

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

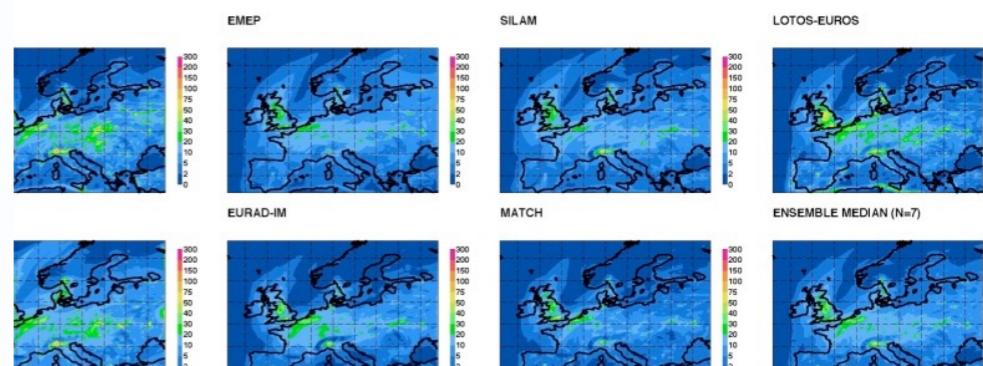


CAMS <http://www.copernicus-atmosphere.eu>

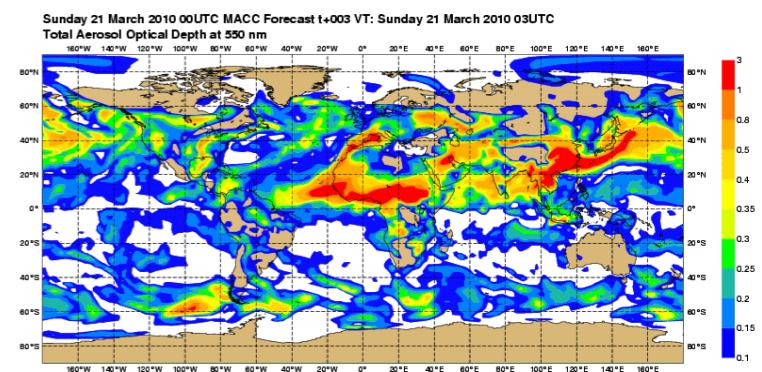
The screenshot shows the MACC Project - Home - Mozilla Firefox browser window. The address bar shows <http://www.gmes-atmosphere.eu/>. The page title is "Monitoring atmospheric composition & climate". The header includes the MACC logo and the GMES logo. The main content area features a "Latest News" section with a link to "Reanalysis production started: Volcanic Eruption in Iceland MACC supports HIPPO-III campaign". It also includes sections for "Services by Theme" (European Air Quality, Global Atmospheric Composition, Climate, UV, Solar Energy, Stratospheric Ozone), "Services by User" (Health Community, Environmental Agencies, Science Community, Citizens, Meteorological Institutes), and "Today's Forecasts" (Reactive Gases, Aerosols, European Air Quality, UV Index). A sidebar on the right lists "Services by Theme" such as European Air Quality, Global Atmospheric Composition, Climate, and UV, Solar Energy, Stratospheric Ozone. At the bottom, there is a "Potential users of MACC are invited to complete the questionnaire at this [link](#)". A note at the very bottom states: "MACC is a Collaborative Project (2009-2011) funded by the European Union under the 7th Framework Programme. It is coordinated by the European Centre for Medium-Range Weather Forecasts and operated by a 45-member consortium." Below the browser window, a blue arrow points down to a world map titled "a posteriori total emissions".

