Name of research institute or organization:

Bundesamt für Gesundheit, Sektion Umweltradioaktivität

Title of project:

Aerosol Monitoring Station at the Jungfraujoch

Project leader and team:

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Project description:

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

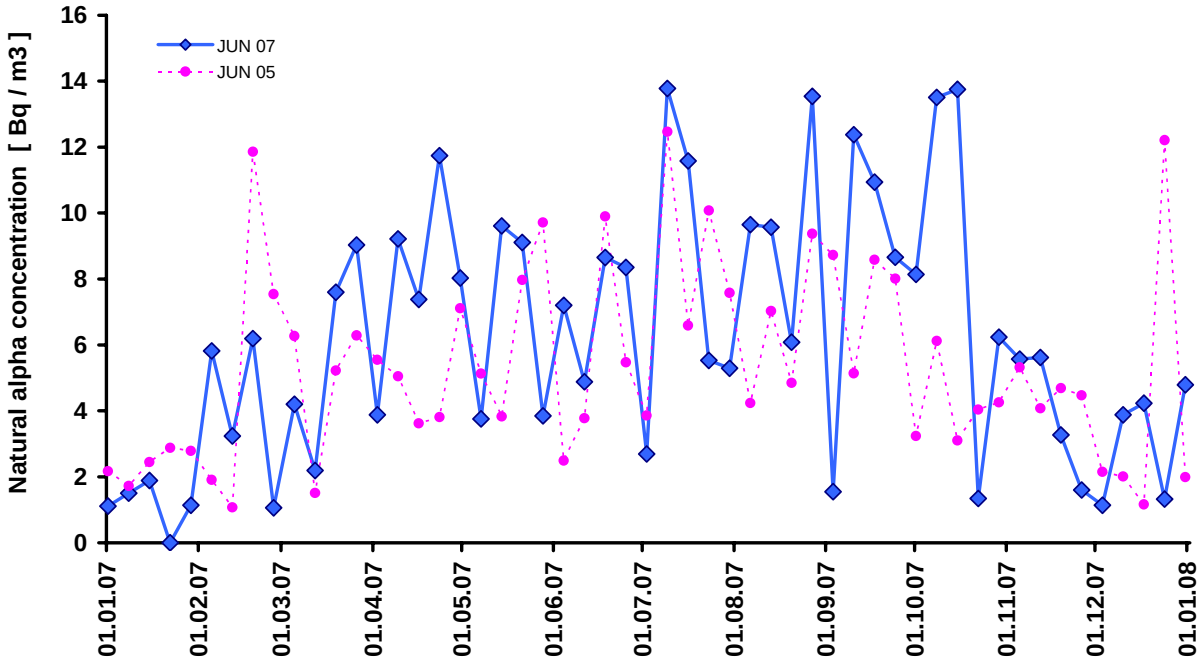
- To detect rapidly any increase of air radioactivity at the altitude of 3400 m above sea level,
- The detection limit for artificial gross beta radioactivity is as low as 0.1 Bq/m^3, due to the very low Radon daughter concentration at this altitude.

Comments on the measurement of 2007:

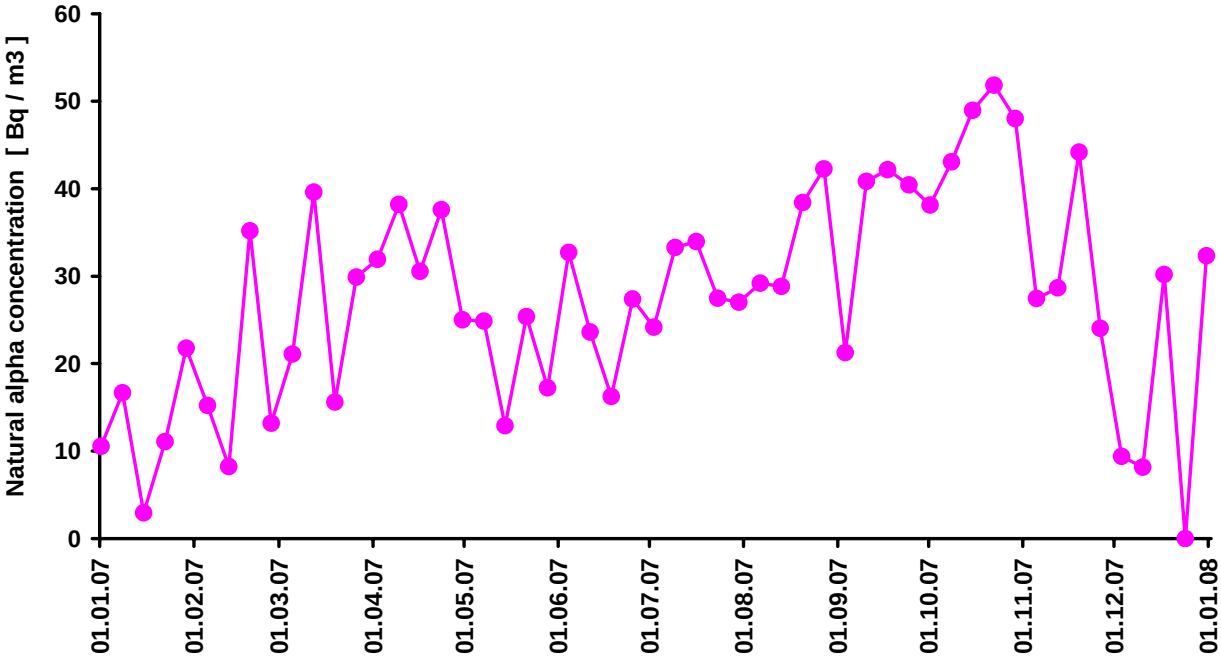
Graph 1 shows the contribution to the gross alpha radioactivity during 2007 (and 2005).

