# Atmospheric Inversion results

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Viterbo RECCAP

# Tutorial 1 : Logistics

- Results accessible at: http://transcom.lsce.ipsl.fr

  - Plotted maps and time series ("component" fluxes X aggregated regions) – no psswrd

  - Data files ("component" fluxes X aggregated regions and gridded) - psswrd

- 11 "state of the art" inversions (some *multiple* submissions)

- All re-gridded to a common grid (1°x1°, monthly)

"transcom"

- "Component" fluxes = prior, fossil fuel, posterior (estimate)

- "Regional" fluxes = land/ocean regions + various aggregates (109)

- Region "mask" – boundaries of the chosen regional breakdown and aggregates (regular and extended)

- We urge regional leads to contact "inverters" for additional clarification

- The complete 1°x1°, monthly files are also available – "roll" your own regions

# Tutorial 2 : Participants

| Name | Time period | Transport model | Winds | Atm Data | Flux spatial res. | Flux temp. Res. | Inverse Method |
|---|---|---|---|---|---|---|---|
| Lsce_an_v2.1 | 1996 - 2004 | LMDZ v4 | ECMWF | Monthly mean | gridcell | monthly | Bayesian Matrix |
| Lsce_var_v1.0 | 1990- 2008 | LMDZ v3 | ECMWF | Raw | gridcell | 8 day with night & day sep | Variational |
| Jena_s96_v3.2 | 1996 - 2008 | TM3 | NCEP reanalysis | Raw | gridcell | Daily | Variational |
| Carbntrckr_US | 2000 - 2008 | TM5 zoom | | Raw | 156 ecoregions | weekly | Kalman smoother |
| Carbntrckr_EU | 2000 - 2007 | TM5 zoom | | Raw | 145 land + 30 ocean | weekly | Kalman smoother |
| Rigc_patra | 1993 - 2007 | NIES/FRCGC | NCEP reanalysis | Monthly mean | 64 | Monthly | Bayesian Matrix |
| T3 mean | 1995 - 2008 | 13 models | 13 models (climatology) | Monthly mean | 22 | Monthly | Bayesian Matrix |
| JMA | 1985 - 2007 | | | Monthly mean | 22 | Monthly | Bayesian Matrix |
| Nicam_Niwa | | NICAM-TM | | Monthly mean | 22 | Monthly | Bayesian Matrix |
| C13_MATCH Rayner | 1992 - 2005 | MATCH | NCEP 1999 (climatology) | Monthly mean | 116 | Monthly | Bayesian Matrix |
| C13_CCAM Law | 1992 - 2005 | CCAM | NCEP 1999 (climatology) | Monthly mean | 146 | Monthly | Bayesian Matrix |

We are choosing a start date of 1995 for RECCAP

# Tutorial 3: Miscellaneous notes

○ Fossil emissions differed between inversions:

> Attempted "fix": Fossil "adjustment" with common fossil fuel $CO_2$ flux

○ Uncertainties: (in progress, Enting et al., Transcom)

- "Bayesian" errors will be provided for key regions
- Spread induced by changing model components available for few cases (contact individual modeler)

○ "Validation" against independent data (in progress)

- Atm. Vertical profile, campaign, independent C-cycle obs, etc

○ Regridding & land/sea mask can create inaccuracies
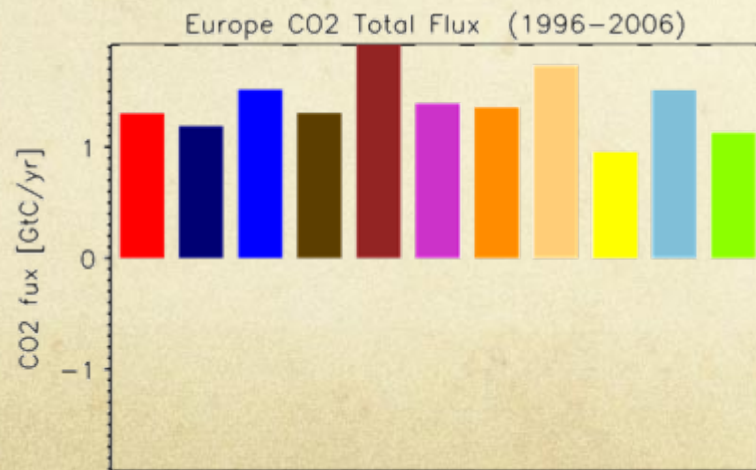   ➔ special care for regions with shaped coastal boundaries
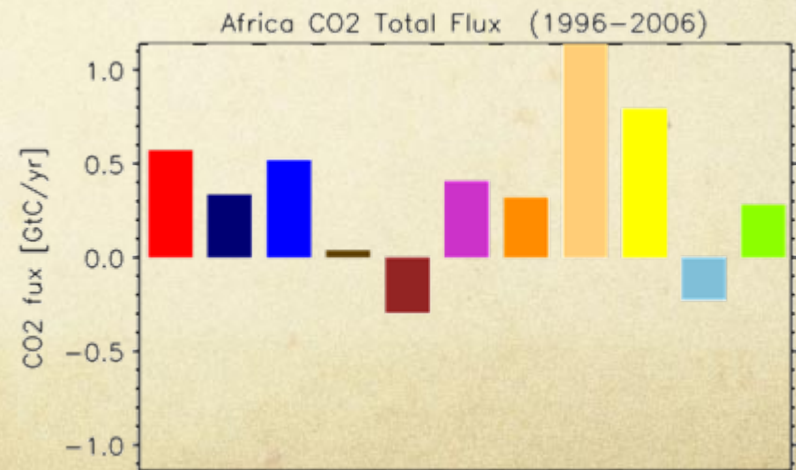
# Website



Thank you Zegbeu!

