2024 European Polar Science week

Copernicus Atmosphere Monitoring Service (CAMS)

Laurence ROUIL

Atmosphere Monitoring

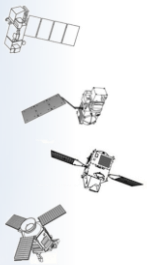
PROGRAMME OF THE EUROPEAN UNION

Copernicus Europe's eyes on Earth

IMPLEMENTED BY ECMWF

CAMS: A UNIQUE INTEGRATED SYSTEM…

Atmosphere Monitoring

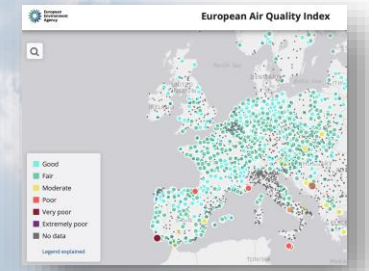


Earth Observation

from satellite (>90 instruments)

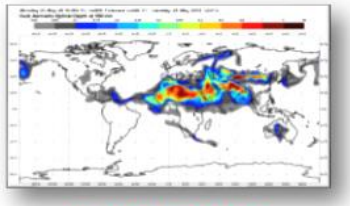
In-situ networks

(regulatory and research)



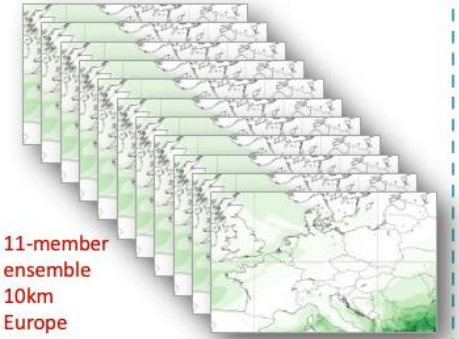
Instrument	Satellite	Space Agency	Provider	Species	Status
AATSR	ENVISAT	ESA	ESA	AOD	REA(A)
AHI	Himawari-8	JMA	JMA	FRP	GFAS(P)
GOME-2	METOP-B, -C/ METOP-B, -C/ METOP-A/ METOP-A, -B	EUMETSAT-ESA	AC-SAF	O_3, NO_2, SO_2/ HCHO/ O_3, NO_2, SO_2, HCHO/ O_3, NO_2	GRTF(A)/ GRTF(M)/ GRTF(M)/ REA(A)
IASI	METOP-B, -C/ METOP-A/ METOP-A, -B, -C/ METOP-A, -B/ METOP-A, -B/ METOP-A, -B	EUMETSAT-CNES/ -/-/-/-/EUMETSAT	AC-SAF/AC-SAF/ULB-LATMOS/LMD/LMD/ EUMETSAT	CO/CO/O_3, SO_2/ CH_4/CO_2/CH_4, CO_2	GRTF(A)/ GRTF(M)/ GRTF(P)/ GDM(A)/ GDM(P) / REA(A)
Imager	GOES-E, -W	NOAA	NOAA	FRP	GFAS(P)
MIPAS	ENVISAT	ESA	ESA	O_3 profile	REA(A)
MLS	EOS-Aura	NASA	NASA	O_3 profile	GRTF(A)/REA(A)
MODIS	EOS-Aqua, -Terra	NASA	NASA	AOD/AOD/FRP	GRTF(A)/ REA(A)/ GFAS(A)
MOPITT	EOS-Terra	NASA	NCAR	CO	GRTF(A)/ REA(A)
OCO-2	OCO-2	NASA	NASA	CO_2	GDM(P)/ GHGI(A)
OMI	EOS-Aura	NASA	KNMI	O_3, NO_2, SO_2/ O_3, NO_2	GRTF(A)/ REA(A)
OMPS	S-NPP, NOAA-20	NOAA	EUMETSAT	O_3	GRTF(A)
PMAp	METOP-A, -B/ METOP-C	EUMETSAT	EUMETSAT	AOD	GRTF(A)/ GRTF(M)
SBUV-2	NOAA-19/ NOAA-14, -16, -17, -18 and -19	NOAA	NOAA	O_3 profile	GRTF(M)/ REA(A)
SCIAMACHY	ENVISAT	ESA	KNMI	O_3, NO_2, CH_4, CO_2	REA(A)
SEVIRI	MSG	EUMETSAT	ICARE/ EUMETSAT	AOD/FRP	GRTF(P)/ GFAS(P)
SLSTR	Sentinel-3	ESA-EUMETSAT	EUMETSAT	AOD/FRP	GRTF(P)/ GFAS(P)
TANSO	GOSAT	JAXA	SRON/ Uni. Bremen/ SRON-Uni. Bremen/SRON	CH_4/ CO_2/ CH_4, CO_2/CH_4	GDM(A)/ GDM(A)/ REA(A) GHGI(A)
TROPOMI	Sentinel-5p	ESA-NSO	ESA-KNMI-DLR-/ ESA-KNMI-SRON-DLR	O_3, SO_2 /NO_2, CO, HCHO/ CH_4	GRTF(A)/ GRTF(M)/ GDM(P)
VIIRS	S-NPP, NOAA-20	NASA-NOAA	EUMETSAT	AOD	GRTF(P)

