EUMETNET
EUROPEAN METEOROLOGICAL SERVICES NETWORK

Deutscher Wetterdienst
Wetter und Klima aus einer Hand
DWD

2nd European Nowcasting Conference

BOOK OF ABSTRACT

03 - 05 May 2017, Offenbach, Headquarters of DWD

Table of contents

THE IMPORTANCE OF NOWCASTING IN THE WMO WWRP STRATEGY

Estelle de Coning

WMO

Science and innovation are at the heart of the WMO strategy for improving national capacity to face weather hazards in a changing climate, and to provide better weather and climate related services to all citizens worldwide. The WMO World Weather Research Programme (WWRP) aims to expand the frontier of weather science by exploring new predictive capabilities, connecting weather and climate communities, and improving all elements of the weather information value chain.
Over the last decades, a number of major international research initiatives have accelerated the rate of progress in weather science. Today's state of the art technologies offer a unique opportunity for weather science to address the ever changing challenges. The WWRP aims for 2016-2023 will be achieved through research activities in the three core projects on High Impact Weather, Polar Prediction, and Sub-seasonal to Seasonal prediction. The scientific guidance, technical advice and coordination that the WWRP Working Groups and Expert Teams will bring to these projects, will be key to their success. However, it is also crucial to have a strong connection with other programmes and partners - such as EUMETNET - to provide a favourable framework for stimulating research activities and collaborations across a broad range of disciplines.
The WWRP core project best related to nowcasting activities is the High Impact Weather project. The High-Impact Weather Project aims to improve the seamless prediction of high-impact weather events at a wide range of scales – from nowcasting to seasonal prediction – with a particular focus on smaller scales. In this process, it is not only good enough to improve the science, but also to target the communication of forecasts and warnings, including information on potential consequences of high-impact events. If watches and warnings can be issued of the anticipated impact on end-users in such a way that better decisions are made to save lives and protect property, then nowcasting has truly reached its goal.
In this presentation the importance of nowcasting in the WMO WWRP strategy will be highlighted to demonstrate the role of international partners and collaboration in this field.

THE EUMETNET ASIST PROJECT

Meirold-Mautner, Ingo, Wang Yong, Bañón Luis, de Haan Siebren, Kann Alexander, Gundersen Paul, Simon André

ZAMG - Zentralanstalt für Meteorologie und Geodynamik

Nowcasting systems typically are developed at weather services based on the needs by end users who rely on forecasts with very high spatial and temporal resolution for relatively short lead times (around +6h). Amongst these end users are public authorities responsible for civil protection, hydrology, aviation or traffic. This setting caused the development of application specific nowcasting systems which are often tuned to regional and local specificities and provide only a limited set of parameters (most commonly precipitation and wind). An exchange of know-how, experiences, methods and methodologies between developers and users of different systems does not occur systematically. For this reason the European Economic Interest Group (EIG) EUMETNET proposed – besides the already existing cooperation programmes for observation and NWP – to establish a European cooperation project on nowcasting.

Following the "Nowcasting Activity" (2013-2014), the ASIST – Application oriented analySIS and very short range forecasT environment project was installed in 2015. It is targeted at coordinating (1) nowcasting developments, (2) NWP and observation, (3) verification and training and (4) application and user aspect. Besides the traditional observation based nowcasting, ASIST will also cover the very short range forecasting, which increasingly involves NWP models.
This presentation gives an overview of the ASIST project.

USE OF APPLICATIONS IN NOWCASTING AND VERY SHORT RANGE FORECASTING IN EUROPE – A STUDY WITHIN THE FRAMEWORK OF THE EUMETNET ASIST PROJECT

André Simon (OMSZ), Paul Gundersen (Met Office), Mihály Szucs (OMSZ), Máté Mile (OMSZ)

Hungarian Meteorological Service

Currently, there exist many applications in nowcasting and very short range forecasting (VSRF), which are operated by European national meteorological and hydrological services for different purposes and for different users (general forecasting and severe weather warning, hydrology, road meteorology, agrometeorology, aviation, wind energetics, etc.). A survey was organized within the framework of the EUMETNET ASIST project (Application oriented analySIS and very short range forecasT environment) to provide an overview of the accuracy, technical aspects, advantages and weaknesses of such systems. Participation in the survey came from 15 European meteorological services. Whilst the scientific and technical background of respective applications is very different, several common characteristics and problems could be identified.
The first issue is the accuracy of the forecasts, which often concern special parameters or methods applied upon standard numerical weather prediction (NWP) inputs, as well as post-processing techniques. These are typically more sensitive to the errors in nowcasting systems or high-resolution NWP models in the background (good examples are forecasts of road surface temperature with the aid of road forecasting models). The forecast uncertainty in some explicit NWP outputs (e.g. precipitation-type) leads to a situation whereby empirical methods are still widely used or preferred in nowcasting or VSRF. This is amplified by fact that in forecasting praxis the use of deterministic output is dominating at short time-scales, although probabilistic approaches could be helpful in many problematic cases. Introduction of Rapid Update Cycles (RUC) of non-hydrostatic, high-resolution NWP models increases the predictability of convection in VSRF, mainly in situations with strong synoptic forcing. However, forecasting of multicellular (not-organized) convection or achieving higher consistency between simulated and observed mesoscale convective systems is still challenging.
Besides accuracy, the correct distribution and interpretation of nowcasting information (so that it corresponds with official forecasts and warnings) are also important. Last, but not least, verification of several special outputs provided to external users is often complicated and sometimes missing. It is proposed that international cooperation in the above-listed topics might focus on extended research (e.g. in winter precipitation, convection, nowcasting-EPS, verification methods) but also on exchange of experiences and methods of communication with end-users and forecasts dissemination.

Observations as basis for Nowcasting

RADAR DATA - PROCESSING AND THEIR APPLICATION IN THUNDERSTORM NOWCASTING AT ZAMG

Tüchler, Lukas; Meyer, Vera

ZAMG - Zentralanstalt für Meteorologie und Geodynamik

Weather radar data is one of the most important data sources in nowcasting. To improve the quality and the usage of the radar data, the data processing system - from the raw data on up to the radar products - is currently under renewal at ZAMG. New quality control algorithms and dual polarized data are used to derive radar products for all thereon based systems, like nowcasting, or NWP assimilation.
An important application of the processed radar data is the thunderstorm nowcasting. The Austrian thunderstorm nowcasting tool (A-TNT) developed by ZAMG, which identifies and tracks convective cells and generates thunderstorm warnings, will also be presented in detail.
The algorithm identifies and monitors regions of intense precipitation and lightning activity separately by analyzing radar precipitation intensity maps and lightning densities, respectively. Each data source is processed by a stand-alone identification, tracking and nowcasting procedure, where the two separate tracking results are combined to a comprehensive "convective cell" in a subsequent, final step. With this approach lightning data is used as a second, independent and complementing data source to improve storm identification, tracking, and nowcasting in those regions where radar data is not or poorly available and to compensate for occasional data failures.

POTENTIAL USES OF THE SESAR 3D RADAR REFLECTIVITY MOSAIC FOR AVIATION APPLICATIONS IN UK AIRSPACE

Robert Scovell, Katie Brown

Met Office

Three dimensional mosaics of weather radar reflectivity data can provide an invaluable source of information about the location and vertical extent of severe weather. A prototype product has recently been developed by Met Office and Météo France for the Single European Skies Air Traffic Management Research (SESAR) programme. The prototype has high resolution (1km, 5min), with the ability to generate gridded datasets extending over scales ~1000km horizontally and exceeding 12km AMSL vertically.
Following a brief review of the factors affecting the accuracy of the 3D product, e.g. depending on radar network coverage, we report on recent studies undertaken at Met Office which focus on exploiting this vertical information for aviation applications. This includes a potential enhancement to an automatic system for reporting severe convection in UK airspace and the development of some related products, such as the Vertically Integrated Ice, which can be a useful tool for operational forecasters. Further, some examples of problems encountered when using 3D data in this way are demonstrated.

Reference:

Mosier, R. M. et al., 2011: Radar nowcasting of cloud-to-ground lightning over Houston, Texas. Weather and Forecasting, 26.2, 199-212.

Scovell, R. and H. al-Sakka, 2016: A Point Cloud Method for Retrieval of High-Resolution 3D Gridded Reflectivity from Weather Radar Networks for Air Traffic Management. J. Atmos. Oceanic Technol., 33, 461–479, doi: 10.1175/JTECH-D-15-0051.1.

PREDICTION OF OBSERVATION UNCERTAINTY USING DATA ASSIMILATION IN AN ENSEMBLE-NOWCASTING SYSTEM

Claire Merker, Felix Ament, Marco Clemens

Universität Hamburg, Meteorologisches Institut

The quantification of measurement uncertainty for rain radar data remains challenging. Radar reflectivity measurements are affected, amongst other things, by calibration errors, noise, blocking and clutter, and attenuation. Their combined impact on measurement accuracy is difficult to quantify due to incomplete process understanding and complex interdependencies. An improved quality assessment of rain radar measurements is of interest for applications both in meteorology and hydrology, for example for precipitation ensemble generation, rainfall runoff simulations, or in data assimilation for numerical weather prediction. Especially a detailed description of the spatial and temporal structure of errors is beneficial in order to make best use of the areal precipitation information provided by radars.
Radar precipitation ensembles are one promising approach to represent spatially variable radar measurement errors. We present a method combining ensemble radar precipitation nowcasting with data assimilation to estimate radar measurement uncertainty at each pixel. This combination of ensemble forecast and observation yields a consistent spatial and temporal evolution of the radar error field. We use an advection-based nowcasting method to generate an ensemble reflectivity forecast from initial data of a rain radar network. Subsequently, reflectivity data from single radars is assimilated into the forecast using the Local Ensemble Transform Kalman Filter. The spread of the resulting analysis ensemble provides a flow-dependent, spatially and temporally correlated reflectivity error estimate at each pixel. We will present first case studies that illustrate the method using data from a high-resolution X-band radar network.

