ORIGIN OF PRECIPITATION OF THE NORTHERN ANTARCTIC PENINSULA AND SHETLANDS ISLANDS: PRELIMINARY RESULTS

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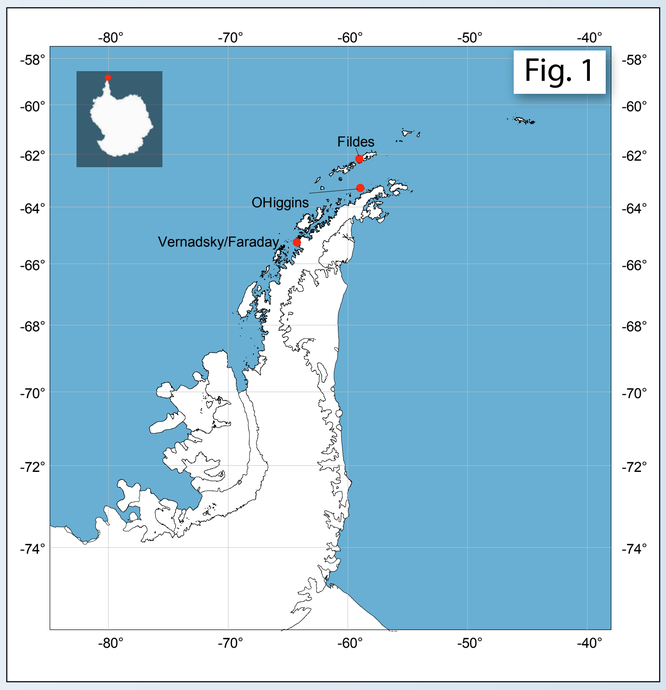


Introduction

It is well known in the scientific community that the Antarctic Peninsula is suffering strong warming processes. Regional trends are well above the global and regional tendencies reaching up to 2.5°C for the last 50 years. However there are no extensive meteorological records in any of the Stations. The longest registry is found at the Vernadsky/Faraday Station (Ukraine), where the meteorological data goes back to 1947. In the same way, not much of the changes in the hydrological cycle (past and present) are well understood. Presently most of the information comes from few ice cores and surface snow samples retrieved in different scientific expeditions.

Aiming to fill this information gap, daily precipitation samples are collected since January 2008 in two Chilean Antarctic stations (Fildes Peninsula, King George Island and O´Higgins Station, Antarctic Peninsula) (Fig 1), within the frame of studying the recent climate variability on the Antarctic Peninsula and South Shetland Islands. With the objective of to extend the present data into the past, a firn core was retrieved near the O´Higgins Station in 2008.

Both data sets were analyzed by stable isotope in order to gain information on seasonal temperature variations ($\delta^{18}O$, δD) and origin of the precipitation (d excess $d = \delta D - 8 * \delta^{18}O$)

Results

The first geochemical analysis for samples collected in Fildes Peninsula during January and February of 2008 (n=12) (Fig. 2), shows mean isotope values of -8.16‰ $\delta^{18}O$ and -64‰ δD vs. VSMOW (amount weighted) (Table 1). The calculated d-excess values vary between -0.7‰ and 4.2‰ most likely reflecting different physical-chemical conditions during primary evaporation in the moisture source. $\delta^{18}O$ and δD are in well agreement with the mean monthly air temperature for Fildes Peninsula (1.5°C), reflecting the relative high summer temperature and high humidity regime (low d-excess values). Other stations at the west side of the Antarctic Peninsula exhibit similar isotope compositions for summer season (e.g.: Vernadsky -8.8 ‰ $\delta^{18}O$, -71.4 ‰ δD, -2.4‰ d-excess) .

