



Overwash observations on a Dutch barrier island

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Background

Overwash and inundation are able to cause large-scale coastal changes that can range from the breaching of islands to vertical accretion of sediments (Donnelly et al., 2006). Vertical sediment accretion might aid in mitigating the effects of sea level rise and subsidence (Oost et al., 2012), and therefore the restoration of washovers is being considered. Within this project we aim to characterize overwash conditions on barrier islands in the Wadden Sea.

Research questions

- What are the flow- and wave conditions during an overwash event?
- How do waves transform across the island during overwash or inundation?

Field observations

From November 2014 until the end of January 2015, ten pressure sensors, three acoustic doppler velocimeter (ADV) and three optical backscatter sensors were deployed on the low-lying (max height $\sim 1.70\text{m}$, relative to NAP) eastern end of the Dutch barrier island Schiermonnikoog. Here, only results from the pressure sensors are shown.



Figure 1. The field site is located on the Dutch barrier island of Schiermonnikoog. Approximate locations for available wave - and water level data (RWS) are indicated. The instrument locations of ADVs (blue squares) and pressure sensors (orange squares) are shown in the inset.

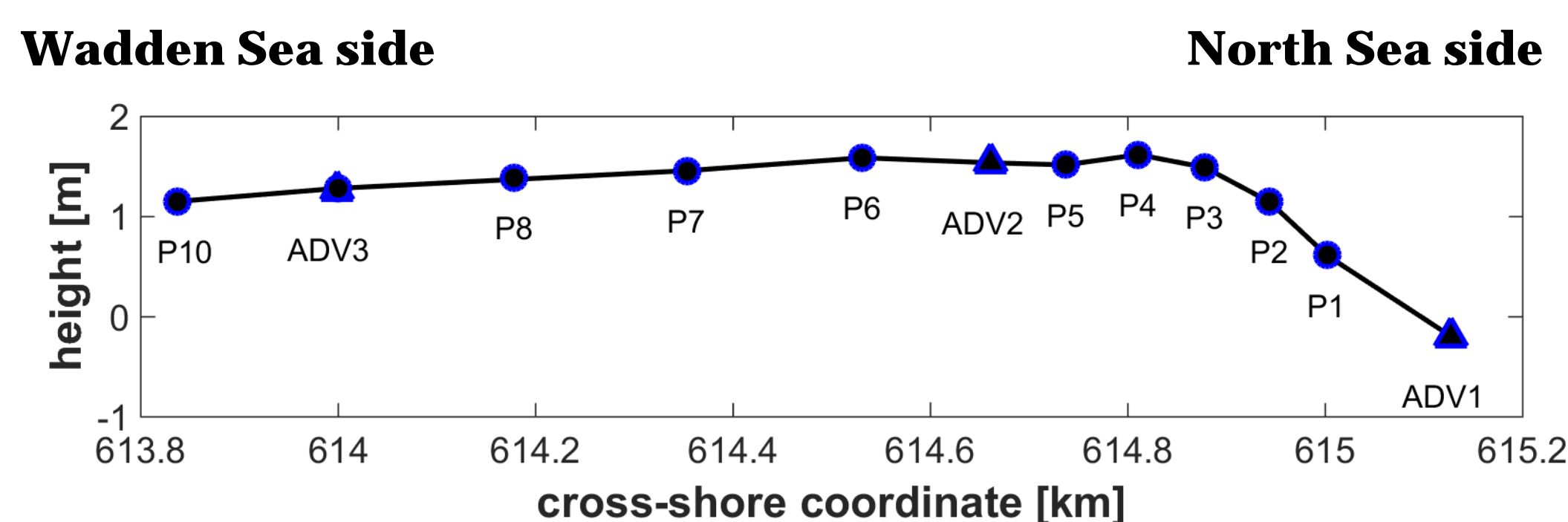


Figure 2. The cross-shore profile (black line) during deployment is shown with the Wadden Sea to the left and the North Sea to the right. Blue triangles show the ADV frames and blue circles the pressure sensors.

