ABSTRACTS

Joint SRNWP-EPS and Post-processing workshop 2020

Workshop on "Practical Operational implementation of Statistical Post-Processing for ensemble forecasts"

27-30 October 2020, BlueJeans video-conference meeting

Session 2: EPS applications

Probabilistic storm forecasts for wind farms in the North Sea

Geert Smet, Joris Van den Bergh and Piet Termonia (RMI, Belgium)

In the last few years there has been a significant increase in Belgian offshore wind energy production, with a 2.262 GW total installed capacity being expected by the end of 2020. Storm events over the North Sea can impact many of these wind farms at roughly the same time, because they are situated relatively close together in a narrow band in the North Sea. Each wind turbine has a characteristic cut-out (wind) speed, above which they will decrease production rapidly or shut down as a protection measure. In case of a major storm, many wind turbines could shut down at the same time, creating a so called cut-out event for the wind farm(s). When such cut-out events occur at multiple wind farms at the same time, this can lead to large imbalance risks in the electricity grid. To better understand and predict such events, the Royal Meteorological Institute of Belgium (RMI) is involved in the development of a dedicated storm forecast tool for Elia, the Belgian transmission system operator for high-voltage electricity.

The aim is to forecast large storm events, several days up to seven days ahead, and associated cut-out events, a day ahead and up to two days, making use of weather models that generate wind speed forecasts at turbine height and location. Because there can be substantial uncertainty in the precise location, timing and intensity of a forecasted storm, and cut-out events are moreover very sensitive to whether or not a high wind speed threshold is exceeded or not, a probabilistic forecast approach was taken. Moreover, Elia also required high temporal resolution forecasts (output every 15 minutes), so that a combination of a high resolution deterministic model and lower resolution ensemble weather prediction model was used. This allows both detailed forecasts and a good estimation of the uncertainty in the forecasts, thereby helping end users in their decision making process.

The storm forecast tool developed at the RMI makes use of the deterministic ALARO model (4 km resolution) combined with the ENS ensemble forecasts (18 km resolution) of the European Centre for Medium Range Weather Forecasting (ECMWF). Since November 2018, the storm forecast tool is running operationally at the RMI, starting with a 1-year test phase for Elia. We will give an overview of the current status of the storm forecast tool, together with its performance over the past years, and conclude with some planned future developments, including some preliminary results on ensemble calibration with historical wind speed measurements, using the member-by-member approach.

Post-processing, interpretation, and verification of short-term, probabilistic thunderstorm guidance from the Warn-on-Forecast System (invited)

Patrick Skinner (NOAA/NSSL Affiliate / USA)

NOAA's National Severe Storms Laboratory has run a convection allowing ensemble prediction system to provide short-term (0-6 h), probabilistic guidance for convective storm hazards such as tornadoes, large hail, and flash flooding each spring since 2016. This system, known as the Warn-on-Forecast System (WoFS) differs from typical "next day" convection allowing ensembles in that it is designed to provide guidance on space and time scales of individual thunderstorms rather than for regional threats. To accomplish this, WoFS utilizes rapidly cycling data assimilation of radar and satellite observations to initialize individual convective elements, then issues short-term, 18-member forecasts twice per hour with guidance available every 5 minutes during the forecast period.

The short duration, high temporal resolution, and ensemble nature of WoFS forecasts present challenges for post-processing, visualization, and verification of the guidance. Specifically, probabilistic guidance products need to be generated with minimal latency to preserve as much usable forecast period as possible; products must convey information that can be rapidly interrogated by forecasters working in a cognitively demanding environment; and forecast quality must be evaluated using verification metrics that preserve storm-scale information. This presentation will detail current methods for mitigating these post-processing, visualization, and verification challenges. The current workflow for post-processing real-time WoFS output will be presented alongside several examples where differing post-processing techniques provide potentially contrasting information in guidance products. Additionally, object-based verification strategies for WoFS will be described using results from 2016–2019. Finally, preliminary results from object-based, machine learning models for predicting specific severe weather hazards will be presented.

