RUSSIAN FEDERATION

RUSSIAN FEDERAL SERVICE FOR HYDROMETEOROLOGY AND ENVIRONMENTAL MONITORING

WWW TECHNICAL REPORT ON THE GLOBAL DATA PROCESSING AND FORECASTING SYSTEM FOR 2003

Country: Russian Federation **Centre: WMC/RSMC Moscow**

1. Highlights of the year

Development of the operative NWP system for running on CRAY Y-MP 8E computer

1.1 The issue of operational forecasts on term 1-10 days on global spectral model T85L31 is being continued to run. Operative exploitation of the global data assimilation system based on the T40L15 model is being continued to run.

1.2 The quality of numerical weather prediction near-surface characteristics: temperature, pressure, wind velocity, precipitation total produced on the basis of global spectral T85L31 model has been improved.

2.4.5. No substantial changes have been made in the equipment in operational use; the data input system; the data quality control system in comparison with that of 2002.

3. Data and products in use received from GTS.

For the tasks of the Objective Analysis (OA) the following types of meteorological observations are used: SYNOP, SHIP, BUOY, TEMP, PILOT, SATEM, AMDAR, AIREP, SATOB (wind), SATOB (surface temperature). Apart from this fields of forecasts from RSMC Bracknell with lead time 12 hours with the initial hours 00 and 12 UTC (GRID 2,5 x 2,5 ?) are used.

6. Observing system monitoring

There is carried out the monitoring of arriving and the quality of the radiosonde observations for the territory of Russia. Monitoring of arriving and the quality of the Russian observations SYNOP, and measurements of pressure receiving from the Russian commercial ships is also made.

7. Forecasting System

7.1. System-run schedule. Times of forecasts.

Basic initial terms of the Forecasting system are 00 and 12 UTC. The products of the Global Data Assimilation System is formed for 00,06,12,18 UTC.

7.2,7.3. System for the medium and short range forecasting

7.2.1,7.3.1. Data assimilation, objective analysis and initialization.

The products of the System of the Objective Analysis (the method of two-dimensional interpolation for 1-level characteristics and three-dimensional optimal interpolation for the fields of geopotencial and wind).

- sea level pressure, surface air temperature, smoothed temperature of underlying surface, surface air humidity and wind velocity, total cloudiness in octants, snow cover height, sea surface temperature, geopotencial heights of isobaric surfaces, wind velocity, temperature and air humidity at the standard isobaric surfaces.

The products is produced on grid 2,5 x 2,5 ?, a number of surface characteristics on grid 1,25 x 1,25?.

7.2.2, 7.3.2. Model.

The Global spectral atmosphere model T85L31 is the basic model for the issue of forecasts for 1-10 days for the entire territory of Russia.

Operational testing of a new 30-level regional atmosphere model in sigma –system coordinates is being carried out. In 2003-2004 at Hydromrtcentre of Russia the area forecast 137 x 209 points of equable Cartesian grid (with resolution 75 km. on horizontal) on the chart stereographic projection. Maximum term of forecast is 48 hours. The version of regional model of the Hydrometcentre of Russia is running in experimental- operational mode at RSMC Khabarovsk.

For the Moscow Region (area 300 x 300 km) there has been put into operational use a non hydrostatic mesoscale model with 10 km. resolution. Maximum term of forecast is 36 hours.

7.2.3, 7.3.3. Numerical Weather Prediction Products.

Issue of forecasts and products formation for transmission via telecommunication channels was carried out on the basis of the calculation results by the Global spectral T85L31 atmosphere model twice a day with the initial data for 00 and 12UTC with term of forecast from 84 to 240 h., respectively. The outputs (geopotential fields forecasts, temperature, wind velocity at 15 standard isobaric surfaces up to 10 hPa, relative air humidity up to 300 hPa, mean sea level pressure, 6-hourly precipitation total, surface air temperature) are coded in GRIB code form with 2,5 x 2,5? and 1,25 x 1,25? resolution, and in GRID code form with resolution 2,5 x 2,5? and 5 x 5? and also transmitted via GST and Internet. The forecasting digital facsimile charts of the mean sea level pressure,

heights at 500 hPa, surface temperature at 850 hPa, relative humidity at level 850 (700) hPa for the Northern Hemisphere and Europe depending on the season are also transmitted via GTS.

On the basis of the mesoscale model for the Moscow region users are operationally provided with the forecast of surface air temperature and precipitation with detailing of 1h.

