Interrelations of global change and Siberia regional climate

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Some results of analysis of recent observations and coupled climatic model projections of Siberia climate, surface hydrology and vegetation dynamics under global changes are reported.

Special attention is paid to surface temperature behavior, circulation regime changes that play a significant role in Northern Eurasia/Arctic Climate System and to feedbacks between regional climate and the terrestrial surface hydrology and vegetation.

Outlines

Circulation

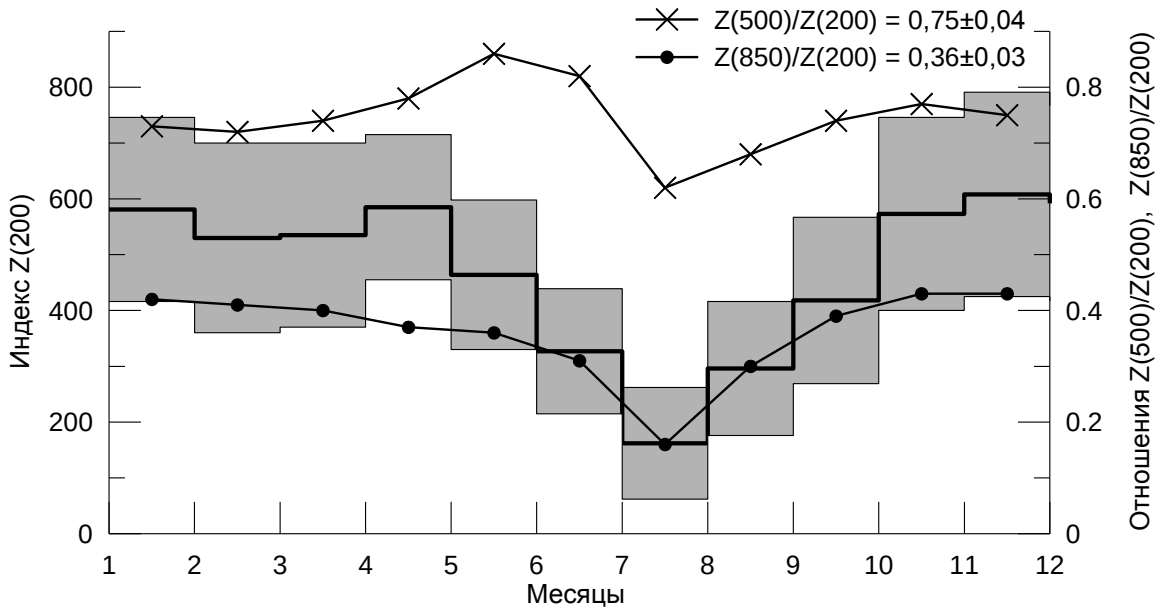
Temperature

Vegetation

circulation

Zonal (Z) and meridional (M) circulation indexes for West Siberia were calculated on the base of ERA-40

Zonal monthly circulation index for cold season (October – May) is higher then this for warn season.



Z(200 hPa)

Left:

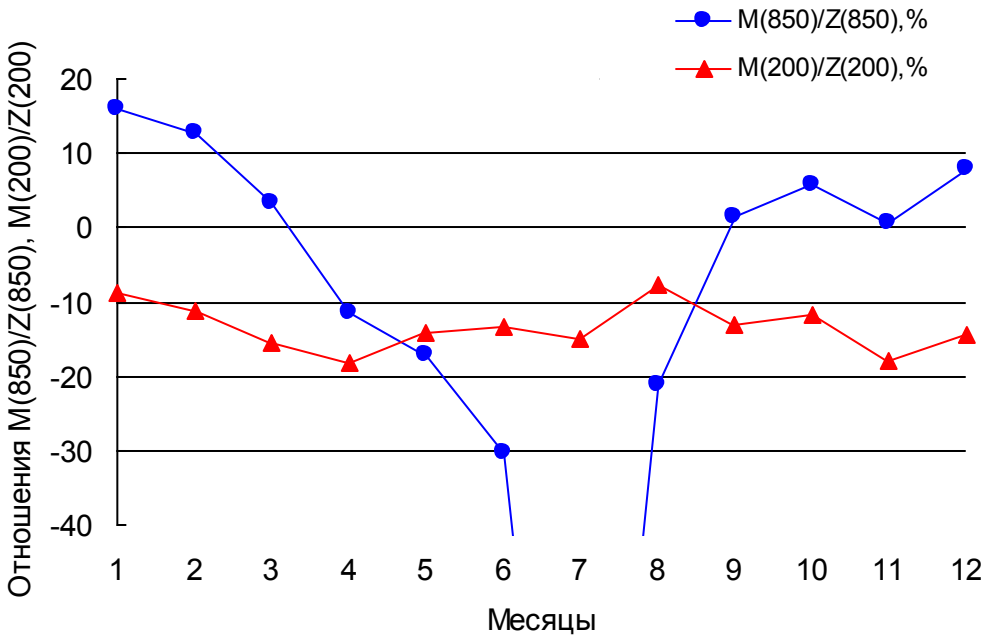
solid line – means, grey - errors;