AIRCRAFT MOISTURE OBSERVATIONS: THEIR IMPORTANCE IN NOWCASTING AND NWP

Ralph Petersen (UW-CIMSS), Brett Hoover, Anne-Sophie Daloz, Lee Cronce, Tim Wagner, Skyler Williams (all UW-CIMSS), Richard Mamrosh (NWS), Randy Baker (UPS), Patricia Pauley, and Nancy Baker (NRL)

University of Wisconsin-Madison, SSEC/CIMSS (UW-CIMSS)

Numerous studies have assessed the impact of AMDAR temperature and wind reports in local forecast offices and both regional and global NWP systems. The results have shown very positive impact on time scales from hours to days, as well as documenting that aircraft data are the most cost effective of all major observing systems. However, the full impact of the AMDAR observations as a supplement/enhancement/gap-filler for traditional rawinsonde data in NWP, as well as for local, short-range hazardous weather forecast applications, has in the past been limited by the lack of sufficient moisture measurements in the aircraft ascent/descent profiles.
Specific humidity reports using the WVSS-II laser-diode sensor are now available from over 135 aircraft over the CONUS, providing more than 1000 profiles throughout the day. We show that these

data are as accurate and representative as rawinsonde humidity measurements, if not more so. This will be followed by examples of forecaster use of these higher-time-frequency reports in a variety of hazardous weather applications.
Although the use of frequently observed moisture profiles can play a key role in subjective Nowcasting, the impacts on NWP much more readily quantified. Two different approaches are then used to assess impact in two NWP systems – a data denial observing system experiment and an adjoint-based observation sensitivity experiment. In both cases, very few changes were needed to Q/C. Improving moisture analyses and forecasts in larger-scale models is essential to advancing Nowcasting, in that they provide analysis background and boundary conditions for higher resolution local area models.
Results will show that for forecasts over the CONUS, AMDAR WVSS-II profile data have a larger influence than any other in-situ observation, with the greatest positive impact warm-season humidity analyses and forecasts (including precipitation) in the first 12 hours, but extending beyond 72 hours. Impacts are noted throughout the troposphere, with AMDAR data collected during ascent and descent having nearly equal impact per report. The availability of multiple moisture observations at locations more distant from rawinsonde launch sites appears to be key to the analysis and forecast improvements.
Detailed results, including comparisons against independent precipitation analyses and GPS total-column precipitable water measurements, will show that the improvements using WVSS data extend to extreme events as well as less dramatic cases. The potential to manage costly, specially launched, off-time rawinsondes launches will also be discussed.

THE POTENTIAL OF THE S-NPP VIIRS DNB FROM A FORECASTER'S PERSPECTIVE

Erik Wiesemann, Jörg Asmus, Peter Schmitt, Katja Hungershöfer

Deutscher Wetterdienst

The Visible Infrared Imaging Radiometer (VIIRS) is the first instrument on board of an operational weather satellite, namely Suomi NPP that offers the possibility to measure in the visible spectrum during the night with the so-called Day/Night Band (DNB). Depending on the phase of the moon as main illuminant, different phenomena are detected ranging from clouds, lightning and snow cover to fires, city lights and fishing boats.
Possible applications of these additional nighttime measurements are presented and discussed from a weather forecaster's perspective.

POTENTIAL OF THE LIGHTNING MAPPING ARRAY FOR THE NOWCASTING OF SEVERE WEATHER

Albert Salvador, Joan Montanyà, Nicolau Pineda, Gloria Solà and Oscar van der Velde

Servei Meteorològic de Catalunya

The electrical activity within a convective cell is related to the strength of its updraft, and thus, to its potential severity. The trends in the lightning activity may help to diagnose the severe weather potential of a thunderstorm. Observational evidence suggests that the trends of the intracloud fraction of the total lightning activity may be a more robust indicator, compared to some characteristics of the cloud-to-ground fraction (e.g. positive polarity dominance). The present study takes advantage of the three-dimensional lightning mapping system (Lightning Mapping Array, LMA)

to analyze severe weather episodes occurred in Catalonia (NE Iberian Peninsula). The main objective is to investigate the potential of the LMA to detect trends that can be useful as nowcast predictors (e.g. trends in the total flash rate, changes in the height of the charge layers, polarity reversal). Complementary data includes radar reflectivity to detect convective cores, temperature profiles from NWP and complementary LINET lightning data.

LIGHTNING CHARACTERISTICS DURING HAILSTORMS

Petra Mikus Jurkovic, Natasa Strelec Mahovic

Meteorological and Hydrological Service of Croatia (DHMZ)

Lightning characteristics were studied in the hail-producing storms over Croatia during summer months 2008 to 2012, in order to determine typical behavior of lightning that could be used in hail nowcast. Lightning distribution was compared to hail occurrences registered at the hail polygon covering an area of ~600 km2 located in the northwest Croatia. During the hailstorms lifetime lightning characteristics such as type, polarity, height of IC lightning strokes and mean current amplitudes were followed along the track of the hailstorm and compared to physical properties of the hail on the ground.
The results showed that in the majority of the cases the frequency of total lightning strokes increases shortly before hail occurrence while at the beginning of hailfall the number of total lightning strokes briefly decreases. Additionally, the largest values of mean current for both CG+ and CG- as well as for IC strokes are detected before hailfall, being rather low during hailfall. The average height of IC strokes slightly increases before and decreases during hailfall, especially in cases with large hail.

MULTI-SENSOR INSIGHT INTO SEVERE CONVECTIVE EVENTS: POTENTIAL FOR IMPROVING THE NOWCASTING OF HAILSTORMS

Kathrin Wapler

Deutscher Wetterdienst

An 8-year analysis of Central European hail storms is presented. A comprehensive set of six hundred hail storms that occurred on 172 different days in various parts of Germany is used to characterise these events. The analysed observations include measurements from a lightning detection network, precipitation radar, as well as information from automated cell detection algorithms based on radar reflectivity and radial winds which are combined with severe weather reports. Additionally to the storms' parameters during the time of the observed hail, the temporal evolution of the storms' characteristics is analysed in order to study the convective life-cycle and identify parameters with predictive skill.
A special focus is on the lightning characteristics of the convective cells. A feature that is shown to occur in many of the analysed severe hail cases is the lightning jump, i.e., a rapid increase in the total lightning density. It occurs well before the observed hail and has thus a great potential to increase the lead time of warnings of severe hail events. Instead of fixed thresholds for the definition of a lightning jump, a lightning jump intensity parameter is introduced and tested. The analysis also reveals that several storms show a pulsating lightning activity. Furthermore, nearly three quarters of the hail events are associated with a mesocyclone that was automatically detected in radar data. As expected, high reflectivity values were measured during the time of the observed hail.

CONVECTIVE STORM NOWCASTING BY REMOTE SENSING DATA COMBINATION

Michaela Valachová, Petra Sýkorová

Czech Hydrometeorological Institute

Nowcasting of convective storms is one of the most challenging tasks for operational weather forecasters. Despite the fact that storm characteristics depend on many factors, the processes of electrification, dynamics and microphysical composition of storm clouds are closely related. Methods of remote sensing offer comprehensive information about a storm life-cycle, moreover these data sources are independent. At Czech Hydrometeorological Institute remote sensing is the essential source of information about a storm development, however, satellite, radar, sounding and lightning observations are used more or less separately. By means of multi-sensor measurements we focus on a temporal evolution of the storms in Central Europe. According to the observations, three categories of storms are characterised: non-severe, severe and supercell, which could bring direct use for very short-term forecasting and improve a real-time warning process. In our studies we seek severe storm indicators by effective data combinations of available measurements to fulfil remote sensing potential and meet the requirements of forecasters for a better nowcasting tool.

CONVECTIVE GROWTH AND GLACIATION WITH METEOSAT IN RELATION TO PRECIPITATION FORMATION

Senf, Fabian; Deneke, Hartwig

Leibniz Institute for tropospheric Research, TROPOS

The growth phase of convective storms and their transition to maturity is investigated over Central Europe. Using data from the SEVIRI imaging radiometer aboard the geostationary Meteosat satellite, dynamical and microphysical properties of developing storms are collected and combined for the years 2012 to 2014. Several satellite-based storm properties, e.g. cloud-top temperature, cloud-top cooling rate and cloud particle effective radius, are studied following storm tracks. In addition, the onset and magnitude of radar-based surface precipitation and their temporal changes in vicinity of the satellite-based storm tracks are considered.
We will show the storm composite behavior and discuss implications for satellite-based nowcasting methods and for the evaluation of convective-scale weather simulations. The majority of analyzed cases shows a distinct maximum in cloud-top cooling rate, which is used here for temporal synchronization. Cloud growth spans a period of approximately half an hour. Glaciation rate indicators suggest that freezing 15 min prior to the maximum cooling plays an important role in invigorating convective updrafts through the release of latent heat. Smaller ice particles are found for larger cloud-top cooling, which provides observational evidence that ice particles form later and have less time to grow in stronger convective updrafts. Furthermore, maximum cloud-top height, anvil expansion rate, maximum precipitation intensity and core size are found to be positively correlated. With respect to the onset of precipitation, our analysis shows a high probability that significant precipitation already occurs 30 min prior to maximum cloud-top cooling.

VALIDATION OF THE SATELLITE-BASED THUNDERSTORM DETECTION AND NOWCASTING SYSTEM CB-GLOBAL WITH IAGOS ONBOARD MEASUREMENTS

C. Forster, A. Tafferner, D. Stich, A. Petzold, K. Beswick

Deutsches Zentrum für Luft- und Raumfahrt (DLR), Institut für Physik der Atmosphäre

Based on geostationary satellite data, Cb-global detects, tracks, and predicts thunderstorm hazards for aviation for up to one hour (=nowcasting). In the present study, Cb-global is validated with data from IAGOS instruments. Flight tracks of IAGOS flights over the past 5 years have been compared to Cb-global detections, and it is shown that the flown routes avoid the hazardous regions marked by Cb-global in most of the cases. Obviously, the on-board radar picture, the pilot's basis for thunderstorm recognition during flight, is in good accord with the Cb-global detections. In addition, IAGOS measurements, e.g. ice particle number concentrations, temperature, and water vapor, along the flight routes that avoid the Cb-global hazard regions indicate that the flown routes are safe with respect to thunderstorm hazards. In contrast, the few cases where the flight route leads through Cb-global hazard regions show high ice particle number concentrations within these regions and confirm that these regions should preferably be avoided. The study demonstrates that IAGOS observations are a unique data base to provide proof of the quality of Cb-global. From a large number of IAGOS cases examined, we can conclude that Cb-global is not only a meteorological information, but also a tool on which pilots can rely on. If uplinked to the cockpit of aircraft in real time, Cb-global nowcasts provide the pilot an overview of the thunderstorm situation and its development in the near future. This enables him to strategically plan a safe and optimal flight route around the thunder cells instead of tactically reacting to the situation and searching for gaps between the cells. Thus, the use of Cb-global contributes to increased flight safety, improved comfort for passengers and cost savings through improved flight routings, fuel savings and fewer delays.

