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Sea surface model wind bias reduction with satellite scatterometer observations

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The accuracy of numerical storm surge model simulations depends critically on the quality of the atmospheric forcing, i.e. the surface boundary conditions used to drive the simulation. The forcing – usually supplied to operational storm surge models by atmospheric model forecasts – is dictated by the physical variables producing the surge and determining its evolution. The wind at the sea surface has a key role, as the surge elevation depends on the wind stress, which is proportional to the squared wind speed. Recently it has been demonstrated the possibility to reduce the bias at the sea surface between global model wind field forecasts and wind observations using satellite scatterometer data [Zecchetto et al.: *Mitigation of ECMWF–scatterometer wind biases in view of storm surge applications in the Adriatic Sea*, Advances in Space Research, 55(5), 1291–1299, 2015.] The method, called wind bias mitigation (WBM), supplies a "mitigated model wind" ws'_m obtained by multiplication of the "standard model wind" field ws_m by a factor $(1+\Delta ws)$: $ws'_m = (1+\Delta ws)ws_m$. In our study we compare the performance of four mathematical approaches to WBM, leading to a total of eight different formulations of the multiplicative factor Δws compensating the model wind underestimation. Four datasets of model and scatterometer wind fields, simulated and observed during several storm surge events (SEVs) in the city of Venice (northern Adriatic Sea) since 2004, are used for the assessment of the eight different formulations of WBM: a collection of 29 SEVs in the years 2004-2014, a collection of 48 SEVs in the years 2013-2016, a collection of 364 cases of random sea level conditions in the same period, and a collection of the seven SEVs in 2012-2016 that were worst predicted by the Centro Previsioni e Segnalazioni Maree, Comune di Venezia (Venice Tide Forecast Centre of the Venice Municipality). The statistical analysis shows that the bias mitigation procedure supplies a mean wind speed more accurate than the standard forecast in more than 70% of the analysed cases, when compared with scatterometer observations.