Session 3: EPS

Evaluation of MOGREPS-UK – a 'back-to-basics' approach

Anne McCabe, Nigel Roberts, David Flack, Aurore Porson, Stu Webster, Mike Bush, Steve Willington, David Walters (MetOffice, UK)

In recent years we have made a number of improvements to the UK Met Office convective-scale ensemble, MOGREPS-UK. Although the benefit of each update can be seen in the objective verification scores, the impact on the ensemble spread is moderate and MOGREPS-UK remains under-spread over all – both in terms of the standard spread-error relationship, and in the experience of operational meteorologists. With the aim of identifying the cause of this lack of spread, we take a 'back-to-basics' approach and consider in isolation the impact of ensemble perturbations to the initial conditions, boundary conditions and model physics. Using a research version of MOGREPS-UK, we present the results from two month-long trials and evaluate the contribution from each different type of uncertainty at a range of spatial scales and lead times. We focus in particular on the perturbation growth from our stochastic physics scheme and consider whether we are increasing variation at appropriate spatial scales. We also consider the difference between 'more spread' and 'useful spread' and offer up for discussion the question, 'what characteristics do we want our ensemble to have?', and importantly, 'are we measuring them?'.

Accounting for representativeness in the verification of ensemble forecasts (invited)

Zied Ben Bouallegue (ECMWF)

If observation errors are not accounted for during the ensemble verification process, then the investigator may draw inappropriate conclusions about the quality of the prediction system.

In order to account for observation uncertainty in the ensemble verification process, observation errors have first to be characterized. Representativeness errors are assumed to be the dominant contribution to observation errors associated with station measurements in our application.

So the question is to what extent measurements at a single location is representative of averages over a larger area. Characterization of representativeness error is made in probabilistic terms using a parametric approach, that is by fitting a probability distribution. The shape of the distribution depends on the weather variable of interest while its parameters are estimated with the help of a

high-density network of stations. Based on this analysis, uncertainty associated with the scale mismatch between forecast and observation can be accounted for in the verification process by applying a so-called perturbed ensemble approach. Verification results show a large impact of representativeness on forecast reliability and skill estimates. In addition, the perturbed ensemble approach provides the basis for a model-independent post-processing implementation at minimal running and maintenance costs.

Overview of Operational Verification of Convection Forecasts (invited)

Beth Ebert (Bureau Of Meteorology, Melbourne, Australia)

Forecasting convection is one of the most important uses of operational numerical weather prediction. High resolution ensemble NWP is run at many centres to support high impact weather forecasting, while observations-based nowcasts continue to play an important role at very short ranges. Understanding their accuracy is critical to using these forecasts most effectively to enhance public safety and make further improvements to the forecasts.

Operational centres around the globe use a variety of approaches to verify their forecasts of convection, ranging from simple categorical metrics that are easy for users to understand, to spatial verification approaches that quantify errors in forecast location and intensity of storms, to assessing the extremeness of the probability distribution for convective wind and rainfall. New approaches for evaluating the predicted impacts of convection (e.g. damage and disruption) are starting to emerge. Getting adequate observations of the highly variable and rapidly changing weather elements is a challenge for verifying convection forecasts.

This talk will provide a brief overview of approaches used by operational centres around the world to verify their forecasts for convection.

Physically-based model error representation applied to turbulence and shallow convection parameterizations (poster)

Axelle Fleury, François Bouttier (CNRM - Centre National de Recherches Météorologiques, Toulouse, France)

Stochastic perturbation methods are widely used to represent the contribution of model-errors to the uncertainty of a meteorological forecast. While a number of these methods are empirical, some approaches try to take into account information from the physical parameterizations in order to design "physically-based" stochastic perturbation schemes. In this presentation I will show the results for two approaches that have been tested on the turbulence and shallow convection scheme, on a 1D version of the mesoscale NWP model Arome.

