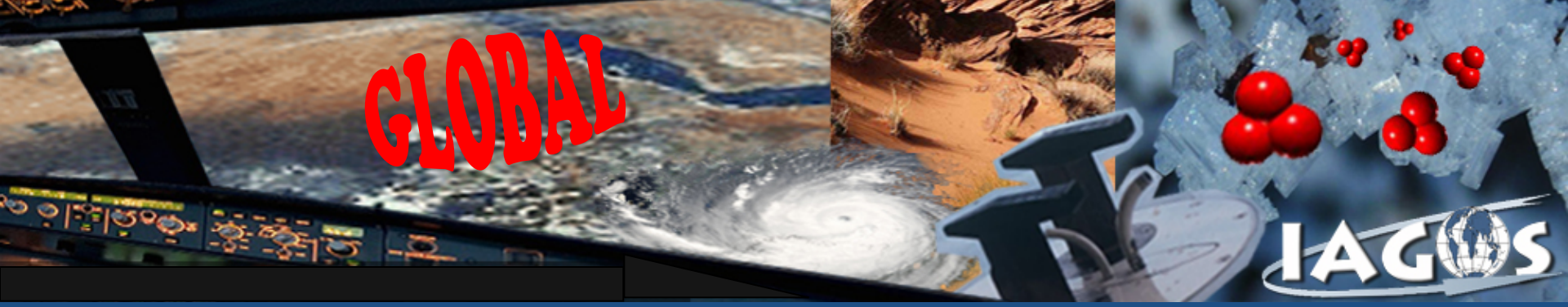
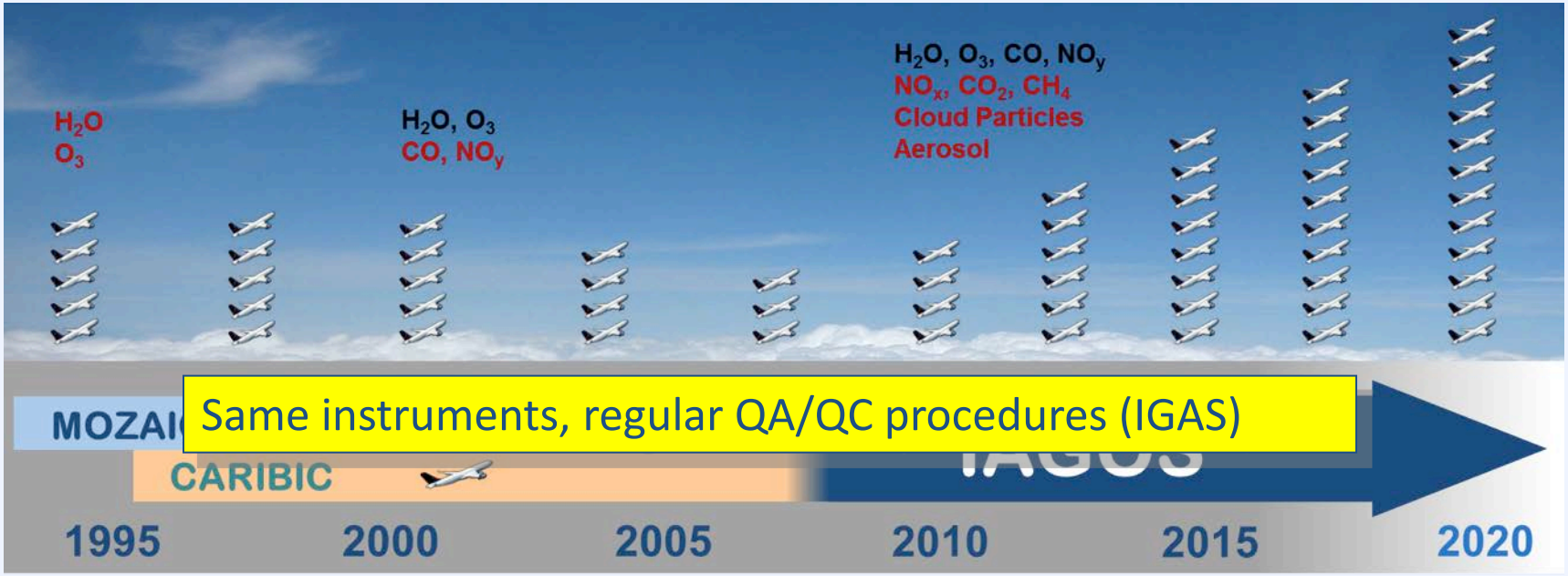


IAGOS - Status and Perspective

A. Volz-Thomas, M. Gallagher, C. Gerbig,
A. Petzold, V. Thouret, A. Zahn
and the IAGOS-Team

History and Future



IAGOS combines the advantages of MOZAIC and CARIBIC:

IAGOS-CORE: Key components on many aircraft, every day with quasi-global coverage, 500 flights/ac/yr

IAGOS-CARIBIC: Many species for a deeper understanding on one aircraft, ca. 50 flights/yr

Objectives

- **Equip 20 longhaul aircraft with scientific instruments for:**
  - chemical composition (H_2O, O_3, CO, NO_x, NO_y, CO_2, CH_4),
  - aerosol
  - cloud particles
- **Longterm deployment (20 yrs)**
- **Global coverage**
- **Open data policy (GEO/GEOSS)**
- **Near-realtime data provision to CAMS and Met Services**
- **Monthly deployment of the CARIBIC laboratory on board of 1 aircraft (Lufthansa D-AIHE)**

Scientific Value

- **Changes in the Tropopause Region**
  - Spatial and temporal resolution (background and trends)
- **Validation of Atmospheric Models and Satellite Retrievals**
  - Tropospheric profiles of O_3, CO, NO_x, aerosol, CO_2, CH_4
- **Global Air Quality**
  - Influence of developing regions, biomass burning, climate change,...
- **International Transfer Standard**
  - Same systems everywhere
  - Regular Quality Assurance

