FIRST GLOBAL MEASUREMENT OF MIDTROPOSPHERIC CO2 FROM NOAA POLA SATELLITES: TROPICAL ZONE

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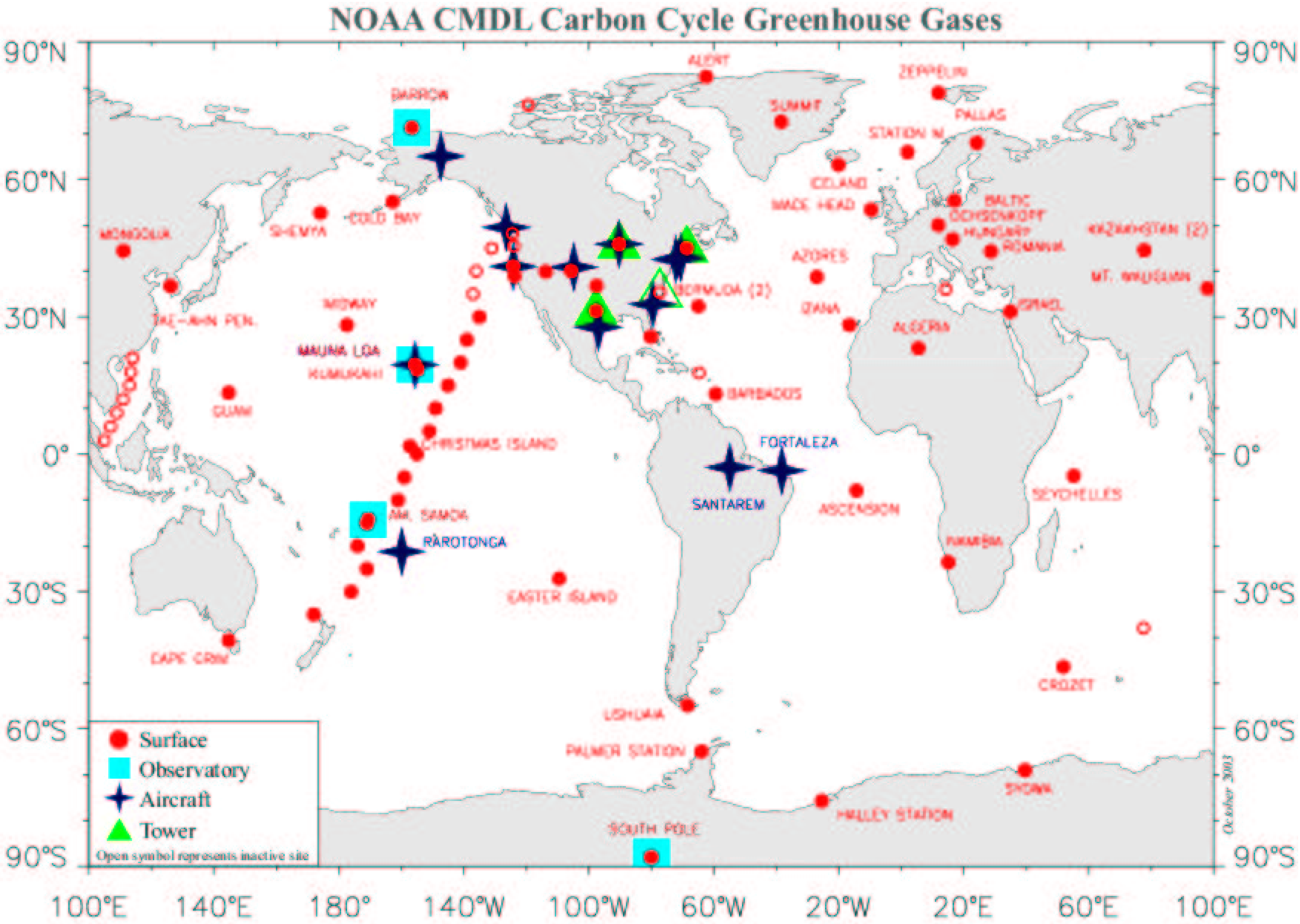
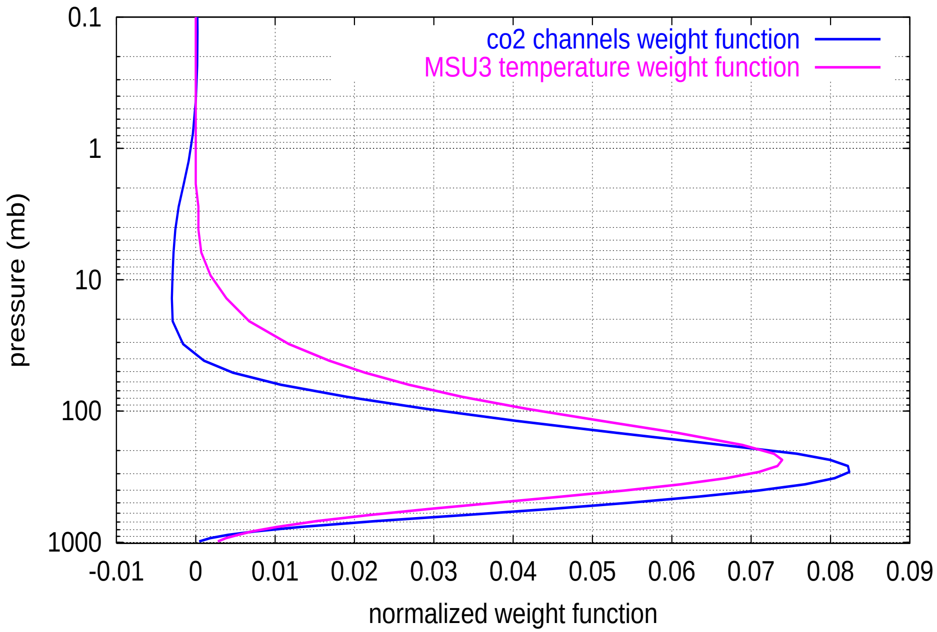
NOAA CMDL CCGG Cooperative Air Sampling Network



