Annual WWW Technical Progress Report on the Global Data - Processing and Forecasting System 2004

REPUBLIC OF SERBIA

1. CONTENTS

- The 120-hours regional Eta forecasts are generated twice a day, using data from 00UTC and 12UTC and DWD NMC Offenbach boundary values on PC Linux and 18km on BEOWULF Cluster with 9 nodes. Beowulf cluster with 16 and 20 nodes are in experimental use.

- The 72-hours regional Eta forecasts are generated twice a day, using data from 00UTC and 12UTC and ECMWF boundary values on PC Linux 18km resolution.

- SMS-ECMWF in experimental use

- Connecting through RMDCN with ECMWF

- Replace existing MSS with Corobor dual host message switching system

- The implementation of the graphical package METVIEW–ECMWF in operational use

2. EQUIPMENT IN USE AT THE CENTRE

2.1. Work stations and PC Pentiums

- **37 x PC Pentium :**
  2,8GHz
  512MB RAM
  80GB HDD
  OS: Linux SUSE 9.2; Windows XP

- **Beowulf Cluster -** 3x3 diskless nodes:
  1 Server node + 1 buck up node-server module
  Switch module is based on Cisco switch 2950 and Panduit passive components
  AMD Athlon processor on 1.4GHz
  512 MB RAM
  4 Ethernet ports (one has 5 Ethernet ports) which enables to link them in simple star or 2-D grid.
  OS: Linux Red Hat 7.2
  This configuration works as single computer with 5GB memory,

processor performance of 5 Gflops and 100 Mbit Ethernet interconnection between nodes
Message Passing Interface (MPI) /MPICH- for parallel processing
Portland Group Fortran compiler

Used for operational forecasts and research.

2.2. The Hardware Characteristics of Telecommunications

The core of data receiving, processing and data distribution system (DPR&DDS) based on the COROBOR dual host with adequate Data Base Management System (DBMS) in testing phase

3. DATA AND PRODUCTS FROM GTS IN USE

GTS data are received directly through two X.25 (9600 bps, channels from RTH Sofia / NMC Budapest.

- Data in use:
  SYNOP 10000 - 12000 / day
  TEMP 360 - 430 / day
- Products in use:
  GRID ECMWF 40 - 50 / model output
  GRID EGRR 610 - 630 / model output
  Significant weather forecast
  Winds/Temperature forecasts for various flight levels

3.1 Products from the Internet in use

DWD products in GRIB {GRIB KWBC 360 / model output.}
ECMWF products in GRIB {GRIB KWBC 360 / model output.}

3.2 Products from the RMDCN in use

ECMWF products in GRIB (model output, bitmap)

4. DATA INPUT SYSTEM

Fully automated system.

5. QUALITY CONTROL SYSTEM

Automated quality control system.

5.1. Quality control of national data prior to transmission on the GTS

There is quality control system in use.

5.2. Quality control of incoming data

The formats of all coded reports are checked.

Surface and upper air reports are checked for internal consistency before storing and exchange.

Checks on temporal consistency.

Checks against the model background values.

Buddy checks.

6. MONITORING OF THE OBSERVING SYSTEM

Surface observations and upper air observations are monitored on the national level.

7. FORECASTING SYSTEM

The main component of the forecasting system is the limited area model, with the Eta vertical coordinate and step-like mountain representation, is operationally produced twice a day.

7.1. System run schedule

120–hours forecasts based on 00 and 12 UTC observational data are produced twice a day (DWD boundary condition).

72–hours forecasts based on 00 and 12 UTC observational data are produced twice a day (ECMWF boundary conditions).

7.2. Medium-range forecasting system (4 - 10 days)

7.2.1 Data assimilation, objective analysis and initialization

Assimilated data: TEMP (parts A and B), SYNOP and SHIP.

Assimilation cycle: 12 hours.

Cut - off time: 3 hours.

Analysis method:
- multivariate analysis by successive corrections (Bratseth,1986);
- multivariant spectral (truncated Fourier series) fitting method applied to the differences between observations and first - guess values.

Analyzed variables: sea level pressure, geopotential, horizontal wind components and specific humidity.

Coverage:
- Europe, North Atlantic, North Africa;
- 24°N - 70°N, 40°W - 55°E.

Horizontal resolution: 0.33° x 0.33° ;
0.125x0.125 experimentaly.

Vertical resolution: ten standard pressure levels, from 1000 hPa to 100 hPa.

