

# **Assessment of CO<sub>2</sub> flux variation for Russian forest ecosystems under climate change with JSBACH model**

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# GOAL

**to assess the response  
of the geographical distribution of woody  
vegetation in Russian and their ability to absorb  
carbon dioxide from the atmosphere  
to the climate forcing set by the RCP 8.5 scenario**

# Experimental Design

## Atmospheric data:

### 1. INMCM4 (Global climate model)

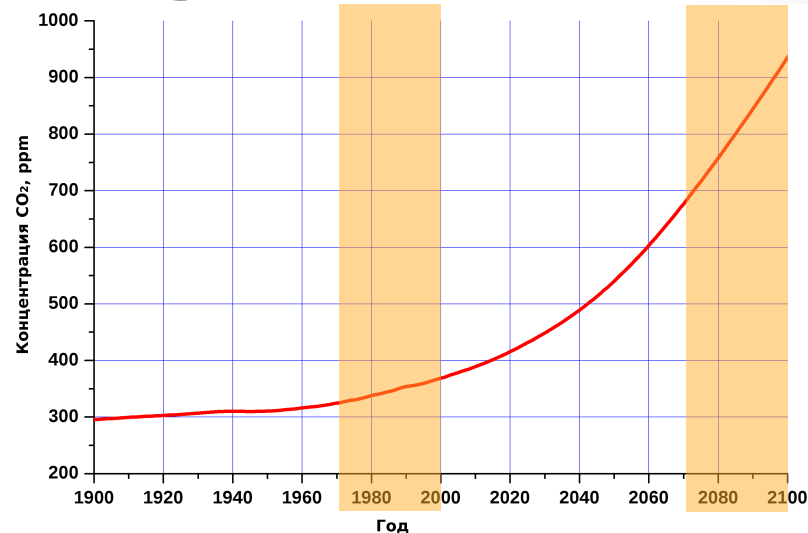
[Volodin E. et al., 2010]

### 2. PLASIM (Global large scale model of intermediate complexity)

[Fraedrich K. et al., 2005]

#### For each model day:

- Minimum and maximum day temperature at 2 m [ $^{\circ}\text{C}$ ]
- Wind speed at 10 m [m/s]
- Precipitation [ $\text{kg}/\text{m}^2\text{s}$ ]
- Specific humidity at surface [ $\text{kg}/\text{kg}$ ]
- Shortwave and longwave downward radiation [ $\text{W}/\text{m}^2$ ]
- Clear sky downward shortwave radiation [ $\text{W}/\text{m}^2$ ]



Atmospheric CO<sub>2</sub> concentration, RCP 8.5, 1901-2100.

#### 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)

# Considered parameters

- Extra-tropical evergreen
- Extra-tropical deciduous
- Vegetation fraction
- Mean annual gross CO<sub>2</sub> assimilation
- Mean annual CO<sub>2</sub> flux to atmosphere
- 1981-2000
- 2081-2100

# Results and Conclusion

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(Wed.)

## Assessment of CO<sub>2</sub> Flux Variation for Russian Forest Ecosystems under Climate Change with JSBACH Model

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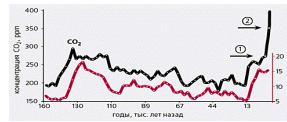
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### MOTIVATION

Ecosystems of the territory of Russia are considered to be very sensitive to climate change, since their existence in a particular territory is limited to low temperatures. An increase in the growing season and an increase in temperature reduce some environmental restrictions and open up areas for invading plants from lower latitudes. It is expected that local species diversity will increase, since the rate of distribution of species from low to higher latitudes will be higher than the rate of extinction of species already existing in this area.

Figure 1. Reconstruction of the variation of CO<sub>2</sub> concentration and Earth global surface temperature (160 000 years ago – 2100). CO<sub>2</sub> 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:

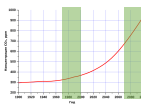
to assess the response of the geographical distribution of woody vegetation in Russia and their ability to absorb carbon dioxide from the atmosphere to the climate forcing set by the RCP 8.5 scenario

### EXPERIMENTAL DESIGN

#### Atmospheric data:

1. INMCM4 (Global climate model) [Volodin E. et al., 2010]
2. PLASIM (Global large scale model of intermediate complexity) [Friedrich K. et al., 2005]

Figure 2. Atmospheric CO<sub>2</sub> concentration, RCP 8.5, 1802-2100.



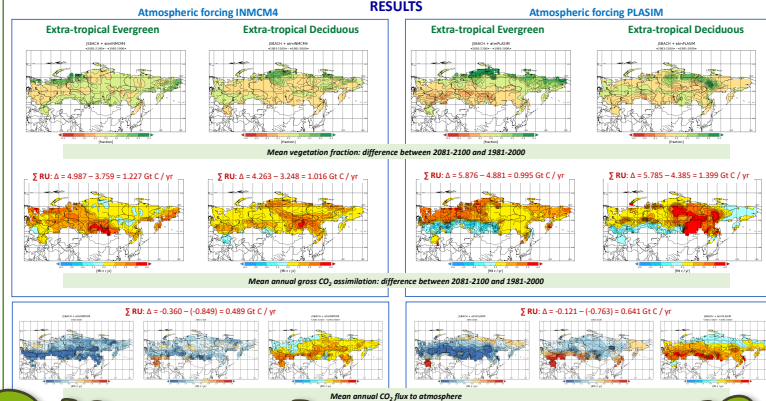
- For each model day:
- Minimum and maximum day temperature at 2 m [°C]
  - Wind speed at 10 m [m/s]
  - Specific humidity at surface [kg/kg]
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### RESULTS



### CONCLUSION

With the growth of the greenhouse effect, there was not only a significant expansion of the area of the plant kingdom, but also a significant increase in the absorption from the atmosphere over the entire area where this type is located.

➢ An increase in the absorption intensity of carbon dioxide from the atmosphere occurs in the territory of Russia on the whole.

### REFERENCES

- Raddatz T. J. et al., 2007. Simulation of the climate - carbon cycle feedback in the land part of the MPI-ESM model. *Journal of Climate*, 20, 10, 2968-2984. doi:10.1175/JCLI4206.0711
- Reick, C., 2013. The land part of the MPI-ESM model. *Journal of Climate*, 26, 10, 2968-2984. doi:10.1175/JCLI4206.0711
- Friedrich K., Jansen M., Willebrandt, K., 2005. The Planet Simulator: Towards a global model of the atmospheric and oceanic general circulation. *Journal of Atmospheric and Oceanic Technology*, 22, 4, 434-451.

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