

Annual Report 2015

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Highlights

New Aircraft Equipped with IAGOS-CORE

In March 2015, the IAGOS-CORE rack was installed for continuous operation on an AIRBUS A330-300 operated by Deutsche Lufthansa. The modification was made by Lufthansa Technics during a scheduled layover of the aircraft in Malta. D-AIKO is the second aircraft of Lufthansa which carries IAGOS-CORE equipment for making atmospheric measurements.

[https://www.lufthansagroup.com/index.php?id=104&tx_ttnews\[tt_news\]=3501&L=1&no_cache=1](https://www.lufthansagroup.com/index.php?id=104&tx_ttnews[tt_news]=3501&L=1&no_cache=1)



With the new aircraft, the IAGOS-CORE fleet now comprises six longhaul aircraft of the type AIRBUS A330 or A340. Flying regularly between Europe, West Africa and the Arabic Peninsula, the new aircraft increases the spatial coverage of IAGOS data.

Photo: Helmut Schnichels, planespotters.net

KIT Takes Over Coordination of IAGOS-CARIBIC

After successful completion of the negotiation between the institutions involved, the Karlsruhe Institute for Technology, KIT, had accepted in 2014 to take over the coordination of IAGOS-CARIBIC and the responsibility for operation of the flying laboratory. In preparation of this task, a new laboratory hall was constructed at KIT for servicing the container and the instruments, including the necessary infrastructure for conduction of pre- and post-flight calibrations and functional tests. In parallel, servers for storage and backup of the CARIBIC data have been set up at the KIT Steinbuch Centre for Computing. The transfer was completed in April 2015 by moving the CARIBIC related equipment and special tools from the Max-Planck Institute for Chemistry (MPI-C) in Mainz to KIT.

The arrival of the project was celebrated at KIT with 70 invited guests on 27th October 2015. After the celebration ceremony, the CARIBIC workshop took place with ~40 participants. Besides the exchange on scientific achievements, major topics included a review of the transfer of the coordination CARIBIC from MPG to KIT, the preparation of the planned modification of the CARIBIC container in 2016, and discussions on the long-term financing of the CARIBIC operation.



The CARIBIC Flying Laboratory in the new maintenance centre at KIT

Annual Meeting 2015

This year's Annual Meeting was organised jointly with the Annual Meeting of the FP7 project IGAS (IAGOS for the GMES Atmospheric Service) at the International Conference Centre of Météo France in Toulouse from November 16th to 20th.



*IAGOS-IGAS joint meeting, 16-20 November 2015
Centre International de Conférences - Météo-France - Toulouse*

The main focus of the meeting was on informing stakeholders about the progress achieved since the foundation and the plans for future development of the IAGOS infrastructure.

Agenda and presentations are available at www.iagos.org/Meetings.

Special Issue “MOZAIC-IAGOS 20th Anniversary Symposium”

The Special Issue, published in *Tellus B*, contains a selection of papers presented at the MOZAIC-IAGOS Scientific Symposium on Atmospheric Composition Observations by Commercial Aircraft held from 12 to 15 May 2014 in Toulouse, France. This compendium of publications describes the IAGOS programme and highlights the scientific achievements using commercial aircraft as measurement platforms. In total, 16 manuscripts have been submitted, one of which was published in 2014, 14 have been published in 2015 and one is under final review for publication in early 2016. The publications can be accessed at <http://www.tellusb.net/index.php/tellusb/pages/view/thematic>

IAGOS Results Published in Nature

A recent publication in *Nature communications* revealed a significant radiative impact of volcanic aerosol in the lowermost stratosphere (LMS) by combining satellite observations with in-situ data obtained from the measurements made in IAGOS-CARIBIC. “We show that half of the global stratospheric aerosol optical depth in the years 2008 to 2012 is attributable to LMS aerosol particles generated after the eruption of the volcanos Kasatochi, Sarychev, Nabro and others.” Their radiative impact is remarkable and occasionally exceeded 0.5 W/m^2 in the northern hemisphere (Andersson et al., 2015). See also: KIT Press Release 075/2015 http://www.kit.edu/kit/english/pi_2015_075-volcanic-eruptions-slow-down-climate-change-temporarily.php

IAGOS Data Essential for Copernicus

IAGOS was invited by the European Centre for Medium-range Weather Forecasts (ECMWF), to tender for regular provision of data, both in real time and near real time, for the Copernicus Atmosphere Monitoring Service (CAMS). Negotiations for the first funding period (2016-2018) have started in 2015.



IAGOS, represented by its Member CNRS, has joined a contract with ECMWF in October 2015. This contract, CAMS-84, is coordinated by KNMI and is dedicated to “global and regional a posteriori validation, including focus on the Arctic and Mediterranean areas”. The project is the follow-up of the MACC-VAL subproject. Examples of validation plots can be found at <http://www.iagos.fr/macc>.

IAGOS Participates in European Cluster ENVRI^{plus}

ENVRI^{plus} is a Horizon 2020 project bringing together Environmental and Earth System Research Infrastructures, projects and networks together with technical specialist partners to create a coherent, interdisciplinary and interoperable cluster of Environmental Research Infrastructures across Europe. ENVRI^{plus} gathers all domains of Earth System Science – Atmospheric, Marine, Biosphere/Ecosystem and Solid Earth - to work together, capitalize the progress made in various disciplines and strengthen interoperability amongst Research Infrastructures and domains. Environmental Research Infrastructures participating in ENVRI^{plus} are shown below.



The project, which started on 1st May for a duration of 4 years, is coordinated by the University of Helsinki. IAGOS, represented by its Members CNRS and FZJ, has the leading role in the atmospheric domain. Major contributions of IAGOS focus on the development of joint data structures and access portals for environmental data across the domains and on the joint development of novel technology and services of atmospheric research infrastructures. Details of the project can be accessed at www.envriplus.eu.

Organisation

IAGOS is organised as an International not-for-profit Association (AISBL) with its seat in Brussels.

Members of IAGOS-AISBL are:

	Forschungszentrum Jülich GmbH, Jülich, Germany	FZJ
	Centre National de la Recherche Scientifique, Paris, France	CNRS
	Max-Planck Gesellschaft zur Förderung der Wissenschaften e.V., München, Germany	MPG
	Météo France, Toulouse, France	MF
	The University of Manchester, Manchester, United Kingdom	UMAN
	Deutsches Zentrum für Luft- und Raumfahrt e.V., Köln, Germany	DLR
	Leibniz-Institut für Troposphärenforschung e.V., Leipzig, Germany	TROPOS
	Karlsruher Institut für Technologie, Karlsruhe, Germany	KIT