Right: ratios

Z(500)/Z(200) – crosses

Z(850)/Z(200) – dots

Circulation

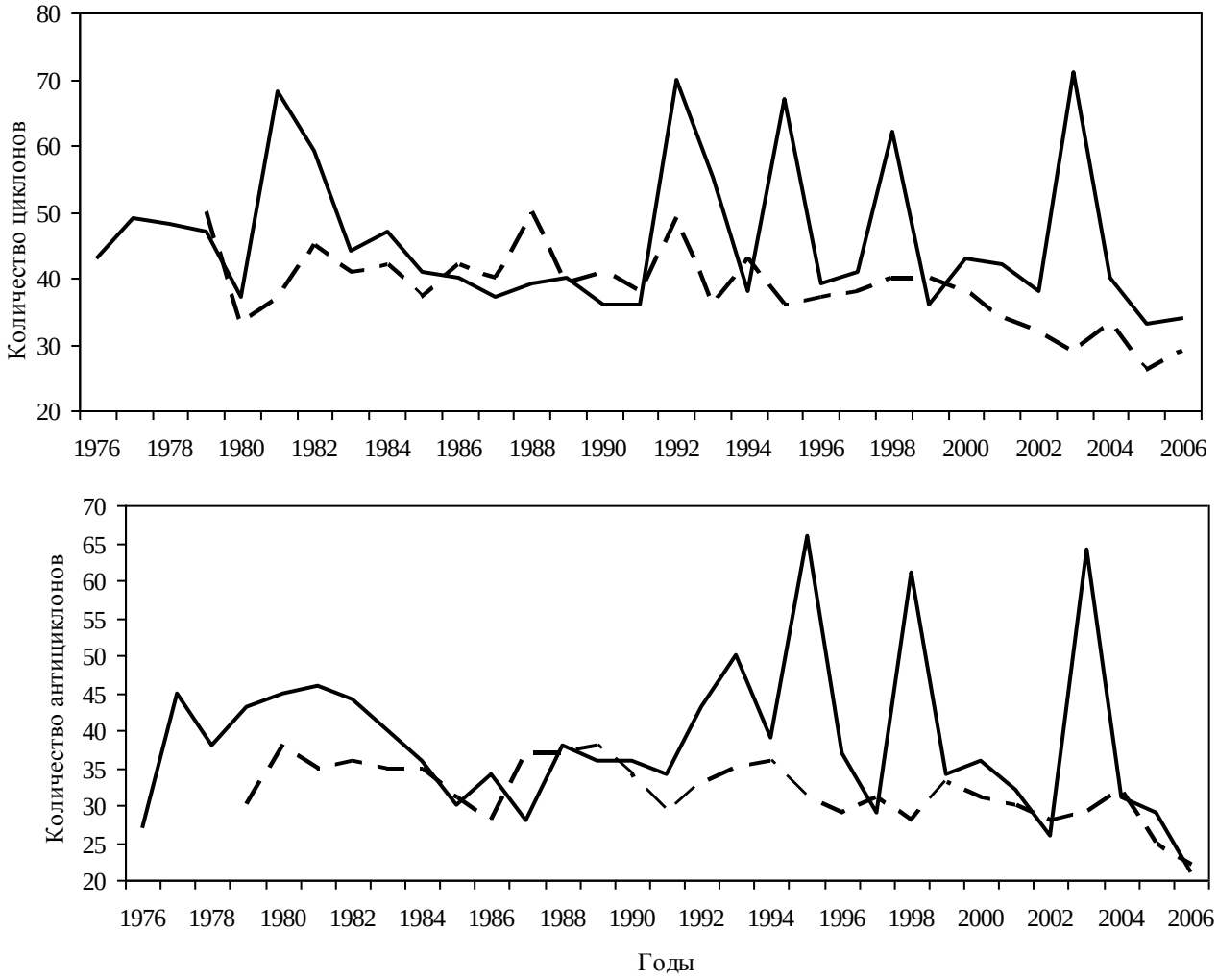


Ratio of meridian to zonal circulation index
M(850)/Z(850)- dots
M(200)/Z(200) –triangles

Circulation

For 1957-2002 indexes trends are statistically insignificant

Cyclone and anticyclone number behaviour might clarify situation

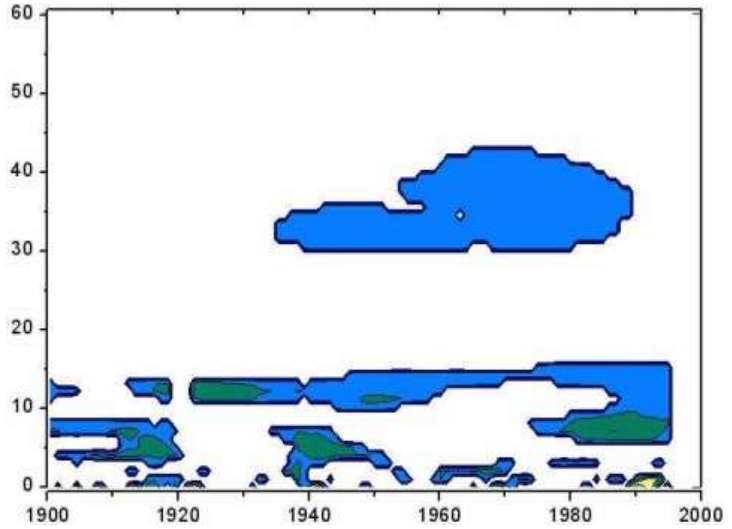


Number of cyclones (a) and anticyclones (b) retrieved from synoptic maps (solid line) and reanalysis data (dashed line)

circulation

•Correlation analysis of mean annual NAO index (zonal transport from West) for 100 years and mean surface pressure shows their anticorrelation (0.8).
•Correlation of NAO and mean annual temperature are low (0.3) however statistically significant for periodicity 30-40 years in the interval 1955-1995.

It shows the role of zonal transport in the West Siberia temperature regime.

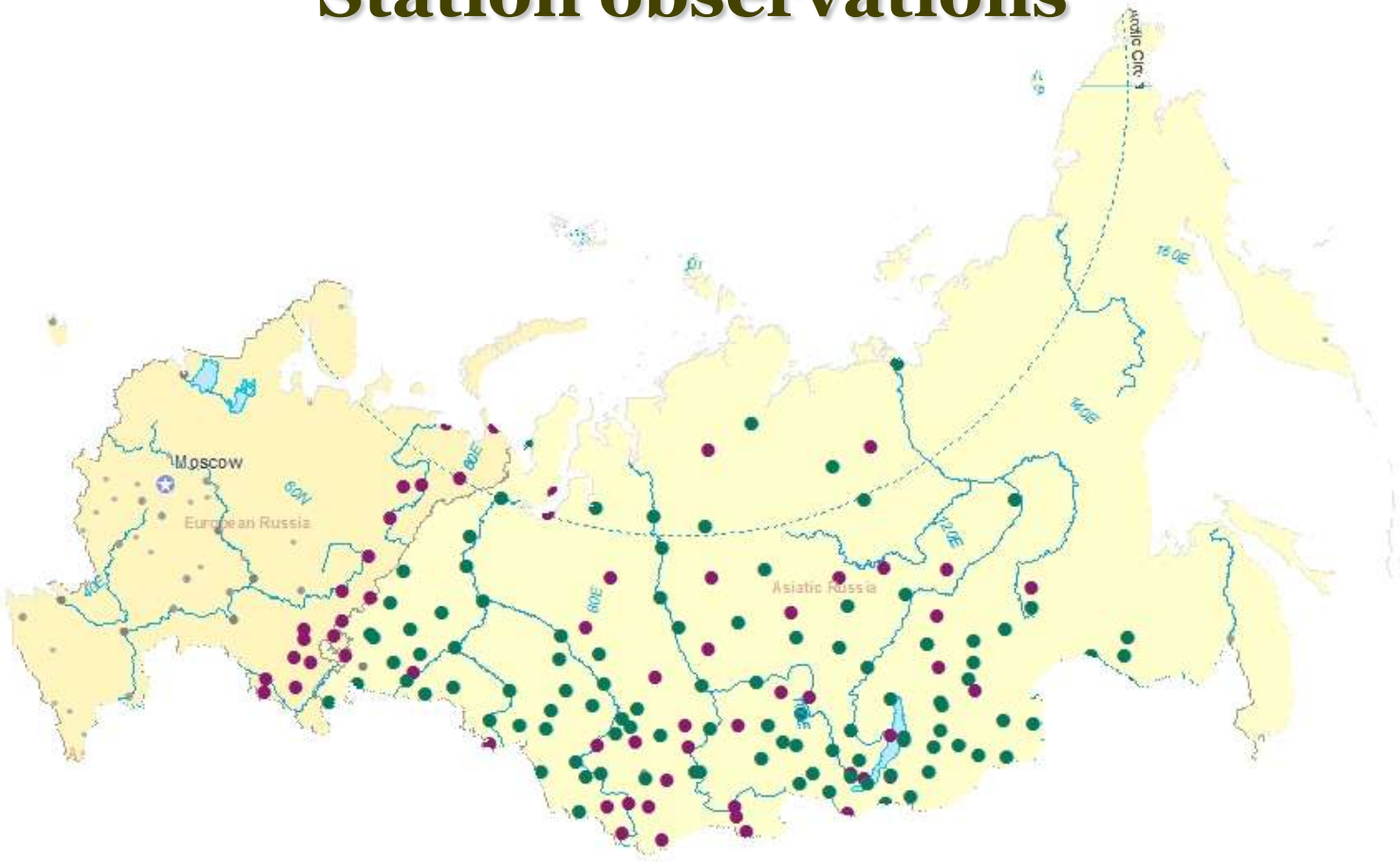


Wavelet Correlation of mean annual surface temperature and NAO

Datasets

Dataset	*Organization*	*Time period*	*Resolution*	*Assimilation*	*Data format*
			Station observation datasets		
9092c Global Synop. Network (2095 stations)	RIHMI-WDC	1881-2001	8h(up to 1935) 6h(up to 1965) 3h (since 1966) 684 stations	-	ASCII
Dataset of daily temperature and precipitation (518 stations)	RIHMI-WDC/CDIAC	1881-2010	daily 221 stations	-	ASCII
			Modelled datasets		
NCEP/NCAR Reanalysis	NCEP/NCAR	1951-2001	12 h., 2,5°×2,5° 17 pres.lev.	3D-Var	GRIB 1
NCEP/DOE Rean. AMIP II	NCEP/DOE	1973-2003	6 h., 2,5°×2,5° 17 pres.lev.	3D-Var	NetCDF
ECMWF ERA-40 Reanalysis	ECMWF	09.1957-08.2002	6 h., 2,5°×2,5° 23 pres.lev.	3D-Var	NetCDF
ECMWF ERA Interim Rean.	ECMWF	1979-present	6 h., 1,5°×1,5° surface	4D-Var	NetCDF
APHRODITE JMA Precipitation dataset	JMA	1951-2007	1 d. 0,25°×0,25° surface	Weight mean interpolation method	NetCDF

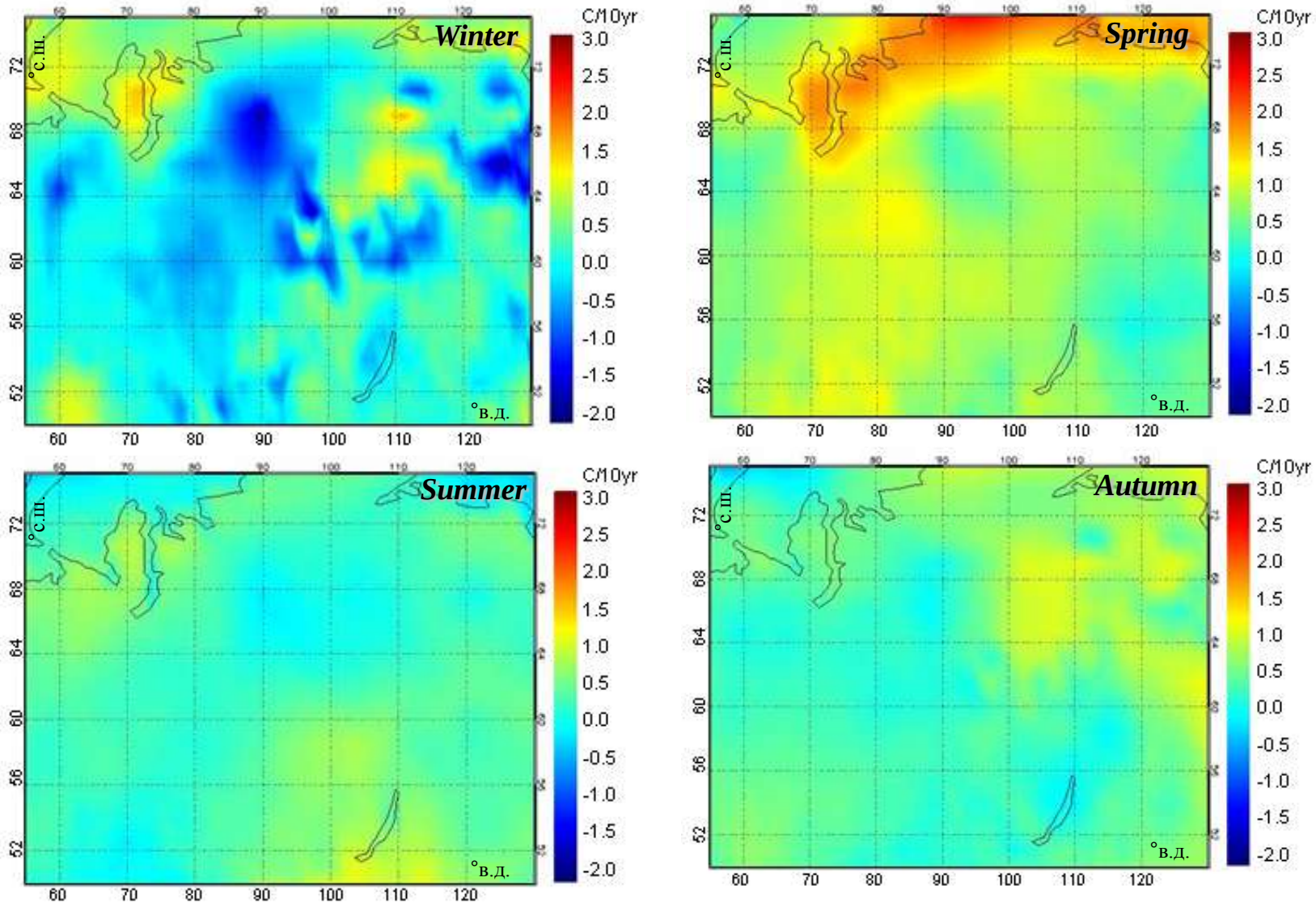
Station observations



164 time series of daily surface air temperature and precipitation from **RIHMI-WDC/CDIAC dataset** of 518 time series over Russia

103 time series of atmospheric pressure from ***Global Synoptic Network 9092c dataset*** (green points)

Surface temperature



Trend of mean seasonal surface temperature (°C/10 лет). ECMWF ERA INTERIM, 1979-2007.

Possible vegetation response

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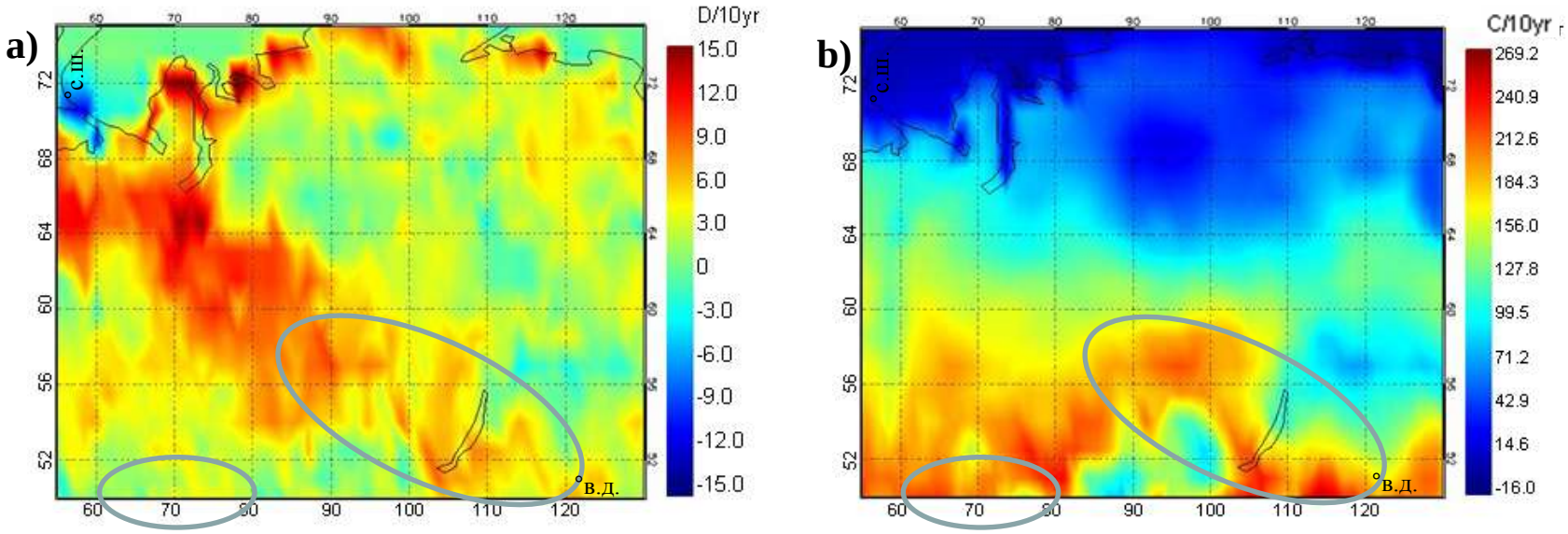


a) Trend of growing season length (days/10 years)

b) Trend of sum of daily mean temperature within it (°C/10 years)
. ECMWF ERA INTERIM, 1979-2007.

Climatic model

Global large-scale model of the intermediate complexity **“Planet Simulator”**

Parts of model: atmosphere, ocean, soil, sea ice, biosphere

Convective convection – convective precipitation

Large-scale convection – large-scale precipitation

Vegetation types: forest, grass and vegetation absence

Initial and boundary conditions: land-sea mask and topography - TOPO30; sea ice cover - SSMI; other are adapted from ECHAM 4.

Forest feedback

How variations of teritory occupied by forest vegetation effect on near surface temperature and humidity in Siberia.

Forest feedback

Region: 52° N - 73° N, 60° E - 90° E,
Horizontal resolution - 5.6° x 5.6°

Vertical resolution:
Atmosphere (σ-layers): 1.0, 0.8, 0.6, 0.4, 0.2;

Soil (m): 0.4, 0.8, 1.6, 3.2, 6.4

Time step: 30 minutes

Modeling period: 90 years

$$\lambda_{T_s} = \frac{\partial R}{\partial x}\frac{dx}{dT_s}, \quad \lambda_{q_s} = \frac{\partial R}{\partial x}\frac{dx}{dq_s}$$

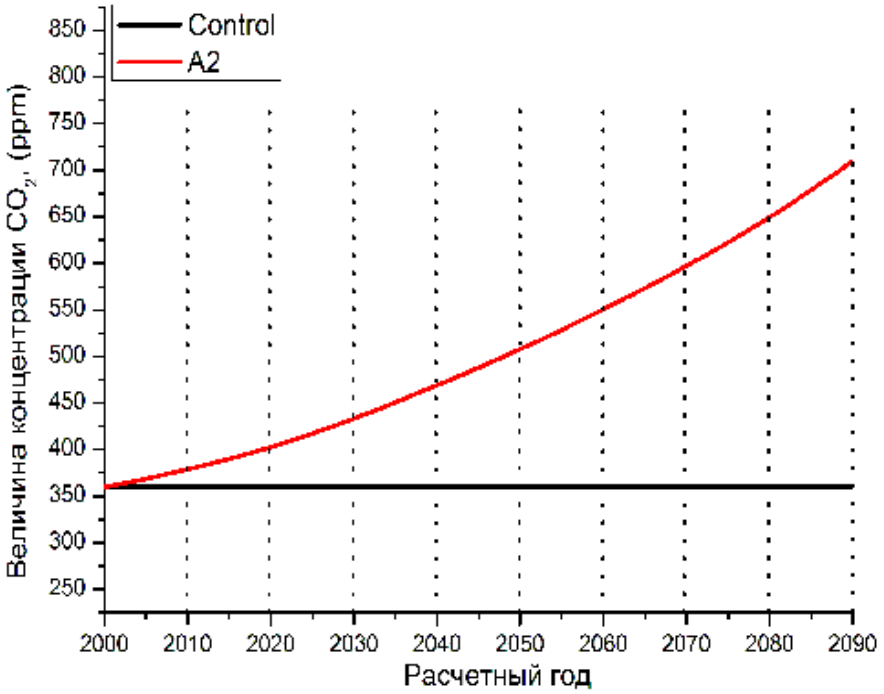
λ_{T_s}, λ_{q_s} - feedback coefficients forest cove and temperature and humidity

