# The Hydrometcentre of Russia: Seasonal Forecasting – 2010

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# Presentation outline

Long-range forecasting system of the Hydrometcentre of Russia:

1. SL-AV atmospheric general circulation model;

2. Ocean model and coupled system;

3. Statistical postprocessing of dynamical LRF

# 1. SL-AV AGCM

- Semi-Lagrangian vorticity-divergence dynamical core of own development and ARPEGE/LACE parameterizations;
- SL-AV model versions with different spatial resolution are used for operational LRF, MRF and regional SRF (version with variable resolution and rotated poles)
- MRF: Currently, 0.9ºx0.72º lon/lat, 28 levels. Version with 0.45ºx0.37º resolution and 50 levels is under testing;
- LRF: 1.125º /1.40625º lat/lon, 28 sigma levels.

  50 levels under testing.

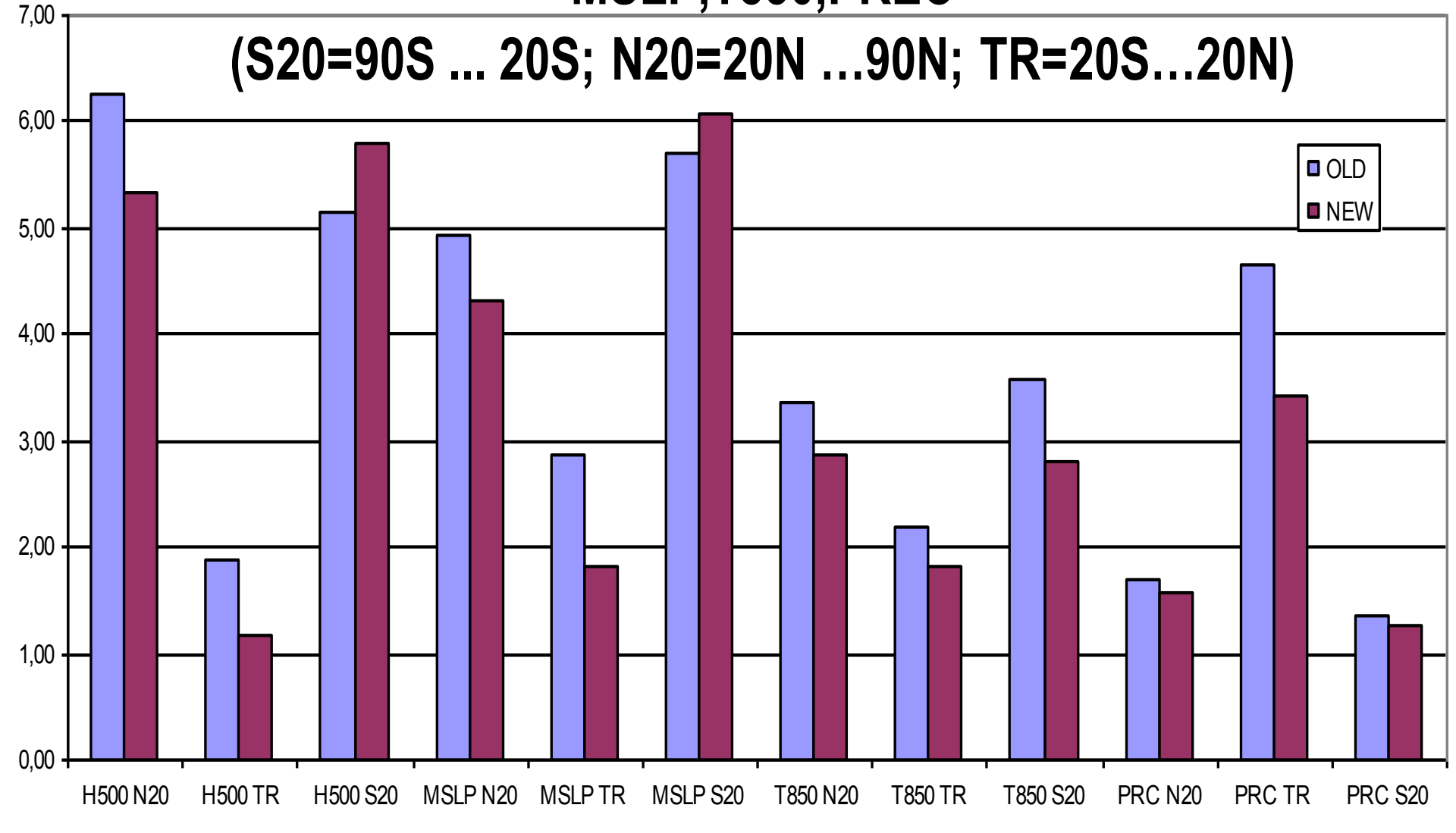
# LRF-version of SL-AV model with updated physics has been prepared to replace the previous AGCM in 2010

