

The Zonally Asymmetric Elevated Stratopause in WACCM and MLS

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Elevated Stratopause (ES) Events in WACCM and MLS

What is it? A decade of polar temperature profiles

How does it form?

Why is it important?

Previous work

Composite ES event

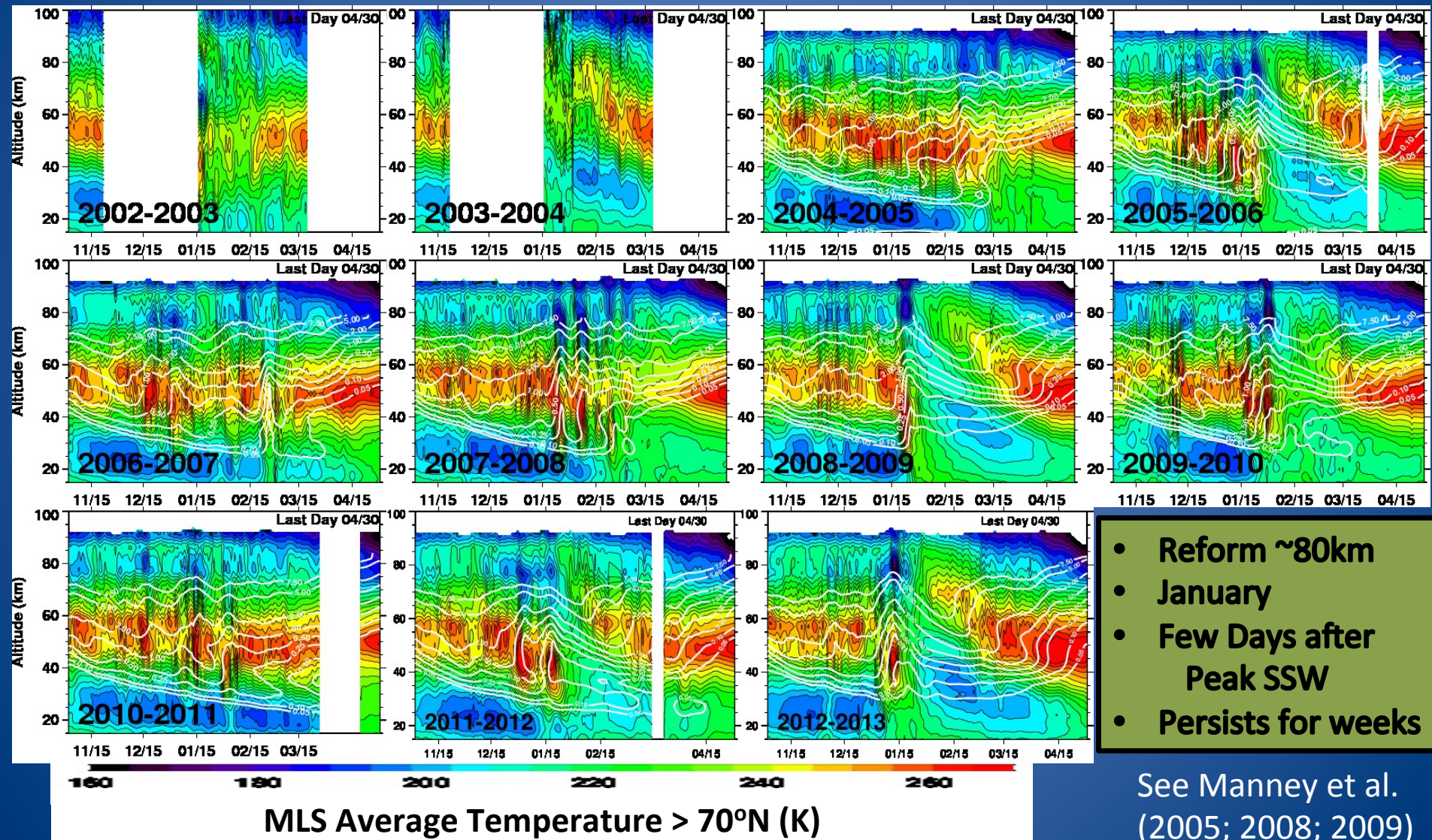
Arctic vortex structure. 3D movie

Citation: France, J. A., and [V. L. Harvey](#) (2013), A climatology of the stratopause in WACCM and the zonally asymmetric elevated stratopause, *J. Geophys. Res. Atmos.*, 118, doi:10.1002/jgrd.50218.