*Air-quality
ensemble
forecasts*

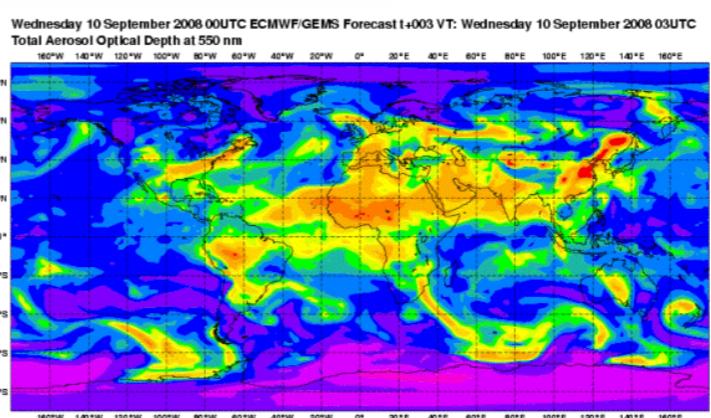
*and
(re-)analyses*



Global Aerosol

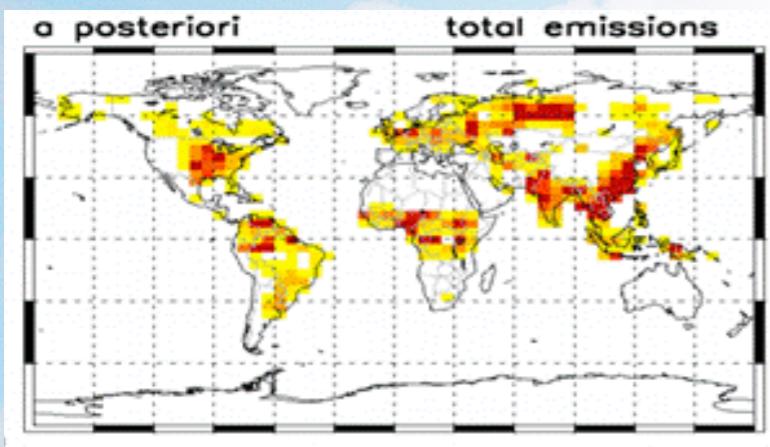


*Global
Gases*



...And many more services.

*Greenhouse gases,
monthly emissions*

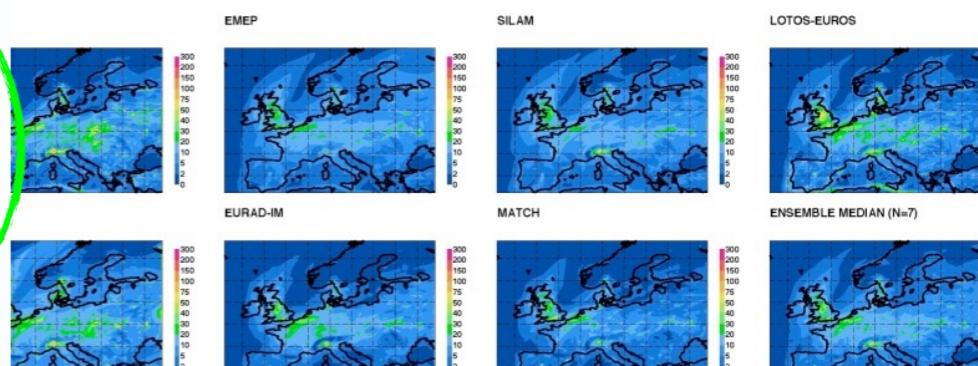


CAMS <http://www.copernicus-atmosphere.eu>

MACC Project - Home - Mozilla Firefox
File Edit View History Bookmarks Tools Help
BBC - Homepage http://www.gmes-atmosphere.eu
MACC Project - Home x BBC - Homepage x
Monitoring atmospheric composition & climate
macc Monitoring atmospheric composition & climate gmes
HOME NEWS ABOUT THE PROJECT SERVICES DATA PRODUCTS DOCUMENTS EVENTS CONTACT US
Home >
macc - Monitoring Atmospheric Composition and Climate - is the current pre-operational atmospheric service of the European GMES programme. MACC provides data records on atmospheric composition for recent years, data for monitoring present conditions and forecasts of the distribution of key constituents for a few days ahead. MACC combines state-of-the-art atmospheric modelling with Earth observation data to provide information services covering European Air Quality, Global Atmospheric Composition, Climate, and UV and Solar Energy.
Services by theme
European Air Quality Global Atmospheric Composition Climate UV, Solar Energy, Stratospheric Ozone
Services by user
Health Environment Science Community Citizen Meteorology
Potential users of MACC are invited to complete the questionnaire at this link
MACC is a Collaborative Project (2009-2011) funded by the European Union under the 7th Framework Programme. It is coordinated by the European Centre for Medium-Range Weather Forecasts and operated by a 45-member consortium.
Done

