

## Report of the Director

It is my pleasure to introduce the many activities that took place over the course of 2011 at the infrastructures of HFSJG at Jungfraujoch and Gornergrat.

2011 was designated as the International Year of Chemistry by the United Nations, “stressing that education in and about chemistry is critical in addressing challenges such as global climate change, in providing sustainable sources of clean water, food and energy and in maintaining a wholesome environment for the well-being of all people” and “being aware that the year 2011 provides the opportunity to celebrate the contributions of women to science on the one-hundredth anniversary of the awarding of the Nobel Prize in Chemistry to Maria Skłodowska-Curie”.

Therefore, the investigations on atmospheric composition, their changes and evolutions at the HFSJG infrastructures performed by national and international research groups are very applicable to the International Year of Chemistry 2011. This activity report goes even beyond the focus on chemistry as documented by the individual reports, the number of refereed publications and conference contributions for the year 2011.

Regarding celebrations, the upcoming year 2012 will focus on the Bernese Oberland and the centennial of the Jungfrau Railways. Congratulations! The Jungfrau Railways is not the only one that will celebrate: HFSJG and the Sphinx AG will celebrate the 75<sup>th</sup> anniversary of the Sphinx building in October 2012.

### The Foundation HFSJG

As per the by-laws of the Foundation HFSJG, the Board has its regular meetings only every other year. This year's meeting of the Board took place on September 2 and 3, 2011, in Zermatt. It was the first meeting of the Board under Prof. Erwin Flückiger as president of HFSJG and Prof. Markus Leuenberger as director of the two research stations. The statement of accounts for the year 2010 was approved and the HFSJG administration was given discharge. The budget for 2012 and 2013 were approved by the Board, taking note of the extraordinary planned expense for the renewal of the protection roof on the research station. The Treuhand Cotting AG (Mr. Lüdi) was elected for an additional two years term as auditor. Under the agenda item “Honors” the title corresponding member of HFSJG was awarded to Prof. Dr. Urs Würgler for his personal efforts on behalf of the University of Bern's membership in the Foundation HFSJG since 2008 and for the University's support for the Foundation not only financially but with many contributions in kind such as offices, IT-services etc. Prof. Christian Schlüchter, Institute of Geological Sciences, Quaternary and Environmental Geology, University of Bern gave a scientific talk entitled “The Zermatt Area – Relevance to Paleoglaciology and Glacial Geology”.

We have the sad duty to inform you that our corresponding member Prof. Dr. Gisbert Winnewisser passed away on March 21, 2011, at the age of 75. Prof. Winnewisser initiated the KOSMA project of the Universität Köln at Gornergrat and very successfully led the sub-millimeter telescope research for several decades.

We thank Prof. Dr. Winnewisser for all he has done for our foundation and will keep him in fond memory.

**Figure 1.** Prof. Dr. Gisbert Winnewisser†





**Figure 2.** Snapshot from the meeting of the Board HFSJG in Zermatt, September 2, 2011.

The Jungfraujoch Commission had its annual meeting on July 1, 2011, at the House of Science, SCNAT Bern. It was decided not to continue the plans for a touring exhibition entitled “Technique and Research in High mountains – 100 years Jungfrau Railways” planned in collaboration with the local “Naturforschenden Gesellschaften” due to limitations of available funds and the rather sparse interest of regional and local “Naturforschenden Gesellschaften” to host the exhibition. However, to emphasize the presence of science at Jungfraujoch, a small exhibition was envisaged. In agreement with the Jungfrau Railways, the planning of the scientific exhibition at Jungfraujoch started in autumn 2011. Furthermore, the Jungfraujoch commission decided to form a workgroup “Strategy planning Jungfraujoch” with the mandate to draft a White Book about the short, middle, and long-term perspectives of quality assurance at the unique and globally important research station Jungfraujoch. The following items shall be addressed by this White Book: (i) conditions for guaranteeing reliable measurements in global, European, and Swiss environmental networks; (ii) necessary adaptations of presently available infrastructures; (iii) opportunities for potential extensions of the Research Station Jungfraujoch; (iv) the often contradictive interests and priorities for a steadily changing touristic top attraction and an international renown key station for environmental research. This White Book shall be presented for approval to the SCNAT and the Board of our Foundation.

The Astronomic Commission meeting was held January 20, 2011, in Bern. A lively discussion was held regarding the contamination problem that arose with the start of the excavation of rock formations for the new gateway planned by the Jungfrau Railways. This new gateway will allow the tourists to reach attractions more easily and without intersecting other tourist groups. Since emissions were present - more or less severely - over the course of the full year, it was decided to mount a protective wall in the laboratory on the second level of the Sphinx building in order to protect the highly sensitive instrumentation run by Empa, PSI and the University of Bern. At the end of the meeting, Dr. Michael Bittner, the representative of the scientific team at Schneefernerhaus, informed us about the “virtual institute” that was founded in 2007.

The meeting of the Board and the General Assembly of the Sphinx AG took place at Jungfraujoch on June 8, 2011. Unfortunately, the director could not attend the meeting due to other obligations.

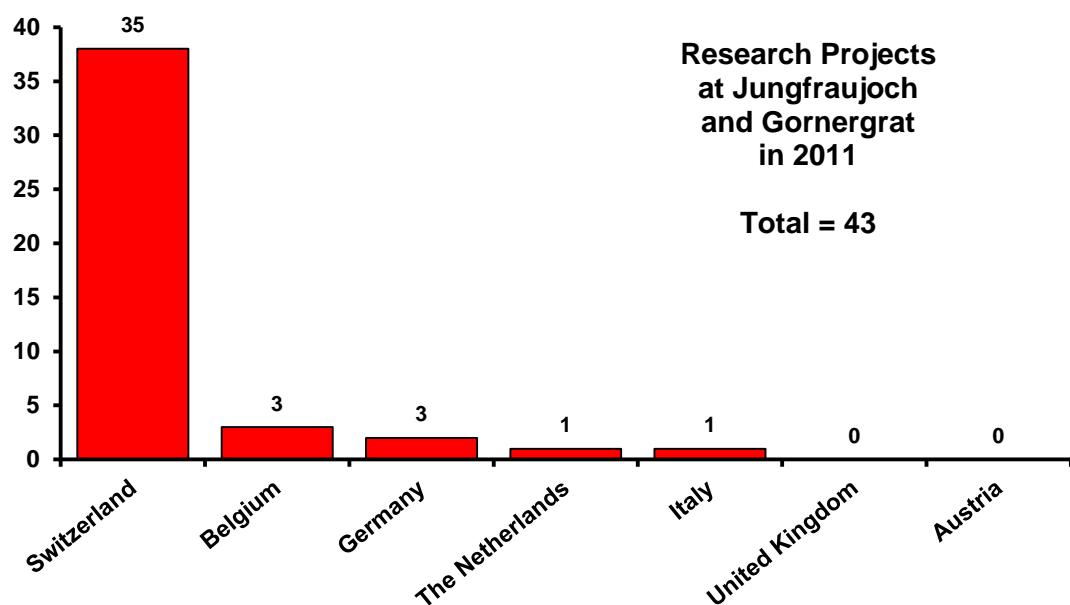
We further upgraded the webpage of the Foundation. In particular, information about each project can be accessed by an easy search for a specific institute, person, or any key word. This helps visualize the activities at Jungfraujoch and Gornergrat and facilitates potential collaborations thanks to the greater transparency.

