Building Resilience to Disasters in Western Balkans and Turkey

LONG-RANGE FORECASTING TRAINING
(LRF Training)

Belgrade, Serbia, November 13-16, 2013

WORKSHOP REPORT

1. Introduction

In the framework of the IPA/2012/290552 multi-beneficiary project "Building Resilience to Disasters in Western Balkans and Turkey", a regional training on Long-Range Forecasting was organized on 13-16 November 2013 in Belgrade, Serbia. The overall objective of the project is to reduce vulnerability of IPA beneficiary countries to disasters caused by natural hazards in line with the Hyogo Framework for Action and increase their resilience to climate change. The direct beneficiaries are the national authorities in charge for the disaster risk reduction and disaster risk management and the National Meteorological and Hydrological Services (NMHSs) of Albania, Bosnia and Herzegovina, Croatia, Montenegro, Serbia, Kosovo*, the former Yugoslav Republic of Macedonia and Turkey. The regional training on Long-Range Forecasting was hosted by the Republic Hydrometeorological Service of Serbia (RHMSS).

*This designation is without prejudice to positions on status, and is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo Declaration of Independence

The regional training on Long-Range Forecasting was one of the three events planned in a consecutive way as follows:

- 13–16 November 2013 - Regional training on Long-Range Forecasts
- 18–19 November 2013 - MedCOF-1
- 20-21 November 2013 - SEECOF-10

The list of participants is attached as Annex II. Agenda is attached as Annex I.

2. Meeting Concept and Format

This training event was organized around three thematic blocks covering the main aspects of Long-Range Forecasts. These three blocks corresponding to three sessions were: i) monitoring and verification; ii) available information sources for Long-Range Forecasting; and iii) methods, algorithms and relevant projects.

The main idea behind this concept was to introduce the areas which will be further developed on successive training specialized events. A list of possible themes to be subject of future training events was discussed and prioritized in the wrap up session.

3. Activities

Session I – Opening Session

The Opening Session was conducted by Branko Bijelic, who is forecaster and Chief of the Monthly weather forecast unit of the Department of Hydrometeorological Early Warning System and Aviation Meteorology at the Republic Hydrometeorolocical Service of Serbia (RHMSS).

Professor Jugoslav Nikolic, Permanent Representative of the Republic of Serbia with the World Meteorological Organization (WMO), Deputy Director of the RHMSS and representative of the Serbian Government, warmly welcomed the participants of the LRF training. He recalled that at the beginning of 2006 and following the WMO recommendations, RHMSS initiated the foundation of a sub-regional South East European Virtual Climate Change Centre (SEEVCCC). SEEVCCC became operational in June 2009. With the establishment of SEEVCCC new possibilities were opened for strengthening the regional scientific and technical cooperation in the field of meteorology, hydrology and climate change, especially in terms of transfer of technology, knowledge and experience with the view to reinforcing technical, technological and human resources of the National Hydrometeorological Services of the South East Europe and Caucasus region. One of the major activities of SEEVCCC conducted since 2010 has been the organization of the WMO/South East European Climate Outlook Forums – SEECOFs. By opening the expert meeting – Regional training on Long-Range Forecasts, Climate Watch Related Aspects and Climate Scenarios, Prof. J. Nikolic noted that RHMSS was not a first time organizer and host of these and similar kinds of events. In addition to other international meetings, RHMSS had organized and hosted two face-to-face SEECOF sessions so far (November 2010 and 2011).

The introductory presentation, titled *Climate prediction at regional and local scales for the benefit of climate services* was delivered by Ernesto Rodríguez-Camino on behalf of Francisco Doblas-Reyes. Francisco Doblas-Reyes is Research Professor at the Catalan Institute for Climate Sciences (IC3) and his main research interests are climate variability and climate prediction, ranging from one month to several years. He started his presentation making a review of the international context in the climate prediction arena. He also presented some cases of miscommunication of probability forecast causing social alarm.