A NOVEL MULTISPECTRAL ALGORITHM FOR THE DETECTION, TRACKING AND NOWCASTING OF THE THUNDERSTORMS USING THE METEOSAT SECOND GENERATION IMAGES

Michele de Rosa, Matteo Picchiani, Massimiliano Sist, Fabio Del Frate

GEO-K s.r.l.

The number of the extreme meteorological events has increased in the last few years and the trend should be the same for the next future. These events develop very quickly and the damages could be very huge in terms of human life losses. Therefore, it is very important to monitor and prevent these natural hazards by means of advanced techniques which must able to: detect the event as soon as possible, track the behavior of the event and predict the development of the event. The StormTrack algorithm embeds a novel model able to accomplish these requirements. The detector applies a multispectral approach to identify the convective objects and extract some features like the geometry and level of hazard. At the second stage the detected objects are tracked and their trajectories are estimated. At the final stage, the nowcasting of the detected objects has computed up to 30 minutes ahead. A service, working on the whole MSG disk and the Indian Ocean MSG service, is operational. In this work a description of the algorithm is presented together with its validation over Europe on a period of about 18 months using the Model Evaluation Tool as validation framework. The lightnings data coming from the ATDNet network has been used as ground truth in order to characterize the performance of the algorithm in different conditions.

SATICUS - A NOVEL APPROACH FOR THE DETECTION AND SHORT-TERM FORECAST OF THUNDERSTORMS.

Richard Müller, T. Leppelt, K. Hungershöfer, J. Asmus, M. Jerg, S. Haussler

Deutscher Wetterdienst

Severe convection, as induced by thunderstorms, is one of the most important weather events for aviation. Severe convection is hazardous for aeroplanes and requires rerouting of flights which leads to significant delays. Severe weather events account for approximately 70% of the total delays. During summertime approximately 50 % of these events are caused by convection (Source: Federal Aviation Administration). This shows that an accurate detection and short term forecast of thunderstorms is quite important.
Within this presentation a novel method for the detection and short term forecast (0-3h) of thunderstorms will be presented. The method relies on data fusion of satellite information, numerical weather prediction (NWP) and lightning data. The basis for the detection of thunderstorms is satellite information combined with a stability filter based on NWP data. Lightning data is used to improve POD and to reduce FAR where available. The forecast is performed with optical flow in combination with NWP data. The correlation between size of the cells and lifetime is explored to improve the reliability of the forecast. The thunderstorm information will be given as probability of occurrence and intensity. Additionally, the cloud top height will be derived in order to provide information for the overflight option. Within the presentation special focus will be given on the novel aspects of the method and its validation. Further, its use within the aviation section of DWD will be discussed as well.

IMPROVING SATELLITE-BASED CONVECTIVE WEATHER NOWCASTS BY COUPLING SHORT-RANGE GOES-R LEGACY SOUNDING NEARCASTS TO CONVECTIVE INITIATION PRODUCTS

Ralph Petersen (UW-CIMSS), Lee Cronce (UW-CIMSS), John Mecikalski (University of Alabama in Huntsville, UAH) and Chris Jewett (UAH)

University of Wisconsin-Madison, SSEC/CIMSS (UW-CIMSS)

The GOES-R Convective Initiation (CI) algorithm has successfully used a combination of satellite cloud signatures and very-short-range NWP output to differentiate which new cloud elements will develop into significant radar echoes in the next hour. Over-forecasting, however, often hampers the overall skill and utility of the products to forecaster. In an effort to improve and reduce over-forecasting within the current version of the 0-1 h CI products, 1-3 hour NearCasts of GOES-R Legacy Sounding Moisture and Equivalent Potential Temperature (.e) products of the pre-storm environment are coupled with the GOES-R CI algorithm as a means of better differentiating areas in which storms are most likely to grow from those where growth is less likely, in a probabilistic sense. This combined NearCast-CI procedure maximizes use of all capabilities of the forthcoming GOES-R Advanced Baseline Imager (ABI) visible and infrared (IR) high time-resolution (1-5 min) imagery, as well as the 15-30 min interval clear-air profiles (especially moisture) that are not used in the numerical weather prediction (NWP) inputs. The CI and NearCast datasets are physically consistent and complimentary, with NearCasts often providing a better depiction of evolving stability patterns in advance of storm development than those available from NWP, which can suffer from significant forecast errors in the first forecast hours, with summertime Threat Scores can as low as 12%. The fusion of GOES-R CI and NearCast methods can mitigate these deficiencies with NearCast providing a consistent, frequently updated depiction of the vertical and horizontal distribution of moisture in the pre- and near-storm

environment, and CI providing improved situational awareness of which radar returns are most likely to intensify once cloud growth has commenced.
Through fusion of GOES-R CI and NearCast, forecasters will gain several advantages over using both products individually, including low-level moisture and boundary detection, which becomes a method of enhancing GOES-R CI performance. The ability of NearCasts to use full resolution satellite observations to improve the depiction of water vapor features, movements and gradients will help isolate boundaries of moisture in the near-storm environment that lead to CI and upscale convective storm development. The Lagrangian-transported NearCast potential temperature and moisture fields identify general regions that are favorable for CI over the coming few hours.
Initial results using NearCast moisture tendency and short-range thresholds reduce by nearly 30% the over-forecasting of CI events with probabilities greater than 50%. These NearCast stability tendency fields are currently being studied for use as an additional input to GOES-R CI (in a logistic regression framework), information that is presently lacking within the algorithm. The greater impact of satellite moisture products over .e in the tests to date is consistent with the greater sensitivity of GOES observations to moisture than temperature.
Data from the current GOES-East satellite will be presented. High-impact severe weather event days over the U.S. in which the original CI algorithm produced undesirable levels of over-forecasts will be evaluated. Results will illustrate not only the benefits of NearCast/CI fusion, but also how those benefits are affected by geographical location (local climate effects), season, time of day and strength of dynamical forcing. The fusion procedure should also be applicable to SEVIRI, as well as MTG-I (and MTG–S) observations in the future.

Nowcasting technics and systems

THE NOWCASTING SAF (NWC SAF): PRODUCTS AND USER SERVICES. CURRENT STATUS AND FUTURE PLANS.

Pilar Rípodas, Xavier Calbet

AEMET Agencia Estatal de Meteorología

The Nowcasting SAF (NWC SAF, www.nwcsaf.org) belongs to the EUMETSAT SAF Network, being one of the first SAFs to be stablished in 1997.
Its main objective is the generation of satellite-derived products with a direct application to Nowcasting. For this, two different NWC SAF software packages, for polar and geostationary satellites, are developed, maintained and delivered to users. Training and user support is also a key point in the SAF activities.
In the proposed paper, the NWC SAF is presented. First the structure of the NWC SAF is explained, indicating the consortium members and its responsabilities inside the SAF. A relation of the NWC SAF products is shown, including consolidated Products and recent products developments. The NWC SAF services to users are presented, focusing in the more relevant and recent achievements.
Finally, the future plans of the NWC SAF for the next years, which include new products development and adaptation to the new era satellites (MTG and EPS-SG), are highlighted.

THE NOWCASTING SAF (NWC SAF), EXAMPLES OF OPERATIONAL USE OF PRODUCTS IN NOWCASTING

Javier García Pereda

AEMET (Agencia Estatal de Meteorología - Spanish National Weather Service)

The objective, status and plans of the Nowcasting SAF (NWC SAF) were presented in a previous presentation by Pilar Rípodas.
This additional presentation wants to give some examples of real operational use of NWC SAF products in nowcasting tasks, with a special interest in its precipitation, convection, clear air and wind products: the options they give for watch and warning tasks, and how and in which conditions they can work better and be more useful for the forecast.
The objective of this is to show the potential of NWC SAF products for a better operational forecast.

NOWCASTING OF THUNDERSTORMS AND SEVERE CONVECTION IN SWITZERLAND

Ulrich Hamann, Elena Leonarduzzi, Lorenzo Clementi, Alessandro M. Hering, Luca Nisi, Marco Sassi, Urs Germann

Swiss Federal Office of Meteorology and Climatology MeteoSwiss

Thunderstorms are often accompanied with hail, heavy rain and gale-force wind gusts. Furthermore, lightning and flash floods could cause severe damages at properties and infrastructure and may induce live threatening situations. For example, about 23% of all weather related damages in Switzerland are linked to thunderstorms. Due to limited spatial resolution and parameterized cloud physics, current Numerical Weather Prediction models face difficulties to predict the exact position and strength of thunderstorms. Nowcasting methods improve the quality of the thunderstorm prediction for a forecast period of some hours and, therefore, provide an essential support for issuing corresponding severe weather warnings.
In this talk we present the thunderstorm nowcasting algorithm Context and Scale Oriented Thunderstorm Satellite Predictors Development (COALITION) developed by MeteoSwiss. Its overall goal is to identify, track and nowcast the position and intensification of convectively active regions in an accurate, continuous and robust manner. It focuses on Switzerland and its adjacent regions, has an update cycle of 5 min and a spatial resolution of 1 km. It performs following steps: 1. estimation of the cloud motion, 2. identification of convectively active regions and thunderstorms, 3. nowcasting of the future position, properties and associated threads of the thunderstorms and 4. visualization of the results for forecaster. The current version of the algorithm, COALITION-2, is entirely based on MSG/SEVIRI observation. This version was tested at MeteoSwiss as pre-operational algorithm in the summer 2016. A validation of the nowcasting results for about 30 thunderstorm events in this period is presented. Developing thunderstorms are reliably identified. COALITION-2 also detects optically thick clouds, however not all of those are active mature thunderstorms. The position of thunderstorms is predicted with an average accuracy of about 7 km for lead times smaller than one hour. The area covered by the ambos is adequately estimated for thunderstorms existing longer than 30 min, while for younger thunderstorms the ambos area is underestimated. Finally, plans for further development of COALITION in 2017 including the exploitation of radar and NWP data are discussed.

