WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR BASIC SYSTEMS

RA VI MEETING OF THE WORKING GROUP ON PLANNING AND IMPLEMENTATION OF WWW CO-ORDINATORS

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STATUS OF DATA-PROCESSING AND FORECASTING SYSTEMS

(Submitted by the Secretariat)

Summary and Purpose of the Document

The document contains the general status of the operation of the Data-processing and Forecasting Systems in Region VI.

ACTION PROPOSED

The meeting is invited to consider the status of the operation of the Data processing and Forecasting Systems in Region VI together with the report of the rapporteur on Data processing and Forecasting Systems. It is invited to develop appropriate recommendations to mitigate any deficiencies observed and enhance the relevant systems to meet regional and global needs.

STATUS OF RA VI DATA-PROCESSING AND FORECASTING SYSTEM

1. GDPFS centres active in NWP, including RSMCs, and the types of models run, are listed in Table 1. The processing equipment available at GDPFS centres, as reported by them, is listed in Table 2. Most RSMC and NMCs operations in the Region have shown sustained improvement, with enhancement of forecasting systems and computer facilities, thereby improving the accuracy of their products. Thanks to the enhanced computer power obtained by the use of massive parallel processor technology, advanced GDPFS Centres have implemented Data Assimilation Systems with 3-D VAR and even some of them 4-D VAR Analysis (ECMWF and Toulouse). These schemes improve the initial fields starting the forecast runs. Improvements in analysis of direct satellite radiance data are noticeable, as well as for humidity analysis, even if in that field much progress remains to be done. Physical parameterization schemes (such as convection, cloud, and radiation) are constantly improved, leading to better very-short and short-range predictions. Five RA VI RSMCs (Bracknell, Moscow, Offenbach, Toulouse and ECMWF) are running global models.

2. The four RA VI RSMCs with geographical specialization: Bracknell, Moscow, Offenbach and Rome provide regional products to assist NMCs in the forecasting of small-scale, mesoscale and large-scale meteorological systems. RSMC Bracknell is disseminating WAFS Products for aviation worldwide through SADIS, which covers RA I, RA VI and the western part of RA II. Offenbach is disseminating charts on T4 format through the FAX-E system over East Europe. RSMC Toulouse is also disseminating over Europe and RA I charts and fields via the RETIM system. Most RSMC operations have shown sustained improvement, where many Centres have enhanced their forecasting systems and computer facilities, thereby improving the accuracy of their products.

3. ECMWF has been one of the first among the leading GDPFS Centres to implement a four-dimensional variational (4-D VAR) Data Assimilation System, making use of the massive parallel-processor technology. In year 2003, ECMWF uses 2 IBM Cluster 1600 with 1620 processors. ECMWF global model is now a T511L60. A subset of its products is disseminated on the GTS in GRID and GRIB codes. A 50-member (T255L40 model) Ensemble Prediction System (EPS) for medium-range is run daily and the results are made available to the ECMWF Member States. A sub-set of results as probabilities of reaching some thresholds is made available on the GTS and Internet.

4. The two RA VI RSMCs designated for the provision of transport model products for environmental emergency response, Bracknell and Toulouse, have implemented the regional and global arrangements for the provision of specialized transport/ dispersion/deposition model products over Region VI and also Region I.

5. Secondary computers and workstations as well as mainframes are used for NWP at NMCs. Many NMCs in Regions VI have well-developed computer capabilities (see Table 2). Among 31 NMCs running NWP models, 13 NMCs in RA VI run a Limited Area Models with resolution coarser than 36 km and 26 Centres run 28 meso-scale models with resolution finer than 37 km. Some Centres, like Bracknell, Offenbach, Rome (Bologna), and Zürich have started operational running of high-resolution non-hydrostatic models. The supply of boundary conditions required for a LAM is handled through bilateral arrangements between originating Centres and receiving Centres. Satellite-based dissemination systems enable NMCs to receive also more products directly and reliably from WMCs and RSMCs. All RA VI GDPFS centres now have Internet access to selected GDPFS products made available by some GDPFS centres.

6. The monthly exchange of verification scores using standards and procedures has continued among the Centres in Bracknell, ECMWF, Melbourne, Montreal, Moscow, Offenbach, Tokyo, Toulouse and Washington. All RA VI forecast Centers have shown a general trend

towards improved forecasts in the 72 hour to 120 hour range (see URL page: http://www.wmo.ch/web/www/Status-Reports/21st/Chapter4/chapter4.html).

