Understanding the Spatial Pattern of the Glacier Changes in the Tibetan Plateau

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Abstract

Many Asian large rivers originate from glaciers over the Tibetan Plateau. The changes of glaciers in this region have a significant impact on water supply. In recent years, the Karakoram Anomaly, i.e., the glaciers in Karakoram remained stable and even expanded in contrast to the receding of the glaciers nearby and worldwide, has attracted much attention. There have been many attempts to explain this phenomenon. In order to better understand the causes of this phenomenon, the spatial pattern of the variations of the glaciers in the whole Tibetan Plateau should be explored on a longer time scale. During the Little Ice Age (LIA), the glaciers over the Tibetan Plateau advanced and formed easily recognizable end and lateral moraines, which could be used to identify the extents of glaciers. Using remote sensing images and aerial photos, along with field works, we recognized the distributions of the LIA's moraines of about 2000 glaciers over the Tibetan Plateau. It was found that the glacier areas have reduced by larger than 25% in the southeast Tibetan Plateau and the northeast margin of the Tibetan Plateau while less than 10% in the northwest Tibetan Plateau (including the Karakoram) since the LIA. A similar spatial pattern of the shrinkages of the glaciers was also revealed over the past decades. It's noted that the summer freezing level is much higher than the glacier median elevation in the southeast Tibetan Plateau while much lower in the northwest Tibetan Plateau, and the summer freezing level showed a decreasing trend in the northwest Tibetan Plateau (including the Karakoram) while increasing in the southeast Tibetan Plateau over the past decades. These imply that the summer freezing level play an important role in the spatial variations of the glaciers over the Tibetan Plateau.

Keywords: Tibetan Plateau, Glacier, Spatial variations, freezing level