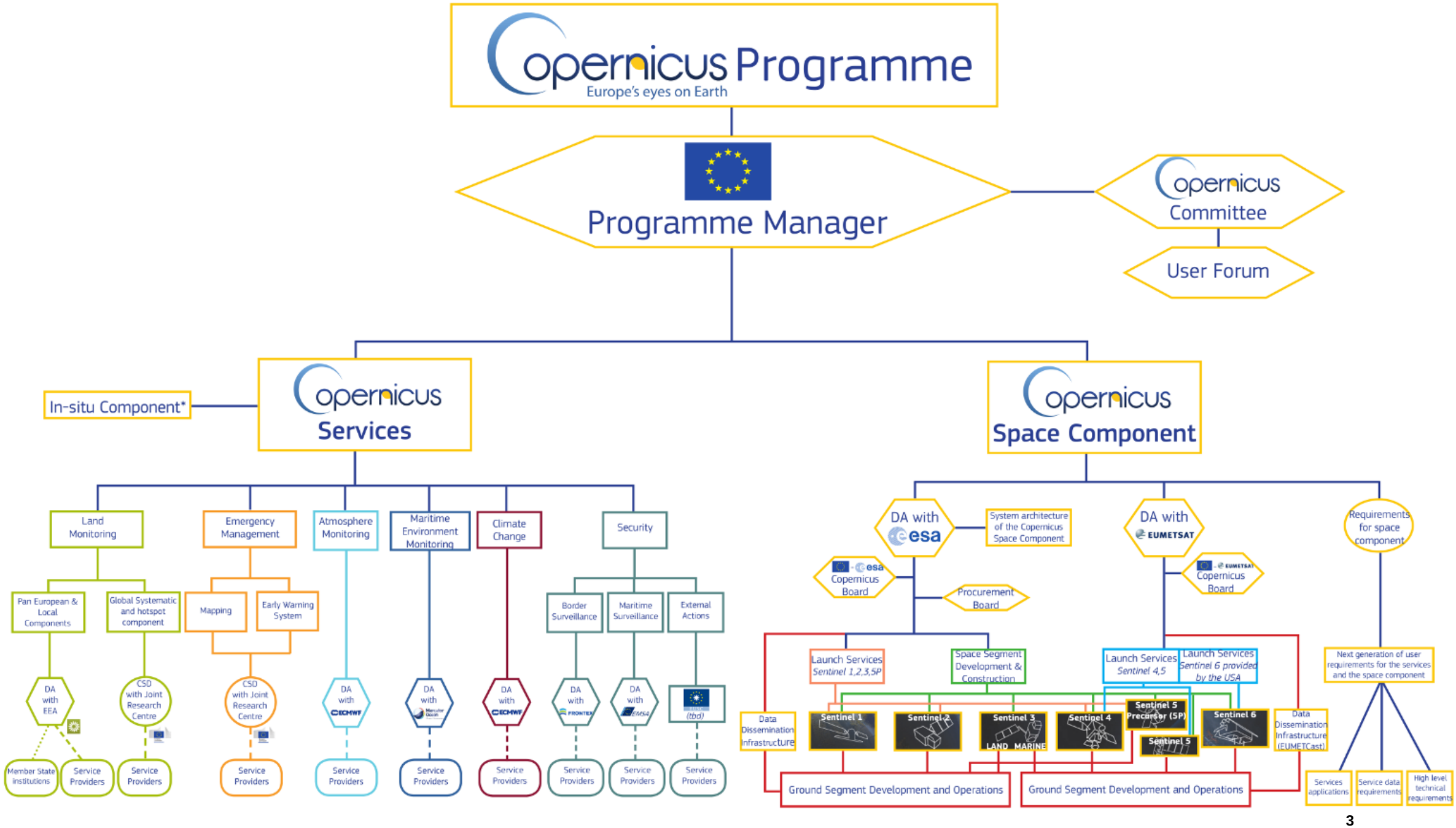
Visualisation in Copernicus Atmosphere Monitoring Service

