Requirements for the high resolution satellite imagery of atmospheric GHG in view to monitor the emissions from large cities

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[2]IUP, Univ Bremen, Germany
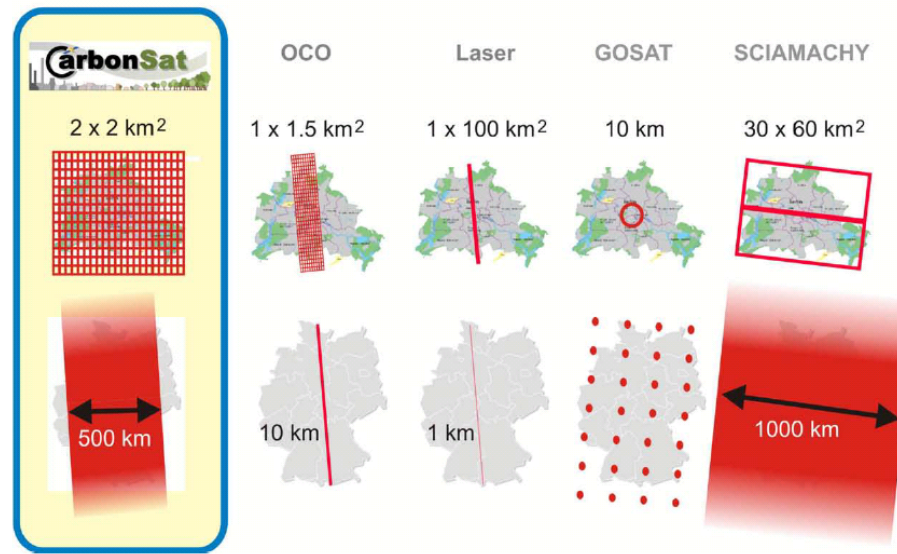**[3]AIRPARIF**, Paris, France

**and other
LOGOFLUX I & II (ESA) and BridGES partners**

High Resolution imagery for monitoring GHG city emissions

- Political need for **improving / verifying** the estimate of **emissions from cities**

- Increasing number of **city scale in situ CO2 measurement networks**:
  - ➤ difficulties to deal with **local signals**, to get integrated views of city plumes
  - ➤ **political issues** for setting-up in situ networks dedicated to verification

- Plans for **HR imagery of XCO2/XCH4: Carbonsat (2 km / ~5 days) & propositions for XCO2 with Sentinel-5 (8 km / ~1 day)**

- ➤ Study of its potential for quantifying emissions of large cities: **tests for Paris**
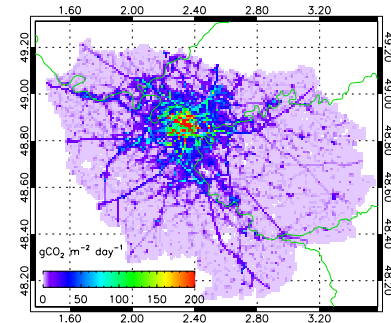
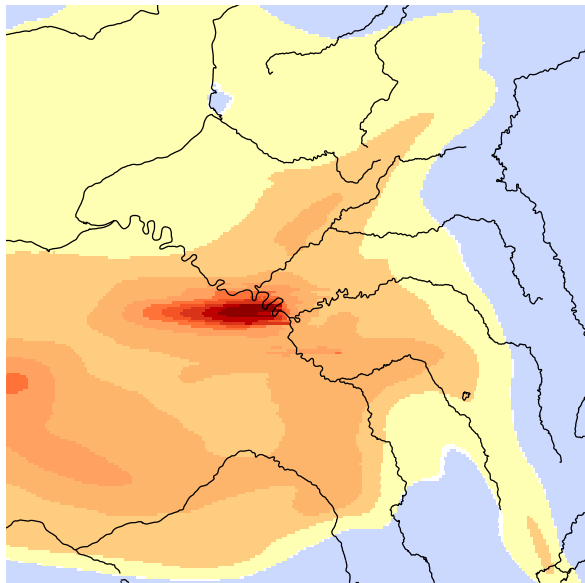*Satellite measurement footprints*

