



Low Ozone Events Over the Western Pacific in SD-WACCM

Cameron Homeyer

With contributions from:
Laura Pan, Chuntao Liu, Doug Kinnison

Outline

- Examples of low ozone observations in WP TTL for which reproduction in chemical forecasts is desired
- Examination of low ozone features and evolution in a 9+ year run of SD-WACCM
- GOALS:
 - Test fidelity of chemical forecasts for providing guidance on ozone transport from large-scale and meso(convective)-scale processes (parameterized)
 - Provide some guidance on key altitudes/methods of analysis for in-field forecasting and flight planning

SD-WACCM

- Dynamical core from CAM, chemistry package from MOZART
- Specified dynamics: nudging of meteorological parameters (u,v,T,p) from GEOS-5 analyses
- Output of chemicals and meteorological variables once per day (00 UTC) from 2002 to 2011
- Serves as a proxy for the performance of in-field SD CAM-chem forecasts

Observations of low TTL Ozone in the West Pacific

WP TTL Ozone Laminae

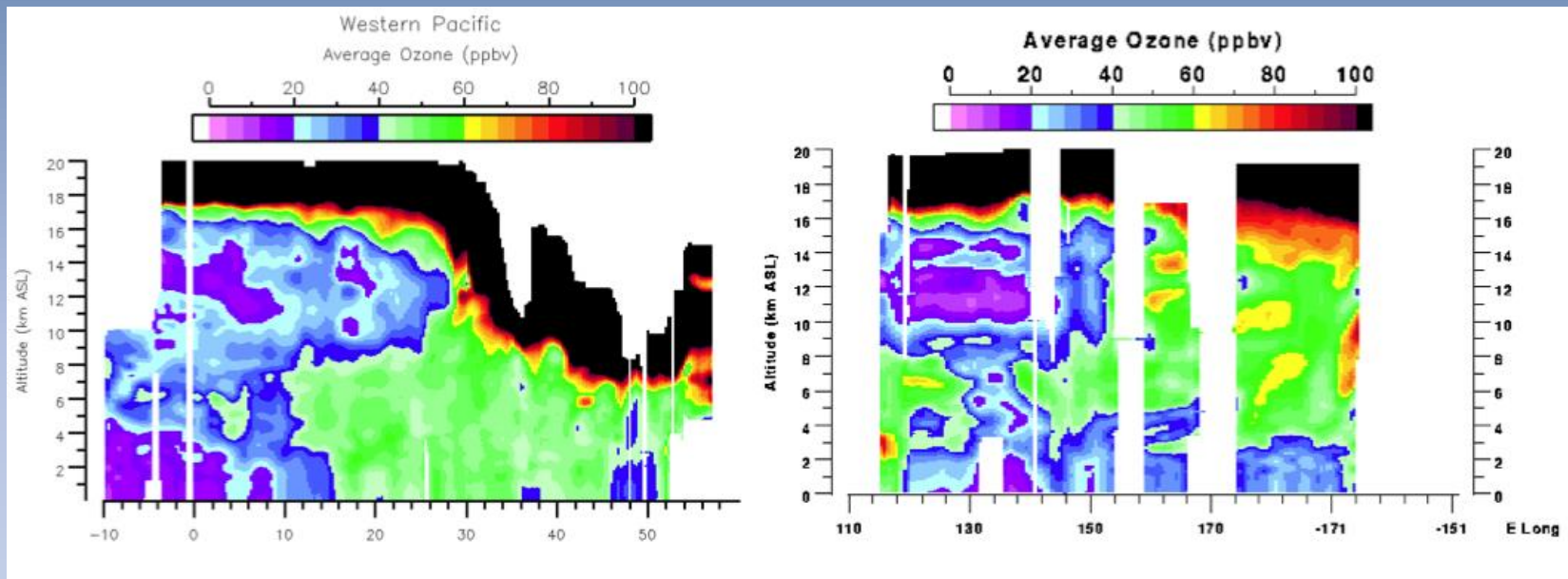
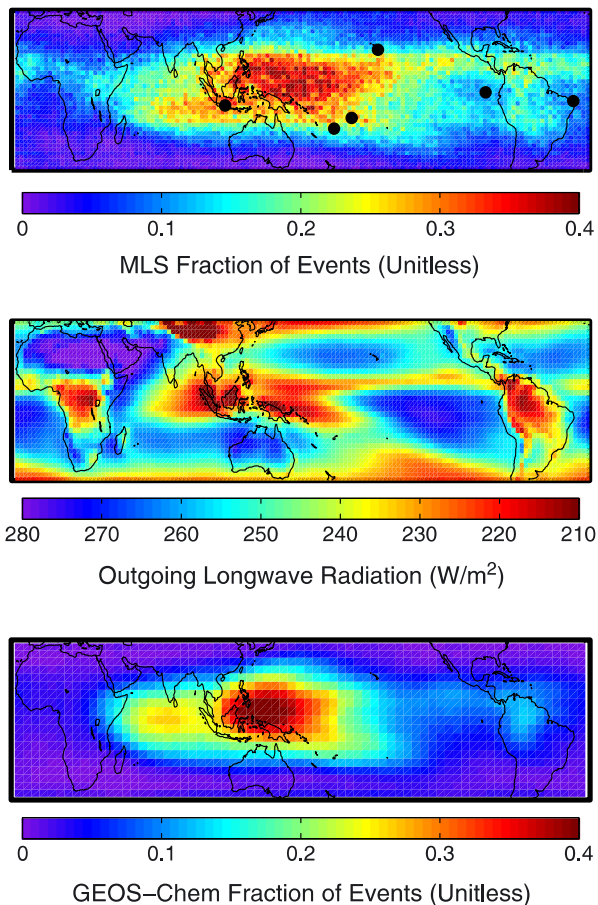