- Alpha radioactivity - Radon daughter products - is transported mainly up to the Jungfraujoch by air masses from the lowlands;
- During the period January 1^{st} to December 31 maximal values were observed every - week;
- This maximal values are approximately 2 to 7 times lower at the Jungfraujoch than those on the Swiss Plateau; for instance the highest natural gross alpha concentration observed near the Paul Scherrer Institute were 40 to 50 Bq/m^3 (See below, graph 1);
- Normally the highest values are recorded between March and November, due too the greater thermal move of the air in summer that in winter. (in year 2005 there were two additional maxima in February and December caused by meteorological effects combined with of thermal inversion near the ground (fog));
- The maximal values in 2007 were *approximately* the same as last years (see 2005)

Maximal values of the natural alpha concentration
Jungfraujoch: jan-dec 2007

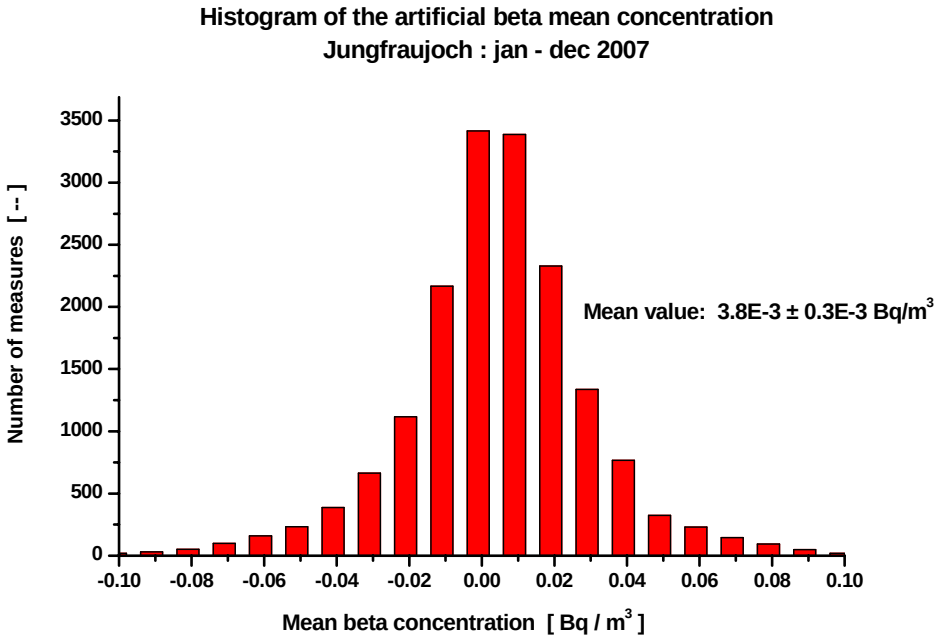


Maximal values of the natural alpha concentration
Paul Scherrer Institut: jan-dec 2007



Graph 2 shows the calculated net beta radioactivity for 2007.

- No artificial beta concentration above the detection limit of 0.1 Bq/m^3 was observed;
- As the subtracted value for the natural radioactivity was too small, the histogram is slightly shifted towards positive values. At the Jungfraujoch natural radioactivity is extremely low, this makes a precise determination of the natural background activity concentration is rather difficult;
- As shown in the histogram below 95 percent of the values of 2007 were below 0.08 Bq/m^3.
- The histogram is rather symmetric; this shows that the compensation technique was good.



Graph 2

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

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.

Comments on technical aspects:
In year 2006 a new aerosol sampler (DIGITEL) was installed in the same room as the FHT59S monitors. The temperature of the room is increased by 7 -10 degrees due to thermal dispersal of the two monitors. Two fans were installed, one to suck up external air and the other to evacuate the air. The pump of the FHT59S monitor has been replaced by another model which causes less heat. Now, the temperature of the room is 1 - 2 degrees lowers that before.

