CarbonSat: a Candidate Greenhouse Gas Earth Explorer

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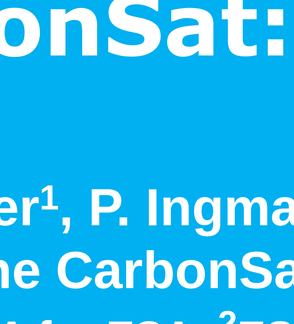
Introduction

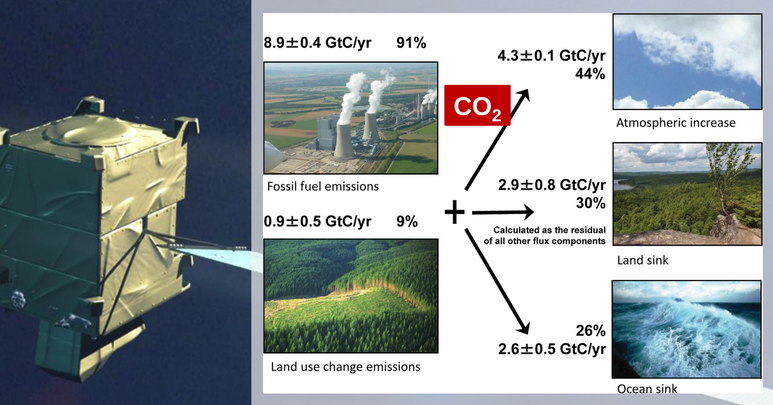
Within ESA's Earth Observation Envelope Programme, two candidate missions, called FLEX and CarbonSat, had been evaluated.
In September 2015, the Earth Science Advisory Committee has recommended FLEX as ESA's eighth Earth Explorer, which was endorsed by the Programme Board for Earth Observation in December 2015.

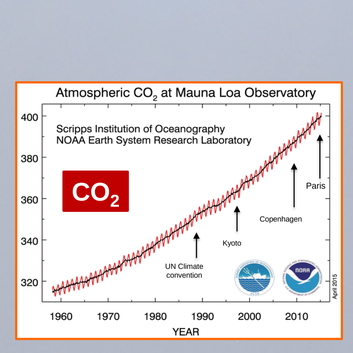
This poster provides an overview of activities related to CarbonSat and an outlook on future activities in the frame of Copernicus.

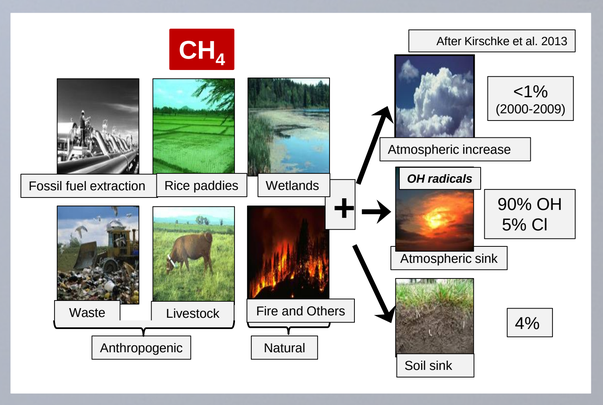


Knowledge Gaps in Global Carbon Budget

From the identified knowledge gaps emerges the need to increase both spatial and temporal coverage allowing for better sampling of under-sampled regions, to investigate the response to climate variability and to separate anthropogenic emissions from natural fluxes.







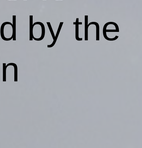
Mission Objectives

The CarbonSat mission objectives are at

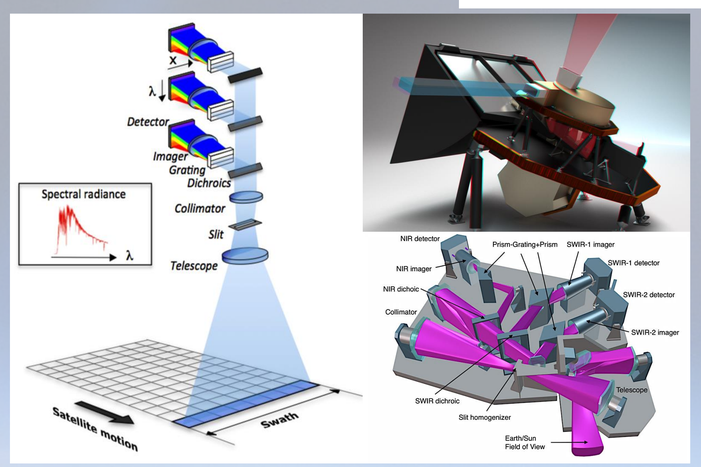
- **Regional scale:**
  to provide a breakthrough in the quantification and attribution of regional-scale surface-to-atmosphere fluxes of CO_2 and CH_4

