

Amazonian Carbon Observatory (ACO) Network

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Motivation

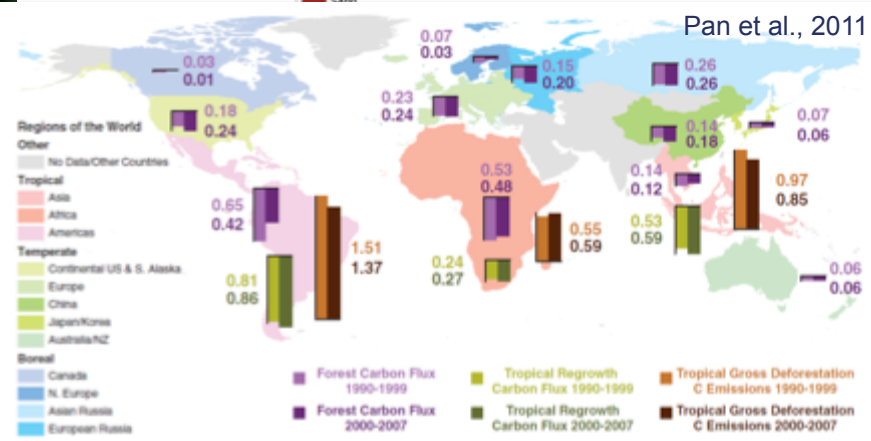
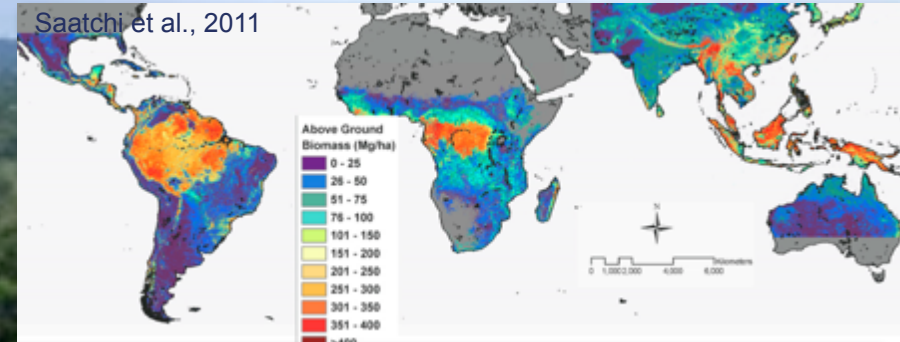
Amazonia is key region for global carbon cycle that stores vast amount of carbon

- 25% of tropical forest carbon stocks
- 14% of total carbon stored in forest

Amazonia has some of largest carbon fluxes between surface and atmosphere:

- Uptake by forests and emission from land use change

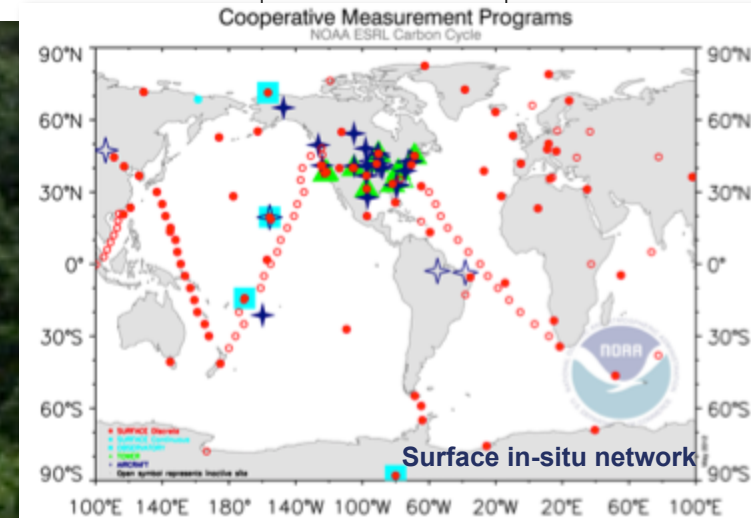
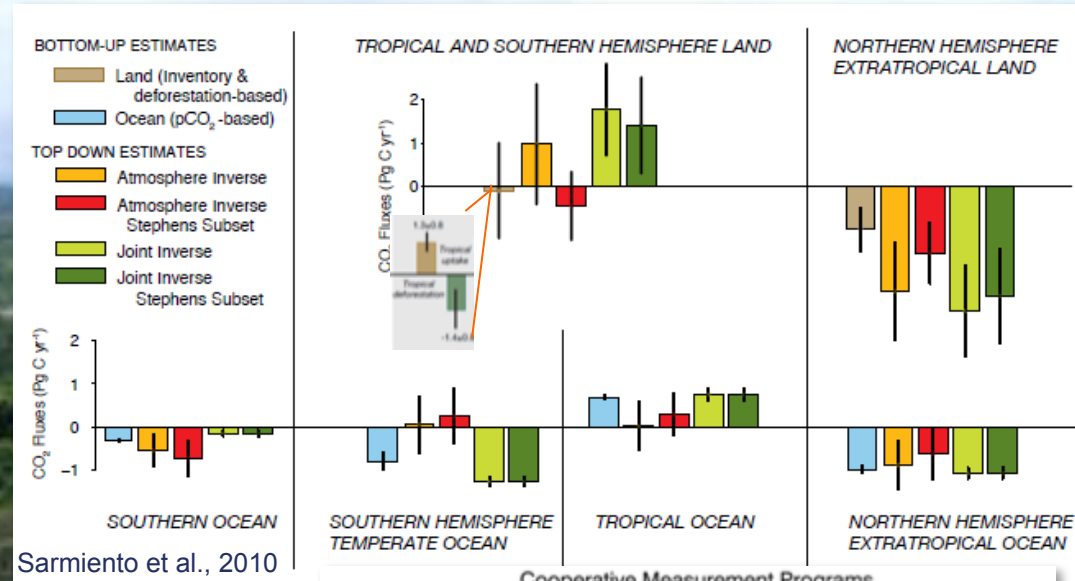
Amazonia is not only subject to changes in climate but also to rapid environmental change (deforestation and urbanisation) which can cause further shifts in carbon balance