Figure 3. Composite latitudinal and longitudinal cross-sections of ozone of the Western Pacific and across the tropical Pacific during PEM-WEST [Crawford *et al.*, 1997; Browell *et al.*, http://asd-www.larc.nasa.gov/lidar/pwb/pwb_msn.html]. Measurements show the penetration of low ozone air masses to the tropical upper troposphere, and demonstrate that the lowest ozone features are located above the Western Pacific Warm Pool.

Analysis of satellite remote sensing observations of low ozone events in the tropical upper troposphere and links with convection

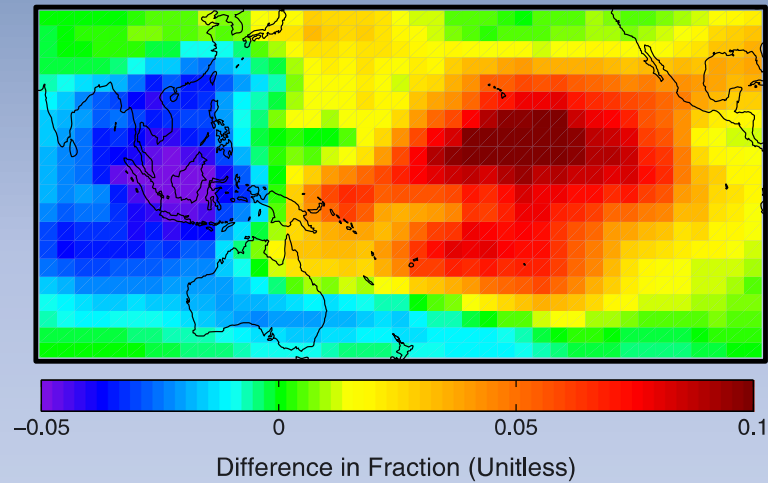
Matthew J. Cooper,¹ Randall V. Martin,^{1,2} Nathaniel J. Livesey,³ Doug A. Degenstein,⁴ and Kaley A. Walker^{5,6}

Received 7 June 2013; revised 25 June 2013; accepted 2 July 2013; published 23 July 2013.