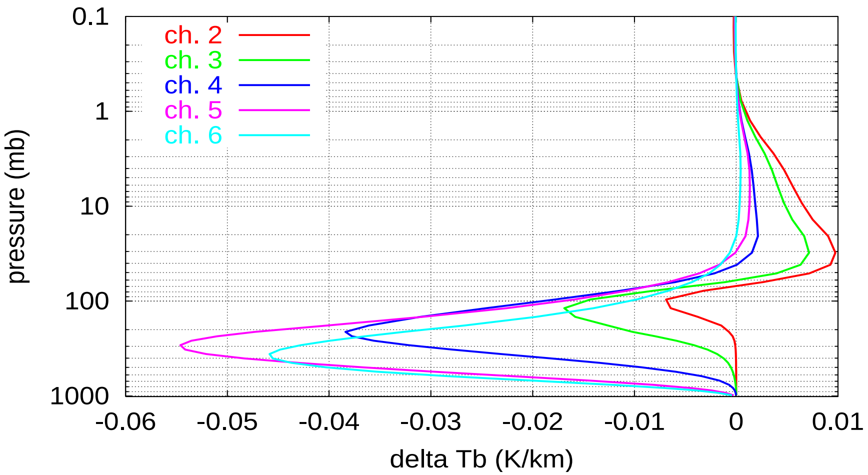
TOVS CO_2- channels selected

Radiative transfert model simulations over tropical atmospheres data base

Channel	Wavelength, µm	CO2: +3%
2	14.7	0.13 ± 0.02
3	14.5	0.002 ± 0.02
4	14.2	0.27 ± 0.03
5	14.0	0.32 ± 0.02
6	13.7	0.32 ± 0.02



Mean co2 jacobians – co2 +3%

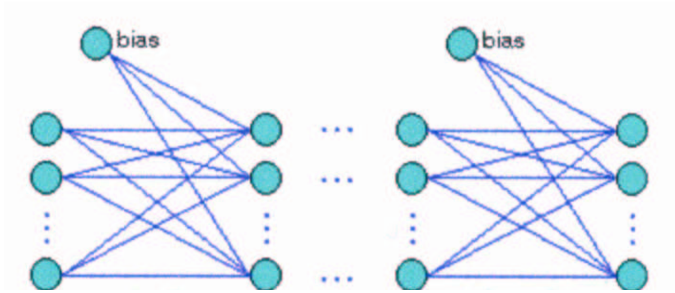


MSU3 temperature weight function and mean co2 channels weight function cover ~ the same pressure range

Retrieval method of CO_2 from NOAA polar satellites

Ø A non-linear regression approach : Mulilayer Perceptron (Rumelhart,1986)

HIRS and MSU →



→ $q_{co2\ var} - q_{ref}$

$T_{B\ co2\ var} - T_{B\ TIGR}$

q_{ref} =355 ppmv ~ central value for NOAA-10

2 hidden layers

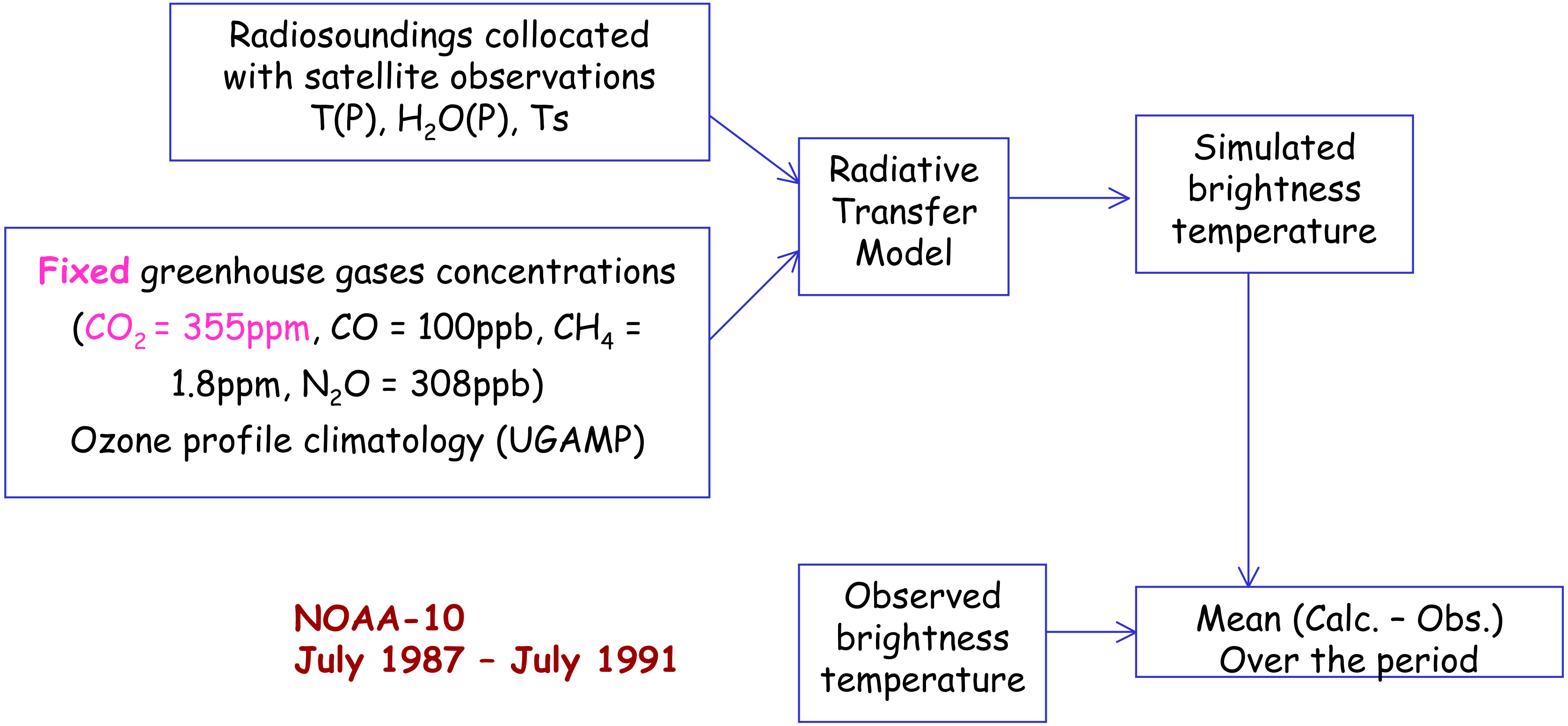
Ø MLP trained on the TIGR data set with variable q_{co2} drawn at random (341à 369 ppm)