NOWCASTING ACTIVITIES AT THE ROYAL METEOROLOGICAL INSTITUTE OF BELGIUM

Maarten Reyniers, Lesley De Cruz, Laurent Delobbe, Loris Foresti

Royal Meteorological Institute of Belgium

In this contribution we give an overview of the nowcasting activities at the Royal Meteorological Institute (RMI) of Belgium, both in operations and in research.
The operational nowcasting system of the RMI is INCA-BE, which is based on the INCA system from ZAMG (Austria), but since its implementation at the RMI in 2011, the system has been heavily modified and improved. Additions include a dedicated interactive webportal, a nowcast of the lightning activity based on the BELLS network, the integration of the RMI webcams, an automatic monitoring system, the integration of the INCA-BE output in the free public smartphone app of the RMI, the addition of an uncertainty plume to the precipitation forecast and the addition of hail and severe hail as precipitation types in the precipitation type forecast.
In parallel to our operational nowcasting system, we have implemented and evaluated STEPS-BE. STEPS-BE is the local implementation of the probabilistic Short-Term Ensemble Prediction System that was jointly developed by the Australian Bureau of Meteorology and the UK MetOffice. This system generates an ensemble of precipitation nowcasts by perturbing a deterministic radar extrapolation nowcast with spatially and temporally correlated stochastic noise. To account for the dynamic scaling of precipitation fields, i.e. the observation that large scale features are more predictable than small scale features, the precipitation fields are decomposed into an 8-level multiplicative cascade. The STEPS-BE system is now ready to be transferred to our operational HPC infrastructure, allowing for the generation of an ensemble of 48 members every five minutes.
Our current research activities concern the further development of both INCA-BE and STEPS-BE. For INCA-BE, we aim at the development of a warning module that will be used to generate push-notifications for dangerous weather through the RMI smartphone app. For STEPS-BE, we are testing the level-by-level blending of high-frequency (3 minutes) NWP output from the ALARO-0 model in STEPS-BE. The purpose of this blending is to extend the skill of STEPS-BE to longer lead times. The scale-dependent weights of the extrapolation-based and the NWP forecasts are determined from either climatology or the recent skill of the respective forecasts (estimated in real-time).

LIGHTNING JUMP AS AN OPERATIONAL NOWCASTING TOOL AT THE METEOROLOGICAL SERVICE OF CATALONIA

Carme Farnell, Tomeu Rigo, Nicolau Pineda

Meteorological Service of Catalonia

Trends in total lightning are robustly correlated to severe weather (large hail, strong convective winds, and/or tornadoes) with rapid increases in total lightning ,generally occurring tens of minutes prior to the onset of severe weather. Such sudden increases, termed “lightning jumps”, are caused by an increase in the strength of the updraft of the thunderstorm as it passes through the mixed-phase layer, a known area of significant charge separation and electrification. Observational evidence suggested that this pattern is a robust predictor of severe weather and some algorithms have been developed since then. Taking advantage of the Total Lightning Location System (intra-cloud in VHF plus cloud-to-ground in LF) of the Meteorological Service of Catalonia (SMC), Farnell et al. (2017) had developed a "lightning jump" algorithm intended for nowcasting and surveillance of severe weather. After one year of operation, this paper analyzes the strengths and weakness of this new promising tool.

UTILIZATION OF RADAR REFLECTIVITY CORES CHARACTERISTICS IN THE CZECH HYDROMETEOROLOGICAL INSTITUTE

Hana Kyznarova, Petr Novak

Czech Hydrometeorological Institute

Weather radar data are very useful for convective storms nowcasting and warning. Convective storms correspond well with cores of high radar reflectivity. A convective storms nowcasting algorithm named CELLTRACK, that identifies and tracks individual reflectivity cores, was developed in the Czech Hydrometeorological Institute (CHMI) and is operationally used for several years in the CHMI forecast offices.
CELLTRACK identifies reflectivity cores as continuous areas of reflectivity higher than a given threshold. After testing of several reflectivity thresholds, the value of 44dBZ was chosen as a most useful for convective storms nowcasting. CELLTRACK allows tracking of the identified reflectivity cores and is also able to deal with splitting and merging of the cores.
CELLTRACK also allows assigning different radar and lightning detection characteristics to individual reflectivity cores. Available characteristics are maximum reflectivity, height of maximum reflectivity, echotop height, area, vertically integrated liquid, hail probability, number of associated lightning strokes and others. Radar characteristics are calculated operationally, operational use of lightning detection data is currently under preparation. Sounding measurements are also used for computation of some of the characteristics.
Although the characteristics of reflectivity cores are currently calculated operationally, they are not available in appropriate form usable in CHMI forecast offices. New version of the web-based application JSMeteoView for operational visualization of radar data is currently under development. This new version will include also visualization of reflectivity cores characteristics.
The contribution will show a brief description of CELLTRACK algorithm, it will focus on reflectivity cores characteristics calculation and their utilization. It will also discuss possibilities of visualization of reflectivity cores characteristics that satisfies the needs of CHMI forecasting offices.

KONRAD3D: A NEW TOOL FOR DETECTION AND NOWCASTING OF CONVECTIVE CELLS AT DWD

Manuel Werner

Deutscher Wetterdienst

In order to further improve the performance of DWD's automated warning decision support system AutoWARN, the development of a new tool for the automated detection, tracking and nowcasting of convective cells, called KONRAD3D, has been initiated. KONRAD3D will be based on three-dimensional radar data and represents the successor of the operational system KONRAD (Konvektive Entwicklung in Radarprodukten) used up to now. The main goals are to further reduce advance warning times, improve POD and FAR for cell detection, to enhance the performance of generated forecasts, and to give a more adequate classification into severity categories.
KONRAD, so far, uses a single-threshold connected component labelling approach (46 dBZ) applied to a two-dimensional near-ground radar reflectivity composite covering Germany to detect cells. It provides various cell properties, cell tracks, forecasts of cell centroids, and issues hail, heavy rain, and wind gust warnings. Besides the use of KONRAD within NowCastMIX and AutoWARN, it is also directly supplied to DWD forecasters via the visualization system NinJo, and it is used by disaster management authorities, e.g., as part of the fire department information system FeWIS.

The novel tool KONRAD3D is currently being newly developed from scratch using DWD's software framework POLARA. Within KONRAD3D, convective cells are detected in three-dimensional radar reflectivity sweep data which is quality controlled using dual-polarimetric algorithms. Hail and heavy rain warnings will be based on dual-polarimetric Hydrometeor Classification and Quantitative Precipitation Estimation schemes. It will further make use of state of the art techniques for detection, tracking and forecasting of convective cells. For instance, we resort to adaptive thresholding schemes not being bound to a single fixed threshold anymore. In addition, cell tracking is supported by standard optical flow methods imported from the widely used OPENCV (Open Source Computer Vision) software library. Moreover, it is planned to combine radar reflectivity cells with features derived from lightning and satellite data as well as with objects created by DWD's mesocyclone detection algorithm into consolidated objects. In all of these steps, particular importance is attached on a generic software design. Basic techniques, like, e.g., feature extraction and tracking algorithms, are linked into a software library called FTN (Fundamental Techniques for Nowcasting) which can be separately supplied to developers of other nowcasting tools. Finally, another focus of the development will be placed on the derivation of cell life-cycles and their incorporation in the nowcasting.
In this work, we present the basic design of KONRAD3D in more detail and show first results with the detection and tracking functionality in KONRAD3D using three-dimensional polar radar reflectivity data for a prominent example case.

NOWCASTMIX – AUTOMATIC WARNINGS AND FEATURE TRACKING FROM CONTINUOUSLY MONITORED NOWCASTING SYSTEMS BASED ON OPTIMALLY CLUSTERED FUZZY-LOGIC ASSESSMENTS OF STORM ATTRIBUTES

P. M. James, B. K. Reichert, D. Heizenreder

Deutscher Wetterdienst

The German Weather Service's AutoWARN system integrates various meteorological data and products in a warning decision support process, generating real-time warning proposals for assessment and possible modification by duty forecasters before dissemination to customers. On nowcasting timescales, several systems are continuously monitored to capture rapidly developing mesoscale events, including radar-based cell tracking methods, 3D radar scans, lightning strike locations, calibrated precipitation extrapolations, live synoptic reports and numerical forecast models. To help the forecasters manage this large volume of rapidly changing data, NowCastMIX processes it into an integrated grid-based analysis, providing an optimal warning solution with a 5-minute update cycle. Inputs are combined using a fuzzy logic approach for estimating likely storm attributes, deriving optimized estimates for the storm cell motion vectors. An adaptive ensemble clustering optimization is then deployed to reduce the spatial complexity of the resulting warning fields and smooth out noisy temporal variations to a manageable level for the duty forecasters to deal with. NowCastMIX thus delivers an on-going real-time synthesis of the various input data to provide consolidated sets of most-probable short-term forecasts for the whole of Germany within the context of AutoWARN and for flight safety in civil aviation. The system has run over six years, yielding a rich and complete high resolution analysis of thunderstorm activity and corresponding warnings, providing a valuable research resource for improving the system further. Recently an explicit tracking of storm cell clusters has been introduced, which can capture and track anomalous cell motions which sometimes occur, such as so-called "right-moving" supercells, further improving forecast quality.

NOWCAST OF LIGHTNING AS A BLEND OF PROBABILISTIC DATA

Moseley, Stephen

Met Office

Severe atmospheric convection presents a significant hazard to aviation due to the associated turbulence, up and down draughts, hail, lightning and icing (Brown et al, 2014, Bradbury, 2000).
The accurate identification, location and movement vector of an active convective storm is valuable information for the national air traffic control (NATS) for routing aircraft safely. The increased workload this brings and the reduced airspace capacity are already being mitigated against with a 5-day forecast of disruption in the LTMA (Brown et al, 2014).
A nowcast tool of lightning probability as a proxy for severe convection is presented, building on the empirical thresholding Convection Diagnosis Scheme of Hand, 2002 applied as a probabilistic forecast from a high-resolution NWP model. The nowcast tool uses a nowcast ensemble precipitation rate forecast (using STEPS; Bowler et al. 2006) and an extrapolation-based thunderstorm tracker to modify the first-guess NWP fields.
Verification of the probabilistic nowcast tool is presented, demonstrating how this tool improves on the skill of the NWP forecast in the nowcast time frame.

