Name of research institute or organization:

Bundesamt für Gesundheit; Sektion Umweltradioaktivität, Bern

Title of project:

Aerosols radioactivity monitoring (RADAIR) and DIGITEL at Jungfraujoch

Project leader and team:

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

Project description:

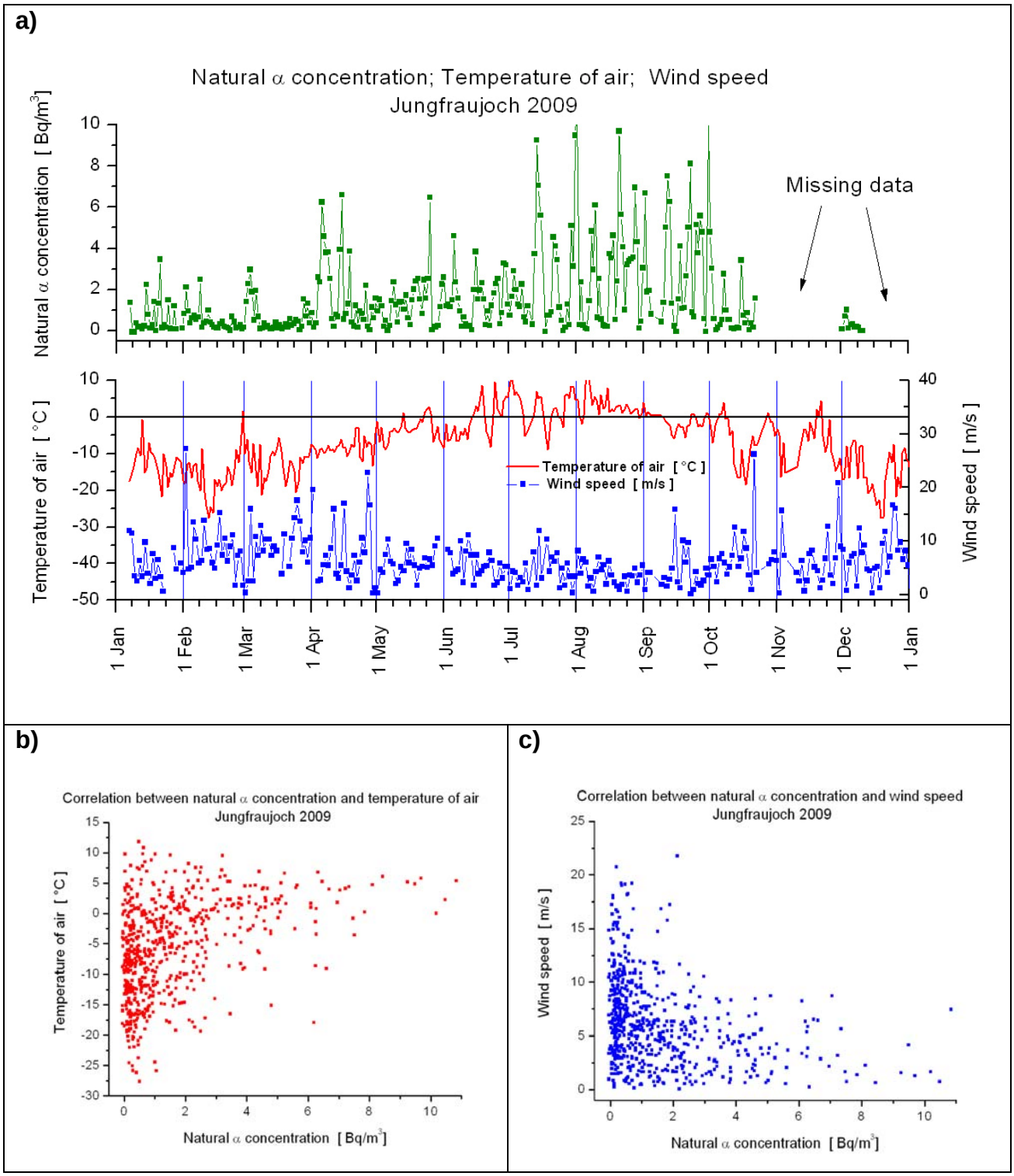
Aerosol Monitoring Station at the Jungfraujoch:
An automatic aerosol radioactivity monitor FHT59S is operated at Jungfraujoch research station by the Swiss Federal Office of Public Health. It has the following particular features:

- 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/m^3. Such a high sensitivity is made possible due to the very low Radon daughter concentration at this altitude.