Global and European forecasts, analyses and reanalyses of GHG, reactive gas and aerosols

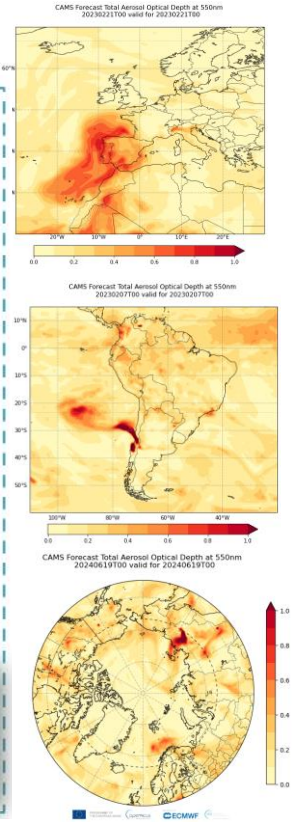


IFS 40km (oper) Globe

CAMS main operational data assimilation and modelling systems



= Europe's eyes on Earth



Monitoring wildfires and forecasting

Atmosphere Monitoring

Global Fire Assimilation System (**GFAS**); http://apps.ecmwf.int/datasets/data/cams-gfas/
Uses satellite observations of Fire Radiative Power (FRP)

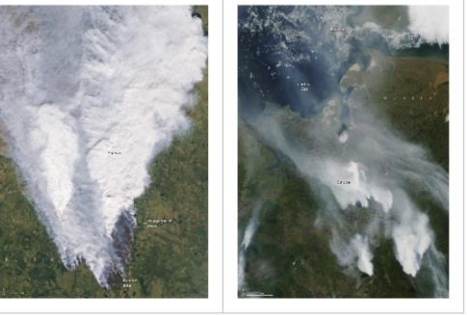
- Currently Aqua and Terra MODIS and VIIRS FRP observations
- Sentinel-3, and geostationary satellites are being tested for future implementation

