Water stable isotope ($\delta^{18}O$ and δD) variations in rainfall and water vapor over tropical rainforest region of Sarawak, Malaysia

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In the Sarawak region of Borneo Island, strong diurnal cycle of convection and rainfall is dominated, associated with local and island-scale land-sea breezes (e.g., Ichikawa and Yasunari, 2005). Furthermore, because the evapotranspiration of plant is very large at these tropical rainforests, moisture that originates from land surface (or forest) significantly contributes to the daily rainfall in this region. The purpose of this study is to identify the moisture origin of precipitation observed in Borneo-Sarawak tropical rainforest region by using water stable isotopes (HDO, $H_2{}^{18}O$) which is widely used as tracer in hydrological cycle, and examine the hydrological processes.

The sampling of precipitation has been carried out daily at the crane site in Lambir Hills National Park from July 2004. The isotopic ratios ($\delta^{18}O$ and δD) in samples of daily precipitation collected from July 2004 to December 2004 were analyzed using a mass spectrometer.

The temporal $\delta^{18}O$ variation in observed daily precipitation shows that low $\delta^{18}O$ values occurred mainly during the active rainfall period. The isotopic content of precipitation is influenced by the removal of moisture from air parcel in process of vapor transport, and supply of additional water vapor from land surface. Generally, the progressive removal of atmospheric moisture through condensation by rainfall depletes the heavy isotopic content as the air travels from the origin to the observation point. To examine the contribution of rain-out from air parcel during transport to isotopic ratio of daily precipitation, we analyzed convective activity over and around the observation area. As an indirect but continuously available indicator of convective activity, we calculated the area of clouds with colder than 235K of cloud top temperature using hourly GOES-9 Tbb data. Back-trajectory analysis was made using these cloud data to estimate the exposure time of water vapor in the transportation process from the origin to the observation point. These results show that the low $\delta^{18}O$ values appeared when convective activity was active near and around the observation area associated with rainfall in or downwind of organized mesoscale convective systems.