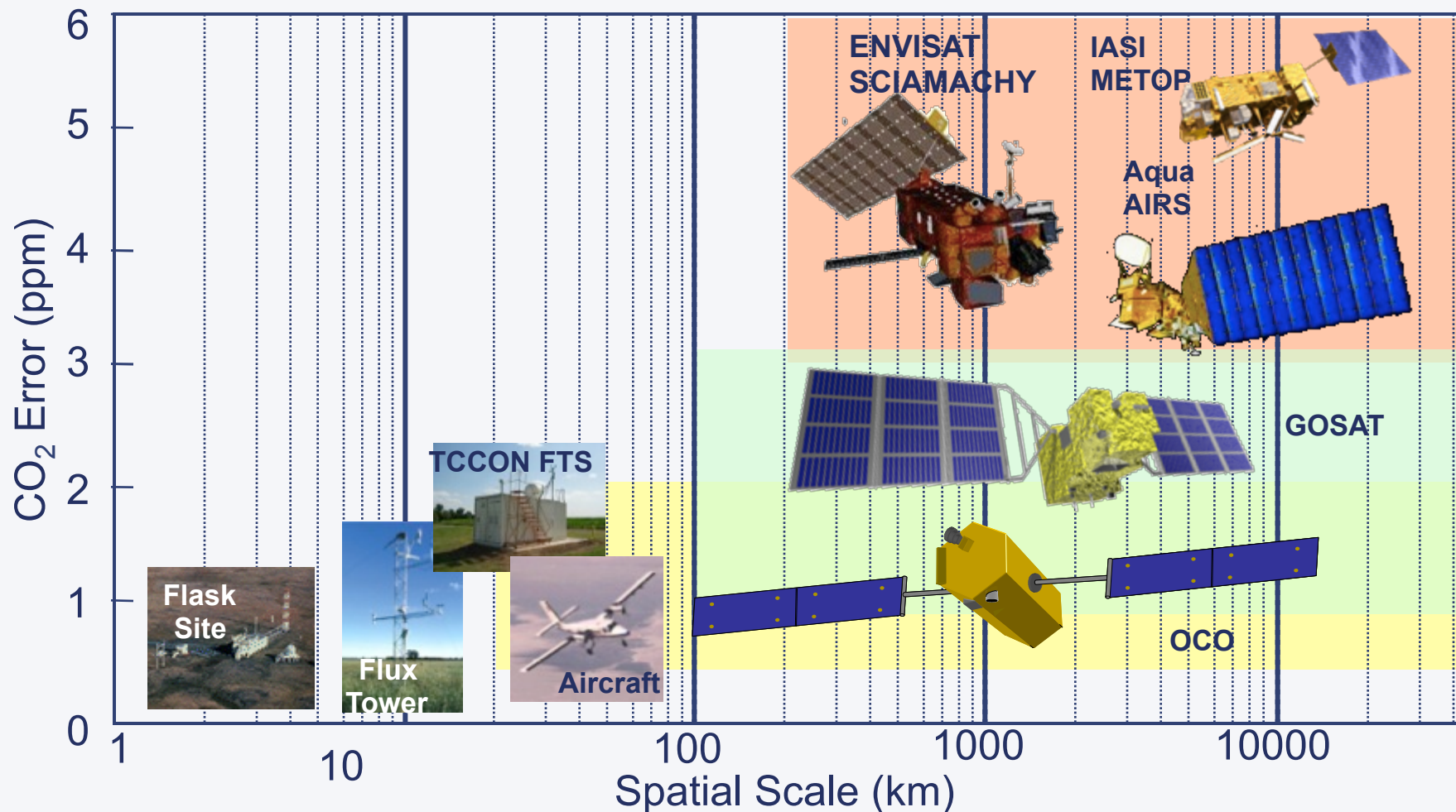
Motivation

Our understanding of the Amazonian (and tropical) carbon cycle is poorly constrained by observations

- Large gap between bottom-up (inventories) and top-down (from atmospheric data)
- Results in large uncertainties in fate of the Amazonian carbon budget under a warming climate

