

Copernicus Atmosphere Monitoring Service

Use of surface in-situ, surface remote sensing, aircraft, balloon and satellite measurements for the validation of the CAMS services:
a wish list

Henk Eskes



Funded by
the European Union

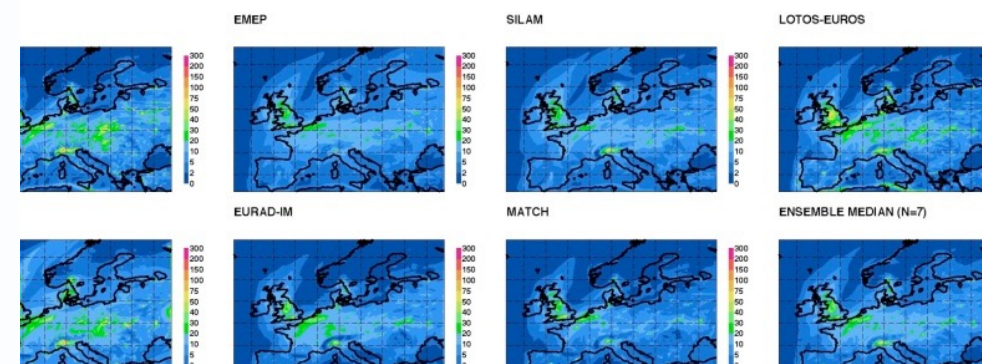
Implemented by  **ECMWF**

CAMS <http://www.copernicus-atmosphere.eu>

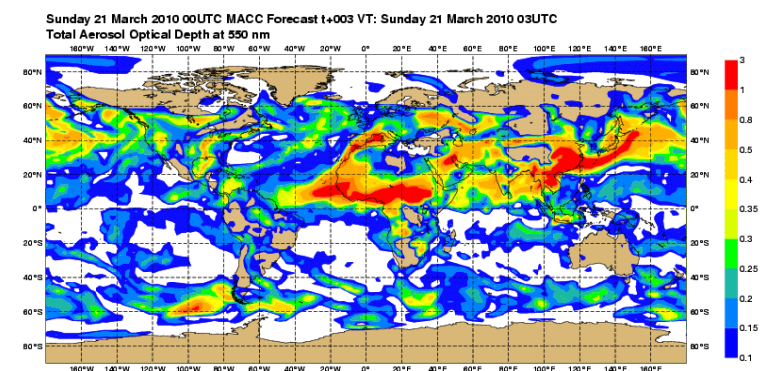


**Air-quality
ensemble
forecasts**

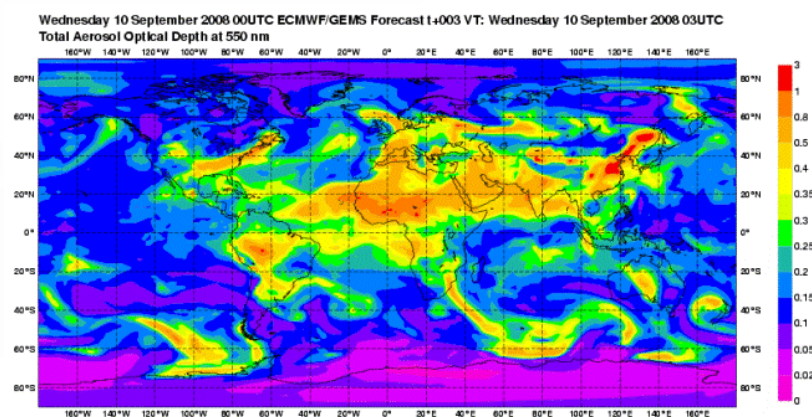
**and
(re-)analyses**



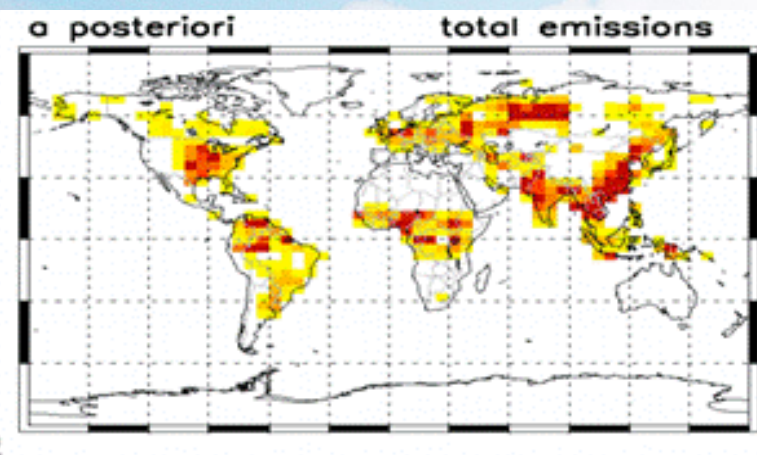