Initialization: scale - selective dynamic initialization scheme.

7.2.2. Preprocessing

New items such as soil and vegetation type have been introduced. Sintetization of SST (NCAR climatology data set), soil temperature and soil wetness has also been implemented.

7.2.3. Model

Basic equations: Primitive equations system.

Independent variables: λ, φ, η, t.

Dependent variables: T, u, v, q, surface pressure, turbulent kinetic energy, surface potential temperature, ground wetness and depth of snow cover.

Numerical technique: horizontal advection has a built-in nonlinear energy cascade control on semi - staggered Arakawa E grid, split-explicit time differencing.

Integration domain: limited area with 73 x 121 grid points
limited area with 201 x 353 grid points.

Resolution:
- horizontally : ~ 52 km;
- horizontally : ~ 18 km;
- vertical: 32 η layers in
- time step: 120 s.

Vertical coordinate:
- η - coordinate

Orography:
- grid box representation;
"silhouette" mountains extracted from 30'' degree US Navy data set

Boundaries: forecast fields with 6 hours interval functioning as boundary values have been obtained from ECMWF and from DWD, NMC Offenbach.

Physical parameterization:

- Mellor Yamada level 2.5 turbulence closure model for PBL and for surface layer processes;
- fourth order nonlinear lateral diffusion;
- surface processes;
- OSU parameterization scheme;
- large scale precipitation;
- Betts-Miller-Janjic deep and shallow convective scheme;
- GFDL radiation scheme.

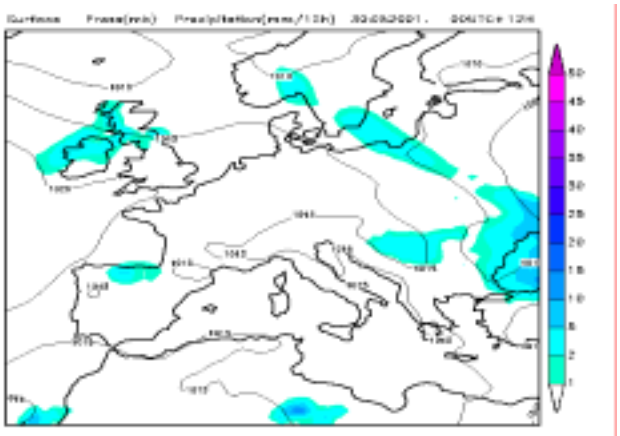
7.2.4. Numerical weather prediction products

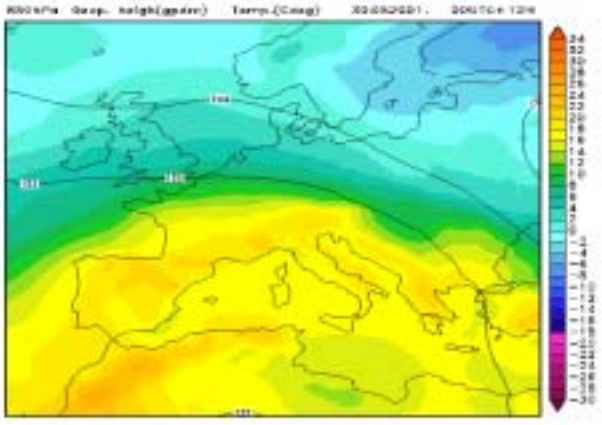
- geopotential
- mean sea level pressure
- temperature
- horizontal and vertical wind components
- precipitation (total and convective)
- wind stress
- specific humidity
- short wave and long wave radiation
- turbulent kinetic energy
- turbulent exchange coefficients
- surface potential temperature
- soil moisture
- snow cover
- evaporation
- surface sensible heat flux
- surface latent heat flux
- convective cloud top and depth
- total cloud cover
- frontogenetic parameter
- R_i number

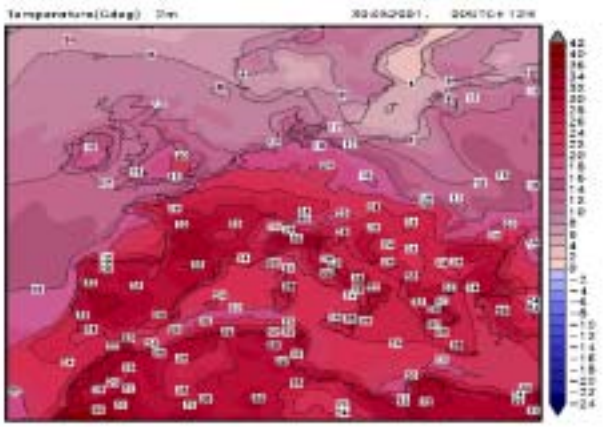
Regional Eta model products are distributed internationally through Internet as the primary means of distribution (address: **www.hidmet.sr.gov.yu**)

