Analysis of Mesoscale Model Data for Wind Integration

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Western Wind and Solar Integration Study (WWSIS)

- Data sets designed to:
  - Provide a robust and consistent data set for modeling studies of integrating significant amounts of wind in balancing areas
  - Used for “what if we had wind turbines here” type of modeling studies
  - Cover the same time period as load data in the studies
  - Recreate historical climate and weather data to enable historic modeling of winds
  - Analyzed in conjunction with load, hydro and other climate/weather related data

- Data sets are not designed to:
  - Predict distribution, location, and size of future wind plants across the U.S.
  - Predict the long-term power production from a particular wind plant
  - Predict future wind generation levels from a state or region
  - Replace updated state wind resource maps
  - Be the only basis for investment in wind development

Why Numerical Mesoscale Modeling for Wind Integration Studies?

1. Supports examination of implications of national 20% wind vision
2. Provides input to integration and transmission studies for operational impact of large penetrations of wind on the grid
3. Generates consistent wind speed and power plant output time series data sets
   - Time series capture geographic diversity issues for:
     • Resource planning
     • System operations
     • Transmission expansion analyses

Eastern Wind Integration and Transmission Study (EWITS)

- Study area includes:
  • PJM
  • Midwest ISO
  • Mid-Continent Area Power Pool
  • Southwest Power Pool
  • TVA
  • New York ISO
  • Other interested parties

Validation

Model and Observed Wind Speeds at One EWITS Validation Tower

Diurnal

Monthly

Design of EWITS and WWSIS Mesoscale Data Sets

Validation Conclusions

- EWITS and WWSIS data sets developed using different numerical computer models
- EWITS used MASS model, part of AWS Truewind’s MesoMap® system
- WWSIS used WRF model as employed by 3TIER
- Both models were optimized using comparisons between raw model data and measurement from tall towers
- Greatest uncertainty in model data occurs:
  - In complex terrain (e.g. downslope acceleration)
  - Where wind flows are thermally driven (e.g. land-sea breeze)
  - Where there are strong flows near the top of the boundary layer (e.g. low-level jets)

Future Work for Mesoscale Data Sets

- Tall tower measurement campaign to increase understanding of boundary layer and validate mesoscale model data
- Validation of mesoscale wind speed time series
  - Diurnal
  - Seasonal
- Comparison of overlap areas of EWITS and WWSIS data
- Standardization of data set characteristics
  - Wind plant shapes
    • Series of individual grid points versus amalgamated grid cells
  - Horizontal resolution of grid cells and wind plant installed capacity
  - Protocol for converting wind speeds to wind plant production
  - Calculation of losses
  - Appropriate IEC turbine class based on wind speed

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