Global Aerosol



**Global
Gases**



**Greenhouse gases,
monthly emissions**



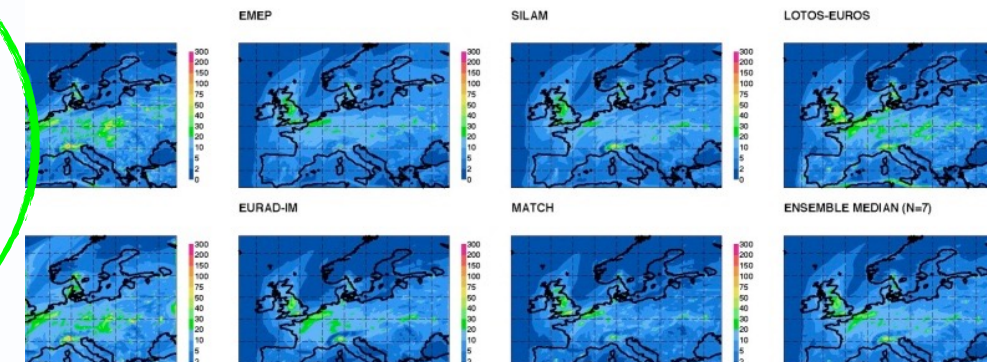
...And many more services.

CAMS <http://www.copernicus-atmosphere.eu>



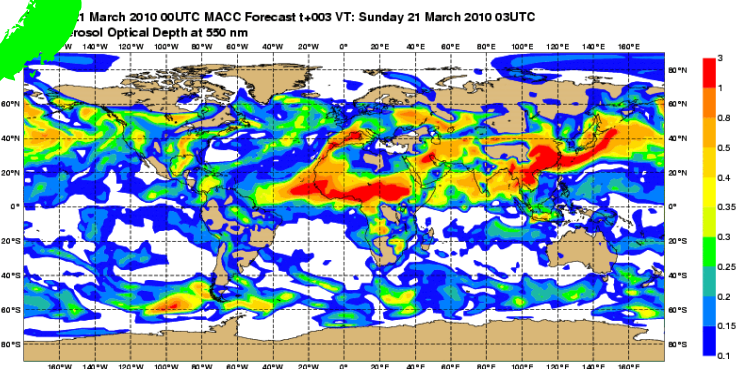
**Air-quality
ensemble
forecasts**

**and
(re-)analyses**

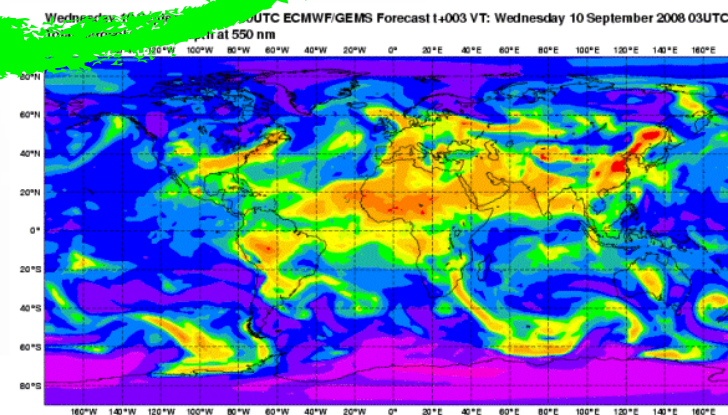


Validation

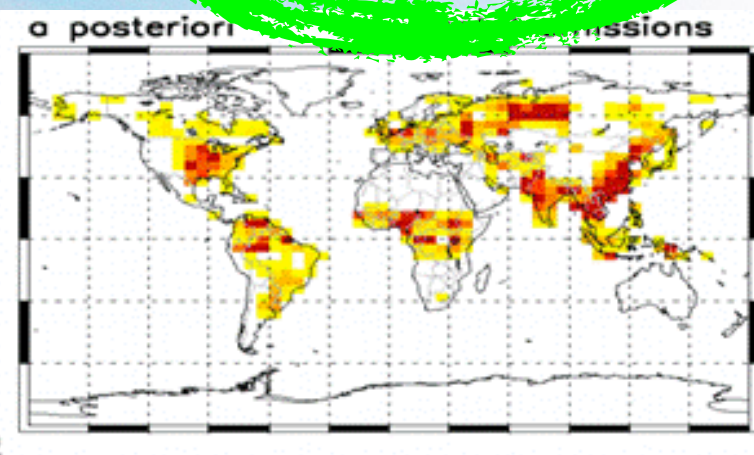
Global Aerosol



**Global
Gases**



**Greenhouse gases,
monthly emissions**






...And many more services.