What are ES Events?

2004, 2006, 2009, 2012, 2013



See Manney et al.
(2005; 2008; 2009)

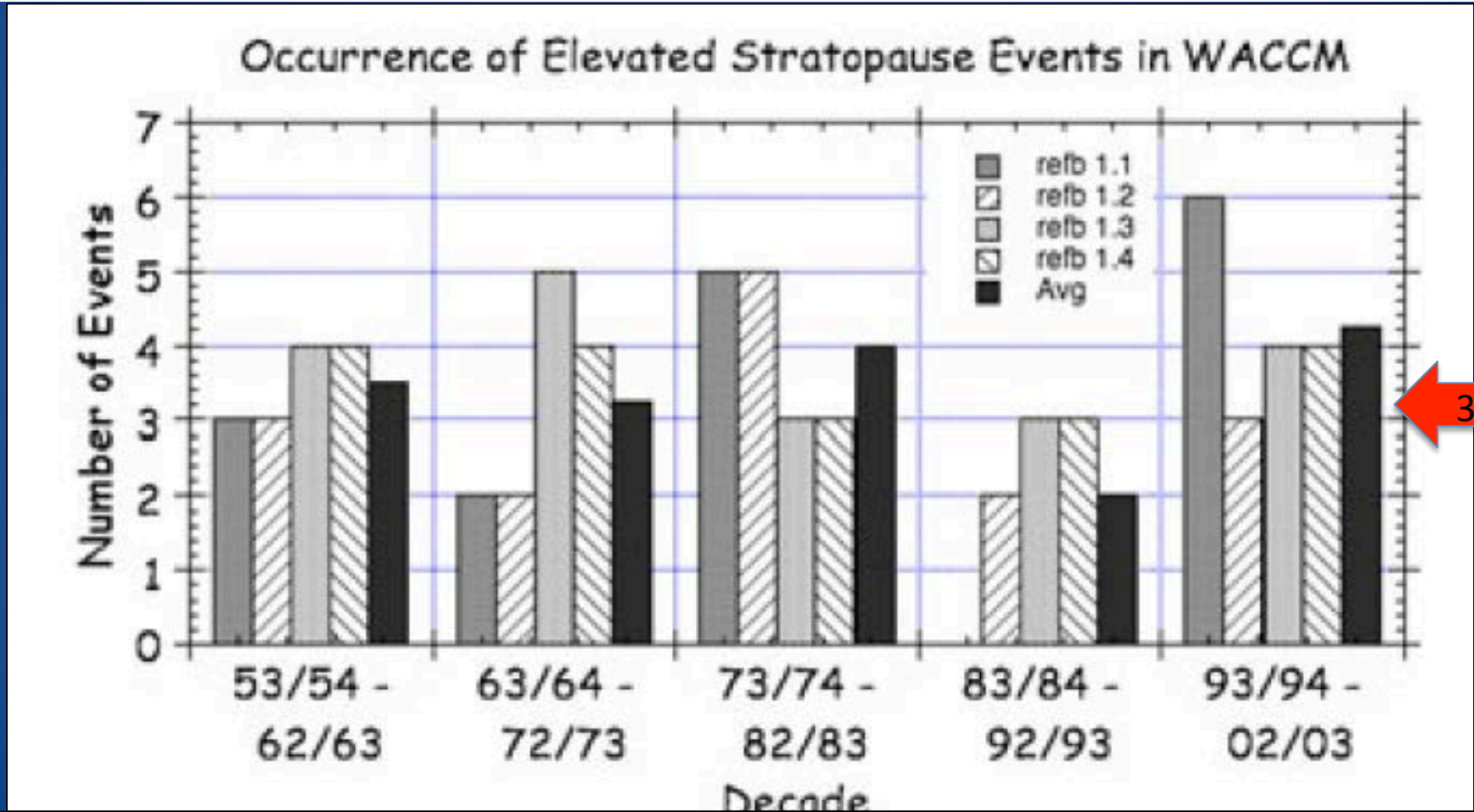
How and Why?