7.2.4. Operational techniques for NWP products application. Short Range Forecast.

Short range forecasts of the surface air temperature, humidity, precipitation, wind velocity, precipitation with 1h detailing and also the air temperature extremes for 24h. are daily calculated for the towns of the European territory of Russia. There is in performance the automated System for physico-statistical interpretation of numerical modeling results producing short-range elements forecasts and significant weather phenomena (thunderstorms, heavy showers, hail, icing (glaze), snowstorms).

7.3.4. Operational techniques for NWP products application. Medium range forecast.

System of statistical interpretation of the results of the Medium range of the hydrodynamic modeling is used (MOS system). Initial time - any. An automated system provides the issue of meteorological forecasts with lead time up to 7 days for 5000 towns of the Globe and also for the regions of the Russian Federation.

7.4. Specialized forecasts.

a) Sea wave forecast.

There is produced an operational issue of forecasts on the basis of spectral-parametric model of wind wave. Forecast is issued for 2 components: wind waves and waves of swell. For wave forecast the objective analysis data and the products of the Hydrometcentre of Russia the Global Spectral T85L31 atmosphere model are used, diagnosis and wind velocity forecast on grid 2,5 x 2,5?.

b) Long-Range forecasting of sea ice on non-Arctic seas of Russia.

Long-Range forecasting (with lead time of several months) of sea ice cover, based on a notion of the cyclicity of individual hydrometeorological elements and of active interaction between the atmosphere and hydrosphere in the winter period is regularly issued. On the basis of the sea-ice cover forecast of high validity the forecasts are issued for ice boundary disposition, ice thickness (including maximum one), ice period duration, dates of sea ice removal. The method uses the technique of decomposition with natural orthogonal components. The atmospheric circulation characteristics and air temperature for the previous periods are used as the predictors for ice parameters forecasting.

7.5. Extended Forecasts (10-30 days)

An integrated hydrodynamical statistical forecasting scheme with lead time 10-30 days of air temperature fields at land surface and at standard isobaric surfaces 500, 850 hPa, and also surface air temperature values for 75 points of the former USSR has been used operationally. It is based on an ensemble approach (model T40 L15).

Forecast of mean monthly temperature fields are regularly placed to the web-site http://www.meteoinfo.ru. Programming tools for ensemble forecast scoring were developed and implemented. Brier skill score, ROC-curves, rank histograms and economic value assessment are used for results verification.

8. Verification of prognostic products

In accordance with the WMO standards there is carried out the monitoring of quality of the basic operational model of the Hydrometcentre of Russia – the Global spectral model of the Hydrometcentre of Russia for initial times of 00 UTC and 12 UTC.

The main results of monitoring for the year 2003 are given below.

8. 1.1. Mean sea level pressure

Forecast range	**RMSE** (hPa)		KA		S1	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC	00 UTC	12 UTC
24	2,30	2,27	0,95	0,96	39,25	38,42
48	3,50	3,47	0,91	0,91	48,75	48,08
72	4,72	4,71	0,83	0,84	58,25	57,50
96		5,96		0,75		65,58
120		7,15		0,64		72,75
144		8,17		0,54		78,08
168		8,93		0,45		81,92
192		9,59		0,36		84,92
216		10,21		0,29		86,75
240		10,69		0,23		88,08

8.1.2. 500 hPa height

Forecast range	**RMSE** (m)		KA		S1	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC	00 UTC	12 UTC
24	17,88	17,63	0,98	0,98	23,08	22,83
48	30,82	30,47	0,95	0,95	32,58	32,42
72	44,83	44,54	0,89	0,89	41,33	41,17
96		59,61		0,81		49,17
120		74,32		0,71		55,92

144		87,39		0,59		61,83
168		98,81		0,49		66,33
192		107,06		0,40		69,42
216		114,68		0,31		72,00
240		121,14		0,24		74,17

8. 1.3 250 hPa height

Forecast range	**RMSE** (m)		KA		S1	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC	00 UTC	12 UTC
24	23,41	22,79	0,98	0,98	19,58	19,08
48	40,74	40,23	0,95	0,95	28,00	27,83
72	59,93	55,55	0,89	0,90	36,17	35,92
96		80,92		0,82		43,42
120		102,08		0,71		50,25
144		120,58		0,61		55,58
168		138,38		0,51		59,75
192		150,77		0,42		63,03
216		162,20		0,34		65,58
240		172,02		0,27		67,50

