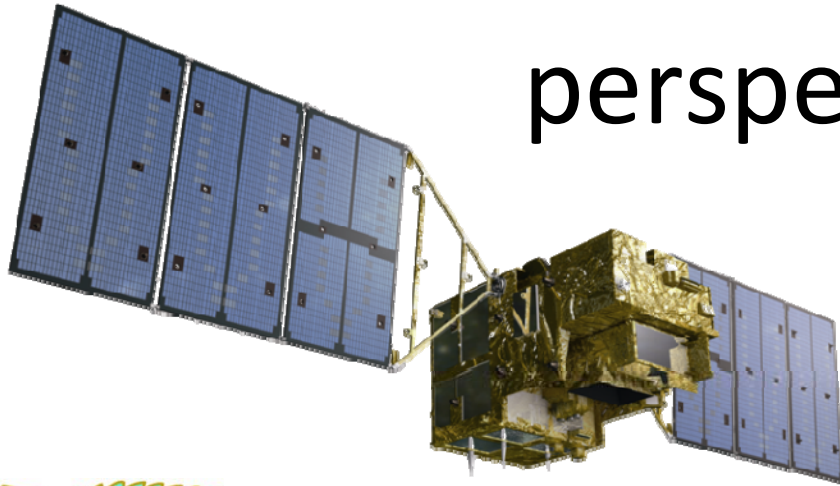


GHG monitoring from outer space

- current outcome and future
perspective -



**SBSTA36 Research Dialogue
Bonn, Germany
19 May 2012**

TATSUYA YOKOTA

National Institute for Environmental Studies (NIES), Japan

GOSAT project is a joint effort of JAXA, NIES, and MOE of Japan.

Brief history of space-based GHG monitoring (CO₂ and CH₄)

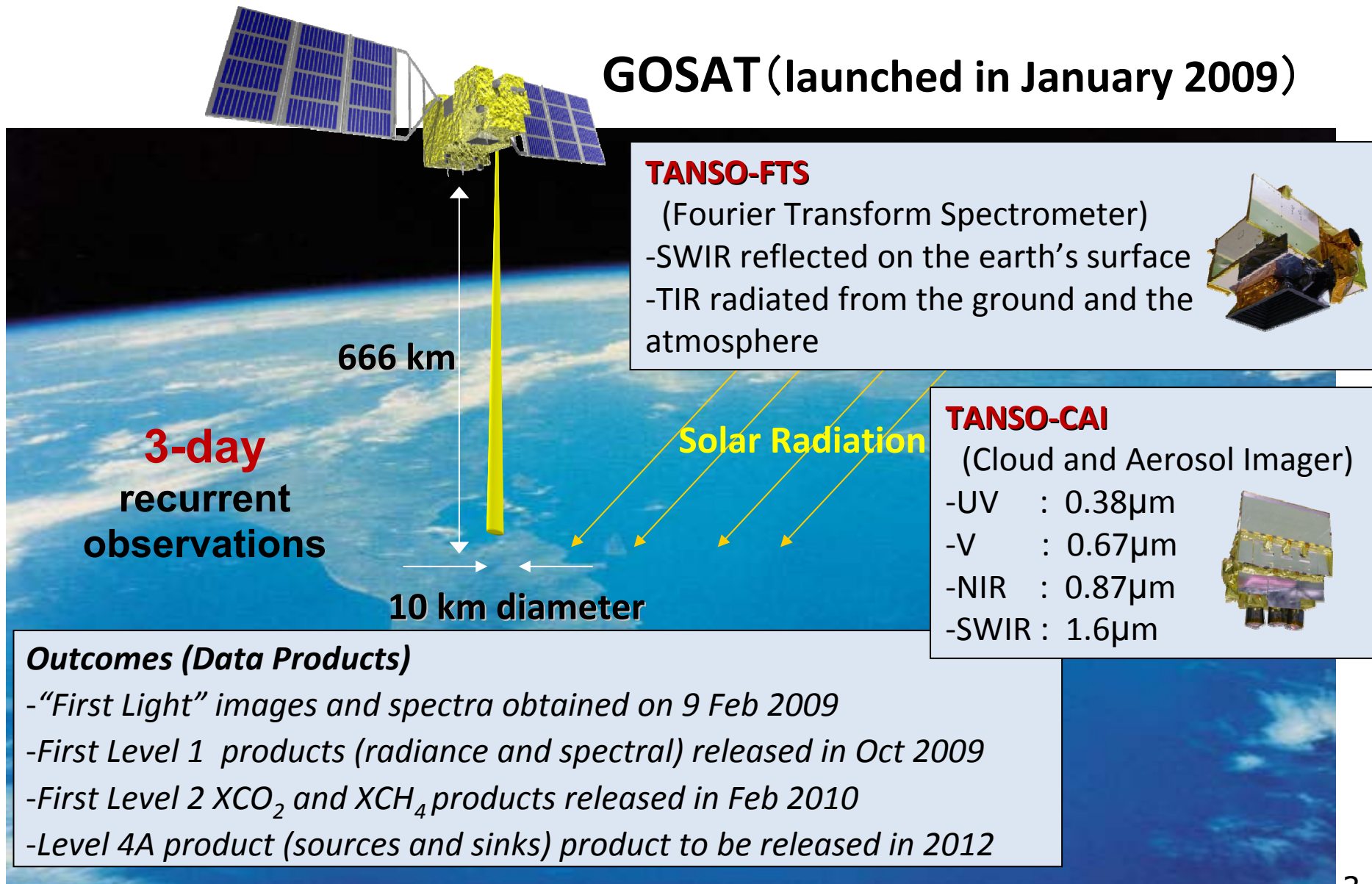
- **SCIAMACHY on Envisat (ESA): 2002 – 2012 (10 yrs)**
- **AIRS on Aqua (NASA) : 2002 – (more than 10 yrs)**
- **TES on Aura (NASA): 2004 – (almost 8 yrs)**
- **IASI on MetOp-A (EUMETSAT): 2007 – (5 yrs)**
- **TANSO on GOSAT (JAXA, NIES, MOE):**
 - 2009 – (more than 3 yrs)
 - The first satellite dedicated to monitor GHGs
 - Many researchers in the world are using GOSAT data
 - To retrieve concentrations of CO₂ & CH₄ more accurately
 - To reduce uncertainty in estimates of CO₂ fluxes