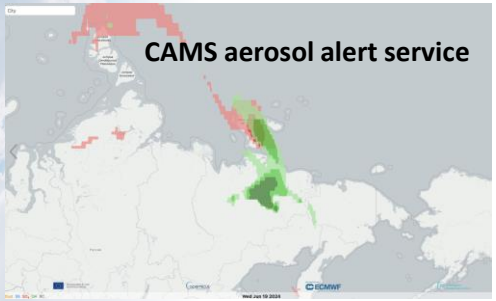
Global Coverage at ~10km Resolution

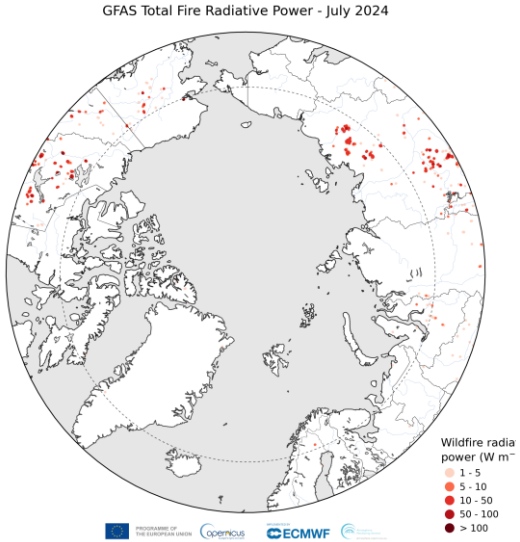
Daily Output: 1-day behind NRT

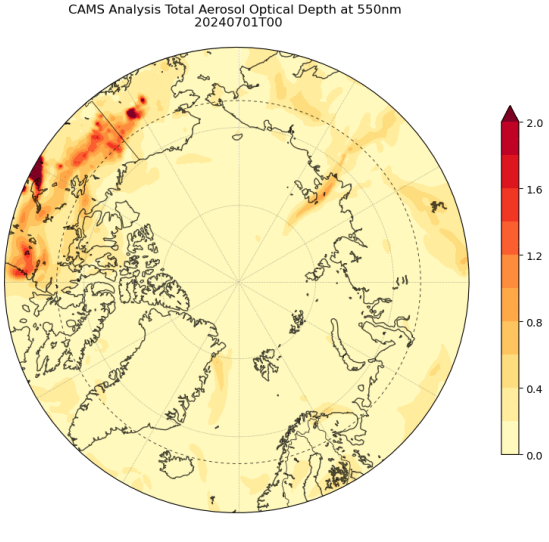
Hourly Output (+24-h means): 7-hours behind NRT

Emissions of aerosols and gases are estimated using factors dependent on vegetation type.
Injection heights calculated with Plume Rise Model and IS4FIRES









Carbon and air pollutants emissions

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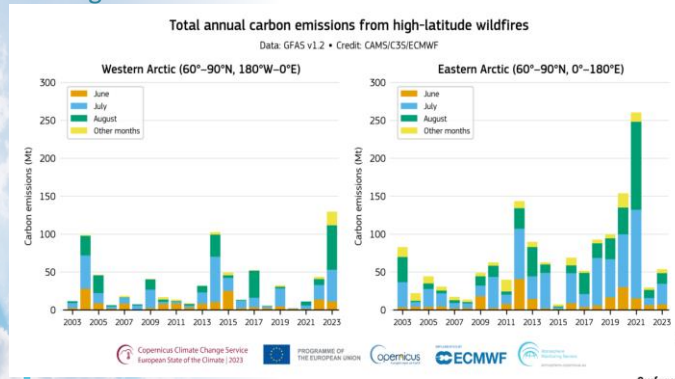
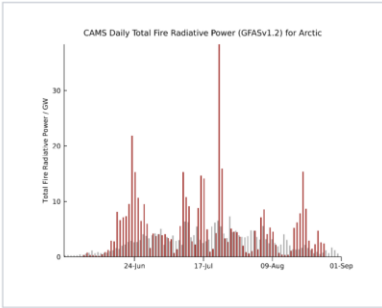
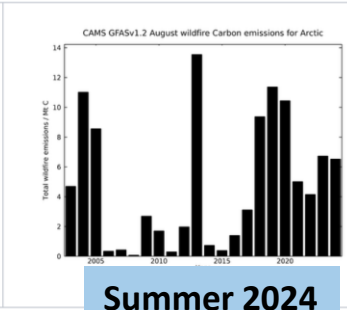
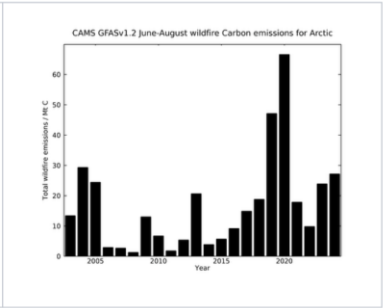
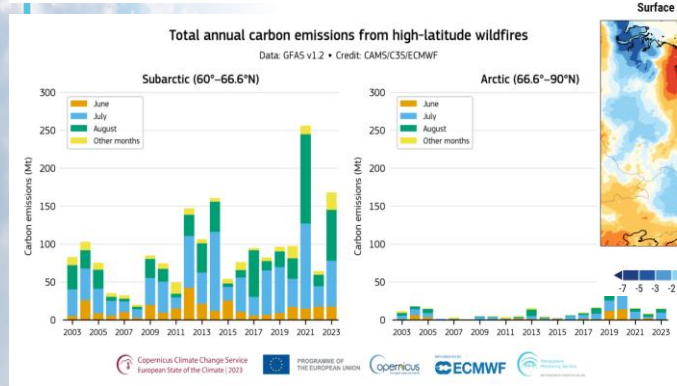


