



## GEOLAND2 and MACC: linking the GMES land and atmosphere services

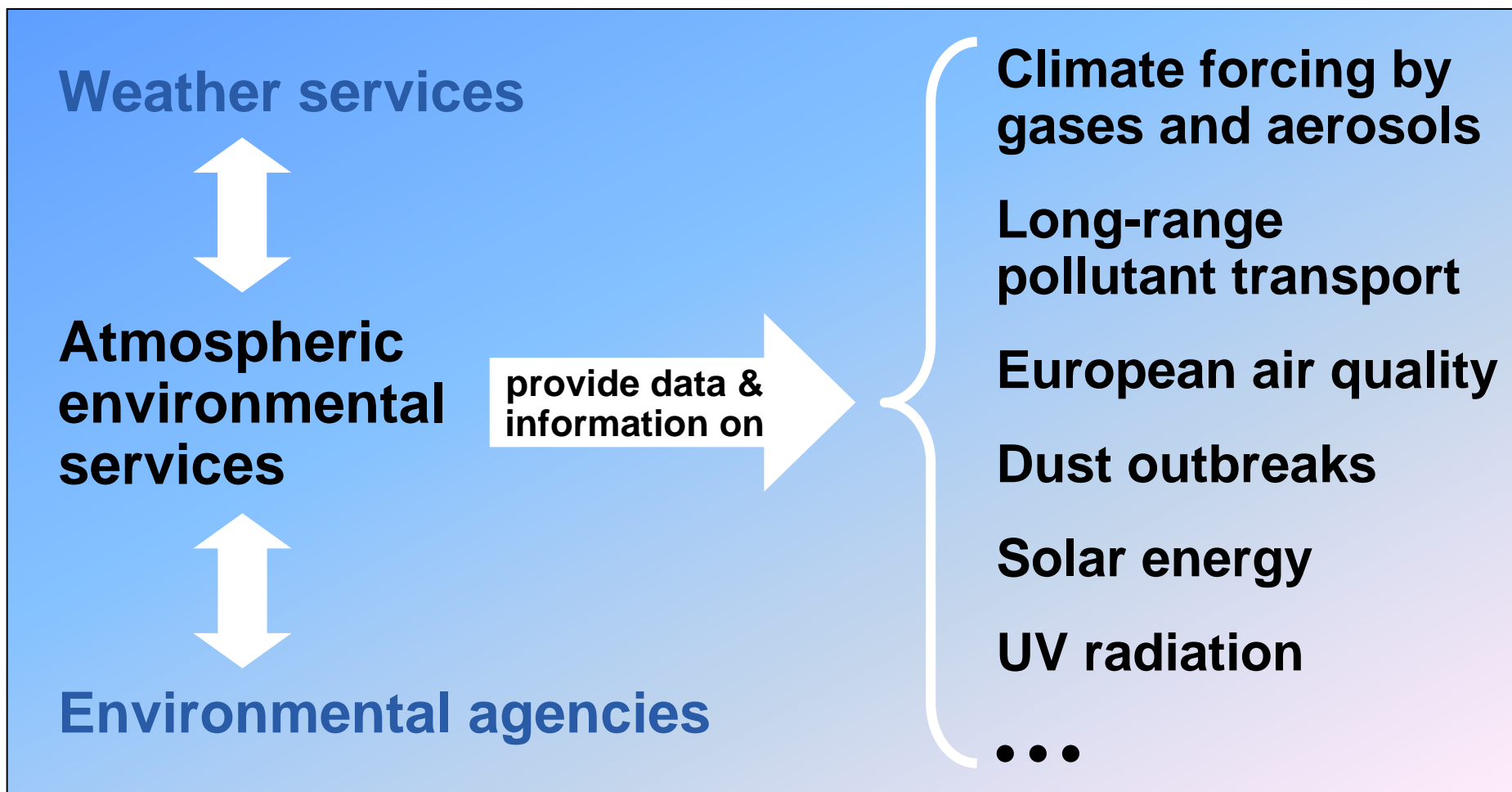
Richard Engelen



## MACC – Monitoring Atmospheric Composition and Climate

- **Integrates space-based and in-situ observations of atmospheric composition with state-of-the art atmospheric modelling**
- **Provides monitoring and forecasting services for atmospheric composition**
- **Helps Europe to respond to climate change and poor air quality**

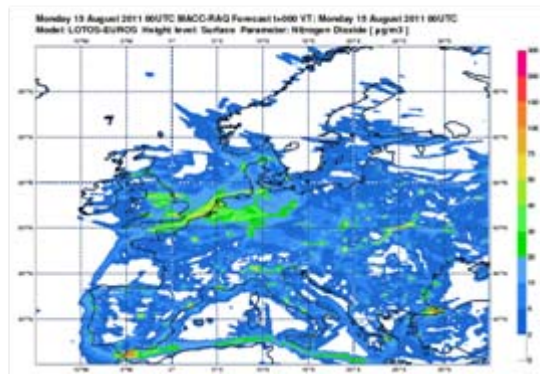
## Services related to the chemical and particulate content of the atmosphere