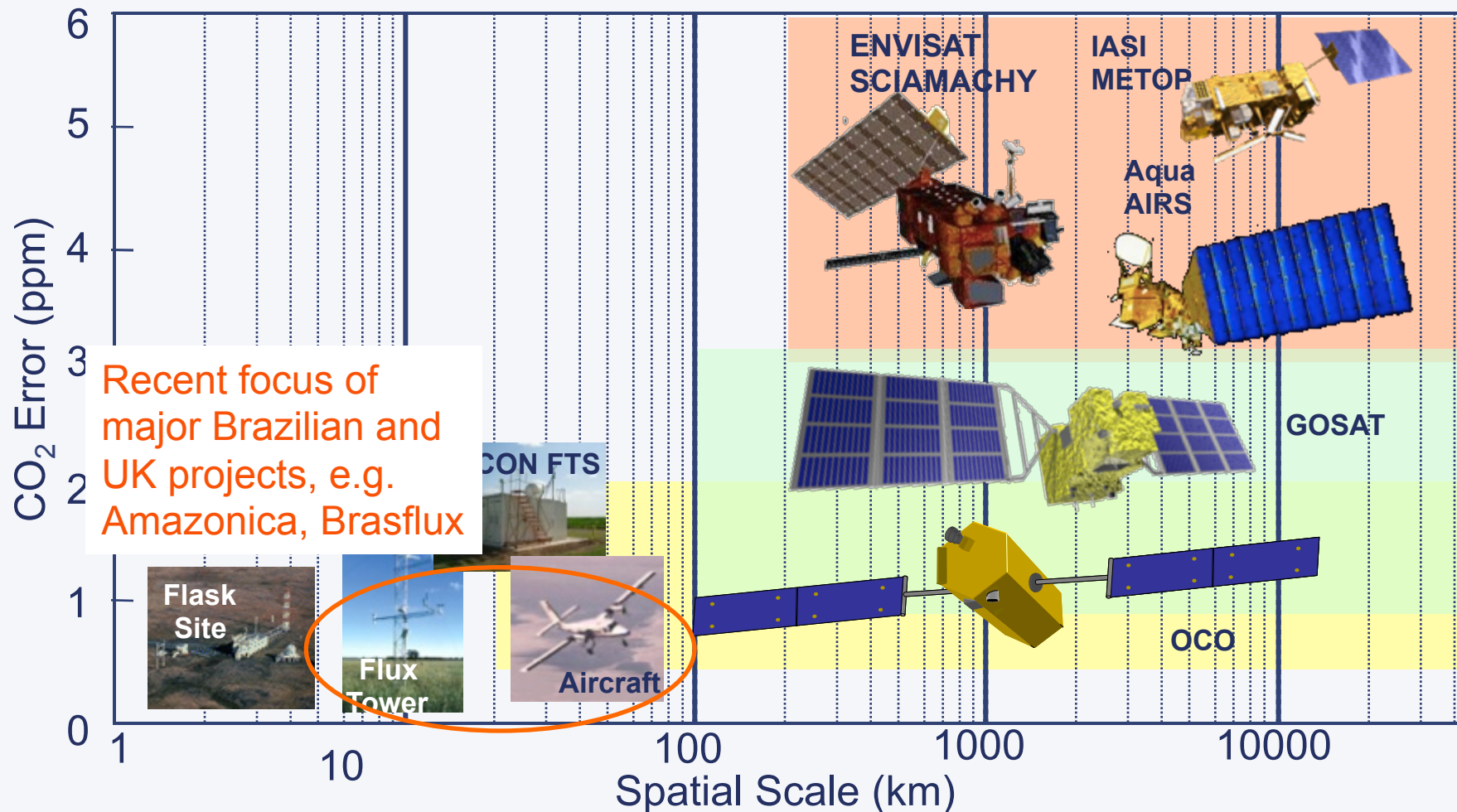


GHG Observations



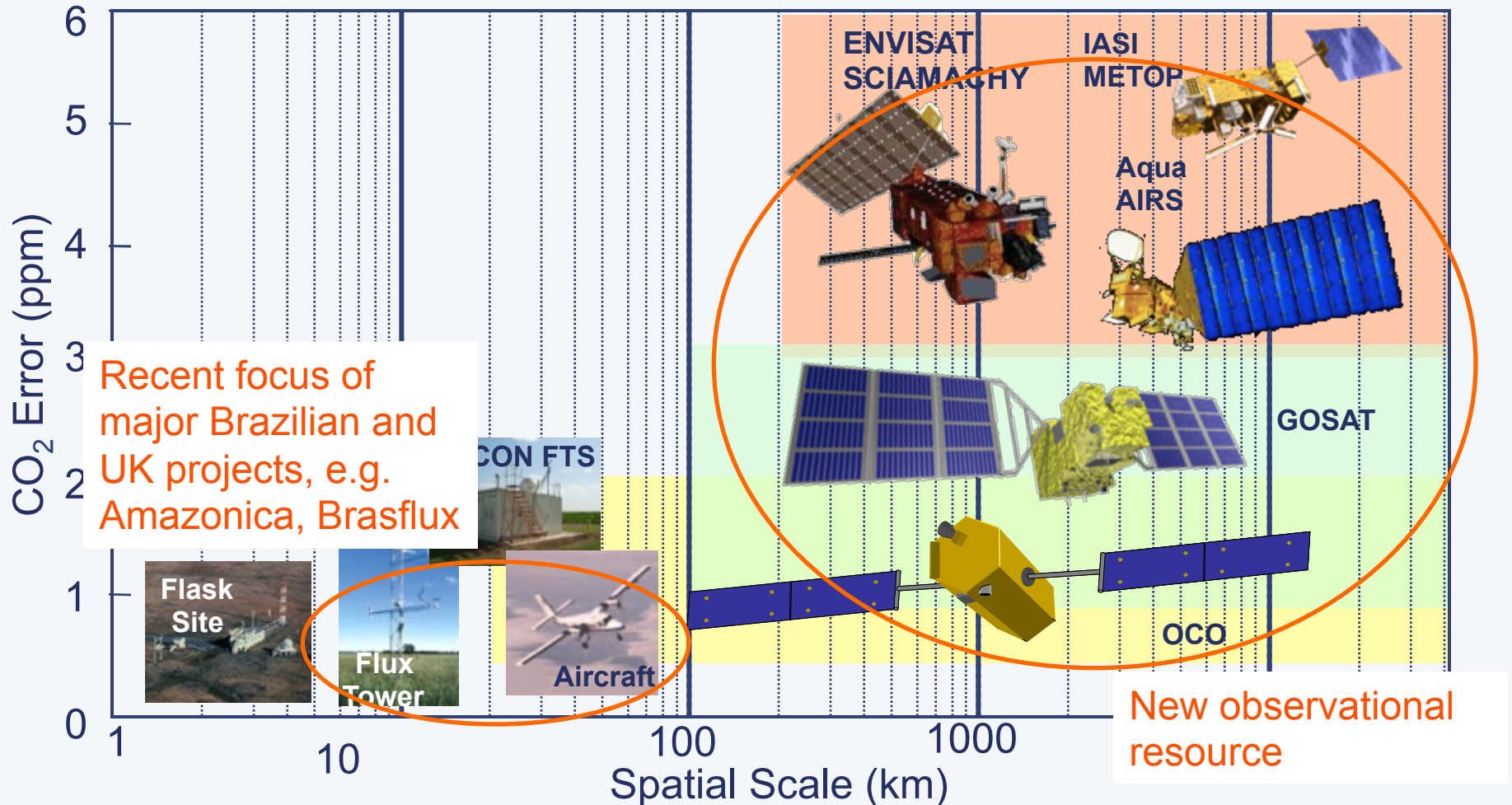
+ Remote sensing of land surface, fires, Fluorescence, add. trace gases, aerosols