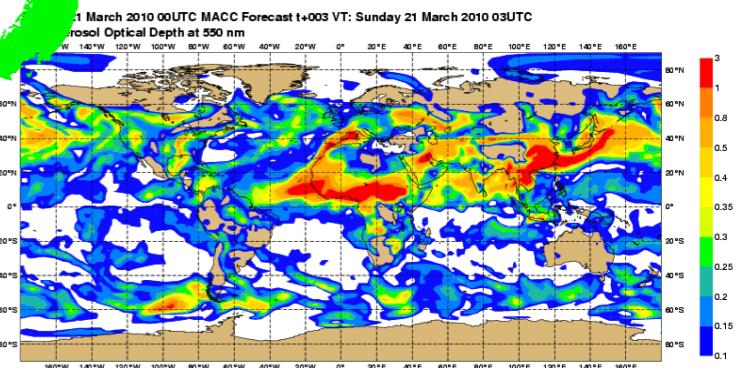
Air-quality ensemble forecasts

and (re-)analyses

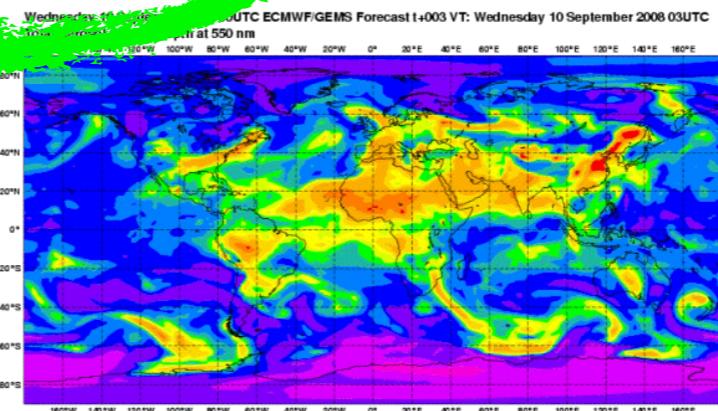


Validation

Global Aerosol



Global Gases



...And many more services.

Greenhouse gases, monthly emissions

CAMS / MACC Product Catalogue

Monitoring atmospheric composition & climate Not logged in | Login

macc Monitoring atmospheric composition & climate GMES

HOME **NEWS** **CATALOGUE** **PRESS ROOM** **ABOUT THE PROJECT** **CONTACT US**

Home > Catalogue

Product

Air quality & atmospheric composition
Aerosol
Dust AOD
-- Please select a data type --
-- Please select a geographic area --

Reset

Search

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

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

The screenshot shows the CAMS / MACC Product Catalogue interface. On the left, a sidebar displays search criteria: 'Product' dropdowns for 'Air quality & atmospheric composition', 'Aerosol', 'Dust AOD', 'Please select a data type', and 'Please select a geographic area'. Below these are 'Reset' and 'Search' buttons. An orange box highlights the search criteria. On the right, a large central window shows a 3D character holding a hammer, with a speech bubble saying 'Validate or I'll smash you!'. The character is positioned next to a computer monitor displaying an RSS feed icon. A vertical sidebar on the far right contains 'login', 'Search', 'OD', and 'OD'. An orange box highlights the 'Products found' section. A callout points from the 'Products found' box to the central window. At the bottom of the central window, the URL 'www.feedforall.com' is visible.

Monitoring atmospheric composition

macc Monitoring atmospheric composition &...

HOME **NEWS** **CATALOGUE** **PRESS R...**

Home > Catalogue

Product

Air quality & atmospheric composition
Aerosol
Dust AOD
-- Please select a data type --
-- Please select a geographic area --

Reset

Search

Products found

Validate or I'll smash you!

