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Conference Report

Conference Report 2nd European Nowcasting Conference

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Abstract

The 2nd European Nowcasting Conference took place in Offenbach, Germany, on 3–5 May 2017. The conference was structured into four thematic sessions i) observations as basis for nowcasting, ii) nowcasting techniques and systems, iii) application, user aspects and verification, and iv) combination of numerical weather prediction and nowcasting. This report summarises the scientific contributions presented and the open scientific questions discussed at the conference.

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

1 Introduction

Nowcasting applications are developed to provide the best possible forecasts for the coming minutes up to the next few hours. These are typically based on spatially and temporally highly resolved observations, with a rapid update cycle. Nowcasting applications are particularly valuable for small-scale features and in convectively unstable situations that are often associated with severe weather hazards that pose a significant threat to life, property and economy. Therefore the provision of accurate and timely nowcast information, i.e. warnings provided by the national meteorological services, is essential for the general public as well as special users. Very short-term forecasts from a few minutes to a few hours are needed for a variety of applications, including aviation weather forecasts, water and power management, construction industry and leisure industry. Thus, accurate nowcasting might contribute to a reduction of fatalities and injuries, a reduction of private, public, and industrial, property damage, and to improved efficiency and savings for industry, transportation and agriculture (WMO, 2017; presentation by de Coning).

The second European Nowcasting Conference was organised in the framework of EUMETNET (European Meteorological Network) which includes the project ASIST (Application oriented analysis and very short range forecast environment) dedicated to nowcasting (presentations by Meirold-Mautner et al., Simon et al.; further information also available at: http://eumetnet.eu/activities/forecasting-programme/current-activities-fc/asist/).

The goal of the conference was to promote recent advances in the theory and practice of nowcasting in Europe and other parts of the world. The conference welcomed participants from operational, research and forecast user communities to discuss methods for improving the quality of nowcasting in Europe. The conference was attended by about 100 participants from 21 countries, representing national meteorological services, universities/research institutes and the commercial sector. The scientific program featured 52 contributed presentations and offered room for discussions. The conference was organized into the following four topical sessions:

- Observations as basis for nowcasting
- Nowcasting techniques and systems
- Application, user aspects and verification
- Combination of numerical weather prediction and nowcasting

A large number of contributions addressed the nowcasting of precipitation, deep convection and associated phenomena. Some contributions were concerned with other meteorological conditions, including winter weather (presentations by Kaltenboeck et al., Kann et al.), solar surface irradiance (presentation by Mueller et al.), and cloudiness (presentations by García Perada, Ripodas and Calbert). 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/enc-2017/.

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2 Observations as basis for nowcasting

The quality of observation data is important for the quality of the nowcasting products, but the quantification of measurement uncertainty for observation data remains challenging. Methods combining ensemble radar precipitation nowcasting with data assimilation (presentation by Merker et al.) and methods exploiting polarimetric measurements (presentation by Tuechler and Meyer) have the potential to estimate radar measurement uncertainty. Furthermore, an effective data processing is important for operational applications (presentation by Tuechler and Meyer; poster by Hungershoefer).

Besides the traditional use of radar data for thunderstorm nowcasting applications, lightning measurements play an increasingly important role. The analysis of a storm's lightning characteristics, especially lightning density and its temporal evolution, can serve as a useful predictor for the classification of storm intensity and its further development (presentation by Mikuš Jurković and Strelec Mahović, Salvador et al., Wapler; poster by Moehrlein et al.).

Multispectral satellite data are used to detect, track and nowcast thunderstorms (presentations by de Rosa, Müller et al., Senf et al., Tafferner et al., Petersen et al.). Satellite data are especially important in regions where lightning and weather radar data are missing or do not provide significant signals. Intense precipitation often already occurs prior to maximum cloud-top cooling which emphasizes the challenges for satellite based detection algorithms trying to identify the convective initiation (CI) phase (presentation by Senf et al.). A coupling of 1–3 hour NearCasts of Sounding Moisture and Equivalent Potential Temperature products of the prestorm environment with CI algorithms help to better differentiate areas in which storms are most likely to grow from those where growth is less likely, in a probabilistic sense.

While radar, satellite and lightning detection network measurements have often been analysed separately, a multi-sensor approach can yield a much more comprehensive insight (presentations by Valachová and Sýkorová, Wapler; poster by Schubert; Wapler et al., 2015).

Furthermore, new data sources can be used to try to capture the state of the atmosphere in as much detail as possible which is a prerequisite for accurate nowcasting and forecasting. E.g. AMDAR observations of specific humidity help as a supplement, enhancement and a gap-filler for radiosonde data (presentation by Petersen et al.). Another type of observation that might become more relevant in the future is data collected using cell phone technology, especially for verification of traditional and impact-based warnings (open discussion).