Changes:

- ISBA-parameterization of interaction between soil, vegetation, snow, soil ice and the atmosphere (Noilhan, Planton 1989, Giard, Bazile, 2000) was implemented;
- New version of solar and thermal radiation;
- Some changes in PBL and cloudiness parameterizations;

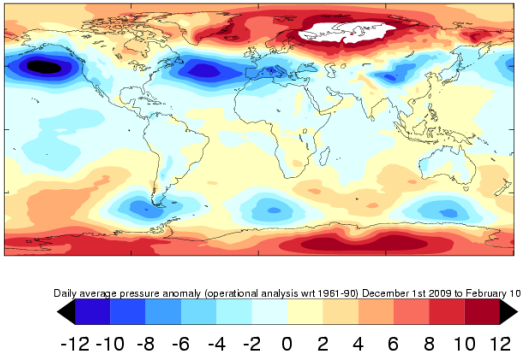
+ It is planned to apply realistic climate ozone distribution instead of height-only dependence. This helps to reduce errors in Southern Hemisphere.

# Averaged over 4 seasons and 25 years RMSE for SL-AV seasonal hindcasts: H500*0.1, MSLP,T850,PREC



# Negative AO, DJF 2009/10

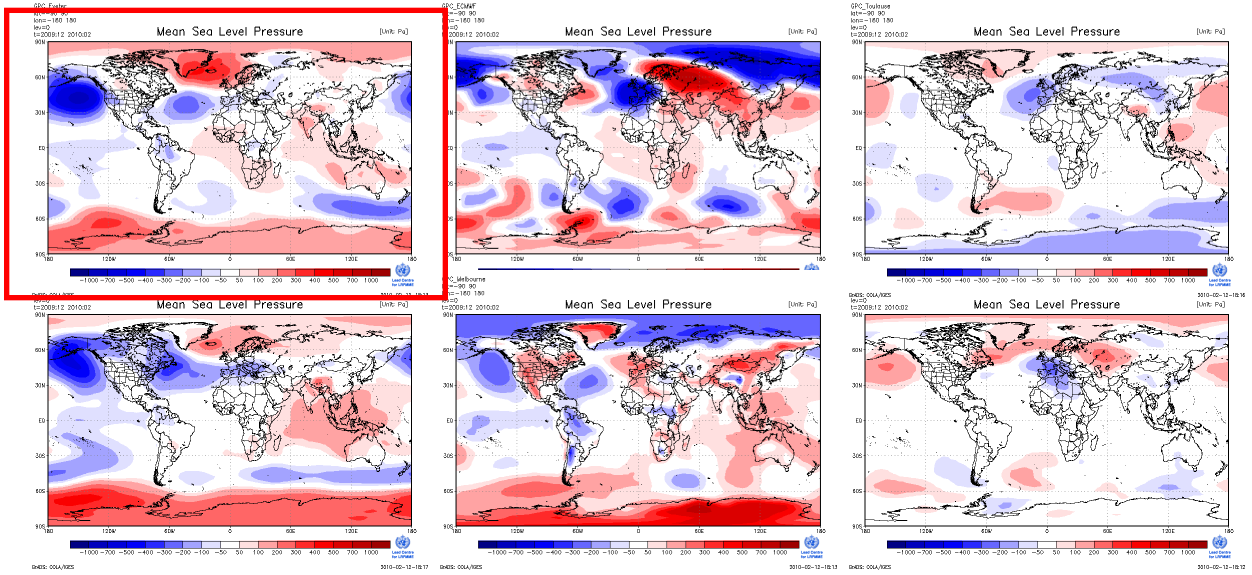
## MSLP anomalies: observed and GPC predictions from Nov09 (ensemble mean)

