Permafrost degradation increases future costs of infrastructure on Qinghai-Tibet Plateau

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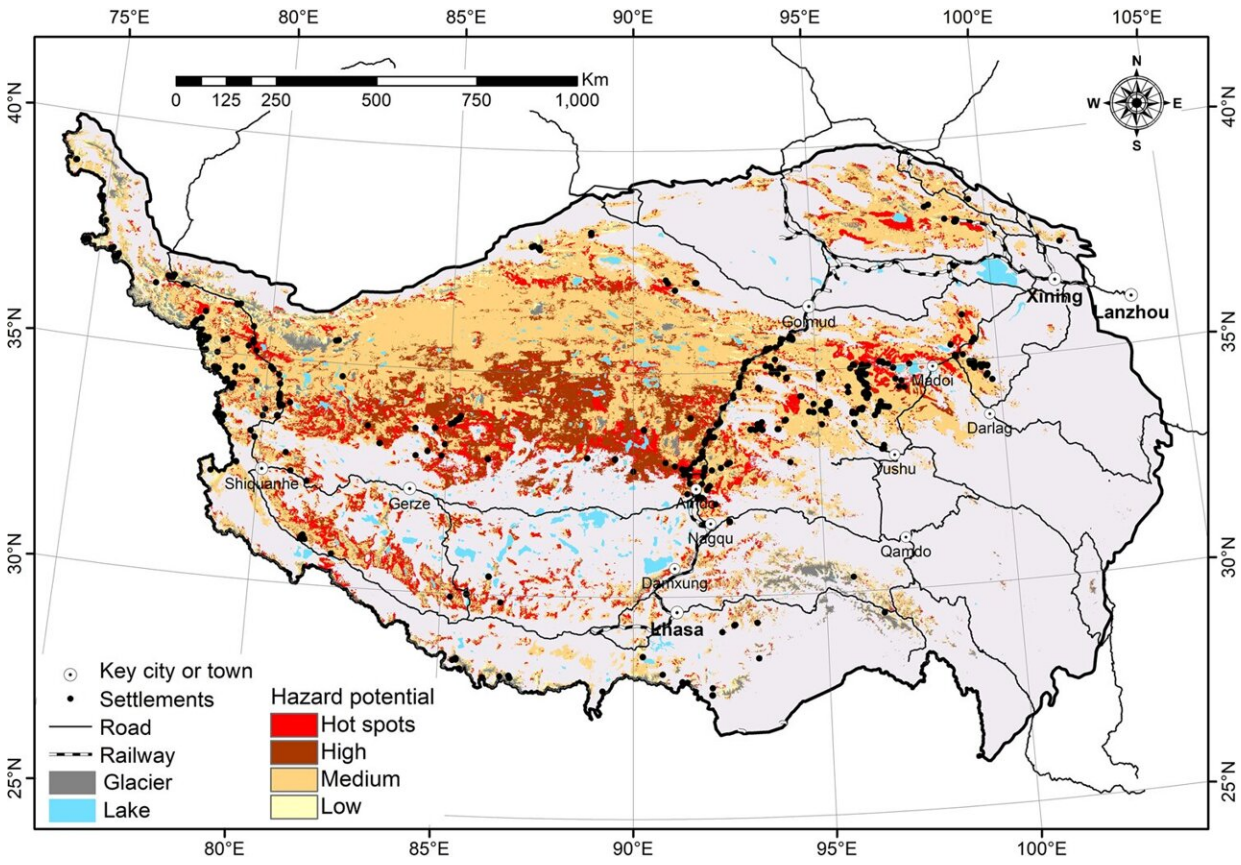

The distribution of infrastructure hazard zones by 2050 (2041–2060) under the historical scenario (SSP245). The hazard levels (high, medium and low) of permafrost degradation for infrastructure were derived from five hazard indices (thermal index, settlement index, bearing capacity index, risk zone index, and expert-based index) using a majority vote procedure. Hotspot areas indicate that at least four indices showed high hazard levels. Infrastructure, including

backbone road networks, railways, and buildings, is shown, while the distribution of power lines is generally consistent with the road network. Thus, the infrastructure pattern over the Qinghai-Tibet Plateau mainly includes three regions, i.e., the western engineering corridor (north of Shiquanhe), the central Qinghai-Tibet engineering corridor from Golmud to Lhasa, and the eastern corridor around Madoi. The infrastructure distribution data extracts from OpenStreetMap data and are licensed under CC BY-SA 2.0 (https://creativecommons.org/licenses/by-sa/2.0/). Glacier and lake extent data obtained from National Tibetan Plateau Data Center (10.3972/glacier.001.2013.db) and are licensed under CC BY 4.0 (https://creativecommons.org/licenses/by/4.0/). Credit: *Communications Earth & Environment* (2022). DOI: 10.1038/s43247-022-00568-6

Depending on altitude, the warming rate of the Qinghai-Tibet Plateau (QTP) has been twice the global average in recent decades. Climate change-induced permafrost degradation can seriously threaten the stability of the infrastructure and thus increase infrastructure repair and replacement frequency.

Integrating data-driven projection, multi-hazard index, and lifespan replacement models, researchers from the Northwest Institute of Eco-Environment and Resources of the Chinese Academy of Sciences (CAS) have evaluated the economic damage of permafrost degradation on the infrastructure over the QTP for the first time. Their results were published in *Communications Earth & Environment* on Oct. 13.

According to the researchers, 38% of roads, 39% of railways and power lines, and 21% of buildings may be threatened by permafrost degradation in high-hazard areas (SSP245) by 2050. These proportions may nearly double by the end of this century.

Correspondingly, the additional cost of $4 billion (net present value,

2.85% annual discount rate) by 2050 and approximately $6.3 billion by the end of this century will be needed to maintain the service function of current infrastructure under the historical scenario (SSP245).

Under the green scenario (SSP126), an additional cost of $3.6 billion will be required by 2050, which is a substantial reduction compared to the results under SSP245. This reduction could further increase to $1.6 billion by the end of this century.

The global climate warming goals of the Paris Agreement could have considerably different influences on hazard levels by the end of this century. Controlling global warming below 1.5 °C may reduce the infrastructure in high-hazard zones by approximately half and reduce the costs by $1.3 billion compared to the results under the 2 °C target.

The adaptation measures for high-grade roads, railways, power lines and buildings would greatly reduce this additional cost. By 2050, the percentage of potential cost savings from adaptations is approximately 15% (SSP245). This savings could reach 21% by the end of the century.

More information: Youhua Ran et al, Permafrost degradation increases risk and large future costs of infrastructure on the Third Pole, *Communications Earth & Environment* (2022). DOI: 10.1038/s43247-022-00568-6

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