Ø Noised T_B (instrumental and model noises))

Ø 49 MLPs trained (6 surface elevations (1013 to 875 hPa) over land and one over sea, and 7 viewing angles (from nadir to 40°))

Application of Neural Network to observations requires knowledge of systematic biases Between simulations and observations

(Simulations - Observations) systematic biases calculation

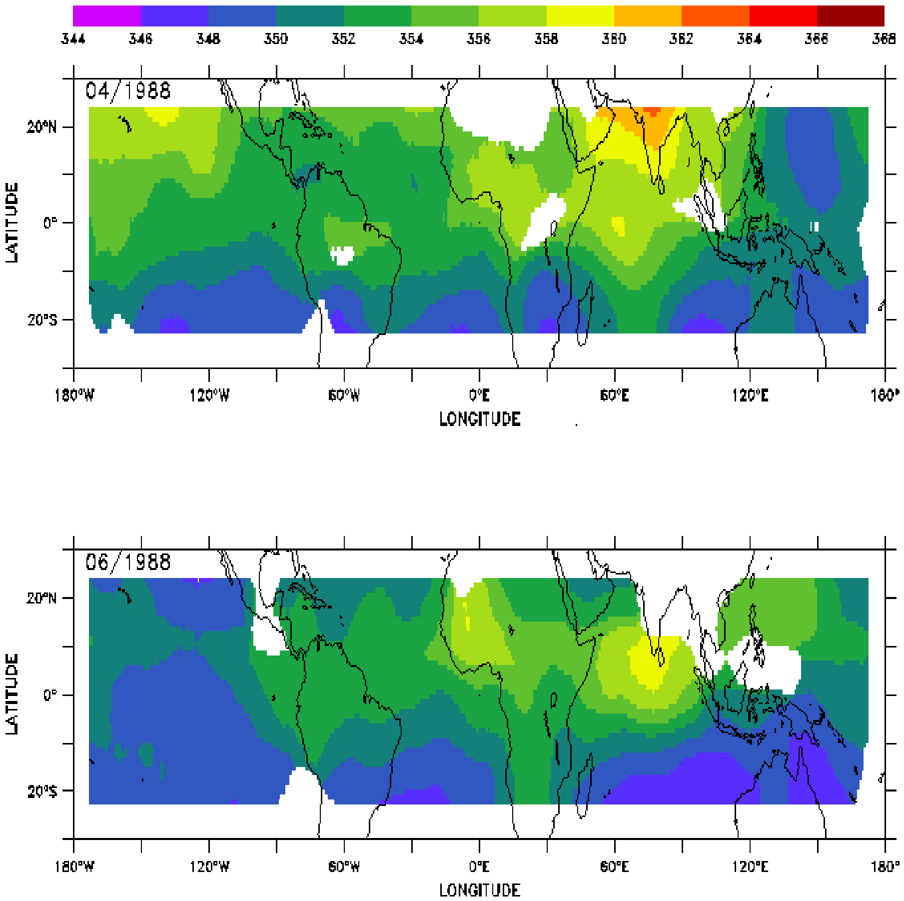


these biases allow connection between ‘simulation world’ and ‘observation world’

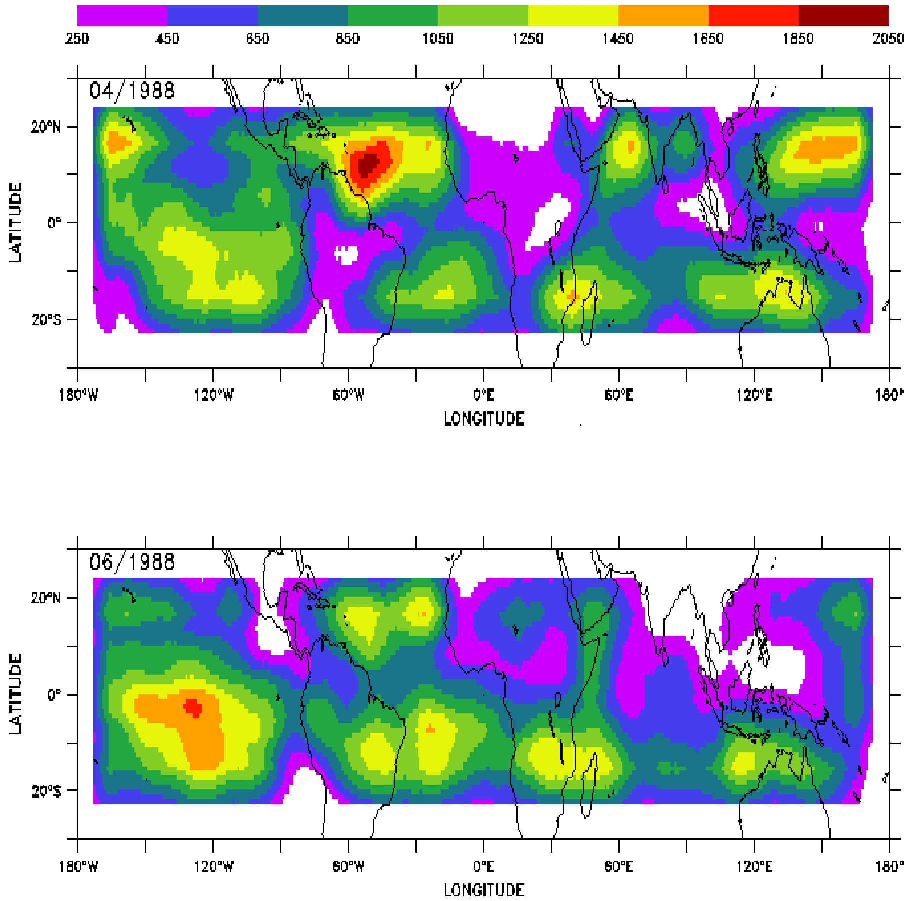
Global Maps of Mid-to-High tropospheric CO2

15°X15° (1° moving average)

CO_2 (ppmv)