GHG Observations



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GHG Observations

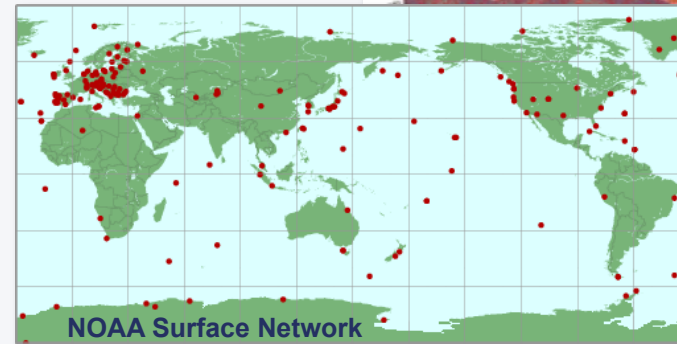
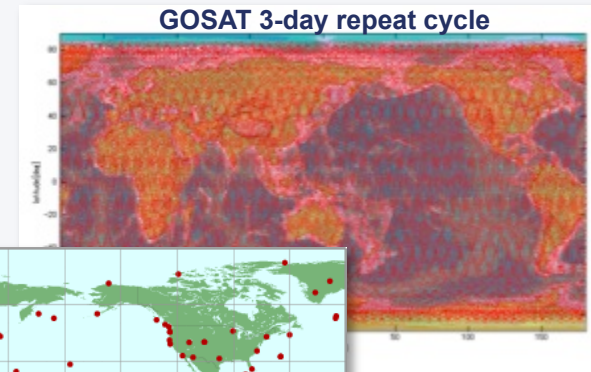


+ Remote sensing of land surface, fires, Fluorescence, add. trace gases, aerosols

What do space based observations of GHG offer?

Advantages

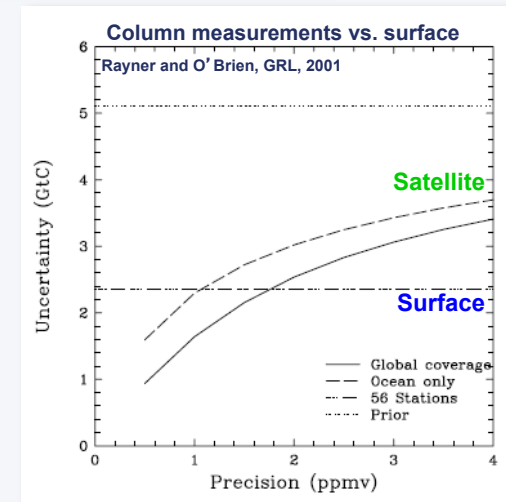
- Global
- Uniform
- Dense
- Frequent
- Source/sink estimation
- Quantification of underlying mechanisms



Challenges

- Column measurements
- High precision and accuracy is needed
 - Clouds, aerosol, albedo ...
- Sensitivity to surface

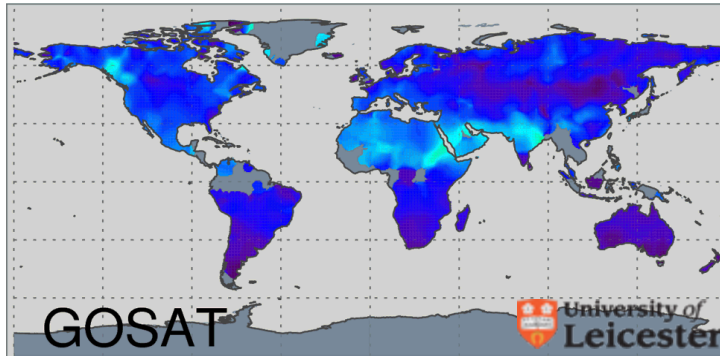
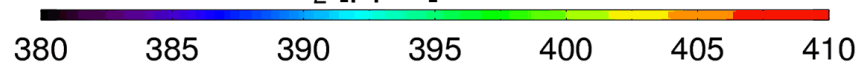
Offer great potential for ‘under-observed’ regions such as Tropics