# Tutorial 4: Proceed with Caution
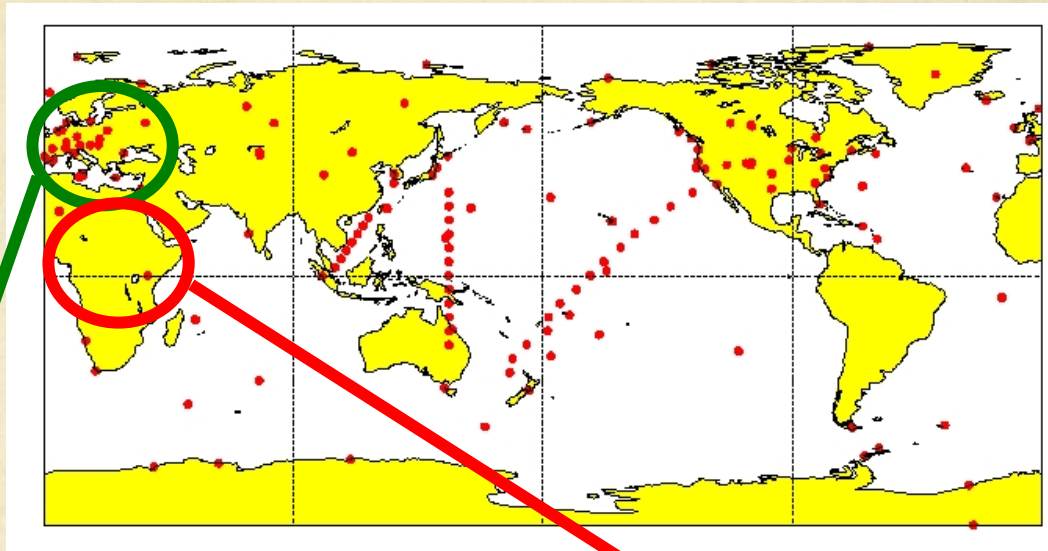


1. Well-constrained region (Europe)

2. Poorly-constrained region (Africa)

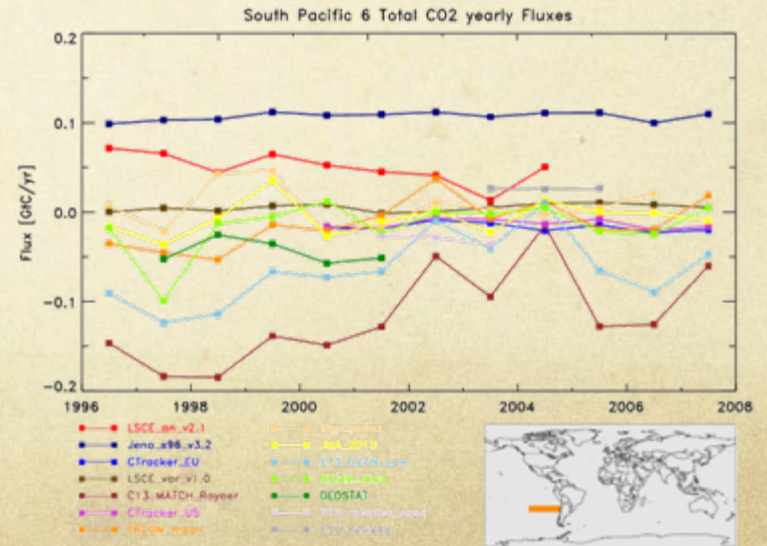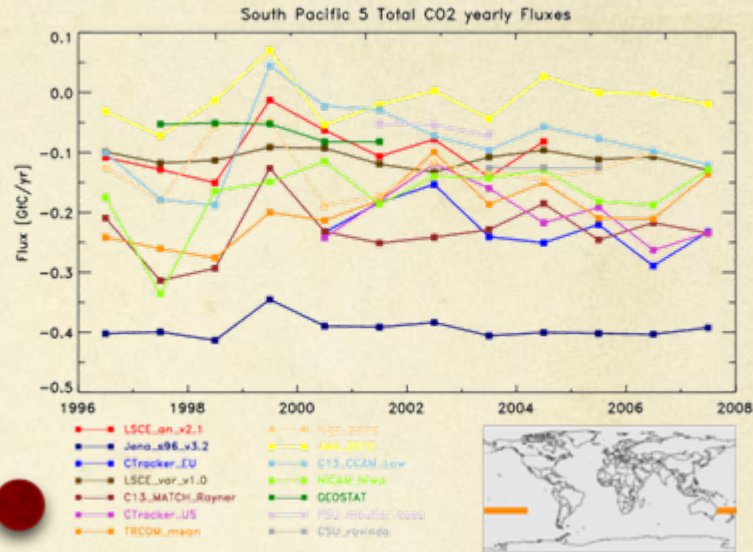# 4 continued: Consequences of poor constraints

- Influence of prior

- Sensitivity to an individual site

Jena (dark blue) only inversion without EIC and very different E-W flux split



South Pacific 5 Total CO2 yearly Fluxes


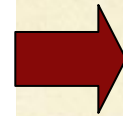
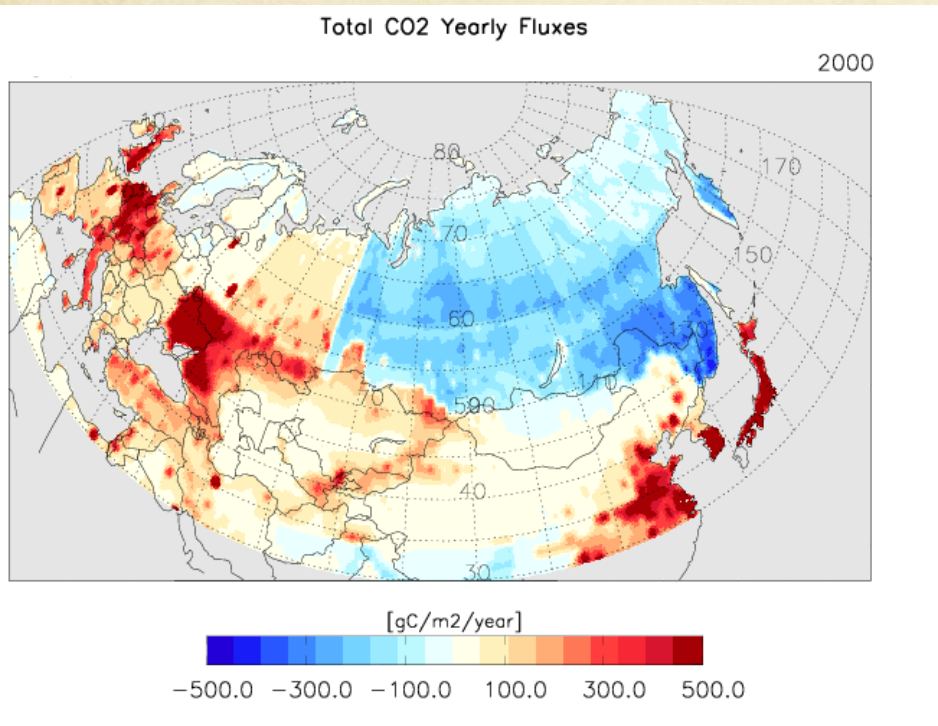South Pacific 6 Total CO2 yearly Fluxes
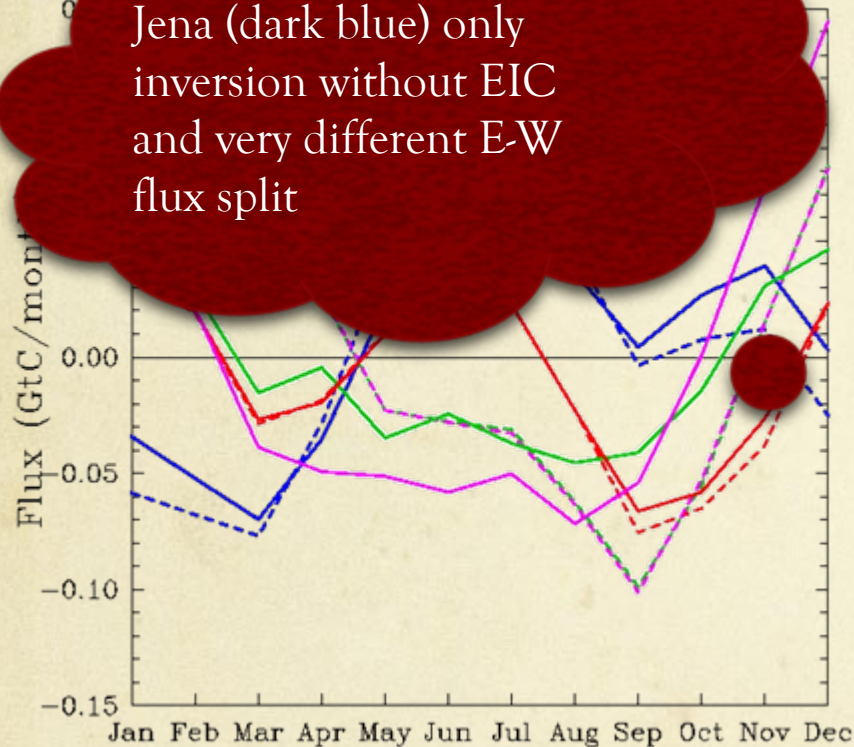
Australian seasonal cycle from 4 inversions. Posterior (solid), prior (dashed).