Number of items averaged



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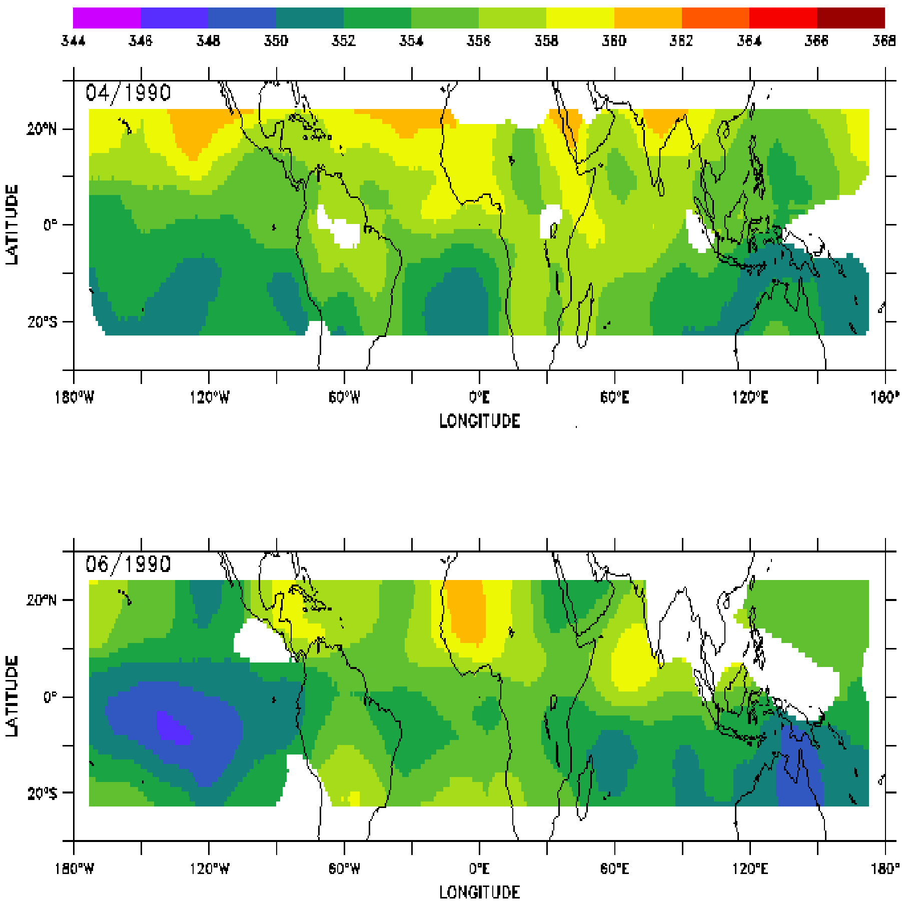
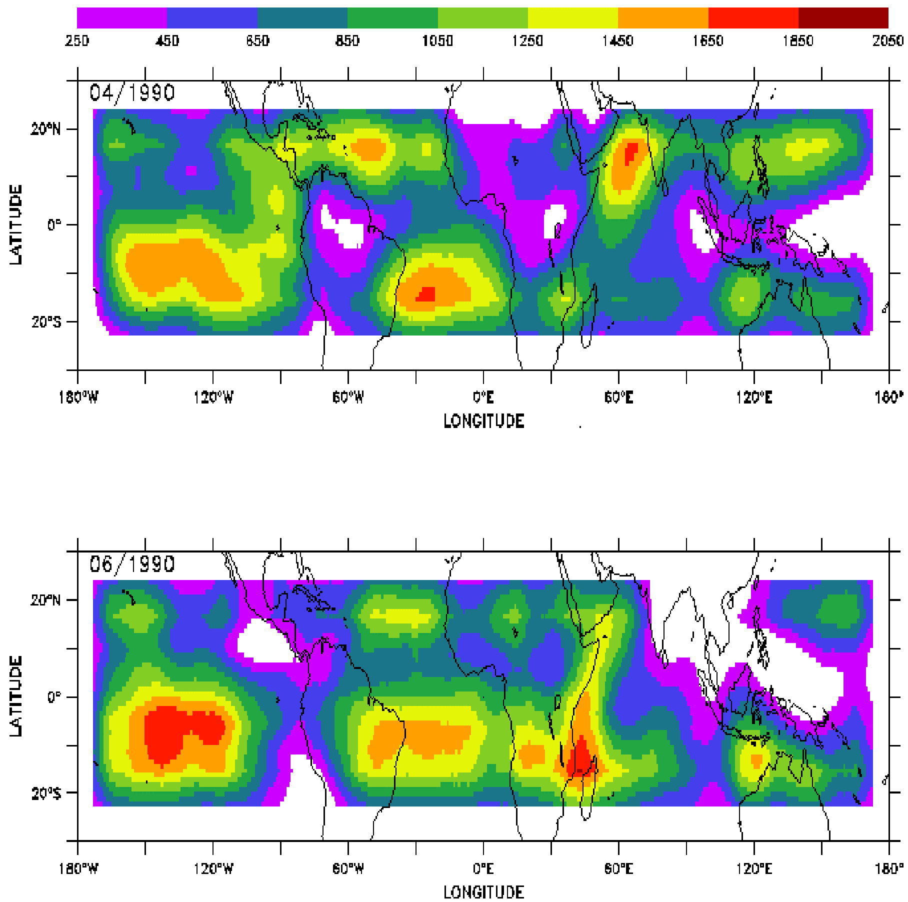


