Annual WWW Technical Progress Report

On the Global Data Processing and Forecasting System 2004

RUSSIAN FEDERATION

Country: Russian Federation **Center: 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. There have been incorporated in the operational exploitation the transmission via telecom channels of numerical weather prediction near-surface characteristics: temperature, precipitation totals and their characteristics, frontal cloudiness produced on the basis of global spectral T85L31 model

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 2003.

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 Exeter 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 geopotential 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, geopotential 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 continued at Hydrometcentre of Russia. The area forecast is 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 meso-scale model with 10 km. resolution. Maximum term of forecast is 36 hours.

For the Moscow Region (area 300 x 300 km) the operational testing of the surface air temperature forecasts by the model MM5 has been started.

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 meso-scale 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 including also the towns 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 2004 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	2,24	2,15	0,96	0,96	38,91	37,73
48	3,42	3,35	0,91	0,91	48,45	48,09
72	4,64	4,61	0,84	0,84	57,55	57,09
96		5,84		0,75		65,36
120		6,90		0,65		72,55
144		7,87		0,55		77,82
168		8,74		0,45		82,18
192		9,43		0,36		85,09
216		10,05		0,28		87,36
240		10,40		0,24		88,36

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	17,38	16,95	0,98	0,98	23,64	23,36
48	30,29	29,87	0,94	0,94	33,36	33,36
72	44,66	44,25	0,88	0,89	42,64	42,45
96		58,98		0,80		50,55
120		72,79		0,69		57,73
144		85,96		0,58		63,73
168		97,46		0,47		68,55
192		106,49		0,36		72,00
216		114,00		0,27		74,27
240		119,38		0,21		76,09

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	22,36	21,75	0,98	0,99	19,91	19,55
48	39,89	39,26	0,95	0,95	29,00	28,91
72	59,82	58,68	0,89	0,89	37,55	37,36

96		79,39		0,81		45,27
120		98,77		0,71		51,91
144		117,79		0,59		58,00
168		133,77		0,48		62,55
192		145,96		0,38		66,09
216		156,83		0,30		68,55
240		165,60		0,23		70,18

8.1.4. 500 hPa temperature

Forecast range	**RMSE** (K)		KA	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC
24	1,16	1,15	0,94	0,94
48	1,72	1,73	0,88	0,88
72	2,29	2,28	0,79	0,80
96		2,84		0,69
120		3,33		0,58
144		3,78		0,47
168		4,17		0,36
192		4,42		0,28
216		4,65		0,22
240		4,86		0,17

8.1.5. 250 hPa temperature

Forecast range	**RMSE** (K)		KA	
(hours)	00 UTC	12 UTC	00 UTC	12 UTC
24	1,46	1,42	0,91	0,91
48	2,00	1,99	0,81	0,81
72	2,48	2,48	0,71	0,71
96		2,88		0,61
120		3,19		0,51
144		3,50		0,42
168		3,70		0,35
192		3,87		0,30
216		4,00		0,25
240		4,12		0,22

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	-0,49	-0,57	5,19	5,12
48	-0,64	-0,71	7,00	6,98
72	-0,62	-0,72	8,85	8,86
96		-0,69		10,68

120		-0,66		12,35
144		-0,67		13,76
168		-0,65		14,97
192		-0,65		15,80
216		-0,65		16,37
240		-0,66		16,81

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	-1,51	-1,46	7,17	7,08
48	-1,63	-1,56	9,96	9,92
72	-1,55	-1,51	12,75	12,66
96		-1,46		15,39
120		-1,46		17,77
144		-1,52		19,94
168		-1,52		21,69
192		-1,54		22,95
216		-1,61		23,84
240		-1,65		24,62

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 (2005 - 2006)

9.1. Preparation for the operational use of a new version of the Global Data Assimilation System.

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

9.3. Preparation for the operational use of a new version of the Global semi – Lagrange model of the atmosphere

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

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

9.6. Verification of meso-scale non hydrostatical atmosphere model.

9.7. Incorporating into the operational exploitation of the version of model MM5 adapted for the territory of the Moscow region and adjacent areas.

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

Country: Russian Federation **Center: RSMC Novosibirsk**

1. Highlights of the year.

1.1. Transition from of analogue telecommunication channels to the digital channels has started. Transition of such channels as Novosibirsk- Omsk, Novosibirsk-Krasnoyarsk, Novosibirsk-Area Forecasting center "Novosibirsk-Tolmachevo" has been implemented.

1.2. Putting into operation of computer technology for the preparation and observational data transmission from the hydrometeorological stations under the zone of the responsibility of the Western-Siberian Territorial Hydrometeorological Service has been continued.

2. Equipment in use.

2.1. The data processing center is equipped with computer CRAY-EL and several PC.

2.2. New 32 bit version of GIS* "Meteo" with 5 automated work places has been put into operational exploitation.

2.3. Software-Hardware complex MTS is in operation. The collection of the hydrometeorological information from the territory under zone of the responsibility of the RSMC Novosibirsk is carried out on the computer networks.