Status of Fleet and Operation

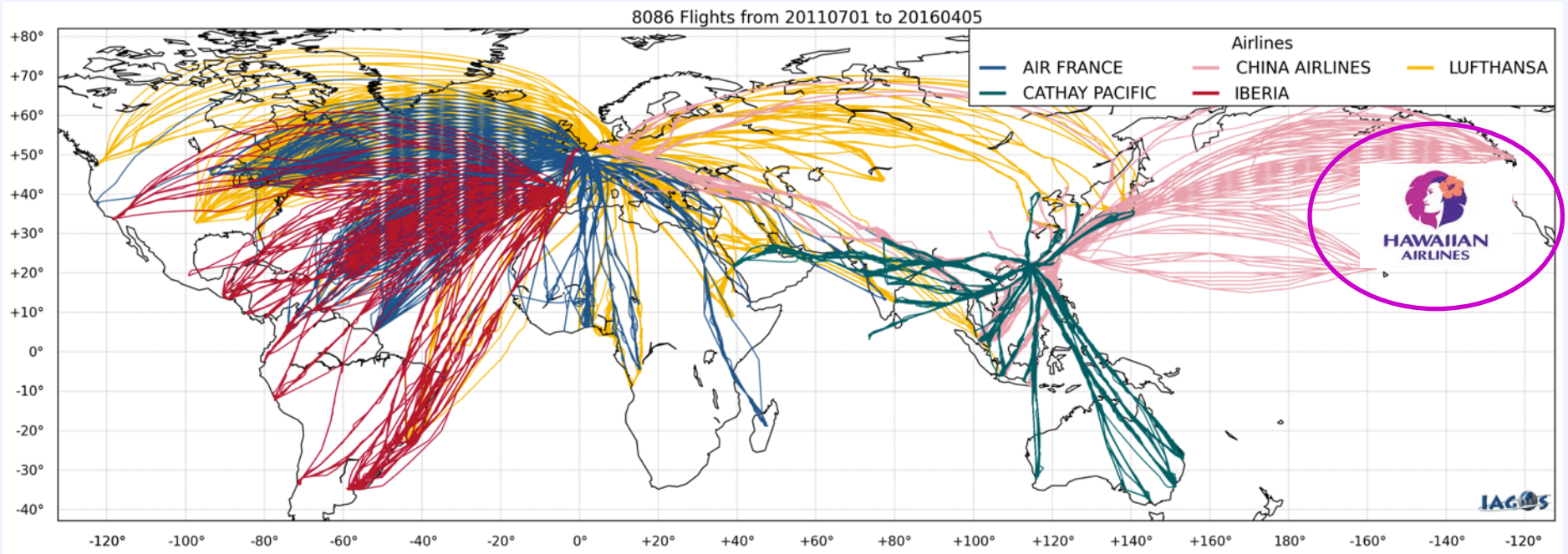
- 6 aircraft with IAGOS CORE rack (O_3, CO, H_2O, BCP)
  - 2 DLH, 1 AFR, 1 CAL, 1 CPA, 1 IBE
- 1 (DLH) with Package 2b (NOx) or Package 2a (NOy)
- 7th a/c to be equipped in July 2016 (CAL)
- 8th and 9th a/c in 2017 (CAL and AFR)
- Negotiations with HAL for installation in 2017

=> 10 a/c equipped in 2017

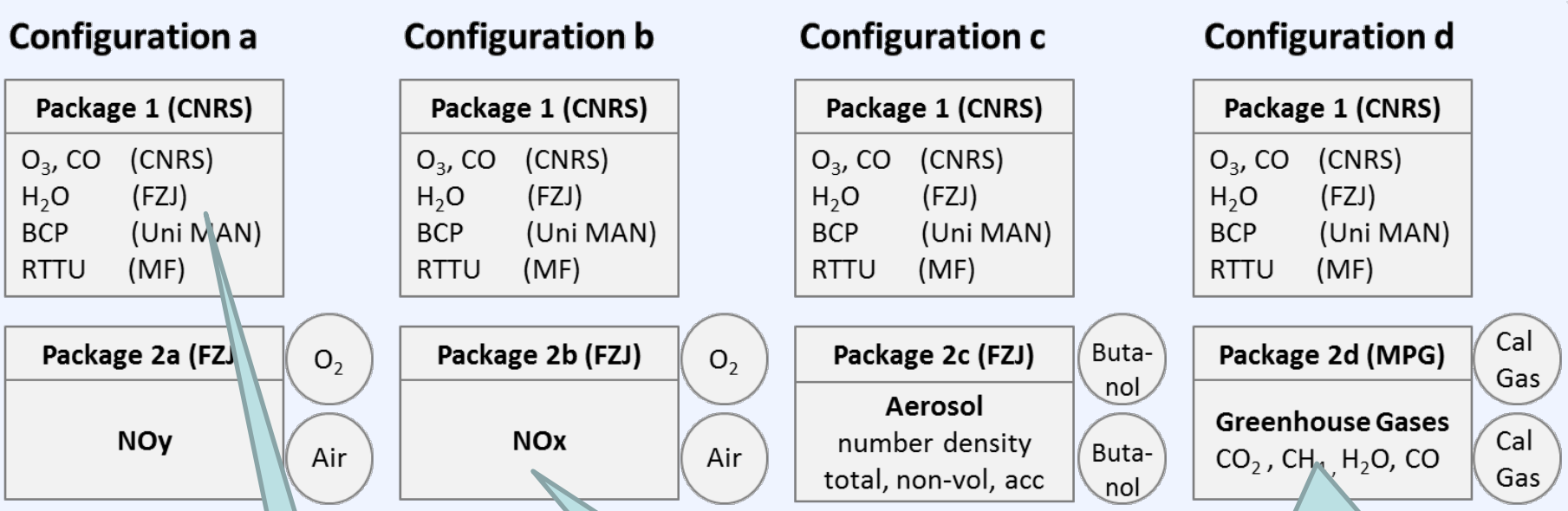
- STC for Package 2d (GHGs) in progress at EASA
- IAGOS-CARIBIC container under major revision for installation of new and improved instruments

IAGOS-CORE Flight Routes

> 8300 flights July 2011 - May 2016



IAGOS - CORE Instrumentation



Configurations for IAGOS-CORE

- Package 1 o es on all IAG aircraft (developed
- Package 2 ption for one IAGOS-CORE aircraft)
  - NOx (P2a, P2b)
  - Aerosol properties (P2c)
  - Greenhouse gases, CO_2 ,CH_4 (P2d)

