Flux inversion capabilities in CAMS and related H2020 research projects

Atmosphere Monitoring

Richard Engelen
ECMWF

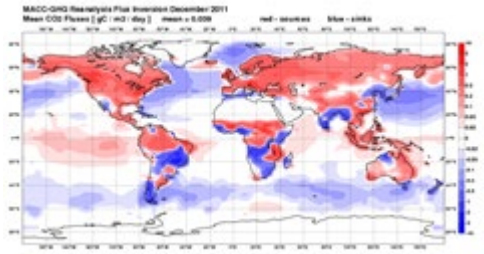
Copernicus Europe's eyes on Earth

European Commission

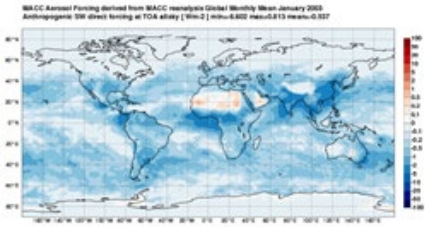
Copernicus Atmosphere Monitoring Service

Atmosphere Monitoring

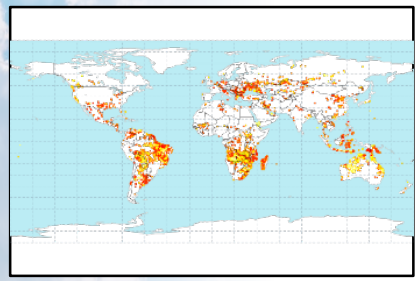
Greenhouse gas fluxes



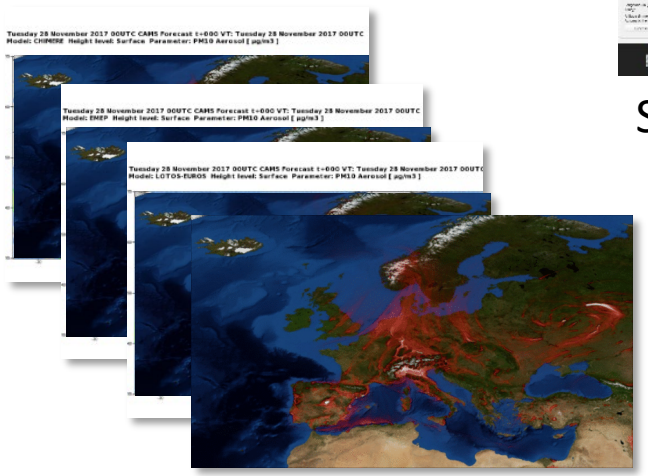
Radiative forcing

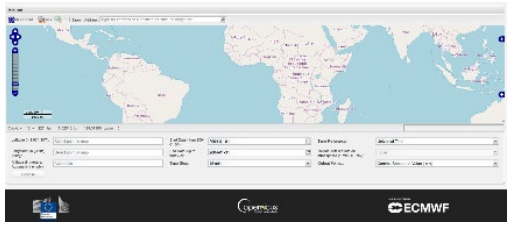


Fire emissions

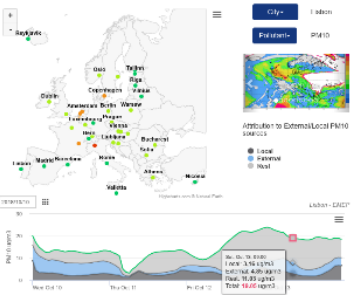


Global forecasts

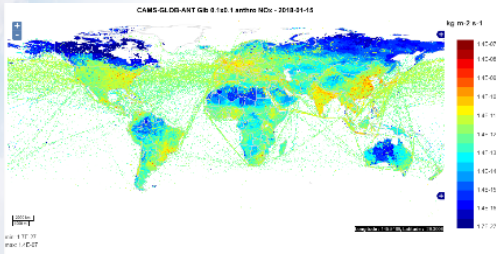




Solar radiation



Policy tools



Emissions

European forecasts

IMPLEMENTED BY ECMWF

Copernicus Europe's eyes on Earth

European Commission

Developing a new CAMS service element

Atmosphere Monitoring

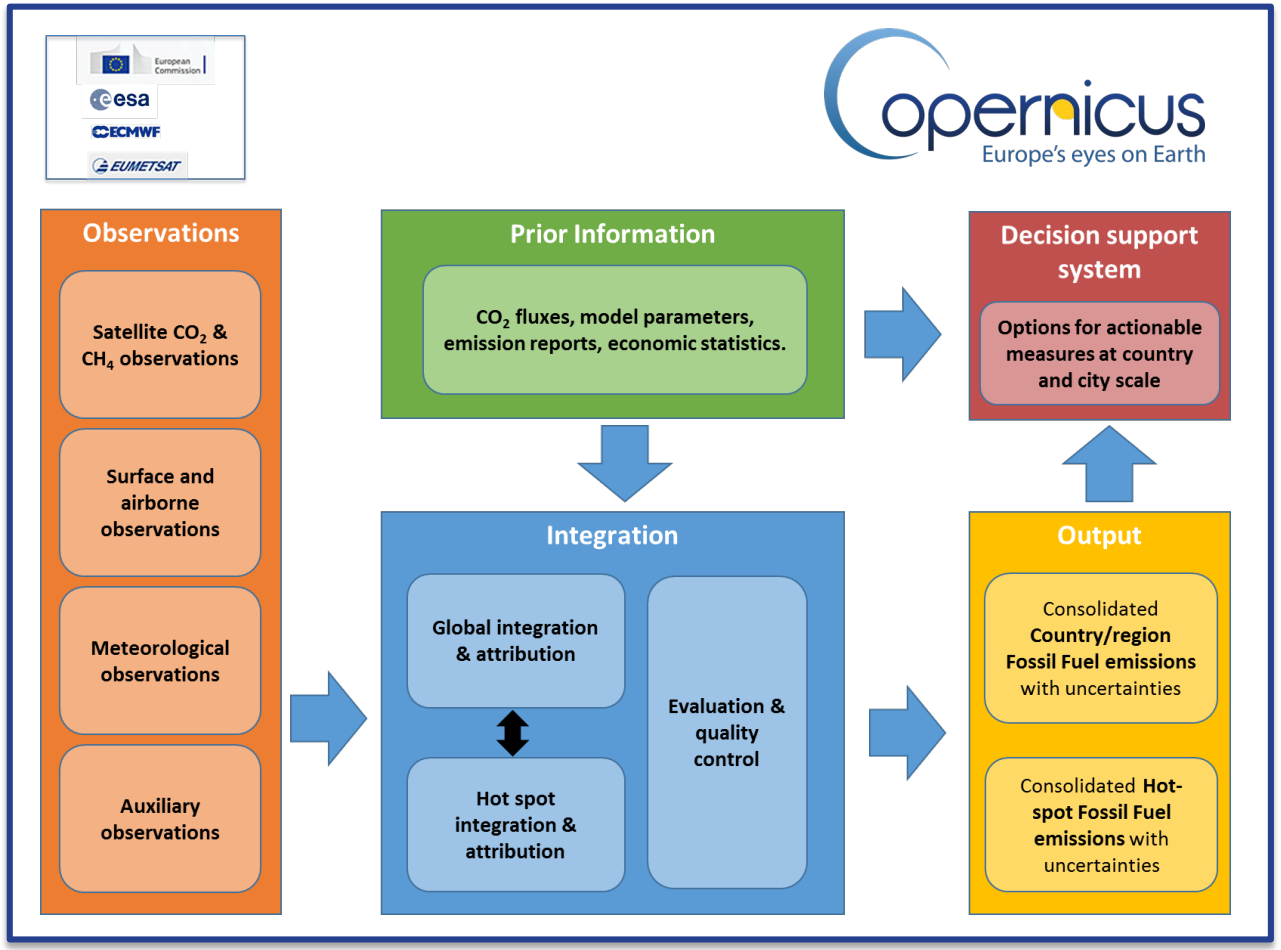
Copernicus anthropogenic CO_2 emissions monitoring & verification support capacity

Atmosphere Monitoring Service
atmosphere.copernicus.eu

Climate Change Service
climate.copernicus.eu

The European Commission plans a new Copernicus CO_2 service as part of CAMS.

Synergies with existing Copernicus services will be exploited, especially with CAMS plans for emissions estimation for CO and NO_2.



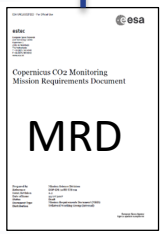
IMPLEMENTED BY ECMWF
Copernicus Europe's eyes on Earth
European Commission

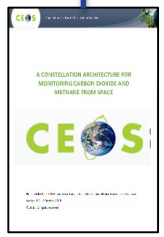
Roadmap

Atmosphere Monitoring

CO_2 Monitoring Task Force

2015 — 2018 — 2020 — 2022 — 2024 — 2026 — 2028





1st global stocktake

Launch of the CO_2 Sentinel constellation

2nd global stocktake

Prototyping activities including relevant CO_2 satellite missions from international space agencies

Copernicus service in full operations using CO_2 Sentinels and international virtual constellation

