

# Expert Team on Atmospheric Composition Data Management (ET-ACDM)

Report to the WMO RB GAW SSC 7th Session 8-11 Feb 2021



**WMO OMM**

World Meteorological Organization  
Organisation météorologique mondiale

Jörg Klausen (chair ET-ACDM)  
Members of ET-ACDM  
Contributing Data Centers

# ToRs of ET-ACDM

- Document issues with and coordinate the development and implementation of common data and metadata standards within GAW in alignment with WIS/WIGOS, and assist Contributing Networks with utilizing the WIGOS metadata standard;
- Advise the SAGs, WMO expert teams and partners, and the GAW initiatives' steering committees on harmonizing data management; enabling F.A.I.R. data principles (findable, accessible, interoperable, re-usable) in support of plug and play capability (data formats and application program interfaces (APIs) of GAW data;
- Collect and provide information on near-real-time NRT (within 24h of observation) data transmission to station operators; Facilitate timely submission of quality-controlled data for long-term archival in the respective GAW World Data Centres (DCs);
- Provide comprehensive and up-to-date guidance on the data and metadata submission process, revision and re-submission, including consideration of data policy, licences, provenance and data quality as well as consistency between the data and metadata;
- Monitor the data submission to the thematic GAW WDCs and provide consolidated annual statistics on data submission, distribution, and use to EPAC SSC;
- Document/identify issues and propose solutions in support of the further development of GAWSIS, as an integral component of OSCAR/Surface, and as the central catalogue of observing facilities and observations supporting GAW, linking the WDCs and Contributing Data Centres.
- Guide GAW WDCs on implementing WMO data policies, in providing user groups with free and open access to all data, complemented with access to innovative and mature data products, together with tools for QA, data analysis and research, following WIGOS policies in particular with regards to metadata documentation
- Guide GAW WDCs and archives of Contributing Data Centres on implementing new technologies that improve information management within GAW, as well as Contributing Networks, in-line with the evolution of WIS/WIGOS.

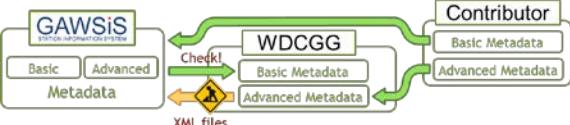


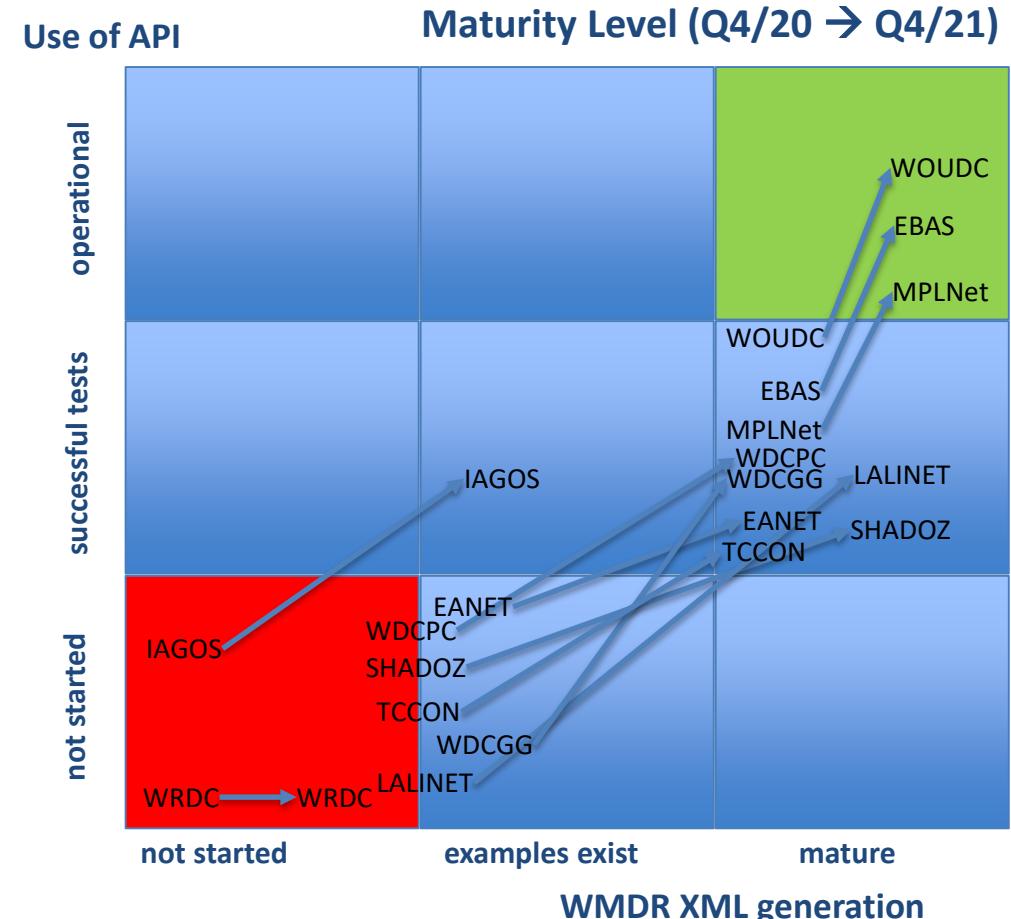
# Achievements 2020

- (World) Data Centres
  - Maintain and evolve operation of individual data centers (BIG achievement!)
  - WOUDC included in Copernicus CDS (<https://sis-dev.climate.copernicus.eu/cdsapp#!/dataset/insitu-observations-total-column-ozone-ozonesounding?tab=overview>); EUBREWNET federated search in the context of DCIO available at WOUDC, covering WOUDC, SHADOZ, NDACC, NILU O3 sondes data
  - SHADOZ included in Copernicus CDS (<https://sis-dev.climate.copernicus.eu/cdsapp#!/dataset/insitu-observations-southern-hemisphere-additional-ozonesondes?tab=overview>)
  - OSCAR/Surface discoverable in NextGEOSS portal (<https://catalogue.nextgeoss.eu>)
- ET-ACDM (<https://github.com/wmo-cop/et-wdc/wiki/>)
  - 6 Telecons held after physical meeting in 2019
    - mostly focusing on linking WDCs to GAWSIS-OSCAR/Surface → separate slide
    - discussion of PIDs/DOIs for data → separate slide
  - Contribution to joint SAG/ET sessions
  - Contribution to WMO Data Conference, Nov 2020 (<https://github.com/wmo-cop/et-wdc/wiki/ET-ACDM-at-WMO-Data-Conference-October-2020>)
- Related Activities
  - Representation in SG-DIP on new WMO data policy resolution («Res 42»)
  - Re-establishment of WG Atmospheric Composition Vocabulary (<https://github.com/wmo-im/wmds/projects/7>) as an ad-hoc group reporting to TT-WIGOSMD



# M2M link to GAWSIS-OSCAR/Surface

- Individual solutions for various WDCs and other DCs for the old GAWSIS became obsolete with the launch in 2016 of the unified GAWSIS-OSCAR/Surface applications and the migration to the WIGOS metadata standard.
- In 2020, a consultant (Drasko Vasiljevic) hired by WMO GAW for 9 months assisted the WDCs and other DCs with the creation of compliant XML encoding of observation metadata and use of the API. This work is not yet complete.
- WDCGG follows a useful delineation and approach
  - 
  - Diagram will be expanded / more specific for different user roles



# PIDs/DOIs for data

- Status in data centers\*
  - In use: WOUDC, WDCA, WDCRG, WDCPC, ICOS, NDACC, TCCON
  - Plans: WDCGG, SHADOZ, INDAAF, MPLNET
  - No plans: WRDC, LALINET, AD-Net
- Various approaches
  - DOI for observing facility
  - DOI per annual submission
  - DOI for each version of continuous time series
  - DOI for latest version of a continuous time series
- Clear requirements are needed from SSC, followed by a CR for the WMDS\*\* and the OSCAR Application Board\*\*\*

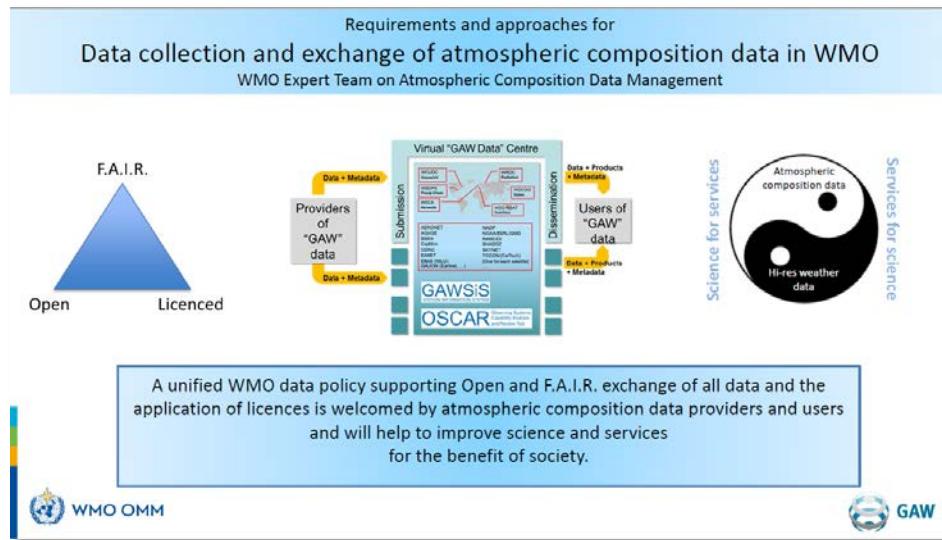
\* [https://github.com/wmo-cop/et-wdc/wiki>Status-of-use-of-DOIs-or-PIDs-at-WDC-and-GAW-Contributing-Networks-\(June-2020\)](https://github.com/wmo-cop/et-wdc/wiki>Status-of-use-of-DOIs-or-PIDs-at-WDC-and-GAW-Contributing-Networks-(June-2020))

\*\* Need to open an issue under <https://github.com/wmo-im/wmdr>

\*\*\* WMO represented by Etienne Charpentier, Luis Nunes

# WMO Data Conference

- Preparatory workshop contribution:  
[https://github.com/wmo-cop/et-wdc/blob/master/WMO Data Conference Preparatory Workshop-20201021 Klausen.pdf](https://github.com/wmo-cop/et-wdc/blob/master/WMO%20Data%20Conference%20Preparatory%20Workshop-20201021_Klausen.pdf)
- Unified policy and need for attribution / licenses defended



- Further need to respond to user requirements

A screenshot of a video conference slide. The title is '5- Unify the Data format of World Data Centers of GAW'. The slide contains a bulleted list of points:

- GAW program covers different parameters (Radiation, Aerosols, GHG, Reactive gases, Ozone, and acid rain).
- Collecting data for each element is the responsibility of one of the global data centers, which deals with the data in a different way and format from other centers and also different from the rest of the meteorological elements (as temperature, pressure, and wind), which impedes the ease of finding and using the data.
- To facilitate the exchange and utilization of this kind of data; a unified and simple format should be found between World Data Centers.
- WMO should encourage its members to establish stations for the measurements of the atmospheric composition and exchange them through the GAW program.

