昭和基地に高温をもたらす気団の特徴

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Identification of air mass responsible for warm events ay Syowa station

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Warm events, or time periods when the surface air temperature exceeds melting point, have been recorded during the austral summer at Syowa station on the East Antarctic coast. Changes in the frequency and duration of such events may strongly affect surface melt and mass balance. This study identifies air masses responsible for remarkable warm events at Syowa in the 2013 and 2014 austral summer using shipboard observations of water vapor isotopologues.

Continuous measurement of water vapor isotopologues (δD and $\delta^{18}O$) were made along the JARE 55 and JARE 56 cruise track between Australia to Syowa station. A water vapor isotope analyzer (WVIA) was installed in a laboratory placed on the top deck of the ice breaker *Shirase*. H_2O concentration and water vapor isotopes in surface air were recoded by the WVIA every 10 minutes.

The δD ($\delta^{18}O$) values obtained from the cruises showed a decreasing trend toward Syowa. This trend was different depending on regions. Over the oceanic region where SST is higher than 5ºC, variability in δD values was relatively small and was synchronized with those in locally evaporated moisture. In the cold ice-free ocean (SST < 5ºC), δD values dropped below the δD variations in evaporation from the sea surface and approached depleted values observed values observed at Antarctic coast because of the influence of advection of moisture from the Antarctic coast. The δD values over the ice-covered region were further decreased compared with the values in the cold ice-free ocean. In addition, these values varied widely from day to day. The highest δD values observed when air masses transported from the ice-free ocean. In contrary, the lowest δD values appeared when air masses originated from Antarctica were dominant. These results suggest that the δD values of ice-covered region reflect the relative contribution of maritime versus glacial air masses. Thus, we can classify air masses arriving at Antarctic coast into maritime and glacial origin based on their isotopic features.

The time series of the normalized δD anomalies in vapor during the period when the ship was near Syowa station are shown in Figure 1, together with surface air temperature (T_a) variations at Syowa. Maritime air advecting from ice-free ocean to Syowa is characterized by relatively high δD. The largest positive δD anomalies were observed from January 17-19, 2015. This remarkable event corresponded to a significant poleward moisture transport organized in a narrow band features identified as an atmospheric river (AR) event. Figure 1 shows that T_a warmed close to the melting point during the AR event. However, T_a during the warm period in late-December (December 21-23, 2014) was much higher than during this event. During this warm period, daily maximum air temperature exceeded 5ºC. In addition, the fact that the warmest period was characterized by negative δD anomalies suggests that, paradoxically, glacial air mass is responsible for warm event.

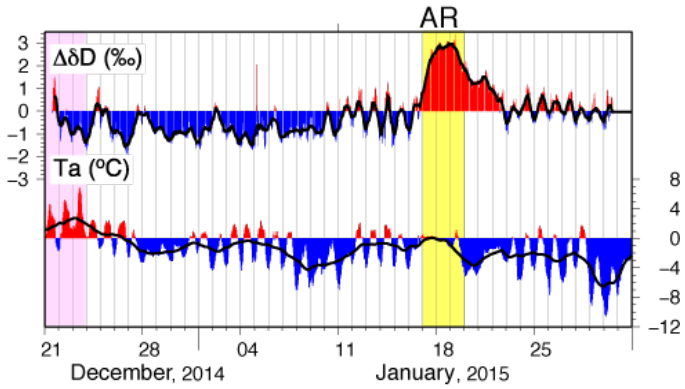

Figure 1 Time series of δD anomalies observed at Shirase during the JARE56 cruise and air temperature (T_a) at Syowa

The air mass trajectory analysis showed that warm event was associated with the transport of glacial air across the mountains of Enderby Land by northeasterly winds. Archived numerical forecast output from the Antarctic Mesoscale Prediction System (AMPS) showed that the prevailing northeasterly winds flow over the mountain range of EL and descend downslope to Syowa. This indicates that air mass on the west coast was warmed additionally by adiabatic compression as the air descended to Syowa (foehn effect). Foehn wind is characteristically warm and dry; low relative humidity condition has been observed at Syowa during warm period (not shown). Although a quantitative understanding of this warm event and the influence of downslope foehn wind at Syowa is the subject of ongoing research, this study provides strong evidence that foehn winds play a significant role in warming event at Syowa.