GHOST & Global Hawk: A Science User Perspective

Global Hawk hangar at NASA Armstrong, Edwards Air Force Base, California

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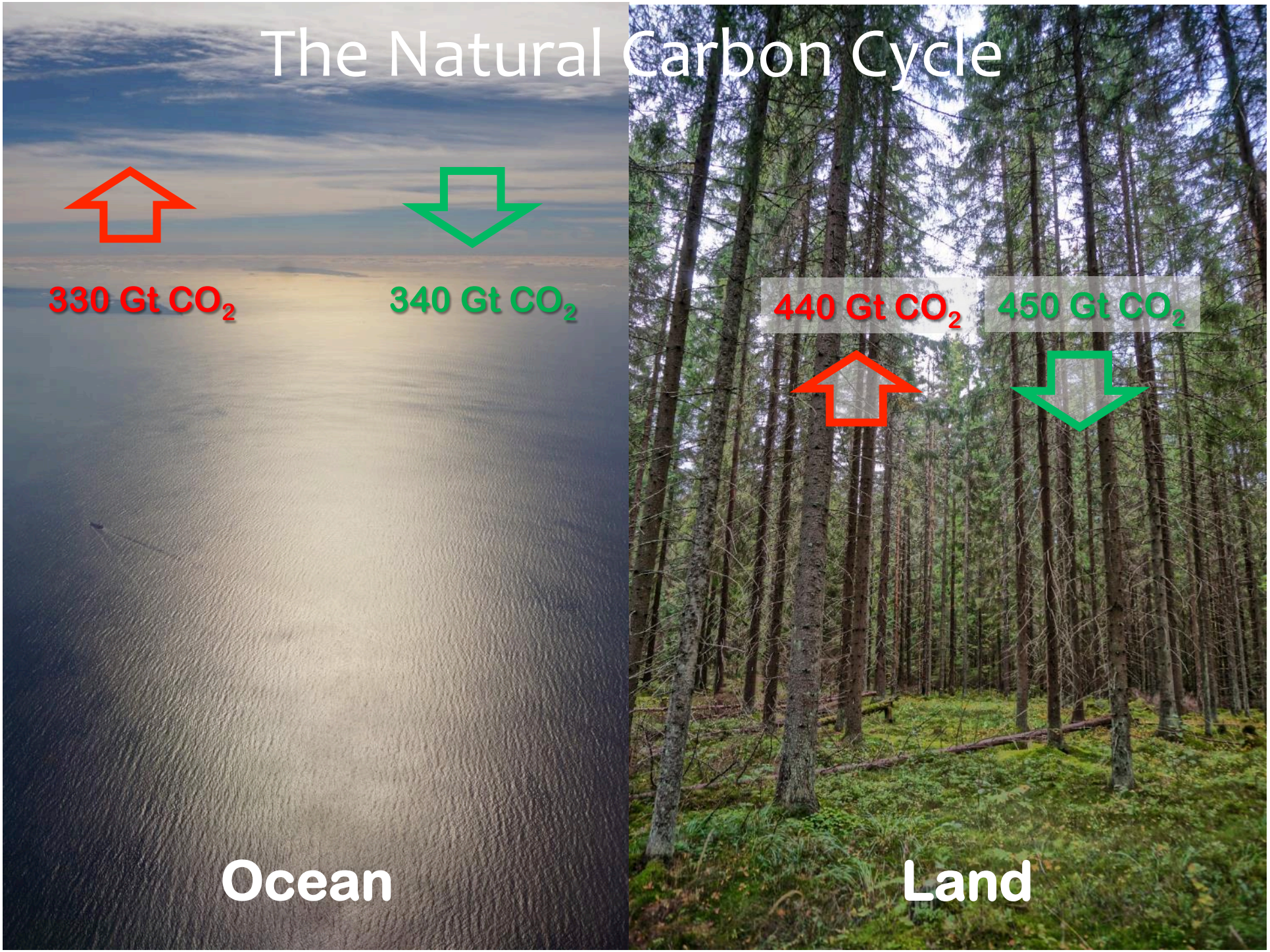
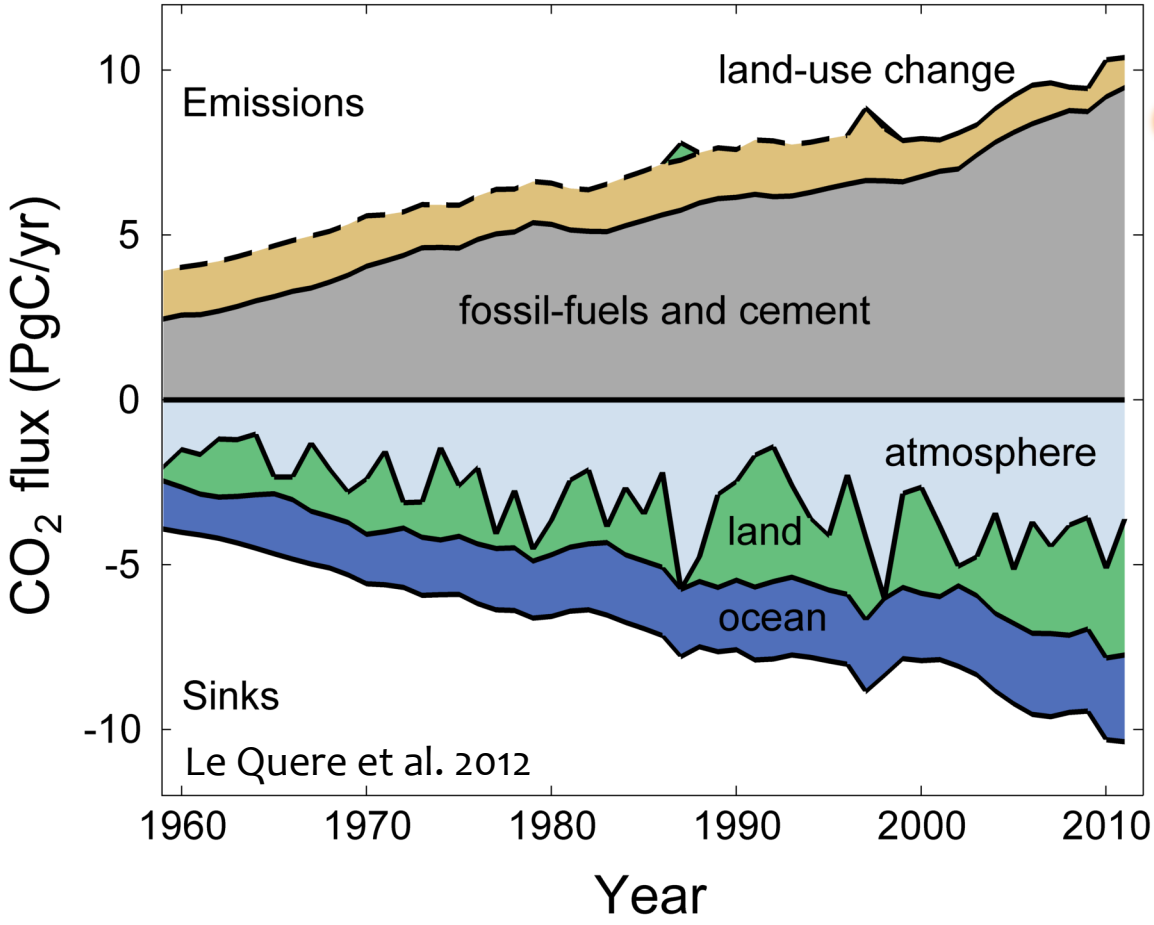