- How does it form?
 - Large amplitude planetary waves that persist alter the vertical propagation of gravity waves.
- Why is it important?
 - Descent of NO_x, Stratospheric Variability and Trends, Ozone Loss, Atmospheric Coupling.

Zonal asymmetries result in NO_x loss due to sunlight

A climatology of elevated stratopause events in the whole atmosphere community climate model

A. Chandran,¹ R. L. Collins,^{1,2} R. R. Garcia,³ D. R. Marsh,³ V. L. Harvey,⁴ J. Yue,⁵ and L. de la Torre⁶ **JGR (2013)**



68 ES events in 212 winters. 68% follow vortex splitting

Small PWs during 13% of events. Why?

ES Identification

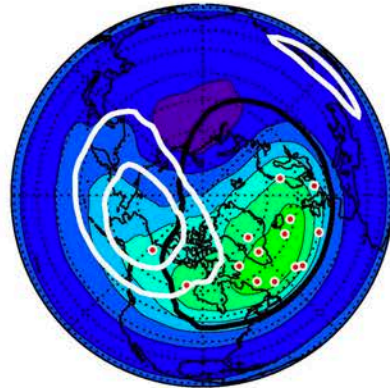
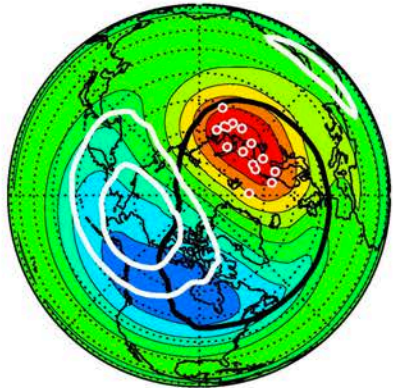
- Daily polar cap mean temperature
- Assign “Day 0” when stratopause height increases by >25 km in 1 day
- 15 Events in a 40-Year free-running simulation
- 4 Events in 8 Years of observations
- Frequencies agree with Chandran et al. (2013)

ES Composite

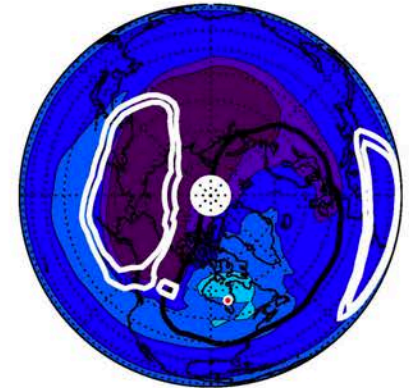
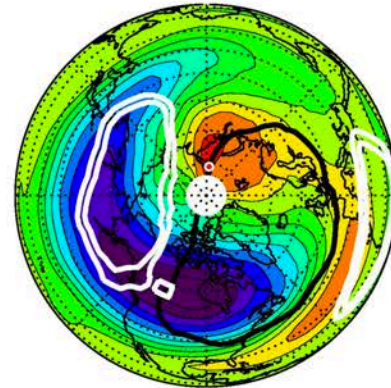
1 Month Before and 1 Month After ES Events

WACCM

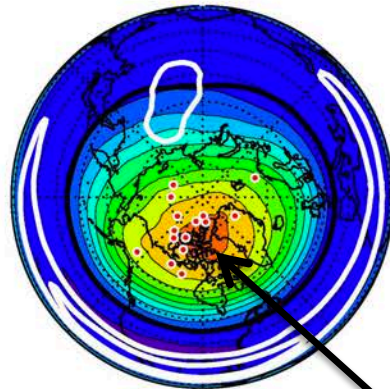
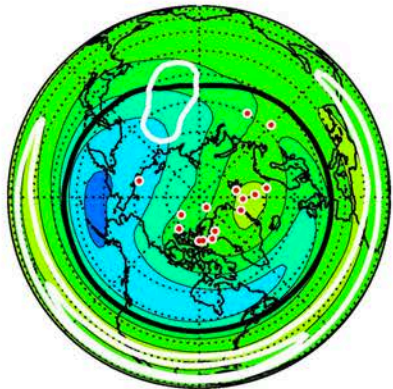
MLS 2012



