PROCEEDINGS OF THE RA VI TASK TEAM ON THE PROVISION OF SEASONAL TO INTER-ANNUAL FORECASTS AND REGIONAL CLIMATE CENTRE SERVICES (RA VI-TT/SIRCC)

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1. Introduction

1.1 Opening

The meeting of the RA VI Task Team on the provision of Seasonal to Inter-annual Forecasts and Regional Climate Centre Services (TT/SIRCC) was held in Reading, UK, from 14 to 16 April 2003. Mr Stefan Mildner, Germany, the chairman of the Task Team, opened the meeting. In his opening remarks, the chairman thanked Dr David Burridge, Director of the European Centre for Medium-Range Weather Forecasts (ECMWF), for hosting the meeting. He provided a brief background to the meeting including the Terms of Reference of the Task Team. The main objective of the Task Team is to establish a mechanism for the provision of long-range forecast on an operational basis and also to define the services to be provided by Regional Climate Centres in RA VI. He pointed out that the expected output of this meeting was a plan of an implementation programme to be submitted to the acting president of RA VI. He further recalled that Members in RA VI placed high expectations on the developing skills in Long-Range Forecasting (LRF), particularly in terms of predicting extreme weather events, which have recently affected large parts of the Region. He cautioned, however, that in view of the limited quality of LRF in mid-latitudes only modest results can be expected during the start-up phase of the intended system. Mr Mildner recalled that the Task Team's activities are cutting across several WMO Programmes, namely the WWW and WCP but also CAS and WCRP and contributed to the development of the relevant regional component which fell under the responsibility of the RA VI working groups on WWW planning and implementation and on Regional Climate Related Matters which were represented on the Team.

Dr Burridge, the director of ECMWF welcomed the Task Team and expressed his appreciation for being able to host the meeting. He referred to the activities of the Centre in the field of LRF, which showed already promising results on a global scale. He informed the meeting that ECMWF is in the process of changing its Convention to include the provision of LRF on an operational basis and further research into multi-model ensemble prediction the results of which will be made available to all Members. Dr Burridge assured the Team of the full support of the ECMWF both in regard to the operational production of global LRF and relevant research programmes. He wished the Task Team a successful meeting.

1.2 Adoption of Agenda

The Agenda was adopted with a minor change on item 2.2 to indicate that the Workshop on SI Forecasts held in Geneva was organised by the Commission on Basic Systems (CBS) in collaboration with the Commission on Climatology (CCl). The Agenda and the list of participants are contained in Annexes 1 and 2 to this report.

1.3 Organisation of the Session

The Task Team agreed on its working hours during the session and other organisational matters.

2. TERMS OF REFERENCE AND REQUIREMENTS

2.1 Review of the Decisions of XIII-RA VI

The chairman introduced Resolution 9 of XIII-RA VI in which the terms of reference, the membership of the Team and the reporting mechanism are defined. He emphasised that RA VI had requested the Team to report directly to the president of the Region to ensure that the implementation of an operational system providing LRF to Members in RA VI would not be

delayed. A phased approach will be needed to establish the operational mechanism required for provision of LRF to the Member States.

2.2 Results and Recommendations of the CBS/CCl Workshop on LR Forecast

The Task Team noted the results and recommendations of the CBS/CCl Workshop on SI Forecast held in Geneva 10-13 February 2003. It was appreciated that in the global comparison of producers of LRF the centres in Europe represented a fairly advanced stage, which allowed an early transition to the operational phase. The Team further considered that the development of the user interface in RA VI would need particular attention since the majority of Members in the Region had not yet gained practical experience in the use and interpretation of LRF products and relevant requirements are different in various parts of the Region. It agreed that introducing operational LRF services could greatly benefit all Members in the Region once the quality of the global products and the methods of downscaling them to regional applications had reached an acceptable level.

Statement of Requirements

Different approaches for developing a statement of requirements were discussed. It was noted that it is difficult to propose requirements from a small expert group without broad consultation among NMHSs and end users before the LRF products are commonly known and used. The Task Team recalled that lists developed earlier by the Inter-Commission Task Team and approved by EC gave a fairly comprehensive view of existing requirements, which will have to be adapted to regional needs. One pragmatic way was to start looking at what the Global Producing Centres (GPCs) in RA VI can readily provide on the understanding that the process of defining LRF requirements will continue as Members are gaining experience with the application and interpretation of such products.

Peer Hechler, representing the RA VI Working Group on Climate Matters, informed the Task Team that there are a number of requirements for Regional Climate Centre (RCC) functions in addition to those related to the operational provision of LRF. The Team was pleased to note that he had already taken initiative to compile such requirements by means of a questionnaire sent to the CLIPS focal points of RA VI Members, and that first results are expected already in June this year at the RA VI CLIPS workshop in Erfurt, Germany.

The Task Team followed the above pragmatic approach and agreed on a list of LRF products which is reproduced in Annex 3 and taken from the CBS Expert Team on Infrastructure for Long-range Forecasting meeting held in Geneva from 12 to 16 November, 2001. It contained products most of which are already available or can be made available by each of the four GPCs in RA VI (ECMWF, UKMO, MétéoFrance and RosHydromet). It was agreed to use this list as a basis for starting the implementation of a LRF system in RA VI.