### **The High Altitude Research Station Jungfraujoch**

As is seen from the individual reports and the lists and statistics, the High Altitude Research Station Jungfraujoch remains a lively site for high level science. In 2011, 28 (2010: 34) teams were active at Jungfraujoch. More than half of the total 40 (2010: 41) research projects were primarily based on remote controlled automated monitoring around the clock.

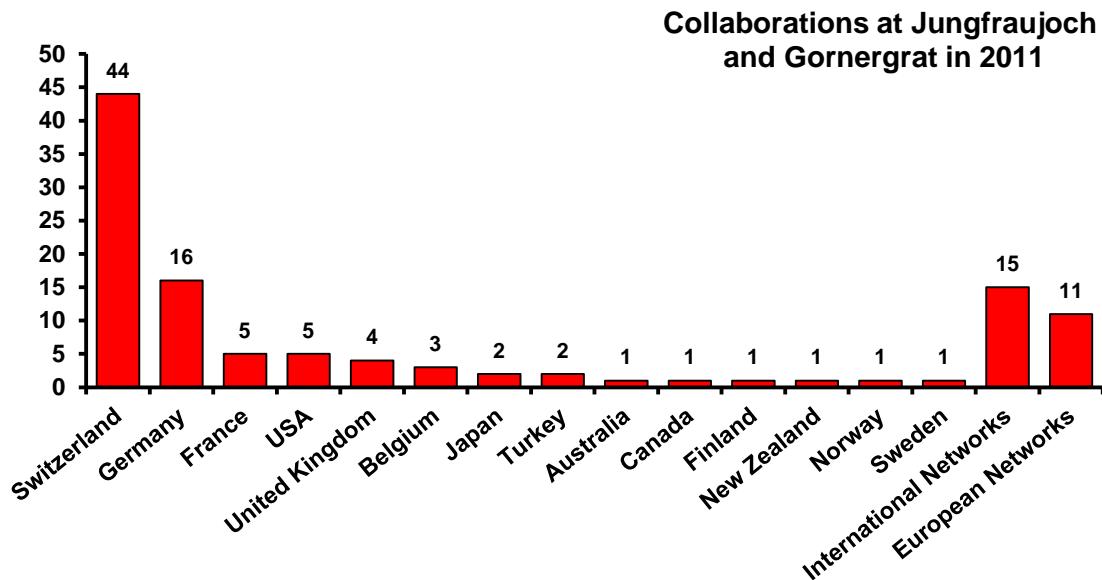
All of the HFSJG member countries profit from carrying out research projects at Jungfraujoch either through direct involvement with research organisations from other countries or through their participation in international organisations as WMO or programs such as the Global Atmosphere Watch (GAW) or the Network of Detection of Atmospheric Composition Change (NDACC). Despite the fact that there was no direct involvement from Austria or the United Kingdom, there have been collaborations with other European institutions that are active on Jungfraujoch as documented by the collaborations visible on the HFSJG Webpage (<http://www.hfsjg.ch/jungfraujoch/researchprojects/overview.php>) as well as in Figure 4. The presence and active role in national and international networks is important in order to improve the visibility of a station. In this regard Jungfraujoch plays a major role with the involvement in about 30 programs (Table 1).

By number of projects, Germany and Belgium were again the most frequent users after Switzerland.

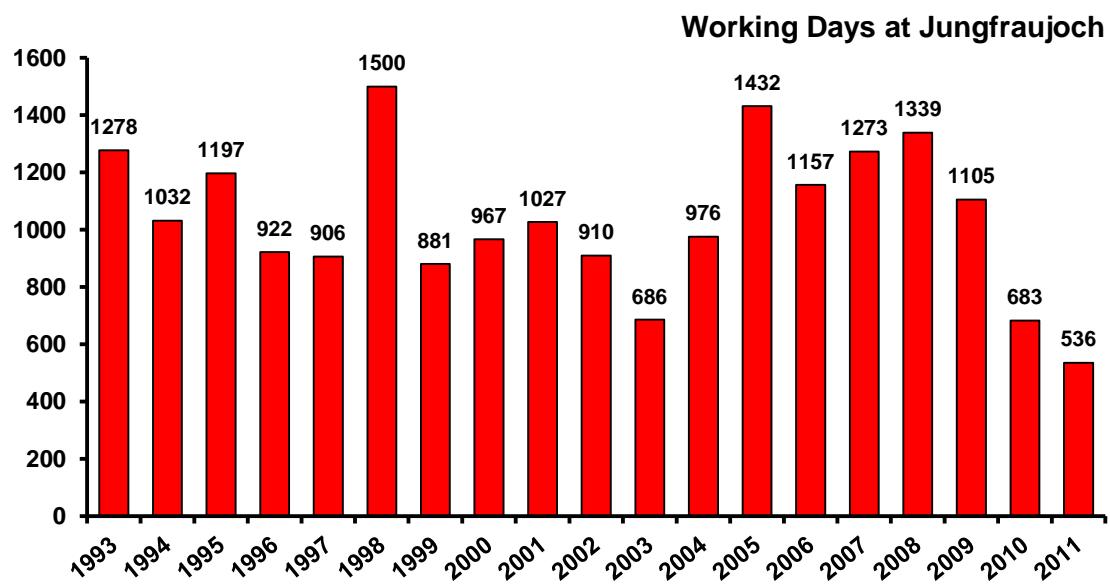


**Figure 3.** Number of research projects at the High Altitude Research Station Jungfraujoch and Gornergrat in 2011 by country

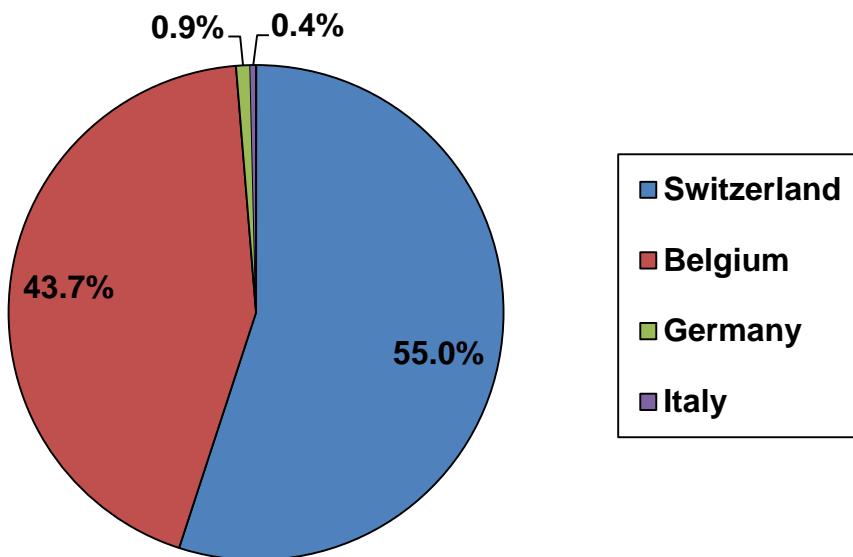
The decreasing trend of overnight stays continued in 2011 (439 in 2011, 522 in 2010). Scientists spent a total of 536 person-working days at Jungfraujoch. As shown in Figure 5, this is also less than in the previous year (2010: 683). Therefore, the trend to remote operation of experiments was further pronounced in 2011. However, in 2012 we expect an increase due to announced medical campaigns.



