

The High Altitude Research Station Jungfrauoch

1. The International Foundation High Altitude Research Stations Jungfrauoch and Gornergrat (HFSJG)

The Jungfrauoch research station is run by the International Foundation High Altitude Research Stations Jungfrauoch and Gornergrat (HFSJG). Members of the foundation are: Belgium, Germany, United Kingdom, Italy, Austria, and Switzerland. Besides the Jungfrauoch, two astronomical observatories, Gornergrat South and Gornergrat North, are operated by the Foundation. Administrative assistance and information are provided by the Foundation's offices that are integrated in the University of Berne, Switzerland. Professor Erwin Flückiger is director of the foundation.

The Foundation provides the necessary infrastructure for scientific work for researchers from all over the world. No research is carried out by the Foundation itself. Scientists from universities, schools of technology, and research institutes of the member countries, and exceptionally from other countries, can carry out research in the laboratories and observatories provided by the Foundation.

2. Research interests

Practically all research areas requiring a high alpine environment or high altitude are covered. Only major activities in the field of atmospheric chemistry are mentioned here. More information is found at <http://www.ifjungo.ch/jungfrauoch/projects.html>

Aerosol measurements (see Table 1, below) are performed by the Laboratory of Atmospheric Chemistry (LAC) of the Paul Scherrer Institute (PSI, <http://lac.web.psi.ch>). The LAC includes an aerosol group, a gas phase chemistry group and a group working on ecosystem fluxes using stable isotopes. It consists of about 35 scientists. The aerosol group of the LAC has in-depth experience with the design of experiments to characterize physical and chemical properties of aerosols and has a strong interest in the impact of aerosols on climate. New instrumentation is being developed for specific purposes, e.g. to measure the hygroscopic growth of aerosol particles with increasing relative humidity at temperature relevant for the lower free troposphere (i.e., below 0°C). The group performs a continuous aerosol programme at the Jungfrauoch within the Global Atmosphere Watch (GAW) programme of the World Meteorological Organisation (WMO). The Jungfrauoch is among the four GAW stations with the most extensive aerosol programme worldwide. A major interest lies in the investigation of aerosol/cloud interaction processes at the Jungfrauoch. In this context, three major CLACE campaigns (CLOUD and Aerosol Characterization Experiments) have been conducted in 2000, 2002, and 2004. Aerosol research from the Jungfrauoch has been presented in about 25 peer-reviewed papers in the last 7 years. In the future, specific gas phase measurements complementing those of EMPA (see below) are also foreseen.

Urs Baltensperger is head of the LAC. He is chairman of the Scientific Advisory Group for Aerosols within the GAW program.

Measurements of the gas phase parameters (Table 1) are performed by the Air Quality/Environmental Technology Laboratory at the Swiss Federal Laboratories for Materials Testing and Research (EMPA) (<http://www.empa.ch>). It consists of about 25 scientists and technicians. EMPA has been in charge of the operation of the Swiss National Air Pollution Monitoring Network (NABEL) since its inception in 1978. Further, EMPA operates a Quality Assurance/Science Activity Centre (QA/SAC) and the World Calibration Centre for Surface Ozone, Carbon Monoxide and Methane (WCC-EMPA) in the framework

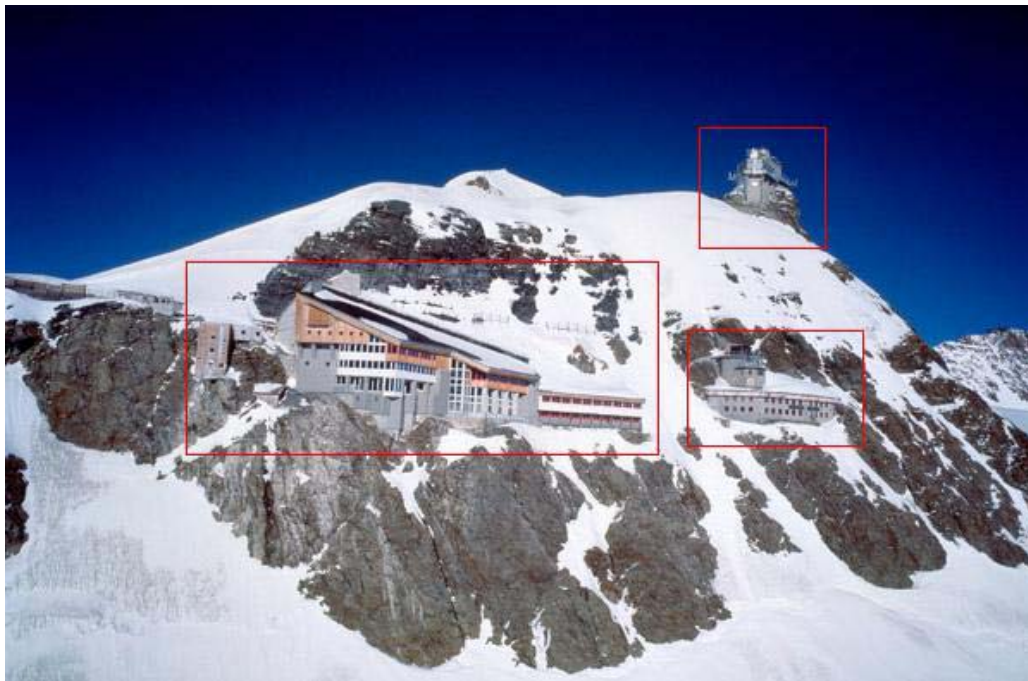
of Global Atmosphere Watch. The laboratory's main expertise is in ambient air monitoring (greenhouse and reactive gases, particles), the associated QA/QC activities, modelling of long-range transport, provision of level 3 satellite products, as well as air quality database systems. Research results have been published regularly in yearly reports and in 16 peer-reviewed publications in the last 5 years.