At the bottom of the slide, there are icons for Chat (5 messages), Raise Hand, Q&A, and English language settings. The top right corner shows 'Recording' and 'Zainab Salah Mahmoud is talking...'.

# Work plan / topics to address for 2021

- Operation
  - Continue operations of the DCs, evolve in consultation with ET-ACDM
  - Support users, provide feed-back to ET-ACDM and SAGs
  - Link WDCs operationally to GAWSIS-OSCAR/Surface
    - WOUDC, WDCGG, WDCA/WDCRG
  - Link at least some data centres of contributing networks operationally to GAWSIS-OSCAR/Surface
    - INDAAF, IAGOS
  - Produce a «Data QC at DCs status report»
- ET-ACDM
  - Respond to SAGs' requests (→ call to SAGs to be pro-active) and inform SSC on any proposals
  - Develop a common set of KPIs for the data centers supporting GAW
  - Explore netCDF/CF as a common data format, accompanied with WIGOS metadata as a common metadata format for all of GAW and assess the possibility / challenges of writing converters to current formats in use.
  - Propose to include DOI/PID in the WIGOS metadata standard for both observing facilities and observations / deployments.

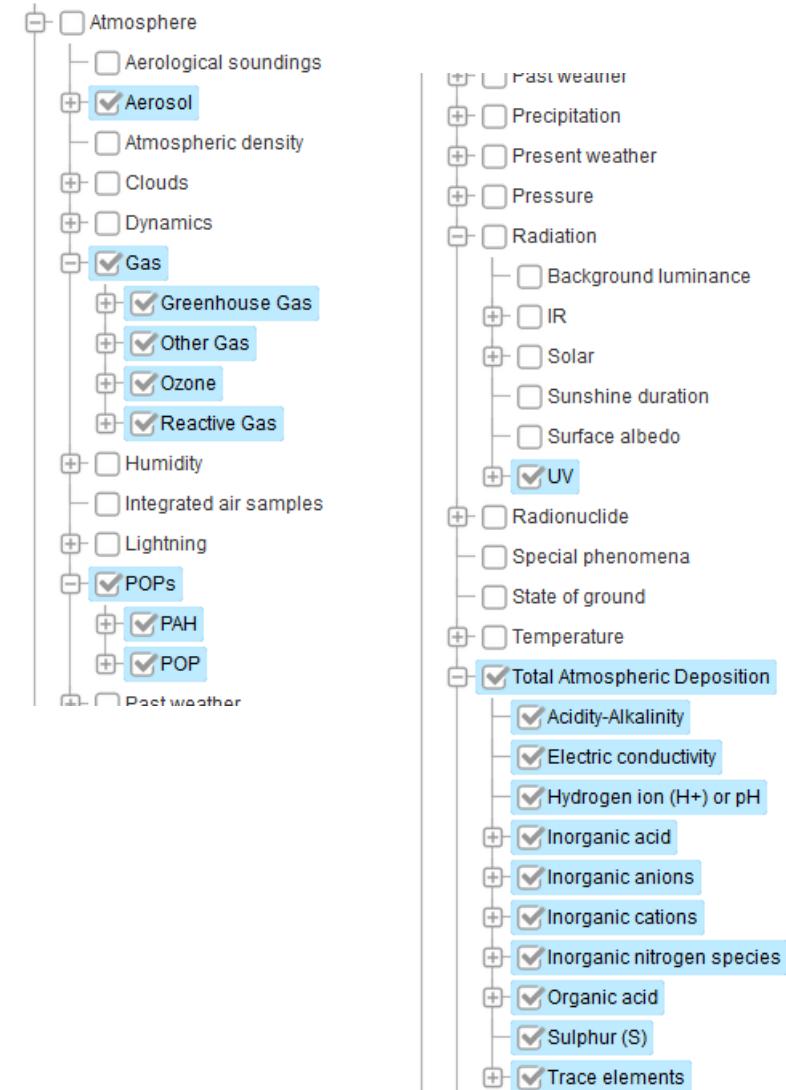


# Guidance expected from SSC (1)

- Recommendation on developing/adopting a single data / metadata format for all of GAW, considering costs/benefits
- Recommendation on use of DOIs/PIDs for GAW data and inclusion in the WIGOS metadata standard
- Formulate clear requirements (application-driven) per GAW focus area on the need for real-time and/or near-real-time data management and the expectations for the existing data centers
- Clarify the expectations for ET-ACDM according to overarching ToRs (the strategic dimension) and help recruit more experts outside the body of DC managers to guide the ‘doers’.  
→ current members can discuss/decide on approaches for meeting requirements, but they cannot provide the requirements.

# Guidance expected from SSC (2)

- Scope of GAW in terms of organic chemicals and what to include in /exclude from WIGOS variable list.
  - Should everything that is archived in one of the data centres be registered? E.g., everything in NILU/EBAS be registered? Or everything that is labeled as GAW in EBAS?
  - Potentially an endless list of chemicals (and non-resolved combinations) ...  
→ TT-WIGOSMD expects guidance from SAG-RG and SAG-GHG.
- Organization of variables
  - Does the current organization make the most sense scientifically and for the users?
  - Issues relate to proper delineation of terms, e.g., POPs but also some other species could be found in any or all of 'Gas', 'Aerosol (particle phase)', 'TAD' depending on how the analytics work
  - Information: Biometeorology to be included under Atmosphere/Pollen



# Update of GAW Implementation Plan

- Better integration with other existing regulatory material, references to
  - WIGOS Manual
  - WIGOS metadata standard
- Clear statements on data policy and ambitions regarding (near-)real-time data, access and use of GTS/WIS
- Ambitions and rules for timeliness of data submissions, affecting reporting status
- Clearer guidance on use of GAWSIS-OSCAR/Surface for station registration and application to become a GAW station
- Clear statements on ambitions regarding required interoperability of data centers
  - Accepted data and metadata submission format(s)
  - Expected data products from individual and across data centers, including data and metadata format(s)

# ORIGINAL CONTRIBUTIONS

# WOUDC Updates

- Operations (2019)
  - 815K data files
  - Over 100K data files received (88% pass rate)
  - Website: 187M hits, 1.7M visits
  - Website/services stable
  - Main challenge remains manual intervention of fixing data submissions
- Data centre interoperability
  - EUBREWNET federated search operational (2020)

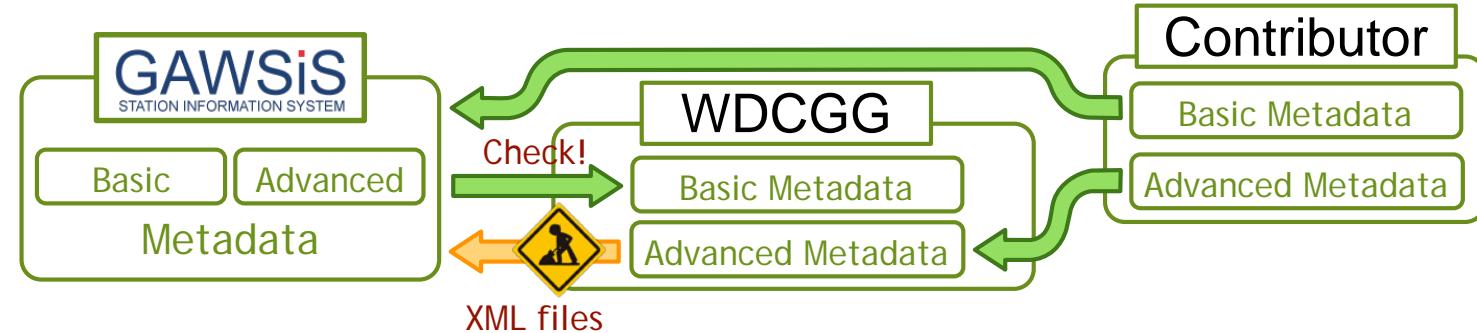
# WOUDC Updates

- Objectives
  - WIGOS integration (near completion)
  - Data centre interoperability
    - Continued integration via DCIO efforts
  - WOUDC 2.0 (updated services and website)
- Challenges / items to address
  - DOIs for individual stations should be implemented
  - Unified data formats across data centres
    - Is the emerging WMO CF/NetCDF an option?

# WDCGG Activities

## - Metadata delivery/synchronization -

- WDCGG checks the basic metadata on GAWSIS once a week to keep consistency the basic metadata information (station name, location...) between GAWSIS and WDCGG.
- The tool is prepared to convert the advanced metadata on WDCGG into an XML format to upload on OSCAR/Surface (test page).



## - NetCDF -

- Provision of netCDF format to provide data (currently only text format) (~ Early in 2021).
- The test has completed successfully in the development environment.