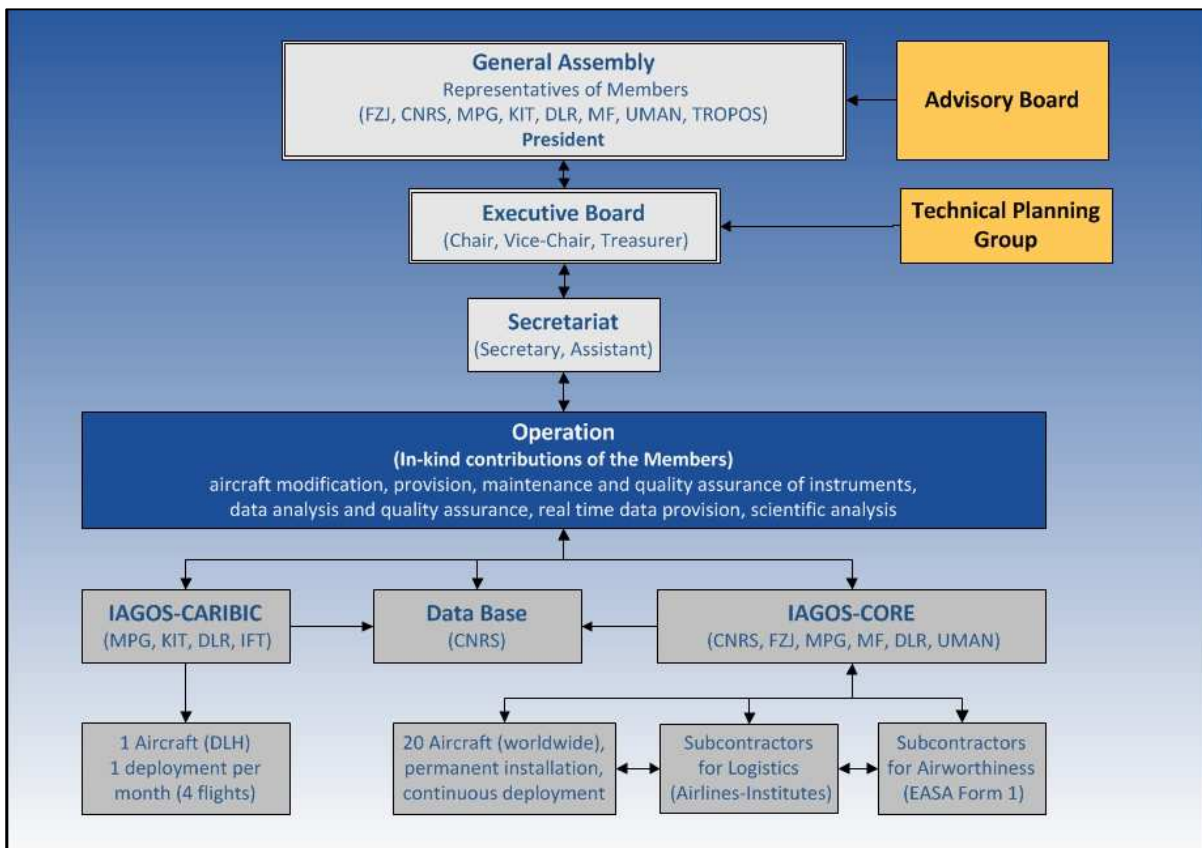
The activities of IAGOS-AISBL are twofold (Statutes are available for download at <http://www.iagos.org>):

1. Activities conducted by the organs of the Association
2. Coordination of the technical and scientific activities carried out by the Members from own resources

The governance structure of the Association is shown below.

The General Assembly (GA) is the highest decision making body. It is composed by the representatives of the Members and is chaired by the President, Jean-Marie Flaud, CNRS. Andreas Wahner, FZJ, serves as Vice-President.

The daily management is conducted by the Executive Board (EB). It is composed by Martin Gallagher, Andreas Petzold (Treasurer), Valerie Thouret (Chair), and Andreas Zahn (Vice-Chair). The EB is assisted by an Executive Secretary (ES).



An Advisory Board (AB) regularly reviews the progress made and gives advice to the Members of IAGOS-ASBL for future development and strategic orientation of the IAGOS research infrastructure in the global landscape. Members of the AB are J.H. Butler, NOAA, USA (Chair); J. Haywood, UKMO, U.K.; G. Pappalardo, CNR, Italy; V.-H. Peuch, ECMWF.

A Technical Planning Group has been established for the technical planning in relation to construction and operation of IAGOS in cooperation with the associated airlines. In 2015, these were: Lufthansa, Air France, China Airlines, Cathay Pacific, and Iberia (see pictures below for details on aircraft involved).

For more information and Statutes see: <http://www.iagos.org>

Activities of the Association

Activities of the Association included seven meetings of the Executive Board (3 by Teleconference), two meetings of the General Assembly, one meeting of the Advisory Board, and 3 Meetings of the Technical Planning Group.

Executive Board

Meetings

Brussels, 21 January 2015 (4 EB members, ES, P, VP)

- Member resources deployed for attribution of vote.
- Budget and activity plan for 2015-2016

Teleconference, 6 February 2015 (4 EB members, ES, P, VP)

- Preparation of the GA on 2nd March 2015
 - Activity Plan for 2015 and long-term implementation plan
 - Annual Report 2014 (activity report and financial report)
 - Updated Budget 2015

Brussels, 6 May 2015 (1 EB Member, ES, P, VP) no quorum for decisions

- Revisions to implementation plan
- Discussion on the IAGOS proposal for data provision to CAMS

Teleconference, 22 June 2015 (4 EB members, ES, P, VP)

- Validation of the revised implementation plan

Brussels, 22 September 2015 (4 EB members, ES, Adm. Assist., P, VP)

- Preparation of GA on 17. Nov 2015
- Discussion on the IAGOS proposal for data provision to CAMS

Teleconference, 21 October 2015 (4 EB members, ES)

- Final check of preparatory material for the GA Meeting

Toulouse, 20.11.2015 (new EB, 3 Members present, ES)

- Wrap-up of the Annual Meeting and AB recommendations
 - Contacts for and outreach to airlines
 - Overview article in, e.g., BAMS
- Discussion on open issues regarding activities 2015/2016, notably
 - RTTU installations in the framework of IGAS and CAMS
 - Acquisition and maintenance of BCPs
- Finalisation of the Questionnaire to GSO for recognition as Global Infrastructure
- Discussion on Terms of Reference for the Executive Secretary

General Assembly

Brussels, 2.03.2015

- Approval of the Activity Plan for 2015, including confirmation of foreseen in-kind contributions of the Members
- Approval of the Budget for 2015
- Approval of the Annual Report for 2014

Toulouse, 17.11.2015

- Approval of the Budget for 2016
- Approval of the Activity Plan for 2016, pending availability of Members' resources (to be confirmed in spring 2016)
- Exoneration of EB Members
- Election of new EB Members,
- Election of EB-Chair, Vice-chair and Treasurer

Advisory Board

Toulouse, 16.11.2015

- Review of actions in response to recommendations made at last meeting
 - IAGOS as Global RI
 - Outreach and visibility
 - Relation to other European RIs in the environmental domain, i.e. ENVRI^{PLUS}
- Discussion of IAGOS approach to realtime data transmission
- Discussion of the role of IAGOS for CAMS
- Discussion on the expansion of IAGOS,
 - Involving a US airline, i.e. Hawaiian Airlines
 - Need for communication
 - Coordination with Mauna Loa Observatory

