Examining Publicly-Available Tall-Tower Observations

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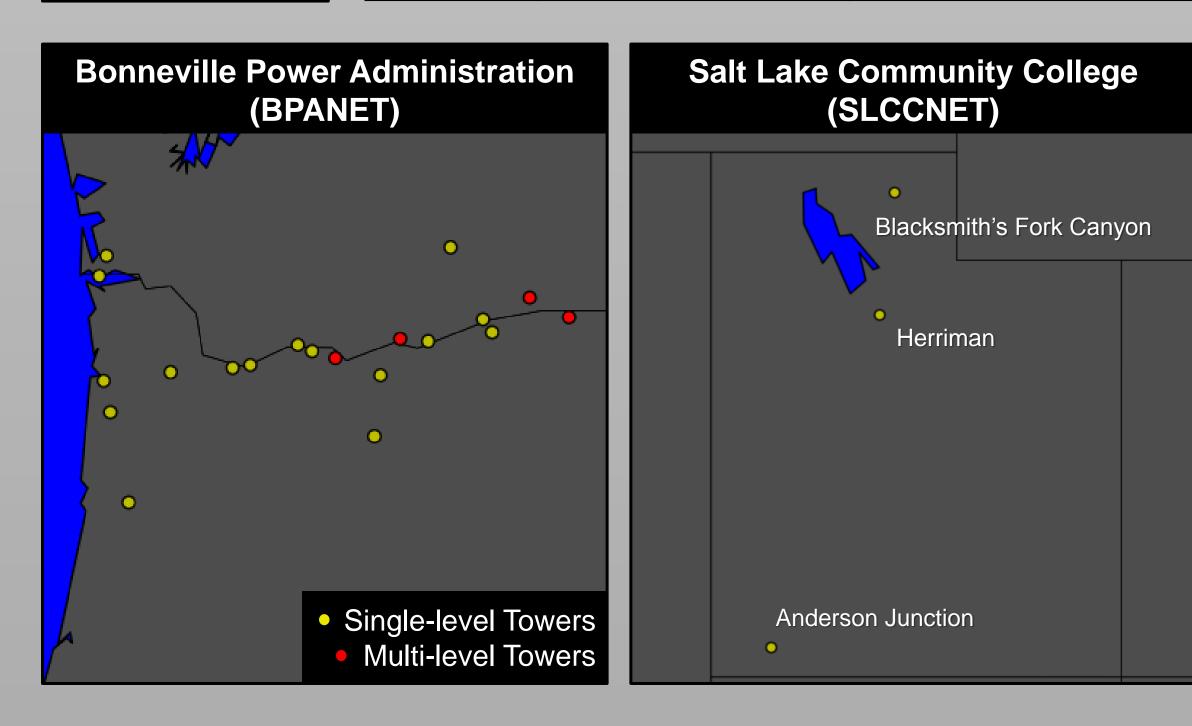
Primary Motivation

- MesoWest: collaborative project between the University of Utah, National Weather Service, and over 120 data providers
  - Goal: provide access and displays for current and archived surface weather observations across the United States
  - Data for 34,000+ unique stations (21,800+ in real-time)
  - Aggregation and dissemination source for:
    - Meteorological Automated Data Ingest System (MADIS)
    - National Center for Environmental Prediction (NCEP)
- Requests received to acquire and archive observations from data providers with multiple wind sensors on tall towers

Present Tall-Tower Providers

- Utah Office of Energy Development's Anemometer Loan Program now managed by Salt Lake Community College
- In partnership with MesoWest, real-time cell phone access to multiple wind sensors on up to fifteen 20-60 m tall-towers is being implemented by Fall 2012 (SLCCNET network)
- Bonneville Power Administration (BPANET): network of tall towers primarily located along the Columbia River Gorge
- Oak Ridge National Laboratory (ORNL): network of 11 tall towers located on ORNL property in Tennessee

Network	BPANET	SLCCNET
Stations	20	3 (+12)
States	OR/WA	UT
Data	Jan 2012 – pres.	June 2012 – pres.

Bonneville Power Administration (BPANET)

Salt Lake Community College (SLCCNET)