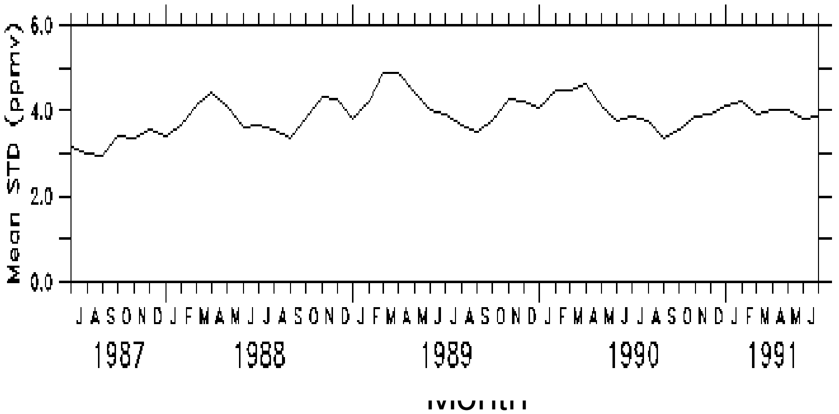
Number of items averaged

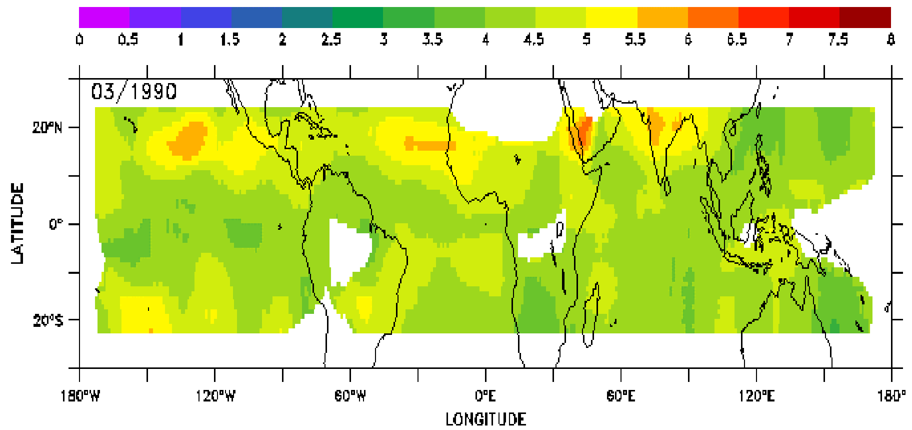


Dispersion of CO2 retrievals

Global Maps 15°X15° (1° moving average)

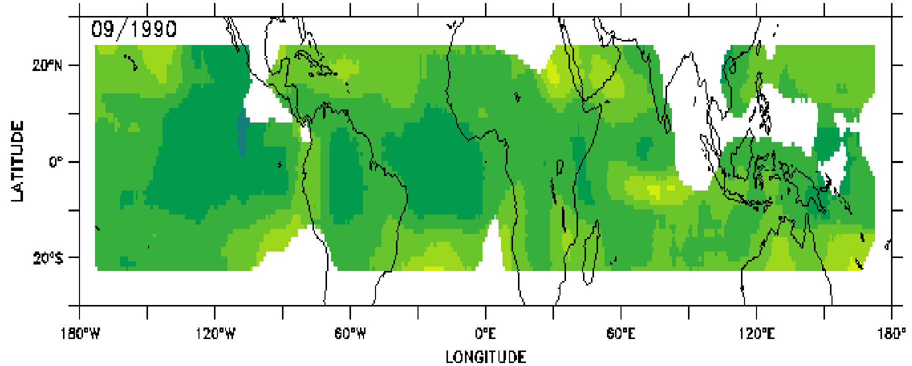
Standard deviation seasonal variability





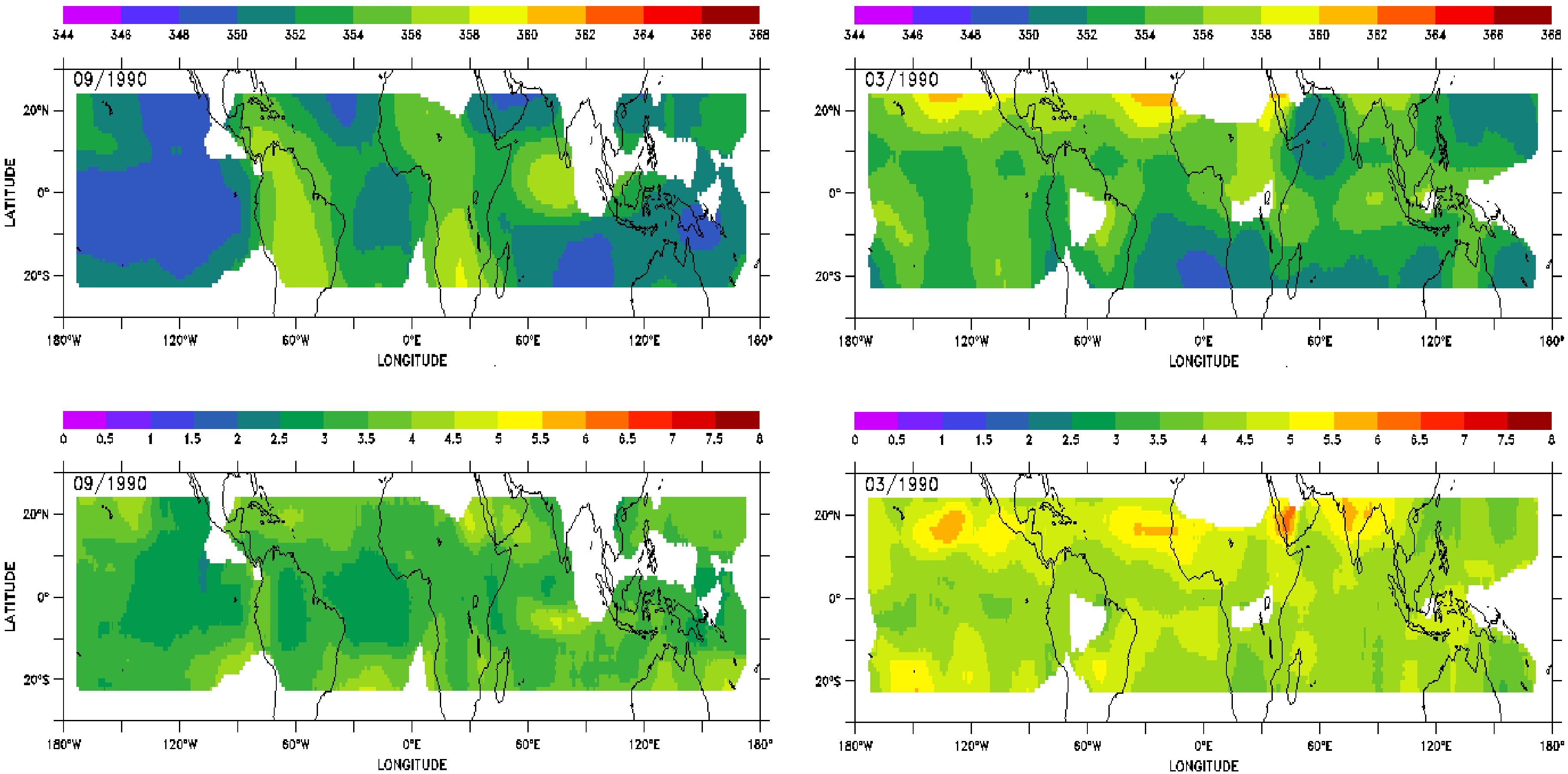
Minima in summer maxima in spring

Stdv of the method (Std_M) ~ 3 ppm



Is the natural variabilitythe cause of the diffrence?