R&D Support Actions

CO_2 Human Emissions

VERIFY

CoCO2 Prototype system for a Copernicus CO_2 service

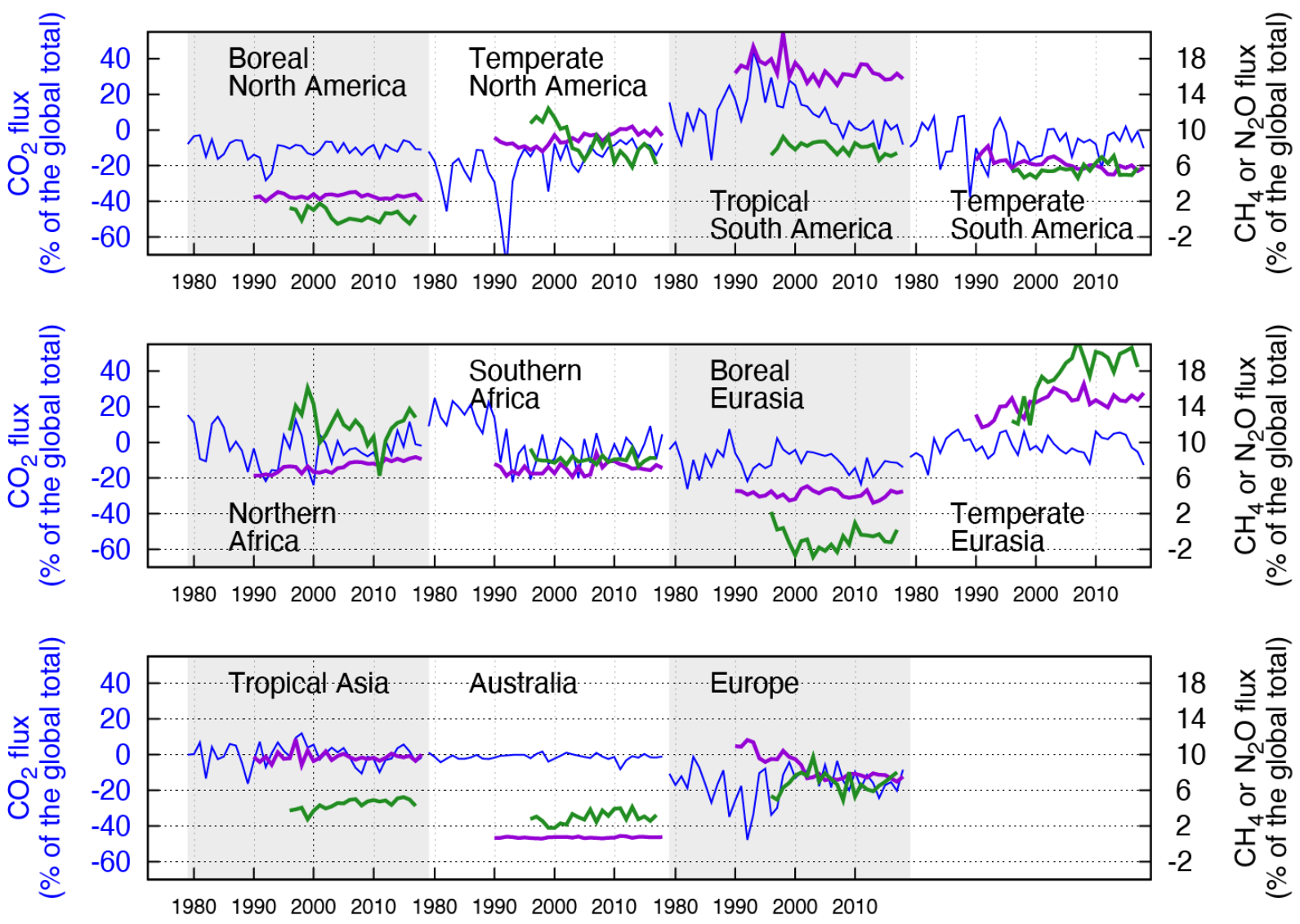
IMPLEMENTED BY ECMWF

Copernicus Europe's eyes on Earth

European Commission

CAMS global flux inversions (in situ)

Atmosphere Monitoring



Annual net CO_2 flux due to natural effects (vegetation and fires) over land (blue), and net fluxes of CH_4 (purple) and N_2O (green) associated with different regions of the globe.

Credit: Copernicus Atmosphere Monitoring Service (CAMS) /ECMWF /LSCE /TNO /NILU.

