Update on NWP activity at the Hydrometcentre of Russia

Roshydromet

HYDROMETCENTER OF RUSSIA
About the weather - at first hand

Forecasts | Actual data | Climate | Around the Weather | About us

Forecasts › Uncategorised › Medium-range forecasts for cities of Russia

- Medium-range (1-week) forecasts for cities of Russia
  - Global medium-range forecasting system description
- Short-range limited area forecasts by COSMO-RU model: Meteograms
  - COSMO-RU model with grid spacing 2.2 km: Forecast maps
  - COSMO-RU model with grid spacing 6.6 km: Forecast maps
- Nowcasting of precipitation intensity
- Global forecast of ocean wave parameters
- Global medium-range forecast fields in GRIB format
- Meteoalert
  - Central Federal District
  - Northwestern Federal District

Medium-range forecasts for cities of Russia

Country: RUSSIA | Region of Russia: MOSCOW AREA | Station (city): KASHIRA

Actual weather Look CHERUSTI, MOSCOW

1-week forecast | GRAPHS

	Wednesday November, 9	Thursday November, 10	Friday November, 11	Saturday November, 12	Sunday November, 13	Monday November, 14	Tuesday November, 15
Day							
T max	8°	7°	7°	9°	6°	1°	-4°
Precipitation, mm (probability)	0.1 (81%)	0	0.5 (91%)	0.1 (87%)	0	0.2 (71%)	0
Wind, m/s	↗ 4	↗ 5	→ 3	→ 6	↘ 8	↓ 6	↘ 3
Pressure	744	745	747	745	745	747	753
Night							
T min	5°	5°	6°	6°	1°	-6°	
Precipitation, mm (probability)	0	0.1 (83%)	0	0.1 (83%)	0	0	
Wind, m/s	↗ 5	↗ 4	→ 6	↘ 7	↘ 6	↘ 3	
Pressure	745	746	748	742	746	751	

Elena Astakhova, WGNE37, November 10, 2022

NWP systems: operation and research

Federal Service for Hydrometeorology and Environmental Monitoring
HYDROMETEOROLOGICAL CENTRE OF RUSSIA

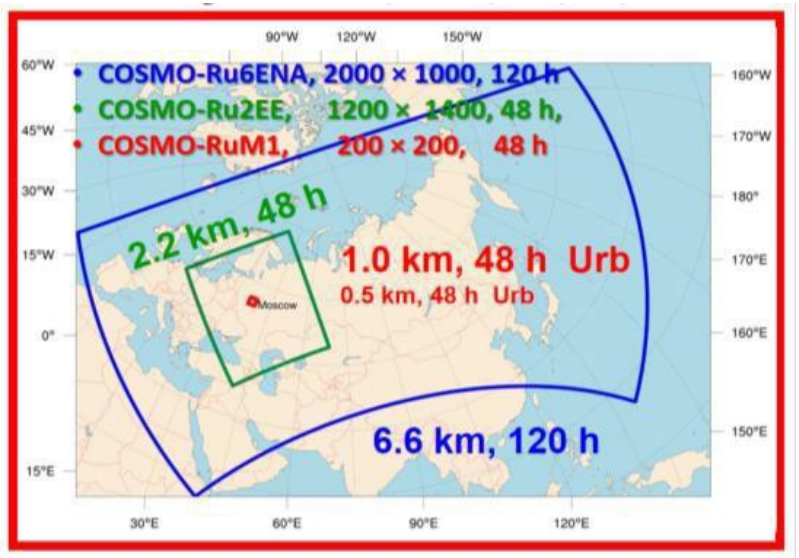
Global data assimilation

Operational 3D-Var; EnVar under development

- Data from the Russian satellite microwave radiometer MTVZA-GY (atmospheric temperature channels) and the infrared Fourier spectrometer IKFS-2 (channels in the 15-micron carbon dioxide absorption band, sensitive mainly to atmospheric temperature) are now assimilated operationally.
- Preliminary assessment of AMV from the satellite Arctica-M N2 on a highly elliptical orbit is ongoing.
- Development of a neural-network based technique to assess sea ice concentration from satellite microwave, infrared, and visible observations is underway.