CAMS / MACC Product Catalogue

Monitoring atmospheric composition & climate

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 Monitoring atmospheric composition & climate

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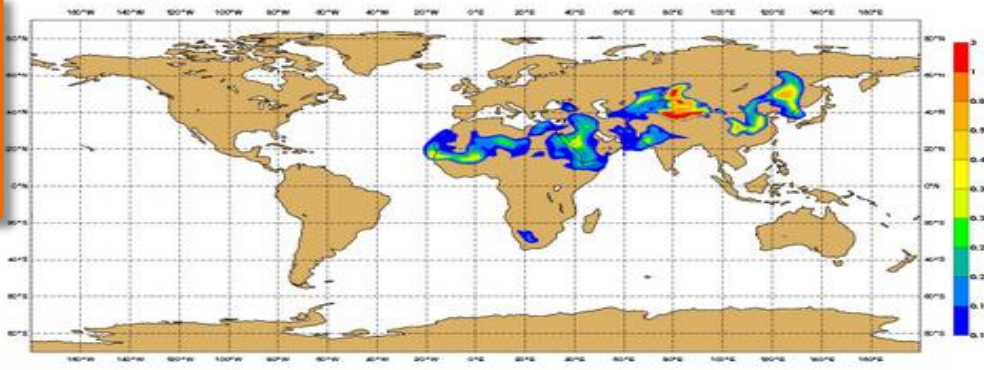
Product	Name	Service Type	Product Family	Parameter
Air quality & atmospheric composition	MACC-IFS NRT forecast of global dust aerosol optical depth at 550 nm	Air quality & atmospheric composition	Aerosol	Dust AOD
Aerosol				
Dust AOD	MACC-UKMO NRT dust AOD forecast	Air quality & atmospheric composition	Aerosol	Dust AOD
-- Please select a data type --				
-- Please select a geographic area --				

Reset

Search

MACC-IFS NRT forecast of global dust aerosol optical depth at 550 nm

Description: This service provides pre-operational daily forecasts up to 5 days for dust aerosol optical depth.
Saturday 3 November 2012 00UTC MACC Forecast t+012 VT: Saturday 3 November 2012 12UTC
Dust Aerosols Optical Depth at 550 nm



Service type: Air quality & atmospheric composition

Product family: Aerosol

Parameter: Dust AOD

Geographical: Global

Vertical coordinate: column

Time resolution: 3-hourly

Data type: Model

Production: -

Products found

Search criteria based on service themes, species, geographic area, etc.

Pop-up window with product description and links to plots, data, and validation

CAMS / MACC Product Catalogue

Monitoring atmospheric composition

macc Monitoring atmospheric composition & quality

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Product	Name
Air quality & atmospheric composition	MACC-II optical depth
Aerosol	MACC-II optical depth
Dust AOD	MACC-II optical depth
-- Please select a data type --	
-- Please select a geographic area --	

Reset

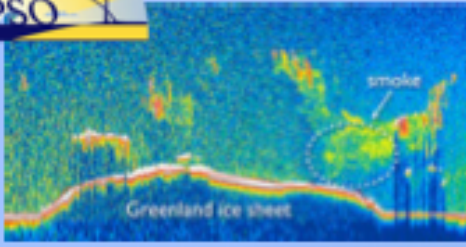
Search

Search criteria based on service themes, species, geographic area, etc.

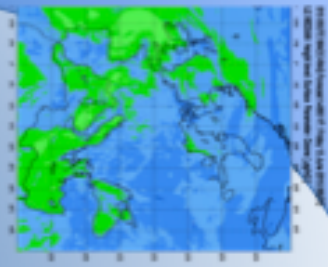
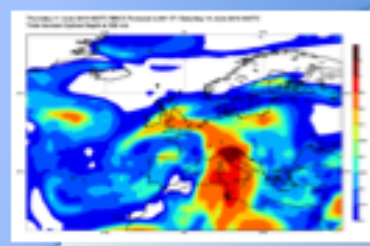
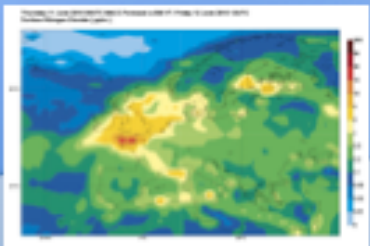