Concerning RCC services, the Team considered that it would be premature to come up with a statement of requirements before Members in RA VI had a chance to respond to the above questionnaire. However, in the course of its deliberations the Team agreed to identify all those functions, which it considered necessary for the performance of a RCC.

3. EXISTING LRF PRODUCTS AND SERVICES IN RA VI

3.1 Presentations by Global Producing Centres in RAVI

The four Centres in RA VI who have committed to provide LRF products to Members in the Region on an operational scale gave presentations on their activities with particular

emphasis on issues such as their products and accessibility, computing capabilities and research programmes. A summary of their presentations is given in Annex 4 – 7.

The Task Team was pleased to note that the ECMWF and the UK Met Office have already reached the stage of operational LRF production and make many of their products available through the Internet. The other two centres are still in the pre-operational stage but can be upgraded to operational production within relatively short time. All RA VI GPCs can commit to providing the full range of products to Members in RA VI as soon as the system is formally established or at least within twelve months thereafter.

3.2 Operational Products

In keeping with the above-mentioned pragmatic approach, the Task Team considered the present production of LRF in the four centres concerned. Despite the fact that there are a few differences, it was confirmed that harmonisation of the production schedules and contents was possible. In this connection the ECMWF informed the Team that the provision of some of the products from its operational output would require approval of the ECMWF Council before broad availability can be granted. The Team agreed therefore that a subset of the list of GPC products and services referred to in paragraph 2 (see Annex 3) above could serve as a starting point for the operational LRF system to be implemented in RA VI.

3.3 Research Programmes

The Task Team then considered several ongoing or planned research projects relating to the LRF activities of the four GPCs in RA VI. The Team was pleased to note that three of the centres are participating in the EU project DEMETER to develop and validate a European multi-model seasonal forecast system. This project, coordinated by ECMWF, has provided excellent opportunities for the further development and improvement of the global LRF products and of methodology for downscaling of global LRF products for regional application. It noted in this context that the project DEMETER complete in October 2003 and that resulting data sets are available to the research community. It was further informed that under this project several groups have developed methods for downscaling of global products which are due to be published soon. In addition ECMWF, Met Office and Météo-France are collaborating in the implementation of a real-time multi-model forecast system to be run at ECMWF.

The Task Team congratulated the three GPCs on collaborating in projects like DEMETER or ENACT. It noted that follow-up projects such as ENSEMBLE have already been started or are planned. It considered that such joint research projects carry a high potential for improved services for the whole of RA VI. The Team emphasized in this connection that RosHydromet be invited to collaborate with the other GPCs in future research activities.

It also agreed that an important RCC function would be to participate and follow-up on the developments in the research field, particularly concerning downscaling methods and products for special applications for regional use.

4. A SYSTEMS APPROACH FOR RA VI

4.1 Infrastructure Requirements

The Task Team considered the requirements for operational infrastructures needed for the LRF system in RA VI. It noted that many of the required products were already made available on the web sites of the GPCs concerned. (A list of relevant URLs is given in Annex 8) Other channels for the provision of regular services, e.g. the RMDCN, are also available to

guarantee the exchange of LRF products on the various levels. Apart from recommending mutual linking of the web sites the Task Team saw no need for special arrangements at this stage.

It was noted in this context that the access to specific climate data sets used for the calibration of LRF products and verification purposes was limited. On the other hand it appeared unnecessary at this stage to change the present practice of LRF verification performed by the GPCs. Globally, the verification of LRF products is co-ordinated by GPC Melbourne and Montreal, which were recently designated by CBS/Ext. Cairns, Australia.

The Team emphasised that Members should have ready access to all LRF products from the GPCs in RA VI and to the results of comparisons as well as verifications conducted under the standard verification scheme agreed by the WMO programmes. It recommended that such results be published in a standard format for use in RA VI. The offer by the ECMWF to co-ordinate this activity for the region was noted with appreciation.

The Task Team concluded that use of the current available infrastructure satisfied the needs of a regional LRF system at least during the initial phases. It is expected, however, that infrastructure demands may increase, as the use of LRF products by the NMHSs will expand.

4.2 Organisational Aspects and Standards Needed

It was observed that ECMWF has already established a fixed schedule for the issuance of their LRF products. The other GPCs are invited to also establish and publish their production schedules for the benefit of all Members in RA VI who wish to make regular use of these products.

It was agreed that standard output formats will be graphical in the first phase with a view to introducing additional standard formats for data representation (namely GRIB fields) as agreed by the four European GPCs in conformity with global practice

The Task Team observed that there are a number of other standardisation issues which need to be addressed. These related for example to the detailed content of the LRF products (use of median vs. mean values, the different data sets or model climatology used for calibration/verification and possibilities for further harmonisation of the graphical presentation standards.)

4.3 Potential for Joint, Coordinated Research Activities

The Task Team briefly reviewed the ongoing and proposed joint research activities being undertaken within RA VI that were already referred to in paragraph 3.3. It noted that from this list project DEMETER was one of the good examples of joint research activities the results of which are now becoming available to the NMHSs and the research community.

