

Report of the Director

The year 2015, the warmest on instrumental record, brought much better weather conditions during summer and autumn than in 2014. This allowed us to finalize the work on the new protection roof of the Research Station Jungfrauoch. The first experiences with the new, steeper protection roof are positive in that the snow load slides down when warming up.

More than one million tourists have visited Jungfrauoch last year. Now the goal – announced way back by the Jungfraubahn CEO – is reached. It is a tremendous economic achievement. Congratulations to the Jungfraubahn AG. However, an unprecedented steep increase of tourist numbers in this region must go along with intensified discussions between the Jungfraubahn and HFSJG to take actions to control local emissions.

On the Gornergrat, the Stellarium project is shaping towards a very interesting destination for students but also for the public at large. Already for the third year, the public outreach event “Dining with the stars” has been successfully organised in collaboration with the Gornergrat-Kulmhotel, the Gornergrat Bahn and the Burgergemeinde Zermatt.

The Foundation HFSJG

In 2015 our Board meeting took place on September 4/5 in Zermatt. The president especially welcomed Prof. St. Udry, University of Geneva, who attended this meeting for the first time, Prof. H. Gäggeler, the new president of the Jungfrauoch-Commission and delegate of the SCNAT, Prof. M. Huber, the immediate past president of the Jungfrauoch-Commission, and Prof. S. Decurtins, University of Bern, the designated president of the Foundation HFSJG. Prof. R. Davies, the delegate of the Royal Society had to cancel his participation due to health problems and resigned as delegate on short notice. No replacement person could be found. Therefore, no representative of the Royal Society was present, however a ballot sheet with the votes of the Royal Society was available. The statement of accounts for the year 2014 was approved and the HFSJG administration was given discharge. The budget for 2015 and 2016 was approved by the Board, who took notice of the extraordinary expenses allowed for the extension of the protection net for falling rocks above the research station and the renewal of the fresh and waste water linings therein. The CORE Treuhand Cotting AG (Mr. Lüdi) was elected for an additional two years term as auditor, namely the years 2016 and 2017.



Figure 1. From left to right, the three delegates Jürg Lauper, Jungfraubahn, Martin Heimann, Max Planck Gesellschaft, Germany and Heinz Gäggeler, SCNAT during the coffee break at the meeting of the Board on September 4, 2015 at Zermatt (left) and excursion to Gornergrat with the delegates of the Foundation HFSJG, Saturday September 5, 2015 (right).

Prof. Erwin Flückiger announced to resign as president of the International Foundation HFSJG at the end of February 2016. He was active first of all as scientist at Jungfrauoch since 1968 and served as director of the Research Stations Jungfrauoch and Gornergrat

between 1999 and 2009 as well as president of the International Foundation HFSJG from 2010 to 2016. For his tremendous commitment he was elected as corresponding member of the Foundation after being nominated by the honorary president Prof. Balsiger.

According to the Foundation's bylaws, the election of the president occurs through the Swiss Academy of Sciences SCNAT. The nomination of the candidate is made by the Jungfrauoch-Commission of the SCNAT. The president of the Jungfrauoch-Commission, Mr. H. Gäggeler, was looking for a possible successor – together with the honorary president, Mr. H. Balsiger. After a careful evaluation, Prof. Silvio Decurtins of the University of Bern was suggested as a qualified candidate to the members of the Jungfrauoch-Commission. At the 2015 annual meeting of the Jungfrauoch-Commission, Mr. Decurtins was officially nominated for the office of president of the Foundation. In the meantime the SCNAT approved the nomination and confirmed Mr. Decurtins as the new president of the International Foundation HFSJG as of March 1, 2016.



Figure 2. New protection roof of the Research Station Jungfrauoch after finalizing the work in autumn 2015. Below is the extended photovoltaic power plant for panel testing.

The annual meeting of the Jungfrauoch Commission of the Swiss Academy of Sciences was held on June 19, 2015 at the House of Sciences, Bern. In June 2015, the Foundation HFSJG in collaboration with the SCNAT published the White Paper: Research at Jungfrauoch – Vision and Mission Statement 2015 – 2050. Strategy for the development of the unique, internationally renowned High Altitude Research Station Jungfrauoch.

The Jungfrauoch Commission and the Swiss Committee on Polar and High Altitude Research of the SCNAT agreed to share and award the Prix de Quervain alternately. On November 5, 2015, the president of the Jungfrauoch Commission handed over the Prix de Quervain to three persons, namely Dr. S. Sylvester for his PhD thesis, C. Gabbud for her Master thesis and an extraordinary prize to M. Heiniger for his movie “Base Camp Circus”.

The annual HFSJG user meeting took place at the Hotel Bern on May 8, 2015. After discussing agenda items related to the two research stations, Ms. Jost, co-ordinator of International Affairs, Federal Office for Spatial Development ARE, was informing the participants about the activities within the framework of the Alpine convention and more specifically about the EU Strategy for the Alpine Region (EUSALP) where the initiative from

Germany to promote the Virtual Alpine Observatory may be of importance for the Foundation HFSJG.

Hans Boss, the HFSJG architect, will resign after having had this mandate for many decades. We had two interviews with potential successors and decided to give this mandate to the ateliermarti architekten ag from Unterseen.



Figure 3. Erwin Flückiger (right) and Hans Boss (left) will resign as president and architect of our Foundation HFSJG in 2016.

We sadly took notice of the decease of three former supporters of our Foundation: Prof. Rodney Davies, Professor of radio astronomy at the University of Manchester and – among many other prestigious positions – a delegate of the Royal Society in our Foundation HFSJG, passed away on November 8, 2015, Prof. Marcel Golay, astronomer and well known for his development of the 7-color photometry and corresponding member of our Foundation, passed away on April 9, 2015 and Prof. Urs Würzler, mathematician and rector of the University of Bern as well as corresponding member of our Foundation, passed away on November 16, 2015. We also are in deep sadness about the decease of Adrian Marti-Berger, 51 years of age, on July 14, 2015 during his work as helicopter pilot.

The High Altitude Research Station Jungfraujoch

The High Altitude Research Station Jungfraujoch is proud of the many science projects of national and international importance. In 2015, 37 (2014:43) research institutions were active at Jungfraujoch. About 25 of 48 (2014:62) research projects at Jungfraujoch are automated and remotely accessible by their corresponding institutions. The significant reduction of projects is because no larger campaign was on-going in 2015.

Involvement in international programmes is essential for many of the above mentioned projects: The two programmes, Global Atmosphere Watch (GAW) and the Network of Detection of Atmospheric Composition Change (NDACC), can count on many projects conducted at Jungfraujoch. However, international embedment is not restricted to these two but extents to a large variety of programmes, listed in Table 1.