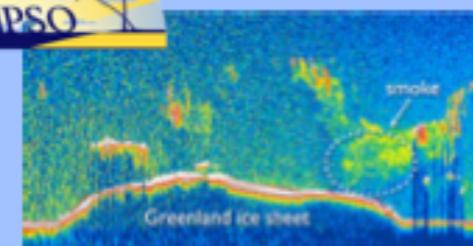
Name

MACC-II optical d...
MACC-U...

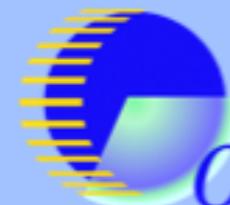
www.feedforall.com

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

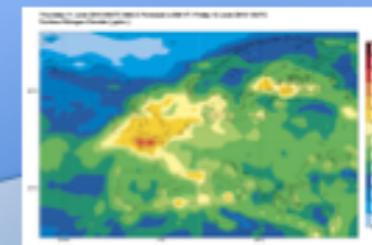
Pop-up window with product description and links to plots, data, and validation



GOME-2
Global Ozone Monitoring Experiment

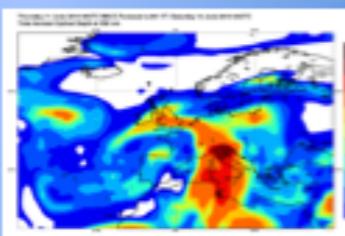
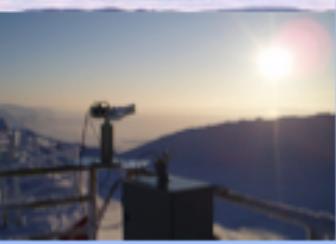


TROPOMI



AERONET

Aerosol Robotic Network



European Environment Agency

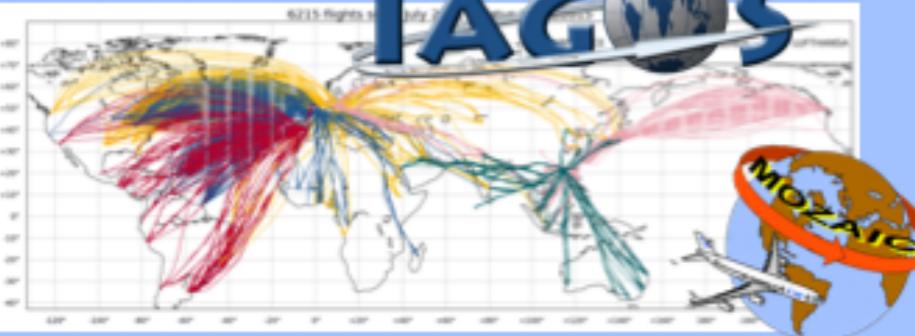


GAW

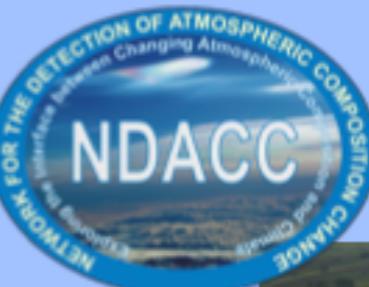
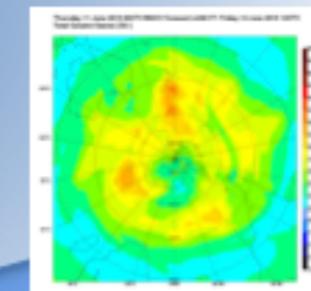
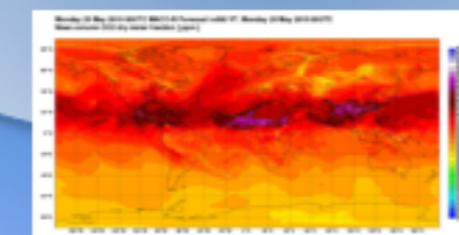
iCO_S