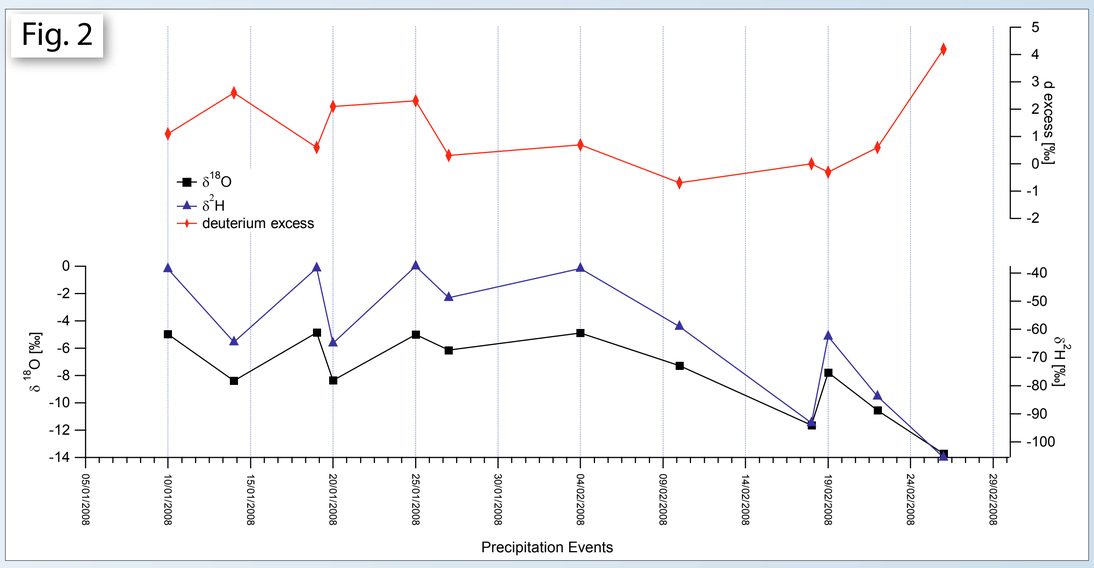


Table 1

Date	Sample N.	Preciptitation Type	Amount	d18O (o/oo) vs. SMOW	dD (o/oo) vs. SMOW	d excess (o/oo)
10/01/2008	PF-01	rain/snow	4.6 mm	-4.97	-38.6	1.1
14/01/2008	PF-02	rain/snow	4.0 mm	-8.39	-64.5	2.6
19/01/2008	PF-03	drizzle/rain	8.8 mm	-4.86	-38.3	0.6
20/01/2008	PF-04	rain/snow	5.0 mm	-8.37	-64.9	2.1
25/01/2008	PF-05	drizzle/rain	4.6 mm	-4.99	-37.6	2.3
27/01/2008	PF-06	rain/snow	4.2 mm	-6.14	-48.8	0.3
04/02/2008	PF-07	snow	9.2 mm	-4.90	-38.4	0.7
10/02/2008	PF-08	rain	8.6 mm	-7.29	-59.0	-0.7
18/02/2008	PF-09	rain	8.4 mm	-11.64	-93.2	0.0
19/02/2008	PF-10	rain	3.8 mm	-7.78	-62.5	-0.3
22/02/2008	PF-11	rain	7.4 mm	-10.55	-83.8	0.6
26/02/2008	PF-12	rain/drizzle	10.6 mm	-13.72	-105.5	4.2
		Amount weighted averages		**-8.16**	**-64.04**	**1.53**

For every registered event, 3-days backward air trajectories were computed (Fig. 3). For this study the NOAA – Hysplit v4.8 model was used, which was fed with GDAS (NCEP) meteorological archives. Events with d-excess values between -0.7‰ to 0.7‰ and 2.1‰ to 2.6‰ (n=10) are the most common and its origin is located in the Pacific Ocean at the West of the Peninsula: Precipitation with negative (light blue line) (n=2) are most likely transported from the South-West side of the Antarctic Peninsula (Bellingshausen Sea). However no definitive conclusion can be made *a priori*, because the small d-excess differences could be within the detection limit of this technique. Two cases shows completely different values: one of them with a d-excess close to 1‰ and a backward trajectory coming from the South Atlantic Ocean (green line).The second case with a value of 4.2‰ and with the most negative $\delta^{18}O$ value (-13.7‰), shows a transport with pass line over South America (yellow line). Isotopes reflect probably a most evolved moisture with different precipitation events in his way to Fildes Peninsula.