In 2015, projects with principal investigators from ten different countries as displayed in Figure 4 could be welcomed and hosted at Jungfraujoch. When taking collaborations into account, the number of countries involved increases to 14 as visible in Figure 5. All this information can also be retrieved from the HFSJG Webpage.

(<http://www.hfsjg.ch/jungfraujoch/researchprojects/overview.php>)

The number of working days is varying quite strongly from year to year mainly due to the number of campaigns present during a year. In 2015, only one medical campaign was held at Jungfraujoch, hence only 720 (1393 in 2014) person-working days were counted. The importance of campaigns is visualised in Figure 6 with the number of working days split into different categories. Half of the working days were spent by staff from Swiss institutions, followed by Belgium and Austrian organisations.

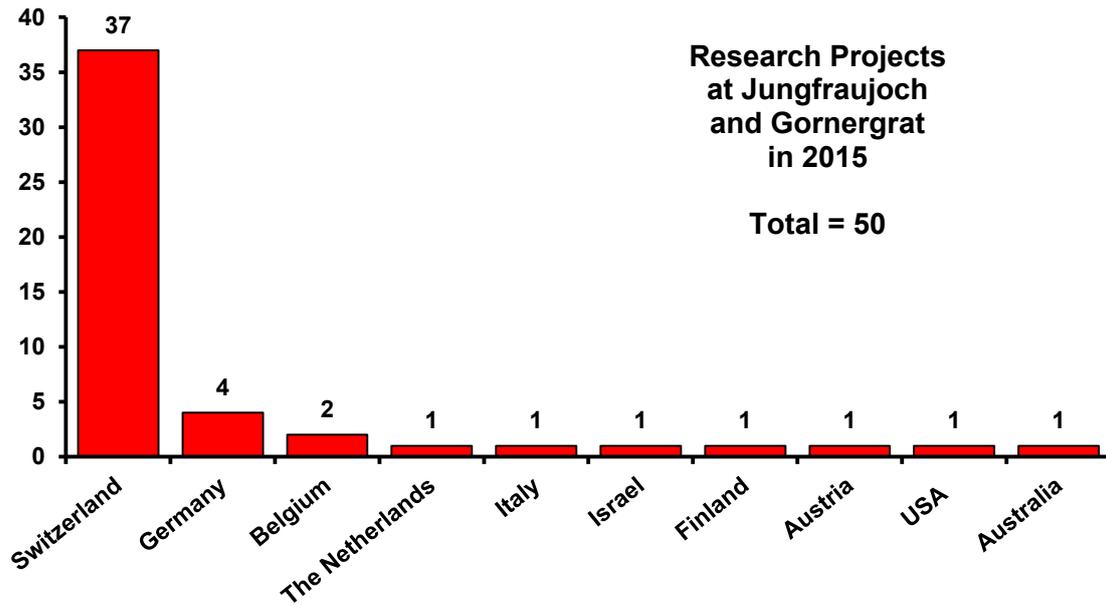


Figure 4. Number of research projects at the High Altitude Research Stations Jungfraujoch and Gornergrat in 2015 by country.

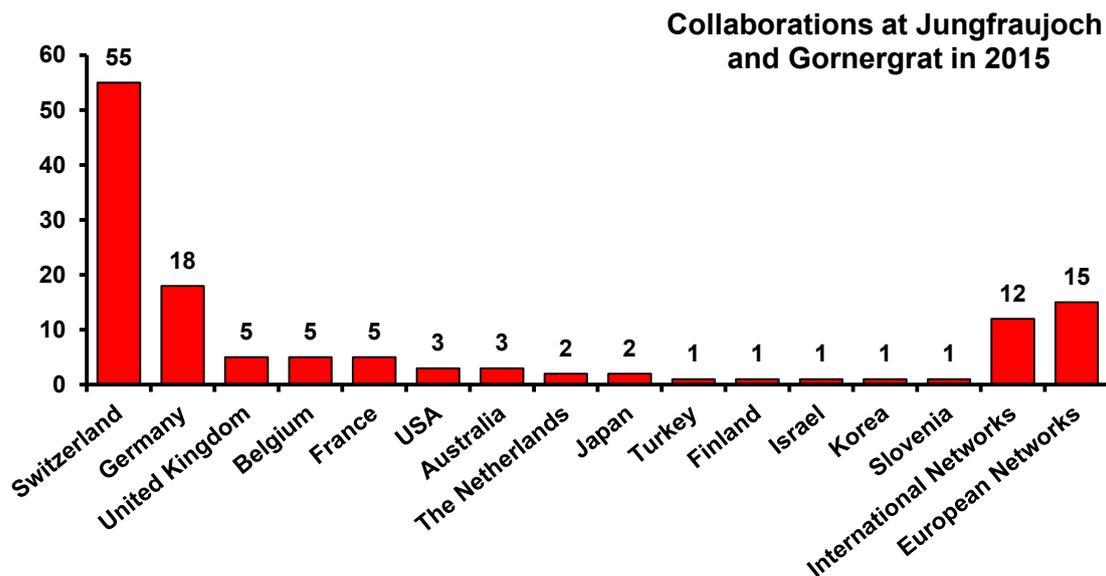


Figure 5. Number of collaborations at the High Altitude Research Stations Jungfraujoch and Gornergrat in 2015.

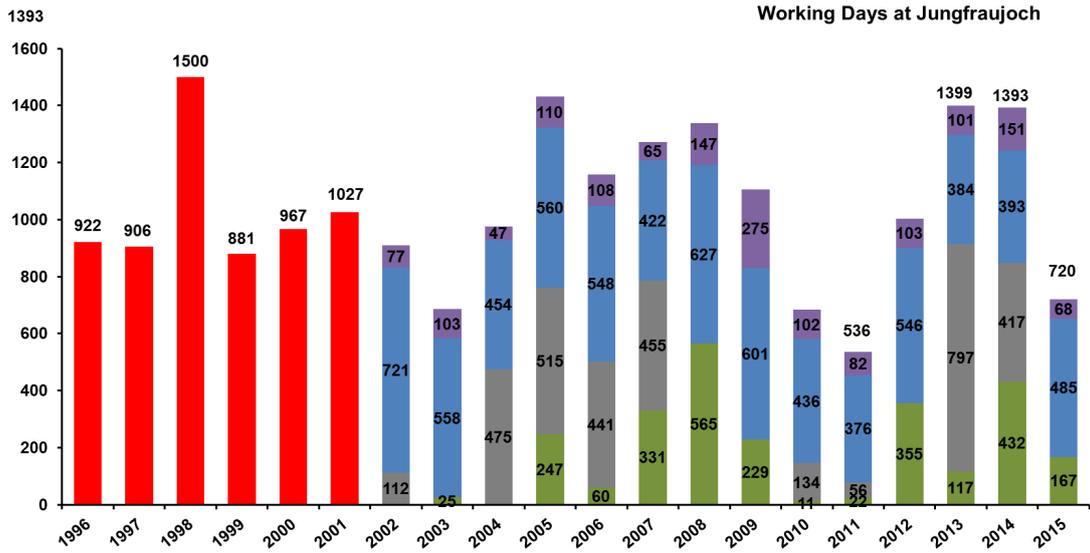


Figure 6. Number of working days spent by scientists at the High Altitude Research Station Jungfrauojoch during the past years. The number in 2015 was split up into four categories, i.e. medical campaigns (green), CLACE campaign (grey), atmospheric research (blue), others (purple).

