TEST_IPICS_2020

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Ice records provide new insights

Author: Doris Bühler[None]

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Ice records provide new insights

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Melt-induced fractionation of major ions and trace elements in an Alpine snowpack

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Understanding the impact of melting on the preservation of atmospheric compounds in high-Alpine snow and glacier ice is crucial for future reconstruction of past atmospheric conditions. However, detailed studies investigating melt-related changes of such proxy information are rare. Here we present a series of five snow pit profiles of 6 major ions and 34 trace elements at Weissfluhjoch, Switzerland, collected between January and June 2017. Atmospheric composition was preserved during the cold season, while melting toward the summer resulted in preferential loss of certain species from the snowpack or enrichment at the base of the snowpack. Increasing mobilization of major ions with meltwater (NH4+ < Cl− ˜ Na+ < NO3− ˜ Ca2+ ˜ SO42−) can be related to their stronger enrichment at ice crystal surfaces during snow metamorphism. Results for trace elements show that less abundant elements such as Ce, Eu, La, Mo, Nd, Pb, Pr, Sb, Sc, Sm, U, and W were best preserved.

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Impact of anthropogenic and biogenic sources on the seasonal variation in the molecular composition of urban organic aerosols:

a field and laboratory study using ultra-high-resolution mass spectrometry

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Aerosols affect the Earth's climate and ecosystems, as well as human health. A main contributor to aerosol mass is organic aerosol (OA). OA can be directly emitted as primary particles (POA) or produced by oxidation and subsequent condensation of volatile organic compounds (VOCs) (secondary OA, SOA). Sources of both POA and SOA can be natural, such as plant debris, resuspension, and biogenic VOC (BVOC) oxidation, or anthropogenic, such as from traffic, cooking, or residential heating using wood or fossil fuels. The resulting SOA is typically a highly complex mixture of unknown compounds, the chemical characterization of which requires comprehensive analytical strategies (e.g. Noziere et al., 2015).

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Extraction of dissolved organic carbon from glacier ice for radiocarbon analysis

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Alpine glaciers are valuable archives for the reconstruction of human impact on the environment. Besides dating purposes, measurement of radiocarbon (14C) content provides a powerful tool for long-term source apportionment studies on the carbonaceous aerosols incorporated in ice cores. In this work, we present an extraction system for 14C analyses of dissolved organic carbon (DOC) in ice cores. The setup can process ice samples of up to 350 g mass and offers ultra-clean working conditions for all extraction steps. A photo-oxidation method is applied by means of external UV irradiation of the sample. For an irradiation time of 30 min with catalyzation by addition of Fe2+ and H2O2, we achieve an efficiency of 96 ± 6% on average. Inert gas working conditions and stringent decontamination procedures enable a low overall blank of 1.9 ± 1.6 μg C with a F14C value of 0.68 ± 0.13. This makes it possible to analyze the DOC in ice samples with a carbon content of as low as 25 μg C kg−1 ice. For a first validation, the new method was applied to ice core samples from the Swiss Alps. The average DOC concentration and F14C values for the Fiescherhorn ice core samples show good agreement with previously reported data for the investigated period of 1925–1936 AD.

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Variation of ice nucleating particles in the European Arctic over the last centuries

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The historical development of ice nucleating particle concentrations (NINP) is still unknown. Here, we present for the first time NINP from the past 500 years at two Arctic sites derived from ice core samples. The samples originate from the EUROCORE ice core (Summit, Central Greenland) and from the Lomo09 ice core (Lomonosovfonna, Svalbard). No long-term trend is obvious in the measured samples, and the overall range of NINP is comparable to present-day observations. We observe that the short-term variations in NINP is larger than the long-term variability, but neither anthropogenic pollution nor volcanic eruptions seem to have influenced NINP in the measured temperature range. Shape and onset temperature of several INP spectra suggest that INP of biogenic origin contributed to the Arctic INP population throughout the past.

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Talk Margit

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Disproportionately strong climate forcing from extratropical explosive volcanic eruptions

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Extratropical volcanic eruptions are commonly thought to be less effective at driving large-scale surface cooling than tropical eruptions. However, recent minor extratropical eruptions have produced a measurable climate impact, and proxy records suggest that the most extreme Northern Hemisphere cold period of the Common Era was initiated by an extratropical eruption in 536 CE. Using ice-core-derived volcanic stratospheric sulfur injections and Northern Hemisphere summer temperature reconstructions from tree rings, we show here that in proportion to their estimated stratospheric sulfur

injection, extratropical explosive eruptions since 750 CE have produced stronger hemispheric cooling than tropical eruptions. Stratospheric aerosol simulations demonstrate that for eruptions with a sulfur injection magnitude and height equal to that of the 1991 Mount Pinatubo eruption, extratropical eruptions produce time-integrated radiative

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The physics and chemistry of ice

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This themed issue compiles a selection of invited talks given at the 14th International Conference on the Physics and Chemistry of Ice (PCI) hosted by the Paul Scherrer Institute (Switzerland) in January 2018. PCI is an international symposium series dating back 55 years and is devoted to research on all aspects of ice. Its 14th edition reflects the ongoing interest in ice research. Apart from its environmental relevance on Earth and in Space and its importance in everyday life, ice is an excellent model system for phase transitions, interface and deformation processes that are studied in materials in general, but with distinct advantages of availability, accessibility, non-toxicity, design and transparency.

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