Atmosphere Monitoring

The contribution of IAGOS to the Copernicus Atmosphere Monitoring Service

Henk Eskes, KNMI

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EU Copernicus programme

European response to global needs:

- to manage the environment,
- to mitigate the effects of climate change and
- to ensure civil security

Copernicus Atmosphere Monitoring Service (CAMS)

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Atmosphere Monitoring

CAMS: From observations to information

CAMS
co-ordinated by
ECMWF

- Ozone and precursors
- Aerosol
- Greenhouse gases

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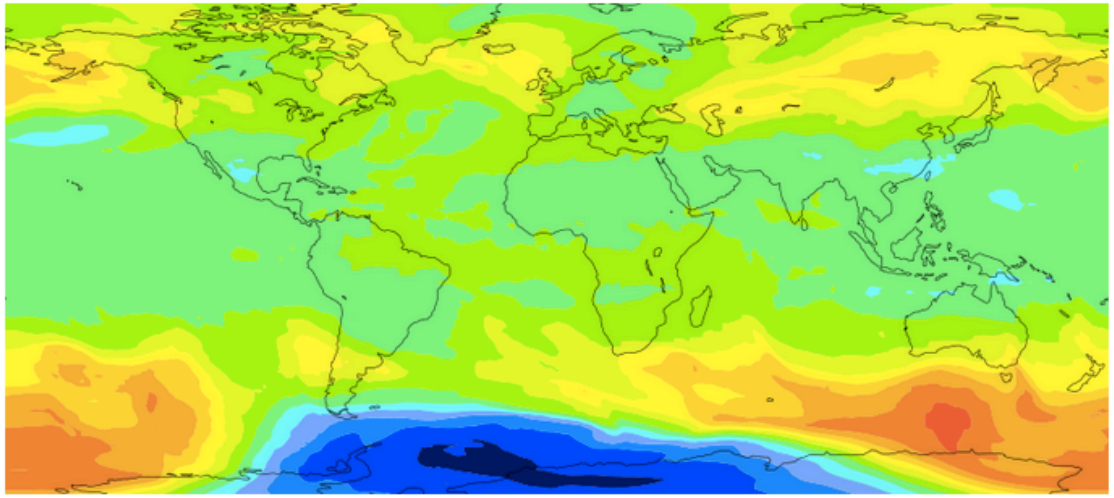
CAMS Catalogue

Atmosphere Monitoring

ABOUT CAMS | NEWS & MEDIA | EVENTS | CATALOGUE | RESOURCES | TENDERS | USER SUPPORT

Global forecasts of assimilated chemical species - ozone

Back to index



GetCapabilites

This service provides daily forecasts up to 5 days of chemical species that are directly constrained by observations

Theme: Air quality and atmospheric composition, Ozone and Ultraviolet radiation

Product family: Global forecasts

Parameter: Ozone

Geographical area: (-180, 180, -90, 90)

Time coverage:

Metadata: XML

Data download | Verification results | Validation reports | Plots | Documentation | Contact us

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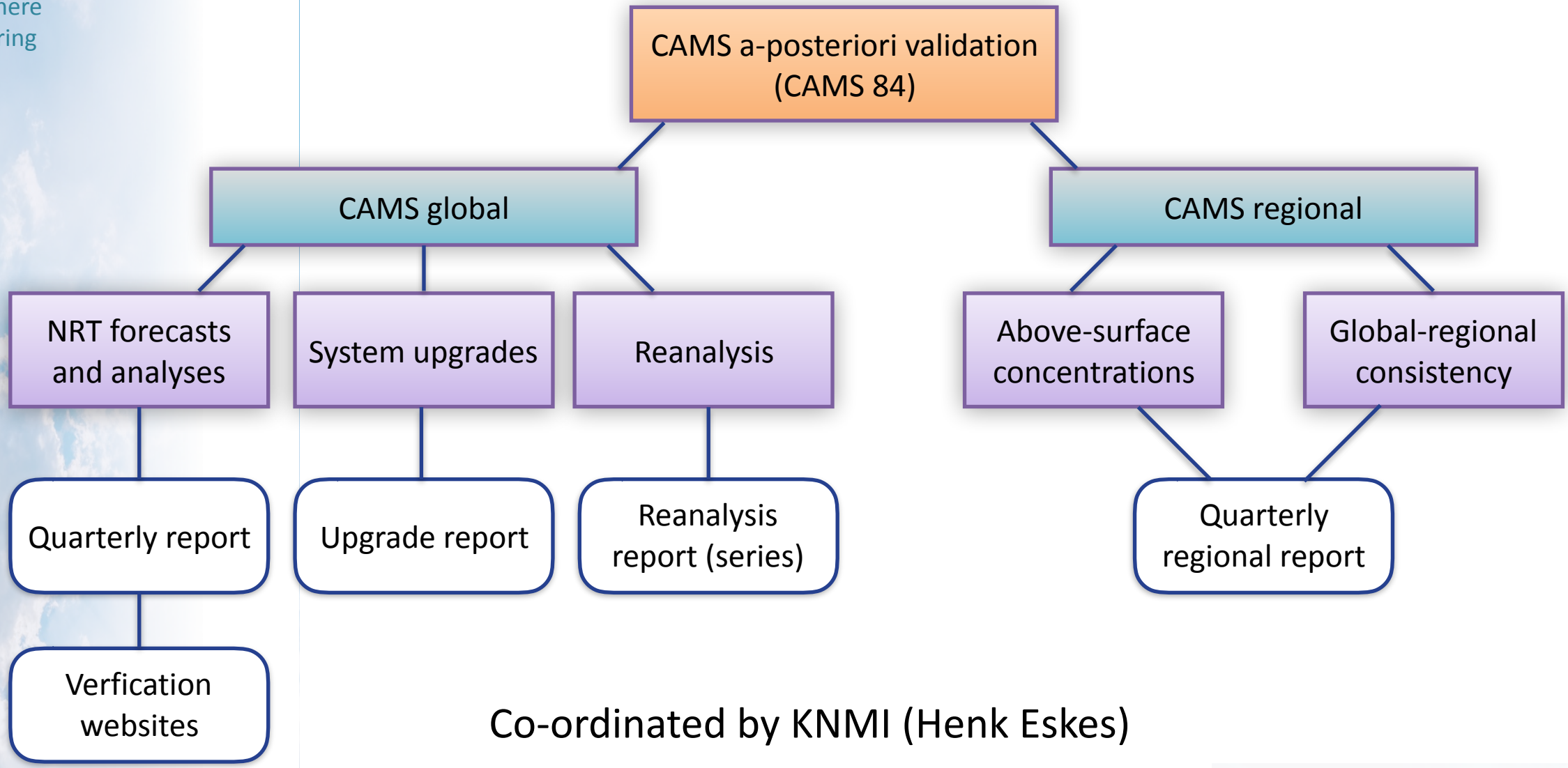
CAMS a-posteriori validation activities



