

⁸⁵Kr Activity Determination in Tropospheric Air

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1. Project description

Monitoring of tropospheric ⁸⁵Kr activity concentrations at Jungfraujoch (JFJ) was continued in 2019. Krypton is separated from about 10 m³ of air continuously collected during one week and sent to the Bundesamt für Strahlenschutz in Freiburg i.Br. to measure the ⁸⁵Kr activity concentration. Since 2014 the noble gas laboratory at BfS in Freiburg is accredited according to DIN EN ISO/IEC 17025 [1].

The major sources of atmospheric ⁸⁵Kr are nuclear reprocessing plants. During the last few decades, the most relevant emitter is the facility in La Hague in France. Due to a half-life of 10.74 years ⁸⁵Kr accumulates in the atmosphere if the release rate from all reprocessing activities exceeds the decay rate of the ⁸⁵Kr inventory in the atmosphere. Over the last ten years the baseline ⁸⁵Kr activity concentration was rather stable indicating a relatively stagnant global reprocessing capacity.

Emissions from La Hague are characterized by pulsed releases. The released plumes can be detected at sampling stations located downwind even at distances of a few hundred kilometres (spikes in Figure 1). Amplitude and frequency of activity concentration peaks at Freiburg but also at JFJ are generally highest during periods of high reprocessing activities in La Hague. Above the planetary boundary layer the strength and frequency of such spikes however are reduced compared to stations at lower altitudes. A statistical evaluation of almost 30 years of ⁸⁵Kr data from the JFJ compared to data from Freiburg shows that above baseline ⁸⁵Kr activity concentrations are lower at JFJ and, on average, activity concentrations in winter are lower than in summer (the complete dataset is published in [1]). Very rarely however (e.g. late April 2019) peaks in ⁸⁵Kr at JFJ may have similar or even higher amplitudes as in Freiburg. This can be caused by vertical thermal convection of boundary layer air e.g. due to intense warming and/or trajectories of air masses that originate from La Hague but bypass the area of Freiburg i.Br. The peak observed at the JFJ late April followed a high processing period at La Hague.

The location of the JFJ sampling site for ⁸⁵Kr sampling is crucial because of its altitude. Krypton-85 activity concentrations are representative for the northern tropospheric background level and are important for the assessment and quantification of

environmental radioactivity and radiation exposure in Germany and Switzerland [1-3]. The data are also used for studies on the dispersion and transport of air masses, e.g. the inter-hemispheric exchange. The known temporal ⁸⁵Kr activity evolution in the atmosphere is also the basis for dating groundwater on timescales of decades [1, 4].

References

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Collaborating partners / networks

Roland Purtschert, Climate and Environmental Physics, Physics Institute, University of Bern

Scientific publications and public outreach 2019

Refereed Journal articles and their internet access

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Data books and reports

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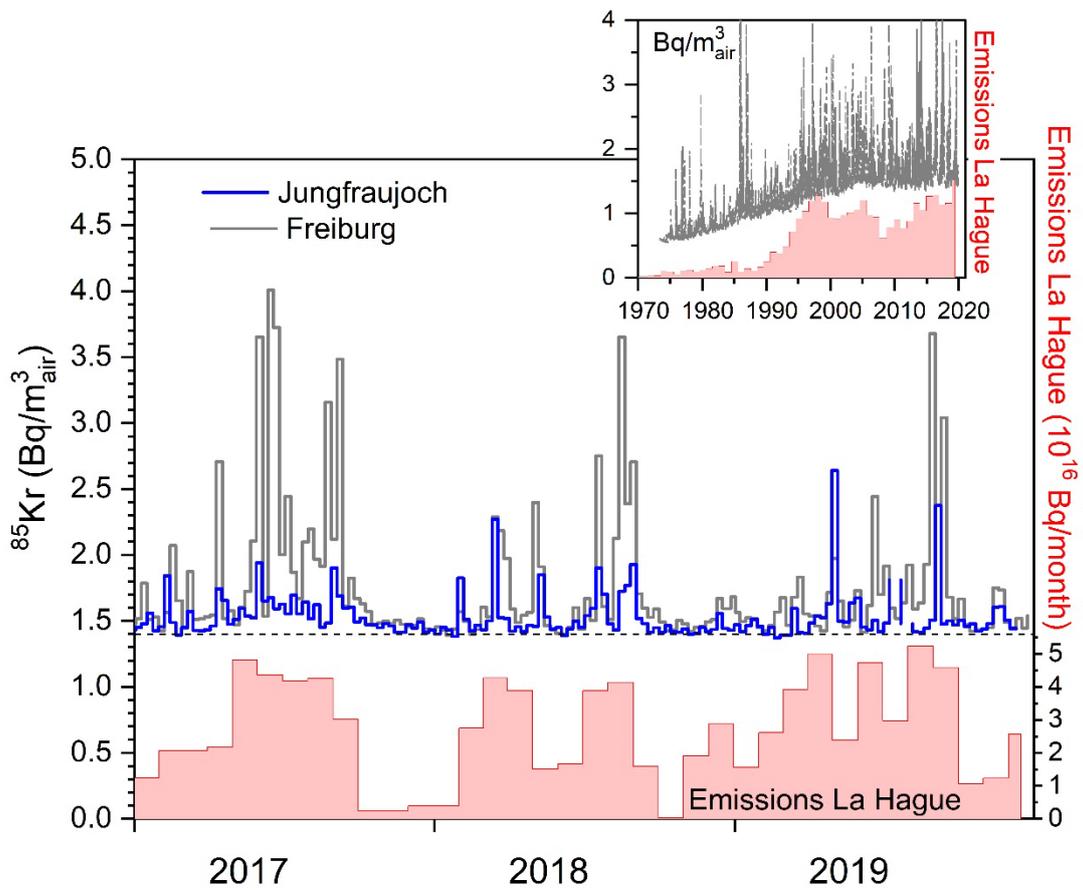


Figure 1. Measured atmospheric ^{85}Kr activity concentrations in weekly air samples, collected at Jungfrauoch (3500 m asl) and Freiburg i. Br. (280 m asl), during the last three years. The red columns represent the monthly emissions from La Hague (data provided by ORANO, 2020). The dotted line represents a baseline activity concentration of $1.4 \text{ Bq/m}^3_{\text{air}}$. Inset: ^{85}Kr data for Freiburg i. Br. and the yearly emission from La Hague (in arbitrary units) over the last 49 years.