Objectives of the GOSAT Project

1. To obtain the global distributions of GHG concentrations (CO_2 and CH_4) and their temporal variations
 - To visualize changing GHG global distributions
 - To fill out the blanks in the network of ground monitoring stations
2. To improve accuracy of the carbon flux (sources and sinks) estimation on a sub-continental scale
3. To develop technologies for future GHG observing satellites.

GOSAT observation, Sensors, and Products

GOSAT (launched in January 2009)

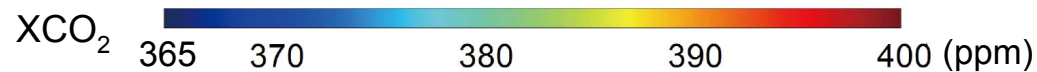
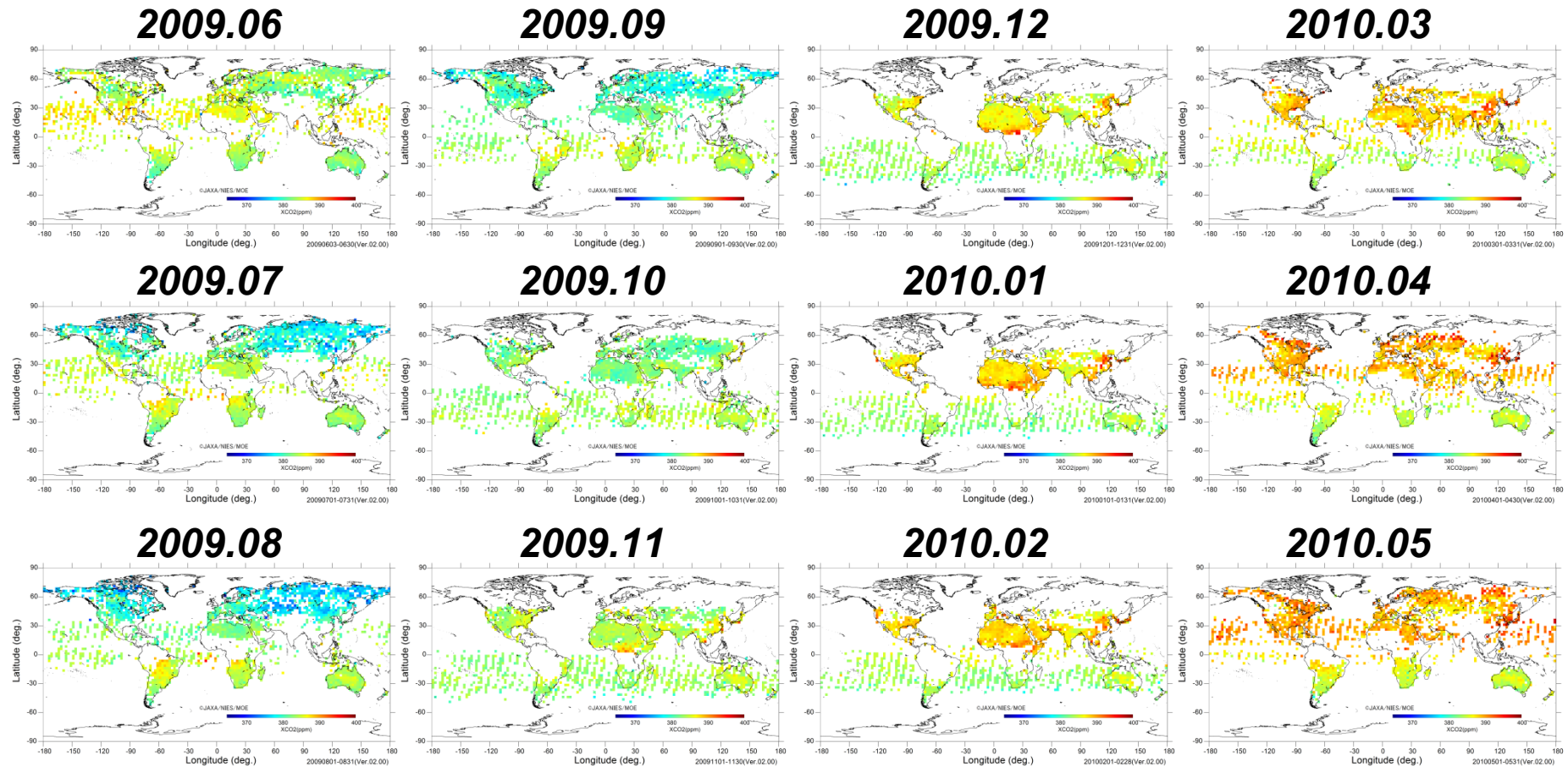


