Name of research institute or organization:

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

Title of project:

^{85}Kr Activity Determination in Tropospheric Air

Project leader and team:

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Project description:

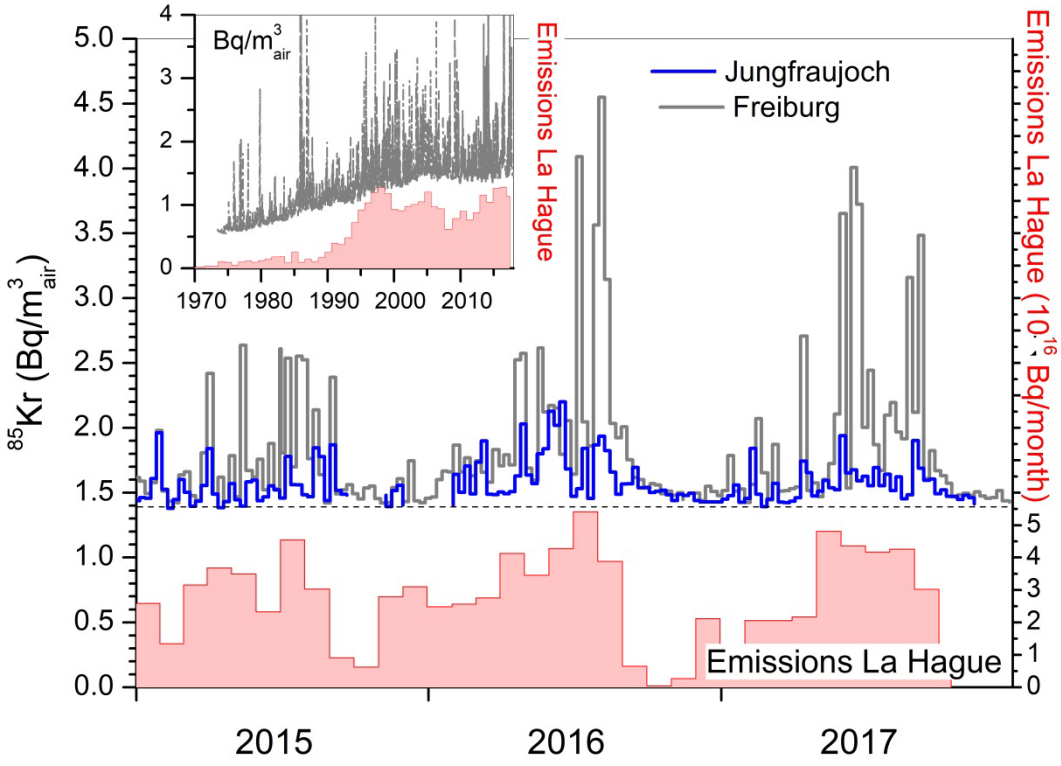

Figure 1. Measured atmospheric ^{85}Kr activity concentrations in weekly air samples, collected at Jungfraujoch (3500 m asl) and Freiburg i. Br. (280 m asl), during the last three years. The red columns represent the monthly emissions from La Hague (the values for November and December 2017 are missing). The dotted line represents a baseline activity of 1.4 Bq/m$^3_{air}$. Inset: ^{85}Kr data for Freiburg i. Br. and the yearly emission from La Hague (in arbitrary units) over the last 47 years.

Monitoring of tropospheric ^{85}Kr activity concentrations at Jungfraujoch (JFJ) was continued in 2017. Krypton is separated from about 10 m^3 of air continuously collected during one week and sent to the Bundesamt für Strahlenschutz in Freiburg i.Br. for measuring the ^{85}Kr 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 Bq/m$^3_{air}$. A similar pattern is also observed in 2017. 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. However, over the last three years the baseline activity concentration was rather stable.

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]. This method will become even more important in the future with the development of novel detection methods for ^{85}Kr in environmental samples [5].

Key words:

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

Collaborating partners/networks:

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Scientific publications and public outreach 2017:

Refereed journal articles and their internet access

[1] Schlosser, C., A. Bollhöfer, S. Schmid, R. Krais, J. Bieringer and M. Konrad, Analysis of radioxenon and Krypton-85 at the BfS Noble Gas Laboratory, Applied Radiation and Isotopes, **126**, 16-19, doi: 10.1016/j.apradiso.2016.12.043, 2017.
http://www.sciencedirect.com/science/article/pii/S0969804316305255?via%3Dihub

[4] Gerber, C., R. Purtschert, D. Hunkeler, R. Hug and J. Sültenfuss, Using Environmental Tracers to Determine the Relative Importance of Travel Times in the Unsaturated and Saturated Zones for the Delay of Nitrate Reduction Measures, Journal of Hydrology, 2018, accepted.

[5] Zappala, J.C., K. Bailey, P. Mueller, T.P. O'Connor and R. Purtschert, Rapid processing of ^{85}Kr/Kr ratios using Atom Trap Trace Analysis, Water Resources Research, **53**, 2553-2558, doi: 10.1002/2016WR020082, 2017. http://onlinelibrary.wiley.com/doi/10.1002/2016WR020082/full

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, 2017 (in preparation).

[3] Umweltradioaktivität und Strahlenbelastung, Deutschland, Jahresberichte 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017 (in preparation); Reihe Umweltpolitik; Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit.

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