Acknowledgements

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References

Donnelly, C., Kraus, N., Larson, M., 2006. State of knowledge on measurement and modeling of coastal overwash. *Journal of Coastal Research* 22, 965–991. <http://dx.doi.org/10.2112/04-0431.1>.
Oost, A.P., Hoekstra, P., Wiersma, A., Flemming, B., Lammerts, E.J., Pejrup, M., Hofstede, J., Van der Valk, B., Kiden, P., Bartholdy, J., Van der Berg, M.W., Vos, P.C., De Vries, S., and Wang, Z.B., 2012. Barrier island management: lessons from the past and directions for the future. *Ocean and Coastal Management*, 68, 1–21.

Results

Boundary conditions

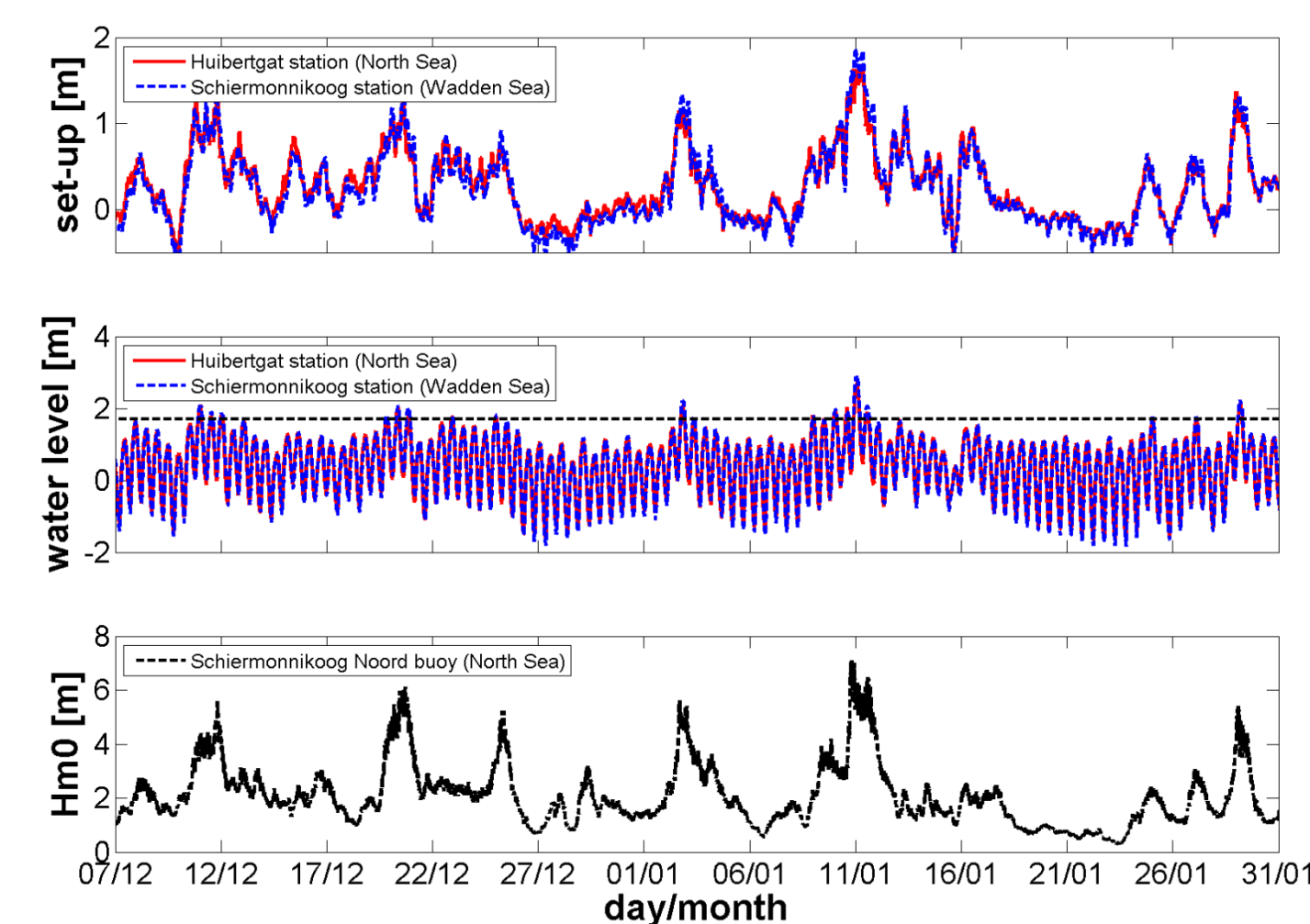


Figure 3. Set-up (a.) and water level variations (b.) for the Huijbertgat station and the Schiermonnikoog station (see figure 1 for location) and significant wave heights (c.) at the Schiermonnikoog Noord buoy. The dashed line shows the critical level when the island will be flooded.