Some recent material on the steady progress of climate prediction due to the improvement in the representation of many processes (sea ice, projections of volcanic and anthropogenic aerosols, vegetation and land, coupling, etc) and to leveraging knowledge from other sectors of climate research conveyed an optimistic message about the perspectives of improving skill at seasonal scales for midlatitudes. In particular, he presented very promising results of a state-of-the-art model able to predict the winter NAO index with a very acceptable skill. He recommended to do more effort on statistical than dynamical downscaling due to the high computing cost of dynamical methods and also because statistical downscaling is less affected by non-stationarity of the relationships than climate change. He also stated that reliable and robust calibration and combination is absolutely needed to improve our scores and that forecast quality assessment should always be included. Finally, he recommended having more sensitivity to the users' needs.

Session II – Monitoring and verification

Peter Bissolli (Deutscher Wetterdienst, Germany) presented his talk titled *the European (RA VI) Regional Climate Centre Node on Climate Monitoring.* He described RCCs as Centres of Excellence assisting WMO Members in a given region to deliver better climate services and products including regional long-range forecasts, and to strengthen their capacity to meet national climate information needs. RCOFs belong to the main users of RCC services. He presented the RA VI Regional Climate Centre (RCC) network co-ordinated by Deutscher Wetterdienst (DWD). Presently, three RCOFs are served by the RA VI RCC: SEECOF (southeastern Europe), NEACOF (north Eurasia, in collaboration with RA II) and MedCOF (Mediterranean, in collaboration with RA I). The co-ordination of the RCOFs is under responsibility of the RCC node on Long-Range Forecast (RCC-LRF, lead: Météo France and Roshydromet). Contributions are also given by the RCC node on Climate Monitoring (DWD and SEEVCCC, Serbia). RCC Climate Monitoring products are used for verification of the RCOF consensus forecasts and for climate analyses and diagnostics. He stressed that RA VI RCC appreciates feedback from RCOF participants for development of further appropriate products and services for the special needs of RCOFs in future.

Ernesto Rodríguez-Camino on behalf of Andre Kamga (ACMAD) summarized in his presentation *Climate monitoring by RAI RCC* the main information provided by the ACMAD web page. He described in detail the different types of bulletins produced by ACMAD for different periods (7 days, 10 days, 1 month …) and different users (health, water, …). Most bulletins include both monitoring and forecast information predominantly based on external sources. As ACMAD has a relative long experience in organizing RCOFs and producing consensus forecasts, it was possible to show some results of objective probabilistic verification based on the consensus forecasts. It was insisted and recommended to implement as a routine practice some agreed package of objective probabilistic verification of RCOF forecasts.

Goran Pejanovic (RA VI RCC-SEEVCCC, RHMS) began his presentation titled *Verification of operational seasonal forecasts at RA-VI Regional Climate Cente*r with an in-depth overview over mandatory operational functions dividing them into 3 key segments: climate data node, climate monitoring node and long-range forecast node providing detail information on each of its products. Additionally to the tasks and products of the climate monitoring node based on ECA&D, NCAR/NCEP reanalysis, emphasis was put on the winter hindcast (1981-2010) and operational forecast available in GRIB via WIS-DCPC-Belgrade as the two novelty features of the seasonal forecast. Focus of the presentation was particularly on the verification, indicating the inflation of variance-correction and best ensemble approach as well as on the Climate watch system that is being issued for the entire South-East European region.

Fatima Driouech (Direction de la Météorologie Nationale, Morocco) presented her talk titled

Seasonal Forecast in Morocco and NA-RCC. She started by briefly describing the history of operational seasonal forecast in Morocco until the recent implementation at DMN of the new version of the seasonal forecasting system based on ARPEGE-Climat with high resolution (~ 54Km over Morocco) and OPA/NEMO. She also presented some evaluation and verification results over Morocco (against observations) and over the North African RCC domain (against reanalysis) of the DMN seasonal forecasting system. Then she described the structure of the pilot North African RCC network and its distribution of responsibilities. Morocco and Egypt are co-leaders for LRF, whereas Algeria and Tunisia for Climate Monitoring. She presented the respective web pages still in developing process.

