UEF 2014

Working together to address weather forecasting challenges

Using ECMWF's Forecasts (UEF2014)

4 – 6 June 2014

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Strengthening forecasting services in developing countries

10:00 **Isla Finney** (Lake Street Consulting Ltd)
Bespoke forecasts for businesses, or multi-variable optimized solutions? The role of the middle man in weather

10:20 **Florian Pappenberger** (ECMWF)
Increasing the limits of predictability of floods by using NWP ensemble forecasts

COFFEE BREAK

11:10 **Ervin Zsoter** (ECMWF)
TIGGE in applications

11:30 **Ana Lopez and Sophie Haines** (University of Oxford)
The use and usability of probabilistic forecasts: emerging themes from an interdisciplinary study

Severe Weather

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Severe weather events... from a NMS perspective

12:20 **Tim Hewson** (ECMWF)
New initiatives for Severe Weather prediction at ECMWF

12:40 **Thomas Haiden** (ECMWF)
Verification of extreme events in numerical weather prediction

LUNCH BREAK (13:00 TO 14:30)

14:30 **Nicole Girardot** (Météo-France)
Forecasting tropical cyclones

14:50 **Christian Csekits** (Austrian Meteorological Service, ZAMG)
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15:10 **Ari-Juhani Punkka** (Finnish Meteorological Institute)
Improving wind gust and precipitation form forecasts by post-processing ECMWF data

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16:10 **Nevena Živanović** (Republic Hydrometeorological Service of Serbia)
Investigation of the accuracy of "Košava" wind forecasting using different ECMWF products

16:30 **Helpdesk sign-up and group photo**

17:00 **DRINKS RECEPTION & POSTER SESSION**

Poster presentations

Laura Ferranti (ECMWF)
Heat waves predictability at extended range forecast

Bruce Ingleby (ECMWF)
Use of BUFR radiosonde and surface observations in NWP

Anna Maidens (The Met Office)
Long range forecasting: Drivers of predictability and how to model them

Michel Matter (Federal Office of Meteorology and Climatology MeteoSwiss)
What is the Forecaster's added value with respect to NWP ?

Jean Neméghaire (Royal Meteorological Institute of Belgium (RMIB))
Integrating NWP data into weather impact applications

Sergio Nordio (OSMER)
The intense snowfall of 31 January – 2 February 2014 on the eastern Alps: a subjective and objective experience for a challenging forecast of the (weak) border between snowfall and rainfall

Anders Persson (Swedish Meteorological Society)
We cannot escape probabilities

Tijana Radović (Republic Hydrometeorological Service of Serbia)
Investigation of the accuracy of extreme precipitation forecasting using different ECMWF model parameters

Thomas Schumann (Deutscher Wetterdienst)
Predicting the windstorm "Christian" from 28 Oct 2013

Levent Yalcin and Huseyin Yuksel Ozalp (Turkish State Meteorological Office)
A case study for Unprecedented Storm in Turkey in 2012

Thursday 5 June 2014

Seamless forecast and uncertainty

09:30 Keynote: **Anna Maidens** (Met Office)
Long range forecasting: Drivers of Predictability and how to model them

10:00 **Franco Molteni** (ECMWF)
Sub-seasonal prediction at ECMWF and links with international programmes

10:20 **Tim Stockdale** (ECMWF)
Long range predictability of winter circulation

COFFEE BREAK

11:10 **Ken Mylne** (Met Office)
Seamless use of ECMWF and Met Office NWP

11:30 **Christoph Spirig** (MeteoSwiss)
Ongoing developments in the use of extended range and seasonal forecasts at MeteoSwiss

NWP developments

11:50 Keynote: **David Richardson** (ECMWF)
Developments of the ECMWF Integrated Forecasting System

12:20 **Tiziana Paccagnella** (ARPA SIMC)
Experimentations with the COSMO-based ensemble systems in the framework of C-SRNWP collaboration

12:40 **Gianpaolo Balsamo** (ECMWF)
Introducing inland water bodies and coastal areas in ECMWF forecasting system

LUNCH BREAK (13:00 TO 14:30)

14:30 User Voice Corner (part I)

COFFEE BREAK

16:00 User Voice Corner (part II)

19:30 ZeroDegrees

Friday 6 June 2014

09:30 **Vito Romaniello** (INGV)
Impact of sea surface temperature on COSMO forecasts of a Medicane over the western Mediterranean Sea

09:50 **David Tan** (ECMWF)
ECMWF atmospheric reanalysis (ERA) products

COFFEE BREAK

11:00 Panel Discussion

LUNCH BREAK (13:00 TO 14:00)

14:00 HelpDesk Activities

ABSTRACTS

Oral presentations (in programme order)

Integrating NWP data into weather impact applications

Strengthening forecasting services in developing countries

Daniel Kull, Vladimir Tsirkunov, David Rogers

The World Bank Group

The World Bank's Global Facility for Disaster Risk Reduction (GFDRR), in partnership with the WMO, focuses on strengthening the capacity of National Meteorological and Hydrological Services (NMHSs) in developing countries. Experience has shown that NMHSs modernization cannot be piecemeal, requiring a transformative process to help ensure that delivered services meet stakeholder demand.

Forecasting across timescales is an integral component of service delivery, and global NWP products produced by global centers such as ECMWF are key resources for NMHSs. Unfortunately, however, NMHSs in developing countries are often not able to fully take advantage of these, usually due to lack of capacity, connectivity and/or financial resources.

Within World Bank/GFDRR hydromet modernization projects we are increasingly encouraging developing country NMHSs to adopt cascading forecasting approaches, supporting a focus on delivering highest quality services to national/local users and partners within contexts of limited budgets. An example is the WMO's Severe Weather Forecasting Demonstration Projects (SWFDPs), which through WMO regional centers directly link improvements in global NWP with improvements in forecasting skill and services delivered at the national level.

To provide the best possible warnings from nowcasting and short-range forecasting, NMHSs need to work with emergency responders and others to interpret forecasts, require skills to understand how weather impacts society, and develop tools to more effectively inform users. A major advance, which builds on the current skill in weather forecasting, would be the introduction of impact forecasting – forecasting the impact of hydrometeorological hazards, not just predicting the physical phenomena.

