

Name of research institute or organization:

Bundesamt für Gesundheit; Sektion Umweltschutz, Bern

Title of project:

Aerosols radioactivity monitoring (RADAIR)

Project leader and team:

Beuret Pierre, project leader
Dr. Sybille Estier, Matthias Müller

Project description:

Aerosol Monitoring Station at the Jungfraujoeh

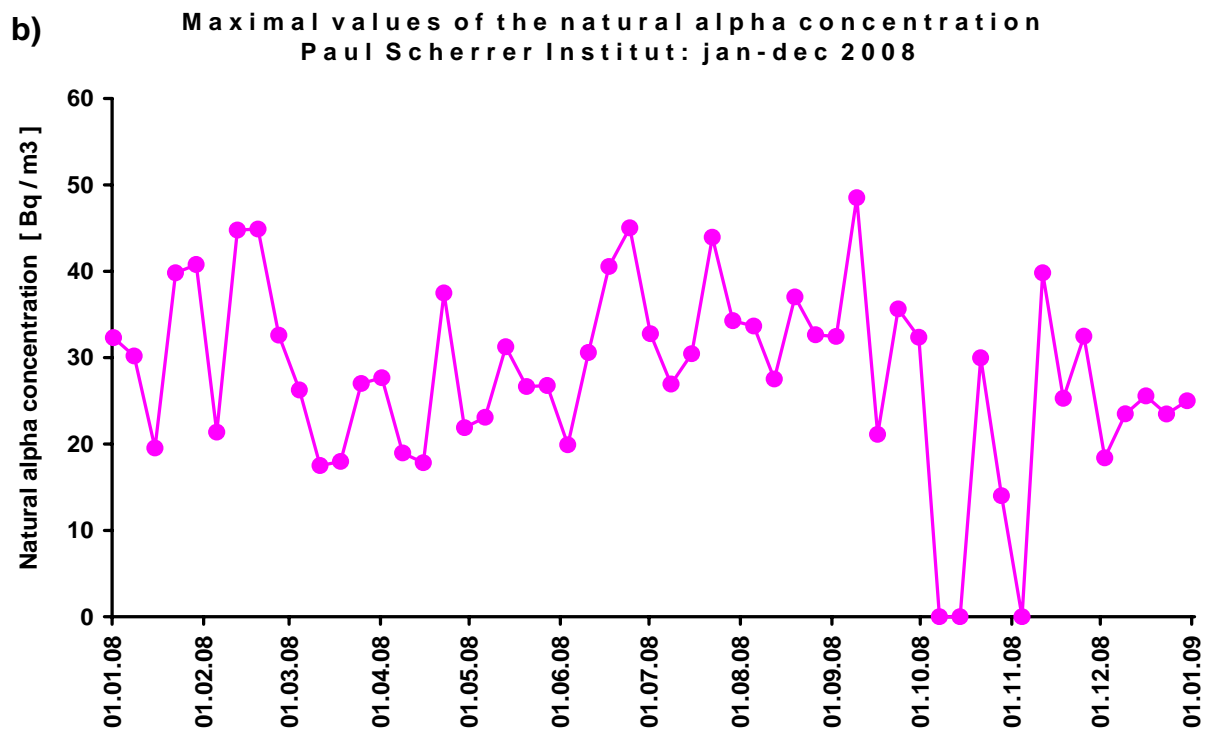
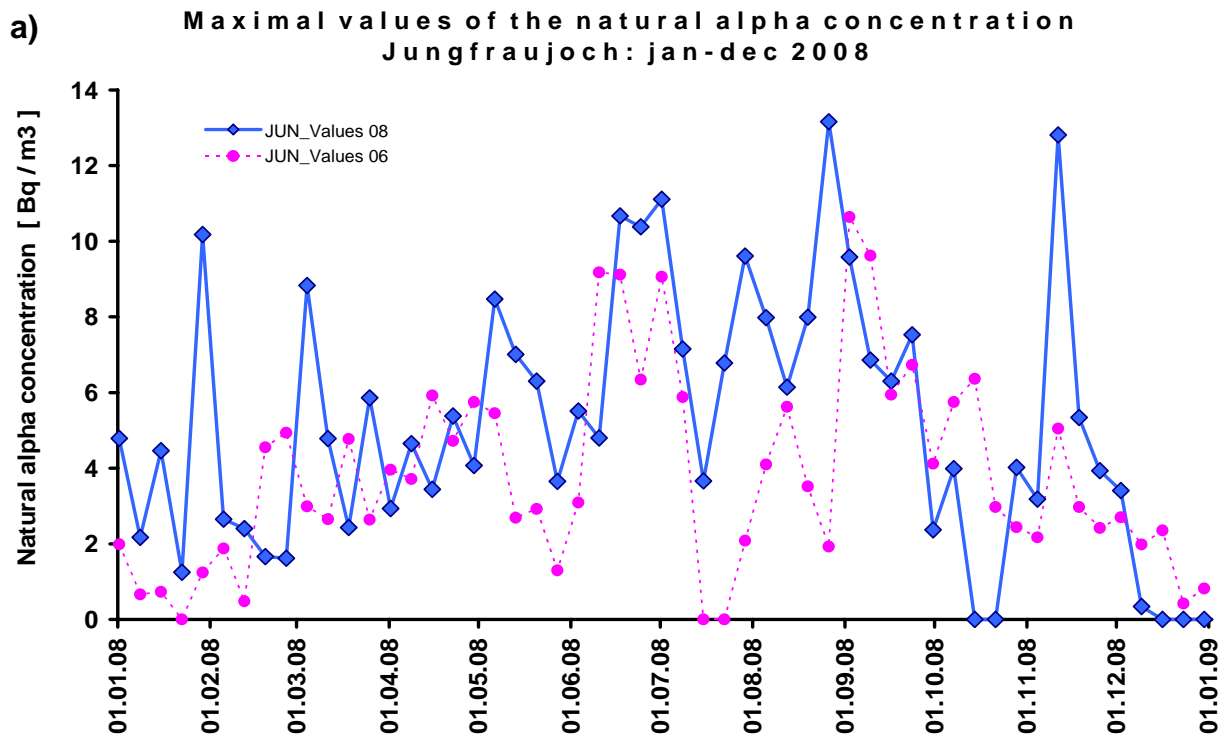
An automatic aerosol radioactivity monitor FHT59S is operated at Jungfraujoeh research station by the Swiss Federal Office of Public Health. It has the following particular features:

- Quick detection of any increase of radioactivity in air at the altitude of 3400 m above sea level.
- A detection limit for artificial beta radioactivity as low as 0.1 Bq/m³. Such a high sensitivity is made possible due to the very low Radon daughter concentration at this altitude.

Comments on the measurement performed in 2008:

Graph 1 shows the maximal values of the gross alpha radioactivity recorded every week during the period January 1st to December 31 2008 (and 2006).

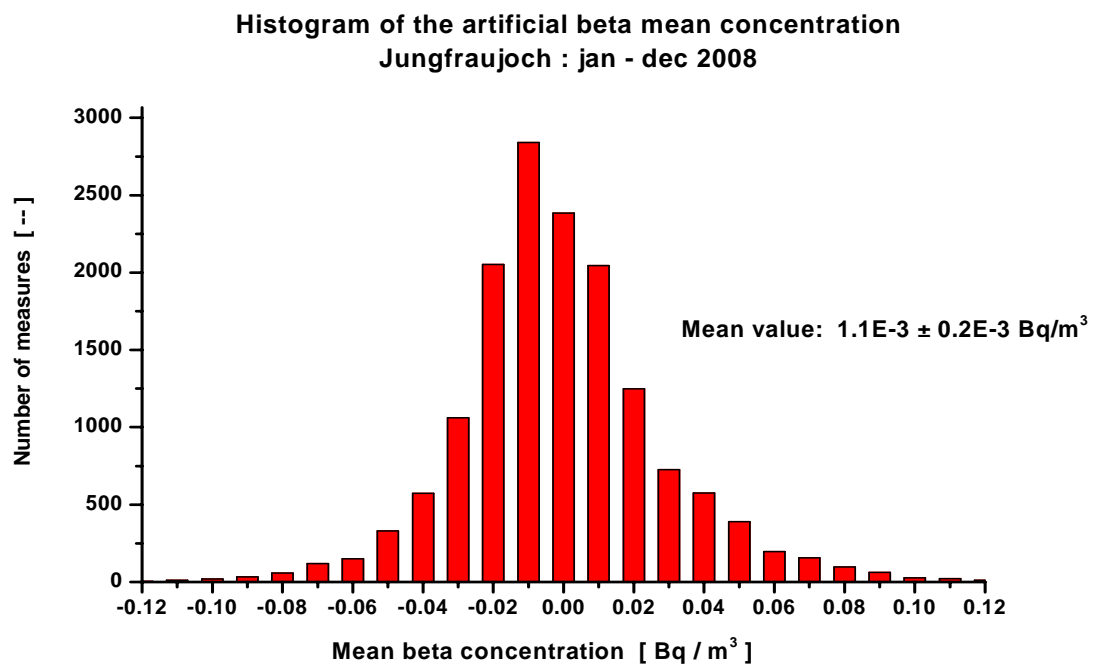
- Alpha radioactivity - Radon daughter products - is transported mainly up to the Jungfraujoeh by air masses from the lowlands;
- The maximal values are approximately 2 to 7 times lower at the Jungfraujoeh than those on the Swiss Plateau. For instance the highest natural gross alpha concentration observed near the Paul Scherrer Institute were typically 30 to 50 Bq/m³ (See Graph 1b);
- Due to greater thermal air movement in summer than in winter, the highest values are usually observed from March to November.
- The maximal's values recorded in 2008 are slightly higher than those observed in 2006.



Graph 1

Graph 2 shows the calculated net beta radioactivity for 2008.

- No artificial beta concentration above the detection limit was observed;
- As shown in the histogram below some 95 percent of the values recorded in 2008 were below 0.08 Bq/m^3 .
- The histogram is rather symmetric; this shows that the compensation technique was good.
- For weak natural activities the calculated beta radioactivity was slightly over compensated (peak at a negative value: -0.01 Bq/m^3).
- When the alpha concentration decreases rapidly, the compensation technique can't follow and some values are therefore greater than 0.1 Bq/m^3 .



Graph 2

For normal situations, i.e. with no artificial radioactivity in the air, the calculated net Beta radioactivity at the Jungfrauoch, using the Alpha-Beta compensation technique (See below), is less than 0.1 Bq/m^3 . At the top of Europe, a radiation incident causing an increase of the artificial beta radioactivity in the atmosphere of as low as 0.1 Bq/m^3 could therefore be detected.

The automatic α/β -compensation technique applied by our aerosol monitoring stations is based on the simultaneously measured gross Alpha (A_G) and gross Beta (B_G) radio-activity of the aerosols collected on the filter. The net (artificial) Beta radioactivity (B_N) is calculated by the following formula: $B_N = B_G - f \cdot A_G$. The constant factor f can be adapted either by the software program or by the operator.