Comments on the measurement performed in 2009:
Graph 1, part a) shows the natural alpha radioactivity, the temperature of the external air and the speed of the wind during the period January 1st to December 2009. The correlation between the natural alpha radioactivity and the temperature of the external air and the speed of the wind are depicted on graph 1, parts b) and c) respectively. These figures show that :

- Alpha radioactivity - Radon daughter products - is transported mainly up to the Jungfraujoch by air masses from the lowlands;
- The highest values are usually observed from April to October. (See Graph 1a and b) due to greater thermal air movement in summer than in winter;
- When the main winds blow, the natural radioactivity decrease due to the dilution in the air (See Graph 1a and c)

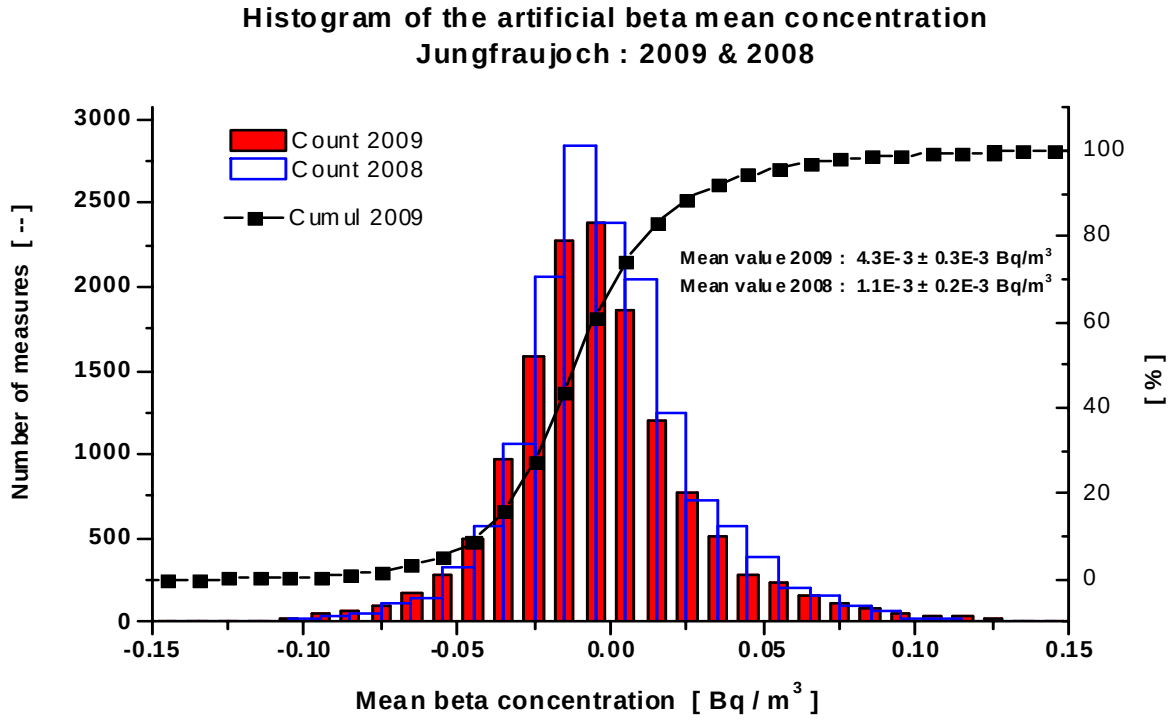
In 2009, the weather was particularly dry from August to October; this is the reason why the alpha radioactivity - Radon daughter products concentrations are higher during this period (See Graph 1a).


a)
Natural α concentration; Temperature of air; Wind speed
Jungfraujoch 2009
Natural α concentration [Bq/m³]
Missing data
Temperature of air [°C]
Wind speed [m/s]
Temperature of air [°C]
Wind speed [m/s]
1 Jan
1 Feb
1 Mar
1 Apr
1 May
1 Jun
1 Jul
1 Aug
1 Sep
1 Oct
1 Nov
1 Dec
1 Jan
b)
Correlation between natural α concentration and temperature of air
Jungfraujoch 2009
Temperature of air [°C]
Natural α concentration [Bq/m³]
c)
Correlation between natural α concentration and wind speed
Jungfraujoch 2009
Wind speed [m/s]
Natural α concentration [Bq/m³]

Graph 1

Graph 2 shows the net beta radioactivity in aerosol for 2009 (and 2008). Note that the net beta radioactivity concentrations cannot be measured directly and are calculated automatically by the monitor by applying an α/β-compensation technique (see below for more details).