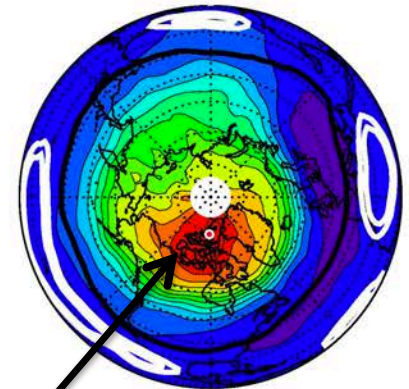
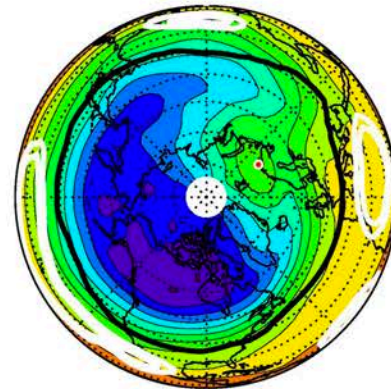
Month Before



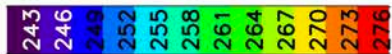
Month Before



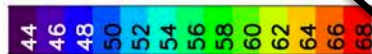
Month After



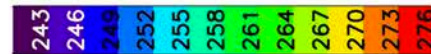
Month After



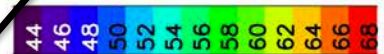
Stratopause Temperature (K)



Stratopause Height (km)



Stratopause Temperature (K)



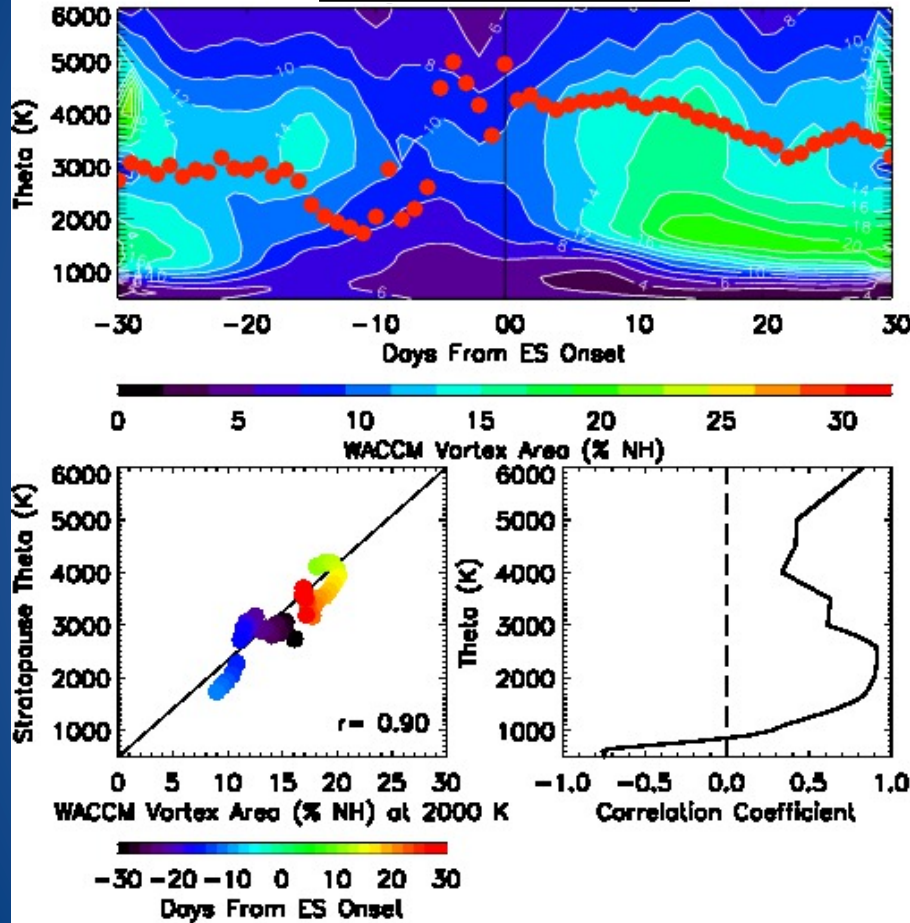
Stratopause Height (km)