E. Rodríguez-Camino (Agencia Estatal de Meteorología, Spain) presented *Guidance of the WMO Commission for Climatology on verification of operational seasonal forecast.* Most of the talk aimed at justifying the need to move from current verification practices of consensus forecasts frequently based on qualitative procedures to a true objective standardized system verifying the probabilistic consensus outputs. He proposed to strictly follow the guidance on verification of operational seasonal climate forecasts recently delivered under the auspices of the WMO Commission for Climatology. He also insisted in the importance of common reference periods to ensure comparability of results which are extremely dependant of the chosen reference period. Among other recommendations he mentioned the need of agreeing upon a minimum set of verification procedures/scores for RCOF product, to assess the degree to which consensus forecast are being hedged on normal and to aim at greater standardization in forecast production. He finally proposed to start with a minimum verification package (following WMO-CCI guidelines) for verifying the (tercile-based) consensus forecast produced so far by SEECOF and PRESANORD and to initially use ECA&D data from a set of selected stations.

Tim Stockdale (ECMWF) in his talk *Verification of ECMWF long range forecast systems* explained that a number of factors limit the performance of long range forecast systems. The first is bias, which develops in longer integrations of numerical models and is often comparable in size to the signals which are being predicted. However, bias can be estimated and removed from the forecasts, and it is the calibrated forecasts which should be verified. Calibration can also involve correcting the variance of model forecast, as is done for Nino SST indices at ECMWF. Other systematic errors, such as errors in the spatial structure in modes of variability, are typically not corrected, and will contribute to the forecast errors that a verification system measures. He then explained the different ways to measure forecast skill, as described by the SVS-LRF. However, several important issues should be remembered. Sample size (number of years) is often too small to determine the scores with any accuracy, and the uncertainty from this should always be assessed before any conclusions are drawn about model skill. The effect of long term trends is also important; if these are represented by a model, then the forecast scores can look good even if year-to-year changes are poorly forecast. Finally, he stressed that ensemble size can have a large impact on skill scores, so care must be taken with scores estimated from typical re-forecasts which may have O(10) members instead of the O(50) members of real-time systems.

Branko Bijelic in his talk titled *Current practices in the verification of seasonal forecasts in the South-East European and Caucasus Climate Outlook Forum (SEECOF) region* informed MedCOF-1 audience about the history of SEECOF which was the first COF on the territory of Europe, about the number of SEECOF participants, as well as about the structure of SEECOFs. After that, he presented the sources for the analyses of the previous seasonal air temperature and precipitation anomalies. Examples of the monitoring results for winter 2012/2013 were shown, along with high impact events and the verification of the last SEECOF-8 Consensus statement for winter 2012/2013. At the end of the presentation, he outlined the problems which appeared during the last 7 SEECOF meetings.

Session III – Available information sources for Long-Range Forecasting

Roxana Bojariu (National Meteorological Administration, Romania) presented *Sources of climate variability and predictability in the Mediterranean regions.* He started her talk by introducing the recurrent climate patterns in the Mediterranean area and the sources of such patterns. Among the natural modes of variability and teleconnections affecting the region, she paid special attention to North Atlantic Oscillation, Atlantic Multidecadal Oscillation and El Nino – Southern Oscillation. She also underlined the effect of soil moisture as a local mechanism affecting climate. She mentioned Mediterranean cyclones and Saharan dust events as other local mechanisms affecting climate. She concluded by recalling that climate predictability is regionally and temporally dependent and therefore climate prediction strategy has to be regionally-orientated. She also remarked that existence of scientific significance of climate prediction results does not guarantee socio-economic significance (cost/benefit ratio). She brought attention to the new and updated information on decadal climate predictability produced by IPCC AR5/CMIP5. Finally, she mentioned that the deontological and ethical implications related to socio-economic fast response to climate prediction which should be taken into account.

Tim Stockdale (ECMWF) in his talk *Sources of predictability and error in ECMWF long range forecasts* presented an overview of the operational seasonal forecasting system at ECMWF, known as “System 4”. ECMWF has been running real-time seasonal forecasts since 1997, and now has firmly established operational systems. The model and initialization methods are updated at roughly 5 year intervals, and the present system is the 4th generation. The atmosphere model is at TL255 resolution (about 80km grid) with 91 levels reaching above the top of the stratosphere. Model forecasting systems such as those at ECMWF are now well developed, and have shown continuous improvement in terms of reduced biases, better representation of processes, and better skill scores. System 4 is notable for a substantial improvement in the stratosphere compared to previous versions. Despite this, many challenges remain, for example consistent initialization of the stratosphere and the land surface, as well as model imperfections. He remarked that recent research has demonstrated that observed NH winter is better predicted by the model than should be possible, given the noise levels within the model; for example, the AO can be predicted with an ACC of over 0.6 for a 30 year period. He summarized by saying that GCM forecasting systems are steadily improving; although performance is good in many regions, there are still significant deficiencies in the models and the outcomes they predict; and there seems to be scope for substantial further improvement, in particular for NH winter circulation.

