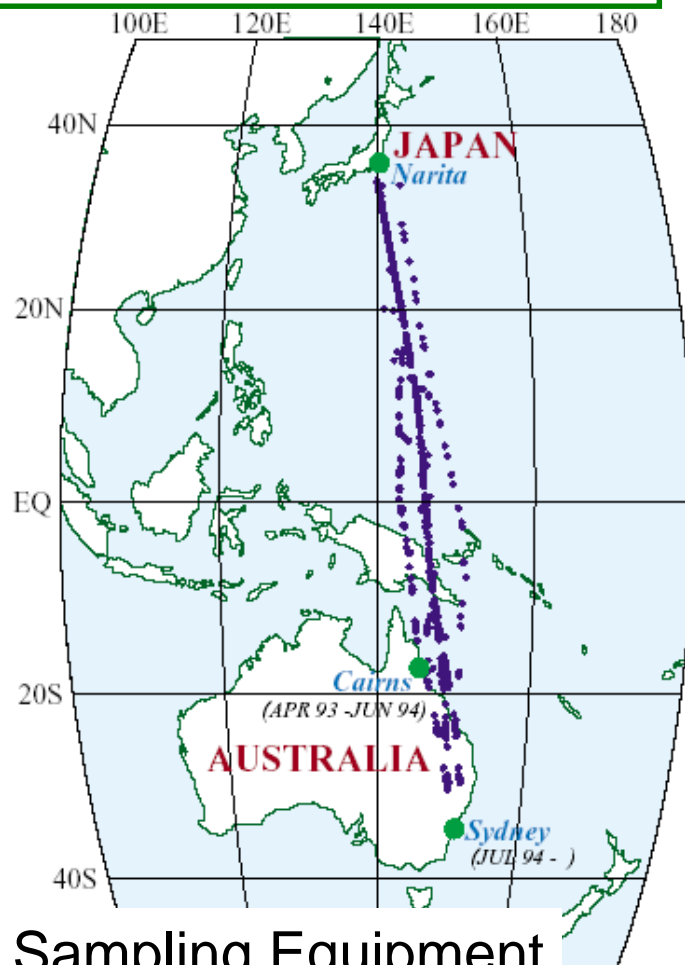
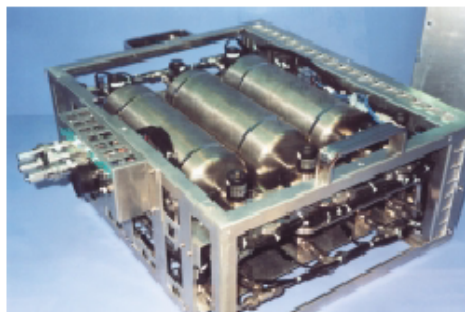
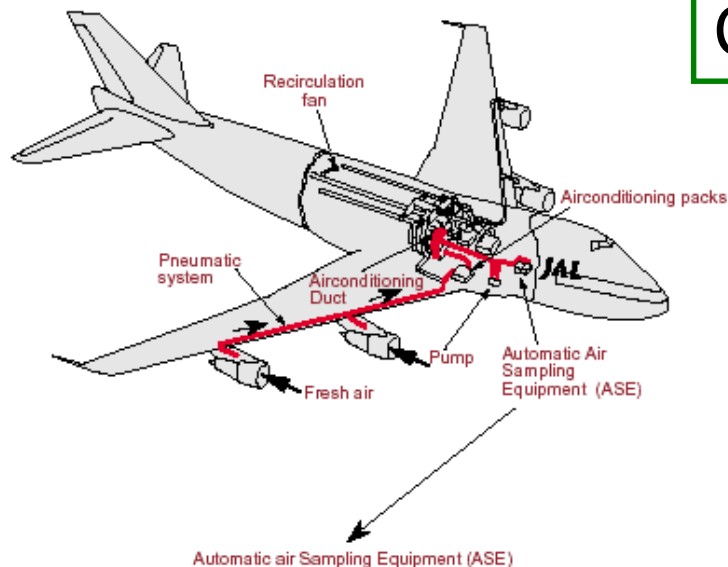