ES Height Maxima over Canadian Arctic

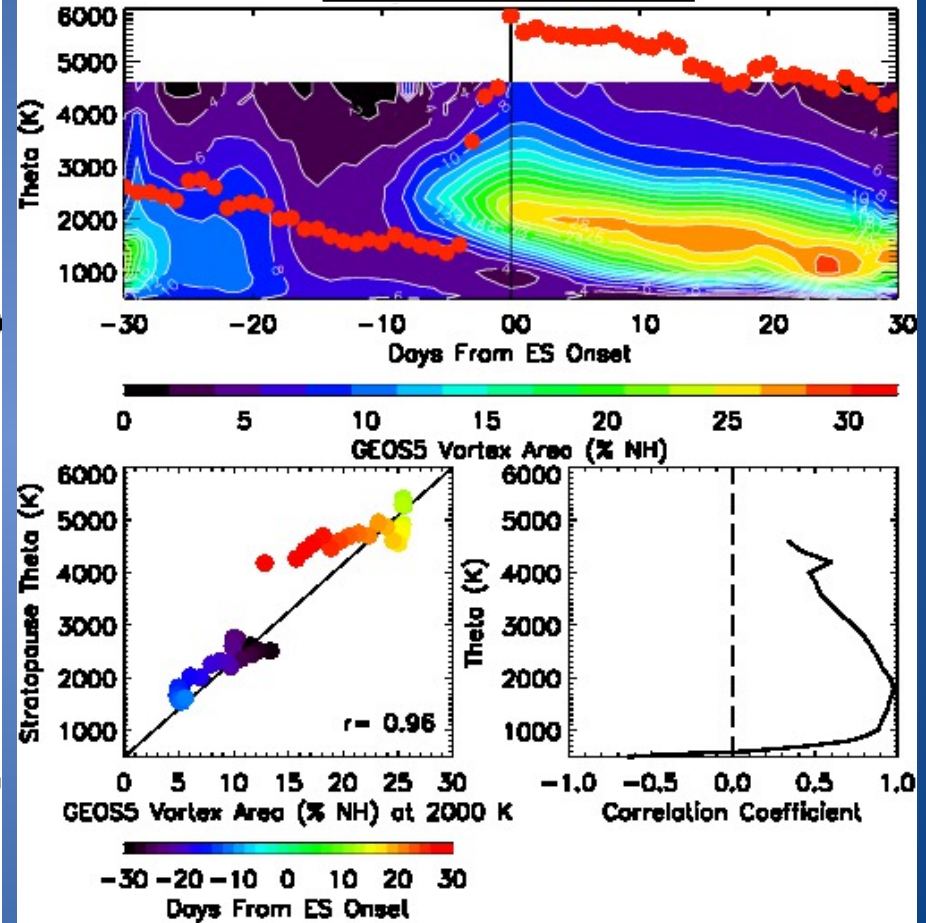
Composite Vortex Area

ES Composite Vortex Area

WACCM