Enrico Scoccimarro (INGV-CMCC) presented the *Activities of Seasonal Modeling at the Euro-Mediterranean Center on Climate Change (CMCC).* He stressed the big effort put by CMCC along the last few years for the implementation of a functioning and reliable forecast system suitable for seasonal and multiannual prediction. He described the current seasonal prediction system (CMCC-SPSv2) consisting of a fully coupled general circulation model initialized in three of the main components of the climate system: ocean, atmosphere and land surface. Then, he summarized the main skill features of CMCC-SPSv2. The skill of CMCC-SPSv2 is very high in the equatorial Pacific, whose Sea Surface Temperature variability linked with ENSO (El Nino Southern Oscillation) is the main driver of the global interannual variance. As a consequence, regions strictly associated with ENSO, such as northern South America and western Pacific, have the highest correlation with observations. Skill is high over North Atlantic in the winter semester, and this could possibly enhance predictability of the European sector. Good performances are found in the forecast of West African Monsoon, allowing potential predictability for the Mediterranean summer. Nevertheless, the amount and pattern of precipitation anomalies in central Africa and Sahel are not accurately simulated. He also mentioned that particular attention was recently paid to initialization of the land surface component of the CMCC-SPSv2 system and to disentangle its contribution from that given by atmosphere initial state. He attributed in general terms

progress in the skill of ocean forecast to the upgraded atmosphere initialization, while predictive skill and accuracy over continents to the effect of land surface initial state. Among the topics becoming critical for the progress of seasonal forecast he mentioned land surface and Arctic sea ice initialization

Vladimir Djurdjevic (RA VI RCC-SEEVCCC) in his presentation titled *Operational sub-regional Long-Range Forecasting Unit at RA VI Regional Climate Center* outlined the operational dynamical downscaling of the ECMWF seasonal forecast started in mid-2009's as a one of the first activities (recommended function) in SEEVCCC. He told that the two-way regional coupled model (RCM-SEEVCCC), based on the ETA/NCEP limited area model for the atmospheric part and on the Princeton Ocean Model (POM), has been used and verified for various applications such as: downscaling of medium range forecast of atmosphere and sea, reanalysis downscaling (Era-Interim downscaling), climate change scenarios downscaling. He also gave information on the SEEVCCC dynamical downscaled seasonal products (51 ensemble member of monthly mean temperature and accumulated precipitation on the regular id 0.25°x0.25º grid) which are available via WMO WIS (http://wis-geo.hidmet.gov.rs:8080/geonetwork/srv/en/main.home)

Jean-Pierre Ceron (Meteo-France) in his talk titled *RA VI RCC Network – LRF Node: activities and products* started by describing the RA VI RCC Network as composed by 3 Nodes for data, monitoring LRF, respectively. The LRF Node is led jointly by Meteo-France and RosHydromet. In addition, the Norwegian Meteorological Institute; the Republic Hydrometeorological Service of Serbia (RHMSS) and the Turkish State Meteorological Service are also contributing to this consortium. A dedicated web site was set up (www.rccra6.org/) and all nodes are providing a catalogue of products and services including the description, main characteristics and examples. These catalogues are currently available in English; they should be also available in Russian in the next. The operations are conducted on a monthly base. Nevertheless, the main seasons of interest are the Winter (DJF) and Summer (JJA) periods (referring to seasons in the Northern Hemisphere).