Reference:

Bradbury, T., 2000, Meteorology and Flight. Black Publishers Ltd. ISBN: 978-0713668315
Brown, K., Maisey, P., 2014, Improving forecasting of disruption due to convection within the LTMA, Met Office internal report for the Civil Aviation Authority.
Bowler N, Pierce CE, Seed A., 2006, STEPS: a probabilistic precipitation forecast scheme which merges an extrapolation nowcast with downscaled NWP. Q. J. R. Meteorol. Soc. 620A: 2107–2125.
Hand, W.H., 2002, The Met Office Convection Diagnosis Scheme, Meteorol. Appl., 9, 69-83

NOWPAL: NOWCASTING PRECIPITATION ACCUMULATIONS

Matteo Buzzi, Luca Panziera, Marco Boscacci, Marco Gaia

MeteoSwiss

The nowcasting system NOWPAL, recently introduced in a preoperational phase at MeteoSwiss, has been developed to issue automatic precipitation alerts for predefined and user dependent geographical regions in Switzerland, combining precipitation accumulations in the recent past with the INCA precipitation forecast. Different accumulations temporal windows and regional thresholds derived with an extreme precipitation analysis are used. The presentation give an overview on the system and presents the first experiences.

A PROBABILISTIC INCA BASED ON ERROR STATISTICS

Atencia, Aitor; Kann, Alexander; Tüchler, Lukas; Wang, Yong

ZAMG - Zentralanstalt für Meteorologie und Geodynamik

The latest radar observations are widely used as the main source for deterministic nowcasting techniques, such as INCA, in operational and research centers. However, this approach does not take

into account other sources of information such as the actual rainfall measured by rain gauge in the analysis step or errors in temporal extrapolation of the analysis due to changes in the motion vectors or growth and decay of precipitation.
Quantitative precipitation estimation based on weather radar data is affected by many uncertainties and errors. To handle the uncertainties in the precipitation products, statistical properties of the errors between the radar estimation and the measured rainfall are used to derive a probabilistic QPE analysis. The used ensemble generator is based on a stochastic simulation using LU decomposition of the error covariance matrix and autoregressive filtering allowing the representation of the actual spatio-temporal dependence of radar observational errors.
Lagrangian forecasts can be generated from these realistic ensemble of analysis. To account for other sources of errors such as the growth and decay, a Markov process is applied to create or destroy rain keeping the properties of the analysis errors. The existence of observed predictable properties in the small-medium scales are introduced in the generation of the stochastic noise. These properties, such as the diurnal cycle of precipitation among others, provide realistic ensembles of different meteorological situations, narrowing the spread among members.
Finally, some statistical spatial and temporal properties of the final set of ensembles have been verified to determine if the technique developed introduced enough uncertainty while keeping the properties of the original field.

NOWCASTING OF WINTER WEATHER WITH INCA

Alexander Kann, Benedikt Bica, Jasmina Hadzimustafic, Yong Wang

Zentralanstalt für Meteorologie und Geodynamik

Precise nowcasts of winter weather hazards like icing, low visibility or heavy snowfall are of crucial interest both for public security and specific applications, e.g. road management. To account for this increasing demand, the analysis and nowcasting system INCA has been refined and further developed. Within a cooperation with the Austrian highway company, surface temperature, icing, snowfall and road condition nowcasts have been specifically designed for high-resolution road sctions. It is shown that pavement temperature measurements and a thermal mapping based downscaling process add value to the nowcasting skill of INCA.
Within the WMO WWRP RDP/FDP project ICE-POP 2018, which aims to improve the understanding severe weather in winter over complex terrain, the INCA system is chosen to be an essential contribution for nowcasting. After successful implementation of INCA in the Olympic region of Pyeongchang, Korea, further refinements and developments, taking into account the characteristics of local measurements, scientific issues and specific needs of the Olympic organizers, are currently realized and planned. Apart from first results, a preliminary validation and future plans will be discussed.

HYBRID HUMAN EXPERT AND MACHINE-BASED THUNDERSTORM WARNINGS: A NOVEL OPERATIONAL NOWCASTING SYSTEM FOR SEVERE WEATHER AT METEOSWISS

M. Gaia, G. Della Bruna, A. Hering, D. Nerini, V. Ortelli

MeteoSwiss

Thunderstorm warnings to the population and the authorities are a high priority task for national weather services. Indeed, the impact of thunderstorms can be very severe. The main challenge in the context of a thunderstorm warning system is to achieve, with sufficient warning time, both precision (high time and spatial resolutions, useful estimate of intensity) and accuracy (high probability of detection and low false alarm ratio), in order to satisfy users' needs in their decision processes.
MeteoSwiss has recently developed a new automatic thunderstorm warning system based on an operational algorithm called "TRT" (Thunderstorms Radar Tracking). The weather radar detects the convective cells and TRT derives their motion and intensities. After extrapolating the location of each cell under the assumption of persistence, a notification informing about the location, the intensity and the lead-time of the convective cell can automatically be sent to the internal or external users.

During the research phase a systematic comparison between the automatic and the fully manual thunderstorm warning system was carried out during three summers, in order to evaluate their performance. This comparison was performed at the level of the 159 warning regions. From the results of the statistical validation of the test campaigns it emerges that the overall performance of the automatic system was better than the performance of the fully manually produced thunderstorm warnings. Especially interesting is the comparison of the lead time for the warnings: the automatic system was able to send out warnings 14-18 minutes before the manual warning system. This is a very significant improvement for nowcasting thunderstorm warnings.
Therefore since summer 2016 this information is submitted by the system as a proposal to the forecaster on duty, integrated in the main visualization and production tool used by MeteoSwiss, called NinJo. The forecaster on duty can then choose to accept, modify or reject such proposal. Without intervention in the 2 minutes following the proposal, the system will automatically issue the thunderstorm warning to the public.
During the summer seasons 2014, 2015 and 2016, MeteoSwiss has also launched three test campaigns with more than 600 beta testers. They has the opportunity to subscribe to thunderstorm warnings via SMS for up to three locations of their choice. The results of the test campaigns have been very promising: the beta testers' feedback reported a quite encouraging scenario from the users' point of view. Finally, users showed general satisfaction for the new automatic system and they appreciated the opportunities offered by such systems (e.g. customization). Especially the possibility to get thunderstorm warnings for a given location, defined by geographical coordinates, and not only for large warning regions has been appreciated.
At the nowcasting conference we will present the overall results of the test campaigns and we will illustrate how MeteoSwiss uses the new potentialities of the real-time automatic warning system in order to improve the quality of the thunderstorm warnings for the authorities and for the population. We will also discuss how important it is to involve the internal and external users during the development phase of a new warning system, in order to take care of their needs.

AWI, THE POST-PROCESSING TOOL FOR NOWCASTING AND VERY SHORT-RANGE FORECASTING OF THE ITALIAN AIR FORCE METEOROLOGICAL CENTRE

Marco Alemanno, Lucio Torrisi, Antonio Vocino, Francesca Marcucci

Italian Air Force Meteorological Centre

An automatic post-processing software applied to the deterministic NWP model output fields, named Automatic Weather Interpretation (AWI), is in use at COMET, the Italian Air Force Meteorological Centre.
In detail, downstream of the COSMO-ME limited area model, running on the Euro-Mediterranean domain, a series of multi-parameter decisional trees allows the determination of the weather phenomena (drizzle, rain, snow, thunderstorms, fog, etc.) as well as of the cloud type, including base and top height, and the risk of icing, strong wind or heat waves.
AWI is a software developed by the Italian Air Force and written in C and Fortran, designed to assist the weather forecasters, especially in the fields of nowcasting and very short-range forecasting, by means of charts with a clear indication of the expected phenomenon for each grid point within the area of interest.
Recent developments include the implementation of a simplified Tiedtke's algorithm for the determination of the base and top height of convective clouds, in order to better predict cumulonimbus clouds.

Application, user aspects and verification

USING VERTICAL INTEGRATED LIQUID/ICE, ROTATION AND LIGHTNING DENSITY TRACKS FOR OPERATIONAL SEVERE WEATHER WARNINGS

Christian Herold, Adrian Leyser, Sebastian Schappert, Thomas Hengstebeck, Michael Mott, Kathrin Wapler

Deutscher Wetterdienst

Severe weather associated with deep convection poses a significant threat to life, property and economy. The nowcasting of severe convective events remains a challenging endeavour. Newly developed products can support the forecaster in the warning decision process. The use of the vertical integrated liquid/ice, rotation and lightning density tracks in an operational warning and forecasting environment are presented from a forecaster’s perspective.
Vertical Integrated Liquid/Ice (VIL/VII) products are generated as national composite using the 3D-reflectivity volumes of all DWD radar stations. For a given grid-cell a VIL value is calculated by integrating exactly vertical. A VIL-Track is created by taking the maximum value of all VIL values for this pixel in the last three hours. The VIL Track product is useful for depicting paths of moving cells. In case of cell splits two divergent VIL paths can be observed. The reflectivities are always interpreted as belonging to liquid hydrometeors. However, this overestimation pronounces severe storms, which make VIL a kind of “storm severity indicator”. In the VII product the lower integration limit is lifted in order to catch just the frozen hydrometeors, so that VII may be better suited to imply the presence of hail. Preliminary tests showed a relationship with hail size.
The rotation product is meant for visualising the azimuthal shear connected with rotation in meso-(anti)cyclones. Each pixel within this composite is assigned a value corresponding to the average azimuthal shear in the vertical column above the pixel, for the low-level rotation product between 0

and 3 km above ground level (agl) and for the mid-level rotation product between 3 and 6 km height agl. The related track products are obtained by pixelwise accumulating the maxima from the LL and ML rotation products of the last 3 hours, so that only positive shear is picked up. The low level and mid level rotation track products can help to distinguish between close to ground (implication for possible occurrence of tornadoes) and mid level atmospheric rotation.
Lightning strokes are mapped on a grid with a spatial resolution of 1 km. The grid is similar to that of the VIL/VII and rotation products. The lightning density product shows the number of lightning strokes per km² for a 5 minute interval. The lighting density track is created by accumulating the lightning density products from the last 3 hours. Each pixel of the lightning density track product is assigned the total of all lightning density values for this pixel. Intense convective storms tend to have higher lightning stroke densities. A so-called lightning jump, i.e. a rapid increase in the lightning stroke rate of a storm, has in many cases shown to be a precursor of severe weather (e.g. gusts, hail or tornadoes).