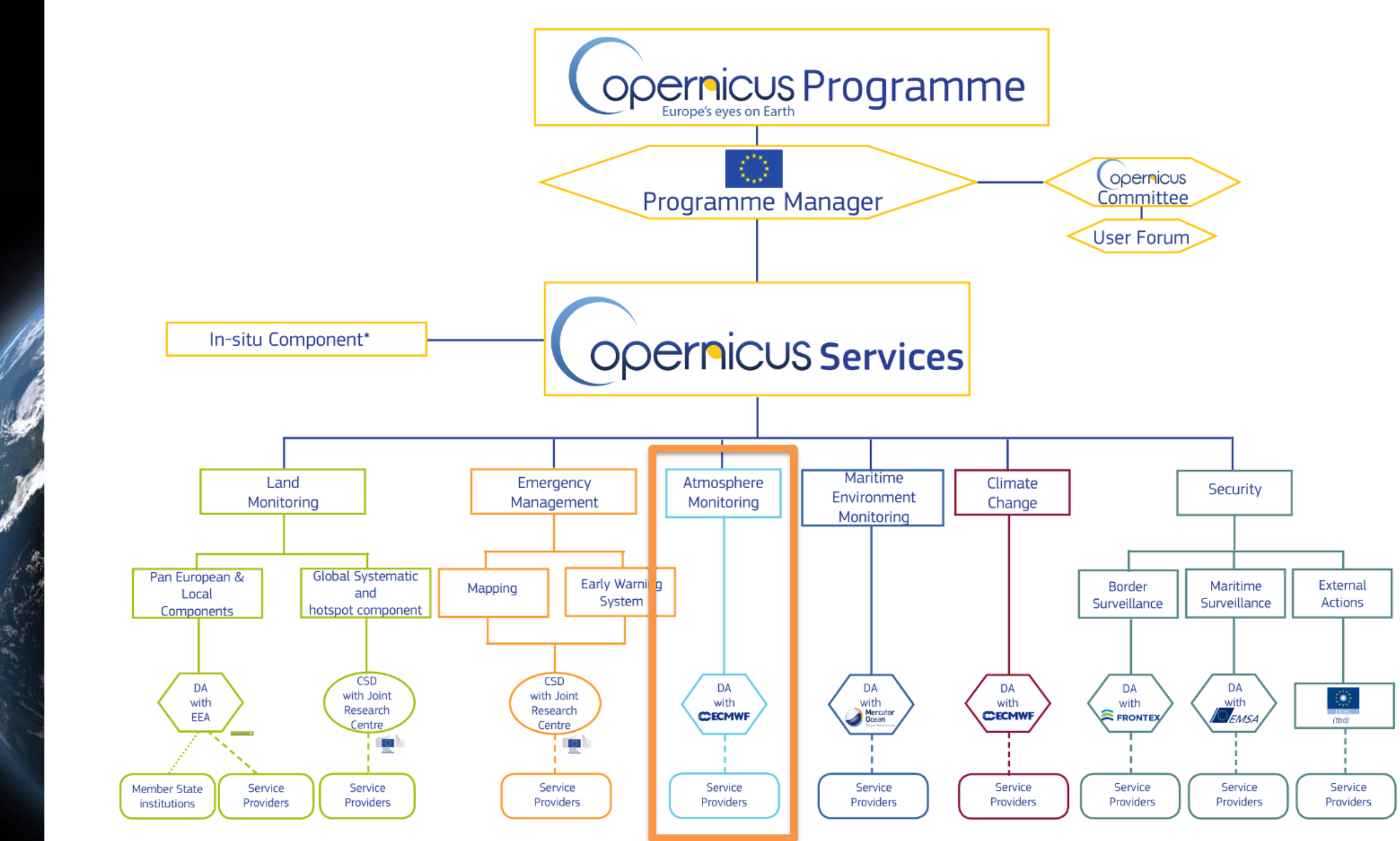
Miha Razinger

with thanks to CAMS colleagues

Funded by the European Union

Implemented by ECMWF


Copernicus Programme
Europe's eyes on Earth
Programme Manager
Copernicus Committee
User Forum
In-situ Component*
Copernicus Services
Land Monitoring
Pan European & Local Components
Global Systematic and hotspot component
DA with EEA
CSD with Joint Research Centre
Member State institutions
Service Providers
Service Providers
Emergency Management
Mapping
Early Warning System
CSD with Joint Research Centre
Service Providers
Atmosphere Monitoring
DA with ECMWF
Service Providers
Maritime Environment Monitoring
DA with
Service Providers
Climate Change
DA with ECMWF
Service Providers
Security
Border Surveillance
Maritime Surveillance
External Actions
DA with FRONTEX
DA with EMSA
(tbd)
Service Providers
Service Providers
Service Providers
Copernicus Space Component
DA with esa
System architecture of the Copernicus Space Component
esa Copernicus Board
Procurement Board
Launch Services Sentinel 1,2,3,5P
Space Segment Development & Construction
Data Dissemination Infrastructure
Sentinel 1
Sentinel 2
Sentinel 3
LAND MARINE
Sentinel 4
Sentinel 5 Precursor (5P)
Sentinel 5
Sentinel 6
Data Dissemination Infrastructure (EUMETCast)
Ground Segment Development and Operations
Ground Segment Development and Operations
DA with EUMETSAT
EUMETSAT Copernicus Board
Launch Services Sentinel 4,5
Launch Services Sentinel 6 provided by the USA
Requirements for space component
Next generation of user requirements for the services and the space component
Services applications
Service data requirements
High level technical requirements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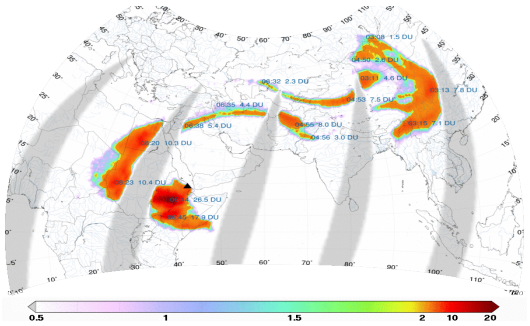
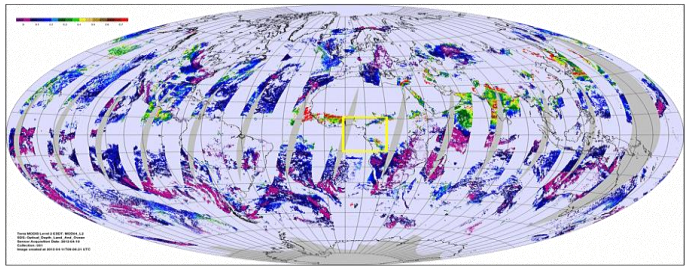
Copernicus Atmosphere Monitoring Service

- **current information** on atmospheric composition, forecasts for a **few days ahead**, and consistant **retrospective analyses** of data records for recent years
- application domains: health, environmental monitoring, renewable energies, meteorology, climatology
- product groups: global atmospheric composition, European air quality, greenhouse gases and aerosol climate forcing, UV and stratospheric ozone, solar radiation, emission inventories and products

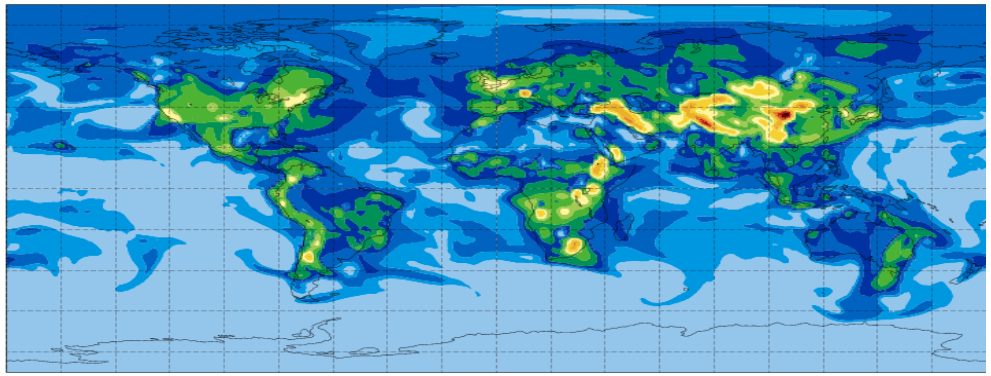
European Commission

From EO to policy-relevant products

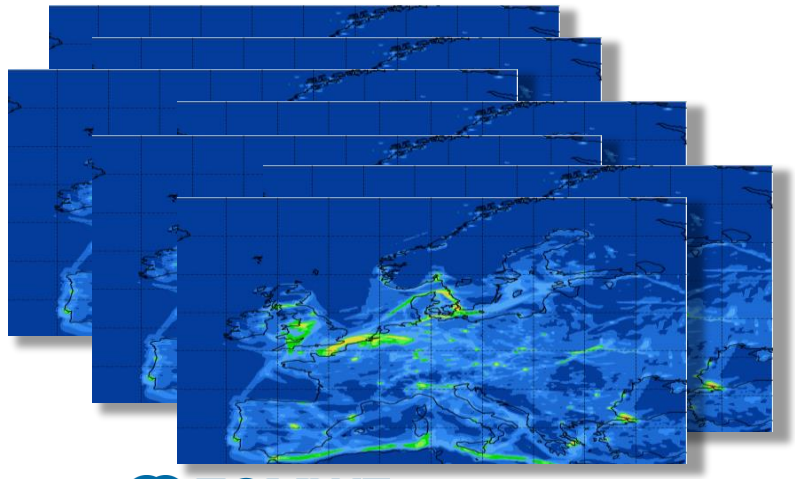




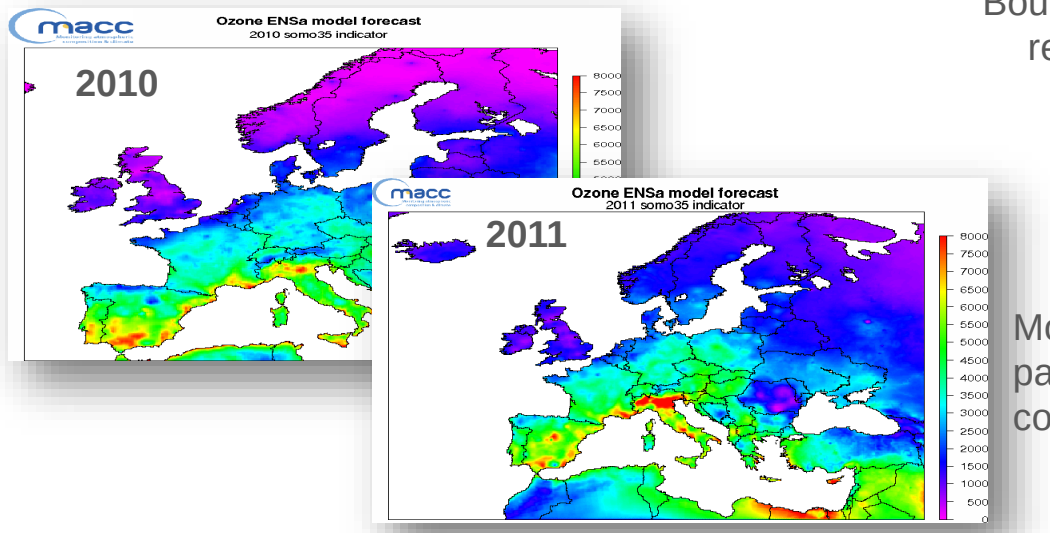
Over 60 EO instruments are assimilated in the global system



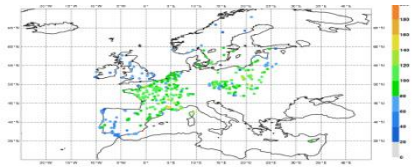
Boundary conditions feed an ensemble of high-resolution European AQ systems (in order to assess uncertainties)



More data are assimilated (in particular hourly surface AQ concentrated by EEA/EIONET)



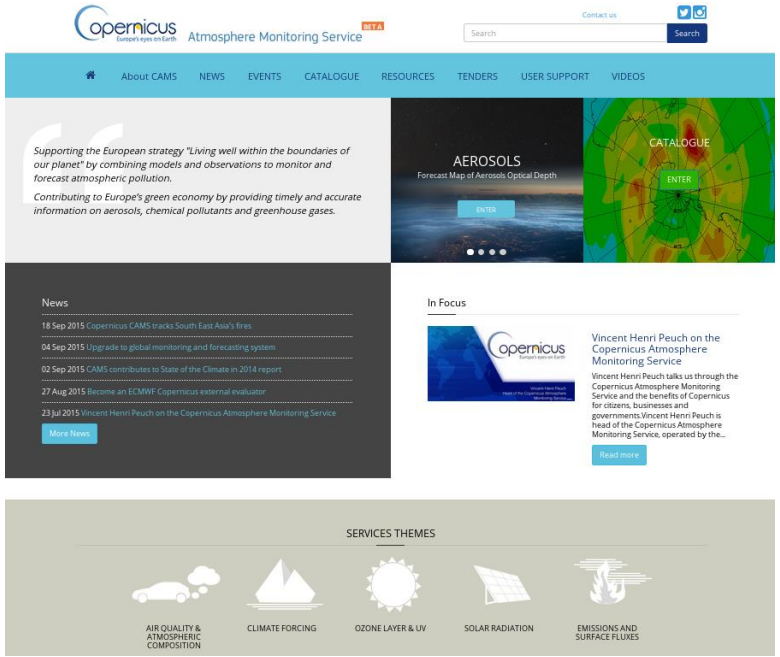
Policy-relevant (here health indicator for ozone) products are delivered. They are “maps with no gaps”, which observations alone don’t provide and are essential to assess impacts.