DL	Gas Species	GAW ID	Organization	Type	Period	Filename	Size	Plot
<input checked="" type="checkbox"/>	CO2	MNM	JMA	hourly	1993-01-01 00:00:00 - 2020-08-31 23:00:00	co2_mnm_surface-insitu_1_9999-9999_hourly	(Text: 24.92MB ; NetCDF: 51.82MB )	<a href="#">png</a>
<input checked="" type="checkbox"/>	CO2	MNM	JMA	daily	1993-01-01 00:00:00 - 2020-08-31 00:00:00	co2_mnm_surface-insitu_1_9999-9999_daily	(Text: 1.04MB ; NetCDF: 2.17MB )	<a href="#">png</a>
<input checked="" type="checkbox"/>	CO2	MNM	JMA	monthly	1993-01-01 00:00:00 - 2020-08-01 00:00:00	co2_mnm_surface-insitu_1_9999-9999_monthly	(Text: 0.04MB ; NetCDF: 0.09MB )	<a href="#">png</a>
<input checked="" type="checkbox"/>	MET (CO2)	MNM	JMA	hourly	1993-01-01 00:00:00 - 2020-08-31 23:00:00	co2_mnm_surface-insitu_1_9999-9999_hourly_met	(Text: 26.49MB ; NetCDF: 34.24MB )	-

# WDCGG Other Activities

## - DOI plans -

- WDCGG will assign DOIs for the dataset on WDCGG soon (~Mar. 2021).
- WDCGG joined as a member of JaLC (Japan Link Center: Registration Agency of DOI in Japan) and is working on DOI (for metadata, web).
- WDCGG will issue DOIs for the dataset:
- Yearly fixed dataset from all stations (ex. all CO<sub>2</sub> data at the time of September 2020, 2019, ...)
- Each dataset (ex. CO<sub>2</sub> data at Minamitorishima) only if data provider requested (for each dataset, the same DOI will be used even if it is updated)

2 types of granularity are prepared.

Each gas species

Each dataset



CO<sub>2</sub> :  
doi:10.XXXXXX/YYYYYY\_co2

JMA RYO co2 surface insitu data1  
JMA YON co2 surface insitu data1  
⋮

CH<sub>4</sub> :  
doi:10.XXXXXX/YYYYYY\_ch4

JMA RYO ch4 surface insitu data1  
JMA YON ch4 surface insitu data1  
⋮

N<sub>2</sub>O :  
doi:10.XXXXXX/YYYYYY\_n2o

JMA RYO n2o surface insitu data1  
JMA AOA n2o surface insitu data1  
⋮

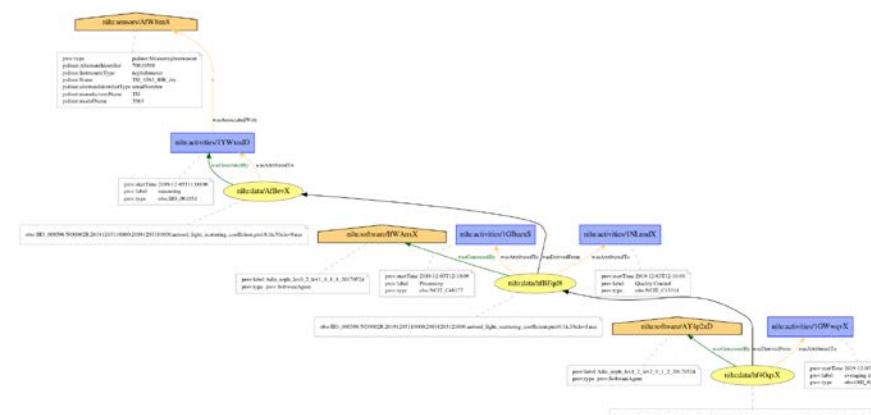
⋮

## - Improved data search/access -

- Easy to find dataset (show quick plot, select dataset by scale, ...)
- Users can select/get more than one dataset as they select (~ Mar. 2022).
- Started satellite data from 2019 as well as data by the ground, ships, aircraft, etc.

# WDCA & WDCRG Operational achievements and challenges

- Operations and data submissions fully continued despite Covid-19 related challenges (including real-time data).
- Standardised machine-2-machine interfaces for data & metadata in place
- Introduced more stringent data curation workflow, documented in issue tracker with issue for each submission.
- Implementing data FAIRness: data identification (DOI), documenting provenance (e.g. RT data).
- Connection to WIGOS ongoing, vocabulary issues to be resolved.



# WDCA/WDCRG 2021 Objectives for GAW

- Finish link to OSCAR / WIGOS, work on missing vocabulary.
- Roll-out of data identification by DOI, granularity to resolve individual PIs and contributors, meeting various use cases:
  - DOI per annual submission.
  - DOI for each version of continuous time series.
  - DOI for latest version of a continuous time series.

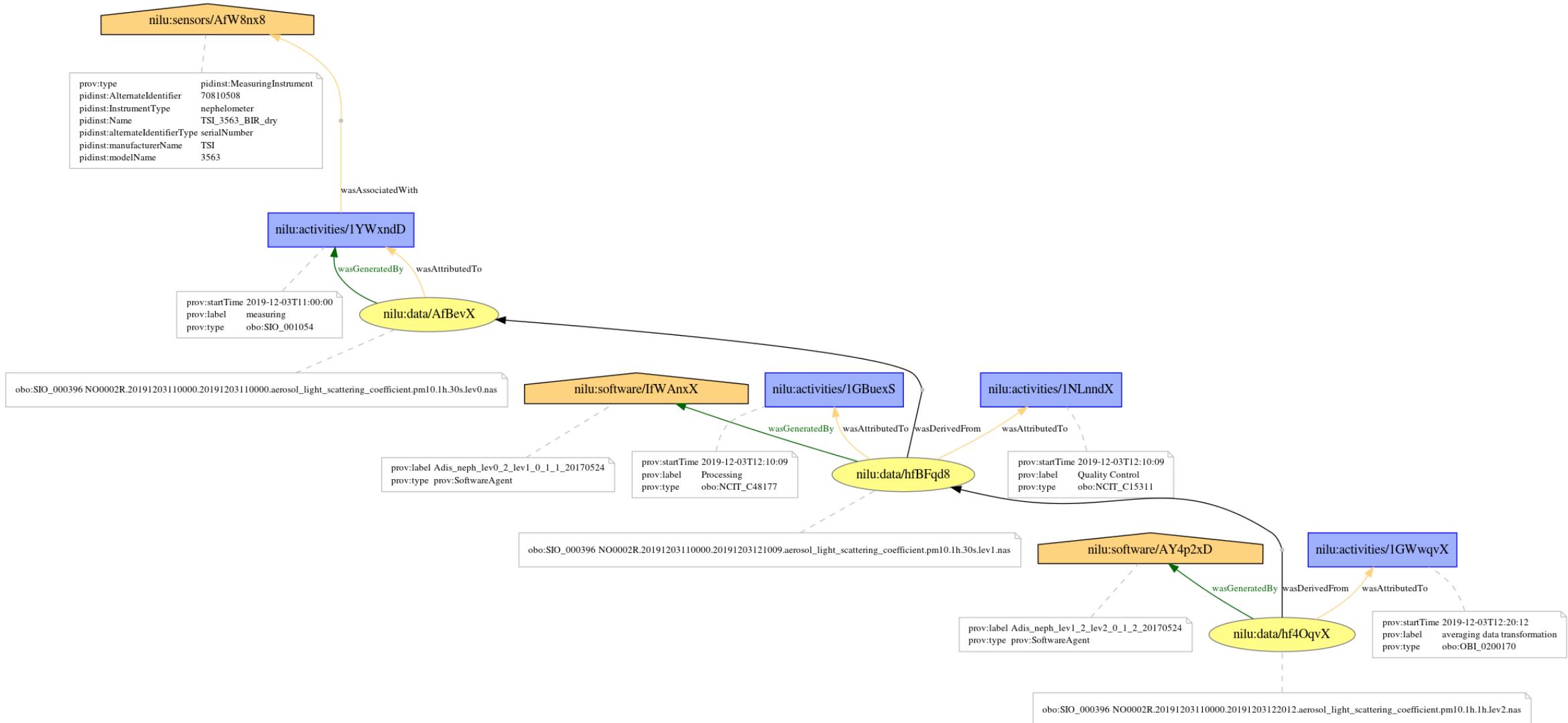
# Topics/projects to address in ET-ACDM & SSC

## Licences for data:

- Ensure data provider & curator rights, legal safety to data user.
- GAW works with scientific data providers: attribution is key and «currency of payment»
- Lobby with WMO to ensure attribution & enable licence use, simple and inexpensive attribution solutions are available, even for operational environments (no excuses).

Creative Commons Attribution 4.0  
International (CC BY 4.0)





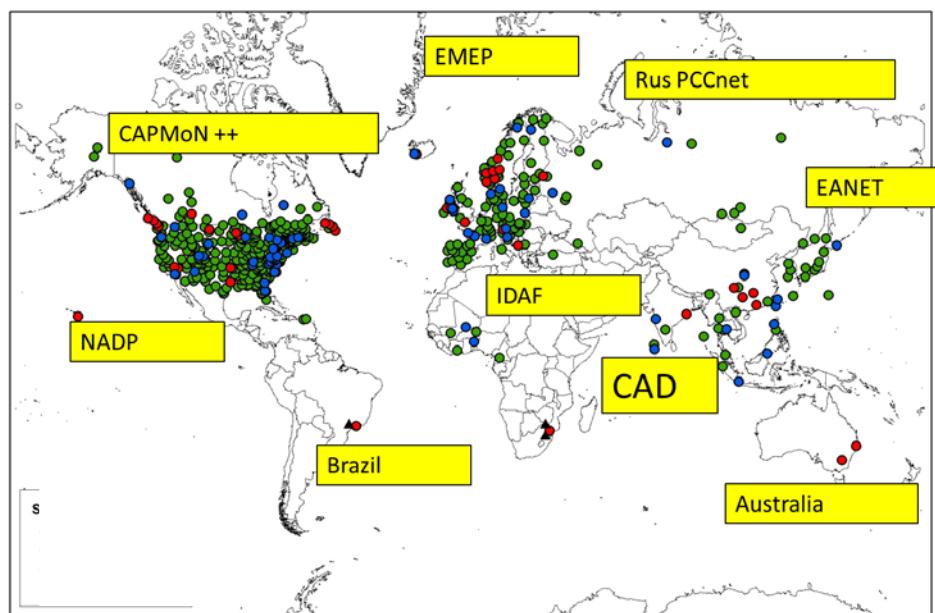
# World Data Centre for Precipitation Chemistry

Welcome to the World Data Centre for Precipitation Chemistry or WDCPC. This centre receives and archives precipitation chemistry data and complementary information from stations around the world. Data archived by this centre are accessible via connections with the WDCPC database. Freely available data from regional and national programmes with their own Web sites are accessible via links to these sites. The WDCPC is one of six [World Data Centres](#) in the [World Meteorological Organization Global Atmosphere Watch \(GAW\)](#). The focus on precipitation chemistry is described in the [GAW Precipitation Chemistry Programme](#). Guidance on all aspects of collecting precipitation for chemical analysis is provided in the [GAW Guidelines for Precipitation Chemistry and Deposition Measurements](#).