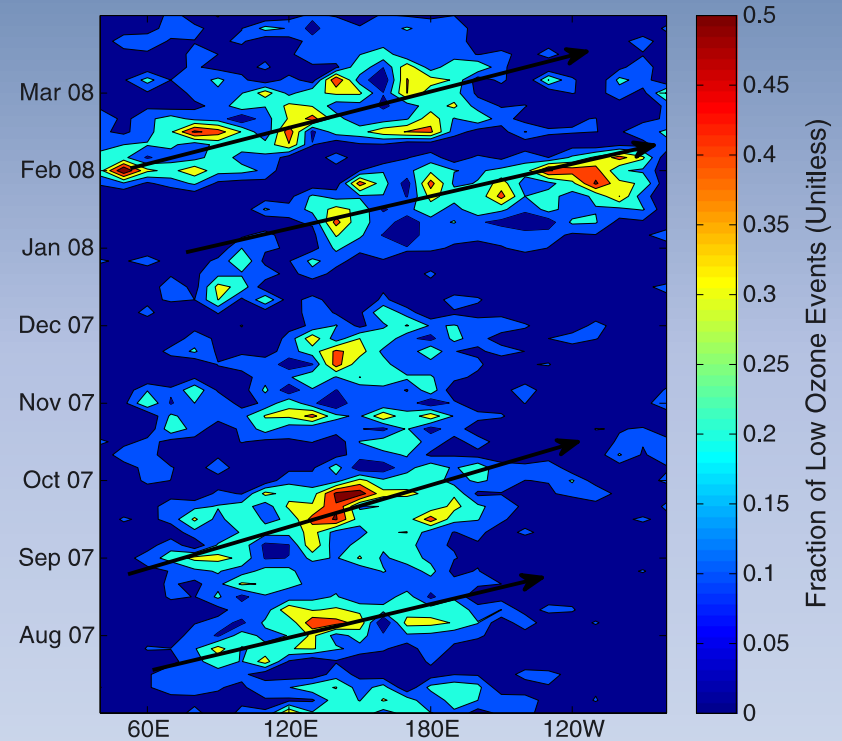


- O₃ < 20 ppbv @ 215 hPa is an event
- 9 yr of MLS data (2004-12)
- 7 yr of GEOS-Chem output (2004-10)
- Model w/o convection shows large decrease in low ozone events