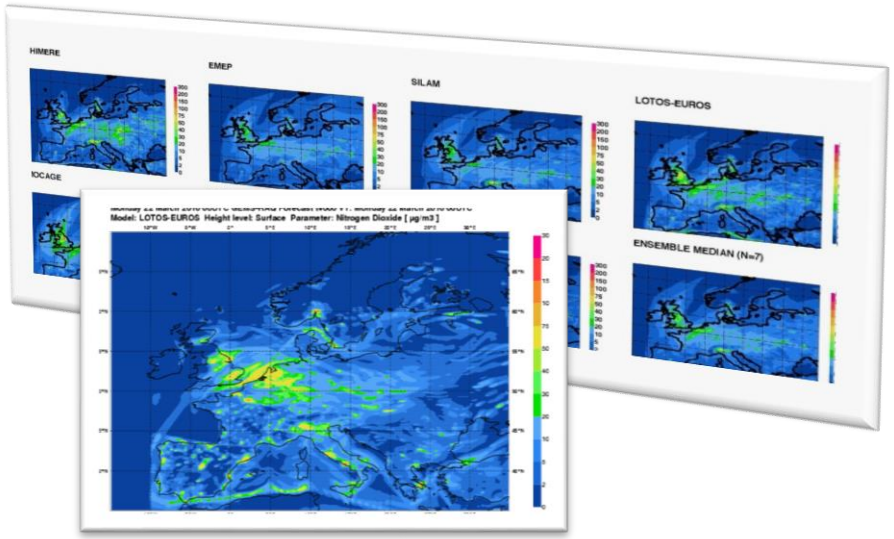
ECMWF

EEA

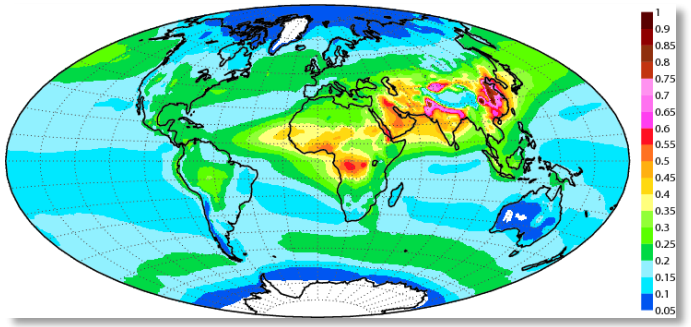
http://atmosphere.copernicus.eu



European Air Quality

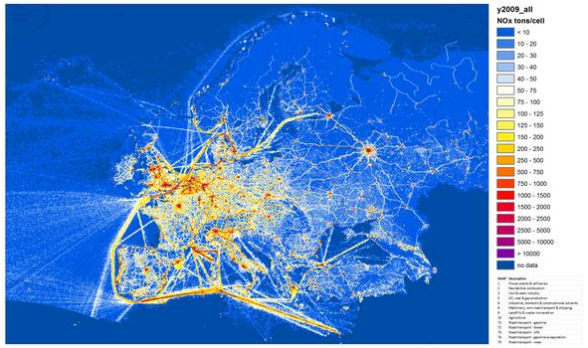


Global atmospheric composition

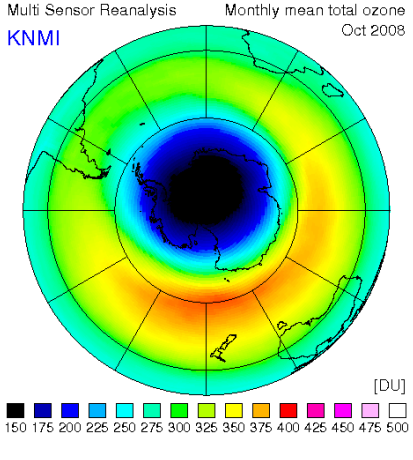


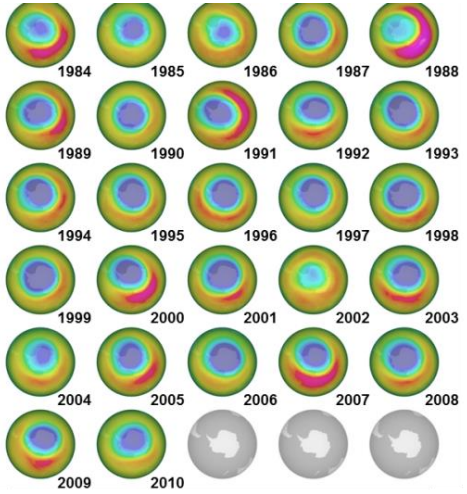
Surface fluxes:

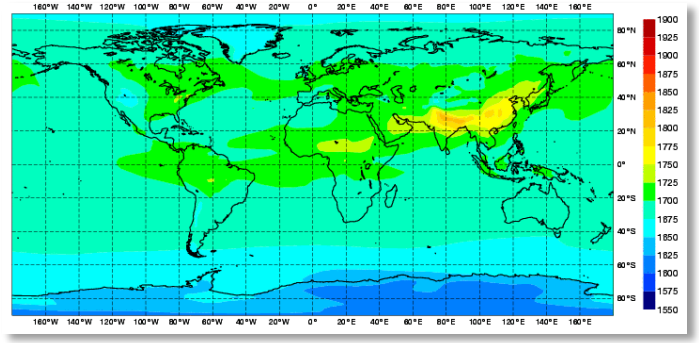
greenhouse gases, fires, emissions (GFAS, MACCity, MACC/TNO)



Radiation and ozone layer

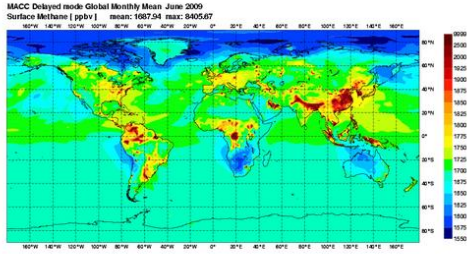






Flux inversion delayed-mode of global methane - Atmospheric concentrations

Description: This data provides CH4 atmospheric concentrations based on the estimated surface fluxes in a delayed-mode, based on air mole fraction records from CH4 records from NOAA/ESRL.

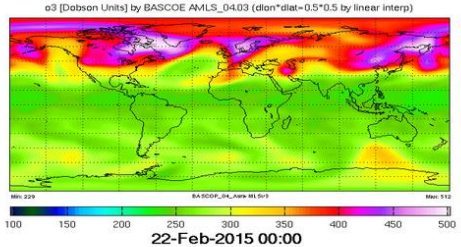


Service type:	Climate forcing; Air quality and atmospheric composition	**Vertical coordinate:**	Potential temperature; Potential vorticity; Model; Surface; Pressure
Product family:	Greenhouse gas	**Time resolution:**	Monthly
Parameter:	CH4	**Data type:**	Analysis
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Pre-operational

Links: Data access Documentation Contact us XML

BASCOE NRT global stratospheric analyses

Description: Analyses of stratospheric species using MLS observations in the BASCOE data assimilation system

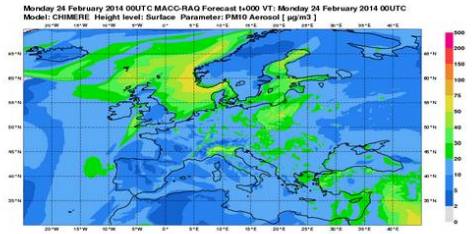


Service type:	Ozone and Ultraviolet radiation	**Vertical coordinate:**	Model
Product family:	Reactive gas	**Time resolution:**	3-hourly
Parameter:	N2O; HNO3; HOCl; O3; H2O; HCl	**Data type:**	Analysis
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Pre-operational

Links: Plots Data access Contact us XML

European-scale AQ PM10 forecast by CHIMERE

Description: This service provides pre-operational European-scale air quality PM10 forecasts for every hour up to 4 days in advance provided by the CHIMERE model. The maps provided are only representative for large scale phenomena, they cannot reproduce local aspects of air pollution.

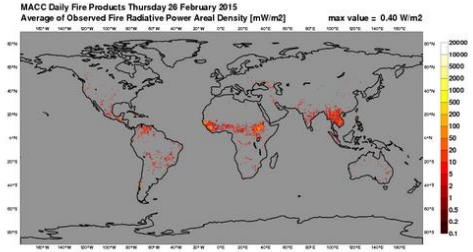


Service type:	Air quality and atmospheric composition	**Vertical coordinate:**	500 m; Surface; 3000 m; 1000 m
Product family:	Aerosol	**Time resolution:**	Hourly
Parameter:	PM10	**Data type:**	Forecast
Geographical area:	Europe (-25, 45, 30, 70)	**Service status:**	Pre-operational

Links: Plots Data access Verification results Documentation Contact us XML

NRT Biomass burning emissions of carbon and various trace species based on assimilated Fire Radiative Power (FRP) (GFAS)

Description: This service provides daily biomass burning emissions of various aerosol, greenhouse gas, and chemical species based on Fire radiative Power (FRP) satellite observations

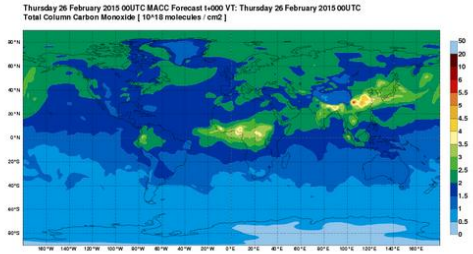


Service type:	Emissions and fluxes	**Vertical coordinate:**	Surface
Product family:	Fire; Reactive gas; Greenhouse gas; Aerosol	**Time resolution:**	Daily
Parameter:	Fire Radiative Power	**Data type:**	Analysis
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Pre-operational

Links: Plots Data access Contact us XML

C-IFS-TM5 NRT analyses of global carbon monoxide

Description: This service provides pre-operational daily analyses of carbon monoxide using the C-IFS-TM5 model.