NWP systems: operation and research

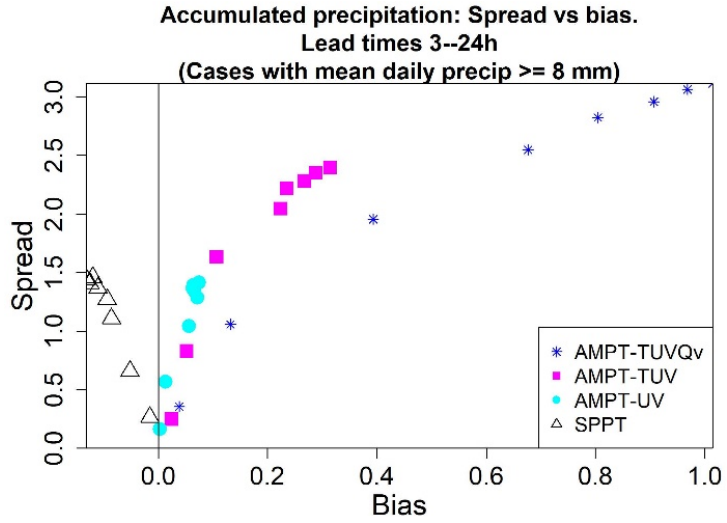
Regional Forecasts



Based on COSMO model
3 operational domains, horizontal step from 6.6 km to 1 km
1.0 km resolution over Moscow region with urban effects
On-going transfer from COSMO to ICON
Postprocessing using Neural Network

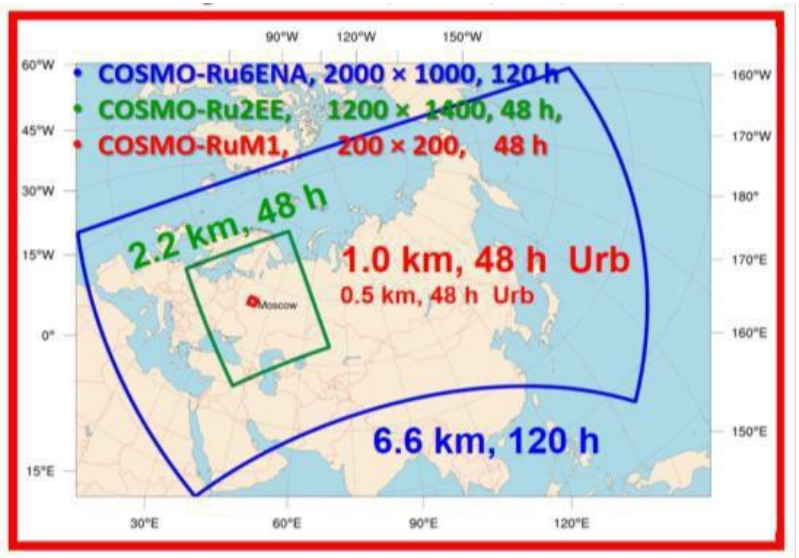
Research in model uncertainty:

Work on the technique termed Additive Model perturbations scaled by Physical Tendency (AMPT) has been continued. Perturbing humidity with AMPT deteriorates the bias-to-spread ratio.



NWP systems: operation and research

Regional Forecasts



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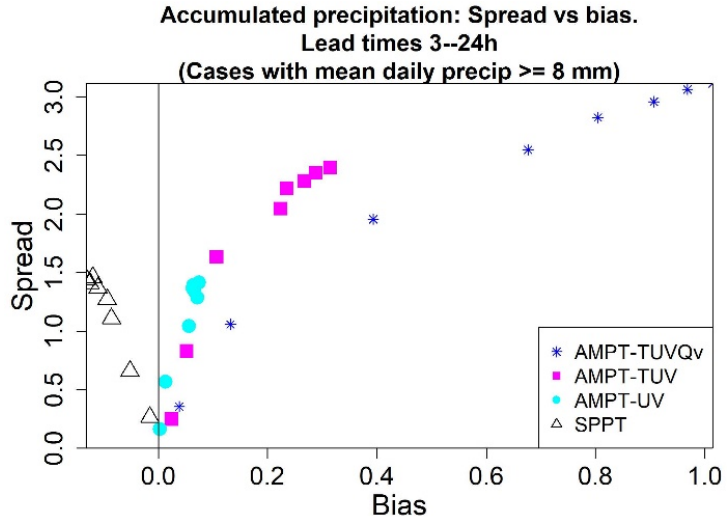