# Observation of Atmospheric GHGs by Passenger Aircraft -CONTRAIL Project-



T. Machida<sup>1</sup>, H. Matsueda<sup>2</sup>, Y. Sawa<sup>2</sup>  
1. NIES, 2.MRI,

1993-2005, Twice/month  
 $\text{CO}_2$ ,  $\text{CH}_4$ ,  $\text{CO}$



ASE: Automatic Air Sampling Equipment

# New ASE developed in 2005

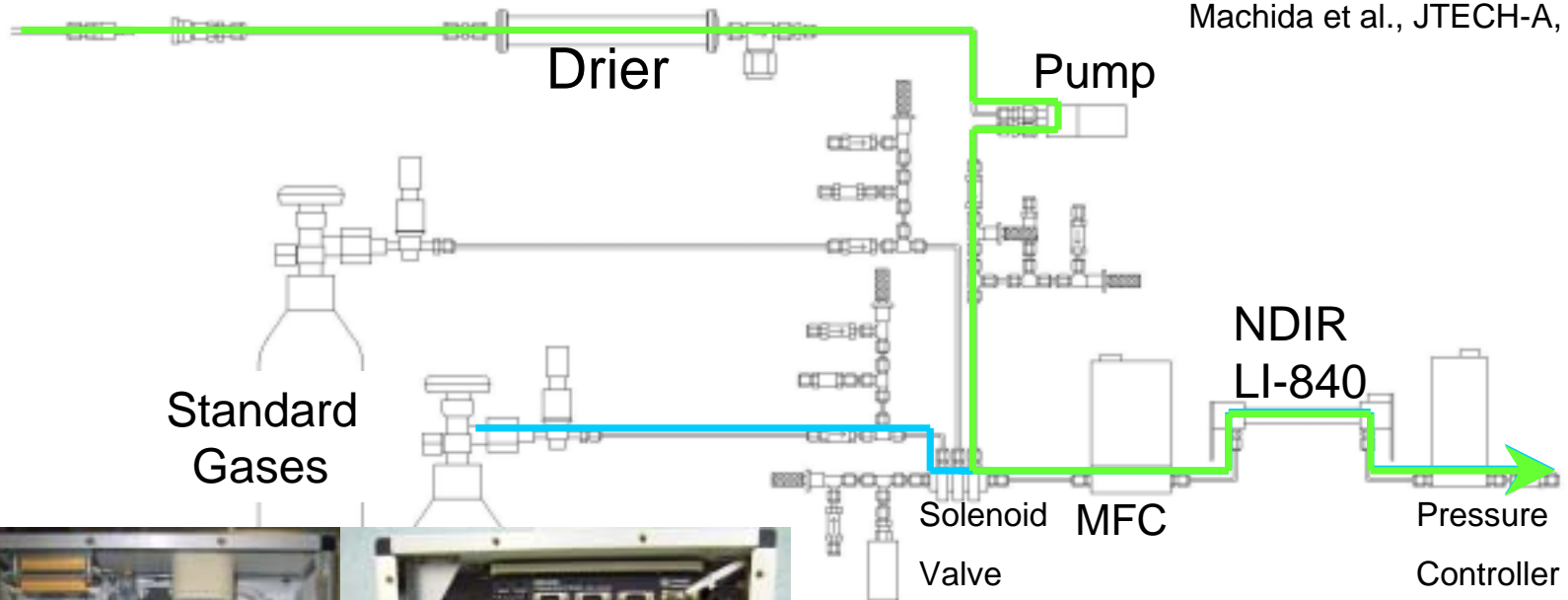


Flask: 12 Titanium  
Sampling: Twice/Month  
Australia-Japan  
Analysis: Next Day (in 2days)

	old ASE	new ASE
Control Trigger:	Timer	ARINC Fixed Position Vertical Sampling
Measurement:	CO <sub>2</sub> , CH <sub>4</sub> , CO	CO <sub>2</sub> , CH <sub>4</sub> , CO N <sub>2</sub> O, SF <sub>6</sub> , H <sub>2</sub> CO <sub>2</sub> isotope

# Continuous CO<sub>2</sub> Measuring Equipment (CME)

Machida et al., JTECH-A, (2008)



**ARINC**

Latitude, Longitude, Altitude,  
Ground Speed, Wind Speed,  
Wind Dir., Air Temperature

Size: 570H \* 320W \* 255D  
Weight: 25 kg (incl. Cylinders)

# Two Equipments on 777-200ER



Aft Cargo Room



ASE

Fwd Cargo Room



CME



# Installation of ASE on 777-200ER



# Aft Cargo room of 777-200ER

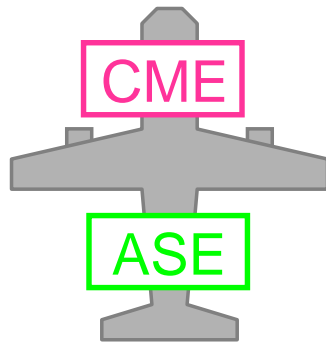
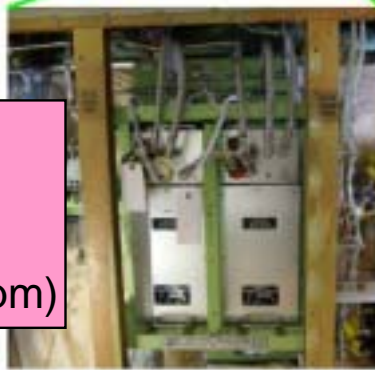


# 3+2 of 777-200ER aircraft



CME: Continuous  
CO<sub>2</sub> Measuring  
Equipment  
(Precision <  $\pm 0.2$  ppm)

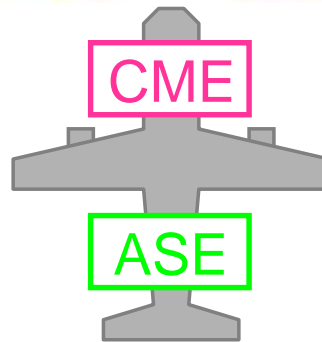
new ASE for CO<sub>2</sub>, CH<sub>4</sub>,  
CO, N<sub>2</sub>O, SF<sub>6</sub>, H<sub>2</sub>,  
isotopes



