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Agroclimatic potential in central Siberia in an altered 21st century climate

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The largest temperature increases are currently found in Northern Hemishpere upper latitudes, and this is where temperature increases from climate change are predicted to be the greatest in the future. Alteration of boreal and Arctic landscapes is already apparent, particularly in Siberia. In this work, we will explore the current spatial and temporal patterns of agriculture potential in Siberia and then investigate potential future agriculture dynamics.

Humans have traditionally cultivated steppe and forest-steppe on fertile soils for agriculture. It is predicted that forests will move northwards in a warmer climate and be replaced by forest-steppe and steppe ecosystems. Climate change impacts on agriculture in south-central Siberia are analyzed based on the hypothesis that agriculture in traditionally cold Siberia may benefit from warming. Simple models are used to determine crop range and regression models are constructed to determine crop yield, and these are applied to climate change scenarios for various time frames: pre-1960, 1960-1990, 1990-2010 using historic data and for 2020 and 2080 using HadCM3 B1 and A2 projections. From 50 to 85% of central Siberia is predicted to be climatically suitable for agriculture by the end of the century, and only soil potential would limit crop advance and expansion to the north. Crop production could increase twofold. Future climatic resources in Siberia would provide potential growth for a variety of crops that previously did not exist on these lands. Traditional Siberian crops could gradually shift as far as 500 km northwards (about 50-70 km per decade) within suitable soil conditions, and new crops, nonexistent today, may be introduced in the dry south that would necessitate irrigation.

Agriculture in central Siberia would likely benefit from climate warming but would also result in different feedbacks to the atmosphere and climate systems, in terms of an altered landscape albedo, substantially modified hydrological regimes and an extended and altered fire regime. However, adaptation measures would sustain and promote food security in a warmer Siberia.