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The coastal wind resources over Europe as observed from satellites

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The coastal zone is a valuable target area with respect to renewable energy resources. The relatively shallow bathymetry and proximity to the land make installing offshore wind farms highly attractive and thus coastal zones around the world are now receiving increased attention with respect to their wind resources and dominant wind regimes. In situ measurements are necessary in order to evaluate wind resources offshore, nonetheless, meteorological towers are limited due to high costs in installation and maintenance. Over the last decade, the use of space-borne remote sensing observations for offshore wind energy applications has increased exponentially: satellite wind retrievals are being used for initial wind resource mapping, meso-scale model validation, wake monitoring and analysis. Nonetheless, limitations include the higher uncertainty with proximity to land and the original reference height of 10 m above the surface, which is typically low compared to wind turbine hub heights offshore, i.e. 70 m and higher. To address some of the topics that reflect the complexity of the coastal zone, the availability of coastal satellite and in situ observations and the impact of anthropogenic activities in this work, we aim to show the applicability of scatterometer and Synthetic Aperture Radar wind retrievals for the purpose of wind energy development in the European coastal areas. New ASCAT stress-equivalent winds specifically developed for the coastal areas are compared to meteorological mast observations. Moreover, wind resources are estimated from long-term satellite wind retrievals at 10 m above the surface. Finally, using a 10-year stability correction from the meso-scale model WRF, the wind resources are extrapolated to the turbine-relevant height of 100 m and compared with averaged wind resources from the meteorological towers.