

ECO FLIGHT Activity



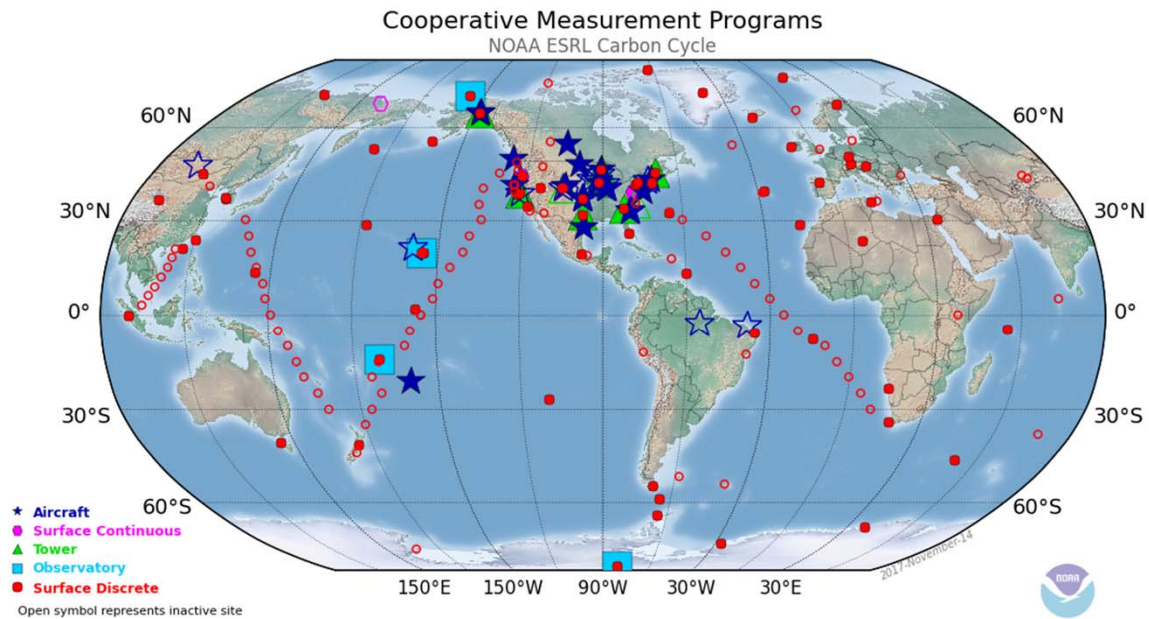
Atmospheric Observation with commercial aircraft

Takeshi Honda, JAL Engineering

CONTRAIL Team (National Institute for Environmental Studies (NIES),
Meteorological Research Institute (MRI), JAMCO, JAL Foundation and JAL)

Atmospheric Observation in Global

Pictures from NOAA (National Oceanic and Atmospheric Administration)

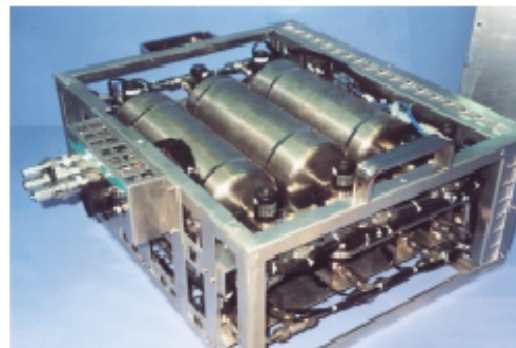
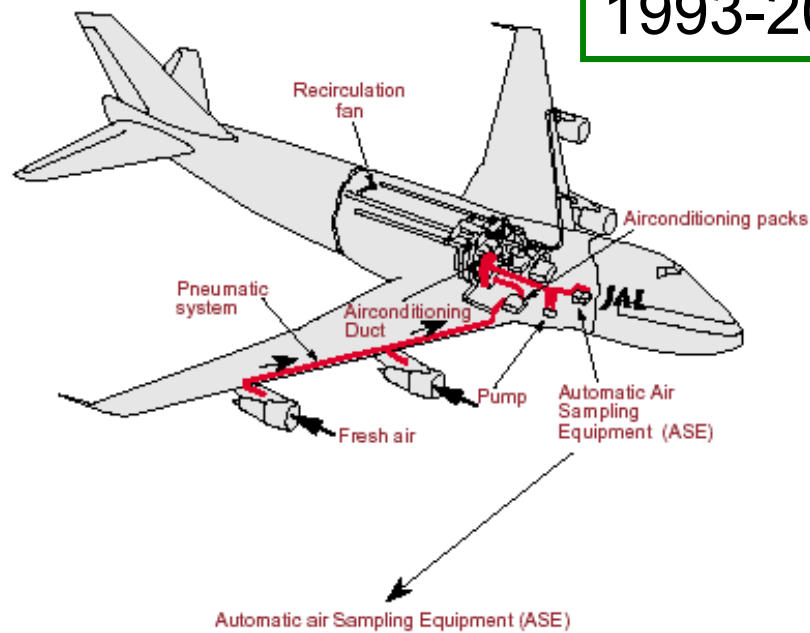


NOAA ESRL Carbon Cycle operates several measurement programs. Semi-continuous measurements are made at 4 baseline observatories, a few surface sites and from tall towers. Discrete surface and aircraft samples are measured in Boulder, CO. Presently, atmospheric carbon dioxide, methane, carbon monoxide, hydrogen, nitrous oxide, sulfur hexafluoride, the stable isotopes of carbon dioxide and methane, and halocarbon and volatile organic compounds are measured. Contact: Dr. Pieter Tans, NOAA ESRL Carbon Cycle, Boulder, Colorado, (303) 497-6678, pieter.tans@noaa.gov, <http://www.esrl.noaa.gov/gmd/ccgg/>

Project with MRI, JAL and JAL Foundation, before 2005

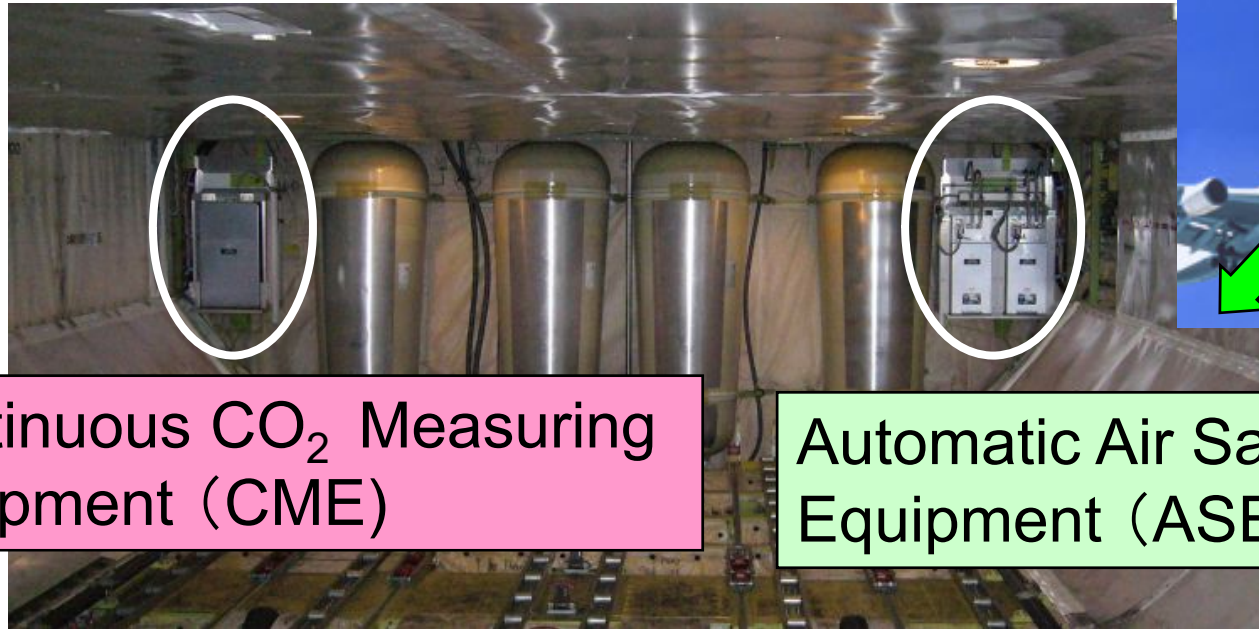
Matsueda et al., 2002

1993-2005, Twice/month (CO_2 , CH_4 , CO)