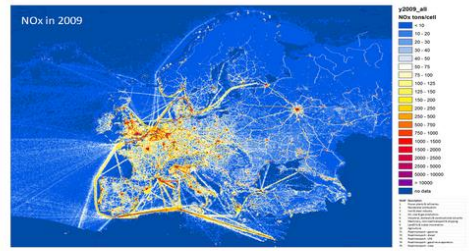


Service type:	Air quality and atmospheric composition	**Vertical coordinate:**	Potential vorticity; Potential temperature; Model; Surface; Pressure
Product family:	Reactive gas	**Time resolution:**	6-hourly
Parameter:	CO	**Data type:**	Analysis
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Pre-operational

Links: Plots Data access Verification results Validation reports Documentation Contact us XML

TNO-MACC-II European anthropogenic emissions

Description: This services provides anthropogenic emissions for various chemical species for the European domain.

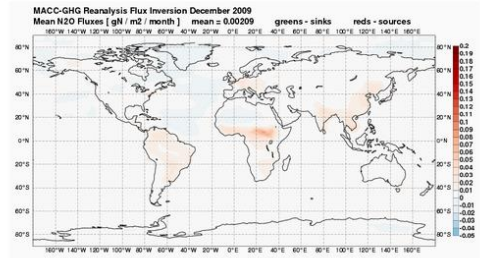


Service type:	Emissions and fluxes	**Vertical coordinate:**	Surface
Product family:	Reactive gas; Greenhouse gas; Aerosol	**Time resolution:**	Monthly
Parameter:	NOx; SO2; PM2.5; PM10; CH4; NH3; CO; NMVOCs	**Data type:**	Analysis
Geographical area:	Europe (-25, 45, 30, 70)	**Service status:**	Pre-operational

Links: Plots Data access Contact us XML

Flux inversion reanalysis fluxes of global nitrous oxide - Fluxes

Description: This data provides N2O surface fluxes over 12 years, from 1998 to 2009, at 3.75degree x 2.5degree (longitude-latitude) and monthly resolution, based on air mole fraction records from 70 N2O sites plus ship-based and ocean mooring records from NOAA/ESRL, AGAGE, CSIRO, NIES, and Tohoku University.

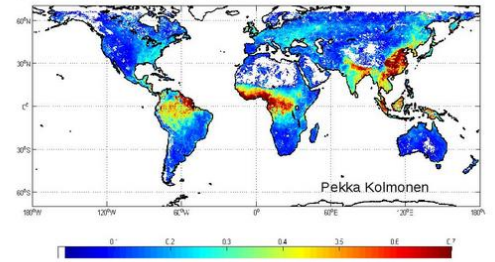


Service type:	Climate forcing; Emissions and fluxes	**Vertical coordinate:**	Surface
Product family:	Greenhouse gas	**Time resolution:**	Monthly
Parameter:	N2O	**Data type:**	Reanalysis
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Pre-operational

Links: Plots Data access Contact us XML

ATSR-DV global aerosol

Description: Aerosol optical depth (AOD) retrievals at 555nm from AATSR on ENVISAT

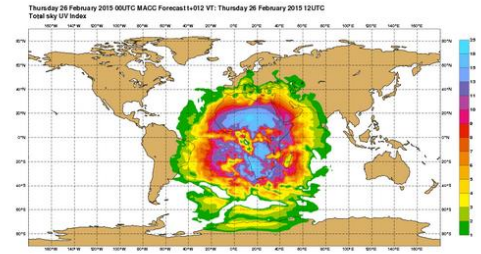


Service type:	Air quality and atmospheric composition	**Vertical coordinate:**	Column
Product family:	Aerosol	**Time resolution:**	Daily
Parameter:	Total AOD	**Data type:**	Observations
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Experimental

Links: Plots Data access Contact us XML

Global solar UV index forecast

Description: This service provides pre-operational daily forecasts up to 5 days for the total sky and clear sky UV index.



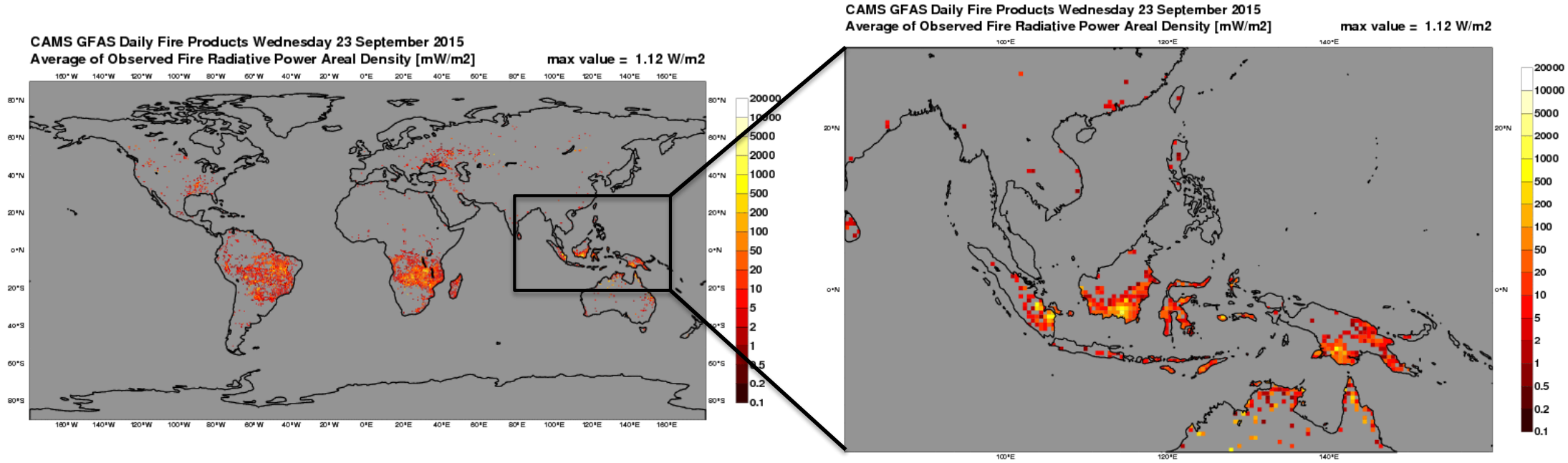
Service type:	Ozone and Ultraviolet radiation	**Vertical coordinate:**	
Product family:	Radiation; Reactive gas; Aerosol	**Time resolution:**	3-hourly
Parameter:	UV index	**Data type:**	Forecast
Geographical area:	Global (-180, 180, -90, 90)	**Service status:**	Pre-operational