The datasets associated with the global assessment of precipitation chemistry and deposition can be found here:  
<https://doi.org/10.5281/zenodo.3981435>.

Please contact [manager@qasac-americas.org](mailto:manager@qasac-americas.org) if you have data that meet the guidance in WMO-GAW Report 160 and could be added to the WDCPC archive.

The WDCPC is closely linked with the Quality Assurance/Science Activity Centre – Americas (QA/SAC-Americas), which helps to ensure and document data quality at precipitation chemistry laboratories. [Graphical and tabular summaries](#) on the QA/SAC-Americas Web site enable researchers and other users to assess the quality of data suitable for their applications.



**Air Resources Laboratory**

Advancing Atmospheric Science and Technology through Research

# WDCPC Achievements and Challenges

- Automated coding of incoming data
  - Chemical ion balances, rainwater collection efficiency
- Public distribution of data with Digital Object Identifiers (DOIs) achieved
- Metadata consistent with WMO Integrated Global Observing System (WIGOS) specifications
  - Example: Station latitude/longitude, collection date, sampling type, sample preservation
  - Challenges in creating XML file format which is fully compatible with OSCAR; may require manual data entry
  - Limitation in defining single metadata set for sites with multiple collection types, or changes in time.

# Public Data Release with Digital Object Identifiers (DOIs)



Atmospheric Environment

Volume 93, August 2014, Pages 1-2



Preface

A global assessment of precipitation chemistry and deposition of sulfur, nitrogen, sea salt, base cations, organic acids, acidity and pH, and phosphorus

Robert Vet (Guest Editor) , Richard S. Artz (Guest Editor), Silvina Carou (Guest Editor)

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<https://doi.org/10.1016/j.atmosenv.2013.11.013>

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Investigating and assessing the chemical composition of precipitation and atmospheric deposition is essential to understanding how atmospheric pollutants contribute to contemporary environmental concerns including ecosystem acidification and eutrophication, loss of biodiversity, air pollution and global climate change. Evidence of the link between atmospheric deposition and these environmental issues is well established. The state of scientific understanding of this link is that present levels of atmospheric deposition of sulfur and nitrogen

A new global assessment of precipitation chemistry and deposition has been published. See:  
<https://doi.org/10.5281/zenodo.3981435>.

August 12, 2020

Dataset Open Access

## Dataset: Global assessment of precipitation chemistry and deposition

Robert Vet; Richard S. Artz; Silvina Carou; Mike Shaw; Chul-Un Ro; Wenche Aas; Alex Baker; Van C. Bowersox; Frank Dentener; Corinne Galy-Lacaux; Amy Hou; Jacobus J. Pienaar; Robert Gillett; M. Cristina Forti; Sergey Gromov; Hiroshi Hara; Tamara Khodzher; Natalie M. Mahowald; Slobodan Nickovic; P.S.P. Rao; Neville W. Reid

An international team of 21 scientists from 14 countries, working under the auspices of the WMO Global Atmosphere Watch Scientific Advisory Group for Precipitation Chemistry, has produced a global assessment of precipitation chemistry and deposition. This assessment appears in a Special Issue of the journal, Atmospheric Environment, Volume 93 (2014), and includes three articles:

1. Preface by Guest Editors, Robert Vet (Environment Canada), Richard Artz (National Oceanic and Atmospheric Administration), and Silvina Carou (Environment Canada). <http://dx.doi.org/10.1016/j.atmosenv.2013.11.013>.
2. Robert Vet, Richard S. Artz, Silvina Carou, Mike Shaw, Chul-Un Ro, Wenche Aas, Alex Baker, Van C. Bowersox, Frank Dentener, Corinne Galy-Lacaux, Amy Hou, Jacobus J. Pienaar, Robert Gillett, M. Cristina Forti, Sergey Gromov, Hiroshi Hara, Tamara Khodzher, Natalie M. Mahowald, Slobodan Nickovic, P.S.P. Rao, and Neville W. Reid. A global assessment of precipitation chemistry and deposition of sulfur, nitrogen, sea salt, base cations, organic acids, acidity and pH, and phosphorus. <http://dx.doi.org/10.1016/j.atmosenv.2013.10.060>.
3. Addendum by Vet, et al. <http://dx.doi.org/10.1016/j.atmosenv.2014.02.017>.

The goal of the assessment was to provide the international science and policy communities with the best available data and information on regionally-representative precipitation chemistry and atmospheric deposition. The information in this publication, together with the supporting data and maps, is an important contribution to the study of atmospheric deposition and to related scientific studies, such as the study of ecosystem impacts, human health effects, nutrient processing, climate change, global and hemispheric modeling, and biogeochemical cycling.

132  
 views

152  
 downloads

[See more details...](#)

Indexed in

**OpenAIRE**

Publication date:

August 12, 2020

DOI:

[DOI 10.5281/zenodo.3981435](https://doi.org/10.5281/zenodo.3981435)

Keyword(s):

precipitation chemistry atmospheric deposition  
emissions major ions pH assessment  
Global Atmosphere Watch

# WDCPC Objectives for 2021

- Preparation of metadata sets and overcoming technical challenges in posting to OSCAR; appreciate the group's technical support and development of user resources.
- Release of validated data sets by station and year via Zenodo (to enable DOIs), with data guides posted at <http://wdcpc.org>.
- Continued work with Science Advisory Group on Total Atmospheric Deposition (SAG-TAD) to link data quality objectives with data sets.



# SHADOZ – Southern Hemisphere Additional Ozonesondes

## A WMO GAW Contributing Network



### Goals & Achievements

- Coordinate ozonesonde launches in tropics, subtropics, and Southern Hemisphere for satellite cal/val, tropical dynamics, transport, and climate studies
- Make ozonesonde data & metadata open and publicly available through **NASA GSFC archive and WOUDC**; some stations also at **NDACC**
- Lead in (1) ozonesonde data QA/QC and homogenization activities w/international partners (eg. ASOPOS) and (2) outreach and capacity-building through site visits and JOSIE campaigns
- 2019: SHADOZ V06 data**, metadata, & uncertainties available for 1998-current; documented in *Witte et al. (2017;2018)* and *Thompson et al. (2018)*
- 2021: Over 9000 SHADOZ ozone and PTU profiles** openly available at archive

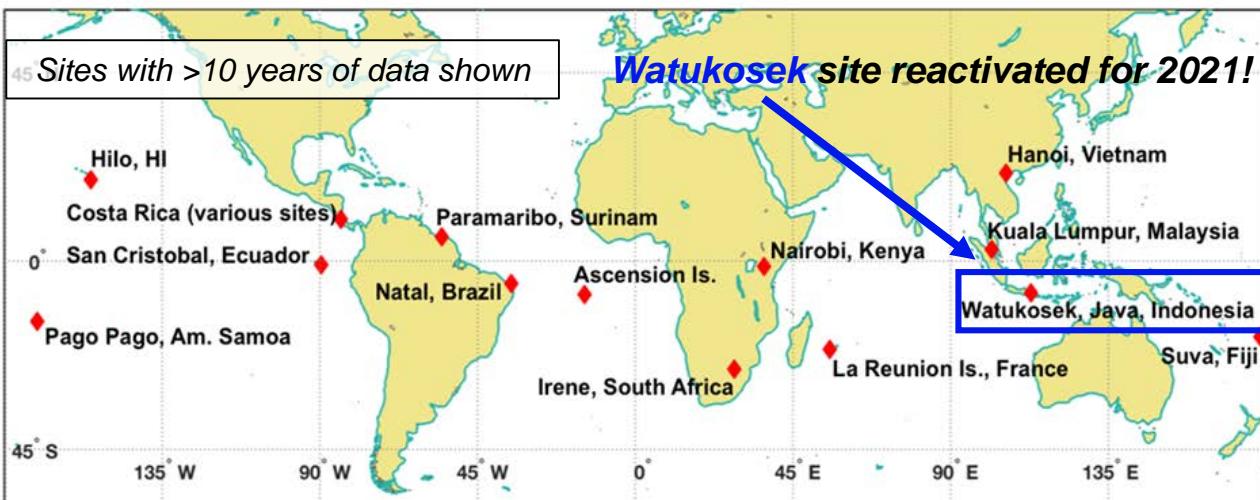
### Objectives for 2021 Beneficial to GAW

- Finish metadata updates for all 14 SHADOZ stations in GAWSIS OSCAR Surface database (DB).
  - Basic information synced in 2020; info on V06 data & QA/QC to be added.
  - Update reactivated stations and station contacts for 2021. SHADOZ data deliveries are typically “quarterly” and DB will be updated similarly.
  - Problem to address w/ ET-ACDM:** How do we organize shared editing with multiple measurements & data contacts at stations?
- Work towards obtaining **DOIs** for **SHADOZ** datasets through NASA’s Science and Technology Institute (STI) in 2021 (~FY2022 Q1).
  - To start, DOIs will be issued for each station’s V06 SHADOZ data record.
  - New DOIs will be created for each future version of data available for each station.
- Deliver SHADOZ V06 2020 datasets to WOUDC; some stations also to NDACC.

### Instrumentation & QA/QC Activities

- Balloon-borne Electrochemical Concentration Cell (ECC) ozone sonde ⇒ ozone profile, surface to above 30 km
  - ECCs manufactured by En-Sci and Science Pump
  - Radiosondes: Vaisala RS80, RS92, RS41; iMet-1, iMet-4; Graw DFM-09, Sippican LMS6 and Modem M10 for PTU profiles
- Ozonesondes evaluated in **World Calibration Centre for OzoneSondes (WCCOS)** environmental chamber in Jülich, Germany (**Jülich OzoneSonde Intercomparison Experiments; JOSIE-SHADOZ 2017** most recent; *Thompson et al. 2019*)
- Assessment for **Standard Operating Procedures for OzoneSondes (ASOPOS)** panel (led by SHADOZ investigators) updated WMO/GAW ozonesonde guidelines report (**Slide 2**).