**Figure 4.** Number of collaborations at the High Altitude Research Station Jungfraujoch and Gornergrat in 2011



**Figure 5.** Number of working days spent by scientists at the High Altitude Research Station Jungfraujoch during the past years



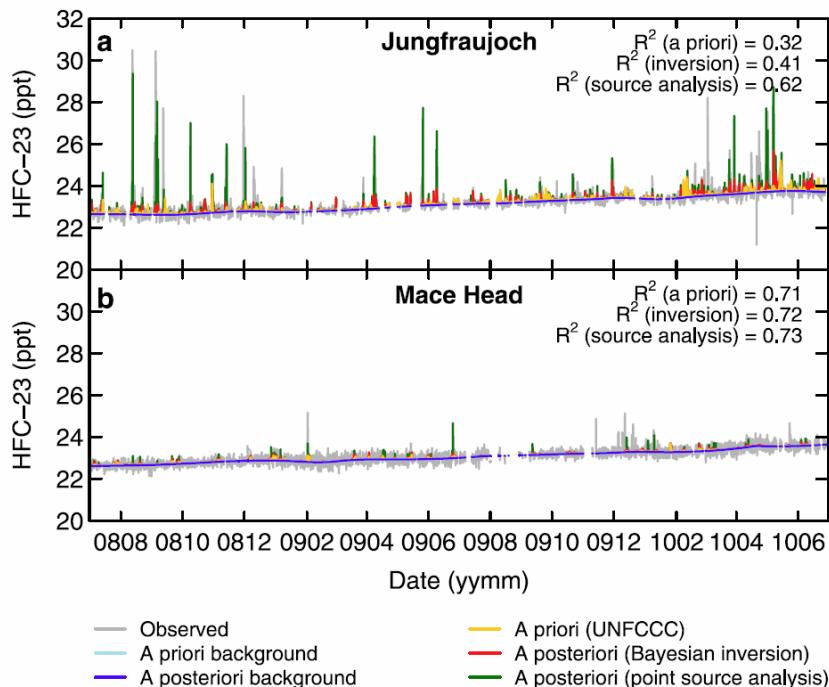
**Figure 6.** Percentage of person-working days in 2011 at the High Altitude Research Station Jungfraujoch per country

The research conducted at Jungfraujoch resulted in the following output in 2011:

- 42 refereed publications,
- 77 conference presentations / posters,
- 2 Popular publications and presentations
- 12 data publications and reports,
- 12 PhD (7) and Master (5) theses, and
- 4 book / edited books

Scientific results obtained at Jungfraujoch were presented by the various research groups at a number of international conferences in 2011, e.g. at the Non-CO<sub>2</sub> greenhouse gases (NCGG-6), Amsterdam, 2-4 November 2011 (NL), at the EGU General Assembly, Vienna, 3-8 April 2011 (A), at the NEU Nitrogen & Global Change 2011 conference, Edinburgh, 11-15 April 2011 (UK), at the WCRP OSC Climate Research in Service to Society, Denver, 24-28 October 2011 (USA), at the NOAA ESRL Global Monitoring Annual Conference, Boulder, 17-18 May 2011 (USA), at the 16th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2011), Wellington, 25-28 October 2011 (NZL), at the GEO-Carbon Conference, Rome, 24-26 October 2011 (I), at the GAW-CH Conference, Zurich, 18-19 January 2011 (CH), at the Goldschmidt Conference, Prague, Hungary, August 14 -19, 2011 (CZ), at the International Symposium Climate Change in High Mountain Regions, Zentralanstalt für Meteorologie und Geodynamik, Salzburg, August 28 - September 1 (2011) (A), at the European Aerosol Conference 2011, Manchester, September 4-9 (2011) (UK), at the 15th ETH-Conference on Combustion Generated Nanoparticles, June 26-29, 2011 (CH), at the The XXV IUGG General Assembly, Melbourne, June 28 – July 7, 2011 (AUS), at the 43th Meeting of AGAGE scientists and Cooperating Networks, Bristol, 22-26 May 2011 (UK), at the GMES conference, Copenhagen, 13 October 2011 (Da), and at the AGU, San Francisco, US, 05-09 December 2011 (USA).

The numerous refereed publications and conference contributions convincingly document the importance of the Jungfraujoch Research Station within the European setting, in particular in the field of environmental science. Jungfraujoch is part of many national and international networks as listed in Table 1.



**Figure 7.** HFC-23 time series of observations (grey), background signal (blue), and model-predicted prior (yellow) and posterior concentrations determined from the Bayesian inversion (red) and the point source analysis (green), respectively, at (a) Jungfraujoch and (b) Mace Head between July 2008 and June 2010. Correlations with observations are given on top right.

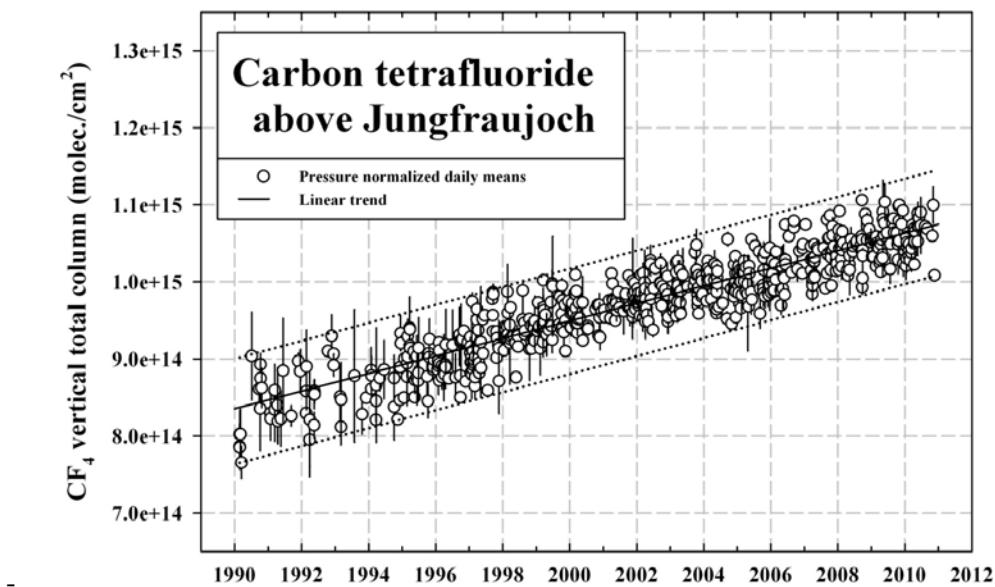
A media success in 2011 was a publication about the greenhouse gas trifluoromethane (HFC-23) emissions by Keller et al., [2011] from the Laboratory for Air Pollution and Environmental Technology of the Swiss Federal Laboratories for Materials Science and Technology, Empa. Country by country, the most pronounced disagreement between observations and officially declared emissions was found for Italy. This discrepancy was publicized by the national and international media.