Then, he made a summary of RCC LRF products. The LRF Node provides products relevant and/or tailored for the RA VI some being directly provided by GPCs (and especially GPC Toulouse and GPC Moscow which have a privileged linkage with the RCC network). The access to the different products is done through dedicated web sites (http://elaboration.seasonal.meteo.fr for Météo-France and http://neacc.meteoinfo.ru/ for RosHydromet (password protected – access granted on request under the WMO umbrella)). All the available products are detailed inside the different catalogs; among them one can quote:

- Monthly SST Niño "plumes" and OOPC boxes over the Tropical Atlantic (North and South) and Indian Ocean (West and East); including IOD and TASI indexes
- Probability forecasts and associated verification for extreme categories
- Climagrams for land boxes for precipitation and temperature
- Forecasted anomaly frequency occurrence of Circulation regime over North Atlantic

The LRF Node provides also products relevant and/or tailored for sub-regions in RA VI like Statistical Adaptation of LRF to Scandinavian regions (using ECMWF forecasts) or Regional dynamical downscaling using fully coupled atmosphere-ocean Regional Climate Model for South-Eastern regions (and ECMWF fields as boundary conditions).

Among the expertised products produced once a month, the LRF Node edits a Global Climate Bulletin (GCB) in collaboration with the GPC Toulouse. The expected lead-time is 1 month for forecasts and it is edited by the end of the current month (for next 3 month forecasts). It contents a review of the state of the climate system and an overview of

seasonal forecasts from individual GPCs and MMEs (Euro-SIP and LC). In addition through a multidisciplinary discussion, guidance is proposed for the most likely scenario over the RA VI region. So the outlooks are provided monthly. The GCB is also adapted to support some COFs.

As experimental products to be shortly provided, he specially mentioned new circulation regimes (using velocity potential and stream function) and an assessment of the current predictability. The velocity potential gives insight into the atmospheric response in terms of Hadley-Walker circulation anomalies whereas the stream function gives complementary insight into the atmospheric response to tropical forcing (especially in terms of teleconnections with mid-latitudes) which is very relevant for the assessment of the current predictability. As an example of use of such information he showed the large improvement in the prediction of the years with a high number of High Precipitation Events (>100mm/day) at fall over the Mediterranean Basin. Another experimental products -so far only produced for France- are related with hydrological seasonal forecasts (Soil Wetness Index and River Flow forecasts).

With respect to capacity training, he mentioned that a 1-week seasonal forecast training is available in Toulouse (presently in French but which could be extended to English). He said that they are participating to several training to the benefit of COFs. Especially in 2012, they have set up a full training session for the implementation of a new COF for the South West Indian Ocean (training both in English and French).

Finally he listed the following points to highlight and recommendation to address:

- To work on sub-regional information /downscaling
- To work on MME issues (especially in relationship with the previous point)
- The use of circulation regimes vs variability modes (including corresponding studies on the impact of large scale signal onto the sub-regional areas).
- To work on the climate trend vs seasonal anomaly (characteristic in the hindcast, relative weight in the scores, filtering or not in the post-processing, …)
- To investigate some other parameters like extreme events (especially related to climate watches), drought related information (e.g. Soil Wetness Index)
- To work on the assessment and prediction of the current predictability (especially using velocity potential and stream function in the high troposphere).
- To work on the use of the intraseasonal information (including MJO, monthly desegregation of LRF etc.)
- To promote the sharing of expertise on operational climate models
- Issuance date of GPC products is critical for the operations of the RCC and the linkage to and feedback from users is of particular importance.

Session IV – Methods, algorithms and relevant projects

Vladimir Djurdjevic (RHMSS/SEEVCCC) comprehensively presented the *Integrated Earth Modeling System (IEMS) used in RA VI RCC-SEEVCCC/RHMSS* based on the NMMB model (which is also used in SEEVCCC/RHMSS as a global model for 10 days ahead). He described its main characteristics including an introduction to the downscaling set-up (14 km horizontal resolution, 8 km experimental, initial and lateral boundary data, period, data used for the verification, etc). He also described other components of the IEMS such as the hydrology component (HYPROM) and the aerosol component or dust model (DREAM) with examples showing the improvement of some results.