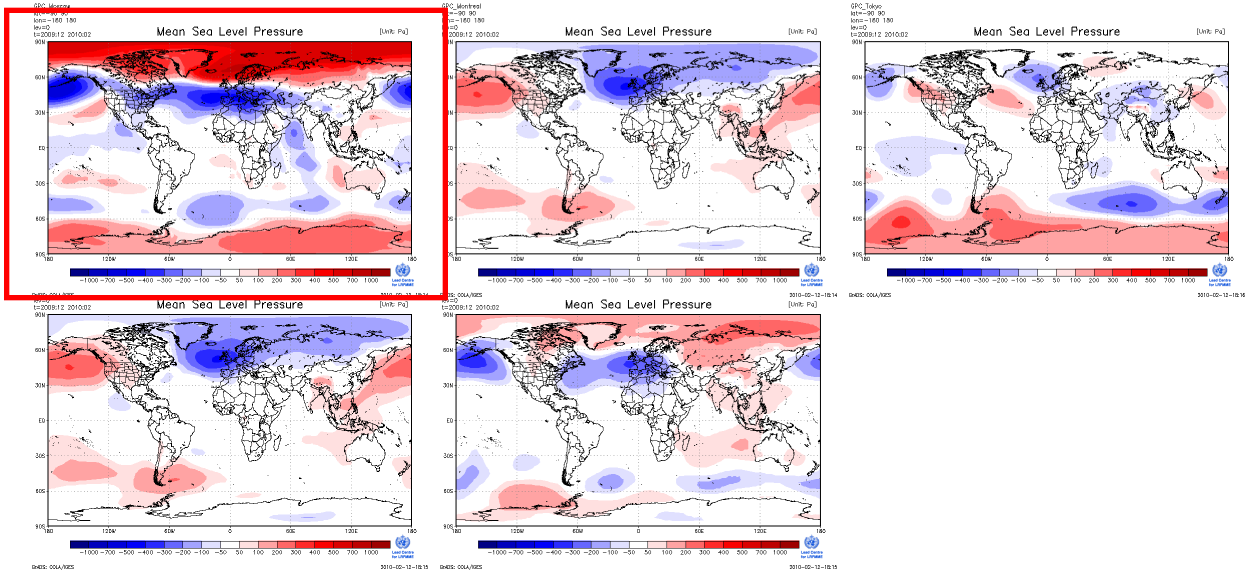



**Observed pmsl anomalies (wrt 1961-1990)**

1-tier

2-tier




From LC-LRFMME website
http://www.wmolc.org/

# 2. Ocean General Circulation Model (OGCM) in Curvilinear Coordinates

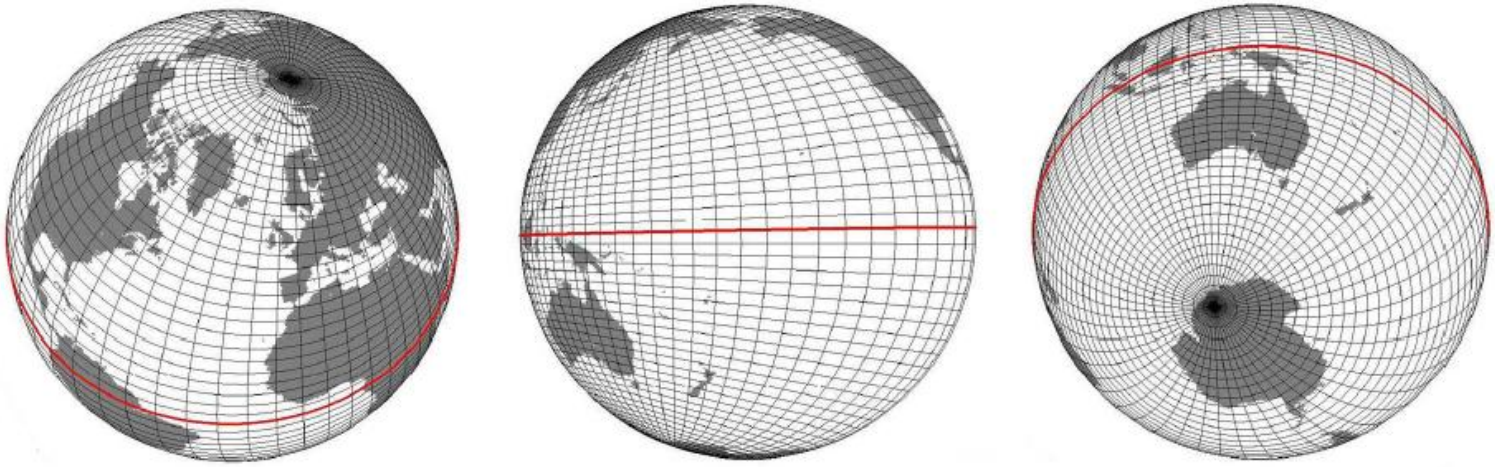
- The OGCM (Vector Invariant Formulation [Madec et al, 1998]) is based on the primitive equations in the following approximations: spherical Earth; Boussinesq; hydrostatics; incompressibility.