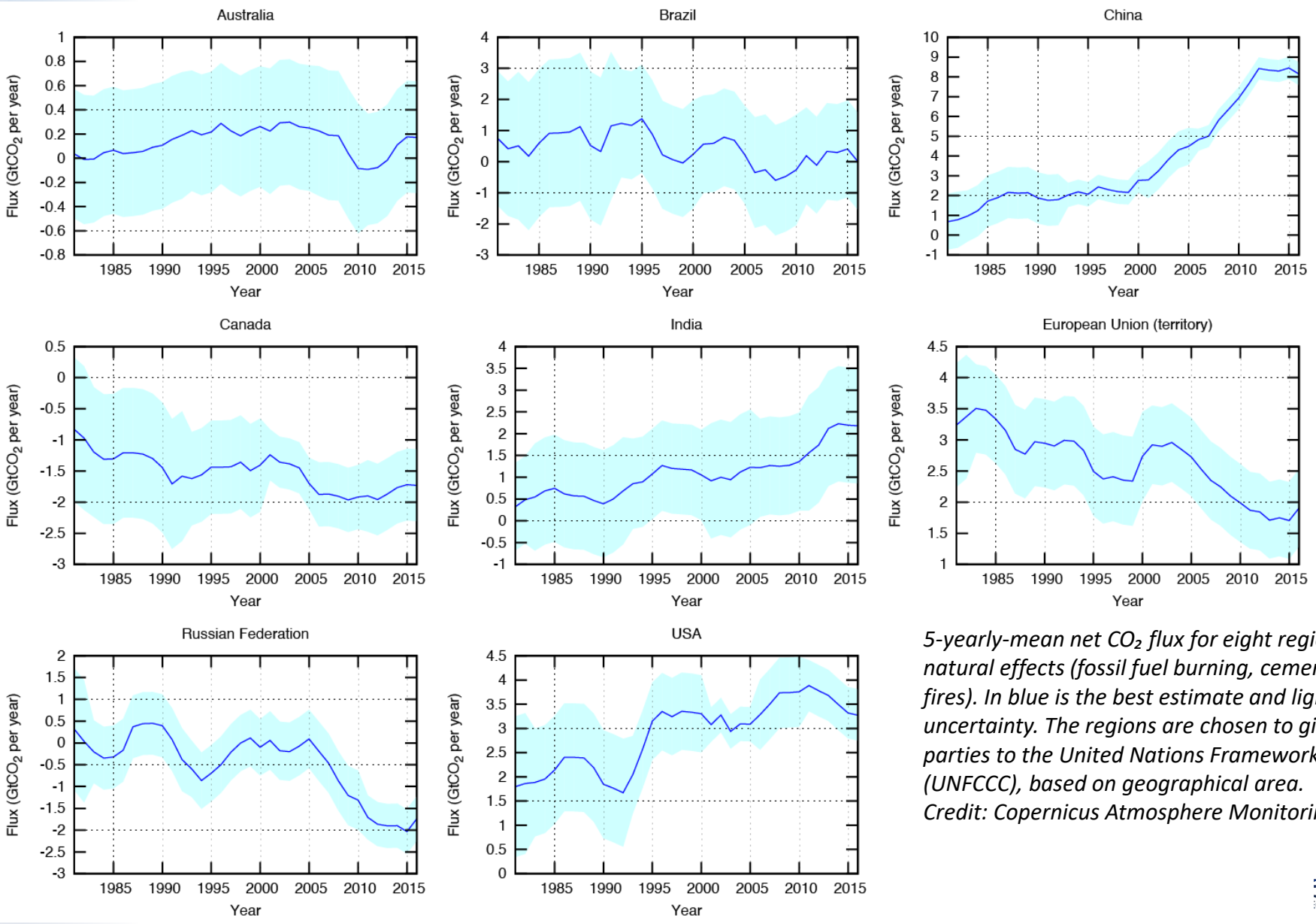
IMPLEMENTED BY ECMWF

Copernicus Europe's eyes on Earth

European Commission

Atmosphere Monitoring

CAMS global flux inversions (in situ)