Potentialities of stochastic ensemble generation strategies for heavy precipitation forecasting over the western Mediterranean

Alejandro Hermoso Vergel, Víctor Homar Santaner (Balearic Islands University, Spain)

The design of convection-permitting ensemble prediction systems able to produce accurate forecasts of high-impact events is an extremely challenging effort. The common underdispersion found at these scales motivate the research of methodologies that adequately sample all relevant uncertainties emerging from the determination of the initial atmospheric state and its time-integration through numerical models. This study investigates the potential of multiple techniques to account for model uncertainty. The performance of multiple stochastic schemes is analyzed for a singular heavy precipitation event occurred in eastern Spain. In particular, the stochastic methods are compared to the multiphysics in terms of both diversity and skill. The considered techniques include stochastic parameterization perturbation tendencies of state variables, perturbations to influential parameters within the microphysics scheme (cloud condensation nuclei, fall speed factors, saturation percentage for cloud formation) and stochastic modifications to the sea surface temperature. The introduction of stochastic perturbations to the microphysics parameters results in greater ensemble spread throughout the entire simulation. A conclusion of special importance for the western Mediterranean, where deep moist convection and local orography play a crucial role is that stochastic methods significantly outperform the multiphysics-based ensemble, suggesting the potential positive effect of stochastic parameterizations for the forecast of extreme events in the region.

Session 4: SRNWP-EPS Convection-permitting LAM-EPS database

Using machine learning to advance probabilistic convective hazard prediction with convection-permitting models (invited)

Ryan Sobash (NCAR/UCAR Mesoscale & Microscale Meteorology Lab, USA)

Direct prediction of convective hazards using atmospheric models is difficult due to their small spatial scale; even convection-permitting (CP) numerical weather prediction forecasts do not directly resolve hazards. Further, CP models often err in the placement, initiation, and intensity of convective storms, requiring uncertainty estimates for hazard occurrence. To date, methods to extract probabilistic hazard guidance from CP models have relied on surrogate diagnostics (e.g., updraft helicity [UH]), with uncertainty information coming from spatial smoothing or estimated based on CP ensembles, which are often under-dispersive.

Machine learning (ML) techniques offer a framework to produce improved predictions of convective hazard occurrence and uncertainty. Ideally, ML techniques will learn the flow-dependent and regime-dependent characteristics associated with convective hazard predictability, potentially improving the uncertainty estimates from existing methods. Here, we provide a summary of ongoing work to understand the capability of ML systems to produce reliable probabilistic predictions of convective hazards, as well as interpret the internal relationships learned by the models. To initially demonstrate these capabilities, a feedforward neural network (NN) was used to produce gridded probabilistic convective hazard predictions over the CONUS. Input fields to the NN included 42 base predictors from ~500 deterministic, 3-km, CP model forecasts of severe weather events occurring between 2010-2017, with observed storm reports used for training and validation. Forecasts were produced each forecast hour on an 80-km grid, with forecasts valid for the occurrence of any severe weather report within 40 or 120 km, and 2 h, of each 80-km grid box.

NN probability forecasts (NNPFs) were compared to a non-ML surrogate-severe probability forecasts (SSPFs), generated with UH, to place forecast skill in context of existing hazard prediction guidance. The NNPFs were superior to SSPFs across all forecast hours and most regions of the CONUS, producing statistically significant improvements in forecast reliability and resolution. NNPFs were most skillful relative to SSPFs in situations when using UH alone was detrimental to forecast skill, such as during model spin-up, nocturnal periods, and regions and environments where supercells were less common, such as the western and eastern United States and high-shear, low-CAPE regimes. NNPFs were often able to discriminate between hazard types, especially intense wind and large hail events, while the SSPFs could not. Using a random forest, instead of a NN, produced similar gains in forecast skill, suggesting that the predictions are likely not overly sensitive to algorithm choice. In subjective evaluations conducted in Spring 2020, the NNPFs were favored over the SSPFs, supporting the objective metrics. Due to the initial successes with the NNs at predicting hazards, ongoing and future work involves probing the internals of the NNs for new insights into the performance of CP models when predicting convective hazards and applying the methods to other CP model datasets. Some of these preliminary efforts will be discussed.

SRNWP-EPS ensemble intercomparison in the Arome-France-EPS overlap zone: first results (poster)

François Bouttier (CNRM - Centre National de Recherches Météorologiques, Toulouse, France)

The SRNWP-EPS archive is an opportunity to compare neighbouring convection-resolving ensemble prediction systems in their overlap zones. We show a short statistical intercomparison in terms of ensemble scores and diagnostics, and an attempt to interpret them in terms of strength and weaknesses of the involved ensembles.

