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Continuous monitoring of isotopic compositions of surface water vapor on the East Rongbuk Glacier, Mt. Qomolangma (Everest), Third Pole

Content

Stable isotopic compositions (oxygen and hydrogen) of ice cores provide unique archives of past climate changes on the Third Pole. Previous documented relationships between precipitation stable isotopes and temperature based on in-situ observations at low-altitude stations or observed modern spatial gradient with altitude are commonly used for quantitative temperature reconstructions in ice cores. Plenty of studies also suggested that the isotope-temperature relationships have distinctly spatial-temporal characteristics due to the alternative actions between the westerlies and Indian monsoon in this region. However, depositional processes linked with variability of stable isotopes between atmospheric vapor and surface snow on glaciers remain poorly documented in this unique high-altitude region, which is essential to understand the climatic interpretation of ice cores. Here we presented the in-situ continuous monitoring of atmospheric water vapor stable isotopes on the East Rongbuk Glacier at three altitudes (6300 m a.s.l. on the glacier, 5800 m a.s.l on the moraine and 5150 m a.s.l about 10 km away from the glacier terminal) from 25th May to 31st May 2018 to understand the process controlling variations of atmospheric vapor stable isotopes at different altitudes in the Himalayas. Three Picarro L2130i cavity-ring down spectroscopy granted by the Pan-Third Pole Environment (Pan-TPE) program had been ployed at these three altitudes. Evaluation of the simulations using isotopic-enabled general circulation models (ECHAM5-wiso) were also used to document the influence of large-scale advection and local circulation on atmospheric water vapor stable isotopes along the Himalayas. Our results suggested the diurnal variations of atmospheric water vapor stable isotopes exist at different altitudes on the glacier associated with distinct fractionation processes and our results also firstly documented the significant altitudinal variations of atmospheric water vapor stable isotopes on the glacier at minutes to diurnal scales in this region.

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