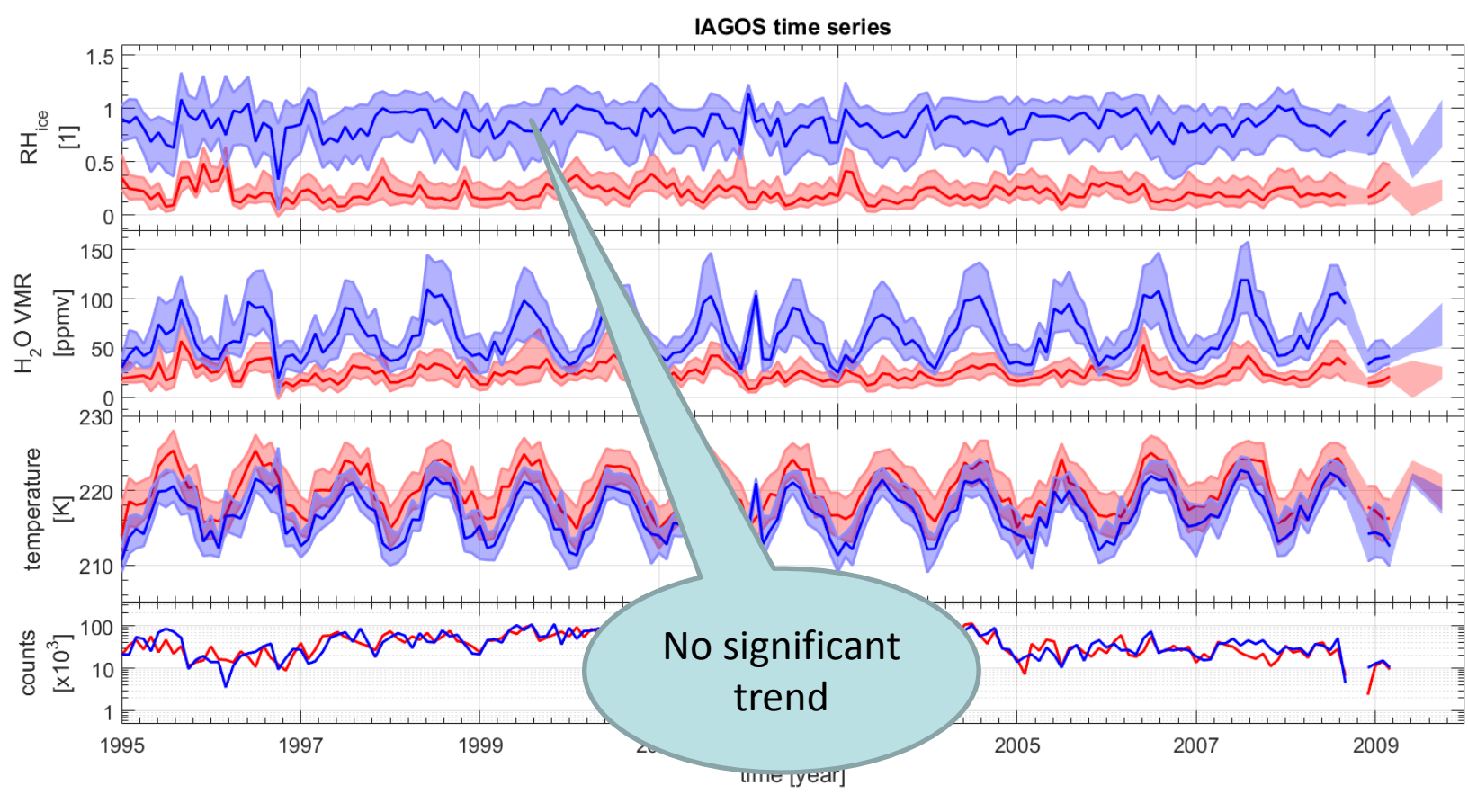
On all 6 a/c

On 1 a/c

EASA certification almost completed; P2a,b,c to follow

Water Vapour over the North Atlantic

by Patrick Neis, FZ-Jülich



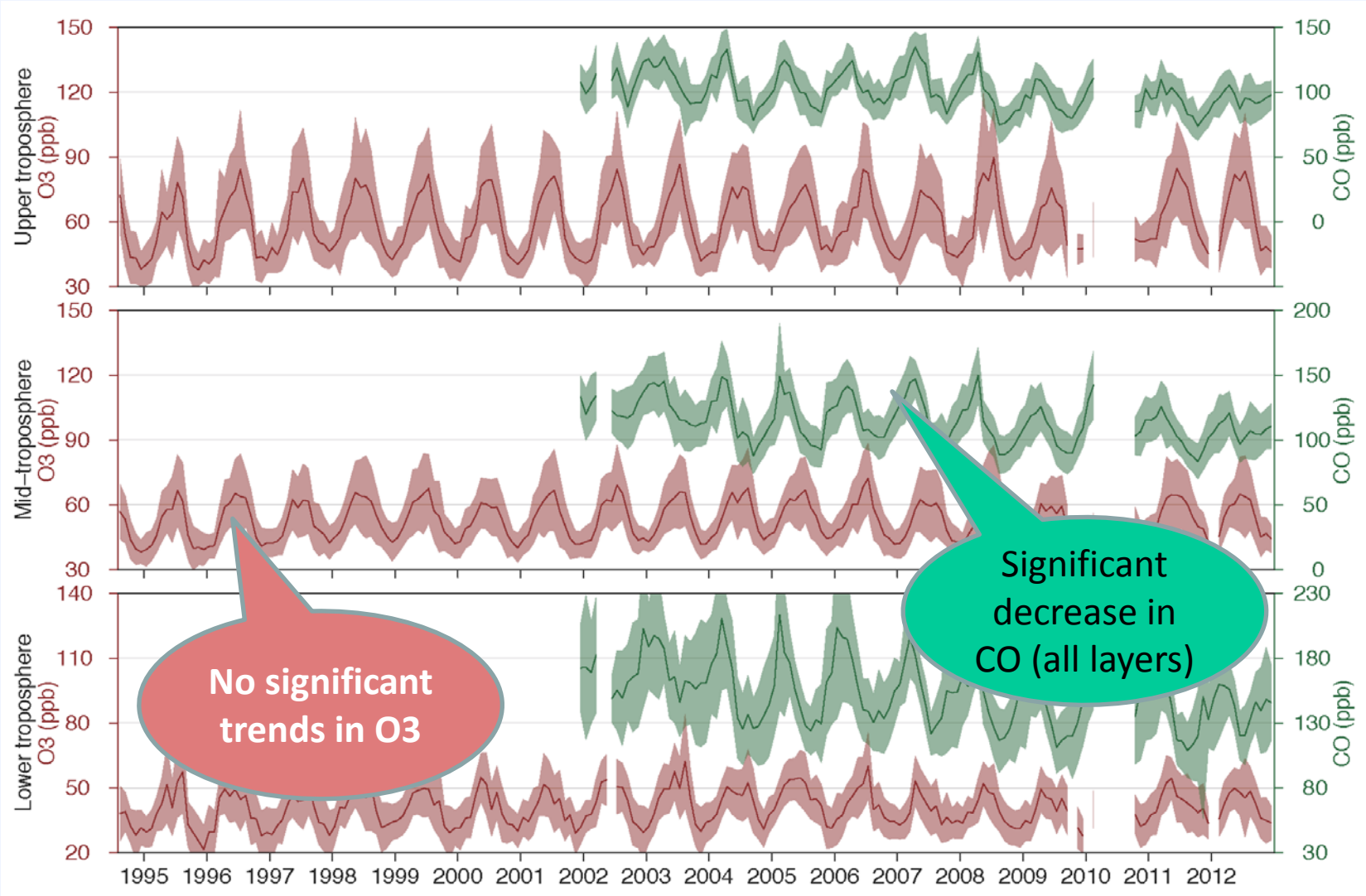
Thermal Tropopause derived from ECMWF ERA-Interim