Modelling the Paris CO2 plume seen from space

- Paris = "easy" case (dense city remote from other large urban areas, flat topography)

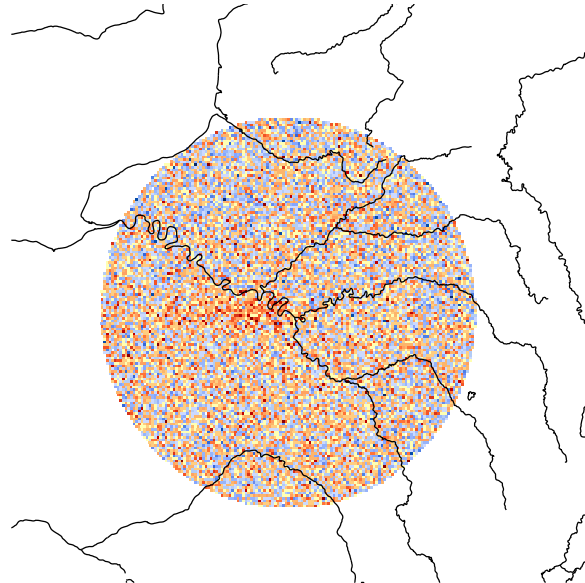- The signature of 1-hour emissions vanishes from the XCO2 image in ~5-6 hours

Annual Fossil Fuel emissions in the Paris area (total ~ 15MtC; AIRPARIF)
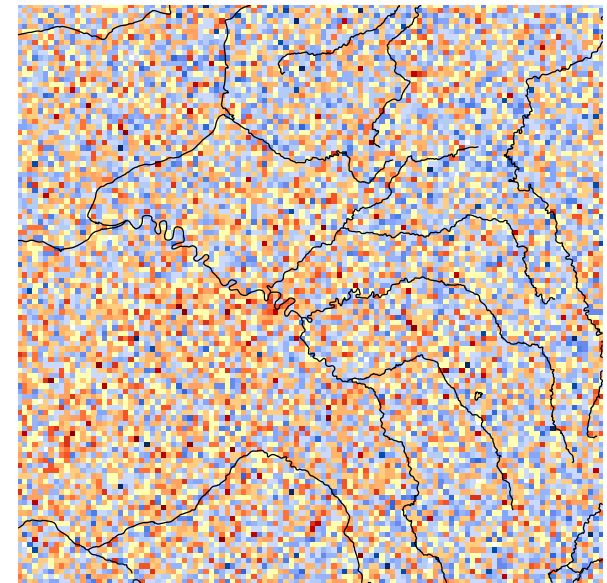

