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ABSTRACTS OF POSTERS

3. Rainfall and runoff ensembles produced based on the quality index of radar precipitation data

J.Szturc (1), T.Einfalt(2), K.Osrodka (1), A.Jurczyk (1)
(1): Institute of Meteorology and Water Management, Ground-based Remote Sensing Department, Warszawa, Poland
(2) Hydro & Meteo GmbH & Co. KG, Lübeck, Germany
jan.szturc@imgw.pl

The aim is to present results of rainfall ensemble generation from radar-based data and using them to produce runoff ensembles. The rainfall ensembles are generated based on information about radar data uncertainty, which is introduced as quality index fields. The used scheme of the quality index is based on selected quality parameters, that are connected with basic sources of radar errors and the radar data properties, among others. The quality information is attached to each radar data field and are employed to get the data error fields. Cholesky decomposition of the error covariance matrix is used to generate different perturbation fields that are introduced into the radar data. In this way various equiprobable rainfall scenarios as ensembles are generated on data from Polish weather radar network POLRAD and from the German Weather Service Essen radar. The runoff ensembles were obtained from the precipitation scenarios employing a rainfall-runoff model, that is a physicall y-based, spatially distributed NASIM model. The investigations are carried out on two small catchments where flash floods constitute significant source of flood hazard: the mountainous upper Wisla river catchment and a semi-urban creek catchment in the Wupperverband area.

11. Impact of the use of two different hydrological models on scores of hydrological ensemble forecasts

A. Randrianasolo (1), M.H. Ramos (1), G. Thirel (2), V. Andréassian (1), E. Martin (2)
(1) Cemagref, Hydrology Research Group, Antony, France,
(2) CNRM-GAME, Météo-France, CNRS, GMME/MOSAYC, Toulouse, France

At operational flood forecasting centres, forecasters usually have to deal with forecasts issued by different models and combine them to support their decisions and communicate flood alerts to end-users. In this study a comparative analysis is conducted to assess the quality of streamflow forecasts issued by two different modelling conceptualizations of catchment response, both driven by the same weather ensemble prediction system. Weather forecasts come from the ensemble prediction system PEARP of Météo-France, which is based on the global spectral ARPEGE model zoomed over France. The model runs 11 perturbed members for a forecast range of 60 hours. The two hydrological modelling approaches used are: 1) the coupled physically-based hydro-meteorological model SAFRAN-ISBA-MODCOU developed at Météo-France and based on a fully distributed catchment model, and 2) the GRPE forecasting system developed at Cemagref and based on a lumped soil-moisture-accounting type rainfall-runoff model. The study is conducted on a set of about 250 gauging stations representative of a wide range of upstream catchment areas and hydro-meteorological conditions in France. The discharges simulated by both systems are compared over an 18-month period (March 2005-September 2006). Skill scores are computed for the first two days of forecast range and the performance of both hydrologic ensemble forecasting systems is assessed.

13. High resolution ensemble forecast of flash-flood

B. Vincendon,V. Ducrocq, O. Nuissier, G-M. Saulnier
beatrice.vincendon@meteo.fr

Several uncertainties damage the forecasts of Mediterranean intense weather events and propagates on hydrological response of the small rivers which are often affected by devastating flash-floods. Indeed, the nature and temporal and spatial scales of precipitating systems leading to flash flood, make difficult its forecast even for high-resolution convection-resolved numerical weather prediction systems.

Those meteorological uncertainties forecasting strongly influence hydrological modelling. During the last autumn, the ISBA-TOPMODEL hydrometeorological system, developed within the framework of the GMES/PREVIEW project, was used driven by meteorological forecasts from AROME. Hourly discharges at several outlets of the Cévennes-Vivarais (Massif Central) region were predicted every day. This hydrometeorological chain gives us the opportunity to evaluate the uncertainties of the high-resolution rainfall forecast and investigate their propagation in the hydrological model.