Katarina Stefanović (RA VI RCC-SEEVCCC, RHMS of Serbia) presented *Current practice in the RA VI RCC-SEEVCCC/RHMSS Operational Issuing of the Climate Watch Advice on the subregional level* with examples of operational CW advice for two events, flooding in

February 2013 and heat wave in August 2013. Till the end of 2012 the Climate Watch System (CWS) Bulletin was issued for Serbia and whole SEECOF region as a pilot project, whereas from 01 January 2013 it is fully operational. She invited participants to take active part in preparation of subregional advice for SEE region. She concluded saying that the CWS is an operational cooperative system for climate warning based on existing meteorological facilities and infrastructure at regional and national level. According to that, she recalled the necessity to continue establishing CWS in WMO RA VI RCC Networks on CM LRF and that the purpose of subregional CW advice for SEE region is to support National Meteorological and Hydrological Services (NMHS) in implementing national CWS. In order to continue issuing subregional CW advice for SEE region, she stressed the importance of regional NMHSs participation in the preparation and evaluation of CW advice. Finally, she recommended expanding CW advice from subregional to national level.

Massimiliano Pasqui (IBIMET, Italy) in his talk titled *Seasonal forecasts based on statistical algorithms* presented an overview of several statistical methods operationally active on the Mediterranean basin and in particular over Italy. Since 2007 these methods were developed for the Technical Board for the Monthly-to-Seasonal Forecasts for the Italian National Civil Protection as an aid in water management activities. Beside the technical descriptions and examples of relevant seasonal forecast application on intense anomalies occurred, it is shown how statistical methods, both for direct forecast production and for numerical models downscaling purposes, can be effectively useful for improving forecast estimates at seasonal time scale. Furthermore statistical models can give comparable and even higher skills for specific regions and for some variables and their results can be easily applied for practical use without a full comprehension of physical mechanisms behind. Finally statistical models need little computational resources being much simpler to be used than dynamical ones, but they require some careful attention since reliability is obtained through a balance between goodness-of-fit and stability of the model. Since seasonal forecasting deals mainly with large scale climatic phenomena and, in particular with emerging atmospheric-oceanic regimes, circulation classification methods can provide a useful analysis tool for increase forecasted information reliability.

Ana Vukovic (RA VI RCC-SEEVCCC, RHMS of Serbia) presented *Seasonal forecast post-processing development for the local end-user benefit.* After describing the SEEVCCC LRF system setup based on a fully coupled atmosphere-ocean RCM for dynamical downscaling of ECMWF seasonal forecasts, she enumerated some applications of LRF and paid special attention to special operational products for the agricultural sector.

Jean-Pierre Ceron, (Meteo-France) in his talk titled *Current status of EUPORIAS and SPECS projects* provided updated information on the progress of both project relevant to the seasonal forecast community.

With respect to SPECS project (http://www.specs-fp7.eu), he recalled that the main objective of the project was to deliver a new generation of European climate forecast systems, including initialised Earth System Models (ESMs) and efficient regionalisation tools to produce quasi-operational and actionable local climate information over land at seasonal-to-decadal time scales with improved forecast quality and a focus on extreme climate events, and provide an enhanced communication protocol and services to satisfy the climate information needs of a wide range of public and private stakeholders. Among the main tasks to be developed within the project he mentioned: (i) work on initialisation; (ii) model improvement; (iii) calibration and combination; (iv) forecast quality assessment; (v) improving processes like sea ice, projections of volcanic and anthropogenic aerosols, vegetation and land, …; (vi) more sensitivity to the users' needs.

With respect to the EUPORIAS project (http://www.euporias.eu), he recalled that the project intends to improve our ability to maximise the societal benefit of these new technologies.

Working in close relation with a number of European stakeholders this project want to develop a few fully working prototypes of climate services addressing the need of specific users. The time horizon is set between a month and a year ahead with the aim of extending it towards the more challenging decadal scale. After summarizing the main outcomes from the initial stakeholder meeting held at the beginning of the project, he described with some detail the contribution of Meteo-France to the project. This contribution was mainly focused on calibration and downscaling, on the impact of relevant climate information indices, on impact models for impact predictions, and on the real impact of climate information onto the decision making process. In connexion with this last theme, he introduced the placebo concept to evaluate the impact of climate information on decision processes.