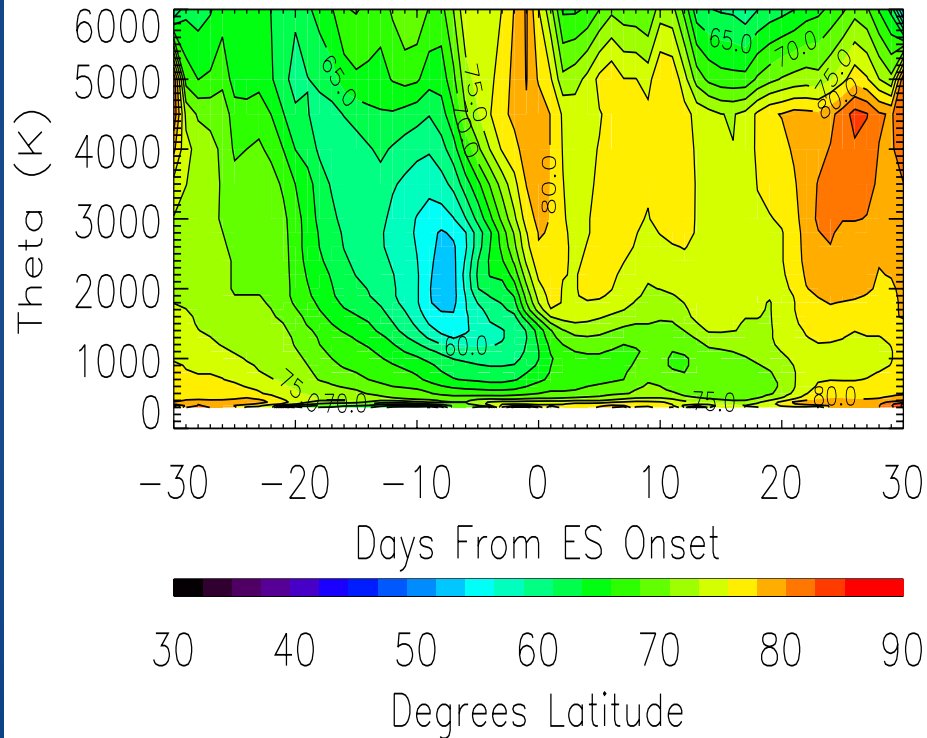
MLS/GEOS



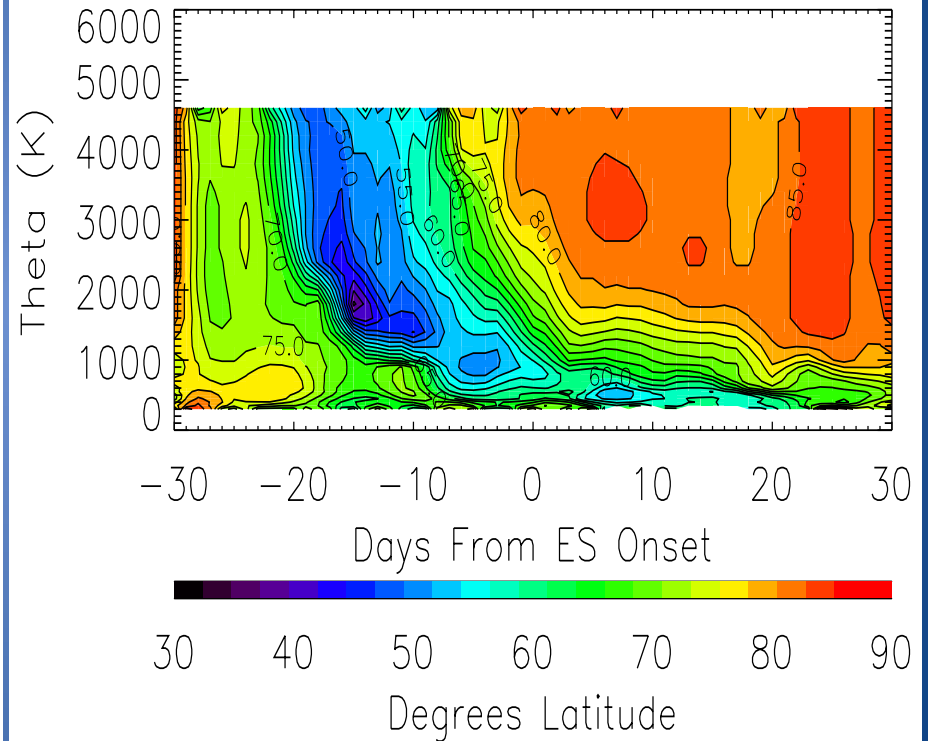
Vortex Area is correlated with Stratopause height