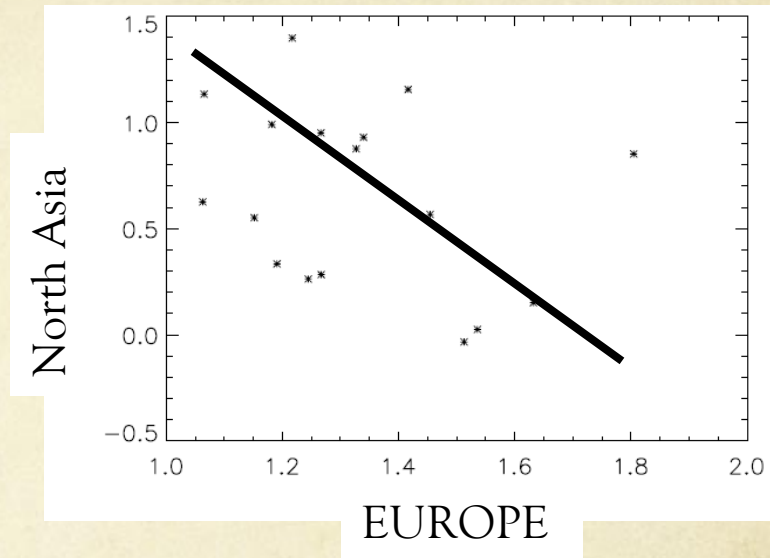Different prior seasonality due to inclusion or not of biomass burning.

# 4 continued: Caution with "big region" estimates



Total CO2 Yearly Fluxes — 2000
[gC/m2/year]
−500.0  −300.0  −100.0  100.0  300.0  500.0
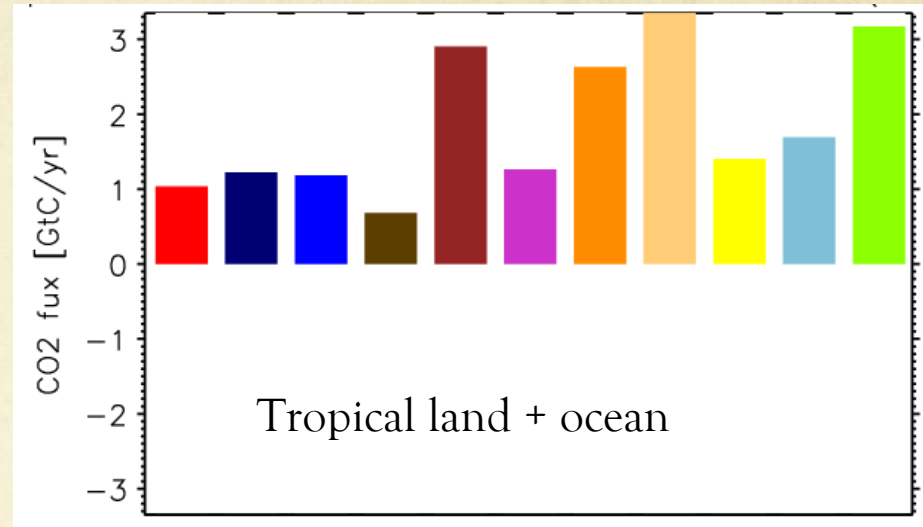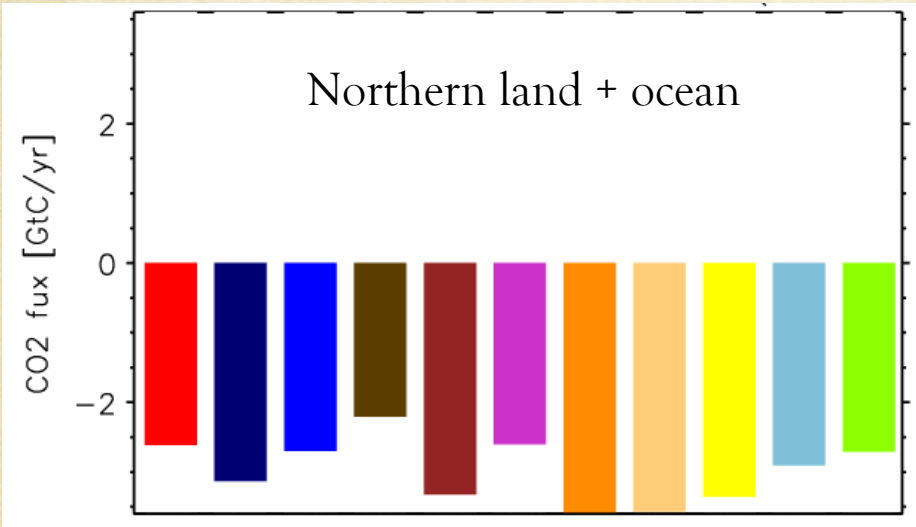
Annual total flux (GtC/yr)