Fact 1: GOSAT has observed globally.

[2.5 deg. grid monthly means of XCO₂]

(TANSO-FTS SWIR Level 2 Ver.02.00)

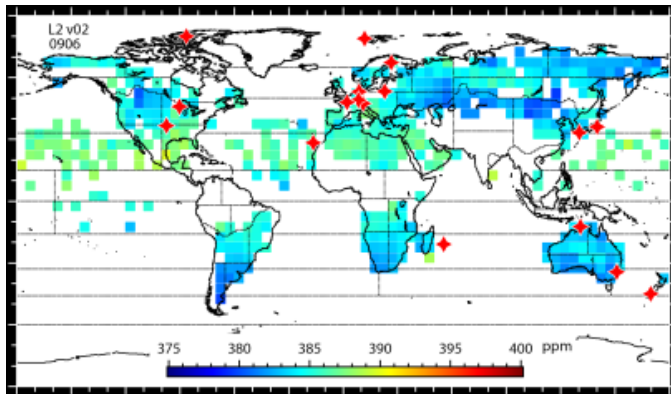
Ex.) June 2009 – May 2010 (12 months)



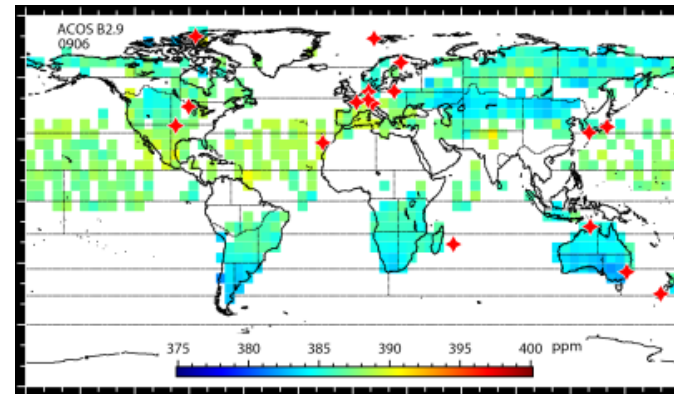
Fact 2: Institutes and universities in the world have retrieved column CO₂ (XCO₂) using different algorithms.

(Data for April 2010)

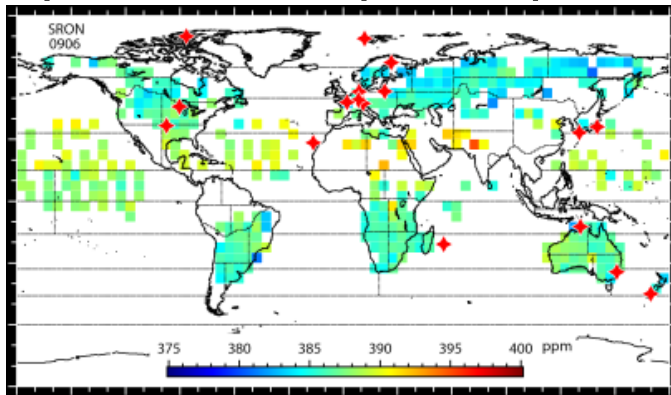
NIES (Japan)