Progress on the potential of accessing other ensemble data to MOGREPS-UK over the UK: identification of cases, planning and summary of discussions so far

Aurore Porson, David Flack, Andrew Ryan, Steve Willington, Anne McCabe, Caroline Bain, David Walters, Francois Bouttier (Météo-France), Henrik Feddersen (DMI), Alan Hally (Met Éireaan), James Fannon (Met Eireaan)

From the 1st June to the 31st August 2020, the Met Office contributed to the SRNWP-EPS multi-model ensemble project by archiving ensemble data from MOGREPS-UK, our operational convective-scale ensemble, to the allocated SRNWP-EPS project space at ECMWF. For these archives, the ensemble data contain 2 ensemble cycles a day (i.e., 00Z and 12Z). Each of these two cycles contains 6 hourly cycles of 3 members and the post-processing of these 6 hourly cycles leads to a time-lagged 18-member ensemble. The following fields were archived for every hour up to T+66: rainfall and snowfall accumulations (including graupel), relative humidity, specific humidity, dew point temperature, temperature, hourly maximum temperature, hourly minimum temperature, air pressure, sea-level air pressure, total cloud cover, 10-m U wind, 10-m V wind and 10-m hourly maximum wind gust.

Operationally, MOGREPS-UK is often regarded not adding enough value to the deterministic UKV model and often follows the deterministic solution too closely. This is also supported by metrics used to quantify the ensemble spread against the ensemble performance related to observations. One of our main objectives in this collaboration is thus to evaluate the potential of accessing other ensembles with different characteristics, to supplement the use of MOGREPS-UK. In the first phase of this project, we then conducted a mini testbed activity to keep a record of the high impact cases. Our presentation will focus on the activity we led this summer and how we selected the best set of cases. We will describe some of these cases and what we think can be achieved from using other ensemble data.

We will also present the outcomes of the discussions we held with Meteo-France, DMI and Met Eireann and a brief outline of our plans in these collaborations.

Finally, we would like to put forward our views on some of the suggestions related to this project from the EPS sessions at EWGLAM.

Session 5: Postprocessing

Statistical calibration of ensemble forecasts of heat indices (invited)

Sandor Baran (University of Debrecen, Hungary)

According to the US National Weather Service, heat is the number one weather related killer in the country, and heat waves in Europe also regularly cause large number of casualties. Accurate and reliable prediction of heat indices therefore has a substantial importance in decision making, especially in terms of warnings. We investigate the effect of statistical post-processing on the forecast skill of discomfort index (DI) and indoor wet-bulb globe temperature (WBGTid) ensemble forecasts, both calculated from the corresponding forecasts of temperature and dew point temperature. Two different approaches to calibration are compared. In the first case we start with joint post-processing of the initial temperature and dew point forecasts and then create calibrated samples of DI and WBGTid using samples from the obtained bivariate predictive distributions. This approach is compared with direct post-processing of the heat index ensemble forecasts, for which purpose a novel ensemble model output statistics model based on a generalized extreme value distribution is proposed. The predictive performance of both methods is tested on 50-member operational temperature and dew point forecasts of the European Centre for Medium-Range Weather Forecasts and the corresponding forecasts of DI and WBGTid. Comparison is made with the raw ensemble or with a simple calibration increasing the ensemble spread by adding random perturbations in order to account for representativeness error. For short lead times (up to day 6), both investigated approaches to calibration significantly improve the forecast skill. Among the competing post-processing methods, direct calibration of heat indices exhibits the best predictive performance, very closely followed by the more general approach based on joint calibration of temperature and dew point temperature.

Making the most of convection-permitting ensembles in post processing

Nigel Roberts, Ben Ayliffe, Gavin Evans, Katherine Hurst, Stephen Moseley, Fiona Rust, Caroline Sandford (MetOffice, UK)

In recent years, Numerical Weather Prediction (NWP) at National Meteorological Centres has transitioned much more towards the use of kilometre-scale ensembles. This provides both an opportunity and a challenge if we want to make the best use of this information.

