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Link to article, DOI:
10.5194/egusphere-egu22-12923

Publication date:
2022

Document Version
Publisher's PDF, also known as Version of record

EGU22-12923, updated on 02 Jan 2023
https://doi.org/10.5194/egusphere-egu22-12923
EGU General Assembly 2022

Highlight results of the Smart4RES project on weather modelling and forecasting dedicated to renewable energy applications

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In this presentation we detail highlight results obtained from the research work within the European Horizon 2020 project Smart4RES (http://www.smart4res.eu). The project, which started in 2019 and runs until 2023, aims at a better modelling and forecasting of weather variables necessary to optimise the integration of weather-dependent renewable energy (RES) production (i.e. wind, solar, run-of-the-river hydro) into power systems and electricity markets. Smart4RES gathers experts from several disciplines, from meteorology and renewable generation to market- and grid-integration. It aims to contribute to the pathway towards energy systems with very high RES penetrations by 2030 and beyond, through thematic objectives including:

- Improvement of weather and RES forecasting,
- Streamlined extraction of optimal value through new forecasting products, data market places, and novel business models;
- New data-driven optimization and decision-aid tools for market and grid management applications;
- Validation of new models in living labs and assessment of forecasting value vs costly remedies to hedge uncertainties (i.e. storage).

In this presentation we will focus on our results on models that permit to improve forecasting of weather variables with focus on extreme situations and also through innovative measuring settings (i.e. a network of sky cameras). Also results will be presented on the development of seamless approach able to couple outputs from different ensemble numerical weather prediction (NWP) models with different temporal resolutions. Advances on the contribution of ultra-high resolution NWPs based on Large Eddy Simulation will be presented with evaluation results on real case studies like the Rhodes island in Greece.

When it comes to forecasting the power output of RES plants, mainly wind and solar, the focus is on improving predictability using multiple sources of data. The proposed modelling approaches aim to efficiently combine highly dimensionally input (various types of satellite images, numerical weather predictions, spatially distributed measurements etc.). A priority has been to propose models that permit to generate probabilistic forecasts for multiple time frames in a seamless way. Thus, the objective is not only to improve accuracy and uncertainty estimations, but also to

simplify complex forecasting modelling chains for applications that use forecasts at different time frames (i.e. a virtual power plant - VPP- with or without storage that participates in multiple markets). Our results show that the proposed seamless models permit to reach these performance objectives. Results will be presented also on how these approaches can be extended to aggregations of RES plants which is relevant for forecasting VPP production.

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