Cooper et al 2013 cont.: Support for Convective Lofting



El Niño – La Niña Low Ozone Events

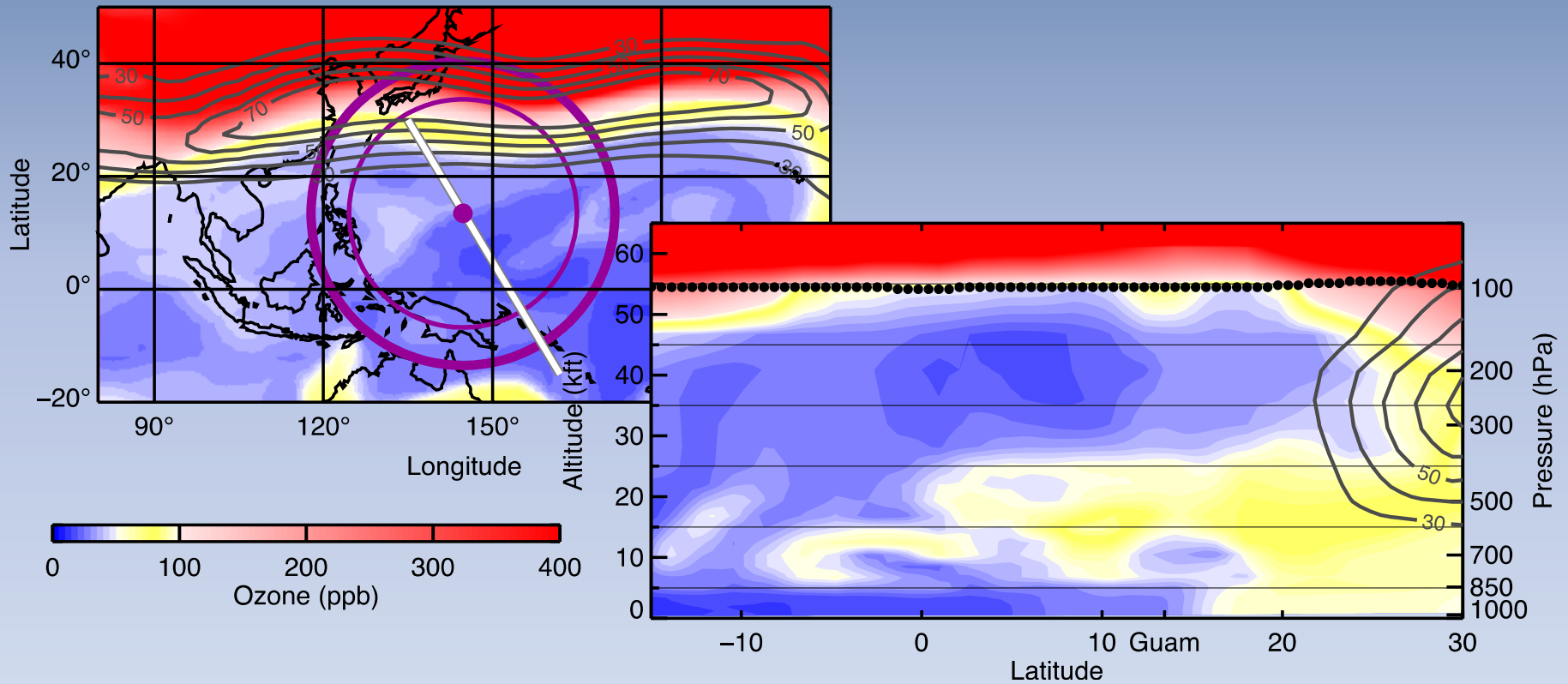


Low Ozone Events Track with MJO