Water levels

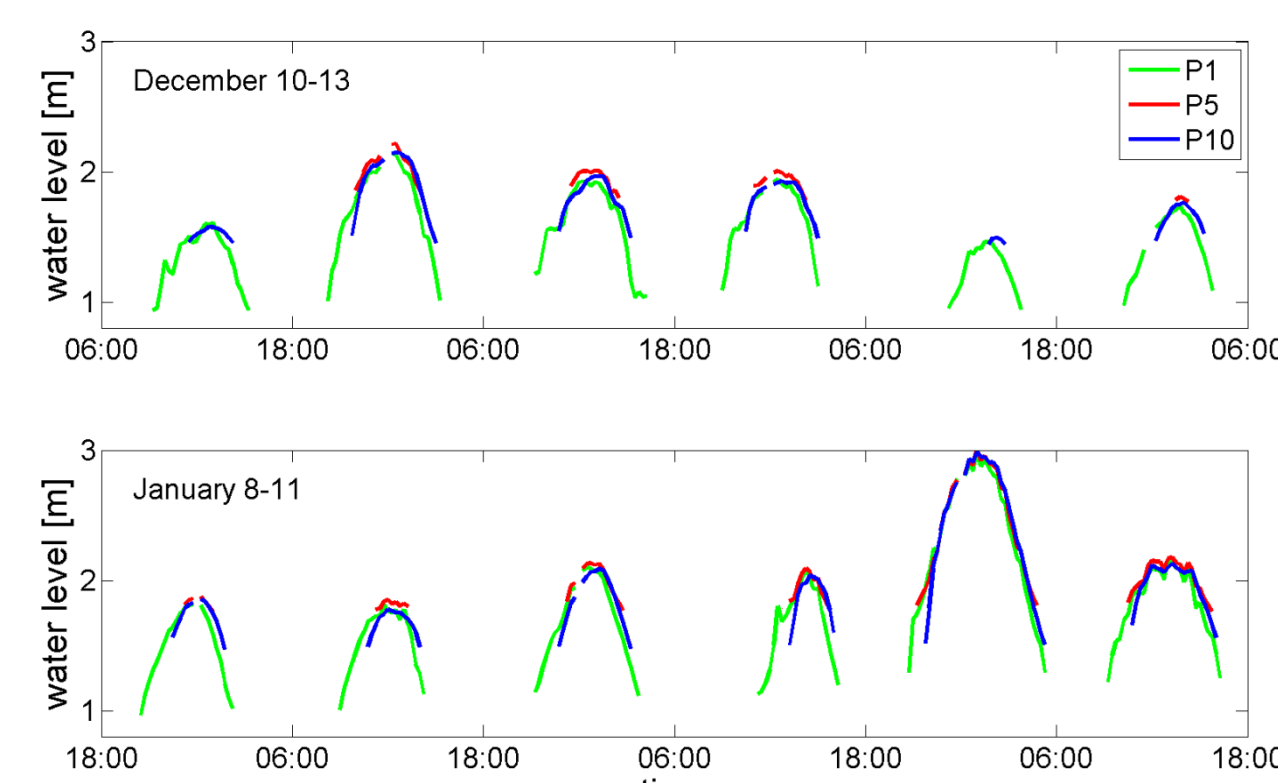
