Wind Speed Changes Over North America

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Numerous recent studies have reported changes in surface wind speed across the planet. These changes have been noted among both average, 50^{th} percentile winds, as well as so called extreme winds in the 90^{th}+ percentiles measured at 10 m above ground. Though a cause has not been confirmed, it is important to both realize that changes in wind speeds are occurring and investigate why this may be so. Okin et al. (2006) state that wind processes are tightly linked to vegetation and soil changes in semi-arid and arid climates. Vegetation in these areas controls the progression of wind erosion, and soil and vegetation patterns also influence global distributions of dust and its impacts. Changes in surface wind speeds are also directly linked to the evaporation rate and various meteorological phenomena. Here, I will note the changes in wind speed that have been observed over North America, discuss why these changes may be occurring, and also discuss potential shortfalls to these studies.

Over much of the United States and Canada, a decreasing trend has been found in surface wind speeds. Using data from the National Climatic Data Center, Pryor et al. (2007) discovered in much of the US, particularly in the eastern states, this trend has been evident over the past thirty years. Additionally, the regions of western and southern Canada have experienced decreased wind speed in all seasons (Wan et al., 2010). Some locations in eastern Canada have also reported a negative trend in wind speed; however, most locations are observing no significant trend, and some locations are even seeing a positive trend in wind speed (Hundecha et al., 2008). The decreases that have been reported in surface wind speed are around 5-15% over the mid-latitude continental areas, with extreme winds having a larger decrease than weak winds (Vautard et al., 2010).

In Iowa, a study of surface winds has revealed some interesting facts. In the past 70 years, the average surface wind speed has decreased by about 1 m/s (Fig. 1), and direction has rotated clockwise by about 30 degrees (Fig. 2) (Avila et al., 2012). This decrease in speed is consistent over all seasons in each city studied. Though surface winds are shown to be decreasing, this does not necessarily translate to a decrease in wind speed aloft. Wind speeds at 80 m, where wind turbines operate, are impacted by different processes than winds near the surface.

