Development of a high-topped CAM

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Motivation:

To build a climate model:

• With a better resolved stratosphere for studies of dynamics of the stratosphere and stratospheric-tropospheric coupling

• That can simulate well:
  - Sudden stratospheric warmings
  - Stratospheric-tropospheric coupling
  - Quasi Biennial Oscillation

• That is computationally more efficient than WACCM
Goal:

- CAM: 26 levels up to 3.5 hPa or ~40 km
- WACCM: 66 levels up to ~150 km
- MACAM:
  - Middle Atmosphere Community Atmosphere Model
  - 45 to 50 levels with lid at ~80 km
  - CAM Physics + GWs from WACCM
  - No other WACCM physics included
  - Chemistry – let’s discuss
Progress:

- Started with CAM4
- Took bottom 52 levels from WACCM
- Top at: .0065 mb or ~83 km
- Added non-orographic GWs
- Chemistry: ozone prescribed from WACCM’s Refb1
- Did a few tuning experiments
Results:

MACAM - 01:
\[ \text{taubgnd} = 1.5 \quad \text{effgw_oro}=0.125 \]

MACAM - 04:
\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro}=0.0625 \]
Results:

MACAM - 04:

\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro}=0.0625 \]

ERA 40:

\[ \text{SSWs: 6/10} \quad \text{SSWs: 2/15} \]
Results:

MACAM - 04:
\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro} = 0.0625 \]

MACAM - 04_tms:
\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro} = 0.0625 \]
Results:

**MACAM - 04:**
\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro} = 0.0625 \]

**SSWs:** 2/15

**MACAM - 04_tms:**
\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro} = 0.0625 \]

\[ \text{SSWs: } 3/10 \]
\[ + 4 \text{ Final warmings in } 10 \text{ years} \]
Results:

MACAM - 04:
\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro} = 0.0625 \quad \text{dc} = 30 \text{ m/s} \]

MACAM - 06:
\[ \text{taubgnd} = 1.5 \quad \text{effgw_oro} = 0.0625 \quad \text{dc} = 15 \text{ m/s} \]

No More Split in Jet
Tropics:

MACAM - 04:

\[ \text{taubgnd} = 3.0 \quad \text{effgw_oro} = 0.0625 \quad \text{dc} = 30 \, \text{m/s} \]
Zonal Winds (10 DJF avg) at 30 hPa

Control (CAM4 w/ top at 2hPa)

MACAM 04

MACAM 04 + TMS

Reanalysis zonal winds

dd_merra_jan04

30-mb Zonal U-Wind (m/s) DJF (11)
What’s next?

• Change vertical level to include more levels in the lower stratosphere (for QBO)
• Experiment with # of levels (to find balance between cost and proper resolution)
• Chemistry?
• Finish Tuning: experiment with linking frontal spectrum properties to tropospheric properties
What’s next?

• YOUR INPUT IS NEEDED !!!!
• Especially regarding chemistry:
  - Dataset vs
  - Super-fast / Simplified
• Without it, we’ll proceed as we want!
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