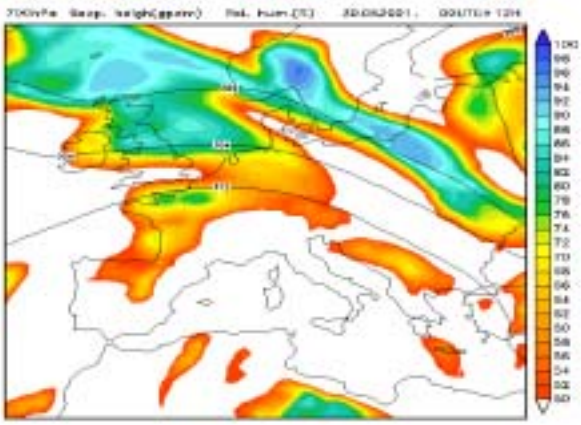
They are also distributed nationally on the National Telecommunication System

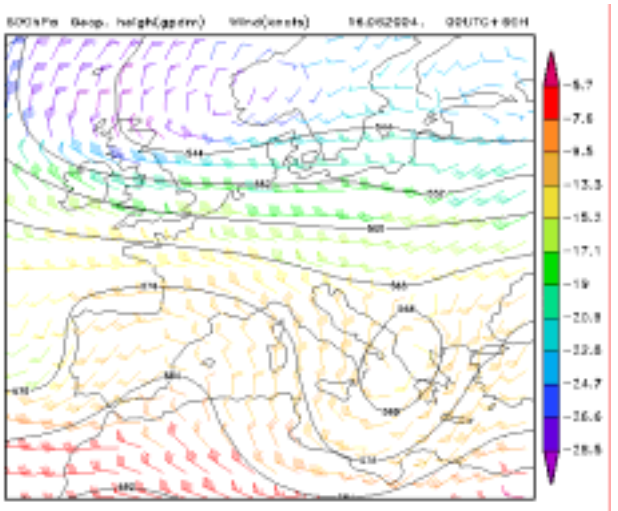
Post processing

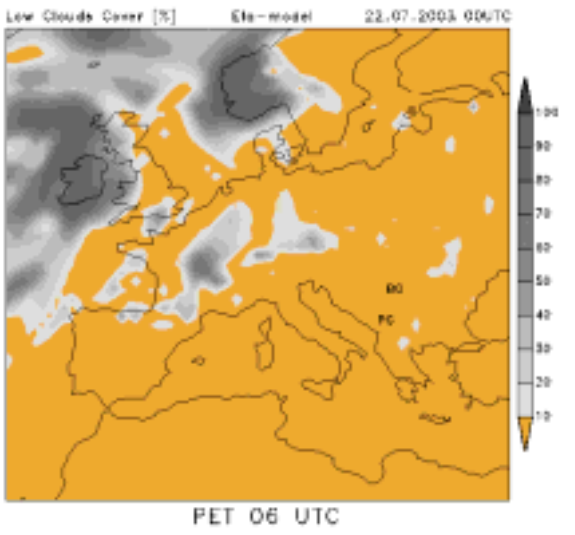


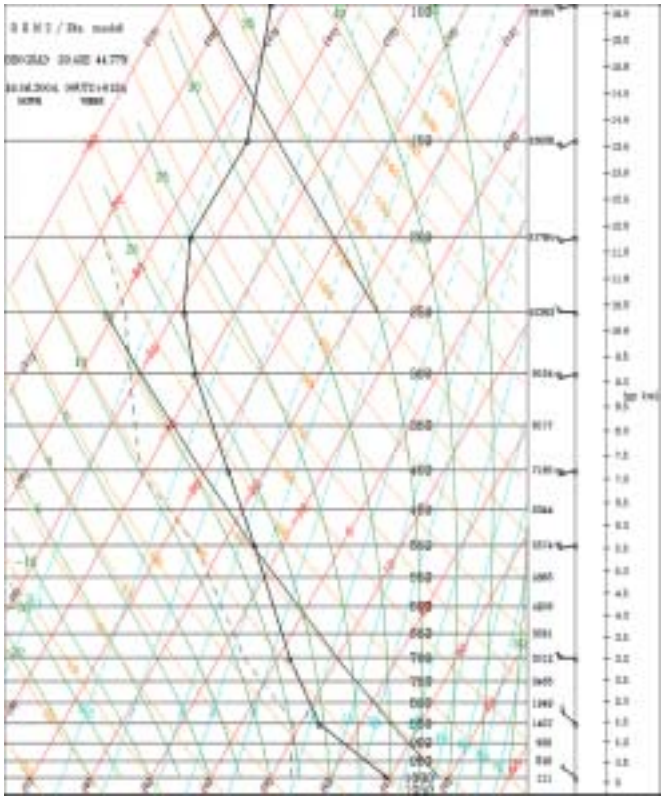


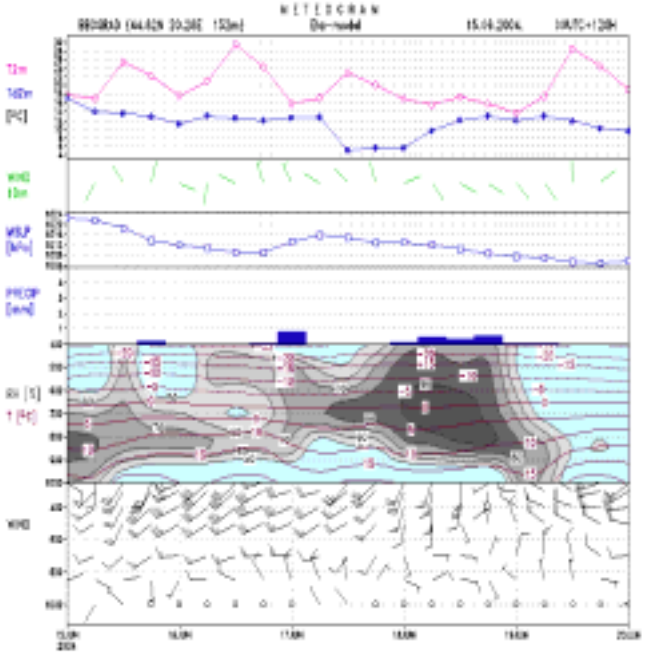


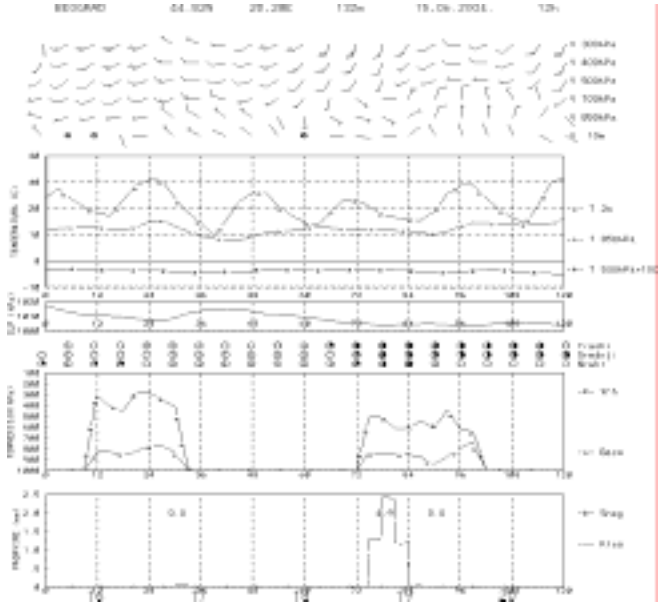