3. Data and Products in use received from GTS

3.1. Observational data and processed information: SYNOP, TEMP, PILOT, CLIMAT, SATEM, SAREP, SATOB, BUOY, ROCOB, GRID, GRIB. Total daily volume of data is about 50 Mb. Products in GRID code form: WMC (Moscow), WMC (Washington), ECMRWF (Reading), RSMC Novosibirsk; . Products in GRIB: WMC Moscow (00 and 12 UTC), WMC Washington (00 and 12 UTC), ECMWF Reading (00 and 12 UTC),RSMC Exeter (00 and 12 UTC, including P at sea level, T and wind at the station level).

3.2. Graphic information (prognostic weather charts and basic topography) from Exeter, Moscow, Khabarovsk, Kazakhstan.

4. Data input system .

No changed

5. Quality Control system.

Quality Control system meets the requirements of the operational practice.

6. Observing system Monitoring.

6.1 Operational monitoring of the observational data for the SYNOP, TEMP is performed on the national level for the stations located in the South of the Western Siberia of Russia and the territory of the Republic of Mongolia.

6.2 Non – operational monitoring of observational data is performed on the international level for the reports: SYNOP, TEMP, PILOT, CLIMAT TEMP over

the territory of RAII (Asia), including Mongolia. Mutually agreed non-operational monitoring of the information flow via GTS is performed from 1-st to 15-th October.

7. Forecasting system

7.1 System – run schedule

7.1.1. The following is functioning at RSMC:

- operational numerical short-range forecasting system "Region", maximum forecasts range is 60 hours (dissemination over GTS up to 48 hours) 12 UTS.
- hemispheric spectral model T4OL15 (up to 3 days) developed by the Hydrometcentre of Russia (calculation for OO and 12 UTS on the CRAY – EL.
- local – climatic, local stationary, regression models for a forecast of mean monthly air temperature anomaly and precipitation anomaly;
- synoptic statistical model for a forecast of meteo elements and phenomena up to 10 days.

7.2 Medium range forecasting system

7.2.3. Numerical weather prediction products: The products of Moscow , Reading, Exeter centers is used. Processing and visualization of the information is performed by GIS (geoinformational system) "METEO".

7.2.4. Operational techniques for NWP products application: Calculation results of weather elements and unfavorable phenomena on the basis of statistical methods for interpretation of products of the hydrodynamic forecasts developed at RSMC Novosibirsk are used. The results are transmitted to the prognostic organizations of the territorial Hydrometeorological services of the western Siberia and the Ural Region: extreme air temperature for 1 – 6 days, pentads, half-day amount of precipitation (for 1 – 5 days), light, prevailing and strong wind (for 1 – 5 days), frosts (for 1 – 5 days), cloudiness in octants (for 1 – 5 days)

7.3. Short range forecasting system

7.3.1. Data assimilation objective analysis and initialization.

There is functioning the Data assimilation system for the northern hemisphere based of the optimal interpolation on the basis of spectral model T40L15 (horizontal resolution 2,5*2,5) and also the System of the objective analysis for the territory $40^oN - 80^oN$; $40^oE - 146.6^oE$ using as the first guess field the forecasts NMC Washington (code GRID) horizontal resolution: on latitude 1.66, on longitude 1.25; initialization: non-linear, on normal modes for a limited area model.

7.3.2. Model

The regional atmosphere model "Region", based on primitive equations of hydrodynamics is used in sigma-system of vertical coordinates. The area of integration on horizontal $40^oN - 80^oN$; $40^oE - 146.6^oE$; on vertical from the Earth to δ=0,1.

7.3.3. Numerical weather production products

Code GRID: pressure forecasts at mean sea level, forecasts of geopotential heights, temperature, wind at levels 925, 850,700,500 hPa, wind and temperature forecasts for aviation at levels 300, 200 hPa, vertical flows forecasts at levels 850,700,500 hPa . (Products of short – range numerical weather forecast of the model "Region" in code GRID are transmitted to the operational prognostic units of the territorial Hydrometeorological services of the Western Siberia and the Ural – Siberian region).

7.4. Extended forecasts (10 – 30 days)

Extended forecasts (10 – 30 days) for the territory of Western Siberia are performed on the basis of the methods developed at RSMS Novosibirsk. Numerical forecasts of air temperature anomaly for a decade are issued daily; monthly forecasts of mean decade air temperature are issued two times a year

9. Plans for the future (2005 – 2006)

In view of the forthcoming technical modernization of RSMC Novosibirsk it is planned:

- to start experimental testing of the Regional Numerical model with high resolution for the Siberian region;
- to introduce semi-Lagrange model of the fields of meteo-elements forecasts for the Northern in hemisphere up to 5 days with a new Data assimilation system developed by the HMC of Russia

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

1. Highlights of the year

1.1. There has been prepared and is being introduced stage by stage into the operational exploitation a new computational frame for the automated processing of the operational information and for the formation of the analytical and prognostic products.

1.2. There has been started the dissemination of prognostic products with detailing of 1 hour.

1.3. In the development of the delivery facilities and provision the users with products there has been developed soft ware for the visualization of prognostic products with arbitrary time step multiple 1 hour.

1.4. The soft ware is set on PC of the user. Information is transmitted in digital form compressed Windows standard programmes.