integrated
carbon
observation
system

IAGOS



CAMS84
validation



total carbon column observing
network



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

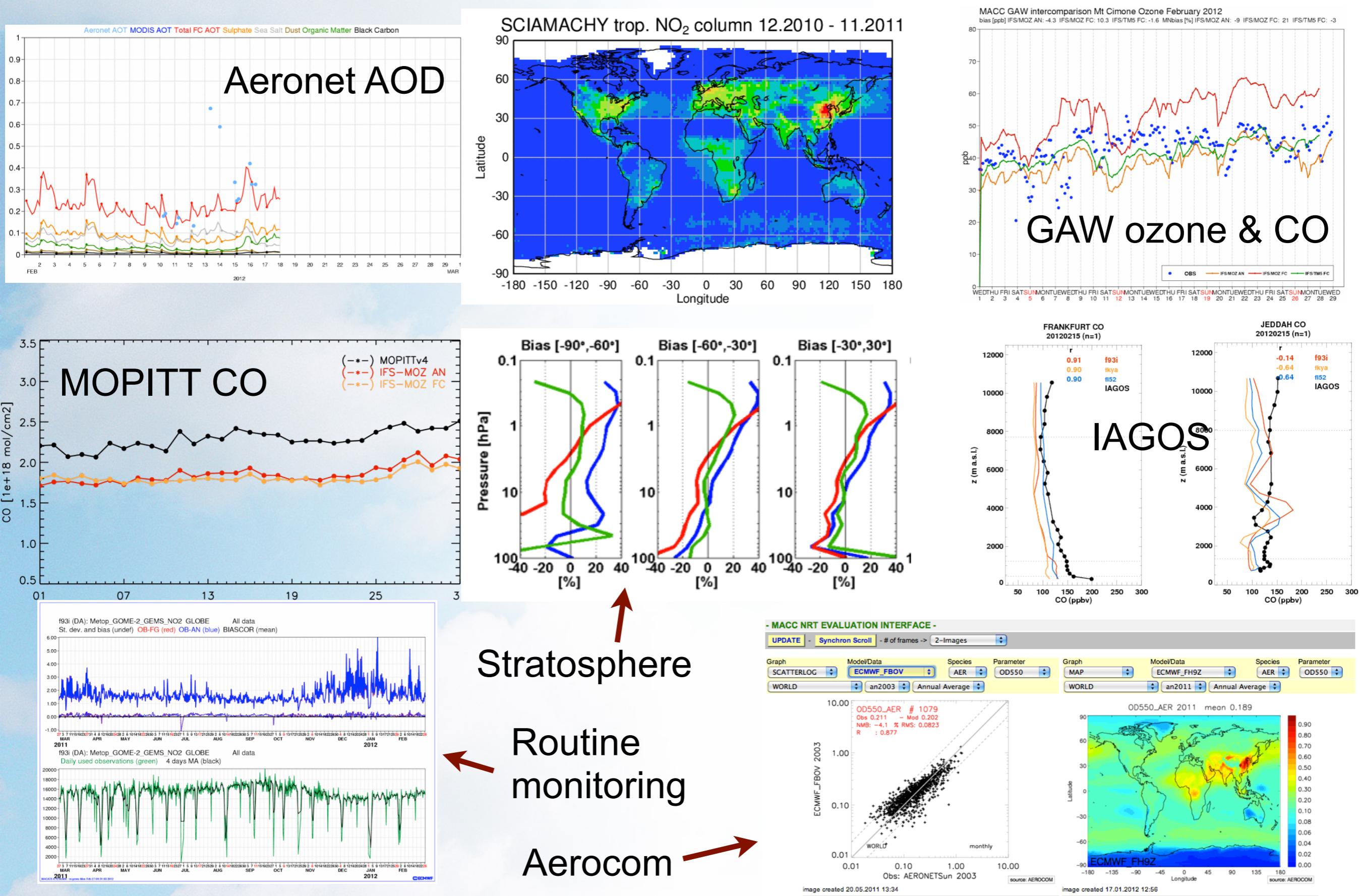
REF.: CAMS_VAL_NRTReport_20150918



Funded by the European Union

Implemented by ECMWF

Verification websites: overview



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)

