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The stable isotopes record of the surface snow along a route through Institute-Möller Ice Stream basins and the Southern lobe of Pine Island Glacier basin, West Antarctica

Content

A relevant key for the comprehension of spatial climate variability of the Antarctic is the stable isotopes content from snow (⊠18O, ⊠D and d-excess). This study focused on the surface snow isotopic composition variations along two transects (a 645 km south-north transect and another 350 km west-east transect) in the region of three glacial drainage basins in the West Antarctic Ice Sheet (WAIS) – in the basins of the Möller and Institute Ice Streams (Weddell Sea Sector; WSS) and in the Southern lobe of Pine Island Glacier basin (Amundsen-Bellingshausen Sea Sector; ABSS). The transects were travelled on the first genuinely Brazilian traverse to Antarctica in the 2014-2015 austral summer. The variations of snow isotopic composition are discussed by 92 snow samples (⊠0.2 m deep), which were collected along the traverse route approximately every 10 km. We used a wavelength-scanned cavity ring-down spectrometer (WS-CRDS; L2130-i, PICARRO®) to determine the stable isotope ratios of water. The accuracy was better than 0.2‰ and 0.9‰ for ⊠18O and ⊠D, respectively. The d-excess was calculated by the linear definition: d=⊠D-8x⊠18O. We computed the isotopic-geographical characteristics (latitude, altitude, distance to the coast and longitude) and spatial co-isotopic empirical relationships (δD/δ18O and d-excess/δs). Further, we compared the isotopic results with the tropospheric mean annual temperature (1000-600 mb) obtained from ERA5 reanalysis data, and the air mass trajectories simulated by the HYSPLIT (v4) model. Our isotopic results were sensitive to capturing the well-known climatic asymmetry between the ABSS and WSS. Relatively warmer air masses (oceanic) originating from the Pacific Sector mainly influence the Pine Island Glacier basin surface snow and the north area of the Institute Ice Stream basin (marked primarily by the significant, negative isotopic content/continentality relationships: strong for the northern region of the south-north transect (r=-0.85 (δ18O), r=-0.84 (δD); p<0.001) and moderate for the west-east transect (r=-0.58 (δ18O), r=-0.53 (δD); p=0.001-0.01)). On the other hand, colder air masses (continental) impact the surface snow isotopic content of the south area of the Institute Ice Stream basin and the Möller Ice Stream basin (marked by isotopic signal homogenization and the persistency of the more continental δ values in the southern region of the south-north transect: ⊠18Omean = -40.67‰ ± 1.73‰; ⊠Dmean = -319.80‰ ± 13.98 ‰). The spatial distribution of δs and d-excess and the co-isotopic relationships (two significant (p<0.001), negative trends between d-excess and δ18O) reflect two preferential fractionation paths: one from the coast of the ABSS to the WSS (major importance), and another from the coast of the WSS to the inland (minor importance). The Pacific Ocean is confirmed as the principal source of moisture for both sectors.

Keywords: Stable Isotopes. Surface Snow. West Antarctica.

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