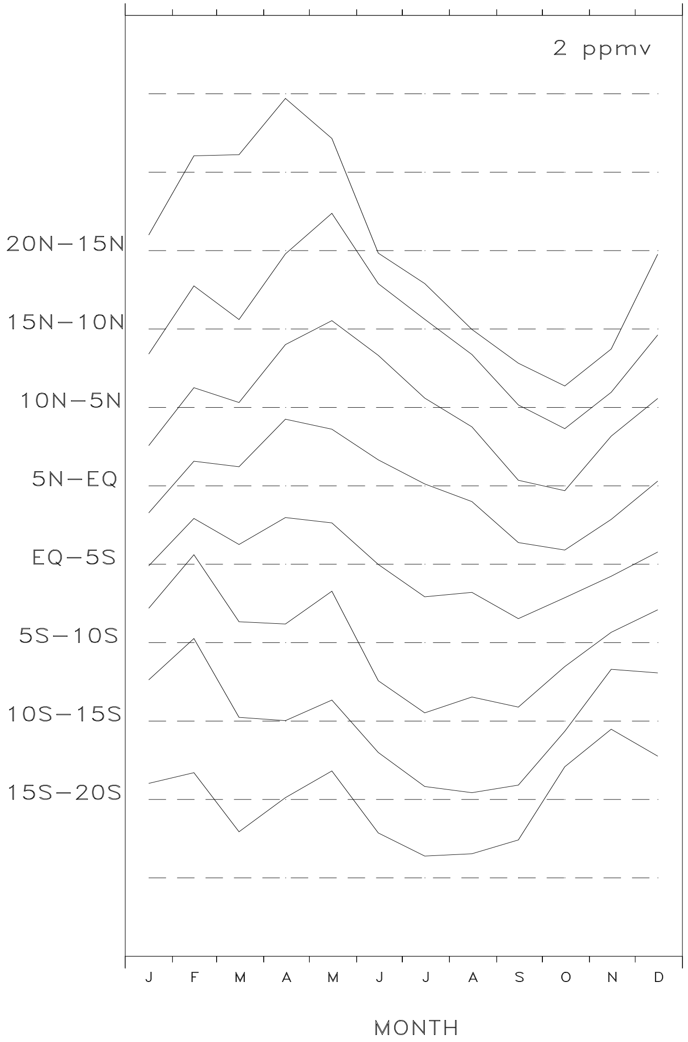
Dispersion of CO2 retrievals



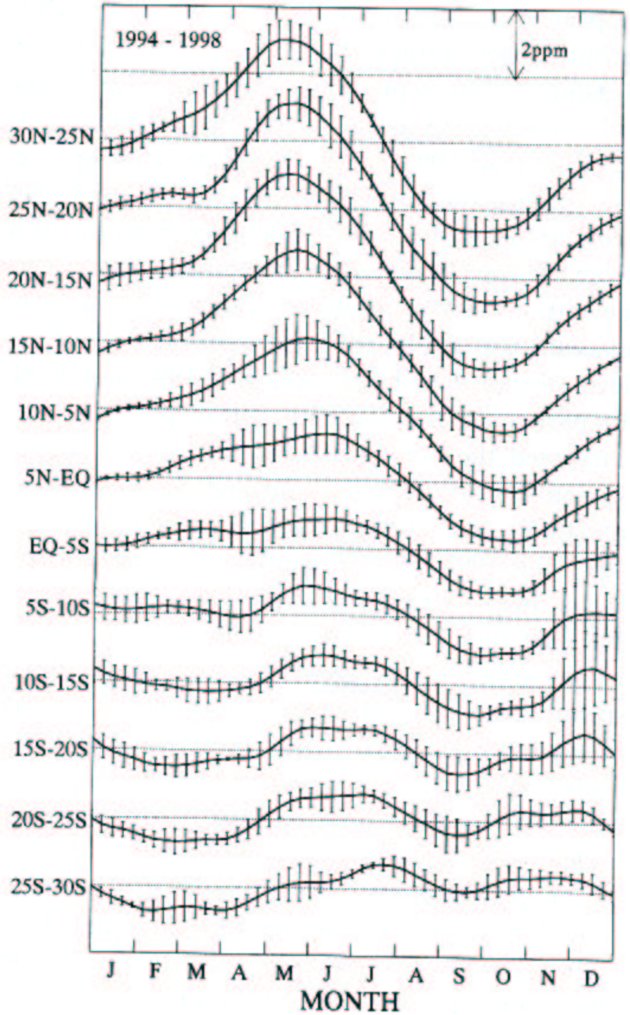
higher Stdv often localised in regions of CO_2 strong gradients

Mean Seasonal Cycles

As seen by NOAA-10 (5-14 km; 1987-1991)



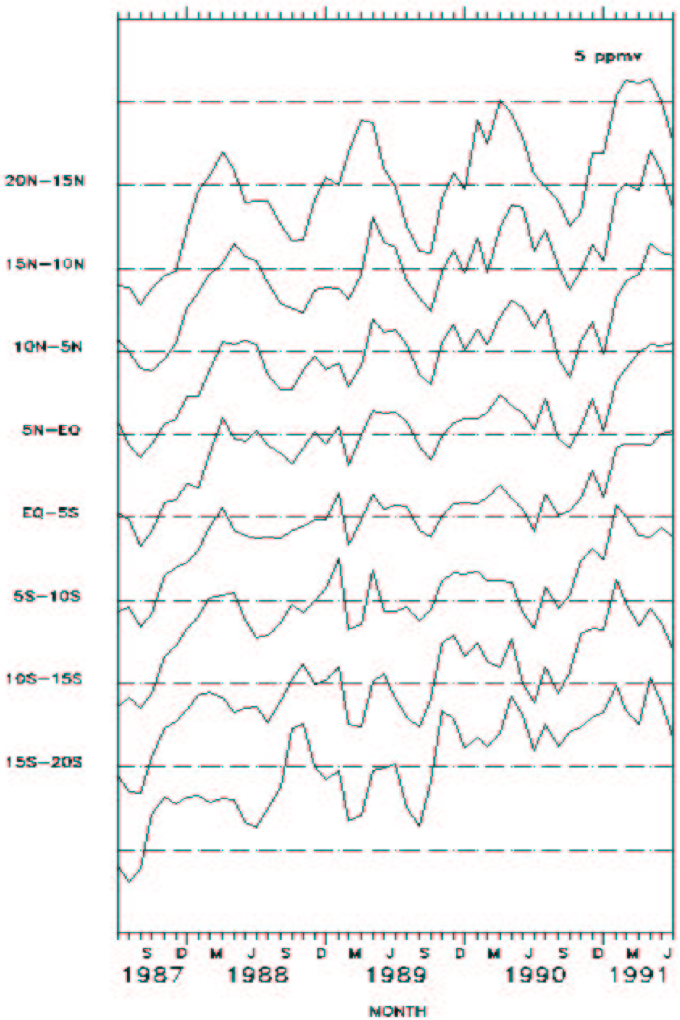
As measured in situ (8-13 km; 1993-1999)