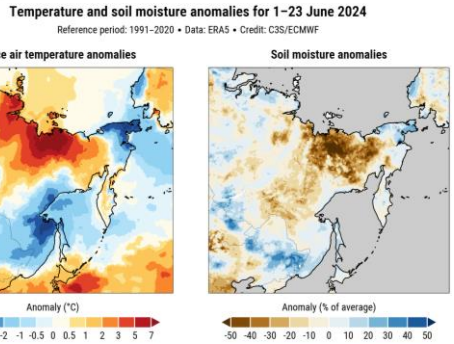


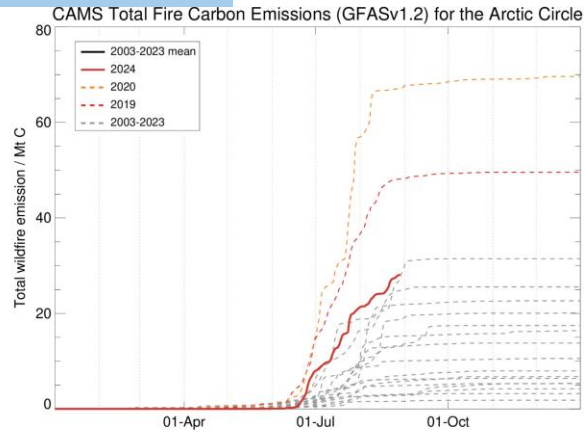




Summer 2024







2023 Carbon emissions from the Arctic regions
(source: 2023 European State of Climate report)

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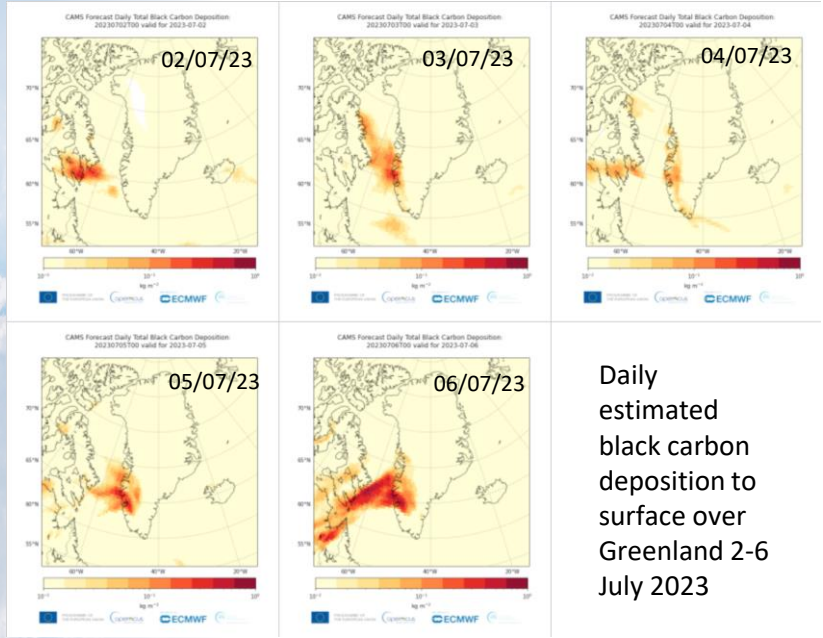
Assessing impacts on BC deposition and air quality