Blacksmith's Fork Canyon

Herriman

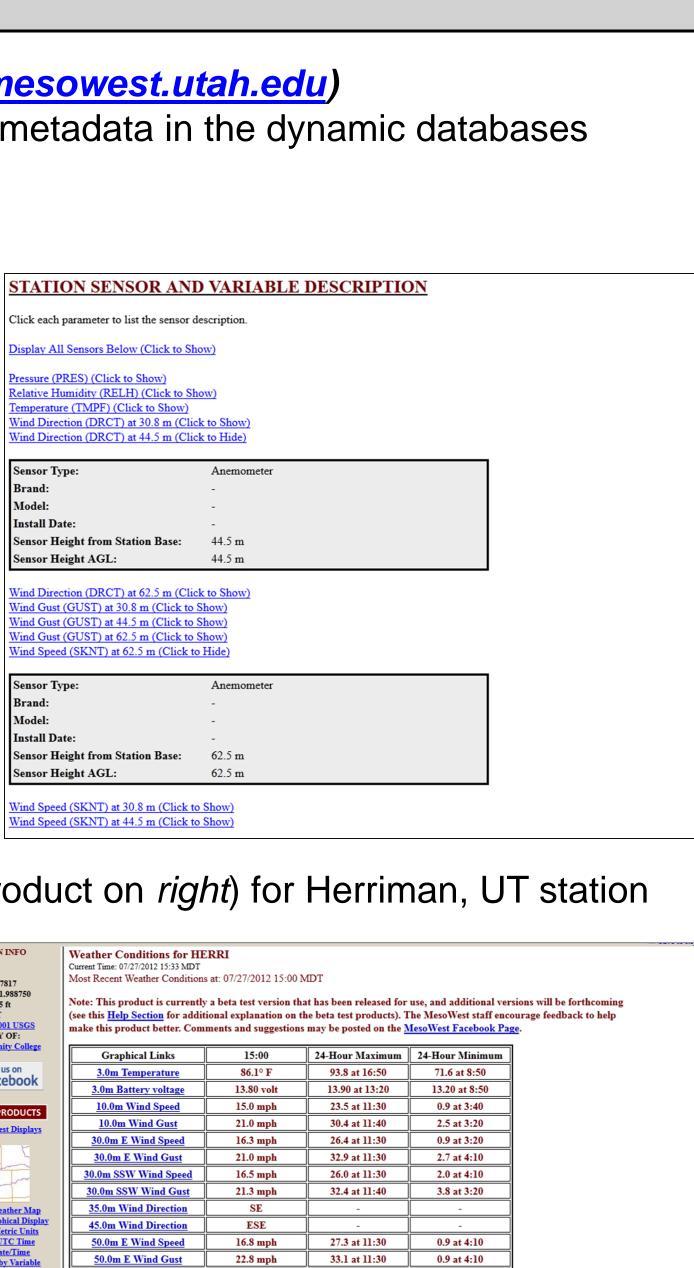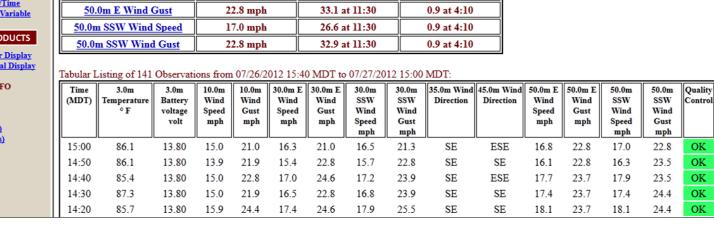Anderson Junction

- Single-level Towers
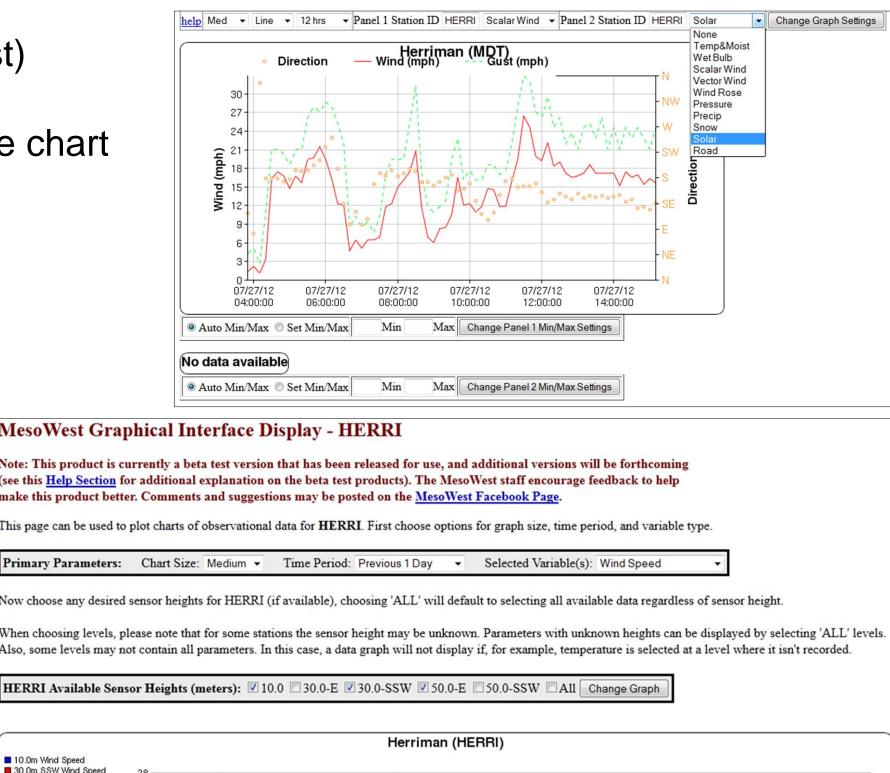- Multi-level Towers

