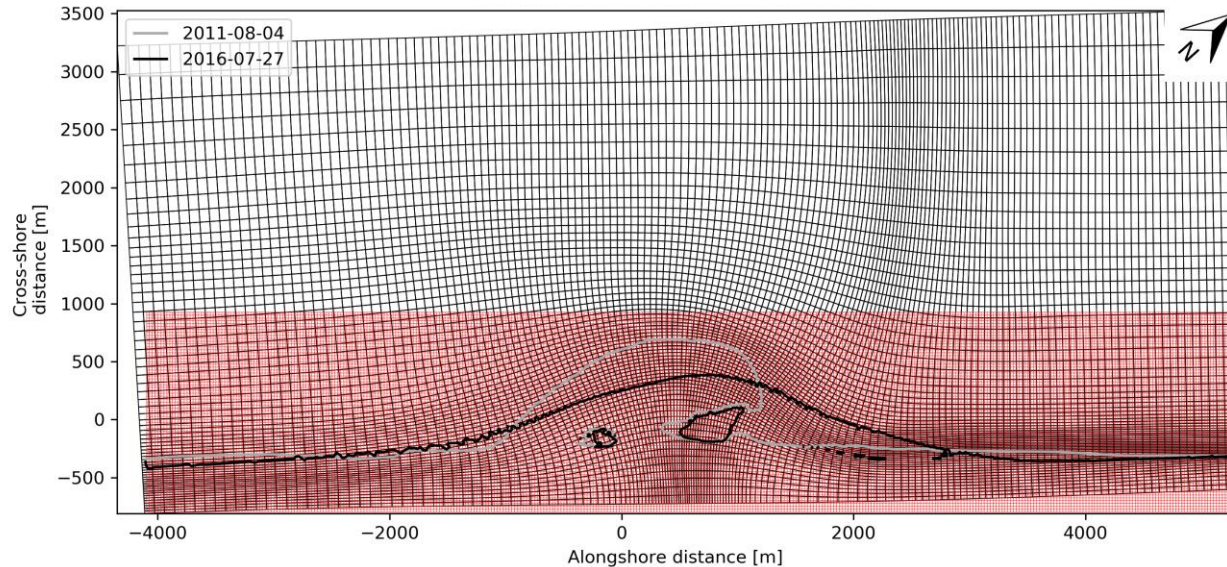


Practical application – spatial domain

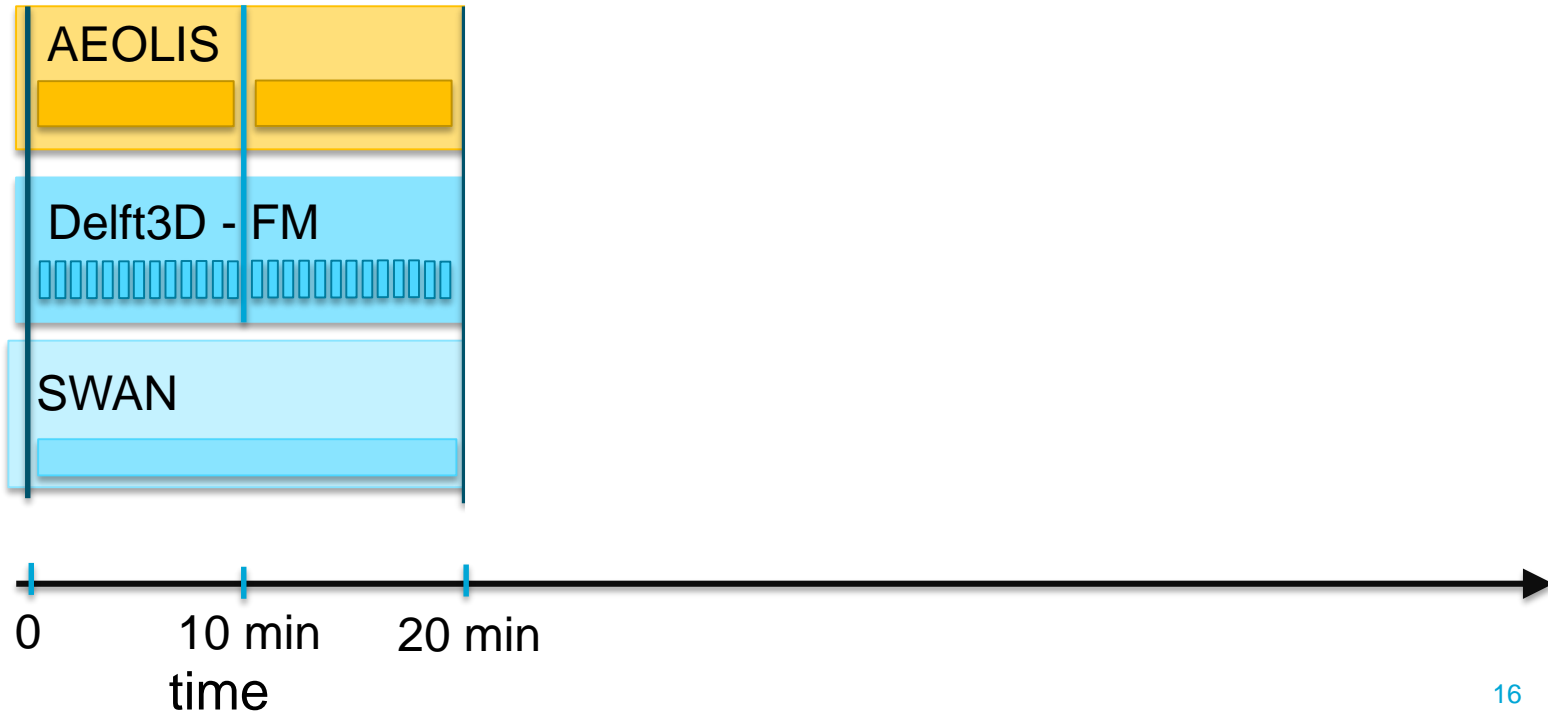