777-200  
(JA705J)  
Jun/2006-



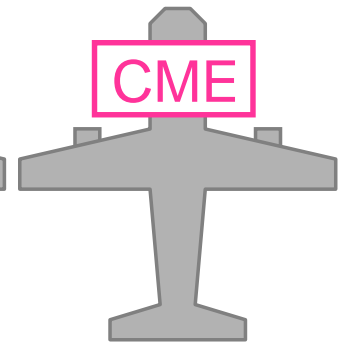
777-200  
(JA703J)  
Oct/2006-



777-200  
(JA707J)  
Nov/2006-



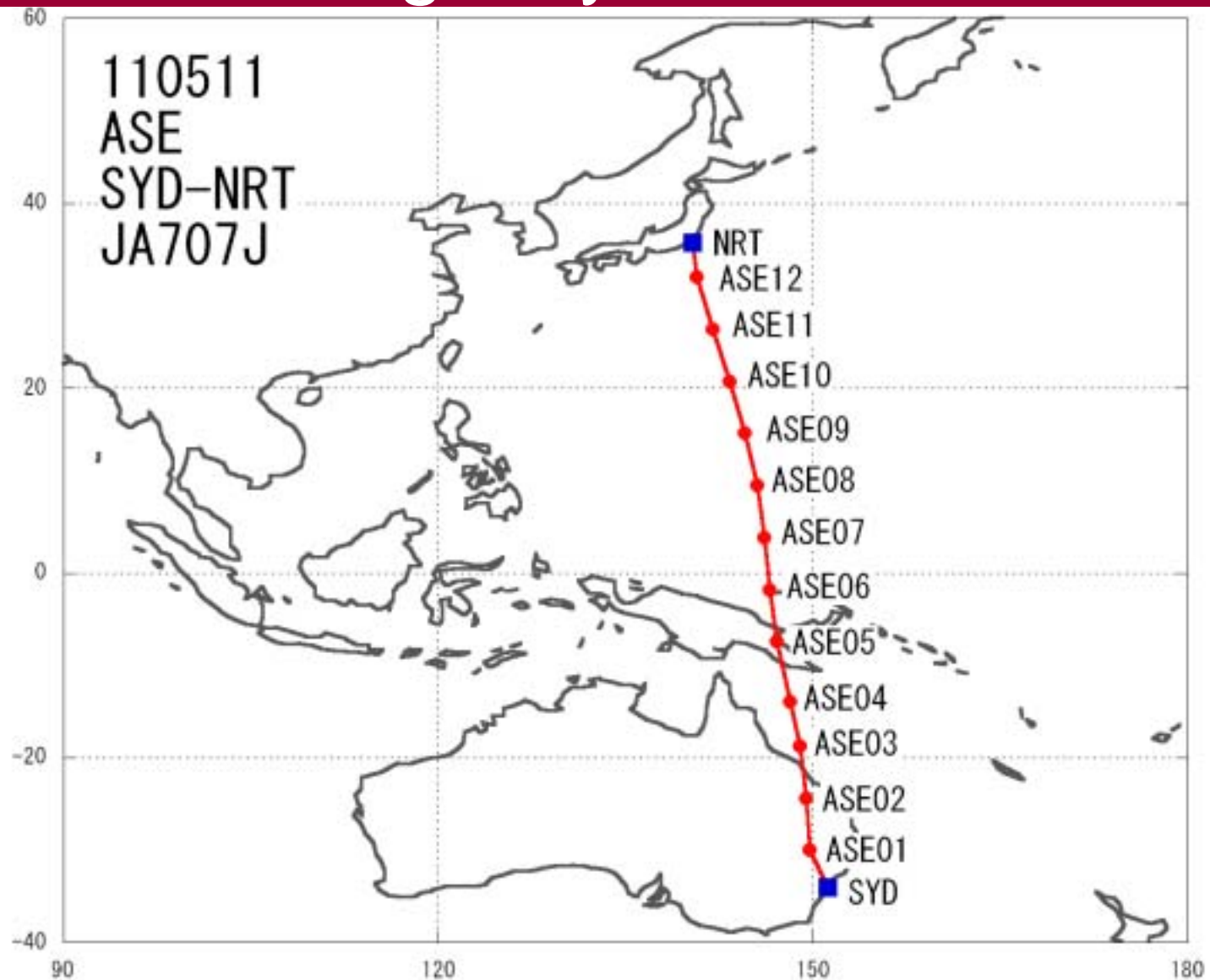
