

The 11-year Solar Cycle Variations on Gravity Waves using WACCM and SABER

Chihoko Cullens¹, Scott England¹, and Rolando Garcia²

1. Space Sciences Lab, UC Berkeley
2. NCAR

Objective

- To study responses of gravity waves to the 11-year solar cycle using 102 years of WACCM simulations and SABER observations.

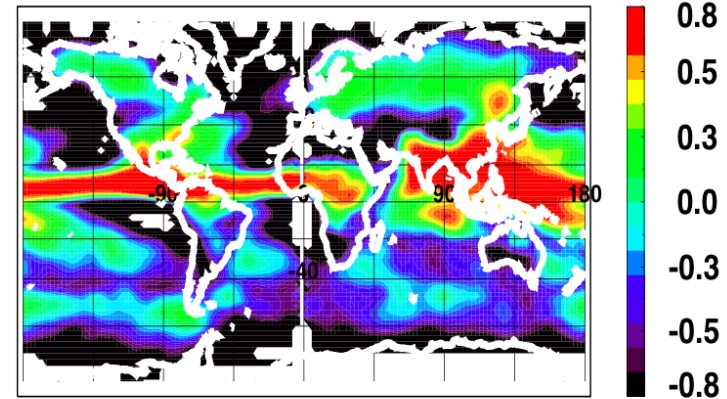
WACCM Analysis

- WACCM-SMax : 51 year run (fixed f10.7 = 220)
- WACCM-SMin: 51 year run (fixed f10.7 =70)
- Solar Cycle Influences =
WACCM-Smax - WACCM-SMin
- In the stratosphere and MLT region, results are highly influenced by SSWs and QBO (quasi-biannual oscillations).
 - the winter Southern Hemisphere to avoid SSWs.
 - Separated by QBO phase

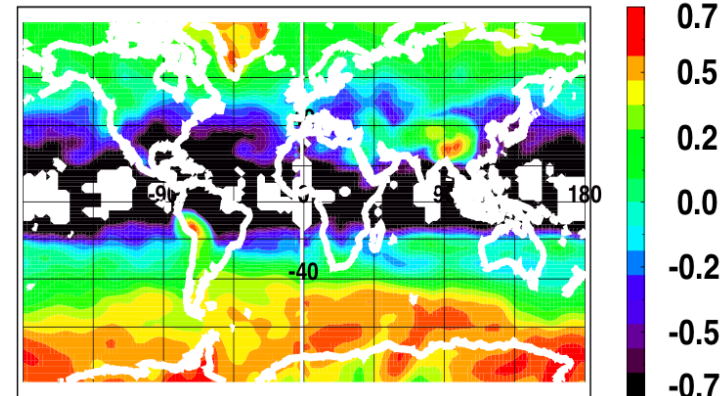
WACCM Model Gravity Wave Parameterization

- Horizontal resolution
 - 1.9x2.5 degree
- Model Domain
 - Surface to ~150 km
- Gravity wave source variations (Topography, Convection, Front System)