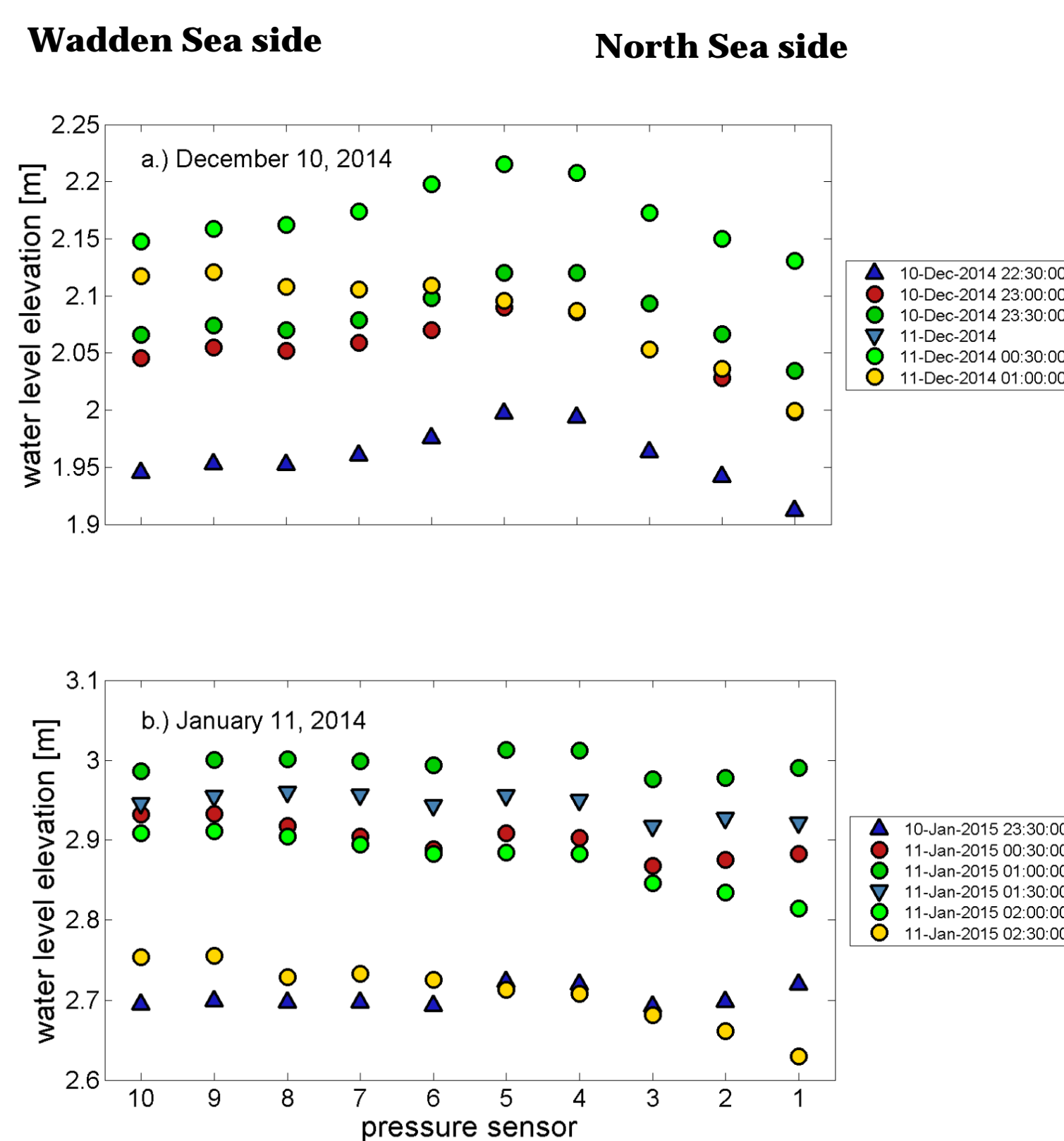