Links: Plots Data access Contact us XML

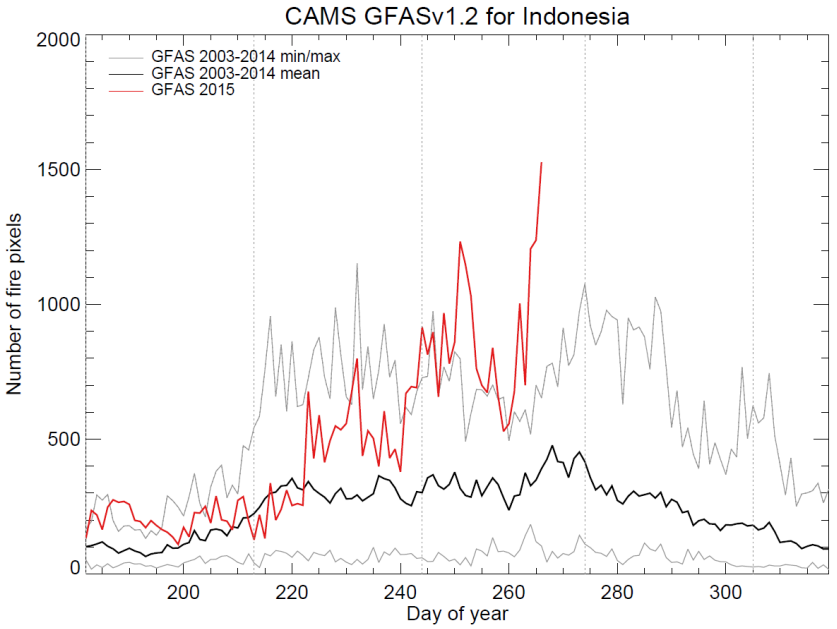
Examples

Fire emissions monitoring

Mark Parrington

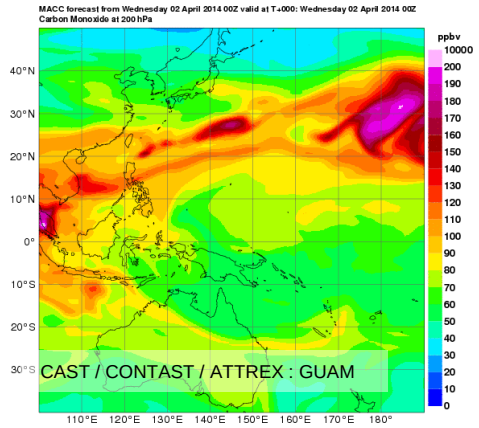


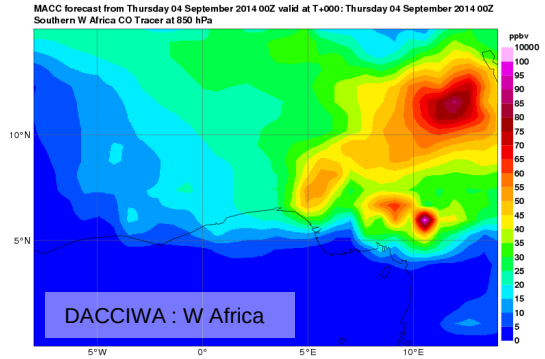
- CAMS Global Fire Assimilation System (GFAS) provides NRT information on the location and intensity of forest fire emissions.
- Daily maps show the distribution of most recent fire activity globally and by region.
- Routine plots of time series show context related to current and historic fire seasons (e.g., 2015 fire season in Indonesia).

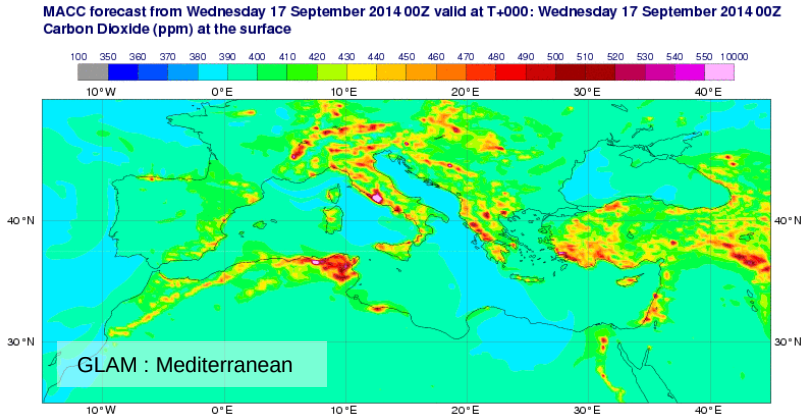


Field-Campaign Support

- CAMS supports scientific field-campaigns with custom-generated plots published on the web
- They fill in a questionnaire to specify required domain, parameters, levels, cross-sections, colour-schemes, etc.
- Recent campaigns:
  - CAST/CONTRAST/ATTREX (Co-ordinated Airborne Studies in the Tropics / CONvective TRansport of Active Species in the Tropics / Airborne Tropical TRopopause EXperiment)
  - DACCIWA (Dynamics-Aerosol-Chemistry-Cloud Interactions in West Africa)
  - GLAM (Gradient in Longitude of Atmospheric constituents above the Mediterranean basin)
- Very good feedback from the campaigns



