IMPACT/DAO Model
Description

Joyce Penner, Xiaohong, Liu, Michael Herzog
IMPACT/DAO

- Uses NASA DAO 1997 meteorological fields
  - No soil moisture, no 10 m wind fields
  - Dust, sea salt not interactive
- Uses IPCC-recommended emissions inventories except for dust (from Ginoux for 1997 DAO winds)
- Emissions put into BL for dust and biomass burning
- Wet scavenging as in Harvard GEOS-CHEM model except that large scale scavenging uses 0.5 g/m3 for LWC
- Dry deposition as in Zhang, Gong et al. [AE, 2001]
Unique features

- DAO version has improved LWC for sulfate chemistry
- GMI model is based on IMPACT
- Will run with more than one meteorological fields:
  - IMPACT/DAO
  - GMI/MACCCM3
  - GMI/GISSII’
## Comparison of burdens

<table>
<thead>
<tr>
<th>Burden</th>
<th>wet (Tg/yr)</th>
<th>dry (Tg/yr)</th>
<th>Lifetime (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAO</td>
<td>0.058</td>
<td>1.75</td>
<td>2.40</td>
</tr>
<tr>
<td>GISS</td>
<td>0.080</td>
<td>2.04</td>
<td>3.26</td>
</tr>
<tr>
<td>NCAR</td>
<td>0.060</td>
<td>1.88</td>
<td>2.4</td>
</tr>
</tbody>
</table>

**GRANTOUR/CCM1 fffBC+bbBC:**

<table>
<thead>
<tr>
<th></th>
<th>wet (Tg/yr)</th>
<th>dry (Tg/yr)</th>
<th>Lifetime (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAO*</td>
<td>0.20</td>
<td>2.66</td>
<td>5.97</td>
</tr>
<tr>
<td>DAO*</td>
<td>0.14</td>
<td>1.65</td>
<td>7.52</td>
</tr>
</tbody>
</table>
NCAR MACCM3 met data maintain highest gradients for a "fuel tracer" introduced as aircraft emissions

Burdens:
DAO 3.3e-4 Tg
GISS 5.7e-4 Tg
NCAR 4.1e-4 Tg
Adding sulfate to IMPACT/GMI

Need LWC of clouds to calculate aqueous conversion of $\text{SO}_2$ to $\text{SO}_4$

Compare LWP from models to data:

- Greenwald: 76.2 g/m$^2$
- Weng: 48.7 g/m$^2$
Comparison of LWP from IMPACT/DAO and data

LWC = 0.18(g/m³)e^{-Z/H}

Large scale:
CF = 1 - sqrt(1 - (RH - RHc)/(1 - RHc))
(Sundquist et al 1989)

Convective:
CF = C₀ + C₁ log(Mc) + C₂ (log(Mc))²
(Xu and Krueger, 1991):
Near term plans: Implement aerosol dynamic model
Aerosol dynamic modules

- **AER**: sectional model, 40 size bins (0.39nm < r < 3.2μm)
- **Mod6M**: quadrature method of moments
- **UMaer**: model of modes and moments
Nucleated particles after 1 day
Condensation after one day
Coagulation after one day
Gravitational settling after 1 day
Accumulation mode after one day