The Natural Carbon Cycle
330 Gt CO_2
340 Gt CO_2
440 Gt CO_2
450 Gt CO_2
Ocean
Land

Sources & sinks of CO_2



2003-2012 Sources (PgC/yr)

- LUC: 0.8±0.5 (9%)
- FF: 8.6±0.4 (91%)

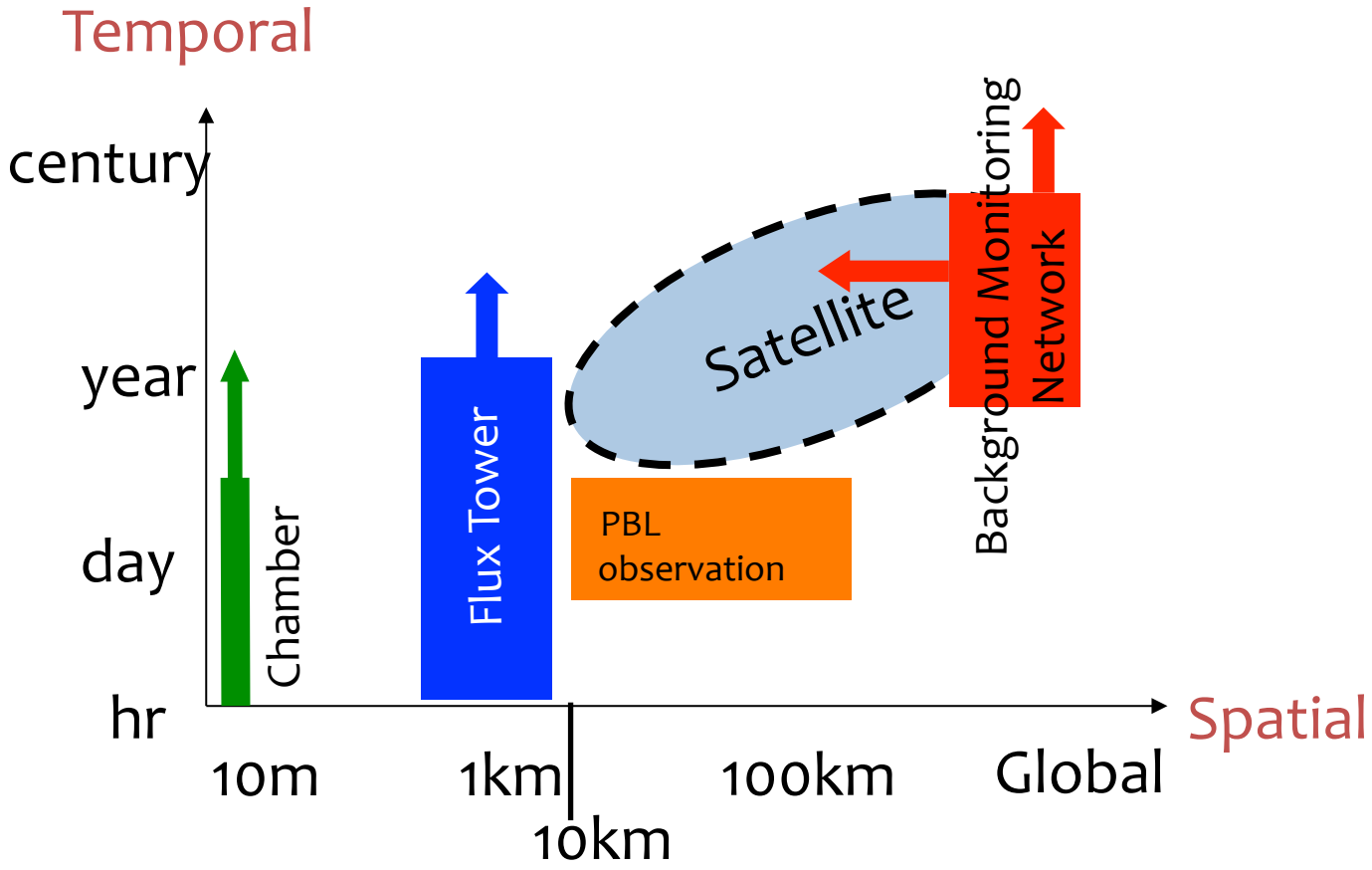
2003-2012 Sinks (PgC/yr)

- Atmosphere: 4.3±0.1(45%)
- Ocean: 2.6±0.5 (27%)
- Land: 2.6±0.8 PgC/yr (28%)

(land estimate residual)

- What natural processes absorb half of the CO2 emitted by human activities?
- Why does the amount of CO2 absorbed change from year to year?
- Will this change in the future, as the climate changes?