7. Ensemble Prediction Systems technique can be applied to all time ranges, depending on the size of the phenomena to predict. Forecasters in all Centres are progressively learning to use the results of the ensembles, which relate to probabilistic forecasting. The increase computer power has also enabled ECMWF, Bracknell and Toulouse to run ensemble-forecasting systems, for medium and long ranges. .ECMWF has a 50 members EPS up to 10 days using the singular vector technique for perturbation of the analysis. ECMWF runs also a 30 members coupled model ensemble up to 6 months. Bracknell runs a 9 members, 6 hours time lagged ensemble over 2 years. Toulouse runs a 10 members, time lagged ensemble over 129 days.

8. Some GDPFS centres are actively engaged in long-range forecast activities at global, regional or national levels. The Global Producing Centers of Seasonal to Interannual Forecasts (GPCs) in RA VI: ECMWF, Bracknell, Moscow and Toulouse perform operational production of Long Range Forecasts (LRF). They provide NMHSs and Regional Climate Centres (RCCs) with LRF products. ECMWF, Bracknell and Toulouse are now operationally running atmospheric models coupled with SST fields or ocean models. They are producing long-range forecasts up to seasonal and multi-seasonal prediction periods, for sea-surface temperature and some atmospheric parameters. These centres make available on the Internet extended and long-range forecasts including national and even global seasonal forecasts. (see URL page http://www.wmo.ch/web/www/DPS/EPS-HOME/Long-range). Access is often restricted by password, which is usually given to NMHSs. In addition to ECMWF Member countries, WMO Members may request the password for having access to ECMWF extended tropical belt products and to ECMWF global products. CBS has defined and recommended standard scores to be attached to the long-range forecast and used for quality assessing. The core standardized verification system also provides a means of exchange between GDPFS centres of standardized verification statistics (see URL page: http://www.wmo.ch/web/www/DPS/LRF-verification-systems.html).

9. Bracknell, ECMWF and Offenbach provide lead centre functions for monitoring respectively global marine and upper-air data and Region VI surface data (See URL page: http://www.wmo.ch/web/www/DPS/Monitoring-home/mon-leadcentre.htm). The lead centres generate monthly or six-monthly reports on the results of data quality monitoring which are being distributed to Members concerned to initiate remedial action with respect to the suspect stations detected by the lead centres.

TABLE 1* - STATUS OF RSMCs AND NMCs RELATIVE TO NUMERICAL MODELS *(2001 , 2002 or 2003 information)

(last update 28/07/03)

							DISSEMINATION			
CENTRE	***STATUS***	***MODELS***	***RESOL.***	***LEVELS***	***RANGE***	***Boundary***	***GTS***	***FAX***	***SATELLITE***	***SPECIAL***
ANKARA	NMC	full access to GM (ECMWF)								
		MSM (NCEP/ETA)	27 km	32	48 h					
ATHENS	NMC	full access to GM (ECMWF)								
		LAM (ETA-NMC)	0.21°	32	48 h					
		MSM (nested)	0.07°	32	24 h					
BELGRADE	NMC	LAM-(ETA 95) 3D-VAR	46 km	32	120 h	NCEP (USA)				
		MSM (ETA)	23 km	64	48 h	ETA				
BET DAGAN	NMC	MSM (HRM)	13 km	30	48 h	GME (Offenbach)				
BRATISLAVA	NMC	MSM (ALADIN/ SLOVAKIA)	7.18 km	31	48 h					
BRUSSELS	NMC	full access to GM (ECMWF)								
		MSM (ALADIN)				ALADIN (France)				

GM = Global Model

LAM = Limited Area Model (resolution coarser or equal to 36 km

MSM = Meso Scale Model (resolution finer than 36 km)

Perturbation technique for ensemble prediction systems: SV = Singular Vectors, BGM = Breeding of Growing Modes, LAF = Lagged Average Forecasts