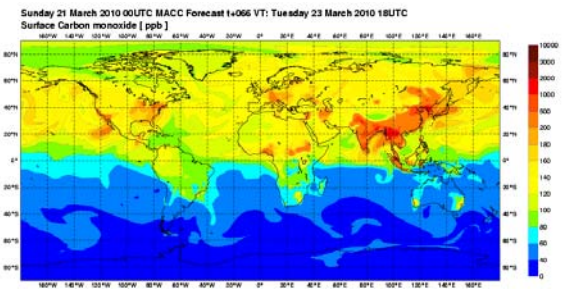
# MACC Daily Service Provision

The screenshot shows the MACC website interface. At the top, it says 'Monitoring atmospheric composition & climate'. Below that is the MACC logo and the text 'Monitoring atmospheric composition & climate'. There is a search bar and a navigation menu with items like HOME, NEWS, ABOUT THE PROJECT, SERVICES, DATA PRODUCTS, DOCUMENTS, EVENTS, CONTACT US. The main content area includes a 'Home' section with a brief description of MACC, 'Services by theme' (European Air Quality, Global Atmospheric Composition, Climate, UV and Solar Energy), and 'Services by user' (Health, Environment, Science Community, Citizen, Meteorology). At the bottom, it mentions that MACC is a collaborative project funded by the European Commission.

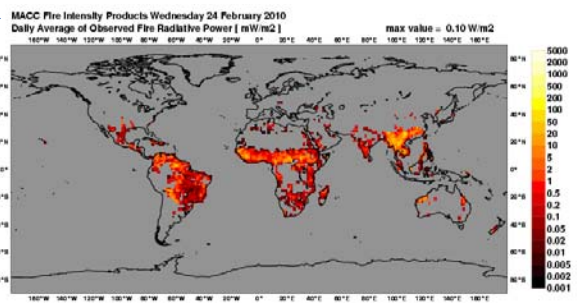
Air quality



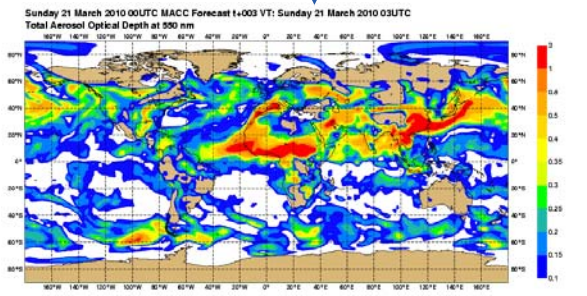
Global Pollution



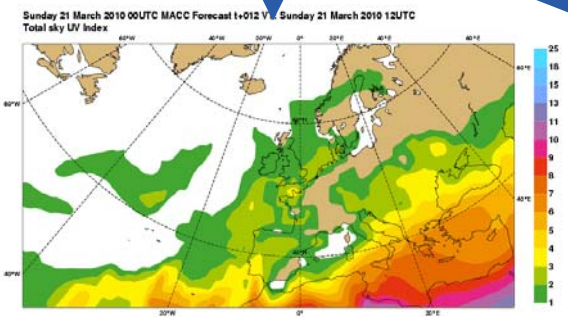
Biomass burning



Aerosol



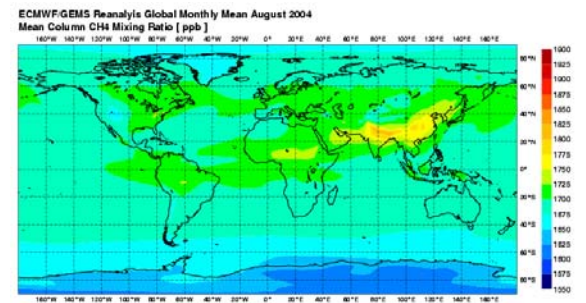
UV index



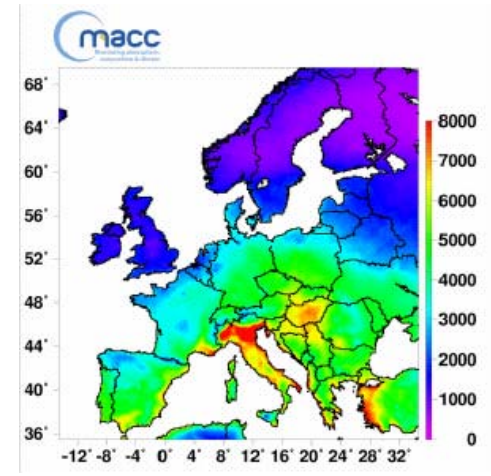
# MACC Service Provision

The screenshot shows the MACC website interface. At the top, it says 'Monitoring atmospheric composition & climate' with the MACC logo and 'emes' logo. Below is a navigation bar with links like HOME, NEWS, ABOUT THE PROJECT, SERVICES, DATA PRODUCTS, DOCUMENTS, EVENTS, CONTACT US. The main content area includes a 'Home' section with a brief description of MACC, 'Services by theme' (European Air Quality, Global Atmospheric Composition, Climate, UV and Solar Energy), and 'Services by user' (Health, Environment, Science Community, Citizen, Meteorology). There are also 'Latest News' and 'Quick Links' sections.