777-200  
(JA708J)  
2012-



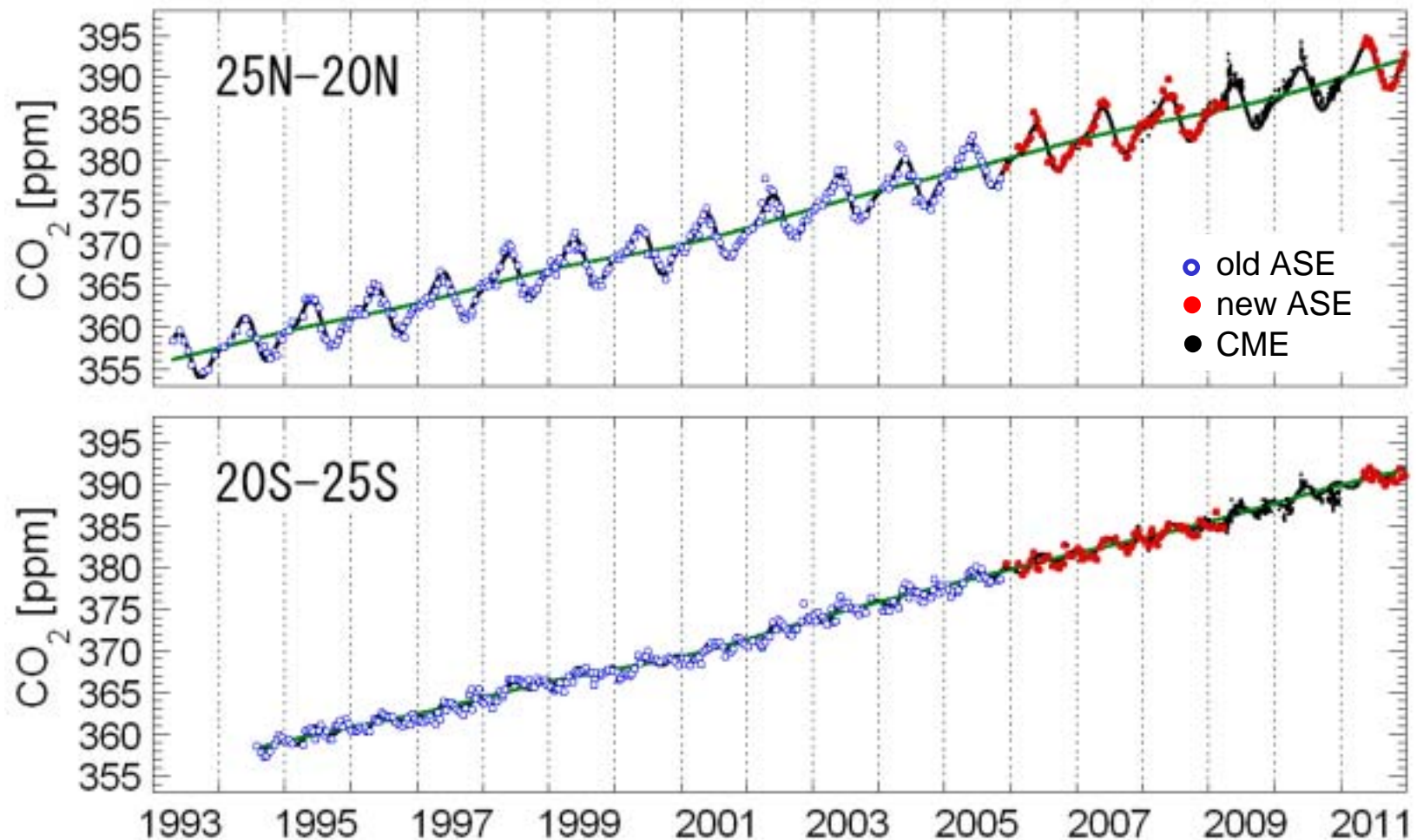
777-200  
(JA709J)  
2012-



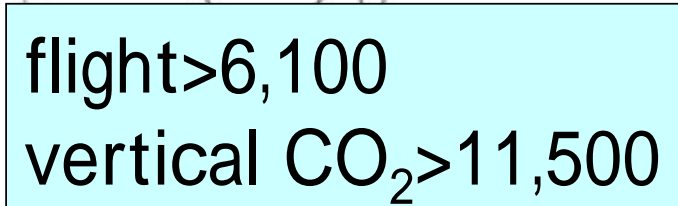