North Asia vs EUROPE

➜ "spurious" anti-correlations – a form of "representation error"
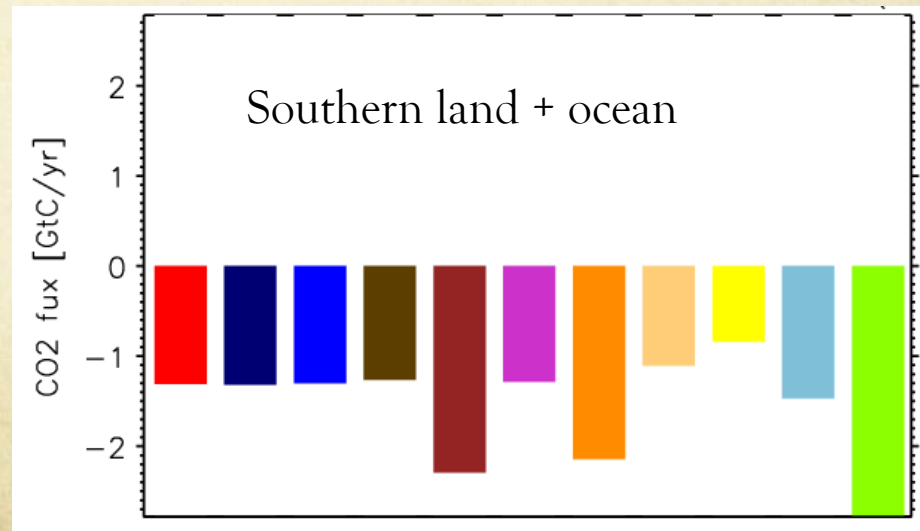
➜ Large flux dipoles : « regional estimates should be interpreted

with great care depending on the boundary of the regions

# Results 1 : Long term means

Natural fluxes (GtC/yr) – 2000-2003 period



Northern land + ocean

Tropical land + ocean
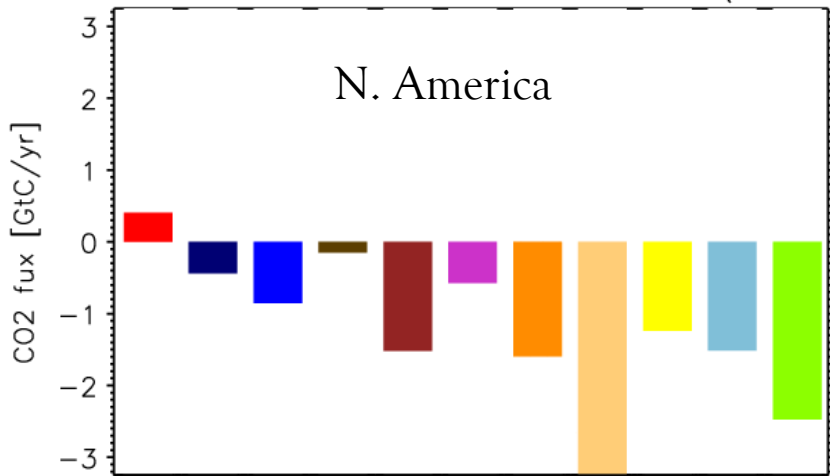
Southern land + ocean

LSCE_an_v2.1
JENA_s96_v3.2
CTracker_EU
LSCE_var_v1.
C13_MATCH
CTracker_US
TRCOM_me
RIGC_patra
JMA_2010
C13_CCAM
NCAM_Niwa

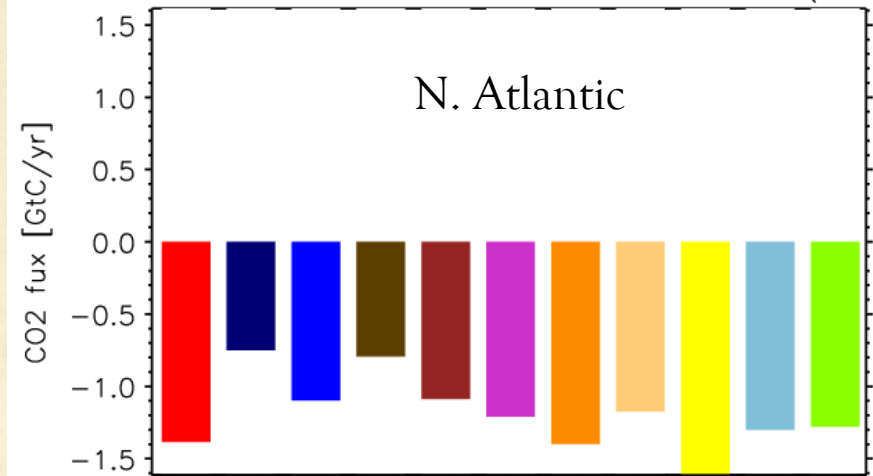The following results are preliminary and based on current submissions. These may change at a future time.

# Results 1 : Long term means

Natural fluxes (GtC/yr) – 2000-2003 period

# Results 2: IAV (land)



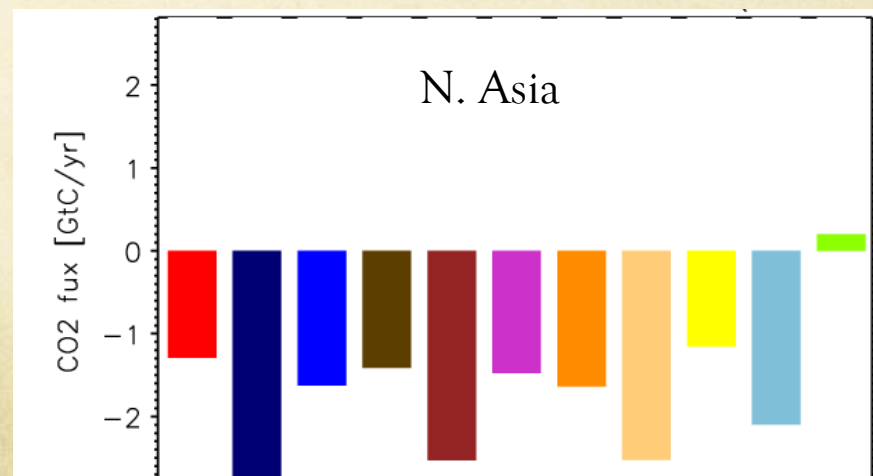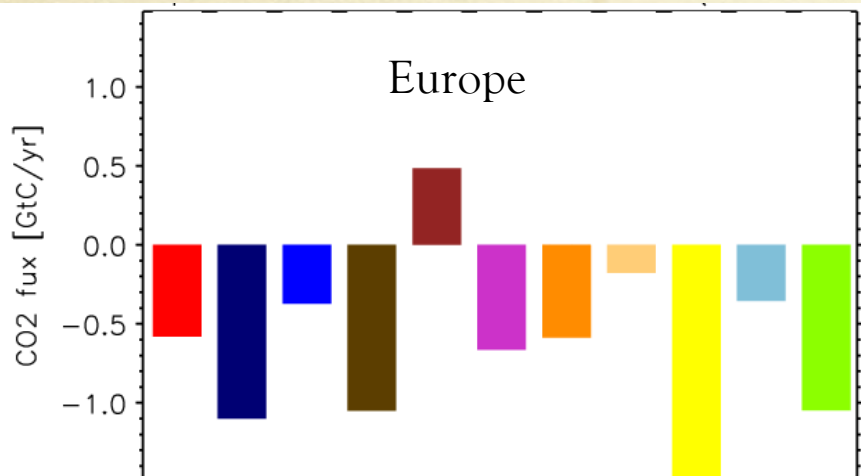Global Land Total CO2 yearly Flux Anomalies

