Quality Assurance / Science Activity Centre Switzerland
Empa, Laboratory for Air Pollution / Environmental Technology
Ueberlandstrasse 129
CH-8600 Dübendorf, Switzerland

Dr Martin Steinbacher
phone: +41 (0)58 765 4048
email: martin.steinbacher@empa.ch

ACTIVITY REPORT 2022
QA/SAC SWITZERLAND

The Global Atmosphere Watch (GAW) programme, coordinated by the World Meteorological Organization (WMO), is a truly international endeavour driven by the need to understand and control the increasing influence of human activity on the global atmosphere. Several hundred registered stations contribute to the GAW programme. GAW data from all over the globe must be appropriately documented, consistent, traceable to common reference scales, and of known and adequate quality. Meeting these quality objectives is essential to address the spatial and temporal variability of atmospheric composition, which is necessary for retrieving robust averages, detecting regional gradients and long-term trends, and for verification of models and satellite retrievals.

Since the establishment of the GAW programme in 1989, an elaborate quality management framework was developed. Cornerstones are so-called Central Facilities responsible for quality control, scientific guidance and data curation and dissemination. Next to other facilities, four Quality Assurance/Science Activity Centres (QA/SACs) perform network-wide data quality and science-related functions.

The Quality Assurance/Science Activity Centre Switzerland (QA/SAC-CH) was established at Empa in collaboration with MeteoSwiss in 2000. QA/SAC-CH is closely linked to the World Calibration Centre, also hosted by Empa (WCC-Empa), and well embedded into Empa's Laboratory for Air Pollution / Environmental Technology's monitoring and research activities. QA/SAC-CH focuses on surface ozone, carbon monoxide, methane, and carbon dioxide measurements but also provides technical and scientific support in general.

For 2022, QA/SAC-CH's planned 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 areas is given below.

Science Activities, including QA/QC

Evaluation of new laser spectrometers for N_2O measurements

In the recent past, developments in laser spectrometry led to major advances in atmospheric trace gas detection. Consequently, different implementations of laser spectroscopy became the state-of-the-art technique for many species. Currently, an increasing number of manufacturers provide such analysers, some of them offering miniaturized instruments with less power consumption and reduced costs.

QA/SAC tested a new long-path tunable diode laser spectrometer from Aeris Technologies and an optical feedback – cavity enhanced absorption spectrometer from LI-COR Biosciences in the laboratory and performed side-by-side comparisons with established nitrous oxide (N_2O) instruments, such as off-axis integrated cavity output spectroscopy (ABB / Los Gatos Research) and tunable infrared laser direct absorption spectroscopy (Aerodyne Research). The tests revealed similar results with respect to operation, precision and data handling and gave insights into the calibration strategies required for long-term operation. Both instruments are promising alternatives for N_2O measurements in data sparse regions, as they are less expensive and require less space and power than the traditional models. Suitable quality assurance / quality control mechanisms still need to be developed as the current stability in instrument response requires a frequent application of references gases. An oral presentation about the results was given at the Integrated Carbon Observation System (ICOS) Monitoring Station Assembly meeting in December.

Scientific interpretation of GAW data

Jointly with Vietnamese colleagues, observations at Pha Din (Vietnam) were analysed to study the influence of biomass burning on air quality on the Indochinese Peninsula in Southeast Asia. Carbon monoxide (CO) data were compared with two atmospheric transport and chemistry simulations (Copernicus Atmospheric Monitoring Service (CAMS) global reanalysis and FLEXPART backward simulations). The simulations confirmed the large impact of biomass burning at Pha Din in spring and indicated that mostly very fresh biomass burning plumes were sampled when large carbon monoxide peaks were observed. The results were submitted as a chapter in a new book on Vegetation Fires and Pollution in Asia (Pieber et al., in review). The manuscript is currently under review. A corresponding poster was presented at the ICOS Science Conference in September in the Netherlands.