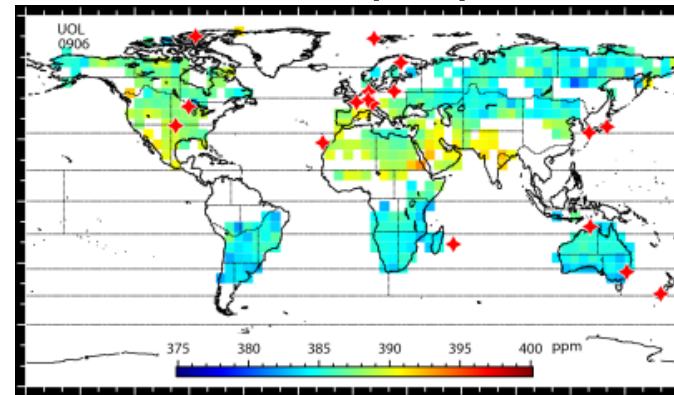
ACOS (USA)



SRON (Netherlands) / KIT (Germany)



UoL (UK)

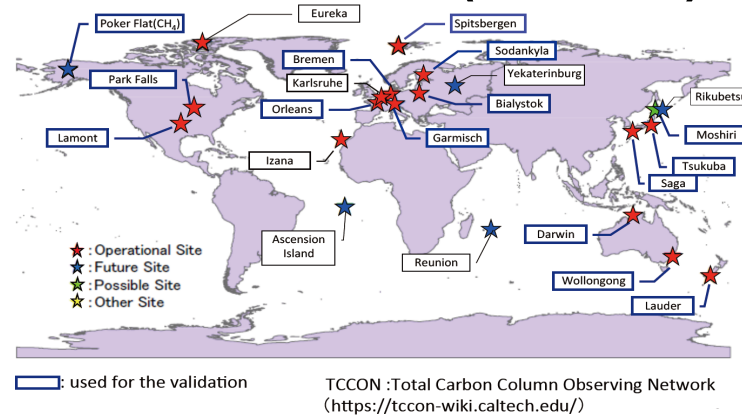


(+ : TCCON validation sites)

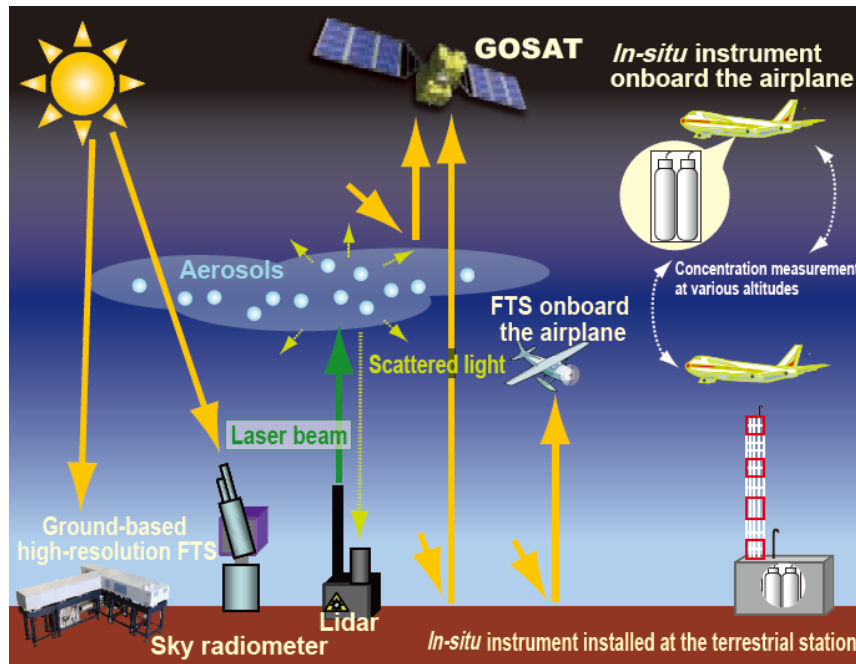
(by H. Takagi (NIES))

Fact 3: Several teams in the world have validated the retrieved XCO₂ with data obtained by ground-based FTSs and aircraft.

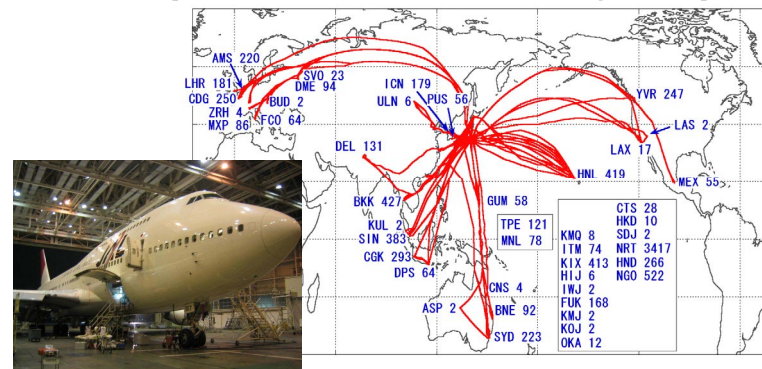
Data from ground-based FTS network (TCCON)



