Atmospheric Inversion results

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Tutorial 1 : Logistics

- Results accessible at: [http://transcom.lsce.ipsl.fr](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)

- “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

<table>
<thead>
<tr>
<th>Name</th>
<th>Time period</th>
<th>Transport model</th>
<th>Winds</th>
<th>Atm Data</th>
<th>Flux spatial res.</th>
<th>Flux temp. Res.</th>
<th>Inverse Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lsce_an_v2.1</td>
<td>1996 - 2004</td>
<td>LMDZ v4</td>
<td>ECMWF</td>
<td>Monthly mean</td>
<td>gridcell</td>
<td>monthly</td>
<td>Bayesian Matrix</td>
</tr>
<tr>
<td>Lsce_var_v1.0</td>
<td>1990 - 2008</td>
<td>LMDZ v3</td>
<td>ECMWF</td>
<td>Raw</td>
<td>gridcell</td>
<td>8 day with night &amp; day sep</td>
<td>Variational</td>
</tr>
<tr>
<td>Jena_s96_v3.2</td>
<td>1996 - 2008</td>
<td>TM3</td>
<td>NCEP reanalysis</td>
<td>Raw</td>
<td>gridcell</td>
<td>Daily</td>
<td>Variational</td>
</tr>
<tr>
<td>Carbntrckr_US</td>
<td>2000 - 2008</td>
<td>TM5 zoom</td>
<td>Raw</td>
<td>156 ecoregions</td>
<td>weekly</td>
<td>Kalman smoother</td>
<td></td>
</tr>
<tr>
<td>Carbntrckr_EU</td>
<td>2000 - 2007</td>
<td>TM5 zoom</td>
<td>Raw</td>
<td>145 land + 30 ocean</td>
<td>weekly</td>
<td>Kalman smoother</td>
<td></td>
</tr>
<tr>
<td>Rigg_patra</td>
<td>1993 - 2007</td>
<td>NIES/FRCGC</td>
<td>NCEP reanalysis</td>
<td>Monthly mean</td>
<td>64</td>
<td>Monthly</td>
<td>Bayesian Matrix</td>
</tr>
<tr>
<td>T3 mean</td>
<td>1995 - 2008</td>
<td>13 models</td>
<td>13 models (climatology)</td>
<td>Monthly mean</td>
<td>22</td>
<td>Monthly</td>
<td>Bayesian Matrix</td>
</tr>
<tr>
<td>JMA</td>
<td>1985 - 2007</td>
<td></td>
<td></td>
<td>Monthly mean</td>
<td>22</td>
<td>Monthly</td>
<td>Bayesian Matrix</td>
</tr>
<tr>
<td>Nicam_Niwa</td>
<td></td>
<td>NICAM-TM</td>
<td></td>
<td>Monthly mean</td>
<td>22</td>
<td>Monthly</td>
<td>Bayesian Matrix</td>
</tr>
</tbody>
</table>

We are choosing a start date of 1995 for RECCAP.
Fossil emissions differed between inversions:
At tempted “fix”: Fossil “adjustment” with common fossil fuel CO₂ 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
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

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

Australian seasonal cycle from 4 inversions. Posterior (solid), prior (dashed).

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

• Sensitivity to an individual site
4 continued: Caution with “big region” estimates

Large flux dipoles: « regional estimates should be interpreted with great care depending on the boundary of the regions

➤ “spurious” anti-correlations – a form of “representation error”
Results 1: Long term means

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

Northern land + ocean

Tropical land + ocean

Southern land + ocean
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

- N. America
- N. Atlantic
- Europe
- N. Asia

### CO2 flux [GtC/yr]
- LSCE_an_v2.1
- JENA_s96_v3.2
- CTracker_EU
- LSCE_var_v1.1
- C13_MATCH
- CTracker_US
- TRCOM_me
- RIGC_patra
- JMA_2010
- C13_CCAM
- NCAM_Niwa

## Results

- **Europe:**
  - LSCE_an_v2.1: -1.0
  - JENA_s96_v3.2: -0.5
  - CTracker_EU: 0.0
  - LSCE_var_v1.1: -1.5
  - C13_MATCH: -1.0
  - CTracker_US: -0.5
  - TRCOM_me: 0.0
  - RIGC_patra: -1.0
  - JMA_2010: -0.5
  - C13_CCAM: 0.0
  - NCAM_Niwa: 0.0

- **N. America:**
  - LSCE_an_v2.1: -3.0
  - JENA_s96_v3.2: -2.0
  - CTracker_EU: -1.0
  - LSCE_var_v1.1: -0.5
  - C13_MATCH: 0.0
  - CTracker_US: 0.5
  - TRCOM_me: 1.0
  - RIGC_patra: 1.5
  - JMA_2010: 2.0
  - C13_CCAM: 2.5
  - NCAM_Niwa: 3.0

- **N. Atlantic:**
  - LSCE_an_v2.1: -1.5
  - JENA_s96_v3.2: -1.0
  - CTracker_EU: 0.5
  - LSCE_var_v1.1: 1.0
  - C13_MATCH: 1.5
  - CTracker_US: 2.0
  - TRCOM_me: 2.5
  - RIGC_patra: 3.0
  - JMA_2010: 3.5
  - C13_CCAM: 4.0
  - NCAM_Niwa: 4.5

- **N. Asia:**
  - LSCE_an_v2.1: -0.5
  - JENA_s96_v3.2: 0.0
  - CTracker_EU: 0.5
  - LSCE_var_v1.1: 1.0
  - C13_MATCH: 1.5
  - CTracker_US: 2.0
  - TRCOM_me: 2.5
  - RIGC_patra: 3.0
  - JMA_2010: 3.5
  - C13_CCAM: 4.0
  - NCAM_Niwa: 4.5
Results 2: IAV (land)

Global Land Total CO2 yearly Flux Anomalies

- Total land
- Northern land
- Tropical land
- Southern land

Models:
- LSCE_an_v2.1
- JENA_s96_v3.2
- CTracker_EU
- LSCE_var_v1.1
- C13_MATCH
- CTracker_US
- TRCOM_me
- RIGC_patra
- JMA_2010
- C13_CCAM
- NCAM_Niwa
Results 2: IAV (ocean)

Global Ocean Total CO2 yearly Flux Anomalies

Total ocean

Northern ocean

Tropical ocean

Southern 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
Results 2: IAV (continental scale)

N. America

Europe

N. Atlantic

N. Asia

- 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
Results 3: Seas. Cycle & IAV

Seas. Cycle

Mean amplitude of all models

Standard dev. of all models

IAV

Mean IAV for all models

Standard dev. of all models
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