**SHADOZ Sites:** <https://tropo.gsfc.nasa.gov/shadoz>

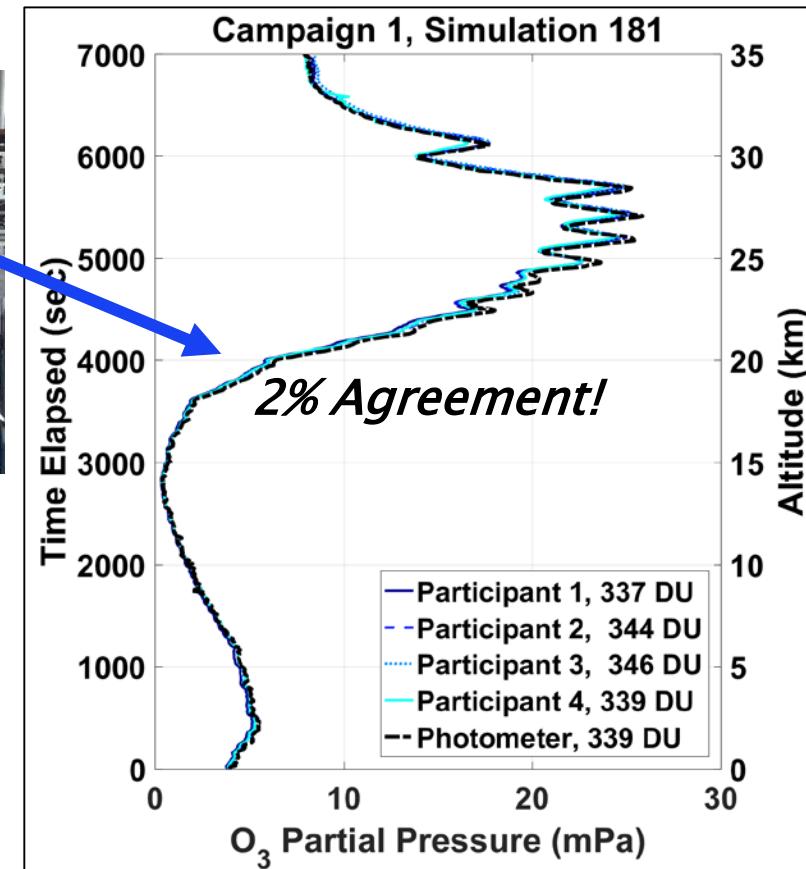
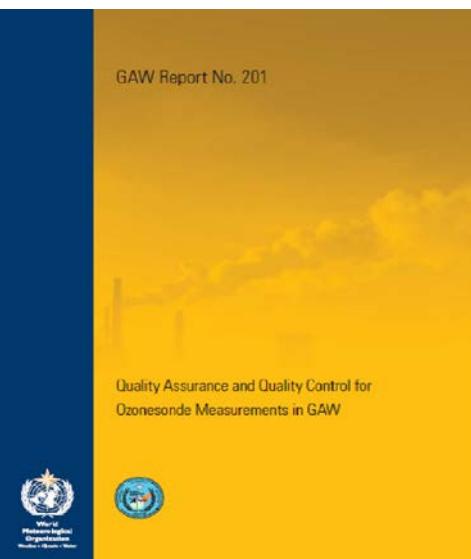




# SHADOZ – Southern Hemisphere Additional Ozonesondes QA/QC Activities for Ozonesonde Data



- SHADOZ leads the effort to QA/QC and homogenize global ozonesonde data.
- Ozonesondes are tested in the **World Calibration Center for OzoneSondes (WCCOS)** in Jülich, Germany to develop Standard Operating Procedures (SOPs) for the 60 worldwide ozonesonde stations.
- SHADOZ Investigators spearheaded the **2021 WMO/GAW ASOPOS 2.0 Report** (in press), replacing the WMO 201 “Sonde Guidelines”: A. Thompson, Co-Editor (SHADOZ PI); Authors B. Johnson, D. Kollonige (SHADOZ Archiver), R. Stauffer, H. Vömel. Peer reviewed by 6 ozonesonde experts from 6 continents.
- This report includes recommendations for: **standardized measurements, data processing, and data/metadata for networks**.



*Example simulated profile from JOSIE-SHADOZ 2017 with four ozonesondes (Thompson et al., 2019; BAMS)*

# AD-Net management & plan

- In 2020, 16 lidars were operated for more than 90% hours of the year. 2 lidars > 85%.
- Routine operation (4 profiles per hour) is expected in 2021 also. But lidars in Korea and Mongolia suffer from annual on-site maintenance work.
- NetCDF and figures containing 532nm&1064nm attenuated backscatter, 532nm depolarization ratio, 532nm extinction coefficients by sphere and mineral dust are uploaded to AD-Net webpage (linked from OSCAR) every hour.
- Currently no new lidar deployment is planned.
- Some Mie-scattering lidars might migrate to High-Spectral-Resolution Lidars in next several years.





# LALINET – Latin America Lidar Network

## 2021 – Perspectives & Goals

1. Recover Full Operation Scheme lost in 2020 – Run Maintenance in many stations – Second Semester 2021
2. Perform the organization of post-poned 2020 Workshop – Second Semester 2021
3. Expand metadata with GAWSIS-OSCAR to Other stations – Only SPU station started
4. Increment database infrastructure – ongoing Project



# The NASA Micro Pulse Lidar Network (MPLNET): Data Center Updates



Project Head: Ellsworth J Welton  
<https://mplnet.gsfc.nasa.gov>



## Operational Achievements and Challenges:

- Release of new Version 3 processing system and product suite in 2020
  - Multi-threaded, auto-processing system using online management interface
  - Expanded products: examples include cloud phase, mixed layer height (and its optical depth) and more
  - Near real time processing, product delivery < 1.5 hours
  - Improved data distribution system
  - New APIs for data access and dynamic plotting/images
  - New network partner accounts (login for privileged access to site management, data, and other tools)
  - More comprehensive metadata system, allows easier alignment with OSCAR

## Objectives for 2021:

- Version 3 reprocessing of our entire data archive is underway (79 sites worldwide since 2000, grows each year)
- Goal: complete reprocessing of all sites back to 2006 by end of 2021
- Older sites from our Version 1 era will require more effort to reprocess (target 2022)
- Complete development of new Level 3 products (regridded climatologies)
- Add a hot swap server backup for redundancy
- Complete update of MPLNET metadata in OSCAR

# The NASA Micro Pulse Lidar Network (MPLNET): Data Center Updates

## Status of metadata delivery to OSCAR:

- MPLNET has 79 sites worldwide since project start in 2000
  - 9 sites are in OSCAR, and affiliated
  - 24 sites are in OSCAR, but not yet affiliated
  - 46 sites are not in OSCAR (no matching site based on lat/lon)
- In 2020 much effort was put into developing a system to update MPLNET metadata using the OSCAR API
  - Problems with code list vocabularies and traceability to OSCAR requirements were noted
    - These issues have delayed completion of this task. Some problems have been addressed, but not all.
    - Decision was made to update the information we could, and wait for the remaining vocabulary issues to be fixed in future and update again.
  - Programs to update our metadata for the 9 affiliated sites and 24 non-affiliated sites were completed in summer 2020
    - Unfortunately this coincided with release of a new version of OSCAR, and extensive updates to our programming are required before our metadata files will pass the new OSCAR requirements
    - This work was put on hold until 2021 due to other demands within MPLNET
  - There is currently no good solution to add the remaining 46 MPLNET sites to OSCAR
    - These sites span multiple countries. A process to work with international networks is required.

## Specific topics/projects to address in ET-ACDM in 2021:

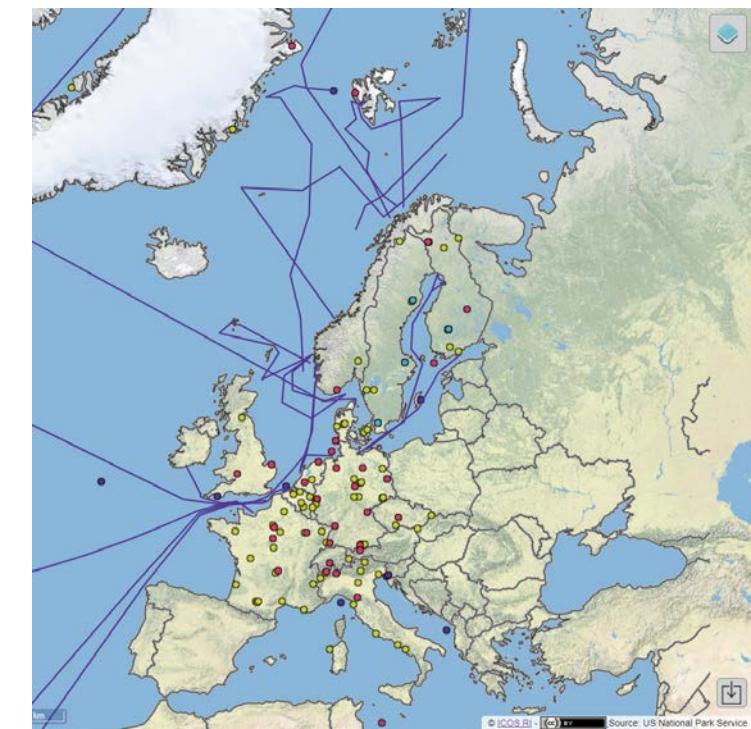
- Continue updates and additions to the code lists, in particular for aerosol and remote sensing related parameters
- Pursue a mechanism to allow contributing networks to utilize GTS for near real time delivery to forecast & modeling centers

## Other Business:

- Finish construction of the GAW Aerosol Lidar Observation Network (GALION) data center

# ICOS Carbon Portal, CAL and ATC

- ICOS is the Integrated Carbon Observation System, established as ERIC since 2015. It provides operationally standardised high precision and long-term observation data on the carbon cycle for the three domains Atmosphere, Ecosystem and Ocean from more than 140 stations from currently 13 member states. Stations undergo rigorous certification (labelling) and follow standard protocols.
- The atmosphere GHG data is curated centrally by the Atmosphere Thematic Centre with regular QC by the stations PIs. Calibration and measurement are performed following the GAW recommendations. The central calibration lab provides working standards referenced to the GAW scales and analyses the flask samples from the stations e.g. for  $^{14}\text{CO}_2$
- All data is transferred in NRT to the central repository (Carbon Portal), each file receives PID
- Automated QC'ed NRT data is available with max 24 hr delay
- Regular final quality controlled data is released as station and data collection
- All final quality controlled and elaborated data receive DOI
- All ICOS data is licensed under CC4BY
- Reprocessed historical data is available for ICOS and non-ICOS stations
  - InGOS project for  $\text{CH}_4$  and  $\text{N}_2\text{O}$  incl. uncertainties
  - Drought time series  $\text{CO}_2$  incl. uncertainties from 1979 until mid 2019
- Advanced data portal with faceted data search, preview and downloads
- Carbon Portal is developed following the FAIR principles optimised for M2M
- Carbon Portal will apply for CoreTrustSeal in 2021