Co-ordinated by KNMI (Henk Eskes)

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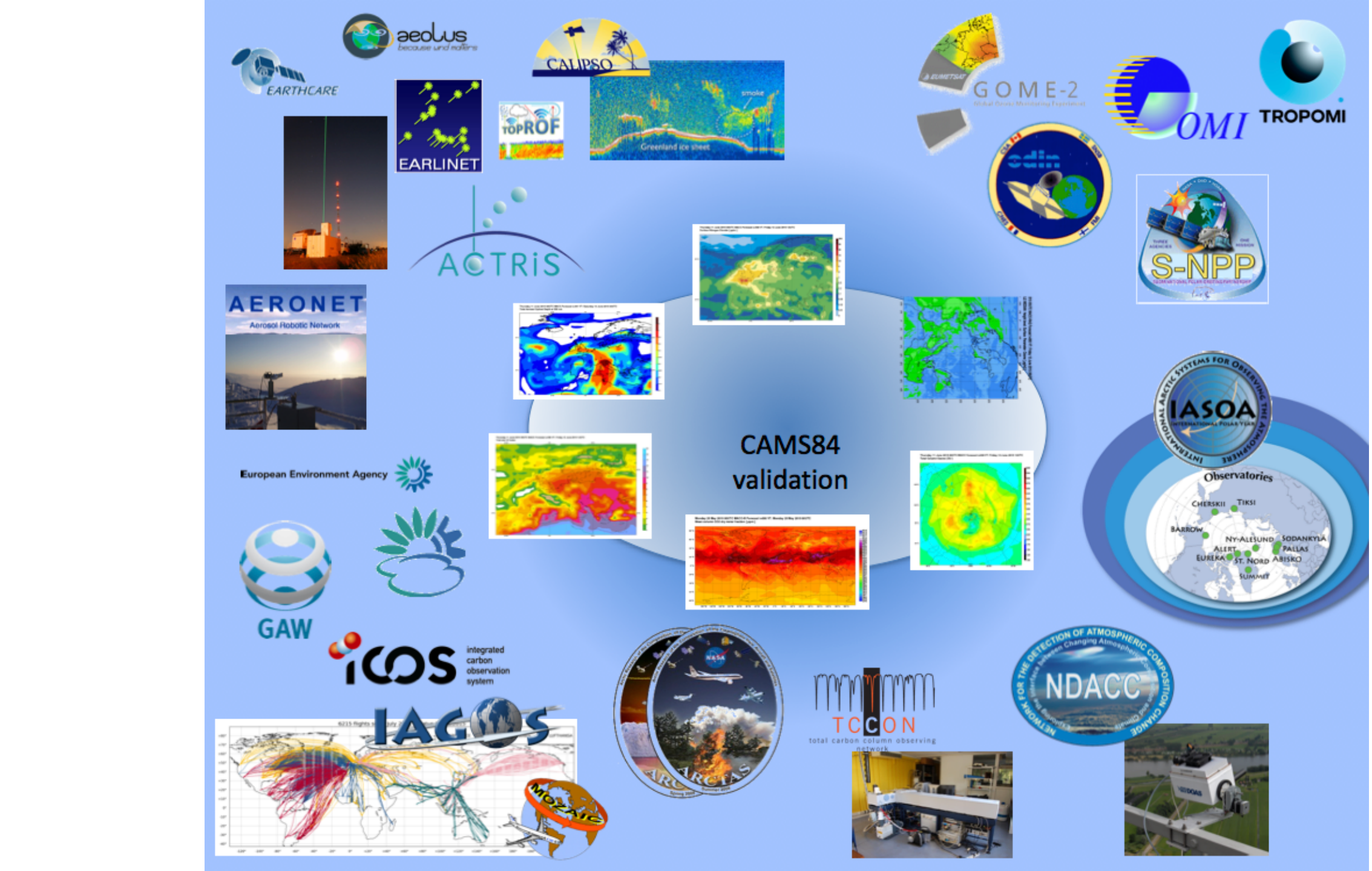
aeolus
because wind matters
EARTHCARE
CALIPSO
smoke
Greenland ice sheet
EARLINET
TOPROF
GOME-2
OMI
TROPOMI
ACTRiS
AERONET
Aerosol Robotic Network
S-NPP
CAMS84
validation
European Environment Agency
IASOA
Observatories
CHERSKII
TIKSI
BARROW
NY-ALESUND
SODANKYLÄ
ALERT
PALLAS
EUREKA
ST. NORD
ABISKO
SUMMIT
GAW
icos
integrated
carbon
observation
system
IAGOS
MOZAIC
ARCTAS
TCCON
total carbon column observing network
NDACC