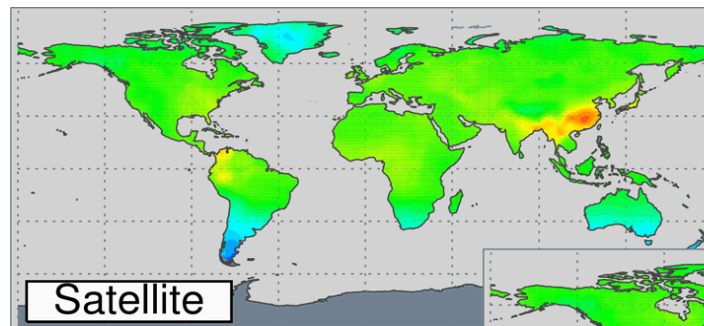
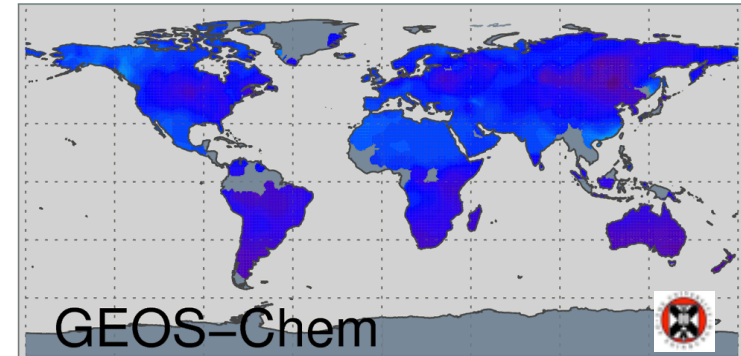
Satellite Remote Sensing of CO₂ and CH₄

Total Column Observations from GOSAT

XCO₂ [ppm] for 200906

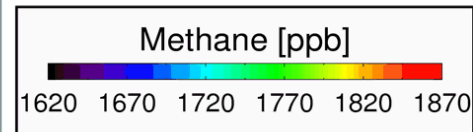
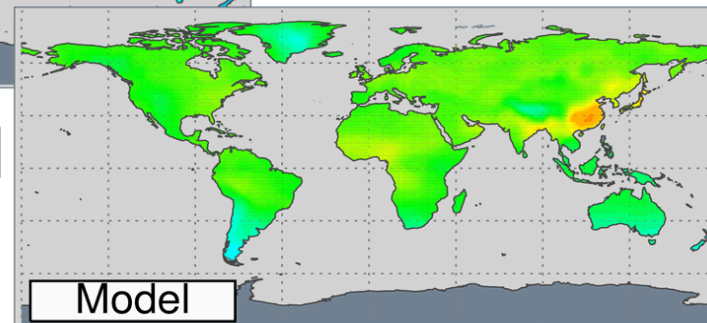


(Cogan et al., JGR, 2012)



June 2009

University of Leicester National Centre for Earth Observation
NATURAL ENVIRONMENT RESEARCH COUNCIL



(Parker et al., GRL, 2011)

<http://www.leos.le.ac.uk/GHG/data/>

Amazonian Carbon Observatory Network

Main Goals

- Evaluate feasibility of remote sensing of greenhouse gas (GHG) concentrations for the purpose of GHG flux monitoring over Amazonia
- Develop understanding of how these data can be integrated with in situ concentration data
- Develop a coherent long-term monitoring strategy of Amazonian carbon fluxes that includes in-situ and remotely-sensed data

Network project jointly funded by NERC and FAPESP with focus on

- Organizing workshops
- Exchanges and secondments between UK and Brazilian institutions
- Collaborative studies aligned with workshops



*Kick off meeting at IPEN,
Sao Paulo (3 and 4
September 2012)*



UK – Brazilian Project Team



**Hartmut Bosch (PI-UK),
Alex Webb, Robert
Parker**



Manuel Gloor, Chris Wilson



**Paul Palmer, Siegfried
Gonzi**



**John Miller (NOAA, USA)
Thorsten Warneke (IUP Bremen, Germany)
Cyril Crevoisier (LMD, France)
Manvendra Dubey (Los Alamos, USA)
Peter Bernath (Old Dominion, USA)**

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Domingues, Caio S.C.
Correia, Viviane Borges,
Angelica Pretto, Juliana C.
Izidoro, Carlos Rossatti**



