B03-O03

CLIMATE-INDUCED CHANGES IN STABILITY OF RUSSIAN URBAN INFRASTRUCTURE BUILT ON PERMAFROST

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Planned socio-economic development during the Soviet period promoted migration into the Arctic and work force consolidation in urbanized settlements to support mineral resources extraction and transportation industries. These policies have resulted in very high level of urbanization in the Soviet Arctic. Despite the mass migration from the northern regions during the 1990s following the collapse of the Soviet Union and the diminishing government support, the Russian Arctic population remains predominantly urban. In five Russian Administrative regions underlined by permafrost and bordering the Arctic Ocean 66 to 82% (depending on region) of the total population is living in Soviet-era urban communities. The political, economic and demographic changes in the Russian Arctic over the last 20 years are further complicated by climate change, which is greatly amplified in the Arctic region. One of the most significant impacts of climate change on arctic urban landscapes is the warming and degradation of permafrost, which negatively affects the structural integrity of infrastructure. The majority of structures in the Russian Arctic are built according to the passive principle, which promotes equilibrium between the permafrost thermal regime and infrastructure foundations. This presentation is focused on quantitative assessment of potential changes in stability of Russian urban infrastructure built on permafrost in response to ongoing and future climatic changes using permafrost - geotechnical model forced by GCM-projected climate. To address the uncertainties in GCM projections we have utilized results from 6 models participated in most recent IPCC model inter-comparison project. The analysis was conducted for entire extent of Russian permafrost-affected area and on several representative urban communities. Our results demonstrate that significant observed reduction in urban infrastructure stability throughout the Russian Arctic can be attributed to climatic changes and that projected future climatic changes will further negatively affect communities on permafrost. However, the uncertainties in magnitude and spatial and temporal patterns of projected climate change produced by individual GCMs translate to substantial variability of the future state of infrastructure built on permafrost.