The cascading system supporting these advances in developing countries depends on the largesse of the providers of global observations and numerical products such as ECMWF. This is not financially sustainable and undermines the reliability needed for long-term service delivery. Public financing models and opportunities to support and further develop these systems need therefore to be explored.

Bespoke forecasts for businesses, or multi-variable optimized solutions? The role of the middle man in weather

Isla Finney

Lake Street Consulting Ltd

Weather forecasts are being used by an increasing variety of 'end users'. National Weather Services now provide an array of services and, in some instances, consultancy options. Certain industries, eg energy companies, are aware that hiring in-house meteorologists makes financial sense. Nonetheless, there are still many businesses which are impacted by the weather, yet lacking easy access to forecasts relevant to the decisions they need to make.

Understandably most businesses do not have the threshold knowledge required to translate forecasts into the multi-variable optimized solution relevant to them. Indeed, ascertaining exactly which meteorological variables they require (sigma .995 or 10m winds?) can seem daunting. And this is where the middle (wo)man in weather can help: by speaking with the business owner in their language, and delivering a bespoke forecast which shows the potential impact on profit, loss and/or quality.

We will present a straightforward agricultural example where the relevant weather data presented in a business friendly way can aid harvest timing decisions, enabling maximisation of product value and/or minimisation of losses. The aim is to demonstrate that whilst weather forecasts are used more widely today than 10 years ago, further applications exist. Indeed, in light of concern about climate variability, then getting smarter about man's use of weather forecasts seems like a logical next step.

Increasing the limits of predictability of floods by using NWP ensemble forecasts

Florian Pappenberger[(1)], David Lavers[(1)], Lorenzo Alfieri[(2)], Jutta Thielen[(2)], Fredrik Wetterhall[(1)], Peter Salamon[(2)], Ervin Zoster[(1)], Anna Kauffeldt[(1)], Konrad Bogner[(1)], Francesca Di Giuseppe[(1)], Stephan Hermi[(1)]

[(1)]Forecast Department, European Centre of Medium Range Weather Forecasts, Reading, UK
[(2)]Joint Research Centre of the European Commission, EC, Ispra, Italy

The skill of weather prediction has steadily improved over the past decades through higher resolution models, improved physics, remote sensing data and better data assimilation methods. These improvements led to the founding of the 'Hydrological Ensemble Prediction Experiment' (HEPEX, see http://www.hepex.org) in 2004 as an international initiative to foster interdisciplinary dialogue between the meteorological and hydrological communities, and to promote the use of ensemble prediction systems for floods, droughts and general water management on short, medium and seasonal time scales. HEPEX clearly demonstrated the additional benefit from using ensemble predictions for such applications. While the number of research projects focused on ensembles has increased rapidly, the implementation of ensembles in operational hydrological services has been much slower. On the European Continent, the European Flood Awareness System (EFAS see http://www.efas.eu) is using ensemble forecasts to predict floods in the medium range. EFAS went operational in 2012, with ECMWF running the operational center. More than 35 hydrological and civil protection services in Europe are part of the EFAS network. EFAS aims to provide (i) added-value early flood forecasting products for hydrological services; (ii) a unique overview of current river conditions; and (iii) forecast floods in Europe more than 3 days in advance.

EFAS research has shown how flood forecasting at different temporal and spatial scales can produce a skillful seamless suite using long-, medium- and short-range weather forecasts ranging from qualitative early warning information to quantitative reliable short-term information. In this talk we will demonstrate how these limits of predictability can be increased by using multi-model ensembles, ensemble systems with a monthly lead time, atmospheric rivers and post/pre-processing.

TIGGE in applications

Ervin Zsoter, Richard Swinbank, Florian Pappenberger, Richard Mladek, David Richardson

ECMWF

The THORPEX Interactive Grand Global Ensemble (TIGGE) is a major component of the WWRP-THORPEX research program, whose aim is to accelerate improvements in forecasting high-impact weather. TIGGE provides a data base of ensemble predictions from leading operational NWP centers for scientific research on various topics, and has been instrumental in supporting cooperation between the academic and operational meteorological communities. In turn it has provided a basis for research studies on objective evaluation, predictability and dynamical processes. The research undertaken includes studies on multi-model combination, correction for systematic errors, tropical cyclones and the dynamics of extra-tropical storm tracks.

Although TIGGE is a research project, it has proved invaluable for the development of several applications in relation to operational forecasting. Examples include the development of multi-model tropical cyclone tracks, severe weather early warning products for heavy rainfall or strong winds, and various applications in flood forecasting using coupled hydrological models.

In this talk we intend to give an overview of the different applications where TIGGE plays a major role. We are going to focus on the FP7 project GEOWOW which contributes significantly to this area by improving accessibility to TIGGE (including the implementation of the limited area version TIGGE-LAM) and developing and demonstrating multi-model products using TIGGE to support high impact weather forecasting.

The use and usability of probabilistic forecasts: emerging themes from an interdisciplinary study.

Ana Lopez[(1)], **Sophie Haines**[(2)]

[(1)] Physics Department, Oxford University
[(2)]Institute for Science, Innovation and Society, Oxford University

The Oxford Martin Programme on Resource Stewardship brings together researchers from across the physical and social sciences and humanities to rethink approaches to monitoring, managing, maintaining and allocating globally important resources. Within this framework, our interdisciplinary project involves physical and social scientists, working together to explore the use of weather and climate forecasts in decision-making about natural hazards and resources. By examining practices, techniques and methodologies employed throughout weather/climate forecast and user networks, the projects aims to identify technical and non-technical factors that promote, enable or constrain the successful use of probabilistic forecasts, and the extent to which forecast information quality and/or institutional practices contribute to these forecasts [not] being used.