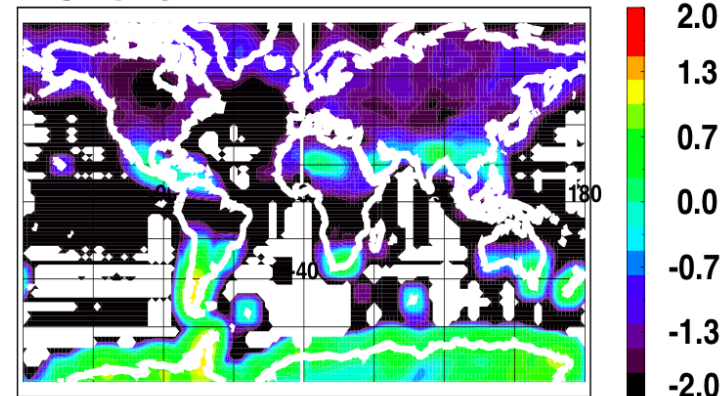
Convection at 10 hPa, Jul 2002-2012



Front at 10 hPa, Jul 2002-2012



Orography at 10 hPa, Jul 2002-2012



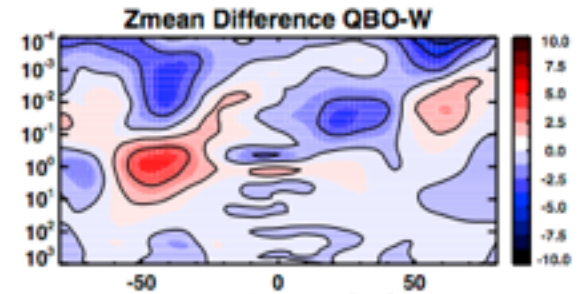
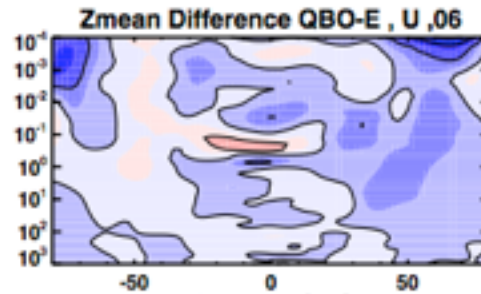
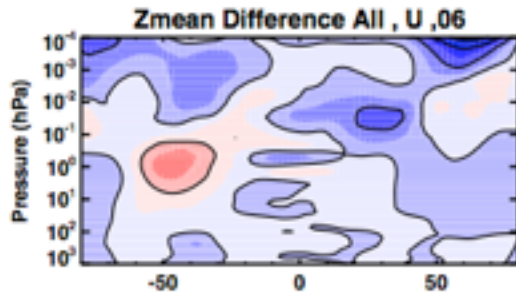
Difference between Smax and Smin (Zonal Wind)

ALL

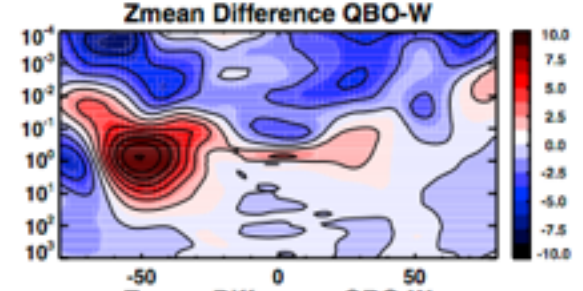
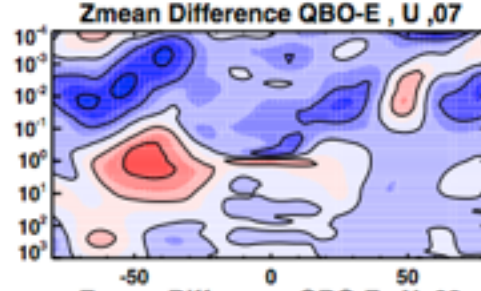
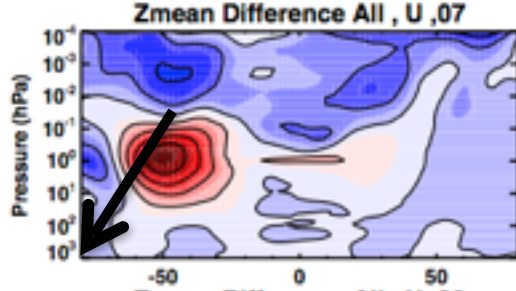
QBO-East phase

QBO-West phase

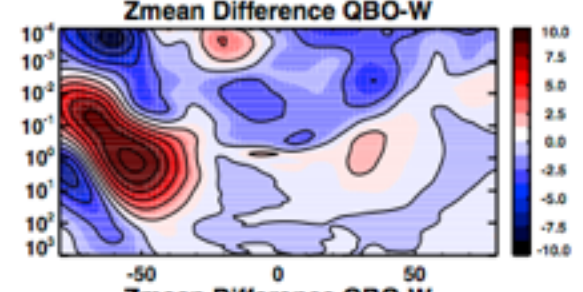
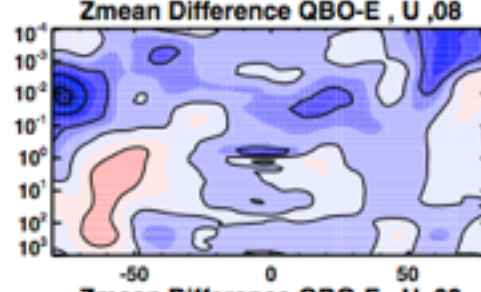
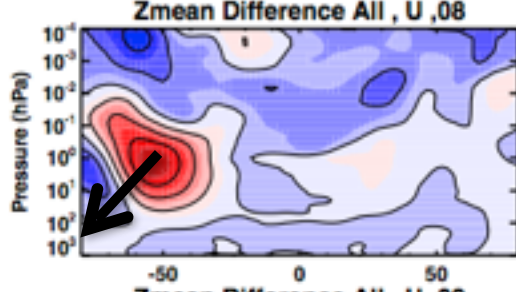
June