The uncertainty of the rainfall from the deterministic AROME forecast was first evaluated by comparison to observed rainfall (radar and raingauges). Then so as to take into account the uncertainties of the rainfall forecast and produce ensemble discharge forecast, we use the high-resolution ensemble AROME forecast rainfall fields as input to ISBA-TOPMODEL. Another method is investigated. Assuming conservation of some statistical or physical properties of the rainfall forecast some perturbations will be introduced in the AROME rainfall fields. In this way, we hope to take into account location errors, bias in the rainfall intensity distribution and bias in the areal rainfall at the hydrological scales. The two methods will be first carried out on the 21 and 22 October 2008 flash-flood events over the Cévennes-Vivarais region. The hydrological responses obtained with those two methods will be compared.

This study aims at preparing an ensemble flash flood forecast system that will be run during the observing periods of the HYMEX field experiment (http://www.cnrm.meteo.fr/hymex/).

19. Hydrological Ensemble Prediction System for the River Scheldt and the Meuse Basins.

Joris Van den Bergh and Emmanuel Roulin (Royal Meteorological Institute)
joris.vandenbergh@oma.be

A system based on the use of the SCHEME semi-distributed hydrological model and the ECMWF ensemble prediction system has been running pre-operationally since 2005 over two test catchments in Belgium: the Demer in the River Scheldt Basin and the Ourthe in the River Meuse Basin. The system delivers daily probabilistic streamflow forecasts for the next ten-day period. The procedure is now extended to the entire Scheldt and Meuse basins in Belgium and upstream in France.

Hindcasts from 2006 to 2008 have been performed, and a set of verification methods has been applied on the results, in order to evaluate the skill of the system for sub-basins with various sizes. The operational setup and future developments are outlined.

24. Generation and Verification of Ensemble Precipitation Forecast from Single-Value QPF at the Catchment Scale

Limin Wu[1,3], Dong-Jun Seo[1,2], Julie Demargne[1,2], James Brown[1,2]

limin.wu@noaa.gov

[1]National Oceanic and Atmospheric Administration, National Weather Service, Office of Hydrologic Development, 1325 East-West Highway, Silver Spring, Maryland 20910, USA
[2]University Corporation for Atmospheric Research, P.O. Box 3000, Boulder, Colorado 80307, USA
[3]Wyle Information Systems, 1651 Old Meadow Road, McLean, Virginia 22102, USA

It is widely recognized that, in some mean sense, the single-valued quantitative precipitation forecast (QPF), with value added by human forecasters at the NWS/NCEP/Hydrometeorological Prediction Center (HPC) and at the NWS/River Forecast Centers (RFC), is more accurate than the raw NWP single-valued QPF. It is also widely recognized that the current NWP ensemble forecasts tend to be under-spread and may not contain significant skill in the higher-order moments beyond the ensemble mean. For these reasons, the NWS Hydrology Program has been pursuing statistical techniques that can produce reliable precipitation ensemble forecasts from HPC/RFC's single-valued QPFs. In this presentation, we describe the improvements made since the initial development of the technique (Schaake et al. 2007). The improvements include explicit accounting of precipitation intermittency via the mixed-type bivariate meta-Gaussian model (Herr and Krzysztofowicz 2005), nonparametric modeling of marginal probability distributions, and parameter optimization under the Continuous Ranked Probability Score (CRPS), and other criteria. We present both dependent and independent validation results for selected river basins in the southern plains, California, and middle Atlantic regions, and comparative verification results with the operational GEFS precipitation ensemble forecasts.

25. Streamflow ensemble forecast driven by COSMO-LEPS for small-size catchments in northern Italy

T.Diomede(1,2), C.Marsigli(1), A.Montani(1), T.Paccagnella(1)
tdiomede@arpa.emr.it
(1) ARPA-SIMC, HydroMeteorological and Climate Service of the Emilia-Romagna Regional Agency for Environmental Protection, Bologna, Italy
(2) CIMA Research Foundation, International Center on Environmental Monitoring, Savona, Italy

