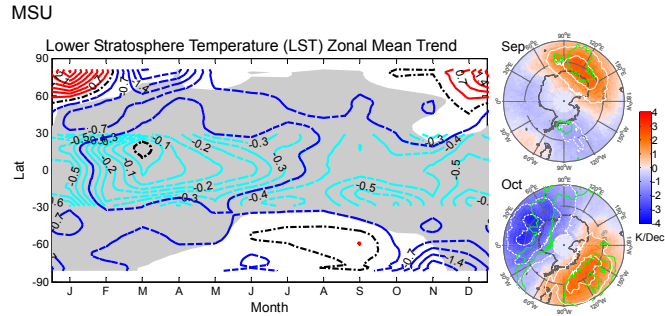


CCM simulations of recent trends in lower stratospheric temperatures and stratospheric residual circulation

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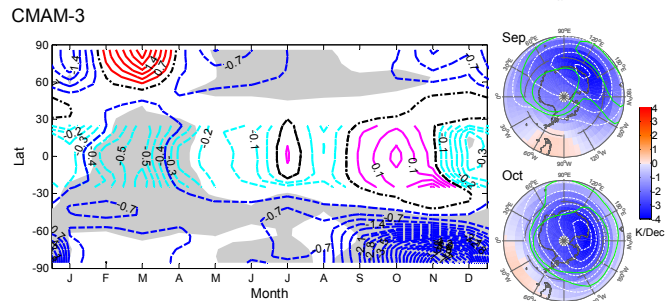
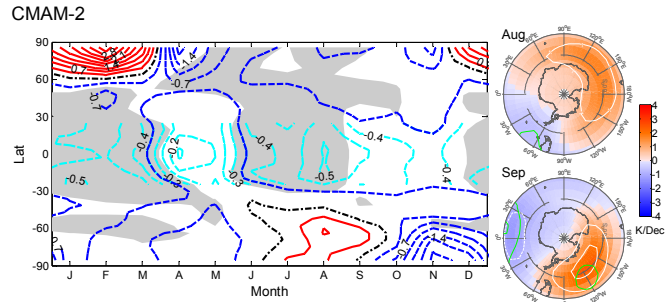
Observed Trends 1979-2006



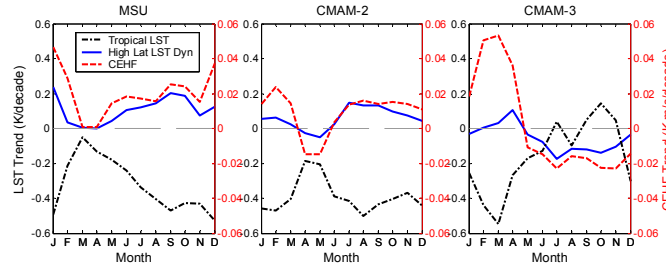
- Large seasonal variations in zonal mean trends;
- SH high latitude (dynamical) warming in late winter-spring;
- Anti-correlation between high latitude and tropical trends;
- These features are not captured in CMIP3 simulations.

CMAM Simulations

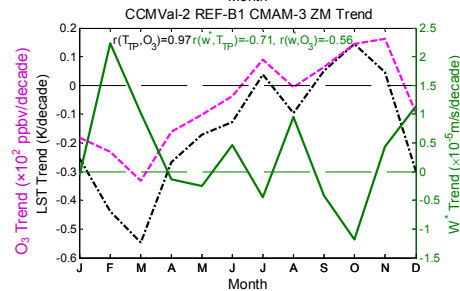
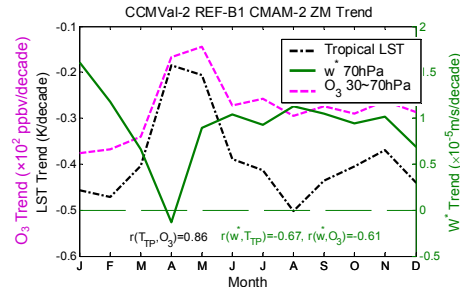
Examine two ensemble members of CMAM CCMVal-2 REF-B1 simulations.