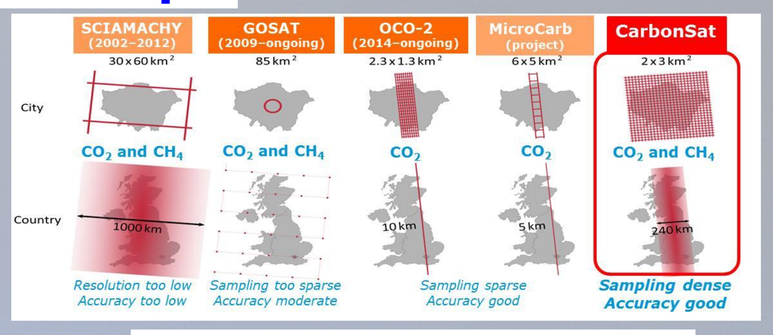
- **Country scale:**
  to increase the flux-resolving power of greenhouse-gas observing satellites to the scale of medium-sized countries

- **Local scale:**
  to pioneer the spaceborne detection, characterisation and quantification of strong local sources of CO_2 and CH_4



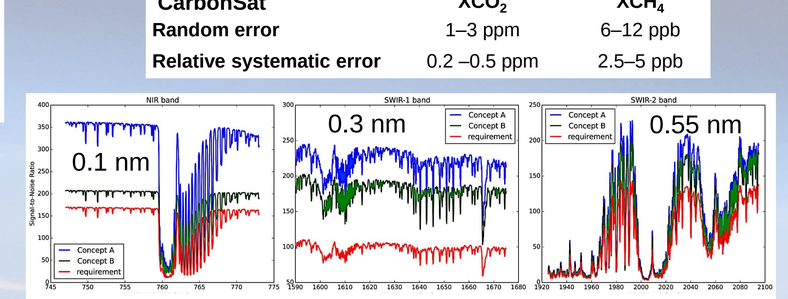
Mission Concept





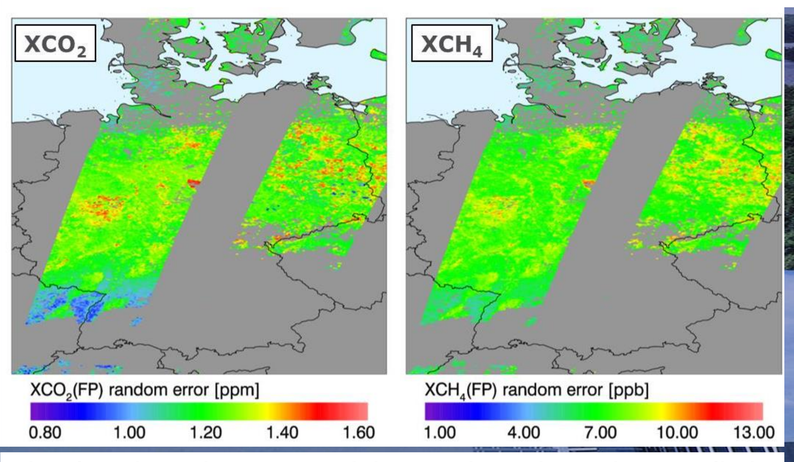
- Imaging spectrometer with NIR (O_2) and SWIR (CO_2 and CH_4) bands
- Demanding spatial, radiometric and characterisation requirements

CarbonSat	XCO_2	XCH_4
Random error	1–3 ppm	6–12 ppb
Relative systematic error	0.2 –0.5 ppm	2.5–5 ppb

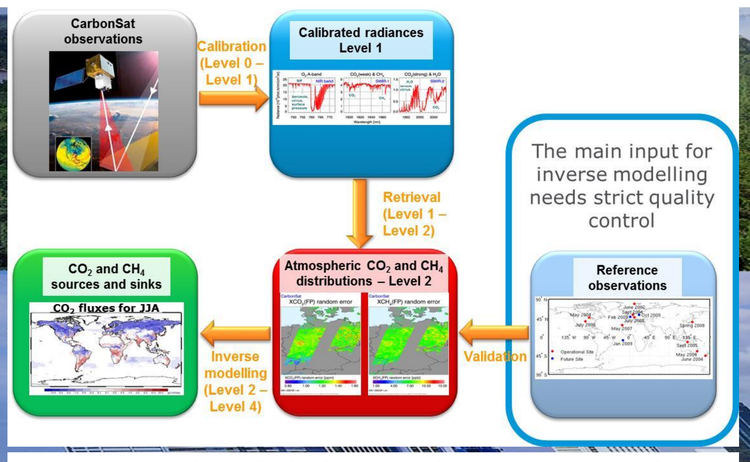


Modelled signal-to-noise spectra of the three bands and their spectral resolution