The quantitative precipitation forecast is a challenging task at the scales of interest for hydrological predictions over small and medium-size catchments. Although the use of high resolution limited-area models has improved the short-range prediction of locally intense events, an accurate forecast of the space-time evolution of these phenomena is still difficult, especially for ranges longer than 48 hours. Nowadays, in order to improve both the accuracy of hydrological model predictions and the reliability of uncertainty estimates, the use of meteorological ensemble systems as an input to river flow forecasts is increasing.
In the present study the usefulness and the skill of a Limited-area Ensemble Prediction System based on the non-hydrostatic limited-area model COSMO (COSMO-LEPS) is evaluated as a tool to drive a flood forecasting chain. The river hydrographs are simulated by means of the distributed rainfall-runoff model TOPKAPI.
The COSMO-LEPS methodology performs a dynamical downscaling of the ensemble forecasts produced by the global model of ECMWF. This methodology combines the advantages of a global-ensemble prediction system with the ability typical of limited area models to detail atmospheric phenomena on more local scales, particularly in those regions dominated by the effects of complex orography. COSMO-LEPS has been developed for the late-short to early-medium forecast range (48-132 h), and it has repeatedly been upgraded by increasing the layers in the vertical (from 32 to 40) and the number of members (from 5 to 16). The horizontal resolution is of about 10 km.
The performance of the proposed meteo-hydrological coupled system is evaluated for some small-size catchments located in the Emilia-Romagna Region, northern Italy. In particular, streamflow forecasts are simulated for the autumn and spring seasons in the years 2003-2007. Results have been investigated by statistical analyses, especially with respect to the verification of warnings and alarms.
Two typical responses result from the model coupling, depending on the atmospheric flow direction, localisation and orography of the selected catchments. Generally, in case of intense rainfall events leading to high discharge peaks, the forecast streamflows are underestimated when the flow is mainly from the south-west quadrant (downwind catchments), then the 75%-90% quantile confidence interval provides better results. On the other hand, the ensemble mean and the percentiles around the median provide better discharge forecasts when the flow is mainly from the east quadrant (upwind catchments).

29. An estimation of QPF uncertainty by ensemble skill

P. Zacharov, D. Rezacova/IAP ASCR Prague, CR.
petas@ufa.cas.cz, rez@ufa.cas.cz

Several convective storms, which occurred over the Czech territory and caused local flash flooding, were studied by using COSMO model in experimental mode. A driving COSMO (LLM) was run with the horizontal resolution of 11 km and with initial and boundary conditions derived from ECMWF analyses. The driven COSMO (SLM) used the horizontal resolution of 2.8 km and the initial and lateral data from LLM. The SLM integration started at 06 UTC and finished at 24 UTC of the same day. The storms produced the convective precipitation fields of various area extents and structures identified by radar. Multicellular storms with a repeated cell development over a given locality are the most common storm type in such situations. The time and space resolution of SLM enables a direct physical simulation of convective motions (convection permitting mode) and simulate realistic precipitation fields useful for hydrological modelling.

The events have been analyzed in an ensemble forecast regime. The ensemble of 13 members has been formed by linear shifting the initial fields in 8 directions. We have analyzed differences among the QPF of ensemble members by using traditional and fuzzy approaches. Specifically, we focused on the relationship between ensemble spread and ensemble skill. The spread and skill values have been calculated by using Fractions Skill Score. The ensemble skill has been evaluated by comparing the ensemble member forecasts with radar-based rainfalls and the spread was estimated comparing the ensemble member forecasts with the undisturbed control forecast. The effect of scale has been assessed by considering squares of various sizes that were centered in grid points of the verification domain. A scale dependence of spread and skill was analyzed at different times of integration and for various rainfall thresholds.

On the basis of good correlation between the FSS-spread and FSS-skill, we estimated the forecast FSS-skill for an independent event. We made an interpolation of spread-skill relation for four days and we made a projection of the fifth day ensemble mean spread into the interpolation curve. The skill forecast appears to be useful in uncertainty forecasting. It represents well the real skill and would be used as a combined input to the hydrological models together with deterministic or ensemble precipitation forecast.

The work is supported by the COST 731 (project OC112) and by the grant GACR 205/07/0905.

31. Probability forecast of intensive precipitation and floods in mesoscale catchments located in the Rhine basin – Experimental results and operational design.