CO₂ is determined from biweekly flask samples by the Climate and Environmental Physics Institute, University of Bern, Switzerland (<http://www.climate.unibe.ch>). Continuous CO₂ measurements using NDIR are scheduled to start within the next months.

Measurements of radiation, optical depth, and the meteorological parameters (Table 1) are performed by MeteoSwiss (<http://www.meteoswiss.ch/en/index.shtml>).

High resolution, solar infrared Fourier Transform Infrared Spectrometry is performed by the Institute of Astrophysics and Geophysics, University of Liège, Belgium (<http://sunset.astro.ulg.ac.be/girpas/gir4proe.htm>). The two high-performance infrared spectrometers allow to routinely derive total abundances of more than 20 constituents: gases related to the erosion of the ozone layer in the stratosphere (HCl, ClONO₂, HNO₃, NO, NO₂, HF, COF₂, O₃, ...), greenhouse gases monitored in the frame of the Kyoto protocol (N₂O, CH₄, CO₂, SF₆, CCl₂F₂, CHClF₂, ...) and gases affecting the oxidization processes in the troposphere (CO, C₂H₂, C₂H₆, OCS, HCN, H₂CO, ...). The resulting databases allow the determination of the short-term variability, seasonal modulations, as well as long-term changes affecting most of these species. On the average, the group spends more than 200 working days per year at the Jungfraujoch, with good weather conditions on more than 100 days.

3. Description of the facilities



View of the Jungfraujoch research station. Top: Sphinx station; lower right: research station; lower left: facilities of the Jungfrau railway, including restaurant. Most atmospheric research is performed at the Sphinx station, while accommodation for scientists is provided in the research station.

a) Geographical and meteorological information:

- Latitude and longitude of the Sphinx laboratory: 7° 59' 2" E, 46° 32' 53" N
- Altitude of the research station: 3450 meters above sea level
- Altitude of the Sphinx laboratory: 3580 meters above sea level
- Air pressure at Sphinx laboratory: 619 mbar < p < 675 mbar; p(average) ≈ 653.3 mbar
- Air temperature: -37°C < T < +10°C; T(average) ≈ -8.2°C

b) Instrumentation available

The instrumentation for atmospheric research is described at <http://www.empa.ch/gaw/gawsis/>, and in Table 1. For FTIR measurements see <http://sunset.astro.ulg.ac.be/girpas/gir4proe.htm>.

Table 1. Overview of the instrumentation for atmospheric research.

type	parameter	method	start	end
Aerosol	Light absorption coefficient	Aethalometer	01.08.1995	
	Light scattering coefficient	Nephelometer	01.08.1995	
	Mass (major inorganic components)	Ion Chromatography (IC) [general]	01.01.1999	
	Mass (total aerosol)	Filter sampling + gravimetry	01.01.1973	
	Number concentration	Condensation particle counter	01.08.1995	
	Optical depth	Sunphotometry/Filter Radiometry	01.04.1999	
Greenhouse Gas	CFCs	GC-MS	01.01.2000	
	HCFCs	GC-MS	01.01.2000	
	HFCs	GC-MS	01.01.2000	
	SF6	GC-MS	01.01.2000	
	CO2	Flask samples	01.10.2000	
	CH4	GC	planned	
	N2O	GC	planned	
Meteo	Humidity			
	Pressure			
	Temperature			
	Trajectories			
	Wind direction			
	Wind speed			
Ozone	Surface ozone	UV photometry [general]	01.01.1986	
	Total column ozone	unknown/unspecified	28.09.1957	30.10.1958
Precipitation	Anions (inorganic)		01.01.1980	01.01.1995
Radio Nuclide	Beryllium [Be-7]			
	Radon [Rn-222]		01.01.1996	
	Carbon [C-14]			
Reactive Gas	Krypton [Kr-85]			
	CO	Non-dispersive IR (NDIR)	01.04.1996	
	NO	Chemiluminescence (CL) [general]	01.09.1991	
	NO2	Photolytic conversion - CL	01.09.1991	
	NOy	Catalytic conversion 'Au' - CL	01.04.1997	
	SO2	H2O2 conversion - IC	01.01.1981	
Solar Radiation	VOC	GC-MS	01.01.2000	
	Direct irradiance	Pyrheliometer	01.07.1996	
	Global irradiance	Pyranometer	01.07.1996	
	IR	Pyrgeometer	01.07.1996	
	UV Broadband	UV photometry [general]	01.07.1996	
	UV Spectral	Sunphotometry/Filter Radiometry	01.04.2000	