The DEMETER project (Development of a European Multiple-model Ensemble system for seasonal to interannual climate prediction), is investigating the benefits of a multi-model forecast system comprising seven European ocean-atmosphere models, and the potential benefits that such a forecasting system would bring to agricultural and health sector applications. The project has included development of several downscaling methods to adjust the raw model output to the scales required for the applications, and thus has built expertise and infrastructure in this field that will be of use in RCC and other user activities. Retrospective forecast datasets from the DEMETER multi-model are available from the ECMWF website and may be used, for example, for training purposes or for investigating potential forecast services.

Improvement of seasonal predictions through implementation of enhanced ocean data assimilation schemes are being investigated under the EU project ENACT (ENhanced ocean data Assimilation and Climate predicTion). The goal of the ENACT project is to produce global ocean analyses for the last 45-plus years, and to examine ocean climate variability and uncertainty on a wide range of time scales. In addition to greatly enhancing the implementation of state-of-the-art data assimilation systems in climate forecast models, ENACT will also quantify their impact on seasonal climate forecasts, and provide exploratory results on multi-annual forecasts, so paving the way for the establishment of a real-time European climate analysis and prediction activity on seasonal to multi-annual timescales. For the first time, seasonal outlooks will include in the ensemble of forecasts the influence of the uncertainty in the ocean initial conditions.

Further exploration of the potential of a European multi-model system is planned as part of the proposed ENSEMBLES project. The overall objective of ENSEMBLES (ENSEMBLE-based predictions of climate changes and their impactS) is to maintain and extend European pre-eminence in the provision of policy relevant information on climate and climate change and its interactions with society, by (i) developing a high-resolution ensemble prediction system validated against high resolution gridded datasets for Europe to produce for the first time an estimate of uncertainty in future climate, (ii) quantifying and reducing the uncertainty in the representation of physical, chemical and human-related feed-back in the Earth System, (iii) exploit the results into a range of applications including agriculture, health, water resources and weather risk management.

The Task Team commended all those actively contributing to the joint research projects in this area. It underpinned the potential role of RCCs in LRF research activities and the need to allow active participation of NMHSs as well as end users to derive maximum benefits from the results of this work. The Team further noted that developing multi-model ensemble systems promises not only better model results but would also lead to more standardisation of the output products.

In view of the existing LRF research activities the Team felt that there is no need to come up with proposals for additional co-ordinated projects. It confirmed, however, that the method of downscaling and application of global LRF products to regional user needs requires future attention particularly by the RCCs in RA VI.

4.4 List of Products and Services Required

Annex 3 gives a list of products recommended by the Geneva meeting to be provided by different GPCs. However, the Task Team recommended a list of products provided by ECMWF, which could realistically be provided by the four European GPCs within a reasonable time frame. This list is given in paragraph 7.2.

The Task Team entrusted the chairman to submit this list to the acting president of RA VI as part of the proposal for the implementation of the operational LRF system in the Region.

ECMWF mentioned that requests were expressed in Geneva that its LRF SST products are used as boundary conditions for (two-tiered) AGCM predictions and that such provision needs to be agreed by the Council. The Task Team supported this request on the understanding that it would be brought to the attention of the ECMWF Council at the next session.

4.5 Arrangement for Feedback from Users

The Task Team agreed that regular feedback from LRF users is of vital importance for the further development and adaptation of these products for operational use. It considered

options to institutionalise the dialogue between providers and users of LRF in RA VI. The Team was pleased to note that the ECMWF is organising workshops for its Members every other year which provided excellent opportunities for NMHSs and end users to provide feed-back to GPCs. The Team recommended that participation in workshops on LRF be open as far as possible to all NMHSs in the Region. It also recommended that GPCs may take turns in hosting events dealing with all questions relating to operational provision and use of LRF products. The Team further stressed the need to involve also end users in the provision of feed-back to the LRF producers.

The Task Team agreed that it should be a key role of RCCs in RA VI to organise events as required to discuss LRF and RCC services between the users and providers of these services. These events would also provide welcome opportunities for training of experts and capacity building for NMHSs in understanding and using the LRF products available in RA VI.

Having considered the above options, the Task Team agreed that there are many opportunities already existing to provide for a regular dialogue between GPCs and users of their products. Other opportunities mentioned in this context are the forthcoming RA VI CLIPS workshop, (June, Erfurt/Germany), relevant workshops organised by the ECMWF and the other GPCs, or possibly also the ECAC meeting planned to be held in Nice/France in 2004.

5. POST PROCESSING OF LR FORECASTS

5.1 Downscaling of Global Products for Use in RA VI

The Task Team acknowledged the efforts made to develop methods of downscaling LRF products as a spin-off of research projects like DEMETER. It noted that these developments are just being published and will require much more research work before a stage of operational application is reached. The Team therefore encouraged the collaborating GPCs/NMHSs to continue and possibly strengthen their efforts within the framework of joint co-ordinated projects. The Team agreed that, lacking a proven methodology, it would be not appropriate at this stage to centralise the functions of downscaling LRF products and application to special uses, e.g. in the areas of food production or health etc.