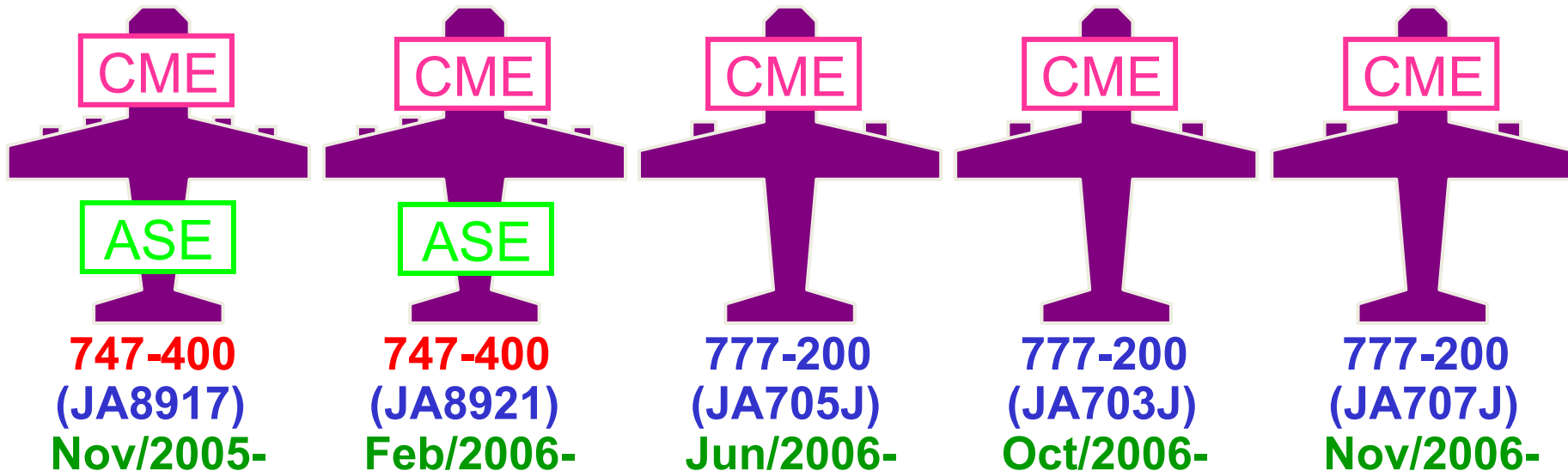
ASE: Automatic Air Sampling Equipment

CONTRAIL project started in 2005



Continuous CO₂ Measuring Equipment (CME)

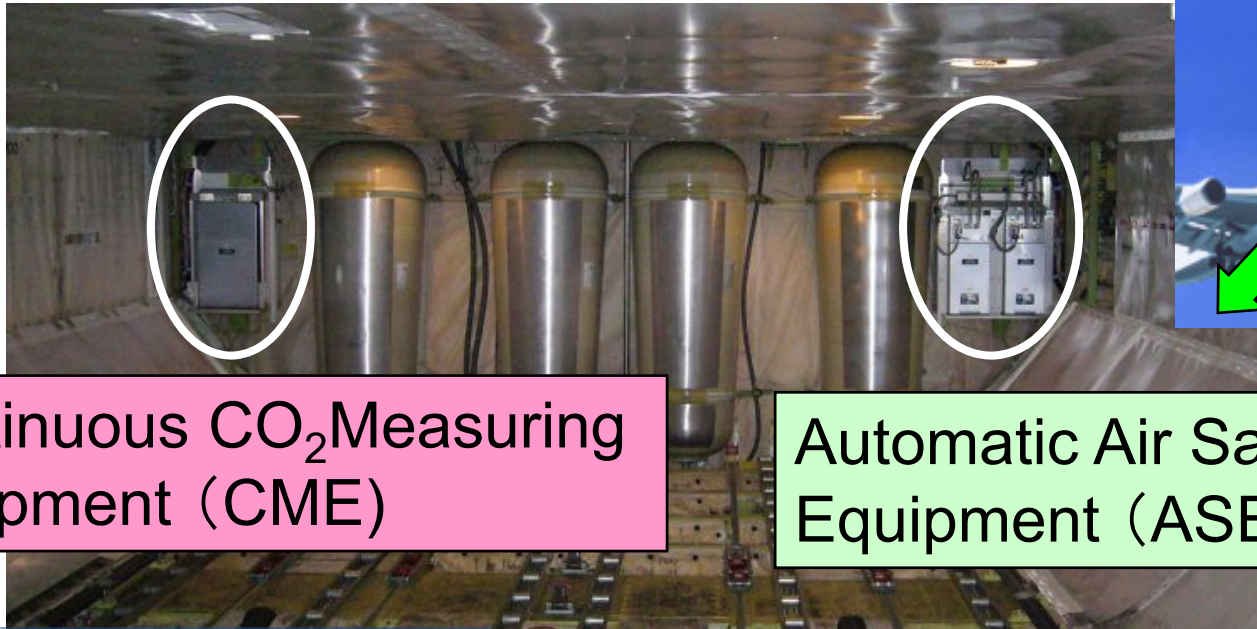
Automatic Air Sampling Equipment (ASE)







747-400s were retired in 2010



Continuous CO₂ Measuring Equipment (CME)

Automatic Air Sampling Equipment (ASE)

Retired
Oct/2010

747-400 (JA8917) Nov/2005-
747-400 (JA8921) Feb/2006-

A diagram showing two purple airplane silhouettes. Each silhouette has a pink box labeled 'CME' on the upper fuselage and a green box labeled 'ASE' on the lower fuselage. A white box with black text 'Retired Oct/2010' is centered between the two aircraft. Below each silhouette, the aircraft type and registration number are listed, followed by the operational period.

777-200 (JA705J) Jun/2006-

A diagram of a purple airplane silhouette with a pink box labeled 'CME' on the upper fuselage. Below the silhouette, the aircraft type and registration number are listed, followed by the operational period.

777-200 (JA703J) Oct/2006-

A diagram of a purple airplane silhouette with a pink box labeled 'CME' on the upper fuselage. Below the silhouette, the aircraft type and registration number are listed, followed by the operational period.

777-200 (JA707J) Nov/2006-

A diagram of a purple airplane silhouette with a pink box labeled 'CME' on the upper fuselage. Below the silhouette, the aircraft type and registration number are listed, followed by the operational period.