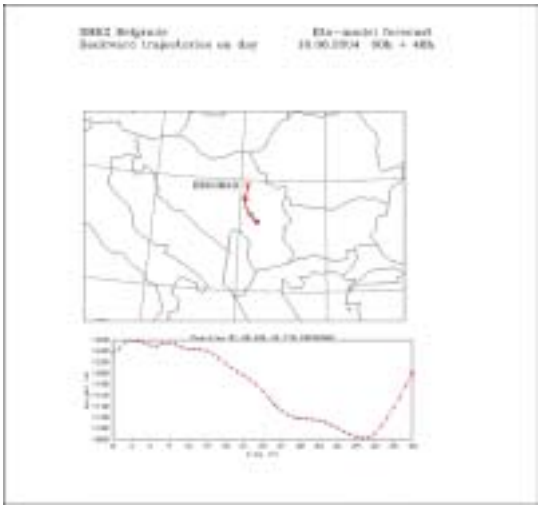


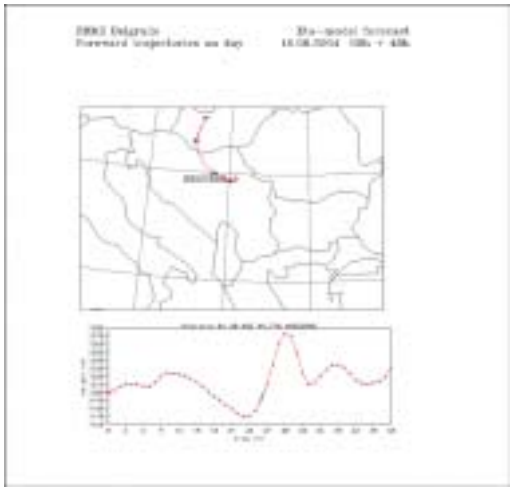




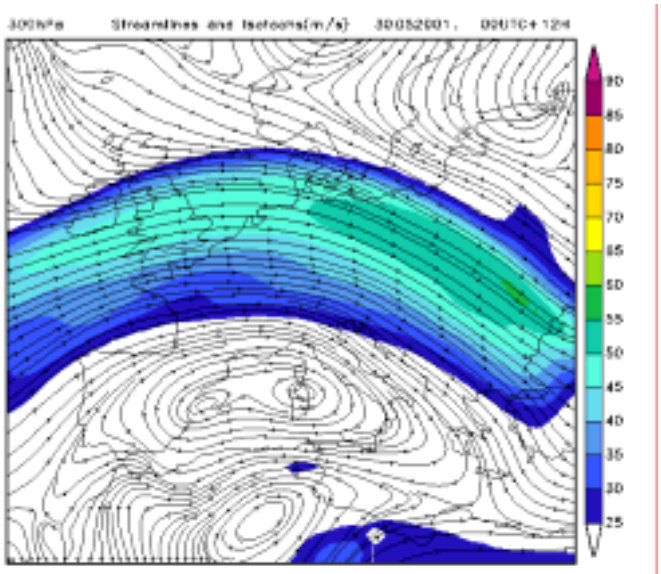


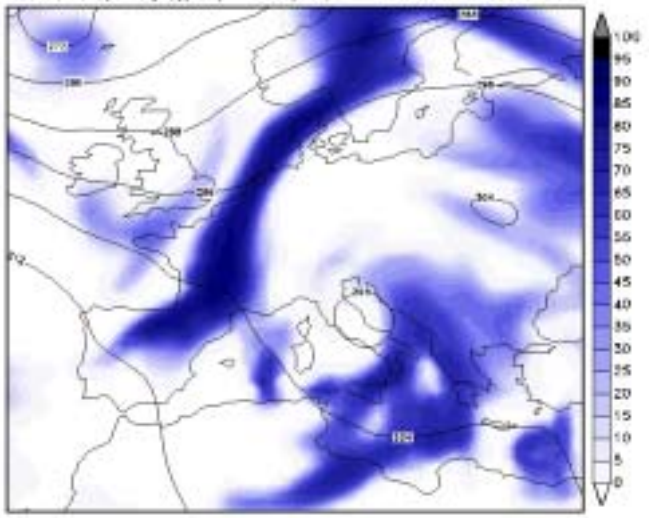


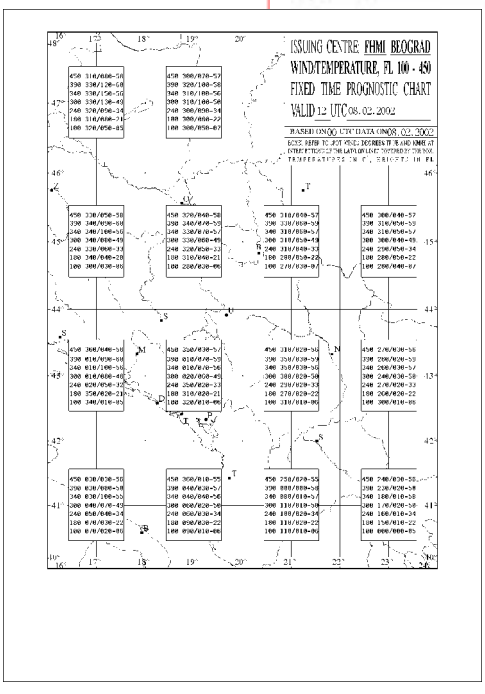




Forecasts for aviation







8. VERIFICATION OF FORECASTING

The objective verification of subjective forecasts based on Eta model output is presented. The verification system includes the comparison of forecasting with observations of minimum and maximum temperature in several cities in Serbia. The verification of precipitation is also included. Period of verification is from September 22nd, 2004 till December 31st, 2004.