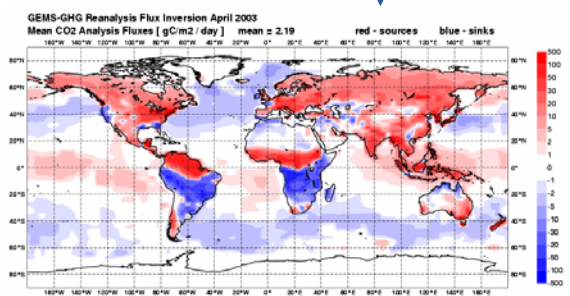
Global Reanalysis



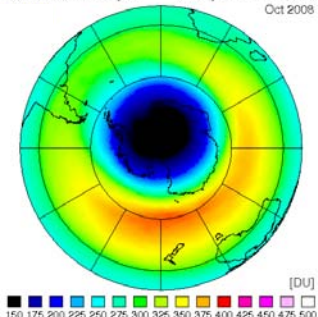
Reanalysis of air quality



Flux Inversions

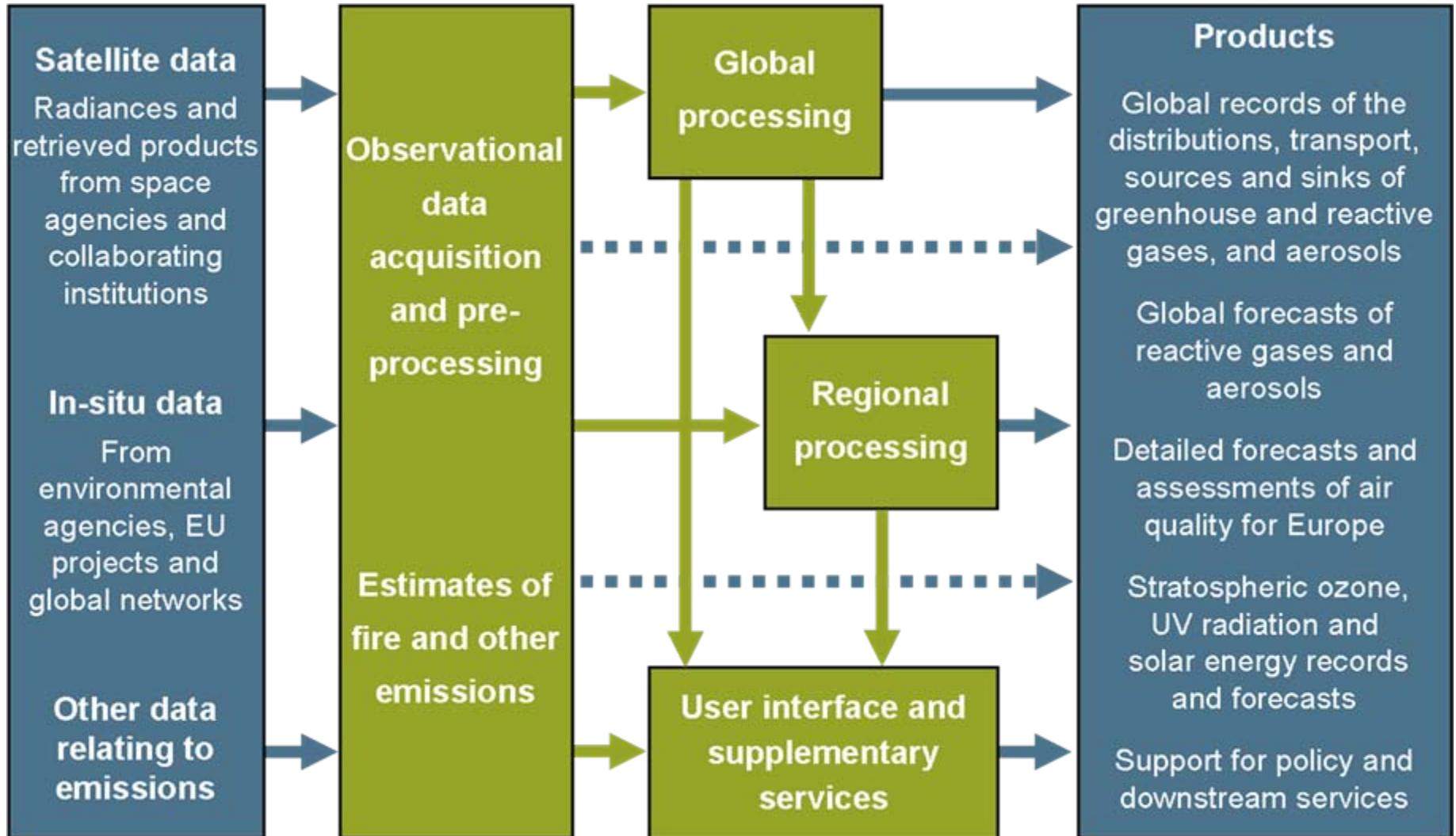


Multi Sensor Reanalysis Monthly mean total ozone Oct 2008



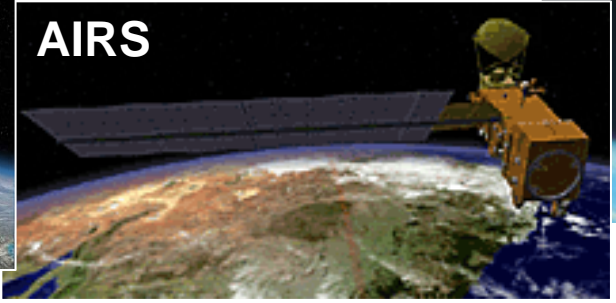
Ozone records

# MACC Project Structure



# Greenhouse Gases

MACC aims to optimally combine the information of satellite and ground-based observations to monitor atmospheric CO<sub>2</sub> and CH<sub>4</sub> concentrations and fluxes

