

Name of research institute or organization:

**Bundesamt für Strahlenschutz, Freiburg i.Br.
Climate and Environmental Physics, University of Bern**

Title of project:

⁸⁵Kr Activity Determination in Tropospheric Air

Project leader and team:

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Project description:

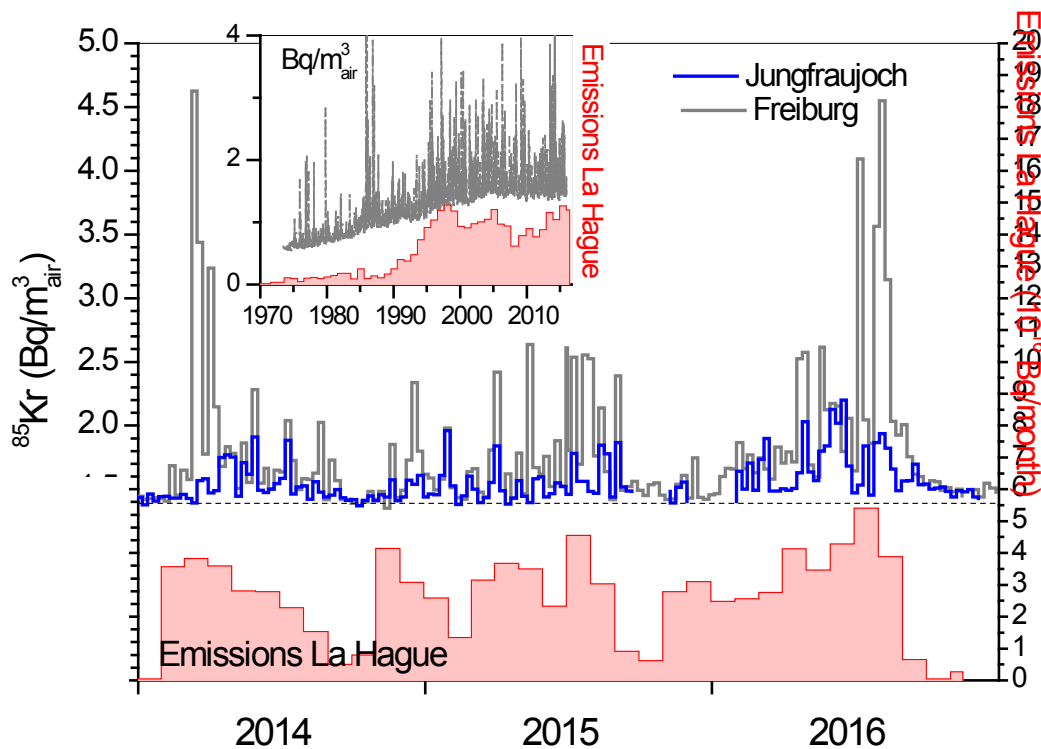


Figure 1. Measured atmospheric ⁸⁵Kr activity concentrations in weekly air samples, collected at Jungfrauoch (3500 m asl) and Freiburg i. Br. (280 m asl), during the last three years (some data from JFJ are missing due to abstraction of samples during transport). The red columns represent the monthly emissions from La Hague (the value for December 2016 is missing). The dotted line represents a baseline activity of 1.4 Bq/m³_{air}. Inset: ⁸⁵Kr data for Freiburg i. Br. and the yearly emission from La Hague (in arbitrary units) over the last 40 years.

Monitoring of tropospheric ⁸⁵Kr activity concentrations at Jungfrauoch (JFJ) was continued in 2016. Krypton is separated from about 10 m³ of air continuously collected during one week and sent to the Bundesamt für Strahlenschutz (BfS) in Freiburg i.Br. for measuring 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 ^{85}Kr are nuclear reprocessing plants which are characterized by pulsed releases. During the last few decades the most relevant emitter is the facility in La Hague in France. The released plumes can be detected at sampling stations located in downwind direction 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 (Figure 1). This is particularly obvious for autumn 2016, when the emission rates reached the highest value over the last three years. This maximum is also reflected by the very high activities measured in Freiburg and, to a lesser extent, at JFJ. In the subsequent period, when the emissions basically stopped, the measured concentration at both stations converged towards the baseline activity of $1.4 \text{ Bq/m}^3_{\text{air}}$. Due to a half-life of 10.76 years ^{85}Kr accumulates in the atmosphere if the release rate exceeds the decay rate of the ^{85}Kr inventory in the atmosphere. The increasing trend of emission rates in La Hague over the last 6 years (Figure 1, inset) again led to a slightly increase of the baseline ^{85}Kr activity over North West Europe.

The location of the JFJ sampling site is crucial because of its altitude. The data 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 [2, 3]. Krypton-85 data are also used for studies about the dispersion of air masses, e.g. the inter-hemispheric exchange. The known temporal ^{85}Kr activity evolution in the atmosphere is also the basis for dating groundwater on timescales of decades [4].

References:

- [4] Alikhani, J., A.L. Deinhart, A. Visser, R.K. Bibby, R. Purtschert, J.E. Moran, A. Massoudieh, and B.K. Esser, Nitrate vulnerability projections from Bayesian inference of multiple groundwater age tracers, *Journal of Hydrology*, **543**, Part A, 167-181, 2016. <http://www.sciencedirect.com/science/journal/00221694/543/part/PA>
- [1] Schlosser, C., A. Bollhöfer, S. Schmid, R. Kraus, J. Bieringer, and M. Konrad, Analysis of radioxenon and Krypton-85 at the BfS Noble Gas Laboratory, *Applied Radiation and Isotopes*, 2016. <http://dx.doi.org/10.1016/j.apradiso.2016.12.043>

Key words:

Krypton, ^{85}Kr , radioactivity in air, reprocessing plants

Collaborating partners/networks:

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Scientific publications and public outreach 2016:

Data books and reports

- [2] Umweltradioaktivität und Strahlendosen in der Schweiz, Bundesamt für Gesundheit, Abteilung Strahlenschutz, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 (in preparation).
- [3] Umweltradioaktivität und Strahlenbelastung, Deutschland, Jahresberichte 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016 (in preparation); Reihe Umweltpolitik; Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit.

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