Session V – Closing session - Wrap up and the way forward

E. Rodríguez-Camino (Agencia Estatal de Meteorología, Spain) presented a short summary of the LRF Training event outcomes. He started by recognizing the steady improvement of seasonal models as it was shown and discussed during the sessions. Recent results of NAO forecasts seem to point towards a remarkable increase of skill at winter season. He stressed the need of monitoring information for verification purposes and over all the need of standardized verification of probabilistic consensus outlook following the guidelines proposed by CCI. He also underlined the need to evaluate/verify every model used during consensus exercises and the need for a systematic approach to the sources of predictability as input both to the development and use of empirical algorithms and to the evaluation of models. He finally recalled the recommendation mentioned during the training event of applying downscaling algorithms and the convenience of including during the sessions, as a source of additional information, updates on relevant projects/initiatives.

Then, a lively discussion followed on some questions important for the design of future training events. The first point to be raised was the convenience of holding LRF training events jointly with forum sessions or uncoupled from them. After considering the pros and cons, most participants showed their preference for training events separated from forum sessions. Organizers would have in this way more flexibility both in terms of dates and venues. Also the excessive duration of joint events could be palliated by separating forum and training sessions. It was also preferred slightly longer training events (1 week) and focused on some specific theme. With regard to prioritized themes for the next LRF training session, there was preference for “Basic knowledge on climate for seasonal forecasting purposes including predictability aspects”. Other themes also proposed for successive training events were: i) practical work on downscaling methods; ii) applications including tailoring of products and communication. Although rotation among countries was considered as something desirable for organizing LRF training events, the existence of adequate facilities (including residence) was considered a decisive factor to choose one particular venue.

4. Conclusions and Recommendations

We can draw the following non-exhaustive list of conclusions and recommendations from both the individual presentations and discussions held during the training event.

Conclusions:

- Models are steadily improving due to the better representation of many processes (sea ice, projections of volcanic and anthropogenic aerosols, vegetation and land, coupling, etc) conveying an optimistic message about the perspectives of improving skill at seasonal scales for midlatitudes. In particular, very promising results of a state-of-the-art model able to predict the winter NAO index with a very acceptable skill were shown.

- Sample size (number of years) is often too small to determine the scores with any accuracy, and the uncertainty from this should always be assessed before any conclusions are drawn about model skill.
- The effect of long term trends is also important; if these are represented by a model, then the forecast scores can look good even if year-to-year changes are poorly forecast.
- Ensemble size can have a large impact on skill scores
- From the perspective of the sources of climate variability and predictability, it must be taken into account that climate predictability is regionally and seasonally dependent and therefore any climate prediction strategy has to be regionally-orientated.
- Statistical methods, both for direct forecast production and for numerical models downscaling purposes, can be effectively useful for improving forecast estimates at seasonal time scale.
- Statistical models can give comparable and even higher skills for specific regions and seasons and for some variables and their results can be easily applied for practical use without a full comprehension of physical mechanisms behind.
- Statistical models require some careful attention since reliability is obtained through a balance between goodness-of-fit and stability of the model.
- Need of agreeing upon a minimum set of verification procedures/scores for RCOF products to assess the degree to which consensus forecast are being hedged on normal and to aim at greater standardization in forecast production.
- Importance of common reference periods to ensure comparability of results which are extremely dependant of the chosen reference period.
- Issuance date of GPC products is critical for the operations of the RCC and the linkage to and feedback from users is of particular importance.
- Cases of miscommunication of probability forecast are not infrequent. Special emphasis should be put in the communication of seasonal forecasts.

Recommendations:

- To do more effort on statistical than dynamical downscaling due to the high computing cost of dynamical methods and also because statistical downscaling is less affected by non-stationarity of the relationships than climate change.
- To conduct reliable and robust calibration and combination to improve scores.
- To include always forecast quality assessment.
- To have more sensitivity to users' needs.
- To use RCC Climate Monitoring products for verification of the RCOF consensus forecasts and for climate analyses and diagnostics.
- To follow the guidance on verification of operational seasonal climate forecasts recently delivered under the auspices of the WMO. Commission for Climatology.
- To work on MME issues
- The use of circulation regimes vs variability modes (including corresponding studies on the impact of large scale signal onto the sub-regional areas).
- To work on the climate trend vs seasonal anomaly (characteristic in the hindcast, relative weight in the scores, filtering or not in the post-processing, …)
- To investigate some other parameters like extreme events (especially related to climate watches), drought related information (e.g. Soil Wetness Index)
- To work on the assessment and prediction of the current predictability (especially using velocity potential and stream function in the high troposphere).
- To work on the use of the intraseasonal information (including MJO, monthly desegregation of LRF, …)
- To promote the sharing of expertise on operational climate models