In regard to the role of RCCs, the Team agreed that they should collaborate closely with the GPCs in developing relevant post-processing methods and co-ordinate training and capacity building activities to serve NMHSs and end users in their area of responsibility.

5.2 Applications for Specific Users

The Task Team observed that most of the application models are tuned on observed data and therefore require downscaled forecasts as input. The Team noted that data sets for developing and validating downscaling methods e.g. from the DEMETER project, have just started to become readily available. It is therefore recommended to wait until the methodology is ready before central application in RCCs.

6. TRAINING AND CAPACITY BUILDING REQUIREMENTS

6.1 The Role of NMHSs and GPCs

The Task Team considered the need for capacity building and training with regard to the use of LRF products. Given the fact that many NMHSs in RA VI are not familiar with the use of LRF products the Team felt that the level of awareness be raised and relevant measures be

taken to familiarise Members with these products now becoming available. In this connection it was acknowledged that the GPCs have published a lot of information on their LRF products, which is available through the internet. The Team encouraged the use of this material and other publications and invited the RA VI programme bodies to consider the issuance of guides or manuals as a basis for training experts and end users.

In view of a considerable number of activities planned in RA VI which can be used as opportunities to promote the potential use of LRF the Team agreed that these were sufficient, if used systematically, to meet the needs for training and capacity building of NMHSs. It further recognised that such events should eventually be open to end users developing their capability to deal with LRF products in their specific areas of application. From the events mentioned in this context, the ECMWF seminars and workshops, the RA VI CLIPS Workshop in June and the ECAC (European Conference on Applied Climatology, in Nice/France 2004) were quoted. Similarly, the three other GPCs are organising regular user meetings which could be focused on LRF and might be able to arrange for special training courses upon request on a cost recovery basis.

The Task Team agreed that GPCs together with the programme bodies of WMO have to play a major role in arranging for LRF training by making use of the opportunities offered in RA VI.

6.2 The Role of RCCs

The Task Team emphasised that the role of the RCCs is equally important since they shall focus on the application of LRF in the Region and provide the interface between the GPCs and the NMHSs. The Team agreed that the RCCs could provide very useful services to help NMHSs and their end users to better understand and use the potential benefits of LRF products.

7. IMPLEMENTATION PLAN FOR RA VI

7.1 Development of a Proposal for RA VI Operational Structure

The Task Team discussed the general layout and content of a plan and implementation programme for the provision of LRF products in RA VI, which are outlined in the following paragraphs.

7.2 Action Plan for Implementation

The Task Team reviewed the user requirements for LRF products as recommended by the CBS Expert Team on ILRF and reviewed again in the recent WMO workshop on GPC (Annex 3). The Team agreed that the requirements list provided a viable basis for the implementation of operational LRF activities in RA VI. However, it felt that for the purpose of establishing the operational services in the Region, a subset of items on the list may serve as a pragmatic starting point.

The Task Team was informed that the four global LRF centres in RA VI already produce and to a varying extent provide a range of LRF products to the users. ECMWF and the Met Office operate web sites for access by WMO Members under password protection while WMC Moscow and METEO-FRANCE currently provide products for internal use only.

The following table gives the range of products, which are routinely available from the ECMWF web site in graphical form.

Table 1: The following Products are routinely available in graphical form in a password protected are from ECMWF website (http://www.ecmwf.int/products/forecasts/seasonal)

1.	**Ocean analysis**
	Parameter: - Temperature anomaly along the equator (ocean cross-section) - Sea level anomaly - Zonal wind stress anomaly
	Area: - Tropical belt
	Period and valid time: - 7-day mean, updated weekly
2.	**Seasonal forecasts: Nino's indices** - Nino 3, 3.4, 4 SST anomaly plumes
3.	**Seasonal forecasts: Forecast maps**
	Area: - Global and sub-areas
	Parameter: - Precipitation - Temperature at 2 metres - Mean sea level pressure - Sea surface temperature
	Type: - Ensemble mean value - Probability of below/above various thresholds
	Lead time: - 1, 2, 3 months
	Period and valid time: - 3-month averages, updated monthly

The Task Team agreed that the ECMWF list of products is in agreement with the products requirements list specified by the ETILRF and meets these requirements to a large extent. The range of products available from the Met Office site is similar and can readily be extended to match the ECMWF list.

While acknowledging that the current GPC activities and services provide the basis for establishing some initial LRF activities in the region, the following plan for the implementation of a full range of services was considered to be achievable:

- Additional parameters as specified by the ETILRF will be considered for distribution by ECMWF, with the necessary agreement of its Council, i.e. Z500, T850 and surface pressure field indices as graphical products (end 2003);
- Monthly averaged SST forecasts in gridded form (GRIB) will be considered for distribution by ECMWF, with the necessary agreement of its Council (early 2004);
- Met Office to expand the product range on its own website to include a larger subset of the recommended products (2004);
- Met Office and Météo-France LRF system will be run jointly with ECMWF seasonal forecasts in a multi-model system:
  - Met Office products initially (early 2004), and Météo-France (later in 2004) LRF products to become available in a graphical form equivalent to the ECMWF products;
  - multi-model products to be developed based on the three models (2004/2005);

- WMC Moscow to develop web site with LRF products for NMHS users (later 2004).

