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Can dynamically downscaled windstorm footprints be improved by observations through a probabilistic approach?

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Windstorms are a main feature of the European climate and exert strong socio-economic impacts. Large effort has been made in developing and enhancing models to simulate the intensification of windstorms, resulting footprints, and associated impacts. Simulated wind or gust speeds usually differ from observations, as regional climate models have biases and cannot capture all local effects. An approach to adjust regional climate model (RCM) simulations of wind and wind gust towards observations is introduced. For this purpose, 100 windstorms are selected and observations of 173 (111) test sites of the German Weather Service are considered for wind (gust) speed. Theoretical Weibull distributions are fitted to observed and simulated wind and gust speeds and the distribution parameters of the observations are interpolated onto the RCM computational grid. A probability mapping approach is applied to relate the distributions and to correct the modeled footprints. The results are not only achieved for single test sites, but for an area-wide regular grid. The approach is validated using root mean squared errors on event- and site basis, documenting that the method is generally able to adjust the RCM output towards observations. For gust speeds, an improvement on 88 of 100 events and at about 64% of the test sites is reached. For wind, 99 of 100 improved events and about 84% improved sites can be obtained. This gives confidence on the potential of the introduced approach for many applications, in particular those considering wind data.