Other international collaborations on scientific interpretation of GAW data resulted in publications on

(i) the sensitivity of biomass burning emissions estimates to land surface information (Saito et al., 2022),
(ii) developments in China's energy policy, coal production, and rice-cultivation practices and their effects on methane emissions (Zhang et al., 2022),
(iii) updated European methane emissions through a combination of surface observations and high-resolution inverse modelling (Bergamaschi et al., 2022),
(iv) terrestrial global N_2O emissions, determined with a coupled soil-atmosphere isotope model and atmospheric observations (Harris et al., 2022), and
(v) new methane satellite retrievals and their comparisons with ground-based observations (Schneider et al., 2022).

The analysis of global trends of tropospheric CO and the role of biomass burning together with colleagues from India and Japan is still ongoing. A meeting with the lead author of the study (Chinmay Mallik) was held in September in Germany.

Contribution to GAW Expert Teams and Scientific Advisory Groups

In 2022, Martin Steinbacher officially joined the Expert Team on Atmospheric Composition Measurement Quality (ET-ACMQ) and was appointed ET-ACMQ co-chair by the Environmental Pollution and Atmospheric Chemistry Scientific Steering Committee (SSC-EPAC). Next to regular teleconferences, a three-day in-person meeting was held in Paris in October.

As an affiliate member of the GAW Scientific Advisory Group for Reactive Gases, Martin Steinbacher took part in a series of conference calls and hybrid meetings.

Conferences and collaboration with other QA/SACs

QA/SAC-CH attended the WMO Greenhouse Gas/Carbon Monitoring Workshop entitled 'The case for a coordinated Global Greenhouse Gas Monitoring Infrastructure' in Geneva in May. The meeting launched the development of a concept for a GHG Monitoring Infrastructure, providing an end to end global infrastructure including observing systems, data exchange, modeling, data assimilation, dissemination and verification. Martin Steinbacher gave an oral presentation on 'Challenges for operational greenhouse gas monitoring'.

Martin Steinbacher attended the D-A-CH Meteorologietagung 2022 remotely and contributed a talk entitled 'Operationelle in-situ Messungen von Luftschadstoffen und Klimagasen im nationalen und internationalen Kontext ' to the session on 'Research infrastructures in weather and climate research'.

QA/SAC-CH participated in the 5th ICOS Science Conference and the 21st WMO/IAEA Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT) in September in the Netherlands. At GGMT, a joint QA/SAC-CH and QA/SAC Japan poster on the contributions to the quality of GAW's GHG observations was presented. Discussions about synergies and stronger collaboration and communication among the QA/SACs were initiated. QA/SAC-CH and QA/SAC Japan have committed to strengthen their common activities in Southeast Asia, where both centres strongly support the GAW programme.

Training, Twinning, and Capacity Building

Requests for support

QA/SAC-CH responded to a wide range of requests from GAW stations for support regarding measurements and data management. Priority was given to QA/SAC-CH's long-term twinning partners, especially to the **Indonesian Agency for Meteorology, Climatology and Geophysics** (BMKG) and the **Kenya Meteorological Department** (KMD) and the stations implemented during the CATCOS (Capacity Building and Twinning for Climate Observing Systems) project. The latter sites are Pha Din (Vietnam), El Tololo (Chile), and Cholpon Ata (Kyrgyz Republic).

BMKG largely reached autonomy in terms of operation and data processing at **Bukit Koto Tabang** (BKT). In 2022, QA/SAC-CH was only consulted to review BKT's final data prior to submission to the GAW data centres. However, mentoring is still provided in support of the expansion of BMKG's monitoring network, mainly in **Central Sulawesi and Papua**. Greenhouse gas analysers are purchased and in place but modifications and advances are still needed in term of the overall setup and quality assurance and quality control strategies.