**Saulo Freitas, Yosio E.
Shimabukuro, Dermerval
Moreira, Rodrigo Braz,
Liana O. Anderson**



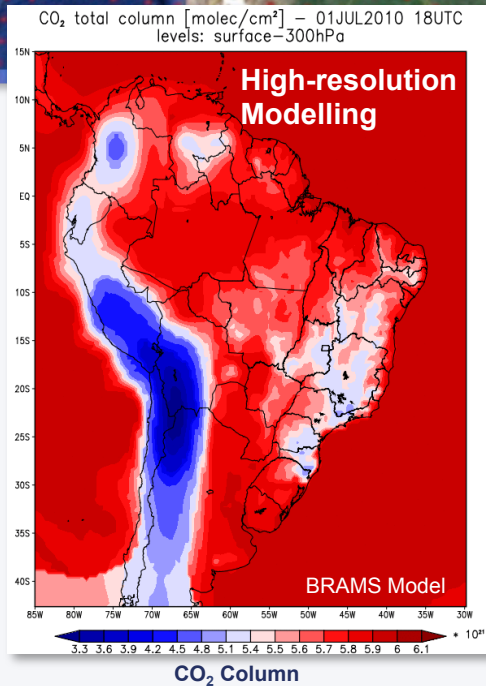
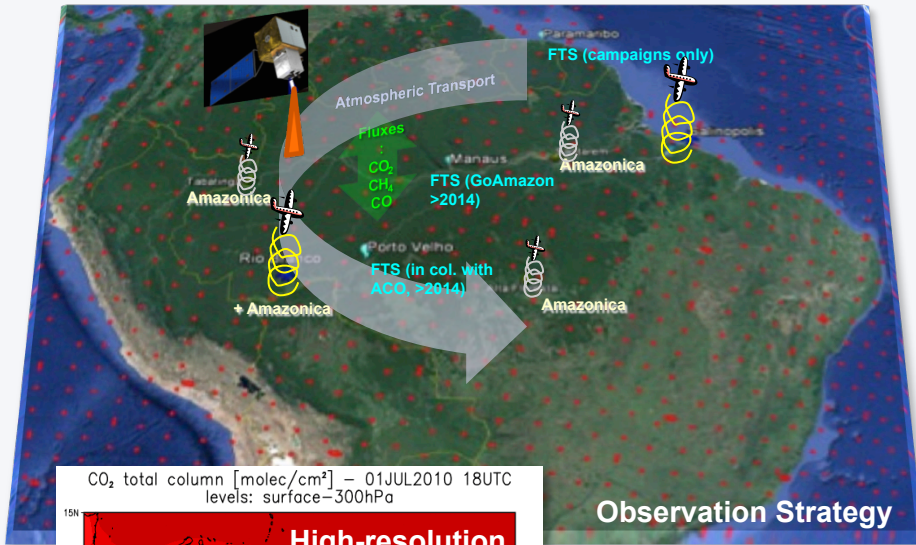
Humberto R. da Rocha



Project partners:

**Frederic Chevallier (LSCE, France)
Annmarie Eldering (JPL, USA)
Chris Jones (Met Office, UK)
John Grace and Patrick Meir (University of
Edinburgh, UK)
Martine De Maziere (BIRA, Belgium)**

Project Overview



WP2: 'Linking in-situ and remotely sensed data' (Boesch and Gatti)

- Aircraft in-situ observations
- Ground-based column observations (FTS)
- Satellite observations
- Data assimilation/Model calculations

WP3: 'Carbon surface flux estimation over the Amazon' (Palmer and Freitas)

- Atmospheric transport models
- Fluxes from in situ data and other sources
- Pilot study - Flux inversion from space-based data

WP4: 'Towards an integrative Amazonian Carbon Observatory' (Gloor and de Rocha)

- Synthesis of the outcomes of WP2 and WP3
- Development of a coherent strategy for an integrative Amazonian Carbon Observatory

High-Altitude Aircraft Profiling

First routine aircraft air sampling profiling up to 8 km (to better represent total column)

- Monthly profiles at coastal (Salinopolis) and central (Rio Branco) site with local aircraft
- Flask samples are analyzed at IPEN
- Location and data of GOSAT overpasses

Mitsubishi MU2
(Rio Branco)



Cessna Caravan (Salinopolis)