Observation equipment were installed on 777 airplanes

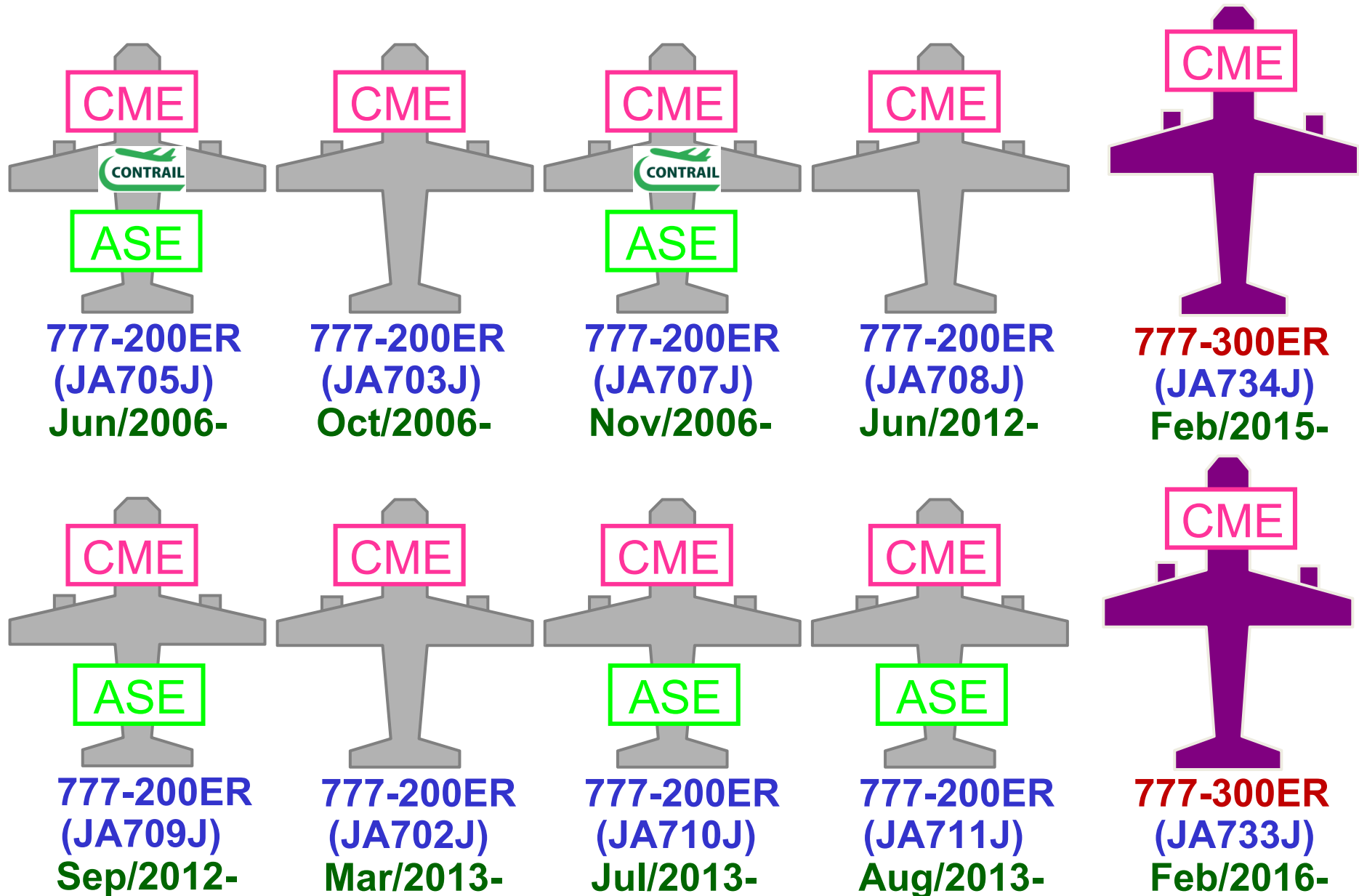


CME:
CO₂ Continuous
Measuring Equipment

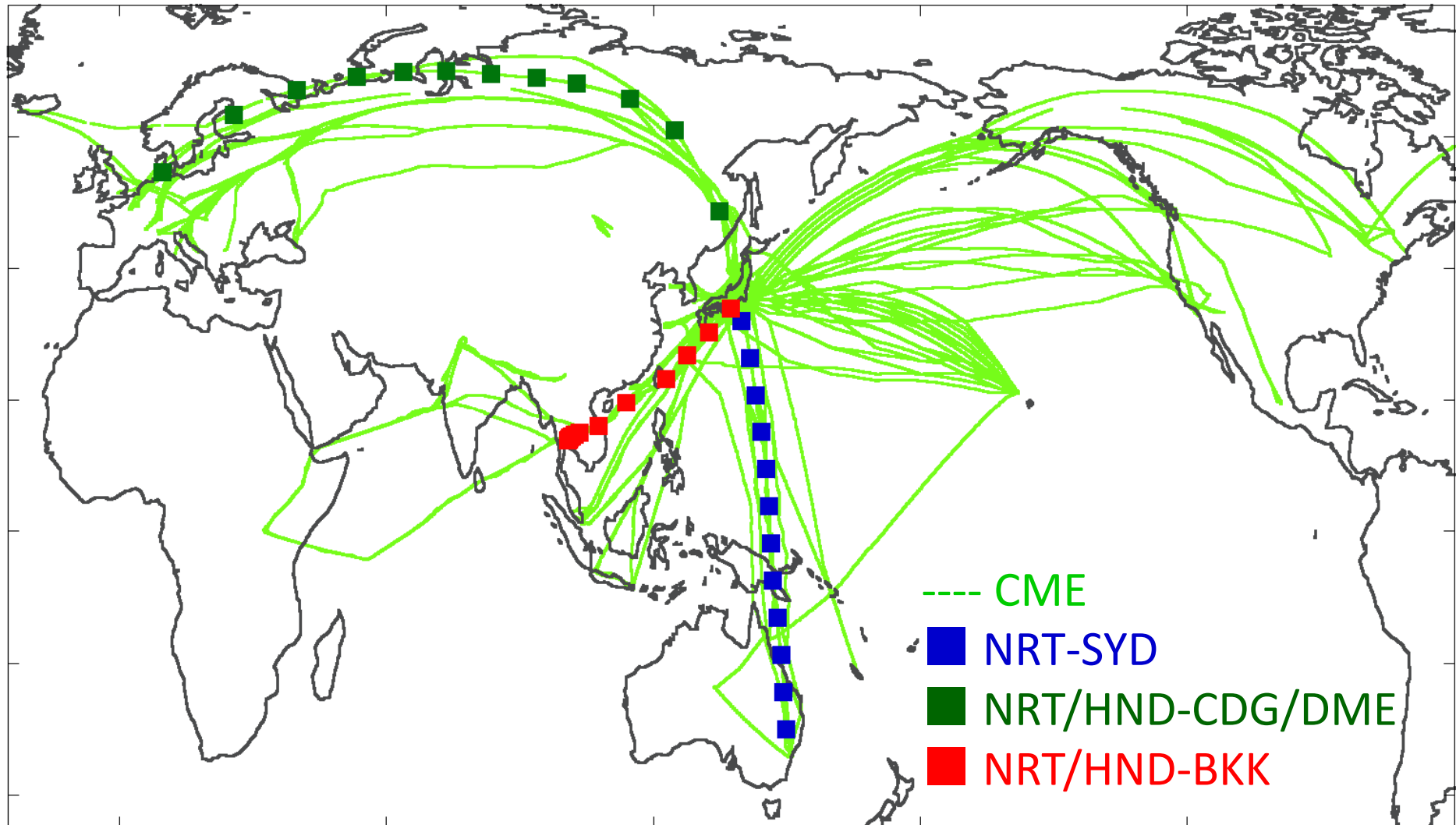


ASE:
Automatic Sampling
Equipment for CO₂, CH₄, CO,
N₂O, SF₆, H₂, isotopes

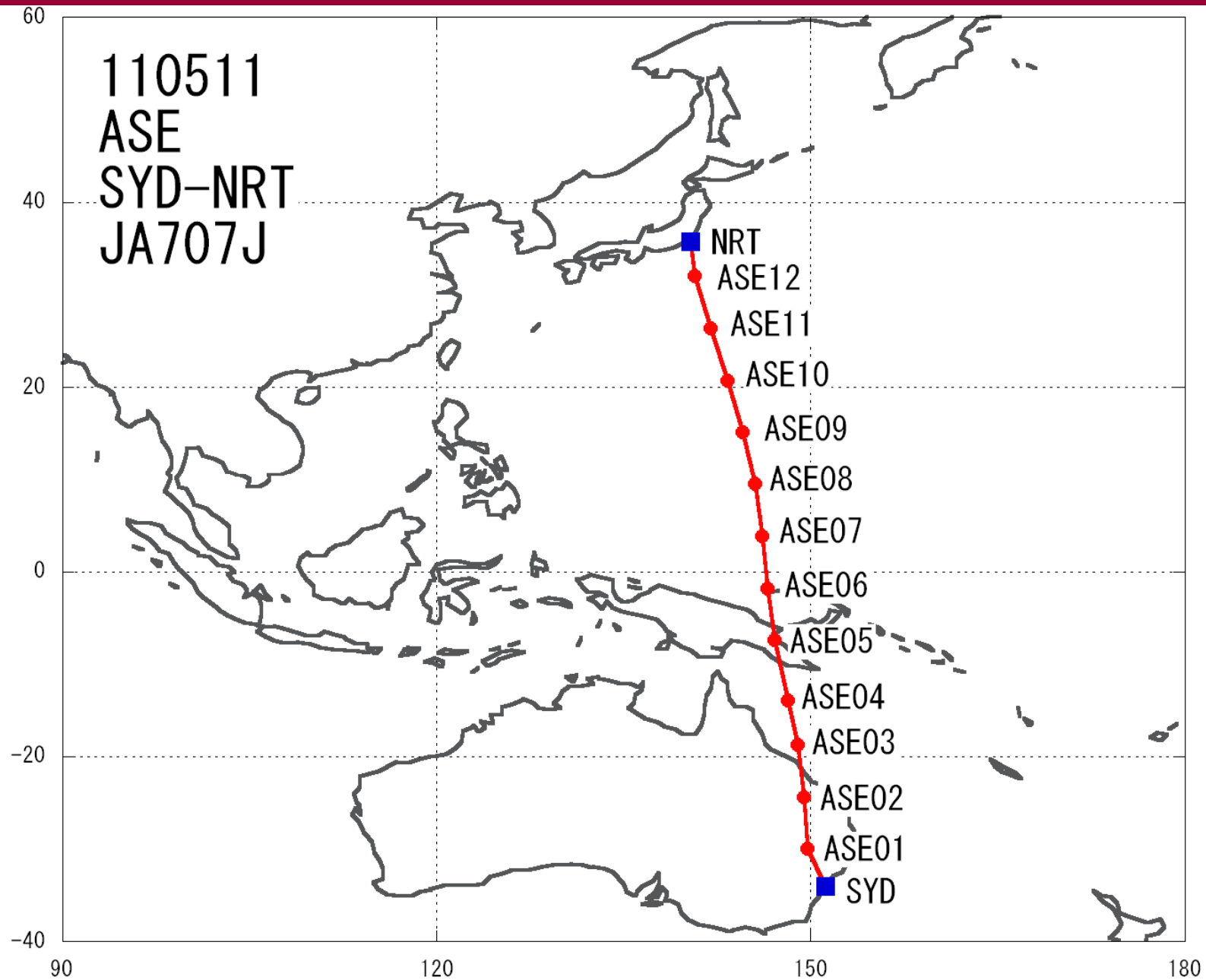