XCO2 spatial variations in the modeling domain on Oct 6 2010 at 11:00

Simulation at 2km res without measurement error
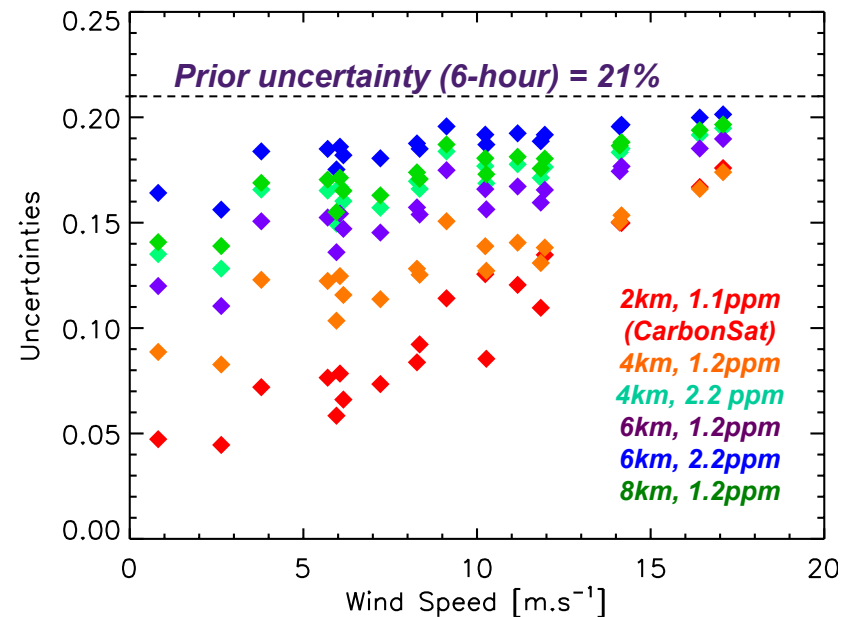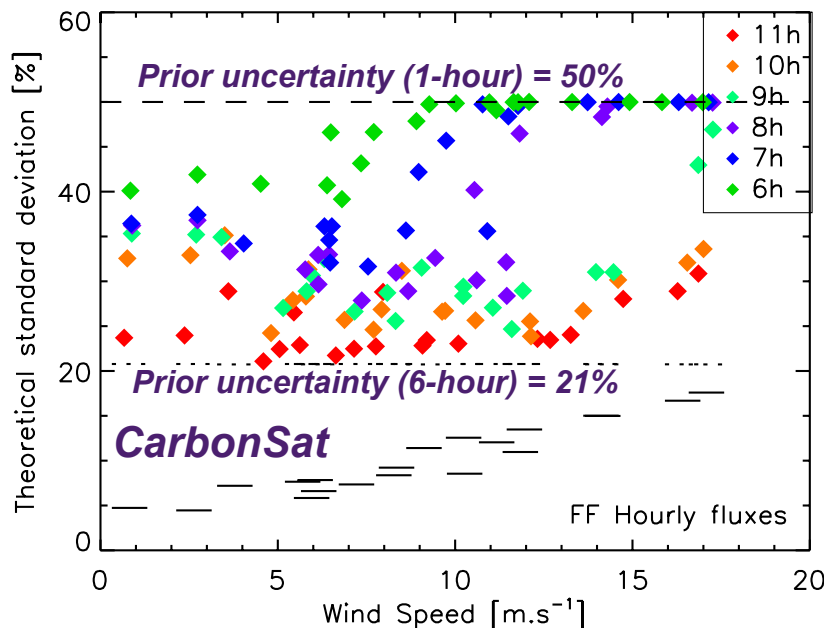
CarbonSat obs with 1.1 ppm measurement noise

4km imagery with 1.2 ppm measurement noise

Results for CO2 with an optimistic configuration

- **Use individual images at 11:00** to retrieve **the emissions 6 hours before**

➤ 20 test cases (20 days in Oct): dependence of the results to the wind speed

- Ignore transport errors, clouds, systematic errors

- **20-70% uncertainty reduction for 6-hour emissions** with Csat, potential to solve for temporal profiles, **dependence to space res and meas error**
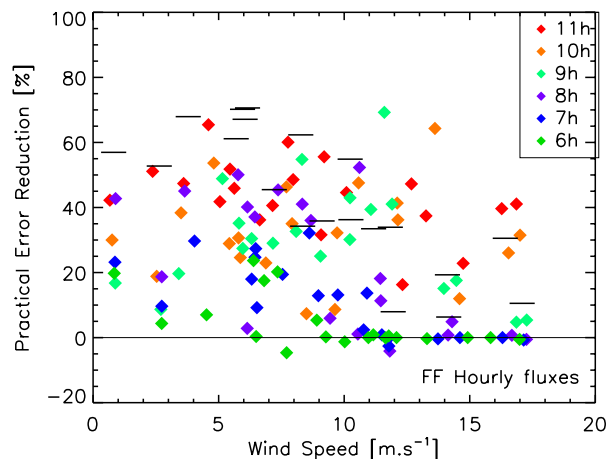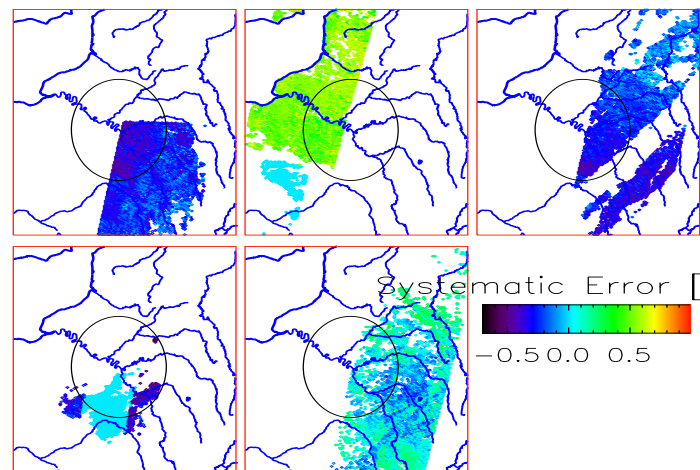