J. Bliefernicht1, A. Bárdossy1 and N. Demuth2
Jan.Bliefernicht@iws.uni-stuttgart.de

1: Institute of Hydraulic Engineering, University of Stuttgart, Germany
(Jan.Bliefernicht@iws.uni-stuttgart.de /Phone: ++49 711 685 64703)

2: Environment State Agency Rhineland-Palatinate, Germany
(Norbert.Demuth@luwg.rlp.de /Phone: ++49 6131 6033-1710)

Forecasts of local surface variables like precipitation or discharge are uncertain. This arises from sources like the incomplete description of the state of the atmosphere and the hydrosphere and assumptions and simplifications made during the model development. To describe the forecast uncertainty ensemble prediction systems (EPS) are developed providing a number of realisations for the local-surface variable. In this presentation we propose an al-ternative forecasting technique based on a statistical downscaling which transfers the deterministic outcomes of a global numerical weather prediction model to the local scale. The statistical approach consists of two components: An analogue forecasting routine provides a probability forecast of daily areal precipitation for the basin of interest. Afterwards, a simulation model disaggregates the daily precipitation into spatiotemporal high-resolved realisations meeting the requirements of a distributed hydrological model. In the near future, the precipitation model will be tested as one component of the operational flood warning system running at the Environment State Agency Rhineland-Palatinate, Germany. It will provide a short-range forecast every six hours for several mesoscale catchments located in the German Rhine basin. In this presentation we will highlight the following points: I.) The precipitation model has been tested in a perfect prognosis environment with reanalysis data. A brief description of the precipitation model is given and the results of the model development are presented. II.) Operational flood forecasting requires a reasonable compromise between the ensemble size and the computing time needed to issue a flood warning. A basic concept is presented reducing the number of precipitation realisation without losing too much information to still provide a valuable flood forecast. The methodology is not only restricted to statistical downscaling techniques and can be transferred to EPS as well.

32. Inflow Forecast Verification at Hydro-Québec

Luc Perreault, Jocelyn Gaudet, and James Merleau
gaudet.jocelyn@ireq.ca

One way to assess the impact of meteorological forecasts on an hydrologic prediction system is to evaluate the quality of the inflow forecast. Here, we present the operational inflow forecast verification system that we developed at Hydro-Québec. The system is built primarily to verify ensemble forecasts, but also to evaluate the quality of deterministic forecasts. Our system is built around a number of different quality measures, as a variety of tools is necessary to do a thorough evaluation of a forecast's quality. We first describe our tools, then we explain how they are used to examine a series for forecasts, with some examples. The importance of having a measure that is close to the decision process, when applicable, is discussed. Finally, we present some results from the analysis of the impact of two different meteorological series on simulated inflows.

33. Verifying Hydrologic and Hydrometeorological Ensemble Forecasts in the U.S. National Weather Service

Julie Demargne[1,2], James Brown[1,2], Yuqiong Liu[1,3], Dong-Jun Seo[1,2], and Limin Wu[1,4]

[1]Office of Hydrologic Development, NOAA/National Weather Service, United States of America
[2]University Corporation for Atmospheric Research, United States of America
[3]Riverside Technology, Inc., United States of America
[4]Wyle Information Systems, United States of America

Recent progress has been made in the NOAA/National Weather Service (NWS) on a comprehensive verification system for routine and systematic verification of hydrometeorological and hydrologic ensemble forecasts. The NWS Office of Hydrologic Development (OHD) has been developing an experimental hydrologic ensemble forecasting system to produce reliable hydrometeorological and hydrologic ensemble forecasts that account for atmospheric and hydrologic uncertainties. In order to verify the ensemble forecasting system, OHD has developed the Ensemble Verification System (EVS). In this paper, we present verification results for experimental precipitation and streamflow ensemble reforecasts derived for 14 days in the future from new ensemble preprocessing techniques. Flow ensemble forecasts were evaluated both against observed flows and against simulated flows (i.e., flows generated from observed hydrometeorological inputs) to separate the input and hydrologic uncertainties, assuming that uncertainties in the observed hydrometeorological inputs are much smaller than hydrologic uncertainty. Such verification analysis helps identify the different sources of uncertainty and skill across the river forecasting process, and evaluate the improvements in forecasting skill contributed by new science. OHD is also working closely with the NWS River Forecast Centers to define standard verification metrics and summary scores that could effectively help forecasters and end users in their decision making, as well as techniques for identifying historic analogs to real-time ensemble forecasts and bias-correcting ensemble forecasts in real-time (before the corresponding observations occur). We also describe the need for closer collaborations between the meteorological and hydrologic communities and the joint NOAA-Environment Canada project to evaluate and implement existing and emerging verification methods for atmospheric and hydrologic ensemble forecasts in the HEPEX Verification Test Bed.