Research in radiation

ICON

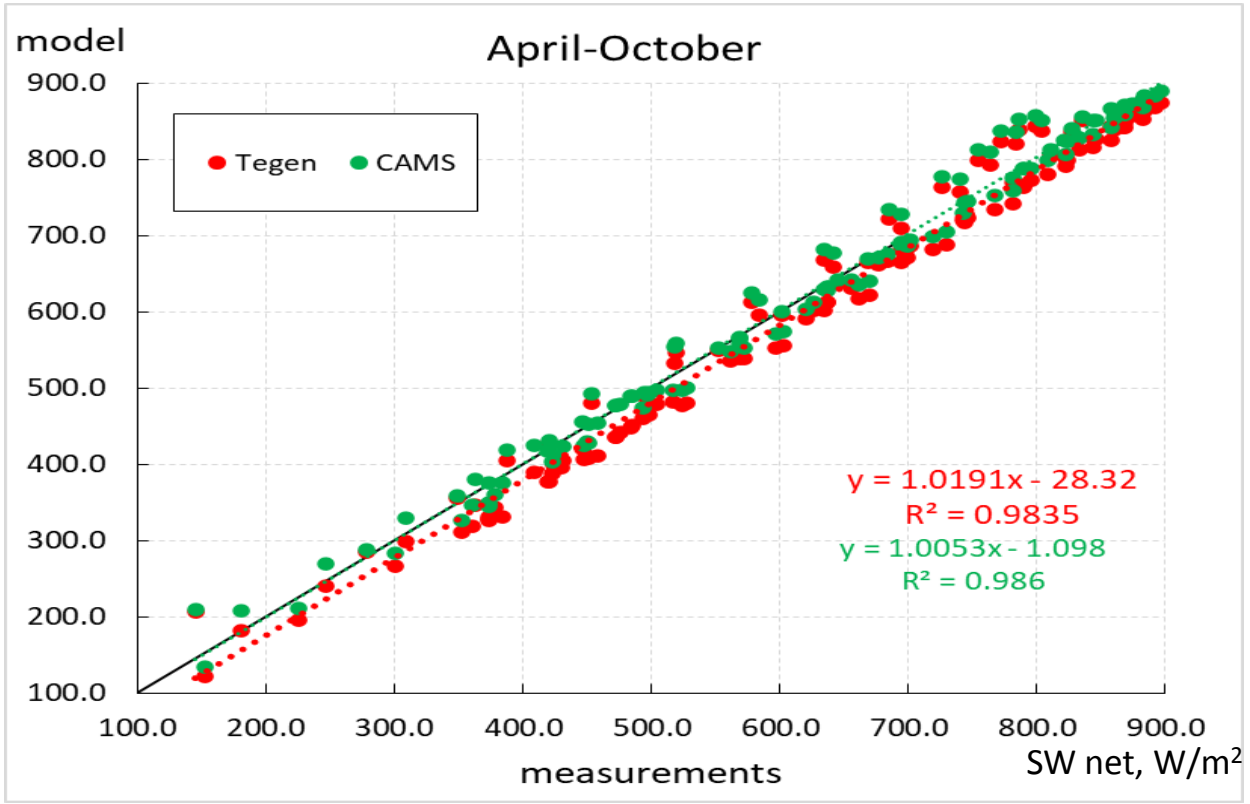
- New modular radiation scheme ecRad (Hogan, Bozzo, 2018)
- 3 options for solvers for radiative transfer equations (McICA, Tripleclouds, SPARTACUS)
- New CAMS aerosol climatology has been implemented in ICON (model code and external parameter database and software EXTPAR)

Assessments show an improvement of the SW net radiation simulation with the CAMS climatology compared to the previous one with Tegen climatology

<u>Mean error in SW net radiation for clear sky</u>
Tegen aerosol climatology **-16.6 ± 4.4 W/m²**
CAMS aerosol climatology **2.2 ± 3.9 W/m²**

However there is some inconsistency for March:

- *due to AOD discrepancy between CAMS and observations*
- *due to error in forecasted surface albedo (snow/no snow)*



Courtesy A. Poliukhov, M.Shatunova

Research in radiation

COSMO as a tool to investigate aerosol indirect effects

CLOUDRAD is a cloud-radiative interaction scheme that takes into account the indirect effects of aerosol through the number concentration of cloud condensation nuclei, NCCN (Muskatel et al., 2021).