The nature of the forecast outputs and associated errors has changed considerably from the older deterministic coarser-resolution models.

Some of the challenges we face in terms of correcting biases, dealing with spatial uncertainty, blending between different models and extracting more relevant information will be discussed in the context of the development of a new probabilistic post processing system (IMPROVER) at the UK Met Office.

Improving probabilistic blending between a high resolution ensemble and a global ensemble using statistical post-processing

Gavin Evans and Fiona Rust (MetOffice, UK)

Different atmospheric ensemble model configurations e.g. high resolution and global models are forced to take different approaches when representing meteorological processes at scales that are largely resolved in one model, but need to be parametrized in another. This leads to differences in model characteristics that may result in noticeable jumps or discontinuities when blending models together in probability space to create a seamless probabilistic forecast. The work in progress investigates using Reliability Calibration (Flowerdew 2014) with a rolling training period to improve the model blend, as a non-parametric technique that can easily be applied to diagnostics with complicated distributions, such as, precipitation rate and cloud amount.

References

Flowerdew, J., 2014: Calibrating ensemble reliability whilst preserving spatial structure. Tellus, Ser. A Dyn. Meteorol. Oceanogr., 66, 1–20, https://doi.org/10.3402/tellusa.v66.22662.

The flash flood use case in the MISTRAL Project: post-processing and blending ECMWF- and COSMO ensemble forecasts

Andrea Montani, Estíbaliz Gascón and Tim Hewson (ECMWF, Reading UK; Bologna, Italy)

Localised heavy rainfall is difficult to predict accurately. This is a significant societal problem because for severe flash floods extreme rainfall is the primary cause. Ideally, weather forecasts should be provided for points and not for the large regions represented by global model grid boxes. This mismatch can be addressed using high resolution limited-area models (perhaps post-processed), or by applying some post-processing to global forecast models, such as in “ecPoint-Rainfall”. ecPoint is a new ECMWF probabilistic post-processing technique that accounts for expected sub-grid variability and expected grid-scale bias in forecasts of surface weather (here rainfall), on the basis of grid-box weather types.

The MISTRAL (Meteo Italian SupercompuTing PoRtAL) project is funded under the Connecting Europe Facility - Telecommunication Sector Programme of the European Union. The main project goal is to facilitate and foster the re-use of datasets by weather-dependent communities, to provide added value services using HPC resources. ECMWF participates in the project with the goal of improving probabilistic rainfall forecast products, to help with the prediction of flash floods in Italy and nearby Mediterranean regions. One of the objectives here is to exploit the CINECA supercomputer facilities in Bologna to extract maximum benefit from ecPoint-Rainfall and a 2.2km resolution COSMO limited-area ensemble.

To the COSMO ensemble we apply a new and innovative scale-selective neighbourhood post-processing technique, with the primary aim being to identify and preserve the most reliable heavy rainfall signals. The technique computes the scales over which ensemble members reach a specified level of agreement, to give a measure of the location-dependent believable scales for an ensemble forecast. The post-processing enables to retain, at the finest scales, rainfall signals when it is in good agreement between all the ensemble members which are reliable at those scales, as for examples the orographically-forced rainfall. At the same time, it can spread out the information from nearby gridboxes when we have discrepancies in time and space between the different ensemble members.

We then blend the post-processed COSMO ensemble output with ecPoint-Rainfall, using lead-time tapered weighting, to exploit the most skilful aspects of the two systems. The final product comprises, for 6-h accumulated rainfall and for each COSMO grid-box, both percentiles (1, 2,..99) and (derived from these) probabilities of exceeding certain thresholds. The post-processing and blending approach aims to improve forecast quality in general terms, and to in particular support decisions regarding weather alerts related to flash flood prediction. Thus, we aim to provide forecasts with enhanced reliability and resolution, for Italy and nearby regions, and at the same time feed these into a gateway for the broader European community. In this presentation we will introduce the various methodologies applied to create the final probabilistic product and will show verification results for each forecast system, with and without applying the corresponding post-processing. We will also demonstrate the utility of the blended product using recent Italian flash flood events.