Technical Planning Group

Teleconference, 20.01.2015

- IAGOS operations (Package 1, BCP, H2O)
- Package 2 STC and planning for future installations
- Package 2 availability
- Planning for new aircraft installations
- Instrument coordination with CARIBIC
- RTTU installation (IGAS WP3)

Frankfurt, 10.06.2015

- Renewal of TPG members
- IAGOS operations – Maintenance Center Operations
- BCP issues
- Data transmission of ICH with Package 1
- Package 2 status and installation planning
- Budget issues: IAGOS spare parts, BCP orders, installation kits improvement
- Status of CARIBIC after change of coordination from MPG to KIT

- Planning for new aircraft installations and new airlines

Frankfurt, 20.10.2015

- IAGOS operations - approval of revised equipment (P1, Pump Box, BCP, RTTU)
- Maintenance Center Operations (web site, cost distribution)
- Status of STC for Package 2
- Digital data transmission of ICH with Package 1
- Options for Real Time data transmission (Copernicus Proposal)
- Planning for new aircraft installations and new airlines - Contracts with airlines
- Status of CARIBIC (coordination, operation)
- Budget issues: IAGOS spare parts, BCP orders, installation kit improvements)

Frankfurt, 15.12.2015

- H2O / ICH modification for digital signal acquisition
- Maintenance Centre short term operations
- "Marketing" for new airlines - IAGOS web sites

Communication and Outreach

- Supervision of a special issue in Tellus-B MOZAIC-IAGOS (see Publications)
 - 16 manuscripts submitted; 1 published in 2014; 14 published in 2015; 1 in press
- Presentation of IAGOS at Conferences (see Publications)
 - Climate Conference in preparation of COP21 (Paris, July)
 - GRUAN ICM-7 Meeting (Matera, Feb)
 - EGU General Assembly (Vienna, April)
 - TOAR meeting (Madrid, April)
 - European Aerosol Conf. (Milano, September)
 - GGMT Conference (San Diego, Sept)
 - ENVRI^{PLUS} Week (Prague, Nov)
 - JPI Climate Workshop on European Long-Term Observation Networks (Paris, Nov)
 - AGU Fall Meeting (San Francisco, Dec)
- Preparation and organisation of the Annual Meeting 2015
- Preparation of a strategic document for submission to the G7+ Group of Senior Officials (GSO) for application as Global RI
- Preparation of a document for publication on the ESFRI Roadmap 2016 (Landmarks)

Activities of the Members under Coordination of IAGOS-AISBL

IAGOS-CARIBIC

One AIRBUS A340-600 operated by Lufthansa carries provisions for operation of the IAGOS-CARIBIC Flying Laboratory, a modified cargo container (shown above) with state-of-the-art instrumentation for in-situ and remote sensing measurements, and for the collection of whole air samples. The latter are analysed in different European laboratories for a more detailed view



of the atmospheric composition during the flights. The aircraft carries a special inlet probe which is connected to the instruments inside the container during preparation of the deployment. Operation of the CARIBIC container is discontinuous with 10 to 12 deployments per year, each for 4 consecutive flights.

Activities 2015

The Members involved in IAGOS-CARIBIC, Karlsruher Institut für Technologie (**KIT**), Max-Planck Gesellschaft zur Förderung der Wissenschaften (**MPG**), Deutsches Zentrum für Luft- und Raumfahrt (**DLR**), and Leibniz-Institut für Troposphärenforschung (**TROPOS**), concluded the following tasks:

In 2015, the CARIBIC observatory was deployed on 10 flight sequences for a total of 40 flights (for destinations see www.caribic.de). In May 2015, the entire operation (container, hydraulic platform, supporting data and electronic test systems, aircraft power supply, vacuum systems etc.) was moved from the Max-Planck Institute for Chemistry (**MPI-C**) at Mainz to the new laboratory hall at **KIT**.

Since May 2015, the official CARIBIC data server is also located at **KIT**. Similar to the prior arrangement, the CARIBIC data set is backed up to tapes by the IT service center of **KIT**. In addition, a local copy is maintained at **MPI-C**. The primary data format (NASA AMES v2) was maintained. Binary files (netCDF) are provided upon user request.

In addition, CARIBIC data have been transferred to the IAGOS database in Toulouse. Work on integrating metadata into the IAGOS database is in progress.

MPI-C maintained the operation of the whole air sampling systems with a performance of almost 100% and of a single particle soot photometer that had been integrated in the container in 2014 and operated flawlessly in 2015. The GHG analysis at **MPI-C** experienced problems, which will be solved by cooperation with **MPI-BGC**. Analysis of flask samples for organic compounds was continued routinely, including analyses for halocarbons made at the University of East Anglia, Norwich. Tests were made by **MPI-C** for the analyses of nitrogen compounds and the analytics for sulfur compounds was brought into operation.

At **KIT**, a new laboratory hall was constructed in 2014/2015 and equipped in preparation of the changeover of coordination and operation of CARIBIC and the technical staff was trained in the

operation and quality assurance of the container. Further work included the preparation of the major container modification planned for 2016.

In April 2015 all CARIBIC equipment (truck, high-loader, power supply etc.) was transported from MPI-C to KIT. Since May 2015 coordination and operation of CARIBIC are under the responsibility of KIT. Altogether 40 long-haul measurement flights during 10 sequences (420 flight hours) have been conducted, including pre- and post-flight tests, calibrations. The preparation of the container modification envisaged for summer 2016 has been started. Transfer of the IAGOS-CARIBIC data base was also completed in May 2015. For this purpose, two server systems for storage and backup of the CARIBIC data were installed at KIT's IT centre.

KIT is also responsible for the operation of five in-situ instruments for the analysis of H₂O, cloud water/ice, H₂O isotopic composition, CH₄, and some volatile organic compounds (VOCs) like acetone, acetonitrile, and methanol.

Work in 2015 included the maintenance of the instruments, data quality assurance and transfer of the data to the data base, as well as improvement of the software for instrument data analysis in order to speed up the data availability.

The development of novel equipment, i.e., an improved mass spectrometer for the measurement of organic compounds (PTR-MS-2), of a spectrometer for the analysis of the isotopic composition of water vapour (ISOWAT-2), and a cavity ring-down laser spectrometer for the detection of NO₂, NO₃, N₂O₅, and O₃ (together with University Cork, Ireland and NOAA, US) was continued, partially in the framework of the FP7 project IGAS.

DLR is responsible for operation of an instrument for measurements of nitrogen oxides (NO and NO₂) and total odd nitrogen (NO_y) aboard the container.

Work in 2015 included the preparation of the instrument before and after each deployment, quality assurance, and provision of the data to the data base. Further work concerned the implementation of formal procedures for QA/QC according to WMO standards and the planning for a modification of the instrument in 2016.