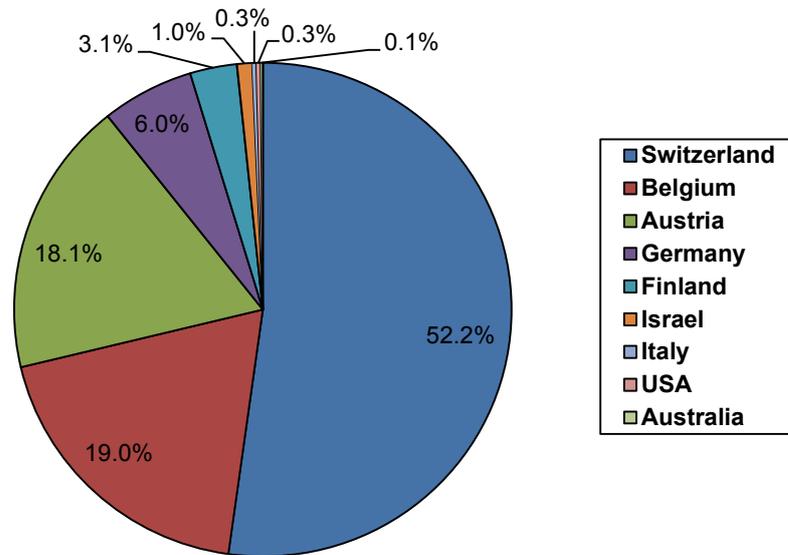


Figure 7. Percentage of person-working days in 2015 at the High Altitude Research Station Jungfrauojoch per country.

The research conducted at Jungfraujoch resulted in the following output in 2015:

- 47 refereed publications
- 49 conference presentations / posters
- 6 popular publications and presentations
- 9 data publications and reports
- 10 bachelor- (0), master- (2), PhD (8) thesis and
- 0 book / edited books

Researchers active at Jungfraujoch presented once again their results at many national and international conferences in 2015 including: AAAR 34th Annual Conference, Minneapolis, USA, October 12-16, 2015; European Aerosol Conference, Milano, Italy, September 6-11, 2015; ATMOS 2015 conference, University of Crete, Heraklion, Greece, June 8-12, 2015; EGU 2015 General Assembly, Vienna, Austria, April 12-17, 2015; NDACC-IRWG meeting, University of Toronto, Toronto, ON, Canada, June 8-12, 2015; 10. Deutsche Klimatagung, Hamburg, Germany, September 21-24, 2015; IUGG General Assembly, Prague, Czech Republic, June 22 – July 2, 2015; American Geophysical Union, San Francisco, CA, USA, December 14-18, 2015; Goldschmidt Conference, Prague, Czech Republic, August 16-21, 2015; Gordon Research Conferences, Atmospheric Chemistry, Waterville, NH, USA, August 2-7, 2015; Chemistry of Atmospheric Aerosols, Honolulu, HI, USA, December 15-20, 2015; ACTRIS-2 Kick-off Meeting, Rome, Italy, June 3-5, 2015; 16th Swiss Global Change Day, Bern, Switzerland, April 1, 2015; MIR Spectroscopy beyond trace levels - environmental and industrial applications, CLEO, San Jose, USA, May 10-15, 2015; VAO Symposium 2015 Abstracts, p. 64, Salzburg, Austria, October 27-30, 2015; GAS 2015, Rotterdam, Netherlands, June 11, 2015; 13th Swiss Geoscience Meeting, Basel, Switzerland, November 21, 2015.

The science partners did once again an excellent job. Thank you very much. This is documented by the number of publications, the presentations in form of an oral or poster contribution at conferences as well as in contributions to the media and therefore to the public. Many of these studies have been funded within an international setting as documented by Table 1. From the many exciting and interesting research projects conducted throughout the year 2015, I would like to highlight three investigations: (i) efficient removal of ice nucleation active particles by precipitating clouds, (ii) cloud radiative effect in dependence on cloud type and (iii) isotopic composition of N₂O at Jungfraujoch.

(i) Franz Conen and co-workers investigated ice nucleation particles. Ice nucleation in cold clouds is a decisive step in the formation of rain and snow. Observations and modelling suggest that variations in the concentrations of ice nucleating particles (INPs) affect timing, location and amount of precipitation. A quantitative description of the abundance and variability of INPs is crucial to assess and predict their influence on precipitation. Here we used the hydrological indicator $\delta^{18}\text{O}$ to derive the fraction of water vapour lost from precipitating clouds and correlated it with the abundance of INPs in freshly fallen snow. Results show that the number of INPs active at temperatures ≥ -10 °C (INPs₋₁₀) halves for every 10% of vapour lost through precipitation. Particles of similar size (>0.5 μm) halve in number for only every 20% of vapour lost, suggesting effective microphysical processing of INPs during precipitation. We show that INPs active at moderate supercooling are rapidly depleted by precipitating clouds, limiting their impact on subsequent rainfall development in time and space.

Fraction of water vapour lost

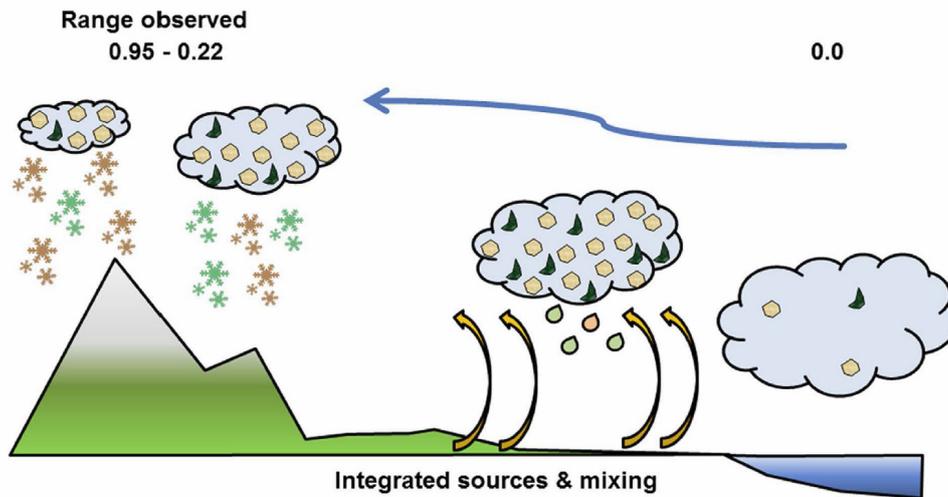


Figure 8. Relationship between the fraction of water vapour lost from a precipitating cloud (derived from stable isotope ratios in snow ($\delta^{18}O$)) and ice nucleating particles (INPs, measured in snow).