Evaluation of space-borne XCO2data : "missing" scale filled by Global Hawk-like UAV



(Significant) ongoing challenges:

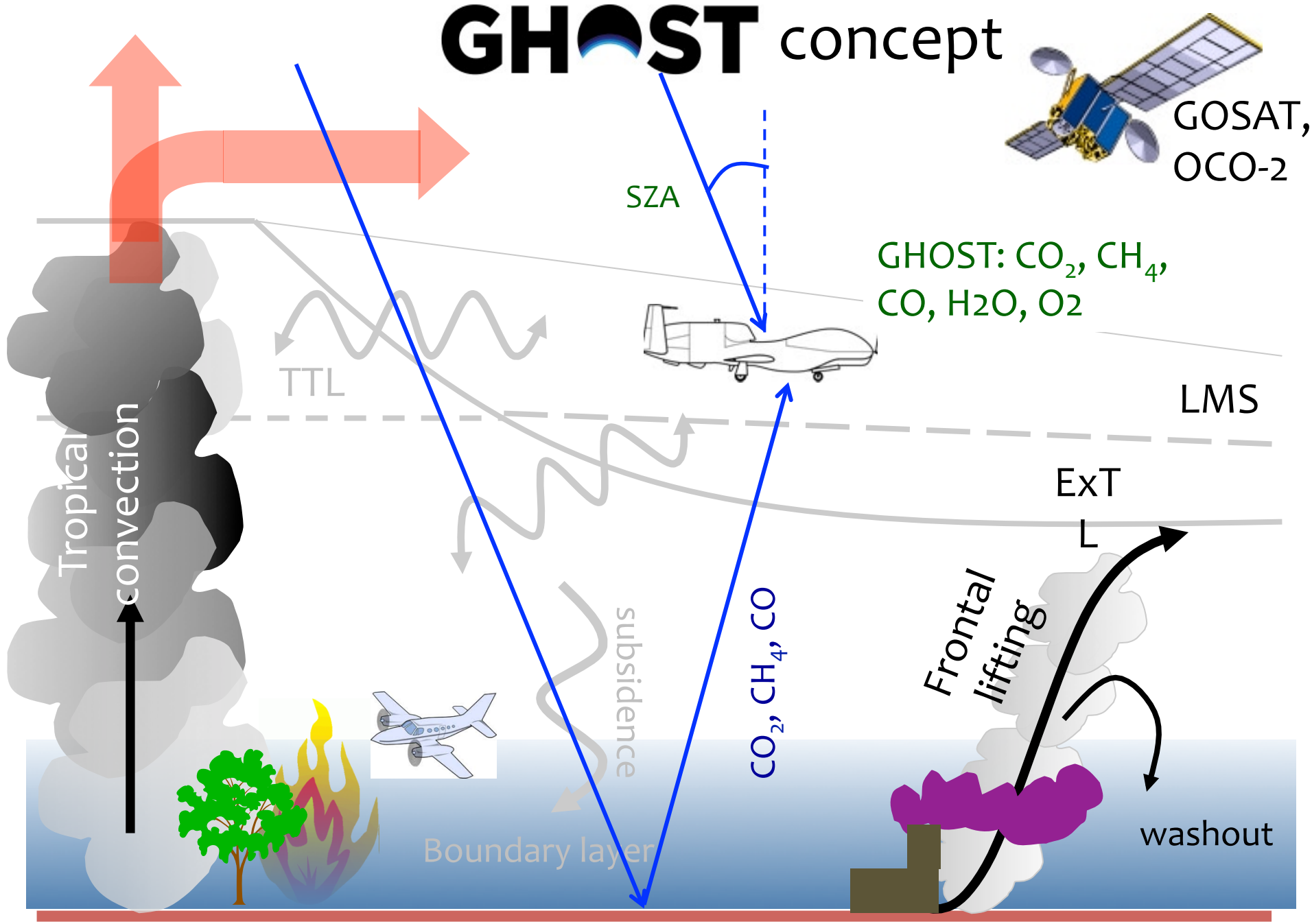
1) Traceability between measurements and science and policy needs; &/or

2) Complementary data used for e.g. source attribution.