Upper tropopause layer: 30 hPa below tropopause

Lowermost stratosphere layer: 30 hPa above tropopause

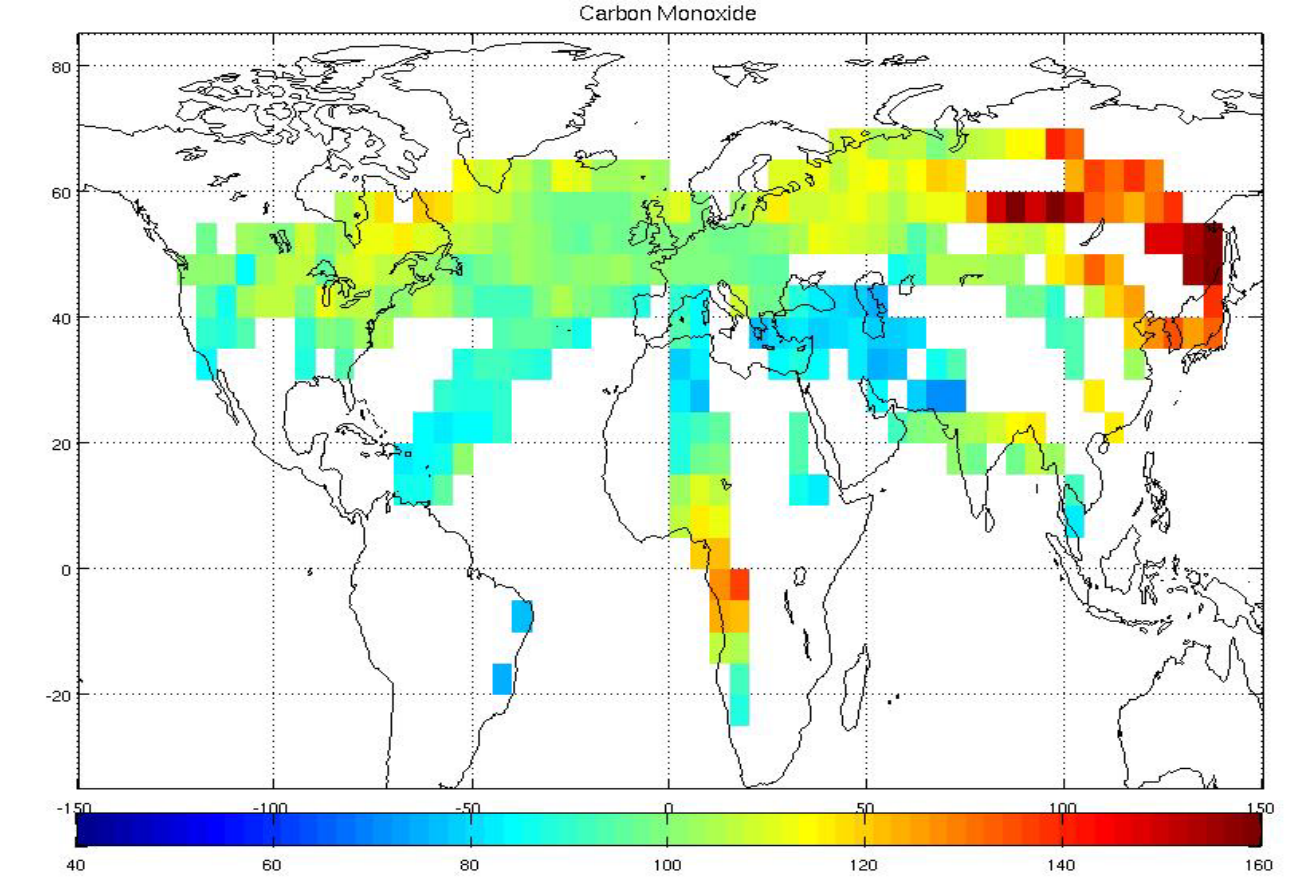
Trends O_3 and CO

by Herve Petetin, CNRS



Enhanced CO in the UT from Fires

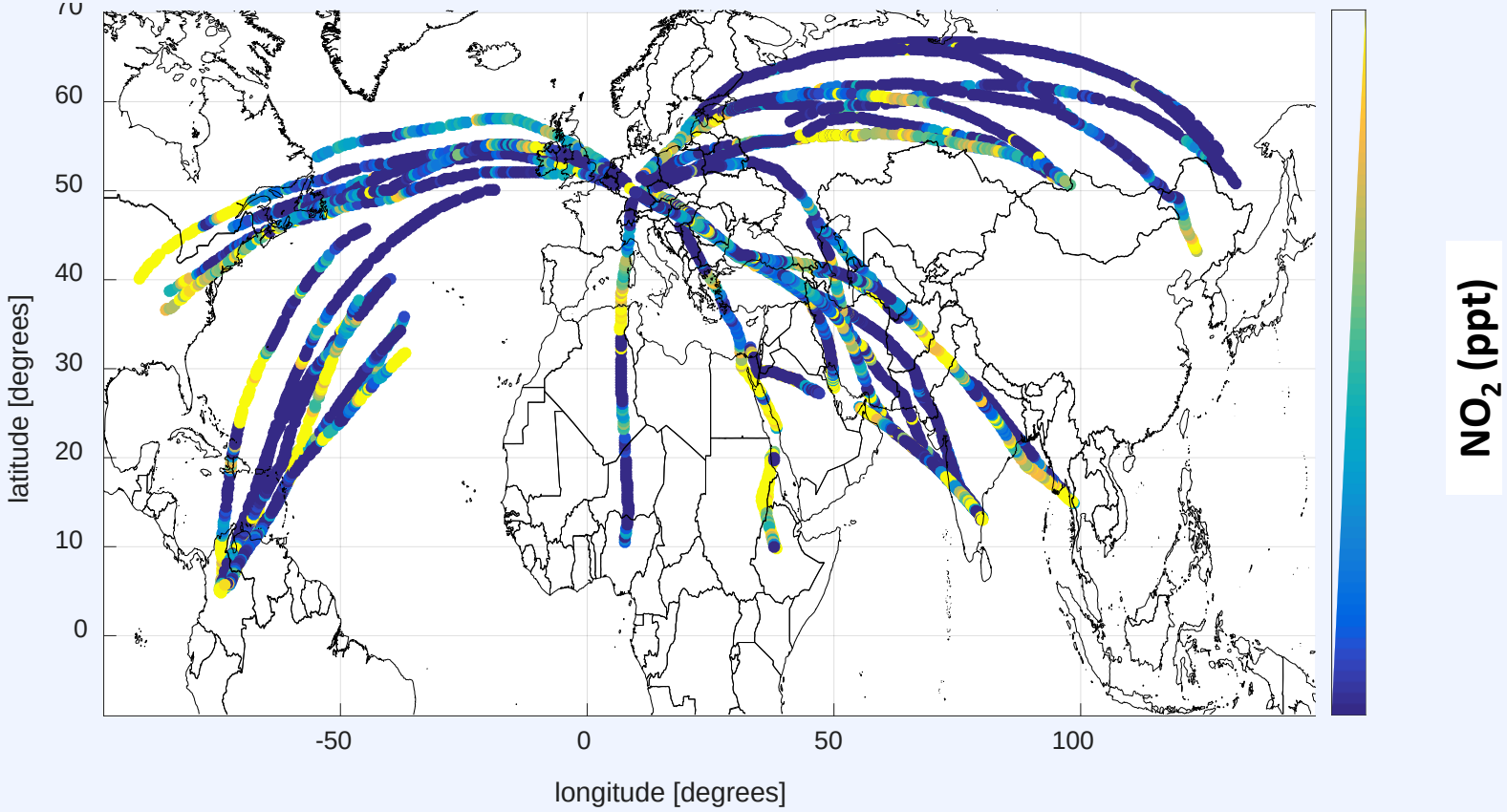
Philippe Nedelec, CNRS



IAGOS NO_2 at Night

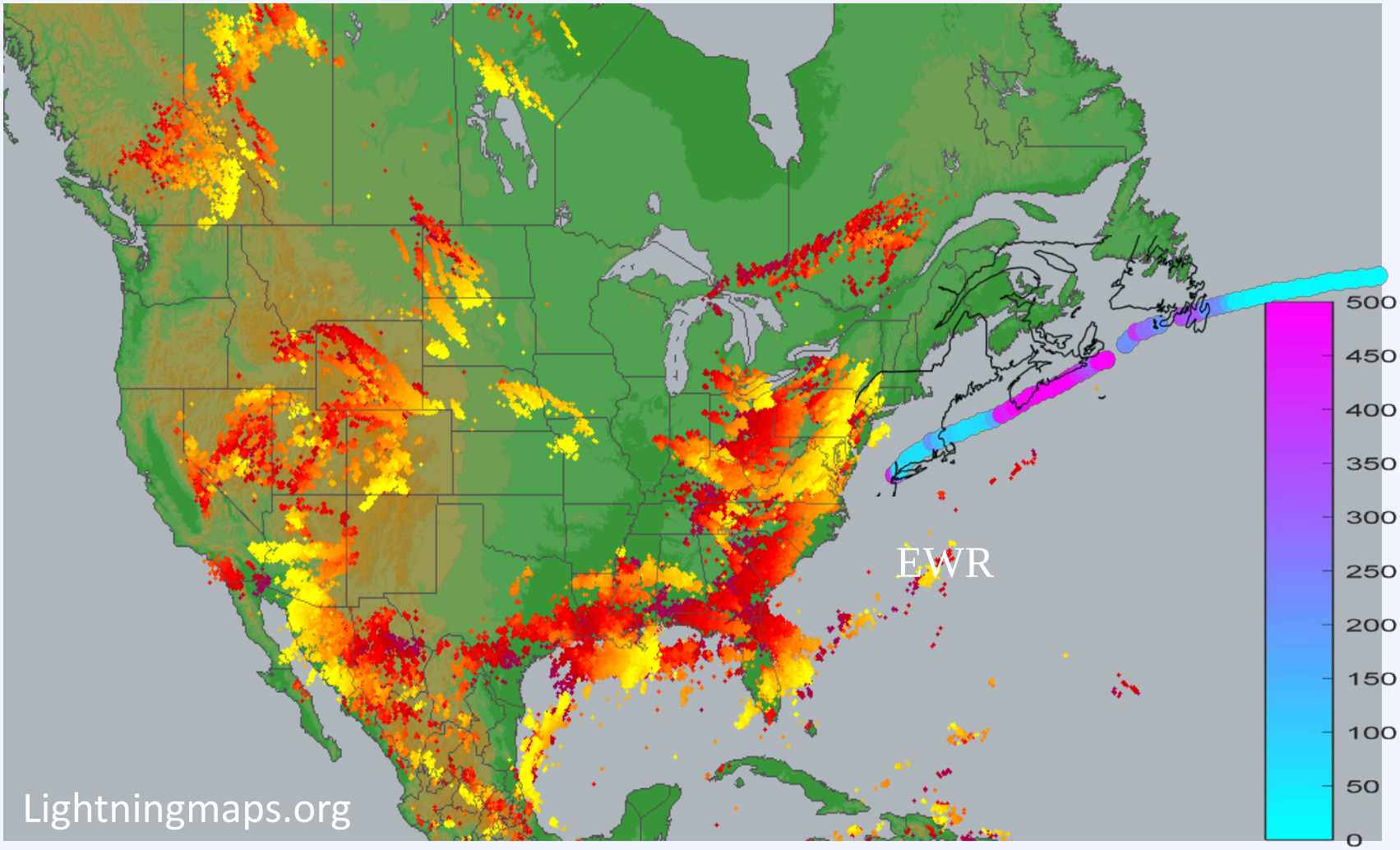
by Florian Berkes, FZ-Jülich