Total land
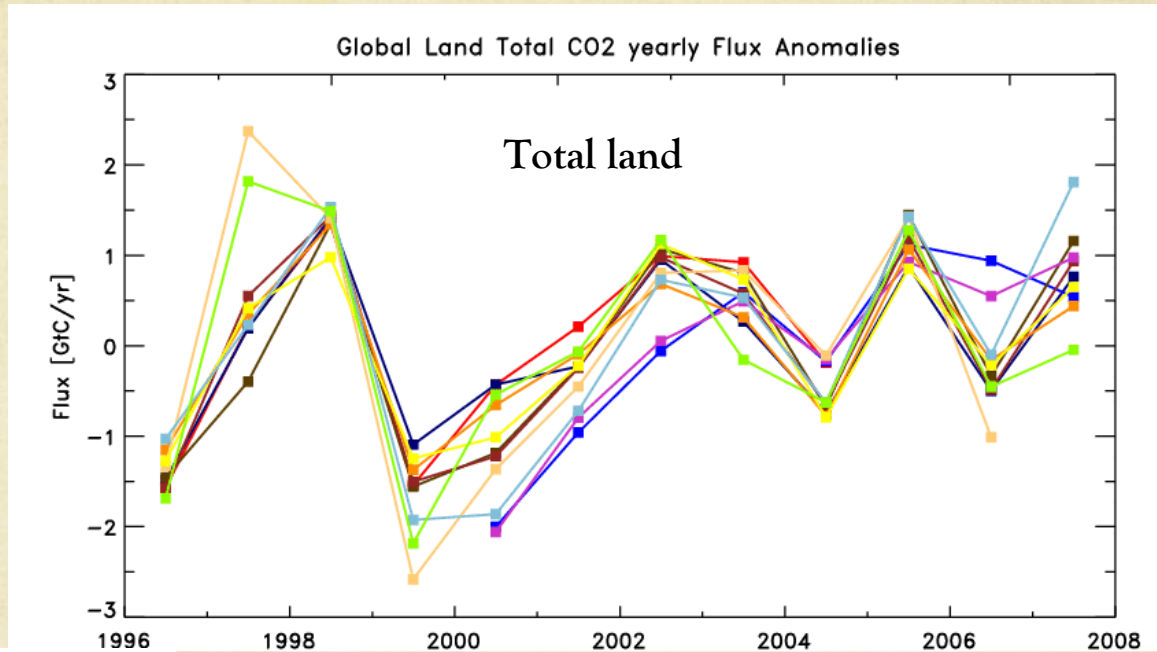
LSCE_an_v2.1
JENA_s96_v3.2
CTracker_EU
LSCE_var_v1.
C13_MATCH
CTracker_US
TRCOM_me
RIGC_patra
JMA_2010
C13_CCAM
NCAM_Niwa

Northern land

Tropical land

Southern land

# Results 2: IAV (ocean)



**Global Ocean Total CO2 yearly Flux Anomalies**

Total ocean

LSCE_an_v2.1
JENA_s96_v3.2
CTracker_EU
LSCE_var_v1.
C13_MATCH
CTracker_US
TRCOM_me
RIGC_patra
JMA_2010
C13_CCAM
NCAM_Niwa