- No artificial beta concentration above the detection limit was observed;
- As shown in the histogram below, some 95 percent of the beta concentrations recorded in 2009 were below 0.08 Bq/m^3.
- For weak naturals activities, the calculated beta radioactivity was slightly overcompensated (peak at a negative value: -0.01 Bq/m^3).
- When the alpha concentration decreases quickly, the compensation technique can't follow. Some values are therefore greater than 0.1 Bq/m^3.
- The histogram recorded for 2009 is slightly less symmetric than the one recorded for 2008; the automatic compensation technique can however be generally considered as adequate.



Graph 2

For normal situations, i.e. with no artificial radioactivity in the air, the net Beta radioactivity at the Jungfraujoch, calculated using the Alpha-Beta compensation technique, 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.

Automatic α/β-compensation: this technique applied by our aerosol monitoring stations is based on the simultaneously measurements of gross Alpha (A_G) and gross Beta (B_G) radioactivity of the aerosols collected on a filter. The net (artificial) Beta

radioactivity (B_N) is then calculated by the following formula: $B_N = B_G - f \times A_G$. The constant factor α/β (f) can be adapted either by the software program or by the operator. Note that since 2009, the post compensation was not applied any more; but the factor α/β (f) is periodically adjusted for each monitor.

Comments on technical aspects:
The computer of the monitor was modernized. The old operating System (Windows 3.11) was replaced by Windows XP. The measurement software was also updated. The conventional phone line (ISDN) was replaced by a high speed line (ADSL) for faster data transmission.

Some 2009 data are missing because of two unexpected shut downs of the scintillator's high voltage.

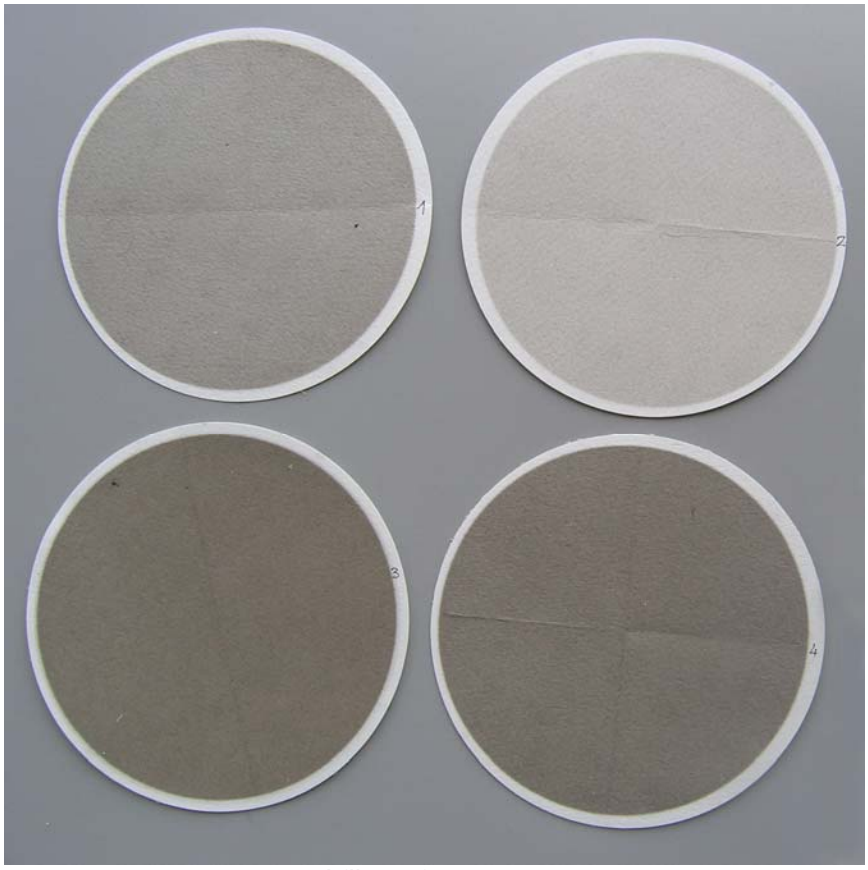
Apart from some minor telecommunication troubles, no major breakdown at the aerosol monitor was registered during 2009.