- Resolution: 1° x 0.5° lon/lat; 40 sigma-levels.

- Besides of the ocean circulation simulation, the program complex includes a sea ice dynamics and thermodynamics model, as well as the original system of the atmospheric forcing implementation on the basis of both prescribed meteorological data and atmospheric model results.

# The OGCM is realized on conformal curvilinear orthogonal grid

New north pole is moved to 100°E, 70°N (Taimyr peninsula) and new south pole is symmetrically moved to 100°E, 70°S (Antarctica) . Moebius transformation is used.

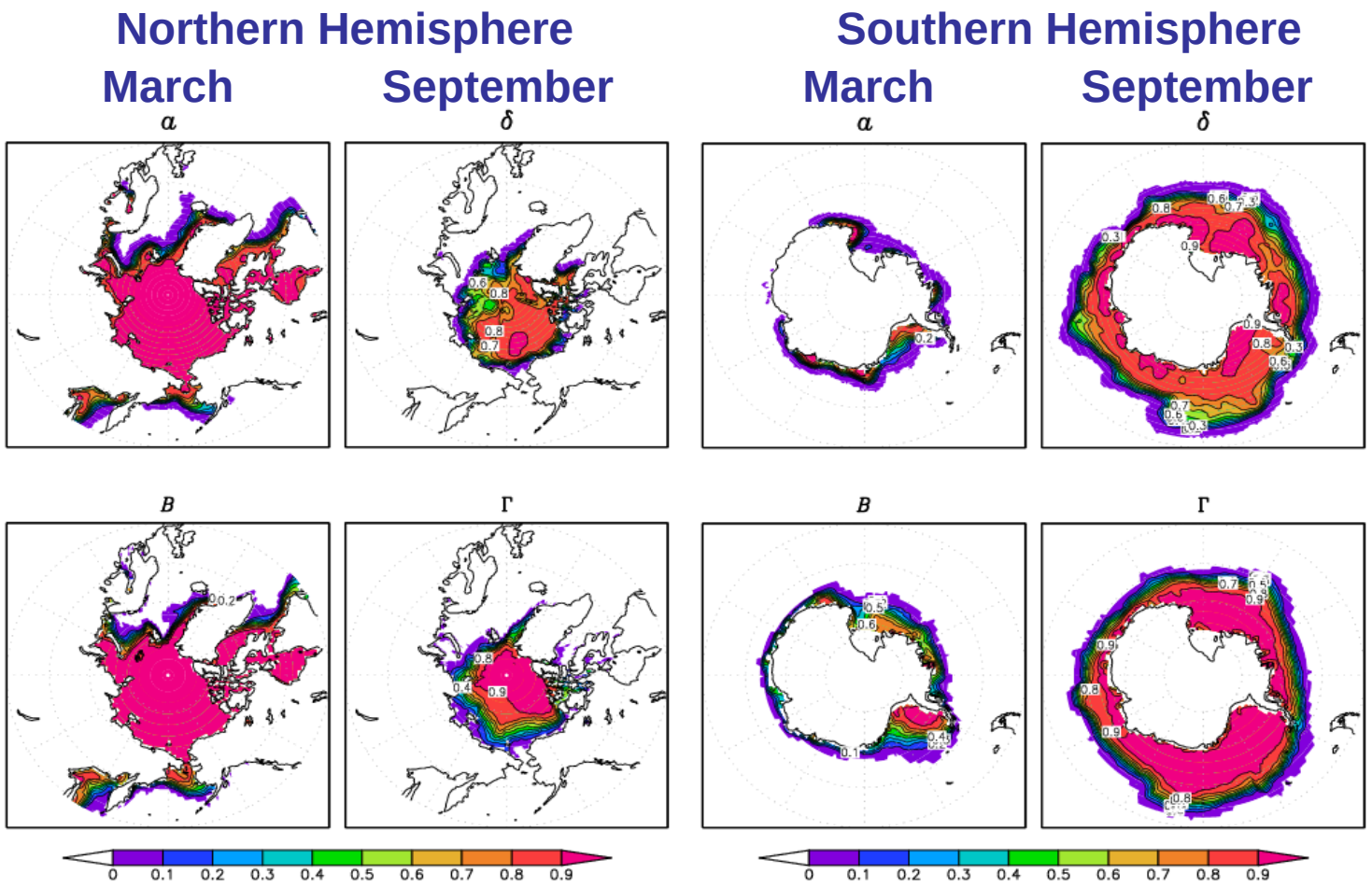


## Grid properties:

1) Orthogonality;
2) Analytical transformation from geographical system;
3) Singularities are beyond the ocean area;
4) Preserved geographical equator position

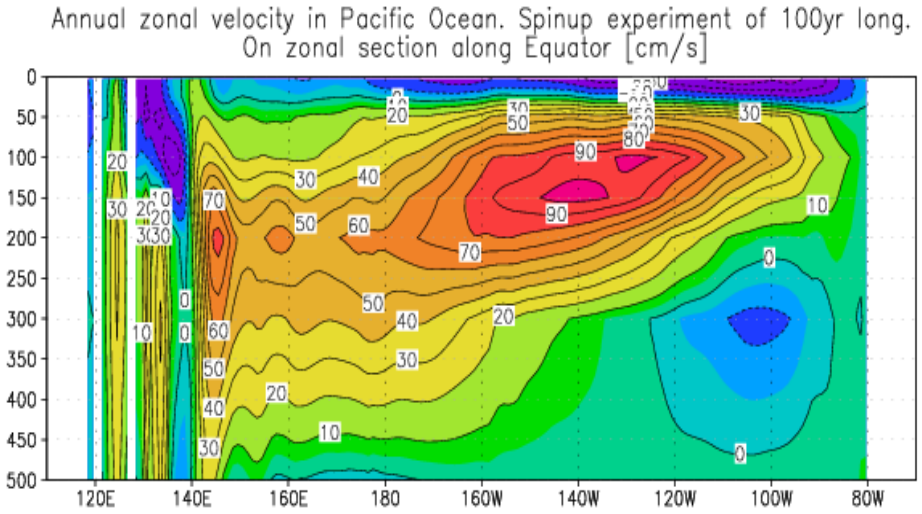
# Sea ice concentration

The OGCM was integrated for 100 years starting from the Levitus January climatology using the realistic atmospheric annual cycle calculated on the base of CORE [Griffies et al 2004] datasets.