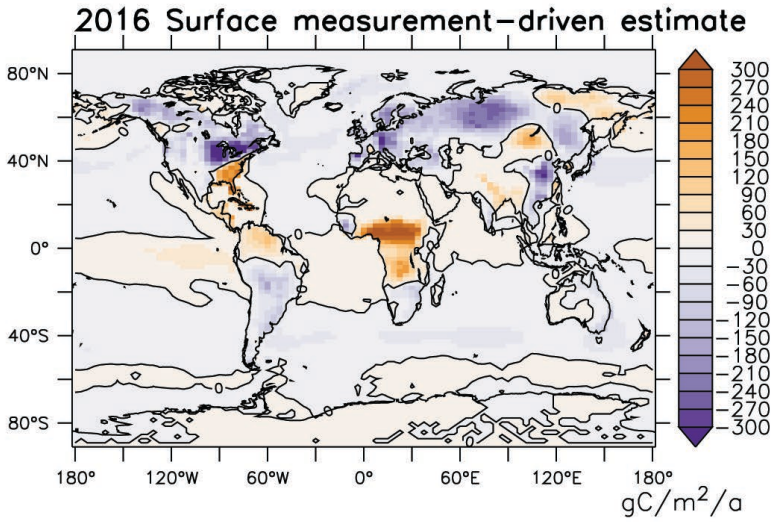


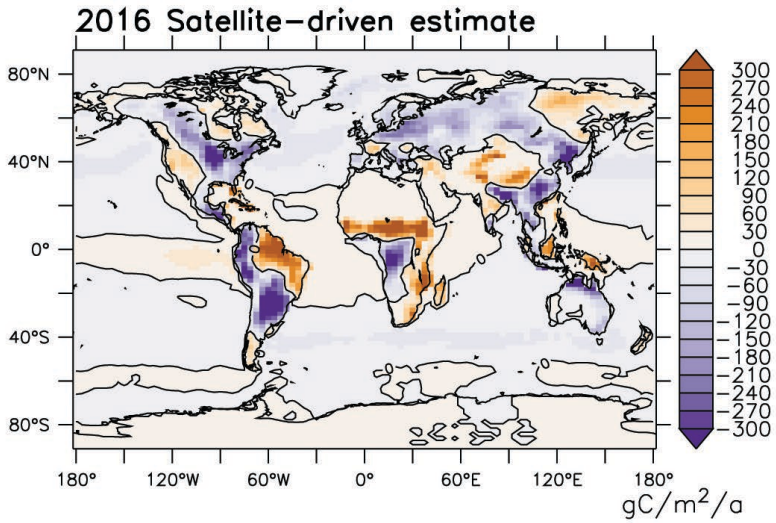
5-yearly-mean net CO_2 flux for eight regions, combining human and natural effects (fossil fuel burning, cement production, vegetation and fires). In blue is the best estimate and light blue shows its estimated uncertainty. The regions are chosen to give estimates for the eight largest parties to the United Nations Framework Convention on Climate Change (UNFCCC), based on geographical area.
Credit: Copernicus Atmosphere Monitoring Service (CAMS) /ECMWF /LSCE

ernicus Europe's eyes on Earth
European Commission

Outlook

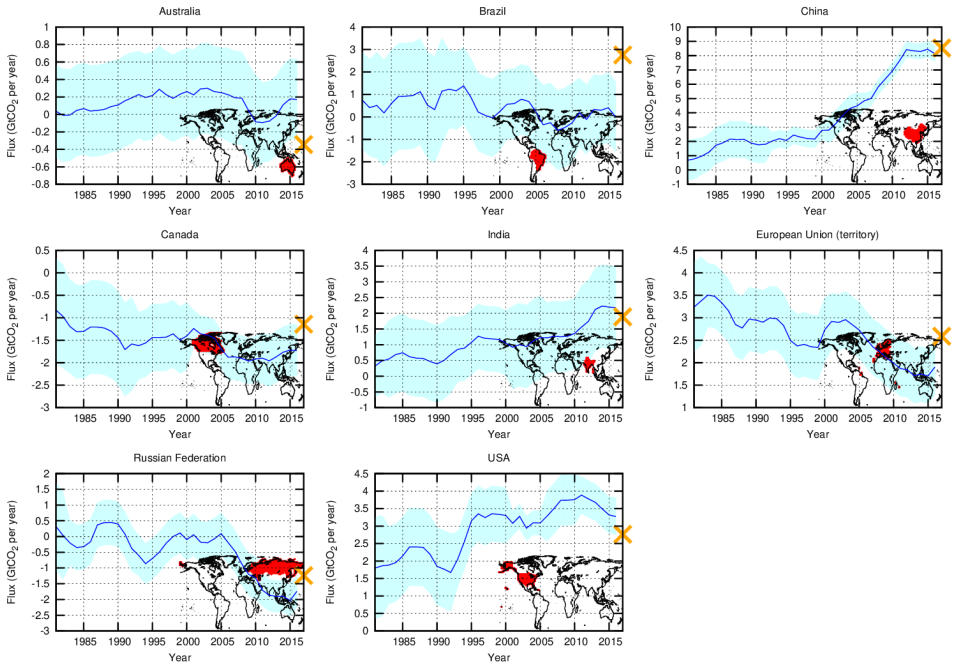
Atmosphere Monitoring





- Increase the horizontal resolution within the next few years, likely to 2.5 x 1.25 deg^2