1.5. In the development of the information provision there was acquired information receiving block with KA "AQUA", performing data reception Modis, 4 times a day (before it was 2 times a day) what makes it possible to improve monitoring of the underlying surface state (sea surface temperature, ice conditions) in particular it enables to timely locate the occurrence of new sources of fires.

2. Equipment in the use

2.1. Automated Data Transmission System

- No changes

2.2. Data Processing Center (RCC, RHMC)

"COMPAREX" Complex GIS-Meteo, 16 bits (Server + 5 work stations 2 two-processor servers XEON (Windows NT4, LINUX), Server + workstations Complex GIS-Meteo 32 bit version on the basis PC Pentium-IV (Windows NT4, LINUX).

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

- No changes

3., 4., 5. No changes

6. Observing System Monitoring

- Not performed

7. Forecasting System

7.1. System-run schedule

- No changes

7.2. Medium Range Forecasting System

- No changes

7.3. Short-Range Forecasting System

7.3.1. Data assimilation

- No changes

7.3.2. Model

- No changes

7.3.3. Numerical Weather Prediction Products

The operational System "Region-DV" performs the calculation the objective analyses of forecasts of geopotential fields, temperature, wind velocity components for 11 standard isobaric surfaces and precipitation field over the Eastern Siberia and the Far East.

Maximum term of forecast is 48 h with an interval 3 h; mean sea level pressure field and precipitation intensity is 1 h.

Calculation is performed two times a day (from 00 h, 12 h UTC).

Prognostic products are disseminated to the Territorial Hydrometeorological Services of the Far East Region via e-mail in the digital format and in the form of charts-slides.

7.3.4. Operational Techniques for NWP Products Application

Half daily and daily precipitation totals for the points as per the list established.

8. Verification of Prognostic Products

Below in the Table the averaged characteristics of the forecast quality in comparison with an objective analysis (all 600 forecasts from 00 h and 12 h UTC) for the period from the 1 January 2003 to the 1 December 2004 are shown.

Geopotential

Level (hPa)	Lead time	Characteristic				
		ε	R_h	δ	σ	S1
250	12	0,7	0,875	3,0	3,5	22
	24	0,5	0,925	3,4	4,2	25
	36	0,5	0,921	4,4	5,3	28
	48	0,6	0,901	6,0	7,0	33
300	12	0,6	0,898	2,6	3,1	22
	24	0,4	0,937	3,1	3,8	25
	36	0,5	0,924	4,2	5,0	30
	48	0,5	0,905	5,6	6,6	34
500	12	0,6	0,881	1,8	2,2	23
	24	0,4	0,932	2,1	2,6	27
	36	0,4	0,915	2,9	3,4	32
	48	0,5	0,894	3,7	4,5	37
700	12	0,8	0,820	1,7	2,0	29
	24	0,5	0,909	1,8	2,1	32
	36	0,5	0,891	2,4	2,9	38
	48	0,6	0,861	3,0	3,6	43
850	12	0,9	0,790	1,6	1,9	35

	24	0,6	0,878	1,8	2,2	40
	36	0,6	0,861	2,5	3,0	47
	48	0,7	0,817	3,2	3,9	52
1000	12	0,8	0,771	1,7	2,1	45
	24	0,6	0,867	2,0	2,5	50
	36	0,6	0,829	2,8	3,4	59
	48	0,7	0,801	3,4	4,2	64

Wind velocity components

Level (hPa)	Lead time (hours)	Characteristic			
		ε	R_h	δ	σ
250	12	1,2	0,689	8,8	10,6
	24	0,8	0,796	8,7	10,5
	36	0,7	0,812	9,2	11,2
	48	0,7	0,801	9,8	11,9
300	12	1,1	0,721	8,0	9,7
	24	0,7	0,810	8,2	10,0
	36	0,7	0,826	8,5	10,4
	48	0,7	0,811	9,2	11,3
500	12	1,0	0,721	5,1	6,2
	24	0,7	0,813	5,3	6,5
	36	0,6	0,818	5,6	6,9
	48	0,6	0,796	6,0	7,5
700	12	1,0	0,730	3,4	4,2
	24	0,7	0,801	3,8	4,7
	36	0,7	0,798	4,0	5,0
	48	0,7	0,762	4,4	5,6
850	12	1,0	0,704	3,1	3,9
	24	0,7	0,780	3,3	4,2
	36	0,7	0,775	3,7	4,7
	48	0,7	0,732	4,1	5,1

ε – relative error;
δ – mean absolute error
σ – root-mean-square error
R_h – correlation coefficient between actual and prognostic fields variation
S1 – skill score of the gradients forecast.

9. Plans for the Future (2005-2006)

Due to technological modernization of the RSMC Khabarovsk (two 2-processor Servers XEON and the complex GIS-METEO 32 bit version) there appeared the possibility to perform operation on the improvement of the quality of the prognostic products of the model. For this purpose it is planned:

- transfer of the all technology of the operational data processing and NWP system to the new computational frame;
- introduction 20-level σ-model into the operational practice;
- calculation of the forecasts with a step of 50 km over the width territory (10800 km x 7800 km).