Positive developments also continue at the **Mount Kenya** GAW station, operated by KMD. CO_2, CH_4, CO as well as O_3 records reveal a good data coverage with only moderate data gaps. With support from MeteoSwiss, a third O_3 analyser was installed on-site, providing additional useful information for investigating a small but systematic bias observed between the two station analysers. Data are submitted to the World Data Centres for Greenhouse Gases and Reactive Gases. Empa, MeteoSwiss and KMD are also partners in the consortium of European Commission's Horizon Europe infrastructure project 'KADI (Knowledge and climate services from an African observation and Data research Infrastructure)'. The project started in September and aims at paving the way to develop science and science-based services in Africa that are needed to sharpen common action on climate change as outlined in the Paris Agreement and the UN Sustainable Development Goals. QA/SAC-CH is mainly involved in a pilot on lessons learned from existing long-term atmospheric and ecosystem observations.

The former CATCOS measurements at **El Tololo** (Chile) suffered from a severe software failure of the greenhouse gas analyser which could only be fixed by the local operators in a lengthy process with support from QA/SAC-CH after some time. This led to a 3-month data gap in the CO_2 and CH_4 measurements. Unfortunately, the channel for CO remains unstable. The CO_2/CH_4/CO instrument is reaching its end of life, remote support by the manufacturer is becoming limited due to the age of the instrument, and a replacement is required soon. Discussions and search for funding opportunities were launched.

At **Pha Din**, a fatal instrument failure resulted in missing CO_2/CH_4/CO data for nearly all 2021. In January 2022, joint efforts of the local operators, an appointed maintenance company and QA/SAC-CH remote support led to a successful resumption of the measurements. Data coverage for 2022 is satisfactory. A station visit of QA/SAC-CH, jointly with WCC-Empa's station and performance audit, was made in November. New calibration standards were connected and the calibration strategy was revised. A malfunction of the O_3 analyser was identified and fixed during the visit. Previous O_3 data need to be revisited accordingly. Shortly after the visit, new issues emerged with the CO_2/CH_4/CO analyser. Spare parts were recently sent. However, the CO_2/CH_4/CO instrument is reaching its end of life, remote support by the manufacturer is becoming limited due to the age of the instrument, and a replacement is required soon. Discussions and search for funding opportunities were launched. The **Vietnam Hydrological and Meteorological Administration** (VNMHA) recently expanded its greenhouse gas monitoring network. Support was given to further optimize the operation of the new measurements.

Measurements at **Cholpon Ata** (Kyrgyz Republic) were running smoothly for most of the time. The O_3 analyser might need a recalibration soon. The station technician is very responsive. However, Kyrgyzhydromet has no budget for operation and maintenance and all required material (like spare parts) needs to be provided by external funds such as Empa's Storehouse for Twinning Stations.

In addition, assistance was provided in response to **other requests for support**, e.g. to

(i) Meteorologische Dienst Suriname (ozone instrument trouble shooting),
(ii) the Servicio Meteorológico Nacional in Argentina (review of ozone data and flagging prior to submission to the GAW data centre),
(iii) Universidad Mayor de San Andrés in La Paz, Bolivia (advice on SO_2 measurements, support of Chacaltaya's application for becoming a global GAW station), and
(iv) the Egyptian Meteorological Authority (support in operation, calibration and quality control strategies of greenhouse gas measurements).

Capacity Development Task Team

Martin Steinbacher is member of the Capacity Development Task Team, led by Julie Nicely, member of SSC-EPAC. The task team is committed to document past and ongoing capacity development efforts across all focal GAW areas, to coordinate future activities across relevant sub-groups, and to establish best practices in capacity development. Collection of information continued and a 'Capacity Development at GAW' webpage was created as subpage of WMO's GAW webpage. A GAW report, tentatively called 'Overview of and lessons learned from GAW's capacity development efforts' is in the making. Preparation of the report is led by Martin Steinbacher and Julie Nicely. A series of conference calls was held among the whole task team as well as among a subgroup to advance the drafting of the GAW report.