We will discuss our mixed-methods approach, and outline some preliminary findings from a series of case studies that incorporate a quantitative component focused on evaluating quality and value of forecasts and how (if) they relate to these qualities as interpreted by the different actors, and ethnographic research in the form of interviews and observations with different actors in the chain from the production to application of the forecast (paying attention to the feedback loops within it).

We will reflect on the role of ECMWF as a provider of data for decision-makers in a range of sectors, in the UK, Europe, and beyond.

Severe weather events… from a NMS perspective

François Lalaurette
Meteo-France

Having been involved with ECMWF in the development of new products for severe weather events in the early 2000's, the author will try to bring along this experience with his most recent one as head of Météo-France production branch. The vigilance system will first be presented, with special emphasis on the most recent developments related to storm surges and high impact snow events. In both cases, the input from NWP products, but also the importance of the dialog with decision-makers will be outlined. Some insight on the way Météo-France is pushing more information on potential events as far as 5 to 6 days ahead will also be given.

In a second part, current plans for a more integrated organisation between NWP developments, data calibration and service delivery will be presented. The development of ensemble products for high resolution, limited area models is a new opportunity to revisit some of our paradigms: how should we define our "most likely scenarios"? Should we edit our forecasts or spend more time analysing them and identifying how some aspects may become critical even if not the most likely? Plans to cover the bridge between Nowcasting and NWP using a new nowcasting, 1h-cycle version of Arome will also be presented. Finally, the development of the "3V" culture (Verification, Validation, Valorisation) across the organisation will once again be advocated, with results of the vigilance evaluation program.

New initiatives for severe weather prediction at ECMWF

Tim Hewson, Ivan Tsonevsky, Fernando Prates, Richard Forbes
ECMWF

To meet user requirements ECMWF is expanding and improving its portfolio of products that focus on severe weather, and this talk will describe progress made, and the related changes that users can expect to see in the next 12 months or so. For the familiar Extreme Forecast Index (EFI)-type products we are expanding the re-forecast dataset used, which should deliver a more accurate representation of the extremes and so provide products with greater integrity and greater stability on consecutive days. The range of EFI-type products is also expanding, and these will cover longer lead times, up to day 15. With regard to precipitation output we have a new initiative to diagnose freezing rain, and a new precipitation-type diagnostic is being introduced in conjunction. Alongside this other new variables will also be made available, to provide for example instantaneous precipitation rate and a measure of visibility. Tracks for named tropical cyclones now extend to 10 days, and we are also in the process of encoding in an equivalent BUFR format the tracks of TCs that develop during the forecast integration. Some new diagnostics, such as convective indices, will also be introduced into ECcharts to aid the forecaster. The various changes to be described in this talk will be illustrated using recent severe weather examples.

Verification of extreme events in numerical weather prediction

Thomas Haiden, Linus Magnusson

ECMWF

Extreme events are a challenge for numerical weather prediction and verification. By definition such events occur rarely, making statistically significant results difficult to obtain. Furthermore, scores tend to degenerate to trivial values in the limit of low rates of occurrence. One way of approaching the problem is to statistically evaluate events which are rare but not extremely so (occurring once or twice a year) using specifically designed scores such as the symmetric extremal dependency score (SEDI), and to study the most extreme events on a case-by-case basis. Results from both methods applied to forecasts from ECMWF's Integrated Forecasting System are discussed. The benefits of probabilistic vs deterministic forecasts of extreme events are illustrated using the potential economic value (PEV) metric. Insights obtained from evaluation of storm events both in the tropics and extra-tropics are presented, with special emphasis on the category 5 typhoon Haiyan which hit the Philippines in November 2013. Verification of precipitation forecasts during the flood event in June 2013 in Central Europe shows the importance of model resolution in the prediction of orographic rainfall enhancement.

Forecasting tropical cyclones

Philippe Caroff, Thierry Dupont, Sébastien Langlade (RSMC La Réunion), Nicole Girardot (Forecasting Division, Toulouse)

Météo-France

Forecasting the Tropical Cyclones (TC) is a core activity in La Réunion, since this Météo-France Centre is one of the 6 Regional Specialized Meteorological Centres (RSMC) devoted to TC monitoring and forecasting, having in charge the South-West Indian Ocean basin.

The responsibility enclosed in the RSMC mission covers time ranges up to a few days. Nevertheless the existing models covering seasonal and monthly scales enable us to have a « zooming » vision of the forthcoming weather.

Concerning the tropical cyclones, the seasonal forecasts can give some pertinent information about possible anomalies in the TC frequency or in the location of TC-genesis.

The monthly forecast estimates the potential cyclone activity for the next weeks.

The medium- to short-range forecasts enable the forecasters to anticipate the genesis and eventually provide the most accurate forecasts helping to warn the users and populations on these dangerous phenomenon and to prevent their impact.

Different products used by the forecasters will be presented according to the different sources of predictability.

The TC forecasters rely heavily on numerical prediction, which has demonstrated tremendous progress in the space of 5 to 6 years. So, some feed-backs about the quality of ECMWF products will be given, stressing the improvements and the remaining challenges and limitations. The recent example of TC Hellen's "bust" will illustrate a case of very rapidly evolving system and the difficulty for the models to catch it.

Severe weather warning system at the Austrian Meteorological Service (ZAMG)

Christian Csekits

ZAMG (Austrian Meteorological Service)

Severe weather warnings have been becoming more and more important during the last years. Exact severe weather warnings both in time and space can save lives and reduce damage on infrastructure, if issued early enough and thus giving civil protection agencies sufficient time for preventive action.

Severe weather warnings at ZAMG are published on municipality level and use the colour system according to the international Meteoalarm scheme (green – yellow – orange – red). Information about high impact weather, like strong wind, heavy precipitation (rain as well as snow), thunderstorms, freezing rain, heat waves, cold spell and forest fires, is provided for government, civil protection agencies, business companies and the general public. More detailed information in situations with high impact weather is available for costumers in web portals.

Severe weather warnings for today and tomorrow are partly based on small-scale models like Arome, Alaro, Cosmo-EU and UK local model or partly on ECMWF model. For high impact weather happening two or more days ahead we are mostly using ECMWF (deterministic and probabilistic model), in few situations UK global model or GFS model, too.