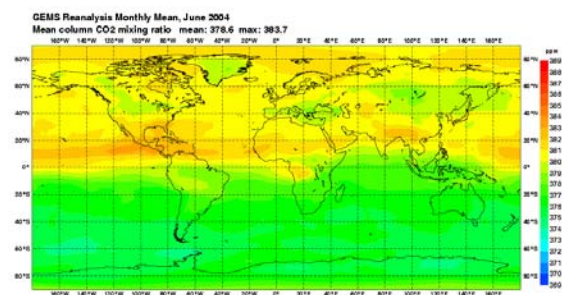
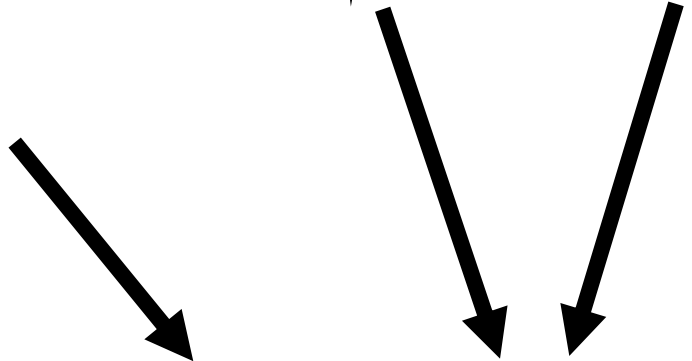
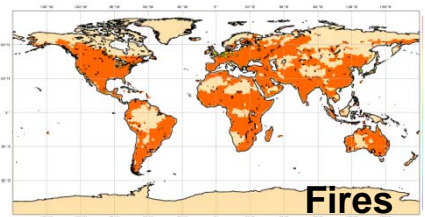
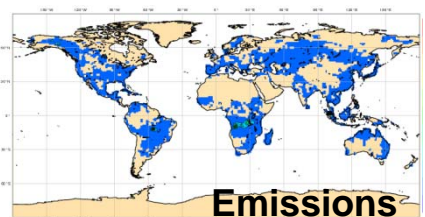
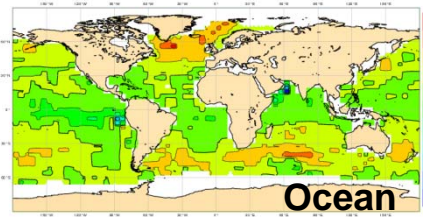
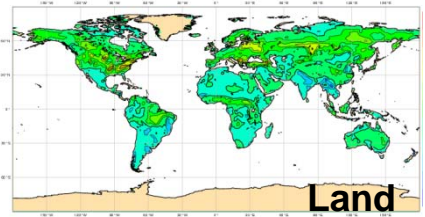


# Flux estimation

Observations

# The MACC 2-step approach

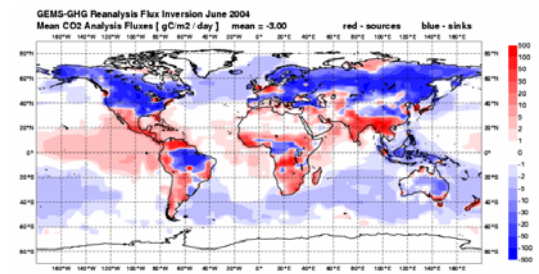
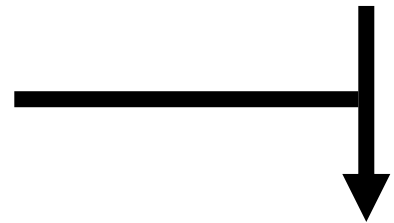
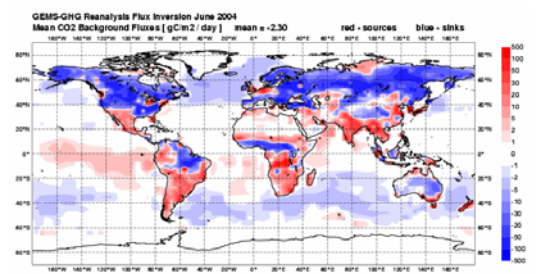
Prescribed Fluxes