ANNEX I

LONG-RANGE FORECASTING TRAINING
(LRF Training)

Belgrade, Serbia, November 13-16, 2013

AGENDA

13 November 2013 (Wednesday) – LRF Training		
11:30-12:00	**Registration**	
12:00-12:30	**Session 1:** Opening/Welcome addresses Introduction forecasting: state-of-the-art	*PR of Serbia with WMO* *WMO Representative* *E. Rodriguez Camino on behalf of F. Doblas-Reyes, IC3*
12:30-14:00	**Training Session 2: Monitoring and verification** • Information elaborated by RA VI RCC on Climate Monitoring • Information elaborated by RA I RCC on Climate Monitoring	*P. Bissolli*, RA VI RCC node on CM *E. Rodriguez Camino*, AEMET *on behalf of RA I RCC*
14:00-15:00	Lunch break & Group photo	
15:00-17:00	• Verification of operational seasonal forecasts at RA VI Regional Climate Center – South-East European Virtual Climate Change Center • Current practices on verification of seasonal forecasts in the South-East European Climate Outlook Forum region • Guidance of the WMO Commission on Climatology on probabilistic seasonal forecasts • Verification of the current seasonal forecasting systems of the European Center for Medium-Range Weather Forecasts as Global Producing Center	*G. Pejanovic*, RA VI RCC-SEEVCCC *B. Bijelic*, RA VI RCC-SEEVCCC *E. Rodriguez Camino*, AEMET *T. Stockdale*, GPC ECMWF
14 November 2013 (Thursday)		
9:00-10:30	• Current practices on	*F. Driouech*, PRESANORD

	verification of seasonal forecasts in PRESANORD **Training session 3: Available information sources for Long-range forecasting** • Sources of predictability at seasonal time scale for the Mediterranean region	*R. Bojariu*, National Meteorological Administration, Romania
10:30-11:00	Coffee break	
11:00-13:00	• Sources of predictability and sources of error in ECMWF long range forecasts • Activities of seasonal modelling at the Euro-Mediterranean Center on Climate Change (EMCCC)	*T. Stockdale*, GPC ECMWF *E. Scoccimarro*, INGV-CMCC
13:00-14:30	Lunch break	
14:30-15:30	• Operational sub-regional Long-Range Forecasting Unit at RA VI Regional Climate Center – South-East European Virtual Climate Change Center	*V. Djurdjevic*, RA VI RCC-SEEVCCC
15:30-16:00	Coffee break	
16:00-	• Information elaborated by RA VI Regional Climate Center Node on Long-range forecasting	*J. P. Ceron*, RA VI RCC on LRF
15 November 2013 (Friday)		
9:00-10:30	**Training session 4: Methods, algorithms and relevant projects** • Integrated Earth Modeling System and its dynamical downscaling of seasonal forecasts • Current practice in the RA VI RCC-SEEVCCC operational issuing of the Climate Watch System bulletin for the advisory purposes on the regional level	*V. Djurdjevic*, RA VI RCC-SEEVCCC *A.* *K. Stefanovic*, RA VI RCC-SEEVCCC
10:30-11:00	Coffee break	
11:00-13:00	• Seasonal forecast post-processing development for the local end-user benefit • Seasonal forecasts based on statistical algorithms	*Vukovic / M. Vujadinovic,* RAVI RCC-SEEVCCC *M. Pasqui*, CNR
13:00-14:00	Lunch break	

14:00-14:30	Coffee break	
14:00-15:30	• Current status of EUPORIAS and SPECS projects	*J. P. Ceron*, RA VI RCC on LRF
16 November 2013 (Saturday)		
9:00-10:30	**Session 5: Closing session -** Wrap up and the way forward	
10:30-11:00	Coffee break	
11:00	FIELD TRIP TO VIMINACIUM	

ANNEX II

PARTICIPANTS TO
THE LONG-RANGE FORECASTING TRAINING (LRF Training)

Belgrade, Serbia, November 13-16, 2013

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