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

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Associated to programme: ICOS (https://www.icos-ri.eu/)

Keywords: carbon dioxide; carbon cycle dynamics; radiocarbon; fossil fuel CO_2

1. Project description

Since 1986, radiocarbon observations on carbon dioxide sampled at Jungfraujoch are being performed by the Heidelberg University. 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 (ICOS RI, 2020). 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 (*Levin et al.*, 2020; *Niu et al.*, 2021; *Rose et al.*, 2020; *Yver-Kwok et al.*, 2021; *Zheng et al.*, 2020; *Zhou et al.*, 2020).

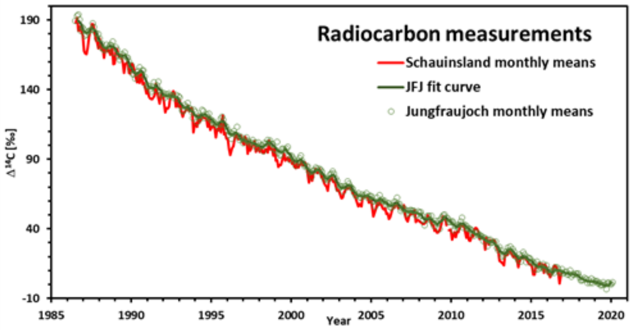

Figure 1. Atmospheric $\Delta^{14}CO_2$ observations at Jungfraujoch (green circles) in comparison to values of the Schauinsland station (red curve). The green line corresponds to a 5-months running mean of the Jungfraujoch values.

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).

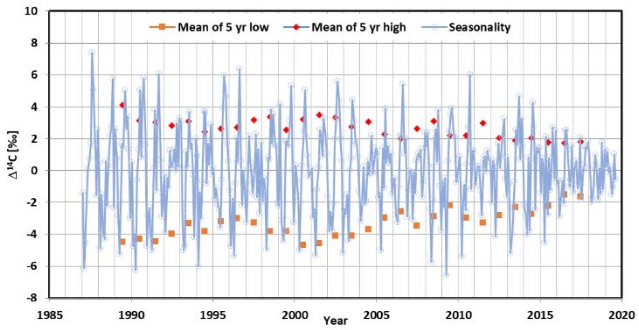

Figure 2. Seasonal amplitude of the Jungfraujoch record based on the monthly values from 1987 to 2020.

The seasonal amplitude 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.

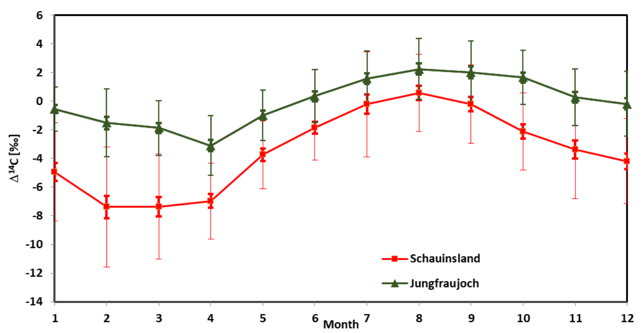

Figure 3. Mean seasonality of the Jungfraujoch and Schauinsland (shifted by the mean offset for the two stations during the overlapping period, i.e. 3.5 ‰). Corresponding uncertainty (1σ, thin line) and (1σ of the mean, thick line) based on the monthly values from 1987 to 2020 for Jungfraujoch and 1987 to 2016 for Schauinsland. January corresponds to month 1.

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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

International Foundation High Altitude Research Stations Jungfraujoch and Gornergrat (HFSJG)
ICOS-RI partner, ICOS-CH partners

Scientific publications and public outreach 2020

Refereed journal articles and their internet access

Levin, I., U. Karstens, M. Eritt, F. Maier, S. Arnold, D. Rzesanke, S. Hammer, M. Ramonet, G. Vítková, and S. Conil, A dedicated flask sampling strategy developed for Integrated Carbon Observation System (ICOS) stations based on CO_2 and CO measurements and Stochastic Time-Inverted Lagrangian Transport (STILT) footprint modelling, Atmospheric Chemistry and Physics, **20**, 18, 11161-11180, 2020. https://doi.org/10.5194/acp-20-11161-2020

Data books and reports

ICOS RI: ICOS Atmosphere Station Specifications V2.0 (editor: O. Laurent), ICOS ERIC, 2020. https://doi.org/10.18160/GK28-2188

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