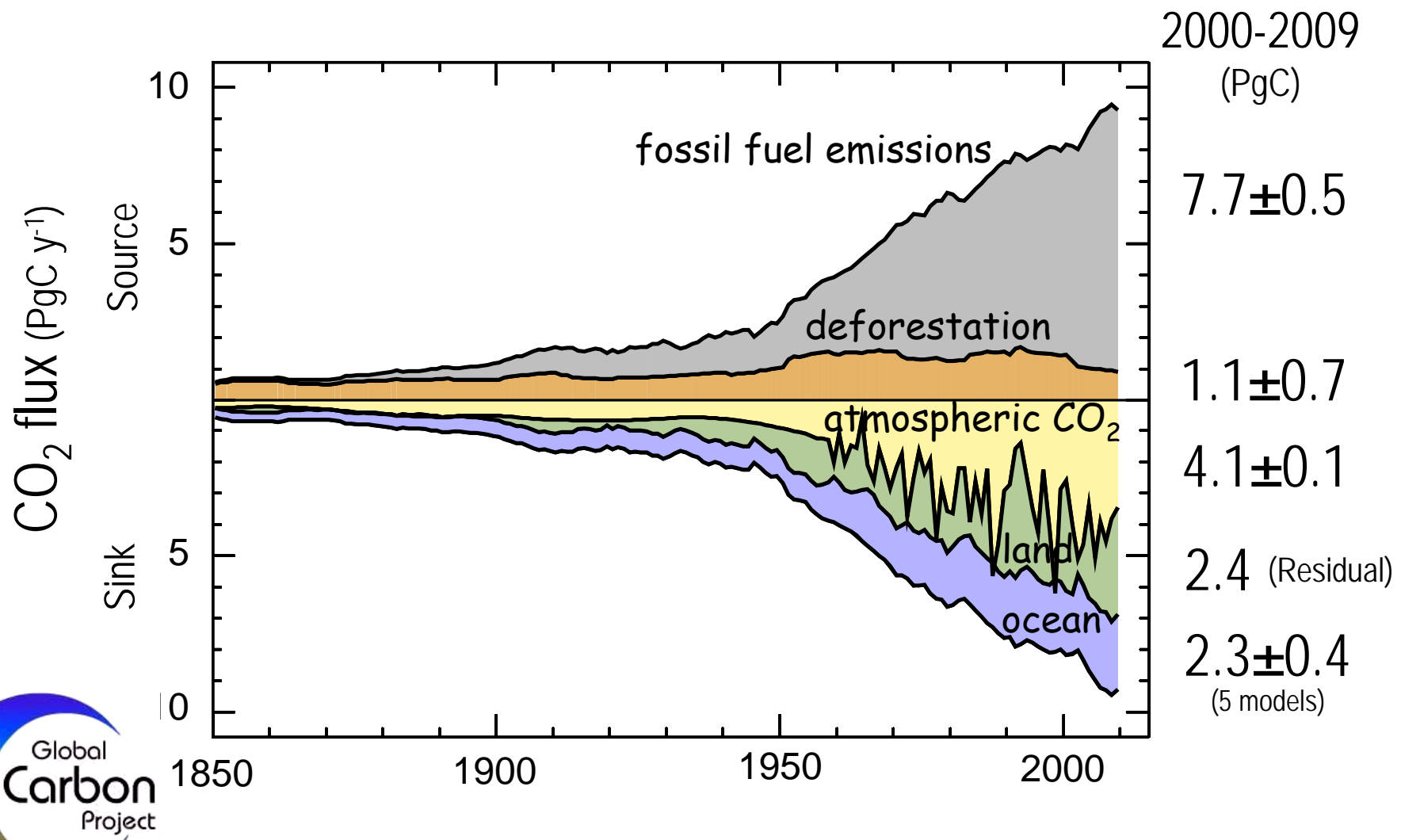
Data Assimilation



Flux Inversion

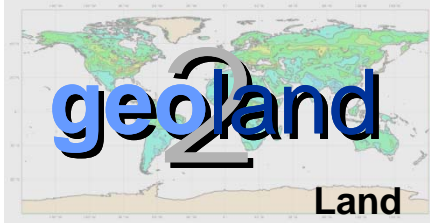


# Why focus on land carbon fluxes?

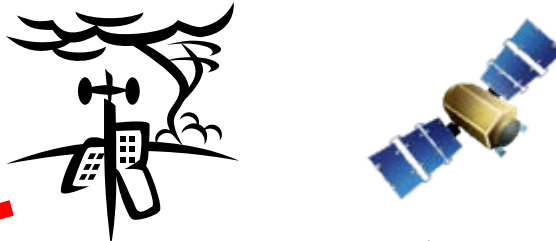


# MACC budget of global CO<sub>2</sub>

Year	Fossil	Fires	Ocean	Land	Net emission	MODEL Atm. Growth	OBS Atm. Growth	Corrected Land
2003	7.61	1.82	-1.42	-1.03	6.98	6.92	4.18	-3.92
2004	7.97	1.76	-1.42	-1.3	7.01	7.62	3.39	-5.70
2005	8.27	1.87	-1.42	-0.91	7.81	8.39	4.77	-4.69
GCP	Fossil	LUC	Ocean	Land	Net		OBS	
GCP (unc)	7.7 (0.5)	1.1 (0.7)	-2.3 (0.4)	-2.4	4.1 (0.1)	N/A	4.1 (0.1)	N/A

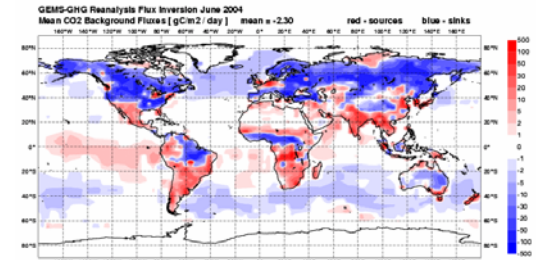


Observations

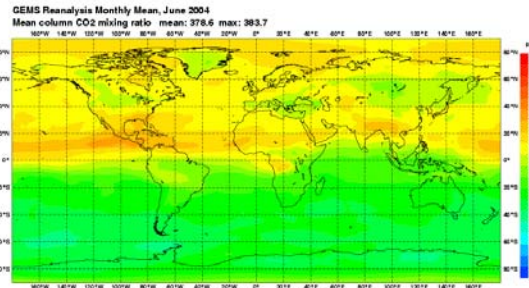
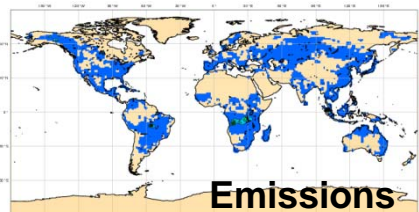
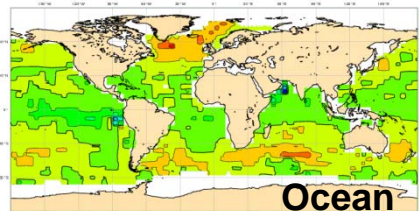