8 777-200ER, 2 777-300ER were modified



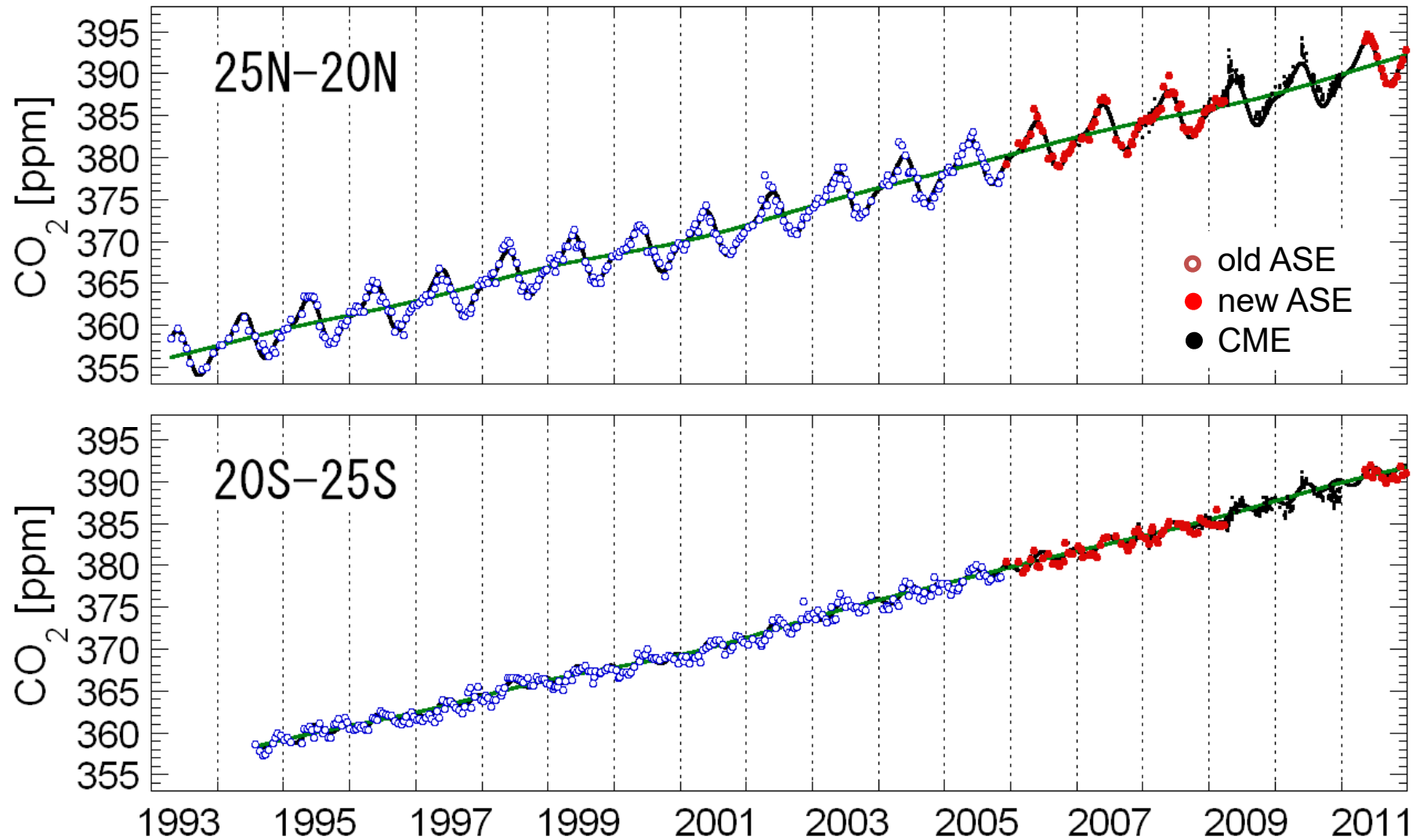
Flight routes for CONTRAIL

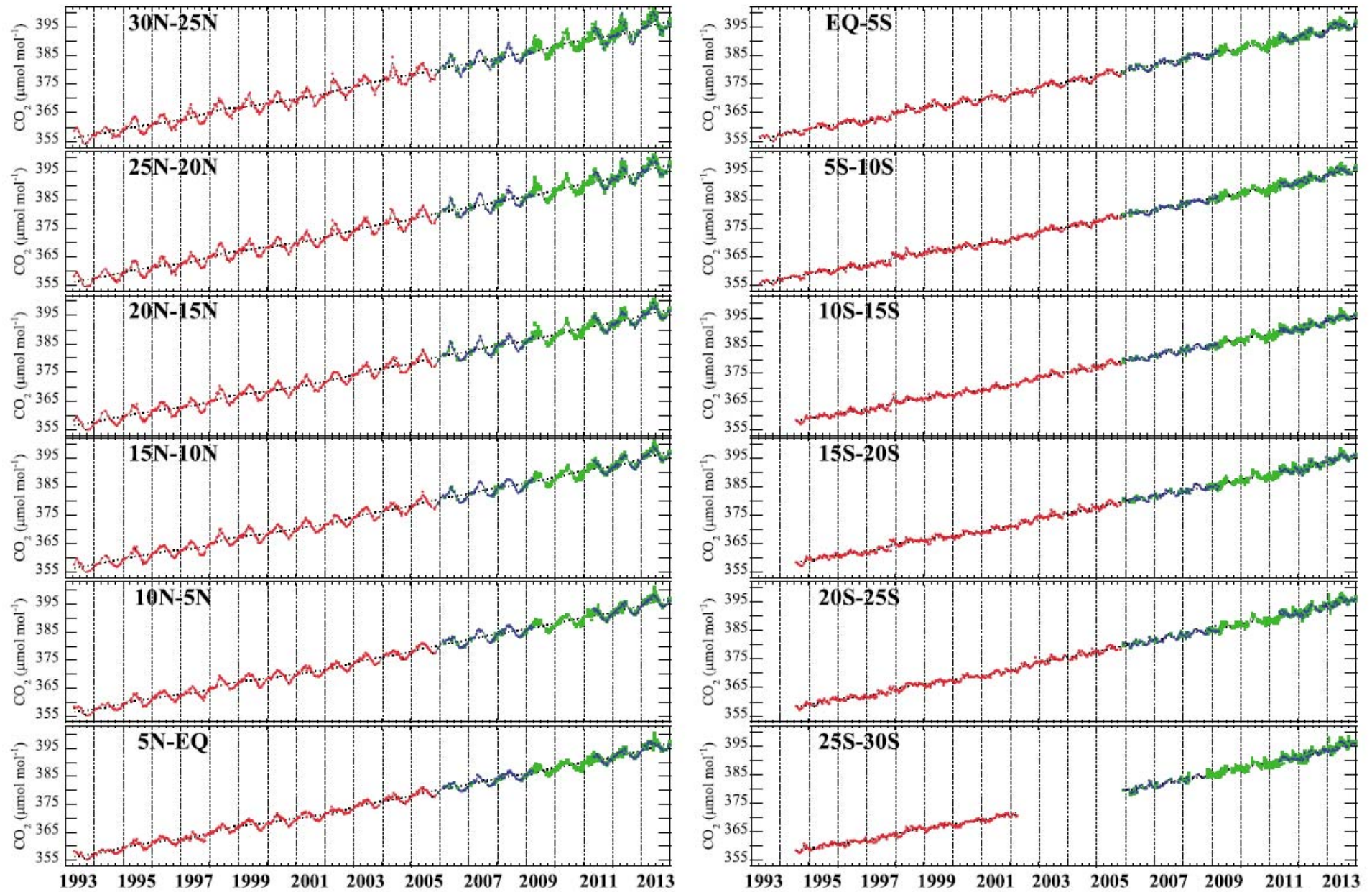


ASE sampling on SYD-NRT



CO₂ Concentration observed by ASE for each latitude since 1993

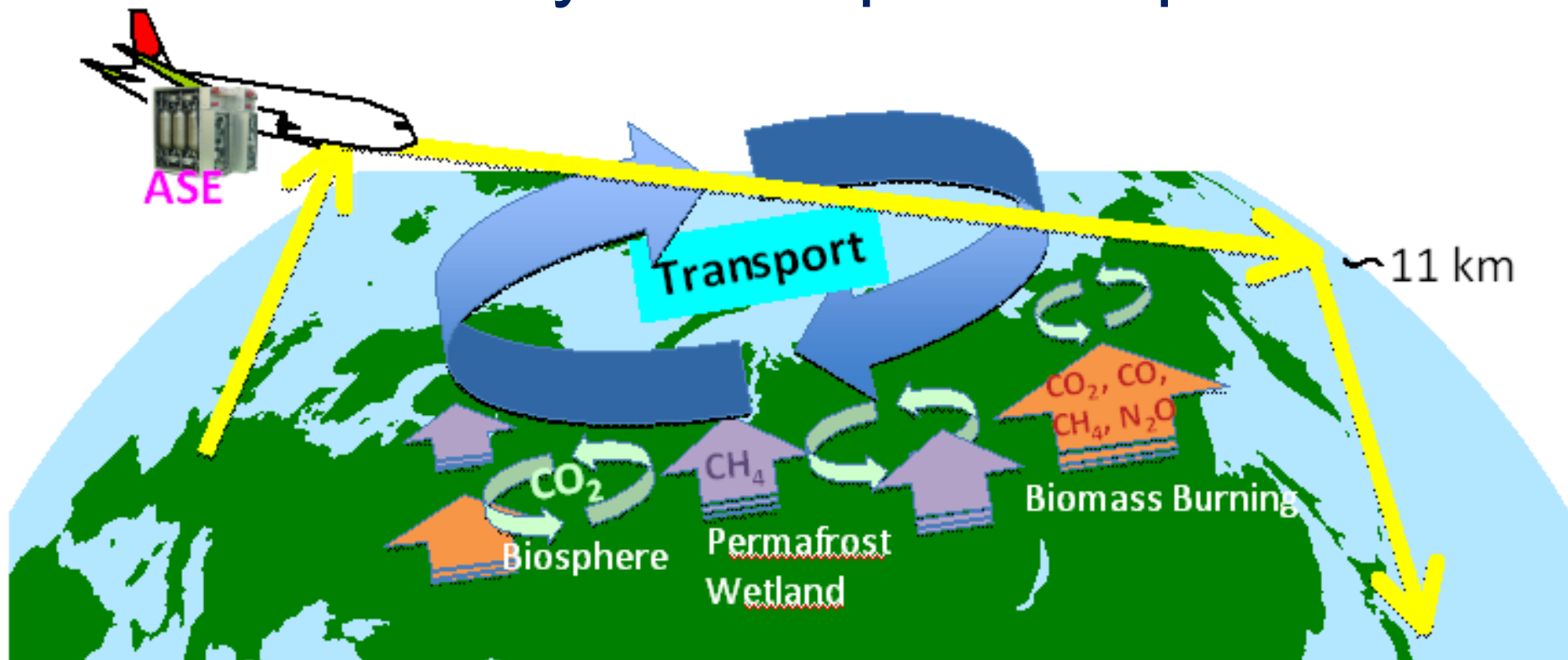




Matsueda et al. (2015)