Current space-borne XCO2 ground-truthing strategy to improve accuracy

TCCON
total carbon column observing network

A growing network of upward-looking Fourier transform spectrometers

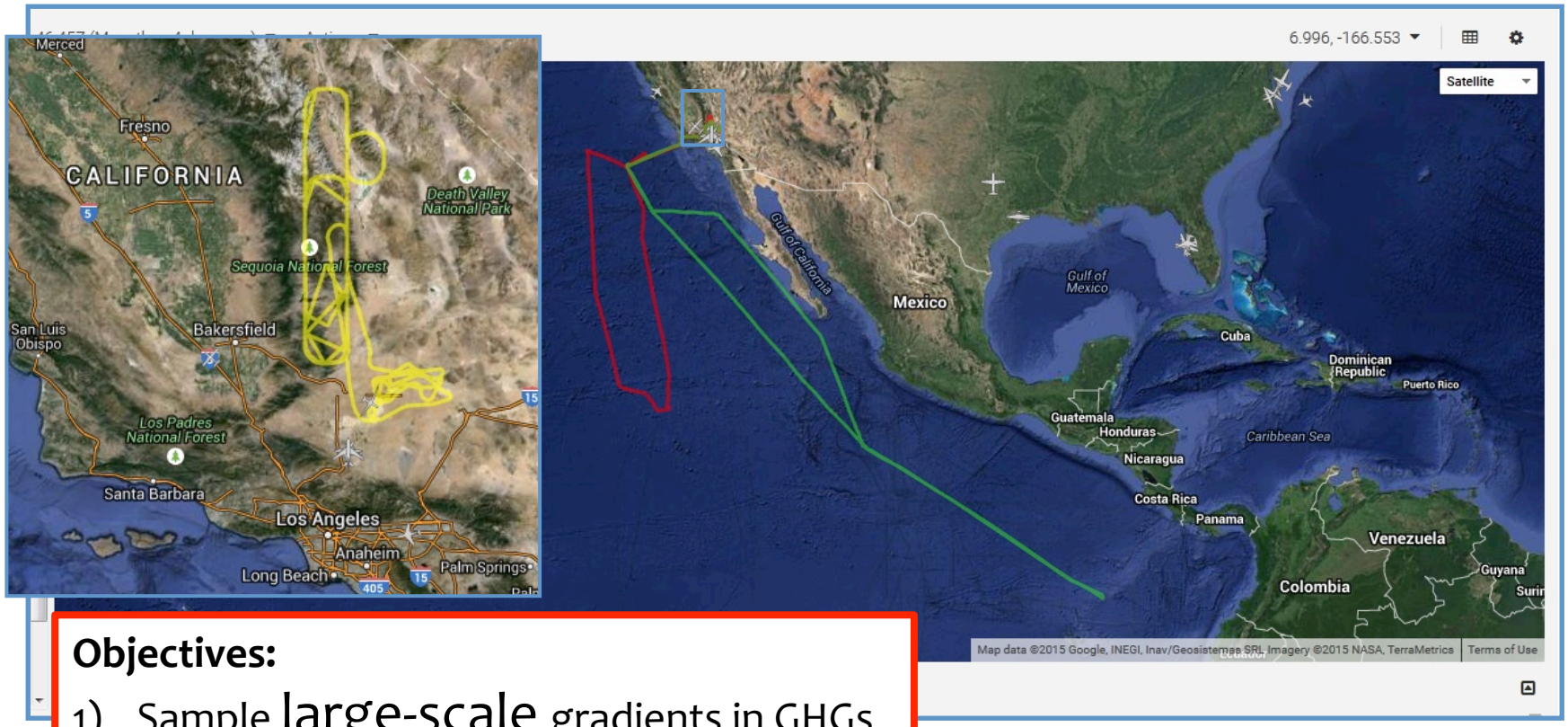

GHOST concept
GOSAT,
OCO-2
SZA
GHOST: CO_2, CH_4,
CO, H2O, O2
TTL
LMS
ExT
L
Tropical
convection
subsidence
CO_2, CH_4, CO
Frontal
lifting
washout
Boundary layer

What makes the Global Hawk an attractive sub-orbital platform?