The Belgium research group from the Institut d’Astrophysique et de Géophysique - Université de Liège lead by Dr. Christian Servais is continuously involved in retrieving new parameters from the spectral data already collected with their FTIR instrumentation. One additional example is carbon tetrafluoride (CF4). CF4 is an extremely stable greenhouse gas, with a lifetime of about 50'000 years and a greenhouse warming potential of about 7400 (CO<sub>2</sub> has a factor of 1), thus a key species among the various greenhouse gases targeted by the Kyoto Protocol. The trend analysis of this time series (Figure 8) shows a linear increase above the Jungfraujoch of  $(1.14 \pm 0.04) \times 10^{13}$  molec./cm<sup>2</sup>/yr over the 1990-2010 time period.

Additional scientific highlights were published in several peer-reviewed journals:

- Zieger et al., Atmos. Chem. Phys., 2011 compares two methods of ambient aerosol extinction coefficients determinations.
- Yver et al. Atmos. Chem. Phys., 2011 presents a new estimation of the recent tropospheric molecular hydrogen budget using atmospheric observations and variational inversion.

- Wacker et al., J. Geophys. Res-Atmosphere, 2011 investigated trends of surface cloud-free downwelling long-wave radiation from four Swiss sites.
- Vollmer et al., J. Geophys. Res., 2011 report on atmospheric histories and global emissions of the anthropogenic hydrofluorocarbons HFC-365mfc, HFC-245fa, HFC-227ea, and HFC-236fa.
- Uglietti et al., Atmos. Chem. Phys., 2011 investigated the European source and sink areas of CO<sub>2</sub> retrieved from Lagrangian transport model interpretation of combined O<sub>2</sub> and CO<sub>2</sub> measurements at the high alpine research station Jungfraujoch.
- Riesen et al., Journal of Glaciology, 2011 report on short-term surface ice motion variations measured with a ground-based portable real aperture radar interferometer.
- Reddington et al., Atmos. Chem. Phys., 2011 investigated primary versus secondary contributions to particle number concentrations in the European boundary layer.
- Pandey Deolal et al., Atmos. Chem. Phys. Discuss., 2011 discuss long-term in situ measurements of NO<sub>x</sub> and NO<sub>y</sub> at Jungfraujoch 1998–2009 time series analysis and evaluation.
- Kohlhepp et al., Atmos. Chem. Phys. Discuss., 2011 observed and simulated time evolution of HCl, ClONO<sub>2</sub>, and HF total column abundances.
- Keller et al., Environ. Sci. Technol., 2011 derived European emissions of halogenated greenhouse gases inferred from atmospheric measurements.
- Bütkofer and Flückiger, Astrophys. Space Sci. Trans., 2011 calculated radiation doses along selected flight profiles during two extreme solar cosmic ray events.
- Brunner et al., Atmos. Chem. Phys. Discuss., 2011 used an extended Kalman-filter approach for regional scale inverse emission estimation.
- Asmi, et al., Atmos. Chem. Phys., 2011 summarized the number size distributions and seasonality of submicron particles in Europe for 2008–2009.
- Bond et al., Tellus Series B-Chemical and Physical Meteorolog, 2011 investigated atmospheric molecular hydrogen (H-2) at the high-altitude site Jungfraujoch, Switzerland.
- Conen et al., Atmos. Meas. Tech. Discuss., 2011 looked at atmospheric ice nucleators active  $\geq -12$  deg C that may be quantified on PM10 filters.
- Cui et al., J. Geophys. Res-Atmosphere, 2011 published on free tropospheric ozone changes over Europe as observed at Jungfraujoch (1990-2008): An analysis based on backward trajectories.



**Figure 8.** FTIR time series of CF4 vertical total abundance above the Jungfraujoch. Data points are daily mean values. Corresponding error bars are 1- $\sigma$  standard deviations. The solid black line reproduces the linear fit through all data points. The 2 black dotted lines are the 1- $\sigma$  limits adopted to filter out our dataset.

**Table 1.** List of major nationally and internationally coordinated networks and/or research programs where Jungfraujoch is a key station