Air Sampling between Europe and Japan

by ASE Apr/2012-Mar/2014
by MSE Apr/2014-present



MSE (Manual air Sampling Equipment)

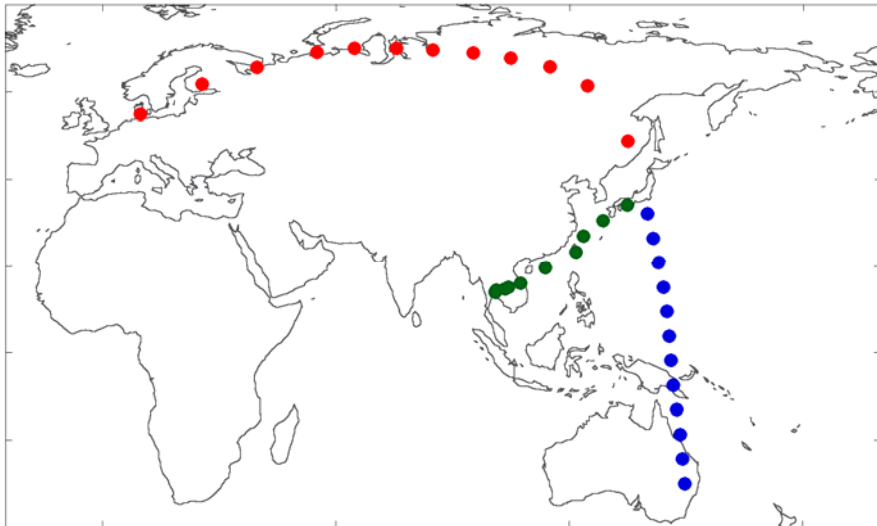


2014.04.15 21:32
Photographs were provided by Japan Airlines.
This picture was taken with special permission, securing flight safety.