"NO ONE WILL GO AND HOLD OR TIE A TREE!" SEVERE WEATHER SITUATIONS FROM AN EMERGENCY SERVICES PERSPECTIVE

Thomas Kox

Freie Universität Berlin

Extreme weather events present great challenges for society and the organizations responsible for their protection. How do emergency services (i.e. fire brigades) handle these critical situations? What determines their work in preparation and during an event? What information would make it easier for them?
Even more sophisticated users such as emergency services vary considerably in their individual perceptions and capabilities, their institutional requirements and legal frameworks (Kox et al. 2015). In order to communicate weather information more effectively it is necessary to determine such influences.
The research was based on data obtained from semi-structured interviews with representatives from different civil protection and emergency management authorities in Germany. The results revealed the importance of dealing with uncertainty, the role of lead times and spatial and temporal resolution, as well as principles of action.

OUTCOME OF THE FIRST NOWCASTING SATELLITE APPLICATION FACILITY (SAF) TESTBED

Xavier Calbet, Pilar Ripodas

AEMET

Nowcasting (NWC) Forecasters face the enormous challenge of having to process a huge amount of data from the observing systems and the numerical weather prediction models. With this data, they issue a forecast or a meteorological warning. Products derived from meteorological satellite data, such as those generated by the NWC SAF, greatly simplify the interpretation of satellite imagery. However, for these products to be useful, Forecasters need to know and be able to interpret them and know their limitations. Because of this, a series of Testbed activities are being performed between 2016 and 2017. The Testbeds consist of assembling a group of Forecasters, together with forecasting product developers, simulating real operational forecasting scenarios using the usual

forecasting tools plus the NWC SAF ones. The ultimate goal is to establish a communication channel between Forecasters and product developers. This presentation informs about the outcome of the first NWC SAF Testbed performed in Malaga (Spain) from 14 to 18 November 2016.

EVALUATION OF NOWCAST SYSTEMS AT THE ESSL TESTBED SINCE 2012

Pieter Groenemeijer, Alois M. Holzer, Tomas Pucik

European Severe Storms Laboratory - Science and Training

Since 2012, the European Severe Storms Laboratory operates the annual ESSL Testbed programme. One of the two main goals of the Testbed is to evaluate new nowcasting and forecasting tools, specificially with respect to hazardous convective weather. In collaboration with DWD, ZAMG, MeteoSwiss, and EUMETSAT, among others, many different external radar, NWP, satellite, lightning detection and several hybrid products were featured at the Testbed. These products were used as a resource for Testbed participants to make real-time experimental weather warnings. During this work and the subsequent evaluation sessions at the Testbed, feedback was collected that has been shared both immediately on-site and afterwards with nowcast tool developers. In this presentation, we will review the evaluation activities and provide an outlook for the near and more distant future of the programme.

Combination of NWP and Nowcasting

ASSIMILATION OF GNSS SLANT INFORMATION FOR NWP AND NUMERICAL NOWCASTING

Siebren de Haan

KNMI

Humidity measurements for operational numerical nowcasting are sparse. Radiosonde and satellite humidity information is valuable for numerical weather prediction (NWP), but generally have a data latency of the order of 45 to 90 minutes. Another source of upper air humidity information that can be derived from a network of Global navigation satellite system (GNSS) receivers is called Zenith Total Delay (ZTD). This information, which is related to the total amount of humidity above the observation site, has proven to be valuable for numerical nowcasting, using the hydrostatic HIRLAM model, and NWP. The latency is short enough.
The actual measurements from a GNSS network are time delays from (moving) satellites to the receiver and thus contains more information on the distribution of upper air humidity. In this study we have assimilated these Slant Total Delay (STD) estimates from a dense network in a non-hydrostatic NWP model Harmonie, at 2.5 km resolution with a three hour update cycle. The first results show a positive impact on cloud cover and rainfall forecasts. Additionally, the STD observations are assimilated in a 1 km grid Harmonie model for numerical nowcasting (one hour cycle), which is nested in the 2.5 km Harmonie model. A case study shows the potential of this system.

VERY SHORT-RANGE NWP FORECASTS INITIALISED WITH STMAS AND WRFDA ANALYSES: AN EVALUATION DURING THE CONVECTIVE SEASON

Jordi Mercader-Carbó, Jordi Moré, Eloi Dalmasso, Abdelmalik Sairouni

Servei Meteorològic de Catalunya

Nowcasting tools are essential for providing assessment on short-range precipitation forecasts, especially in situations when high rainfall intensities are expected. Over the last years, the Meteorological Service of Catalonia (SMC) has taken advantage of an operational very shortrange weather forecasting system based on the combination of observations and the Weather Research and Forecasting – Advanced Research WRF (WRF-ARW) model. In this study, a major update of this system is presented. On one hand, the Space–Time Multiscale Analysis System (STMAS) has been evaluated for several cases spanning from late summer to early autumn of 2016, when significant precipitation events took place in Catalonia. It is shown that shortrange forecasts initialised with this system achieve better skill than the ones using the NOAA's Local Analysis and Prediction System (LAPS), the only data assimilation system in operations that time for nowcasting purposes. On the other hand, short-range forecasts initialised with the analysis resulting from assimilation of RADAR data using the WRF Data Assimilation (WRFDA) system have also been performed for the same cases. Several options for the reflectivity assimilation, the background error characterization or the cycling system have been considered for the WRFDA experiments. Analyses obtained from both WRFDA and STMAS are evaluated and compared, along with their subsequent forecasts.

NWP-SUPPORTED NOWCASTING AT IMWM

Andrzej Mazur, Andrzej Wyszogrodzki

Insitute of Meteorology and Water Management - National Research Institute

At IMWM the nowcasting system INCA (Integrated Nowcasting Through Comprehensive Analysis) works as a system for analysis and ultra-short-term forecasts of the state of the atmosphere. Based on the data from IMWM's measurement network (SYNOP and telemetry stations as well as radar installations) INCA creates an analysis of the state of the atmosphere. On its basis an ultra-short-term weather forecast "for now" (i.e. for the next few hours) is prepared. It is also based on forecasts from numerical model(s) and is adjusted with the latest available observation and measurement data, i.e. the most recent analysis from INCA system. As for basic parameters and fields, INCA prepares results with high horizontal resolution of 1x1km; for all fields except precipitation the analysis is prepared every hour with the forecast for the next eight hours. For precipitation, the analysis is computed every 10 minutes with the forecast for the next two hours.

LAPS NOWCASTING – DEVELOPMENT AND EVALUATION

Petros Katsafados, Spyrou C., V.M. Nomikou, A. Papadopoulos

Department of Geography, Harokopion University of Athens

A simplified forward advection scheme has been embedded in a 3D data assimilation system, namely NOAA's Local Analysis and Prediction System (LAPS) in order to overcome the 'spin up' period which

routinely appears in the conventional numerical weather predictions (NWP). The spin-up has a time window usually up to 6 hours, rendering the numerical models unreliable for operational nowcasting. LAPS is a meteorological assimilation system that uses actual observations (meteorological stations, radar and satellite, soundings and others) and background data to generate a spatially distributed, three-dimensional representation of atmospheric conditions. This way the system was able to advance the meteorological parameters in time and provide an estimation of future conditions 3 hours ahead from the analysis hour.
The performance assessment of the system has as reference the surface measurements available from the WMO network. The comparison against observations was made across Europe. The available surface observations from more than 500 conventional stations were used to verify and compare categorical near to analysis forecasts of the 10-m wind field, 2-m air temperature and sea level pressure for one month period. The evaluation methodology was based on the point-to-point comparison between system-generated variables and observations. On the basis of traditional objective verification techniques the scores produced are the standard mean error (BIAS) and the root mean square error (RMSE).
Furthermore, in order to examine the capabilities of the system against conventional NWP, the WRF model with the NMM core was run in operational mode for the same time period. Using the model output for the same forecast window, which is part of the model 'spin-up' time, WRF-NMM was evaluated having as reference the same station data. BIAS and RMSE were estimated for the 10-m wind field, the 2-m air temperature and the sea level pressure as well. The analysis showed an overall improvement of the new system over the operational WRF model for the first three forecasting hours.

NOWCASTING WITH HOURLY AROME NWP MODEL IN AUSTRIA

Florian Meier, Yong Wang, Christoph Wittmann, Mirela Pietrisi

Zentralanstalt für Meteorologie und Geodynamik (ZAMG)

A nowcasting version of the convection permitting numerical limited area model AROME (Seity et al. 2010) is currently developed at “Zentralanstalt für Meteorologie und Geodynamik” (ZAMG) under the framework of the “Seamless” project. This includes tests with increased horizontal resolution of 1.2km, a reduced cutoff time of 30min, hourly 3D-Var data assimilation including also new observations especially RADAR and aircraft data and hourly forecasts up to 12 hours lead time. In addition, new assimilation components like latent heat nudging of precipitation analysis and forecasts from the conventional ZAMG nowcasting system INCA or cloud nudging are tested. The potential benefit of such a system compared to the operational 3hourly AROME is shown by case studies and for a summer test period.

SEAMLESS PROBABILISTIC ANALYSIS AND PREDICTION IN VERY HIGH RESOLUTION (SAPHIR)

Wang, Yong; Kann; Atencia; Awan; Kemetmüller; Meier; Lang; Schicker; Tüchler; Wastl; Wittmann

ZAMG

A seamless probabilistic system (SAPHIR) including weather analysis, nowcasting and short range prediction in very high resolution has been developed at ZAMG since 2015. SAPHIR is designed in at least 1km horizontal resolution, and updated from 10min to hours depending on weather

parameters. SPAHIR will provide the best possible and statistically optimized probabilistic forecast from 0 to 3 days, which includes probabilistic integration of observations for ensemble analysis, ensemble nowcasting, convection permitting RUC, convection permitting EPS, regional deterministic and ensemble forecasts, global deterministic and ensemble forecasts. SAPHIR will be introduced at the conference.