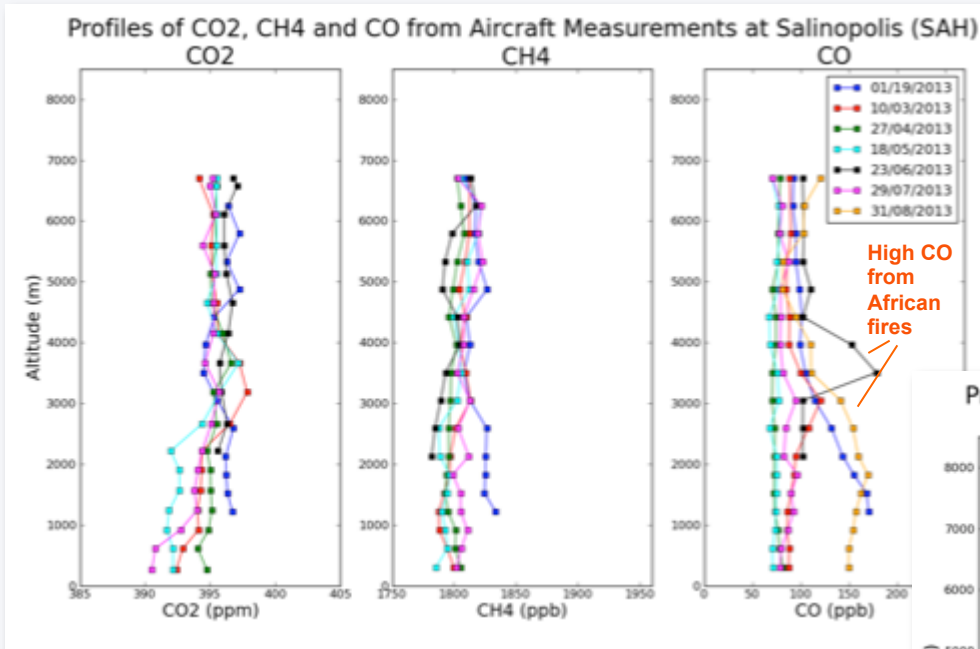


Semi-automatic portable Sampling
Unit with Flask Package



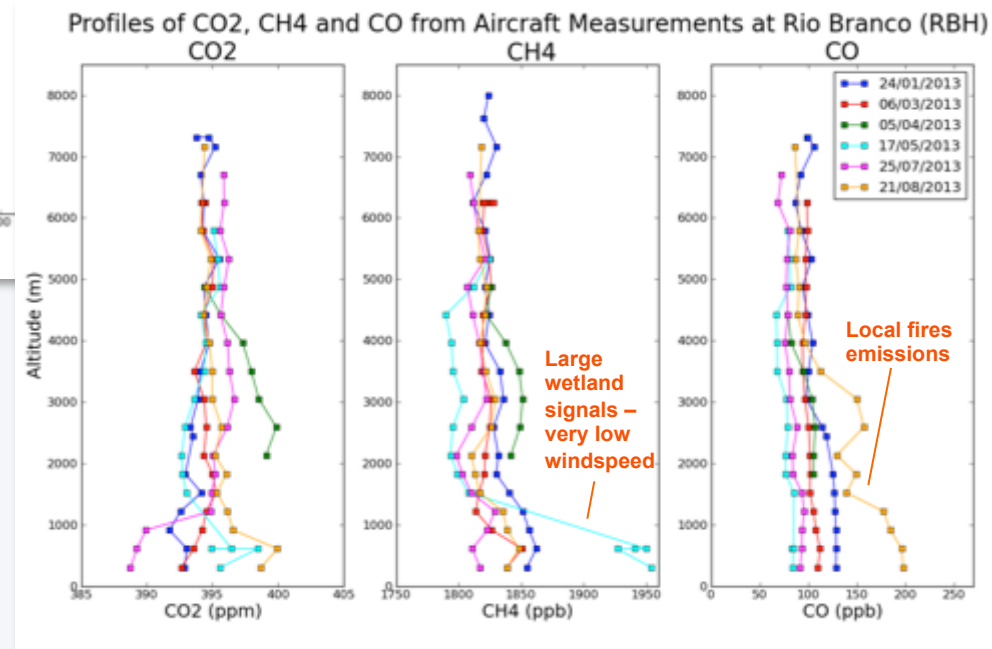
High-Altitude Aircraft Profiling

Coastal Site

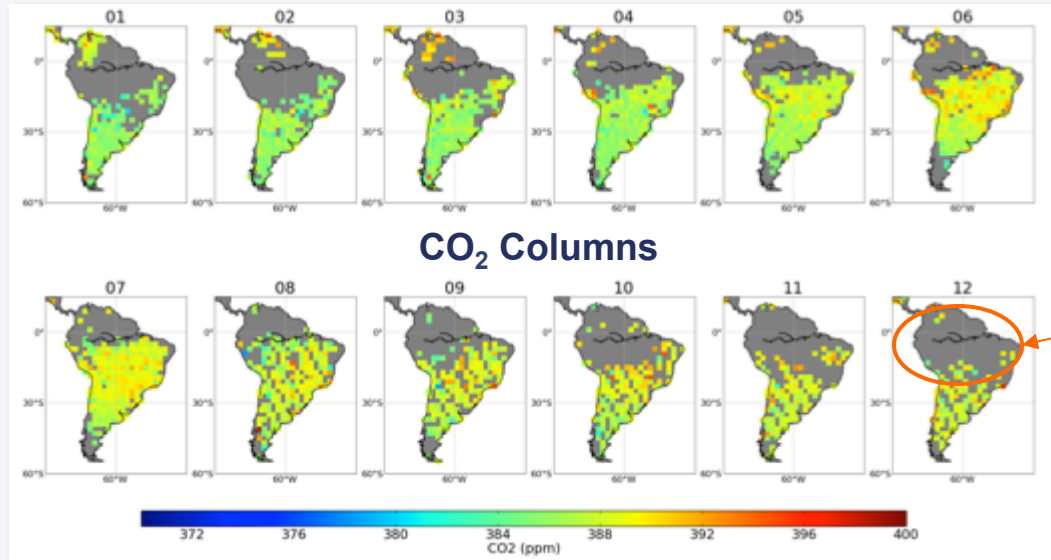


Low but noticeable variability in CO₂ and CH₄ above 5 km altitude

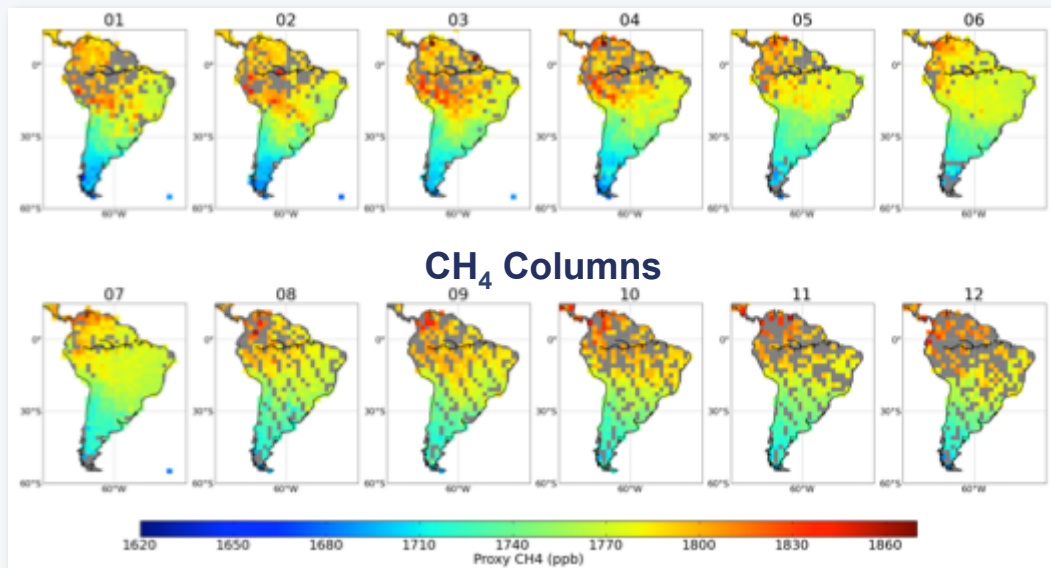
Amazon Basin Site



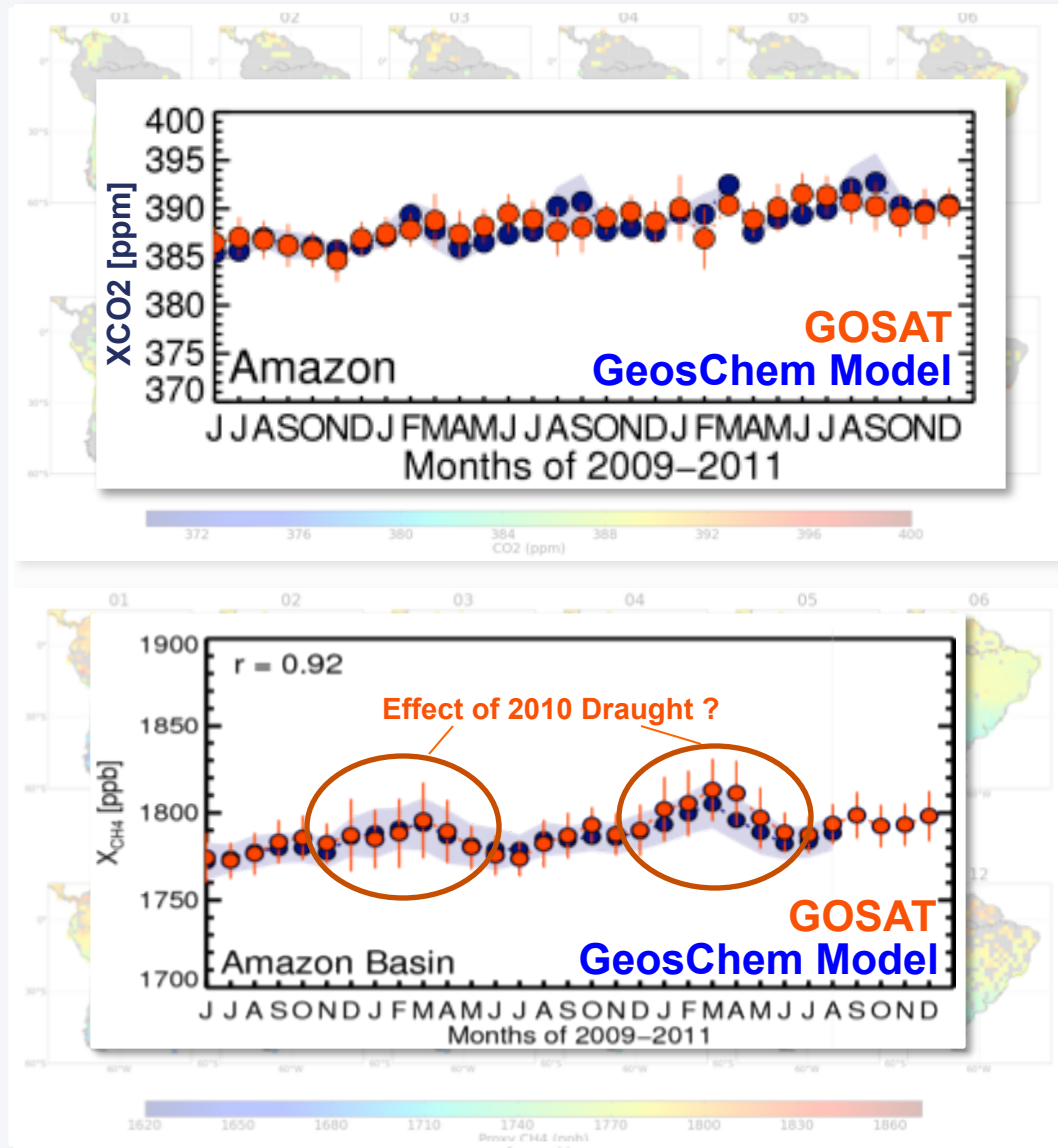
GOSAT Satellite Observations 2010



Significant cloud problem for CO₂ retrievals



GOSAT Satellite Observations



Next Steps

- Continue aircraft profiling program
- Model intercomparisons for Amazon region (UK models Geos-Chem and Tomcat and Brazilian model BRAMS)
- Include upper tropospheric CO₂ and CH₄ data from infrared satellite instruments (IASI) and attempt to increase coverage for CO₂ retrievals from GOSAT
- Detailed comparisons between observations from aircraft and satellite and models
- Organize open workshop in spring next year (probably in UK)

Summary

- Established a network between UK and Brazilian groups (and intern. partner) with very different backgrounds
- Main goal of Amazonian Carbon Observatory is to evaluate the feasibility of remote sensing of GHG concentrations for GHG flux monitoring over Amazonia
- Number of key activities are on-going in UK and Brazil
- Finding of WP2 will be discussed in open workshop in spring 2014.

If you are interested then please get in touch with us

Web: <http://www.leos.le.ac.uk/GHG/ACO/index.html>