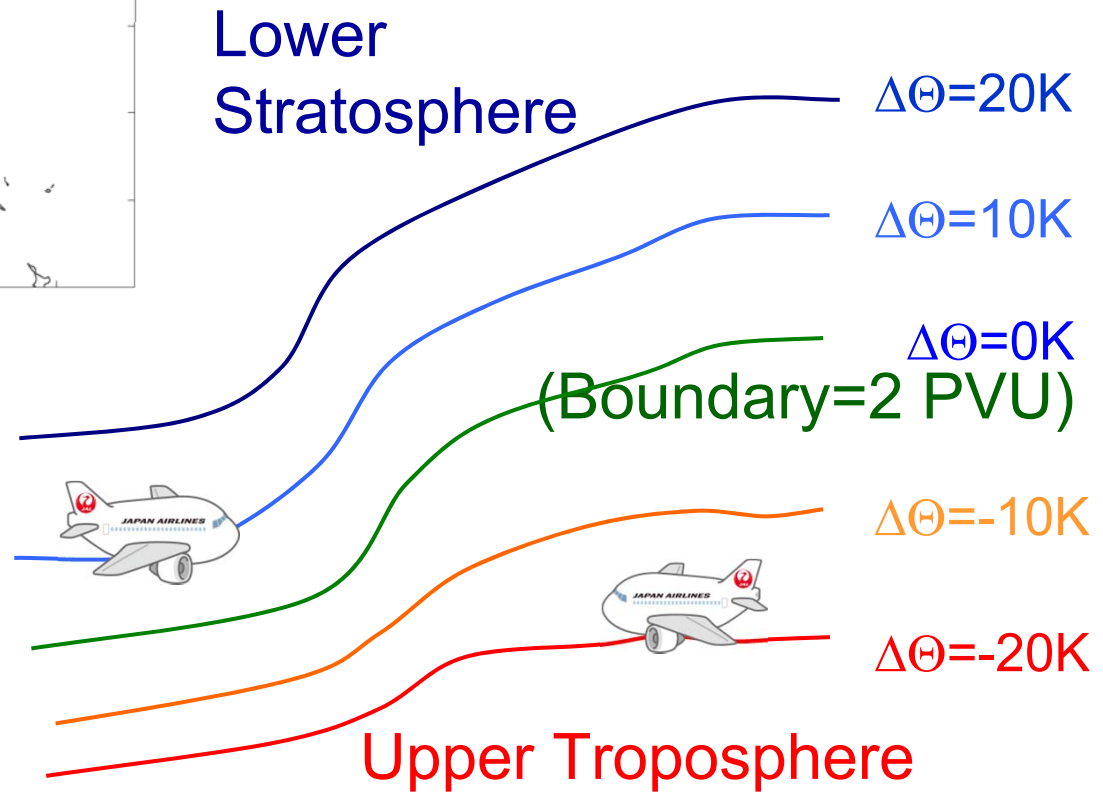




Upper Troposphere (UT) & Lower Stratosphere (LS)

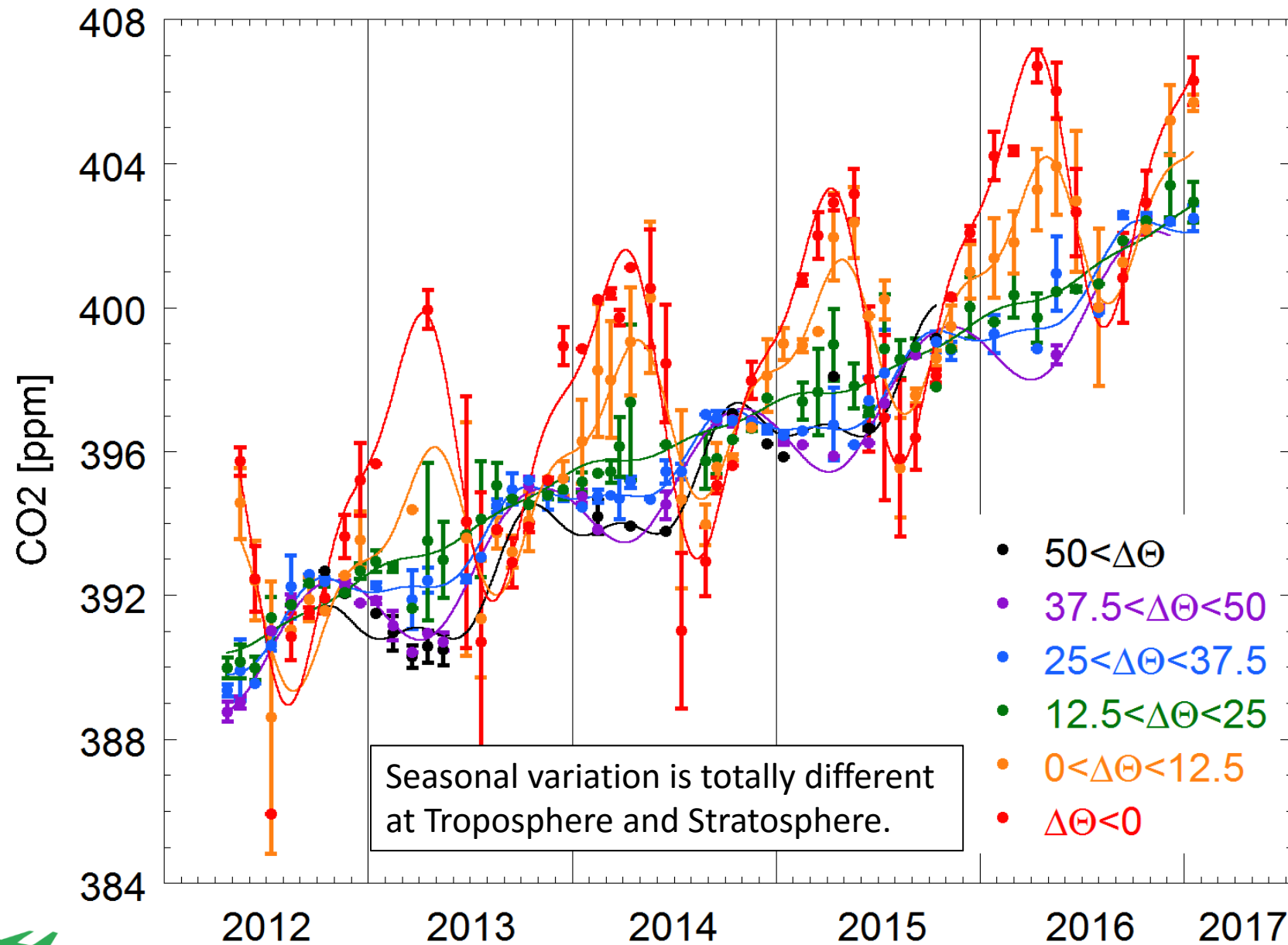


It is possible to observe air of the stratosphere by flying over high latitude route.



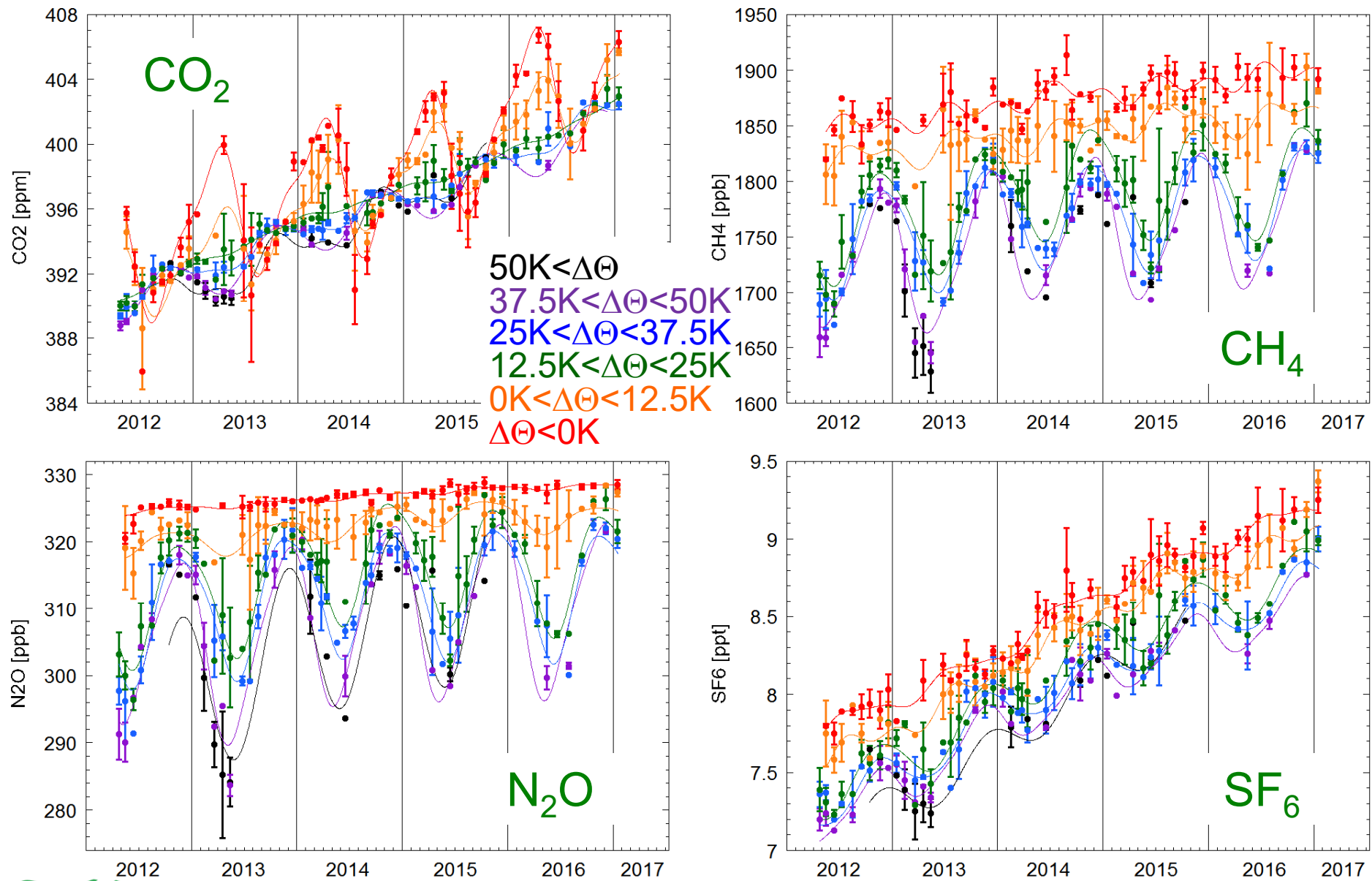
High Latitude \longleftrightarrow Low Latitude