Two winter situations, one with heavy snowfall in the southwestern parts of Austria in January 2014 and one with strong freezing rain in the southeastern parts of Austria in February 2014 will be presented.

Improving wind gust and precipitation form forecasts by post-processing ECMWF data

Simo Neiglick, Paavo Korpela, Ari-Juhani Punkka

Finnish Meteorological Institute (FMI)

A group of FMI forecasters have developed post-processing scripts, called SmartTools which can be run in FMI meteorological workstations and network servers. These SmartTools utilize ECMWF hybrid level data from the 00z and 12z model runs.

One of the tools has been created to improve the forecasts of the form of precipitation. It is based on semiempirical forecasting methods used in the North America and Scandinavia. The form of precipitation is determined by tropospheric temperature and humidity profiles. The current version of the tool includes the following forms: drizzle, rain, sleet, snow, freezing drizzle and freezing rain.

The wind gust SmartTool is based on the vertical distribution of potential temperature and wind speed. The transfer of high momentum flow from the top of well-mixed layer to the surface is modulated by the vertical gradient of potential temperature. According to preliminary verification results, the wind gust SmartTool outperforms the ECMWF wind gust parameter in Finnish land stations with open and flat terrain (airports).

Predictive Skill of Tropical Cyclones in the Southern Hemisphere in Ensemble Weather Prediction Systems

Luteru Agaalii Tauvale

Samoa Meteorology Division

The predictive skills of tropical cyclones (TC) in the Southern Hemisphere by the Ensemble Prediction System (EPS) of the European Centre for Medium Range Weather Forecasts (ECMWF) and the United Kingdom Meteorological Office (UKMO) are explored in this project using data archive from the Observing System Research and Predictability Experiment (THORPEX) Interactive Grand Global Ensemble (TIGGE), a World Weather Research Project.

This will initially examine how well TC can be predicted in terms of location and intensity during the whole study period, from season to season and across different ocean basins. The spreads of both EPS will also consider, determining if the EPS forecasts are over-dispersive or under-dispersive. This was achieved using the TRACK program of Hodges. There are five consecutive Tropical Cyclone seasons included in this study, from October to March, 2008 to 2012. Within these five seasons, 115 storms were identified and are used in the analysis. Results show that the ECMWF EPS has more skill compared to the UKMO EPS with the UKMO EPS mean having an average of 1-2 days less skill than the ECMWF. Throughout the whole dataset, the EPS mean is more skilful than the control and deterministic. The intensities of tropical cyclones were under-predict in most cases most significantly by UKMO EPS and both EPS have under-dispersive spreads. Throughout seasons, improvements were seen in both EPS results in more skilful forecasts with less under-dispersive location and intensity spreads. Over different ocean basin, more accurate forecasts are observed over the Southern Indian Ocean than the Southwest Pacific Ocean.

Investigation of the accuracy of "Košava" wind forcasting using different ECMWF products

Nevena Živanović, Tijana Radović

Republic Hydrometeorological Service of Serbia

"Košava" is a strong south-easterly wind which frequently has gale (60-85 km/h) or strong gale (over 85km/h) force wind gusts of violent storm or hurricane force (over 100 km/h). The "Košava" wind can become a potentially dangerous meteorological event.

The Hydrometeorological Service of Serbia issues yellow warning on meteoalarm if wind gusts reach 85 km/h and red warning if they reach 100 km/h.

In this paper the accuracy of the Kosava wind forecasting using different parameters from ECMWF model was investigated. Besides the basic products of deterministic model, the following parameters were used: EFI (wind gust, wind speed, Global EFI- multiple parameters, EFI distribution), ENS meteograms, probabilities: 24 h maximum of 10 m wind gust. The main goal of the analysis performed was the determination of the effect of the forecasting parameters on the accuracy of the obtained results.

The forecast of the 2m wind speed and gusts obtained using different ECMWF model patameters was compared to the observed values of the wind speed and gusts recorded in the period from 30th of January till 3rd of February, 2014. Strong "Košava" wind affected Serbia during this period with violent storm and hurricane force wind gusts. The strongest gusts were recorded on 1st of February – 170 km/h in Vršac in southern Banat (the second strongest wind gust ever recorded in Serbia).SYNOP data for Belgrade station (13274) and Aiport Vršac, LYVR (13183) were used in the analysis.

Thursday 5 June

Seamless forecast and uncertainty

Long range forecasting: Drivers of predictability and how to model them

Anna Maidens
Met Office

Any long range forecast system has to deal with separating out chaotic atmospheric noise and the slowly varying boundary conditions which may supply sources of potential predictability. There are two challenges: finding sources of predictability in the observational record which are statistically robust; and identifying putative dynamical mechanisms for these sources which can then be captured in models. In this talk, I offer a survey of possible sources of predictability: sea surface temperatures (and ocean heat content) such as the North Atlantic Tripole, the El Nino-Southern Oscillation (ENSO); phenomena such as the Madden-Julian Oscillation (MJO); stratospheric behaviour such as the Quasi Biennial Oscillation (QBO); influences from the cryosphere (Arctic Sea Ice); land-surface processes such as Autumn Eurasian Snow cover; and combined processes (the ENSO-Northern European teleconnection mediated by Rossby wave-breaking in the stratosphere). Some of these links are well established statistically, some less so. I argue that there is a useful interplay between observational evidence, statistical analysis and modelling work, in that modelling work can help us to identify dynamical mechanisms which then enhance our confidence that the putative drivers of predictabilty have a basis in the underlying physics. I look at which features are well-modelled by current state-of-the-art climate models, and which features models struggle to capture. For example, high vertical resolution models with a well-resolved stratosphere and high model lid can reproduce the link between El Nino events, wave breaking and sudden stratospheric warmings, which then lead to cold surface conditions in Northern Europe. In contrast, a range of climate models seem to have consistently struggled to reproduce any link between Autumn Eurasian snow cover and European winter temperatures. I argue that these areas where models struggle can be very useful in identifying focuses for future research.