Atmosphere Monitoring



Daily estimated black carbon deposition to surface over Greenland 2-6 July 2023

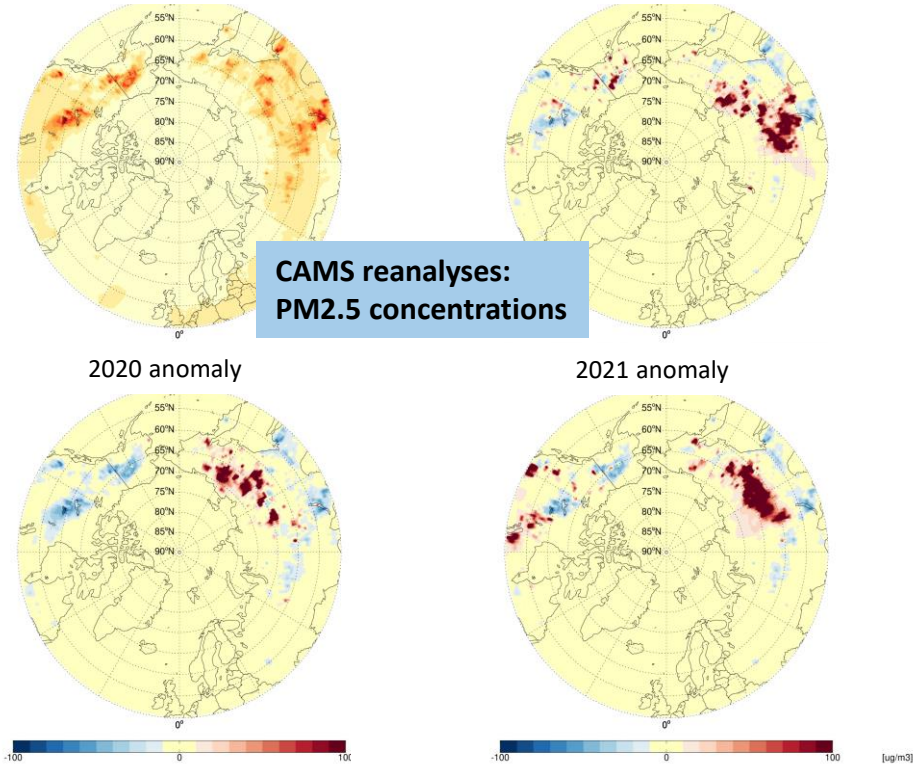
2003-2018 climatology

2019 anomaly

CAMS reanalyses: PM2.5 concentrations

2020 anomaly

2021 anomaly



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Evaluation of CAMS global products against in-situ data

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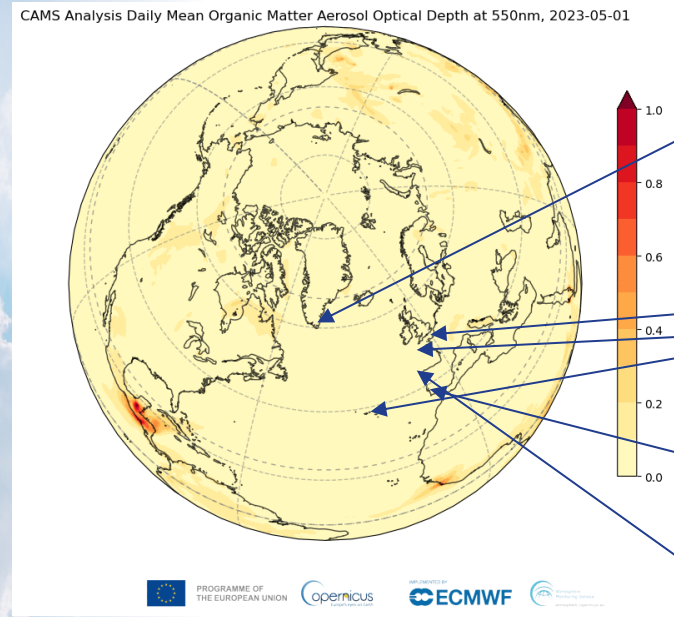