Variation of CO₂ Concentration at UT & LS

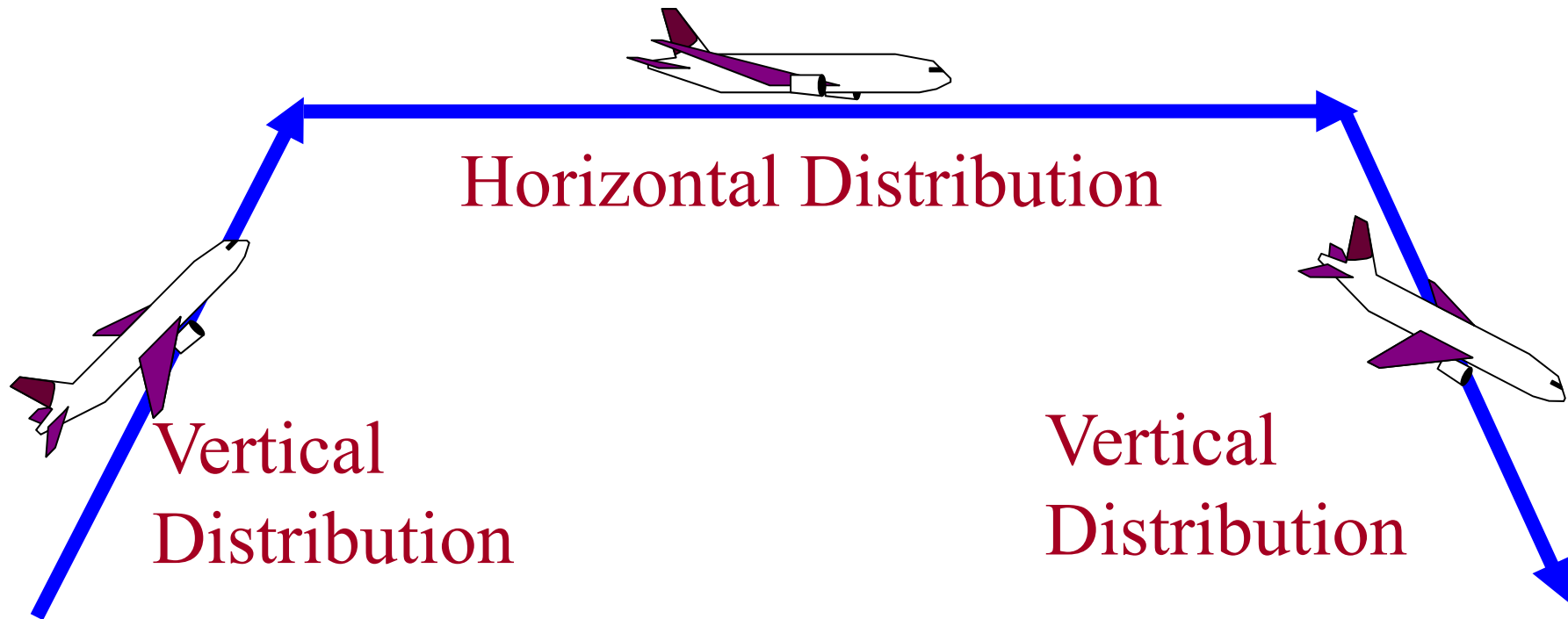


Sawa et al. GRL (2015)

Variation of CO₂, CH₄, N₂O, SF₆

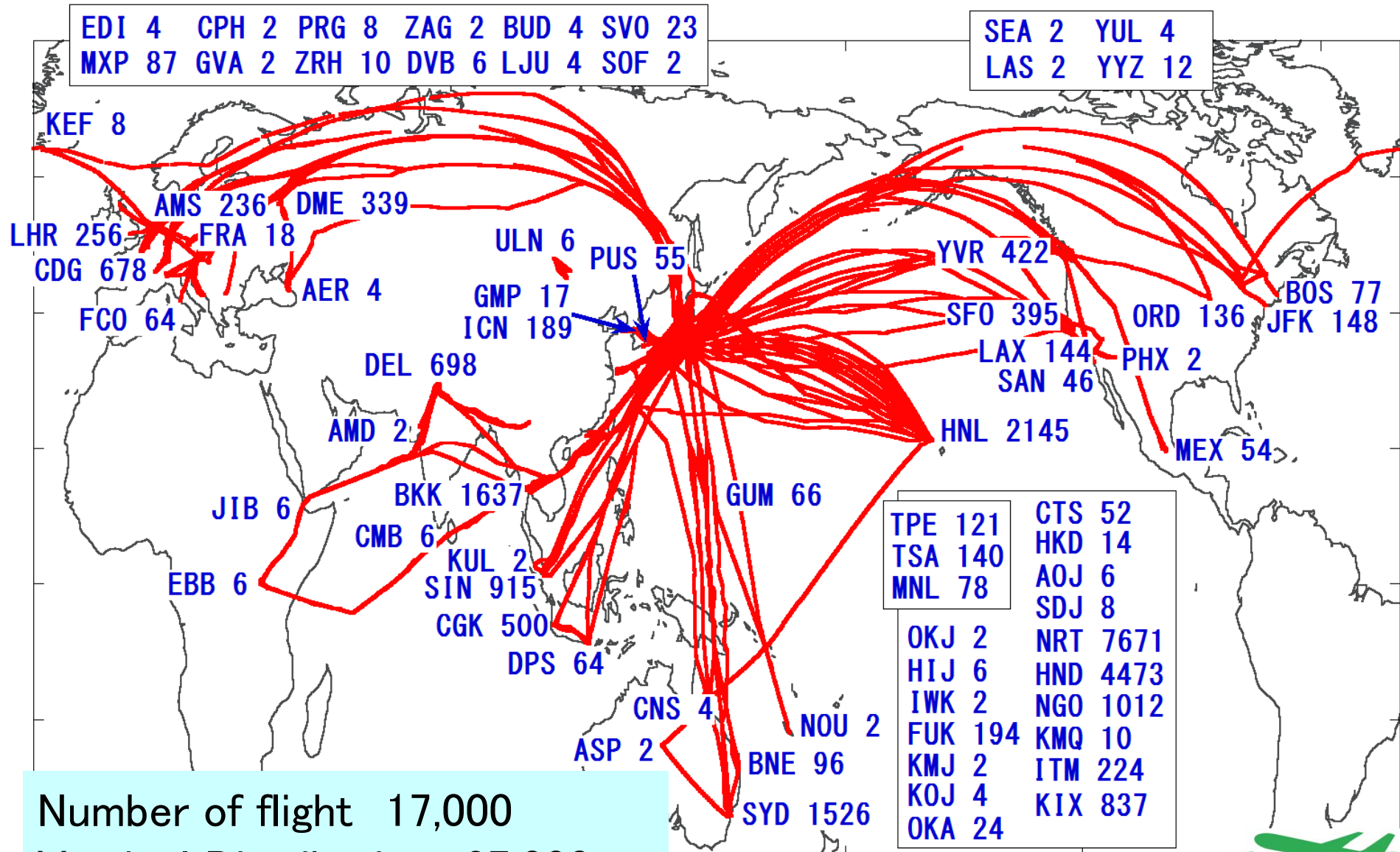


Continuous observation by scheduled flights



- Highly Frequent Observation
- Wide Area of Observation
- Vertical Distribution can be observed (More data)
- Detailed Spatial Distribution can be observed