Sub-seasonal prediction at ECMWF and links with international programmes

Franco Molteni, **Frederic Vitart**

ECMWF

This presentation will review operational developments and research activities at ECMWF in the area of sub-seasonal forecasts (typically in the range of 10 to 60 days) and outline the ECMWF role in the WWRP-WCRP Sub-seasonal to Seasonal Prediction project.

ECMWF has produced monthly forecasts for over 10 years, initially using an independent ocean-atmosphere system, and since March 2008 as an extension of the medium-range ensemble predictions. Two recent developments of the system will be described, namely the extension of ocean-atmosphere coupling to the first 10 days of the ensemble forecasts (which became operational in November 2013 with cycle 40r1) and the extension of the re-forecast set planned for cycle 40r3.

For many years, ECMWF has played an important role in international research projects on sub-seasonal predictability, and currently has a leading (co-chair) role in the WWRP/THORPEX -WCRP Sub-seasonal to Seasonal Prediction project (S2S).

S2S is a new joint research project whose main goals are:

1. improve forecast skill and dynamical understanding on the sub-seasonal to seasonal time scale;
2. promote its uptake by operational centres and exploitation by the application community.

To achieve these goals, an extensive database of sub-seasonal to seasonal (up to 60 days) forecasts and re-forecasts will be established at ECMWF , modelled in part on the THORPEX Interactive Grand Global Ensemble (TIGGE) database for medium range forecasts (up to 15 days)

Long range predictability of winter circulation

Tim Stockdale
ECMWF

The predictability of the Arctic Oscillation in winter is explored using the ECMWF operational seasonal forecast system. Model re-forecasts have only a weak signal in the AO beyond the first month, suggesting that predictive skill should be low, yet the forecast winter signal correlates well with observations. Further experiments suggest a major role for the atmosphere initial conditions in predicting the AO, even on seasonal timescales. The need for caution in interpreting results from a small number of past years will be stressed.

Seamless use of ECMWF and Met Office NWP

Ken Mylne, Rob Neal, Nina Schuhen, Caroline Jones and Simon Jackson
Met Office, Exeter, United Kingdom

The Met Office strategy is to operate its own NWP systems for Week 1 forecasting and to exploit ECMWF data for weeks 2-4. Forecast users require a seamless blend of products making use of the best capabilities of both systems and avoiding apparent transitions between forecasts based on different NWP systems. This talk will illustrate a number of post-processing developments designed to achieve seamless products.

Regime analysis provides an effective way to cluster and interpret ensemble forecasts in a seamless way across timescales and systems. New linked sets of regime definitions have been defined, with 30 regimes for use in the 15-day range and a reduced set of 8 regimes more suitable for longer range forecasts. Clustering both the ECMWF 15-day EPS and Met Office Glosea 6-week forecasts by regimes provides a seamless capability for interpretation and impact prediction.

Ensembles are interpreted in support of severe weather warnings through our EPS-W system which uses both ECMWF and MOGREPS forecasts. This was presented last year, but an update on verification statistics using a longer and more robust verification period, will be presented.

Seamless use of different NWP systems is reasonably straightforward where standard weather variables are used, but becomes more complex where specialised diagnostics are required. The Met Office is working with ECMWF to enable the diagnosis from the EPS of a number of variables which it supports from the Unified Model to enable seamless prediction into Week 2. One example is a UV Index which quantifies the human health risk posed by ultraviolet radiation. Contributing factors are the sun altitude, ozone and aerosol concentration, ground altitude, surface albedo and cloud cover. A global UV index forecast is now derived from ECMWF high-resolution deterministic radiation and ozone forecasts, and work is proceeding to provide probabilistic forecasts based on the EPS.

Ongoing developments in the use of extended range and seasonal forecasts at MeteoSwiss

Christoph Spirig, Irina Mahlstein, and Mark Liniger

Federal Office of Meteorology and Climatology, MeteoSwiss

MeteoSwiss provides monthly and seasonal predictions based on ECMWF forecasts both to the public and commercial customers. So far, these forecast have been provided in the format of tercile probabilities for mean temperature and precipitation sums, either as maps with contours indicating the probabilities of upper and lower terciles or as data files of tercile probabilities. Feedback from the public suggests that these formats are difficult to interpret and commercial customers are increasingly interested in receiving more specific forecast formats, such as predictions of certain indices that are directly relevant to their business. Examples are heating degree days for the energy sector or drought indices for agriculture, both being derived from daily time series of weather variables. We currently investigate the use of ECMWF's extended range and seasonal forecasts at daily time resolution for producing predictions of such climate indices and as a basis for new presentation formats.

We will present first results of our ongoing work with daily data of ECMWF's monthly and seasonal forecasts. For monthly forecasts we experiment with a new presentation format of climagram-like plots showing weekly distributions of daily minimum, maximum and mean temperatures. Simple downscaling approaches were used to produce site-specific ensemble forecasts of absolute temperatures for selected locations in Switzerland. First verification analyses indicate that skilful forecasts in the extended range are possible but skill varied quite significantly between the different test sites. We also investigated potential skill of System 4 seasonal forecasts of temperature based indicators. Indices of aggregated daily temperatures involving thresholds did not show significant differences in skill as compared to those of temperature averages. However, skill of indices based on 'frequency count' showed some regionally interesting patterns, including areas with improved skill compared to those of the underlying variable.

Developments of the ECMWF Integrated Forecasting System

David Richardson
ECMWF

This presentation will give an overview of the performance of the ECMWF Integrated Forecasting System (IFS), review the main upgrades over the past year and provide a look ahead to forthcoming changes.

On 25 June 2013, the vertical resolution of the high-resolution forecast model (HRES) was increased throughout the troposphere and stratosphere (from 91 to 137 levels). This enabled a better representation of physical processes: clouds, inversions and vertically propagating gravity waves, for example.

