

Wind Energy Assessment for Nevada and the Southwest: Improved Estimates of Wind Energy Potential

Richard Reinhardt, Darko Koracin, Tim Minor (Desert Research Institute);
Darrell Pepper (UNLV); Ronald Hess (UNR); Dale Osborn (Distributed
Generation Systems, Inc.)

Summary: Assessment of wind energy, based on observations and modeling, provides improved wind power density maps for Nevada and the Southwest by characterizing variability of the wind resource.

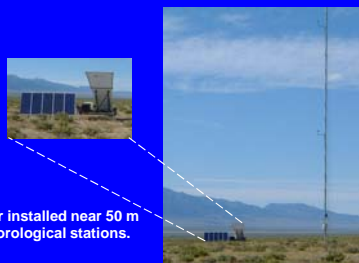
Observations

- Four sites selected for detailed wind analysis and 50 m towers installed



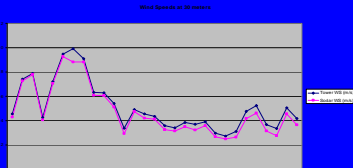
Wind study station locations (map courtesy of Delorme Topo USA).

- An acoustic sounder (sodar) was deployed at two sites to extend wind measurements from 50 to 200 m



Sodar installed near 50 m meteorological stations.

- Acquisition of real-time data and incorporation into DRI's Western Regional Climate Center information system: (<http://www.wrcc.dri.edu/nrel/>)



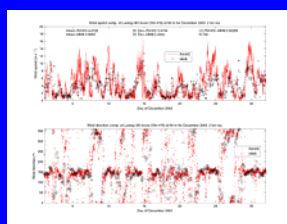
Wind speed observations and acoustic sounder results at 20 meters. Similar results observed a 30, 40, and 50 m. Sodar signal weakens above 60 m due to Nevada's clean, dry atmosphere.

Regional and Mesoscale Modeling

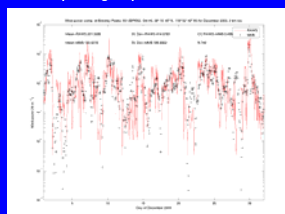
- High-resolution (2 km) MM5 simulations for an annual cycle (Aug 2003–July 2004) for NV
- Four-dimensional data assimilation of RAWS and tower data into the model
- Comparison of simulations with observations (RAWS, 50 m towers) to validate the model
- Development of high resolution estimate of wind energy potential



Modeling domains:
Outer boundary (6 km resolution)
Inner white boundary (2 km resolution)



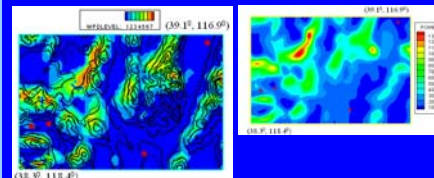
Model evaluation using 50 m tower data (Luning 5N), December 2003.



Wind power density (W/m^2) from the measurements and model at 9 m for Brawley Peaks, December 2003.

Wind Power Density

- MM5 modeling results used to create monthly averaged wind power density maps.
- Results facilitate placement of wind farms in the landscape.



Two-dimensional views of the average wind power density, December 2003. Left figure shows classes (1-7; see Table 1 below) of wind power densities at 50 m; right figure shows average wind power densities at 100 m. Units are W/m^2 .

Wind Power Class	50m (164 ft)	
	Wind Power Density	Mean Speed Range m/s(mph)
1	<200	<5.6(12.5)
2	200-300	5.6(12.5)/6.4(14.3)
3	300-400	6.4(14.3)/7.0(15.7)
4	400-500	7.0(15.7)/7.5(16.8)
5	500-600	7.5(16.8)/8.0(17.9)
6	600-700	8.0(17.9)/8.8(19.7)
7	>800	>8.8(19.7)

Table 1. Wind power density classification (from Battelle Wind Energy Resource Atlas).

Outcomes

- Accurate estimates of wind power potential for Nevada at high vertical and horizontal resolution
- Development of cost-effective methods for assessing wind power potential and determining favorable wind farm locations
- Integration of wind power potential assessment with other alternative energy resources (conventional, solar, geothermal)

Practical Applications

- Evaluating economic potential of wind energy sites
- Testing commercial wind energy sites
- Aiding energy system decision-making