# ASE flight by 777-200ER



# Time series of CO<sub>2</sub> in upper troposphere

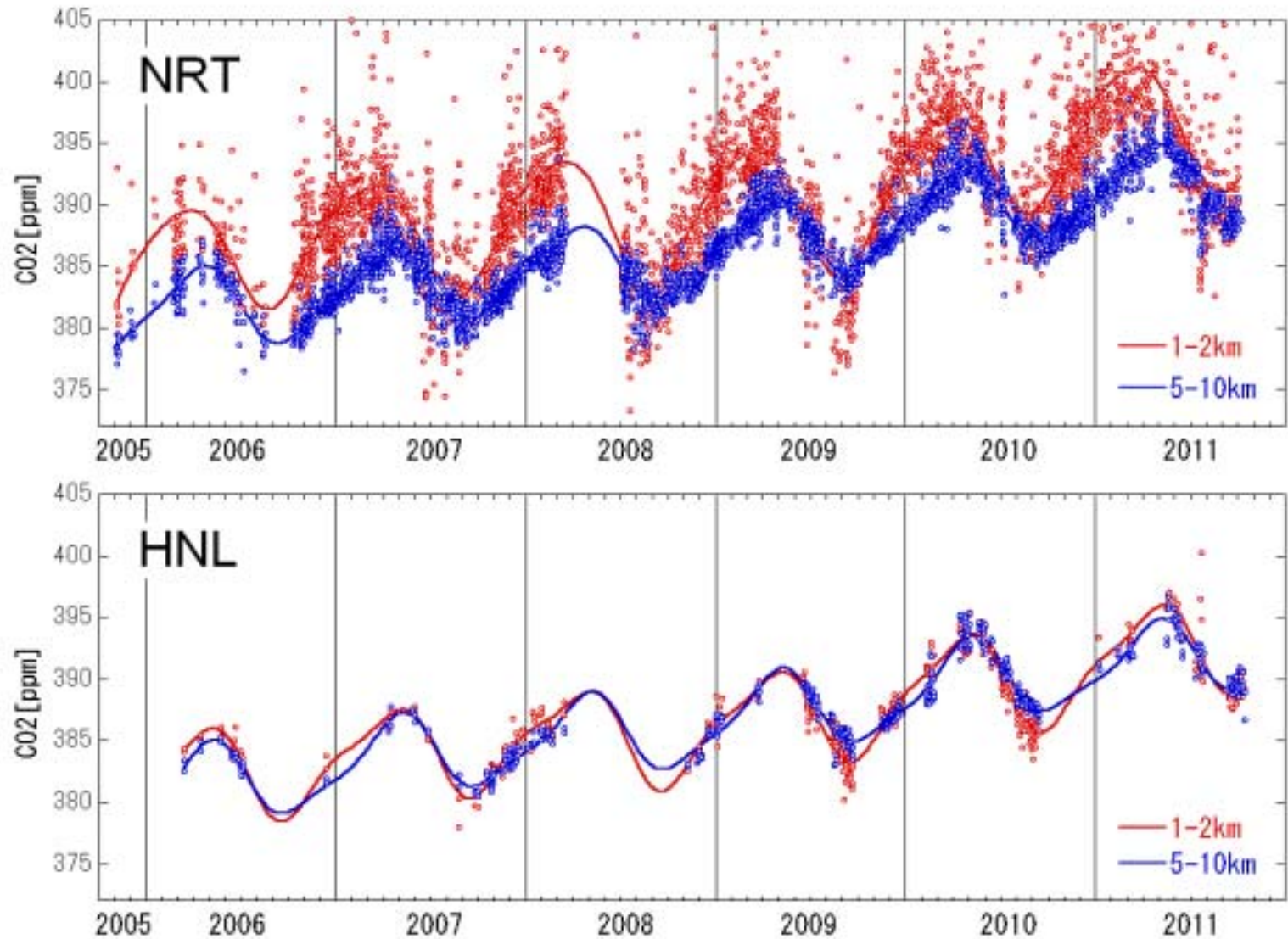


## Observation of CME ( ~ 2011/10)



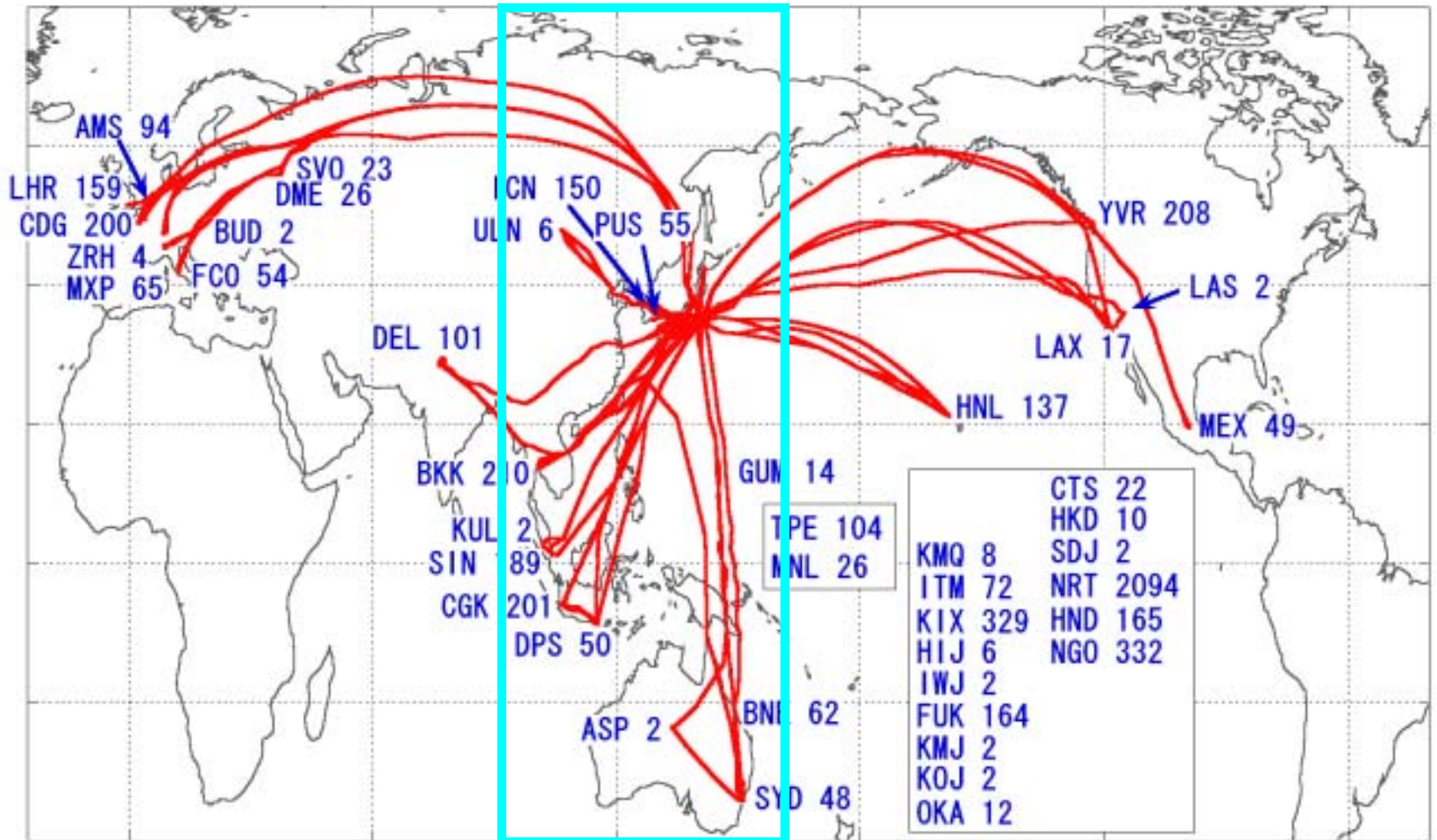