<b>NDACC</b>	Network for the Detection of Atmospheric Composition Change Primary Site ( <a href="http://www.ndacc.org/">http://www.ndacc.org/</a> )
<b>GAW, GAW-CH</b>	Global Atmosphere Watch, Global GAW Station ( <a href="http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html">http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html</a> , and <a href="http://www.meteoschweiz.admin.ch/web/de/klima/klima_international/gaw-ch.html">http://www.meteoschweiz.admin.ch/web/de/klima/klima_international/gaw-ch.html</a> )
<b>GAW-PFR</b>	GAW Aerosol Optical Depth (AOD) Network ( <a href="http://www.pmodwrc.ch/worcc/pmod.php?topic=gawpfr_aod_network_menu">http://www.pmodwrc.ch/worcc/pmod.php?topic=gawpfr_aod_network_menu</a> )
<b>GCOS</b>	Global Climate Observing System ( <a href="http://www.wmo.int/pages/prog/gcos/">http://www.wmo.int/pages/prog/gcos/</a> )
<b>GCOS-CH</b>	Swiss GCOS office ( <a href="http://www.meteoschweiz.admin.ch/web/de/klima/klima_international/gcos/swiss_gcos_off_ice.html">http://www.meteoschweiz.admin.ch/web/de/klima/klima_international/gcos/swiss_gcos_off_ice.html</a> )
<b>SOGE</b>	System for Observation of Halogenated Greenhouse Gases in Europe ( <a href="http://www.nilu.no/soge/">http://www.nilu.no/soge/</a> )
<b>GEOMON</b>	Global Earth Observation and Monitoring of the Atmosphere ( <a href="http://geomon.ipsl.jussieu.fr/">http://geomon.ipsl.jussieu.fr/</a> )
<b>AGAGE</b>	Advanced Global Atmospheric Gases Experiment Collaborative Sampling Station ( <a href="http://agage.eas.gatech.edu/">http://agage.eas.gatech.edu/</a> )
<b>NADIR/NILU</b>	NILU's Atmospheric Database for Interactive Retrieval ( <a href="http://www.nilu.no/nadir/">http://www.nilu.no/nadir/</a> )
<b>IMECC</b>	Infrastructure for Measurements of the European Carbon Cycle ( <a href="http://imecc.ipsl.jussieu.fr/index.html">http://imecc.ipsl.jussieu.fr/index.html</a> )
<b>EUMETNET</b>	Network of European Meteorological Services ( <a href="http://www.eumetnet.eu/">http://www.eumetnet.eu/</a> )
<b>SwissMetNet</b>	Automatic Measuring Network of MeteoSwiss ( <a href="http://www.meteoschweiz.admin.ch/web/de/klima/messsysteme/boden/swissmetnet.html">http://www.meteoschweiz.admin.ch/web/de/klima/messsysteme/boden/swissmetnet.html</a> )
<b>RADAIR</b>	Swiss Automatic Network for Air Radioactivity Monitoring ( <a href="http://www.bag.admin.ch/themen/strahlung/00045/02372/02374/index.html?lang=de">http://www.bag.admin.ch/themen/strahlung/00045/02372/02374/index.html?lang=de</a> )
<b>ICOS</b>	Integrated Carbon Observation System ( <a href="http://www.icos-infrastructure.eu/">http://www.icos-infrastructure.eu/</a> )
<b>NADAM</b>	Netz für automatische Dosis-Alarmierung und –Meldung ( <a href="https://www.naz.ch/de/aktuell/tagesmittelwerte.shtml">https://www.naz.ch/de/aktuell/tagesmittelwerte.shtml</a> )
<b>NABEL</b>	Nationales Beobachtungsnetz für Luftfremdstoffe - National Air Pollution Monitoring Network ( <a href="http://www.empa.ch/plugin/template/empa/699/*---/l=1">http://www.empa.ch/plugin/template/empa/699/*---/l=1</a> )
<b>AGNES</b>	Automated GPS Network for Switzerland ( <a href="http://www.swisstopo.admin.ch/swisstopo/geodesy/pnac/html/en/statjujo.html">http://www.swisstopo.admin.ch/swisstopo/geodesy/pnac/html/en/statjujo.html</a> )
<b>PERMASENSE</b>	Wireless Sensing in High Alpine Environments ( <a href="http://www.permasense.ch/">http://www.permasense.ch/</a> )
<b>PERMOS</b>	Permafrost Monitoring Switzerland ( <a href="http://www.permos.ch/">http://www.permos.ch/</a> )
<b>NMDB</b>	Real-Time Database for High Resolution Neutron Monitor Measurements ( <a href="http://www.nmdb.eu">http://www.nmdb.eu</a> )
<b>E-GVAP I + II</b>	The EUMETNET GPS Water Vapour Programme ( <a href="http://egvap.dmi.dk/">http://egvap.dmi.dk/</a> )
<b>ACTRIS</b>	Aerosols, Clouds, and Trace gases Research InfraStructure Network ( <a href="http://www.actris.net/Home/tabid/4276/Default.aspx">http://www.actris.net/Home/tabid/4276/Default.aspx</a> )
<b>EUSAAR</b>	European Supersites for Atmospheric Aerosol Research ( <a href="http://www.eusaar.net/files/activities/transnat_act.cfm">http://www.eusaar.net/files/activities/transnat_act.cfm</a> )
<b>EUCAARI</b>	European Integrated project on Aerosol Cloud Climate and Air Quality Interactions ( <a href="http://www.atm.helsinki.fi/eucaari/">http://www.atm.helsinki.fi/eucaari/</a> )
<b>COST 726</b>	Long term changes and climatology of UV radiation over Europe ( <a href="http://www.cost726.org/">http://www.cost726.org/</a> )
<b>Swiss Glacier Monitoring Network</b>	Federal Office for the Environment (BAFU) ( <a href="http://glaciology.ethz.ch/messnetz/?locale=en">http://glaciology.ethz.ch/messnetz/?locale=en</a> )
<b>InGOS</b>	Integrated non-CO <sub>2</sub> Greenhouse Gas Observing System ( <a href="http://www.ingos-infrastructure.eu/">http://www.ingos-infrastructure.eu/</a> )

Most of the measurements made at Jungfraujoch are publicly available via the respective databases, many of them in real or near real-time.

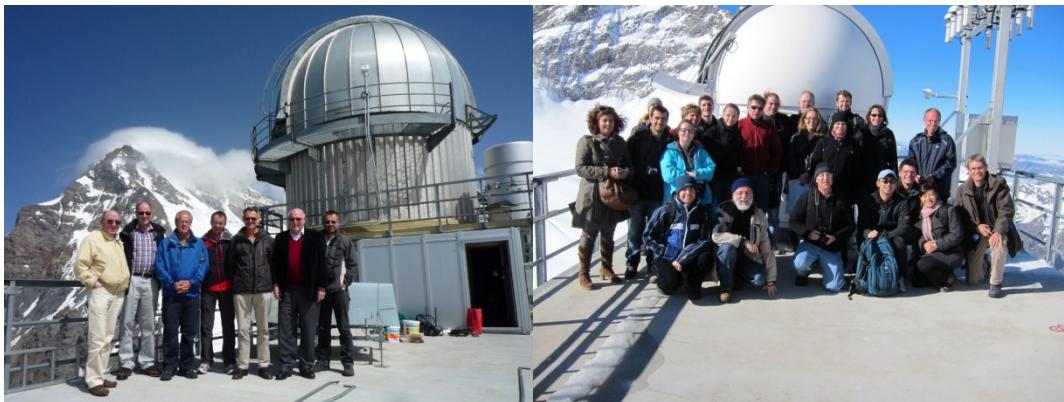
The Research Station remained attractive in 2011 as in previous years. Several organizations initiated meetings of national and international scientific committees in the Jungfrau region and often combined these meetings with an excursion to Jungfraujoch. The research station was also visited by a large number of student and teachers groups as part of a lecture or training school. Examples of the 85 individual and group visitors in 2011 are:

- Beobachter Natur; 03.01.2011
- Gymnasium Bäumlihof, Basel; 27.01.2011
- Les Alpes; 22.02.2011
- PhD students and post-docs of Prof. Aldo Steinfeld, Energy Science Center ETH Zürich and PSI Solar Technology Laboratory; 18.03.2011
- BBC London / Documentary math series; 22.03.2011
- Naturforschende Gesellschaft Bern; 26.03.2011
- Klima- und Umweltphysik Uni Bern / glaciology students / H. Fischer; 13.04.2011
- Bundesamt für Metrologie, Bern-Wabern; 10.05.2011
- Aerosol students / PSI and ETH Zürich; 12.05.2011
- Swedish University of Agricultural Sciences, S-Umea / Prof. Gustaf Egnell with students and co-workers; 28.05.2011
- PD Dr. Adrian Frutiger / participants Symposium Hypoxia – from the mountains to the bedside; 18.06.2011
- Mary Edwards, Paul Steele, Commonwealth Scientific & Industrial Research Organisation, Melbourne, Australia; 28.06.2011
- Dr. Mathias Schaedel, GSI Helmholtzzentrum für Schwerionenforschung GmbH, Darmstadt / Prof. Heinz Gäggeler, Paul Scherrer Institut; 3.-4. 07.2011
- GABA International AG, workshop participants; 02.07.2011
- Kantonale Kader für die Volksschule; 13.07.2011
- University of California Los Angeles UCLA, Program on International Environmental Governance; 17.07.2011
- Eiger-Klima-Schulen 2011; 05.08.2011
- POLARIS Plamsa Coupling in the Auroral Magnetosphere –Ionosphere System. Working group visitors; 11.08.2011
- Dr. Michael Pitts, NASA; 13.08.2011
- Christina M. Harth, Scripps Institution of Oceanography, University of California, San Diego; 30.08.2011
- Graduate School of Environmental Science, Hokkaido University, Japan. Glacial field course in Switzerland; 31.08.2011
- Dr. Bernard Nicolet, former astronomical assistant at Jungfraujoch; 02.09.2011
- Schüler Ergänzungsfach Geographie, Kantonsschule Hottingen, Zürich; 07.09.2011
- Bildungszentrum kbBL, Reinach. Geography teachers: 11.09.2011
- BKW Lehrerfortbildung; 17./18./24./25.09
- International Optoelectronicsw Associations IOA; 18.09.2011 ( at Gornergrat)
- Grossrat des Kantons Bern; 20.10.2011

