

Development of a high-topped CAM



ESSL's Climate & Global Dynamics

CGD

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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

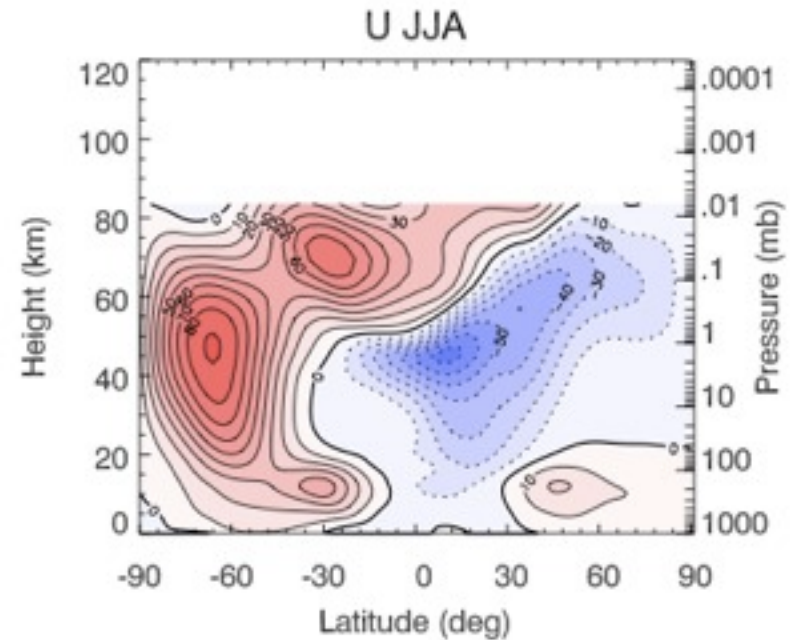
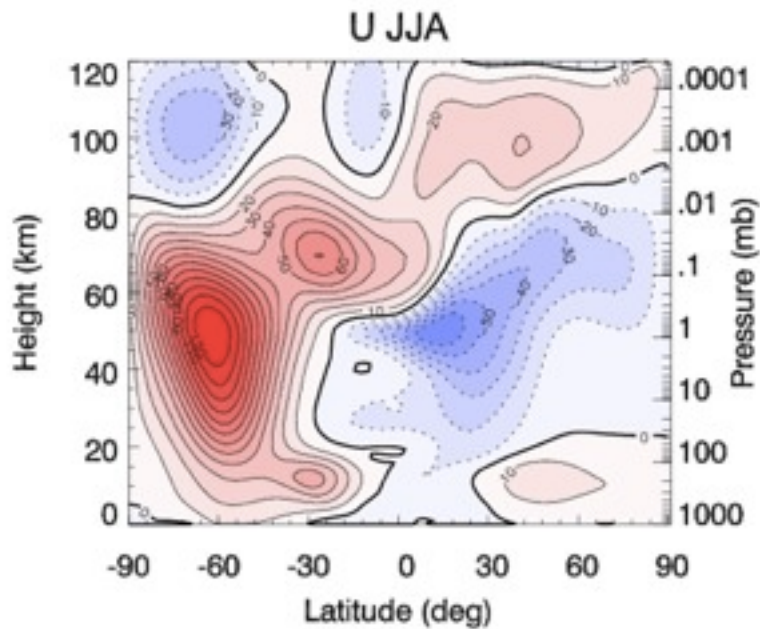
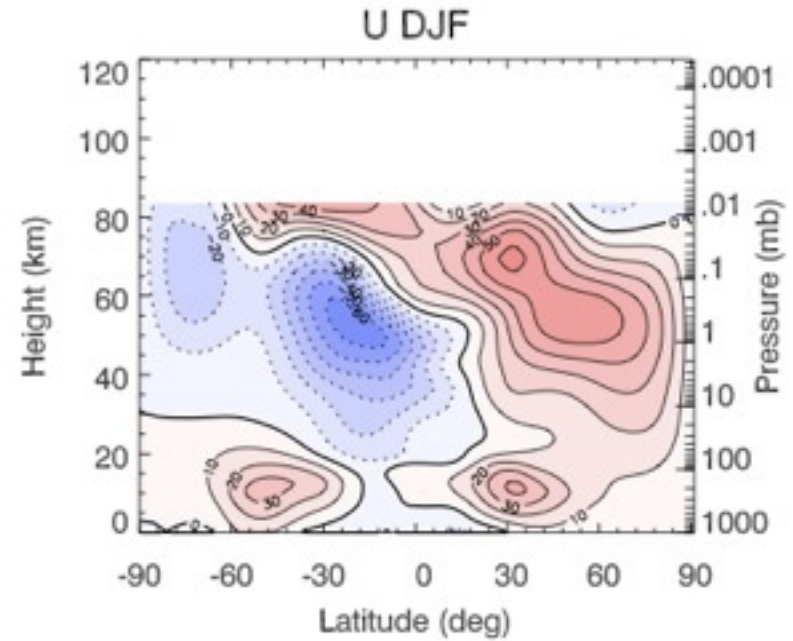
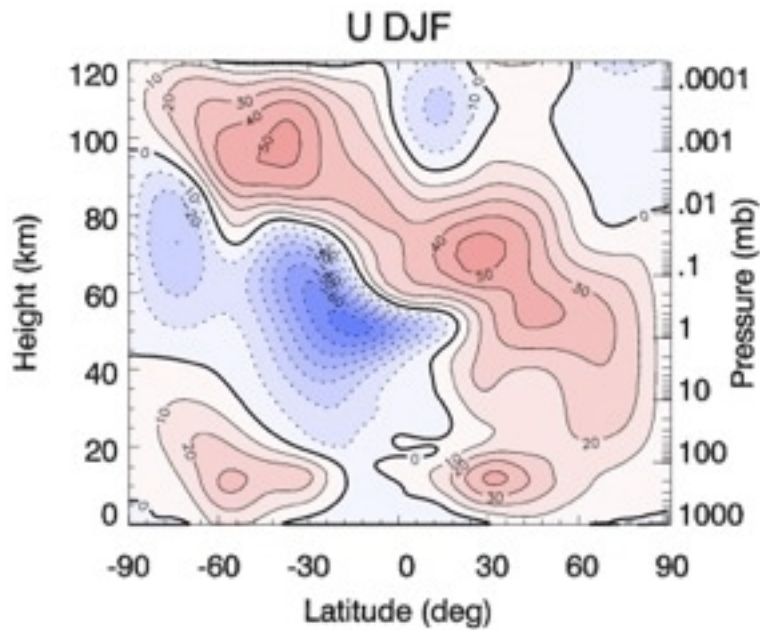
Progress:

- 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:

WACCM - 20th Century Run

MACAM - 01

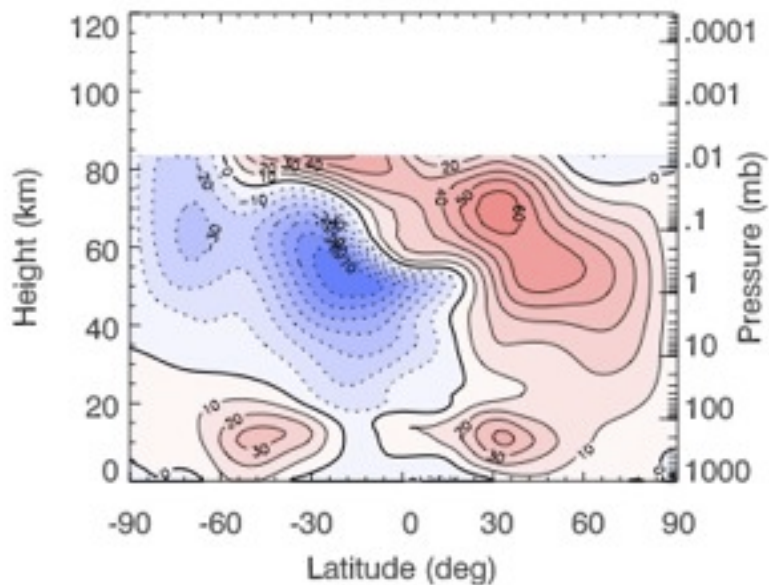


Results:

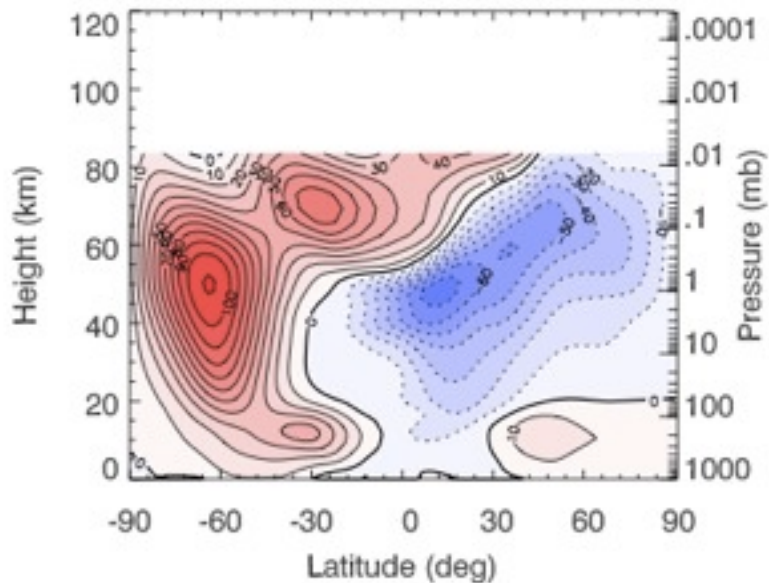
MACAM - 01:

$\text{taubgnd} = 1.5$ $\text{effgw_oro} = 0.125$

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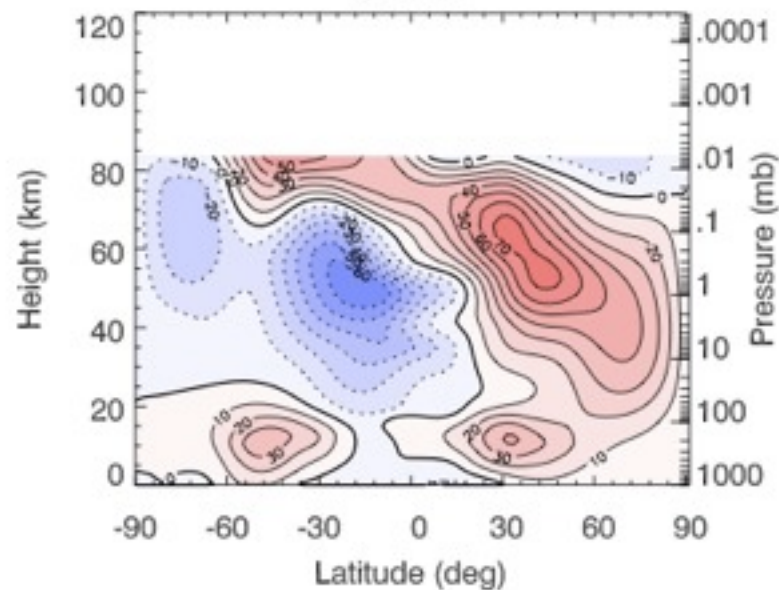
U Jul



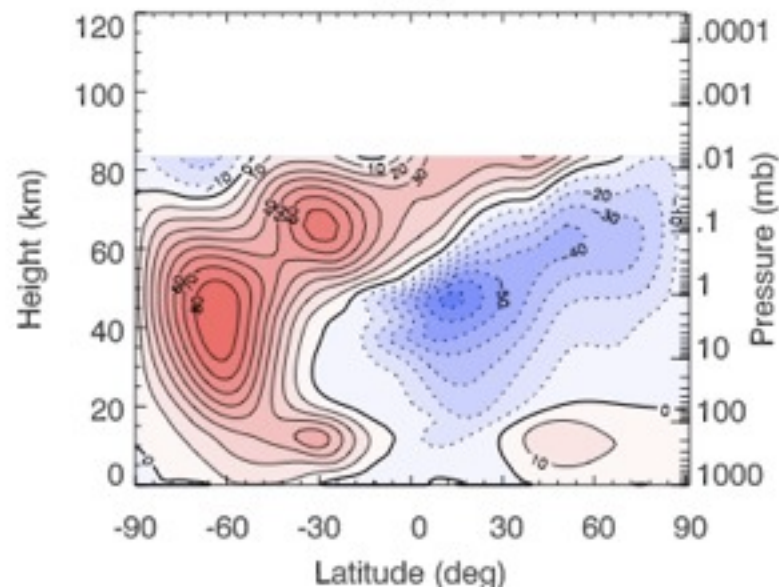
MACAM - 04:

$\text{taubgnd} = 3.0$ $\text{effgw_oro} = 0.0625$

U Jan



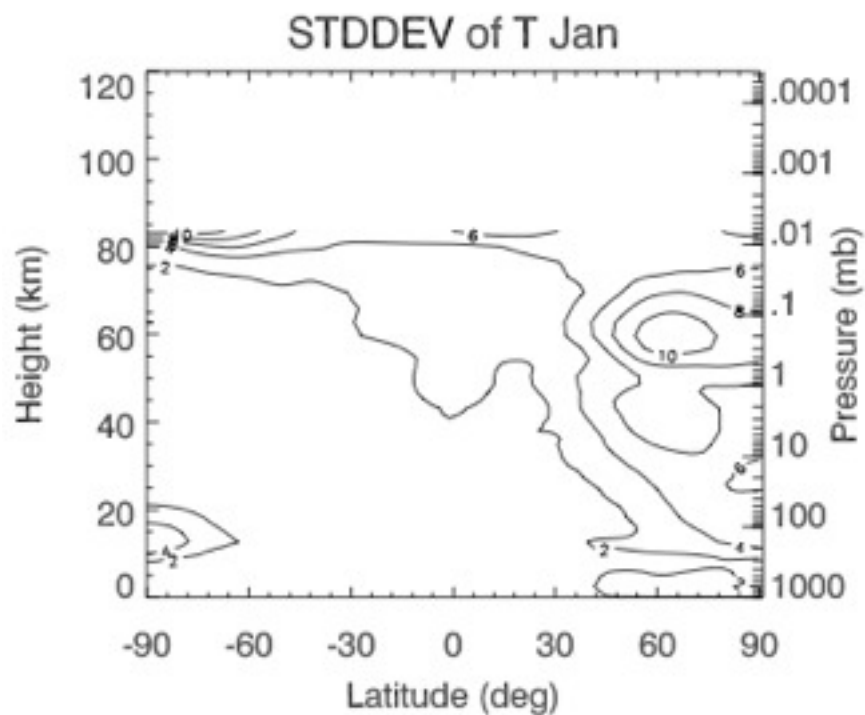
U Jul



Results:

MACAM - 04:

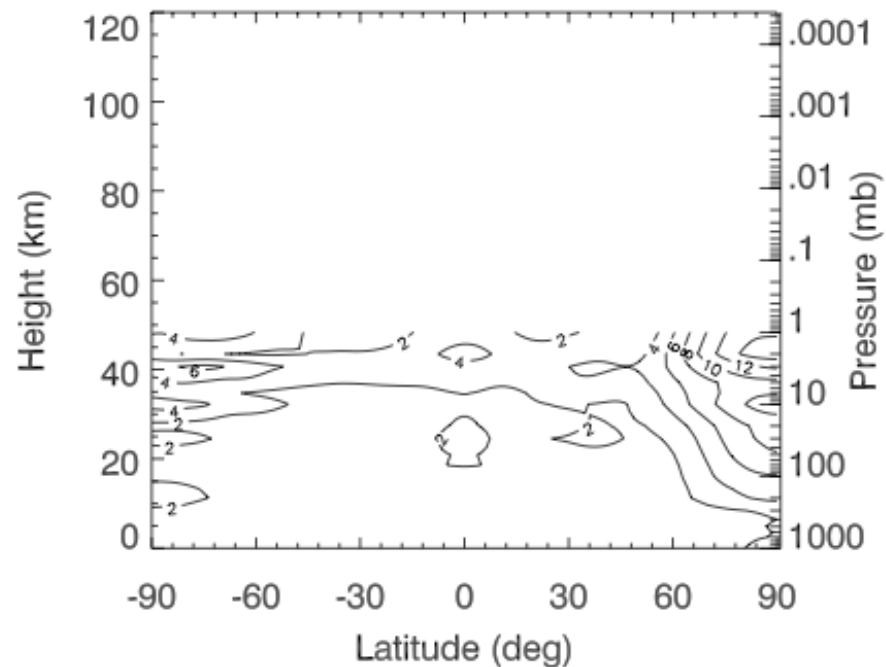
$\text{taubgnd} = 3.0$ $\text{effgw_oro} = 0.0625$



SSWs: 2/15

ERA 40:

STDDEV of T Jan



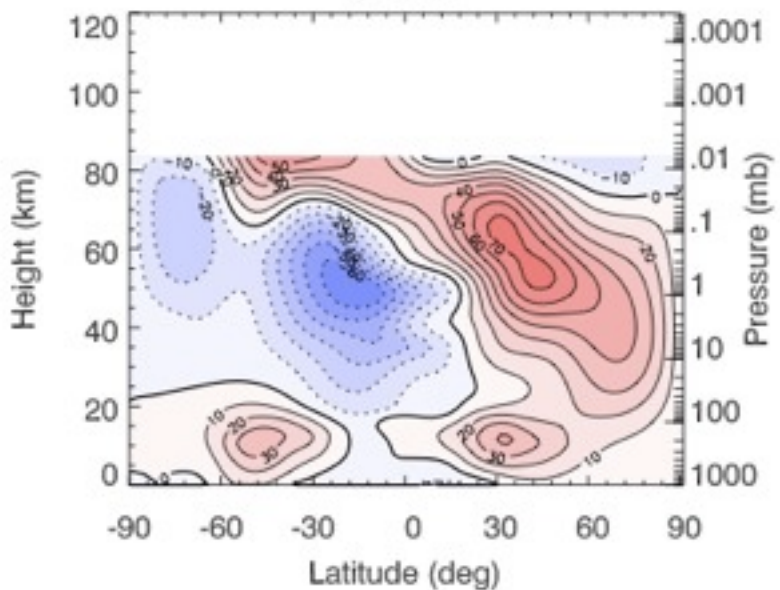
SSWs: 6/10

Results:

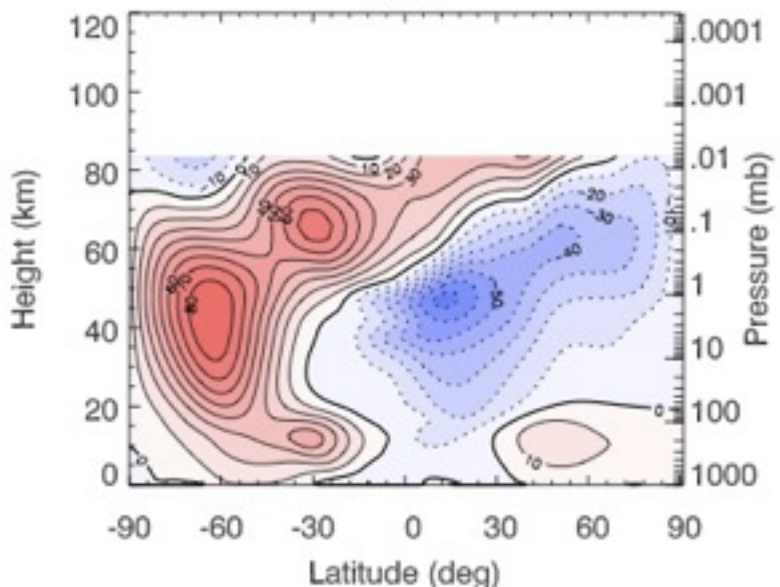
MACAM - 04:

$\text{taubgnd} = 3.0$ $\text{effgw_oro} = 0.0625$

U Jan



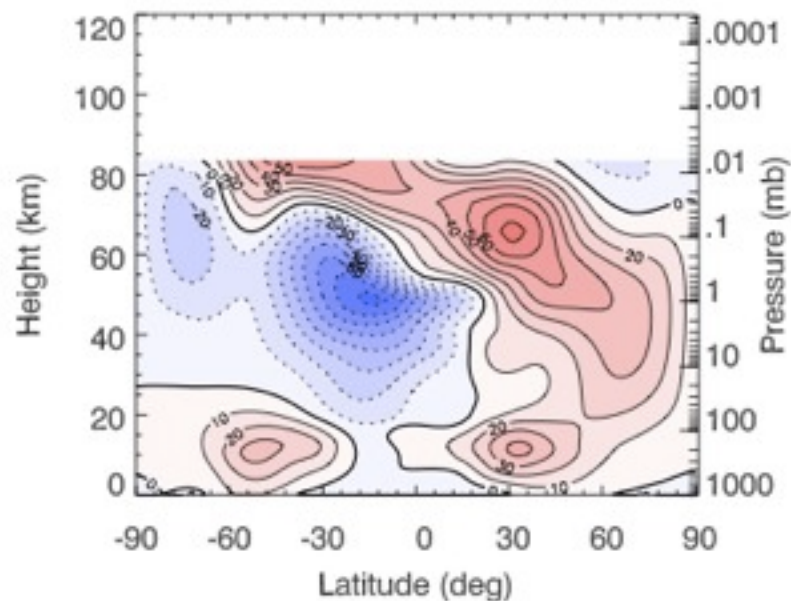
U Jul



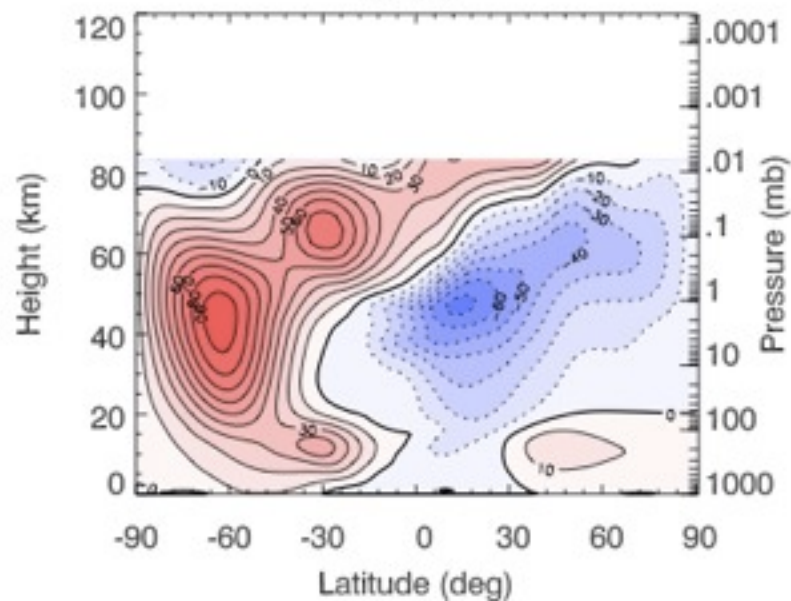
MACAM - 04_tms:

$\text{taubgnd} = 3.0$ $\text{effgw_oro} = 0.0625$

U Jan



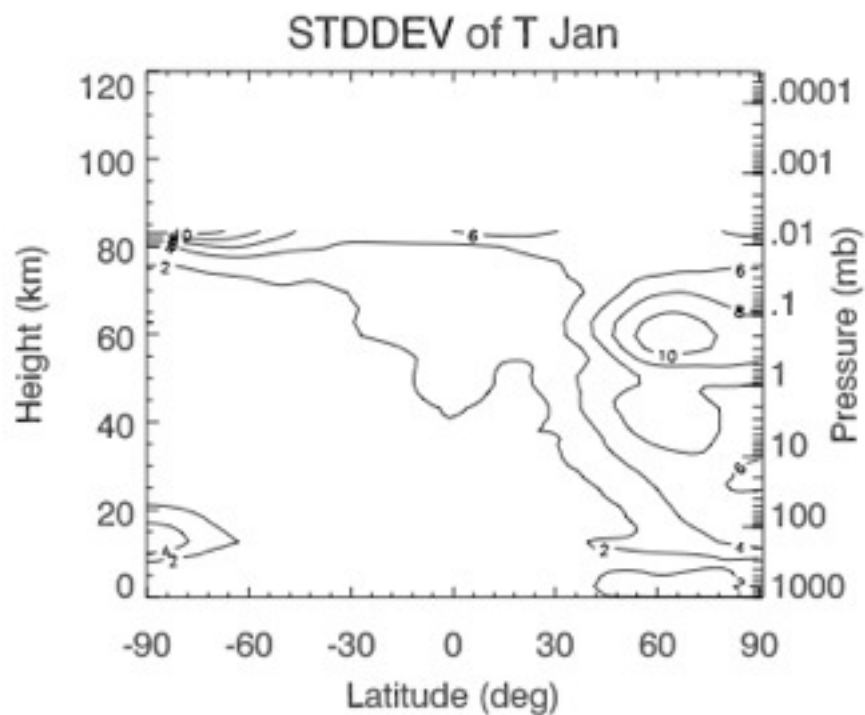
U Jul



Results:

MACAM - 04:

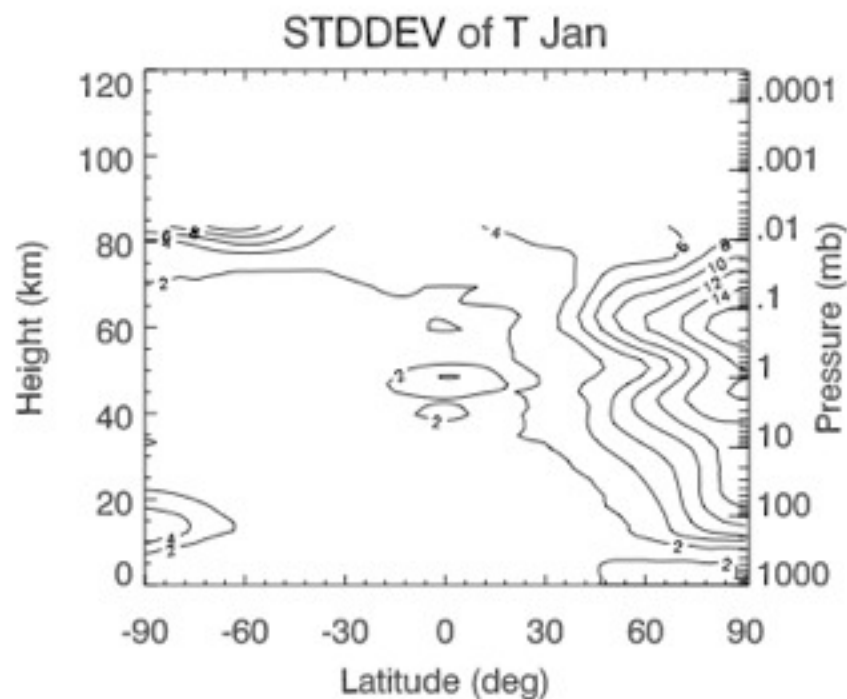
taubgnd = 3.0 effgw_oro=0.0625



SSWs: 2/15

MACAM - 04_tms:

taubgnd = 3.0 effgw_oro=0.0625



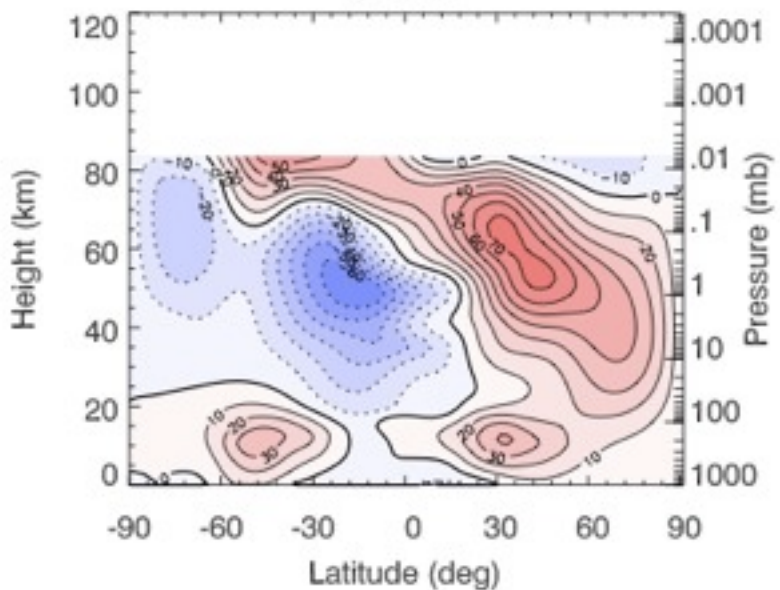
SSWs: 3/10
+ 4 Final warmings in
10 years

Results:

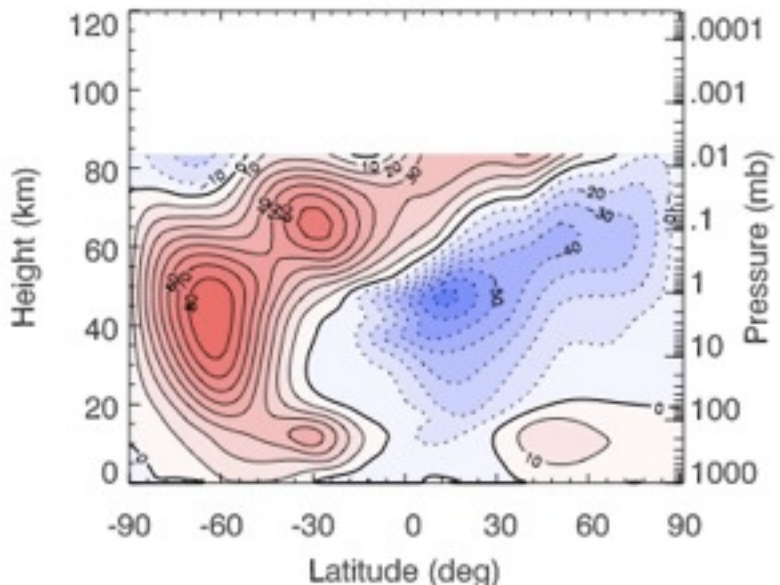
MACAM - 04:

$\tau_{\text{aubgnd}} = 3.0$ $\text{effgw_oro} = 0.0625$ $dc = 30$ m/s

U Jan



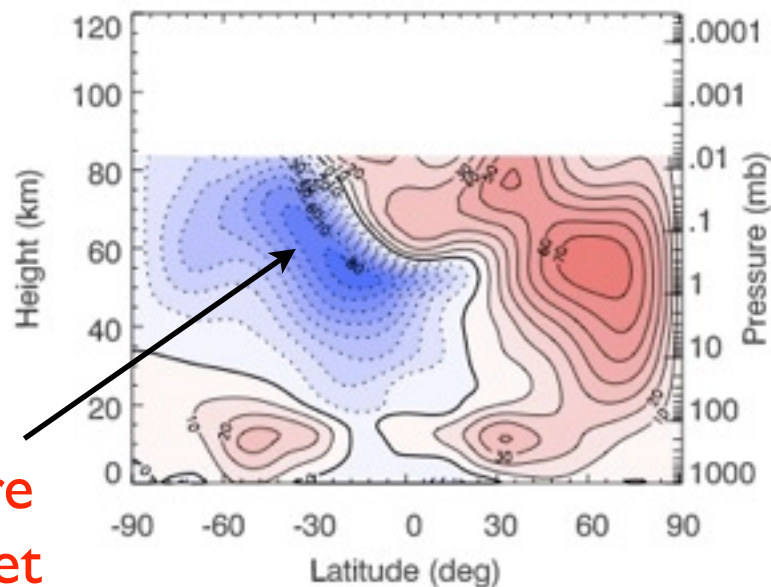
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MACAM - 06:

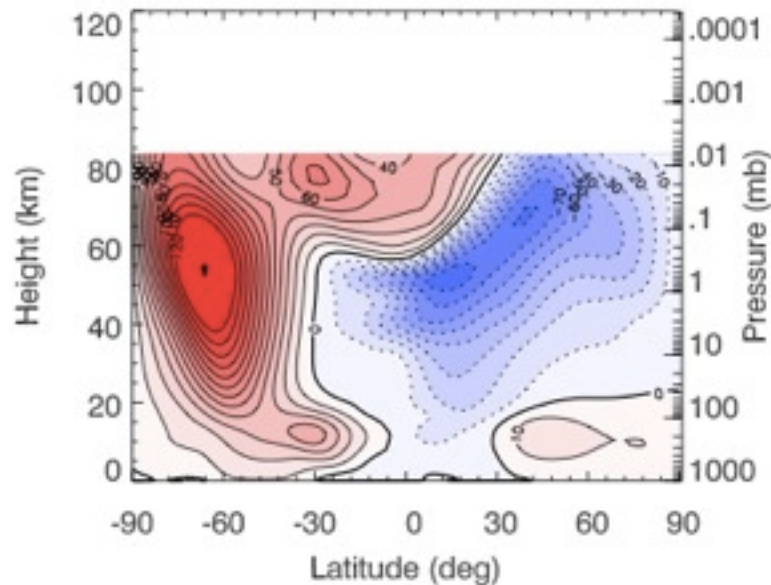
$\tau_{\text{aubgnd}} = 1.5$ $\text{effgw_oro} = 0.0625$ $dc = 15$ m/s

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No More
Split in Jet

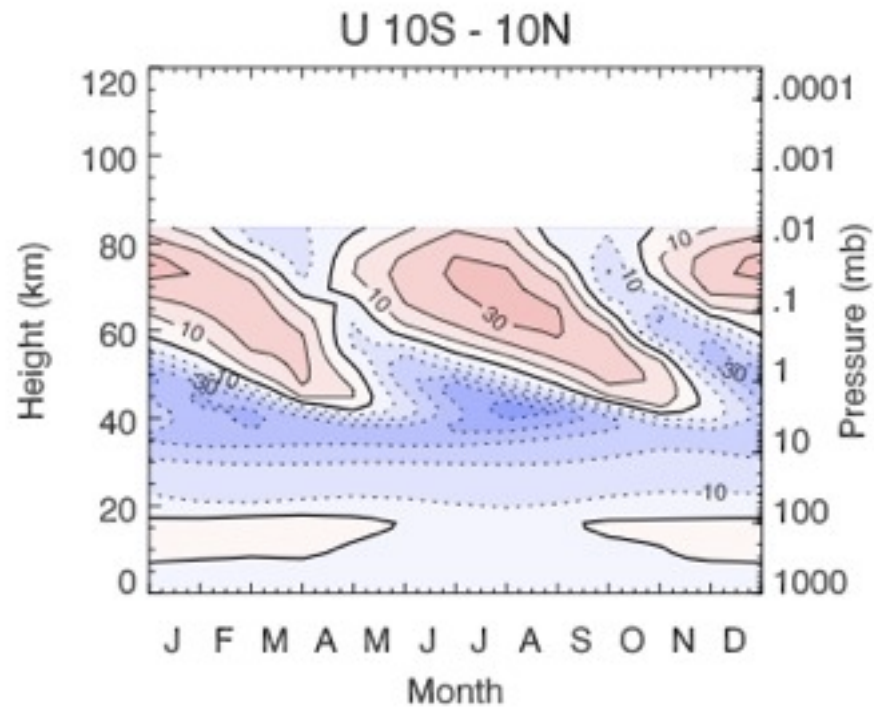
U Jul



Tropics:

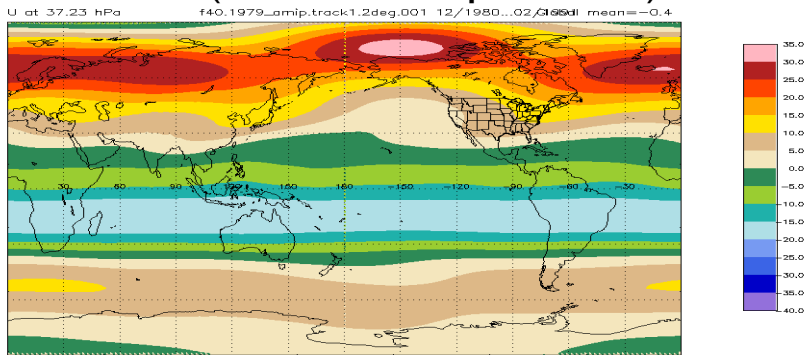
MACAM - 04:

$\tau_{\text{aubnd}} = 3.0$ $\text{effgw_oro} = 0.0625$ $\text{dc} = 30 \text{ m/s}$

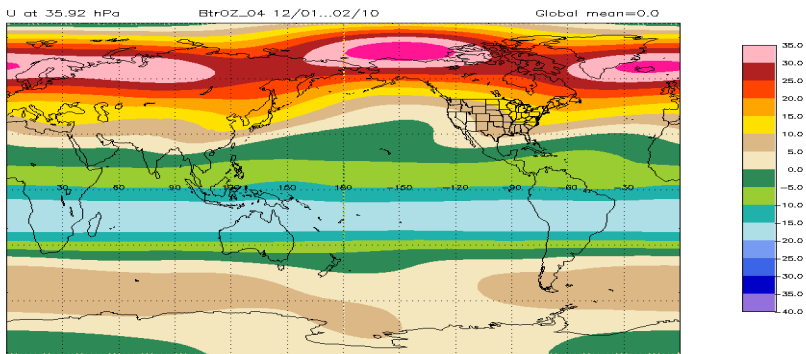


Zonal Winds (10 DJF avg) at 30 hPa

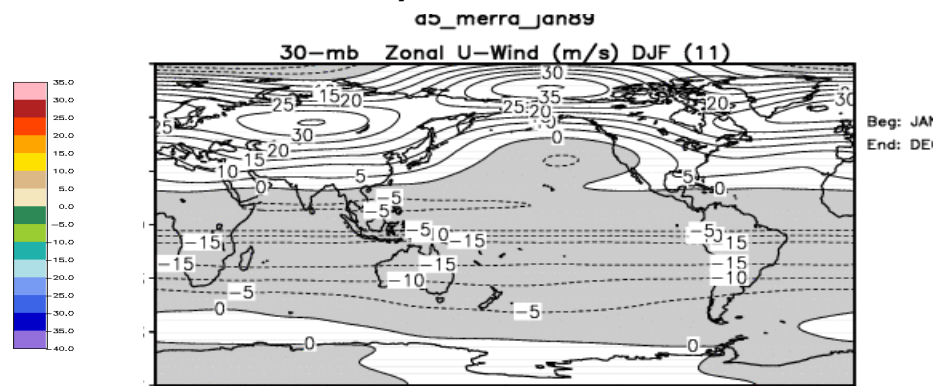
Control (CAM4 w/ top at 2hPa)



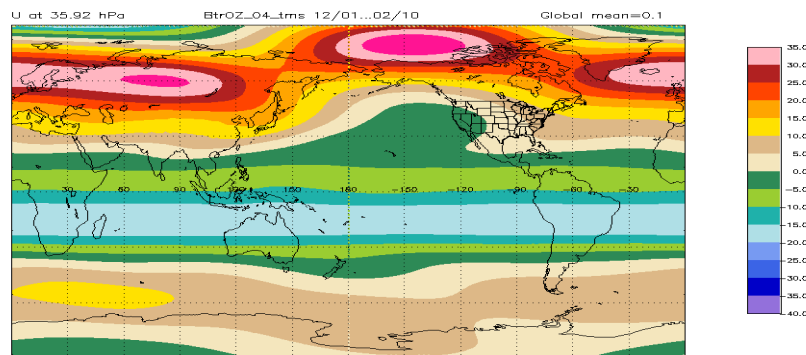
MACAM 04



Reanalysis zonal winds



MACAM 04 + TMS



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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Yaga at jrichter@ucar.edu