Teaching at GAW and GAWTEC courses

In November, Martin Steinbacher taught remotely at the 6th WCC-SF_6 Training and Education Course organised by the National Institute of Meteorological Sciences (NIMS) under the Korea Meteorological Administration (KMA). The title of the lecture was 'Greenhouse Gas Observations with Laser Spectroscopy'. It was attended by about 45 participants.

After two years of break due to the pandemic, the GAW Training and Education Centre (GAWTEC) resumed in 2022 its in-person courses at the Schneefernerhaus. Martin Steinbacher taught twice this year. The spring course (GAWTEC #38) was dedicated to greenhouse gases. QA/SAC-CH's one-day course was on 'Non-CO_2 Greenhouse Gases in the Atmosphere: Long-term Observations, Measurement Techniques, Operation & Maintenance, Quality Control'.

In fall, the overall topic of GAWTEC #39 was 'Reactive Gases'. QA/SAC-CH contributed a one-day course on 'Carbon Monoxide in the Atmosphere'. Teaching at both GAWTEC#38 and #39 included lectures and practical exercises.

Teaching at Zurich University of Applied Sciences ZHAW

In November, Martin Steinbacher taught 4 hours on 'Air quality and air quality management' as part of the 'Environmental Chemistry and Analytics' course for environmental engineering bachelor students.

In December, Martin Steinbacher was invited to give a 45-minute lecture for (architecture) students of the Zurich University of Applied Sciences. The presentation entitled 'Air as a resource - air pollution and air quality management' was attended by about 80 bachelor students.

Contribution to GAW Outreach

GAW Measurement Guidelines

Little progress was made in 2022 for the **measurement guidelines for nitrogen oxides measurements**. A preliminary version was shared among various station operators to receive comments in terms of its usefulness for long-term operation and maintenance and some more illustrative examples were added. Unfortunately, the report could not be concluded in 2022 as anticipated.

The drafting process of the **measurement guidelines for CO_2 observations** gained momentum in fall 2022. Martin Steinbacher is among the author team. His contribution is mainly on GAW station setup and station operating guidelines. Regular conference calls are held to coordinate among the different authors.

A first draft of the planned **GAW report on 'Overview of and lessons learned from GAW's capacity development efforts'** is close to be ready. Currently, it is shared with the WMO's Education and Training Programme office to receive additional input and comments.

QA/SAC-CH was engaged in the preparation of the upcoming **GAW Implementation Plan 2024-2027**. Martin Steinbacher participated in various conference calls of the extended Scientific Steering Committee and he acted as objective lead for strategic objective D, entitled 'Enhance capacity throughout the GAW Programme and promote the use of atmospheric composition information and related services'. A draft version of the implementation plan is expected to be ready in January 2023.

In support of the planned Greenhouse Gas Monitoring Infrastructure endorsed by the WMO Executive Council in 2022, a broad Study Group on **GHG Monitoring Infrastructure** was initiated to develop a **concept** to be presented to the World Meteorological Congress in 2023. The Study

Group has established four task groups to address specific aspects. Martin Steinbacher is member of the task group on input data requirements (observational data requirements, data gaps, observing network design, financial support mechanisms) and contributed specifically on capacity development issues.

Cross-cutting activities

Interaction with the Swiss National Air Pollution Monitoring Network

There is a close collaboration between QA/SAC-CH and the Swiss National Air Pollution Monitoring Network (NABEL), which is run by Empa jointly with the Swiss Federal Office for the Environment. NABEL stations are used as testbeds and provide reference data for the evaluation and assessment of novel instrumentation for long-term monitoring. QA/SAC-CH supervised the data submission of the global and regional GAW stations of the NABEL network (Jungfraujoch, Rigi, Payerne, and Beromünster) to the World Data Centres for Reactive Gases and Greenhouse Gases.