SD-WACCM Simulations

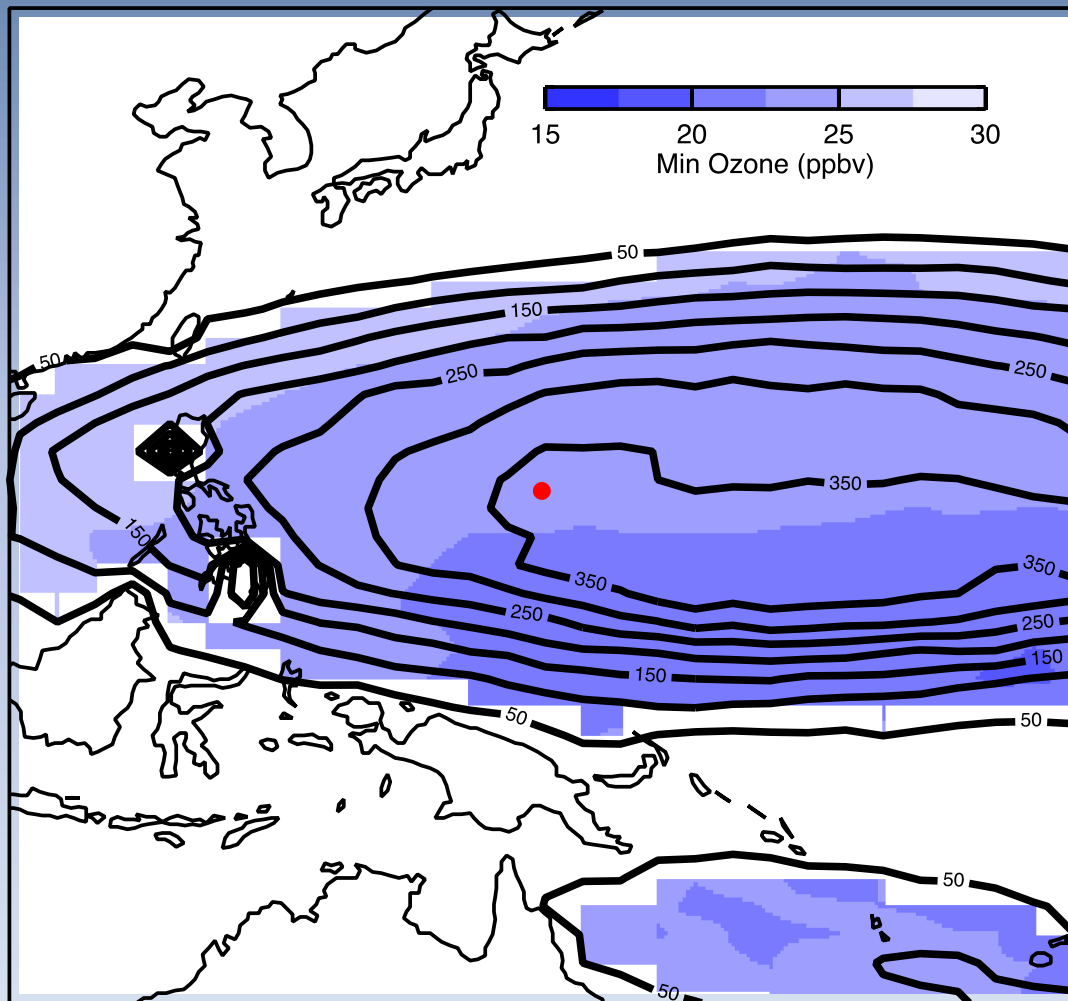
Ozone Laminae in SD-WACCM

200 hPa WACCM Ozone & Wind Speed (m/s) valid 2011-01-28

