Dr. Martin Steinbacher
Empa – Laboratory for Air Pollution/Environmental Technology
Ueberlandstrasse 129
CH-8600 Dübendorf, Switzerland

phone: +41 (0)58 765 4048
fax: +41 (0)58 765 1122
email: martin.steinbacher@empa.ch

ANNUAL ACTIVITY REPORT 2017 OF QA/SAC SWITZERLAND

The program for 2017 proposed activities in four main areas:

- Science Activities including QA/QC (Quality Assurance / Quality Control)
- Training, Twinning, and Capacity Building
- Contribution to GAW Outreach
- Cross-cutting Activities

A detailed account on progress in each of these activities is given below. At the end of this report, a financial statement is given.

Science Activities including QA/QC

Evaluation of new measurement techniques

The evaluation of new measurement techniques mainly concerned mature, laser-based high-precision instrumentation for many years. Such techniques are now well established for many GAW parameters. In 2017, research was intensified on low-precision low-cost sensors as several research groups worldwide (including Empa) started extended activities there. This task was jointly launched in collaboration with WCC-Empa and other Empa colleagues and was finally taken over by Christoph Zellweger who co-authored a GAW technical advice note on low-cost sensors. QA/SAC Switzerland is mainly involved through Martin Steinbacher's involvement in the Integrated Carbon Observation System (ICOS) Research Infrastructure and the associated RINGO (Readiness of ICOS for Necessities of Integrated Global Observations) project (see Cross-cutting activities below) where low-cost sensors are intensively tested for greenhouse gas observations, also on-board of unmanned aerial vehicles. However, despite the rather good performance of low-cost sensors e.g. for CO_2 compared to ozone or nitrogen oxides, they are still far from meeting GAW's data quality objectives.

Tropospheric Ozone Assessment Report

The mission of the TOAR activity ("Tropospheric Ozone Assessment Report: Global metrics for climate change, human health and crop/ecosystem research"), also supported by WMO, is to provide an up-to-date scientific assessment of tropospheric ozone's global distribution and trends from the surface to the tropopause. Martin Steinbacher is part of the team of scientific experts. The assessment is supposed to be published as a special feature in the Elementa journal. The first manuscript describing the development and population of the TOAR database including data from nearly 10'000 stations world-wide was released in 2017 (Schultz et al., 2017).

A paper with contribution from QA/SAC Switzerland on "Present-day distribution and trends of tropospheric ozone relevant to climate and global atmospheric chemistry model evaluation" is currently under review at Elementa (Gaudel et al., submitted 2017). Major input was made to the manuscript on "Tropospheric ozone observations – How well do we know tropospheric ozone changes?", which is still in preparation.

GAW symposium and interaction among QA/SACs

QA/SAC Switzerland attended the GAW Symposium in Geneva in April and presented a poster on "QA/SAC Switzerland – Activities and Achievements". Prior to the meeting, QA/SAC Switzerland contacted all other QA/SACs to prepare a short introductory talk to the "Quality Assurance" session, entitled "The Role of Quality Assurance / Science Activity Centres within the GAW Quality Management Framework", to identify commonalities among the QA/SACs, and to organize an informal meeting during the symposium. Unfortunately, not all QA/SAC were present at the symposium. Discussions were bilaterally held with QA/SAC Germany. Limited manpower resources at most of the QA/SACs and the diversity of the QA/SAC tasks were recognized as the main reasons for the improvable visibility of the individual QA/SAC activities.

Associated SAG RG membership and automated QA/QC

In 2017, Martin Steinbacher became an associated member of the Scientific Advisory Group "Reactive Gases" (SAG RG). In this role, he participated in some of the regular SAG RG teleconferences. As a follow up on one of the issues raised during a teleconference, intense discussions were started between the World Data Centre for Greenhouse Gases, the World Data Centre for Reactive Gases and QA/SAC Switzerland on (automated) quality control of GAW data submitted to the data repositories. It is planned to jointly elaborate on feasible approaches to implement appropriate tools.