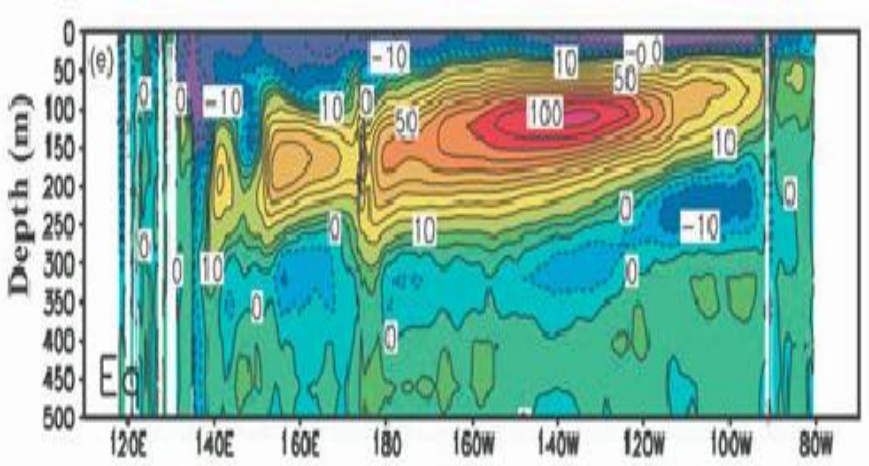


# Annual mean zonal velocity cross-sections at the equator in the Pacific ocean

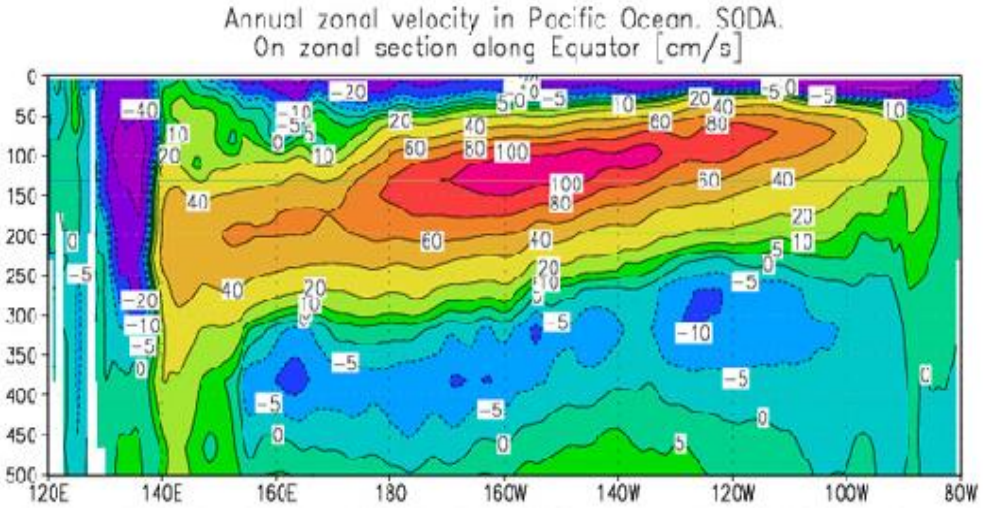
The 1°x0.5°x40 OGCM




The 0.1°x0.1°x54 OGCM for the Earth Simulator (OFES)
[Y. Masumoto et al., 2004]




Assimilation SODA [Carton et al, 2000]



# Coupled atmosphere–ocean model for seasonal prediction

- The atmosphere and ocean models are coupled without flux correction.
- The results of seasonal mean atmospheric circulation for coupled atmosphere-ocean model are compared with the results of atmospheric model which uses simple SST anomalies extrapolation
- Application of coupled model allows to slightly reduce errors in Northern extratropics with respect to the atmospheric model with simple SST evolution. Errors in Tropics and Southern Hemisphere increase.
- Tuning of the atmospheric model (probably, change of short-wave radiation scheme) will be continued to reduce overstated heat flux into the ocean.
- Implemented on Altix 4700, parallelized with OpenMP.

  4-month simulation takes 12 hours on 12 processors.

# 3. Statistical post-processing of dynamical LRF

North Eurasia
Climate Centre

NEACC | Forecasts and Projections | Forecast Verification | Monitoring Data | Contacts and Links

Hi dkiktev,

LOG OUT

- **Seasonal Outlook**
- On communicating forecast uncertainty
- Forecast model description

Forecasts and Projections ▸ Seasonal Outlook

# outlook - March-April-May 2010

Outlook

**Seasonal Outlook for May-June-July 2010**

*The outlook includes the results of seasonal forecasts of Roshydromet (the Hydrometcentre of Russia and Voeikov Main Geophysical Observatory) and WMO global LRF providers. The outlook is based on global forecast models of Roshydromet; the forecast products of other multi-model forecast centers reported in the table. This outlook information is of advisory character and must be applied to particular regions taking into account the predictability of meteorological processes, regional climate, and quality of state-of-the-art forecast models.*