Figure 5. Water level variations over time across the island for two overwash occasions: December 10, 2014 (a.) and January 11, 2015 (b.). The data is averaged over 15 minutes.



Conclusions

- Water levels are fluctuating across the island with time and tidal stage. The effect of wave set-up, which might drive strong cross-shore flows (see poster of D. Wesselman), is visible in the observations.
- Low frequency wave heights typically decrease as waves propagate across the island.
- High frequency waves show frequently increases after initial dissipation.

Some questions to address in future work

- What is the flow velocity during overwash?
- What are the underlying mechanisms that are causing the observed wave height pattern?
- What are the sediment transport rates and mechanisms during overwash?
- What is the morphological response of the spit to overwash?

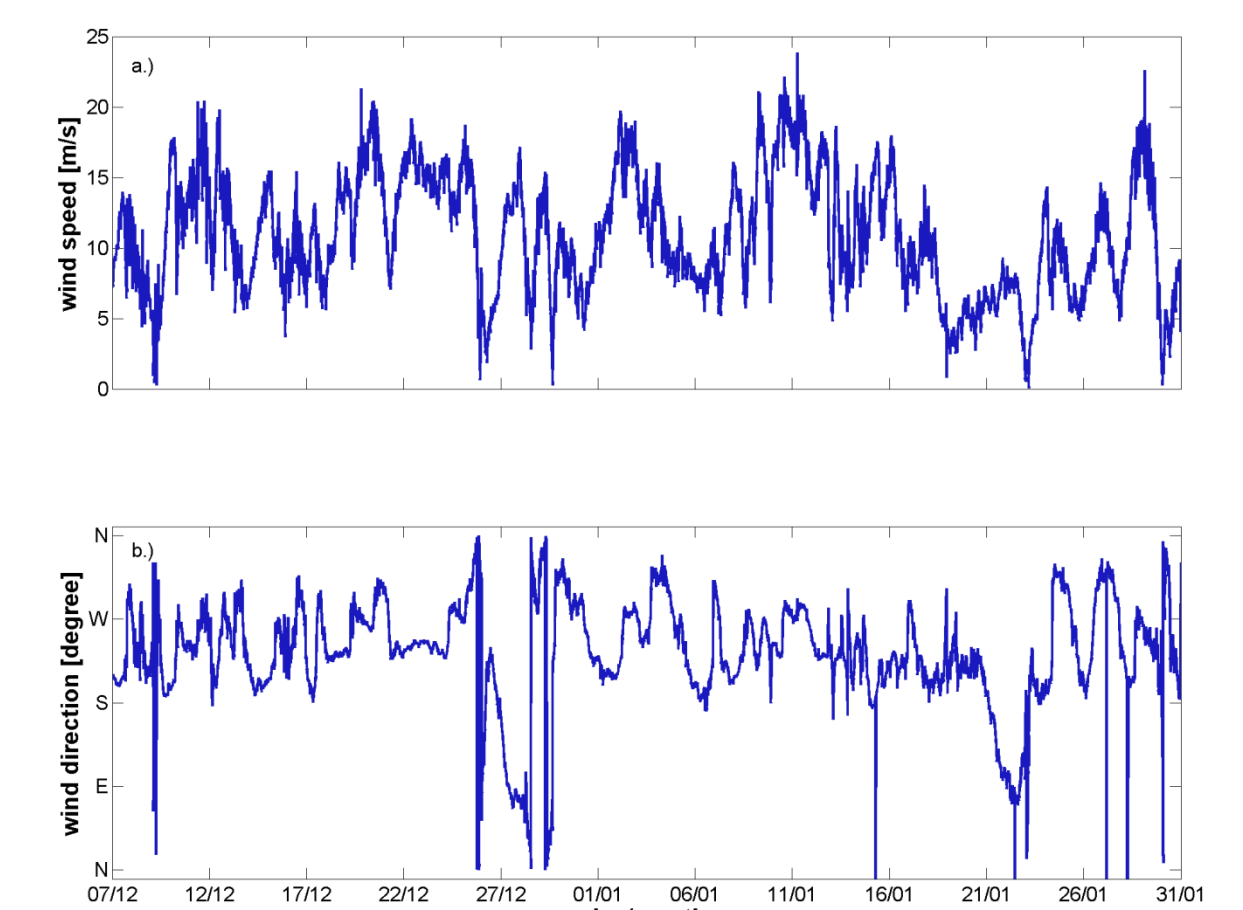


Figure 4. Wind speed (a.) and wind direction (b.) at Wierumergronden (see figure 1 for location).