TROPOS is responsible for operation of instruments for the measurement of particle concentrations aboard the IAGOS-CARIBIC container. These include an Optical Particle Size Spectrometer (OPSS) for the larger particles (0.14-1.05 µm) and three Condensation Particle Counters (CPC) for the smaller particles (0.004 - 2 µm; 0.012 - 2 µm; 0.018 - 2 µm).

Work in 2015 included the maintenance of the instruments, the quality assurance of the data and the data provision to the data base. Further work concerned updates of the technical description of the aerosol instruments (fact sheets, SOPs, technical paper) and a re-evaluation of the entire data set on particle distribution collected since 2010 with a new algorithm.

IAGOS-CORE

IAGOS cooperates with several airlines for quasi-continuous measurements of trace gases, aerosol and cloud particles from a fleet of long-haul passenger aircraft. Each aircraft carries the IAGOS-CORE rack with provisions for installing fully automated instruments measuring ozone, carbon monoxide, humidity and cloud particles (denoted P1), and provisions for installing a second instrument package (denoted P2) for measurements of either total odd nitrogen (P2a) or nitrogen oxides (P2b) or aerosol (P2c) or greenhouse gases (P2d). A special plate with dedicated inlet probes for the different instruments is mounted on the fuselage in the vicinity of the rack. The six aircraft shown below are currently equipped with the IAGOS-CORE Rack and P1.



Instrumentation

Installation and operation on commercial aircraft requires that IAGOS instruments are fully compliant with design standards, safety regulations, and quality management of civil aviation. The aircraft modification has been approved by the European Aviation Safety Agency (EASA) as a Supplemental Type Certificate (STC), which was issued in 2011 for A340 and in 2013 for A330 aircraft. For installation in countries outside the EU, the EASA-STC has to be adopted by the national authorities responsible for the airline of concern. This process had been successfully completed in 2012 for Taiwan (China Airlines) and in 2013 for Hong Kong (Cathay Pacific). Each new aircraft to be equipped with the IAGOS modification must be investigated for compliance with the technical requirements of the IAGOS installation in terms of structure, electrical load and safety.

The set of P2 instruments is still under certification. One aircraft (D-AIGT) is certified to carry P2a or P2b. With the first full certification of P2 instruments being expected for 2016, it is planned to install the new instruments for measurements of nitrogen oxides (P2a/b), aerosols

(P2c) and greenhouse gases (P2d) successively on IAGOS-CORE aircraft. Instrument P2d for greenhouse gases is treated with highest priority and will go into service first.

Real-time data transmission of the IAGOS-CORE data via SATCOM to the WMO Information System (WIS) is under development for operational users such as the Copernicus Atmospheric Monitoring Service.

Activities 2015

The Members involved in IAGOS-CORE, Forschungszentrum Jülich (**FZJ**), Centre National de la Recherche Scientifique (**CNRS**), Max-Planck Gesellschaft zur Förderung der Wissenschaften (**MPG**), Météo France (**MF**), and The University of Manchester (**UMAN**), concluded the following tasks:

FZJ acts as one leading institution in operating the research infrastructure and provides the Vice President and the Treasurer of the Association.

FZJ coordinates the technical and legal work in Germany and with the main partners from other countries, particularly CNRS in France, assumes responsibility for establishing contracts with airlines and maintenance organisations in order to ensure the timely progression of the work.

FZJ acts as the leading German partner in the cooperation with partners in France and U.K. on aircraft modification, including the acquisition of the IAGOS modification kits. FZJ ensures the performance, sustainable operation and data quality of the H₂O, NO_x, NO_y and aerosol instruments by pre- and post-operational tests in its laboratory.

FZJ maintains its strong engagement in the scientific analysis of the data set from own resources. As in the past for MOZAIC, this is achieved through own modelling activities and in collaboration with data users worldwide. **FZJ** is also engaged in the Copernicus Atmosphere Monitoring Service.

In the reporting period 2015, from German resources, **FZJ** financed the installation of the IAGOS kit on board of the Deutsche Lufthansa A330-300 MSN 989 with the call sign D-AIKO. Operation started in March 2015. The technical part of the installation was conducted in close collaboration with CNRS, Deutsche Lufthansa and Sabena Technics.

Hardware acquisition concerned mainly 10 water vapour sensor systems (part of P1) for equipping the growing fleet and for continuous sensor exchange and maintenance in order to ensure data quality. Further hardware was not ordered in 2015 since FZJ decided to wait for the final EASA STC for the IAGOS instruments P2a, P2b, and P2c.

Major progress was achieved in the field of instrument testing, data quality and data analysis:

- The IAGOS Capacitive Hygrometer was evaluated on the basis of results from a campaign conducted in 2013, when several water vapour instruments were operated in parallel on board of one research aircraft. The results demonstrated the robustness of the ICH sensor and its good accuracy for measuring water vapour in the upper troposphere and tropopause region. Detection limit and time response, in particular for the operation in the dry lowermost stratosphere, were quantified (*Neis et al., 2015*). The results will support further scientific exploration of the IAGOS water vapour data set.
- The IAGOS-CORE aerosol instrument (P2c) was fully evaluated in the laboratory (*Bundke et al., 2015*) and successfully deployed on board of the research aircraft Polar 6 operated by Alfred Wegener Institut, Germany.

- The development of an automated data inversion algorithm for water vapour was successfully tested using historic MOZAIC data. Implementation is scheduled for 2016.
- The data inversion algorithms for IAGOS package P2a (reactive nitrogen NO_y) and P2b (nitrogen oxides NO_x) were developed and tested using successful deployment periods aboard Deutsche Lufthansa D-AIGT. The implementation phase is scheduled for 2016.

CNRS acts as one leading institution in operating the research infrastructure and provides the President and the Chair of the Executive Board of the Association.

Laboratoire d'Aérodologie, UMR5560, of **CNRS** coordinates the technical and legal work in France and with the main partners from other countries, particularly FZJ in Germany, assumes responsibility for establishing contracts with airlines and maintenance organisations in order to ensure the timely progression of the work.

CNRS acts as the leading French partner in the cooperation with partners in Germany and U.K. on aircraft modification, including the acquisition of the IAGOS modification kits. CNRS ensures the performance, sustainable operation and data quality of the ozone and CO instruments by pre- and post-calibration procedures in its laboratory. CNRS also ensures the coordination of the IAGOS Data Base in close collaboration with the French data centre AERIS (<http://www.aeris-data.fr>).

CNRS coordinates IAGOS-F (CNRS and MF) which is the national Research Infrastructure of the French Ministry for Research and Education (MESR), which is the French contribution to IAGOS.

CNRS maintains its strong engagement in the scientific analysis of the data set from own resources. As in the past for MOZAIC, this is achieved through own modelling activities and in collaboration with data users worldwide. CNRS is also engaged in the Copernicus Atmosphere Monitoring Service.

In the reporting period 2015, from French resources, **CNRS** financed partially and provided engineering support for the installation of the IAGOS kit aboard the D-AIKO of Lufthansa. Acquisition of hardware for development of the RI included 2 units of Package 1 (O₃, CO), 1 Pump box, and 1 installation kit for future aircraft modifications. Further work included technical improvements and modification of the STC for P1. A feasibility study was performed together with FZJ as part of IGAS on potential improvements of the IAGOS–CORE technical setup, in order to provide more flexibility for the development of the infrastructure. Hawaiian Airlines were contacted in order to explore the possibilities for a future installation.