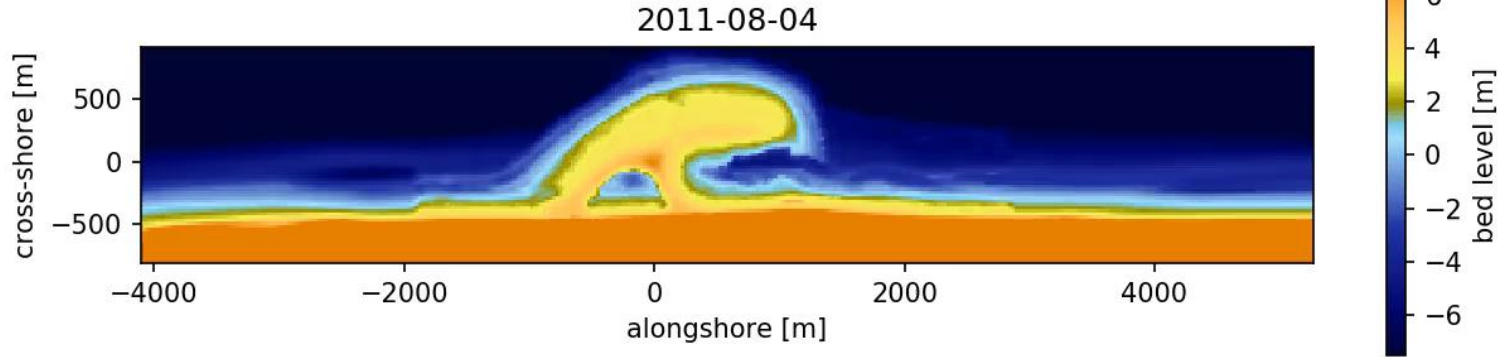
Delft3D grid in **Black** and **Aeolis** grid in **Red**