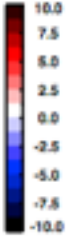
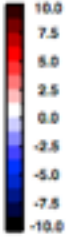
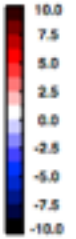
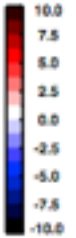
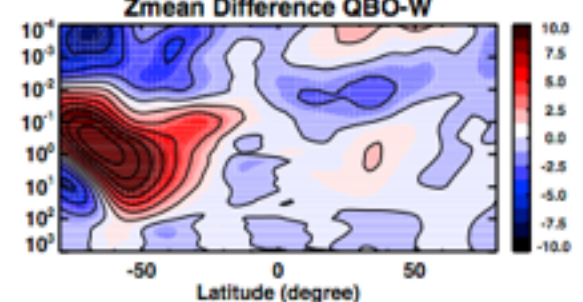
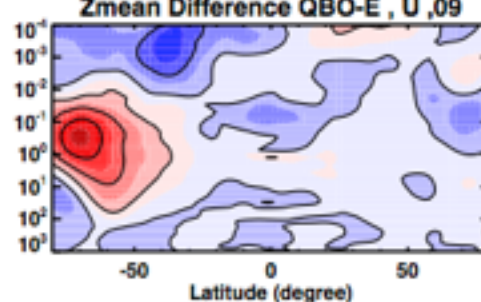
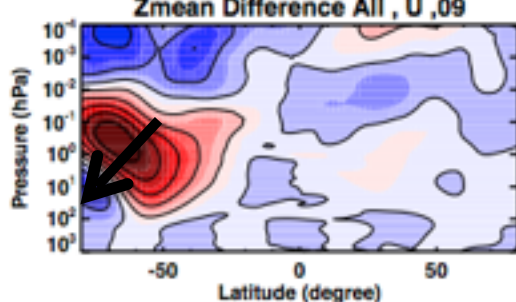
July



August



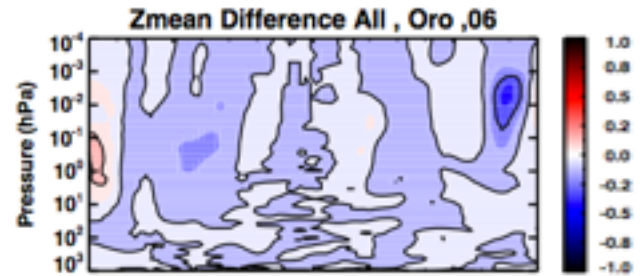
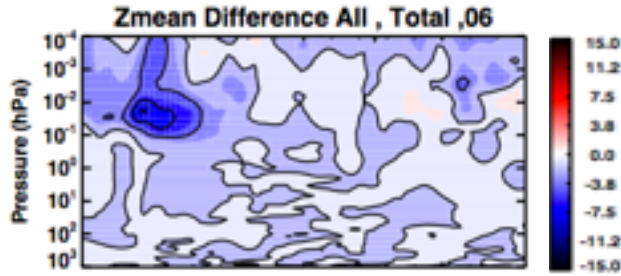
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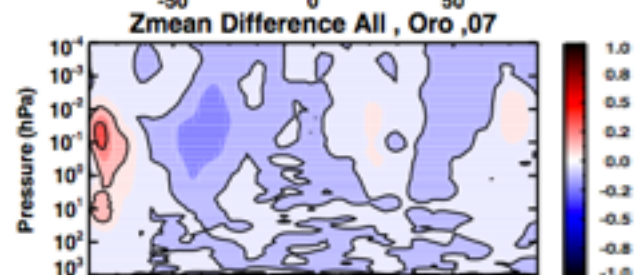
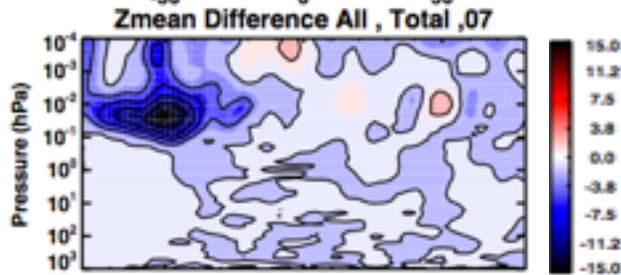
Front + Orography + Convection