A major part of the activities concerned the operation of the equipment aboard 6 aircraft. This includes logistics, maintenance and re-certification, quality assurance of the data for O₃ and CO, and provision of the data and metadata to the IAGOS data base, data transmission in near real time (NRT) to ECMWF for the MACC-III project in preparation of CAMS. Indeed, activities also concerned the development of software for data analysis, quality assurance and near-realtime provision for faster validation and availability of NRT data for CAMS.

Development of the data base included the development of a new web site and a new form for access request by users, provision of added-value products, and inclusion of CARIBIC-II data (partially within IGAS)

CNRS assumed the leading role for IAGOS in the preparation of 2 contracts with ECMWF for CAMS, namely via participation in CAMS-84, a validation project coordinated by KNMI which started in Oct. 2015, and preparation of the IAGOS proposal for NRT and RRT data provision to CAMS, which is coordinated by CNRS and expected to start in spring 2016. CNRS also participated in the proposal for IAGOS-ETN under coordination of MPI-BGC (see below).

The Institute for Biogeochemistry (MPI-BGC) of **MPG** is responsible for implementation and operation of an instrument for the measurement of greenhouse gases (GHGs), namely carbon dioxide (CO₂) and methane (CH₄), as well as carbon monoxide (CO) and water vapour (H₂O). The instrument is referred to as Package 2d (P2d). It is in the phase of obtaining approval by the European Aviation Safety Agency (EASA) for deployment aboard passenger aircraft as part of the IAGOS CORE installation.

The work related to certification of the GHG system (P2d) was continued, and minor modifications to the design were implemented.

A first version of software for processing and quality assurance of GHG data was developed. Also, preparatory steps for GHG data provision in near-realtime were taken, including an implementation for using pre-deployment calibration results.

Other work included the coordination of the FP7 project IGAS and the coordination of a proposal in response to the call for Marie Skłodowska-Curie Innovative Training Networks (MSCA-ITN-201) for IAGOS-ETN (IAGOS European Training Network) to ensure future funding for scientific collaboration within IAGOS.

The contribution of **MF** focuses on real-time data transmission of the IAGOS-CORE data to the WMO Information System (WIS) for operational users, particularly the Copernicus Atmosphere Monitoring Service. During the year 2015, actions were twofold:

In the framework of the FP7 project IGAS, installation of the first Real Time Transmission Unit (RTTU) aboard the AIRBUS A340 D-AIGT was prepared together with Lufthansa. Together with its subcontractor Sabena Technics, **MF** prepared the necessary documentation and delivered it to Lufthansa for preparation of the installation, which was planned to be achieved during a C-check of the aircraft in December 2015. This could not be achieved because of an unforeseen change of schedule in November 2015. Work has been initiated in order to define a new schedule. In parallel, Lufthansa is working on the legal actions required for MF joining the SATCOM-contract of Lufthansa.

Besides, **MF** has taken part in the preparation of a IAGOS proposal for the Copernicus Atmospheric Monitoring Service, in which it shall contribute with the installation of additional RTTU.

UMAN is responsible for operation of the Backscatter Cloud Probe (BCP) aboard all IAGOS-CORE aircraft. The BCP is a new instrument, originally designed as simple cloud detector, which still requires substantial work for characterisation of its performance with regard to analysing the size distribution of cloud particles.

UMAN have worked with the supplier (DMT) to deliver improvements to BCP to improve and extend the operational characteristics and lifetime of the BCP. Some of these improvements are now included in the most recently procured instruments. Laboratory work at UMAN was conducted to improve the BCP sampling volume characterisation as a function of particle size using the droplet gun laser mapping facility at Manchester. A similar facility now established at DMT now allows such calibration to be done prior to delivery of new BCP's.

Metadata file information for the BCP was continuously improved and software tools were developed for improved routine data analysis, in addition to laboratory and software development to improve BCP particle size retrieval algorithms under different environments (dust versus mixed phase versus cirrus ice categories). A new database and analysis manual for BCP has been produced.

Links with the UK Met Office Observations group for using IAGOS data have been fostered (abstract using BCP data submitted to the ICCP 2016 conference).

Feedback from several presentations on IAGOS made in the UK has highlighted the synergy between IAGOS monitoring strategy and future NCAS long term science strategies. As a result, NCAS have agreed to provide continuous funding (subject to NERC contract) for staff to quality control, maintain and analyse BCP data and to help exploit the BC database more fully. A new staff member who has a track record in cloud microphysics has been found and has completed training in the necessary database management duties and the relevant software tools. Operation management training is on-going.

IAGOS Maintenance Centre

The company *enviscope* GmbH is in charge of the maintenance and aeronautical management of the instruments operated on board of civil aircraft. Instrument calibration is conducted at the laboratories of the scientific partners while *enviscope* is responsible for the coordination of the calibration activities and for the quality assurance related to continued airworthiness of the equipment. The company is involved in IAGOS since the beginning with respect to instrument development and aeronautical certification. Hence, in-depth knowledge of deployed techniques and aeronautical procedures is ensured.

Activities in the reporting period covered (i) software development such as the revision of Maintenance Centre Website for interactive usability including connection with *enviscope* data base and database development for document management; (ii) Logistics like instrument storage and shipment for 6 operational IAGOS-aircraft (see table below), and handling of instrument exchange intervals; (iii) instrument maintenance, repair and parts production; (iv) coordination activities like approving of legal aviation requirements, organisation of agreements between Design Organisations and Manufacturers, and participation in the IAGOS Technical Planning Group, including the organisation of meetings.

Financial Information

Balance 2015

Income

Membership Fees	130,000 €
Total Income	130,000 €

Expenditure

Personnel incl. overheads	53,157 €
Services and other expenses	58,867 €
Total Expenditure	112,024 €

Amount carried forward from 2014 72,032 €

Total Balance 31.12. 2015 90,008 €

Resources dedicated to IAGOS by the Members

In 2015, the Members contributed in total approximately 6 Million Euro from own resources in the form of personnel, equipment and consumables to construction and operation of the IAGOS Research Infrastructure according to the Statutes of IAGOS AISBL. The breakdown of costs, calculated according to Article 22 of the Statues, is listed in Table 1.

Table 1: Contributions by the Members to construction and operation of the infrastructure from institutional resources and national funding¹

<i>Member</i>	<i>Operation and Hardware (k€)</i>	<i>Personnel (k€)</i>	<i>Total (k€)</i>
FZJ	840	877	1717
CNRS	374	1116	1491
MPG	300	725	1025
MF	13	78	91
UMAN	46	124	170
DLR	55	206	260
TROPOS	72	176	247
KIT	288	643	932
Total	1988	3945	5933

¹**NOTES:** Personnel costs are calculated based on the average salaries of FZJ and CNRS, including overheads (82.4%). Acquisition of hardware is included by 10% annual depreciation. Not included are MS fees, funding from European projects and work related to scientific activities.