NOWCASTING MOS

Knüpffer, Klaus; Hoffmann, Jan (Geometix GmbH Science & Solutions)

Meteo Service weather research GmbH

MOS (Model Output Statistics) is applied to improve the forecasts of the numerical models already for decades. For standard elements like temperature MSwr-MOS (Meteo-Service- weather-research MOS) reduces the error variance of the direct model output forecasts by about 50% on the average. This corresponds to about 20 years of improvement of
numerical models. MOS algorithms produce - as further benefit - all kinds of probabilistic forecasts which are needed as a basis for optimum decision making. During the last two decades MSwr-MOS applications had been extended to aviation weather (Auto-TAF) and
NowCasting such as Lightning MOS and Radar MOS. All these systems are Eulerian. 10 years ago, Cell-MOS, a Lagrangian MSwr-MOS system, had been developed for the German National Weather Service (DWD): Individual storm cells are tracked by means of MOS and their characteristics (rain, gusts, hail, lightning strokes etc.) are predicted in a probabilistic way. Basic past and current developments regarding these systems are presented.

A DISCUSSION ON THE PROBLEMS OF BLENDING RAINFALL DATA

Moseley, Stephen; Friedrich, Martina; Scovell, Robert

Met Office

Combining information from various sources is central to nowcasting systems. For rain, sources of information can include extrapolation fields based on several time slices of radar analysis, and numerical model rain fields.
It has been found that rain has certain statistical properties, both in terms of intensity distribution, as well as in space-time structure (e.g. Schertzer and Lovejoy 1987, Crane 1990); that rain intensities on different scales combine multiplicatively; and that the lifetime of features is correlated with the spatial scale. We also know that rainfall intensity is approximately normally distributed when considered in log-space.
In the Met Office implementation of the STEPS framework (Bowler et al. 2006), this has led to (a) working with rain rate data in log-space and (b) performing a spatial scale decomposition of rain fields before information is combined: advected small scale structure in extrapolation fields becomes less trustworthy faster than large scale advected features.
Treating a single pixel on a certain scale decomposition layer as a draw from a distribution represented by its local neighbourhood, the information from both sources of information at this layer and point can be combined with an appropriate scale-dependent weighting if the source distributions are equivalent such that the local distribution of rain intensities is the same. Usually, this is achieved by normalizing both local distributions before and re-normalizing afterwards.

We will present how problems with this approach arise if one source of information has no rain at all in the local neighbourhood and hence a flat distribution and suggest possible alternatives.

Reference:

Bowler N, Pierce CE, Seed A. 2006. STEPS: a probabilistic precipitation forecast scheme which merges an extrapolation nowcast with downscaled NWP. Q. J. R. Meteorol. Soc. 620A: 2107–2125.

Crane 1990. "Space-Time Structure of Rain Rate Fields", JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 95, NO. D3, PAGES 2011-2020, FEBRUARY 28, 1990

Schertzer and Lovejoy 1987. "Physical Modeling and Analysis of Rain and Clouds by Anisotropic Scaling Multiplicative Processes", JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 92, NO. D8, PAGES 9693-9714, AUGUST 20, 1987

AN ALTERNATIVE POINT OF VIEW OF SOME ASIST KEY ELEMENTS

Luis Bañon

AEMET

ASIST project (Application oriented analySIS and very short range forecast environmenT) focuses its interest in a seam-less prediction from minutes up to 12 h lead time (very short range forecasting). ASIST is positioned as a link between observations and NWP. Among other project goals is the information exchange with other groups and programmes.

To achieve the project objectives, one of ASIST's work areas focuses on establishing links with EUMETNET's SRNWP-EPS (Short Range Numerical Weather Prediction - Ensembles Prediction System) project. In a recent workshop of this project some challenges in this area were presented.

The presentation offers an alternative point of view of the key elements shown in the workshop and of particular interest to ASIST: sources of uncertainty and generation of perturbations, ensembles and spread, the necessary calibration for reliable probabilistic predictions, communication of uncertainty, etc.

Finally, some questions concerning the common area between probabilistic nowcasting solutions and the ensembles of the SRNWP are posed.

Posters

P1. USE OF NOWCASTING DATA FOR THE ISSUE OF WEATHER WARNINGS AT DEUTSCHER WETTERDIENST

Tim Böhme

Deutscher Wetterdienst

A main task for national weather services is the issue of weather warnings. These warnings inform about hazardous situations both in winter and summer seasons.

For the nowcasting period of up to two hours forecast time, area-wide observational data are key data in nowcasting. At DWD, area-wide observational data are based on radar, satellite and lightning data. Satellite and lightning data are important for warnings during heavy convective weather events, e.g. when heavy thunderstorms in meso-scale weather systems, often accompanied by hail and gail gusts, arise. Radar data are in addition important for warnings during hazardous stratiform or

winterly weather evnts, e.g. when continuous rain fall leads to flooding or precipitation at temperatures around 0°C lead to slippery road surfaces.
The contribution will present existing and currently established nowcasting products at DWD. It will show in which warning situations, nowcasting tasks can access broadly to these nowcasting products and in which situations information of nowcasting data is still very limited. Case studies will illustrate the relevance and the benefit of the nowcasting products.

P2. SPECMAGIC_NOW - A FAST AND ACCURATE METHOD FOR THE CALCULATION AND FORECAST OF SOLAR SURFACE IRRADIANCE

Richard Müller, K. Hungershöfer, T. Leppelt, J. Asmus

Deutscher Wetterdienst

Renewable energies are an important mainstay of the current energy supply and their importance will increase steadily in a world running out of fossils. However, the energy production of solar and wind energy is governed by weather and is therefore characterized by fluctuations. These fluctuations have to be compensated by regulation of other energy sources and by trade. The respective costs and takes as well as the grid security depend strongly on accurate estimation and forecast of solar and wind energy. As a consequence energy meteorology has become a quite important task for weather services nowadays.
Accurate estimation and forecast of solar energy is essential for an efficient and reliable energy supply, especially as the share of solar energy has significantly increased within the last years. This in turn requires the estimation and forecast of solar surface irradiance as the first step.
In this presentation SPECMAGIC_NOW a method for the estimation and short term forecast of solar surface irradiance will be presented and discussed SPECMAGIC_NOW is a combination of a RTM based hybrid-LUT eigenvector approach for the calculation of the solar surface irradiance and the Heliosat method. The latter is applied for the retrieval of the needed cloud information, the effective cloud albedo. For this step the VIS006 channel of SEVIRI onboard of MSG is used. Information about aerosols and water vapor is taken from ECMWF data sets. SPECMAGIC_NOW is partly based on SPECMAGIC which is applied by CM-SAF for the generation of climate data records. These data records are well established and applied besides others within PVGIS, a widely used web app for the planning of PhotoVoltaic (PV) systems around the world.
The short term forecast, up to 6 hours, will be performed by atmospheric motion vectors derived from the sequence of effective cloud albedo images in combination with NWP data, enabling a seamless prediction based on a method of Lorenz et al.
Within the presentation special focus will be given on the novel aspects of the method and its validation. Further, its use within the energy market will be briefly discussed.

P3. REAL-TIME SATELLITE DATA PROCESSING AT DWD USING PYTROLL

Katja Hungershoefer, Jörg Asmus, Christian Kliche, Thomas Leppelt, Richard Müller, Dirk Heizenreder

Deutscher Wetterdienst

The real-time satellite data processing at the Deutscher Wetterdienst (DWD) has taken a turn during the last year. The core of the new system is PyTroll, a modern, Python-based, open-source software. This change does not only herald a new era in software architecture but also a much closer cooperation with remote sensing groups from other weather services and research institutes.

We illustrate the current status of the real-time satellite processing system at DWD. Our plans about the successive replacement of the former software, MTG readiness as well as a possible interface to the POLARA framework complete the presentation.

P4. MULTI-SENSOR CONVECTION DETECTION FOR AUTOMATIC METAR REPORTS USING RADAR, SATELLITE AND LIGHTNING DATA

Thomas Schubert

Deutscher Wetterdienst

The German national weather service (DWD) operates manned weather stations at all 17 international airports. The half hourly flight weather observations (METAR) done by human observers are subject for full automation. The "AutoMETAR" project started in 2014 at DWD.
METARs provide information about the weather conditions at and in the vicinity of airports, e. g. wind, visibility, present weather, cloud cover and height, temperature and pressure. As showers and thunderstorms can be a security risk to civil and general aviation, it is necessary to encode convective clouds and present weather into the METAR. In order to detect towering cumulus (TCU), cumulonimbus (CB), showers (SH) and thunderstorms (TS) automatically, the sub-project "autoKON" (automatic convection detection) was launched. Its aim is to use radar, satellite and lightning data. Remote sensing data have the advantage of an areal detection in contrast to local in-situ measurements. Multiple data types are used to receive the highest benefit, robust products and to avoid product outages.
The work will outline the developed autoKON concept, shows future plans and first results. Radar, satellite and lightning data are first analyzed separately. Therefore the convective cloud mask by Berendes et al. (2008) was tested, a 2D fixed threshold radar cell detection is implemented and a lightning clustering algorithm used. A first version of the data fusion extracts information about thunderstorms in the vicinity of airports. Upcoming is the use of 3D radar data and a convective/stratiform separation for radar reflectivity, cloud detection for TCU and CB based on satellite information and finally the combination of all the analyzed data in a data fusion to determine the convective present weather and clouds.

