Advanced meteorological forecast model and applications in energy market

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Background
Weather is a major driver of energy supply and demand, considering the evolution of technology, extensive adoption of renewable energy sources, producer-consumer relationships, and the energy policies which have been challenging. Therefore, operational and planning decisions in energy systems have to be guided by efficiency and reliability. Weather forecasts, including accurate uncertainty estimates are fundamental tools. In the short-term range, the appropriate understanding and predictions are necessary for an effective decision-making and voluntary, in principle, from minutes to days, while, on the long-range scales, planning and supporting strategies to manage the sub-seasonal and seasonal transitions of weather and climate. Uncertainty modelling techniques should be used in order to adequately minimize forecast errors as well as target variables which mostly impact the decision-making process.

Research activity
Here, we show recent achievements where the model has been used both at local and large scales, particularly over Italy, and Europe. These applications are focused on managing the trade off between transport, storage, and stability of energy resources, estimating the production of electric energy obtained using natural gas in combined cycle power plants, improving efficiency and reducing environmental impact by early warning systems for geo-hazards, forecasting of the industrial and civil consumptions as well as renewable power plants energy productions, optimizing the supply of oil and the industrial refining processes lead by market trends. Benchmark analyses by using observations and climate data have been evaluated, considering both the short-range and the medium-long range predictions; even the analysis of daily forecast performances is routinely performed. Main results have shown high reliability of this forecast system and its great capability to support operative decisions in energy market.

Benchmark analysis of forecasted seasonal temperature over different climatic areas


Hourly weather forecasts for gas turbine power generation


Effects of model horizontal grid resolution on short- and medium-term daily temperature forecasts for energy consumption application in European cities


Local-scale weather forecasts over a complex terrain in an early warning framework: performance analysis for the Val d’Agri (southern Italy) case study