Stopelli, E., F. Conen, C.E. Morris, E. Herrmann, N. Bukowiecki, and C. Alewell, Ice nucleation active particles are efficiently removed by precipitating clouds, Scientific Reports, 5, 16433, 2015.

(ii) Julian Gröbner and his team investigated effects of clouds on radiation. The objective of the project CRUX (Comprehensive Radiation Flux Assessment) is to analyse the effect of clouds on the radiation budget of the Earth and therefore on the climate system. This analysis is performed at three stations at three different altitude levels in Switzerland: Jungfraujoch (3471 m asl), Davos (1590 m asl) and Payerne (490 m asl). CRUX is financed by the Swiss contribution to the Global Atmosphere Watch Programme (GAW-CH) of the WMO. Figure 1 shows the LCE (left) per octa cloud coverage (yellow dots) and the SCE in percent (right) per octa cloud coverage for the automatic detected cloud class fog. The larger the cloud coverage, the larger the LCE. However, the correlations between LCE and cloud coverage as well as SCE and cloud coverage are both not linear. Also for the SCE, the larger the fractional cloud coverage the more negative the SCE values.

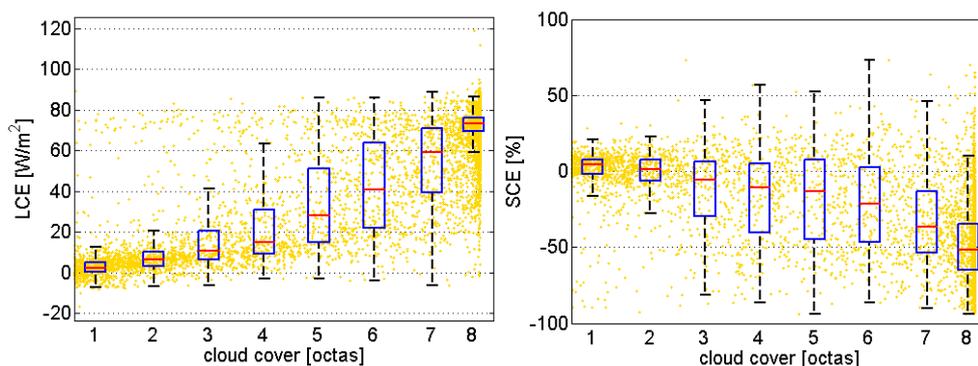


Figure 9. Correlation between cloud cover and longwave cloud effect (left; yellow dots) and cloud cover and shortwave cloud effect (right; yellow dots) for the cloud type fog for Jungfraujoch in the time period from August 1, 2014 to June 22, 2015. The median (red line), the 25- and 75-percentiles (blue box) and the spread (black line) are shown per octa cloud coverage. 1 octa: 5-18.74 %, 2 octa: 18.75-31.24 %, 3 octa: 31.25-43.74 %, 4 octa: 43.75-56.24 %, 5 octa: 56.25-68.74 %, 6 octa: 68.75-81.24 %, 7 octa: 81.25-93.74 %, 8 octa: 93.75-100 % cloud coverage.

Aebi Ch., J. Gröbner, N. Kämpfer and L. Vuilleumier, Cloud radiative effect in dependence on cloud type, poster presentation at EGU General Assembly, Vienna, Austria, April 12 – 17, 2015.

(iii) Joachim Mohn and his team sampled air in flasks and analysed it for N₂O concentration and their isotope compositions using a laser technology.

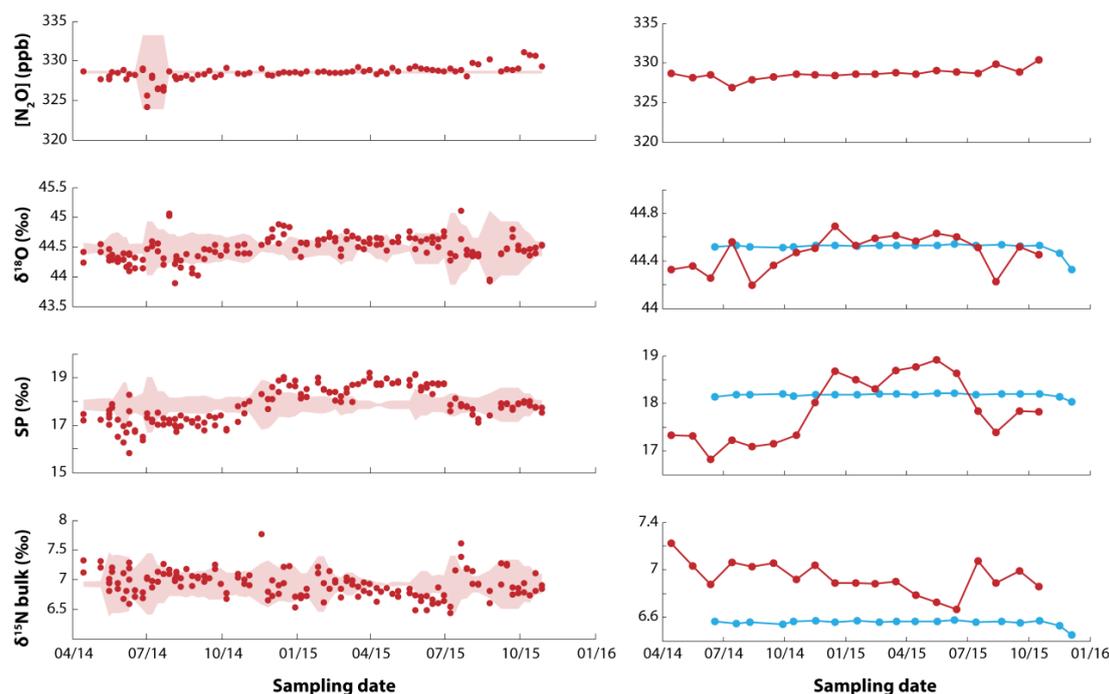


Figure 10. N₂O mole fraction and isotope data from flask samples collected at Jungfraujoch. Individual weekly samples are shown in the left panel, with the 2 σ uncertainty indicated as the shaded area (deviating from the mean). The right panel shows monthly mean data in red, as well as monthly mean values for repeated measurements of compressed air in blue. The compressed air tank was changed in late 2015, accounting for the shift in the last two points.