Organisation and hosting of GGMT-2017 conference

QA/SAC Switzerland and WCC-Empa organised the "19th WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases and Related Measurement Techniques" (GGMT-2017) meeting, held at Empa from 27.-31. August 2017. The meeting was attended by 168 participants from 26 countries and 6 continents. The venue, the logistics and the programme were well appreciated by the attendees. The event provided an excellent platform to make the Swiss GAW activities visible to a global community of experts. The organisation of the event was a major task requiring a significant amount of the manpower resources at QA/SAC Switzerland.

European study on 'top-down' estimates of methane emissions

A broad European study estimating updated European methane (CH_4) emissions is accepted for publication in "Atmospheric Chemistry and Physics" (Bergamaschi et al., 2017). Led by the Joint Research Centre in Ispra, 7 different inverse models were used to infer the emissions based on a recently harmonized dataset of high-precision CH_4 observations from 18 stations across Europe. QA/SAC Switzerland was particularly involved in the preparation of the newly quality controlled observations, which are used as input data for the inverse models.

Collaboration with IAGOS project

A new study was launched with the Université de Toulouse on the "Representativeness of the IAGOS (In-service Aircraft for a Global Observing System) airborne measurements in the lower troposphere". IAGOS data in the lowermost troposphere are compared with data from air quality stations and stations of the GAW network to elucidate the representativeness of the IAGOS observations during take-off and landing, and to assess the impact of emissions related to airport activities and/or other aircrafts on the observations. A publication is submitted to Elementa (Petetin et al., submitted 2017).

Training, Twinning, and Capacity Building

Requests for support

QA/SAC Switzerland responds to various requests from GAW stations for support regarding measurements and data management. In particular, programmatic advice was given to the the Indonesian Agency for Meteorology, Climatology and Geophysics (BMKG) in support of its upgrade and extension of air pollutants and greenhouse gas monitoring activities in Indonesia. To do so, a comprehensive report was prepared jointly with Nicolas Bukowiecki from PSI that summarizes suggestions for suitable instrumentation allowing to measure the majority of GAW recommended in-situ parameters in Indonesia. This report was requested by BMKG following the explicit critique in 2016 assessing the current state of the monitoring network in Indonesia and identifying its shortcomings. Budi Satria, one of the station operators at the Indonesian GAW station Bukit Koto Tabang attended the GGMT-2017 conference at Empa where he was educated in the operation, analysis and interpretation of greenhouse gas observations.
In response to other requests for support, assistance was e.g. (a) provided to the Malaysian Meteorological Department (advice for suitable instrumentation), (b) the Servicio Meteorológico Nacional in Argentina (selection of appropriate reference gases), (c) the Sustainable Development and Energy Sources Department at Research on Energy Systems in Italy being in charge of greenhouse gas observations at Plateau Rosa CO_2 observations (inlet design), (d) the Imperial College in the United Kingdom (carbon monoxide observations in urban settings and sample preparation), (e) the Universidad Mayor de San Andrés (Bolivia) (regular maintenance of carbon monoxide observations), and (f) the Czech Ministry of Education, Youth and Sports (evaluation of research infrastructures).

Training at Regional Calibration Centre in South Americaand follow-up support

QA/SAC Switzerland, together with WCC-Empa, chaired a 5-day training and comparison workshop at the Regional Calibration Centre for Surface Ozone in Buenos Aires. QA/SAC Switzerland mainly contributed to the teaching lessons and the data review of the data available at the GAW repositories. After the workshop, recurrent email exchange was needed to revise and resubmit some of the Argentinian ozone data.
Moreover, ongoing support is provided to the Meteorologische Dienst in Suriname and its operation of surface ozone measurements in Paramaribo. A script was prepared to plot and review the instrument output, and several instrumental issues were identified, which are currently about to be fixed.

Collaboration with Chinese Researcher

The collaboration with Ye Yuan, a Chinese colleague who currently holds a scholarship from the Chinese government at the Technical University in Munich, was ongoing. A statistical data selection strategy to identify atmospheric CO_2 baseline levels and its application to European elevated mountain stations was submitted to "Atmospheric Measurement Techniques" (Yuan et al., 2017). The paper went through the public peer-review discussion phase and is currently prepared for resubmission considering the reviewers' comments.