Aerosol

Ozone

CO

NO2

SO2

CO2

CH4

Species, vertical range	Assimilation	Validation
Aerosol, optical properties	MODIS Aqua/Terra AOD PMAp AOD	AOD, Ångström: AERONET, GAW, Skynet, MISR, OMI, lidar, ceilometer
Aerosol mass (PM10, PM2.5)	MODIS Aqua/Terra	European AirBase stations
O_3, stratosphere	MLS, GOME-2A, GOME-2B, OMI, SBUV-2, OMPS	Sonde, lidar, MWR, FTIR, OMPS, ACE-FTS, OSIRIS, BASCOE and MSR analyses
O_3, UT/LS	MLS	IAGOS, ozone sonde
O_3, free troposphere	Indirectly constrained by limb and nadir sounders	IAGOS, ozone sonde
O_3, PBL / surface	-	Surface ozone: WMO/GAW, NOAA/ESRL-GMD, AIRBASE
CO, UT/LS	IASI, MOPITT	IAGOS
CO, free troposphere	IASI, MOPITT	IAGOS, MOPITT, IASI, TCCON
CO, PBL / surface	IASI, MOPITT	Surface CO: WMO/GAW, NOAA/ESRL
NO_2, troposphere	OMI, partially constrained due to short lifetime	SCIAMACHY, GOME-2, MAX-DOAS
HCHO	-	GOME-2, MAX-DOAS
SO_2	GOME-2A, GOME-2B (Volcanic eruptions)	-
Stratosphere, other than O_3	-	NO_2 column only: SCIAMACHY, GOME-2
CO_2, surface, PBL		ICOS
CO_2, column		TCCON
CH_4, surface, PBL		ICOS
CH_4, column		TCCON

UT/LS

Free trop

PBL, surface

Aerosol

Ozone

CO

NO2

SO2

CO2

CH4

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CO_2, surface, PBL		ICOS
CO_2, column		TCCON
CH_4, surface, PBL		ICOS
CH_4, column		TCCON

UT/LS

Free trop

PBL, surface

Atmosphere Monitoring

The evaluation of the global NRT system

Global CAMS forecast validation report:

- Published every 3 months
- Last available report DJF 2018 (published 1 June 2018)

Validation report of the CAMS near-real time global atmospheric composition service

September-November 2016

Issued by: KNMI / Henk Eskes
Date: 25/02/2017
Ref: CAMS84_2015SC2_D84.1.1.6_2016SON_v1

Why 3-monthly ?

- The CAMS analysis/forecast system is evolving, about 2 updates / yr
- Up-to-date validation results

Approach

- Compare **o-suite** and **control** run against independent observations

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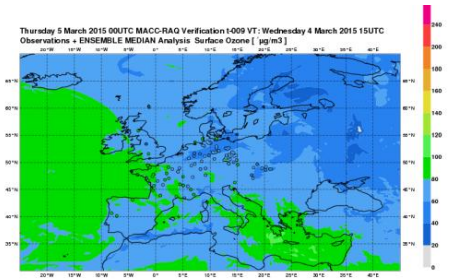
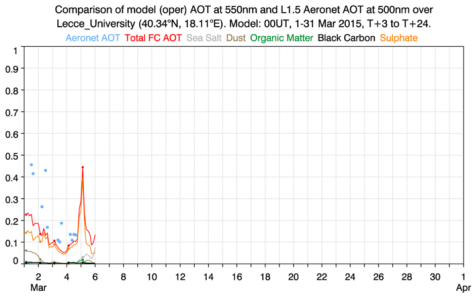
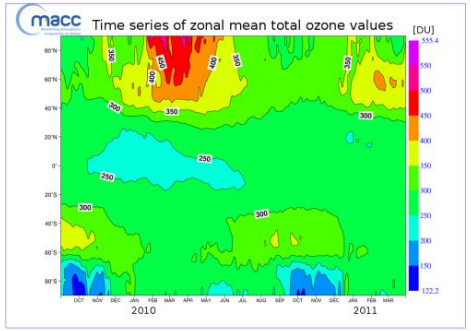
The need for real-time data in CAMS

Timeliness	Real Real-Time < 2-3 hours	Near-Real-Time < 2-3 days	A posteriori < 1 month	Final < 1 year
QC/QA	Automated Filtering, flagging	Semi-automated	Manual, Expertise Semi-validated	Expertise+ Validated
CAMS products	Assimilation (Verification)	Verification (Assimilation)	Validation (Interim re-analyses)	Re-analyses (Validation)







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Importance of IAGOS for CAMS validation:

- Vertical profile information

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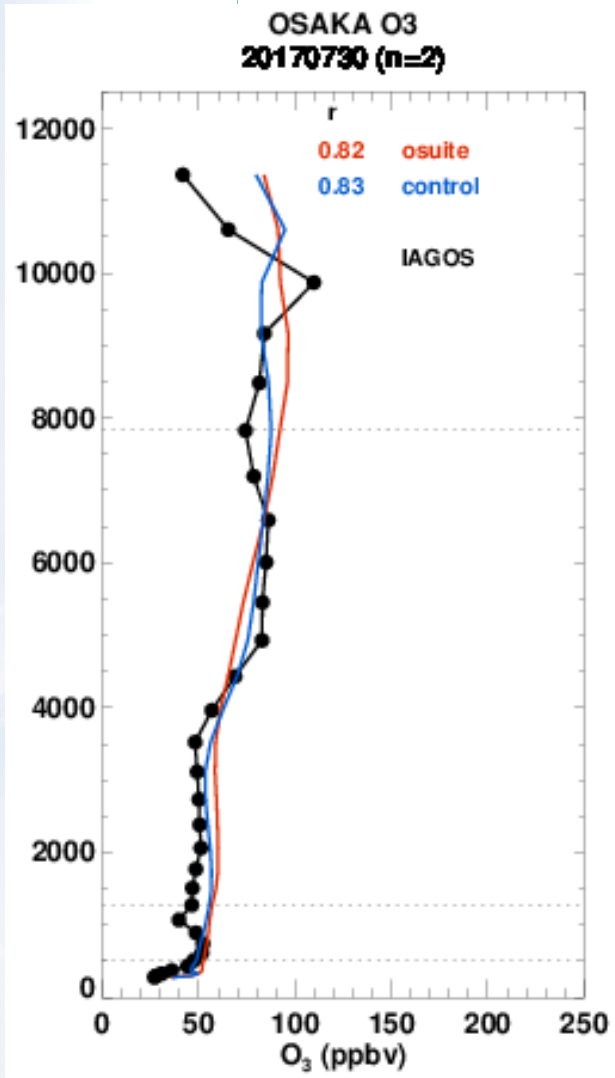
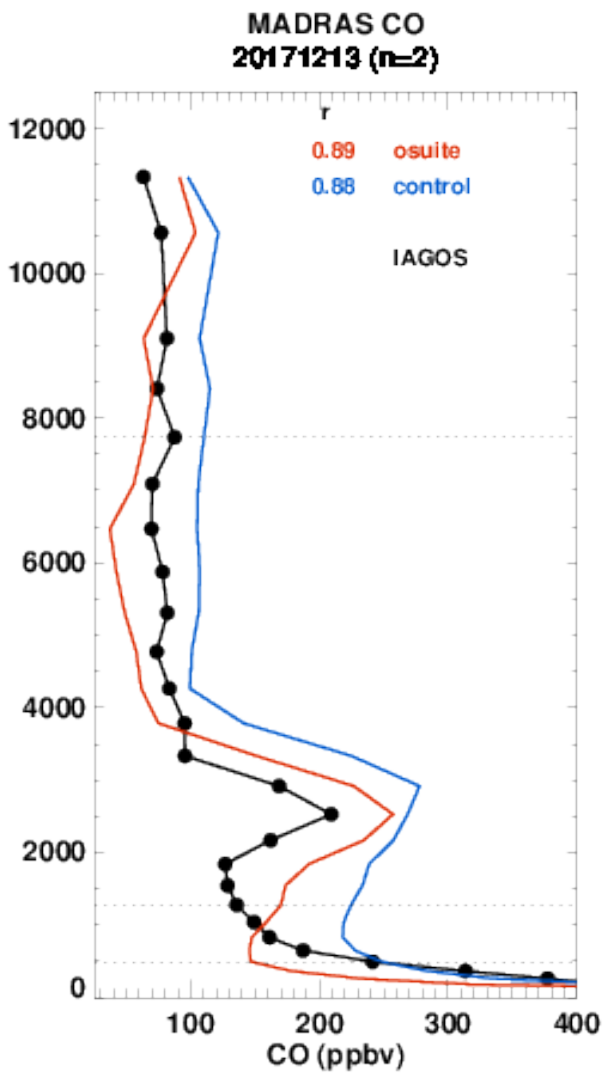
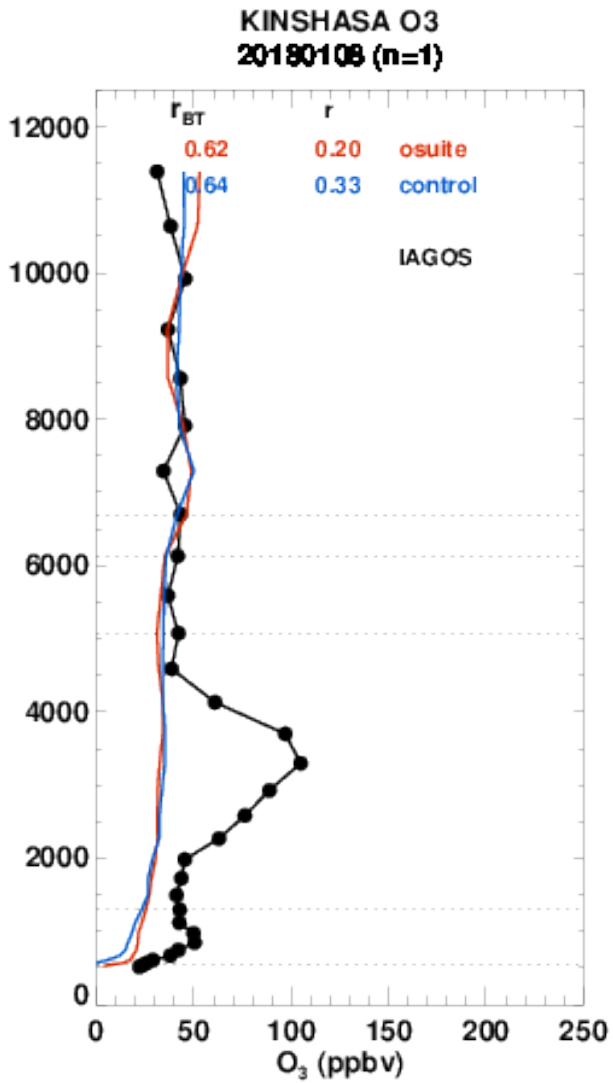
CAMS vs IAGOS: three examples







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Importance of IAGOS for CAMS validation:

- Vertical profile information
- Operational, with real-time data delivery,
  Coverage: Multiple airplanes, multiple profiles per day