# Temporal variations of CO<sub>2</sub> over Narita and Honolulu

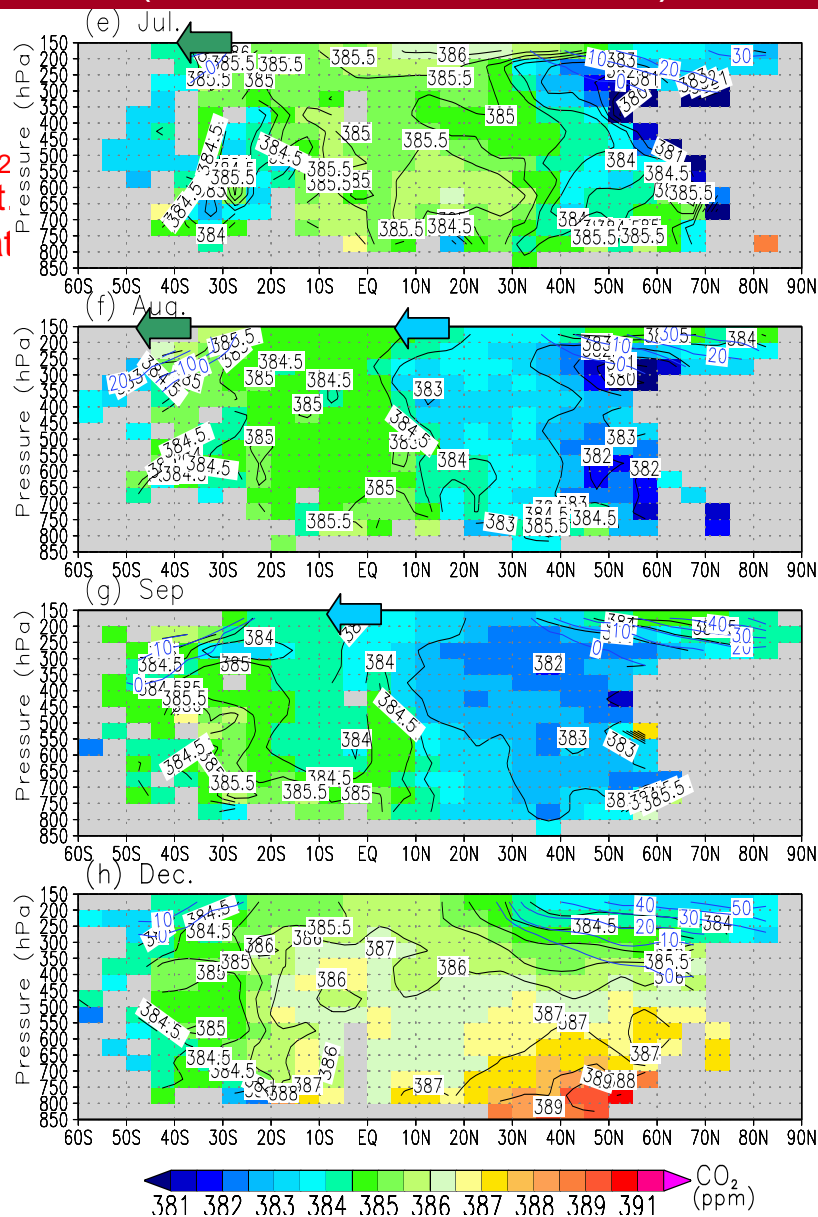
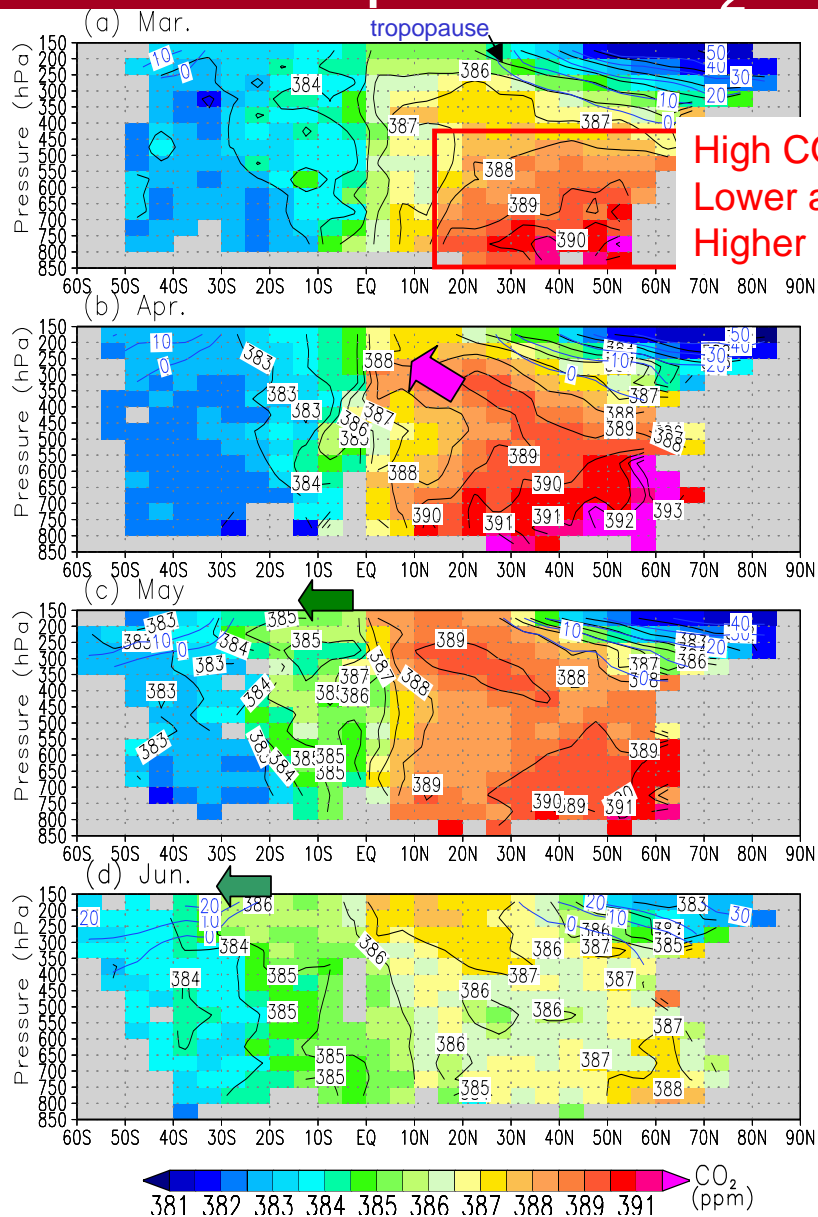