Northern ocean

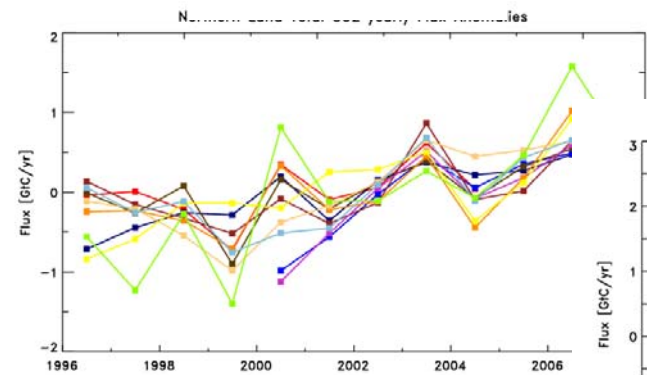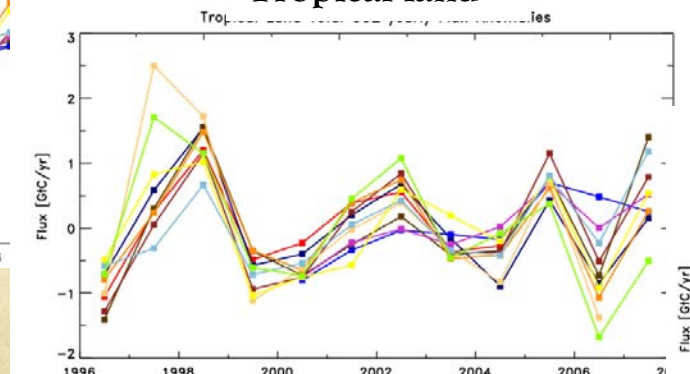Tropical ocean
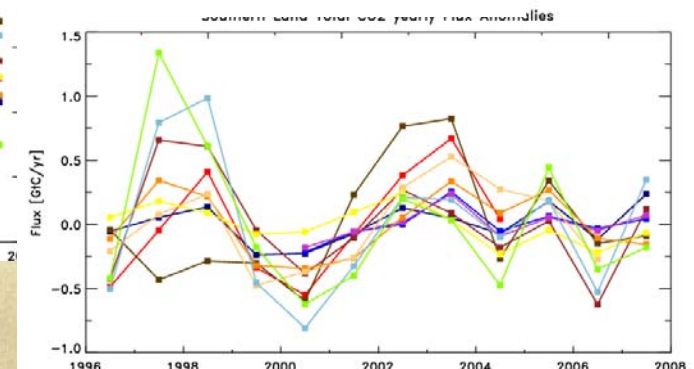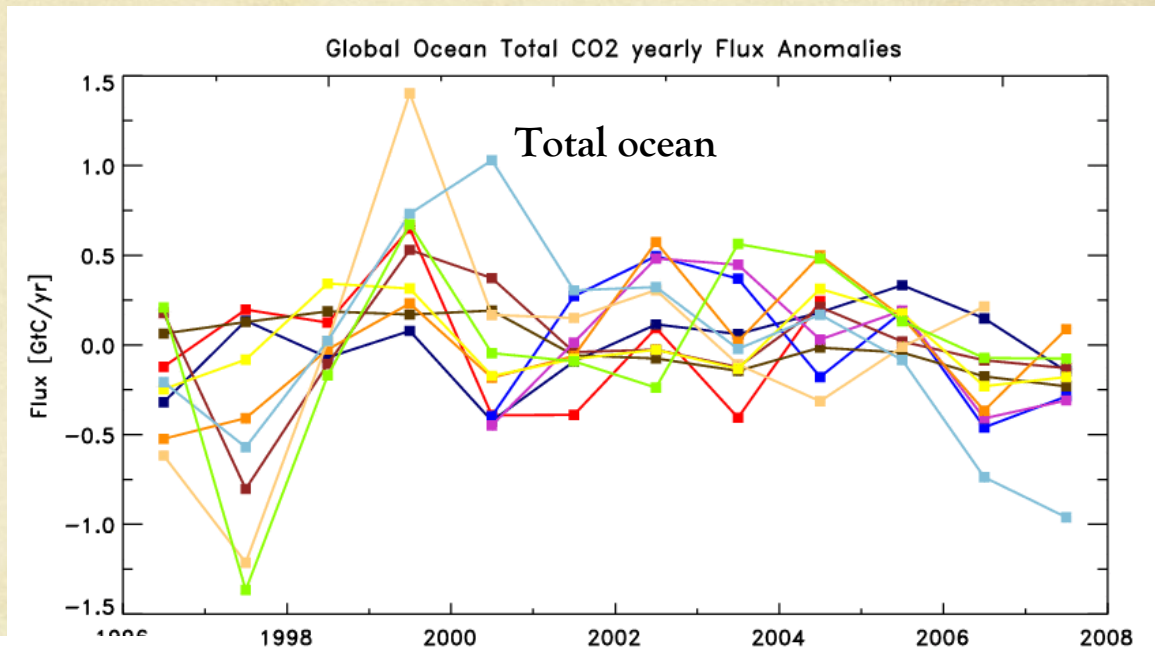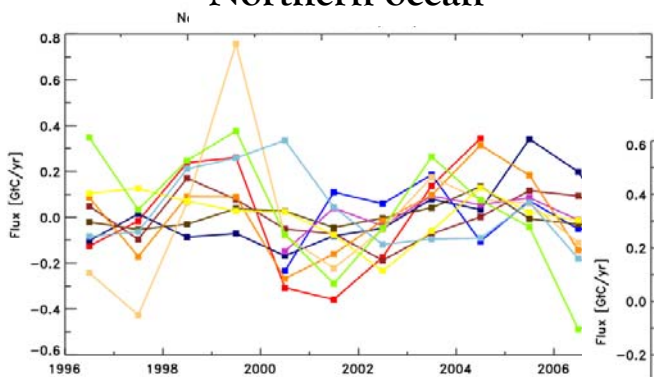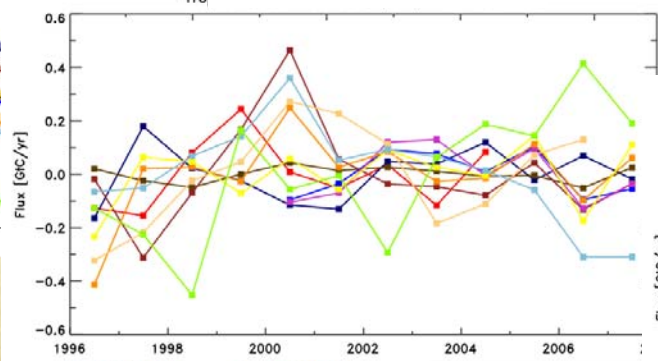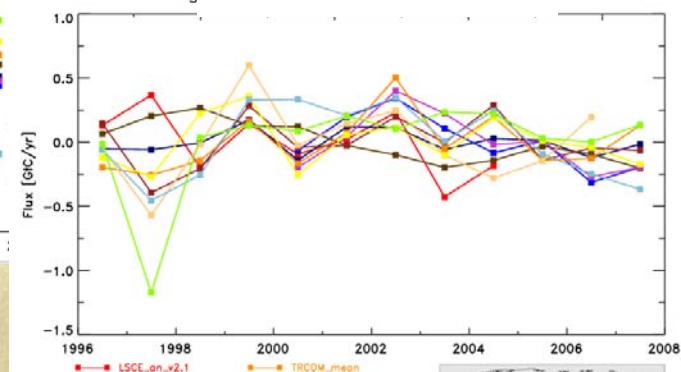
Southern ocean
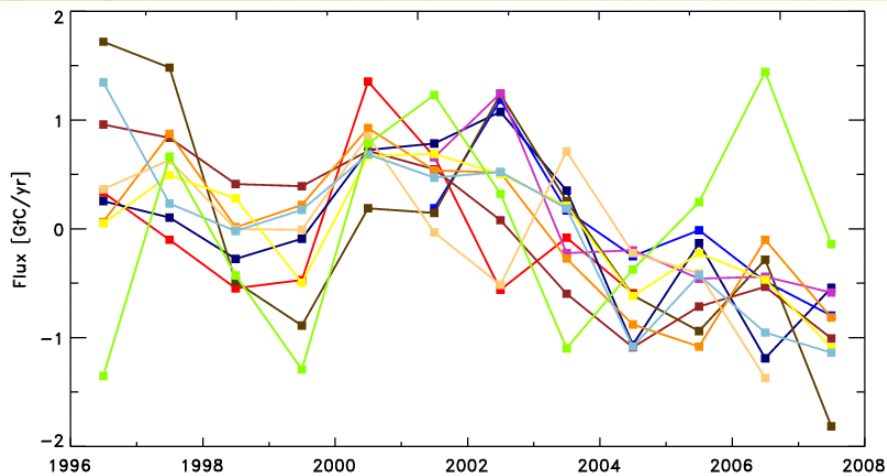
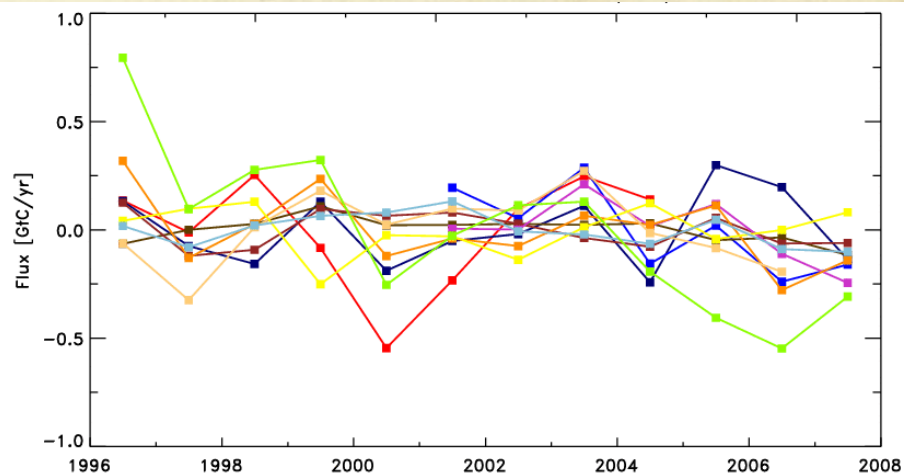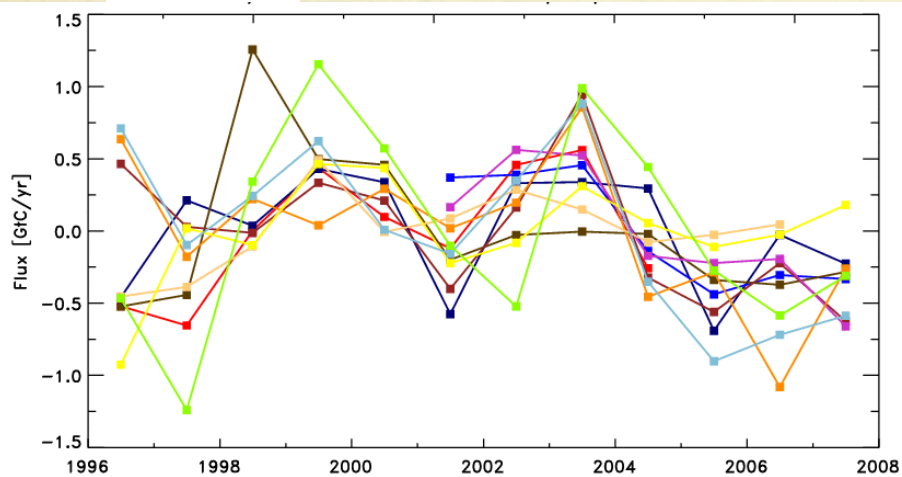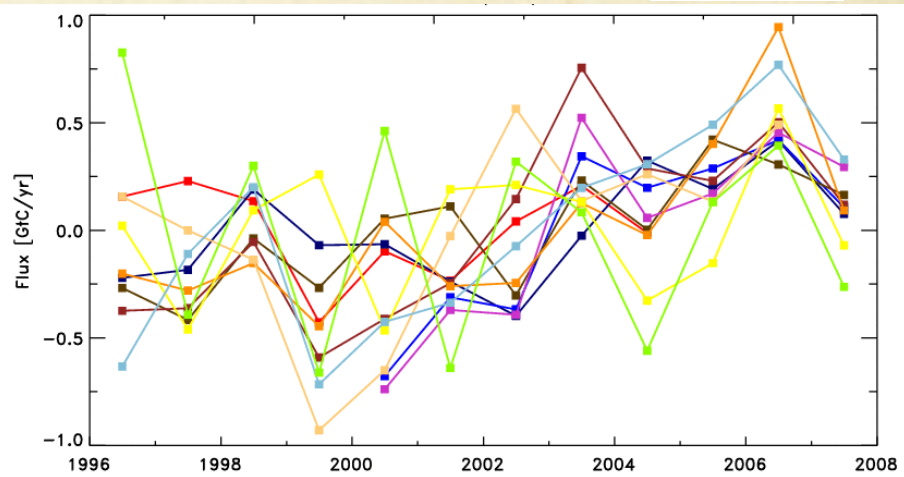# Results 2: IAV (continental scale)