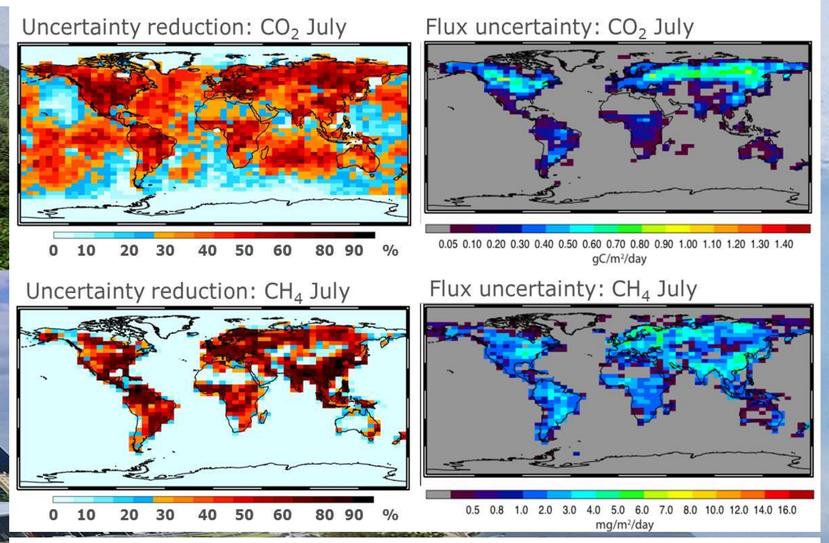
Expected Performance & Science



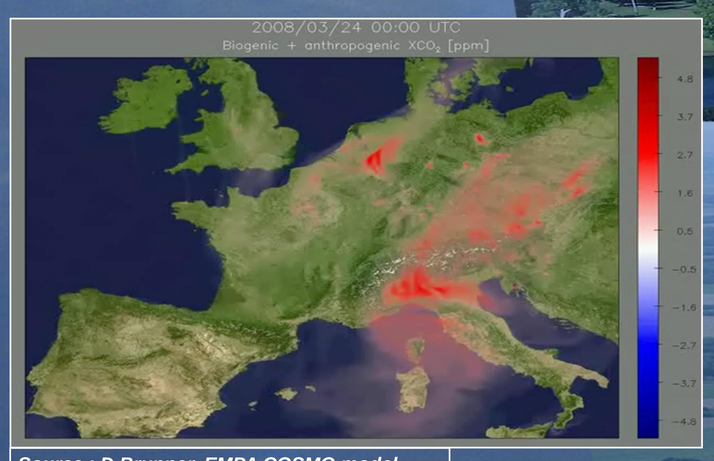
Simulated random error of the products based on realistic data for albedo, aerosol, cloud and other parameters



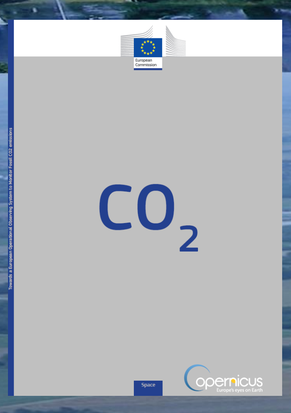
Data processing chain from CarbonSat observations to calibrated spectra, to level-2 and science products



Results from inverse modelling for assessing the expected impact on flux inversion results



Source : D Brunner, EMPA COSMO model



Future Activities

While CarbonSat has not been selected as Earth Explorer-8 and hence the foreseen mission objectives will not be achieved, the results of the scientific and the Phase A/B1 system studies can be partly exploited for defining a dedicated CO_2 emission monitoring instrument.
Following a CO_2 report initiated by the European Commission (EC), the EC is now jointly with ESA investigating the possibilities to establish a pre-operational system for monitoring of CO_2 emissions in the frame of Copernicus. This will be supported by ESA through architectural, instrument design and pre-development activities.

References

- ESA (2015). Report for Mission Selection: CarbonSat, ESA SP-1330/1 (2 volume series), European Space Agency, Noordwijk, The Netherlands. Available via http://esamultimedia.esa.int/docs/EarthObservation/SP1330-1_CarbonSat.pdf
- Towards a European Operational Observing System to Monitor Fossil CO_2 emissions, Final Report, Oct. 2015. Available via http://www.copernicus.eu/sites/default/files/library/CO2_Report_22Oct2015.pdf

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