Period B108: 8th March 2016 - present (72 flights); p < 350 hPa



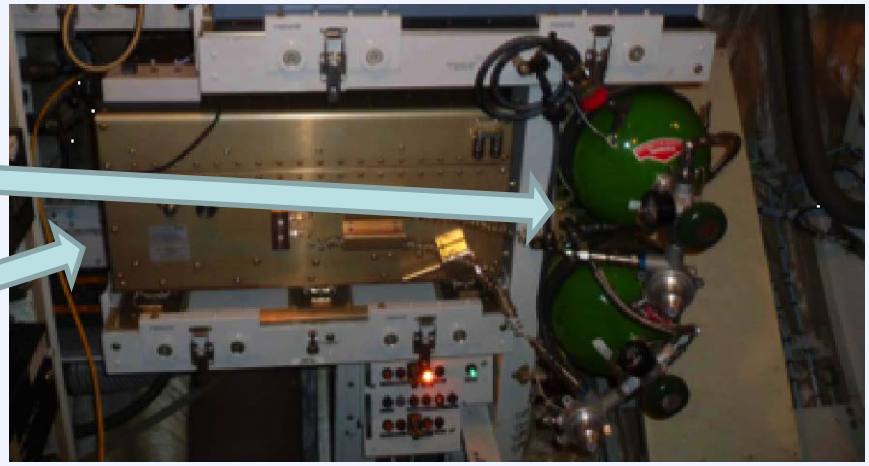
Lightning Influence

Berkes et al., EGU 2016



IAGOS-CORE GHG Observations

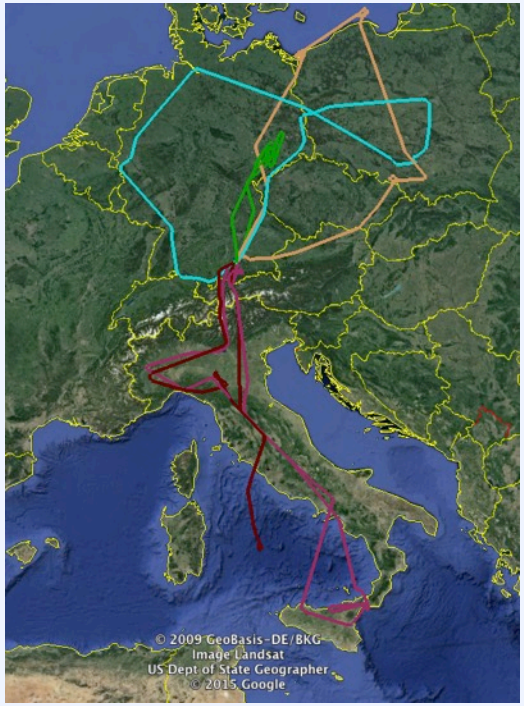
- Method: Cavity Ring-Down Spectroscopy
- Components: Picarro G2401-m,
- In-flight calibration (2 standards)
- Wiring and connectors modified (fire protection);