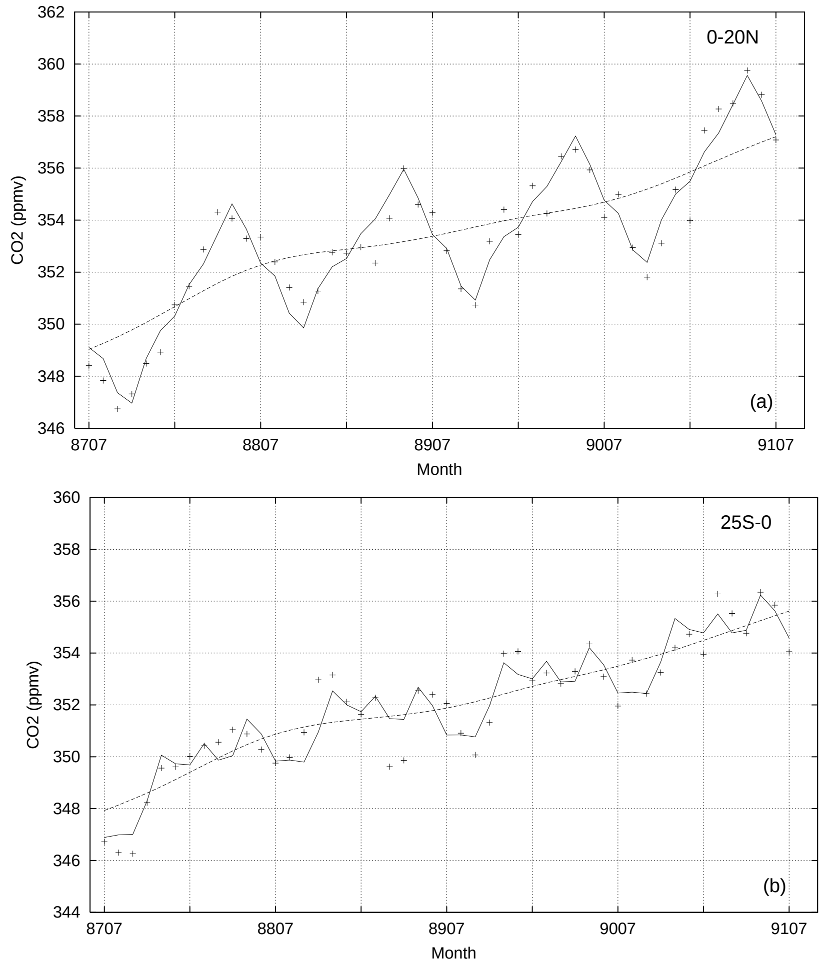


Commercial aircrafts (Matsueda et al., 2002)

Time variations of the CO_2 concentration As seen by NOAA-10

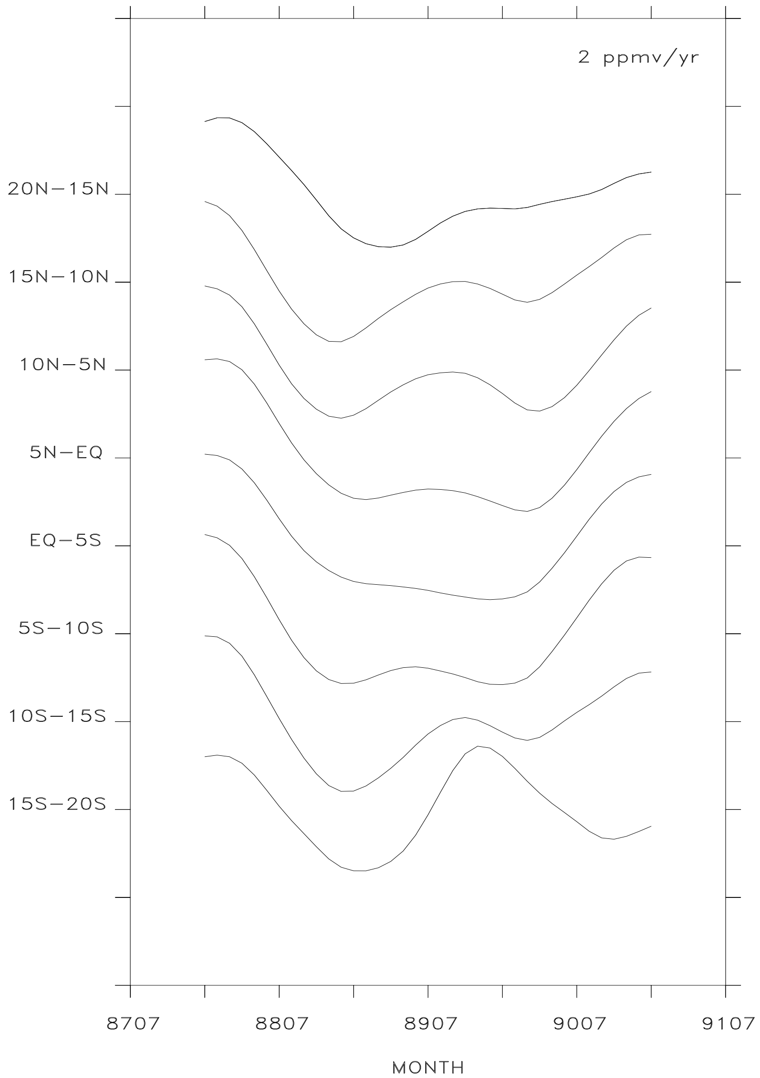
CO_2 retrievals - 5° zonal means





Solid line : sum of the long term trend and four harmonics

CO_2 Growth Rate as seen by NOAA-10 (1987-1991)