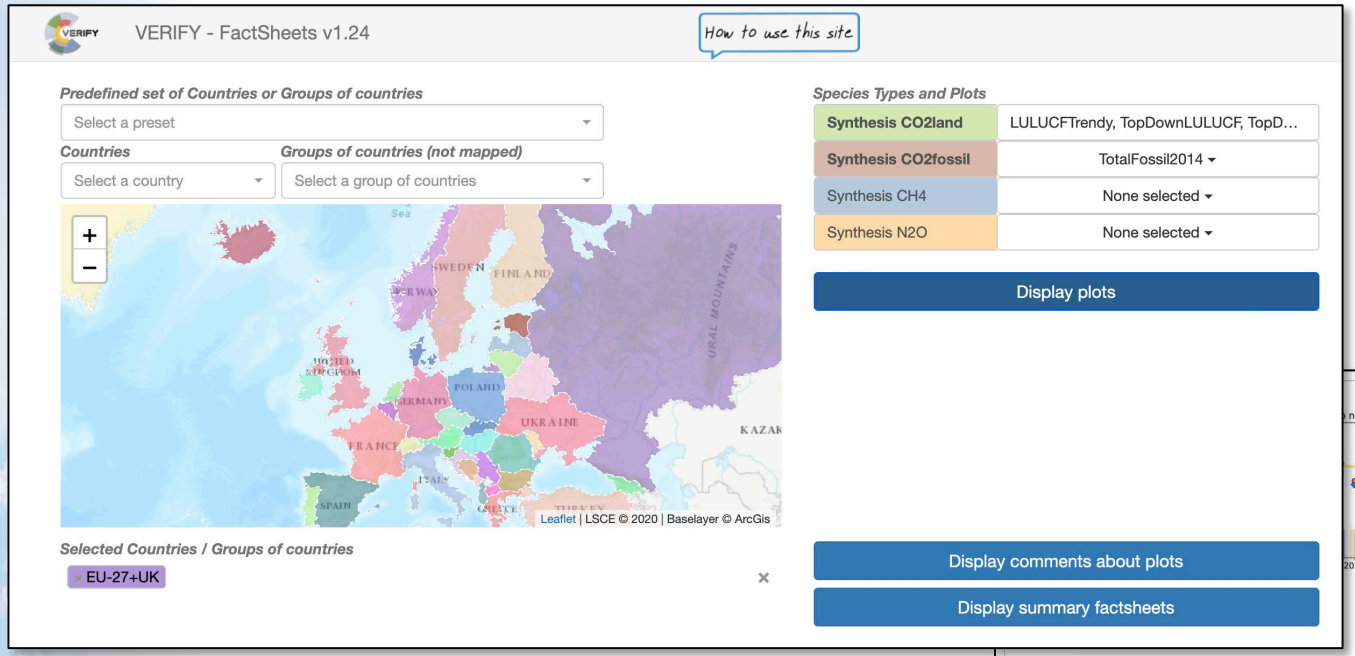
- Use satellite data for this indicator. The consistence between the satellite-driven inversion and the surface-driven inversion is now fairly good but could still be further improved.



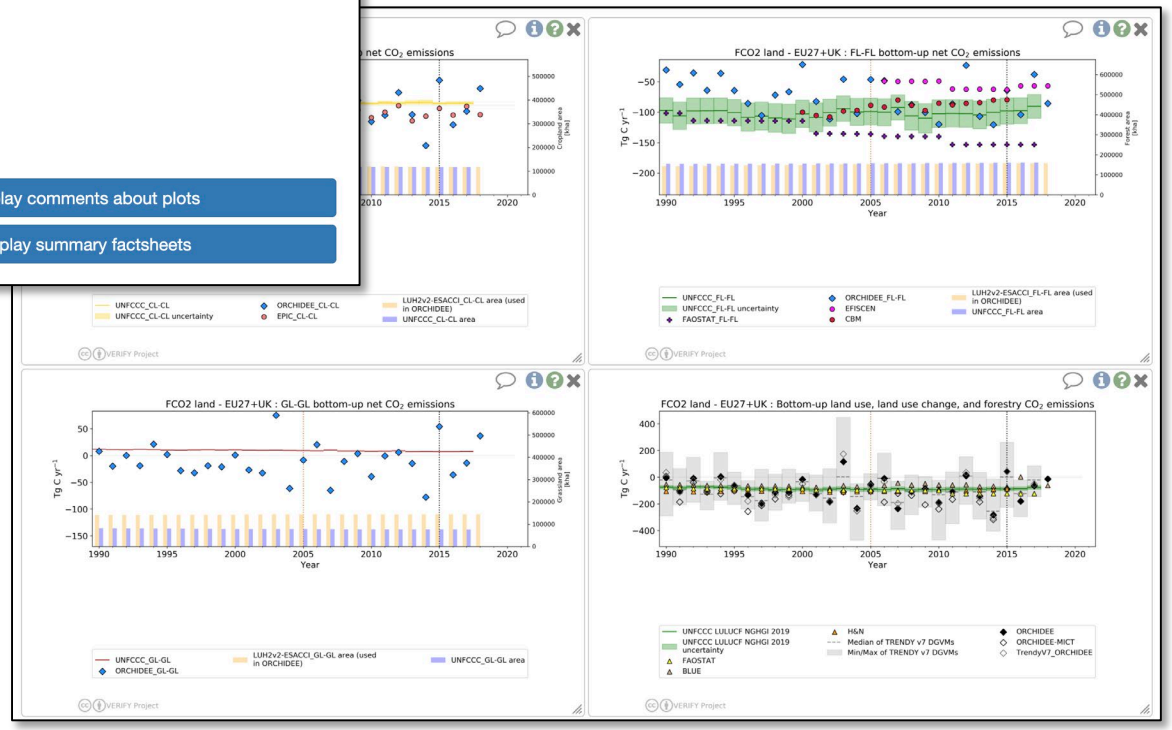
European Commission

VERIFY country fact sheets

Atmosphere Monitoring



Based on bottom-up and top-down in-situ-based analyses.



