Geophysical Research Abstracts
Vol. 15, EGU2013-12445, 2013
EGU General Assembly 2013


# Characterization of wind power resource in Australia

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The wind resource in Australia has been reconstructed and characterized in terms of its geographical distribution, abundance, variability, availability, persistence and intermittency. The impact of raising the wind turbine hub height on these metrics is analyzed. The Modern Era Retrospective Analysis for Research and Applications (MERRA) boundary layer flux data was used to construct wind power density (WPD) and wind speed at 50 m, 80 m, 100 m, and 150 m, which represent current and potential wind turbine hub heights.
The wind speeds at 80 m were quantitatively and spatially similar to a map of wind speed at the same height developed by the Australian Government, although our results suggest lower values in some areas. Our map underestimates areas of offshore wind, as well as wind over land areas. We discuss possible reasons for this.
Mean WPD at 50 m is lowest in mountainous areas along the Great Dividing Range, and in the north west of Australia, and to the south of the Gulf of Carpentaria, and highest in southwest Western Australia, southern South Australia and Tasmania and southwestern Victoria, with the majority of the continent having WPD values below 300 W m-2. Most of the populated east coast of the country has WPD values below the 200 W m-2, which is the cutoff for the production of usable power that turbines can produce. The median WPD at 50 m gives lower values across the continent than the mean, and indicates much more of the continent has WPD values below the 200 W m-2 value. As turbine hub height increases to 80, 100 and 150 m, there is an increase in WPD with turbine hub height.
We characterize the variability of WPD using the robust coefficient of variation and inter-quartile range (IQR). Our results suggest high RCoV values east of the Great Dividing Range, and higher IQR in the south and southwest of the continent (where the highest WPD occurs).
The unavailability of non-useful WPD (proportion of hours where <200 W m-2), and mean episode length(hours) of wind power density above 200 W m-2 were calculated as measures of the reliability and persistence of the wind power density. We found that unavailability, which decreases with height, is generally highest in the areas where mean WPD is highest (southwest and southern Australia, Tasmania), with lower values in the east and across much of the top end. The mean episode length is highest in parts of the Great Dividing Range in the east of the country, where WPD is low, and lowest in the southwest, where WPD is highest. Mean episode length increases with height, and does so most along the Great Dividing Range and southeast coast, where episode lengths are highest.
We can conclude that many areas with abundant wind resource score high on some measures of variability and low on measures of persistence and reliability, and areas where there is a poor wind resource, seem to have more persistent, reliable wind power. Current work is underway to test the assumption of the aggregation of geographically dispersed wind turbines to mitigate intermittency in Australia using a statistic which measures the anti-coincidence of the wind resource.