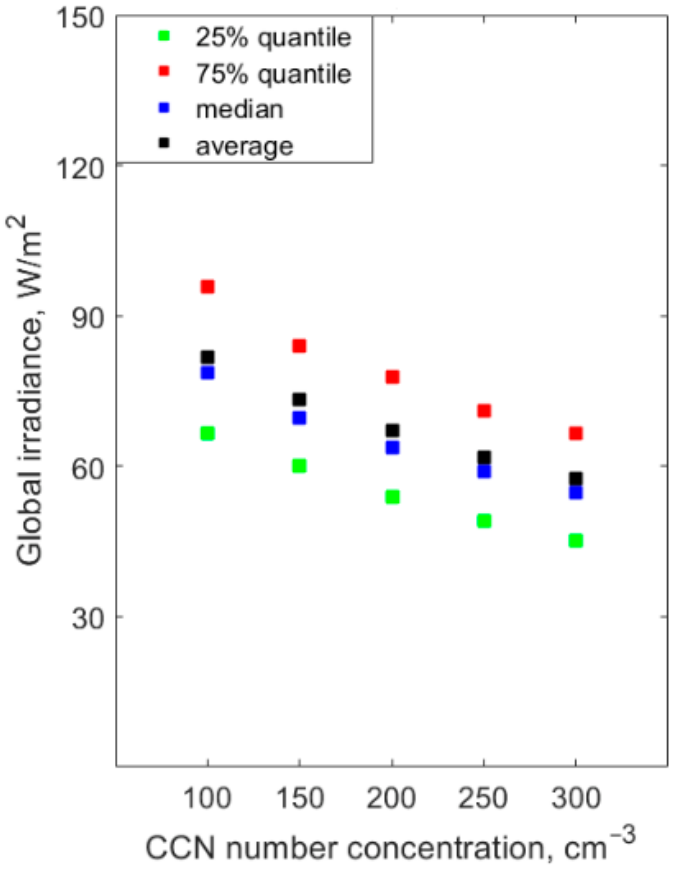
Lockdown during Spring 2020 gave an opportunity to evaluate cloud characteristics and radiation under conditions of reduced pollution:

- Data for springs 2018-2019 & spring 2020
- Similar synoptic conditions (northern advection, liquid low-level clouds, etc)
- MODIS, CERES and ground-based observations
- COSMO simulations with CLOUDRAD (Domain - Moscow region, app. 200x200 km, 1.1 km grid spacing)

Conclusions

Observations: In Spring 2020 we detected an NCCN reduction by 15% (40-50 cm^{-3}), a droplet radius increase by 8%, a cloud optical thickness decrease by 5% compared to Springs 2018-2019.

Simulations: Sensitivity of solar irradiance at the ground to the changes in NCCN: a 5–9 W/m^2 (or 9–11%) increase following from the reduction in cloud droplet concentration by NCCN = 50 cm^{-3} under overcast cloud conditions.



Simulated global irradiance as a function of NCCN for LWP = 200–400 gm^{-2} for overcast conditions.
The solar height is 40°.

*Shuvalova, J. et al., Atmosphere **2022**, 13, 1710. doi.org/10.3390/atmos13101710*

Global SL-AV model: Operational configurations and research

Federal Service for Hydrometeorology and Environmental Monitoring

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Medium-range Forecasts

0.225° x (0.16°-0.24°)L 51 – operational (SL-AV20)
New version 0.1° x (0.08-0.13)° L104 (SL-AV10) - parallel runs since 25/09/2022

SL-AV10

- New orography SRTM30, physiography. Differs especially in vegetation and urbanization fields
- Many improvements in parameterization as developed for long-range forecasts. Including non-orographic GWD parameterization (Hines 97)
- Elapsed time per day – 13 min with I/O @ 2916 cores of Cray XC40
- Very preliminary: better scores w.r.t. to SL-AV20, especially in tropics

