

EGU2020-6246

<https://doi.org/10.5194/egusphere-egu2020-6246>

EGU General Assembly 2020

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## Status, Changes and Impacts of Permafrost on Qinghai-Tibet Plateau

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Due to the climate warming, permafrost on the Qinghai-Tibet Plateau (QTP) was degrading in the past decades. Since its impacts on East Asian monsoon, and even on the global climate system, it is fundamental to reveal permafrost status, changes and its physical processes. Based on previous research results and new observation data, this paper reviews the characteristics of the status of permafrost on the QTP, including the active layer thickness (ALT), the spatial distribution of permafrost, permafrost temperature and thickness, as well as the ground ice and soil carbon storage in permafrost region.

The results showed that the permafrost and seasonally frozen ground area (excluding glaciers and lakes) is 1.06 million square kilometers and 1.45 million square kilometers on the QTP. The permafrost thickness varies greatly among topography, with the maximum value in mountainous areas, which could be deeper than 200 m, while the minimum value in the flat areas and mountain valleys, which could be less than 60 m. The mean value of active layer thickness is about 2.3 m. Soil temperature at 0~10 cm, 10~40 cm, 40~100 cm, 100~200 cm increased at a rate of 0.439, 0.449, 0.396, and 0.259°C/10a, respectively, from 1980 to 2015. The increasing rate of the soil temperature at the bottom of active layer was 0.486 °C/10a from 2004 to 2018.

The volume of ground ice contained in permafrost on QTP is estimated up to  $1.27 \times 10^4$  km<sup>3</sup> (liquid water equivalent). The soil organic carbon stored in the upper 2 m of soils within the permafrost region is about 17 Pg. Most of the research results showed that the permafrost ecosystem is still a carbon sink at the present, but it might be shifted to a carbon source due to the loss of soil organic carbon along with permafrost degradation.

Overall, the plateau permafrost has undergone remarkable degradation during past decades, which are clearly proven by the increasing ALTs and ground temperature. Most of the permafrost on the QTP belongs to the unstable permafrost, meaning that permafrost over TPQ is very sensitive to climate warming. The permafrost interacts closely with water, soil, greenhouse gases emission and biosphere. Therefore, the permafrost degradation greatly affects the regional hydrology, ecology and even the global climate system.