Products found

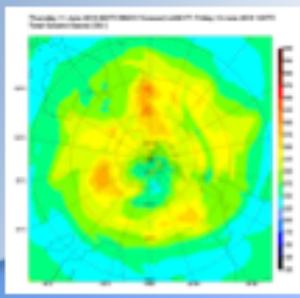
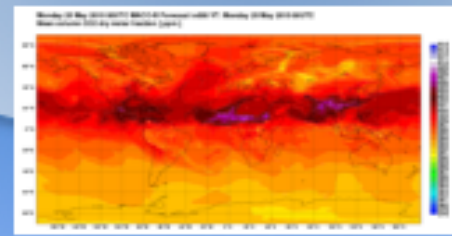
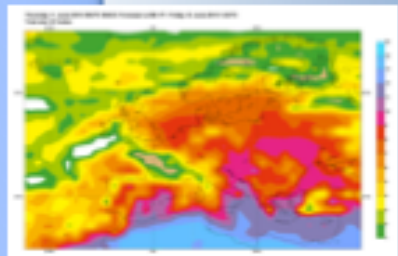
Pop-up window with product description and links to plots, data, and validation



GOME-2
Global Ozone Monitoring Experiment



CAMS84
validation



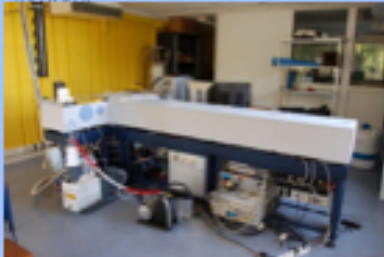
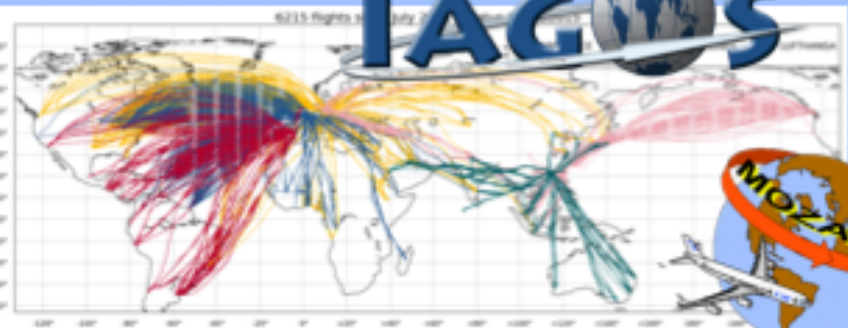
European Environment Agency



GAW



integrated carbon observation system



Observation datasets, networks

Network, database or observation type	Main responsible partner	Contributing partners	CAMS contract
WMO-GAW (including EMEP)	DWD	MET-NO, AA	Yes
ACTRIS / EBAS	MET-NO	KNMI, MPG	Yes
EEA/EIONET (AIRBASE)	(no strong link required) BSC/AEMET		Yes
EAN	(not part of CAMS-84)		Yes
IAGOS (MOZAIC, CARIBIC)	CNRS-LA		Yes
CO ₂ , CH ₄ surface (ICOS, YAK, RAMCES)	CEA-LSCE		Yes
NDACC	BIRA-IASB	IUP-UB	Yes
TCCON	UBC	BIRA-IASB	
AERONET	MET-NO	BSC/AEMET	
Aircraft campaign data: ARCTAS, ACCESS ...	MPG		
IASOA	AU		
ESRL	AA		
Lidars (EARLINET)	KNMI	DWD, MET-NO, BSC/AEMET	
Satellite: UV-Vis (OMI, S5P, GOME-2, SCIAMACHY)	IUP-UB	KNMI, BIRA-IASB	
Satellite: IR, MW	MPG		
Satellite: aerosol (CALIOP, AATSR, MISR, PARASOL)	MET-NO		
Satellite: limb (ACE-FTS, MLS, OMPS, OSIRIS)	BIRA-IASB		

Validation report NRT global service

Latest report: September 2015


- **Summary for users**
- **Overview of model configurations and changes**
including availability statistics
- **Detailed validation results**
- **Case studies:**
Dust, fire, pollution episodes
Low stratospheric ozone
- **Annex: methodology**

Last report: period up to 1 June 2015

(Updates every 3 months)


Copernicus Atmosphere
Monitoring
Service

Report




Validation report of the
CAMS
near-real time global
atmospheric composition service
System evolution and performance statistics
Status up to 1 June 2015