Sometime later in the future, depending on the progress of research and the skill evolution of the forecasting systems, it is anticipated that the products can be provided as monthly averages and in gridded digital form. Also, the higher order information from the forecasting

systems as specified in the ETILRF requirements, such as cyclone activity, frequency of wet and dry or hot and cold spells etc is expected to become available later in the programme.

7.3 Responsibilities for Future Activities under the RA VI Programme

The Task Team agreed that the implementation of a LRF system in RA VI should start as soon as the acting president of RA VI has approved the proposed plan resulting from this meeting. As most of the required preconditions exist in RA VI, and the four GPCs have formally committed their services to provide LRF products to Members, January 2004 is proposed as the official starting date for the provision of operational services in the Region.

Once the system has been established, the planning task of the Team is completed. Looking into the future, the Team considered that the responsibility for follow-up actions will have to be taken up by the regional programme groups, i. e. the RA VI Working Group on WWW Planning and Implementation and its Co-ordinator on the Data Processing and Forecast Systems (DPFS) and the RA VI Working Group on Climate Related Matters and its Rapporteur on the Implementation and Co-ordination or Regional Climate Centres who are both ex-officio members of the Task Team.

The Task Team considered that the four GPCs and RCCs, once formally established, would form a network of LRF providers, which can effectively deal with all questions of operations, standardisation, research and development, user feedback and capacity building etc. These questions will need continued attention as the LRF system in RA VI evolves. The LRF providers would report to the RA VI Working Groups on WWW and on Climate-related Matters. The latter will also cover the RCC services in the climate information domain expected to be defined by the RA VI CLIPS workshop.

It is therefore recommended that the Task Team be kept in place during the start-up phase of the LRF system to ensure that the above questions can be addressed and solved without delay. This function should be completed with a review after the first year of operations and a performance report to the next session of RA VI.

8. CLOSURE

After the customary exchange of courtesies the meeting closed at noon on 16 April 2003.

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ANNEX II

LIST OF PARTICIPANTS

Mr Stefan MILDNER (Chair)
Deutscher Wetterdienst (DWD)
Business Area Technical Infrastructure
P.O. Box 100465
63004 Offenbach
Germany

Tel: (+49 69) 8062 2846
Fax: (+49 69) 8062 5217
E-mail: stefan.mildner@dwd.de

Mr Horst BöttGer
ECMWF
Shinfield Park
Reading, Berkshire RG2 9AX
United Kingdom

Tel: (+44 118) 949 9060
Fax: (+44 118) 986 9450
E-mail: horst.boettger@ecmwf.int

Mr Frédéric Chavaux
Météo-France
42, Avenue G. Coriolis
31057 Toulouse cedex 1
France

Tel: (+33 5) 6107 8210
Fax: (+33 5) 6107 8209
E-mail: frederic.chavaux@meteo.fr

Dr Gregor Gregoric
Environmental Agency of Slovenia
Vojkova 1B
1000 Ljubljana
Slovenia

Tel: (+386 1) 478 4065
Fax: (+386 1) 478 4054
E-mail: gregor.gregoric@gov.si

Mr Peer Hechler
Deutscher Wetterdienst
P.O. Box 100465
63004 Offenbach
Germany

Tel: (+49 69) 8062 2761
Fax: (+49 69) 8062 5207
E-mail: peer.hechler@dwd.de

Dr Richard Graham
Met Office
London Road
Bracknell, Berkshire RG12 2SZ
United Kingdom

Tel: (+44 1344) 856 361
Fax: (+44 1344) 854 499
E-mail: richard.graham@metoffice.com
rjgraham@meto.gov.uk

Dr Dmitry KIKTEV
Hydrometeorological Centre of Russia
11-13 Bolshoi Predtechensky
123242 MOSCOW
Russian Federation

Tel: (+7 095) 255 13 54
Fax: (+7 095) 255 15 82
E-mail: kiktev@rhmc.mecom.ru

Mr Dominique MARBOUTY
ECMWF
Shinfield Park
Reading, Berkshire RG2 9AX
United Kingdom

Tel: (+44 118) 949 9003
Fax: (+44 118) 986 9450
Email: dominique.marbouty@ecmwf.int

WMO Secretariat:

Dr Buruhani NYENZI
Chief, Climate Applications and
CLIPS Division
World Climate Programme Department
7 bis, avenue de la Paix
1211 Genève 2
SWITZERLAND

Tel: (+41 22) 730 8273
Fax: (+41 22) 730 8042
Email: Nyenzi_B@gateway.wmo.ch

ANNEX III

LIST OF RECOMMENDED LRF PRODUCTS
TO BE MADE AVAILABLE BY GLOBAL SCALE PRODUCING CENTRES
(As recommended by WMO/CBS/ETILRF)

The ET considered the recommendations in Annex 1 of ICTT (WCASP-No. 52) and the recommendations of the CBS ET on EPS in its discussions of product requirements. The forecast product requirement addressed by ETILRF is that of experimental access by all NMHSs to LRF products from global scale producing centres. Wider user requirements are addressed in the recommendations of the ICTT.