Data validation scheme

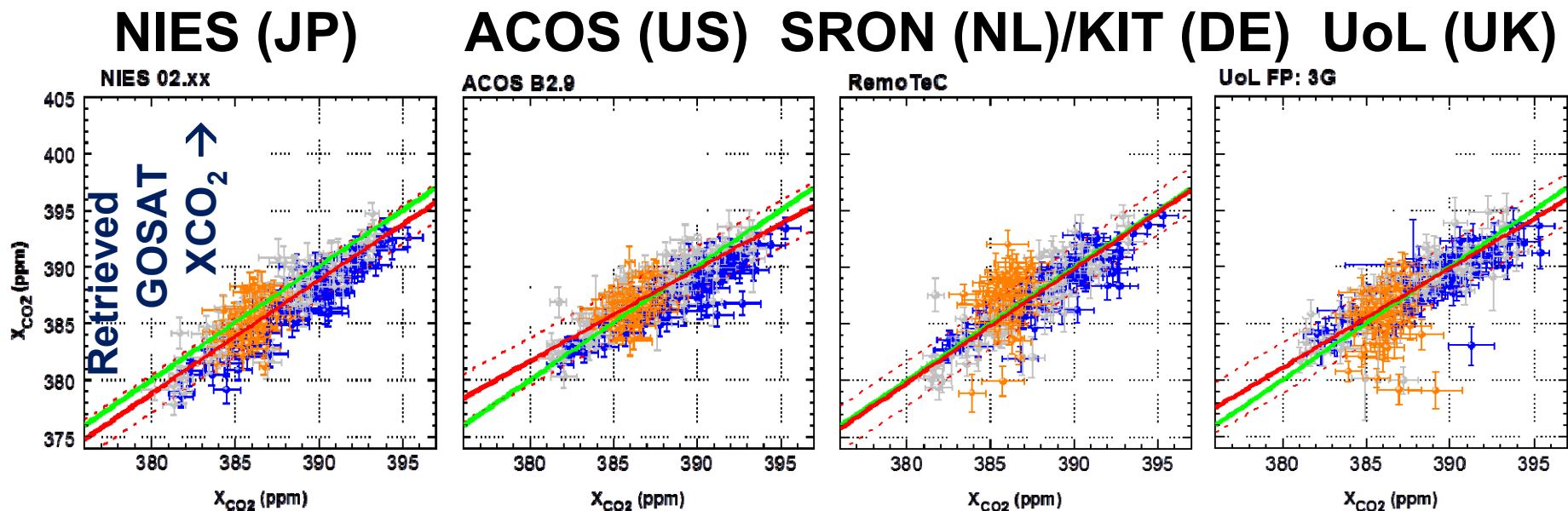


Data from aircraft measurement (CONTRAIL Project)



Fact 4: Quality of GOSAT XCO₂ retrievals in the world is improving.

(Comparison of four independent XCO₂ retrievals with TCCON data)