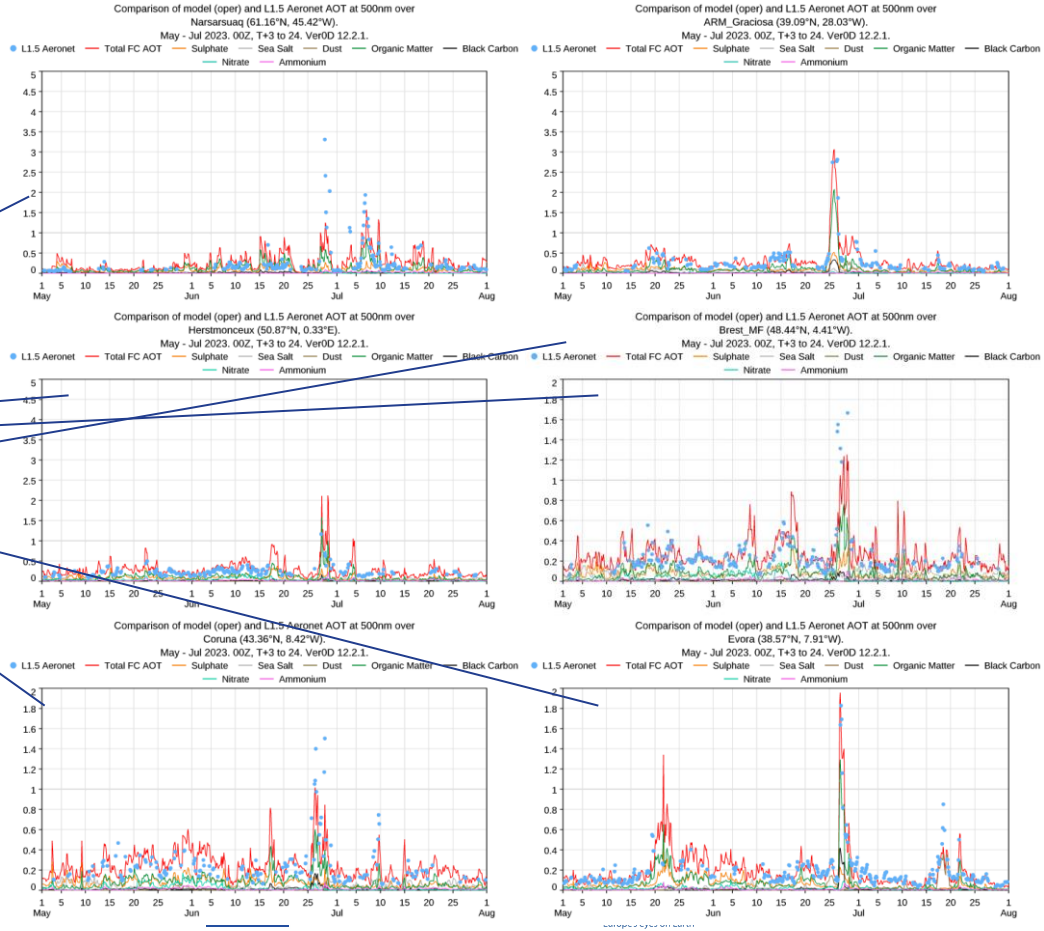

Monitoring stratospheric ozone

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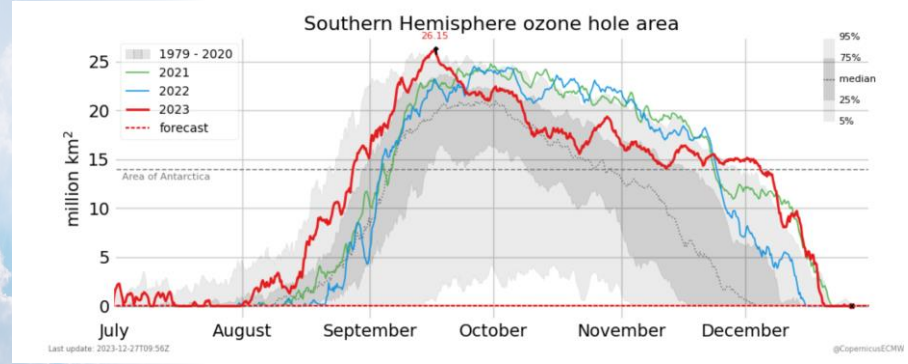
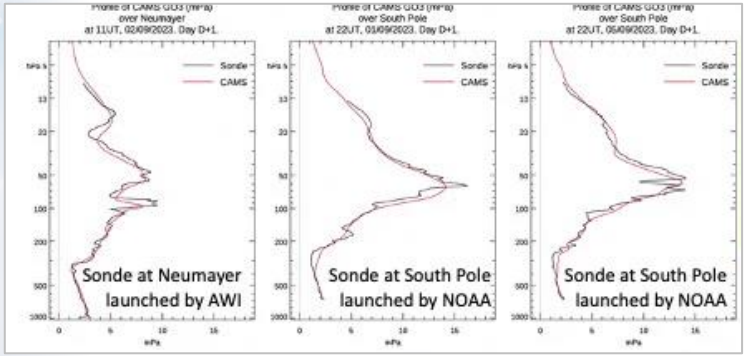
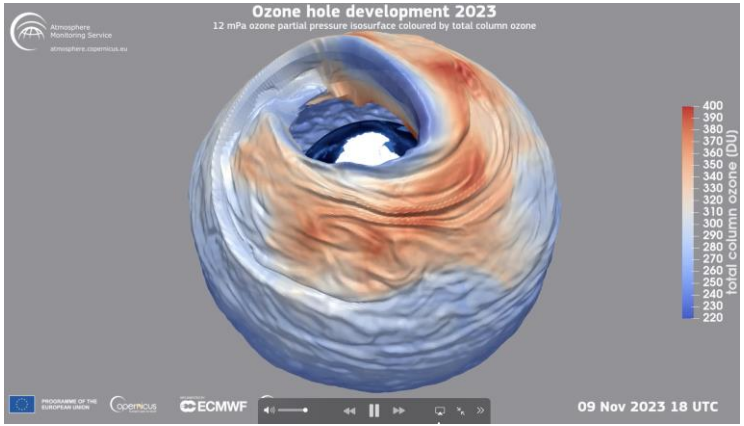
- In 2023, CAMS updated the global modeling system based on IFS (ECMWF) with a new stratospheric chemistry scheme including 57 species.







