Wind Energy Assessment for Nevada – Measurements and Modeling

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Objectives

Wind energy assessment study for Nevada and the U.S. Southwest

Improved estimates of wind energy potential using tower measurements and high-resolution mesoscale/regional scale modeling.

Modeling

Fifth-generation PSU/NCAR Mesoscale Model (MM5)
Weather Research and Forecasting Model (WRF)

Model setup: High-resolution simulations on five domains (horizontal grid resolutions: 18, 6, 2, 0.666, and 0.222 km)

40 unequally spaced layers in the vertical

Model initialization:Eta model outputs (40-km grid resolution)

Measurements

Wind distribution at 50 m

Landscape and the locations of Meteorological towers in Nevada (Source: google-earth)

Table 1. Meteorological towers in Nevada.

<table>
<thead>
<tr>
<th>Tower location</th>
<th>Measurements (anemometer type)</th>
<th>Coordinates (Lat (º N); Long (º W))</th>
<th>Elevation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonopah (T)</td>
<td>10, 20, 30, 40, 50 m (standard)</td>
<td>38.3722; 117.4717</td>
<td>1535</td>
</tr>
<tr>
<td>Stone Cabin (SC)</td>
<td>40, 60, 80 m (sonic)</td>
<td>38.1114; 116.7394</td>
<td>2004</td>
</tr>
<tr>
<td>Kingston (K)</td>
<td>10, 20, 30, 40, 50 m (standard)</td>
<td>39.0455; 117.0008</td>
<td>1780</td>
</tr>
<tr>
<td>Luning 5 (L5)</td>
<td>10, 20, 30, 40, 50 m (standard)</td>
<td>38.5725; 118.1755</td>
<td>1523</td>
</tr>
<tr>
<td>Luning 7 (L7)</td>
<td>10, 20, 30, 40, 50 m (standard)</td>
<td>38.5408; 118.2942</td>
<td>1354</td>
</tr>
</tbody>
</table>

Power spectrum of sonic measured and MM5/WRF simulated wind speeds at 40, 60 and 80 m obtained from different model grid resolutions. The power spectrum is normalized by the maximum value.

Modeling Domains

(D1: 18 km grid; D2: 6 km; D3: 2 km; sub kilometer grids: D4 (666 m) and D5 (222 m))

Monthly distributions of the maximum extractable wind power density extrapolated to 100 m using 2003-2007 composite tower data.

The study indicates that larger wind power is available in Nevada from early spring to summer and moderate wind power during fall and winter months.

Acknowledgements

The authors acknowledge support from the DOE NREL contracts NCL-3-32455-01 and NDO-5-44431-01 and Mr. Travis McCord for technical and editorial preparation.