- Royal Grammar School, Guilford UK / physics students; 22.10.2011
- Laboratory of Hydraulics, Hydrology and Glaciology, ETH Zürich Glaciology students; 02./09.11.2011
- Schweiz. Nationalfonds, evaluation panel of experts in nano-science; 12.11.2011
- Cercl'Air Schweiz. Gesellschaft der Lufthygiene-Fachleute; 30.11.2011

The management HFSJG was particularly honoured to welcome the following official delegations:

- XVIII INQUA Congress / Quaternary sciences – the view from the mountains. Congress participants; 20./24./28.07.
- Jürg Lauper, Prof. Thomas Bieger / Jungfraubahn; 23.08.2011
- Bundesamt für Umwelt, Abteilung Klima; 25.08.2011
- Wolfgang Kusch, former President Deutsche Wetterdienst; 13.09.2011
- AGU Chapman Conference on Advance in Lagrangian Modeling of the Atmosphere, conference participants; 11./14.10.2011
- NBC Today (live broadcast); 10.11.2011

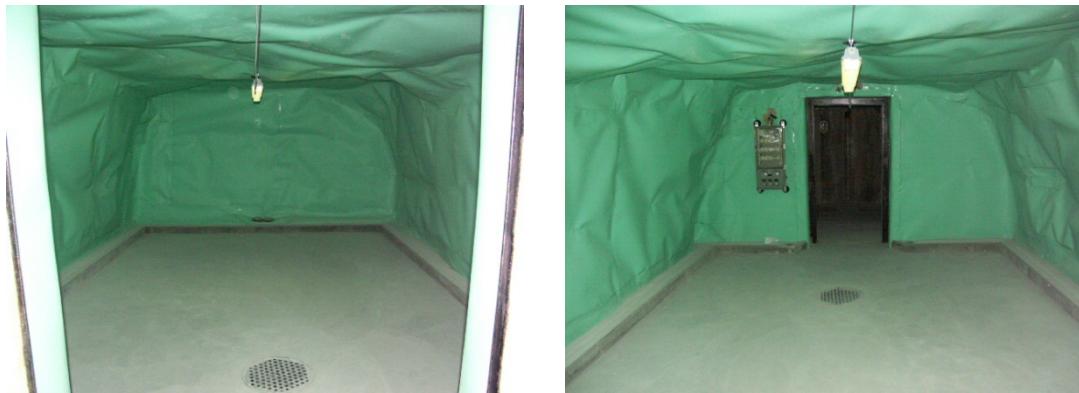


**Figure 9.** Hans Balsiger, Erwin Flückiger, Jürg Lauper, Thomas Bieger, Markus Leuenberger, Martin C.E. Huber, Heinz Schindler at Jungfraujoch on August 23, 2011 (on the left); Excursion to the HFJSG facilities at Jungfraujoch during the AGU Chapman Conference on Advances in Lagrangian Modeling of the Atmosphere Grindelwald, Switzerland 9 – 14 October 2011 (on the right).

The large number of requests for visits of the research station at Jungfraujoch was paralleled by an unbroken intense interest by print media and TV, with more than 55 contributions in 2011. The winner of the lottery of the Grüne Partei, Mrs Aebischer and her family members, were invited for a Jungfraujoch excursion with a guided tour of the Research Station.

In order to provide the researchers good working conditions, continuous efforts are made to update the infrastructure.

In 2011 several infrastructural changes were made at the Jungfraujoch Research Station: (i) Renovation of the cavern near the Research Station entrance; (ii) Renewal of alarm system was finalized in 2011; (iii) Protection against falling rocks was finalized in 2011; (iv) Higher capacity of emergency power supply; (v) A leakage in the power supply to the second level laboratory in the Sphinx building was repaired.



**Figure 10.** Renovation of cavern near the Research Station entrance

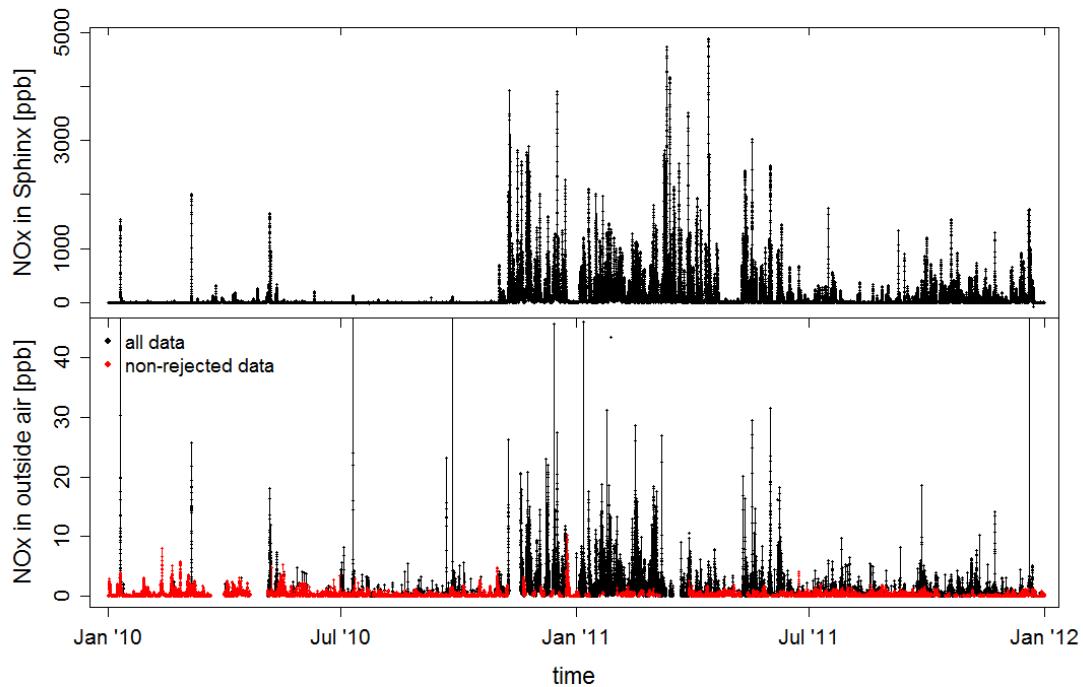
The renovation of the cavern near the Research Station entrance became necessary since water progressively penetrated through the rock and made the cavern unusable. Only a full renovation of the room with fixation of a protective foil against water penetration and a drainage system with water pump helped to dry out the wet room to make it usable again as storage space.