TCCON FTS XCO₂ →

Bias = -1.1 ppm,
σ = 1.7 ppm,

Bias = +0.2 ppm
σ = 2.1 ppm,

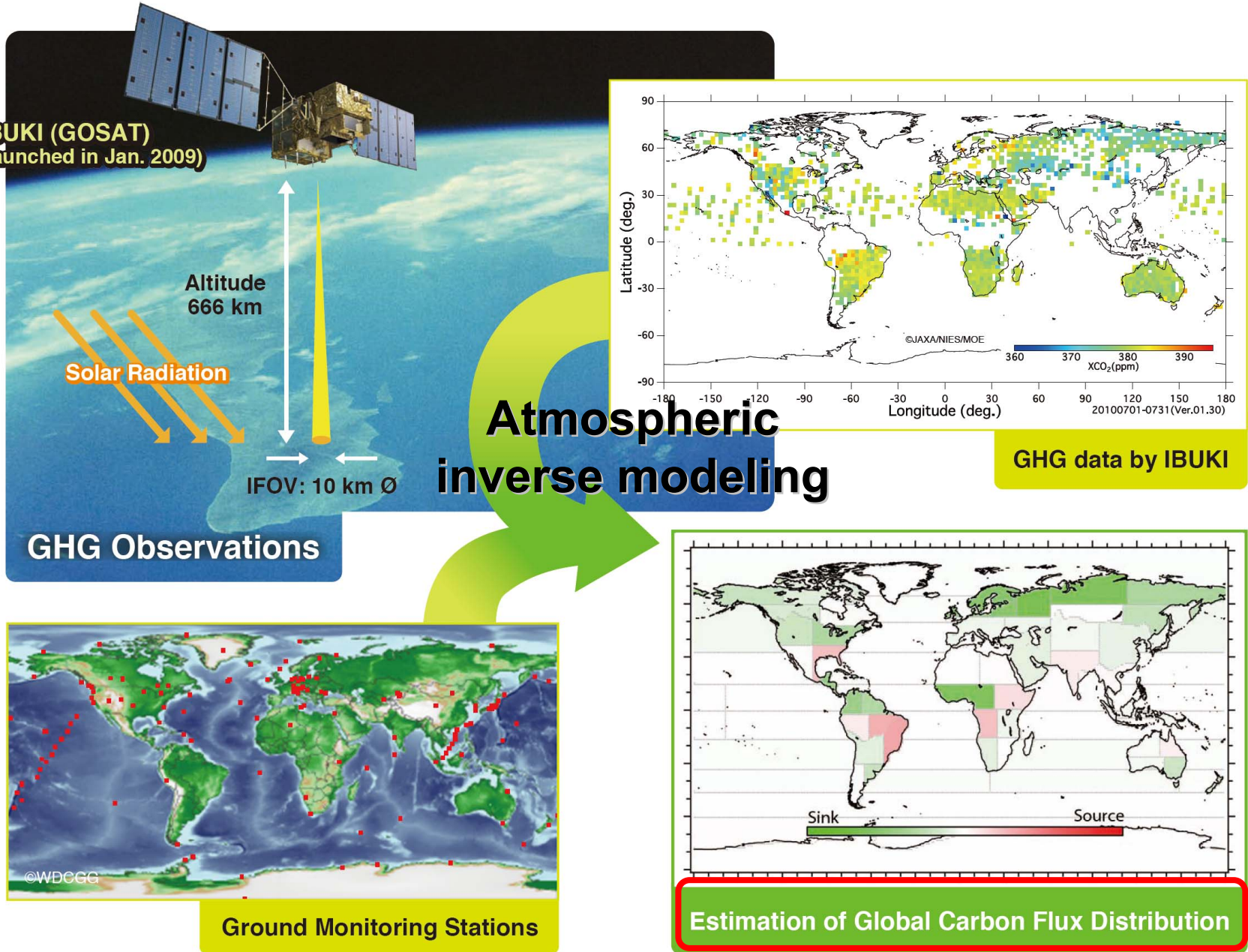
Bias = -0.2 ppm
σ = 2.0 ppm,

Bias = +0.1 ppm
σ = 2.2 ppm,

Note: GOSAT spectral data (TANSO-FTS L1B) used were not the newest.

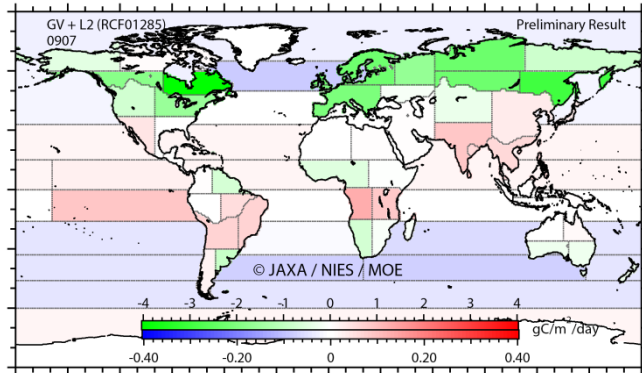
(by S. Oshchepkov & A. Bril (NIES))

Contribution of satellite data to carbon flux estimation

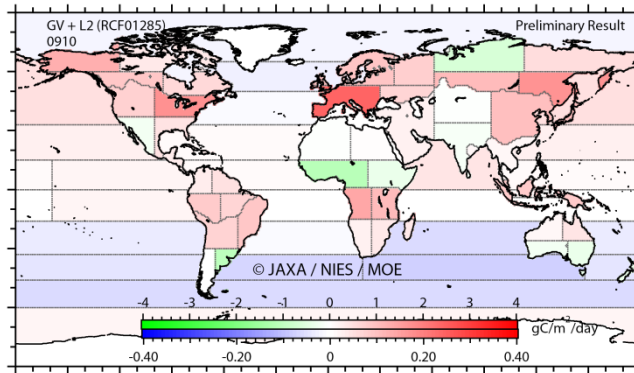


Plan 1: Monthly CO₂ Flux Estimates (Level 4A product)