34. Ensemble flood forecasting: a review

Pappenberger F./ECMWF, Cloke H.L./King's College London
florian.pappenberger@ecmwf.int

Operational medium range flood forecasting systems are increasingly moving towards the adoption of ensembles of numerical weather predictions (NWP), known as Ensemble Prediction Systems (EPS), to drive their predictions. We review the scientific drivers of this shift towards such 'ensemble flood forecasting' and discuss several of the questions surrounding best practice in using EPS in flood forecasting systems. We also critique the main case studies in the literature that claim 'added value' of flood forecasts based on EPS and point to remaining key challenges in using EPS successfully.

35. An ensemble of hydrological climate scenarios

W. Yang, J. Olsson, J. Rosberg, SMHI, Sweden
jonas.olsson@smhi.se

Modelling of past, present and future climate is to an increasing degree involving simulation and evaluation of scenario ensembles. These ensembles encompass a range of different scenario characteristics, each of which adds uncertainty to the simulation. The most important characteristics that are currently considered are type of SRES emission scenario, type of GCM, initialisation of the GCM and type of RCM.

At SMHI, a large ensemble of climate model scenarios is being generated and subsequently used in hydrological simlulations of river discharge by the models HBV and HYPE. A bias correction procedure is applied to precipitation and temperature in the climate model results before they are used as input to the models. The climate model data acquisition, bias correction and hydrological simulations are combined in a semi-automatised system producing hydrological scenarios for different catchments in Sweden. For example, this system can process any of the climate model results currently being available through the ENSEMBLES project.

The hydrological scenario ensemble makes it possible to assess the total uncertainty as well as the contribution to it from each scenario characteristic mentioned above. In this study, we evaluate different aspects of the ensemble for a selected Swedish catchment by a split-sample approach, in which bias correction is calibrated for an early part of the historical reference period and then applied in hydrological simulations of the recent decades. Besides the uncertainty estimation itself, the approach opens up possibilities to rank scenarios with respect to their recent performance, both with and without bias correction, which may be relevant also for performance in a near-future perspective.

37. Tracking the uncertainty in flood alerts driven by grand ensemble weather predictions.

Wetterhall(1), F., Li(2), Z.-J., He(1), Y., Cloke(1), H., Pappenberger(3), F., Bao(2), H.-J.

1. King's College London, Strand, London , UK
2. Hohai University, Nanjing, China
3. European Centre for Medium-Range Weather Forecasts, Reading, UK
fredrik.wetterhall@kcl.ac.uk

One of the most important questions when using ensemble numerical weather forecasts for flood warning systems is how to best utilise this added information to improve forecasts and to avoid costly false alarms. The availability of global ensemble weather prediction systems through the 'THORPEX Interactive Grand Global Ensemble' (TIGGE) offers a new opportunity to develop these multi-ensemble flood forecasting systems. Here we present two case studies using the TIGGE database for flood warnings. The first catchment is the meso-scale Upper Severn catchment (4062 km2) located in the Midlands region of England. The second is the Upper Huai catchment (upstream of Wangjiaba, ca. 30672 km2), the sixth largest river in east-central China which connects to the Yangtse River. A coupled atmospheric-hydrologic-hydraulic cascade system driven by the TIGGE ensemble forecasts has been set-up for the both catchments. Two different hydrological models were used: LISFLOOD-RR for the Upper Severn and the Xinanjiang model for the Upper Huai. Probabilistic discharge and flood inundation forecasts were provided as the end product to study the potential benefits of using the TIGGE database. We assess the dominant uncertainties in the results and their propagation through the modelling chain. The spread of discharge forecasts is generally large and implies a significant level of uncertainty. Nevertheless, the results show the TIGGE database is a promising tool with which to forecast flooding

