

Nowcasting: Artificial intelligence-based short-term weather forecasts

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Climate change in Italy and Europe is leading to a progressive increase in extreme weather events, with repercussions on all social and economic activities: traffic circulation, tourism, agricultural and industrial production, renewable energy, people's health and safety. Always active in environmental modeling, in the past 5 years FBK has built a dense network of relationships with national and international organizations and companies for the research and development of weather models, in particular for extreme events.

More accurate weather models and intelligent warning systems enable the improvement of the resilience of the local areas and production activities. To do this, the application of artificial intelligence and big data models is required.

The Foundation pursues an inclusive collaboration model, where FBK's expertise in artificial intelligence and big data is supported by public/private weather agencies and companies, for the creation of models and projects with local operational implications, both for residents and for specific areas of application (renewable production, agriculture, tourism, mobility).

FBK is engaged in the research of artificial intelligence techniques for the **improvement of weather forecasts in the very short (0-6 hours) and in the short term (6 – 24 hours).**

These approaches aim both at improving the spatial and temporal resolution of the forecasts and their temporal extension.

An application field of this type of environmental modeling are early warning systems, thanks to which the population receives messages targeting categories exposed to environmental risk. These systems are able to aggregate and process multiple data sources in real time. In particular, the technologies developed by FBK in this area focus on the development of fully automated intelligent alert systems, capable of providing personalized alerts for each individual user through various distribution channels (web, chatbot, email, text message).

Those of you who wish to learn more about this topic may find it useful to read more about two projects: **Meteotrentino early warning** and **MIARAD**.

- In Meteotrentino early warning, FBK has developed a **fully automated multi-channel alert system** (Chat, SMS, Email, Web) **for extreme weather events to be sent to civil protection operators** throughout Trentino, to allow rapid response capabilities in the event of events posing hazards for the population. The system is fully operational and uses weather stations and radar for real-time monitoring; it also integrates rainfall forecasts through nowcasting based on FBK's AI and numerical model, which are used to alert about predicted events.
- **MIARAD** aims to **improve regional weather conditions nowcasting capabilities for the Emilia-Romagna Region**. The project involves the development of a 1 km resolution nowcasting system aimed at **launching timely warning messages** (15-60 minutes lead time) for extreme weather events, which uses Deep Learning (DL) methods applied to several data sources, such as weather radar, lightning, rainwater network, and environmental variables. The project also includes the study of a mixed model between DL nowcasting algorithms and physical models, to obtain **real-time forecasts up to 6 hours**.

Last but not least, we must not forget that the excellent technologies and skills available at FBK represent an essential tool for mitigating the effects of [climate change](#) in Italy and in Europe. This phenomenon is in fact leading to a progressive increase in extreme weather events, with repercussions on all social and economic activities: traffic circulation, tourism, agricultural and industrial production, renewable energy, health and safety of people. More accurate weather models and intelligent warning systems enable the increased resilience of local areas and production activities. To do this, it has become essential to apply artificial intelligence and big data models.

The "[Data Science for Industry and Physics](#)" working group of the [FBK Digital Industry Research Center](#), coordinated by **Marco Cristoforetti**, focuses on the application of Data Science methodologies and approaches for the development of predictive models based on machine learning from heterogeneous data. In the industrial sector, other collaborations concern machine learning applied to digital agriculture and the analysis of time series for monitoring conditions and predictive maintenance for the prediction and control of industrial processes.

In the video, researcher **Gabriele Franch** describes the architecture of the solutions developed at FBK, which integrate physical modeling and AI by combining observation and forecasting, for a more dynamic and accurate result that also offers the possibility of sending automatic weather alert messages as soon as pre-set critical thresholds are reached.

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