The corresponding upgrade for the ensemble (ENS) was introduced on 19 November, increasing the number of levels from 62 to 91 levels with the model top being raised to 0.01 hPa. At the same time, the interaction of the atmosphere with the dynamical ocean model was improved through a tendency coupling starting at initial time. Wave effects on ocean circulation were added. Perturbations to land surface parameters were introduced in the ENS initial conditions.

The 19 November upgrade also introduced several significant model changes (in both HRES and ENS), including a revised convection scheme that addresses the long-standing issue of convection over land producing rainfall too early during the day. Changes to the vertical diffusion and sub-grid orography schemes improve the night time low level jets over land (important for wind energy applications) and significantly improve the large-scale circulation in the northern hemisphere during winter time.

The presentation will conclude with an outlook towards future developments. Forthcoming IFS changes include a substantial revision to the cloud physics (that will improve the forecasting of light rain) and an increase in the horizontal resolution. The Scalability Programme set up at ECMWF to address the challenges of highly parallel computing will be briefly introduced.

Experimentations with the COSMO-based ensemble systems in the framework of C-SRNWP collaboration.

Chiara Marsigli, Andrea Montani, Tiziana Paccagnella

ARPA-SIMC, Bologna, Italy.

The ECMWF Research Department offered the European LAM-EPS community data from two configurations of the ENS global ensemble, run with different horizontal resolutions, so as to promote research on Lateral Boundary Conditions (LBCs) for convection-permitting ensembles.

The data from the two configurations were made available for three two-week periods, characterised by high-impact weather events in 2011 and 2012, and were used by different weather centres in Europe.

The C-SRNWP Programme provided a valuable framework to agree on the testing periods for these experiments and to compare and discuss the results obtained by driving different LAM convection-permitting ensembles with ENS LBCs.

In this contribution, the impact of high-resolution boundaries provided by ECMWF is investigated on the performance of both COSMO-LEPS, the operational ensemble system running at ECMWF as a time-critical application, and COSMO-IT-EPS, the convection-permitting ensemble under development at ARPA-SIMC in collaboration with CNMCA and ARPA-Piedmont.

The provision of higher resolution boundaries is found to have a limited positive effect on the performance of both ensemble systems in terms of probabilistic prediction of precipitation. Also, the spread/skill relation in terms of 2-metre temperature slightly improves with high-resolution boundary conditions.

Results suggest that, considering the present configuration of ECMWF EPS, the resolution increase of the LBCs is not the key factor influencing the skill of the LAM ensembles. In this case, major impacts are expected by improving methodologies to generate perturbations to account both for analysis and model errors.

Introducing inland water bodies and coastal areas in ECMWF forecasting system

Gianpaolo Balsamo

ECMWF

A representation of inland water bodies and coastal areas in NWP models is essential to simulate large contrasts in albedo, roughness and heat storage. Land-water contrasts, despite not being a dominant feature, are present over a large part of inhabited land and can affect turbulent heat fluxes towards the atmosphere and the planetary boundary layer evolution.

A lake and shallow coastal waters parametrization scheme introduced in the ECMWF Integrated Forecasting System is expected to become operational in near-future. Its sensitivity and impact from regional to global scale will be presented. Results from fully coupled runs suggest that inland water bodies show can (a) effectively regulate the amplitude of temperature diurnal cycle, (b) produce a shift in the seasonal temperature evolution, and (c) introduce an important source of tropospheric moisture. Those effects are shown to improve significantly the forecasts of near surface temperature and humidity nearly at all forecast ranges considered, from a day to a season ahead.

Friday 6 June

Impact of sea surface temperature on COSMO forecasts of a Medicane over the western Mediterranean Sea

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The study describes and analyzes the sensitivity of an operational atmospheric model for several SST (Sea Surface Temperature) estimates. The model's sensitivity was studied in a Medicane (Mediterranean Hurricane) test case. Numerical simulations were performed using the COSMO (COnsortium for Small-scale MOdeling) atmospheric model, in the COSMO-ME configuration. The results of the model show that the model is capable of capturing the position, timing and intensity of the cyclone.

Sensitivity experiments were carried out using different SSTs as surface boundary conditions for the COSMO forecasts. Four different experiments were carried out: the first two used SST fields obtained from the OSTIA (Operational Sea surface Temperature and sea Ice Analysis) system, while the other two used the SST analyses and forecasts from MFS (Mediterranean Forecasting System). The different boundary conditions determine differences in the main characteristics of the Medicane such as the trajectory, pressure minimum and wind intensity.

The sensitivity experiments showed that a colder than real SST field determines a weakening of the minimum pressure at the vortex center. MFS SST analyses and forecasts determine more intense heat fluxes from the sea to the atmosphere, leading to a strengthening of the vortex itself and a different trajectory for the last hours of the meteorological event.

It was found that MFS forecast SST, as surface boundary conditions for COSMO-ME runs, determines an improvement, compared to ASCAT observations, in terms of the forecasts for wind intensity, cyclone dimension and location.

ECMWF atmospheric reanalysis (ERA) products

David Tan and Dick Dee

ECMWF

ECWMF periodically uses the Integrated Forecast System (IFS) to 're-analyse' past observations, creating global data sets that describe the recent history of the atmosphere, land surface, and oceans. ECMWF atmospheric reanalysis (ERA) products are widely used for monitoring climate change, for research and education, and for commercial applications. In this presentation we briefly describe ERA-Interim, a global atmospheric data set from 1979 to present with monthly product updates reflecting recent changes in the state of the atmosphere. We also discuss current work on climate reanalysis taking place at ECMWF in the framework of the EU projects ERA-CLIM and ERA-CLIM2, including the recently completed ERA-20C reanalysis of surface observations extending back to 1900. Finally we give a brief overview of future plans and directions toward a consistent climate reanalysis of the coupled Earth-system.

POSTER PRESENTATIONS

(in alphabetical order)

Heat waves predictability at extended range forecast

Laura Ferranti
ECMWF

This study assesses the ECMWF extended range forecasts' performance in predicting heat waves. It is well known that the extended-range predictability of temperature extremes is associated with the predictability of large scale flow regimes and soil moisture feedbacks. The analysis make use of an heat wave index that describes spatially coherent patterns of temperature anomalies persisting for a number of days. Objective verification of probability forecasts requires a far larger sample that is available (typically the case for any investigation of extreme events). Therefore the cases were investigated individually. It is difficult to draw any firm conclusions from the limited sample available. However, the skill in predicting heat waves at the extended range seems to be limited by the ability of the forecast model to represent transitions to anticyclonic circulation regimes.