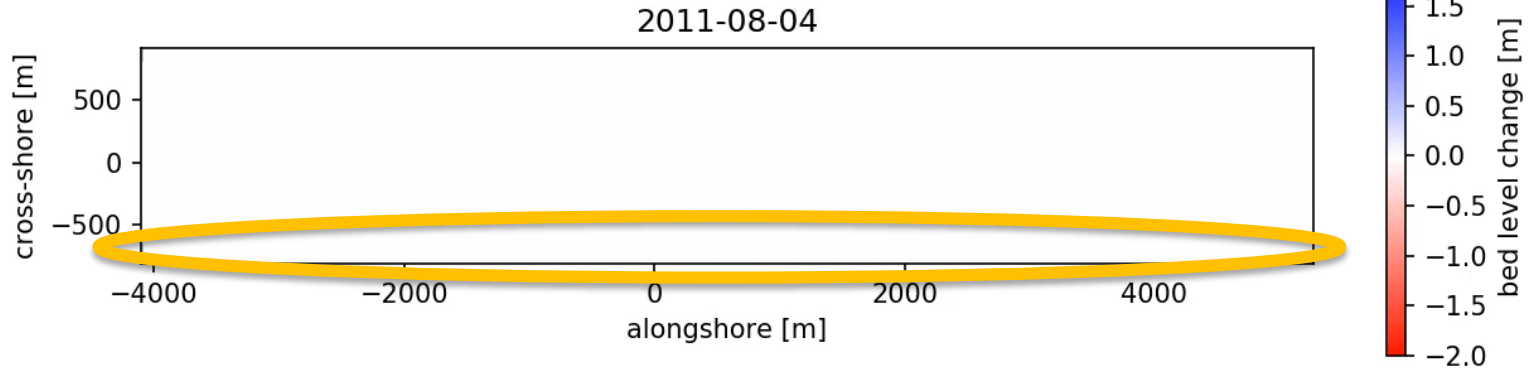
Practical application temporal domain



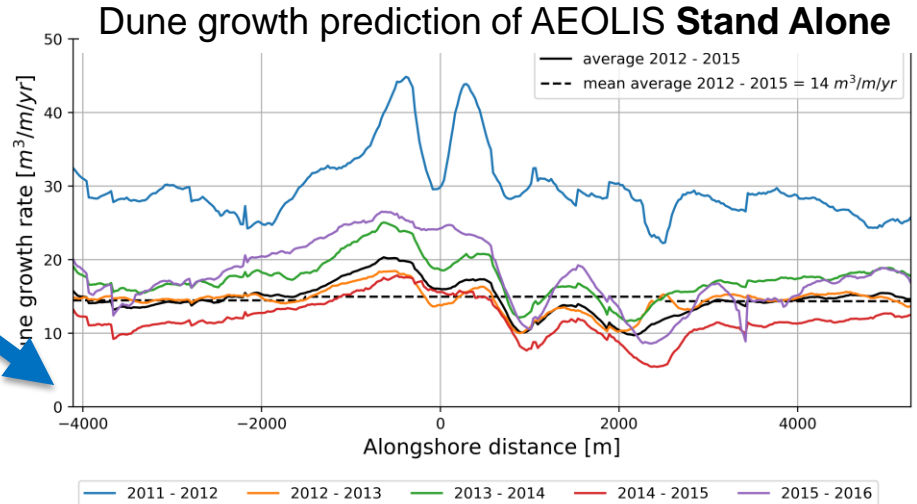
Bed Level



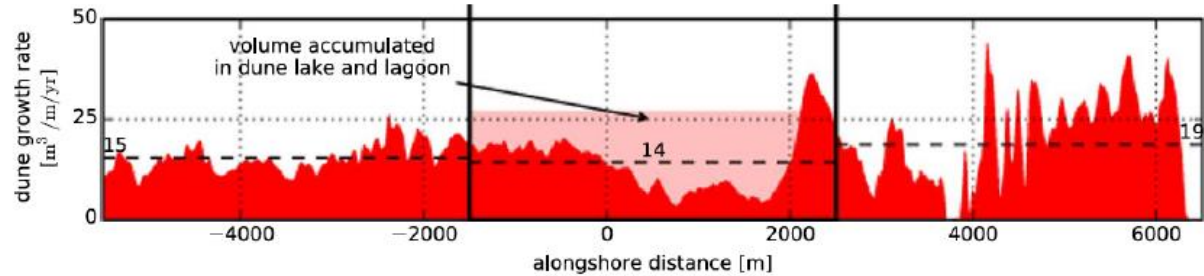
Cumulative Bed Level Changes



Results dune growth rates



Validation



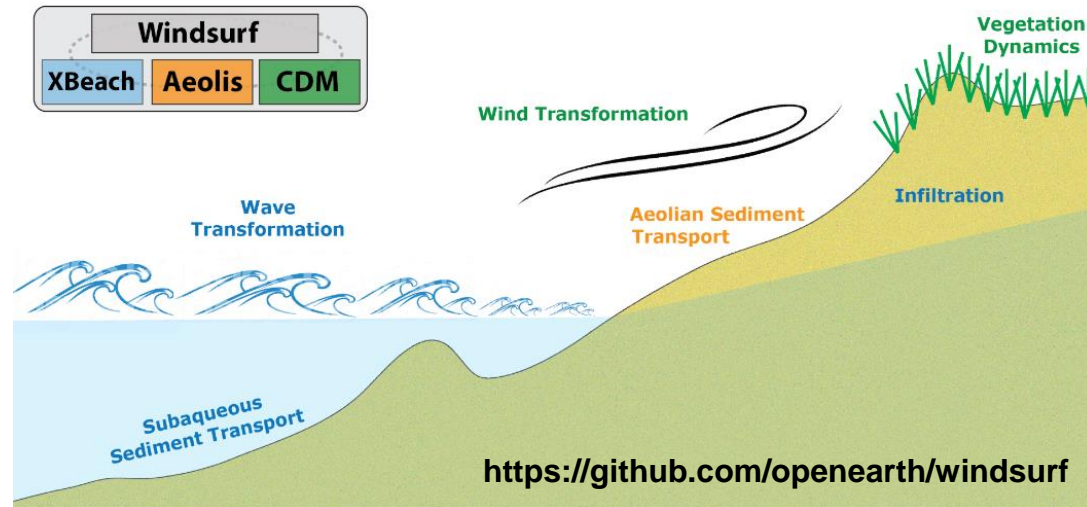
Hoonhout & de Vries, 2017

Conclusion

- Marine influences have a clear effect on aeolian sediment transports at the sand engine.
- Implementation of modelling framework that crosses process boundaries.
- Large potential for modelling large spatial domains and longer timescales.
- Needs new assumptions regarding processes at interface marine/aeolian.

Outlook

- Validation needed.
- How about dunes?
- Recent work by Cohn 2018 provides perspective.



<https://github.com/openearth/windsurf>

Questions ?

An aerial photograph of a coastal landscape. On the left, the blue sea meets a sandy beach with white foam from waves. The beach transitions into a wide, light-colored sandy area with several small, dark blue ponds or depressions. A prominent, narrow, green dune ridge runs vertically through the center of the image, separating the sandy area from a more vegetated, brownish-green area on the right. The terrain on the right appears to be a mix of grass and low-lying vegetation.

References

- Cohn, N. (2018). From the Shoreface to the Foredunes : Coastal Morphodynamics Across the Land-Sea Interface. PhD-Thesis, Oregon State University.
- Hoonhout, B., & de Vries, S. (2017). Aeolian sediment supply at a mega nourishment. *Coastal Engineering*, 123, 11-20.
- Luijendijk, A. P., Ranasinghe, R., de Schipper, M. A., Huisman, B. A., Swinkels, C. M., Walstra, D. J., & Stive, M. J. (2017). The initial morphological response of the Sand Engine: A process-based modelling study. *Coastal engineering*, 119, 1-14.
- Hoonhout, B. M., & de Vries, S. (2016). A process-based model for aeolian sediment transport and spatiotemporal varying sediment availability. *Journal of Geophysical Research: Earth Surface*, 121(8), 1555-1575.
- Peckham, S. D., Hutton, E. W., & Norris, B. (2013). A component-based approach to integrated modeling in the geosciences: The design of CSDMS. *Computers & Geosciences*, 53, 3-12.