The new advection in GEOS-Chem and the next ”chemistry” release

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The advection in GEOS-Chem

Met. fields $P_{s0}, u_0, v_0$

Model $P_{s0}, x_{m0}, y_{m0}$

Ps : surface pressure, $u$ & $v$: horizontal winds, $x_m$ & $y_m$: horizontal mass fluxes
The advection in GEOS-Chem

Ps : surface pressure, u & v: horizontal winds, xm & ym: horizontal mass fluxes
The advection in GEOS-Chem

Met. fields

\( p_{s0}, u_0, v_0 \)

\( p_{s1} \)

Model

\( p_{s0}', x_{m0}', y_{m0}' \)

\( p_{s1}' \)

Pressure fixer

Ps : surface pressure, u & v: horizontal winds, xm & ym: horizontal mass fluxes
The advection in GEOS-Chem

Met. fields $P_{s0}, u_0, v_0$

Model $P_{s0}, x_{m0}, y_{m0}$

Pressure fixer

$P_{s1}$

$P_{s1}'$

$T_{pcore}$:
Lin and Rood, 1996
Lin et al. 1994

$C_{FL} < 1$:
Eulerian scheme, PPM

$C_{FL} > 1$:
Semi-Lagrangian scheme

Ps : surface pressure, u & v: horizontal winds, xm & ym: horizontal mass fluxes
Transport was too strong across the tropopause

Radon for September 2004 with GEOS4 (mBq/cm$^2$)
Problem due to discrepancies between pressure fixer and tpcore

- Implementation of a new P-fixer from GMI (by P. Cameron-Smith)

- Problem with special handling of the poles:
  - Polar cap of 1 latitude cell wide in GEOS-Chem vs. 2 in GMI.

- Solved by:
  - Implementing the tpcore from GMI
  - Switching the polar cap from 1 to 2 latitude cells.
Using tpcore from GMI greatly reduces stratosphere-troposphere exchange, eliminates polar problem.

Radon for September 2004 with GEOS4 (mBq/cm²)

Large differences in the stratosphere and not in the troposphere

See also Dave McKenzie's talk (10:20 today) about the improvement for strat. O3
Fixing the slowdown resulting from OpenMP parallelization of GMI version of tpcore

- Change from // of each small loop in each subroutine to // the tracer loop in the main routine of tpcore.

- Move the loop over vertical levels outside the subroutines for horizontal transport.

- 1 week run, with 43 tracers and no chemistry on 4 processors, resolution 4x5.

<table>
<thead>
<tr>
<th>v8-01-02</th>
<th>v8-01-03</th>
<th>v8-01-03 (+patch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;old&quot; tpcore</td>
<td>GMI tpcore</td>
<td>optimized GMI tpcore</td>
</tr>
<tr>
<td>8 min</td>
<td>15 min</td>
<td>8 min</td>
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</tbody>
</table>

To get the patch, see

Updates contained in this version

- Glyoxal chemistry (T-M. Fu)
- HO2 uptake (L. Jaeglé)
- Updated reaction rates (J. Mao, D. Millet, Palmer group)
- Updated J(O1D) cross sections (L. Zhang, J. Mao)
- Updated dust single scattering albedo (R. Martin)

Status

- Currently in debugging & testing
- This will be a “public” release (i.e. web & docs rewritten, etc.)