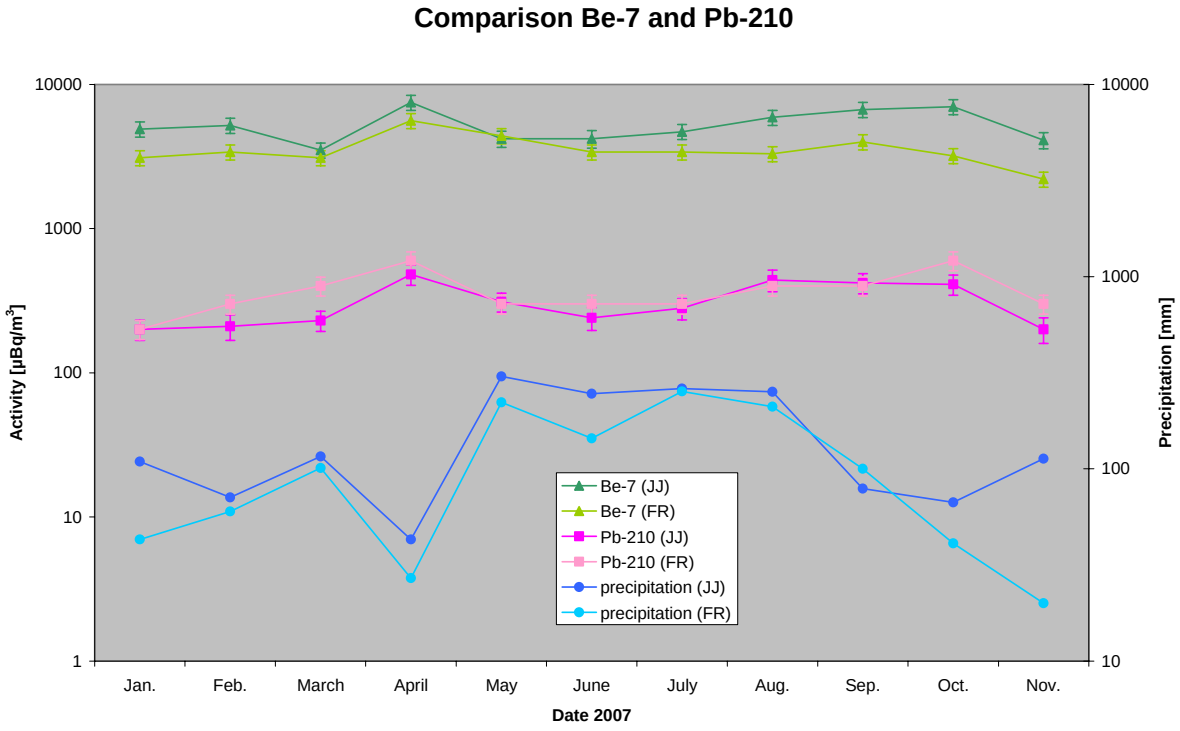
Due to a power failure at the end of January, the hard disk and the power supply of the PC had been damaged. , The pump has been damaged by a second power failure in October.

Apart from some minor telecommunication problems, no major breakdown at the aerosol monitor was registered during 2007.

DIGITEL - aerosol sampler
The Digitel DHA-80 High Volume Sampler is an automatic air sampler with an air flow rate up to 1 m^3/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.

Normally the filters are changed once a week automatically and they 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.

The graph below shows the activity of ^{7}Be and ^{210}Pb at Jungfraujoch (3450 m AMSL) and Fribourg (650 m AMSL):



Concentrations of the cosmogenic radionuclide ^{7}Be are slightly higher at Jungfraujoch, 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. On the other side, snow and ice prevent terrestrial radionuclides to ascend into the atmosphere, which explains the smaller concentrations of the long-lived ^{210}Pb at the high altitude research station.

The heating up of earth's surface in summer leads to more convection in the troposphere and vertical mixing is larger. In this way air from the upper troposphere with higher concentrations is forced downward. The rate of exchange between troposphere and stratosphere is also enlarged in summer bringing air with higher beryllium concentrations down because ^{7}Be formation is largest in the stratosphere, where 70 % of whole production takes place and only 30 % in the troposphere. Convection brings the terrestrial ^{210}Pb to appreciable altitudes where it comes down again due to the same mechanisms as ^{7}Be. Thus ^{7}Be and ^{210}Pb curves should correlate in summer, which is the case for both locations.

The rather untypical behaviour of the graph (generally, concentrations are higher during summer time) is probably due to low precipitations in April and a rainy period between May and August 2007.

Internet data bases:

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

Address:

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