BUCAREST	NMC	MSM (ALADIN)	10 km	31	48 h	ARPEGE (France)				
BUDAPEST	NMC	MSM (ALADIN/HU) – 3 D-VAR	6.5 km	37	48 h	ARPEGE (Toulouse)				
COPENHAGEN	NMC	full access to GM (ECMWF)								
		HIRLAM-G 3 D-VAR	0.45°	40	60 h	ECMWF				
		MSM (HIRLAM-N) (Greenland)	0.15°	40	36 h	HIRLAM-G				
		MSM (HIRLAM-E)	0.15°	40	54 h	HIRLAM-G				
		MSM (HIRLAM-D)	0.05°	40	36 h	HIRLAM-G				
DE BILT	NMC	full access to GM (ECMWF)								
		HIRLAM	0.5°	31	48 h					
DUBLIN	NMC	full access to GM (ECMWF)								
		LAM – MSM (HIRLAM)	0.3°	24	48 h					
HELSINKI	NMC	full access to GM (ECMWF)								
		LAM (ATA) 3 D-VAR	0.4° (44 km)	31	54 h					
		MSM (ENO)	0.2° (22 km)°	31	54 h	ATA				
KIEV	NMC	LAM								
LISBOA	NMC	MSM (ALADIN-Portugal)	12.7 km	31	48 h	ARPEGE-Meteo-France				
LJUBLJANA	NMC	MSM (ALADIN)	11.2 km	37	48 h	ALADIN/LACE				

MADRID	NMC	full access to GM (ECMWF)								
		LAM (HIRLAM)	0.5°	31	48 h					
		MSM (HIRLAM)	0.2°	31	24 h					
MINSK	NMC	LAM	300 km	6	36 h					
NORRKOPING	NMC	full access to GM (ECMWF)								
		LAM (HIRLAM)	0.4°	31	48 h					
		MSM (HIRLAM)	0.2°	31	36 h					
OSLO	NMC	full access to GM (ECMWF)								
		LAM	0.5°	31	48 h					
		MSM	0.1°	31	48 h					
PRAGUE	NMC	MSM (ALADIN/LACE)	12 km	31	48 h	ARPEGE-Meteo-France				
RIGA	NMC	LAM (HIRLAM 2)	55 km	16	36 h					
SOFIA	NMC	MSM	9 km	31	48 h					
WARSAW	NMC	MSM (ALADIN)	17 km	31	38 h	ARPEGE-Meteo-France				
ZURICH	NMC	full access to GM (ECMWF)								
		MSM (LM – COSMO consortium) non-hydrostatic, nudging	7 km	45	48 h	GME (Offenbach)				

ECMWF	RSMC for Medium-Range	GM	T511	60	240 h		GTS			special
		GM Ens.- 50 members SV	T255	40	240 h					special
		GM Ens.- 30 members time -lagged over a month, coupled	T159	40	6 months					special
OBNINSK	T.M. RSMC (for RA II)	full access to GM – HM and LAM								
TOULOUSE	T.M. RSMC	GM (ARPEGE) (4 D-VAR)	Variable mesh T298C3.5 19km to 230 km	41	96 h				SAT-RETIM	special
		GM (ARPEGE-Tropiquee-Indian Ocean)	T358	41	72 h					
		MSM (ALADIN)	7.5 km	41	48 h	ARPEGE				
		MSM (ALADIN Trop. Cyclone-Indian Ocean))	31 km	41	72 h	ARPEGE				
		GM (ARPEGE-Climat) Ens. 10 members – time-lagged	T63	31	129 days					
OFFENBACH	Geo. RSMC	GM (GME) 3 D-VAR	60 km	31	174 h				SAT-FAX-E	special
		MSM (LM – non-hydrostatic)	0.0625° (7 km)	35	48 h					

ROME	Geo. RSMC	full access to GM (ECMWF)						Fax		
		LAM (EuroHRM)	56 km	30	72 h	ECMWF				
		MSM (Med-HRM)	28 km	31	48 h	Euro-HRM				
		MSM (LAMI) non-hydrostatic (run in Bologna)	7 km	35	48 h	GME (DWD)				
BRACKNELL	Geo. and T.M. RSMC	GM (Unified Model) 3D-VAR non-hydrostatic	0.56 lat x 0.833 long.	38	120 h		GTS	Fax	SADIS (WAFS)	
		MSM 3D-VAR non-hydrostatic Some RADAR data assimlation	0.11°	38	36 h	GM				
		GM Ens. 9 members, 6 hours LAF	2.5°	19	4 months					
		GM Ens. 9 members, 6 hours LAF	2.5°	19	2 years					
MOSCOW	WMC, Geo. RSMC	GSM 3D-VAR	T169	31	240 h		GTS	Fax		
		LAM	75 km	30	48 h	GSM				
		MSM	10 km	15	36 h	LAM				
GROUP OF COUNTRIES (LACE project): Austria, Croatia, Hungary, Czech Republic, Slovenia, Slovakia		MSM (ALADIN) /LACE project run in Praguee	12 km	31	48 h	ARPEGE-Meteo-France				