41. Evaluation of a short-range hydrometeorological ensemble forecasting system for the Great Lakes and St. Lawrence River basin

Vincent Fortin (1) , A. Lavoie (2), F. Anctil (2) ,R. Turcotte (3), M. Charron (1) and R. Frenette (4)
(1) Meteorological Research Division, Environment Canada
(2) Dept. of Civil Engineering, Université de Laval
(3) Centre d'expertise hydrique du Québec, Gouvernement du Québec}
(4) Meteorological Service of Canada, Environment Canada
vincent.fortin@ec.gc.ca

Environment Canada's operational ensemble prediction system (EPS) uses an ensemble Kalman filter to generate a 20 member global ensemble on a 0.9 degree grid. This system runs twice a day and forecasts out to 384h (16 days). It is based on the GEM atmospheric model, which can run either on a global or on a limited-area domain. It is well known that both short and medium-range deterministic forecasts (or forecasts from individual ensemble members) can be improved by increasing the horizontal resolution. As an alternative to increasing the resolution of the global EPS, an experimental regional EPS has been designed in which each global ensemble member is downscaled using the limited area configuration running on a 33km grid out to 72h (3 days) over all of Canada and most of North America, resulting in more skilful precipitation forecasts in summer, at a cost significantly lower than that of running the global EPS at 33km. Both the global and the regional EPS can be coupled to the HYDROTEL hydrological model to provide ensemble hydrological forecasts. As part of the HEPEX Great Lakes testbed, we investigate if the improved ensemble atmospheric forecasts provided by the regional EPS translate into improved ensemble hydrological forecasts, by focusing on a period of intense precipitation in the Fall of 2007 in southern Québec

42. A hierarchical modelling approach to the post-processing of ensemble forecasts

Vincent Fortin (1), A.-C. Favre (2) and B.N. Trinh (2)

(1) Meteorological Research Division, Environment Canada}
(2) INRS-ETE, Institut national de la recherche scientifique, Québec
vincent.fortin@ec.gc.ca

Ensemble meteorological forecasts provide a mean to assess dynamically the uncertainty in meteorological forecasts and communicate this information to end users. Unfortunately, current ensemble prediction systems (EPS) typically underestimate the uncertainty, partly because not all sources of uncertainty are taken into account, partly because there is a discrepancy between the temporal and spatial scales at which the variables are predicted and the scales at which they are needed for specific applications. For these reasons, statistical post-processing of ensemble hydrological forecasts is generally necessary in order to obtain a reliable assessment of the forecast uncertainty. Different approaches have been proposed to build reliable probabilistic forecasts from ensemble forecasts, including Bayesian model averaging (BMA, Raftery et al., 2005). In the case of BMA, the predictive distribution of the variable of interest is represented by a finite mixture of regression models.

We propose here a variant on the BMA framework in which most of the parameters of the model mixture are estimated based on regressions between the predictand and either the ensemble mean or the individual ensemble members. This is done by framing the problem as a downscaling issue, and solving it using a hierarchical model: instead of viewing the ensemble prediction system as unreliable for the purpose of forecasting the predictand, we assume instead that it is reliable for an unobserved (or latent) variable, and that there exists a statistical relationship between this latent variable and the predictand. This makes sense for numerical weather prediction models running at a low resolution, such as those used in an EPS, because the numerical models cannot resolve the scales at which observations are taken. As part of the HEPEX Great Lakes test bed project, this approach is tested on ensemble hydrometeorological predictions issued for sub-basins of the Great Lakes and St. Lawrence watershed.

