Press release

Materials Science & Technology

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Empa measures concentration of volcanic ash on Jungfraujoch

From emission source investigations to forecasting

Empa continuously monitors the make-up of the air on Switzerland's Jungfraujoch and has been able to provide important information about changes in the concentration of harmful substances caused by the volcano Eyjafjalloekull. Empa researchers normally use their data in atmospheric transport models to investigate emissions that occurred in the past. If, however, weather forecasting data is fed into the computer simulations, this allows predictions regarding how the clouds of Icelandic volcanic ash are likely to make their way across Europe during the days following their emission.

Since the evening of the 17 April, Empa's Jungfraujoch-based measuring equipment has recorded several marked increases in the level of sulphur dioxide (SO_2) in the atmosphere and in the amount of micro-particles – so-called PM10 particles. Normally, the question to be asked in such cases is: Where have these substances come from? On this occasion, however, the origin of the substances was clear: they have been carried into Switzerland's mountains in clouds of ash emitted by the volcano Eyjafjallajoekull in Iceland.

Empa scientists, working together with the FOEN (the Swiss Federal Office for the Environment), have been able to glean valuable information from the data recorded, particularly about the concentration and composition of the volcanic ash. The highest levels of PM10 particulate matter (particles with a diameter of less than 10 micrometres) recorded on Jungfraujoch over the recent days amounted to some 30 micrograms per cubic metre of air. Empa's researchers are planning to investigate the chemical content of the volcanic ash over the next few days.

Total particle mass – a major factor

Empa's ongoing measurements allow particulate matter concentrations to be determined around the clock, thus providing important information which can be used to assess the risks posed by clouds of ash to aircraft engines. Such data is the ideal complement to laser-based detection and ranging measurements taken by ETH Zurich and MeteoSchweiz (the Swiss Federal Office of Meteorology and Climatology). The latter measurements allow the vertical profile and the height and spread of clouds of ash to be determined, but are unable to provide any reliable information on concentrations. Empa's findings are used together with a string of further analyses made by the Paul Scherrer Institute on Jungfraujoch in order to allow, for example, the size distribution and optical properties of the particles to be determined.

Over the coming days, Empa will carry out an evaluation of the particle filters at the Sphinx Research Station on Jungfraujoch, which is located 3,571 metres above sea level. This evaluation will take several days to complete, since test probes will have to be laboriously prepared before any analysis can be carried out using

the ICP MS (inductively-coupled plasma mass spectrometer). Other high-level recording stations of the Empa-run NABEL (the Swiss National Air Pollution Monitoring Network), for example the one located on Rigi, are able to provide data showing how thick the clouds of ash are and how quickly they are descending. Taken together, the various sets of recorded data are able to provide an accurate picture.

Short-term forecasting is possible – and very much in demand

Empa's researchers normally combine their measurements of harmful substances in the atmosphere with models of atmospheric flow – so-called particle transport models – in order to identify the source of the pollutants discovered. The model provides information about the origin of the air sampled on Jungfraujoch. This principle can, however, be used in reverse: with the aid of weather forecasts, the same model can be used to show how clouds of harmful substances will spread from sources such as volcanoes. This allows meaningful forecasts to be made for periods of two to three days.

When undertaking modelling requiring significant computational power, Empa uses the FLEXPART model together with its powerful Ipazia cluster computing facilities. «The computer images clearly show that fresh cloud moving in the direction of Switzerland is unlikely to affect us until at least Friday,» explain Dominik Brunner and Stephan Henne from Empa's «Air Pollution / Environmental Technology» laboratory. «Great Britain, the Benelux countries and Germany may, in contrast, continue to be affected fairly significantly.» Henne emphasises, however, that these forecasts, much like other computer simulations, are based on assumptions, such as «source strength» – that is, the amount of material being emitted by the volcano. In addition, it is not precisely known what the make-up of the material produced by the eruption is, or to what extent it might be washed out by precipitation.

The measurements themselves as well as the forecasts based on them are of great interest to the Federal Office of Civil Aviation (BAZL), since these and countless other sets of data are used to decide whether flight bans should be imposed, extended or lifted. «Nobody can currently provide maps showing the absolute values present in the various atmospheric layers,» comments Brigitte Buchmann, head of Empa's «Air Pollution / Environmental Technology» laboratory. «Our model calculations are at least able to confirm the correctness of forecasts made, for example, by the British Volcanic Ash Advisory Centre».

Further information

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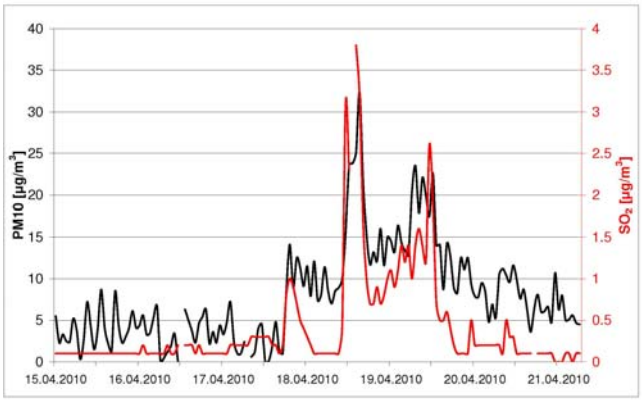
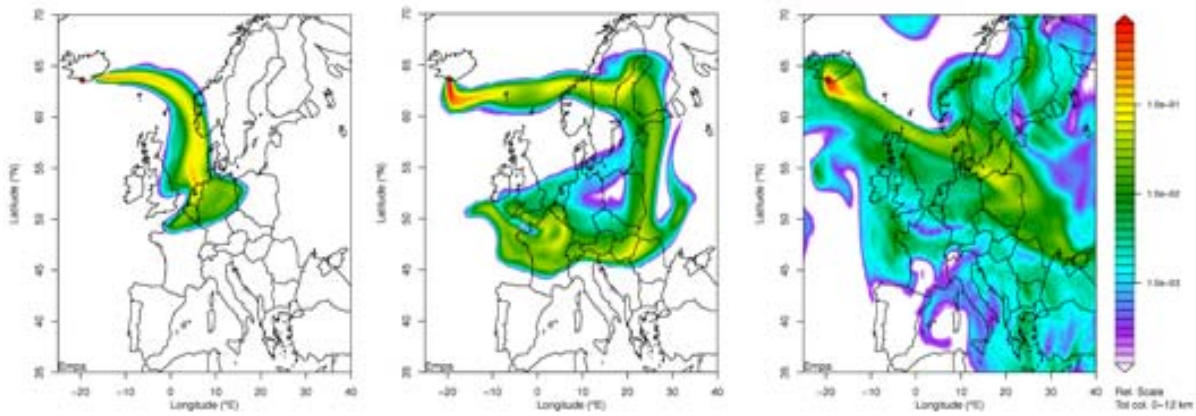


Measurements of PM10 and sulphur dioxide taken by Empa in the alpine research station on Jungfraujoch: the values increase on 18 April and fall back again on 19 April.



Computer simulations of ash cloud movement for 16 April (left) and 20 April (centre) and the forecast for 23 April (right)

Betameter equipment used for analysing measurements of particulate matter on Jungfraujoch – a NABEL (National Air Pollution Monitoring Network) measuring station.

Pictures available from redaktion@empa.ch