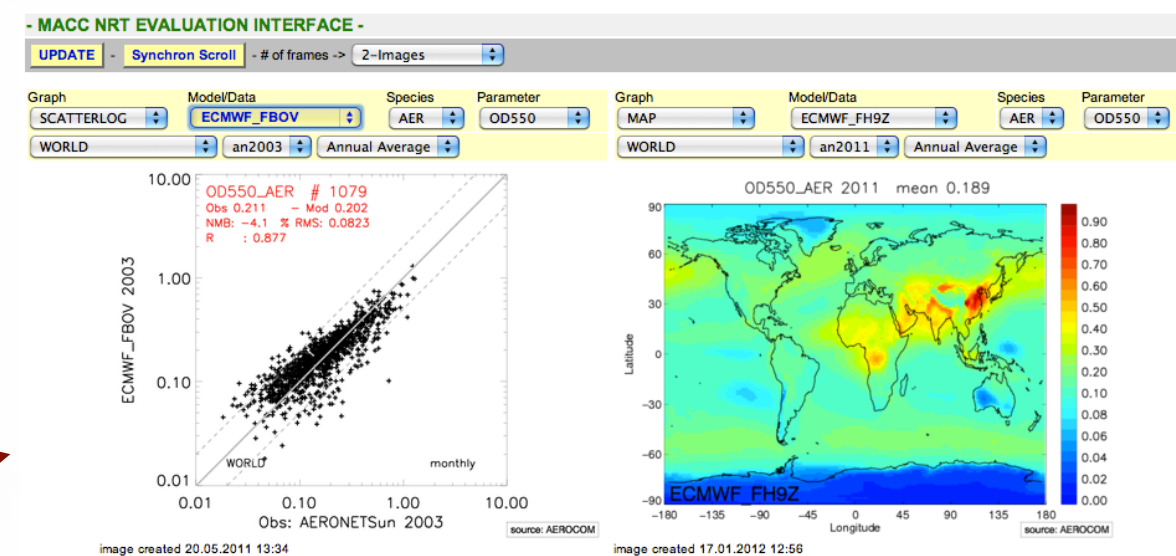
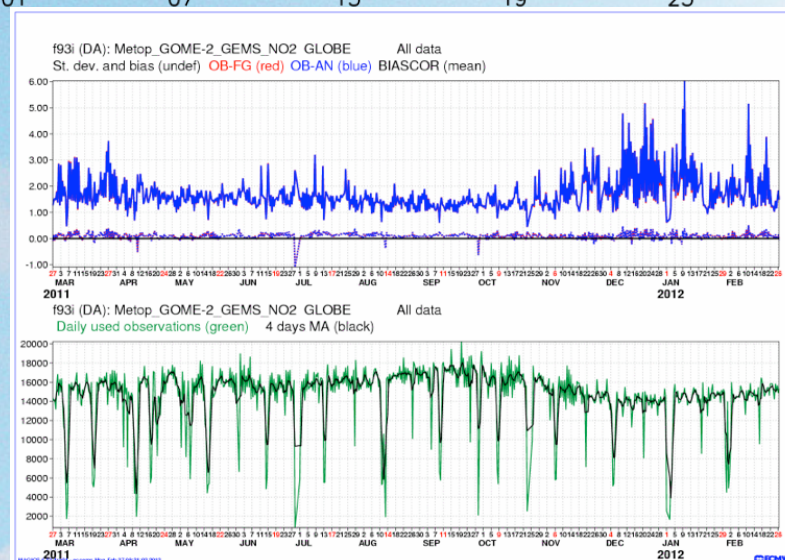
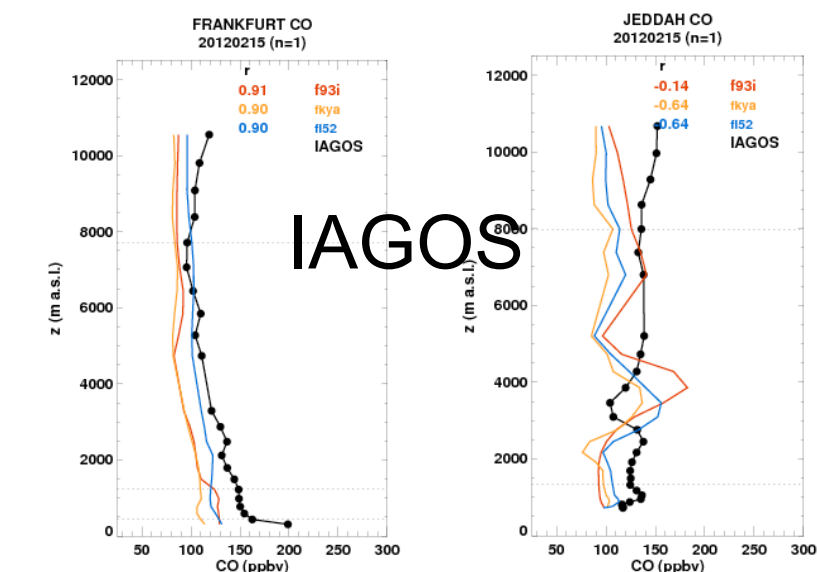
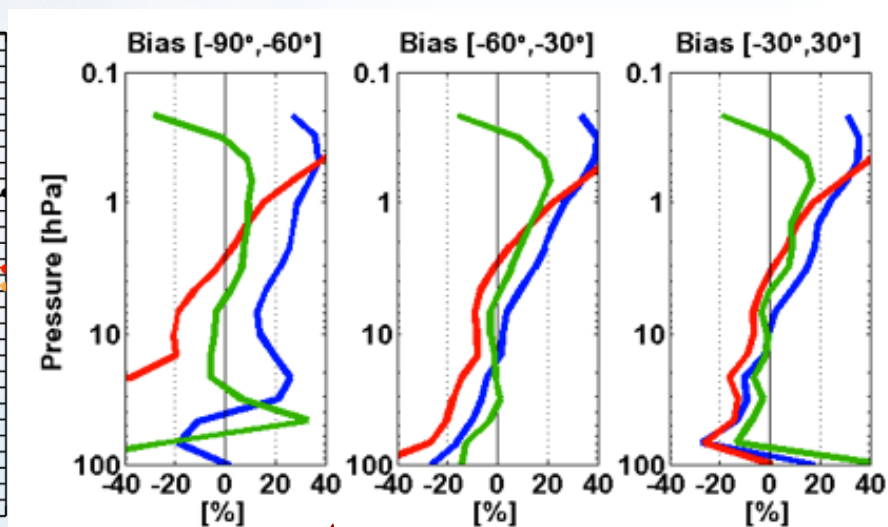
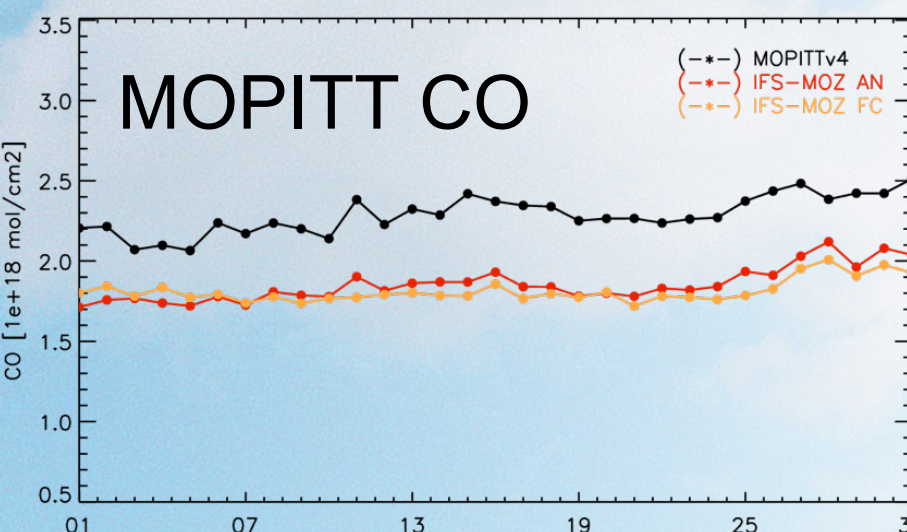