3 Nowcasting techniques and systems

An advanced processing of satellite imagery is expanding its potential as diagnostic tools and improving the predictive capacity of products for cloud-free regions, precipitation, convection, and wind (Nowcasting Satellite Application Facility (NWCSAF), presentations by Ripodas and Calbet, García Perada). In areas with radar coverage, the tracking of convective objects tends to use parameters deduced from radar data, both 2D and 3D. The radar data is exploited to derive the storms' motion including splitting and merging as well as the life-cycle (presentation by Kyznarová and Novák, Werner).

National Meteorological Services, in their efforts to meet the needs of users, are developing and using tools that nowcast more variables than in the past, such as lightning or hail (presentation by James et al.) or offering information on the uncertainty of precipitation. The huge amount of observational and NWP data support the general need of an increased integration of different sources of information in the nowcasting systems (presentations by Kann et al., James et al., Haman et al., Reyniers et al.). The INCA system, as an example for an observation-based, multi-parameter blending system is widely used operationally at the met services in Europe and specifically tailored to the end user's needs (Haiden et al., 2011; Wang et al., in press). The data integration in a coherent framework is even more relevant in case of systems designed for automatic warnings. The NowCastMix (presentation by James et al.) gives a typical fuzzy logic approach for issuing automatic warning proposals combining different sources of information. Also typical radar extrapolation algorithms for thunderstorm forecasting integrate more and more additional information such as lightning and satellite channels (e.g. presentation by Werner).

The human-machine interaction and the role of forecasters are evolving rapidly with the introduction of alert systems which are able to deliver automatic warning proposals. The role of forecasters will be more focussed on the supervision of the different systems and in the advice to the end users, explaining and interpreting the meteorological situation and defining the relevant warning thresholds (presentations by Buzzi et al., Gaia et al.).

Probabilistic information is gaining relevance also in the nowcasting time range on one hand due to the intrinsic uncertainties of the forecasted variable and on the other hand due to the increased need for seamless forecasts and the related combination of nowcasting systems with convection resolving NWP ensemble prediction systems. Quantitative precipitation estimation (QPE) treated traditionally with lagrangian extrapolations techniques can be also performed in a probabilistic framework considering uncertainties in the analysis and the typical chaotic behaviour of precipitation during the extrapolation process, above all in the small scales (presentations by Atencia et al. or Reyniers et al.). For more information on current nowcasting systems and its applications, the reader is referred to the nowcasting guidelines recently published by WMO (Wang et al., 2017).

4 Application, user aspects, and verification

Many nowcasting and very short range forecasting systems are linked with applications, the aim of which is to provide supplementary or user-specific information and support the decisions of users. Newly developed products can support the forecaster in the warning decision process. E.g. tracking of Vertical Integrated Liquid (VIL), Vertical Integrated Ice (VII), low- and mid-level rotation or lightning density can be effectively used in practice for warnings of hail, mesocyclone or strong wind gusts (presentation by Herold et al.). Operational forecasters face the challenge of having to process and interpret available information, integrate new approaches in their routines and issue timely warnings. For newly developed products to be useful in operations they have to be evaluated and their usage trained. Testbeds and trainings are organized for this purpose, e.g. for the nowcasting SAF products (presentation by Calbet and Ripodas) and for several radar, NWP, satellite, lightning detection and hybrid outputs examined during the European Severe Storm Laboratory Testbed (presentation by Groenemeijer et al.).

Among end-users, e.g. emergency services, authorities in civil protection, general public, there is a wide variety in the way end-products are used and understood and in requirements concerning nowcasting and severe weather warning. An insight can be given with help of questionnaires and semi-structured interviews (presentation by Kox). One of the main issues is the use of probabilistic forecasts. The survey indicated that many users would start action by rather high probability of the event occurrence, though it may depend on the type and severity of weather (Kox et al., 2015). Also, impact-based studies and modelling could help to improve or redefine the risk-warning and the communication with emergency services and the general public. For example, using additional geographical or socio-economic information, it is possible to specify the relationships between severe weather and the number of fire-brigade operations (poster by Kox et al.).

Several presenters showed the results of the verification of their nowcasting systems: for instance satellite nowcasting tools (e.g. presentations by Rosa et al., Forster et al., Müller et al.), automatic warning guidance (e.g. presentation by Gaia et al.) and NWP-based applications (e.g. presentations by Moseley, Katsafados et al.). Though, there was no presentation explicitly dedicated to methods and problems of verification this topic was addressed in open discussions. Data that are commonly used for verification include data from lightning localisation networks, rain gauges measurements, automatic weather stations and severe weather reports. Crowdsourcing data could also be often involved in verification of nowcasts in the future. The validation methods range from various objective scores to image comparison and feedback from forecasters/end-users.

