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Westerly drives long-distance transport of radionuclides from nuclear events to the Third Pole

Content

Major nuclear bomb tests and nuclear power plant incidents release large amounts of radionuclides, which disperse globally. The beta (β) activity of radionuclides in ice cores is traditionally used as a chronological tool. This study investigates β activities of radionuclides from four ice cores in the TP to understand the transport routes and related atmospheric processes affecting the radionuclides deposition in glaciers in the Third Pole (TP) region. All the ice cores show three major β activity peaks in the ice layers corresponding to 1963, 1986, and 2011. The β activity peak in the 1963 ice layer is well-known due to the wide deposition in all the ice cores from polar and mountain regions and referred to the 1962 massive atmospheric Nuclear Bomb Test. Beta activity peaks in 1986 and 2011 ice layers are from the Chernobyl and Fukushima Nuclear Incidents (CNI, FNI), respectively. Hysplit forward and backward trajectory analyses from the origins of the three events to the four TP ice core sites suggest that the radionuclides were transported by the prevailing westerly into the stratosphere and then to the high elevation glaciers in the TP. In the case of the FNI, the radionuclides traveled over Japan, the Pacific Ocean, Europe, and central Asia before being deposited in the TP glaciers. Investigating the atmospheric circulation after the CNI and FNI confirm that the stronger northern westerly is responsible for high radionuclides during the FNI in the TP. Less precipitation with the divergence of water vapor flux component after the FNI also contributed to the enriched radionuclides in ice core records.

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