CAMS: MACC Reanalysis of global atmospheric composition (2003 - 2012)

What is the MACC reanalysis?

The MACC Reanalysis is a global reanalysis data set of atmospheric composition (AC), made available by the Copernicus Atmosphere Monitoring Service (CAMS). The dataset spans the period 2003 to 2012. The spatial resolution of the data set is approximately 80 km (T255 spectral) on 60 vertical levels from the surface up to 0.1 hPa for the analysed species and 1.125° by 1.125° at the same 60 levels for the other chemical species.

The MACC Reanalysis was constructed by assimilating satellite data into a global model and data assimilation system. This data assimilation system is based on a 2010 release of the Integrated Forecast System (IFS) (Cy36r1). The chemistry transport model MOZART (Model for OZone And Related chemical Tracers) was coupled to the IFS to provide initial fields and chemical production and loss rates for the reactive gases (Flemming et al. 2009). The system includes a 4-dimensional variational analysis (4D-Var) with a 12-hour analysis window and provides analysis fields of atmospheric composition species, namely ozone (O3), carbon monoxide (CO), nitrogen oxides (NOx), SO2, formaldehyde (HCHO), and aerosols, in addition to meteorological fields. Additional reactive gases species are available from the coupled chemistry transport model MOZART.

The output of the reanalysis has been validated by the MACC-II VAL sub-project and the latest information is available in a validation report. An open-access journal article describing the chemistry part of the MACC reanalysis is available from Atmospheric Chemistry and Physics (Inness et al. 2013). Inness et al. (2013) also lists which atmospheric composition data sets were assimilated in the MACC reanalysis.

We are aware of several quality issues with MACC reanalysis data (see known issues section below).

How to access MACC Reanalysis data and charts/maps?

MACC data is open access (under licence) and free to download.

MACC data can be searched through the CAMS Catalogue (select 'Global reanalyses' in the 'Product Family' section).

The MACC reanalysis data can be downloaded from the ECMWF Data Server or via WebAPI. Those with MARS access may directly retrieve the data from MARS (class=mc, expver=rean) for all analysed species as well as the meteorology. The additional chemical species from the coupled MOZART model are available upon request from the ECMWF ECFS archive (contact Copernicus User Support) in NetCDF format.

MACC Reanalysis maps are also available.

MACC reanalysis parameters listings

The archive of available MACC parameters can be browsed here.

Availability of parameters varies with the type of level selected (model levels, pressure levels or surface).

Known issues

Sea salt aerosol mixing ratio above freshwater: The model is not distinguishing between sea and freshwater in the context of sea-salt emissions. Unfortunately, this appears to affect all cycles from the MACC reanalysis. A fix is planned to be implemented in a future model release (45r1) and will be effective from the implementation date on. This means that the fix will not be retrospective for the MACC reanalysis but will be in future reanalysis.

Changes in biomass burning emissions: The biomass burning emissions were changed on 1 January 2009 from a preliminary version of GFED3 to GFAS version 1.0. The GFAS version 1.0 emissions budget is about 18 % higher than those used during the first 6 yr.

MOPITT CO data: After 23 March 2010 NRT MOPITT CO data were used in the reanalysis instead of the offline product. This change did not have a noticeable impact on the reanalysis fields.

Assimilation of IASI CO: Assimilation of IASI CO after 1 April 2008 led to some changes in the CO field.

Tropospheric O3: Using variational bias correction for MLS ozone profiles led to increased tropospheric ozone and changes to ozone above 15 hPa. However, it did not affect the total column ozone field. These drifts stopped on 1 January 2008 when the bias correction was switched off for MLS, and afterwards agreement with independent ozonesondes and MOZAIc data was improved.

O3 in UTLS: Using NRT MLS data instead of the offline product after 16 March 2009 resulted in larger departures in the upper troposphere and lower stratosphere, because the lowest 3 layers (68–100, 100–146, and 146–215 hPa) of the MLS data could not be used.
OMI O3: NRT OMI ozone columns were assimilated instead of the offline product between 21 March 2007 and 31 December 2007. This did not have a noticeable impact on the ozone analysis.

MOZART model upgrade: A model upgrade to MOZART 3.5 was implemented on 1 January 2009, which slightly improved the representation of the ozone hole in the control run but did not affect the other model fields.

SCIAMACHY NO2: NO2 SCIAMACHY retrievals V1.04 were assimilated until 30 June 2007, SCIAMACHY V1.1 data were assimilated after 11 September 2007, but this only has a minor impact on the analysis fields.

How to cite MACC reanalysis data

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