Ongoing support of CATCOS observations

After the end of the CATCOS (Capacity Building and Twinning for Climate Observing Systems) project in December 2016, limited ongoing support was given to the stations Pha Din (Vietnam) and El Tololo (Chile) mainly in terms of trouble shooting and data processing and submission to the international data repositories. The collaboration with the Kyrgyz Hydrometeorological Service (Kyrgyzhydromet) was more intense due to the late CATCOS implementation in 2016 and the anticipated follow-up collaboration as part of a new project supported by the Swiss

Agency for Development and Cooperation (SDC). For the preparation of the new project proposal, Martin Steinbacher participated in several face-to-face meetings and teleconferences with SDC, MeteoSwiss, WMO, WHO and World Bank representatives.

Provision of backward trajectories for GAW stations

The operational calculation of atmospheric trajectories (every four hours) for a large set of GAW monitoring stations along with the provision of freely available and easily accessible trajectory images on the internet (see http://lagrange.empa.ch/FLEXTRA_browser/) is ongoing and provides a valuable input for many station operators for data evaluation and interpretation.

Teaching at GAWTEC

In 2017, QA/SAC Switzerland taught at the GAW Training and Education Centre (GAWTEC). Topic of the 1.5-day course was "Methane and Sulfur Hexafluoride in the Atmosphere". The teaching included lectures and practical exercises. The overall topic of GAWTEC 32 was "Greenhouse Gases, Data Quality Assurance and Control and Data Evaluation Tools".

Completion of online courses

Several available e-learning platforms were accessed and tested as a first step towards a possible preparation of online tutorials to provide guidance for instrument maintenance within GAW. To do so, several online courses offered by UN CC:learn, Open Learning Campus of the World Bank Group and Coursera (e.g. "Introductory e-Course on Climate Change", "Monitoring and Evaluation of Climate Mitigation Initiatives", "Climate Change Mitigation in Developing Countries") were completed.

Contribution to GAW Outreach

Review of Global Environmental Outlook-6

The United Nations Environment Programmme (UN Environment) currently prepares its next flagship integrated environmental assessment, called Global Environmental Outlook-6 (GEO-6). QA/SAC Switzerland was assigned as one of the reviewers of the assessment. First order drafts were reviewed by a team of about twenty experts in May 2017. Second order drafts, subject to technical and governmental review, were revised by a larger review team in September 2017. QA/SAC Switzerland participated in both draft reviews.

Update of Swiss GCOS Climate Observing System Report

In the light of the elaboration of the new GCOS Switzerland strategy 2017-2027, QA/SAC Switzerland also contributed to the update of the inventory of the most important climate observations and international data centers in Switzerland ("National Climate Observing System - GCOS Switzerland").

Update of GAW Implementation Plan

QA/SAC Switzerland also contributed to the scientific objectives of the Scientific Advisory Group (SAG) "Reactive Gases" as input for the update of the GAW Implementation Plan.

Editing of GGMT-2017 report

Martin Steinbacher (QA/SAC Switzerland) and Andrew Crotwell (NOAA) were assigned as editors of the report of the GGMT-2017 conference. Input was collected from most of the chapter leads, which were identified during the event. The material so far received was reviewed and sent back to the chapter leads for a second iteration.

Input for WIGOS webpage

On demand of Oksana Tarasova (WMO), Martin Steinbacher and Andrea Rossa jointly drafted a paragraph for the WIGOS webpage where collaborations between National Meteorological Services and non NMHS will be exemplarily presented.

Cross-cutting activities

Active role in ICOS

The Integrated Carbon Observation System (ICOS) Research Infrastructure aims at harmonizing high precision long-term observations of greenhouse gases concentrations in the atmosphere and their fluxes from ecosystems and the oceans. Close links do exist with the GAW network but the development of the infrastructure, such as the definition of standard operation procedures, is proactively shaped to ensure consistency with the GAW guidelines. As of December 2017, 34 atmospheric stations spanning from Spitzbergen to Lampedusa (including Jungfraujoch) are striving for full ICOS compliance. Martin Steinbacher was re-elected as deputy chair of the atmospheric ICOS Monitoring Assembly in November 2017 for another 2-years term and is also member of the ICOS Research Infrastructure Committee which is consulted by the ICOS Director General for all general matters.

