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Evaluation of reanalysis near-surface winds over northern Africa in Boreal summer

Sebastian Engelstaedter and Richard Washington

University of Oxford, Centre for the Environment, School of Geography and the Environment, Oxford, United Kingdom (sebastian.engelstaedter@ouce.ox.ac.uk)

The emission of dust from desert surfaces depends on the combined effects of surface properties such as surface roughness, soil moisture, soil texture and particle size (erodibility) and wind speed (erosivity). In order for dust cycle models to realistically simulate dust emissions for the right reasons, it is essential that erosivity and erodibility controlling factors are represented correctly. There has been a focus on improving dust emission schemes or input fields of soil distribution and texture even though it has been shown that the use of wind fields from different reanalysis datasets to drive the same model can result in significant differences in the dust emissions. Here we evaluate the representation of near-surface wind speed from three different reanalysis datasets (ERA-Interim, CFSR and MERRA) over the North African domain. Reanalysis 10m wind speeds are compared with observations from SYNOP and METAR reports available from the UK Meteorological Office Integrated Data Archive System (MIDAS) Land and Marine Surface Stations Dataset. We compare 6-hourly observations of 10m wind speed between 1 January 1989 and 31 December 2009 from more the 500 surface stations with the corresponding reanalysis values. A station data based mean wind speed climatology for North Africa is presented. Overall, the representation of 10m winds is relatively poor in all three reanalysis datasets with stations in the northern parts of the Sahara still being better simulated (correlation coefficients ~ 0.5) than stations in the Sahel (correlation coefficients < 0.3) which points at the reanalyses not being able to realistically capture the Sahel dynamics systems. All three reanalyses have a systematic bias towards overestimating wind speed below 3-4 m/s and underestimating wind speed above 4 m/s. This bias becomes larger with increasing wind speed but is independent of the time of day. For instance, 14 m/s observed wind speeds are underestimated on average by 6 m/s in the ERA-Interim reanalysis. Given the cubic relationship between wind speed and dust emission this large underestimation is expected to significantly impact the simulation of dust emissions. A negative relationship between observed and ERA-Interim wind speed is found for winds above 14 m/s indicating that high wind speed generating processes are not well (if at all) represented in the model.