Policy relevant products/interfaces are being developed together with key user communities.
This ensures the services will be fit-for-purpose.

IMPLEMENTED BY ECMWF Copernicus Europe's eyes on Earth European Commission

CoCO2 plans - focus on 2021

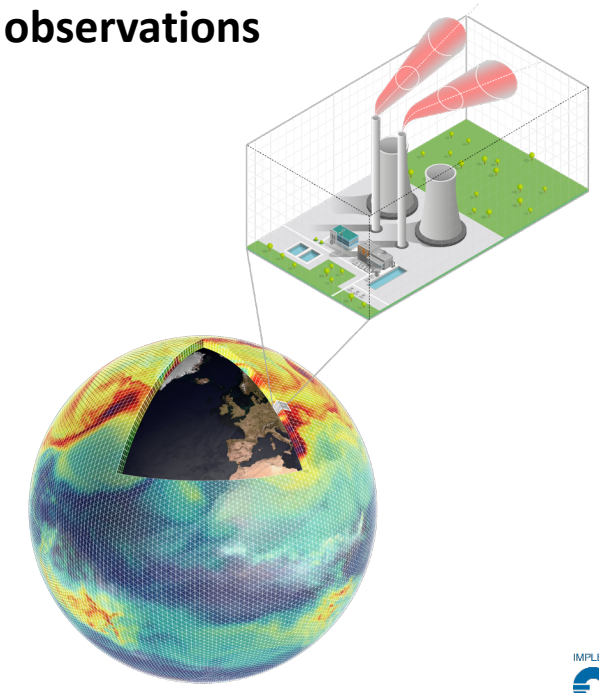
Atmosphere Monitoring

CoCO2
Prototype system for a Copernicus CO_2 service

- Extend VERIFY annual factsheets for 2021 (based
- Emission estimates from each prototype system for 2021 (depending on maturity)