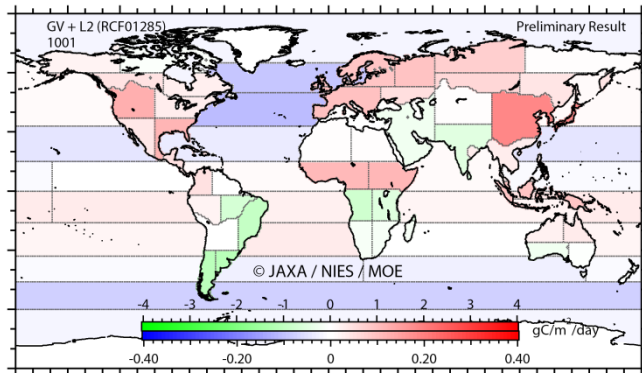
July 2009



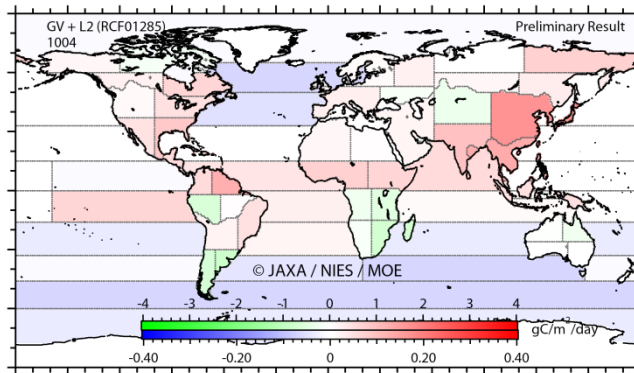
October 2009



January 2010



April 2010



64-regional monthly CO₂ fluxes estimated from ground-based network data* and GOSAT XCO₂ retrievals. Results for four months (July 2009, October 2009, January 2010, and April 2010) are presented here.

*GLOBALVIEW-CO2 (2011), Cooperative Atmospheric Data Integration Project - Carbon Dioxide. CD-ROM, NOAA ESRL, Boulder, Colorado (Also available on Internet via anonymous FTP to <ftp.cmdl.noaa.gov>, Path: [ccg/co2/GLOBALVIEW](ftp://ftp.cmdl.noaa.gov/ccg/co2/GLOBALVIEW)).

(Data between June 2009 and May 2010 will be released in 2012)

(by S. Maksyutov & H. Takagi (NIES))

GOSAT websites

JAXA GOSAT project
NIES GOSAT Project

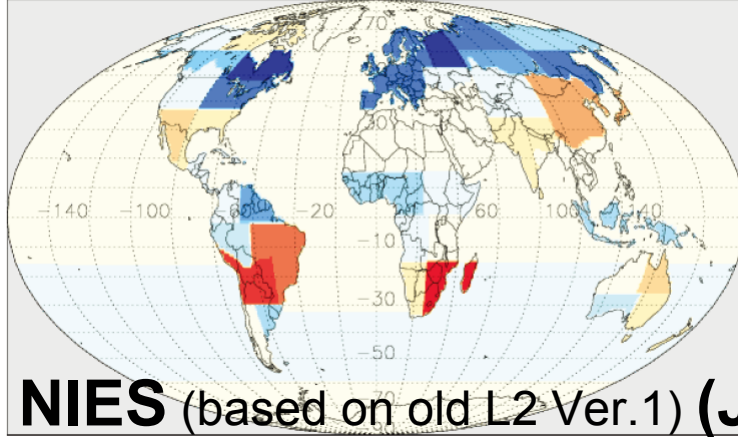
http://www.jaxa.jp/projects/sat/gosat/index_e.html
http://www.gosat.nies.go.jp/index_e.html



Plan 2: GOSAT-based CO₂ flux Inter-comparison campaign is underway by TransCom participants.

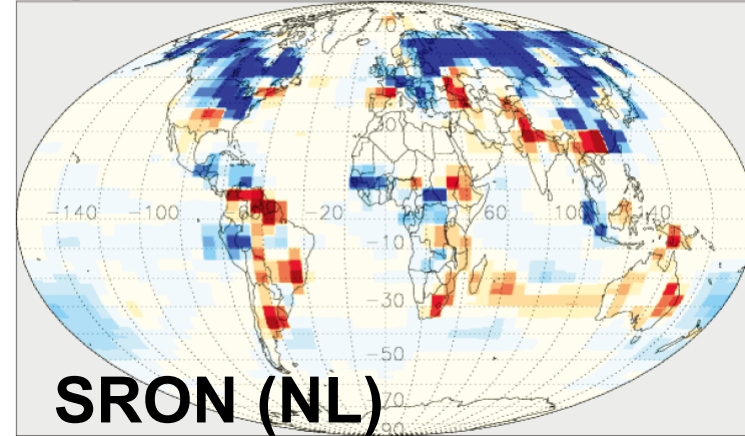
(July 2009) (courtesy of S. Houweling (SRON))

Nies_gosat_v01.00.GL 07 2009



NIES (based on old L2 Ver.1) (JP)