Requirements that have attracted a significant consensus are shown **in bold**. Some of the requirements are new or newly stated relative to previous recommendations noted above.

1. Forecast Products

Note: it is recognised that some centres may provide sub-sets of the product list, according to their LRF capacity.

Basic properties
Temporal resolution.
Monthly and seasonal (3-month) averages/accumulations/incidences

Spatial resolution.
2.5° x 2.5° (note: selected to match resolution of current verification data)

Spatial coverage. **Global**
(separate areas of interest to users, down to sub-regions of a continent or ocean basin, may be provided on special request from Members)

Lead time. 0 – 6 months for monthly forecasts and 0-4 months for seasonal forecasts. This reflects the 6-month requirement regarding products to be issued to end user. Some end user requirements extend to 15 months. Note end-user requirement of 3 months minimum for warnings of high amplitude and abnormal events, such as increase in tropical storm frequency or change in phase of ENSO. (Forecast range determines how far into the future LRF are provided. Forecast range is thus the summation of lead time and forecast period) Note on definition of lead time: for example, a monthly forecast issued on 31 December has a lead time of 0 months for a January forecast, and a lead time of 1 month for February forecast, etc.; a three-monthly forecast issued on 31 December has a lead time of 0 months for a January-to-March forecast, and a lead time of 1 month for February-to-April forecast, etc.

Issue frequency. Monthly

Output types. Gridded numerical values, area-averaged values and indices, and/or images.

Indications of skill must be provided (see "skill and confidence levels" in Section 2), in accordance with recommendations from CBS on the Standardised Verification System.

Content of basic forecast output: (some products are intended as directly meeting NMS requirements with regard to information needed for end-user applications [direct or further processed]; others are to assist the contributing global centres in product comparison and in

the development of multimodel ensembles. These products are regarded as feasible from current systems).

A. Calibrated outputs from ensemble prediction system showing the mean and spread of the distribution for:
   - 2 metre temperature over land
   - sea surface temperature
   - precipitation
   - Z500, MSLP, T850
   - Sea surface temperature area averages for the principal Niño areas (Nino3, Nino3.4, Nino4), including ensemble plumes of monthly values.
   - Surface pressure field indices including the SOI (e.g. inferred Tahiti-Darwin pressure difference) and the NAO (Iceland -Azores difference), including ensemble plumes of monthly values.

   Notes:

   1. These fields are to be expressed as departures from normal model climate.
   2. SST used as boundary conditions for (two-tiered) AGCM predictions should be made available.

B. Calibrated probability information for forecast categories. Tercile categories should be provided, consistent with present capabilities. Information for larger numbers of categories (e.g. deciles) is foreseen, however, as capabilities increase and to match better the anticipated end-user requirements. These targets are implied also for forecasts from statistical/empirical models.

   Note: information on category boundaries should be included.

   - 2 metre temperature over land
   - SST
   - precipitation
   - Z500, MSLP, T850

   (**Note**: "Calibrated" implies correction based on past performance for systematic errors in anomaly predictions, using at least 15 years of retrospective forecasts.)

The ET noted the following issues regarding uniformity of products to be addressed in implementation of the experimental accessibility:

- use of a common grid
- reference climatology
- resolution of the probability distribution
- definition of period for terciles
- category boundaries for terciles
- indication of uncertainty (is spread sufficient ?)
- timing of issue of forecasts

Other requirements, as adapted from Annex 1 of ICTT (WCASP-No. 52)
Some requirements are not as well established or may not be achievable at present. The predictability associated with some products is not yet established.

- As in A and B for sunshine, solar radiation and cloudiness
- As in A and B for 850hPa wind, Z200

- SST area averages for tropical Atlantic and specified sectors of North Atlantic and Indian Oceans
- Ensemble related predictions of the equatorial zonal wind average at heights of 30 and 50 hPa, as an indicator of the QBO.
- Likely seasonal tropical cyclone activity (may be inferred from proxy mean fields)
- Likelihood of within-season activity of wet (including heavy rain) and dry spells, hot and cold (including frost) spells, to provide indications of whether the frequencies and severity will be above normal. (Note: these may be inferred from mean fields)
- Ensemble output related to heating/cooling and growing degree-days using regionally supplied thresholds (Note: these may be inferred from proxy mean fields) (details will depend on regionally-supplied requirements, such as thresholds and averaging periods)
- Ensemble output to indicate onset and duration of rainy and monsoon seasons.
- Non-ensemble outputs of all the above variables/events where models are not operated in ensemble mode (e.g. statistical models)
- Threshold value for the category boundary, e.g."above/near/below normal"
- Related input from centres without global LRF capability.

Note: for some of these quantities (e.g. monsoon onset) provision of daily model fields for all ensemble members for selected areas may be necessary.