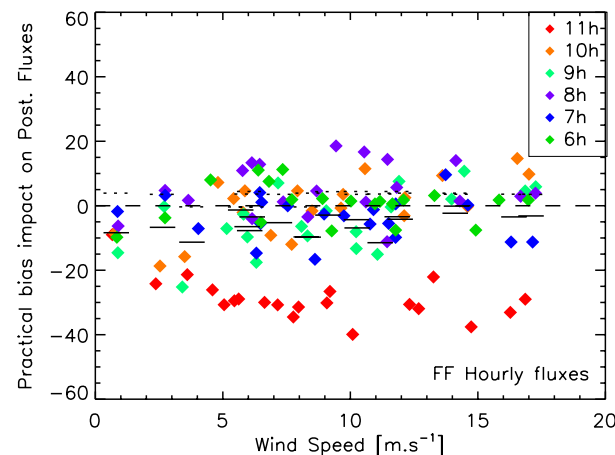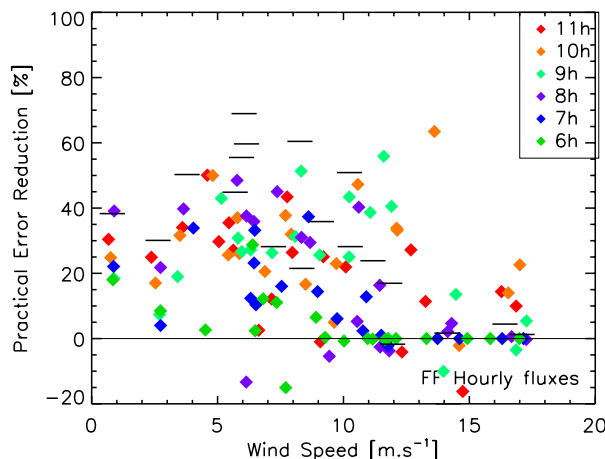*Posterior uncertainty in hourly and 6-hour mean emissions*

Cloud cover and systematic errors for CarbonSat XCO2

- **Using 1-year simulations by IUP Bremen**

➤ only 19 useable images. **Need for other data to derive daily to annual budgets. Ability to monitor trends ?**

➤ smaller uncertainty reduction and **large biases in fluxes. Solving for systematic errors: a critical challenge. Complementarity with ground based networks ?**