Use of BUFR radiosonde and surface observations in NWP

Bruce Ingleby, Enrico Fucile, Drasko Vasiljevic, Tomas Kral, Lars Isaksen
ECMWF

Traditional alphanumeric codes (TACs: TEMP, SYNOP etc) have been used for more than 50 years and are restrictive in some respects. For more than a decade WMO has been promoting a transition to the binary BUFR format. BUFR surface reports contain extra metadata and facilitate higher frequency reporting. BUFR radiosonde reports allow much higher vertical resolution (removing the need to select "significant" levels) and the reporting of time/position at each level. The transition process has been slow because in each country it involves experts in observations, codes, telecommunications, databases, and finally NWP. Currently roughly 50% of SYNOP and radiosonde observations are available on the GTS. From Autumn 2014 circulation of some reports in alphanumeric format may cease.

ECMWF has been working on decoding and storing the BUFR observations and on their use in the NWP system. Validating the reports is important; various errors have been found and reported to the data producers (either directly or via EUCOS and WMO) and some of the errors have been resolved. We are in contact with other NWP centres to pool experience of using the data (see https://software.ecmwf.int/wiki/display/TCBUF/TAC+To+BUFR+Migration) and have requested GTS BUFR bulletins that aren't currently reaching ECMWF. Certain subsets of the BUFR data will be assimilated in the ECMWF system from Cycle 40r3. We do not expect to see much forecast improvement from this change but intend to avoid data gaps opening due to the transition. Over the next year or two there will be further work, checking and introducing other subsets (on a national/regional basis) of the BUFR data. In parallel there will be work on better use of in situ observations, including the extra radiosonde information in BUFR and the introduction of aircraft humidity.

Met Office seasonal predictions of the NAO, the driver of recent extreme UK winters

Anna Maidens

Met Office

GloSea5, the Met Office's Global Seasonal Prediction System, Version 5, is an ensemble forecasting system based on HadGem3, the Met Office's coupled climate model. It runs forecasts out to 6 months from operational atmosphere and ocean analyses taken from short-range NWP forecasts and the FOAM ocean forecasting system, together with initialised sea ice. It is run in conjunction with a 14 year historical re-forecast set (hindcast set) initialised with ERAI atmosphere and the GloSea system's own ocean reanalyses. The hindcast set is used for bias correction and model validation. In this talk I look at recent improvements in producing seasonal forecasts for European Winter brought about by improved horizontal and vertical resolution (with approximately 50km grid spacing in mid latitudes, a higher model lid at 85km and a well-resolved stratosphere). I outline the recent work on improvements in forecasting the state of the North Atlantic Oscillation (the primary driver of winter conditions over Europe). Over an extended 21 year period of hindcasts, GloSea5 shows a correlation of 0.62 with observations for the surface NAO (point index based on sea level pressure difference between Iceland and the Azores). I then look in more detail at case studies: the role of the stratosphere in mediating distant teleconnections (the role of El Nino in the cold conditions of winter 2009-10); the role of ocean heat content (the re-emergent North Atlantic Tripole for SST anomalies and the cold early winter of 2010-11); and our ongoing work in analysing the role of the stratosphere in the mild, exceptionally wet winter of 2013-14.

What is the Forecaster's added value with respect to NWP?

Daniel Cattani, Pierre Eckert, Michel Matter

Federal Office of Meteorology and Climatology MeteoSwiss

We perform a verification of the deterministic precipitation forecasts for selected regions of Switzerland issued by the bench forecasters and compare them to various NWP sources. Outputs provided by the ECMWF HRES model and the Ensemble prediction system for time ranges between D+1 to D+7 are used.

Our main aim is to identify in which contexts (geographical area, time step of the forecast, meteorological situation, …) the forecaster can bring a significant additional value to the NWP output. An assessment of the skill of the forecasters against NWP as well as of the skill of the EPS against HRES can be useful to choose the best forecast guidance. Based on the verification results, specific directives can be addressed to forecasters in order to help them focusing their effort on worthwhile aspects.

The skill score used for assessing the forecasts edited by forecasters against NWP is based on a measure of accuracy. The latter is a part of the global score COMFORT developed and recently deployed at MeteoSwiss for administrative and communication purposes. The observations used in the verification process are provided by a new algorithm developed at MeteoSwiss, which combines high resolution precipitation estimates provided by the radar network with sparser measurements coming from the raingauges.

Challenging weather forecasting projects at medium and possibly more extended ranges in Belgium

Jean Neméghaire with the co-operation of Dr. Fabian Debal, Pascal Mailier, Bert Van Schaeybroeck, Joris Den Bergh and Emmanuel Roulin

Royal Meteorological Institute of Belgium

A planned implementation of early warnings will be largely examined using to a certain extent our short term warnings methodologies and procedures to medium ranges for the first week of forecasts. An impact matrix will be tested regarding the whole country for basic weather parameters with adapted criteria of severity. Probabilities of exceeding meteorological thresholds will be issued from the ECMWF-EPS forecasting system. A correction of these probabilities exploiting a Model Statistics method will be helpfully introduced at least for a few parameters; a post-processing technique like the Kalman Filtering or the Error-in-Variables Model Output Statistics (EVMOS) are the first "candidates" to make corrections. Furthermore to help forecasters to make a decision the consistence of successive EPS forecasts and extreme forecast indices (EFI and SOT) will be proposed. Besides we will briefly present an Hydrological Ensemble Prediction system (HEP) being developed at the RMIB for large river basins (Meuse and Scheldt) and based on ECMWF-EPS data. The HEP products can be helpfully dedicated to forecasters assessing the potential severe impacts of precipitations (rain or/and snow or thaw).