Seamless calibration based on gridded analyses from nowcasting to medium range - the way to operational forecasts at ZAMG

Markus Dabernig, Aitor Atencia and Alexander Kann (ZAMG, Austria)

The goal of the Seamless project at the Austrian weather service ZAMG is to provide seamless forecasts in space and time from nowcasting to medium range, based on the INCA analyses. The input forecasts are different NWP surface variables together with 3D fields in several pressure levels from deterministic ECMWF (0.1° resolution), ensemble ECMWF (0.2° resolution), and two configurations of the convection-permitting AROME model (2.5 km resolution operational), including a rapid update cycle version (AROME RUC 1.2 km resolution). Additionally, invariant fields such as latitude, longitude and elevations of the different NWP models and INCA are provided to the postprocessing.

Ensemble model output statistics are applied to standardized anomalies (SAMOS) of analysis and forecasts to predict all grid points simultaneously. To prevent overfitting a gradient boosting method is applied to detect the most important variables. Improvements in the nowcasting range are obtained by taking into account time-lagged analyses as persistence including a Lagrangian persistence (optical flow is used to derive the advection field). The introduction of the persistence results in seamless forecasts on a horizontal resolution of 1 km from 1 hour up to 6 days for temperature and precipitation. The scores also show an improvement in comparison with the original forecasts.
The project is currently in a preoperational phase and will become operational for temperature and precipitation by the end of this year.

Statistical post-processing of near-real-time ICON ensemble forecasts (poster)

Benedikt Schulz (KIT, Germany)

In the context of an outreach project, we apply post-processing to produce and disseminate near-real time forecasts of different meteorological variables based on publicly available data from the ICON-EPS of Deutscher Wetterdienst (DWD). Temperature, wind speed, precipitation sum and rate as well as direct and diffuse radiation are post-processed via EMOS, cloud cover via a proportional odds logistic regression. We use different distributions and parameterizations for the different variables with forecast distribution parameters estimated based on local monthly training sets, i.e., the parameters used for post-processing are updated once a month, allowing the post-processing model to be run efficiently in a quasi-operational, near-real-time mode. For lead times up to 72h, post-processing improves the performance. The magnitude of the improvement depends on the variable, and generally is in line with results from the extant literature on post-processing. For wind speed and temperature forecasts, it ranges from 35% (1h) to 10% (7 days). Despite the relatively small amount of available data, the methods work well and are expected to improve as the training sets become longer.

Session 6: Postprocessing

Using artificial neural networks for generating probabilistic subseasonal precipitation forecasts over California (invited)

Michael Scheuerer (NOAA – Physical Sciences Laboratory / USA)

Ensemble weather predictions from global forecast systems require statistical postprocessing in order to remove systematic errors and to obtain reliable probabilistic forecasts. In this seminar we present two new postprocessing approaches based on artificial neural networks.

The first approach uses rather basic neural network to link ensemble precipitation forecasts from a numerical weather prediction system to observed precipitation amounts. The second approach uses ensemble forecasts of large scale predictors like geopotential height at 500 hPa and total column water, and uses a convolutional neural network to link the associated weather patterns to observed precipitation amounts. Both methods are demonstrated with week-2, week-3, and week-4 forecasts of precipitation accumulations over California.

The new Global Ensemble Forecast System version 12 Reforecasts, and Applications to Post-Processing (invited)

Thomas M. Hamill (NOAA Physical Sciences Lab, USA)

Abstract not provided.

The EUMETNET postprocessing benchmark project: news, current status and development plan

Jonathan Demaeyer (RMI, Belgium)

In the framework of the current EUTMETNET PP program, an extensive benchmark of postprocessing methods is planned. We report on the advance of this project, which was recently envisioned as a collaboration with ECMWF and their cloud services. We detail the development plan phases and enumerate the challenges ahead to make it a successful tool.

