



Estimating seasonal to inter-annual variability of 10m and 100m monthly wind speed from station measurements and global and regional reanalyses over Germany

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For applications related to wind energy production estimation over Germany, the inter-annual variability of wind speeds is of interest. Here we determine the inter-annual variability and trends from reanalysis fields and compare these with tower and station measurements. As observations at the height relevant for the wind industry are sparse, we start with comparing 10m reanalysis fields with station observations, to make use of this large existing record collected by the Deutscher Wetterdienst (DWD). Station observations of wind speed are known to be influenced locally and by measurement procedures. The exact height of the sensor, the local surrounding of the stations, and the measurement procedures have noticeable influence on the time series. Still, comparing station observations with two global reanalyses (ERA-Interim, ERA-20C) from 1979 to 2014 and 2010, respectively, and one regional reanalysis (COSMO-REA6) from 1999 to 2014 allows us to establish confidence in the seasonal to inter-annual variability, the frequency distributions, and extreme event occurrences deduced from the reanalyses, as relative variations compare well. For selected summer months and station measurements, the “stilling effect”, i.e., the decrease of wind speed since the 1970s, as described extensively in the literature, is observed but found to be small. We compare the trends found in the station measurements to the ones deduced from the reanalyses, which had been postulated to differ due to the missing incorporation of roughness length trends. This effect is decreasing with height, thus an estimate at the ground can be understood as an upper limit at the heights relevant for wind energy. We compare the wind speed variability in the reanalyses at 10m and 100m and the respective difference in statistics of relating observations.