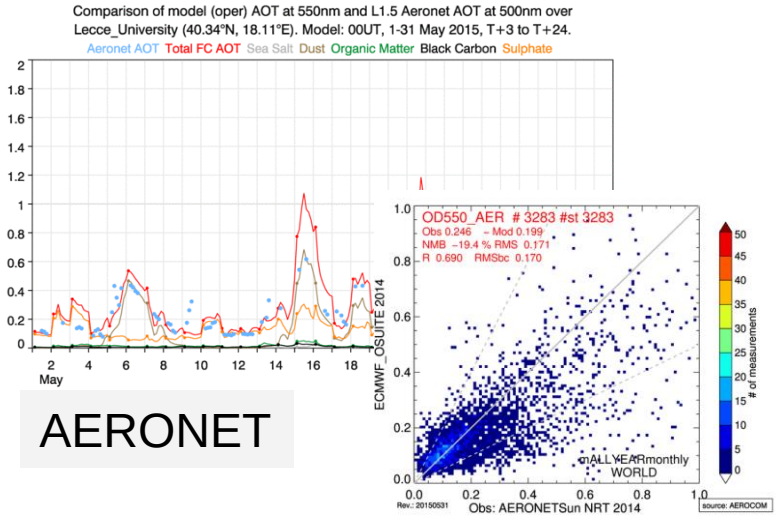




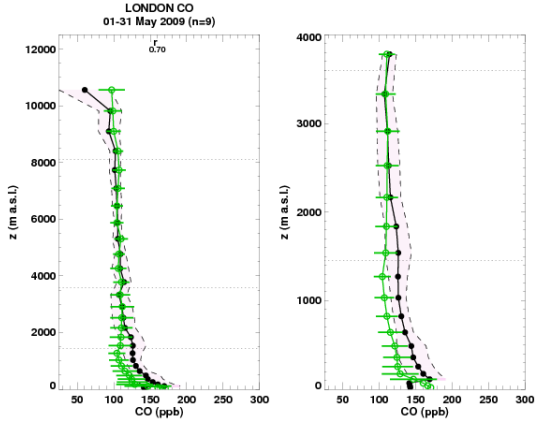
Luke Jones

Evaluation examples

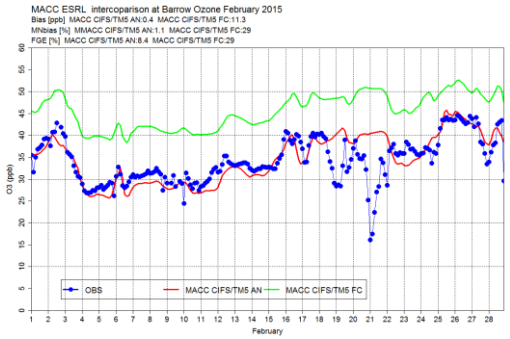
AERONET



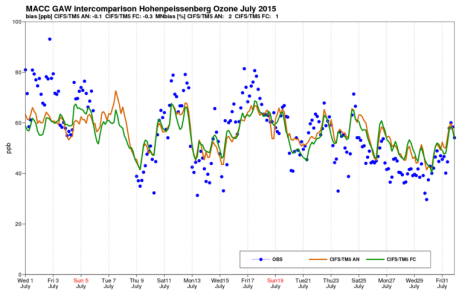
IAGOS



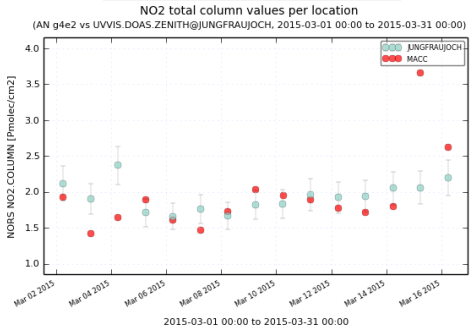
ESRL



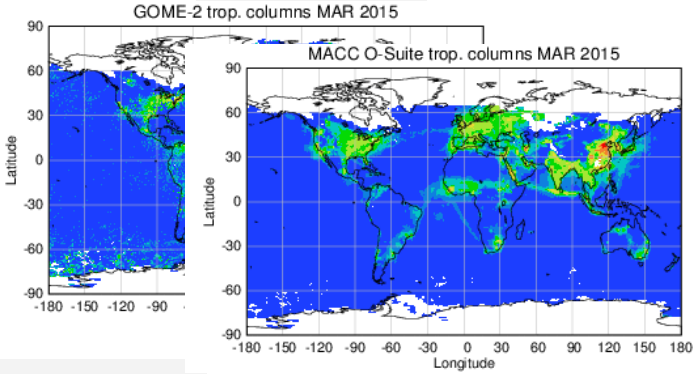
GAW



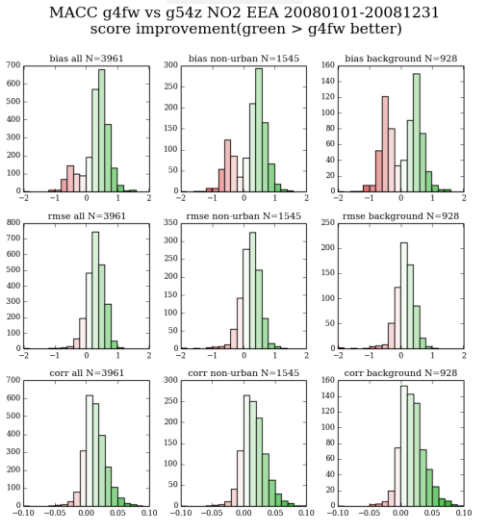
MAX-DOAS



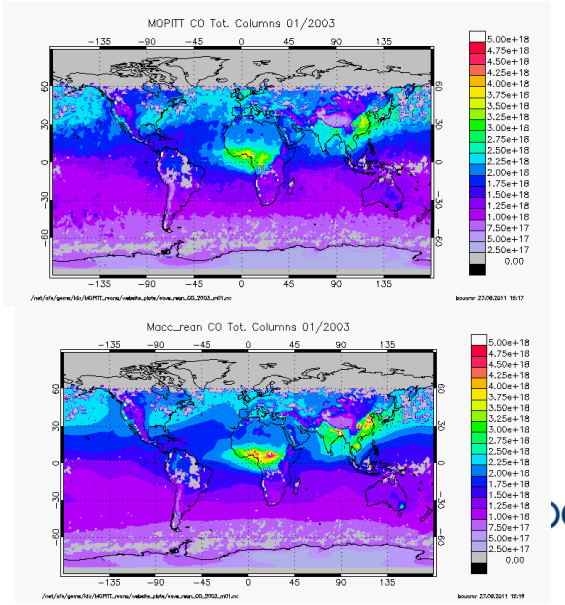
GOME-2



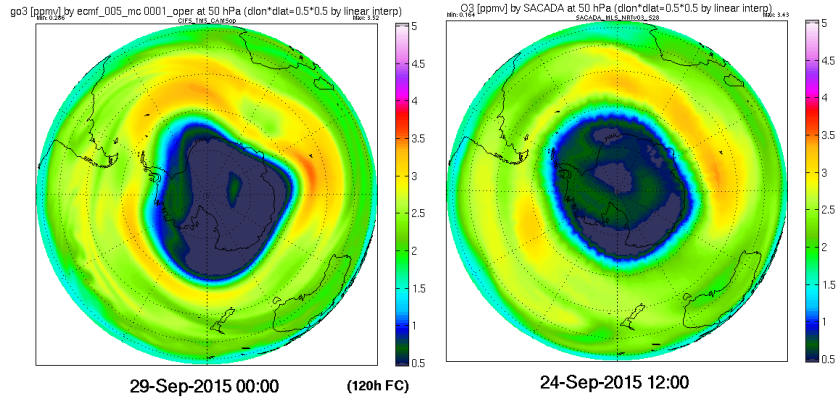
EEA



MOPITT



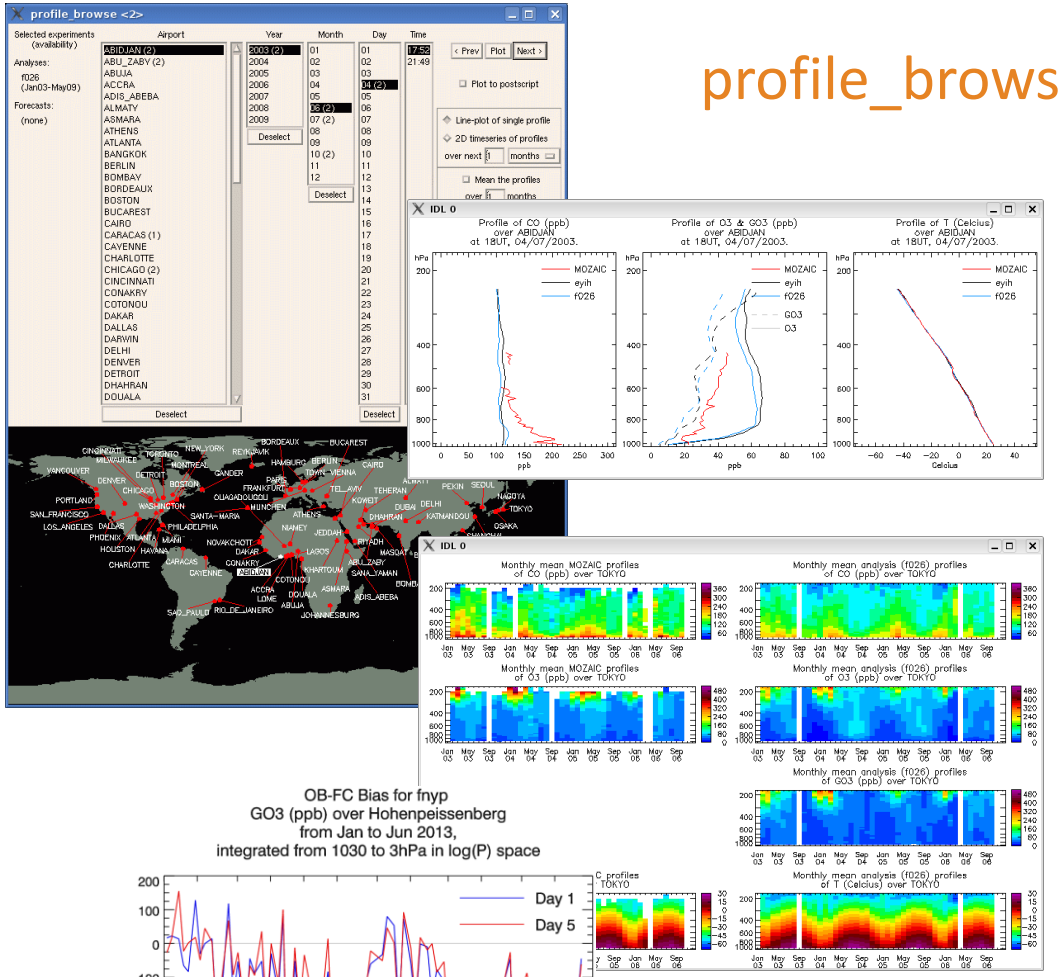
SACADA



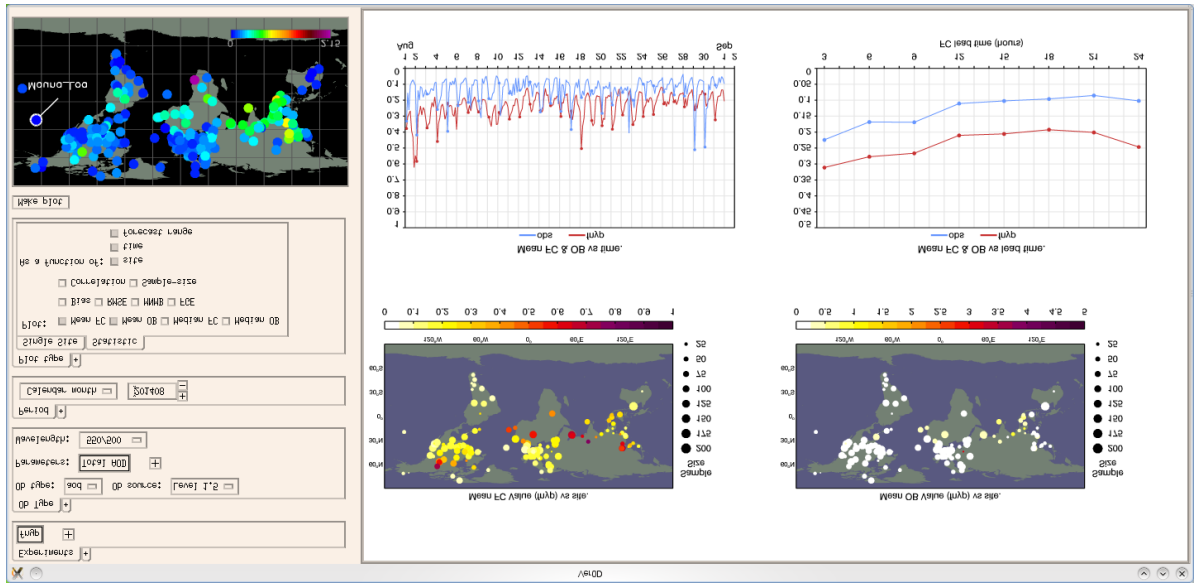
Custom data analysis tools

Luke Jones

profile_browse



Ver0D Graphical User Interface



High resolution atmospheric CO_2 forecast

CO_2 INITIAL CONDITIONS

NRT atm. CO_2 analysis

CO_2 SURFACE FLUXES

Vegetation fluxes + flux adjustment (CTESSEL)