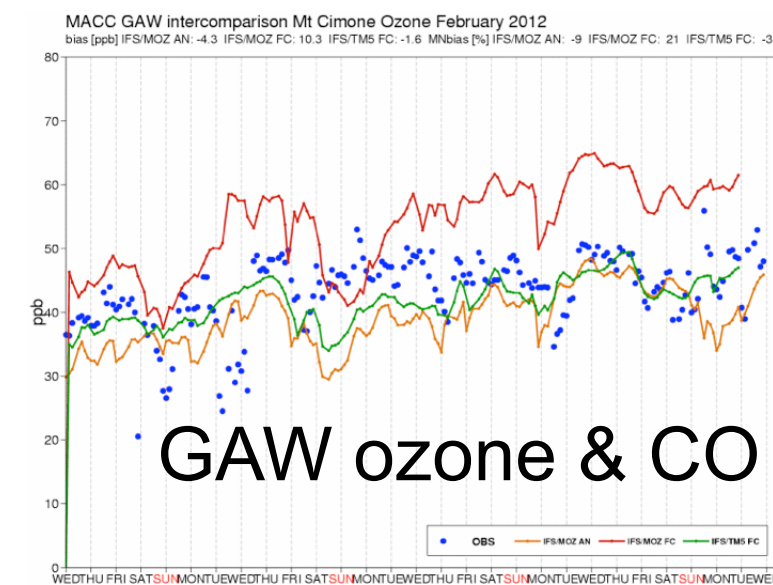
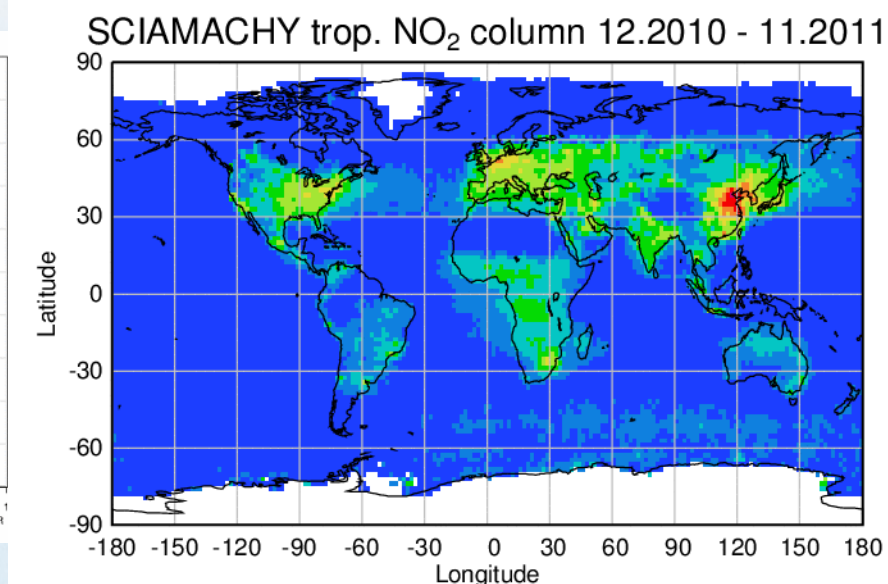
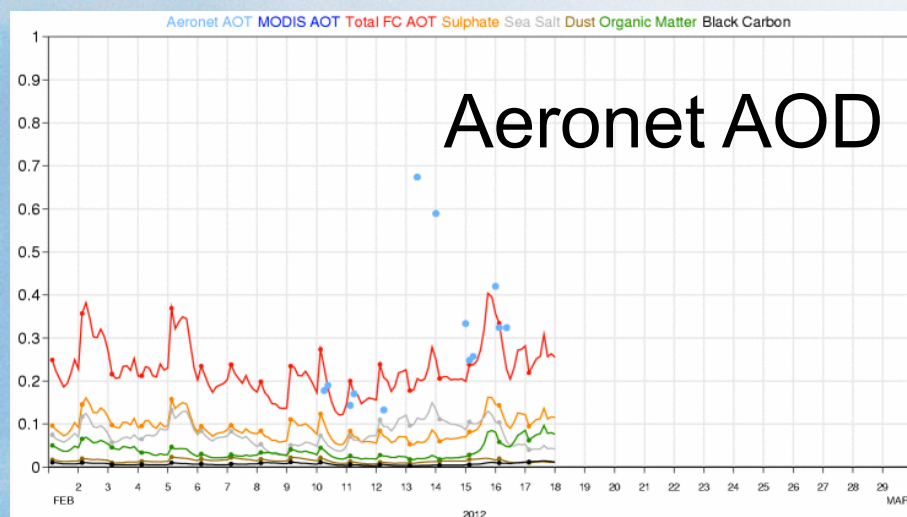
ISSUED BY: KNMI H. J. Eskes
Date: 18/09/2015
REF.: CAMS_VAL_NRTReport_20150918



