Supporting Information for "Atmospherically Driven Seasonal and Interannual Variability in the Lagrangian Transport Time Scales of a Multiple-inlet Coastal System"

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Introduction

This supporting information contains the text S1 that provide details about the validation of the Eulerian numerical model, which was employed to feed a Lagrangian model to obtain particles trajectories. The references used in Texts S1 are also provided.

Text S1

Model validation using sea-surface height (SSH), currents, temperature, and salinity during the year 2009-2010 was done by Duran-Matute et al. (2014) and Gräwe et al. (2016) using similar model configurations. We have validated our simulation only for the years 2009-2010, as was done by Duran-Matute et al. (2014), because the bathymetry is mostly based on those years. Thus, it is expected that the simulation during this timespan is most compatible with observations. We contrast our numerical results with SSH measured at 14 tidal stations located within and around the DWS (Figure 1 from the main manuscript), and with the amplitude and phase of the M2, S2 and M4 tides. In general, our simulation shows similar performance to that of Duran-Matute et al. (2014) (see Table 1), which is remarkable because Duran-Matute et al. (2014) used results from a two-dimensional model with data assimilation to impose SSH at the boundaries. The good performance of the model is also reflected in the form factor F=(K1+O1)/(M2+S2), which is defined as the ratio of the amplitudes of the K1 and O1 harmonics to those of the M2 and S2 ones (Defant, 1961). The observations and the simulation by Duran-Matute et al. (2014) yield F=0.166, whereas F=0.175 for our case. We have not validated directly our simulated particles trajectories with observational data in the DWS due to the difficulty of acquiring it in shallow coastal systems containing large areas of intertidal flats. However, our model configuration was employed recently by Donatelli et al. (2022a, 2022b), whose results showed good agreement with those of previous numerical setups in the DWS region (Duran-Matute et al., 2014; Gräwe et al., 2016). Therefore, we expect that this performance is also reflected in our Lagragian analysis.

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Table 1. Summary of the Model Skill Assessments of the SSH, and M2, S2 and M4 Tides for the Period 2009–2010[a]

	SSH		M2	S2	M4
R	0.98 (0.99)	$\mathbf{MAE}_{amp}$ (%)	4.3 (6.1)	10.6 (4.3)	15.0 (8.7)
RMSE (m)	0.15 (0.10)	$\mathbf{MAE}_{pha}$ (min)	4.6 (8.7)	9.6(9.3)	46.5 (27.5)
NRMSE (%)	3.5 (2.3)				

[a]The values displayed in this table represent the average of the 14 tidal stations located around the DWS (Figure 1 from the main manuscript). In the second column the performance of the SSH is shown in terms of the correlation R, the root mean square error $RMSE$, and the $NRMSE$, which is the $RMSE$ normalized with the difference between the largest and lowest observed SSH. In the last three columns the results for the M2, S2, M4 in terms of the mean absolute error MAE are displayed (see Wilks (2011) for the definition of R, $RMSE$ and MAE). The MAE is in percent for the amplitude and in minutes for the phase. In parenthesis, we give the statistics obtained with the simulation of Duran-Matute et al. (2014).

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