Active role in ICOS

The Integrated Carbon Observation System (ICOS) Research Infrastructure aims at harmonizing high precision long-term observations of greenhouse gas concentrations in the atmosphere and their fluxes from ecosystems and the oceans. To ensure consistency with the GAW guidelines, it is important to actively shape the relevant documents and measurement strategies, such as the standard operation procedures, data formats, auxiliary parameters, etc. Martin Steinbacher participated in the 2 and 3-day atmospheric ICOS Monitoring Station Assembly (MSA) meetings in May and December. He is also member of the ICOS MSA's working groups for Quality Management and Spike Detection.

Martin Steinbacher co-authored a paper on the rationale, establishment, and first achievements of ICOS (Heiskanen et al., 2022) and was part of the author team of the first ICOS European Greenhouse Gas Bulletin, called 'Fluxes' (Kutsch et al., 2022). Fluxes is a new publication by ICOS, which highlights climate issues to an audience of policymakers, policy advisors, and climate journalists.

Swiss Geoscience Meeting

Martin Steinbacher took the lead to convene the session 'Atmospheric Composition and Biosphere-Atmosphere Interactions' at the yearly Swiss Geoscience Meeting, supported by colleagues from Agroscope, the University of Bern and ETH Zurich. Convenorship tasks include the preparation of the call text, the selection of the presentations, compilation of the program schedule, and the chairing of the sessions. This year, the number of received abstracts was below expectations. Measures will be taken to involve more (young) scientists in the coming years.

Virtual Alpine Observatory (VAO)

The 'Virtual Alpine Observatory' (VAO) is a network of European High Altitude Research Stations based in the Alps and similar mountain ranges from ten countries (Austria, Bulgaria, Czech Republic, France, Germany, Georgia, Italy, Norway, Slovenia and Switzerland). VAO is broad in scope and aims at going beyond purely scientific challenges by also embracing a political and societal integration. VAO is part of the European Alpine Convention as well as the Alpine Strategy of the EU. The VAO symposium, scheduled for March 2022 in Germany, was cancelled due to the Covid-19 pandemic and will now take place in March 2023.

Contribution to GEO/GEOSS

The Group on Earth Observations (GEO) and GEO's ambitions to build a Global Earth Observation System of Systems (GEOSS) are important players in the international environmental arena. Coordination of GEO activities and GAW activities is crucial to avoid duplications and inconsistencies. Thus, a thorough monitoring of GEO operations is desirable. Martin Steinbacher attended the yearly GEO/GEOSS national coordination meeting in July, where he presented 'WMO's new case for a coordinated Global Greenhouse Gas Monitoring Infrastructure'.

Activities within the Swiss Academy of Sciences (SCNAT)

In November, Martin Steinbacher was elected member of the Swiss Commission for Atmospheric Chemistry and Physics (ACP) of the Swiss Academy of Sciences, which became effective on January 1st, 2023. Even prior to his assignment he attended two meetings to ensure a smooth transition and a fast onboarding at the beginning of his term.

SCNAT was mandated by the State Secretariat for Education, Research and Innovation (SERI) to coordinate the writing of discipline-specific roadmaps for an overall Swiss National Roadmap for Research Infrastructures 2023 in view of the ERI-Dispatch 2025–2028. Martin Steinbacher was strongly involved in the preparation of the Geosciences Roadmap for Research Infrastructures 2025–2028 by the Swiss Geosciences Community, which was released in spring 2021. A similar process is expected for the period 2029–2032. In preparation of this process, SCNAT invited the lead authors of the last Geosciences Roadmap to a meeting to discuss the first steps towards a new roadmap to be finalized in December 2024.