Verification parameters are BIAS, skill score and threat score. These statistical scores are computed for precipitation.

Belgrade – five days forecast

	HIR	FAR	BS	SS	TS	V
D+1	0,41	0,36	1,20	0,25	0,31	0,77
D+2	0,39	0,50	1,13	0,16	0,28	0,89
D+3	0,45	0,44	1,11	0,24	0,33	0,89
D+4	0,44	0,46	1,11	0,23	0,32	0,90
D+5	0,45	0,44	1,10	0,27	0,33	0,89

Actual day

	HIR	FAR	BS	SS	TS	V
Palić	0,50	0,50	1,00	0,31	0,33	1,00
N.Sad	0,48	0,40	1,10	0,33	0,36	0,88
Loznica	0,51	0,43	1,05	0,29	0,37	0,94
Belgrade	0,44	0,37	1,18	0,29	0,35	0,81
Kragujevac	0,48	0,54	0,99	0,28	0,30	1,02
Negotin	0,47	0,30	1,17	0,40	0,39	0,77
Kraljevo	0,50	0,38	1,10	0,34	0,38	0,88
Kopaonik	0,68	0,28	1,04	0,50	0,54	0,96
Niš	0,40	0,40	1,25	0,21	0,31	0,80

D+1

	HIR	FAR	BS	SS	TS	V
Palić	0,62	0,44	0,95	0,42	0,42	1,06
N.Sad	0,52	0,41	1,07	0,34	0,38	0,93
Loznica	0,47	0,43	1,11	0,26	0,35	0,90
Belgrade	0,41	0,36	1,20	0,25	0,31	0,77
Kragujevac	0,48	0,50	1,00	0,30	0,31	0,98
Negotin	0,45	0,30	1,19	0,38	0,38	0,75
Kraljevo	0,44	0,46	1,10	0,24	0,32	0,90
Kopaonik	0,59	0,26	1,16	0,44	0,49	0,85
Niš	0,41	0,36	1,28	0,24	0,33	0,77

HIR – Hit Rate; FAR – False Alarm Rate; BS – Bias Score; SS – Skill Score
TS – Threat Score (the first category); V = HIR+FAR

Mean error and mean absolute error are computed for verification of the min and max temperature.

Tmax -Belgrade – five days forecast

	ME	MAE
D+1	-0,5	1,9
D+2	-0,0	2,0
D+3	-0,2	2,8
D+4	-0,3	3,4
D+5	-0,7	4,3

Tmin -Belgrade – five days forecast

	ME	MAE
D+1	-0,8	1,4
D+2	-0,7	1,6
D+3	-0,9	1,8
D+4	-1,2	2,3
D+5	-1,0	2,5

Tmax - actual day D

	ME	MAE
Palić	-0,1	1,7
N.Sad	-0,1	1,6
Loznica	0,0	2,3
Belgrade	-0,5	1,9
Kragujevac	-0,4	1,9
Negotin	0,8	2,5
Kraljevo	0,1	1,7
Kopaonik	-0,4	2,2
Niš	0,2	2,2

Tmax - D+1

	ME	MAE
Palić	0,0	1,7
N.Sad	0,0	1,5
Loznica	0,6	2,4
Belgrade	-0,5	1,9
Kragujevac	-0,7	1,8
Negotin	-0,1	2,5
Kraljevo	-0,1	1,9
Kopaonik	-0,2	1,8
Niš	0,1	2,4

Tmin - D+1

	ME	MAE
Palić	-1,0	1,9
N.Sad	-0,4	1,8
Loznica	-1,1	1,9
Belgrade	-0,8	1,4
Kragujevac	-0,6	1,6
Negotin	-1,1	2,3
Kraljevo	-0,5	1,8
Kopaonik	-0,5	1,8
Niš	-0,9	1,9

9. PLANS FOR THE FUTURE

- New non-hydrostatic version should be operationally implemented.
- New methods on objective verification system should be introduced.
- The implementation of new data management system project for non real time data is planned, too .

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