5 Combination of numerical weather prediction and nowcasting

During recent years, the capabilities of NWP models are getting closer to nowcasting requirements, which enables the development of NWP-based and NWP-supported nowcasting systems (Sun et al., 2014). Taking into account the skill of observation-based methods and numerical models, blending approaches combine the extrapolation of radar-based QPE (with or without storm evolution capacities) and NWP precipitation through some spatio-temporal weights, which might be scale dependent (presentations by Mazur and Wyszogrodsky, Moseley et al., but also Kann et al. in session 2). The development of rapidly updated, convection-permitting models and the increase of computational power allow direct use of numerical models for some nowcasting applications, specifically supported by the ability to assimilate radar reflectivities with 3D-VAR and rapidly updated 2D precipitation analyses with latent heat nudging (presentation by Meier et al.). Data assimilation systems as used in the Local Analysis and Prediction System (LAPS, presentation by Katsafados et al.) and in the Space-Time Multiscale Analysis System (STMAS) and Weather Research and Forecast (WRF) Data Assimilation (WRFDA, presentation by Mercader-Carbó et al.) are aiming at atmospheric conditions closest to reality as initial state for very-short range predictions with WRF. The assimilation of modern data sources, such as time delay measurements from GNSS, is able to improve short range predictions of humidity, clouds and precipitation (presentation by de Haan). Finally, advanced systems are designed to ultimately combine data assimilation of radar data with rapid updating NWP models, observation-based extrapolation or cell tracking methods and calibration techniques in a smart, seamless and probabilistic way (presentation by Wang et al.; poster by Blahak et al.). The importance of a probabilistic nowcasting point of view is also emphasized (presentation by Bañón), and in the frame of a Model Output Statistic Nowcasting approach (presentation by Knuepffer and Hoffmann).

6 Summary

To a large extent, observation and nowcasting techniques dedicated to convective phenomena were presented, indicating that thunderstorms are still one of the major themes in nowcasting. Additionally, some contributions focussed on other meteorological conditions, including winter weather, solar surface irradiance, and cloudiness.

The use of various observation types for nowcasting applications was presented. While satellite data are widely used to detect convective systems, it remains challenging to gain lead-time compared to radar-based methods and at the same time have a low false alarm rate. However, there is a clear benefit of satellite-based methods in areas without radar coverage; also the uplink to aircraft could be beneficial as demonstrated in experiments. Most of the presented radar-based nowcasting methods are analysing 3D information to get a better estimate on the strength of the precipitation events compared to 2D approaches. Furthermore, efforts are undertaken to profit from the information provided by polarimetric measurements. Several presentations showed approaches to analyse lightning rates to successfully distinguish between ordinary thunderstorms and those with associated severe weather phenomena.

Some contributions demonstrated the advantages of using a multi-sensor approach. Those combined approaches are best suited to not only provide information on the further propagation of the event but also on its intensification or weakening, thus providing information on the life-cycle. There is a trend towards merging various systems to produce one final product; these include nowcasting systems explicitly suggesting warning guidance to the forecasters, also enabling the issuing of automatic warnings unless the forecasters explicitly wants to change something.

The importance of feedback from the users of nowcasting tools (i.e. the operational forecaster) as well as the end-users of nowcasts (e.g. emergency managers) was discussed. Some presentations showed the usefulness of testbeds to enhance the communication of developers and forecasters, for forecaster training and product evaluation. Questionnaires are shown to be a useful tool to reveal the end-users needs and to assess the reaction of e.g. emergency managers to weather warnings. However, systematic research of the public acceptance and understanding of forecasts and warnings is not commonly conducted.

Efforts towards seamless prediction systems combining observation based nowcasting and NWP are currently made by some European National Meteorological Services. This combination is facilitated by the assimilation of new data types into NWP and the use of rapid update cycles in NWP, which have typically been tested with an hourly updating rate.

In summary, nowcasting approaches, prospectively probabilistic, will profit from the integration of multiple data sources, where available, and the provision of life-cycle information, e.g. strengthening and weakening of the event. Research efforts also include the combination of observation-based nowcasting and numerical weather prediction models with the aim of proving seamless predictions of all relevant parameters, especially high impact weather events. These approaches will benefit from both, the high accuracy, frequent and timely availability of observations-based nowcasting in the first minutes and hours as well as the forecast skill of numerical weather prediction models when reaching longer forecasting time frames. Additionally, more and more systems will provide automated guidance to the forecasters to support decision making in active warning operations. A good knowledge of the requirements from different end-user groups is crucial for improving nowcasting and forecasting systems to support the mitigation of the impact of severe weather situations. This also requires a timely and effective forecast communication.

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