c) Data availability and access to data

Gas chemistry and aerosol data are freely available from the EMEP (Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe) website (<http://www.nilu.no/projects/ccc/>) and the GAW World Data Centre for Aerosols (WDCA) in Ispra, Italy (<http://rea.ei.jrc.it/netshare/wilson/WDCA/>). The data contained within these data archives are to be used for non-profit, scientific and educational purposes only. The WMO Executive Council/Committee on Atmospheric Sciences (EC/CAS) Panel of Experts Working Group on Environmental Pollution and Atmospheric Chemistry remind users of the data to acknowledge and honour the following statement. *"For Scientific purposes, access to these data is unlimited and provided without charge. By their use you accept that an offer of co-authorship will be made through personal contact with the data providers or owners whenever substantial use is made of their data. In all cases, an acknowledgement must be made to the data providers or owners and to the data centre when these data are used within a publication."*

d) Web sites

- International Foundation High Altitude Research Stations Jungfrauoch and Gornergrat: <http://www.ifjungo.ch/>
- Paul Scherrer Institute: <http://lac.web.psi.ch>
- Special website for the public (in German): <http://aerosolforschung.web.psi.ch/>
- EMPA: : <http://www.empa.ch>
- MeteoSwiss: <http://www.meteoswiss.ch/en/index.shtml>
- Jungfrau Railways: <http://www.jungfrauahn.ch/>

e) Access to the facility

The Jungfrauoch is accessible all year round by the Jungfrau railway. Possible routes are:

- Interlaken Ost - Lauterbrunnen - Kleine Scheidegg - Jungfrauoch
- Interlaken Ost - Grindelwald - Kleine Scheidegg - Jungfrauoch

The train ride from Interlaken Ost to Jungfrauoch by either route takes about 2.5 hours. The closest parking possibilities are at the railway stations of Lauterbrunnen and Grindelwald Grund. The research station provides accommodation facilities for up to 12 researchers.



The dining and recreation room (left) and one of ten bedrooms (right).

Two custodian couples are present at the research station in alternating shifts all the time. They maintain the infrastructure, operate the guestrooms, and act as the hosts of the

researchers. The custodians are also responsible for the daily weather reports to MeteoSwiss as well as for the constant supervision of a number of automatic scientific experiments.

Applications for new research projects are welcome at any time. Scientists who intend to work at Jungfraujoch should contact the director's office in Bern well in advance. A simple written inquiry is required at least three weeks before the starting date of the project. In general, a reconnaissance visit at Jungfraujoch with a representative of the Research Station is required. If the direction HFSJG approves the project, the researcher will receive an application form from the secretary's office for the final, binding details concerning the research and its duration. As soon as this form has been reviewed and approved by the director, the secretary's office will issue "legitimation" cards for the project. The legitimation cards not only authorize work and stay at the Research Station Jungfraujoch but, moreover, oblige adherence to the conditions contained in these regulations. The legitimation cards also permit the holder to purchase reduced-priced railway tickets to Jungfraujoch at the railway stations in Interlaken Ost, Grindelwald, and Lauterbrunnen. More detailed information on the application procedure is found at the web site of the Foundation (<http://www.ifjungo.ch/>).

f) Scheduled scientific activities

- CLACE 4 campaign: February/March 2005

g) Association to national, European and international networks

The Jungfraujoch station is part of the Global Atmosphere Watch (GAW) programme of the World Meteorological Organisation.

h) Specific issues on collaboration

Radiation measurements in clouds to perform a radiative closure in CLACE 4 would be particularly welcome.

i) Fee for using the facility

Part of the costs occurring is covered by the charges for overnight stays at the Jungfraujoch. These are CHF 30 and 75 per night for scientists from member and non-member countries, respectively. Additional costs may apply, depending on the size and length of the experiment. As an example PSI pays CHF 100 per m² and week for their long-term experiments.

j) Name and address of contact persons:

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