P. Beuret / URA / BAG

DIGITEL - aerosol sampler

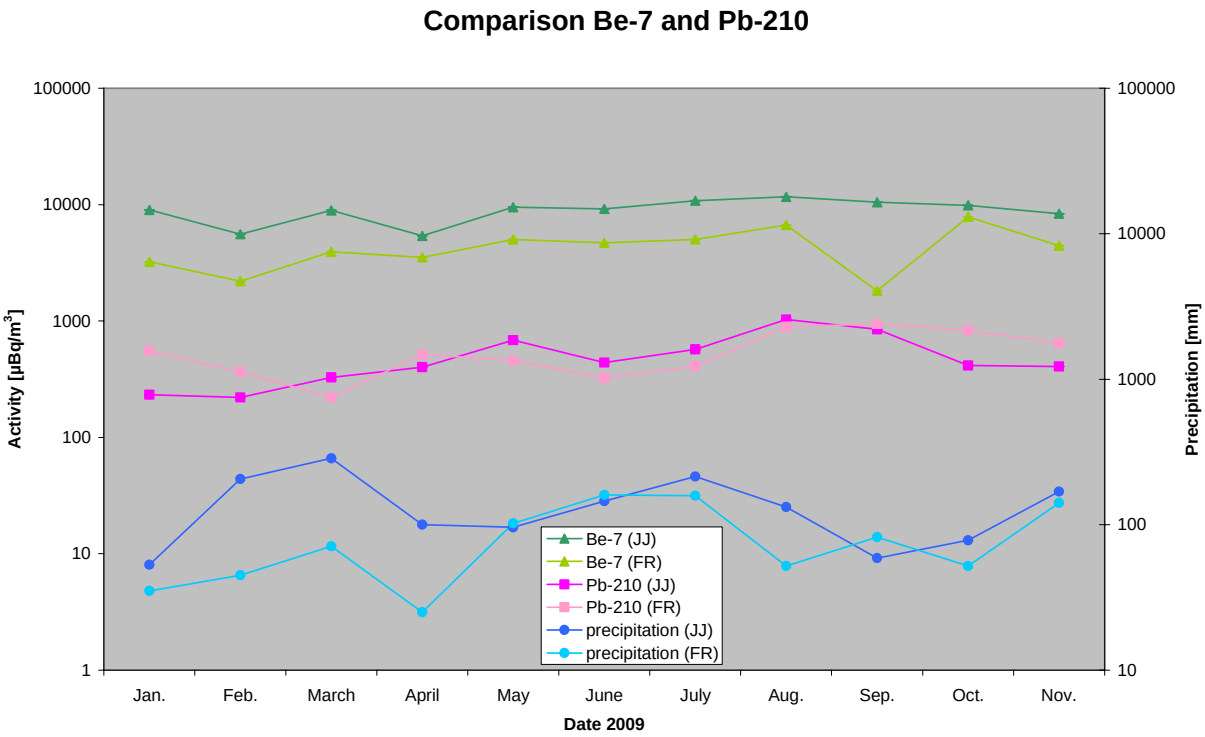
The Digitel DHA-80 High Volume Sampler is an automatic air sampler with a typical air flow rate 0.6 m^3/min. Aerosols are collected on glass fibre filters of 150 mm in diameter. The pump maintains a constant flow rate independent of dust load on the filter. Filter change intervals are programmed in advance 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 in the laboratory using a high purity coaxial germanium gamma-ray detector during 1-2 days.



Exposed filters from August 2009

The graph below shows the activity of ^{7}Be and ^{210}Pb at Jungfraujoch ("JJ"; 3450 m AMSL) and Oberschrot/FR ("FR"; 850 m AMSL):



The atmospheric concentrations of the cosmogenic radionuclide ^{7}Be are higher at Jungfraujoch, as, due to the half-live 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.

The other radioisotope shown in the above figure is ^{210}Pb a long-lived daughter of ^{222}Rn which emanates into the atmosphere from terrestrial sources. During summer convection brings Pb-210 to appreciable altitudes and the concentration at Jungfraujoch are higher than at Oberschrot. In autumne and winter the prevalent occurrences of inversion situations often hinders the vertical mixing of radon-222 and its decendents into the higher troposphere. Consequently the ^{210}Pb concentrations are typically higher at Oberschrot than at Jungfraujoch over this period.

M. Müller / URA / BAG

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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