# Contribution to WMO GAW

ICOS is contributing network of WMO GAW for Greenhouse Gases

- Will implement M2M update of station metadata with GAWSIS (Q3/2021), first tests started 2020
- Will implement automated transfer of final quality controlled data from the labelled stations to WDCGG
- Ready to deliver NRT data to WIGOS
- Delivers (NRT) data to COPERNICUS CAMS and CDS
- Planning to develop a city observations network, thereby contributing to GAW IG<sup>3</sup>IS, including harmonized observations, modelling and data pipelines
- Developing interactive data analysis tools using e.g. Jupyter notebooks with (global and regional) measurements and modelling community, including publication of the workflows and resulting elaborated products

Issues to solve:

- ICOS data license enforcing
- Avoid data replication and double DOI minting
- ICOS wants to preserve the access to its developing and richer metadata (e.g. provenance, contributions) to the users, and the direct link to the (versioned) data objects through PID and DOI



Home > Data products >

## ICOS Near Real-Time (Level 1) Atmospheric Greenhouse Gas Mole Fractions of CO<sub>2</sub>, CO and CH<sub>4</sub>, growing time series starting from latest Level 2 release

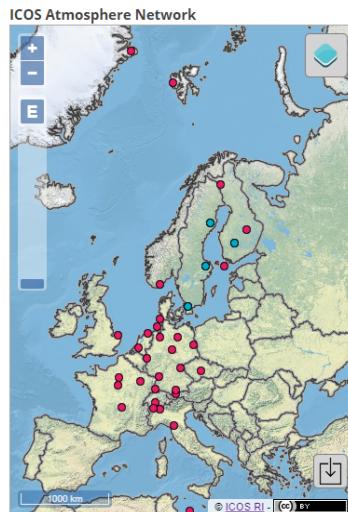
DOI: [https://doi.org/10.18160/ATM\\_NRT\\_CO2\\_CH4](https://doi.org/10.18160/ATM_NRT_CO2_CH4)

**Disclaimer:** Near Real-Time (NRT, Level 1) data is not the final highest quality ICOS data. This data is generated using only completely automated quality control procedures. These NRT time series are generated within 24 hours after measurement and will not be updated later using improved information or become completed with missing data. For your analysis and publications we recommend to use the final completely quality controlled and flagged (Level 2) data that is released with a delay between 6-12 months, that includes all corrections and maximum completion of missing data, also listed in our [data products catalog](#).

**Description:** Near Real-Time growing time series containing data from the atmospheric network of ICOS Research Infrastructure for the stations Gartow, Hohenpeissenberg, Hyttemossa, Ispra, Jungfraujoch, Křešín u Pacova, Lindenberg, Monte Cimone, Norunda, OPE, Pallas, Puy de Dome, SMEAR II (Hyttilä), Svalberget, Torfhaus, Trainou, and Zeppelin Observatory. This collection contains the NRT hourly averaged data for the mole fractions of CO<sub>2</sub>, CO and CH<sub>4</sub>, measured at the relevant vertical levels of the measurements stations, starting from the latest date of final released Level 2 data or the date of labelling. All stations follow the ICOS Atmospheric Station specification V1.3 (<https://www.icos-ri.eu/fetch/ba12290c-3714-4dd5-a9f0-c431b9900ad1;1.0>) and are certified as ICOS atmospheric stations Class I or II. Data processing has been performed as described in Hazan et al., 2016 (doi:10.5194/amt-9-4719-2016).

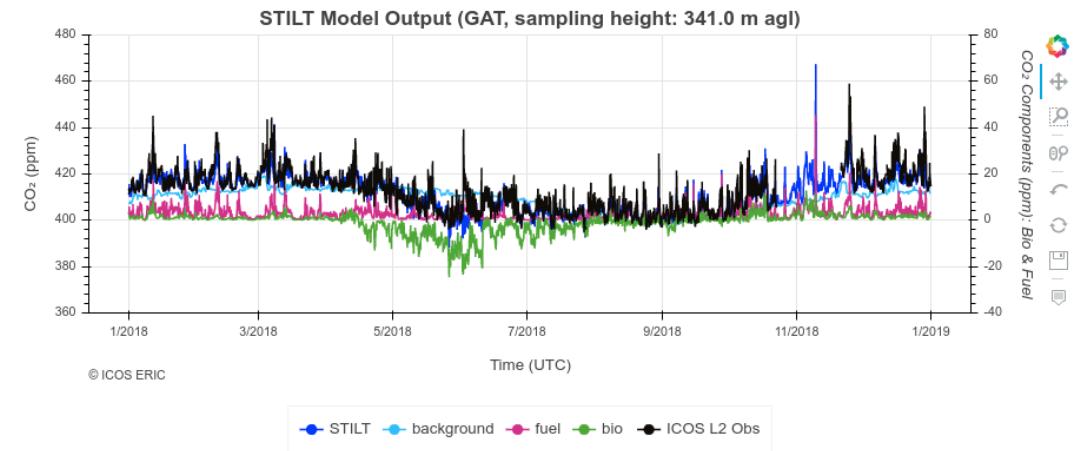
Data licence: CC4BY

[View in the data portal](#)

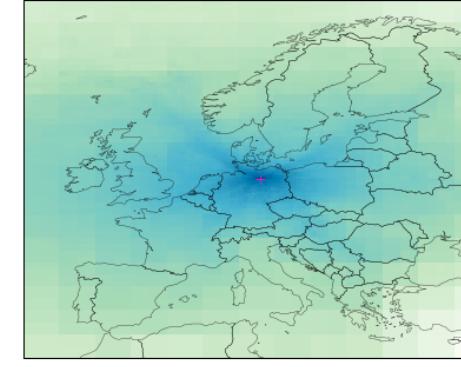


### CO<sub>2</sub> Preview

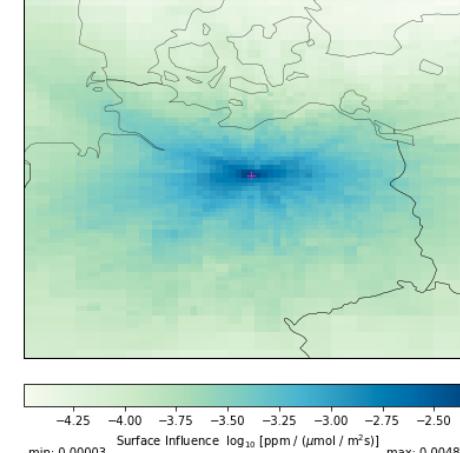
Station	height 1	height 2	height 3	height 4	height 5	All
Gartow	30.0	60.0	132.0	216.0	341.0	All
Hohenpeissenberg	50.0	93.0	131.0			All
Hyttemossa	30.0	70.0	150.0			All
Hyttilä	16.8	67.2	125.0			All
Ispra	40.0	60.0	100.0			All
Jungfraujoch	5.0					
Trainou	10.0	50.0	125.0	250.0		All



Aggregated Footprint (n=2920)  
2018-01-01 - 2019-01-02  
time selection: all  
Station: Gartow (GAT344) 344.0 m agl  
[53.07Nx011.44Ex00344]



Aggregated Footprint (n=2920)  
2018-01-01 - 2019-01-02  
time selection: all  
Station: Gartow (GAT344) 344.0 m agl  
[53.07Nx011.44Ex00344]

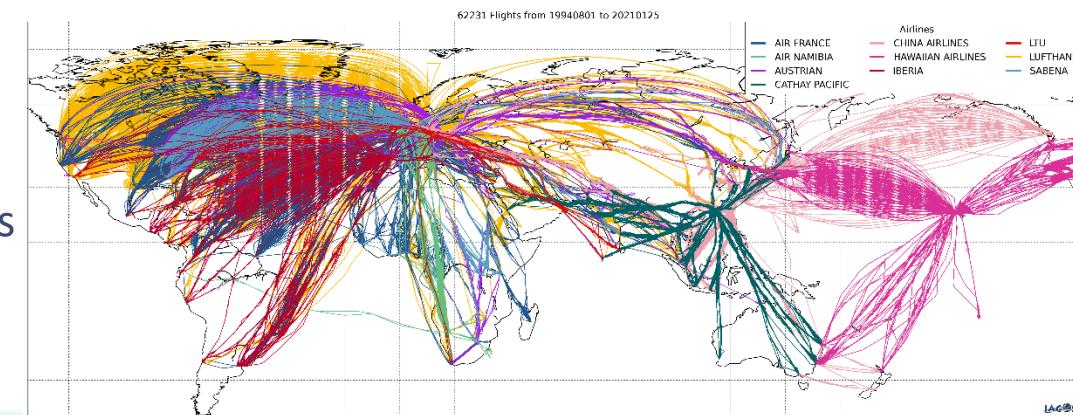


### Data Citation:

ICOS RI, 2019. ICOS ATC CO<sub>2</sub> Release, Gartow (341.0 m), 2016-05-10–2019-04-30, <https://hdl.handle.net/11676/x2gj6BMqkQEbh9281roE3ky>

# IAGOS Data Center : contributing network to WMO/GAW

- ✈ IAGOS is the European Research Infrastructure for global observations of atmospheric composition from commercial aircraft. IAGOS combines the expertise of scientific institutions with the infrastructure of civil aviation in order to provide essential data on climate change and air quality at a global scale. In order to provide optimal information, two complementary systems have been implemented, (i) IAGOS-CORE providing global coverage on a day-to-day basis of key observables and (ii) IAGOS-CARIBIC providing a more in-depth and complex set of observations with lesser geographical and temporal coverage.
- ✈ IAGOS provides a data base for users in science and policy, including near realtime data provision for weather prediction and air quality forecasting. IAGOS data are being used by researchers world-wide for process studies, trend analysis, validation of climate and air quality models, and the validation of space borne data retrievals. The IAGOS data center is accessible via <http://www.iagos.org>
- ✈ The IAGOS data base also contains the data from the precursor projects MOZAIC (1994-2014) and CARIBIC (from 1997). Use of the IAGOS data is free for non-commercial users. Access to the data base is granted after registration and upon acceptance of the data protocol.
- ✈ The IAGOS data base provides in-situ measurements of
  - Greenhouse Gases : CO<sub>2</sub>, CH<sub>4</sub>, H<sub>2</sub>O, N<sub>2</sub>O, CFCs, SF<sub>6</sub>
  - Reactive Gases : Ozone, CO, NO<sub>y</sub>, NO<sub>x</sub>, SO<sub>2</sub>, VOCs, HCHO
  - Aerosols : Number density, size distribution, larger 0.25 microns
  - Cloud Particles (5-75 microns) : Number density



# Contribution to WMO/GAW

## → operational achievements and challenges :

The IAGOS data center is operational, including on-going improvement for users in terms of visualization and plotting facilities for users, on-going improvement towards the FAIR principles.