Funded by the European Union

Implemented by 

Verification websites: overview



Stratosphere

Routine monitoring

Aerocom

Products assimilated/validated (current status)

Species, vertical range	Assimilation	Validation
Aerosol, optical properties	MODIS Aqua/Terra AOD	AOD, Ångström: AERONET, GAW, Skynet, MISR, OMI, lidar
Aerosol, speciation	-	-
O3, stratosphere	MLS, GOME-2A, GOME-2B, OMI, SBUV-2	Sonde, lidar, MWR, FTIR, ACE-FTS, OSIRIS, OMPS, BASCOE and MSR analyses
O3, UT/LS	Indirectly constrained by limb and nadir sounders	IAGOS, sonde
O3, free troposphere	Indirectly constrained by limb and nadir sounders	IAGOS, sonde
O3, PBL / surface	-	Surface ozone: WMO/GAW, NOAA/ESRL

Products assimilated/validated (continued)

Species, vertical range	Assimilation	Validation
CO, UT/LS	-	IAGOS
CO, free troposphere	IASI, MOPITT	IAGOS, MOPITT, IASI
CO, PBL / surface	Indirectly constrained by satellite IR sounders	Surface CO: WMO/GAW, NOAA/ESRL
NO ₂ , troposphere	OMI, partially constrained due to short lifetime	SCIAMACHY, GOME-2, UV-Vis DOAS
HCHO	-	GOME-2, UV-Vis DOAS
SO ₂	OMI (Individual volcanic eruptions and strong sources)	-
Stratosphere, other than O ₃	-	NO ₂ column only: SCIAMACHY, GOME-2
Troposphere, other species	-	-
UV-Index	Constrained by assimilation of ozone and aerosol AOD	COST UV Index Database