Review and consultation engagements for other activities

Martin Steinbacher was invited to join the Access Evaluation Panel within the ATMO-ACCESS project for a fair merit review of user requests to access atmospheric research facilities in Europe. ATMO-ACCESS is the organized response of ACTRIS (Aerosol, Clouds, and Trace Gases Research Infrastructure), IAGOS (In-service Aircraft for a Global Observing System), and ICOS (Integrated Carbon Observation System) for developing a pilot for a new comprehensive and sustainable framework for access to distributed atmospheric facilities. As part of this mandate, he reviewed three proposals in 2022.

In Germany, an 'Integrated Greenhouse Gas Monitoring System for Germany – ITMS' is currently set up for an observation-based assessment of the sources and sinks of CO_2, CH_4, N_2O. A dedicated call for related research projects was launched in fall 2022 and Martin Steinbacher was invited to review five proposals.

QA/SAC-CH participated in the public review of the new Global Climate Observing System (GCOS) 2022 Implementation Plan, which aims to guide the development and improvement of the global climate observing system.

In support of the Swiss Federal Office for the Environment and its preparation of 'Switzerland's Eighth National Communication and Fifth Biennial Report under the UNFCCC', QA/SAC-CH reviewed the chapter on 'Research and systematic observations'.

Acknowledgements

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Peer-reviewed publications

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Contributions to scientific conferences, workshops, meetings, and outreach

Steinbacher, M., C. Hueglin, S. Reimann, B. Buchmann, L. Emmenegger, Operationelle in-situ Messungen von Luftschadstoffen und Klimagasen im nationalen und internationalen Kontext, DACH2022, Leipzig, Germany, 24 March 2022 (talk)

Steinbacher, M., Integrated Carbon Observation System (ICOS) Research Infrastructure – a contributing network to GAW, Expert Team on Atmospheric Composition Measurement Quality Meeting, virtual, 06 April 2022 (talk)

Steinbacher, M., Jungfraujoch Station update & NOx measurements, ACTRIS NOx/VOC QA workshop, virtual, 29 April 2022 (talk)

Steinbacher, M., S. Henne, S. Reimann, L. Emmenegger, Challenges for operational greenhouse gas monitoring - The Swiss perspectives, WMO GHG/Carbon Monitoring Workshop, Geneva, Switzerland, 10-12 May 2022 (talk)

Steinbacher, M., Updates on the Integrated Carbon Observation System Research Infrastructure (ICOS RI), HFSJG Users Meeting, Bern, Switzerland, 20 May 2022 (talk)

Steinbacher, M., Meeting Report on WMO GHG/Carbon Monitoring Workshop, GEO/GEOSS national coordination meeting 2022, virtual, 12 July 2022 (talk)

Steinbacher, M, N. Buchmann, Updates in ICOS RI, ICOS CH National Meeting, Basel, Switzerland, 31 August 2022 (talk)

Steinbacher, M., M. Ramonet, A. Chatterjee, P. Ciais, I. Levin, M. Kumar Sha, C. Sweeney, CO2 in the Atmosphere, Growth and Trends Since 1850, ICOS CH National Meeting, Basel, Switzerland, 31 August 2022 (talk)

Steinbacher, M, Updates from ICOS Atmosphere Network and Jungfraujoch, ICOS CH National Meeting, Basel, Switzerland, 31 August 2022 (talk)

Pieber, S.M., S. Henne, N.A. Nguyen, D.-L. Nguyen, L. Emmenegger, M. Steinbacher, Trace gases and air quality in North-Western Vietnam during seasonal biomass burning on the Indochina Peninsula since 2014 - Field Observations and Atmospheric Simulations, ICOS Science Conference, 13-15 September 2022 (poster)

Steinbacher, M., Y. Kameoka, S. Takatsuji, C. Zellweger, L. Emmenegger, B. Buchmann, A. Kinoshita, QA/SAC Switzerland and QA/SAC Japan - contributions to the quality of GAW's GHG observations, GGMT 2022, Wageningen, The Netherlands, 19-21 September 2022 (poster)

