EMS Annual Meeting Abstracts
Vol. 9, EMS2012-230, 2012
12th EMS / 9th ECAC


# Forecasting Wind Ramps from Pressure Trough Progression

Y. Li, P. Musilek, and E. P. Lozowski
University of Alberta, Canada (petr.musilek@ualberta.ca)

With the rising penetration of wind power into the energy mix, the forecasting of wind power production becomes increasingly important. Sudden, large changes in wind power generation, called wind ramps, require more research attention, because they cannot be well captured using conventional forecasting methods that combine a Numerical Weather Prediction (NWP) model and statistical techniques. Wind ramps are associated with several different weather phenomena. A method to automatically detect these weather phenomena can help to predict the spatiotemporal progression of ramps. It can also help to build statistical models for these weather phenomena.
Pressure troughs, elongated regions of relatively low pressure, are considered significant indicators of wind shifts. They are closely associated with wind changes during two important, ramp-related weather events - fronts and mountain waves. Fronts are primarily characterized by strong temperature gradients; however, wind shifts are more likely to be associated with pressure troughs rather than temperature changes. In the lee of mountains, strong downslope winds can result from large-amplitude mountain waves. They tend to occur when a high-speed, upstream stable flow passes over the mountain almost perpendicular to the ridge line. Diabatic heating and cyclogenesis in the downslope flow can produce a lee trough. Thus, detection of pressure troughs can potentially yield a significant improvement in the quality of wind ramp forecasts.
In this contribution, trough lines are identified using valley detection methods used for image processing. In this application, the proposed method connects the points with maximum level curvature in the pressure field. This approach is illustrated using sea-level pressure fields extracted from the North American Regional Reanalysis (NARR) datasets. Two case studies demonstrate how pressure troughs relate to power production changes in wind farms located on the eastern side of the Rocky Mountains, a region with great potential for wind energy production.