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Development of dynamical-statistical short-range probabilistic wind prediction system for wind regimes in coastal&complex terrain areas

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Abstract

Current state-of-the-art global and regional (mesoscale) models are still limited in representing the challenging wind conditions, such as in coastal and complex terrains. This is due to prevailing wind systems which are – due to their smaller scales – not adequately represented in typical operational weather prediction models.

A new dynamical-statistical short-range (3+ days ahead) wind forecasting system is being developed to reduce meteorological uncertainities related to wind energy integration in coastal and complex terrain. This wind prediction system is coupled (off-line) with WPPT tool of the Croatian Transmission System Operator (HOPS) to support efficient wind energy integration and wind power plant management.

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In focus: Action WILL4WIND NEW!

Weather Intelligence for Wind Energy **WILL4WIND**

Starting date: 10.4.2013.
Duration: 24 months
Cost: 535.863,41 EUR
Grant scheme: IPAIIIc, Science and innovation investment fund (www.siif-croatia.com)
Lead institution: (1) Meteorological and Hydrological Service
Partners: (2) Faculty of Electrical Engineering, (3) Croatian Transmission System Operator Ltd., (4) Energy Institute Hrvoje Požar, (5) RP Global Projekti Ltd.
22 persons in the project team, 4 young researchers employed

Objectives

Objective: To present the first results of the new short-range wind forecasting system prototype designed for the wind regimes prevailing in coastal and complex terrain.

Methods & Results

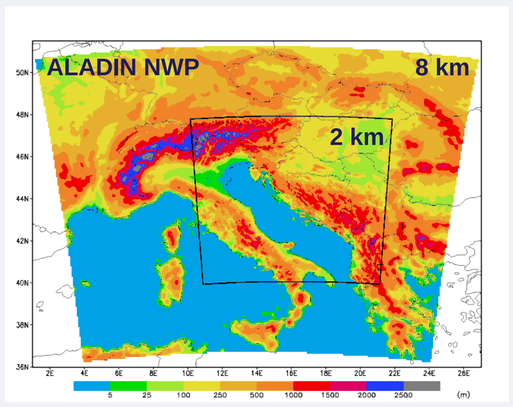
INTEGRATED WIND PREDICTION SYSTEM
For coastal and complex terrain areas
5 minutes to 3+ days ahead

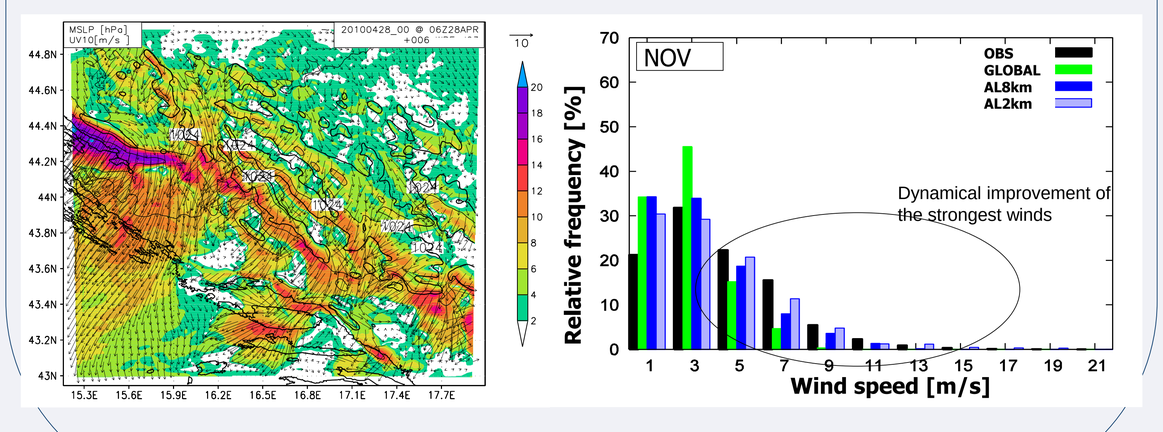
1. DYNAMICAL ALADIN WIND PREDICTION MODEL
- refinement of mesoscale winds, especially strong downslope winds