Additional resources of approximately 515 k€ were deployed in 2015 due to co-funding by the European Union for development of the RI (FP7 project IGAS), coordination with other European RIs (H2020 project ENVRI^{plus}), and contributions to the Copernicus Programme (FP7 project MACC-III).

Acknowledgements

The Members of IAGOS-AISBL acknowledge the funding received from Germany, France and the United Kingdom for the construction phase of the Research Infrastructure and co-funding by the European Commission for development of the infrastructure, coordination with other RIs and for contributions to the Copernicus Atmosphere Monitoring Service. The IAGOS data base is cosponsored by the Centre National d'Études Spatiales via the French data centre AERIS.



The participating Airlines contribute significantly to operation of the IAGOS infrastructure by waving the additional fuel costs incurred by carrying the IAGOS-CORE installation and by providing technical expertise during installation and deployment of the equipment.



Publications

Peer-reviewed Publications

MOZAIC-IAGOS Special Issue (Tellus B, Volume 67)

In total, 17 articles have been submitted for the special issue of which 16 have been published (1 already in 2014). The remaining article is in press.

1. Barrie, L., V. Thouret, A. Petzold (2015), Editorial: The 2014 MOZAIC-IAGOS 20th Anniversary Scientific Symposium on Atmospheric Composition Observations by Commercial Aircraft, *Tellus B*, **67**, 29777, <http://dx.doi.org/10.3402/tellusb.v67.29777>.
2. Beswick, K., D. Baumgardner, M. Gallagher, G. B. Raga, P. Minnis, D. A. Spangenberg, A. Volz-Thomas, P. Nédélec, Kuo-Ying Wang (2015), Properties of small cirrus ice crystals from commercial aircraft measurements and implications for flight operations, *Tellus B*, **67**, 27876, <http://dx.doi.org/10.3402/tellusb.v67.27876>
3. Boschetti, F., H. Chen, V. Thouret, P. Nédélec, G. Janssens-Maenhout, C. Gerbig (2015), On the representation of IAGOS/MOZAIC vertical profiles in chemical transport models: contribution of different error sources in the example of carbon monoxide, *Tellus B*, **67**, 28292, <http://dx.doi.org/10.3402/tellusb.v67.28292>
4. Bundke, U., M. Berg, N. Houben, A. Ibrahim, M. Fiebig, F. Tettich, C. Klaus, H. Franke, A. Petzold (2015), The IAGOS-CORE aerosol package: instrument design, operation and performance for continuous measurement aboard in-service aircraft, *Tellus B*, **67**, 28339, <http://dx.doi.org/10.3402/tellusb.v67.28339>
5. Clark, H., B. Sauvage, V. Thouret, P. Nédélec, R. Blot, K. Y. Wang, H. Smit, P. Neis, A. Petzold, G. Athier, D. Boulanger, J.-M. Cousin, K. Beswick, M. Gallagher, D. Baumgardner, J. Kaiser, J.-M. Flaud, A. Wahner, A. Volz-Thomas, J. P. Cammas (2015), The first regular measurements of ozone, carbon monoxide and water vapour in the Pacific UTLS by IAGOS, *Tellus B*, **67**, 28385, <http://dx.doi.org/10.3402/tellusb.v67.28385>.
6. Filges, A., C. Gerbig, H. Chen, H. Franke, C. Klaus, A. Jordan (2015), The IAGOS-core greenhouse gas package: a measurement system for continuous airborne observations of CO₂, CH₄, H₂O and CO, *Tellus B*, **67**, 27989, <http://dx.doi.org/10.3402/tellusb.v67.27989>
7. Gaudel, A., H. Clark, V. Thouret, L. Jones, A. Inness, J. Flemming, O. Stein, V. Huijnen, H. Eskes, P. Nédélec, D. Boulanger (2015), On the use of MOZAIC-IAGOS data to assess the ability of the MACC reanalysis to reproduce the distribution of ozone and CO in the UTLS over Europe, *Tellus B*, **67**, 27955, <http://dx.doi.org/10.3402/tellusb.v67.27955>.
8. Kalabokas, P. D., V. Thouret, J.-P. Cammas, A. Volz-Thomas, D. Boulanger, C.C. Repapis (2015), The geographical distribution of meteorological parameters associated with high and low summer ozone levels in the lower troposphere and the boundary layer over the eastern Mediterranean (Cairo case), MOZAIC-IAGOS special issue, *Tellus B*, **67**, 27853, <http://dx.doi.org/10.3402/tellusb.v67.27853>
9. Nédélec, P., R. Blot, D. Boulanger, G. Athier, J.-M. Cousin, B. Gautron, A. Petzold, A. Volz-Thomas, V. Thouret (2015), Instrumentation on commercial aircraft for monitoring the atmospheric composition on a global scale: the IAGOS system, technical overview of ozone and carbon monoxide measurements, MOZAIC-IAGOS special issue, *Tellus B*, **67**, 27791, <http://dx.doi.org/10.3402/tellusb.v67.27791>
10. Neis, P., H. G. J. Smit, S. Rohs, U. Bundke, M. Krämer, N. Spelten, V. Ebert, B. Buchholz, K. Thomas, A. Petzold (2015), Quality assessment of MOZAIC and IAGOS capacitive hygrometers: insights from airborne field studies, *Tellus B*, **67**, 28320, <http://dx.doi.org/10.3402/tellusb.v67.28320>
11. Petzold, A., V. Thouret, C. Gerbig, A. Zahn, C. A.M. Brenninkmeijer, M. Gallagher, M. Hermann, M. Pontaud, H. Ziereis, D. Boulanger, J. Marshall, P. Nédélec, H. G.J. Smit, U. Friess, J.-M. Flaud, A. Wahner, J.-P. Cammas, A. Volz-Thomas (2015), Global-scale atmosphere monitoring by in-service aircraft current achievements and future prospects of the European Research Infrastructure IAGOS, *Tellus B*, **67**, 28452, <http://dx.doi.org/10.3402/tellusb.v67.28452>
12. Tanimoto, H., R. M. Zbinden, V. Thouret, P. Nédélec (2015), Consistency of tropospheric ozone observations made by different platforms and techniques in the global databases, *Tellus B*, **67**, 27073, <http://dx.doi.org/10.3402/tellusb.v67.27073>

13. Thomas, K., M. Berg, D. Boulanger, N. Houben, A. Gressent, P. Nédélec, H-W. Pätz, V. Thouret, A. Volz-Thomas (2015), Climatology of NO_y in the troposphere and UT/LS from measurements made in MOZAIC, *Tellus B*, 67, 28793, <http://dx.doi.org/10.3402/tellusb.v67.28793>
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15. Yamasoe, M.A., B. Sauvage, V. Thouret, P. Nédélec, E. Le Flochmoen, B. Barret (2015), Analysis of tropospheric ozone and carbon monoxide profiles over South America based on MOZAIC/IAGOS database and model simulations, *Tellus B*, 67, 27884, <http://dx.doi.org/10.3402/tellusb.v67.27884>