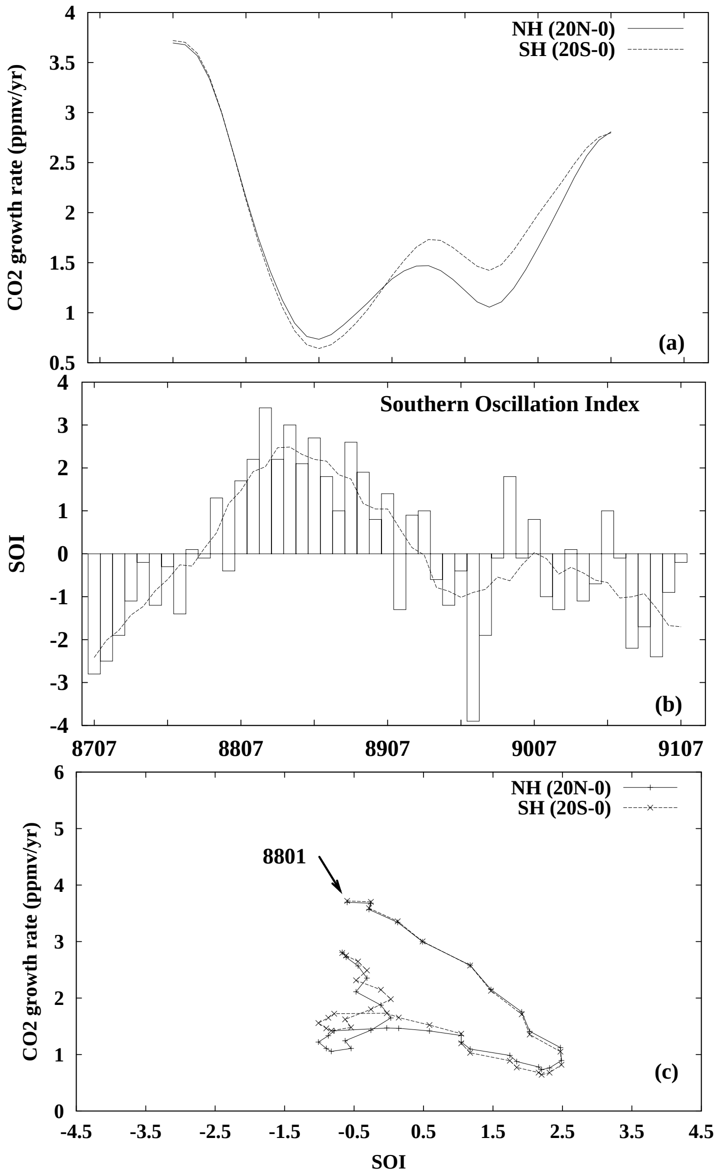
Mean Northern hemisphere 1.76 ppm/yr

Mean Southern hemisphere 1.80 ppm/yr

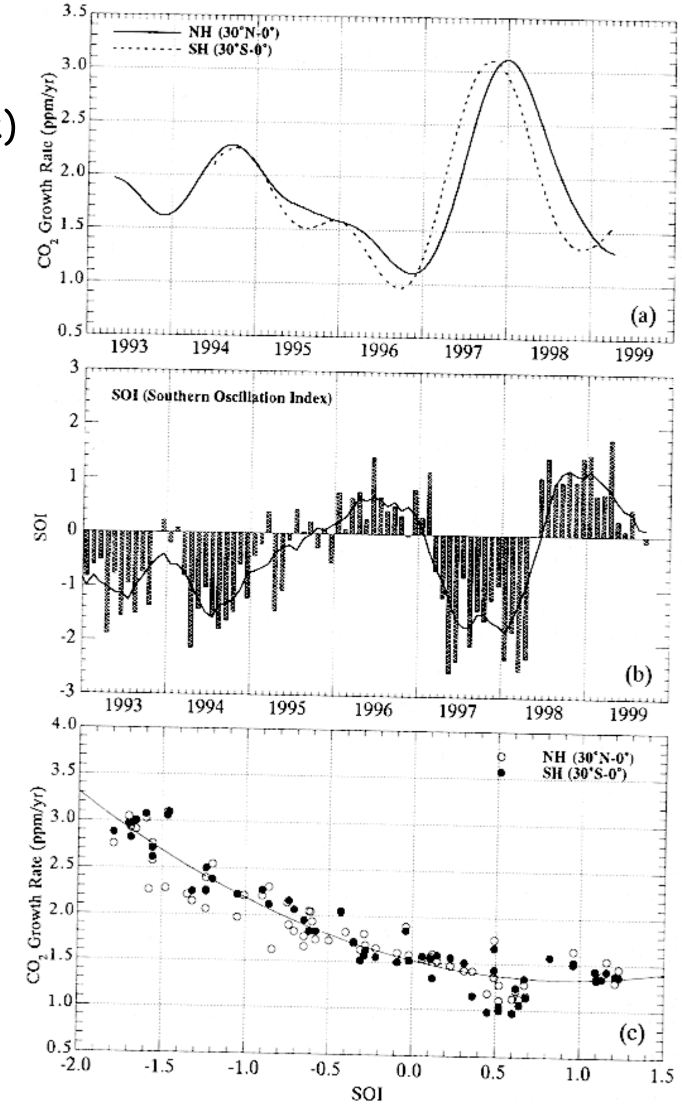
Values consistent with the one observed at the surface = ?? (Conway et al., 1994)

CO_2 and ENSO

As seen by NOAA-10
(Chédin et al., 2003)



As measured in situ
(Matsueda et al., 2001)



Growth rate (GR) time evolution

SOI index time variation

Correlation SOI/GR

Conclusions and perspectives

The method used to infer CO_2 from NOAA polar satellites has proven its ability to retrieve important features of the distribution of CO_2 and its time evolution :

- Ø Mean rate of rise of CO_2 of 1.75 ppm/yr over NOAA-10 period
- Ø Seasonal cycle and impact of ENSO in agreement with Matsueda findings

And now ?

Analys CO_2 data in the tropics and elucidate factors influencing its variation (sources, sinks, transport)

Extend the period to the 25 years of NOAA/TOVS observations (1979-2003)