

Conference Report: Third European Nowcasting Conference

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Abstract

The third European Nowcasting Conference took place in Madrid, Spain, from 24 to 26 April 2019. The conference was structured into four thematic sessions i) observations as basis for nowcasting, ii) seamless prediction, iii) nowcasting techniques, systems and products, iv) verification, societal impacts, applications and user aspects. This report summarizes the scientific contributions presented and the discussed scientific questions.

Keywords: nowcasting, seamless prediction, observations, ensemble, severe weather warnings, user aspects

1 Introduction

The provision of forecasting products from nowcasting – ranging from a few minutes to a few hours – to short range forecasting (up to 72 hours ahead), together with modern, automatic early warning tools, are a key issue for National Meteorological and Hydrological Services (NMHSs) – as detailed in WANG *et al.* (2017). At the [WORLD WEATHER OPEN SCIENCE CONFERENCE \(2014\)](#), the term “seamless prediction” was used generally to cover timescales from minutes to months, but also considering all compartments of the Earth System – including hydrology and atmospheric composition, as well as links to users, applications and social sciences. Seamlessness can be viewed as a useful concept to express the need for information for users, stakeholders and decision makers that is smooth and consistent across the artificial barriers that exist because the information comes from different observing systems, models, time and space scales, or compartments of the earth system. Thus, in the context of the World Meteorological Organization (WMO), seamless prediction considers not only all compartments of the Earth System, but also all disciplines of the weather–climate–water–environment value cycle (monitoring and observation, models, forecasting, end user products, dissemination and communication, perception and interpretation, decision-making) to deliver tailor-made weather, climate, water and environmental information covering minutes to centuries and local to global scales.

The focus of seamless prediction here is on the integration of several elements including nowcasting and numerical weather prediction (NWP) to provide smooth forecasts. Outputs are presented with consistency in quality, skill and content, regardless of the underlying method, with lead times from minutes up to a few days ahead. Sharing expertise, experiences and best practices of developing and implementing nowcasting and seamless prediction systems will enable NMHSs to develop and provide the best possible products to their end users. Therefore, a European wide cooperation on nowcasting exists since 2013, with the aim to collect information about nowcasting systems, observations, verification and applications.

The EUMETNET (European Meteorological Services' Network) Nowcasting Programme (E-NWC; cp. <http://eumetnet.eu/activities/forecasting-programme/current-activities-fc/e-nwc/>) started in 2019 and will last until 2023; it is the follow-up project of ASIST (Application oriented analysis and very short range forecast environment; 2015–2018), which followed the Nowcasting Activity (2013–2014). In the beginning, the focus was predominantly on nowcasting systems, which was extended to very short range forecasts, and finally to seamless prediction. The core activities within this cooperation programme revolve around nowcasting systems, observations used in nowcasting and seamless prediction systems, verification, training and enhanced relations with end users.

Since 2014, a conference dedicated to nowcasting was organized under the umbrella of EUMETNET every two to three years. The goal of the conference is to promote recent advances in the theory and practice of nowcasting in Europe and other parts of the world. It wel-

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comes participants from operational as well as research centers and forecast users to discuss methods for improving the quality of nowcasting in Europe. The results of the second European Nowcasting Conference (ENC), which was held in 2017, are summarized in WAPLER et al. (2017).

The third European Nowcasting Conference took place in Madrid from 24 to 26 April 2019, and was attended by around 100 participants from 22 countries (Austria, Belgium, Bulgaria, Croatia, Czech Republic, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Republic of Korea, Russia, Singapore, Slovenia, Spain, Switzerland, United Kingdom, United States), representing NMHSs, universities/research institutes and the commercial sector. They presented their latest findings on observations, seamless prediction, nowcasting techniques and systems, verification and user aspects.