TABLE 2 **- COMPUTERS USED FOR DATA PROCESSING AT RSMCs AND NMCs** ***(1998, 1999 or 2000 information)*** (last update 28/07/03)

CENTRE	*MAINFRAME (number cruncher)*	*SECONDARY COMPUTER(S)*	*WORK STATIONS*
ANKARA		SGI Onyx 2, DEC station 5000/200, 2VAX3100,8750	Dell Pentium PCs
ATHENS		CONVEX SPP1600-8	SGI: 2 INDIGO – 3 INDY – 1 ULTRA 8 WSs – 1 HP WS - PCs
BELGRADE		SGI POWER INDIGO R8000	SGI INDY, 550, 2xO2 – 6 PCs
BET DAGAN		SGI Origin O300 2000, 2xSGI Origin 200	8 SGI WSs
BRATISLAVA		HP 9000/720, SUN Sparc HS21	HPs
BRUSSELS	CRAY J916	HP servers	WSs
BUCAREST		DEC	PCs
BUDAPEST	IBM Regatta p690 (32 processors)	SGI Origin 2000 (16 procesors) HP L2000 K250, K200, C200, D280, B180, J210, 755, 715, 710, DEC 600	SUN WS - PCs
COPENHAGEN	NEC-SX6 (16 processors)	2Azus A, 4 SGI Origin 200	WSs
DE BILT		SGI Power Challenge, SGI Origin 2000	Compaq clusters - WSs
DUBLIN		2 SGI Origin 200, SGI CHALLENGE L– 2 VAX 4200 – VAX 3100	
HELSINKI	IBM p690 (32 processors) (shared)– SGI Origin 2000	VAX 6240	VAX Clusters - WSs
KIEV		EC-1061	PCs
LISBOA		2 DEC Alpha 2000 4/275, 2 DEC Alpha XP1000	
LJUBLJANA	14 dual processors nodes		PCs
MADRID	CRAY C-94	VAX – HP/HPUX and SUN/SOLARIS	SUN WSs
MINSK		2 Intel Celeron 600	3 Intel PIII, 2 Intel P-II
NORRKOPING	CRAY T3E (232 processors) (shared)	SGI 3800 DEC Alpha servers	29 VAX (Clusters) - 7 DEC – SUN WSs
OSLO	CRAY T3E	2 IBM RS6000 3 SGI Origin 2000, 200	VAX 4000-200/3300 DEC3100 Alpha-200
PRAGUE	NEC SX-4/3A	3 ICL DRS6000	SUN SPARC WKs - 2 TWO - 10 ONE
RIGA		VAX 3100-40	Pentium 90
SOFIA		MOTOROLA SYSTEM	
WARSAW	CRAY YMP4E(shared)	IBM AS/400 – RS/600	PCs
ZURICH	NEC SX-5 (shared)	SGI Origin 3000	WSs
ECMWF	2 IBM Cluster 1600 - 1620 processors - pSeries 690	3 IBM p660, 5 IBM Nighthawk, 3 HP K580, 4 SGI Origin 2000	SGIs indigo – indy, PCs
TOULOUSE	FUJITSU VPP 5000 (124 processors)	HP N4000, HP T600, HP D370, HP C180	
OFFENBACH	IBM RS/6000 (80 x 16 processors)	4 SGI ORIGIN 2000	WSs
ROME	HP ES45, HP GS60, HPGS60E	4 HP Alpha server	HP WSs
BRACKNELL	IBM 9672 R35, IBM 9672 R45, NEC-SX6	2 IBM z800	
MOSCOW	CRAY Y-MP8E	CRAY Y-MPEL 98 – COMPAREX 8/83	2 HP 735 WSs