Random uncertainty reduction when accounting for cloud cover without and with systematic errors
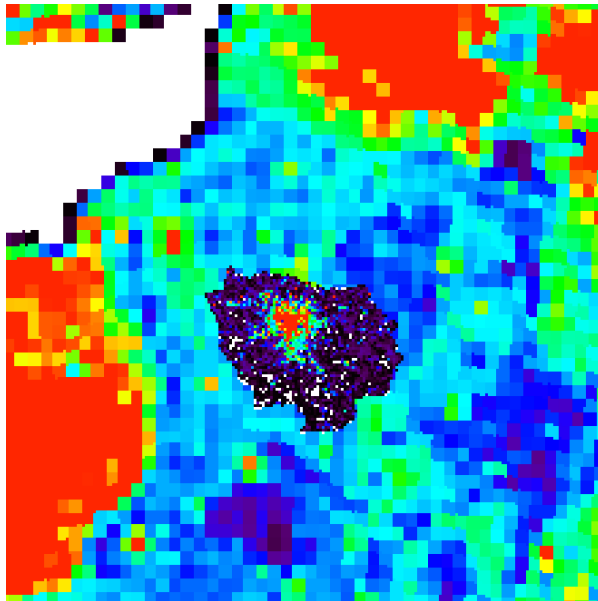
Posterior biases when including syst errors

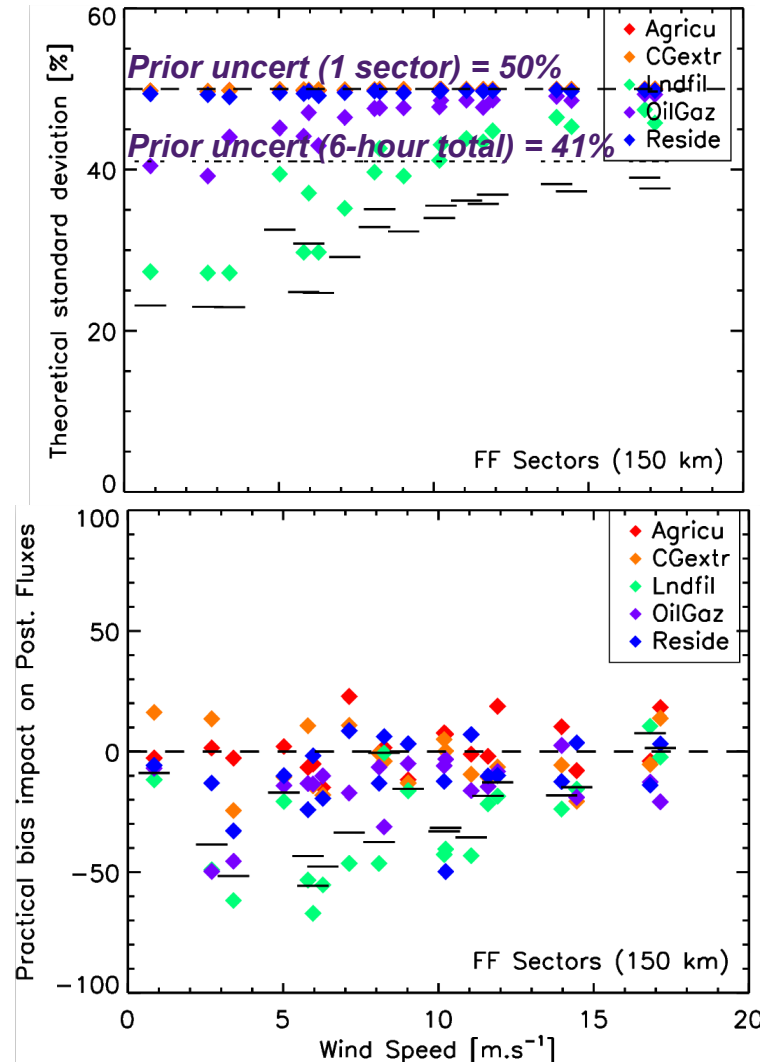LABORATOIRE DES SCIENCES DU CLIMAT & DE L'ENVIRONNEMENT

Inversion of the CH4 emissions using CarbonSat XCH4

- Only landfills can be monitored ?

- Large biases when including systematic errors

➤ **Cities: good test cases for CH4 ?** Need to focus on larger sources (e.g. gas extraction) ?

CH4 emissions in Northern France: AIRPARIF for Ile de France and EDGAR

Uncertainties with 9ppb meas noise only, and bias with syst errors