Participation in RINGO project

Martin Steinbacher attended the Kick-off meeting of the H2020 RINGO (Readiness of ICOS for Necessities of Integrated Global Observations) project in February 2017. RINGO aims at cutting-edge science beyond the current ICOS activities and its transition into operationally run monitoring networks. A particular task relevant for GAW is the assessment of novel flask sampling strategies which can be facilitated by new developments in flask sampler design and control, allowing variable sampling lengths, sampling times, or sampling triggered by external signals like specific signals of continuous analyzers.

Review of QA4ECV project

Quality Assurance for Essential Climate Variables (QA4ECV) is a current project funded by the European Union Framework Program 7. Main goals are the definition of good practice guidance, training, tools for satellite retrieval of essential climate variables and the provision of services. QA/SAC Switzerland was invited to act as a reviewer of the project and attended the project meeting in Darmstadt (D) in February 2017. Significant strategic overlap between the GAW quality management framework and QA4ECV activities exists. Harmonized approaches can be enforced through QA/SAC's reviewer duties.

GAW-DACH and VAO collaboration

Martin Steinbacher attended the Virtual Alpine Observatory Symposium (VAO) in Bolzano (Italy) in March and gave a talk on "Integrated observing systems in support of greenhouse gas emission reductions". VAO meetings are the current set-up for gatherings of representatives from Alpine GAW stations in Germany, Austria, Switzerland and Italy and, thus, replace the tradition of meetings of the GAW-DACH (Germany, Austria, Switzerland) community which has been regularly assembling since the mid-1990s. A VAO strategy paper was discussed during the symposium and revised accordingly. The edited version, shared after the meeting, was reviewed and commented by QA/SAC Switzerland. The purpose of the strategy paper is to define its mission, to identify mutualities and the common benefits of a closer collaboration and to outline the vision of the international effort and the possible services and outreach which may be provided. A bilateral meeting took place with colleagues from the University of Augsburg to

discuss trajectory clustering and source attribution methods to be generically used at high-Alpine stations.

IG3IS and IG3IS pilot

A Project Preparation Funding Application, co-authored by QA/SAC Switzerland, and striving for an "Implementation of Integrated Atmospheric Composition Service in Morocco" was submitted for the attention of the Green Climate Fund (GCF) in July 2017. The resubmission of the revised version addressing GCFs comments is still pending. This project is considered to be a pilot study of the future Integrated Global GHG Information System (IG^{3}IS).
QA/SAC Switzerland also supports the preparation of the IG^{3}IS implementation plan; however, input was recently small as elaboration of technical implementation and quality control of the monitoring equipment is beyond the scope of the implementation plan.

Contribution to ACTRIS

The Aerosols, Clouds and Trace gases Research InfraStructure network (ACTRIS) is currently designing the technical concepts and requirements for ACTRIS Observational Platforms. QA/SAC Switzerland contributed its expertise in terms of trace-gas in-situ observations, in particular for sound observations of nitrogen oxides.

GEO Carbon Initiative

QA/SAC Switzerland closely follows the Geo Carbon and GHG Initiative (GEO Carbon), which is currently mainly supported by the Group on Earth Observations (GEO) and ICOS. The initiative, building on existing initiatives and networks, ambitiously aims at ensuring their continuity and coherence, at facilitating their cooperation, the interoperability of their data and efforts, and at obtaining a comprehensive and globally coordinated carbon and GHGs observation and analysis system. Significant overlap with GAW activities is expected. Beyond that, it is envisioned to explore cross-boundary opportunities between science and society.

Contribution to GEO/GEOSS

Martin Steinbacher attended the „Nationales Koordinationstreffen GEO/GEOSS" on invitation by the Swiss Federal Office for the Environment, and gave a talk on "Empa's contribution to GEO / GEOSS".