Prototype case studies based on existing observations

Global estimates



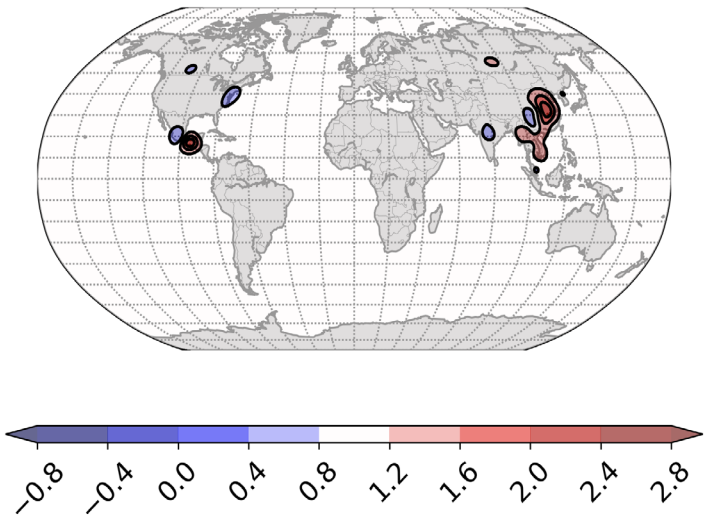
Local estimates

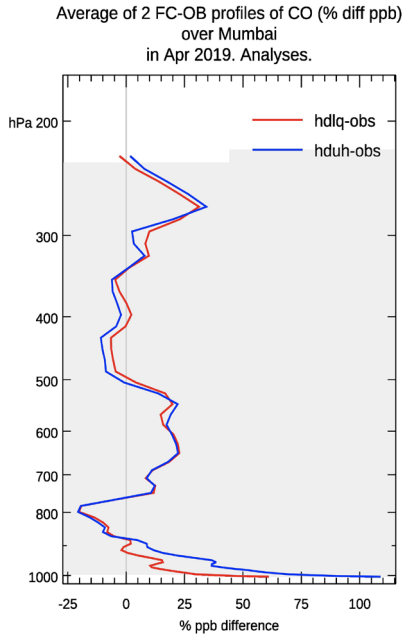
IMPLEMENTED BY ECMWF

Prototype examples

Atmosphere Monitoring

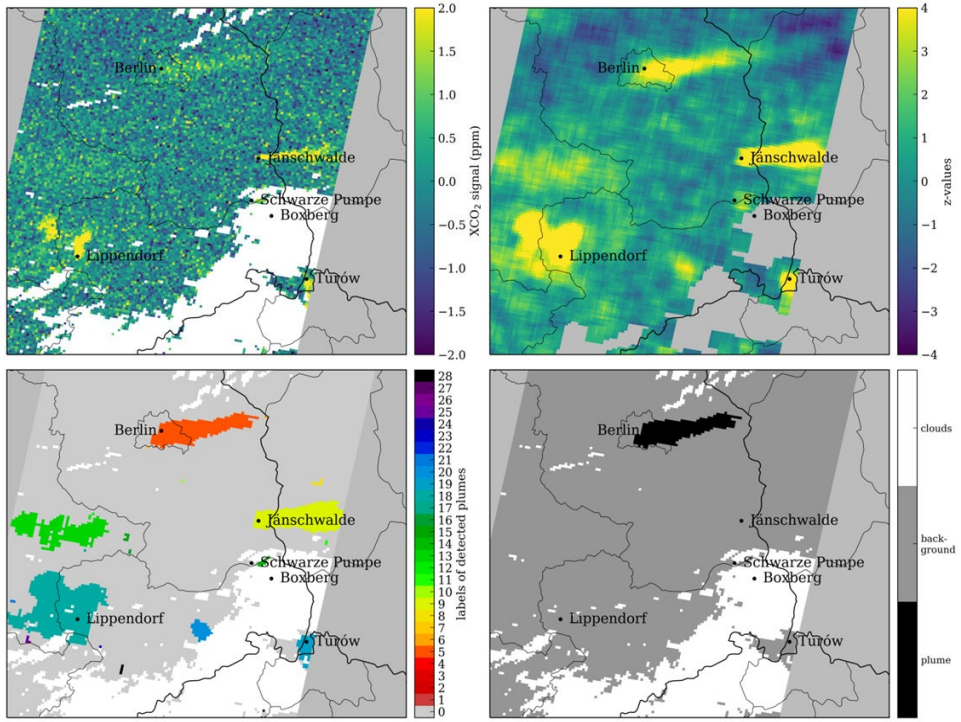
CHE - global CO inversions with ECMWF 4D-Var system (ECMWF)





CO2 Human Emissions

SMARTCARB – identification of individual plumes (EMPA)



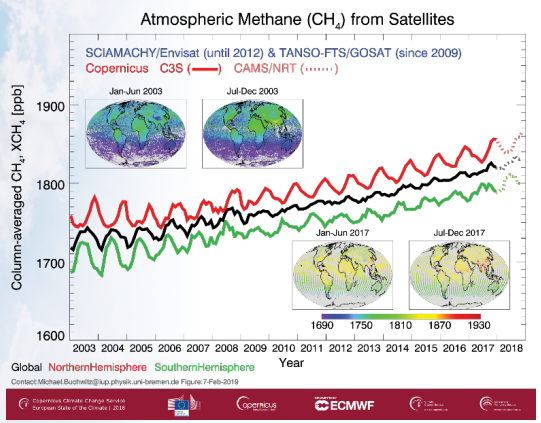
SMARTCARB

IMPLEMENTED BY ECMWF
Copernicus Europe's eyes on Earth
European Commission

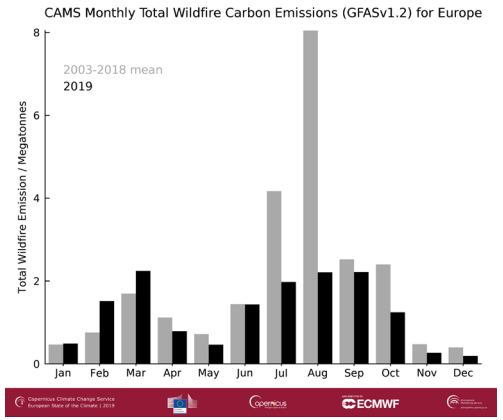
Atmosphere Monitoring

Presenting results

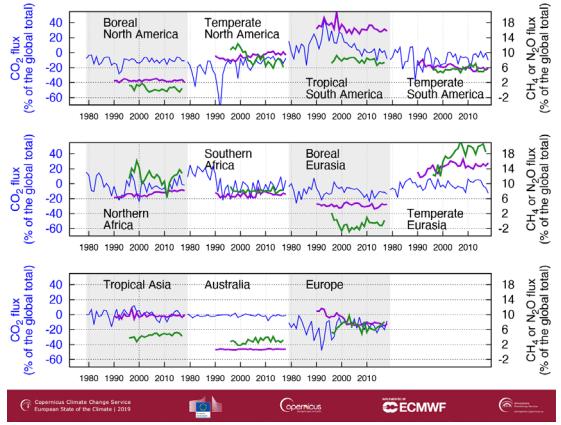
Climate Change Service



Observations



Fire emissions



Flux estimates

IMPLEMENTED BY ECMWF

Copernicus Europe's eyes on Earth

European Commission

Atmosphere Monitoring

Final remarks

- More and more exciting results are becoming available!
- However, these are mostly not targeting the Global Stocktake yet.
- Work in progress to discuss with relevant user communities how observation-based information can provide added value.
- This means not just provision of data but also building policy-relevant interfaces.
- 2021 is approaching fast, so focus will be on showing potential. 2nd Global Stocktake is the goal.
- MIP2 and similar activities are very useful to see where we are and to get a better grip on current uncertainties and future development goals.