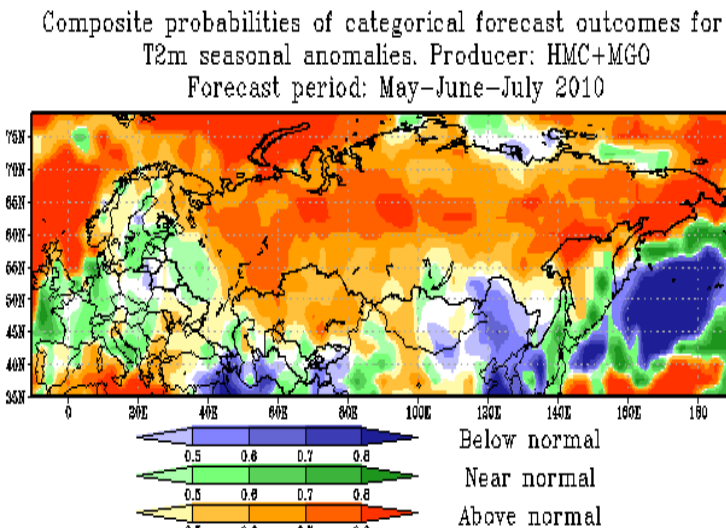
**Temperature regime (near-surface air temperature)**

According to the forecasts of the Hydrometcenter of Russia and Main Geophysical Observatory models, the forthcoming 3-month period is expected:

**Warmer than normal:** In the Scandinavian countries,in Southeastern Europe, in Greece, over most of Turkey, Russia (except f extreme west), Kazakhstan, and Western Mongolia.

**Colder than normal:** In Israel, Transcaucasia, west of Tajikistan, and in the east of Mongolia.

NEACC's Internet address:
English version - http://neacc.meteoinfo.ru




According to the forecasts of the Hydrometcenter of Russia and Main

**Precipitation deficit:** In Scandinavia, the Baltic countries, o and eastern Chukotka), and Mongolia.

**Exceeding precipitation:** In the countries of Central and Eas and Israel.

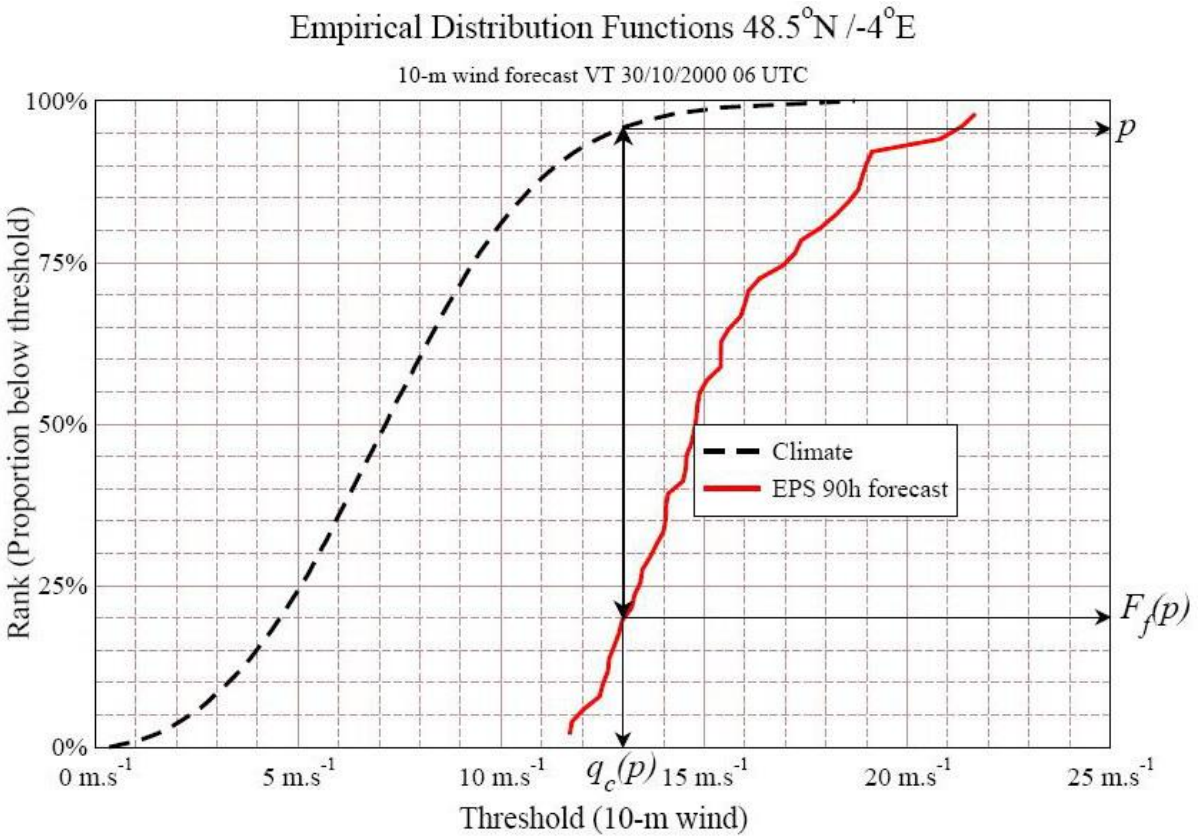
In other North Eurasia regions, the season is expected near climate