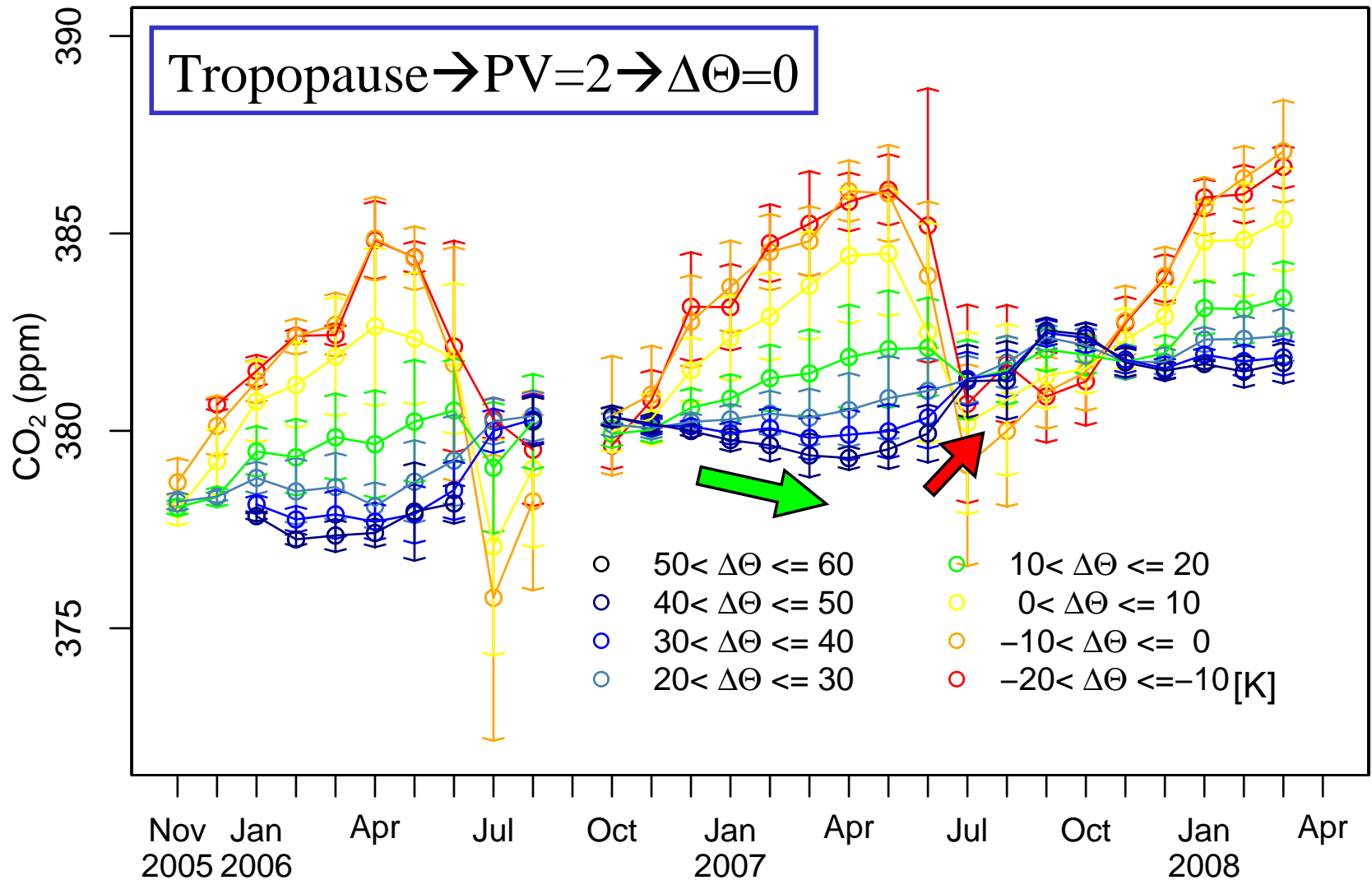
# N-S Cross-section



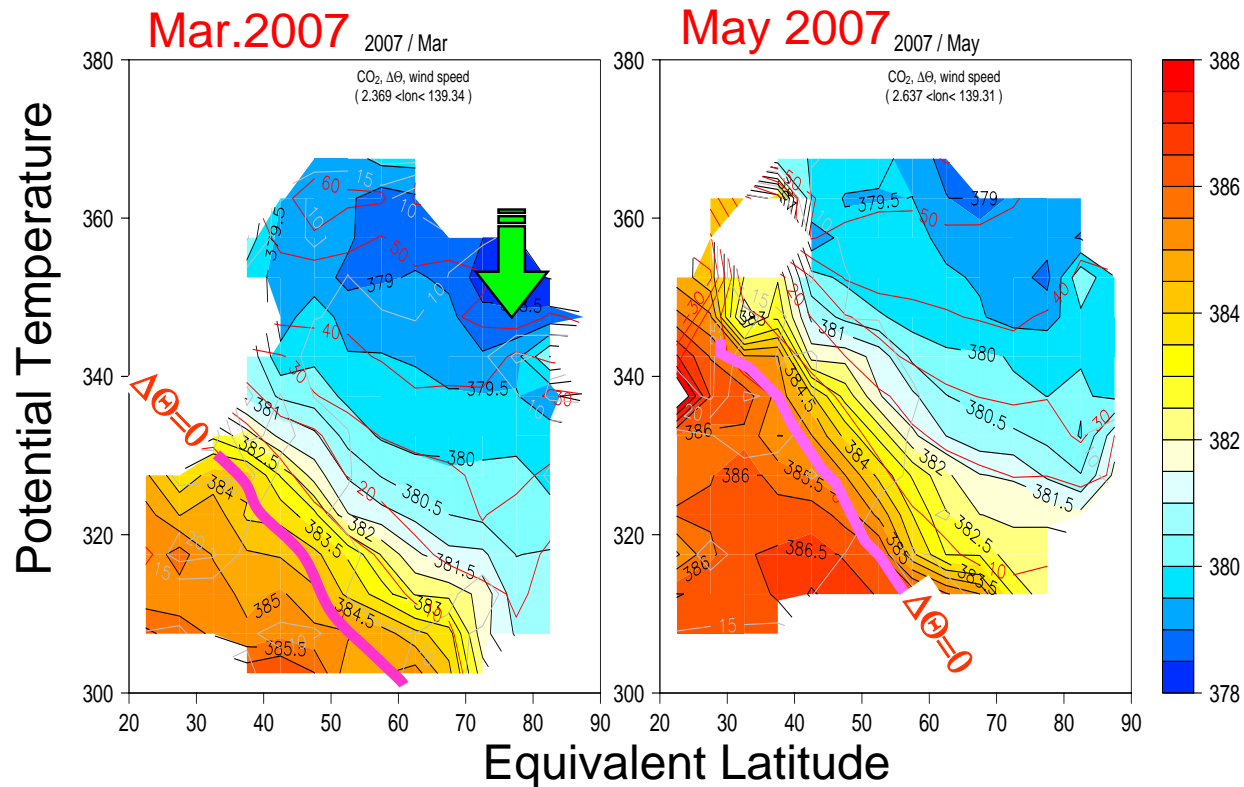
# Transport of CO<sub>2</sub> to SH (Sawa et al., *JGR*, 2012)