- Aircraft-qualified enclosure
- 30 kg, ~300 W
- Rosemount inlet (no aerosols & droplets)
- Certification documentation submitted to EASA

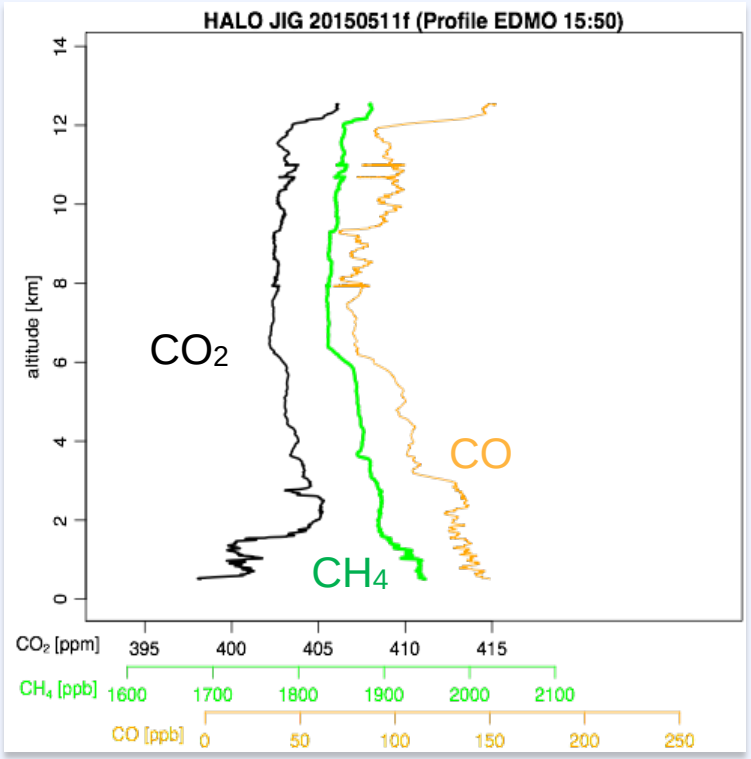


P2d during ground test onboard A340

Species	Time resolution	precision	Compati-bility
CO_2	2.5 s	0.06 ppb	0.1 ppm
CH_4	2.5 s	1 ppb	2 ppb
CO	2.5 s	10 ppb	2 ppb
H_2O	2.5 s	4 ppm @ H_2O <100 ppm 4% (rel.) @ H_2O >100 ppm	