Medium-range EPS

0.9°x0.72°L96, M40, LETKF,
SPP +SPPT for T and vor
Operational since July 2022

Courtesy M.Tolstykh

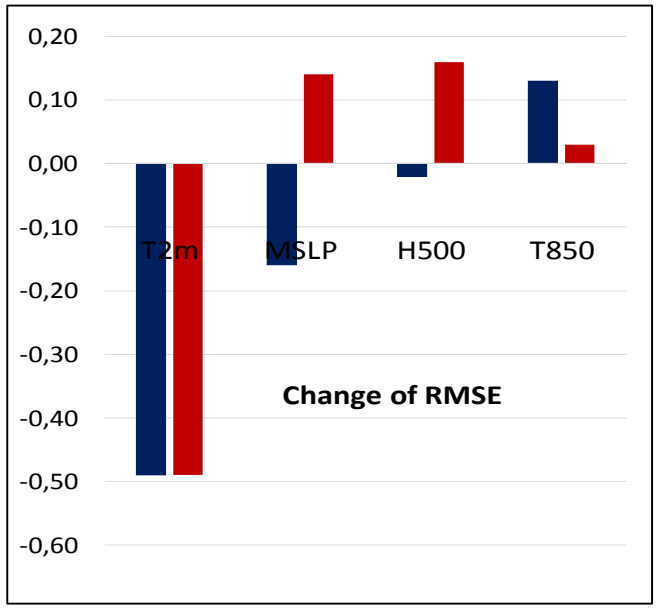
Global SL-AV model: Operational configurations and research

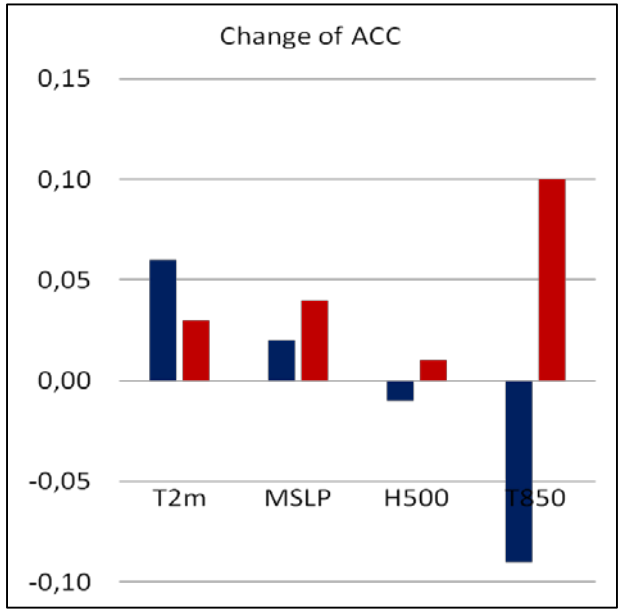
Subseasonal and Seasonal Forecasts
(WMO S2S Prediction project)
Operational model 1.4°x1.1°L28
New version: 0.9°x0.72°L96. Parallel runs since 27/01/2022

Long-range forecast version

- Reproduces QBO (since 2018 version) and MJO (since 2021 version)
- Multilayer soil model works with SEKF initialization for soil moisture

Improvement of long-range forecasts in 2022 (mostly in T2m)