GLOBAL MODEL ARPEGE/IFS (ECMWF)
Grid spacing ~12-16 km

REFINEMENT 1: REGIONAL NWP
Grid spacing ~ 8 km
Mesoscale data assimilation
~100.000 additional observations

REFINEMENT 2: SUBREGIONAL CFD-like NWP (Tudor et al.,2013)
Grid spacing ~ 2 km

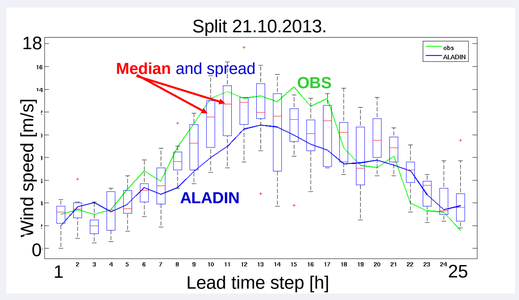




2. STATISTICAL WIND PREDICTION REFINEMENT (INCL. NNs)
- Ultrashort-range wind predictions (5min-3h) using neural networks
- Probabilistic statistical local refinement (6h to 72h ahead)

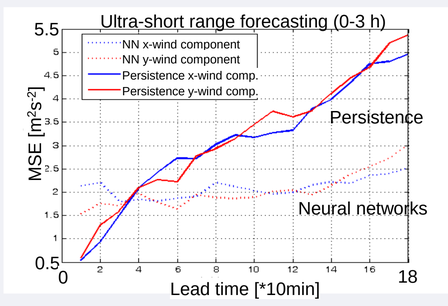
PROTOTYPE

REFINEMENT3: PROBABILISTIC SITE-SPECIFIC
Probabilistic wind predictions (DM, 2011) at wind turbine heights



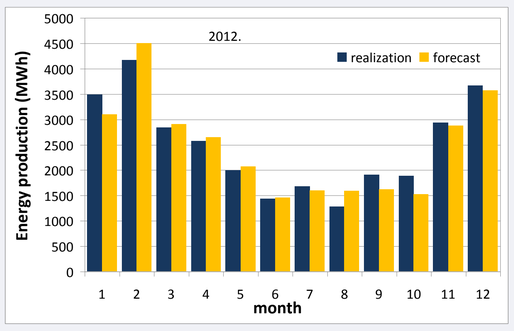
PROTOTYPE

ULTRA-SHORT RANGE: PROBABILISTIC SITE-SPECIFIC
Based on neural-networks
Up to 3 hours ahead



3. STATISTICAL WIND ENERGY FORECASTING
- Statistical relation between wind speed and wind energy production forecast

WIND ENERGY PRODUCTION: WPPT
Statistical self-learning wind energy production forecast (GN, 2008)
Done Off-line in Croatian TSO



Conclusions

Integrated wind forecasting system aimed at wind energy integration in coastal and complex terrain areas should address: (1) high-resolution dynamical modeling to represent (sub-)mesoscale flows and related energy production, (2) Ultra-short range forecasting to address issues of secondary regulation, (3) Treatment of uncertainty at all forecast lead times.

References

1. Tudor M., S. Ivatek-Sahdan, A. Stanesic, K. Horvath and A. Bajic, 2013: **Forecasting Weather in Croatia Using ALADIN Numerical Weather Prediction Model**, *Climate Change and Regional/Local Responses*, Dr Pallav Ray (Ed.), ISBN: 978-953-51-1132-0, InTech, DOI: 10.5772/55698. Available from: http://www.intechopen.com/books/climate-change-and-regional-local-responses/forecasting-weather-in-croatia-using-aladin-numerical-weather-prediction-model.
2. Delle Monache, Luca, Thomas Nipen, Yubao Liu, Gregory Roux, Roland Stull, 2011: Kalman Filter and Analog Schemes to Postprocess Numerical Weather Predictions. *Mon. Wea. Rev.*, **139**, 3554–3570. doi: http://dx.doi.org/10.1175/2011MWR3653.1

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