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

- Barthlott, S. et al., Atmospheric Measurement Techniques, 2015 use XCO₂ retrievals for assessing the long-term consistency of NDACC/FTIR data sets,
- Baudis, L., et al., European Physical Journal C, 2015 investigated cosmogenic activation of xenon and copper.
- Bergamaschi P. et al., Atmospheric Chemistry and Physics, 2015 report top-down estimates of European CH₄ and N₂O emissions based on four different inverse models.
- Chambers, S.D. et al, Aerosol and Air Quality Research, 2015 report about towards a universal “baseline” characterisation of air masses for high- and low-altitude observing stations using radon-222.
- Conen, F., et al., Tellus Series B-Chemical and Physical Meteorology, 2015 investigated atmospheric ice nuclei at the high-altitude observatory Jungfraujoch, Switzerland.
- Cristofanelli, P., et al, Atmospheric Environment, 2015 report about long-term surface ozone variability at Mt. Cimone WMO/GAW global station (2165 m a.s.l., Italy).
- Dammers, E., et al, Atmospheric Chemistry and Physics, 2015 report retrieval of ammonia from ground-based FTIR solar spectra.
- Dufлот, V., et al., Atmospheric Chemistry and Physics, 2015 studied acetylene (C₂H₂) and hydrogen cyanide (HCN) from IASI satellite observations: global distributions, validation, and comparison with model.
- Fernandez, S., et al., Atmos. Meas. Tech., 2015 developed a novel ground-based microwave radiometer for ozone measurement campaigns (GROMOS-C).
- Flentje, H., et al., Atmospheric Environment, 2015 identified and monitored Saharan dust: An inventory representative for south Germany since 1997.
- Fortems-Cheiney, A., et al., Geophys. Res. Atmos., 2015 report an increase in HFC-134a emissions in response to the success of the Montreal Protocol.
- Franco, B., et al., Atmospheric Chemistry and Physics Discussions, 2015 studied diurnal cycle and multi-decadal trend of formaldehyde in the remote atmosphere near 46° N.
- Franco, B., et al., Atmos. Meas. Tech., 2015 report retrievals of formaldehyde from ground-based FTIR and MAX-DOAS observations at the Jungfraujoch station and comparisons with GEOS-Chem and IMAGES model simulations.
- Franco, B., et al., J. Quantitative Spectroscopy & Radiative Transfer, 2015 investigated the retrieval of ethane from ground-based FTIR solar spectra using improved spectroscopy: Recent burden increase above Jungfraujoch.
- Fröhlich, R., et al., Atmos. Chem. Phys., 2015 report about fourteen months of on-line measurements of the non-refractory submicron aerosol at the Jungfraujoch (3580 m a.s.l.) – chemical composition, origins and organic aerosol sources.

- Grazioli, J., et al., *Atmos. Chem. Phys.*, 2015 report polarimetric radar and in situ observations of riming and snowfall microphysics during CLACE 2014.
- Haberkorn A., et al., *Cold Regions Science and Technology*, 2015 studied snow as a driving factor of rock surface temperatures in steep rough rock walls.
- Hammer, E., et al., *Atmospheric Chemistry and Physics*, 2015 calculated sensitivity estimations for cloud droplet formation in the vicinity of the high-alpine research station Jungfraujoch (3580 m a.s.l.).
- Henne S., et al., *Atmospheric Chemistry and Physics Discussions*, 2015 validated the Swiss methane emission inventory by atmospheric observations and inverse modelling.
- Herrmann, E., et al., *Journal of Geophysical Research-Atmospheres*, 2015 report about analysis of long-term aerosol size distribution data from Jungfraujoch with emphasis on free tropospheric conditions, cloud influence, and air mass transport.
- Hoerger, C.C., et al., *Atmos. Meas. Tech.*, 2015 conducted an ACTRIS non-methane hydrocarbon intercomparison experiment in Europe to support WMO GAW and EMEP observation networks.
- Hoyle C. et al., *Atmospheric Chemistry and Physics Discussions*, 2015 discuss chemical and physical influences on aerosol activation in liquid clouds: an empirical study based on observations from the Jungfraujoch, Switzerland.
- Huss, M., et al., *Journal of Glaciology*, 2015 present a new long-term mass balance series for the Swiss Alps.
- Inness, A., et al., *Atmos. Chem. Phys.*, 2015 present a data assimilation of satellite retrieved ozone, carbon monoxide and nitrogen dioxide with ECMWF's Composition-IFS.
- Kienast-Sjögren, E., et al., *Atmos. Chem. Phys.*, 2015 report sensitivities of Lagrangian modelling of mid-latitude cirrus clouds to trajectory data quality.
- Kupiszewski, P., et al., *Atmos. Meas. Tech.*, 2015 present the Ice Selective Inlet : a novel technique for exclusive extraction of pristine ice crystals in mixed-phase clouds.
- Langerock, B., et al., *Geosci. Model Dev.*, 2015 give a description of algorithms for co-locating and comparing gridded model data with remote-sensing observations.
- Lloyd, G., et al., *Atmos. Chem. Phys.*, 2015 present the origins of ice crystals measured in mixed-phase clouds at the high-alpine site Jungfraujoch.
- Lunt, M.F., et al., *Proc. Natl. Acad. Sci. USA*, 2015 reconcile reported and unreported HFC emissions with atmospheric observations.
- Meola, M., et al., *Frontiers in Microbiology*, 2015 report about bacterial Composition and Survival on Sahara Dust Particles Transported to the European Alps.
- Paramonov, M., et al., *Atmos. Chem. Phys.*, 2015 present a synthesis of cloud condensation nuclei counter (CCNC) measurements within EUCAARI network.
- Povinec, P.P., et al., *Radiocarbon*, 2015 report radiocarbon in the atmosphere of the Zlkovce monitoring station of the Bohunice NPP: 25 years of continuous monthly measurements.
- Scheepmaker, R.A., et al., *Atmospheric Measurement Techniques*, 2015 present a validation of SCIAMACHY HDO/H₂O measurements using the TCCON and NDACC-MUSICA networks.
- Schibig, M.F., et al., *Atmos. Meas. Tech.*, 2015 report about a comparison of continuous in situ CO₂ observations at Jungfraujoch using two different measurement techniques.
- Schmidt, S., et al., *Atmos. Chem. Phys. Discuss.*, 2015 present a in-situ single submicron particle composition analysis of ice residuals from mountain-top mixed-phase clouds in Central Europe.
- Schultz M. G., et al., *Elementa*, 2015 discuss the Global Atmosphere Watch reactive gases measurement network.
- Stopelli, E., et al., *Scientific Report*, 2015 report about ice nucleation active particles are efficiently removed by precipitating clouds.
- Van Geffen, J.H.G.M. et al *Atmospheric Measurement Techniques*, 2015 report an improved spectral fitting of nitrogen dioxide from OMI in the 405–465 nm window.
- Vigouroux, C., et al., *Atmos. Chem. Phys.*, 2015 report trends of ozone total columns and vertical distribution from FTIR observations at eight NDACC stations around the globe.
- Vochezer, P., et al., *Atmos. Meas. Tech. Discuss.*, 2015 report in situ characterization of mixed phase clouds using the Small Ice Detector and the Particle Phase Discriminator.
- Vollmer, M.K., et al., *Environmental Science & Technology*, 2015 present first observations of the fourth generation synthetic halocarbons HFC-1234yf, HFC-1234e(E), and HCFC-1233zd(E) in the atmosphere.
- Vollmer, M.K., et al., *Geophys. Res. Lett.*, 2015 report modern inhalation anesthetics: Potent greenhouse gases in the atmosphere.
- Vollmer, M.K., et al., *Geophys. Res. Lett.*, 2015 present abrupt reversal in emissions and atmospheric abundance of HCFC-133a (CF₃CH₂Cl).
- Wacker, S., et al., *J. Geophys. Res.*, 2015 report cloud observations in Switzerland using hemispherical sky cameras.
- <http://dx.doi.org/10.1002/2014JD022643>
- Wang, Y., et al., *Atmospheric Chemistry and Physics Discussions*, 2015 present towards understanding the variability in biospheric CO₂ fluxes: using FTIR spectrometry and a chemical transport model to investigate the sources and sinks of carbonyl sulfide and its link to CO₂.
- Worringer, A., et al., *Atmos. Chem. Phys.*, 2015 report single-particle characterization of ice-nucleating particles and ice particle residuals sampled by three different techniques.