Other ISI-listed Publications using IAGOS data

16. Andersson S.M., B.G. Martinsson, J.P. Vernier, J. Friberg, C.A.M. Brenninkmeijer, M. Hermann, P.F.J. van Velthoven, and A. Zahn (2015), Significant radiative impact of volcanic aerosol in the lowermost stratosphere. *Nat. Commun.* 6:7692 doi: 10.1038/ncomms8692(2015)
17. Bhattacharjee PS, Singh RP , Nedelec P , Vertical profiles of carbon monoxide and ozone from MOZAIC aircraft over Delhi, India during 2003-2005, *Meteorology and Atmospheric Physics*, Vol 127, 2, p 229-240, doi: 10.1007/s00703-014-0349-x
18. Cooper, O. R., Langford, A. O., Parrish, D. D., and Fahey, D. W. (2015), Challenges of a lowered U.S. ozone standard, *Science*, 348, 1096-1097, doi: 10.1126/science.aaa5748.
19. Ding, K, Liu, J ,Ding, A ,Liu, Q ,Zhao, TL, Shi, J ,Han, Y ,Wang, H , Jiang, F., (2015), Uplifting of carbon monoxide from biomass burning and anthropogenic sources to the free troposphere in East Asia, *Atmos. Chem. Phys.*, vol 15, Issue: 5, Pages: 2843-2866, doi: 10.5194/acp-15-2843-2015.
20. Eskes H., et al. (2015), Validation of reactive gases and aerosols in the MACC global analysis and forecast system, *Geosci. Model DevGMD*, Volume: 8, Issue: 11, Pages: 3523-3543, DOI: 10.5194/gmd-8-3523-2015.
21. Friberg J., B.G. Martinsson, M.K. Sporre, S.M. Andersson, C.A.M. Brenninkmeijer, M. Hermann, P.F.J. van Velthoven, and A. Zahn (2015), Influence of volcanic eruptions on midlatitude upper tropospheric aerosol and consequences for cirrus clouds, *Earth and Space Science*, 2 doi: 10.1002/2015EA000110
22. Gromov S. and Brenninkmeijer C.A.M. (2015), An estimation of the 18O / 16O ratio of UT/LMS ozone based on artefact CO in air sampled during CARIBIC flights, *Atmos. Chem. Phys.*, 15, 1901-1912, doi:10.5194/acp-15-1901-2015.
23. Huang J., H. Liu, J. H. Crawford, C. Chan, D. B. Considine, Y. Zhang, X. Zheng, C. Zhao, V. Thouret, S. J. Oltmans, S. C. Liu, D. B. A. Jones, S. D. Steenrod, and M. R. Damon (2015), Origin of springtime ozone enhancements in the lower troposphere over Beijing: in situ measurements and model analysis, *Atmos. Chem. Phys.*, 15, 5161–5179, doi:10.5194/acp-15-5161-2015.
24. Inness et al. (2015), Data assimilation of satellite-retrieved ozone, carbon monoxide and nitrogen dioxide with ECMWF's Composition-IFS, *Atmos. Chem. Phys.*, 15, Issue: 9 Pages: 5275-5303, doi: 10.5194/acp-15-5275-2015.
25. Leedham Elvidge E. C., D.E. Oram, J.C. Laube, A.K. Baker, S.A. Montzka, S. Humphrey, D.A. O'Sullivan, and C.A.M. Brenninkmeijer (2015), Increasing concentrations of dichloromethane, CH₂Cl₂, inferred from CARIBIC air samples collected 1998-2012, *Atmos. Chem. Phys.*, 15, 1939-1958, 2015 DOI: 10.5194/acp-15-1939-2015.
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27. Marey H. S., Hashisho Z, Fu L , Gille J (2015), Spatial and temporal variation in CO over Alberta using measurements from satellites, aircraft, and ground stations, *Atmospheric Chemistry and Physics*, Volume: 15, 7, Pages: 3893-3908, doi: 10.5194/acp-15-3893-2015.
28. Monks P., et al. (2015), Tropospheric ozone and its precursors from the urban to the global scale from air quality to short-lived climate forcer, *Atmos. Chem. Phys.*, 15, 8889-8973, DOI: 10.5194/acp-15-8889-2015.

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30. Schultz M., et al., The Global Atmosphere Watch reactive gases measurement network, *Elementa Science*, DOI 10.12952/journal.elementa.000067, 2015.
31. Srivastava S., M. Naja, and V. Thouret (2015), Influence of regional pollution and long range transport over Hyderabad using ozone data from MOZAIC, *Atmospheric Atmos. Environment Env.*, Volume 117, Pages 135-146.
32. Vernier J.-P., Farlie T.D., Natarajan M., Wienhold F.G., Bian J., Martinsson B.G., Crumeyrolle S., Thomason L.W. and Bedka K. (2015), Increase in upper tropospheric and lower stratospheric aerosol levels and its potential connection with Asian Pollution. *J. Geophys. Res. Atmos.*, 120, doi:10.1002/2014JD022372.
33. Wells K.C., Millet D.B., Boussez N., Henze D.K., Chaliyakunnel S., Griffis T.J., Luan Y., Dlugokencky E.J., Prinn R.G., O'Doherty S., Weiss R.F., Dutton G.S., Elkins J.W., Krummel P.B., Langenfelds R., Steele L.P., Kort E.A., Wofsy S.C., and Umezawa T. (2015), Simulation of atmospheric N₂O with GEOS-Chem and its adjoint: evaluation of observational constraints, *Geosci. Model Dev.*, 8, 3179-3198, doi:10.5194/gmd-8-3179-2015.
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Other Publications (not reviewed)

1. Thouret, V. and Petzold, A.. Report on the MOZAIC–IAGOS Scientific Symposium on Atmospheric Composition Observations by Commercial Aircraft: 20th Anniversary. 12-15 May 2014, Toulouse, France. In: SPARC Newsletter 44, 18-24, January 2015.