Wave heights

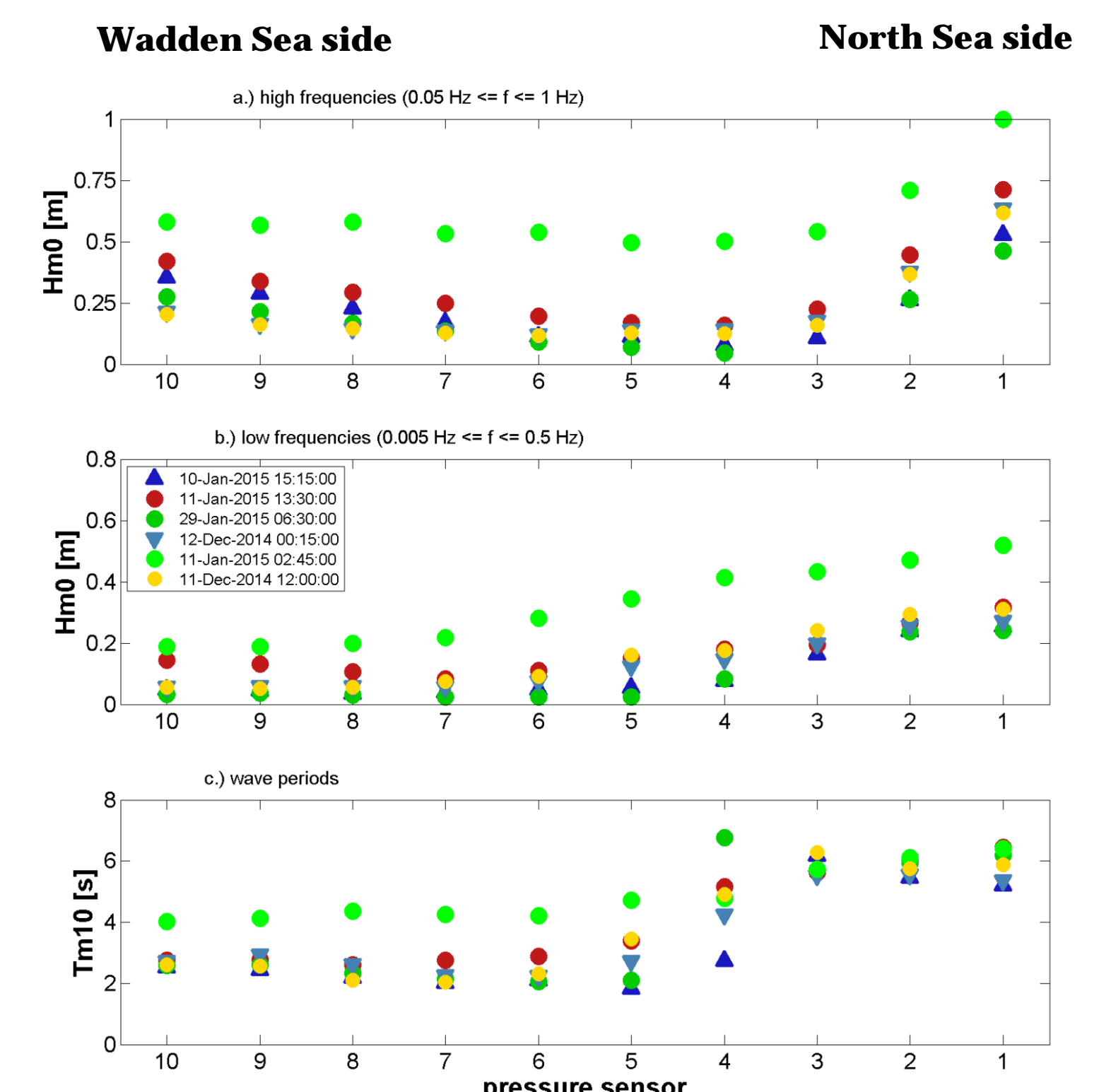


Figure 6 Wave heights across the island on different days (see legend) for a.) high frequency waves, b.) low frequency waves, and c.) wave periods. The data is averaged over 15 minutes.

Figure 7. Water levels across the island during two overwash occasions: December 10, 2014 (a.) and January 11, 2015 (b.). The Wadden Sea is on the left hand side, the North Sea to the right. See legend for times. The data is averaged over 15 minutes.