2. Skill and Confidence levels

- Skill information must accompany each product, with corresponding spatial and temporal detail, to indicate predictability levels. (e.g. a gridded map product should have skill information for the same grid, averaging period and lead time) The skill measures should follow the recommendations of CBS on the Standard Verification System (e.g. ROC values), should be based on at least 15 years of retrospective forecasts, and should also include a widely-understandable form (such as % correct) suitable for direct communication to end-users if required.
- An indication (text statement and/or quantitative indicator) of the confidence in each forecast for example based on model ensemble characteristics, uncertainties in initial conditions, model uncertainties, and degree of consensus and intrinsic lack of predictability.
- An alert, to accompany forecasts, of significant changes in models or practices used to generate the forecasts. Examples are changes to analysis schemes for surface wind stress and sea surface temperature changes in assimilation techniques and model resolution.
- Regions where probabilities are close to climatology level reflect either a lack of predictability demonstrated for the region, or no clear forcing on the climate for the particular forecast period, even though predictability on the average has been demonstrated for the region. It may be useful to distinguish between the two in map format.
- Verification to discriminate between seasons and lead times.

Verification of issued forecasts.

- With each statistical and dynamical model output (single forecast and ensembles), and each consensus forecast, a time series of verification data describing the model and consensus performance. Such data to include outputs from the WMO Standardised Verification Scheme for Long Range Forecasts including ROC catering for flexible event definitions.
- Verification based skill masks to be applied to forecasts for areas where there is little skill, to be developed using criteria agreed with users.

Documentation

- Descriptions of statistical and dynamical models including scope and limitations.
- Descriptions of forecast and hindcast processes.

- Description of consensus procedures.
- Description of calibration and validation procedures with provision of forecast systematic error fields.
- Notifications of intention to upgrade or change models and procedures.

ANNEX IV

PRODUCTS ON SEASONAL TO INTER-ANNUAL FORECASTS GENERATED BY THE EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

URL for seasonal forecast products

Forecasts: **http://www.ecmwf.int/products/forecasts/seasonal/**
Documentation: **http://www.ecmwf.int/products/forecasts/seasonal/documentation/**
Demeter dataset: **http://www.ecmwf.int/research/demeter/data**

Products routinely available from the ECMWF system (Table1)

1.	**Ocean analysis**
	Parameter: - Temperature anomaly along the equator (ocean cross-section) - Sea level anomaly - Zonal wind stress anomaly
	Area: - Tropical belt
	Period and valid time: - 7-day mean, updated weekly
2.	**Seasonal forecasts: Nino's indices** - Nino 3, 3.4, 4 SST anomaly plumes
3.	**Seasonal forecasts: Forecast maps**
	Area: - Global and sub-areas
	Parameter: - Precipitation - Temperature at 2 metres - Mean sea level pressure - Sea surface temperature
	Type: - Ensemble mean value - Probability of below/above various thresholds
	Lead time: - 1, 2, 3 months
	Period and valid time: - 3-month averages, updated monthly

Availability of seasonal forecast products in graphical form on the Web

	Products	Delay and access
Public	• all products listed in Table 1*; area limited to tropical belt • information about the forecasting system and its capabilities	• one week after production, • no limitation
NMHSs of neither Member States nor Co-operating States	• all products listed in Table 1*; no area limitation • verification results as adopted within WMO	not delayed, password-protected

ANNEX V

SI FORECASTING AT WMC MOSCOW

(Submitted by Dr Dmitry Kiktev)

1. Forecast Products

A number of operational 1-month and SI-products are issued on the basis of statistical methods for the territory of Russia in the framework of RSMC activity. Hydrodynamic-statistic 1-month forecasts have been issued since 2000.

Dynamical SI-forecasts of the WMC-Moscow are not calibrated yet and currently available for internal use only.

During 2004 global SI products of the WMC-Moscow are to become accessible via the web site of the Hydrometeorological Centre of Russia (http://hmc.hydromet.ru). Password for access is to be provided on request.

Main products: global 3-month averages for precipitation; Z500; MSLP; T850; T2m including ensemble mean fields expressed as departures from the model climate; characteristics of uncertainty; individual ensemble members (6 or more) expressed as departures from model climate in graphical form. Other products, e.g. for other regions, monthly resolution, and gridded fields, may also be provided.

Model climatology characteristics (model climate means; tercile category boundaries for probability information) and used SST for a two-tier approach are also to be provided.

Timing:

- Issue frequency – monthly;
- Product issuance time – to be announced at the web-site;
- Forecast range – at first stage 4 months (1-month lead-time + 3-months forecast period).

2. Multi-model products (together with the Main Geophysical Observatory) are foreseen in prospect**.**

ANNEX VI

MET OFFICE: LONG-RANGE FORECAST PRODUCTS

(Submitted by Dr Mike Davey)

Website: **http://www.metoffice.com/research/seasonal/**
Password-protected section for NMSs and similar organisations:
http://www.metoffice.com/research/seasonal/nms/

The global gridded LRF products are based on ensemble (40-member) integrations of a coupled ocean-atmosphere GCM.