More  
interactive  
approach

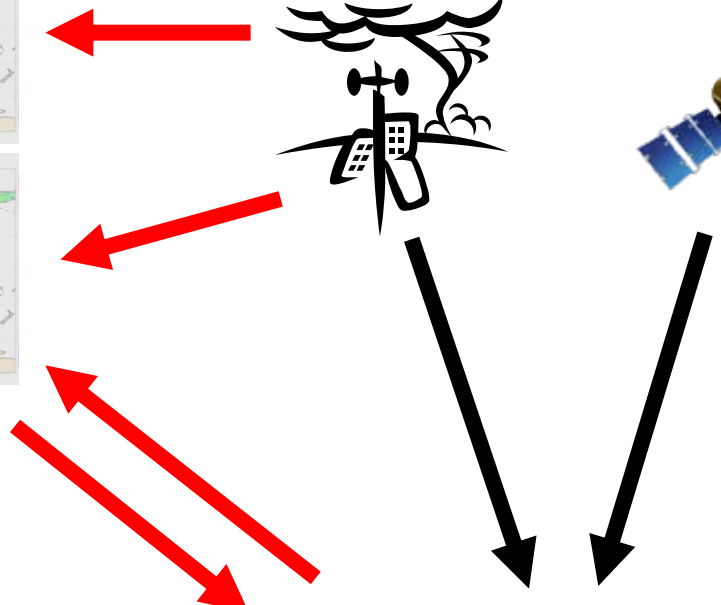
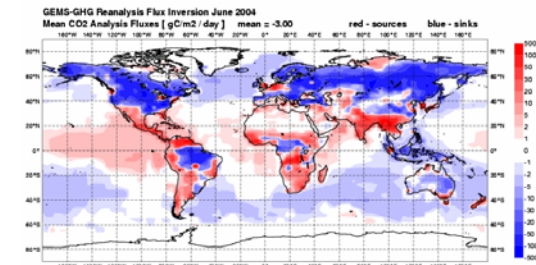
Flux Inversion



Prescribed Fluxes

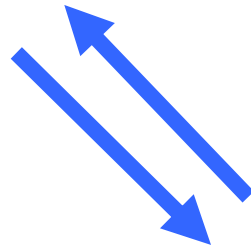


Data Assimilation

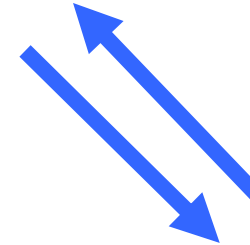




Atmospheric CO<sub>2</sub> model



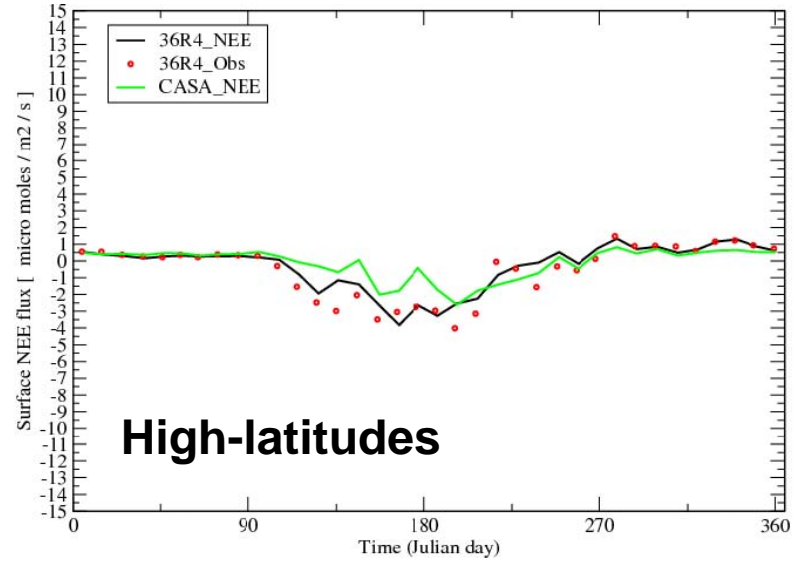
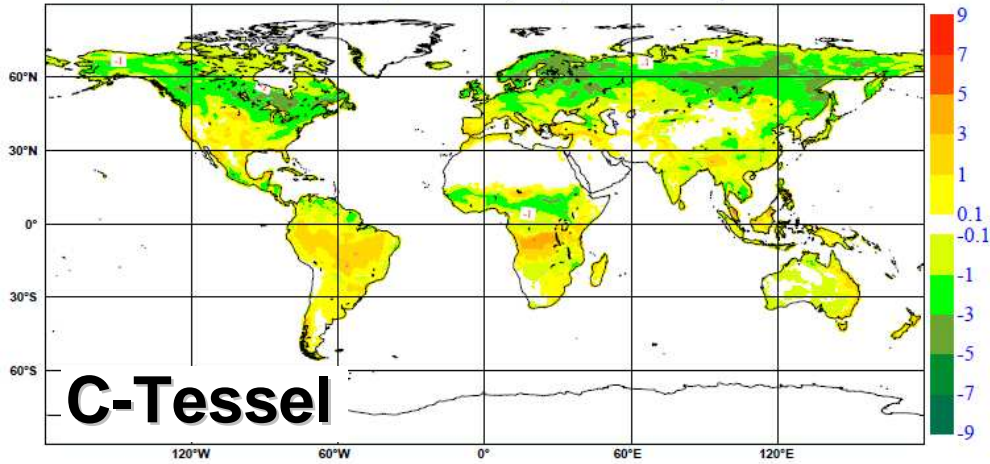
Hydrological flux model