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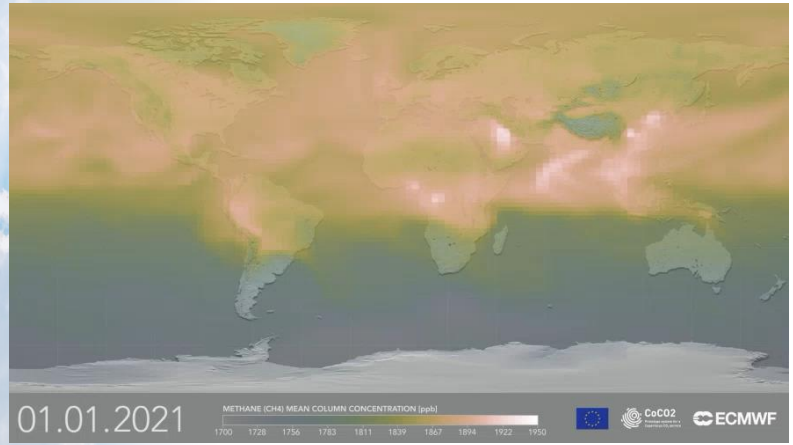
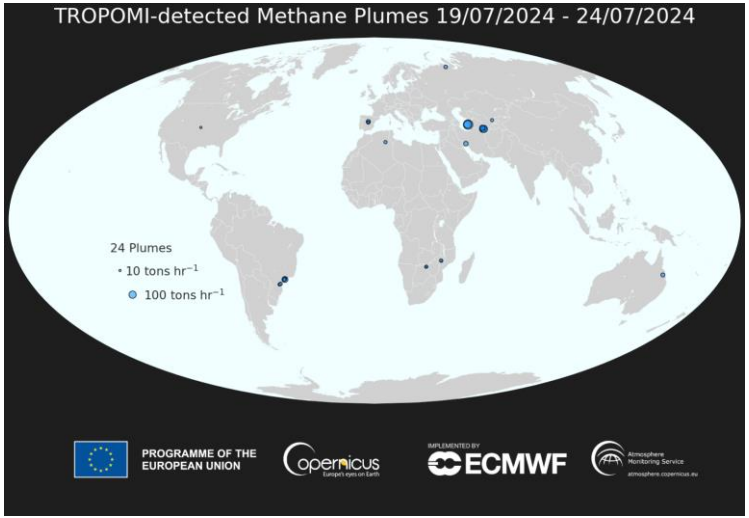
Methane: towards operational monitoring and verification support

- Will expand with the CO2MVS component supported by upcoming space missions



The Horizon Europe CoCO2 project provided key datasets to simulate the variability of CO2, CH4, and CO to support the preparations for the CO2M and Sentinel-5 missions.



New contract (June 2024) with SRON (NL)

Atmosphere Monitoring

Conclusions

- Wildfires, black carbon and air pollutants, stratospheric ozone, methane emissions and fluxes are monitored and forecasted by CAMS with relevant applications for the polar regions.

- More can be done to improve the integrated systems and the service as highlighted in the Copernicus Polar roadmap:
  - Earth observations with optimised spatial and temporal resolutions : FRP, AOD, CH4, CO2..
  - In-situ networks and observations: black carbon and PM, chemical speciation, deposition data ..
  - Historical and NRT datasets
  - Vegetation, peat, permafrost and land cover maps to improve modelling capacities
  - Data assimilation methods

Thank you for your attention!

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