CAMS-84: research/development topics

- * **Observations characterisation** document.
Listing stations involved (and station selection), availability, QA/QC procedures, error characterisation (optimal estimation), representativeness, sampling, collocation/validation methods.
- * **Scoring methods** document.
Documenting scoring approaches. Recommended accuracy measures. User-oriented skill scores.
- * **Data mining** document.
Inventory of observational datasets not yet used and level of maturity of these datasets.

Use of observations

Validation

Timeliness

QC/QA

CAMS products

Real Real-Time
< 2-3 hours

Near-Real-Time
< 2-3 days

A posteriori
< 1 month

Final
< 1 year

Automated
Filtering, flagging

Semi-automated

Manual, Expertise
Semi-validated

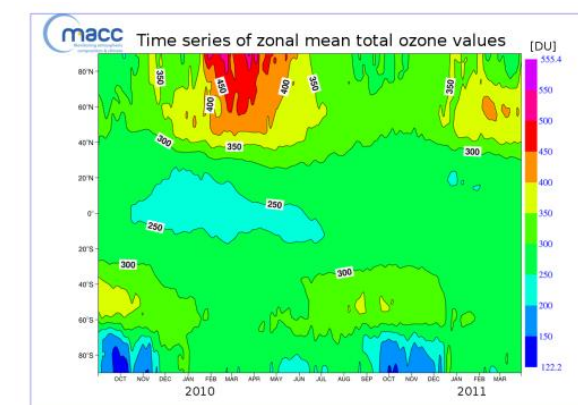
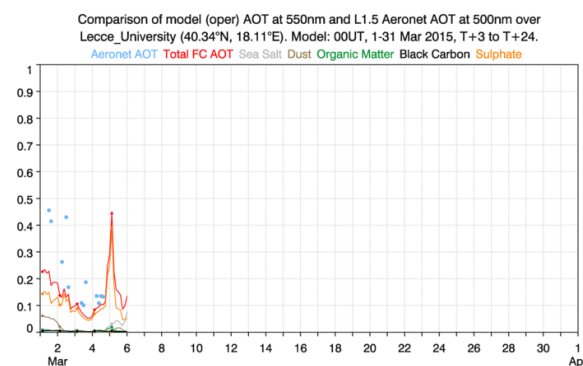
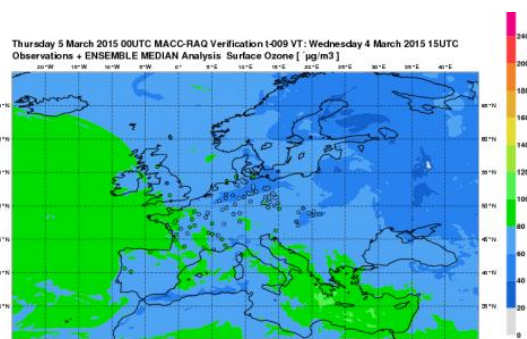
Expertise+
Validated

Assimilation
(Verification)

Verification
(Assimilation)

Validation
(Interim re-analyses)

Re-analyses
(Validation)



Conclusions

- * **Non-satellite observations** are essential to CAMS
- * Using only (operational) regulatory networks would lead to large data gaps. Data from **research networks** plays a key role.
Aim: to use all good data available.
- * **Sustainability** of observations major concern. CAMS/Copernicus offers only limited support.

Wish list

- * Uniform **QA/QC** and realistic **error characterisation** are essential. Systematic errors often difficult to quantify.
- * From operational point of view best to have a **limited number of providers and infrastructures**. This improves homogeneity, consistency, QA/QC and is more practical.
- * For real-time services there is a need for near-real time data, and datasets **available within one month** after sensing. But also older observations will be used (for reanalysis in particular).
- * **Long-term, gap-free records** with uniform quality (sustainability)
Monitor progress made with the services.
- * Estimates of **representativeness** mismatches. Site classification.

Research: Development of (multiple) skill scores

The steps of the proposed user-oriented approach are:

- Choose a Copernicus-atmosphere application area
- Identify user knowledge requirements for this application area
- Identify species involved and available reliable observational data sets
- Identify the perfect skill / no skill reference
- Identify relevant accuracy measures
- Translate the accuracy measures into skill scores:
a quantity without dimension, between 0 (no skill) and 1 (perfect skill),
based on the references.

Work in progress ...

