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CONTROL ID: 1492710

TITLE: Zonobiomes, forests, and major forest-forming conifers across Northern Eurasia by the end of the century under climate warming

ABSTRACT BODY: Simulations of terrestrial ecosystems demonstrated globally the profound effects of the GCM-predicted climate change on their distribution at all hierarchical levels: zonobiomes, forests, and forest-forming tree species. We investigated progressions of potential vegetation cover, forest cover and ranges of forest-forming conifers across Northern Eurasia and Russia in the warming climate during the current century. We developed envelope-type static large-scale bioclimatic models predicting zonobiomes NEBioCliM, forests (ForCliM) and primary forest-forming conifer trees (TreeCliM)) from three bioclimatic indices (1) growing degree-days above 5oC, GDD5; (2) negative degree-days below 0oC, NDDo; and (3) an annual moisture index (ratio of growing degree days above 5oC to annual precipitation), AMI. No soil conditions except presence/absence of permafrost were taken into account in our models. Continuous permafrost was included in the models as limiting the forests and tree species distribution in interior Siberia.

Each zonobiome, forest type and conifer distribution was mapped for the basic period 1960-1990 and for 2080 by coupling our bioclimatic models with bioclimatic indices and the permafrost distribution for the 1960-1990 and 2080 simulations. Climatic departures for the 2080 climate were derived from two climate change scenarios, the HadCM3 A2 and B1 (IPCC, 2007). Kappa (K) statistics were used to compare both the modeled vegetation and the conifer distributions in the contemporary climate to actual vegetation and forest maps. K-statistics proved that NEBioCliM accomplished a fair work in modeling zonobiomes across Russia. The tree species distributions also showed good match with the modeled ranges: 41% (Abies sibirica), 46% (Pinus sibirica), 71% (Pinus sylvestris), 75% (Picea spp.) and 78% (Larix spp.). Those matches might be higher because historically part of the primary conifer forests were replaced by secondary birch and aspen forests after large disturbances (clearcuts and wildfire).

With these projected climates, the zonobiomes would need to shift far to the north in order to reach an equilibrium with the change in climate. Because future climate is predicted to be much warmer and drier, the future climate would be suitable for the forest-steppe ecotone and grasslands (up to 80%) rather than forests (less than 20%). Water stress tolerant light-needled taiga would have advantage over water-loving dark-needled taiga in a new climate. Permafrost wiould not retreat fast enough to make favorable habitats for dark taiga and L. dahurica taiga withstanding permafrost would remain the dominant forest type. Accumulated fire load due to increased tree mortality, especially at the southern forest border and in interior Siberia (Yakutia), together with an increase in fire weather would also initiate large fires facilitating vegetation progression towards an equilibrium with the climate.

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