DIGITEL - aerosol sampler

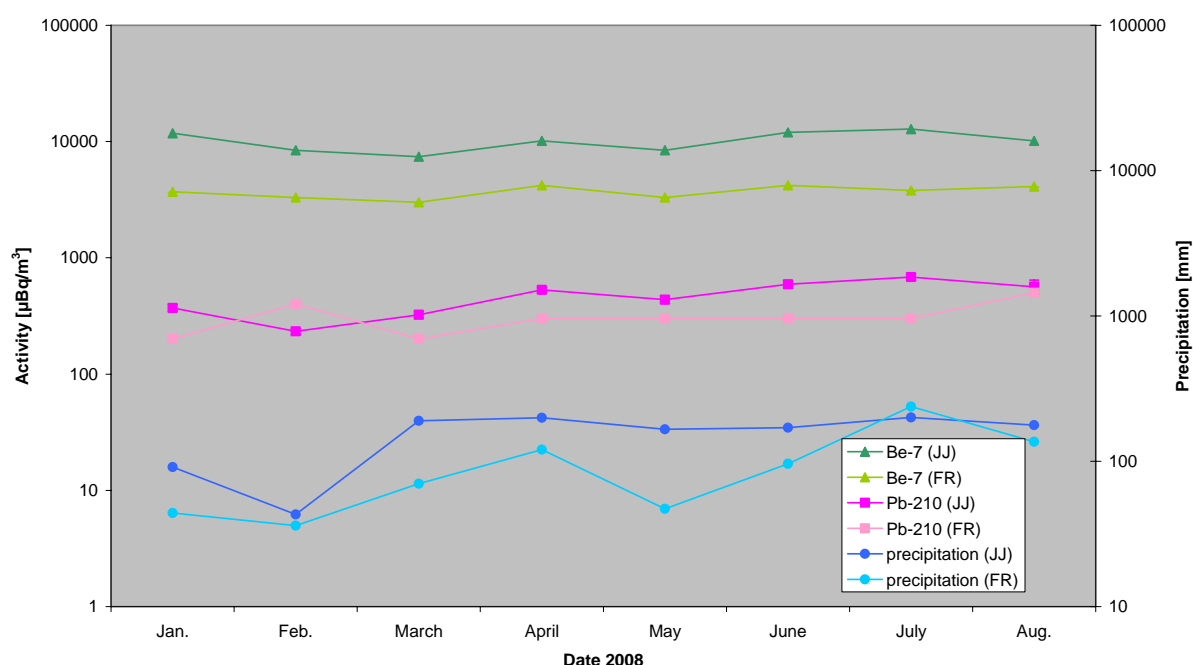
The Digital DHA-80 High Volume Sampler is an automatic air sampler with an air flow rate up to 1 m³/min. Aerosols are collected on glass fibre filters of 150 mm in diameter. The pump maintains a constant flow rate independently of dust load of the filter. Filter change intervals are programmed in advance and the sampler is controlled remotely by an internet connection.

The filters are automatically changed once a week and are measured at the end of the month by gamma ray spectrometry in the laboratory using a high purity coaxial germanium gamma-ray detector during 1-2 days.

Between September and December 2008, the measurements were interrupted due to a pump failure.

The graph below shows the activity of ⁷Be and ²¹⁰Pb at Jungfrauoch (3450 m AMSL) and Oberschrott/FR (850 m AMSL):

Comparison Be-7 and Pb-210



Concentrations of the cosmogenic radionuclide ⁷Be are higher at Jungfrauoch, as, due to the half-life of 53 days and considering a mean residence times of 10-30 days in the troposphere, part of the nuclides decay before arriving at lower altitudes.

Even if snow and ice prevent terrestrial radionuclides like the long-lived ²¹⁰Pb to ascend into atmosphere, convection brings them to appreciable altitudes where they come down again due to the same mechanisms as ⁷Be. Thus ⁷Be and ²¹⁰Pb curves should correlate in summer, which is the case for both locations.

The rather untypical behaviour of the ²¹⁰Pb - graph in February is probably due to low precipitations during this period.

Comments on technical aspects:

Due to high temperatures in the room caused by the presence of both FHT59s monitor and Digital aerosol sampler, the power supply of the automaton as well as the power

supply of the PC have been damaged and replaced. The air evacuation system of the Digitel's pump has therefore been modified: the air evacuated from the pump goes now directly to the canal of outside air.

At the end of November, the FHT59S monitor's filter became blocked due to the presence of snow and ice in the aspiration line. Fortunately, the filter band system is equipped with air bypass and pressure measurement.

Apart from some minor telecommunication troubles, no major breakdown at the aerosol monitor was registered during 2008.

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Key words:

RADAIR, Digitel, Radon, radioactivity, aerosols,

Internet data bases:

<http://www.radair.ch>

<http://www.bag.admin.ch/themen/strahlung/00043/00065/02239/index.html?lang=de>

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