Wind Energy Application

- Tall towers: important data source for nowcasting conditions of the planetary boundary layer for wind energy and public safety
- Critical wind energy concern: nowcasting wind ramp events (Freedman et al. 2008; Kamath 2009; Greaves et al. 2009; Marquis et al. 2011)
  - Wind ramp: an event that produces >50% change in turbine power capacity over a period ≤ 4 hours
  - Ramp-up and ramp-down events refer to power capacity increases and decreases, respectively
- Estimating events from wind observations (Deppe et al 2012)
  - Ramp event: ±3 m s^{-1} change in wind speed when either:
    - Wind speed within 6-12 m s^{-1} (critical power ramp region)
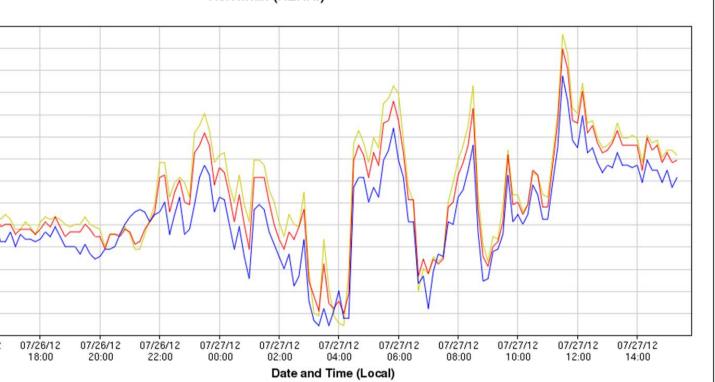   - Wind speed causes turbine shutdown (> ~25 m s^{-1})

Storing and Visualizing Tall-Tower Observations

I. Internal Data Storage in MesoWest

- Primary MesoWest database structure assumes each station only has one of each variable (*e.g.* one wind sensor reporting speed, direction, and gust)
- This structure breaks down when ingesting similar data from multiple sensors (*e.g.* RWIS road data as well as multiple wind sensors on tall towers)
- Station sensor metadata table now utilized to dynamically associate sensor height, orientation, and type to observations stored in new data tables
- Real-time access to tall towers established and data now flowing into new dynamic databases routinely

II. Data Display Products on MesoWest Web Interface (http://mesowest.utah.edu)

- New web display products developed to access tall-tower data/metadata in the dynamic databases

1) Station Metadata Page

- Simplified format
- More images
- Menu display options
- Extended sensor metadata (if it is available for the station)
- Text file option

2) Station Tabular Display (active product on *left*, new beta-test product on *right*) for Herriman, UT station

- Displays observations from multiple sensors
- Extended metadata
- Observation count for 24-hour period
- Can order table by variable type or by sensor height
- Retained options to change units, time period, and time-zone

3) Station Graphical Display (active product on *top-right*, new beta-test products *below*)

- Parameters pertinent to each station (not a default list)
- Dynamically changing list of sensor heights
- Ability to plot one or multiple levels of data on a single chart
- Larger graph sizes
- Better legend location
- Expected in future version releases:
  - Plot and compare two graphs at once
  - Set range minimum/maximum values

Wind Ramp Event Examples

- BPANET Goodnoe Hills (BPGDH)
  - Sited within wind farm area
  - 5-minute wind observations from two sensors at 15.2 and 59.4 m above ground level (AGL)
  - MesoWest archive: late January 2012 to present day with minimal data gaps

Courtesy: Google Maps API

- Ramp events below identified using Deppe et al. (2012) criteria

- 59.4 m AGL wind: 14 UTC 3 May 2012 – 14 UTC 4 May 2012
  - Estimated ramp-up and ramp-down events shaded below

- 15.2 m and 59.4 m AGL wind speed: 0-24 UTC 22 Feb 2012
  - Strong ramp-up event ~10-14 UTC (shaded below)
  - Speeds approach turbine shutdown region ~13-15 UTC
  - Large differences in 15.2 and 59.4 m winds ~11-16 UTC

Summary and Future Work

- Currently ingesting real-time tall-tower data from 3 networks
- Project with SLCC for accessing additional UT tall towers to be completed in Fall 2012
- Web-based data download products and real-time dissemination of all tower data to MADIS in development
- Refine products with additional features and user feedback via email or Facebook (http://www.facebook.com/mesowest)

Acknowledgements

To download a copy of this poster, please feel free to scan the following code provided here: