



Variation of Siberian Vegetation Cover in the XXI in JSBACH Model Output

Martynova Yu.V., Krupchatnikov V.N.

*Institute of Monitoring of Climatic and Ecological Systems SB RAS, Russia, Tomsk, <http://imces.ru>
Siberian Regional Hydrometeorological Research Institute, Novosibirsk, Russia, <http://sibnigmi.ru>*

GOAL

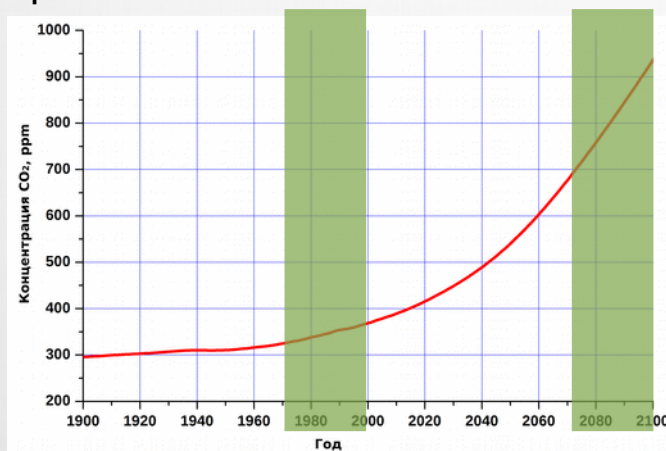
to assess the potential response
of Siberian vegetation
on the atmospheric forcing

Experimental Design

Global large scale model of intermediate complexity PLASIM

(Fraedrich K. et al., 2005)

- **atmosphere**
- ocean and sea ice
- land surface and soil
- biosphere



Atmospheric CO₂ concentration,
RCP 8.5, 1901-2100.

Land surface model JSBACH

(Raddatz T. J. et al., 2007; Reick, C. et al., 2013)

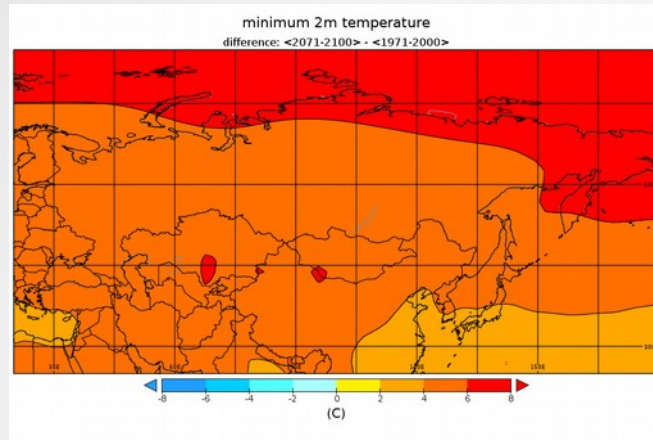
- soil hydrology
- soil heat transfer
- energy balance on the surface
- absorption, storage and emission of carbon from plants and soils
- photosynthesis
- predictive phenological scheme
- vegetation dynamics (natural, as well as damage by wind and fires)

For each model day:

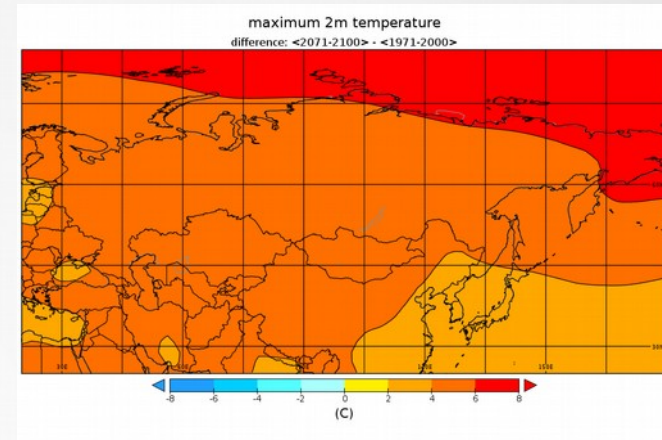
- Minimum and maximum day temperature at 2 m [°C]
- Wind speed at 10 m [m/s]
- Precipitation [kg/m² s]
- Specific humidity at surface [kg/kg]
- Shortwave and longwave downward radiation [W/m²]
- Clear sky downward shortwave radiation [W/m²]

Atmospheric forcing

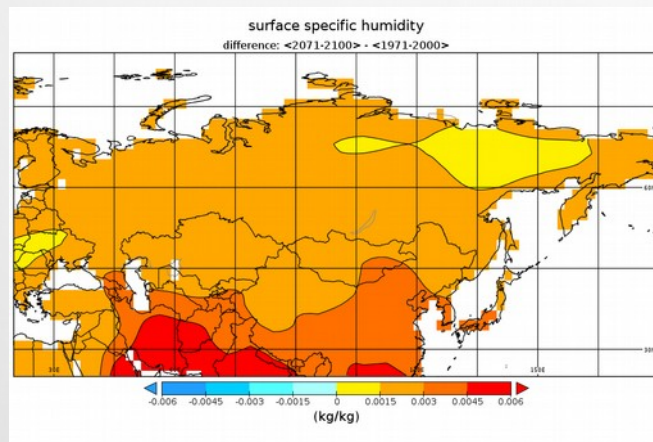
Day min T2m



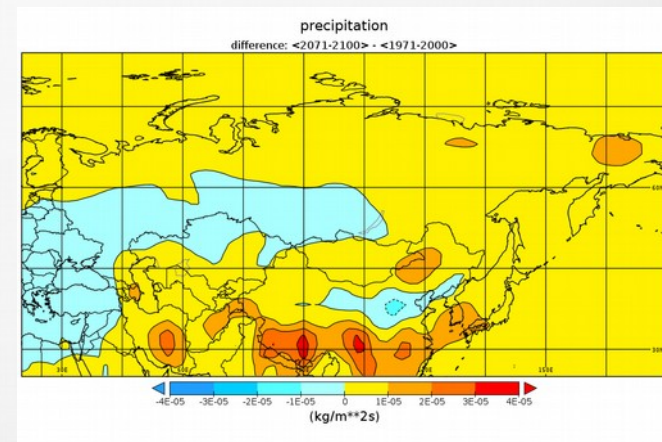
Day max T2m



Surf. spec. humid.



Precipitation



Difference between 2071-2100 and 1971-2000

Results and Conclusion

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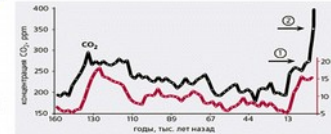
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Institute of Monitoring of Climatic and Ecological Systems SB RAS, Russia, Tomsk, <http://imces.ru>
Siberian Regional Hydrometeorological Research Institute, Novosibirsk, Russia, <http://sibirmgmi.ru>
E-mail: Foxy13@gmail.com, vkupchatnikov@yandex.ru

MOTIVATION

Siberia is a "hot spot", that is, local changes in a given territory can cause global climatic and ecosystem changes. The territory of Siberia is covered by extensive forest cover, which can have a significant effect on the concentration of carbon dioxide in the atmosphere. This influence can be significant not only within the region under consideration, but also can have a global response.

Figure 1. Reconstruction of the variation of CO₂ concentration and Earth global surface temperature (160 000 years ago – 2100). CO₂ concentration (1) 280 ppm, in the industrial revolution beginning, (2) 353 ppm, current time period (Global Common Institute, London, Weizsäcker E.U. von, Earth Politics. Foreword by the President of the Club of Rome. L.; New Jersey, 1994. P.43).



GOAL:

to assess the potential response of Siberian vegetation on the atmospheric forcing

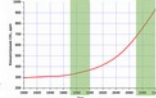
EXPERIMENTAL DESIGN

Global large scale model of intermediate complexity: PLASIM

(Fraedrich K. et al., 2005)

- atmosphere
- ocean and sea ice
- land surface and soil
- biosphere

Figure 2. Atmospheric CO₂ concentration, RCP 8.5, 1800-2100.