| Roshydromet models | Compa |
|---|---|

# Extreme Forecast Index for seasonal time scales?

Extreme Forecast Index (EFI) [Lalaurette,2002] was proposed for short/medium-range ensemble forecasts as a measure of the difference between a probabilistic forecast and a model climate distribution:

$$EFI_{2m+1} = 2(m+1)\int_0^1 (p - F_f(p))^{2m+1} dp$$



# Simple properties of EFI:

- EFI takes values between -1 and +1.

- EFI is calculated in probability space rather than meteorological parameter space. Thanks to this EFI doesn't keep information on original range of values of a particular meteorological parameter.

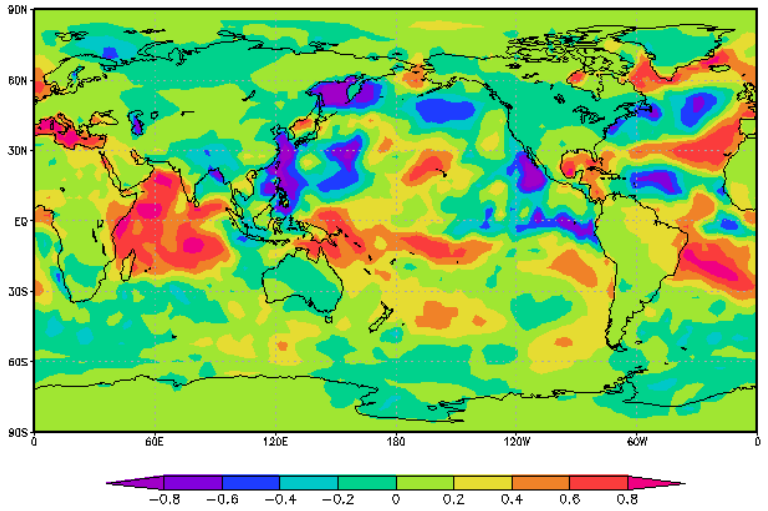
- For various meteorological parameters, seasons and regions EFI can be used uniformly without the problem with critical thresholds definition. This allows to compare EFI values for regions with very different climates and for different variables.

- For detecting severe weather conditions, we not only want to know if the EPS distribution deviates a lot from the climate, but also if it deviates in a direction that may be dangerous: to know that the wind will be unusually calm is very different from knowing that it will blow with unusual strength! EFI takes it into account.

# Modification of EFI for LRF:

- Instead of ensemble forecasts of a particular time range we used all daily forecast data within a season for all ensemble members to build the forecast PDFs.
- Similarly, seasonal model climate PDFs were derived from daily hindcast data.
- To avoid the temporal inhomogeneity in the forecast daily series (due to seasonal cycle) each series was preliminary transformed into standardized series of forecast daily anomalies.

An example forecast map of $EFI_1$ modified for the purposes of LRF on the basis of SL-AV model output. Parameter – T2m. Period - JJA2003.



# First impressions of EFI seasonal forecasting

Not sensitive enough.

This might be expected.. The first version of original EFI has been criticised for being too sensitive to a shift in the median of the forecast distribution and for not being sensitive enough to shifts in the tails.

There are several ways to enhance selectivity of EFI to the changes in the tails of forecast PDFs:
- To use the revised EFI formulation with extra-weight term [Zsoter,2006];
- To try using PDFs of various indices calculated on the basis of daily forecast series (For example, HWDI etc.)

Thank you!