One thematic block which is getting more attention in nowcasting circles is not only about improved datasets but also about crowd-sourced data. This was mentioned as an upcoming topic at the second ENC, and during the third ENC a few presentations were held about crowd-sourced data (e.g. on the usage and verification). Moreover, diagnostic and prediction capacities of Nowcasting Satellite Application Facility (NWC SAF) products has increased, and it is planned to include algorithms on the satellites themselves for faster processing of convective objects. Progress has also been made in nowcasting methods, the techniques of blending gridded variables (especially precipitation) and convective objects. The potential of artificial neural networks (ANNs) was examined (e.g. concerning the evolution of thunderstorms), and new approaches for forecast uncertainty estimates were investigated. Several NMHSs address plans to develop seamless and probabilistic tools from observation to, at least, the very short-term. Finally, more post-processing techniques in the range of nowcasting are addressed, and being applied to several meteorological parameters. Besides the many excellent presentations (40 oral presentations and 26 poster presentations), there was room for discussions during dedicated time slots at the end of each session and during poster sessions. The detailed program of the conference, all abstracts and PDFs of most of the presentations are available online at the following webpage: <http://eumetnet.eu/european-nowcasting-conference-enc-2019/>.

2 Observations as basis for nowcasting

The demand for higher spatial and temporal resolution of weather observations and products is rising, and these need to be available very fast, and updated frequently. NWC SAF develops, freely distributes and maintains software packages that allow users to generate satellite (and NWP-based) derived products locally. New SAF products are available for clouds, stability and hu-

midity, precipitation, convection, wind and extrapolation imagery (presentation by RÍPODAS et al.). VISOR (Real time observations visualizer), a tool developed by AEMET (*Agencia Estatal de Meteorología*), makes it easier to monitor any meteorological situation, which makes it especially useful for the tracking and surveillance of convective systems (presentation by MARCOS et al.). It provides information of automatic weather stations (AWS), radar products, lightning information, METEOSAT Second Generation (MSG) imagery including NWC SAF products, web cams, soundings and warnings. Examples of new products were given as “convective initialization” and “tropopause folding”.

A large number of alternative data sources – including crowd-sourced data – are emerging. Large amounts of meteorological data can be collected e.g. with passenger cars to explore the potential mutual benefits of data exchange between millions of passenger cars and the weather service (presentation by RIEDE et al.). The quality of crowd-sourced data is a major challenge which was discussed. However, the open discussion on this issue showed that generic solutions for this challenge are not (yet) available.

Large potential is seen for the METEOSAT Third Generation (MTG) satellite mission and its future contribution to nowcasting which is the provision of satellite-based atmospheric soundings of temperature and humidity every 30 minutes, derived wind information, continuous observation of lightning activity (every few seconds) and spectral imagery at least every 10 minutes (presentation by BOJINSKI et al. and MARTINEZ and CALBERT). The production of earth observation image products aboard satellites that can be quickly and reliably transferred to the ground given their relatively low data volume are tested (presentation by FIENGO et al.). Such a data-driven system is capable of classifying satellite data aboard the satellite with latencies as short as 1 minute. The use of active and passive ground-based remote sensing data (light detection and ranging – LIDAR – and more specifically differential absorption lidar – DIAL – and microwave radiometry) in combination with infrared sounders (IRS) might overcome the gap of observations in the planetary boundary layer (presentation by LÖHNERT et al.).

As higher resolution and bigger datasets become available, their addition to computing, storage and dissemination channels is challenging. As these data sets might be owned by both public and private sector, Intellectual Property Rights (IPRs) have to be considered. It was highlighted during the discussion that quality control of new data types, especially crowd-sourced data is crucial and far from trivial.

3 Seamless prediction

Seamless prediction systems are currently under development at some NMHSs (e.g. presentations by MOISELIN et al., SANDFORD et al., ATENTIA et al., WAPLER et al., NUOTTOKARI et al.). Seamless techniques in

the very short range are mainly focused on precipitation but can also be beneficial for other parameters, e.g. nowcasting of solar radiation obtained by seamlessly merging satellite and high-resolution NWP data (presentation by MARTÍNEZ-SÁNCHEZ and CALLADO). The remaining contributions focused on precipitation and showed different approaches. Localization by dividing the domain in boxes was used in both contributions by MOISSELIN et al. and ATENCIA et al. The first used the sequential aggregation of predictors by exponential weights, meaning that two predictors are combined; while the second focused on the impact of Bayesian weighting in a probabilistic nowcasting and its benefits with dependence on the ensemble member. The problems of seamless techniques in an operational framework were revisited in the FMI (Finnish Meteorological Institute) Nowcasting system ULJAS (NUOTTOKARI et al.). With the focus on severe summertime convective events, rapid update cycles (RUC) are under development with e.g. hourly updated ensemble forecasts on km-scale (presentation by WAPLER et al.). The nowcasting system is expanded to an ensemble approach and will consider life-cycle information compared to the classical pure advection approach. The specific question of how to combine nowcasting and NWP-based forecasting if the location (and intensity) of heavy precipitation systems do not agree, was also addressed (presentations by MOSELEY et al. and POSADA et al.). A phase or amplitude correction could be a solution to this problem. Yet, the use of nowcasting outputs in RUC system seems a preferred path. More reliable combined products might be achieved by enhancing both nowcasting and NWP-based forecasting separately, and bringing them together thereafter.