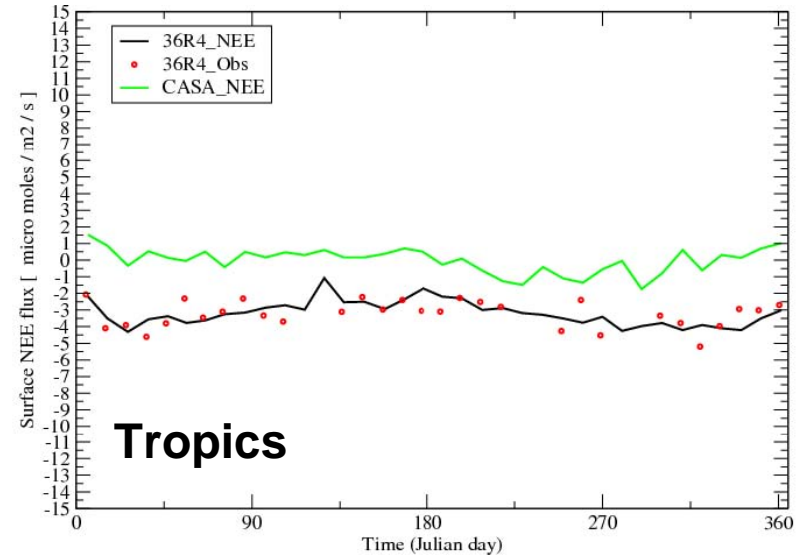
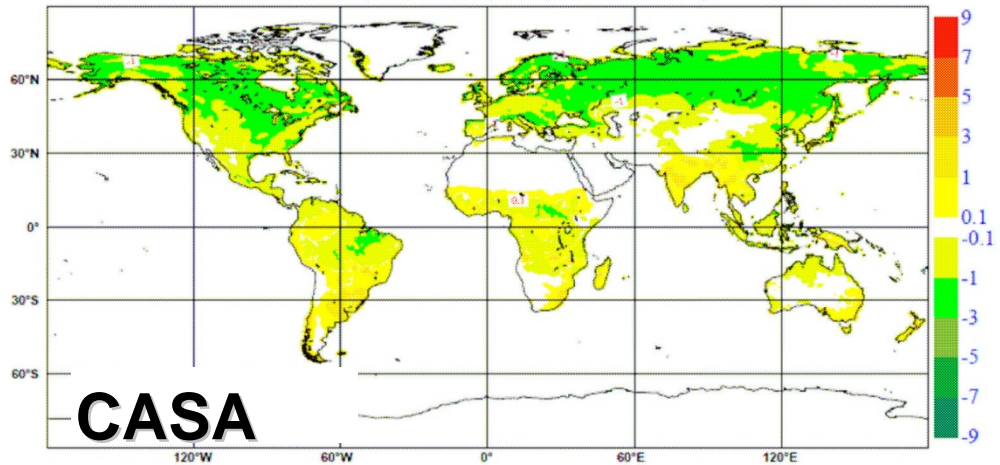
Carbon flux model

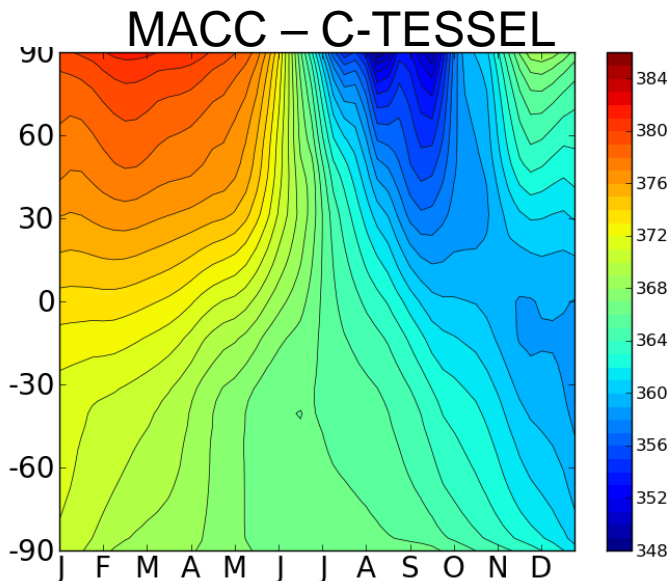
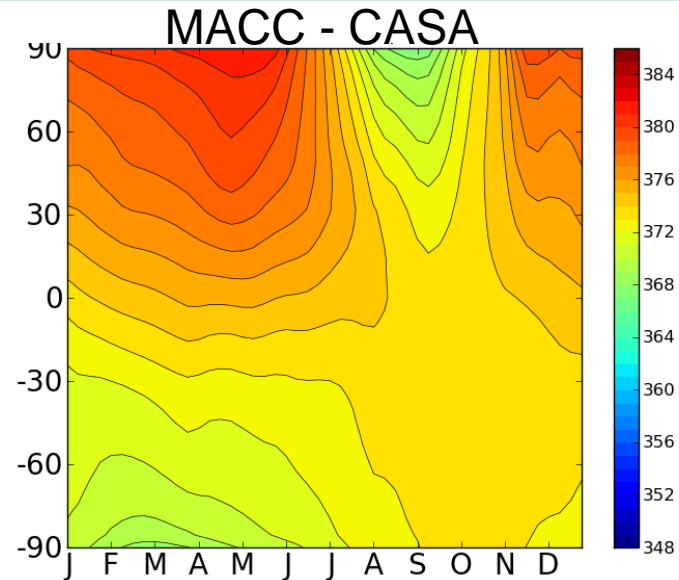
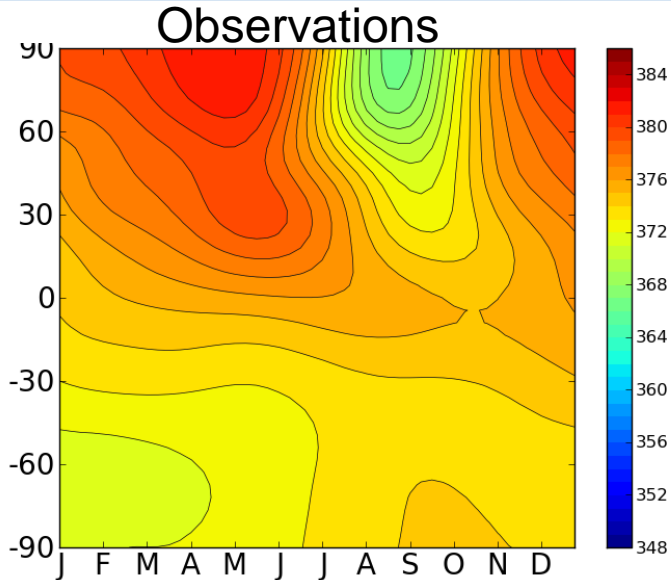
geoland