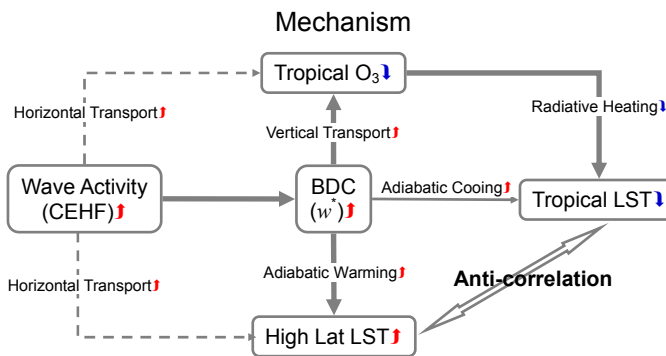
- CMAM-2 results are similar to observations;
- CMAM-3 has opposite seasonal cycle and no significant SH high-lat warming;
- Two simulations have same boundary conditions / forcings and are only different in initial conditions.



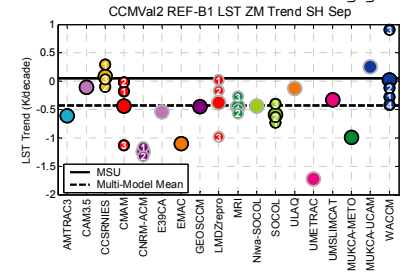
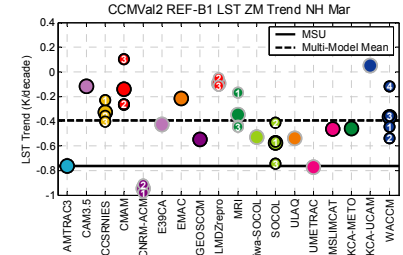
➤ The dynamical component of the high latitude LST trend (blue) is anti-correlated with the tropical trend (black).



➤ Tropical LST trends are lined to w^* and O_3 trends.



CCMVal-2 models



- CCMVal-2 models show large spread in zonal mean LST trends in high latitudes of both hemispheres;
- The spread is comparably large for ensemble members of the same model.

Summary

- Observed recent temperature trends show significant seasonal variations and SH warming in late winter-spring;
- Both aspects have been linked to a strengthening in the stratospheric meridional circulation;
- Stratospheric-resolving CCMs can produce these aspects of temperature trends, but with large spread among models and even ensembles;
- This spread is related to differences in trends of wave activity propagating into the stratosphere;
- These results suggest: (1) the observed temperature trends may not be a robust response to external forcing; (2) comparison with these trends may not be a good test of climate models.

Reference:

(1) Lin et al., 2009, J. Clim.; (2) Hu and Fu, 2009, ACP; (3) Fu et al., 2010, ACP; (4) Randel et al., 2009, JGR; (5) Free, 2011, J. Clim.; (6) Chae and Sherwood, 2007, JGR; (7) Forster et al., 2007, GRL; (8) Salby, 2008, Dyn. Atmos. Oceans; (9) Dall'Amico et al., 2010, Clim. Dyn.; (10) Lamarque and Solomon, 2010, J. Clim.; (11) Randel and Thompson, 2011, JGR; (12) Polvani and Solomon, 2011, submitted to GRL; (13) Konopka et al., 2009, JGR; (14) SPARC CCMVal, 2010, <http://www.atmosp.physics.utoronto.ca/SPARC/>; (15) Acknowledgements to CCMVal-2 modeling groups for providing data for this study.

Data: MSU Lower Stratospheric Temperature (LST); NCEP Eddy Heat Flux (EHF; 100hPa); CCMVal-2 REF-B1 LST, EHF (100hPa), O_3 (30-70hPa), w^* (70hPa).

Definition: Tropics (20°S-20°N), High latitude (40°-90°N/S), Cumulative EHF (CEHF), 3-month (current and the previous two) mean of the EHF.