R – radiation on theupper atmosphere boundary

x – climatic parameter (forest cover);

T_s- near surface temperature;

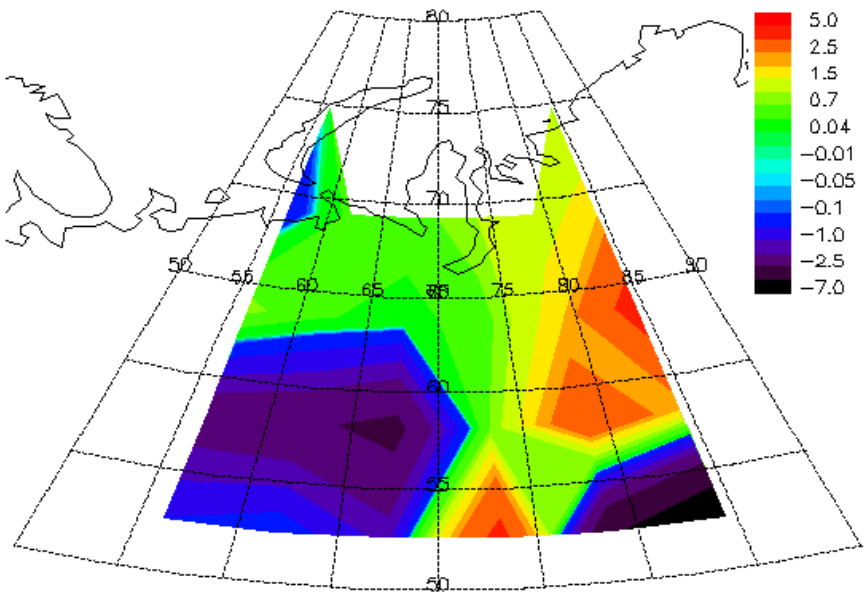
q_s- surface humidity



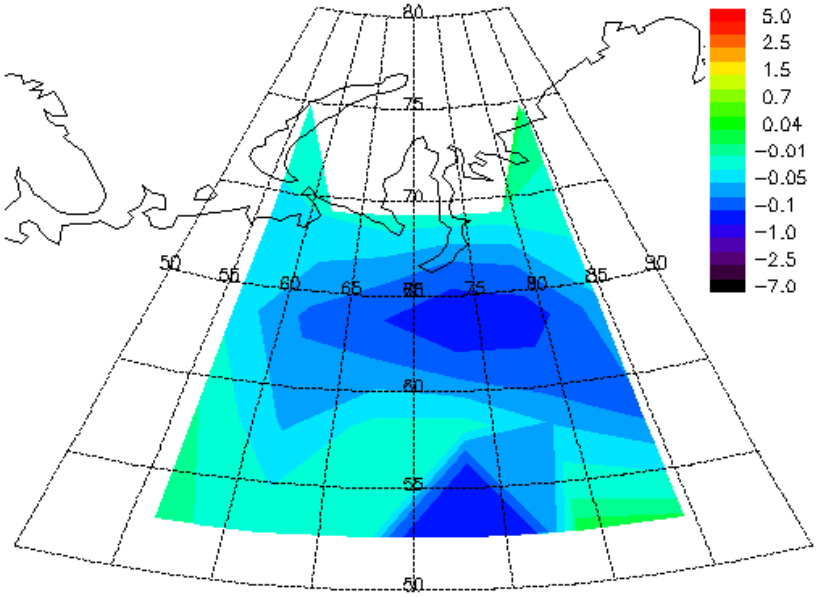
CO2 concentration in atmosphere

Brian J. Soden, Isaac M. Held. *An Assessment of Climate Feedbacks in Coupled Ocean-Atmosphere Models // J. of Climate, Vol. 19,* ***2006****, pp. 3354 – 3360.*