The new fire and smoke alarm system was installed in early 2011 and after a thorough testing phase the equipment was finally put into operation on March 25, 2011. The local fire brigade announced at its meeting on December 9, 2011 that they were fortunate that no severe emergency action had to be taken during 2011.



**Figure 11:** Installation of new alarm system

Discussions about emissions at Jungfraujoch were manifold. The construction work that had to be done during the whole of 2011 influenced many in-situ records at the Sphinx laboratory. Influences are best seen in the NO<sub>x</sub> record measured by Empa (Figure 12). Measured NO<sub>x</sub> values in air of the Sphinx laboratory in parts per billion (ppb) (upper panel) and those of the outside air in black and non-rejected values in red (lower panel) document the obvious strong contamination. The very end of the graph in Figure 12, i.e. the week between Christmas and New Year's Eve, documents the stability of low values when construction work was stopped.



**Figure 12:** NO<sub>x</sub> measurements during 2010 and 2011 performed by Empa

As in previous years, several coordination discussions took place with the management of the Jungfrau Railways. The main annual coordination meeting at Jungfraujoch, a platform for the discussion of items of common concern, took place on October 27, 2011, and was attended by the director of the research stations and Mr. Martin Fischer. Prime topics related to the HFSJG were (i) the emissions related to the construction of the new passage way; (ii) a new, more visible appearance for HFSJG at the entrances to the Research Station and the Sphinx building (iii) the 75<sup>th</sup> anniversary of the Sphinx Building in 2012.

Last but not least I would like to draw your attention to a change of the custodian couples at Jungfraujoch. After three and a half years of enthusiastic work, Mrs Susanne and Mr Felix Seiler decided to resign their job as custodians at the Research Station Jungfraujoch as per the end of September 2011 to take on a new challenge in their working career. I would like to express my sincere thanks to them for their great dedication to their work at the Research Station. Researchers, visitors and the HFSJG staff will certainly remember you, Susanne and Felix, for your competence and kindness. We hope that your work with the Foundation and the researchers has been a memorable experience for you, and we wish you all the best for the future.

The Foundation HFSJG published an advertisement for their job early in 2011 and received about 20 applications, from which Mrs. Lisa-Maria Otz and Mr. Urs Otz were selected as well qualified for the job. I am convinced that Mr. and Mrs. Otz will

be able to meet the double demand of serving international clientele with technical support for research as well as being the hosts in the Research Station.

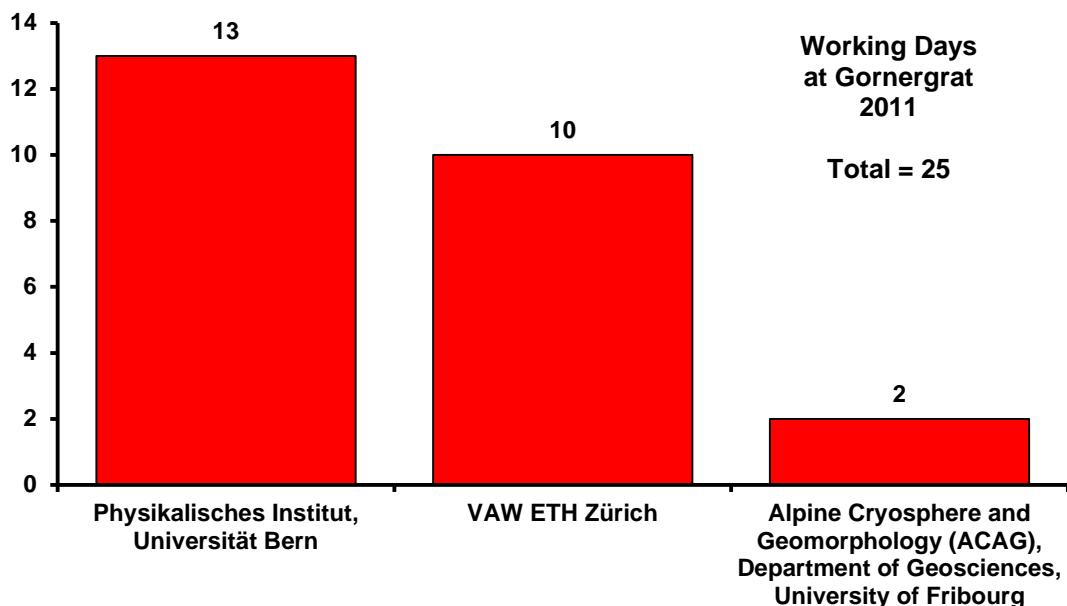
### The High Altitude Research Station Gornergrat

The observatory at Gornergrat is in a transition phase after the KOSMA project was concluded at the end of 2010. The new project Stellarium Gornergrat has started well, and the first part of the instrumentation – an all-sky camera – was installed in August 2011. The financial funding of the Stellarium Gornergrat project comes from the two host universities, i.e. University of Bern (Physics Institute) and the Université de Genève (Observatoire de Genève), from the Burgergemeinde Zermatt, and from an SNF grant under the SNF program AGORA, which aims to intensify the dialogue between science and society by supporting researchers in communicating their knowledge with the public.

The time between routine operations at the Gornergrat observatory was used to make revisions on the hydraulic system of the south dome. The hydraulic system was dismantled and shipped to Birrer Hydraulics at Buttisholz, where it was thoroughly revised.

It is planned that the telescopes will be ordered in spring 2012. This would allow an installation in autumn 2012 and testing phase at the end of 2012.

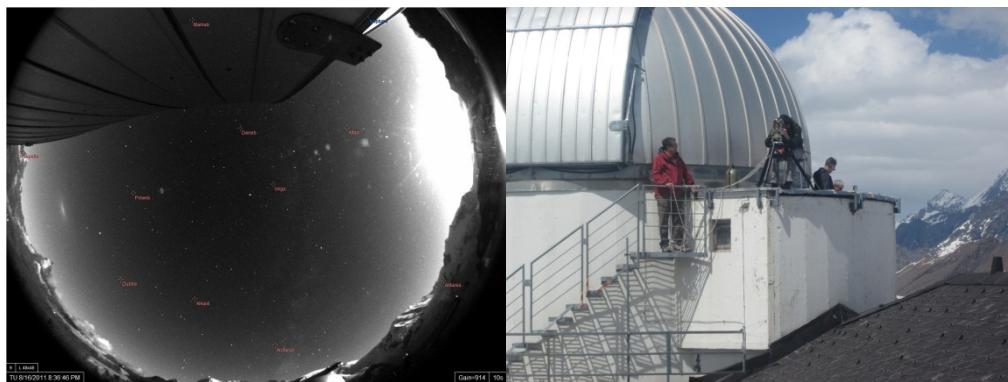
Teams and projects at the High Altitude Research Station Gornergrat are less numerous than at Jungfraujoch as documented by its statistics. In 2011, 3 (2010: 6) teams were active at Gornergrat. Among a total of 3 (2010: 5) research projects, 2 (2010: 2) were primarily based on automatic measurements around the clock.