43. Reconstruction of high-resolution rainfall series using multiplicative cascades.

D. Ceresetti, G. Molinié, J.D. Creutin / LTHE
davide.ceresetti@hmg.inpg.fr

The reliable estimation of the frequency of extreme rainfalls over a surface at different accumulation periods is related both to the gage density within the area of interest and the availability of long rainfall series. However, these two conditions are rarely reached, especially dealing with infra-daily time steps. The scale invariance of rainfall fields offers a possibility to overcome such a limitation. The Universal Multifractal Model (Schertzer and Lovejoy, 1987) is a framework for analyzing the scale invariance of atmospheric processes. A network of over 200 daily raingages is analyzed at different accumulation periods, deriving 2 multifractal parameters and an intermittency-related one (Veneziano et Furcolo, 2005) for 4 climatic seasons. These parameters are used for implementing a multiplicative cascade. It allows to generate hourly rainfall series, assuming auto-affinity of point rainfall distributions at any temporal scale between 1h and 150 h.

Resulting rainfall series at locations of the daily raingage network have higher temporal resolutions. The temporal auto-correlation structure and the distribution moments follow scale-invariance. To assess the technique efficiency, the derived annual maxima are compared with the observed ones.
Results are discussed in terms of the impact of the misestimating of high rainfall rate location or value on the hydrological modeling of flash-flood events.

45. Atmospheric ensemble forecasts of precipitation with the convection permitting model COSMO-DE

S. Theis, C. Gebhardt, M. Paulat, M. Buchhold, R.Ohl
Deutscher Wetterdienst (DWD), Offenbach, Germany

Quantitative information about precipitation is an essential input for hydrological predictions. For a lead time of more than several hours, precipitation forecasts are based on atmospheric models. The benefit of such forecasts for hydrological applications depends considerably on the ability of the model to resolve the relevant scales and processes.

Aiming to improve the very short-range forecast of severe weather triggered by deep moist convection and interaction with small-scale topography, DWD has developed the convection-permitting limited-area model COSMO-DE. This model has a horizontal grid-spacing of 2.8 km, covers the area of Germany and is in operational mode since April 2007. Major advances are the assimilation of radar observations and the formulation of a multi-component cloud microphysics scheme.

To properly take into account the limited predictability of processes on the small spatial scales, the DWD project COSMO-DE-EPS is developing an ensemble prediction system based on COSMO-DE.

Project activities comprise the generation, verification, statistical post-processing, and visualization of ensemble forecasts.

The ensemble perturbation strategy focuses on model physics, lateral boundary conditions, and initial conditions. Model physics is perturbed by altering distinct parameters of the physical parameterization schemes either individually or in combination. Lateral boundary conditions are perturbed by nesting the COSMO-DE-EPS members into members of the COSMO-SREPS (ARPA-SIM, Bologna) which itself is a nested EPS with a grid-spacing of 10km. The development of initial condition perturbations is in its early stages.

The quality of the current version of COSMO-DE-EPS is assessed by PACprove, a probabilistic verification tool developed as part of the project. The tool is able to calculate numerous probabilistic verification scores and also offers the option to focus on different spatial scales of the forecast.

We present the current status of ensemble development by showing results of our ensemble experiments.

51. Monthly and seasonal EPS weather forecasts in hydrological forecasting in Finland

Koistinen Ari, Vehviläinen Bertel, Markkula Juha / Finnish Environment Institute
ari.koistinen@environment.fi

Watershed Simulation and Forecasting System (WSFS) is used for flood forecasting and warning in Finland (www.environment.fi/waterforecast). ECMWF 10 days EPS weather forecasts have been used in the system operationally since year 2000. In the operational forecasts 10 days EPS is continued by climatology, to produce ensemble of 52 different hydrological forecasts. Since year 2007 ECMWF monthly EPS and since year 2008 seasonal EPS have been used in experimental forecasts which have been compared to forecasts based on climatology. Hydrological forecasts for periods of several weeks, even several months, can be valuable in some very large watersheds with big lakes and long delays, like Vuoksi watershed area in Finland. The inflow forecasts based on monthly and seasonal EPS were clearly better than the climatology based ones in southern and central Finland during exceptionally mild winters 2007-2008 and 2008-2009.