8.1.4. 500 hPa temperature

Forecast range	**RMSE** (K)		KA	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC
24	1,19	1,19	0,94	0,95
48	1,75	1,73	0,89	0,89
72	2,30	2,33	0,80	0,80
96		2,91		0,70
120		3,47		0,59
144		3,92		0,49
168		4,33		0,41
192		4,64		0,33
216		4,91		0,27
240		5,14		0,21

8.1.5. 250 hPa temperature

Forecast range	**RMSE** (K)		KA	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC
24	1,46	1,43	0,90	0,90
48	1,98	1,97	0,80	0,81
72	2,43	2,44	0,70	0,70

96		2,82		0,58
120		3,18		0,47
144		3,45		0,38
168		4,69		0,31
192		4,87		0,25
216		4,06		0,20
240		4,22		0,16

8.1.6. 500 hPa wind

Forecast range	MEAN SPEED ERROR (m/s)		RMSEV(m/s)	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC
24	-0,60	-0,65	5,33	5,28
48	-0,73	-0,78	7,18	7,14
72	-0,73	-0,81	9,02	9,00
96		-0,81		10,79
120		-0,78		12,47
144		-0,77		13,92
168		-0,78		15,04
192		-0,76		15,92
216		-0,77		16,58
240		-0,78		17,08

8.1.7 250 hPa wind

Forecast range	MEAN SPEED ERROR (m/s)		RMSEV(m/s)	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC
24	-1,57	-1,53	7,36	7,27
48	-1,68	-1,68	10,09	9,97
72	-1,63	-1,63	12,73	12,67
96		-1,58		15,24
120		-1,59		17,68
144		-1,62		19,86
168		-1,62		21,54
192		-1,67		22,83
216		-1,73		23,92
240		-1,79		24,66

Abbreviation:

RMSE – root-mean-square error of forecast;

RMSEV – root-mean-square error of wind vector velocity;

KA – anomaly correlation coefficient;

S1 – skill score of the gradient forecast.

9. Plans for the future (2004-2005)

9.1. Preparation for the operational use of a new version of the Global Data Assimilation System on the basis of Spectral model T85L31.

9.2. Preparation for the operational use of a new version of the Global spectral model of the atmosphere in configuration T169L31.

9.3. Formation of the Ensemble Forecasting System for Short Range and Medium Range Forecasts.

9.4. Putting into operational use 30-level regional atmosphere model in sigma-system coordinates (with horizontal resolution 75 km).

9.5. Verification of mesoscale non hydrostatical atmosphere model.

9.6. Creation of the technological infrastructure (based on web technology development) for the issue of seasonal-interannual forecasts for the territory of Russia.

Country: Russian Federation **Centre: RSMC Novosibirsk**

1. Highlights of the year

1.1. Hemispheric spectral model and Technology of Numerical Weather Prediction for the Northern Hemisphere developed by the Hydrometcentre of Russia was adapted and put into practice of operational work.

1.2. In January-May 2003 at the *RDRPC there was conducted modernization of the Receiving Complex enabling to start receiving and data processing from the device MODIS installed at board of the space crafts TERRA and AGUA. The processing results are used for the compilation of cloud fields charts, forest fires detection, to conduct monitoring of flood situation. The work has been also started on adaptation of the technique for the assessment of the crop sowings conditions and Yield forecasting applicable to the Novosibirsk district.

1.3. The work has been continued on the development and Program introduction for selection on PCs storm information, daily meteo and agroinformation, programs for calculation of 5 day mean temperature and data plotting in «CLIMATE» code.

1.4. Operational testings were carried out related to the «Improved Technology of the Regional Numerical Short-Range Weather Forecast «Region» with a new Data assimilation system» (author A.A. Fomenko, RSMC Novosibirsk). The conclusions to be obtained during the experiment could be used by the author for further improvement of the numerical model and the technology.

2. Equipment in use

2.1. Presently at the RSMC Novosibirsk there is used on the experimental base an up-to-date version **GIS-Meteo with 4 work stations for weather forecasters.

8. Verification of Prognostic Products

8.1. Root –mean square error of the operational scheme of the Numerical Weather Prediction using the Hydrodynamical «Region 1» model for January-September 2003 is presented in Table 1.