**Figure 13.** Number of working days at the High Altitude Research Station Gornergrat in 2011 by research groups



**Figure 14.** Installation of the all-sky camera at the North tower of the Gornergrat observatory



**Figure 15.** First pictures from the all-sky camera (left) after its mounting by personnel of the University of Bern and a local company under the inspection of HFSJG.

### Summary and Acknowledgements

The year 2011 – the International Year chemistry – has given us again a wealth of new knowledge that substantiates our continued support of research at the High Altitude Research Station Jungfraujoch. The many peer-reviewed publications, the individual activity reports, and the conference contributions document and justify the importance of the HFSJG support regarding infrastructure, maintenance and administration. This ongoing commitment secures the key role of the Research Station Jungfraujoch in a dynamic field of research facilities.

At Gornergrat, a new era has begun with the installation of the all-sky camera, a first small step in the Stellarium Gornergrat project. The HFSJG is proud to continue the tradition of astronomical observations at Gornergrat that started with the construction of a solar observatory by the Astronomic Institute, University of Oxford (Prof. D.E. Blackwell) in 1966/67 in the north tower as well as the construction of an astronomic observatory by the „Centre National Français de la Recherche Scientifique (CNRS)“

and the „Observatoire de Genève“ (Proff. J. Lequeux and M. Golay) in the same year. It is noteworthy that the cupola and 40cm telescope from Jungfraujoch were moved to the south tower at that time.

HFSJG is well aware that the success of our Research Stations is based on the support of many partners. Among them is certainly the international structure of our foundation with its members and their representatives, the Swiss National Science Foundation for the most significant funding, the research organisations using the HFSJG infrastructure, the scientists for their enthusiasm devoted to research, and the administrative personnel of HFSJG. In particular, I would like to thank the three custodian couples who were engaged at Jungfraujoch over the course of 2011, Mrs. and Mr. Fischer, Mrs. and Mr. Seiler as well as Mrs. and Mr. Otz for their continuously excellent and competent work and for providing researchers with a friendly and motivating atmosphere.

Accessibility to both research stations is often taken for granted since both railways, the Jungfrau Railways and the Gornergrat Bahn, exist now for more than 100 years. I would like to congratulate the Jungfrau Railways on its centennial and wish them all the best for the upcoming celebration year 2012. We are aware that the success of both companies is only possible with visionary strategies and investments. We are very thankful to find both companies in good and healthy condition in a very competitive environment, which in turn is extremely beneficial for us. Therefore, I would like to thank the Jungfrau Railway Holding AG, the Matterhorn Gotthard Railway and Gornergrat Railway for the good collaboration. Without their goodwill and their substantial support, both research stations would not be what they are today.

The Board of the Jungfrau Railway Holding AG under its president Prof. Thomas Bieger, the management and personnel of the Jungfrau Railways under Chief Executive Officer Urs Kessler, as well as the Board of the Sphinx AG under its chairman Jürg Lauper were especially busy during the preparative phases of the centennial, yet they were and still are open and mostly positive toward our needs, which quite often conflict with touristic objectives. In this regard, 2011 was a difficult year since the long construction work at Jungfraujoch led to severe problems regarding the most sensitive in-situ measurements performed at the Sphinx observatory. Nevertheless both parties understood each other's situation and searched for acceptable solutions. These times require continuous exchange of information in order for us to benefit from each other. In this respect we express our special thanks to Mr. Jürg Lauper, head of infrastructure and his deputy, Mr. Heinz Schindler, to Mr. Gabriel Roth, head of Zugförderung und Werkstätte (ZfW/JB) und Leiter Jungfraubahnen AG, to Mr. Andreas Wyss, chief of technical services and maintenance division, and his team. HFSJG is very grateful to Mrs. Brigitte Soche and Mr. Martin Soche and the personnel of the restaurants at the Top of Europe for the excellent hosting of our staff, scientists, and visitors.

For Gornergrat our thanks go to the Board of the Matterhorn Gotthard Railway under its president Jean-Pierre Schmid, the management and personnel of the Matterhorn Gotthard Railway under Chief Executive Officer Hans-Rudolf Mooser and its representative in the board HFSJG, Mr. René Bayard. I would like to thank Mr René Bayard and the Gornergrat Bahn for organising the excursion to Gornergrat on the occasion of HFSJG Board meeting 2011 in Zermatt. This continuous support is essential for the scientific success at Gornergrat, particularly in this current phase of transition. In this regard, we would like to express our deepest thanks to the

Bürgergemeinde Zermatt under the presidency of Mr. Andreas Biner, to the members of the Burgerrat, and to Mr. Fernando Clemenz for the continued support and particularly for their involvement in the new Stellarium Gornergrat project. A big thank you goes to Mrs. Nicole Marbach and Mr. Thomas Marbach, the directors of the Kulm Hotel and their team, for their warm hosting of HFJSG staff and researchers. Without their goodwill and support it would not be possible to operate an astrophysical observatory at such a magnificent site.

The HFSJG is honoured to count many organisations and institutions that make use of our infrastructures, since only through use do they become visible in various scientific communities and lead to a renown of high altitude research of highest standard. Therefore, we thank all scientists for their dedication and good collaboration to and among research projects at Jungfraujoch and Gornergrat.

Long-term experiments and records make a station truly important. Therefore all organisations and institutions putting great effort into these programs are highly acknowledged. Our science exhibition that will be opened in April 2012, will allow us to visualise at least part of these important activities.

Good infrastructure is an important ingredient for good science. Nearly two years ago we significantly improved the internet connection to Jungfraujoch that has run smoothly ever since – otherwise we would have heard about it from the researchers. In this respect we thank SWITCH for maintaining stable conditions, as well as Christian Heim and Fritz Bütkofer from the Informatikdienste der Universität Bern for their continuous excellent support in IT matters.

At the administrative office in Bern I would like to thank Dr. Rolf Bütkofer, the IT assistant HFSJG for his excellent work throughout the year and in particular for his tremendous work for the new Stellarium Gornergrat project as well as the preparation of the upcoming science exhibition. We thank Mrs. Louise Wilson for her – well-known – friendly and warm, yet clear, efficient and constructive spoken and written communication. Unfortunately, this activity report will be her last one since she will retire in May 2012. Thanks go to Mr. Karl Martin Wyss for his competent services as our treasurer, and Mr. Christian Gasser for the bookkeeping, and the professional auditing by Treuhand Cotting AG, Bern (Mr. Harro Lüdi). For Mr. Christian Gasser, 2011 is his last bookkeeping year for the Foundation. I would like to sincerely thank him for the many years of excellent bookkeeping and close collaboration with Louise Wilson. I am particularly grateful to the University of Bern, its Rector Prof. Dr. Martin Täuber and the Administrative Director, Dr. Daniel Odermatt, and the director of the Physikalisches Institut, Prof. Willy Benz, for the hospitality and support of our administration.

I conclude this report to thank particularly Prof. Erwin Flückiger and Prof. Hans Balsiger for their constant interest in HFSJG matters and for their openness for discussions. And as a final remark, I would be pleased to welcome our readers at Jungfraujoch to see our science exhibition that will be opened starting April 2012. See you there!



Bern, February 8, 2012

Markus Leuenberger