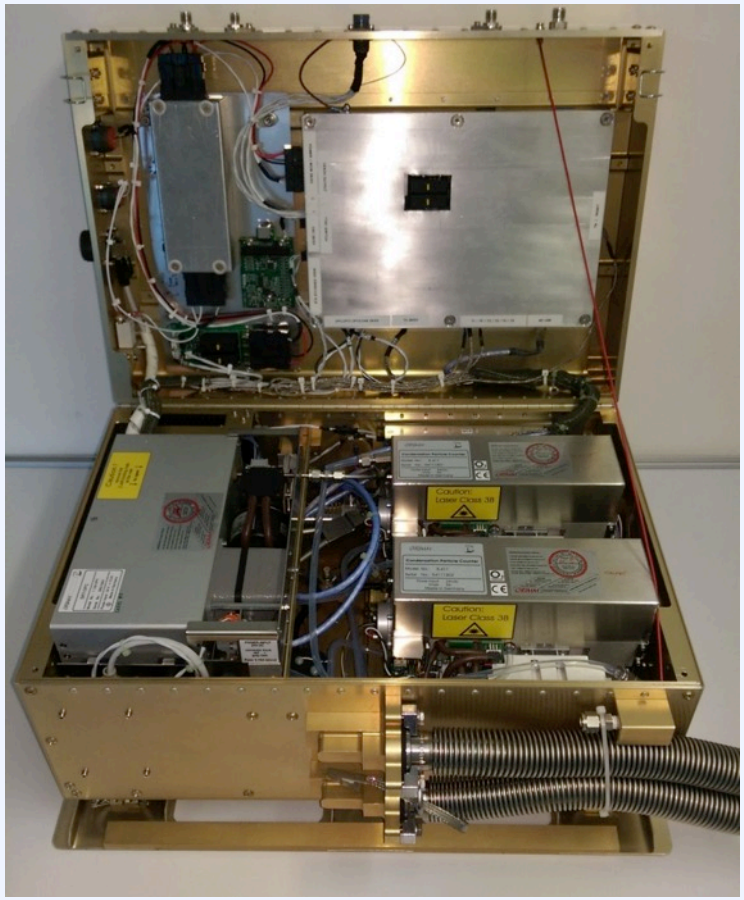
IAGOS core GHG during HALO Test Campaign





- First deployment of IAGOS-P2d with certification for HALO
- System worked fully autonomously throughout all flights
- Results from pre-, post- and in-flight calibration: Traceability to WMO standards verified
- Data processing automated
- Ready for IAGOS deployment

IAGOS Aerosol (Uli Bundke, Jülich)



IAGOS P2c

IAGOS P2c

- particle size distribution (OPC, > 250 nm)
- integral number of particles (CPC; d> 5 nm)
- non-volatile particle cores (CPC, TD; > 10 nm)

Installation scheduled for 2017

IAGOS P2e

- particle size distribution (OPC, > 250 nm)
- Light extinction coefficient (CAPS PM_{ex})
- NO_2 mixing ratio (CAPS NO_2)

Certification scheduled for 2017

P2c and P2e are operated on board of Polar 6 research a/c

IAGOS Aerosol

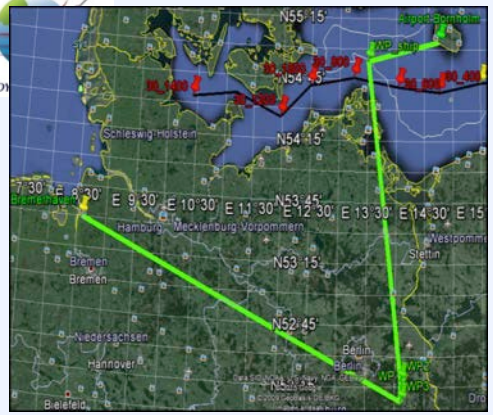
P2e – Test Results

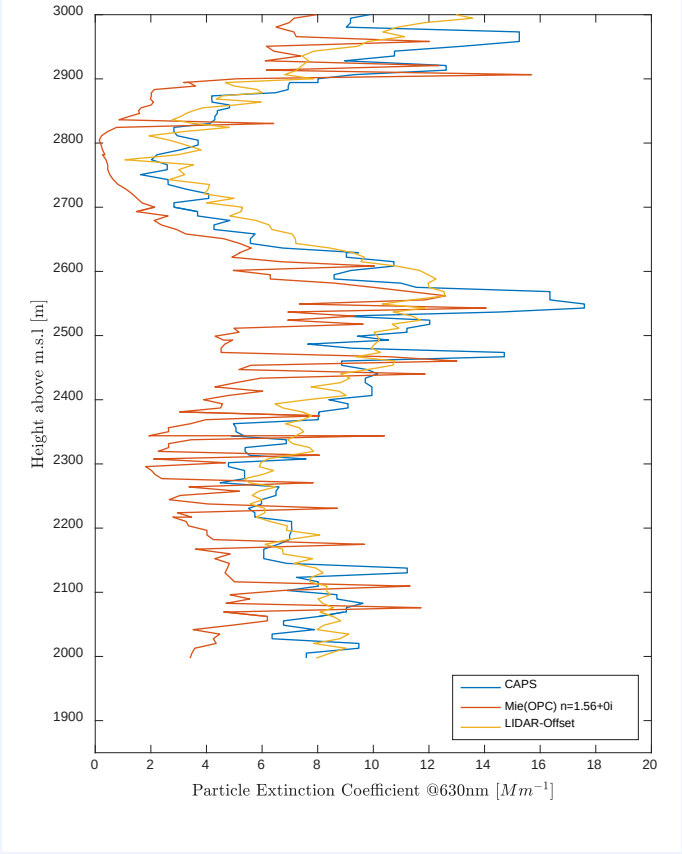
Light extinction coefficient from P2e (CAPS PM_{ex}) compared to Lidar profile above Lindenberg.