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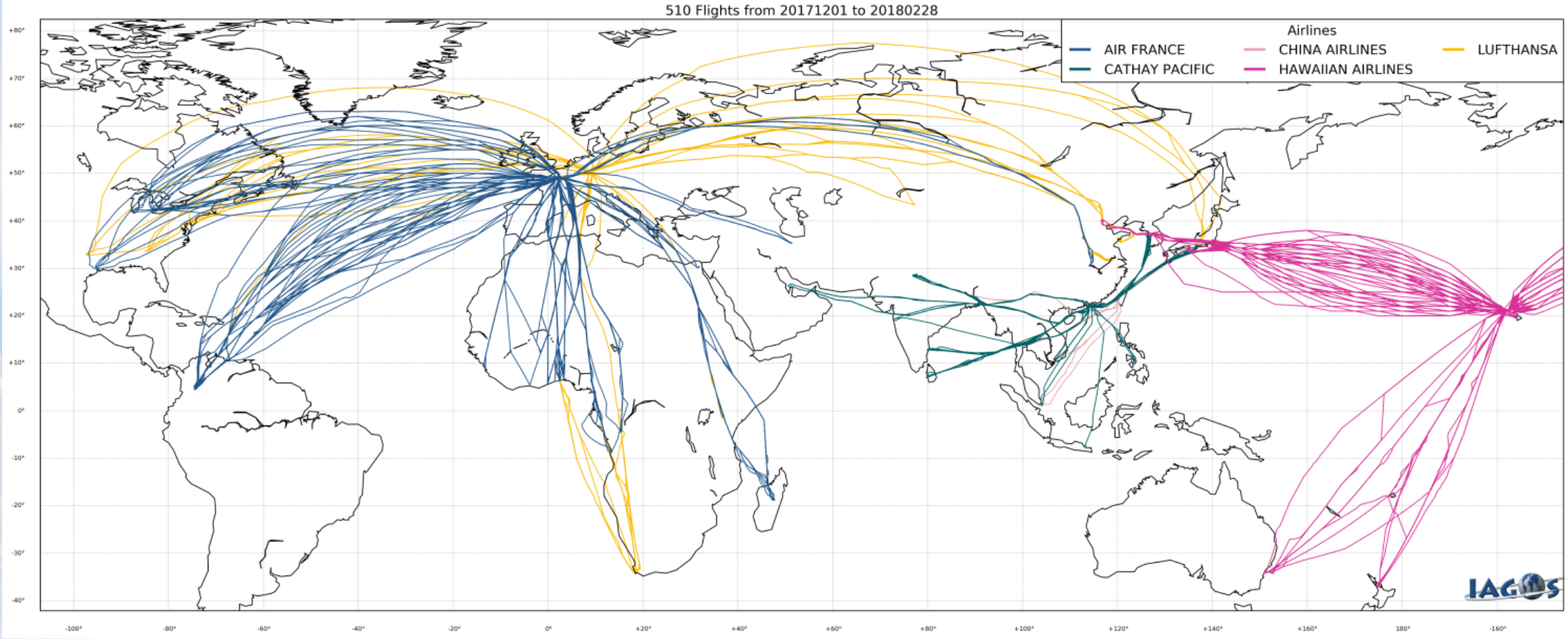
IAGOS coverage

510 flights in 3 months time (DJF 2018 report)



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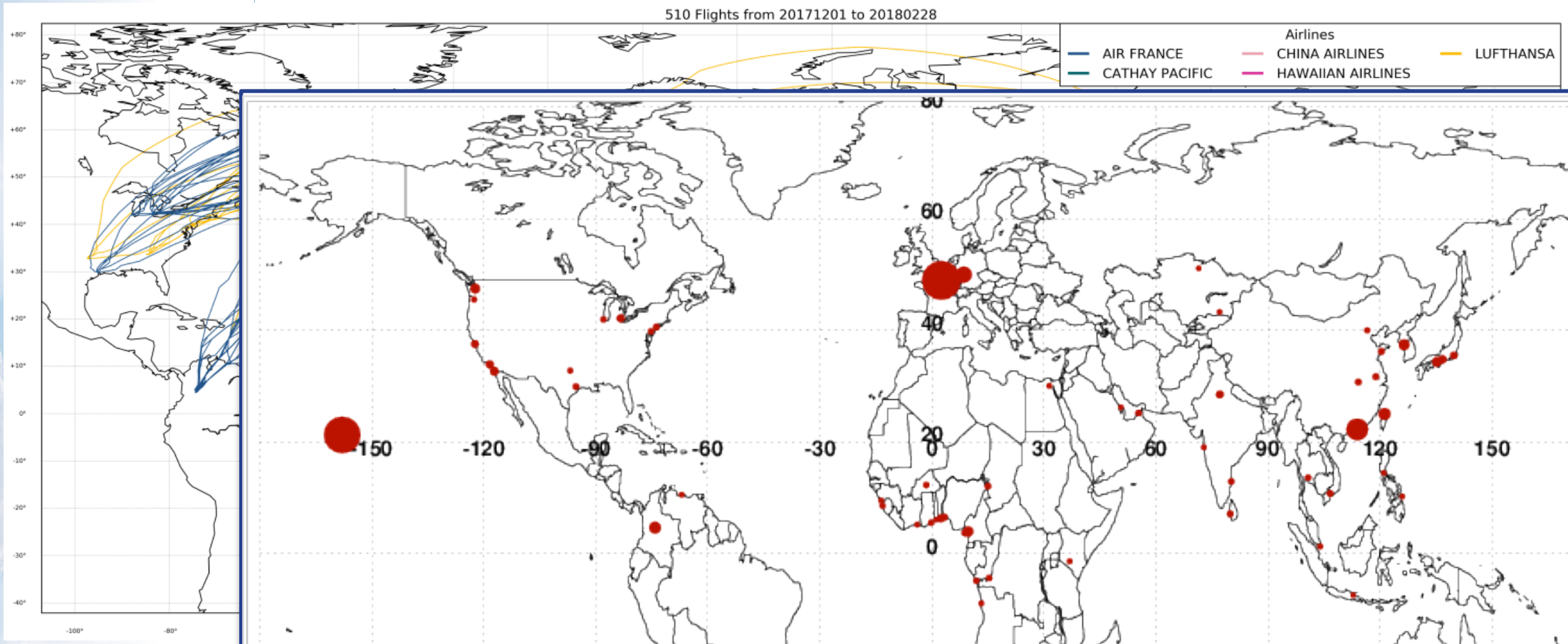
The evaluation of the global NRT system

510 flights in 3 months time (DJF 2018 report)



61 airports in 3 months time (DJF 2018 report)

Importance of IAGOS for CAMS validation:

- Vertical profile information
- Operational, with real-time data delivery,
  Multiple airplanes, multiple profiles per day, coverage
- Flights to/from Europe:
  evaluation regional AQ models

The evaluation of the CAMS regional models

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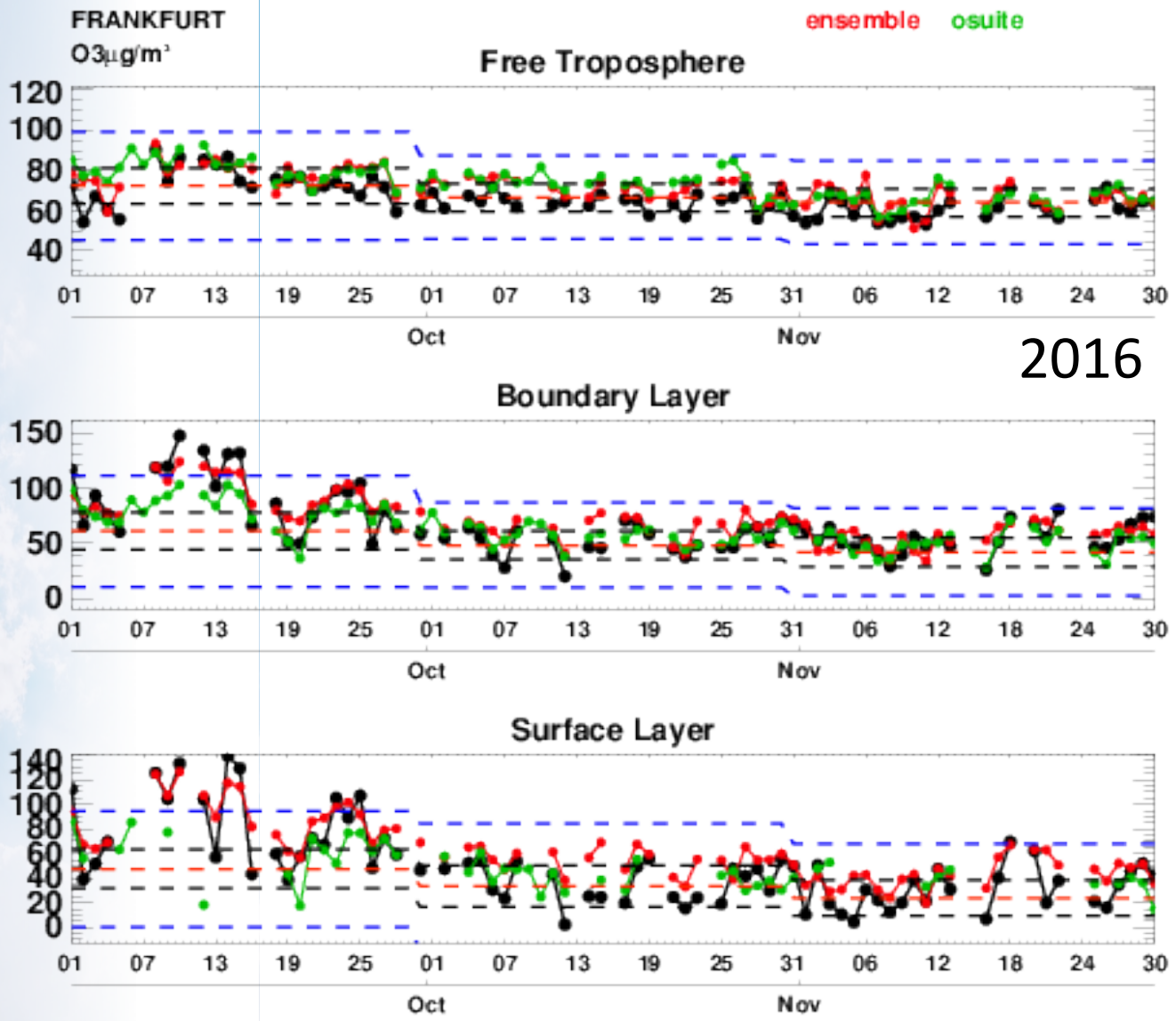

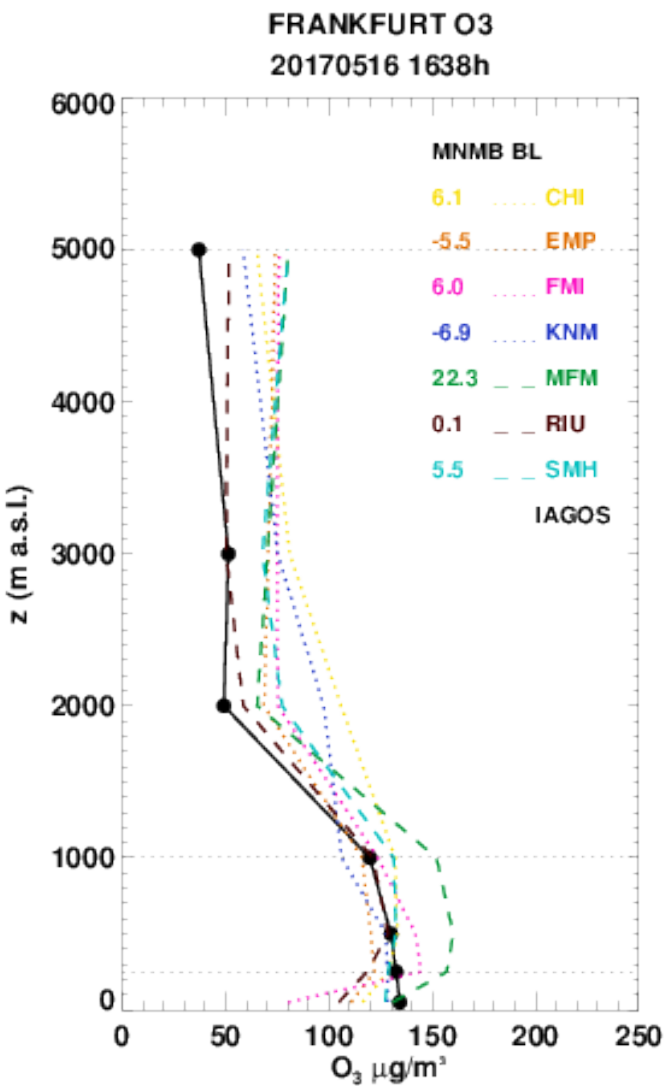

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Importance of IAGOS for CAMS validation:

- Vertical profile information
- Operational, with real-time data delivery,
  Multiple airplanes, multiple profiles per day, coverage
- Flights to/from Europe:
  evaluation regional AQ models
- Long time series: MOZAIC-IAGOS-CARIBIC
  Evaluation of the CAMS reanalysis

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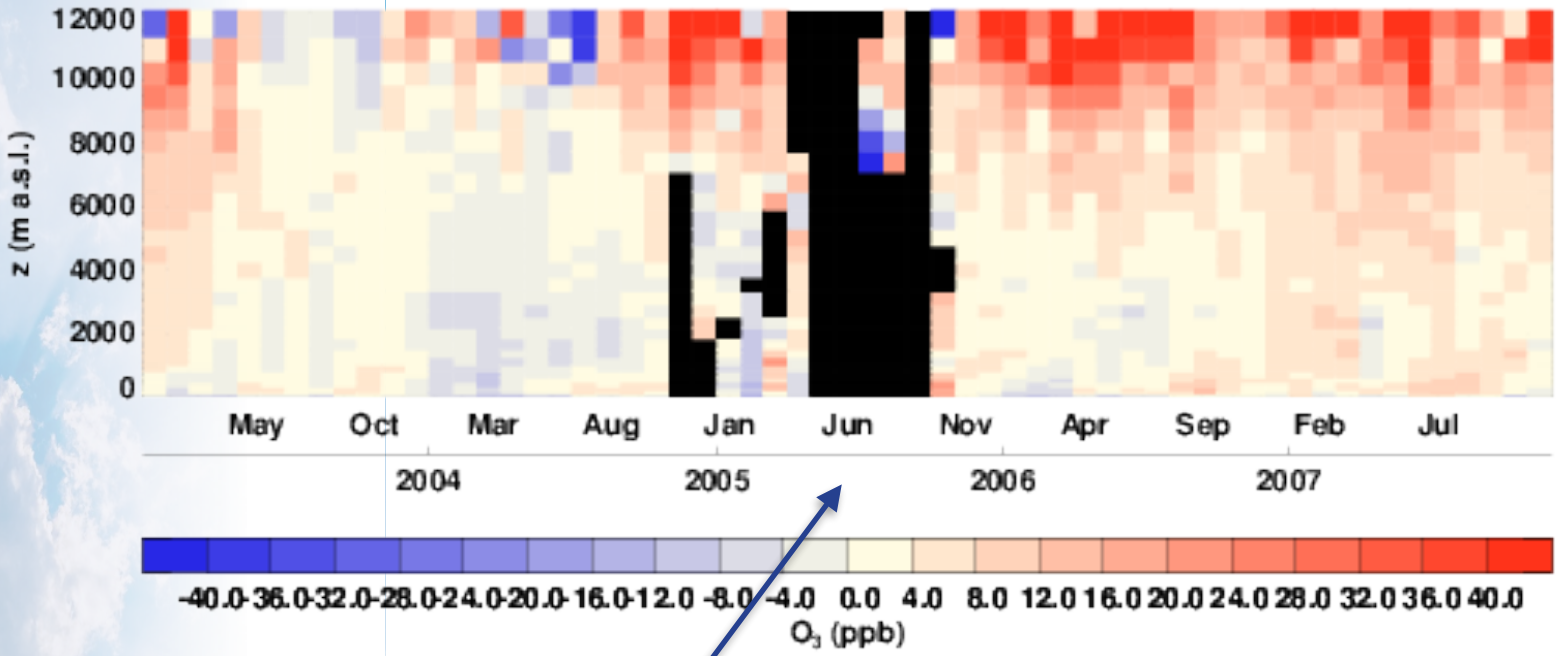
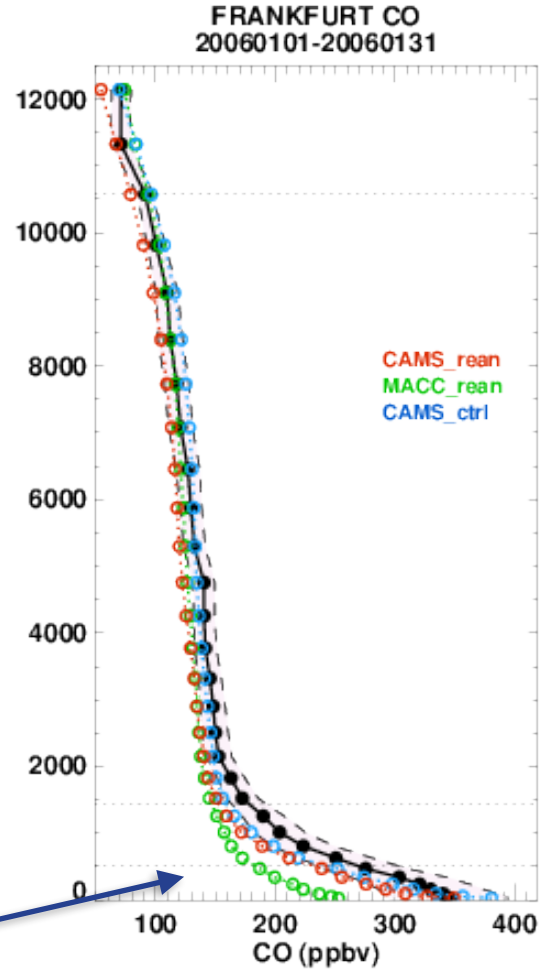
CAMS reanalysis vs IAGOS