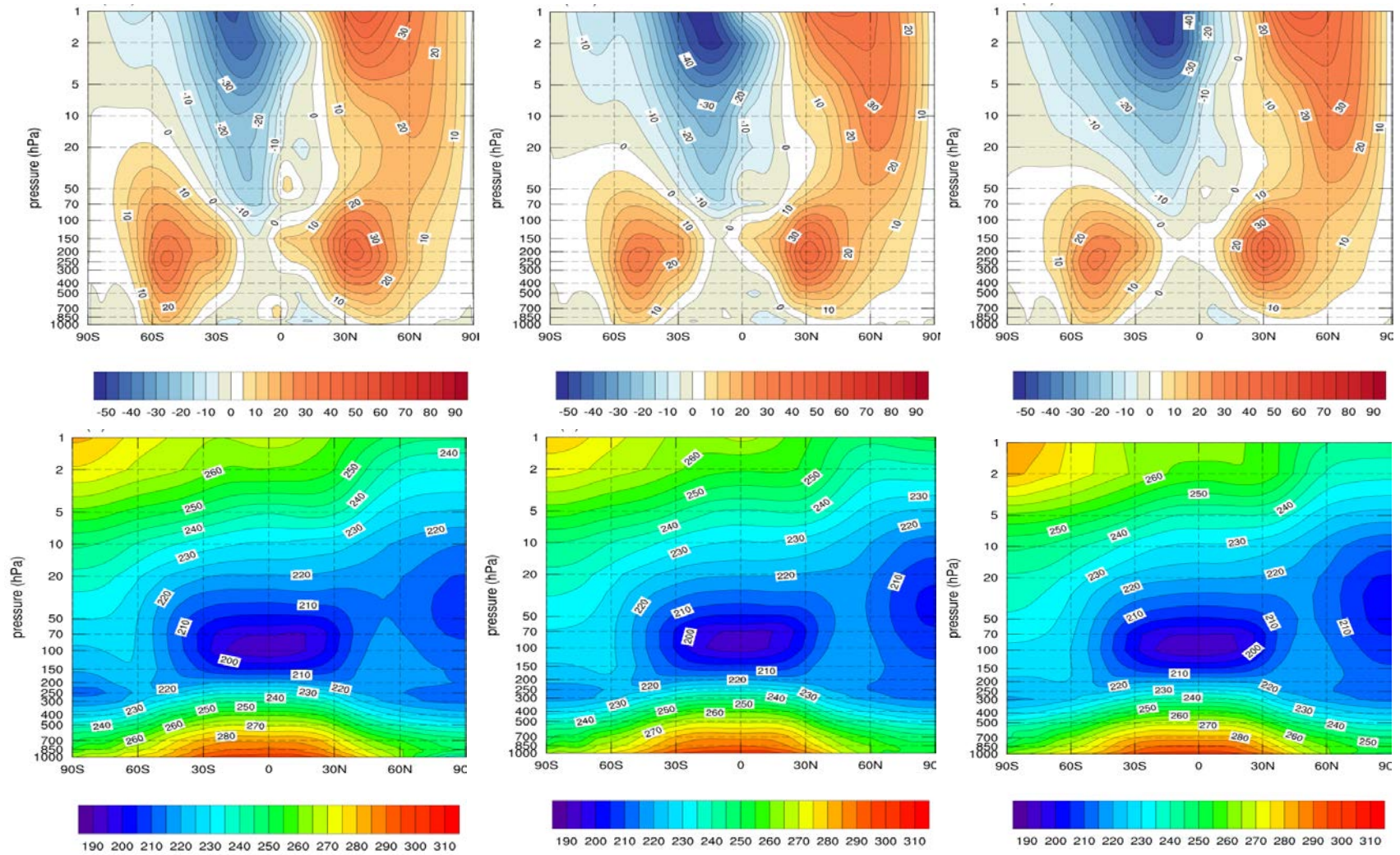


Changes of RMSE and ACC in SL-AV new version operational long-range forecasts: monthly forecast with zero (blue) and 2-week lead time (red). Region 20-180E, 40-70N; 18 cases

Units: degrees for T2m and T850; hPa for MSLP; dam for H500

Improvement of zonal means in new version wrt old version with detailed vertical resolution

SL-AV 2018 – 100 levs | **SL-AV 2022 – 96 levs** | **ERA5**



Zonal mean U (top), T (bottom) in climate run, DJF 1991-2020

SL-AV-model: ongoing works

- More single precision in the code
- Development of the coupled model (NEMO + LIM)
- Implementation of the lake model (Stepanenko et al, 2015)
- Development of non-hydrostatic dynamical core using quasi-uniform horizontal grid

Further plans:

- Medium-range EPS based on SL-AV20
- Testing glacier parameterization (Fadeev et al, 2022) in seasonal forecasts

Development of a new non-hydrostatic model at a cubed-sphere grid

Current status

- Fully explicit 3d non-hydrostatic prototype with orography. Results of idealized test cases. Working on HEVI scheme implementation.

- Preliminary tests of parallel geometric multigrid solver.

- Working on hybrid MPI-OpenMP parallelization.