P5. RADAR BASED ANALYSIS OF CONVECTIVE STORMS USING MESOCYCLONE DETECTION AND COMPOSITE TRACK PRODUCTS

Thomas Hengstebeck, Dirk Heizenreder

Deutscher Wetterdienst

The radar network of the Deutscher Wetterdienst (DWD) provides dual-polarimetric 3D-Doppler-data of 1°x1km resolution in 10 elevations within a 5 min update cycle, supporting the identification and tracking of dynamic small-scale weather phenomena.
The quality assurance of the 3D-Doppler-data includes a polarimetric clutter filter for both reflectivity and radial velocity sweep data. A dual PRF unfolding error correction is additionally applied to the radial velocity data giving a sound basis for shear calculations in downstream algorithms.
Within the mesocyclone detection algorithm, rotation signatures (features) found in the azimuthal shear matrices derived from the radial velocity sweeps of all radar sites are evaluated. Groups of

vertically correlated features are merged into mesocyclone objects, which are ranked according to a severity metric taking into account rotational strength and shape.
Further means for analyzing potentially severe cells are offered by the rotation- and VIL-/VII-composite products together with their tracks.
The rotation product is created by averaging the azimuthal shear as obtained from the radar volume scans in the vertical, so that random noise is suppressed while rotation is amplified in case of well developed "rotating columns". Grid-based VIL (vertically integrated liquid water) and VII (vertically integrated ice) products are generated by vertical integration of the 3D-reflectivity data. In case of the VII product, the vertical integration starts at the -10°C-level as estimated from COSMO-DE model data. Both VIL-/VII- and rotation algorithms operate on the radar sweep data of all DWD radar sites and directly produce composite products. So called track products are finally obtained by accumulating the VIL-/VII- and rotation composites over a time interval of typically 3h to yield VIL-/VII-track and rotation track composites, respectively.
All mentioned products are made visible to the forecaster at DWD by means of the NinJo meteorological workstation system. Meteorologists can judge the significance of mesocyclone detections using the severity scale as guidance and applying persistency and consistency checks (track of mesocyclone detections, additional occurrence of typical weather features e.g. hook echoes). Furthermore, cells with high severe weather potential in from of persistent vorticity (rotation) and hail or heavy precipitation (VIL/VII) show up as line structures in the respective track products.
The mesocyclone detection and rotation track as well as VIL-/VII track algorithms will be introduced and the performance will be demonstrated by means of selected weather cases.

P6. NOWCASTING OF THUNDERSTORMS WITH HIGH-QUALITY 3D LIGHTNING DATA

Matthias Möhrlein, Silvia Riso, Jakob Kohl, Hans-Dieter Betz

nowcast GmbH

Nowcasting of thunderstorms has a long history and significant advancements have been frequently communicated, which improve both recognition of severe weather in near real-time and numerical forecasting. Nevertheless, research continues, especially for improvement of reliable warning and alarm. In the present contribution a new approach is described that exploits stroke parameters from the European lightning detection network LINET in order to identify, analyse, and track thunderstorm cells continuously and in specific details than have not been available before.
Since 2006 LINET is in Europe-wide operation and provides VLF/LF lightning data in real time and with unique properties. The three most important features are high detection efficiency yielding the reporting of weak strokes with currents down to about 2 kA, statistical location accuracy of some 100 m, and 3D-discrimination of cloud strokes with determination of emission altitudes.
We present a powerful method for recognition and nowcasting of severe thunderstorms, characterized by the following features:
continuous and event-driven analysis: occurrence of strokes is monitored and storm cells are newly identified or updated when either a pre-determined number of strokes have occurred, or a pre-determined small time interval has elapsed.
more than some 10 different cell parameters are recalculated whenever a cell has been updated. Most influential parameters are number and density of strokes in time and space, absolute and relative fraction of cloud strokes, including their evolution of emission altitudes, and propagation in terms of direction and speed.

Besides consideration of the entire storm cells a particular algorithm is used that determines the core of the cells ('sub-cells'), which represent the origin of most severe dangers such as strong updrafts, wind shear, heavy precipitation, and hail.
Severity levels can be assigned to sub-cells and other areas of the tracked and nowcasted thunderstorm cells.
As a consequence, there is nearly no delay in recognizing the actual thunderstorm situation. There is virtually no influence of sampling or analysis intervals, and both tracking and nowcasting are as fast as possible when only observed lightning data is used. Even splitting and merging of cells can be taken into account at an early time. Evidently, warning and alarm becomes more reliable, and storm severity with related dangers can be reported in higher spatial and temporal resolution.
Examples will be shown, including nowcasting of hail and observational verification. The usefulness of sub-cells is demonstrated, and reliability of warning and alarm is analysed as derived solely from lightning observations.

P7. High-Resolution Numerical Modeling of a distinct weather event, Cold Surges over the Northern South China Sea

Anupam Kumar, Edmond Lo and Adam Switzer

Nanyang Technological University, Singapore

Cold surges are recognized as distinct extreme weather event that occur during East Asian Winter Monsoon. They are associated with the widespread outbreaks of cold continental air from Siberia and are characterized by strong northeasterly winds, sharp temperature drops and increased surface pressure. These surges cause strong convective activity over South China Sea AND often cause heavy rainfall, floods in the coastal regions. Since these events are associated with acute drop in temperature, they impose immediate adverse effect on human health and also cause sudden death. The present study reviews the modeling performance of the three cold surge events during the year 2008, 2009 and 2016 that was reported in Hong Kong. Among these, one of the most devastating Cold surge event that occurred in southeast China was in the year 2008. This resulted in 4 billion US dollar economic losses, damage of 11867 kilo hectares of Agricultural crops and imposed adverse effect on human life and killed as many as 129 people. In 2016, under the influence of such Cold Surge event, the Hong Kong Observatory recorded a minimum temperature of 3.1 degrees on January 24, 2016. This is considered to be the coldest weather in the past 59 years of the record and the coldest day since 1957. Thus such an extreme event is a big challenge to model for the purpose of weather forecasting. The study aims to model these events in a finer detail using the high resolution Reanalyzed data, Satellite based remote sensed wind data and a very high resolution Numerical Modelling approach i.e. combining fine resolution Reanalysis Data from ECMWF, high resolution Advanced Scatterometer Data Products (ASCAT) comprising wind data and very high resolution Weather Research & Forecast (WRF) model. These results provide guidance for forecasting the strength of cold surges in the short range time scale over HK and in the nearby coastal regions of the SCS.

P8. DEVELOPMENT OF A NEW SEAMLESS PREDICTION SYSTEM FOR VERY SHORT RANGE CONVECTIVE-SCALE FORECASTING AT DWD

Ulrich Blahak, Roland Potthast, Kathrin Wapler, Axel Seifert, Alberto De Lozar, Elisabeth Bauernschubert

Deutscher Wetterdienst

At DWD a new internal project has been set up to develop its future seamless ensemble prediction system for convective-scale forecasting from observation time up to +6 h / +12 h forecasts. The focus is on severe summertime convective events with their associated hazards (heavy precipitation, hail, wind gusts, etc.).
Up to now, for the first 1-2 h this relies mostly on observation-bsaed nowcasting products, whereas convection-allowing ensemble NWP (COSMO-DE-EPS) is only able to reach/outperform the quality of nowcasting at later times. New NWP forecasts are started only every 3 h and after some technical time delay.
Moreover, nowcasting and ensemble NWP are treated as two separate and independent methods, and there are few common products available for the forecasters.
The goal of the new project is to narrow down these gaps, on the one hand by enhancements to both nowcasting and NWP separately and on the other hand by mutual information exchange and combination, to further enhance the quality of both. High-resolution observational data (radar, satellite, GPS-derived moisture, etc.) will be exploited. We consider in particular:

- Nowcasting ensembles, ensembles of "objects", also informed by uncertainties from NWP
- Life cycle in nowcasting, informed by radar, lightning and satellite data and by informations from NWP
- Rapid Update Cycle (RUC) ensemble NWP (km-scale, LETKF, hourly update, ~40 members, 2-moment microphysics including hail)
- Assimilation of radar- and satellite data in ensemble NWP (native observations as well as nowcast "objects")
- New products combining nowcasting and NWP for our forecasters.

This project has been started very recently and the poster will give an overview on the plans.
Further, results of preliminary case studies are shown to motivate the project.

P9. PROJECT WEXICOM - WEATHER WARNINGS: FROM EXTREME EVENT INFORMATION TO COMMUNICATION AND ACTION

Thomas Kox, Tobias Pardowitz, Nadine Fleischhut, Martin Göber

Freie Universität Berlin

In an inter- and transdisciplinary approach involving meteorology, social sciences, and psychology, the project WEXICOM of the Hans-Ertel-Centre for Weather Forecasting (HErZ) investigates the optimal use of weather forecasts -with a focus on severe weather and warnings - to the benefit of the society. The ultimate goal is to facilitate transparent and effective communication of risk and uncertainties to specific user groups in order to foster recipients' ability to make decisions that reduce the risk of loss and damage.
A key element of the approach is the statistical modelling of the impacts of severe weather, thus providing a link between probabilistic weather information and risk-based warnings. As an example, an analysis of the relation between local thunderstorm conditions and the occurrence of local fire

brigade operations in Berlin has been conducted. Local radar reflectivity as a predictor for the cell intensity was linked to the occurrence of fire brigade operations. A strong dependence of operation occurrences, particularly for those tagged with the keyword water damage, at locations affected by a thunderstorm cell was found. Within a 1x1km area and in a time interval of 6 hours after a thunderstorm event, the likelihood of a water damage to occur after a convective event has been detected, was 8 times as a high as when the area has not been affected. No significant difference was found with regard to the intensity within a convective cell's footprint, as indicated by radar reflectivity classes 46dBZ and 55dBZ. A systematic analysis of non-meteorological predictors from OpenStreetMap, land cover datasets and digital elevation models has been conducted to identify suitable socio-economic predictors for the occurrence of different fire brigade operations (e.g. tree or water related). It was found that for most types of operations, building coverage (total area covered by houses per square kilometer) exhibits the highest spatial correlation to long-term operation densities.

In another approach, to test the preferences in the presentation format of uncertainty information by emergency managers, various forms of probabilistic warning information were included into FeWIS, a dedicated platform for professional fire fighters and emergency managers in Germany. The new information consists of one and 3-hourly forecasts 48 hours ahead of: the probability of wind gusts and precipitation exceeding warning thresholds and the probability of lightning as well as quantile forecasts of the variables above. These data are displayed as maps and time series. All the data are derived from a MOS (model output statistics) system including radar and synoptic observations as well as numerical model forecasts. By analyzing web usage and search behavior, we investigated which representations users rely upon under real operational constraints.