Orography

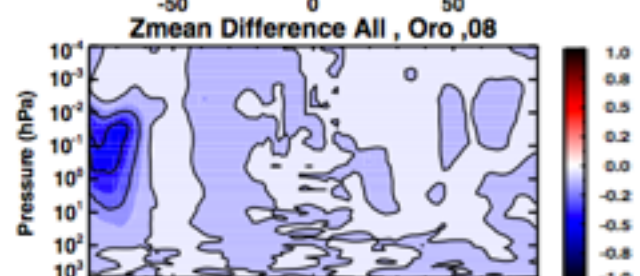
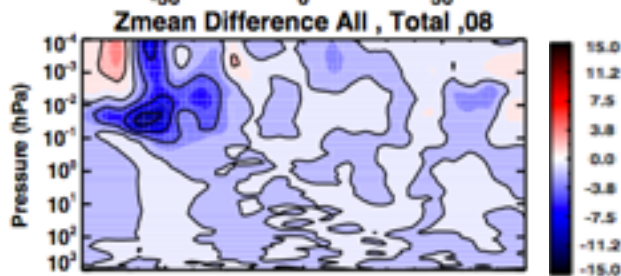
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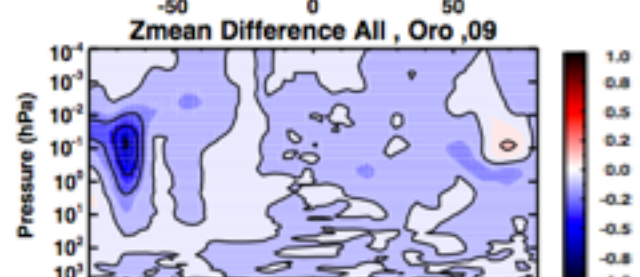
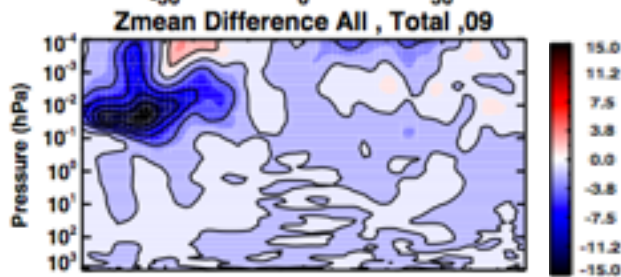
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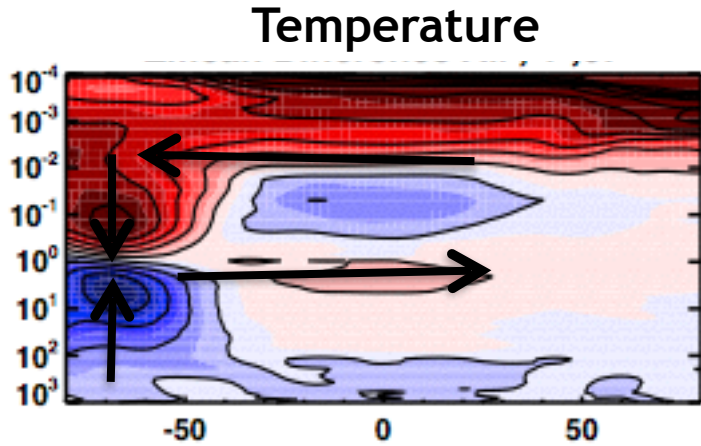
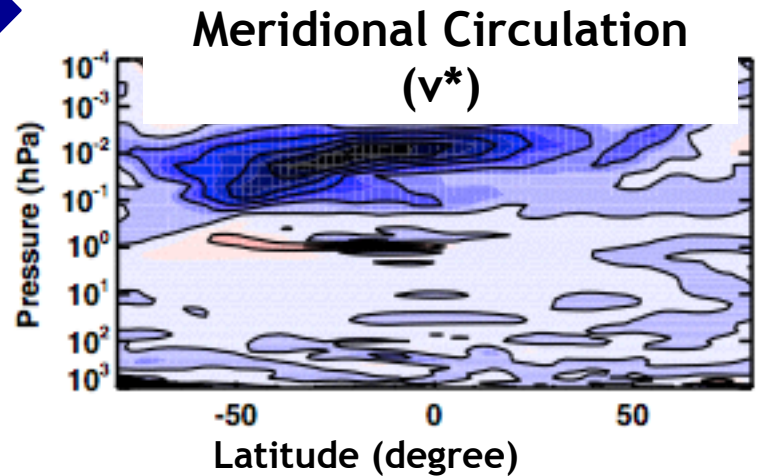