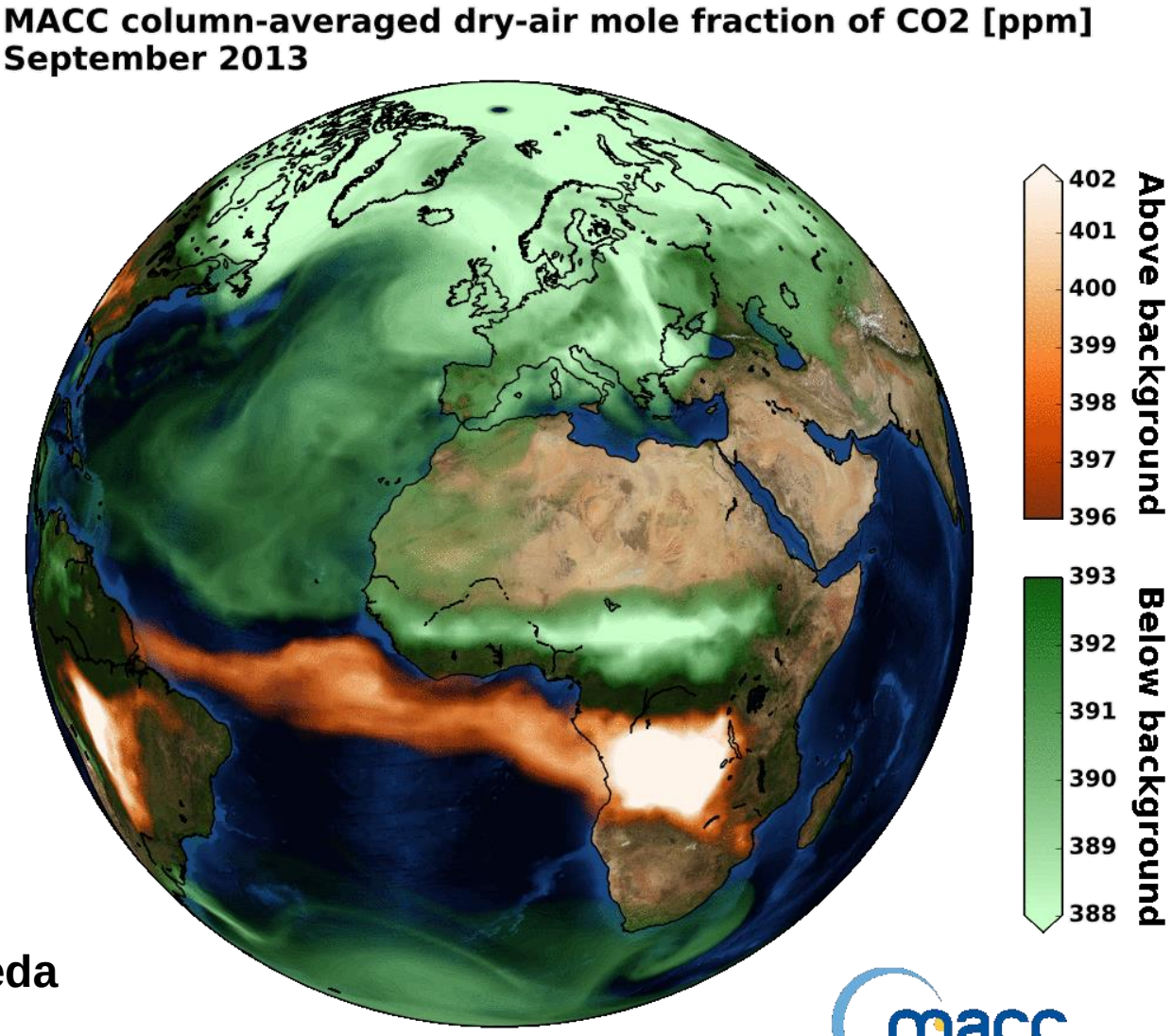
Fires (GFAS)

Ocean (inventory)

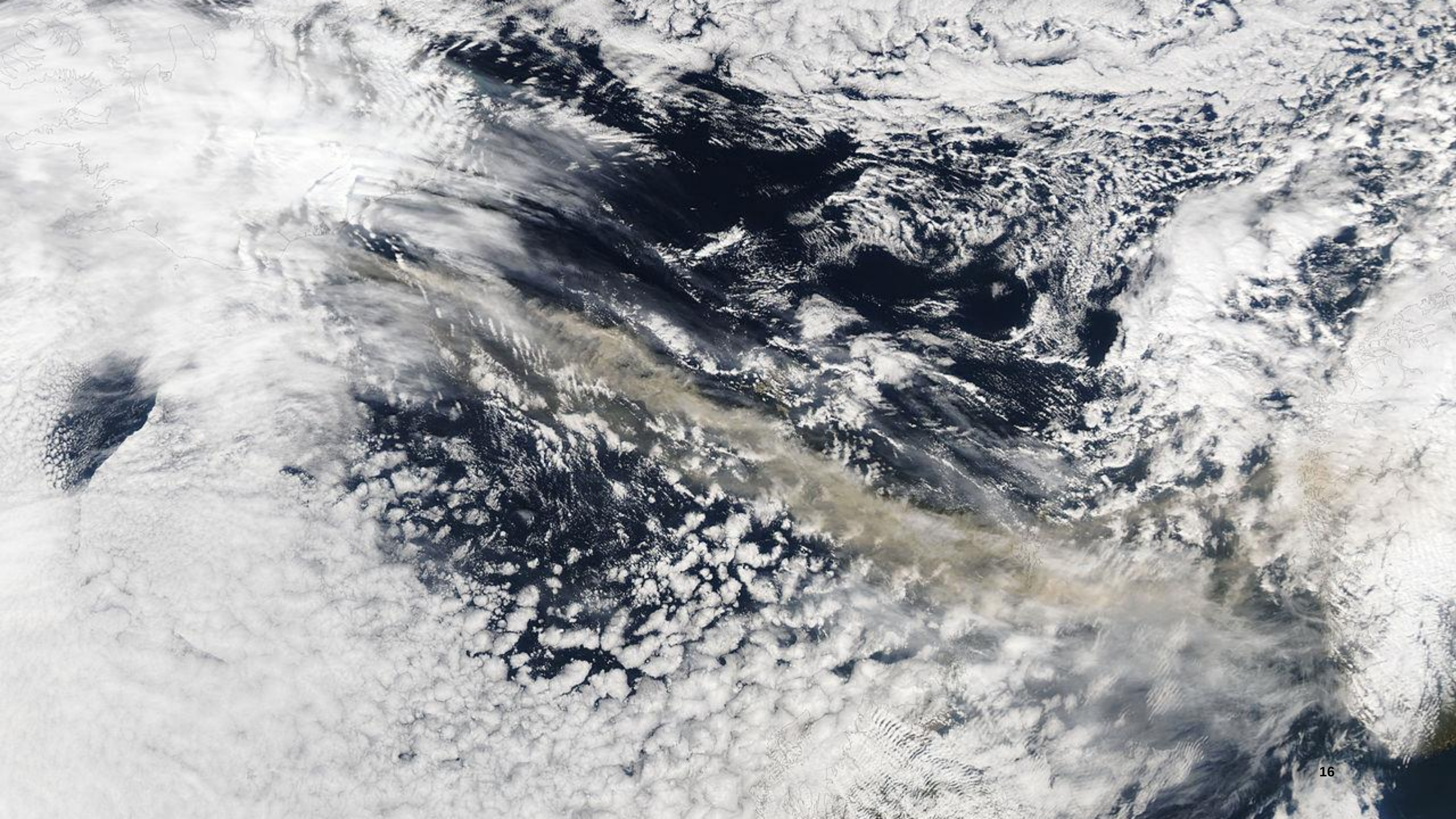
Anthropogenic (inventory)

