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Fire risk and adaptation strategies in Northern Eurasian forests

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On-going climatic changes substantially accelerate current fire regimes in Northern Eurasian ecosystems, particularly in forests. During 1998-2012, wildfires enveloped on average ∼10.5 M ha year-1 in Russia with a large annual variation (between 3 and 30 M ha) and average direct carbon emissions at ∼150 Tg C year-1. Catastrophic fires, which envelope large areas, spread in usually incombustible wetlands, escape from control and provide extraordinary negative impacts on ecosystems, biodiversity, economics, infrastructure, environment, and health of population, become a typical feature of the current fire regimes. There are new evidences of correlation between catastrophic fires and large-scale climatic anomalies at a continental scale. While current climatic predictions suggest the dramatic warming (at the average at 6-7 ºC for the country and up to 10-12ºC in some northern continental regions), any substantial increase of summer precipitation does not expected. Increase of dryness and instability of climate will impact fire risk and severity of consequences. Current models suggest a 2-3 fold increase of the number of fires by the end of this century in the boreal zone. They predict increases of the number of catastrophic fires; a significant increase in the intensity of fire and amount of consumed fuel; synergies between different types of disturbances (outbreaks of insects, unregulated anthropogenic impacts); acceleration of composition of the gas emissions due to enhanced soil burning. If boreal forests would become a typing element, the mass mortality of trees would increase fire risk and severity. Permafrost melting and subsequent change of hydrological regimes very likely will lead to the degradation and destruction of boreal forests, as well as to the widespread irreversible replacement of forests by other underproductive vegetation types. A significant feedback between warming and escalating fire regimes is very probable in Russia and particularly in the permafrost areas. Overall, Russia should expect a disproportionate escalation of fire regimes compared to increasing climatic fire danger. Thus, development and implementation of an efficient adaptation strategy is a pressing problem of current forest management of the country. An appropriate system of forest fire protection which would be able to meet challenges of future climates is a corner stone of such a strategy. We consider possible systems solutions of this complex problem including (1) integrated ecological and socio-economic analysis of current and future fire regimes; (2) regional requirements to and specific features of a new paradigm of forest fire protection in the boreal zone of Northern Eurasia; (3) anticipatory strategy of the prevention of large-scale disturbances in forests, including adaptation of forest landscapes to the future climates (regulation of tree composition; setup of relevant spatial structure of forest landscapes; etc.); (4) implementation of an effective system of forest monitoring as part of integrated observing systems; (5) transition to ecologically-friendly systems of industrial development of northern territories; (6) development of new/ improvement of existing legislation and institutional frameworks of forest management which would be satisfactory to react on challenges of climate change; and (6) international cooperation.