Various publications

Next to the publications mentioned above, various other publications were also co-authored by Martin Steinbacher that mainly made use of data of the GAW site Jungfraujoch. Data from Jungfraujoch were e.g. used as background information for the estimation of the fossil-fuel component in atmospheric CO_2 on the Swiss Plateau (Berhanu et al., 2017), the inverse modelling of European mercury emissions based on Jungfraujoch data (Denzler et al., 2017), and for the understanding of the role of ice nucleating particles in mixed-phase clouds (Lacher et al., 2017).

Financial statement

The detailed expenses for the operation of QA/SAC Switzerland are given below. All expenditures are well within the estimated budget listed in the respective program. Furthermore the QA/SAC Switzerland activities require general Empa infrastructure (see also footnote in the budget).

References

Peer-reviewed publications

Bergamaschi P., U. Karstens, A. J. Manning, M. Saunois, A. Tsuruta, A. Berchet, A. T. Vermeulen, T. Arnold, G. Janssens-Maenhout, S. Hammer, I. Levin, M. Schmidt, M. Ramonet, M. Lopez, J. Lavric, T. Aalto, H. Chen, D. G. Feist, C. Gerbig, L. Haszpra, O. Hermansen, G. Manca, J. Moncrieff, F. Meinhardt, J. Necki, M. Galkowski, S. O'Doherty, N. Paramonova, H. A. Scheeren, M. Steinbacher, E. J. Dlugokencky, 2017. Inverse modelling of European CH4 emissions during 2006-2012 using different inverse models and reassessed atmospheric observations, Atmospheric Chemistry and Physics Discussions, doi:10.5194/acp-2017-273.

Berhanu T. A., S. Szidat, D. Brunner, E. Satar, R. Schanda, P. Nyfeler, M. Battaglia, M. Steinbacher, S. Hammer, M. Leuenberger, 2017. Estimation of the fossil-fuel component in atmospheric CO2 based on radiocarbon measurements at the Beromünster tall tower, Switzerland, Atmospheric Chemistry and Physics, 17, https://doi.org/10.5194/acp-17-10753-2017.

Denzler B., C. Bogdal, S. Henne, D. Obrist, M. Steinbacher, K. Hungerbühler, 2017. Inversion Approach to Validate Mercury Emissions Based on Background Air Monitoring at the High Altitude Research Station Jungfraujoch (3580 m), Environmental Science & Technology, doi: 10.1021/acs.est.6b05630.

Gaudel A., O. R. Cooper, G. Ancellet, B. Barret, A. Boynard, J. P. Burrows, C. Clerbaux, P.-F. Coheur, J. Cuesta, E. Cuevas, S. Doniki, G. Dufour, F. Ebojie, G. Foret, O. Garcia, M. J. Granados-Munoz, J. Hannigan, F. Hase, B. Hassler, G. Huang, D. Hurtmans, D. Jaffe, N. Jones, P. Kalabokas, B. Kerridge, S. Kulawik., B. Latter, T. Leblanc, E. Le Flochmoen, W. Lin, J. Liu, X. Liu, E. Mahieu, A. McClure-Begley, J. L. Neu, M. Osman, M. Palm, H. Petetin, I. Petrapavlovskihk, R. Querel., N. Rahpoe, A. Rozanov, M. G. Schultz, J. Schwab, R. Siddans, D. Smale, M. Steinbacher, H. Tanimoto, D. Tarasick, V. Thouret, A. M. Thompson, T. Trickl, E. Weatherhead, C. Wespes, H. Worden, C. Vigouroux, X. Xu, G. Zeng, J. Ziemke, 2017. Tropospheric Ozone Assessment Report: Present-day distribution and trends of tropospheric ozone relevant to climate and global atmospheric chemistry model evaluation, Elementa, submitted.

Lacher L., U. Lohmann, Y. Boose, A. Zipori, E. Herrmann, N. Bukowiecki, M. Steinbacher, Z. A. Kanji, 2017. The Horizontal Ice Nucleation Chamber HINC: INP measurements at Conditions Relevant for Mixed-Phase Clouds at the High Altitude Research Station Jungfraujoch, Atmospheric Chemistry and Physics Discussions, doi:10.5194/acp-2017-474.