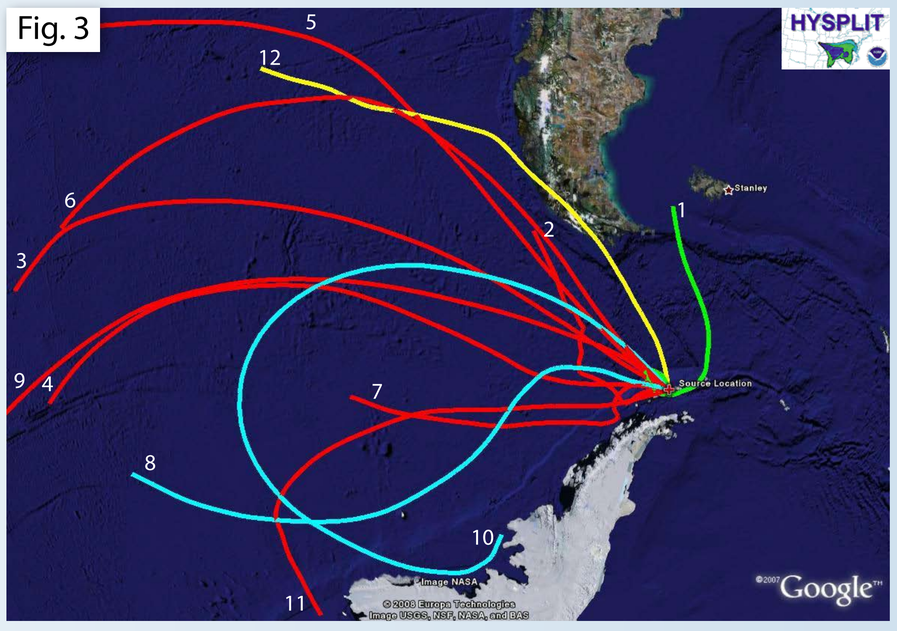
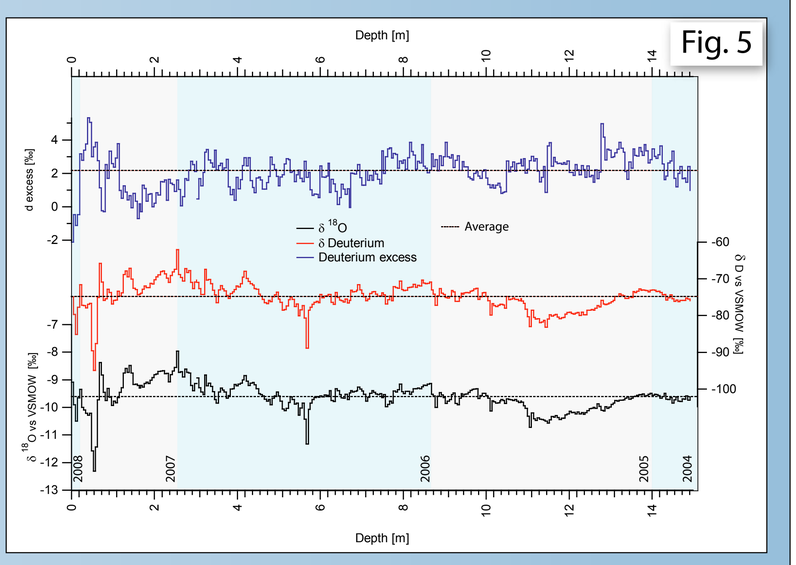



Fig. 4



An ice/firn core drilling campaign was started in 2008. During the past austral summer season (January/February 2008) a first short firn core (15 m depth) was retrieved close to the O´Higgins Station (300 m a.s.l.) (Fig. 4). High resolution (5 cm) isotope analysis was carried out for this core (Fig. 5). These data indicate, that the age of the core is likely between 3 and 4 years. Isotope signals are partially smoothened by melting and percolation processes, making direct inter-comparison with the precipitation samples impossible. For this reason, it is aimed to retrieve cores at higher altitudes on Plateau Laclavére in the following field season.

Mean $\delta^{18}O$ (d-excess) value is lower (higher) than those collected in King George Island, but in this preliminary analysis Fildes Peninsula samples represents just two summer months (heavier isotope content with respect to winter). Average values of $\delta^{18}O$, δD and d-excess in the core are: -9.61‰, -74.8‰ and 2.1‰, respectively.

Outlook and Conclusions

During the next months, and together with the departure of the wintering crews from the stations, we will receive the samples collected in 2008 (Fig. 6). The analysis of the entire year series will be carried out within the first months of 2009 at AWI-Potsdam facilities. After that they will be compared to the short firn cores retrieved in 2008 and the new material, which will be collected in the second expedition to the Antarctic Peninsula in January 2009. This data will give us a broad picture of the provenance of precipitation in the northern Antarctic Peninsula and Shetland Islands.

Further beyond, this information will be used to study the climate variability in Antarctic Peninsula, when a medium-depth core (150 m) will be retrieved between November 2009 and January 2010. It is expected to get the precipitation stored in the ice for at least in the last century, leading us to understand the changes of the hydrological system in this time interval.


Fig. 6

The preliminary results shown here; prove that the isotope analyses combined with the backward trajectory analysis are a powerful tool to get infotmation of the moisture source of precipitations. For rain and snow falls in the first two months of 2008 (Austral summer) on the north zone of the Antarctic Peninsula three main sources where found, each one characterized by a distinctive isotope signature (d-excess values), source locations are: South Pacific Ocean, South Atlantic Ocean and Bellingshausen Sea. This conclusion will be generalized in the next months for all year seasons and later extended into the past, when ice/firn cores are extracted in following field seasons.

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