Challenges are (i) to keep providing added-values products and services, and (ii) to increase the number and diversity of users and usages.

## → objectives of your center for 2021 as they relate to or benefit WMO/GAW :

Main objective is to reach the expected level of interoperability and harmonization of services with other data centers of other research infrastructures and WMO/GAW data centers, including metadata delivery to GAWSIS.

## → status of metadata delivery/synchronization with GAWSIS-OSCAR/Surface :

Only one station is registered in GAWSIS-OSCAR so far. It is the Paris airport, called CDG. Work has to be reactivated. About 300 airports have been and/or still are visited by IAGOS equipped aircraft. Airport can be reported as station providing vertical profiles. The pending question is still the way to include the cruise-phase data sets. Implementation of WIGOS metadata profiles in progress in the frame of the EU ENVRI-FAIR project.

## → specific topics/projects you want to address in ET-ACDM in 2021 :

IAPOS will contact ET-ACDM soon to provide metadata in a machine-to-machine way (Is OSCAR API existing yet ?).

Is the link between OSCAR and WIS existing ?

Need a (better) link between IAGOS with ABOS → Need WMO's support to further encourage airlines to have a IAGOS equipped aircraft in their fleet

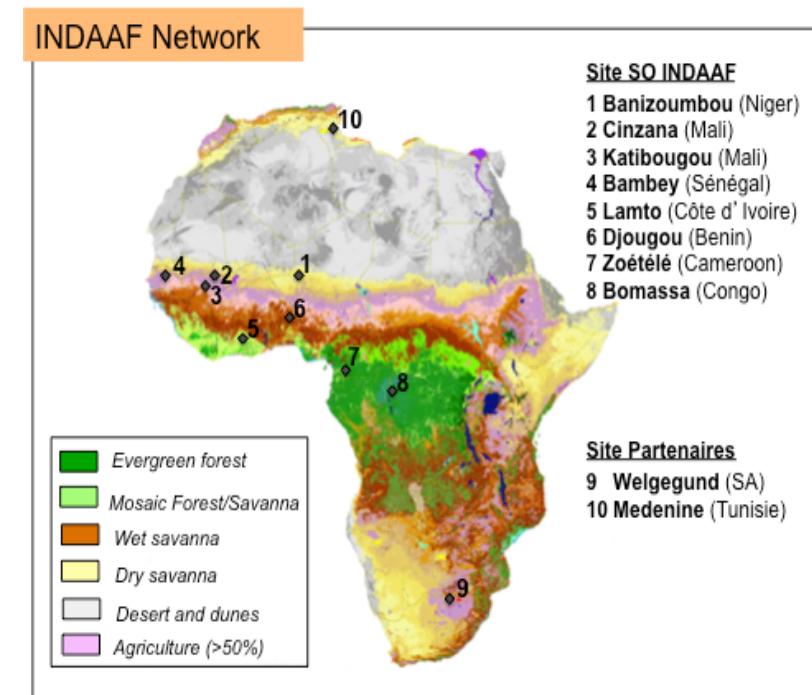
# Contribution to WMO/GAW

→ AOB related to 2 and 3.

- specific items that the SSC should address
- initial thoughts on topics/ideas/new structures/modes of operations etc., for consideration in formulating the next GAW Implementation Plan.
  - Facilitate the links between ABOS and programs like IAGOS and CONTRAIL
  - Further encourage/communicate the need for vertical information within the surfaced-based observing networks, and the need for measuring co-emitted species for both Air Quality and Climate issues

# INDAAF network: contributing network to WMO/GAW

- **International Network to study Deposition and Atmospheric chemistry in AFrica (INDAAF)** is a National observatory (Service National d'Observation) labeled by INSU/CNRS since 1996, part of the research infrastructure ACTRIS-FR. At the International level: INDAAF is a contribution to the deposition task DEBITS in IGAC, a contributing network to GAW WMO programme and to SDS-WAS/WMO.
- **INDAAF coordination:** Laboratoire d'Aérologie (Toulouse), Laboratoire Interuniversitaire des Sciences Atmosphériques (Paris)
- **INDAAF network:** 8 stations in West and Central Africa + 2 affiliated stations in South Africa and South Tunisia.
- **INDAAF provides a data base** for users to document the atmospheric composition representative of the main African ecosystems (dry savanna/wet savanna/forest). INDAAF data are being used by researchers to study biogeochemical cycles, deposition fluxes (wet and dry processes), trend analysis and validation of climate and air quality models.  
Access to the data base is free after registration and upon acceptance of the data protocol.
- **INDAAF data base (<http://indaaf.obs-mip.fr>)** provides in-situ measurements of
  - Precipitation chemical composition to quantify wet deposition fluxes by species
  - Aerosol mass concentration (PM10), mineral and carbon chemical speciation (PM2.5, PM10), total aerosol mass deposition flux.
  - Gases concentrations (monthly, O<sub>3</sub>, NH<sub>3</sub>, HNO<sub>3</sub>, SO<sub>2</sub>, NO<sub>2</sub>) to quantify dry deposition





# INDAAF network: contributing network to WMO/GAW

- **operational achievements and challenges :**

The INDAAF data base is operational, including on-going improvement on data referencment using DOIs. Challenges are (i) to include added-values services for users (i.e SOFT-IO back trajectories), (ii) to develop the number and diversity of users and usage in agreement with SDGs, (iii) to improve the FAIR principles.

- **objectives of your center for 2021 as they relate to or benefit WMO/GAW :**

Main objective is to reach the expected level of interoperability and harmonization with research infrastructure (ACTRIS Europe) and WMO/GAW data centers (MMF-TAD service, Precipitation, Gases, Aerosols), including metadata delivery to GAWSIS.

- **status of metadata delivery/synchronization with GAWSIS-OSCAR/Surface :**

The 8 labelled INDAAF measurement sites were registered in GAW-SIS (metadata) and need to be updated. Work is on going to update information and to include INDAAF sites and datasets metadata in OSCAR/surface.

- **specific topics/projects you want to address in ET-ACDM in 2021 :**

Need assistance from ET-ACDM to fill the GAWSIS-OSCAR /surface.

Need a better link between INDAAF and WDCPC/WDCA

# Atmospheric monitoring site in EANET (2020)

**Total (47)**

## Category

Urban: 17 sites

Rural: 13 sites

Remote: 17 sites

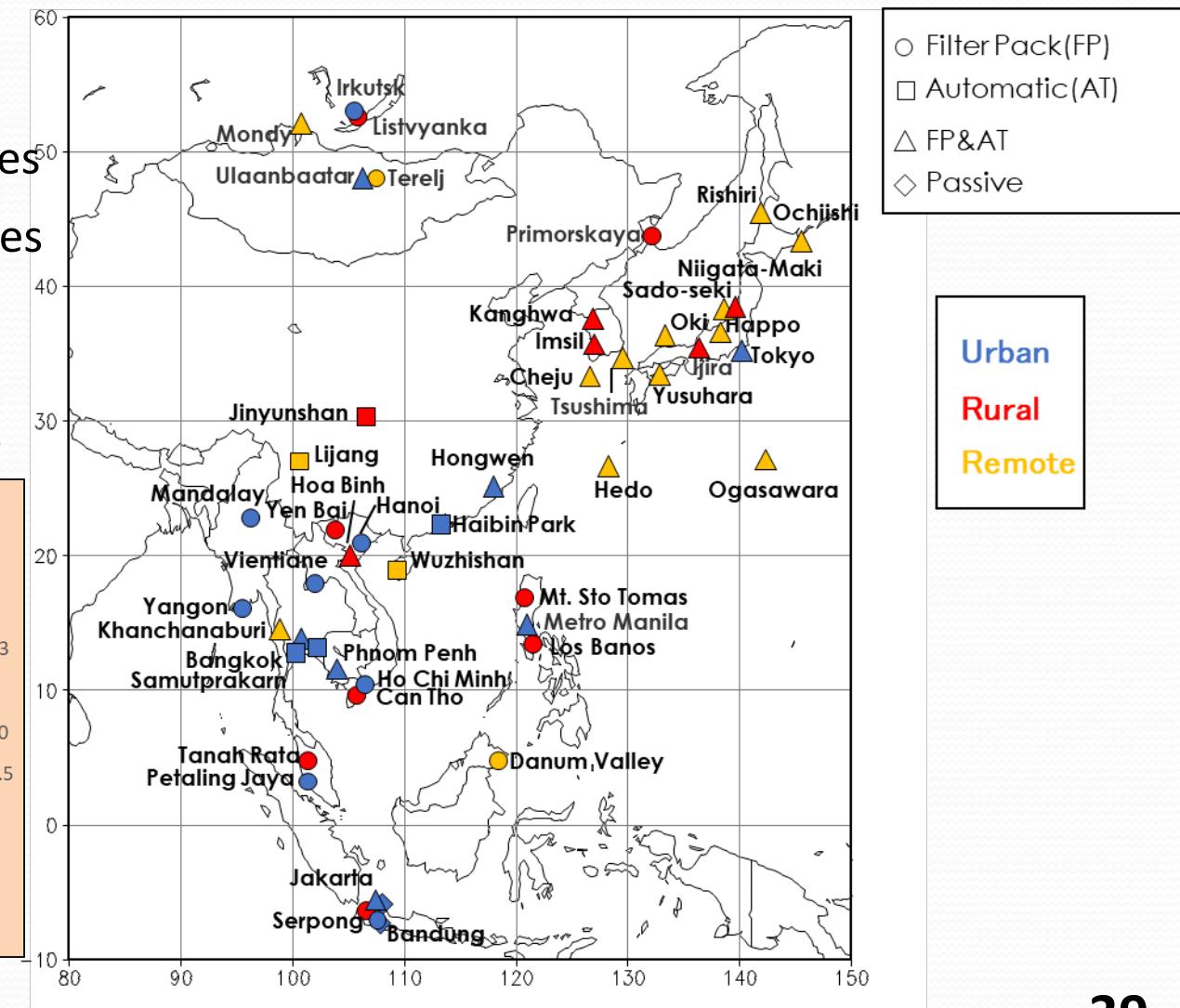
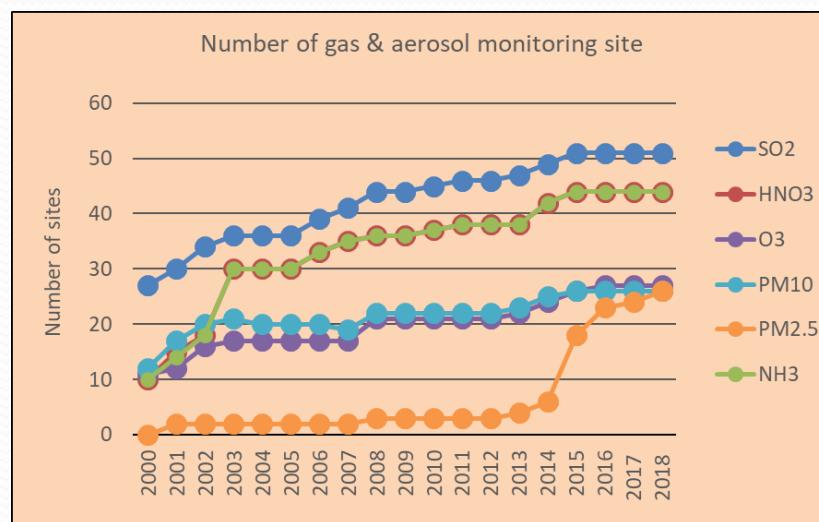
## Methodology