A project aims at completing the current ECMWF-EPS operational clustering based on the geopotential at 500 hPa. Experimental attempts will be proposed focusing the clustering on a smaller domain (Western Europe) for (new) variables at lower tropospheric levels aiming at identifying air masses for the first week of the forecasts. The problem of identifying more clearly these air masses and their anomalies will be raised.

Finally motivations to develop extended range forecasts and appropriated products even for small countries like Belgium will be set out.

The intense snowfall of 31 January – 2 February 2014 on the eastern Alps: a subjective and objective experience for a challenging forecast of the (weak) border between snowfall and rainfall.

Sergio Nordio, Arturo Pucillo, Andrea Cicogna, Livio Stefanuto, Stefano Micheletti

Osservatorio Meteorologico Regionale – ARPA FVG-via G.Oberdan, 18/a Visco (Ud)- Italy

This work aims to provide an interpretation of ECMWF simulations over the Carnic Alps area in the light of the zero degree level derived from the Udine Campoformido 16044 radio-sounding (that is 50 km far to the south-east, over the friulian plain) during the strongest winter storm of the 2013-2014 season. An estimate of the costs and benefits of a forecast for technological infrastructure roads, winter resorts, etc. The comparison of the ECMWF performance in this event and in a well-known event in the 2008-2009 winter season has been provided.

We cannot escape probabilities

Anders Persson
Swedish Meteorological Society

Although there is, and has always been, a strong element of statistics in weather forecasting this has rarely been reflected in the curriculum. Here is an outline of a suggested weekly course in probability theory, which is partly built up from the three different definitions of probabilities:

Monday: The classical definition of probability.

This starts with the familiar illustration of tossing coins and dice, but move on to combinatoric which, among other things, will tell about the problems to add or divide probabilities.

Tuesday: The frequentist definition of probabilities.

This involves verification of probability forecasts, mean and variance and significance. Why is it not possible to deceive the "proper" Brier score? How does it know my true opinion?

Wednesday: The subjective definition of probabilities.

From conditional probabilities (the chance of having rain if it is windy is normally not the same to have windy conditions if it rains. From Bayes' Rule we move into several applications well known in forecasting meteorology.

Thursday: Decisions from probabilities.

From the elementary cost-loss model, we move into more complex models such as the Kahneman-Twersky Prospect theory. The value of total uncertainty will also be explored.

Friday: The psychology of probabilities.

The communication of uncertainty does not totally depend on numerical values of probabilities. Verbal statements can function equally well as well as intervals with tacit probabilities.

Investigation of the accuracy of extreme precipitation forecasting using different ECMWF model parameters

Tijana Radović, Nevena Živanović

Republic Hydro meteorological Service of Serbia

In the period 13th to 16th of May 2014 Balkan peninsula was under the influence of deep low formed over the Adriatic sea, as cold air from central Europe met with warm and humid air mass over the Mediterranean, leading to very low pressure. The low became stationary over the Balkans and produced enormous amounts of precipitation and caused flooding all over central Balkans. There were human casualties and a lot of material damage had been made.

In this paper the accuracy of precipitation forecasting using different ECMWF model parameters was investigated. Besides basic products of deterministic model, few more products were useful: amount of precipitation, EFI (precipitation, Global EFI multiple parameters, EFI distribution), ENS meteograms and SPI. The main goal of the analysis performed was the determination of the effect of these parameters on the accuracy of the forecasts.

The forecast was compared to the observed values of accumulated precipitation using SYNOP data for Serbian stations. The amounts of precipitation broke a lot of historical records. On 15th of May the daily amount of rainfall in Belgrade broke the historical record with 107.9 mm. The amount of rainfall accumulated from 1st to 15th of May in Belgrade was 214 mm, which is three times more than monthly average for May which is 70.7 mm.

Predicting the windstorm "Christian" from 28 Oct 2013

Thomas Schumann
Deutscher Wetterdienst (DWD)

One of the most severe weather events of the last years was the intense low pressure system "Christian" affected the coastal area of Germany with highest gusts of above 100 mph and up to 120 mph reported in southern Denmark close to the German border. This windstorm was causing at least 17 deaths in several European countries. The developing system incorporated the remnants of ex-tropical storm Lorenzo situated in the middle of the Atlantic. The tropical air from this storm provided an input of energy was helping to intensify the cyclone in an area closer to Europe than usual. This has been made forecasts difficult.

An accurate prediction of this type of high-impact events is the core task of the DWD. To provide tailored forecasts for the general public and authorities already during the medium range the web based ECMWF forecast product portfolio is essential. Due to the lack of time in operational shifts the access to forecast products should be kept easy.

During the medium range the ECMWF forecast system did an excellent job. Already 7 days in advance clear signals detecting a major windstorm event were to be seen. The EPS as well as the deterministic runs gave indications so that by the risk assessment of the DWD already during the early medium range an intense low pressure system was announced. Closer to the event NWP models should provide a much more detailed guidance. This was for the major wind storm event "Christian" not always the case.

A case study for Unprecedented Storm in Turkey in 2012

Dr. Levent Yalcin and Huseyin Yuksel Ozalp
Turkish State Meteorological Service

Due to Turkey's geographic location and topographic conditions Turkey is exposed severe weather at times. Turkey has a very large area with different topographic and climate conditions which makes it very difficult to observe and predict the weather. At the date of 18th April 2012, low pressure center which is located so deep in Aegean Sea caused storm and dust transport particularly in western and central part of Turkey. Wind speed which has been measured at many meteorological stations has reached extreme or close to extreme values in the country. Losses of life, injuries, property losses occurred and everyday life such as transportation (marine, air and road) was effected negatively due to this strong wind. In the study, this extraordinary meteorological event is synoptically analyzed. Also use and interpretation of ECMWF products (deterministic, EPS, EFI) in forecasting and warnings of this event in Turkish State Meteorological Service is examined. ECMWF products served this extreme event forecasts successfully to TSMS forecasters in a suitable period of time to warn related units.

Key words: severe weather, storm, dust transport, ECMWF products, Turkey

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