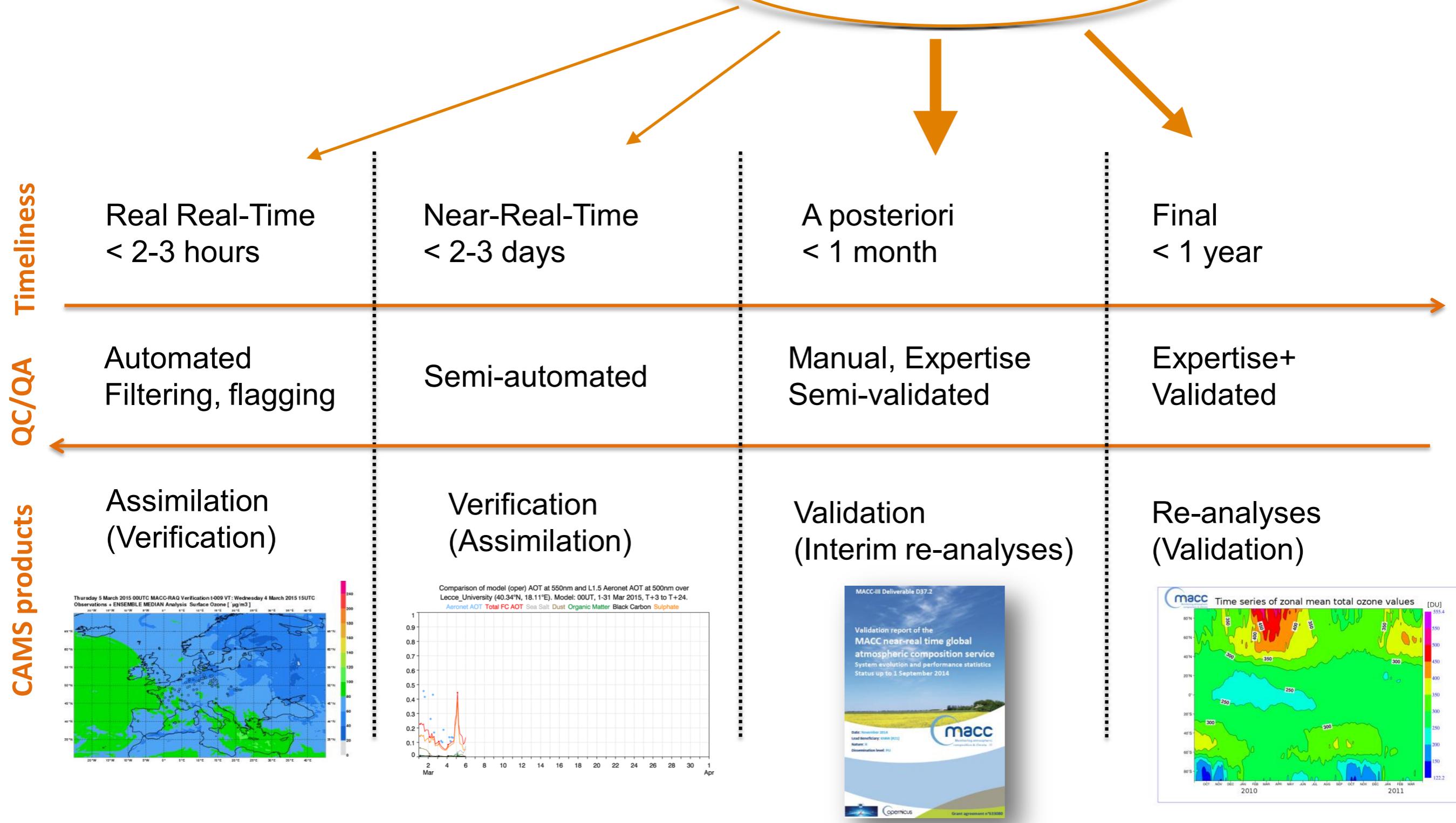
Species, vertical range	Assimilation	Validation
CO, UT/LS	-	IAGOS
CO, free troposphere	IASI, MOPITT	IAGOS, MOPITT, IASI
CO, PBL / surface	Indirectly constrained by satellite IR sounders	Surface CO: WMO/GAW, NOAA/ESRL
NO2, troposphere	OMI, partially constrained due to short lifetime	SCIAMACHY, GOME-2, UV-Vis DOAS
HCHO	-	GOME-2, UV-Vis DOAS
SO2	OMI (Individual volcanic eruptions and strong sources)	-
Stratosphere, other than O3	-	NO2 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



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 ...