Petetin H., M. Jeoffrion, B. Sauvage, G. Athier, R. Blot, D. Boulanger, H. Clark, J.-M. Cousin, F. Gheusi, P. Nedelec, M. Steinbacher, V. Thouret, 2017. Representativeness of the IAGOS airborne measurements in the lower troposphere, Elementa, submitted.

Schultz M. G., S. Schröder, O. Lyapina, O. Cooper, I. Galbally, I. Petropavlovskikh, E. von Schneidemesser, H. Tanimoto, Y. Elshorbany, M. Naja, R. J. Seguel, U. Dauert, P. Eckhardt, S. Feigenspan, M. Fiebig, A. G. Hjellbrekke, Y.-D. Hong, P. C. Kjeld, H. Koide, G. Lear, D. Tarasick, M. Ueno, M. Wallasch, D. Baumgardner, M.-T. Chuang, R. Gillett, M. Lee, S. Molloy, R. Moolla, T. Wang, K. Sharps, J. A. Adame, G. Ancellet, F. Apadula, P. Artaxo, M. E. Barlasina, M. Bogucka, P. Bonasoni, L. Chang, A. Colomb, E. Cuevas, M. Cupeiro, A. Degorska, A. Ding, M. Fröhlich, M. Frolova, H. Gadhavi, F. Gheusi, S. Gilge, M. Y. Gonzalez, V. Gros, S. H. Hamad, D. Delmig, D. Henriques, O. Hermansen, R. Holla, J. Hueber, U. Im, D. A. Jaffe, N. Komala, D. Kubistin, K.-S. Lam, T. Laurila, H. Lee, I. Levy, C. Mazzoleni, L. Mazzoleni, A. McClure-Begley, M. Mohamad, M. Murovec, M. Navarro-Comas, F. Nicodim , D. Parrish, K. A. Read, N. Reid, L. Ries, P. Saxena, J. J. Schwab, Y. Scorgie, I. Senik, P. Simmonds, V. Sinha, A. I. Skorokhod, G. Spain, W. Spangl, R. Spoor, S. R. Springston, K. Steer, M. Steinbacher, E. Suharguniyawan, P. Torre, T. Trickl, L. Weili, R. Weller, X. Xiaobin, L. Xue, M. Zhiqiang, 2017 - Tropospheric Ozone Assessment Report: Database and Metrics Data of Global Surface Ozone Observations, Elementa, 5, 58, doi: https://doi.org/10.1525/elementa.244.

Yuan Y., L. Ries, H. Petermeier, M. Steinbacher, A. J. Gomez-Pelaez, M. C. Leuenberger, M. Schumacher, T. Trickl, C. Couret, F. Meinhardt, A. Menzel, 2017. Adaptive Baseline Finder, a statistical data selection strategy to identify atmospheric CO2 baseline levels and its application to European elevated mountain stations, Atmospheric Measurement Techniques Discussion, https://doi.org/10.5194/amt-2017-316.

Contributions to scientific conferences, workshops and meetings

Burri, S., M. Steinbacher, L. Merbold, L. Hörtnagl, M. Leuenberger, L. Emmenegger, R. Zweifel, N. Buchmann and the ICOS-CH Consortium, Integrated Carbon Observation System Switzerland - ICOS-CH: The Swiss Contribution to a Pan-European Environmental Research Infrastructure, Swiss Global Change Day, Bern, 11 April 2017. (poster)

Dimopoulos Eggenschwiler, P., M. Steinbacher, Publishing in Science, Empa PhD & Postdoc Program 2017, Dübendorf, 06 September 2017. (full day lecture)

Steinbacher, M., The Role of Quality Assurance / Science Activity Centres within the GAW Quality Management Framework, GAW Symposium, Geneva, 10-13 April 2017. (short intervention)

Steinbacher, M., Empa's contribution to GEO / GEOSS, Nationale Koordinationstreffen GEO/GEOSS, Bern, 02 May 2017. (talk)

