Potential climate change effects on biosystems in Siberia by the 2100s predicted from CMIP5

*Nadezhda Tchebakova[1], Elena Parfenova[1], Amber J Soja[2]

1. Sukachev Institute of Forests, Federal Research Center KSC, Siberian Branch, Russian Academy of Sciences, 2. National Institute of Aerospace, NASA Langley Research Center,

Regional Siberian studies have already registered climate warming over the last half century from 1960 to 2015 in Siberia. The CMIP5 model simulations show that by the end of the century Siberia would be characterized by a milder climate, with less permafrost coverage: temperature would increase by 3.4˚C (RCP 2.6 scenario) to 9.1˚C (RCP 8.5 scenario) in mid-winter and by 1.9˚C (RCP 2.6) to 5.7˚C (RCP 8.5) in mid-summer; and precipitation would increase by 60 mm (RCP 2.6) to 140 mm (RCP 8.5).

Our goal was to evaluate climate warming consequences for biological systems in Siberia by the 2080s. We developed and used large-scale bioclimatic models and statistical models to evaluate climate effects on vegetation shifts, changes in forest structure and productivity, drylands, agricultural benefits of warming, biotic disturbances, such as infestations of the Siberian moth (*Dendrolimus suprans sibiricus* Tschetv) and a related pathogen needle cast (*Lophodermium pinastri* Chev) in Siberia for the baseline period 1961-1990 and for the 2080s using the RCP 2.6 and RCP 8.5 scenarios of 20 general circulation models from CMIP5.

Principal results are:

Siberian forests are predicted to decrease and shift northwards and forest-steppe and steppe ecosystems are predicted to dominate 50% of Siberia due to the 2080 RCP 8.5 drier climate. Dark taiga would follow the permafrost retreat. Dahurian larch taiga would continue to dominate over continuous permafrost. New temperate broadleaf forest and forest-steppe habitats are predicted in the south;

Agriculture in Siberia would likely benefit from climate warming although potential croplands would be limited by the availability of suitable soils. Traditional crop production may increase by twofold and new crops (maize for grain, gourds) may be introduced in the south, depending on additional irrigation in a drier 2080 climate;

Biotic disturbances. Under the extremely warm RCP 8.5 scenario Siberian moth habitats would considerably shrink and be limited by the main food resources (*Larix spp., Abies sibirica, and Pinus sibirica*) and by future mild winters with frequent thaws that would damage the Siberian moth larvae. Needle-cast of *Pinus sylvestris* was found to be strongly related to precipitation including snow depth rather than summer temperature. In the predicted drier climate, it would shift northwards followed sufficient water and the tree-host *Pinus sylvistris* distribution;

Ecological Landscape Potential for human settlements would improve for 1 (RCP 2.6) to 2 (RCP 8.5) categories over most of Asian Russia, which could lead to a 5- to 7-fold increase in the capacity of the territory to sustain and become attractive to human populations and lead to increased migrations.

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