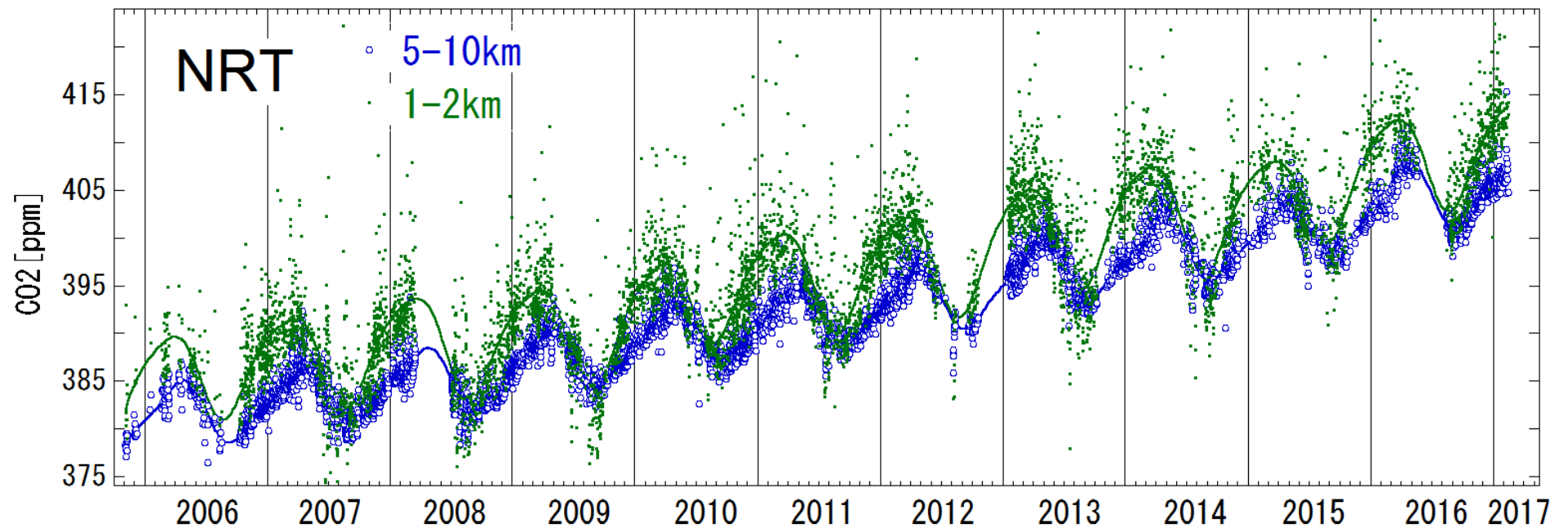
Flight Route with CME & # of Vertical Distribution Observation (~Feb/2017)



Number of flight 17,000
Vertical Distribution 27,000



CO₂ Concentration over Narita



CONTRAIL Team

Installation of CME & ASE to 787

(Currently under study)



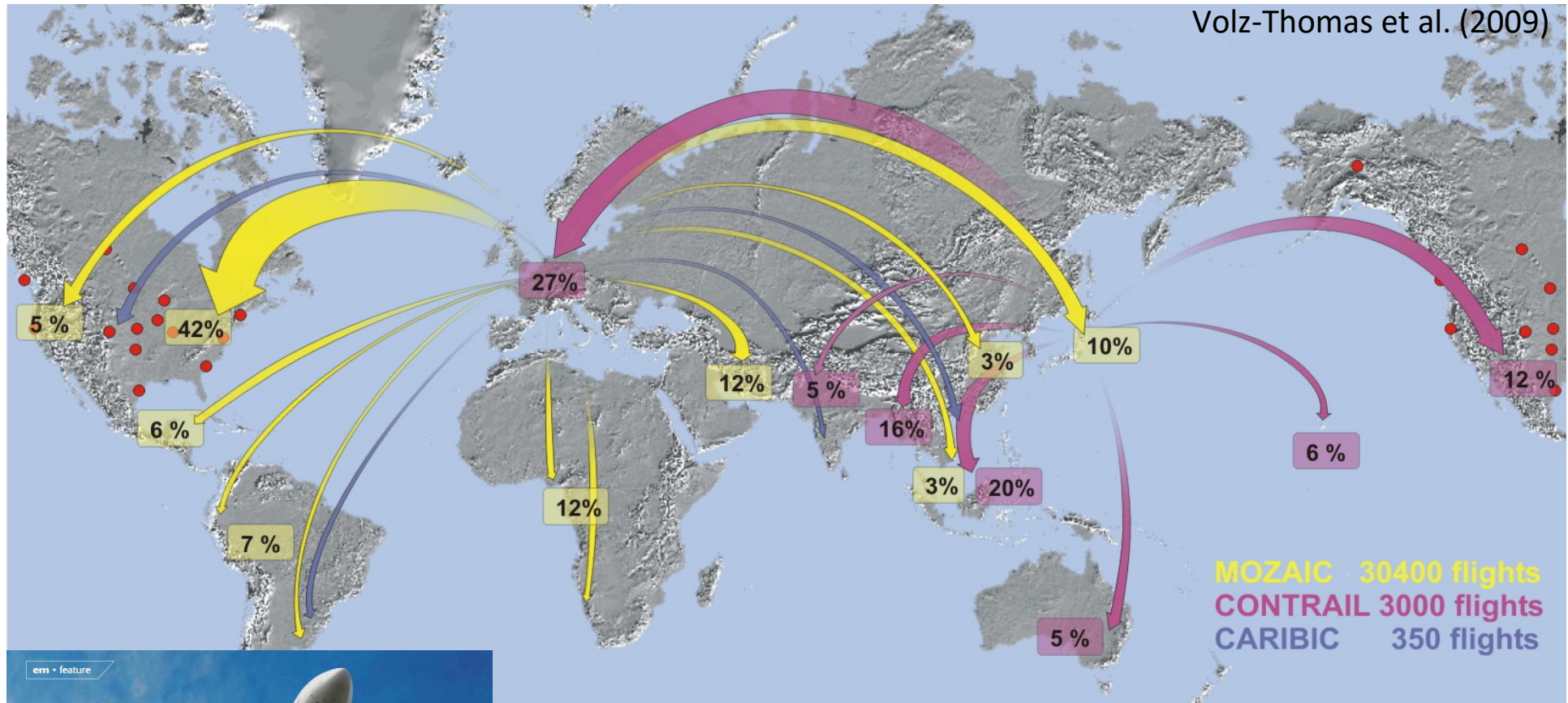
Airplane Observation Project at Europe IAGOS-CORE



Obtained STC for A330 and A340, CO₂/CH₄ Observation Equipment on 16 December 2016.

The role of the CONTRAIL over airplane observation network worldwide

Volz-Thomas et al. (2009)



International cooperation is important in order to have more data. Observation over Asia and Pacific region is sparse compare to other region. Japan is contributing for the data in these area.

CONTRAIL Project (CO₂, CH₄, N₂O, SF₆) is performed by Japan Airlines, while MOZAIC & CARIBIC Project (H₂O, O₃) are performed by Air France, Air Namibia, Austrian, Cathay Pacific, China Airlines, Hawaiian Airlines, Iberia, LTU, Lufthansa, Sabena.(CO₂ just started)



Thank you.