Forest feedback



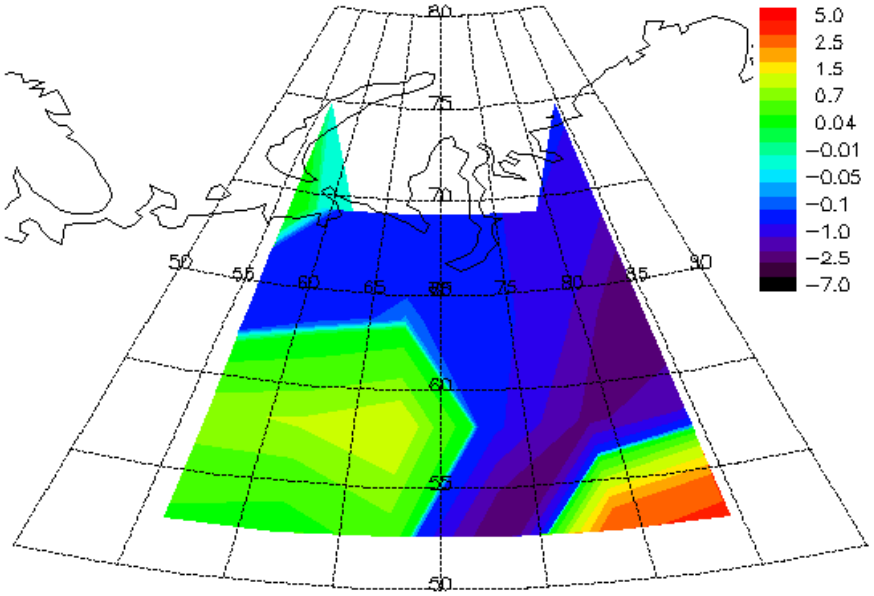
a) Control



b) SRES-A2

Feedback coefficient of relation between ´forested¨ territory and near surface temperature

Forest feedback



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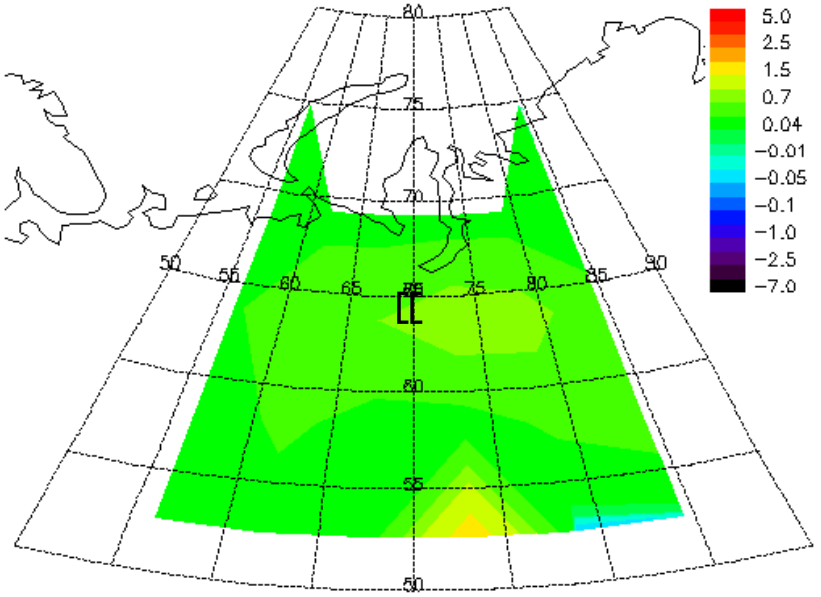

b) SRES-A2

Feedback coefficient of relation between¨ forested¨ territory and humidity

Forest feedback. Results

- Absolute values of coefficient for A2 scenario is is less then for control run.
- Coefficients for forested territory and temperature and humidity have different signs.
- For A2 scenarion domains of positive and negative enfluence are shifted in the both cases.

Plans and all that

- New global reanalyses should be used for Siberia;
- New IPCC scenarios and related feedbacks
- Analysis of of on-going modeling efforts done within IPCC activity

Thank you for attention!