Filter pack: 40 sites

Automatic: 33 sites

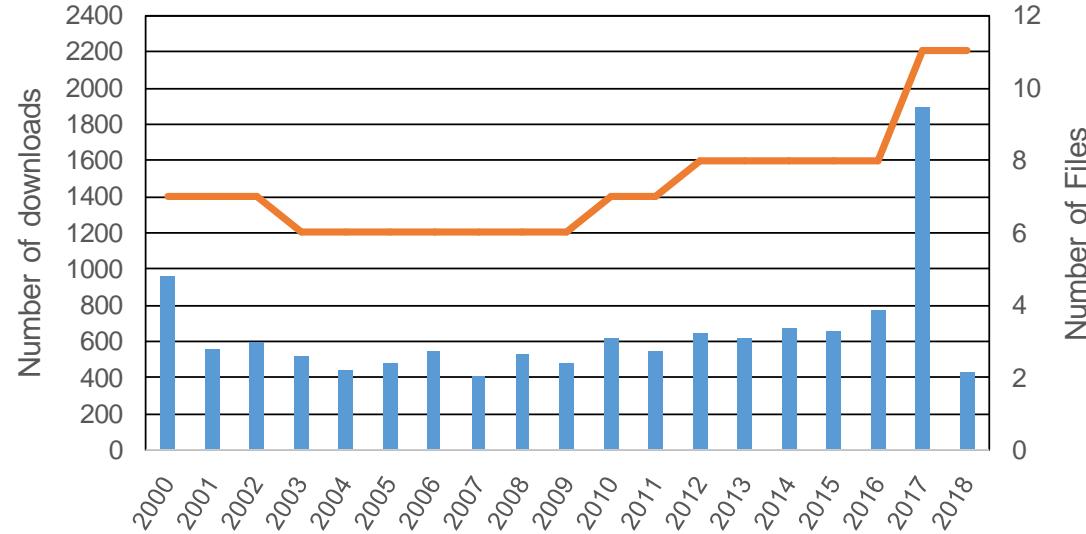
Passive: 6 sites

## Annual variations of site numbers



# Work plan of EANET for cooperation with WMO/GAW in 2021

**Number of file downloads for each annual data report (April 2019-March2020)**



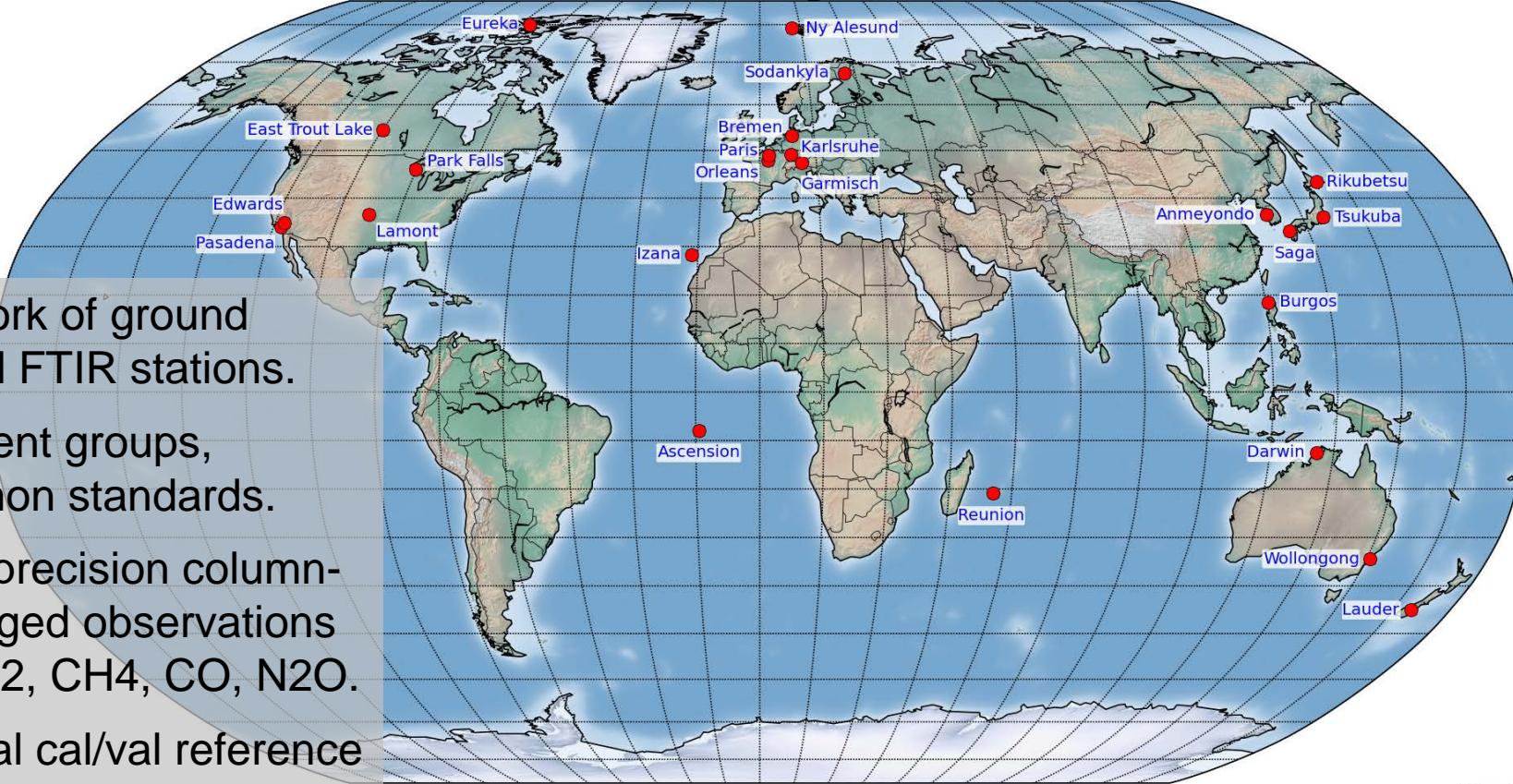
Date: Tuesday-Friday, 1-4 March, 2022

<https://www.acidrain2020.org/>

1. Update of EANET atmospheric monitoring database and exchange information on monitoring database with WMO/GAW (See left)
2. Update EANET metadata by using the National Monitoring Plans of member countries
3. Producing xml file and incorporate to the GAWSIS-OSCAR/Surface or Log into OSCAR focal point account and input the metadata manually
4. To discuss how to contribute of WMO/GAW on the 10th International Conference on Acid Deposition (Acid Rain 2020) (See left)

# Total Carbon Column Observing Network (TCCON)

Total Carbon Column Observing Network (TCCON) 2019



- Network of ground based FTIR stations.
- Different groups, common standards.
- High-precision column-averaged observations of CO<sub>2</sub>, CH<sub>4</sub>, CO, N<sub>2</sub>O.
- Crucial cal/val reference for all satellite GHG observations.

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# TCCON metadata in OSCAR

- TCCON was first contacted about OSCAR database by Drasko Vasiljevic in May 2020.
- TCCON chairs are interested to have TCCON included in OSCAR database.
- Contact: Dietrich Feist (DLR & LMU Munich):
  - TCCON Deputy Chair for Africa & Europe
  - PI of Ascension Island TCCON station
  - Responsible for setup and maintenance of the XML meta data for TCCON dataset DOIs.

# Current status and further steps

- Outdated meta data for several stations already exists in OSCAR from TCCON's initial association with GAW several years ago.
- Probably best to recreate meta data from scratch as many new stations are missing and some have been closed or moved since.
- Some of the metadata required by the WIGOS standard can be derived from the existing TCCON dataset DOI metadata. Some has to be collected from the TCCON PIs.
- Major update of the TCCON data and metadata planned in the first half of 2021 (delayed from Q4/2020). Additional metadata required for WIGOS standard will be collected in the process.
- Creation of WIGOS XML data envisaged for Q2/2021. However, resources for such work are extremely limited.



# Detection of Atmospheric Composition Change

- NDACC is comprised of 157 active measurements at 73 stations plus many short term and campaign datasets
- 8 Instrument types:  
Dobson, Brewer, FTIR, Lidar, Microwave, Sonde, UVVIs, Spectral UV
- 9 Cooperating Networks:  
AERONET, AGAGE, BSRN, GRUAN, HATS, MPLNET, PGN, SHADOZ, TCCON, *EUBREWNET* (soon to come)
- DOIs are crafted at EVDC
- Mirror databases established at EVDC and CEDA
- Active relationships/data or metadata exchange with ACTRIS, CAMS, C<sub>3</sub>S/CDS, DCIO, etc
- DHF at NOAA/NCEP/CPC established in 1991 – 30 years of operations
- Transitioning DHF from NOAA/NCEP/CPC to NASA/LaRC
- Working through process to be a GAW Contributing Network