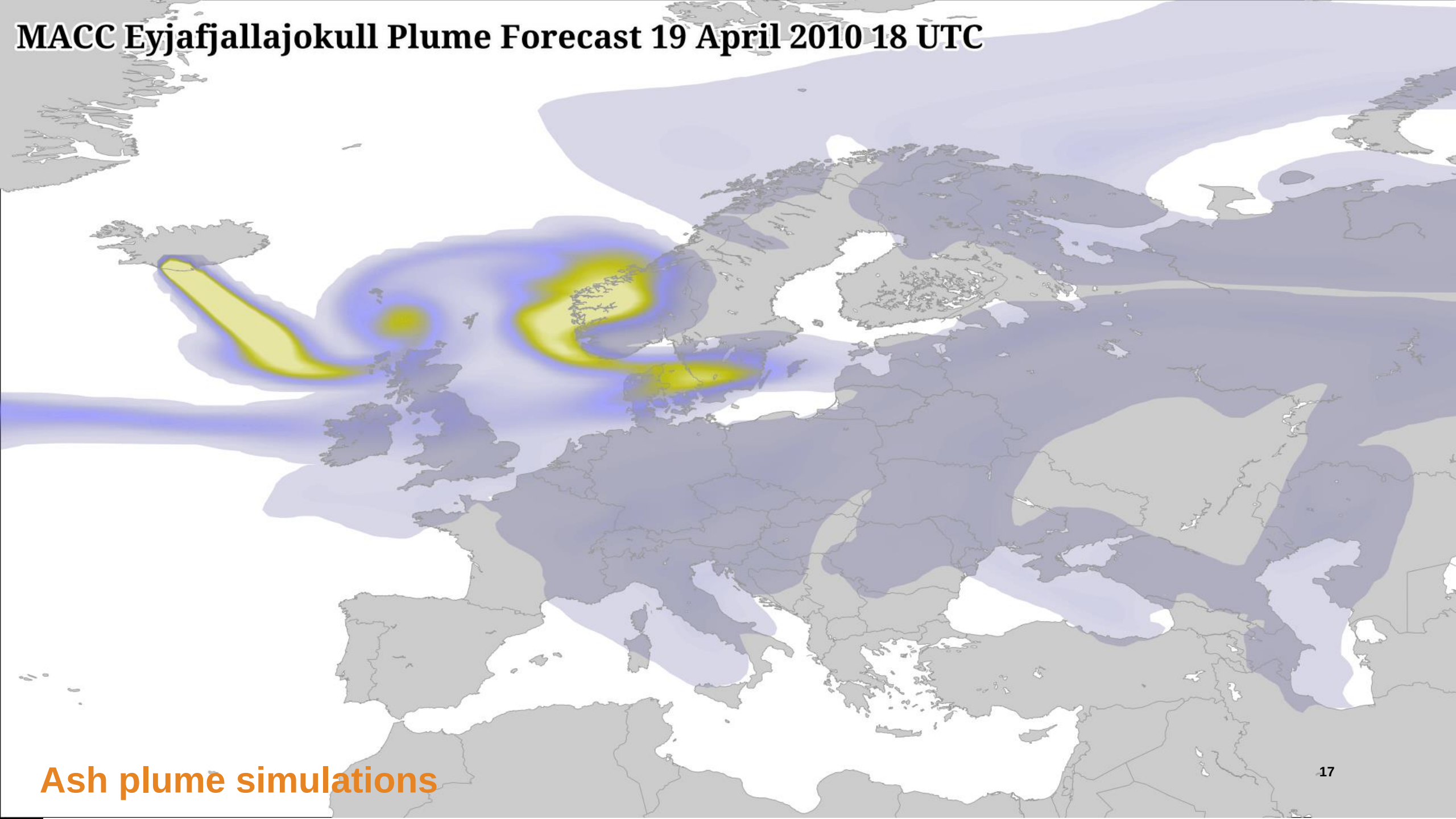
IFS TRANSPORT

At weather forecast resolution (16km,L137)



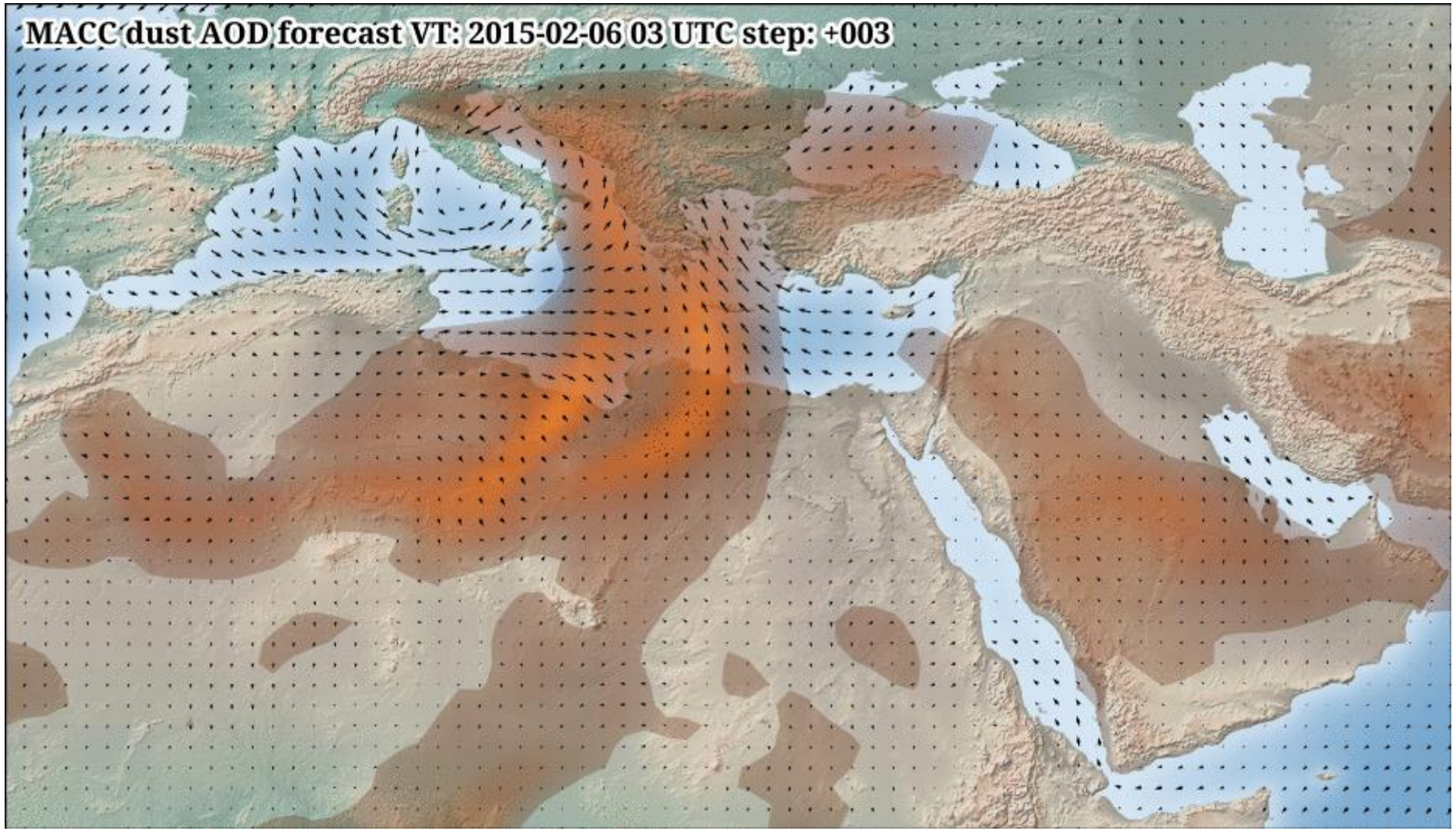
Anna Agusti-Panareda
Sebastien Massart



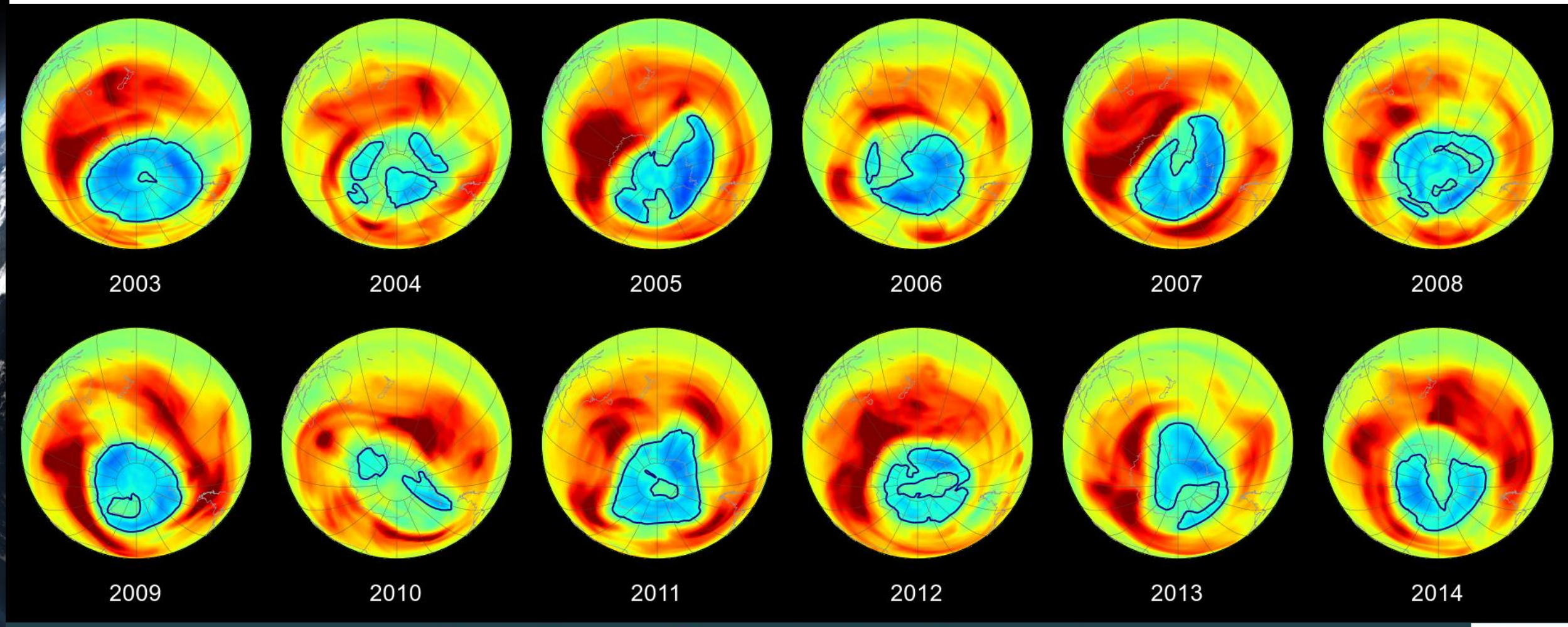


Ash plume simulations

Forecasting dust storms



Ozone hole reanalysis



Thank you

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