Current products (from March 2003):

Public site: Graphical maps (gif format) of probabilities for above normal temperature (T2m) and precipitation (Pr) anomalies for 3-month periods for months 2-4, 3-5 and 4-6 from the forecast start time. (I.e. for the forecast ensemble starting from March 1 2003, months 2-4 are April-May-June.). For each product skill information is provided in the form of maps of Heidke skill scores that are closely related to percent-correct scores.

'NMS' site: Additional graphics of deterministic (ensemble-mean) T2m and Pr anomalies for months 2-4, 3-5 and 4-6 ahead are provided. Further skill masks based on ROC and on correlation significance are provided.

Domain: global. Updated: monthly

Other seasonal forecast products: Forecasts for some specific regions and seasons (e.g. Sahel rainfall); winter NAO index; global-mean annual-mean T are also available on the Met Office seasonal products website.

Products to be added in 2003:

SST above/below normal probabilities for months 2-4, 3-5, 4-6 ahead; Nino3, Nino3.4, Nino4 SST anomaly ensemble plumes to 6 months ahead.

Products to be added in 2004 for NMHSs:

The Met Office will aim to provide the main agreed common LRF products based on the list prepared by CBS ET ILRF. We will also work with our multi-model partners to develop multi-model versions of these products. Other LRF products (e.g. monthly values, tropical cyclone activity etc.) may also be provided. The LRF products are the subject of continuing R&D.

The main products we will aim to provide are:

- 3-month-average gridded global fields of T2m, SST, Pr, Z500, T850, MSLP ensemble mean and a spread measure, for actual values and anomalies from model climate.
- 3-month-average tercile probabilities for T2m, SST, Pr, Z500, T850, MSLP anomalies
- Nino3, Nino3.4, Nino4 ensemble plumes of monthly SST anomalies to 6-month lead
- SOI and NAO index ensemble plumes to 6-month lead

Products will be provided in digital form as well as graphical.

Retrospective forecast products will be provided for at least a 15-year period. Verification information based on the recommendations of CBS ET SVS will be provided.

ANNEX VII

USEFUL PRODUCTS IN THE FRAME OF SEASONAL TO INTERANNUAL FORECASTS AVAILABLE AT METEO-FRANCE

(Submitted by Mr J.P. Céron)

1.	**Seasonal Forecasts**		**Remarks**
	Parameters	Precipitations Temperature at 850 hPa Geopotential at 500 hPa	Expressed as departures from the climatology of the forecasting suite,
	Areas	Global	
	Type	Ensemble mean value (9 members), Significance of the mean anomaly and distribution of the ensemble members in progress,	Both indices (normalized model forecasts) and anomalies (indices renormalized to “observation”).
	Period	Forecasted period 4 months Lead-time 1 month 3-month averages	
	Update	Monthly	
	Format	Graphics: Postscript and Gif Digital: ASCII (self-documented)	
	Issuance	First days of the month	
2.	**Model anomalies**		
	Parameters	Precipitations, Temperature and geopotential at 850 hPa and 500 hPa, Sea Level Pressure, Temperature at 2 m, Wind speed at 10 m, Humidity at 700 hPa,	Expressed as departures of the ARPEGE operational analysis from the ERA climatology,
	Areas	Global and Europe/Atlantic sector	
	Type	Monthly average 3 overlapping monthly average 12 overlapping monthly average	Both Indices and Anomalies,
	Update	Monthly	
	Format	Graphics: Postscript and Gif Digital: grib1	
	Issuance	Beginning of the month	

Seasonal forecasts are, at this stage, available on an internal web site:
http://www-int.meteo.fr/scem/cbd/dev/

Model anomalies are available on an external web site:
http://www.meteo.fr/special/CLIM/clim_model.html

For the future, Seasonal forecasts should be available on an external web site (password protected and/or free access under discussion). The list of available parameters should be progressively extended in order to converge toward the WMO recommendations.

ANNEX VIII

LIST OF URL IN RA VI
FOR ACCESS TO LONG-RANGE FORECAST PRODUCTS

European Centre for Medium-Range Weather Forecasts (ECMWF)
Forecasts: **http://www.ecmwf.int/products/forecasts/seasonal/**
Documentation: **http://www.ecmwf.int/products/forecasts/seasonal/documentation/**
Demeter dataset: **http://www.ecmwf.int/research/demeter/data**

World Meteorological Centre Moscow (WMC)
http://hmc.hydromet.ru *(Password for access is to be provided on request)*

Met Office (United Kingdom)
http://www.metoffice.com/research/seasonal/
http://www.metoffice.com/research/seasonal/nms/ *(Password-protected section for NMHSs and similar organisations)*

Météo-France
http://www-int.meteo.fr/scem/cbd/dev/ *(Seasonal forecasts)*
http://www.meteo.fr/special/CLIM/clim_model.html *(Model anomalies)*

World Meteorological Organization (WMO/Switzerland)
http://www.wmo.ch/web/www/DPS/EPS-HOME/eps-home.htm#Long-range *(EPS/LRF producing centres)*
http://www.wmo.ch/web/www/DPS/GDPS-Supplement5-AppI-4.html **(***Definitions of forecast ranges)*
http://www.wmo.ch/web/www/DPS/LRF-verification-systems.html **(***Verification system for Long-range forecast)*