CETESSEL monthly mean NEE July 2004 [micromoles m<sup>-2</sup> s<sup>-1</sup>]



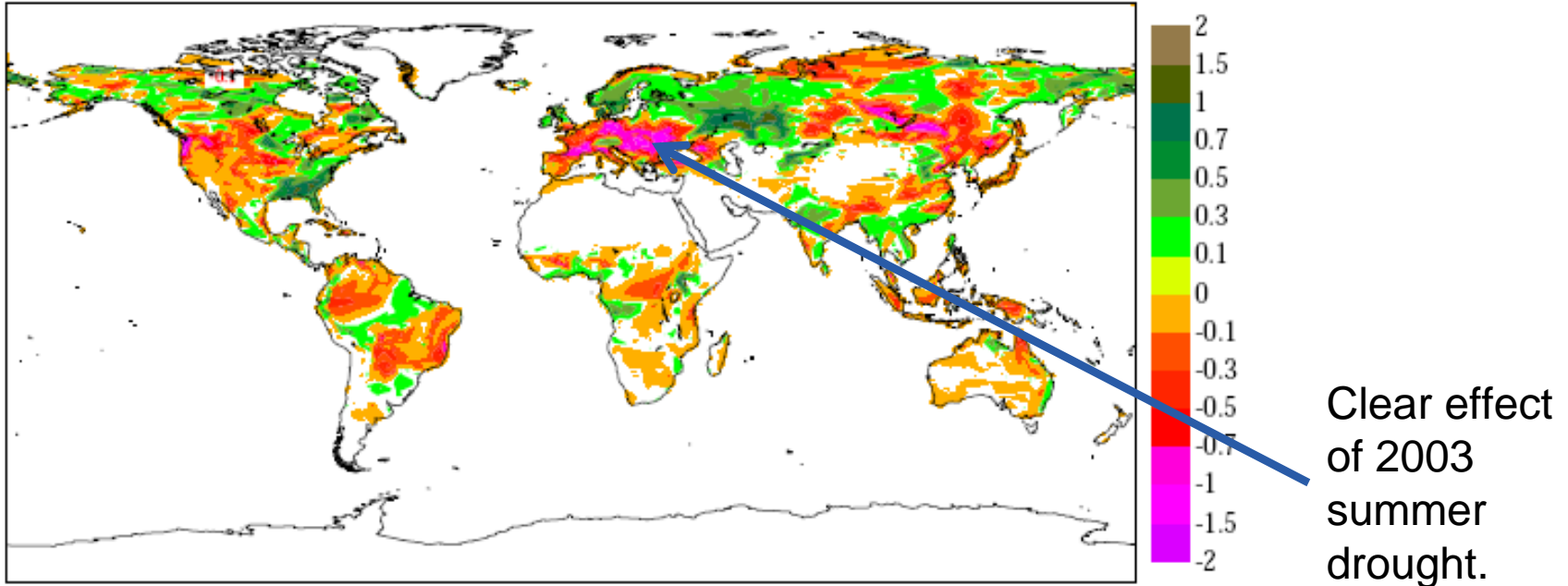
CASA monthly mean NEE July 2004 [micromoles m<sup>-2</sup> s<sup>-1</sup>]





**Collaboration between MACC and GEOLAND2 ensures that C-Tessel can be fine-tuned against flux observations AND atmospheric CO<sub>2</sub> observations.**

CTESSEL Leaf Area Index anomaly from 1979-2010 mean [m<sup>2</sup>/m<sup>2</sup>] for 200307



C-Tessel is tuned to CASA on long time scales, but then allows inter-annual and day-to-day variability driven by observations of soil temperature and moisture and available radiation.

## **Towards an integrated GMES system:**

- **A fully integrated surface flux model constrained by satellite observations will be a major step forward for MACC**
- **The feedback from MACC will help GEOLAND2 to improve its surface model**
- **This is what makes Europe strong! GMES is more than just 6 service themes. The potential of the total sum is unrivalled.**



Thank you!