Session 7: Postprocessing

Postprocessing at MeteoSwiss (double)

Lionel Moret, Christoph Spirig, Jonas Bhend, Regula Keller, Stephan Hemri, Jan Rajczak, Daniele Nerini, Yinghao Dai, Mark Liniger (Federal Office of Meteorology and Climatology MeteoSwiss, Switzerland)

MeteoSwiss is currently upgrading its postprocessing capabilities to provide calibrated probabilistic forecasts for any location in Switzerland. The new system to produce local forecasts is fully automated which allows for more frequent updates with the latest NWP information and it integrates the available information to produce a multi-model consensus forecast. This postprocessed consensus forecast will be communicated to the general public via the internet and the very popular application for mobile devices and will form the basis for additional user-tailored products. In this presentation, we will outline the general approach taken to produce calibrated probabilistic multi-model forecasts also at unobserved locations. We will discuss strengths and limitations of the approach currently being implemented and sketch options for further improvements.

Post-processing activities at IPMA (poster)

João Rio (IPMA, Portugal)

Ensemble Prediction Systems give a set of possible weather forecasts, hence allowing to quantity the forecast uncertainty, provided they adequately sample errors in the initial conditions and in the model itself. Therefore, EPS forecasts are probabilistic in nature, which differs from the tradition deterministic view, which ultimately leads to the problem of how to extract useful information from them. In operational weather centers the task of merging the deterministic forecast with probabilistic products is far from straightforward. This task is even more complex when one considers that a given forecast/product must be given in a clear and effective way to multiple end-users, with clearly different backgrounds.

The approach that has been taken at IPMA and the developments coming in the short-term to address the issues mentioned above are given for two completely different applications.

The first one is concerned with the 10 days' city forecasts, which are publicly available. This application uses data from ECMWF (both HRES and ENS) and the operational run of AROME at IPMA. Statistical post-processing (MOS and Kalman filter) is applied to model data to improve near-surface variables.

Forest fires are a major problem in Portugal due to a combination of several causes. Even though the percentage of forest fires with natural origin is small, awareness to this issue has been growing in the last few years. The second application that is discussed is a specific post-processing, which was requested by the Portuguese civil protection in 2018, that provides guidance on the probability of dry thunderstorms. This application uses exclusively data from ECMWF-ENS.

Neural networks in Bernstein quantile function models for ensemble post-processing

John Bjørnar Bremnes (Norwegian Meteorological Institute, Norway)

Probabilistic forecasting based on Bernstein quantile functions and neural networks allows high degree of flexibility both in the shape of the predictive distribution and the way ensemble output is linked to the distribution (Bremnes (2020)). The presentation will primarily focus on how ensemble(s) of multiple variables can be used as input in this framework as well as other details in designing the network functions.

A First Try of Neural Networks with the Method of Bernstein Polynomials for the Calibration of Temperature in 5 Airports of Spain (poster)

David Quintero Plaza (AEMET, Spain)

The recent work of John B. Bremnes, using the properties of Bernstein polynomials alongside neural networks to calibrate an ensemble, has attracted the attention of the Predictability Group in charge of AEMET's gSREPS multimodel. Bremnes's approach is a flexible way to calibrate different points of an ensemble, all of them at once, for an specific variable at an specific timestep. Bremnes's technique, originally developed for ECMWF ensemble for Norway and the windspeed, obtained very good results and made the probability of quantile crossing very low. In our work, we calibrated the temperature at 2 metres from gSREPS multimodel for 5 airports of Spain. These airports represent very different orographic and climatic conditions. We obtained an improvement with respect to the raw output from gSREPS, while it was not as spectacular as Bremnes's original results with the windspeed for the ECMWF. We think that the reasons for this less spectacular improvement are that the spread from gSREPS is greater than from ECMWF and that the temperature is one of the best forecasted variables in a NWP. In the future, we expect to extend the work to other variables, such as the windpseed, and perhaps to include more points.

The RMI station postprocessing app: methodology, first results and future developments

Jonathan Demaeyer (RMI, Belgium)

The Royal Meteorological Institute of Belgium has started its new postprocessing program by developing an application to perform the calibration of the ECMWF ensemble forecast at the stations points. In this talk, we will describe the "research to application" methodology that we have followed, and present the result of its operation over the first four months. Future developments of this application and of the program will finally be evoked.