N. America

N. Atlantic



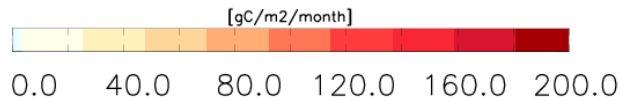| LSCE_an_v2.1 | LSCE_var_v1. | TRCOM_me | C13_CCAM |
| JENA_s96_v3.2 | C13_MATCH | RIGC_patra | NCAM_Niwa |
| CTracker_EU | CTracker_US | JMA_2010 | |

Europe

N. Asia

# Results 3 : Seas. Cycle & IAV

**Seas. Cycle**

### Mean amplitude of all models

[gC/m2/month]

0.0   40.0   80.0   120.0   160.0   200.0

### Standard dev. of all models

[gC/m2/month]

0.0   40.0   80.0   120.0   160.0   200.0
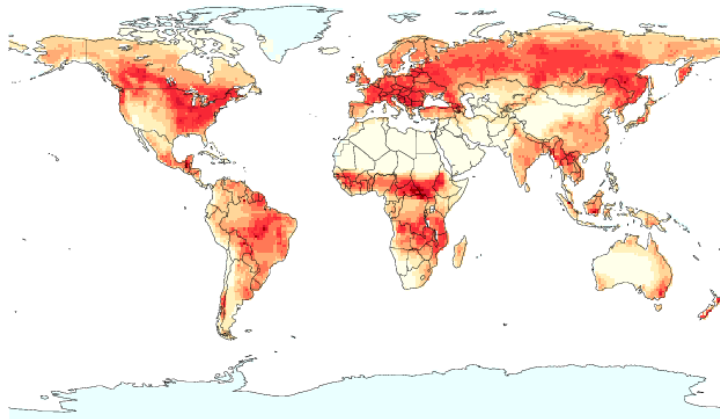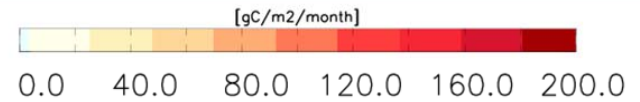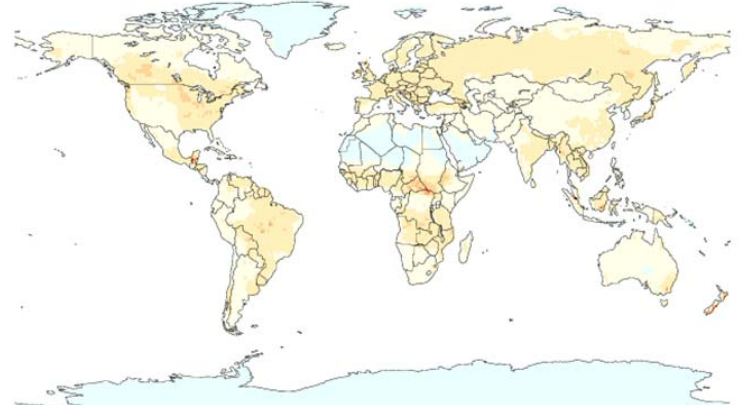
**IAV**

### Mean IAV for all models

[gC/m2/year]

0.0  8.0 16.0 24.0 32.0 40.0 48.0 56.0 64.0 72.0
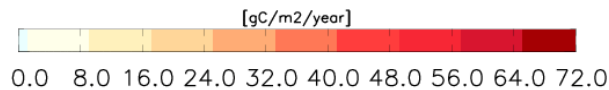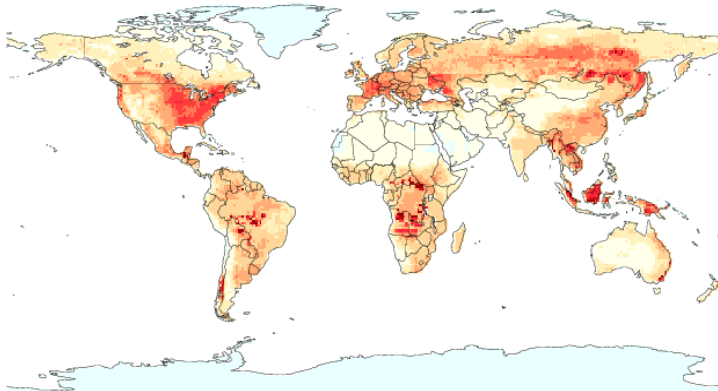
### Standard dev. of all models