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

NDACC	Network for the Detection of Atmospheric Composition Change Primary Site (http://www.ndsc.ncep.noaa.gov/)
GAW, GAW-CH	Global Atmosphere Watch, Global GAW Station (http://www.wmo.int/pages/prog/arep/gaw/gaw_home_en.html), and http://www.meteoschweiz.admin.ch/home/forschung-und-zusammenarbeit/internationale-zusammenarbeit/gaw.html)
GAW-PFR	GAW Aerosol Optical Depth (AOD) Network (http://www.pmodwrc.ch/worcc/index.html)
GCOS	Global Climate Observing System (http://www.wmo.int/pages/prog/gcos/)
GCOS-CH	Swiss GCOS office (http://www.meteoschweiz.admin.ch/home/forschung-und-zusammenarbeit/internationale-zusammenarbeit/gcos.html)
AGAGE	Advanced Global Atmospheric Gases Experiment Collaborative Sampling Station (http://agage.eas.gatech.edu/)
NADIR/NILU	NILU's Atmospheric Database for Interactive Retrieval (http://www.nilu.no/nadir/)
EUMETNET	Network of European Meteorological Services (http://www.eumetnet.eu/)
SwissMetNet	Automatic Measuring Network of MeteoSwiss (http://www.meteoschweiz.admin.ch/home/mess-und-prognosesysteme/bodenstationen/automatisches-messnetz.html)
RADAIR	Swiss Automatic Network for Air Radioactivity Monitoring (http://www.bag.admin.ch/themen/strahlung/00045/02372/02374/index.html?lang=de)
ICOS	Integrated Carbon Observation System (https://www.icos-ri.eu/)
NADAM	Netz für automatische Dosis-Alarmierung und Meldung (https://www.naz.ch/de/aktuell/tagesmittelwerte.shtml)
NABEL	Nationales Beobachtungsnetz für Luftfremdstoffe - National Air Pollution Monitoring Network (http://www.bafu.admin.ch/luft/00612/00625/index.html?lang=de)
AGNES	Automated GPS Network for Switzerland (http://www.swisstopo.admin.ch/swisstopo/geodesy/pnac/html/en/statjujo.html)
PERMASENSE	Wireless Sensing in High Alpine Environments (http://www.permasense.ch/)
PERMOS	Permafrost Monitoring Switzerland (http://www.permos.ch/)
NMDB	Real-Time Database for High Resolution Neutron Monitor Measurements (http://www.nmdb.eu)
E-GVAP I + II	The EUMETNET GPS Water Vapour Programme (http://egvap.dmi.dk/)
ACTRIS	ACTRIS is the European Research Infrastructure for the observation of Aerosol, Clouds, and Trace gases (http://www.actris.eu/)
Swiss Glacier Monitoring Network	Federal Office for the Environment (BAFU) (http://glaciology.ethz.ch/messnetz/?locale=en)
EARLINET-ASOS	European Aerosol Research Lidar Network – Advanced Sustainable Observation System (http://www.earlinetasos.org)
InGOS	Integrated non-CO ₂ Greenhouse Gas Observing System (http://www.ingos-infrastructure.eu)
NORS	Network of Remote Sensing (http://nors.aeronomie.be)
AGACC-II	Advanced exploitation of Ground based measurements, Atmospheric Chemistry and Climate applications (http://agacc.aeronomie.be)
EMEP	European Monitoring and Evaluation Programme (http://www.emep.int)
GAIA-CLIM	Gap Analysis for Integrated Atmospheric ECV CLimate Monitoring (http://www.gaia-clim.eu/)
QA4ECV	Quality Assurance for Essential Climate Variables (http://www.qa4ecv.eu/)

Most of the measurements made at Jungfraujoch are publicly available via the respective databases, many of them in real or near real-time. Further information can be found at www.hfsjg.ch.

The interest in our research infrastructures is unbroken. Several groups visited our two sites partly as excursions during a conference or workshop with a participation of the HFSJG. A selection of individual and group visitors in 2015 is given in the following:

- ETH Zürich, Institute for Atmospheric and Climate Science, 28.01.2015
- Myclimate, Dominik Mösching with international students, 30.01.2015
- Berner Fachhochschule, Seminarteilnehmer, 28.02.2015
- Visitor group from Australia / Albert Einstein tour 2015, 07.03.2015
- Université de Liège / Emanuel Mahieu with students, 07.04.2015
- Paul Scherrer Institut / Sektionen NE/Medizinzyklotron und HIPA, 15.04.2015
- Universität Bern / Klima- und Umweltp Physik / Prof. Hubertus Fischer und Studenten, 24.04.2015
- Johan Hultberg / Swedish Parliament, 12.05.2015
- Lions Club Interlaken, 22.05.2015
- Universität Stuttgart / Institut für Landschaftsplanung und Ökologie / Janet Maringer und Studenten, 23.05.2015
- Siemens AG, 28.05.2015
- Berufsbildungszentrum IDM, 30.05.2015
- Kantonsschule Stadelhofen / Käthi Lienemann mit Schülern, 09.06.2015
- Universität Bern / Prof. Harald Krug mit Studenten, 24.06.2015
- VBS / Führungsunterstützungsbasis FUB, 01.07.2015
- Participants of the Alpine Convention ,We are Alps‘ tour 2015, 02.07.2015
- University of Hannover / Institute of Meteorology and Climatology, 02.08.2015
- University of Zürich / Department of Geography / Samuel Nussbaumer with students, 12.08.2015
- English scouts, 14.08.2015
- Students of the Kellogg University of Chicago, 24.08.2015
- Gymnasium Bäumlhof, Basel / Sacha Glardon mit SchülerInnen, 27.08.2015
- Hokkaido University, Japan / Institute of low temperature science / Shin Sugiyama with students, 02.09.2015
- Paul Scherrer Institut / Sektion Messwesen, 24.09.2015
- MeteoSchweiz und der Peruanische Wetterdienst, 14.10.2015
- Schule Lauterbrunnental / Ronald Schnetzer mit SchülerInnen, 15.10.2015
- Royal Grammar School, UK / Mark Burbidge with students, 19.10.2015
- UVEK, Bundesamt für Verkehr, 05.11.2015
- ETH Zürich, VAW-Glaziologie / Dr. Andreas Bauder with students, 18.11.2015
- Gymnasium Thun / Mirjam Stähli mit SchülerInnen, 14.12.2015

The Foundation HFSJG was particularly honoured to welcome the following official delegations at the Research Station Jungfrauoch:

- Welcome and guided tour for the senior Arctic Officials, international ambassadors and representatives of the EDA in the context of Switzerland’s candidature for Observer Status to the Arctic Council, February 16, 2015.
- Welcome and guided tour for the staff of Geotest and Chinese collaborators, May 05, 2015.
- Welcome and guided tour for the visitors from the Deutsche Meteorologische Gesellschaft, September 5, 2015.
- Welcome and guided tour for the winners of the ‘Schweizer Jugend forscht’ competition together with Prof. Heinz Gäggeler, Paul Scherrer Institute and president of the Jungfrauoch Commission of SCNAT, October 26, 2015.
- Welcome and guided tour for the members of the All European Academies (ALLEA) together with the Swiss Academy of Sciences (SCNAT), September 12, 2015.
- Welcome and guided tour for the participants of the Alpine Convention ,We are Alps‘ tour 2015, July 02, 2015.



Figure 11. Visit of Ambassadors in the context of Switzerland's candidature for the Observer Status to the Arctic Council February 16, 2015 (left); visit of the participants of the Alpine Convention tour 'We are Alps 2015' July 2, 2015 (right).

The research and activities around and in our infrastructure are attractive for the media. We could host several television and radio broadcasting journalist groups as well as delegations from printed media that resulted in 56 contributions in 2015 (2014: 46).

As already mentioned, the renovation of the protective roof went on 2015. This year we were lucky regarding the weather conditions and the work progressed well. Yet, a very strict schedule had to be followed, otherwise it would not have been possible to finish the renovation. We also replaced the pyramid roof on the upper Sphinx terrace to serve two purposes: (i) the snow removal is becoming easier and (ii) we gain space to place instruments outside during campaigns. Unfortunately, the work was affected by a tragedy. During the transport of the old roof a helicopter crashed and the pilot did not survive.

We took notice from the report by Geotest, a company that was given the task to explore the geology risks at Jungfrauoch regarding our facilities, that it is essential to extend the safety constructions to prevent the research station from falling rocks from the steep slope above it. We already took action and initiated a planning of this extension which will be done as soon as the weather conditions will allow it in 2016. In this respect we also will sign a contract with Geotest for annual risk analysis by in-situ controls. Furthermore, we will have to replace the fresh and waste water linings within the research station after more than 80 years, which will again be costly. For this work our new architect team from the ateliermarti architekten ag from Unterseen will be responsible after Hans Boss stepped back from his mandate as HFSJG architect.

We have had several discussions and meetings with the management of the Jungfrau Railway regarding the infrastructure at Jungfrauoch but also the East Ridge. The main annual coordination meeting for all institutions working at Jungfrauoch took place on October, 13, 2015. It was attended by the director of the Research Station and Mr Urs Otz the custodian. Prime topics related to HFSJG were (i) seat reservation capabilities; (ii) emissions associated with the number of visitors documented by differences observed between measurements done at the East Ridge and the Sphinx observatory; (iii) announcement about the White Paper that has been published in June 2015.

The High Altitude Research Station Gornergrat

At Gornergrat again only two projects were conducted in 2015, i.e. “Stellarium Gornergrat” and the cosmic ray research of the University of Bern with 87 working days spent (Figure 12). The Stellarium Gornergrat project has become attractive to both teachers and the public. A significant number of teachers attended the training in October 2015 as documented by Figure 13 and more than 500 visitors could be welcomed at the Gornergrat Observatory. Congratulations to this achievement. Dining with the stars – a collaborative offer by the Gornergrat Railway, the Gornergrat Kulmhotel and the Stellarium Gornergrat Observatory – is a continuation of bringing science to the public. The cosmic ray detector at Gornergrat will be removed in one of the next years. We are in contact with institutions in Africa.

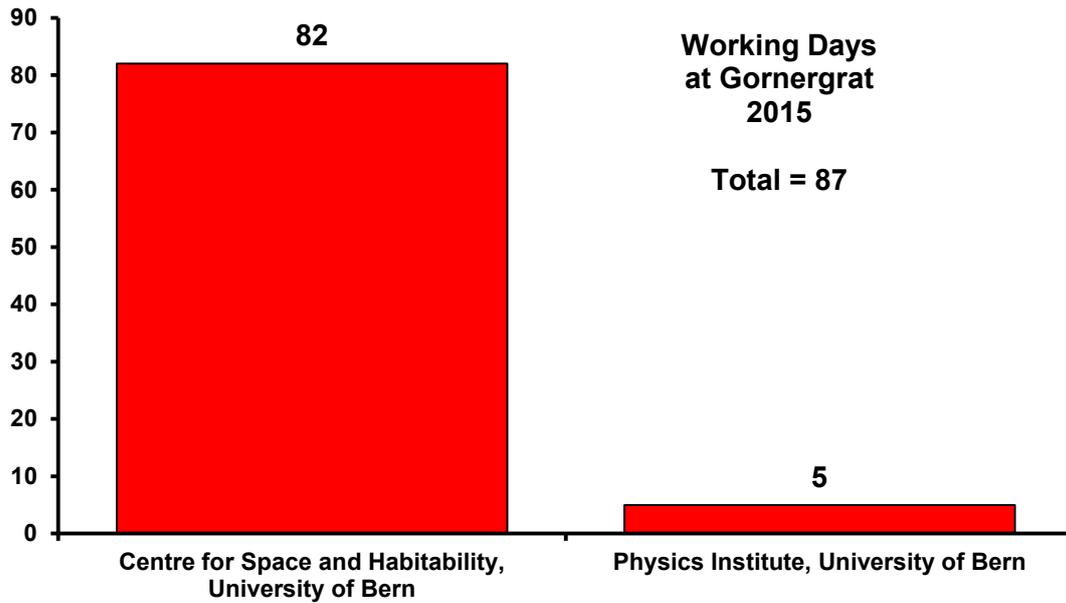


Figure 12. Number of working days at the High Altitude Research Station Gornergrat in 2015 by research groups.



