Models – Repositories of Knowledge
(Proceedings ModelCARE2011 held at Leipzig, Germany, in September 2011) (IAHS Publ. 355, 2012), 327-332.

Wind energy forecast ensembles using a fully-coupled groundwater to atmosphere model

JOHN L. WILLIAMS, III[1] & REED M. MAXWELL[1,2]
1 Colorado School of Mines, Department of Geology and Geological Engineering, Hydrologic Science and Engineering Program, 1500 Illinois St, Golden, Colorado 80401, USA
johwilli@mines.edu
2 Integrated Groundwater Modeling Center, 1500 Illinois St, Golden, Colorado 80401, USA

Abstract As wind energy becomes an increasingly important component in the renewable energy portfolio, accurate wind forecasts become critical. We apply the PF.WRF model, a fully-coupled groundwater-to-atmosphere model incorporating the parallel three-dimensional variably-saturated hydrologic model ParFlow and the Weather Research and Forecasting (WRF) atmospheric model to simulate the components of the hydrologic cycle from bedrock to the top of the atmosphere. Model components are coupled via moisture and energy fluxes in the Noah Land Surface Model. The fully-coupled model dynamically simulates important meteorological effects of interactions between the land surface and the atmosphere, controlled in part by soil moisture distribution and land surface energy flux partitioning. In this study, we complete ensemble simulations for three wind ramping events at a wind energy production site on the west coast of North America using varying stochastic random fields of subsurface hydraulic conductivity and forced with meteorological data from the North American Regional Reanalysis dataset for a series of wind ramp events. We attribute error between the modelled and observed data to uncertainty in the statistical representation of subsurface heterogeneity and errors in boundary condition forcing data.

Key words land–surface atmosphere feedbacks; uncertainty; heterogeneity; wind; wind energy; weather forecasting