

Observed stable isotopes in precipitation and estimated water vapor origins across Japan throughout 2013

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Stable isotopes in precipitation are useful tracers for understanding atmospheric water cycles, estimating water vapor origins. There are a lot of observational studies of stable isotopes in precipitation all over Japan, however, most observations were conducted only one point and only one year. This study investigated spatial and temporal variabilities of stable isotopes in precipitation across Japan and estimates their water vapor origins. Stable isotopes in precipitation were observed at 77 stations throughout 2013. The water vapor origins, that is where the water vapor evaporated from, were estimated by using the isotope-incorporated atmospheric general circulation model.

The Cluster analysis was used to distinguish the spatial grouping of seasonal variability of monthly mean Oxygen-18 anomaly from the annual mean values. Stations belong to the cluster 1, 2, and 3 were distributed mainly in the Pacific Ocean side of the Kanto and Chubu, the Chube mountainous area and North Japan, and the Sea of Japan side and West Japan, respectively. Cluster 1 was characterized extremely low anomaly in January. This was caused by the snowfall event when the Nagan-Low pressure system passed on 14-15 January. Cluster 2 showed clear seasonal variability, high in summer and low in winter. From the estimation of water vapor origins, the Pacific Ocean origin and the Sea of Japan origin were dominated in summer and in winter, respectively. Cluster 3 characterized that Oxygen-18 anomaly in June was much lower than those in May and July. The depletion in June became larger toward south, which had a negative correlation with the precipitation amount. Also, water vapor evaporated from the Indian Ocean which had low isotope values were higher toward south in June. The precipitation amount effect and rainout process of water vapor passage from the Indian Ocean to Japan might be controlling factors to stable isotopes in precipitation in June.

Keywords: stable isotopes, precipitation, water vapor origins