Figure 13. Dining with the Stars – Gornergrat (courtesy Gornergrat Bahn)(left) and impression of the Stellarium Gornergrat teacher’s training in October 2015 (right).

Summary and Acknowledgements

The year 2015 was a successful year. First of all, we published our strategy document – the White Paper – which is available as pdf document for everybody on our homepage (<http://www.hfsjg.ch/publications/>). I would like to thank all who contributed to this document, but in particular Proff. Martin Huber and Erwin Flückiger for their tremendous work and time they dedicated to it. Equally important was the engagement of Claudine Frieden, she did a lot of editing, summarizing and rearranging until the final version was born. Many thanks to the members of the Jungfrauoch Commission of the SCNAT, under the lead of Prof. Heinz Gäggeler, for writing parts of the document and reviewing it all. Furthermore, we would like to thank the SCNAT for the layout and printing support.

In 2015 the work on the protective roof was finalised, which was celebrated on October 23, 2015 in Grindelwald. After the very difficult weather situations in 2014, the work was running smoothly in this regard. Nonetheless, a strict schedule had to be followed for its final success. This has been achieved and therefore, I would like to express my sincere thanks to everybody who was involved in this project. First of all, the companies involved: Aeschmann Elektro AG, Wilderswil, Brawand Zimmerei AG, Grindelwald, Frutiger AG, Interlaken, Scheidegger Gerüstbau AG, Unterseen, Seiler AG, Bönigen, Air Glaciers, Lauterbrunnen, Ruoff AG, Grindelwald and of course Hans Boss, the HFSJG architect. Last but not least, I would like to thank the Swiss National Science Foundation for the extraordinary financial support that was granted to make this necessary renovation possible.

As you will go along this report you can convince yourself that the scientific output with publications, conference contributions and other activities is once again impressive. Close to 50 peer-reviewed publications have been placed. Congratulations to all science partners that have so efficiently used our infrastructure. Your success motivates us from the HFSJG management and administration to do our best in keeping up good and pleasant working and residence conditions and if possible in even improving them.

A key point for having a continued strong publication record with the corresponding visibility is the international setting the Foundation has since its inauguration. Therefore, I would like to thank all members of the Foundation for their financial contributions, but also for their contributions in person during the representation at the Board meeting; the Swiss National Science Foundation for the continued support to run our infrastructure and to guarantee further development of our facilities; our personnel at Jungfrauoch, Mrs. and Mr. Fischer, Mrs. and Mr. Otz, and Mrs. and Mr. Seiler for their excellent work. I was very much pleased about their mutual cooperation to rearrange service plans in order to bridge time periods after unexpected service breaks due to accidents. Thank you so much.

One million tourists at Jungfrauoch per year – a vision? No, not any more. What an achievement. I congratulate the Jungfrauobahn Holding AG (Prof. Thomas Bieger, president of the Board and Mr. Urs Kessler, Chief Executive Officer) for this economic success. Such a high number leads not only to challenges in the logistics but also affects and concerns us as scientists. Therefore, we have to continue to raise the mutual awareness of each other's challenges in order to keep Jungfrauoch clean. I am convinced that this is achievable, also in view of the support of the Jungfrauobahn of our strategy documented in our White Paper.

All year round we can build on substantial support from many different sections at Jungfrauoch and Gornergrat, the Jungfrau Railway infrastructure (Mr. Jürg Lauper and Mr. Heinz Schindler), the Zugförderung und Werkstätte (ZfW/JB, Mr. Gabriel Roth), the Jungfrauobahn Holding AG, the technical services (Mr. Andreas Wyss and his team). Thank you very much. HFSJG experienced once again the friendly and good service of Mrs. Brigitte Soche and Mr. Martin Soche and their personnel of the restaurants at the Top of Europe, hosting our staff, scientists, and visitors.

Stellarium Gornergrat has progressed well with many visitors of their installations and live experiences to view stars during a “Starlight dinner” event or the upcoming “Dining with the Stars”. In this respect, I would like to thank Dr. Timm Riesen and his team from the

University of Bern for their enthusiastic engagement as well as the team at the University of Geneva to promote Gornergrat as science transfer location in astronomy. In this respect, I also thank the Matterhorn Gotthard Railway (Jean-Pierre Schmid, president and Fernando Lehner, Chief Executive Officer and his representative in the HFSJG Board, Mr. René Bayard) and the Gornergrat Railway for the good collaboration and for signing an updated agreement on travel support.

We are well aware of the continued support of the Burgergemeinde Zermatt towards our Foundation and in particular for the project Stellarium Gornergrat. In this respect, I sincerely thank Mr. Andreas Biner, president and Mr. Fernando Clemenz. During these days, I will enjoy again the heartily atmosphere of Mrs. Nicole Marbach and Mr. Thomas Marbach at the Kulmhotel Gornergrat, since I have booked a night to enjoy the “Dining with the stars” event. Thank you for all your support throughout the year.

Year by year, we can count on a fast and robust internet connection to and from Jungfrauoch. This deserves a cordial applause. For Gornergrat, we have an intermediate solution, which requires an update. We still work on an agreement which is required due to the transfer of highly resolved images from the Stellarium Gornergrat. I am optimistic that we will come to a convincing solution.

It would be impossible to do my job without the administrative staff at Bern. Claudine Frieden (secretary) and Dr. Rolf Bütikofer (IT responsible person) delivered once again excellent work. Mr. Karl Martin Wyss for his competent services as our treasurer, Mrs. Theres Trachsel for the bookkeeping, and the CORE Treuhand Cotting AG, Bern (Mr. Harro Lüdi) for the professional auditing, deserve my sincere credit.

The continued support of the University of Bern is so manifold, allow me to express my sincere thanks to its Rector Prof. Dr. Martin Täuber, the Administrative Director, Dr. Daniel Odermatt, and the former Director of the Physikalisches Institut, Prof. Willy Benz, for being a member of our organization, for their hospitality and support of our administration. Finally, I would like to thank Prof. Erwin Flückiger for his steady support in many different respects.

I conclude with the hope that the collaboration with all of you will continue in a good and prosperous way in 2016, and I would be happy to welcome you either at Jungfrauoch or Gornergrat. On behalf of the Directorate HFSJG, best regards to all of you.



Bern, February 10, 2016

Markus Leuenberger