Steinbacher, M., Greenhouse Gas Measurements in Cholpon Ata as part of the CATCOS project and the rationale for follow-up activities under the AiPoCH programme, Kyrgyzhydromet, Bishkek, 06 July 2017. (talk)

Steinbacher, M., Atmospheric observations in support of emission inventories, AiPoCH preparatory meeting, Bern, 04 August 2017. (talk)

Steinbacher, M., Rationale – why do we measure ozone & Introduction to Empa and Swiss GAW activities & TOAR – Tropospheric Ozone Assessment Report & Data handling and evaluation, measurements uncertainty & Data Submission to the World Data Centre for Reactive Gases, 5th Comparison of Surface Ozone Analyzers, Buenos Aires, Argentina, 23-27 October, 2017. (talks)

Steinbacher, M., Updates from ICOS RI Committee, Atmospheric Monitoring Station Assembly Atmospheric Thematic Centre, Scientific Advisory Board, ICOS-CH National Meeting, Davos, 17 November 2017. (talk)

Steinbacher, M., J. G. Anet, L. Emmenegger, B. Buchmann, Implementation of New Greenhouse Gas Measurements in Cholpon Ata, Kyrgyz Republic GGMT-2017, Dübendorf, 27-31 August, 2017. (poster)

Steinbacher, M., S. A. Wyss, C. Hueglin, S. Reimann, M. Leuenberger, L. Emmenegger, Integrated observing systems in support of greenhouse gas emission reductions, VAO Symposium 2017, Bolzano, 28-30 March 2017. (talk)

Steinbacher, M., S. Wyss, B. Tuzson, L. Emmenegger, Greenhouse Gas Measurements at Jungfraujoch, ICOS-CH National Meeting, Davos, 17 November 2017. (talk)

Steinbacher, M., S. A. Wyss, A. Vermeulen, L. Emmenegger, Harmonization of atmospheric greenhouse gas observations in Europe, Swiss Geoscience Meeting, Davos, 18 November 2017. (poster)

Steinbacher, M., C. Zellweger, B. Buchmann, Highlights from GGMT-2017, Landesausschuss-Sitzung GAW-CH, MeteoSchweiz, Zürich, 08 November 2017. (talk)

Steinbacher, M., C. Zellweger, L. Emmenegger, B. Buchmann, WMO/GAW Quality Assurance / Science Activity Centre Switzerland (QA/SAC – CH), Landesausschuss-Sitzung GAW-CH, MeteoSchweiz, Zürich, 08 November 2017. (talk)

Steinbacher, M., C. Zellweger, L. Emmenegger, B. Buchmann, QA/SAC Switzerland - Activities and Achievements, GAW Symposium, Geneva, 10-13 April 2017. (poster)

Steinbacher, M., C. Zellweger, L. Emmenegger, B. Buchmann, QA/SAC Switzerland - Activities and Achievements, GGMT-2017, Dübendorf, 27-31 August, 2017. (poster)

Workflow 2017

1st quarter 2017

- attendance of the Virtual Alpine Observatory Symposium, Bolzano, Italy
- attendance of the RINGO kick-off meeting, Heidelberg, Germany

2nd quarter 2017

- teaching activity at GAWTEC
- attendance of the GAW Symposium, Geneva, Switzerland
- organisation of the GGMT conference
- review of GEO-6 first order draft
- review of the Virtual Alpine Observatory's strategy paper

3rd quarter 2017

- hosting of the GGMT conference
- submission of a publication on a novel background filtering algorithm
- review of GEO-6 second order draft

4th quarter 2017

- tropospheric ozone analyzer comparison campaign, Buenos Aires, Argentina
- publication of TOAR achievements (description of data collection and database)
- publication on European CH_4 emission estimates, accepted for final publication

continuous activity

- support of GAW stations
- cooperation with other projects such as ICOS, InGOS, ACTRIS, CATCOS, DACH, QA4ECV

Dübendorf, January 2018 Laboratory Air Pollution / Environmental Technology

Head of the Department

Dr. B. Buchmann

Project manager

Dr. M. Steinbacher