# CO<sub>2</sub> Variations at UT and LS (Sawa et al., *JGR*, 2008)



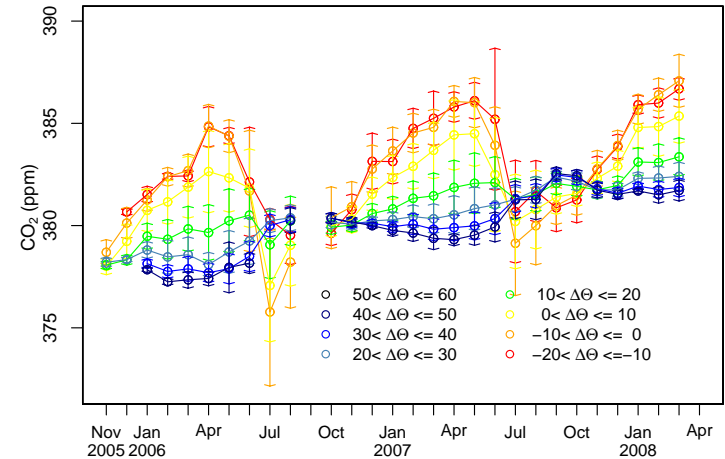
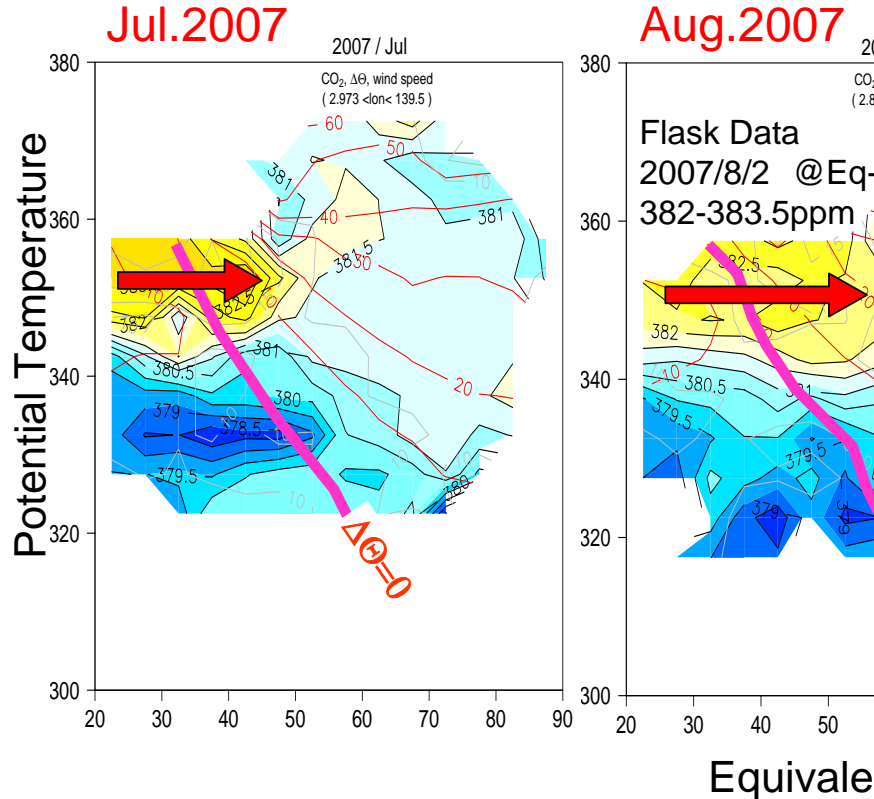
# CO<sub>2</sub> distributions on Equivalent Latitude and $\Theta$ , (Spring)



The CO<sub>2</sub> isopleth parallel to  $\Delta\Theta \rightarrow$  Tropopause barrier  
Downward transport of low CO<sub>2</sub> in upper STR



# CO<sub>2</sub> distributions on



CO<sub>2</sub> isopleth  $\nabla \Delta\theta$ , //  $\theta \rightarrow$  Tropopause no barrier

Meridional transport of high CO<sub>2</sub> across the tropopause

Sawa et al. 2008, *JGR*

# Validation for GOSAT

GOSAT

