Aug 20th, 12:00 PM - 2:00 PM

DRI-wind energy assessment and forecasting

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Presenters
Darko Koracin, Michael L. Kaplan, Radian Belu, Kristian Hovarth, Jinhua Jiang, Kristien C. King, Gregory D. McCurdy, Travis E. McCord, John F. Mejia, and Ramesh Vallore

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DoE-NREL Project: Tall Tower Wind Energy Monitoring and Numerical Model Validation in Southern Nevada

DRI-WIND ENERGY ASSESSMENT AND FORECASTING
Darko Koračin (Darko.Koracin@dri.edu), Michael Kaplan, Radian Belu, Kristian Horvath, Jinhua Jiang, Kristien King, Travis Mc Cord, Greg McCurdy, John Mejia and Ramesh Vellore
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120m Tower to be installed at Searchlight, NV
80m instrumented tower at Stone Cabin near Tonopah, NV.
50m wind tower in western NV near Tonopah.

Conceptual schematic of the proposed wind and solar resource and energy storage forecasting.

Diurnal wind speed variations

Seasonal wind speed variations

Differences in the wind power density (W/m²) between the annual cycle of MM5 simulations and TrueWind results over Nevada at 50 m.

Verification: Observed (sonic anemometer wind measurements) and MM5/WRF-simulated wind speeds at Luning NV (Julian day 40.5 = 9 Feb 2007 1200 UTC). Simulation at top (MM5) and bottom (WRF) for each tower height above ground. Wind powers at 40, 60, and 80 m, respectively.

Vegetation and topography in the model domain. MM5/WRF-simulated wind speeds at Stone Cabin in December 2007, (Top 80 m, center) 60 m, and (bottom) 40 m heights.

Resampled frequency distribution (bootstrapped) of index of agreements for the MM5/WRF simulated 80-m wind speeds at the coarsest (18 km) and the finest (222 m) horizontal grid resolutions against sonic anemometer measurements. The number of pairs is 642, and the resampling size is 1000.

Differences in the wind power density (W/m²) between the annual cycle of MM5 simulations and TrueWind results over Nevada at 50 m.

NYREC PROPOSAL ACCEPTED

Forecasting wind and solar resources and renewable energy storage feasibility in complex terrain

1DRI’s REC
- Originated as part of the Nevada Southwest Energy Partnership (NSWEP) NSWEP Partners include:
  - Nevada research institutions: DRI, URG, UNLV
  - Governmental organizations: DOE, NREL, MDSC
2NSWEP Purposes:
  - Provide NSWEP of renewable energy
  - Partner with private sector
  - Provide education and outreach regarding renewable energy

DRI Renewable Energy Center (REC) - Possible location of tall research 60 m tower.

Vegetation and topography in the model domain. MM5/WRF-simulated wind speeds at Stone Cabin in December 2007, (Top 80 m, center) 60 m, and (bottom) 40 m heights.

DoE-NREL AWARDED STUDY

Diurnal wind speed variations

Table: Observed (sonic anemometer wind measurements) and MM5/WRF-simulated wind speeds at Stone Cabin in December 2007, (Top 80 m, center) 60 m, and (bottom) 40 m heights.

Index of agreement

Modeling

Diurnal wind speed variations

Seasonal wind speed variations

Modeling domain:
Innermost grid and elevation of the adaptive OMEGA model, using approximately 222 m grid edge lengths, static terrain adaptivity, and 90 m terrain data. Terrain elevation ranges from 1500 - 2500 m.

Acoustic sounder – instrument for measuring wind in the lowest few hundred meters.

MM5 and WRF modeling domains (D1: 18 km grid; D2: 6 km; D3: 2 km) sub kilometer grids: D4 (666 m) and D5 (222 m). Terrain data: USGS (1 km resolution) DRI-Renewable Energy Center (REC) - Possible location of tall research 60 m tower.

MM5 and WRF - Nested domains (equi-spaced square mesh)