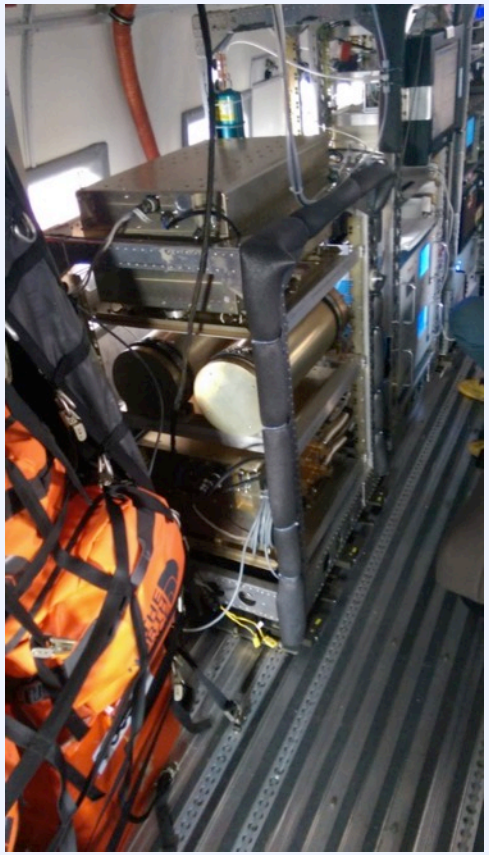
Good agreement with Mie calculations from size distribution.

Future deployment of IAGOS P2e will provide global information on light extinction / AOD and complement AERONET / LIDAR observations.

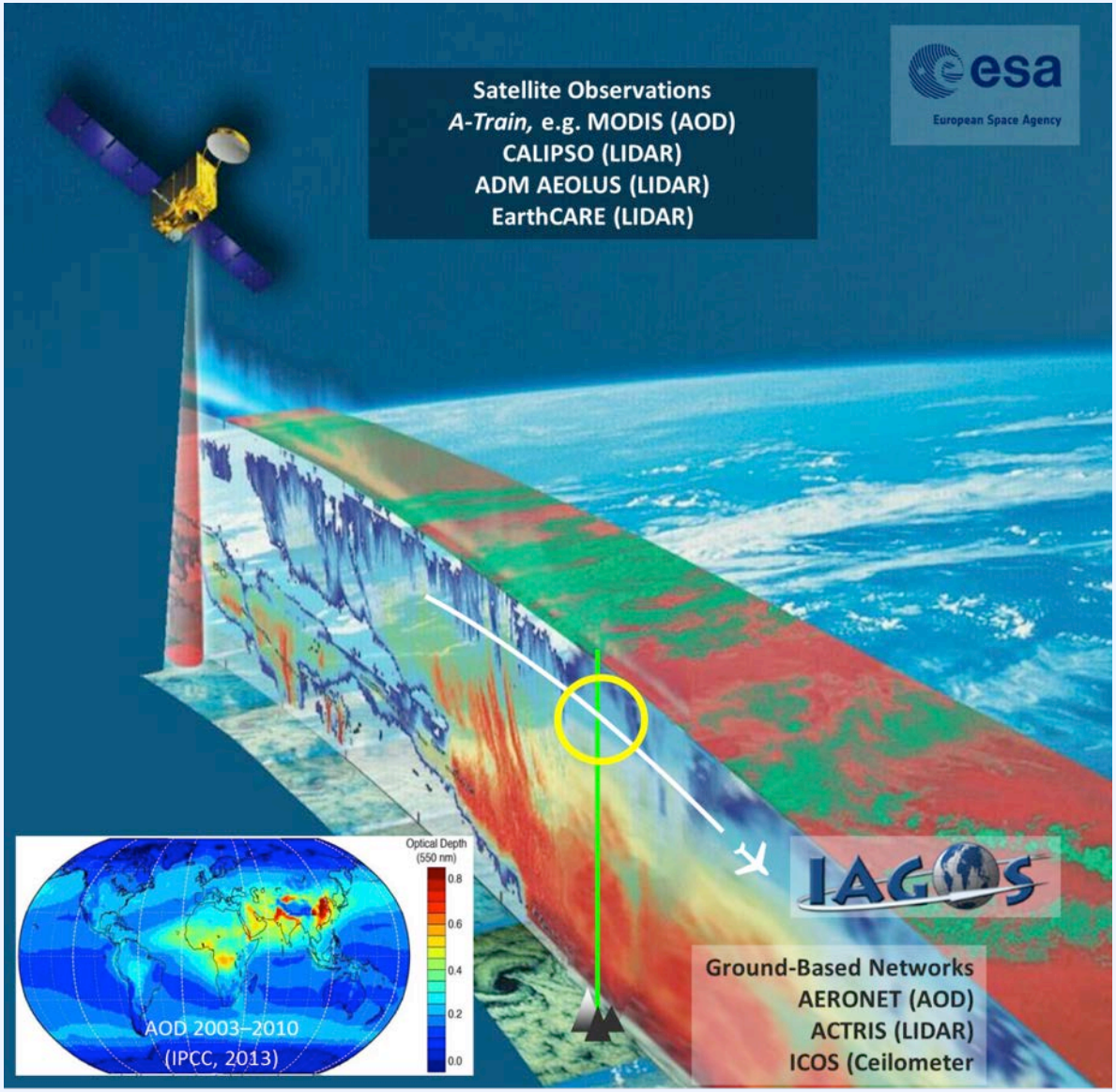
Uli Bundke, Jülich







The Future: Integrated AOD Observations



ICOS INTEGRATED CARBON OBSERVATION SYSTEM

ACTRiS

Summary

- Unique data set on composition in the troposphere and lower stratosphere (UTLS between 9 and to 12 km) and its long-term changes
- Simultaneous measurements of O_3 with precursors (CO, NOx, NOy), additionnal compounds (clouds droplets, aerosols, greenhouse gases)
- Quasi-global coverage from 6 aircraft (ca. 500 flights/ac/yr)
- New aircraft (CAL, AF) and new airlines (HAL) => 10 a/c in 2017
- Additional information on VOC, CFCs HFCs etc. from CARIBIC (monthly deployment for 4 consecutive flights)

- General Information: **http://www.iagos.org**
- Data access request: **http://www.iagos.fr**
- MACC system validation: **http://www.iagos.fr/macc**
- Annual Meeting, Manchester, 17-19 Oct 2016, **Registration open!**

Acknowledgments

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- The European Commission in FP4, FP5, FP6, FP7, H2020 programmes,
- National research programmes in Germany (BMBF), France (INSU-CNRS, MENESR, CNES) and UK (NERC-NCAS),
- Airlines and AIRBUS

Contributions by:

- Florian Berkes Uli Bundke, Patrick Neis; FZ-Jülich
- Herve Petetin, Philippe Nedelec; CNRS / U.Toulouse
- Anette Filges, MPI-BGC Jena
- Karl Beswick, U. Manchester
- Ralf Stosius, enviscope GmbH, Frankfurt