ES Composite Vortex Latitude Phase

WACCM

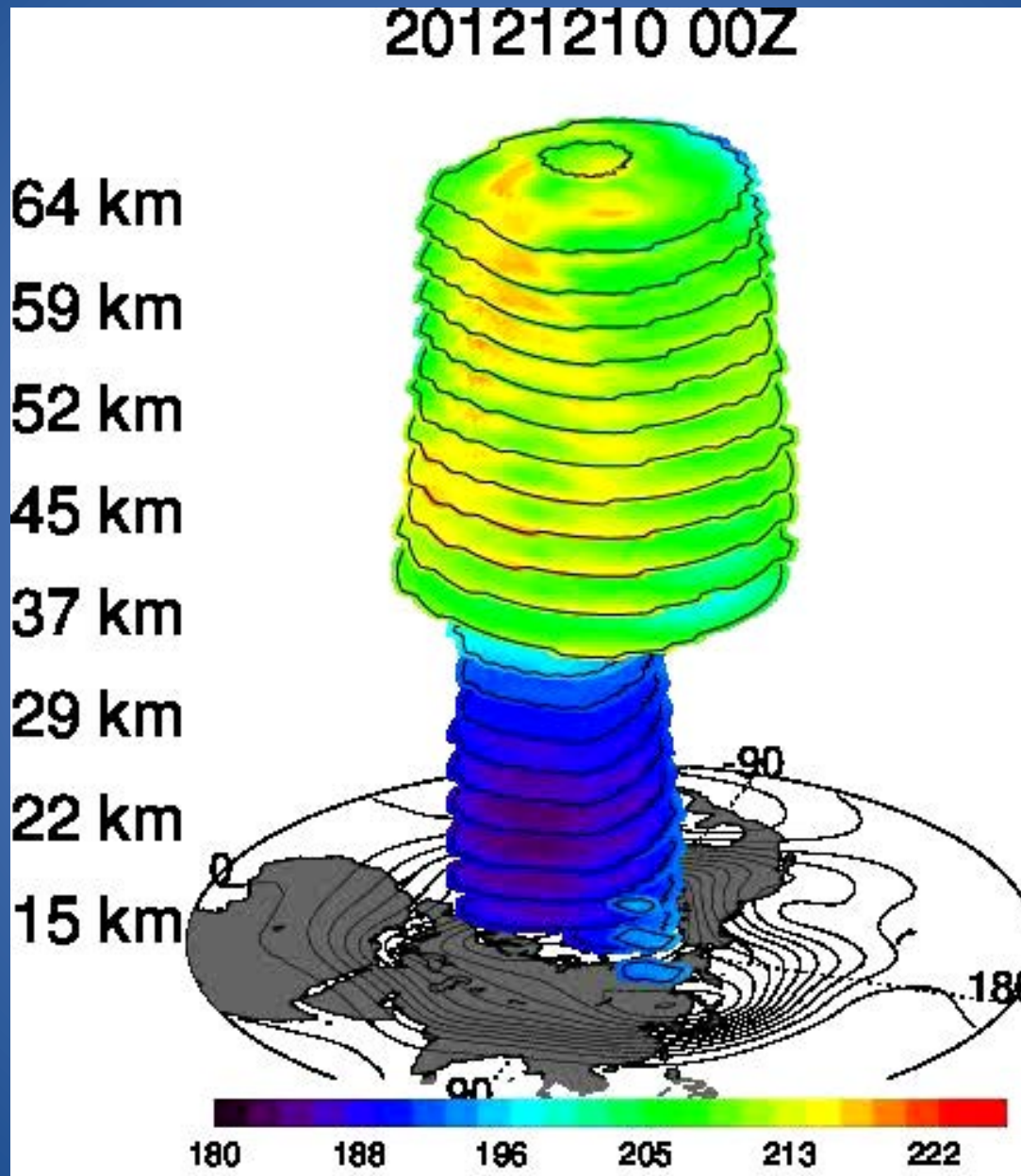


GEOS-5



Pre-ES vortex tilts Equatorward; Post-ES tilts Poleward

2012-2013 Arctic Vortex



Summary

- ES events occur $\sim 3x$ per decade
- Composite Zonal asymmetries
- Stratopause height correlated to Vortex Area
- WACCM vortex area/phase agrees with obs.
- ES in 2013 and 3-D vortex structure

Thank You