9. Plans for the future

9.1. It is planned in the near future to start the work on adaptation and experimenting new numerical weather prediction models developed both in the WMC in Moscow and the Regional Centres of Roshydromet.

_____

*RDRPC – Regional Data Receiving and Processing Centre;
**GIS - Geo Information System.

Table ? 1

Root mean-square error of the Operational numerical weather prediction model «Region»
for January-September 2003.

Forecast Range	Geopotential	Error (m)
24 hours	H-500	22
36 hours	H-500	27
48 hours	H-500	35
60 hours	H-500	42

Country: Russian Federation **Centre: RSMC Khabarovsk**

1. Highlights of the year

1.1. The telecommunication channel Khabarovsk - Tokyo (Protocol TCP/IP Socket) was put into operation.

1.2. As a development into the System of the Regional Short-Range Forecast of meteoelements fields «MODELL» there was developed a prognostic technology Region-FE, performing calculation of the Objective Analysis fields, forecasts of the fields of all the basic meteoelements, chart-slides drawing and dissemination of prognostic products by E-mail.

1.3. The dissemination of the prognostic products of the RSMC Khabarovsk in the form of the charts-slides to the Territorial Hydrometeorological Services of the Far East Region has been started.

2. Equipment in the use

2.1. Automated Data Transmission System.
- network router. Cisco 2509 has been put into operation;
- telecommunication channel Khabarovsk-Tokyo (Protocol TCP/IP Socket) in replacement of Protocol X-25.3 was put into operation from, the 20-th November.

2.2. Data Processing Centre (RCC, RHMC).

The following equipment is used:
«COMPAREX», Complex GIS- Meteo, PCs, LCN.

2.3. Regional Satellite Data Receiving and Processing Centre (RSDRPC).

Technical facilities for satellite data receiving and processing:
MP-1200, T-ris, Tehnavia, Eo Scan, Scanex.

Items; 3 - 7 – no changes

7.3. Short Range Forecasting System

Operational System «Region FE»: provides calculation of the Objective Analyses for forecasts of geopotential fields, temperature, wind velocity component at 11 standard isobaric surfaces and a precipitation field over the territory of the Eastern Siberia and the Far East.

Maximum term of forecast is 48h, with an internal 12 hours;

Calculation is performed two times a-day (00h, 12 h UTC);

Prognostic products is disseminated to the Territorial Hydrometeorological Services of the Far East Region via E-mail in the form of charts-slides.

8. Verification of Prognostic Products

Below in the Table the averaged characteristics of the forecasts quality in comparison with an Objective Analysis for the period from November 2002 to November 2003 are shown.

Geopotential

Level (hPa)	Term of forecast (hours)	?	R?	?	?	S1
250	12	0,8	0,838	3,3	3,9	25
	24	0,6	0,893	4,1	4,8	28
	36	0,7	0,887	5,0	5,9	32
	48	0,8	0,864	6,9	7,9	36
500	12	0,7	0,852	2,0	2,3	26
	24	0,6	0,903	2,5	2,9	29
	36	0,6	0,883	3,1	3,7	35
	48	0,7	0,854	4,1	4,8	40
850	12	1,1	0,759	1,6	1,9	37
	24	0,7	0,850	1,9	2,3	41
	36	0,7	0,842	2,4	2,8	48
	48	0,8	0,807	2,9	3,5	54

Wind Velocity Components

Level (hPa)	Term of forecast (hours)	Characteristics			
		?	R?	? (m/s)	? (m/s)
250	12	1,2	0,658	8,8	10,6
	24	0,8	0,768	8,4	10,4
	36	0,7	0,768	9,1	11,2
	48	0,7	0,762	9,6	11,8
500	12	1,1	0,684	4,9	6,0
	24	0,8	0,778	5,2	6,3
	36	0,7	0,774	5,4	6,8
	48	0,7	0.758	5,8	7,2
850	12	1,0	0,684	3,0	3,7
	24	0,7	0,764	3,2	4,0
	36	0,7	0,759	3,5	4,4
	48	0,7	0,728	3,8	4,8

? - relative error;

? - mean absolute error;

? - root-mean-square error;

R? - correlation coefficient between actual and prognostic fields variation;

S1 - skill score of the gradients forecast.

9. Plans for the Future (2004-2005)

Testing and introduction of a new version of the Regional model for Short Range Weather Forecast in ? - system of vertical coordinates. Modification of Technology and Data Assimilation System.