Long-term observations of $^{14}CO_2$ at Jungfraujoch

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1. Project description

Since 1986, radiocarbon observations on carbon dioxide sampled at Jungfraujoch are being performed by the University of Heidelberg. The responsibility of taking the samples moved to the University of Bern in 2018 due to the involvement in the Integrated Carbon Observation System Research Infrastructure (ICOS-RI). Jungfraujoch is an official ICOS class-1 station. The sampling protocol follows the specifications given by the atmospheric specification document for ICOS stations. The measurements are done at the Central Radiocarbon Laboratory (CRL) at the Institute of Environmental Physics of Heidelberg University and the data are available via the ICOS Carbon Portal (www.icos-cp.eu).

Also this year the ^{14}C record from Jungfraujoch has been used widely as reference in many publications. For instance, for comparison with other records (Aramaki et al., 2019; Faurescu et al., 2019; Hajdas et al., 2019; Hou et al., 2020; Paterne et al., 2019; Quarta et al., 2019; Rinyu et al., 2019; Varga et al., 2019a; Varga et al., 2019b) or for determining fossil fuel sources (Piotrowska et al., 2020) or investigating seasonal behavior as measured in tree rings (McDonald et al., 2019) Furthermore, there was one Bachelor thesis published by the University of Groningen, Netherlands on a comparison of radiocarbon measurements obtained at different stations (Sarkozi, 2019).

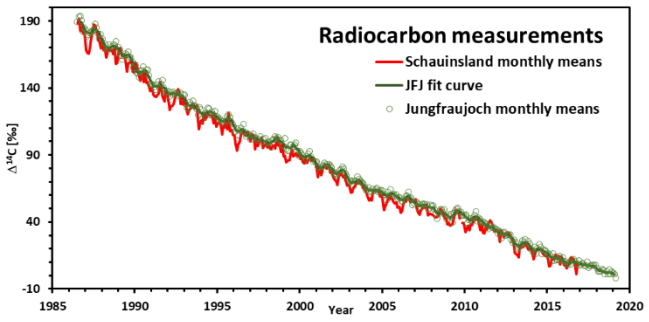

Figure 1. Atmospheric $^{14}CO_2$ observations at Jungfraujoch (green circles) in comparison to values of the Schauinsland station (red curve). The green line corresponds to a 5-months running mean of the Jungfraujoch values (data from Hammer and Levin, 2017).

Radiocarbon is decreasing due to the exchange with the other carbon-containing reservoirs such as the ocean and the land-biosphere, but since the 1990s almost exclusively due to the ongoing (global) input of ^{14}C-free fossil fuel CO_2 into the atmosphere i.e. the global Suess effect (Fig. 1).

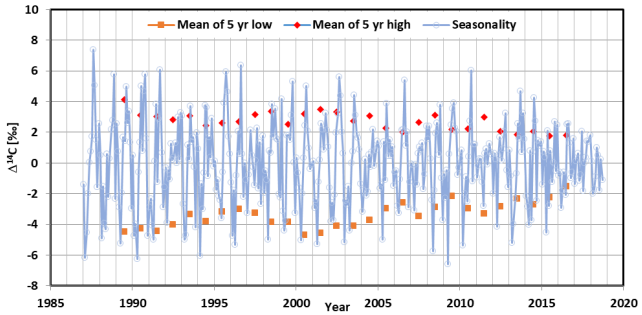

Figure 2. Seasonality of the Jungfraujoch record based on the monthly values from 1987 to 2019.

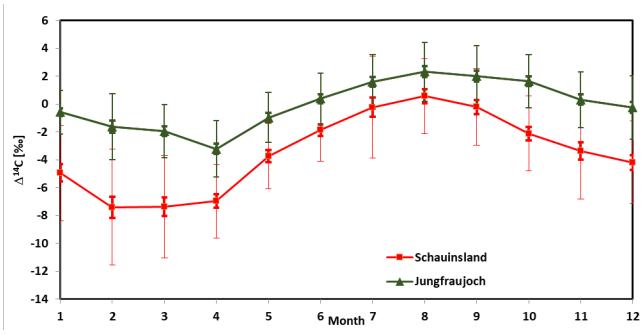

Figure 3. Mean seasonality of the Jungfraujoch and Schauinsland (shifted by the mean offset for the two stations during the overlapping period, i.e. 3.5 ‰). Corresponding uncertainty (1σ, thin) and (1σ of the mean) based on the monthly values from 1987 to 2019 for Jungfraujoch and 1987 to 2016 for Schauinsland. January corresponds to month 1.

The seasonal behavior at Jungfraujoch shows inter-annual variability as documented in Fig. 2. Over recent years the amplitude seems to be smaller compared to previous periods as documented

by the 5 yr minimum and maximum values. The reason for this seasonality decrease is yet unknown.

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Internet data bases

https://heidata.uni-heidelberg.de/dataset.xhtml?persistentId=doi:10.11588/data/10100
https://data.icos-cp.eu/portal/

Collaborating partners / networks

Internationale Stiftung Hochalpine Forschungsstationen Jungfraujoch und Gornergrat (HFSJG)
ICOS-RI partners, ICOS-CH partners

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