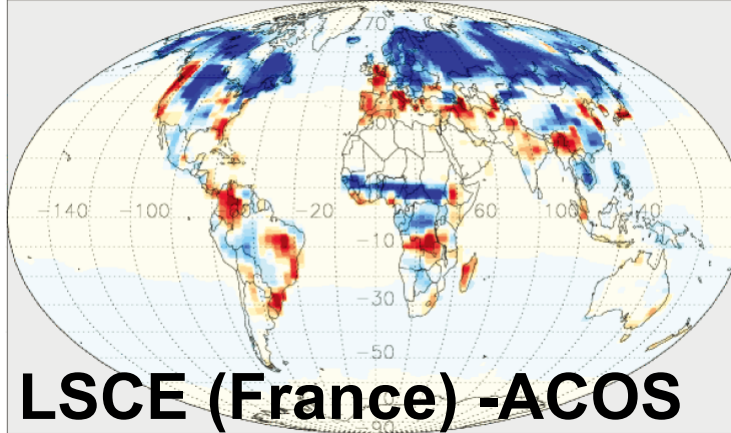
Sron_gosat_v1.0 07 2009



SRON (NL)

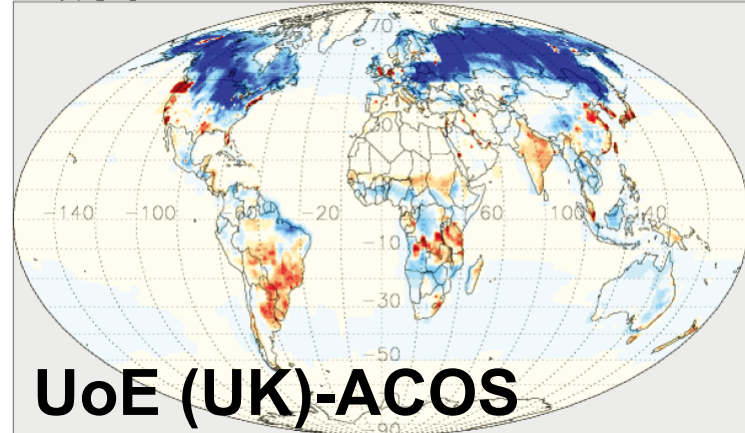
(Preliminary results)

Lscemacc_gosat_v1.0 07 2009



LSCE (France) -ACOS

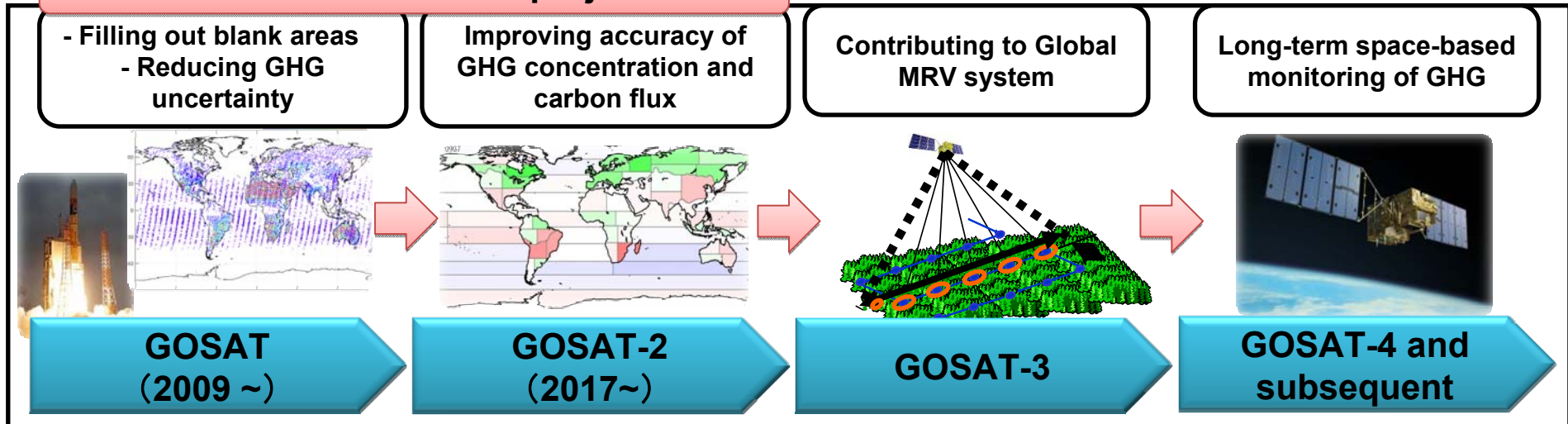
Uoe_pip.gv_gosat_v1.0 07 2009



UoE (UK)-ACOS

Perspective on future GOSAT missions and international cooperation

Goals of the GOSAT project



Possible contribution of GOSAT series

- Elucidating global carbon cycle through precise observation of CO₂ and CH₄
 - ⇒ **Improvement in climate change prediction**
- Early detection of major changes in climate system
 - ⇒ **Identifying changes in global environment**
- Monitoring of GHG reduction (mitigation efforts) (Incl. REDD+ activities)
 - ⇒ **Contribution to climate policy making**

Cooperation in global observation