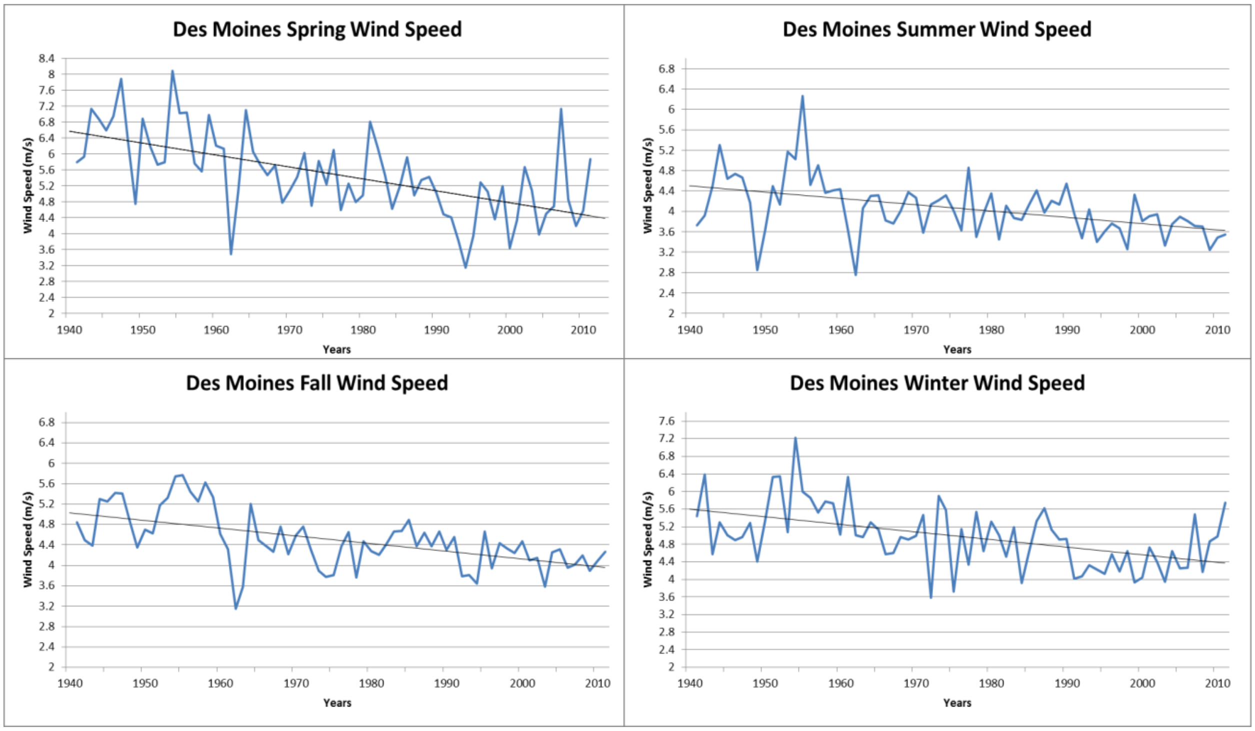

Figure 1. Des Moines 10-m wind speed trend. Spring months: MAM, Summer months: JJA, Fall months: SON, Winter months: DJF. (Avila et al., 2012).

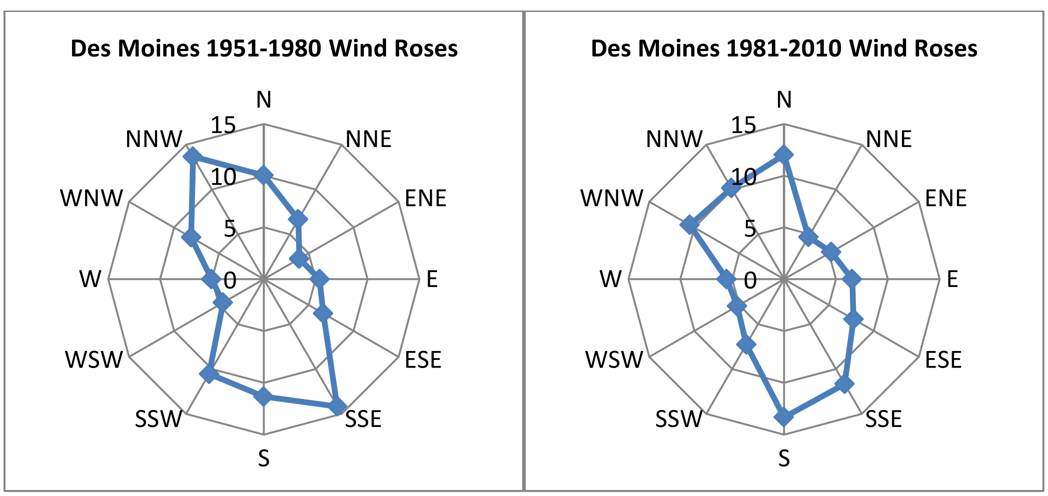

Figure 2. Des Moines annual wind direction roses. (Avila et al., 2012).

With significant decreases in surface wind speed being observed, scientists have published potential reasons for this change. Vautard et al. (2010) suggest that changes in atmospheric circulation account for anywhere between 10 and 50% of this slowdown. In addition, surface roughness changes could explain 25-60% of the decreased speeds. These suggestions are additionally supported by RCM simulations. Areas with the most pronounced negative trend in wind speed generally coincided with increases in biomass over the past 30 years, supporting the idea that surface roughness has an impact on wind speed (Vautard et al., 2010).

Other scientists are not so eager to believe that wind speed decreases are that significant. Principally during the 1990s, many meteorological instrumentation sites saw new anemometers installed, either replacing pressure tubes for rotating cups or just updating the cup anemometer with a new model. Jakob (2010) notes that changes in instrumentation alone can significantly change characteristics of observed wind speed by introducing inhomogeneities in measurements. Correcting for these inhomogeneities is complicated by the fact that no reliable comparison measurements are available. On the other hand, Pryor et al. (2007) also noted this possibility, but found no evidence that instrumentation changes led to significant changes in wind speed measurements.

The relative sparseness of wind measurement locations and short dataset time periods introduce difficulties for scientists to study wind climatology. Due to these shortcomings, the IPCC has low confidence in surface wind trends and their causes at this stage (IPCC, 2012). Additionally, if surface winds are indeed declining, that does not necessarily mean that winds aloft at 80 m, where wind turbines operate, are declining as well. Only continued measurements over time will give more confidence in the results published by various researchers. But as of right now, it appears that surface wind speeds may be decreasing in many locations across North America.

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