- For each model day:
- Minimum and maximum day temperature at 2 m (°C)
 - Wind speed at 10 m (m/s)
 - Precipitation (kg/m²/s)
 - Specific humidity at surface (kg/kg)
 - Shortwave and longwave downward radiation (W/m²)
 - Clear sky downward shortwave radiation (W/m²)

Land surface model: JSBACH (Raddatz T. J. et al., 2007; Reick, C. et al., 2013)

- Land part of MPI-ESM model
- soil hydrology
- soil heat transfer
- energy balance on the surface
- absorption, storage and emission of carbon from plants and soils
- photosynthesis
- predictive phenological scheme
- vegetation dynamics (natural, as well as damage by wind and fires)

RESULTS

Atmospheric forcing (PLASIM)

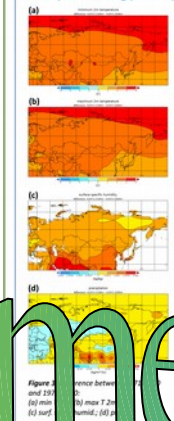


Figure 3. Difference between (a) 1800-1900, (b) 1900-2000, (c) 2000-2100, (d) 1800-2100. Net Primary Production Rate, Net Ecosystem Exchange Rate, Net Ecosystem Respiration Rate, Net Ecosystem Carbon Storage Rate.

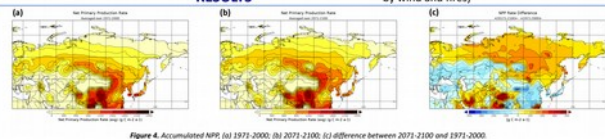


Figure 4. Accumulated NPP: (a) 1800-2000; (b) 2000-2100; (c) difference between 2000-2100 and 1800-2000.

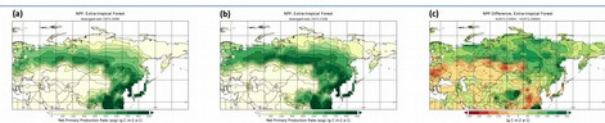


Figure 5. NPP of extra-tropical forest: (a) 1800-2000; (b) 2000-2100; (c) difference between 2000-2100 and 1800-2000.

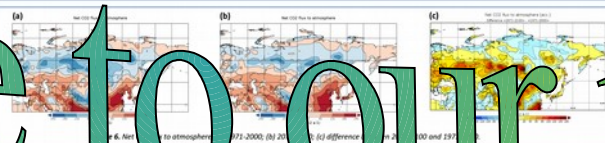


Figure 6. Net CO2 flux to atmosphere: (a) 1800-2000; (b) 2000-2100; (c) difference between 2000-2100 and 1800-2000.

CONCLUSION

- With the growth of anthropogenic load, the main changes in the flow of carbon dioxide to the atmosphere should be expected along the southern border of Russia.
- Changes in CO₂ fluxes indicate the shift of vegetation zones to the north of Russia.
- An increase in NPP is shown in most of Russia, with the exception of its southern border.
- The main contribution is made by forest vegetation in the extratropical latitudes.

Global Common Institute, Weizsäcker E.U. von, Earth Politics. Foreword by the President of the Club of Rome. L.; New Jersey, 1994. P.43.
Raddatz T. J. et al. Will the tropical land biosphere dominate the climate - carbon cycle feedback during the twenty-first century? // Climate Dynamics, 2007, V. 29, P. 565-574. doi: 10.1007/s00382-007-0247-8.
Reick, C., Raddatz, T., Brovkin, V. & Gayler, V. Representation of natural and anthropogenic land cover change in MPI-ESM. // Journal of Advances in Modeling Earth Systems, 2013, V. 5, P. 40. doi:10.1002/jame.20022.
Fraedrich K., Jensen H., Auer U., Galka U., and Lunkeit K. The Planet Simulator: Towards a user friendly model // Meteorol. Zeitschrift, 2005, V. 14, P. 299-304.

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