Steinbacher, M., L. Emmenegger, B. Buchmann, WMO GAW Quality Assurance / Science Activity Centre Switzerland (QA/SAC-CH), ET-ACMQ Core and CCF's Joint Meeting, Paris, France, 11-13 October 2022 (talk)

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Steinbacher, M., C. Zellweger, Swiss – Vietnamese Collaboration in Support of Atmospheric In-Situ Observations at Pha Din, Hanoi, Vietnam, 29 November 2022 (talk)

Steinbacher, M., C. Zellweger, Evaluation of Aeris and Licor spectrometers for N2O measurements, ICOS MSA Atmosphere meeting, virtual, 6 - 8 December 2022 (talk)

Steinbacher, M., Carbon monoxide in the atmosphere – measurement techniques, Global Atmosphere Watch Training and Education Centre (GAWTEC), Grainau, Germany, 09-10 March 2022, (lecture)

Steinbacher, M., (Non-CO2) Greenhouse Gases in the Atmosphere - Long-term Observations, Measurement Techniques, Operation & Maintenance, Quality Control, Global Atmosphere Watch Training and Education Centre (GAWTEC), Schneefernerhaus, Germany, 28-29 September 2022, (lecture)

Steinbacher, M. Greenhouse Gas Observations with Laser Spectroscopy, 6th WCC-SF6 Training and Education Course, virtual, 02 November 2022 (lecture)

Steinbacher, M., Luftqualität und Luftreinhaltung, Zurich University of Applied Sciences (ZHAW), Wädenswil, Switzerland, 17 November 2022 (lecture)

Steinbacher, M., Luft als Resource, Zurich University of Applied Sciences (ZHAW), Winterthur, Switzerland, 15 December 2022 (lecture)

Steinbacher, M., C. Ammann, S. Brönnimann, M. Gharun, U. Krieger, Session "Atmospheric Composition and Biosphere-Atmosphere Interactions", 20th Swiss Geoscience Meeting, Lausanne, 19 November 2022. (organization)

QA/SAC-CH tasks 2022, progress overview

task #	short description	status	remarks
Q22-01	evaluation of the Aeris Technologies N_2O/CO spectrometer	done	June & July '22
Q22-02	investigation of biomass burning influence on air quality in Vietnam	in progress	paper in review
Q22-03	publication on European CH_4 emissions	done	paper published
Q22-04	publication on terrestrial N_2O emission factors	done	paper published
Q22-05	Expert Team on Atmospheric Composition Measurement Quality (ET-ACMQ)	done	assigned as co-chair
Q22-06	ICOS Science Conference	done	poster presentation
Q22-07	Meeting on Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT)	done	poster presentation
Q22-08	support of GAW and CATCOS stations	done	continuous activity
Q22-09	launch of the KADI project	done	start in September '22
Q22-10	audit at GAW station Pha Din, Vietnam	done	November '22
Q22-11	teaching activity at GAWTEC	done	March & September
Q22-12	nitrogen oxides measurement guidelines	in progress	close to final draft
Q22-13	publication of lessons-learned of the Capacity Development Task Team	in progress	first draft available
Q22-14	cooperation with ICOS, ATMO-ACCESS, IG3IS, VAO, ACTRIS, AGAGE, …	done	continuous activity
Q22-15	6th VAO Symposium 2022	cancelled	meeting cancelled
Q22-16	D-A-CH Meteorologietagung	done	oral presentation
Q22-17	White Paper of the Swiss GCOS/GAW Symposium on Earth System Cycles	done	white paper released
Q22-18	organization of a session at SGM	done	November '22

Dübendorf, April 2023

Laboratory Air Pollution / Environmental Technology

Head of Department

Project manager

Brigitte Buchmann

Digital unterschrieben von Brigitte Buchmann
Datum: 2023.04.12 13:06:30 +02'00'

Digitally signed by Martin Steinbacher
Date: 2023.04.05 11:35:06 +02'00'

Dr Brigitte Buchmann

Dr Martin Steinbacher