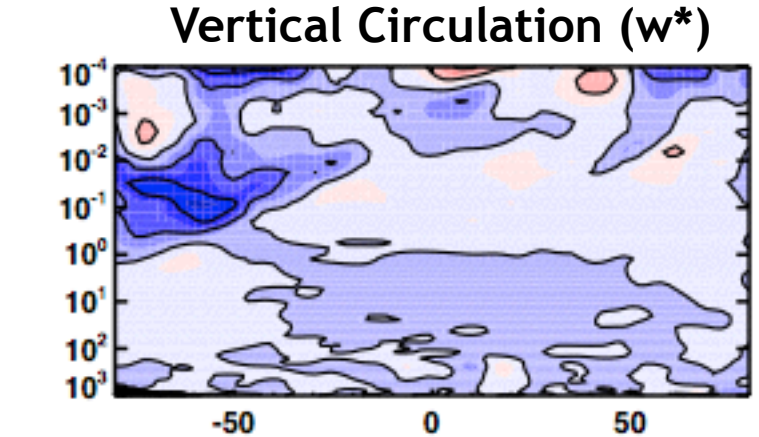
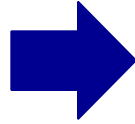
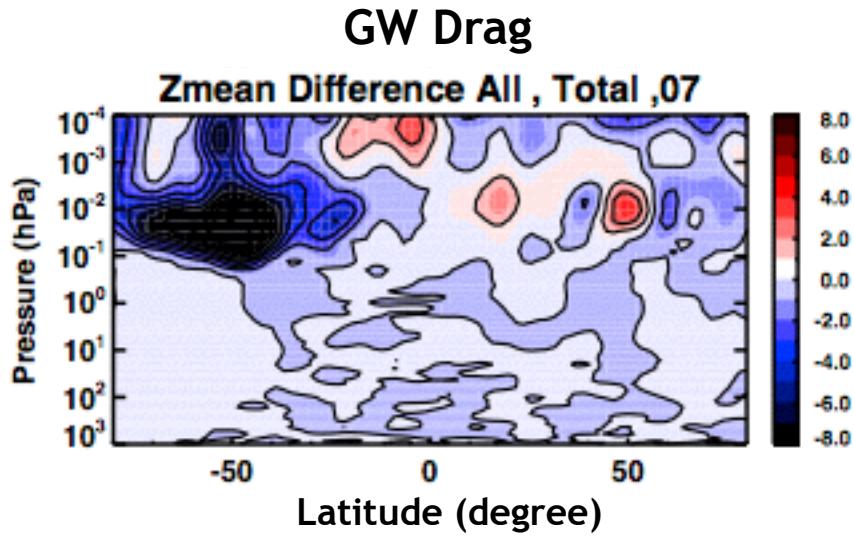
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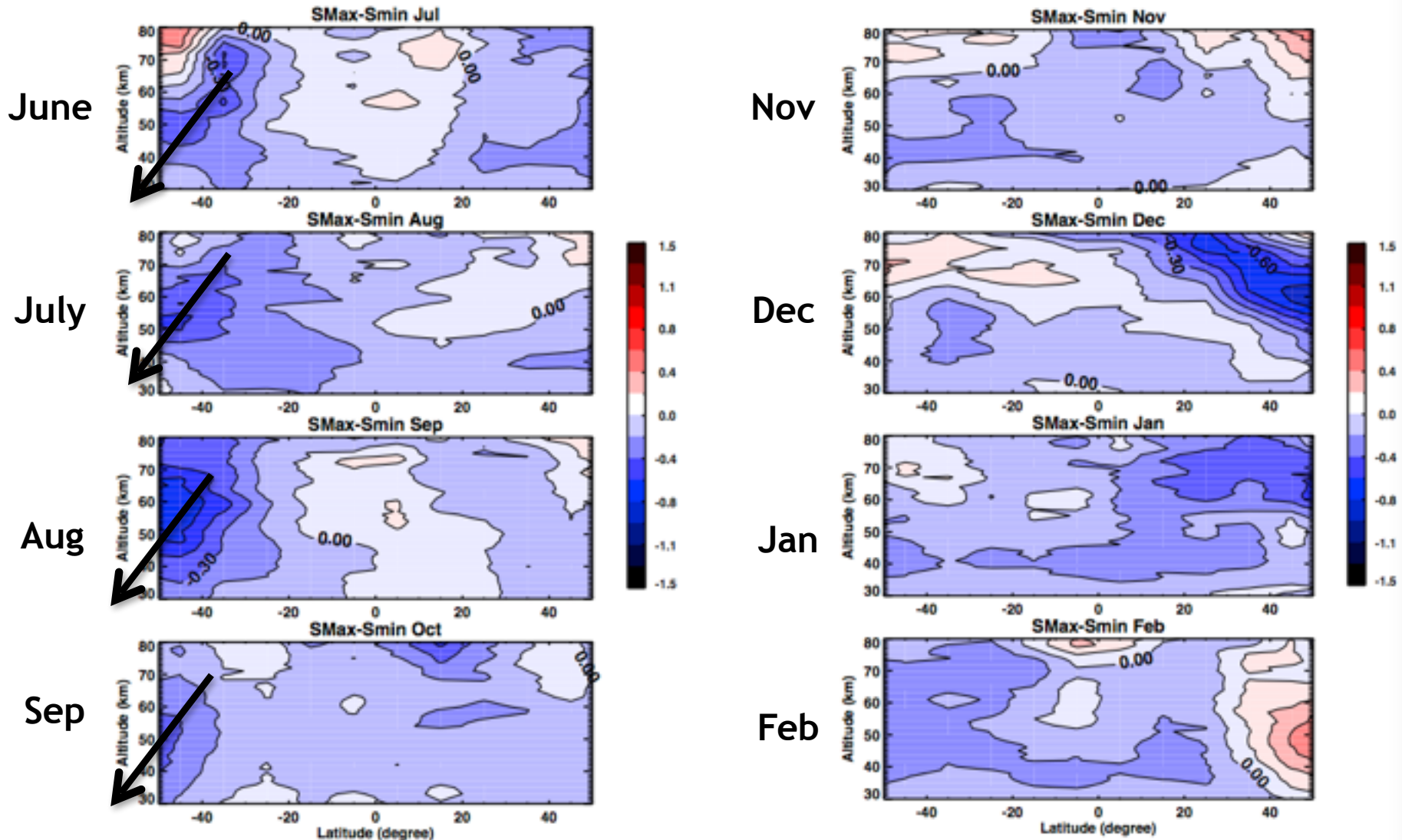
September



Gravity Wave Impacts on Residual Circulation and Temperature



The 11-year signature on SABER GWs (Smax - Smin)



Gravity wave temperature variance changes are ~5%

Gravity wave changes are large in winter hemisphere probably related to

Summary and Future Plan

- Both WACCM and SABER show responses of gravity waves to the 11-year solar cycle.
- SABER data from 2014 and 2015 will be analyzed and added to our analysis.

Question

- How can we combine multiple instrument data to obtain long-term trend for gravity wave study?