58. MRED: Multi-RCM Ensemble Downscaling of global seasonal forecasts

Raymond W. Arritt for the MRED Team
rwarritt@bruce.agron.iastate.edu

The Multi-Regional Climate Model Ensemble Downscaling (MRED) project addresses the question, Do regional climate models provide additional useful information for seasonal forecasts? Nested regional climate models (RCMs) have long been used to downscale global climate simulations. In contrast the use of RCMs in seasonal forecasting has received little attention. MRED is systematically testing the RCM downscaling methodology by using a large ensemble of downscaled global seasonal forecasts, produced by a suite of seven RCMs. The first stage will downscale historical winter forecasts from a T62L64 version of the U.S. National Centers for Environmental Prediction (NCEP) Climate Forecast System (CFS). A global seasonal forecast model based on the NASA Goddard Space Flight Center GEOS5 GCM, currently in development, also will be downscaled. The initial focus is on winter in order to evaluate snow cover, snow melt, and the usefulness of higher resolution for near-surface fields influenced by complex terrain.

The RCM ensemble covers the conterminous United States at approximately 32 km node spacing. Each RCM produces an ensemble of 15 members per year over a period of 22+ years (from 1982 to 2003+) for the forecast period 1 December – 30 April. Ensemble members are produced using a lagged ensemble approach; i.e., using output from global model runs that start from different dates in November before the forecast period. The total ensemble size will thus be (2 global models) x (7 RCMs) x (15 members per RCM) = 210 members. The RCMs provide hydrometeorological output in a standard netCDF-based format for a common analysis grid. MRED compares individual RCM and global forecasts as well as ensemble precipitation and temperature forecasts which are used to drive hydrological land surface models (LSMs). The project also evaluates wind, humidity, radiation, and turbulent heat fluxes, which are important for more advanced coupled macro-scale hydrologic models. Ensemble metrics such as spread, skill, and the resolution and reliability of categorical forecasts also will be evaluated. Process-oriented analysis will be performed to link improvements in downscaled forecast skill to regional forcing and physical mechanisms.

This presentation is dedicated to the memory of John Roads, who had the original vision for MRED and led its development into a funded multi-institution program. John passed away ten days before the start date of the project.

60. Object-oriented SAL Verification in Hydrological Catchments of Finland

Pertti Nurmi and Sigbritt Näsman / Finnish Meteorological Institute
pertti.nurmi@fmi.fi

SAL (Structure-Amplitude-Location) is an object-based verification method suitable for the verification of QPF forecasts within specified domains like hydrological basins. SAL has been applied for several river catchments of various sizes by verifying deterministic forecasts originating from both global (ECMWF) and regional (HIRLAM_RCR, HIRLAM_MB71) models. QPF fields generated by human forecasters, utilizing grid-editing forecast production tools, are also verified to estimate the potential added value of human intervention to NWP. Radar-derived QPE fields are the main source of "observed truth" data but also and rain gauge data can be utilized. The size of the catchments varies between three to thirty thousand square kilometers. The results confirm that higher resolution models do, indeed, perform better than the coarser ones. SAL hence seems to exempt the notorious "double penalty" effects.

62. Ensemble hydrological forecasting for flood management in the Brenta basin

Ferri Michele
ferri@idra.unipd.it

In view of flood control by reservoir regulation in the Brenta basin, in the Italian Alps, an accurate flood forecast is needed some days in advance. Within the MAP D-PHASE project an ensemble hydrological forecasting system was setup capable to predict runoff hydrographs at some dams and river gauges. The system proved to provide useful information for water authorities and civil protection. But for some flood events some false-alarm 'outliers' in the ensemble members of the COSMO-LEPS meteorological system, i.e. high flood forecasts predicting runoff peaks and volumes much higher that the observed ones. If water volumes would be released from reservoirs as a flood mitigation measure relevant economic losses would result. A combination of structural and non-structural measures would be needed for an efficient flood management in the Brenta basin.
The paper shows the effects produced in a set of preferred options if existing storage capacity use in association with a flood forecasting system is introduced.