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Projected Future Wind Speed and Wind Power Density Trends over the Western US High Plains

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ABSTRACT

This manuscript presents the results of research on future changes in wind speed and wind power density across the western US High Plains in an area known for its high wind energy resources. Many current policies and economic analyses involving the rapidly expanding wind energy industry have assumed a constant or near constant wind resource. However, any future change in wind speeds will result in changes in the reliability of wind power as an energy resource. This paper uses current data (1970-2000) and future model output (2040-2070) to analyze decadal and seasonal changes in wind speed across the study area. In addition, estimated hub height wind power densities have been analyzed. Results show projections of a slight overall decreasing wind power in the future across the region. The greatest magnitude changes are estimated to be in the seasonal trends with the most substantial decreases occurring in winter and spring. As climate changes and warms overall, there will be shifts in the temperature gradients and the synoptic storm tracks that drive wind speeds. Thus, it is theorized that the wind speeds will be the result of an earlier transition to, and longer duration of, a calmer summertime pattern. This longer duration of a summertime pattern will lead to the decreased wind speeds and lower wind power output identified in this research. This decrease needs to be factored in for any estimates of the long-term costs and benefits of wind farms in the area.

KEYWORDS

Wind Climatology; Renewable Energy; Climatic Variability

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