- Endurance (altitude and duration)
- Maneuverability
- GH science team support underpinned by NASA airborne science program (existing investment and expertise)

Global Hawk range and science flights

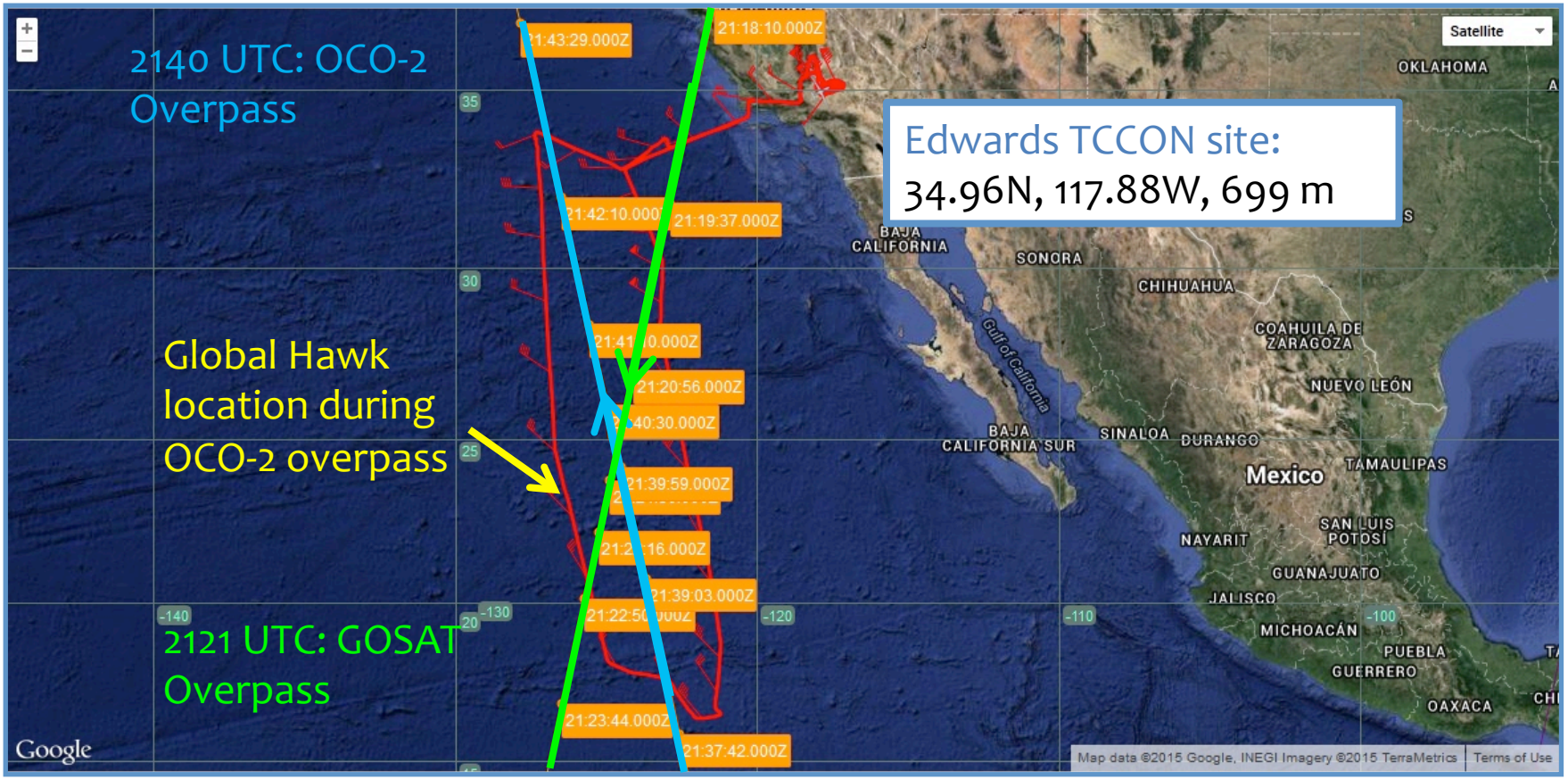
- 26th February 2015 1500 UTC (0700 local, 6.5hr duration)
- 5th March 2015 0400 UTC (2000 local, 21hr duration)
- 10th March 2015 1700 UTC (0900 local, 11.5hr duration)