Models

[gC/m2/year]

0.0  8.0 16.0 24.0 32.0 40.0 48.0 56.0 64.0 72.0
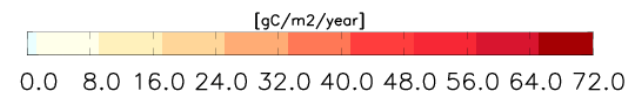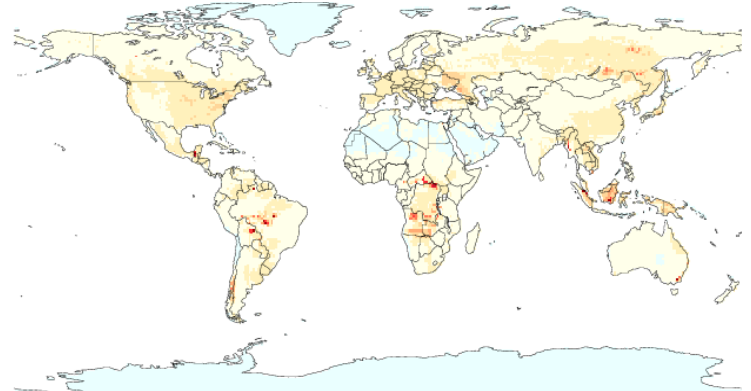
# Results 4 : N-S zonal mean integrated fluxes
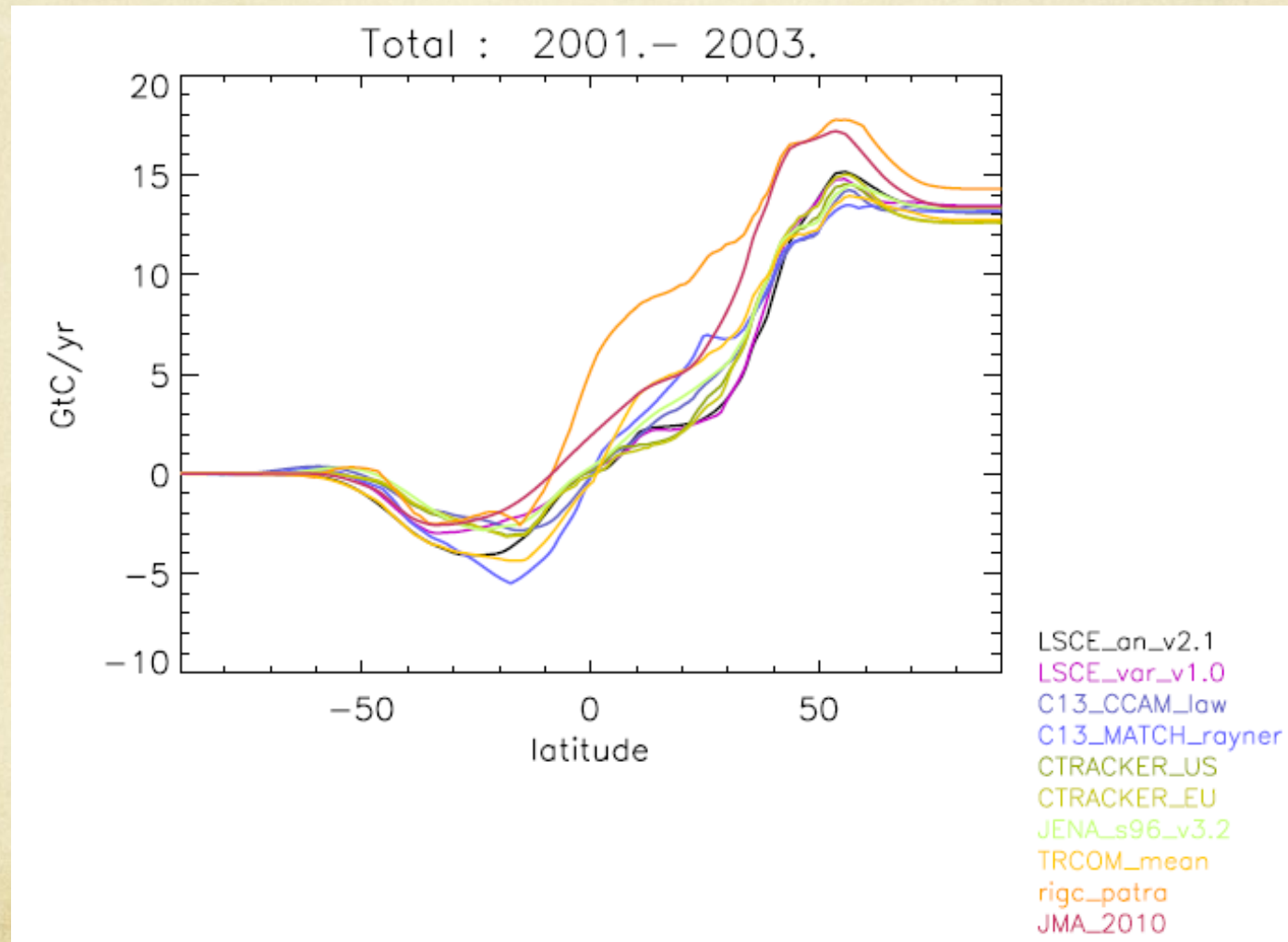
# Summary

- New set of 11 inverse results (which includes TRcom3 mean as 1)

- WEB-site available for downloading

- Uncertainties & Validation in progress (part of Transcom)

- Results may be updated with announcement

- Proceed with caution together with "inverse" specialists


- Differences in long term mean but coherence in IAV
  at large scales

- Small scales regional results sensitive to:
  Network, Priors, Flux resolution...

# Thank You

# Global Inversion Status/Plans

1)  Results accessible at: http://transcom.lsce.ipsl.fr

2)  11 results available at 1°x1° & region (individual and aggregate: 109)

3)  1995 to 2008 (inc) but individuals will run back to 1980 – monthly/annual

4)  Fluxes include: prior, fossil, posterior, total, "adjusted" fluxes

5)  Region "mask" and explanation available

6)  Updates will occur (we will announce)

7)  Uncertainty work & decisions ongoing

8)  Decision on a "weighted" mean ongoing

9)  Proceed with caution (tentative "inverter" assignments made for ocean)

10) TransCom meeting: December San Francisco AGU