4 Nowcasting techniques, systems and products

In many nowcasting systems the combination of different data sources plays an integral part. Today's warning procedures for severe convective storms are often based on nowcasting methods by extrapolating the thunderstorm's position with its current motion while the storm severity is kept constant (Lagrangian persistence assumption). A number of initiatives was taken to detect cells and find the respective motion vector for the system. A rather new implementation of nowcasting thunderstorms and their severity, includes ensemble approaches and uncertainty estimates (presentations by FEGER et al. and SCHULTZE et al.). Different machine learning approaches are tested to predict thunderstorms and rainfall intensity (e.g. presentations by HAMANN et al., BECKER and SUN, VALCHOVA et al., KANN et al.). Machine learning algorithms are also used to produce bias corrected gridded fields of wind (presentation by BUZZI et al.). However, the use of machine learning as spatial interpolation technique remains challenging, in particular in regions characterized by complex topography.

Another focus is on the development of new post-processing systems handling for example a range of exceedance probabilities whose distribution provides a more quantitative assessment of the forecast uncertainty at any given location (presentation by SANDFORD and MOSELEY; MOSELEY et al.). Using crowd-sourced data in developing better post-processing algorithm gives promising results. During the discussions, it was highlighted that public and private data owners should be encouraged to share data and methodology openly, to benefit all users. Developing nowcasting tools, should also be a process of co-design, with the end users' needs taken into account from the first steps of the process.

5 Verification and societal impacts & application and user aspects

A main task of NMHSs is to issue weather warnings e.g. for winter weather (presentation by BÖHME and STEINERT), for urban flood (presentation by JORDAN et al.) or for aviation (presentation by BAZLOVA et al. referring also to the WMO Aviation Research Demonstration Project – AvRDP). MeteoVIAS is for example a web application for winter road weather forecasting, providing automatic products, accessible through any web browser and providing multiple visual severe weather information applied to roads with several levels of detail (presentation by GARCIA et al.). The effectiveness of storm warnings has been verified based on the detection of lightning, and reveals an ability to alert with better lead times of 15 minutes in 90 % of the analyzed situations (presentation by SCHMITT).

The Single European Sky ATM (Air Traffic Management) Research (SESAR) targets a common representation of adverse weather situations for all aviation users. Merging the information of nowcasting products developed at NMHSs (presentation by TURNER et al.) or radar measurements from different national radar networks (presentation by SALTIKOFF et al., FRIEDRICH et al.) may lead to a European composite of convective nowcasting. The knowledge of the public about weather risks may influence their response to weather forecasts and warnings (presentation by FLEISCHHUT and WAPLER).

In conclusion, any improvement of nowcasting systems and techniques as well as increased awareness of the population and other end users is beneficial to better mitigate the risk.

6 Summary

While nowcasting – prospectively probabilistic – is tied to observations of multiple data sources and their short-term extrapolation, new nowcasting techniques and the combination of nowcasting with NWP are also gaining momentum. Efforts towards seamless prediction systems combining (new) observations from different sources, observation-based nowcasting and NWP are

currently made by some European NMHSs with the aim of providing seamless predictions of all relevant parameters, especially high impact weather events. Such a combination is facilitated by assimilating new data types into NWP and using RUC in NWP, which have typically been tested with an hourly updating rate. Moreover, these approaches will benefit from both, the high accuracy, frequent and timely availability of observation-based nowcasting in the first minutes and hours as well as the forecast skill of NWP models when reaching longer forecasting time frames.

In such a heterogeneous and interdisciplinary setting, it is important that the E-NWC programme continues to support the cooperation between nowcasting researchers and practitioners among NMHSs. This E-NWC consortium has increased in number: It is counting 26 members compared to the previous project phase with 24 members (in total, EUMETNET counts 31 European NMHSs as members). E-NWC will also continue to liaise with other EUMETNET programmes (such as METEOALARM or the Observations Capability Area) in the future.

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