Presentations at International Conferences

1. Baker, A. K., C. Sauvage, U. R. Thorenz, C. A. M. Brenninkmeijer, D. E. Oram, P. van Velthoven, A. Zahn, and J. Williams, Evidence for widespread tropospheric Cl chemistry in free tropospheric air masses from the South China Sea, EGU2015-10370, Oral presentation, European Geophysical Union, Vienna, Austria, 12-17 April 2015.
2. Baumgardner, D., IAGOS Team. Sensors & programs for Inflight Icing. In-flight Icing Users Technical Interchange Meeting, Washington DC, USA, 25-26 February, 2015.
3. Blot R., P. Nédélec, H. Petetin, V. Thouret, Long-term CO and Ozone on a global scale from IAGOS in-service aircraft, Poster presentation, Carbon Dioxide, Other Greenhouse Gases, and Related Measurement Techniques (GGMT-2015), La Jolla, California, 13-17 September 2015.
4. Boulanger D., B. Gautron, V. Thouret, M. Schultz, B. Brötz, A. Rauthe-Schöch, The IAGOS information system, Poster presentation, European Geophysical Union, Vienna, Austria, 12-17 April 2015.
5. Boulanger D., V. Thouret, IAGOS (In-Service Aircraft for a Global Observing System), Workshop on Future Directions of GAW Data Management, Zürich, MeteoSwiss, 10-11 August 2015,
6. Bundke, U., Berg, M., Tettig, F., Franke, H., and Petzold, A., Characterization of the Aerosol Instrument Package for the In-service Aircraft Global Observing System IAGOS, EGU General Assembly, Vienna, Austria, 12 - 17 April 2015.
7. Bundke, U., Ibrahim, A., Berg, M., Houben, H. and Petzold, A., First Airborne Measurements of the IAGOS-2c Aerosol Package, Poster presentation, European Aerosol Conference, Milan, 6 – 11 September 2015.
8. Fontaine A., A. Auby, H. Petetin, B. Sauvage, V. Thouret, and D. Boulanger, Lagrangian modelling tool for IAGOS database added-value products, Poster presentation, European Geophysical Union, Vienna, Austria, 12-17 April 2015.
9. Gallagher, M., Bower, K., Connolly, P., Baumgardner, D., Petzold, S., Kaye, P., Choulaton, T., Harris, N., Vaughan, G., Fugal, J., Dorsey, J., Jensen, E., et al. Cirrus Microphysics – Instrumentation & Observations. Cirrus & the Earth System, Royal Meteorological Society, Royal School of Mines, London, U.K., 22 April, 2015.
10. Gallagher, M., Thouret, V., Beswick, K., Baumgardner, D., Petzold, A., Deveraux, S. et al. IAGOS: Status & Overview. National Centre for Atmospheric Science, Annual Meeting, Reading, U.K., 10 December, 2015.

11. Gromov, S., P. Jöckel, and C. A. M. Brenninkmeijer, A consistent simulation of oxygen isotope mass-independent fractionation (MIF) in CO and O₃ using AC-GCM EMAC, EGU2015-6622, Oral presentation, EGU General Assembly, Vienna, Austria, 12 Apr 2015 - 17 Apr 2015.
12. Laube, J. C., E. Gallacher, D. E. Oram, H. Bönisch, Carl A. M. Brenninkmeijer, P. J. Fraser, T. Röckmann, and W. T. Sturges, Fluorinated greenhouse gases in the troposphere and stratosphere, EGU2015-11349, Poster presentation, EGU General Assembly, Vienna, Austria, 12-17 April 2015.
13. Marshall, J. Gerbig, C., Petzold, A., Zahn, A., and the IGAS Team, Towards an exploitation of IAGOS atmospheric composition measurements, EGU General Assembly, Vienna, Austria, 12 - 17 April 2015.
14. Neis, P., Smit, H.G.J., Alteköster, L., Rohs, S., Wahner, A., Spichtinger, P., and Petzold, A., 15 years of upper tropospheric relative humidity in-situ measurements by the MOZAIC programme, EGU General Assembly, Vienna, Austria, 12 - 17 April 2015.
15. Neis, P., Smit, H.G.J., Rohs, S., Rolf, C., Krämer, M., Ebert, V., Buchholz, B., Bundke, U., Finger, F., Klingebiel, M., and Petzold, A., Assurance of MOZAIC/IAGOS relative humidity data quality by evaluating the Capacitive Hygrometer during airborne field studies, EGU General Assembly, Vienna, Austria, 12 - 17 April 2015.
16. Oram, D., J. Laube, B. Sturges, L. Gooch, E. Leedham, M. Ashfold, J. Pyle, A. Abu Samah, S. Moi Phang, C.-F. Ou-Yang, N.-H. Lin, J.-L. Wang, and C. A. M. Brenninkmeijer, Have we underestimated the role of short-lived chlorine compounds in ozone depletion? EGU2015-11891, Oral presentation, EGU General Assembly, Vienna, Austria, 12 Apr 2015 - 17 Apr 2015.
17. Perim de Faria, J., Bundke, U., Freedman, A., and Petzold, A., Modified cavity attenuated phase shift (CAPS) method for airborne aerosol light extinction measurement, EGU General Assembly, Vienna, Austria, 12 Apr 2015 - 17 Apr 2015.
18. Petetin H., V. Thouret, A. Fontaine, B. Sauvage, D. Boulanger, P. Nédélec, Annual and seasonal trends of tropospheric ozone and CO over Frankfurt between 1994-2011 based on MOZAIC-IAGOS aircraft measurements, PICO presentation, European Geophysical Union, Vienna, Austria, 12-17 April 2015.
19. Petetin H., V. Thouret, A. Fontaine, B. Sauvage, D. Boulanger, P. Nédélec, Annual and seasonal trends of tropospheric ozone and CO over Frankfurt between 1994-2011 based on MOZAIC-IAGOS aircraft measurements, Poster presentation, IGAC-TOAR meeting, Madrid, Spain, 28-30 April 2015.
20. Petetin H., V. Thouret, A. Fontaine, B. Sauvage, G. Athier, R. Blot, D. Boulanger, JM. Cousin, P. Nédélec, Assessing the role of vegetation fires in CO vertical profile anomalies in 2002-2012 with MOZAIC-IAGOS airborne observations, Poster presentation, American Geophysical Union, San Francisco, USA, 14-18 December 2015.
21. Petzold, A., Bundke, U., Perim de Faria, J., Onasch, T. B., Keabian, P., and Freedman, A., Evaluation of the Cavity Attenuated Phase Shift Single Scattering Albedo Monitor CAPS PM_{SSA}, Poster presentation, European Aerosol Conference, Milan, Italy, 6 – 11 September 2015.
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23. Rubach, F., Hermann, M., Schneider, J., Wiedensohler, A., and Borrmann, S., An Aerodyne mini-AMS for UT/LMS measurements within the Civil Aircraft for Regular Investigation of the Atmosphere Based on an Instrument Container (CARIBIC) project, Oral presentation, European Aerosol Conference, Milan, Italy, 6 – 11 September 2015.
24. Thouret V., A. Petzold, C. Brenninkmeijer, JP. Cammas, P. Dandin, JM. Flaud, M. Gallagher, C. Gerbig, M. Hermann, P. Nédélec, M. Pontaud, H. Smit, A. Volz-Thomas, A. Wahner, A. Zahn, H. Ziereis, Global-Scale Atmosphere Monitoring by In-Service Aircraft – Current Achievements and Future Prospects of the European Research Infrastructure IAGOS, Poster presentation, Our Common Future Under Climate Change, Paris, France, 7-10 July 2015.
25. Thouret V., and the IAGOS team, MOZAIC-IAGOS: 20 years of in-situ ozone data, IGAC-TOAR meeting, Madrid, Spain, 28-30 April 2015
26. Volz-Thomas, A., GRUAN and EU infrastructure projects, GRUAN ICM-7, Matera, Italy, 23-27 February 2015.

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