CAMS reanalysis 2003-2007



Ozone profile CAMS-IAGOS



Reduced CO bias wrt MACC reanalysis

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Importance of IAGOS for CAMS validation:

- Vertical profile information
- Operational, with real-time data delivery,
  Multiple airplanes, multiple profiles per day, coverage
- Flights to/from Europe:
  evaluation regional AQ models
- Long time series: MOZAIC-IAGOS-CARIBIC
  Evaluation of the CAMS reanalysis
- CO, ozone are key species targeted by CAMS
  Extensions to CO2, CH4, H2O, NOx, aerosol

The IAGOS NO_x Instrument – Design, Operation and First Results from Deployment aboard Passenger Aircraft

AMT, 2018

Florian Berkes[1], Norbert Houben[1], Ulrich Bundke[1], Harald Franke[2], Hans-Werner Pätz[1], Franz Rohrer[1], Andreas Wahner[1], and Andreas Petzold[1]

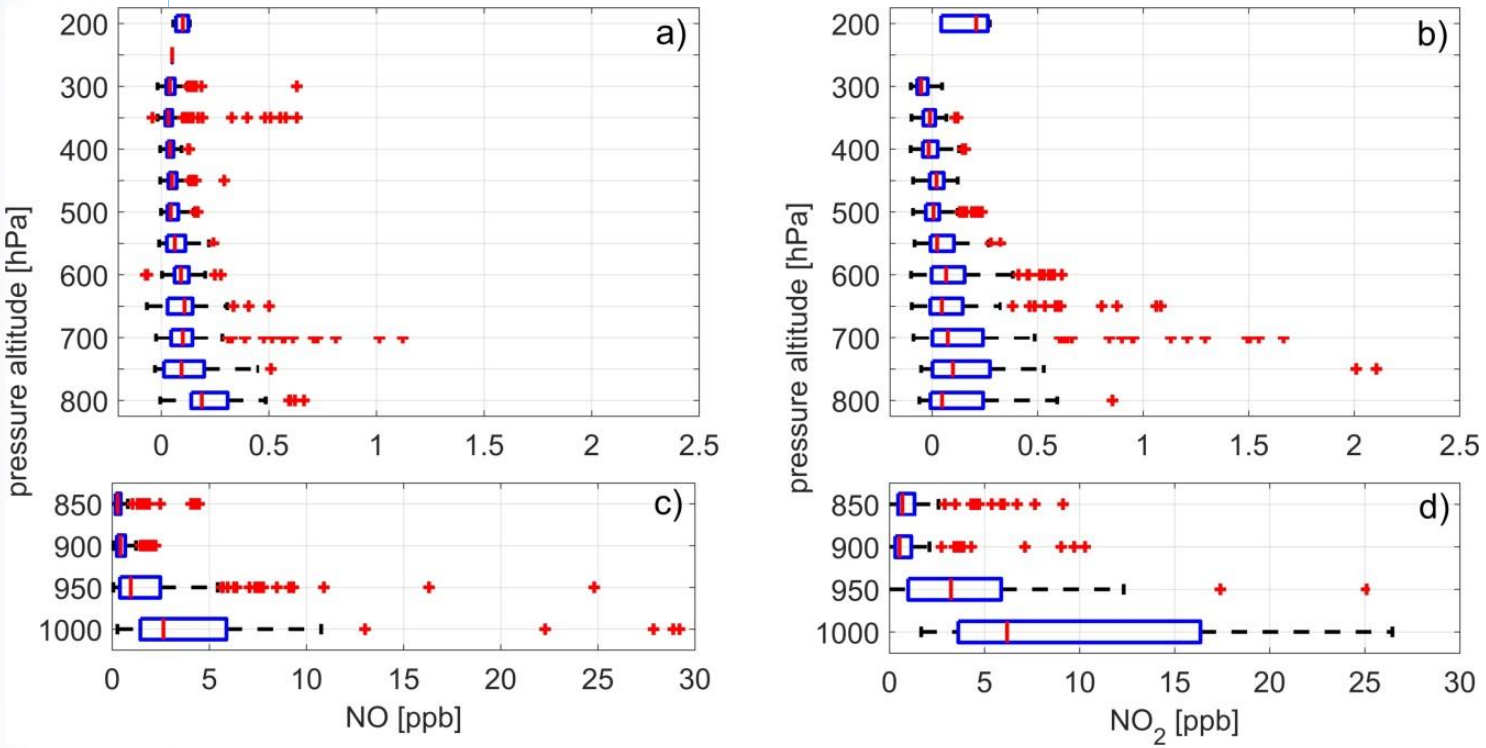

Figure 13: Statistical vertical distribution of NO and NO_2 (only at day time) of a,c) for NO and b,d) NO_2 over Düsseldorf airport in summer (JJA) 2015. Note the different x-axis-scale.

The CAMS validation team

Persons involved in CAMS validation

Y. Bennouna (CNRS-LA), H. Clark (CNRS-LA), V. Thouret (CNRS-LA),
S. Basart (BSC), A. Benedictow (MetNo), A. Blechschmidt (IUP-UB),
S. Chabrillat (BIRA-IASB), Y. Christophe (BIRA-IASB),
E. Cuevas (AEMET), H. Flentje (DWD), K. M. Hansen (AU), U. Im (AU),
J. Griesfeller (MetNo), V. Huijnen (KNMI), J. Kapsomenakis (AA),
E. Katragkou (AUTH), B. Langerock (BIRA-IASB), K. Petersen (MPG), M. Ramonet (CEA-LSCE),
M. Razinger (ECMWF), A. Richter (IUP-UB), M. Schulz (MetNo),
N. Sudarchikova (MPG), W. Thomas (DWD), V. Thouret (CNRS-LA),
M. Vrekoussis (AA), A. Wagner (MPG), T. Warneke (UBC), C. Zerefos (AA)