Objectives:

1) Sample large-scale gradients in GHGs
2) Learn how to use suborbital platform

2nd science flight: satellite overpasses



What makes the Global Hawk less than perfect for UK science?

- Not a UK platform - one-off investment without equity
- Limited accessibility
- Large platform often shared with other science instruments that have conflicting science objectives (e.g., clouds, profiles through cold spots)
- Longevity of Global Hawk programme within NASA – exploration philosophy determined by engineering
- Can't fly over land (limits applications)

Smart cities minimize GHG emissions

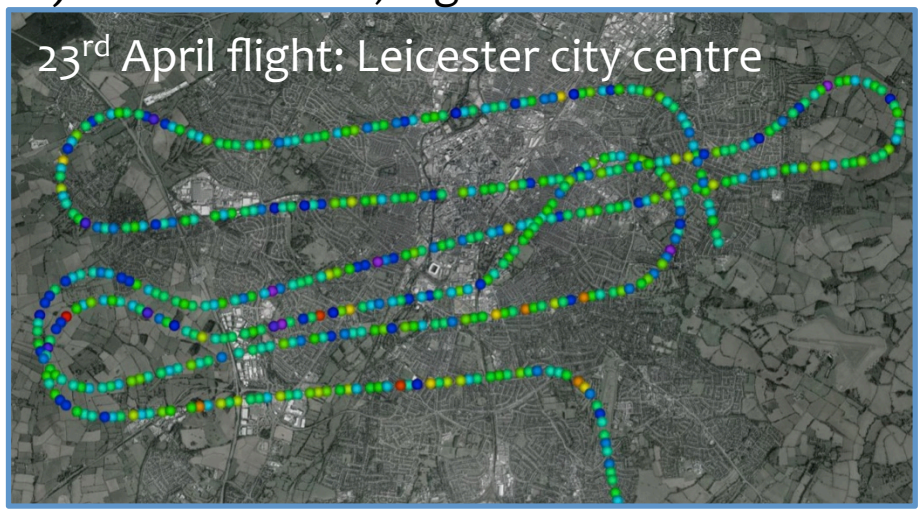
- Other markets are beginning to open
- Need to look for platforms to "own" and develop

(Speaking to Lloyd's of London insurance market)
The Financial Stability Board is considering recommending that G20 national develop a regime of "consistent, comparable, reliable and clear disclosure" of the carbon intensity of different financial assets.

Mark Carney
Governor
Bank of England

Objectives:

1) Sample city-scale gradients of GHGs
2) Point sources, e.g. landfills



Concluding remarks

- The Global Hawk is in many ways the ideal airborne demonstrator platform
- GHOST on the NASA Global Hawk was a unique opportunity and a fantastic experiment

- Unlikely we could rely on this platform for UK science
- Current restrictions on UAVs limits science applications
- Manned/satellite platforms are the way forward for GHOST

- Mood music is that new markets will open for GHOST
- There is an urgent demand for a UK-based airborne demonstrator platform