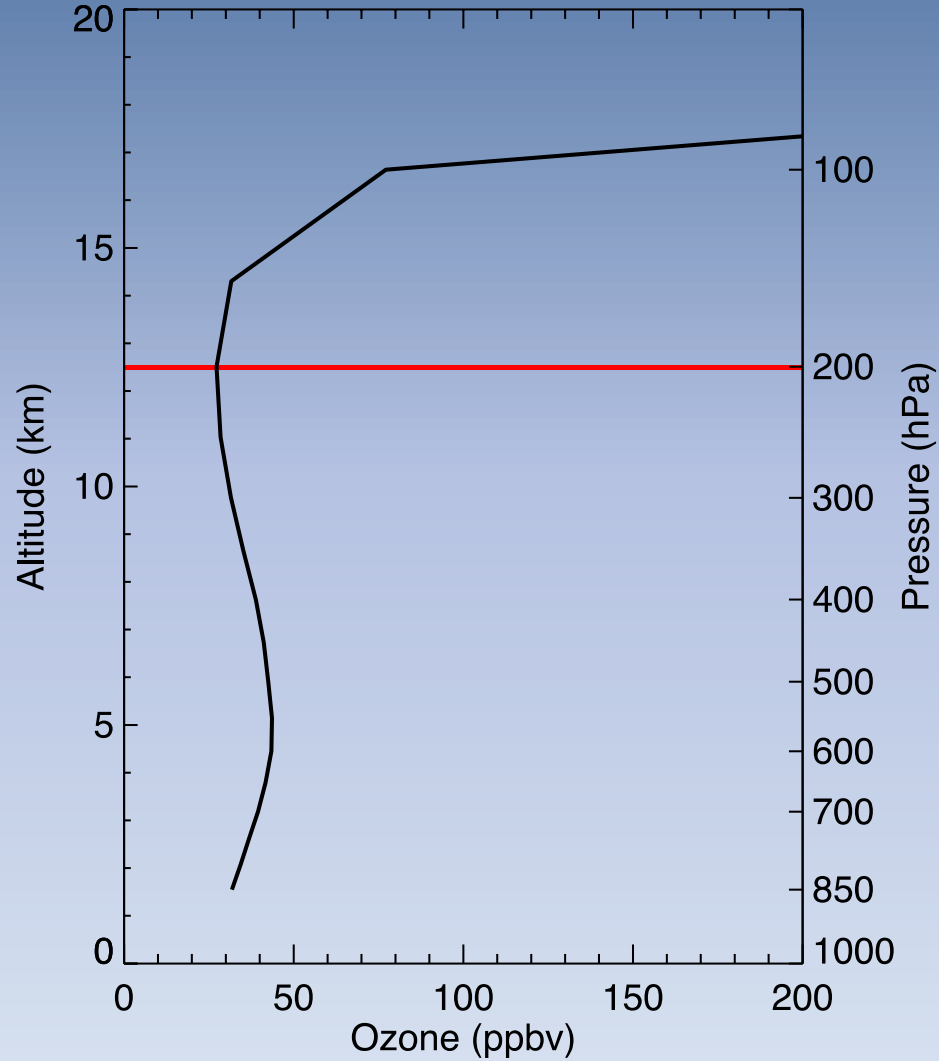


Ozone Laminae in SD-WACCM

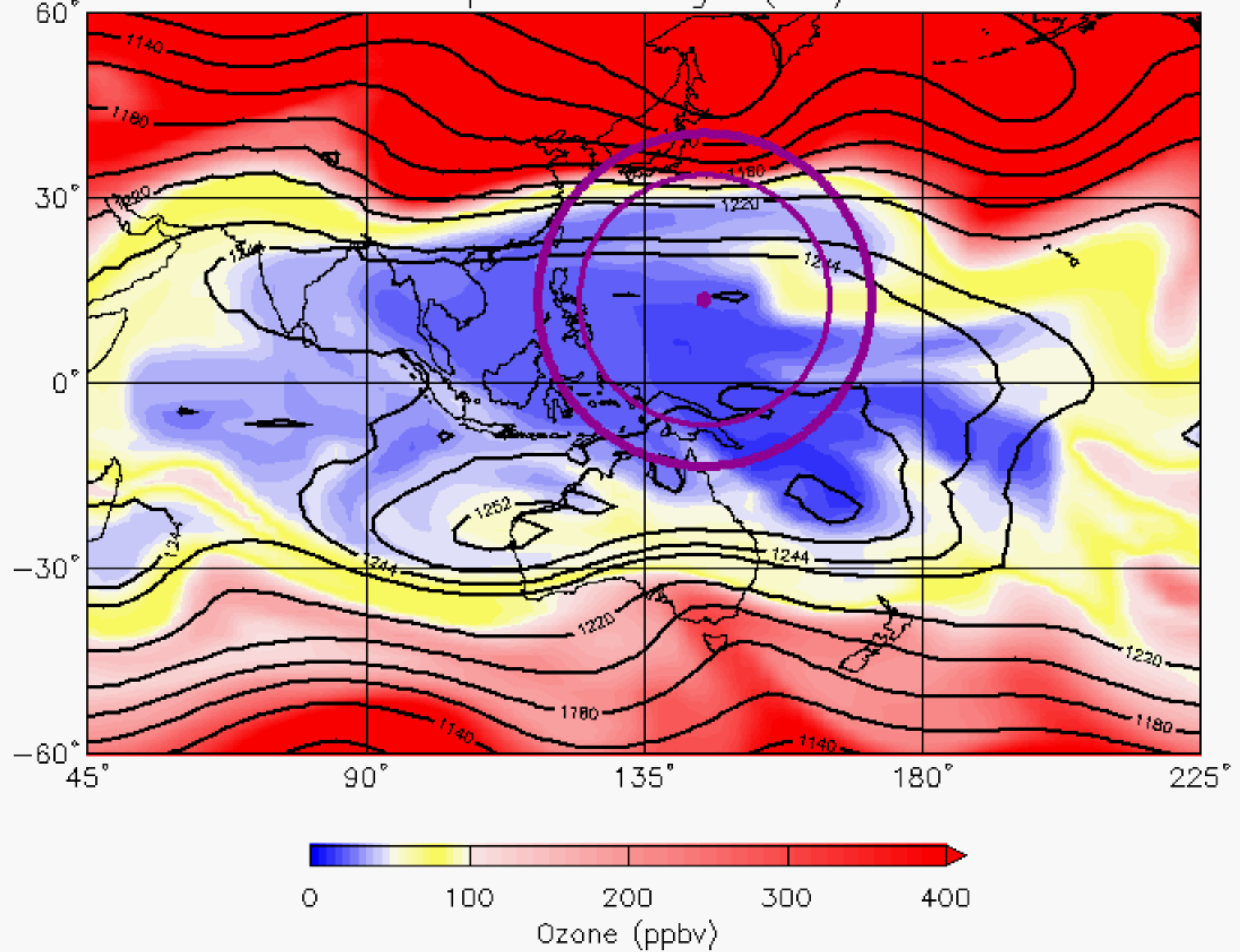
Ozone Laminae (# Days) valid DJF 2002–2011



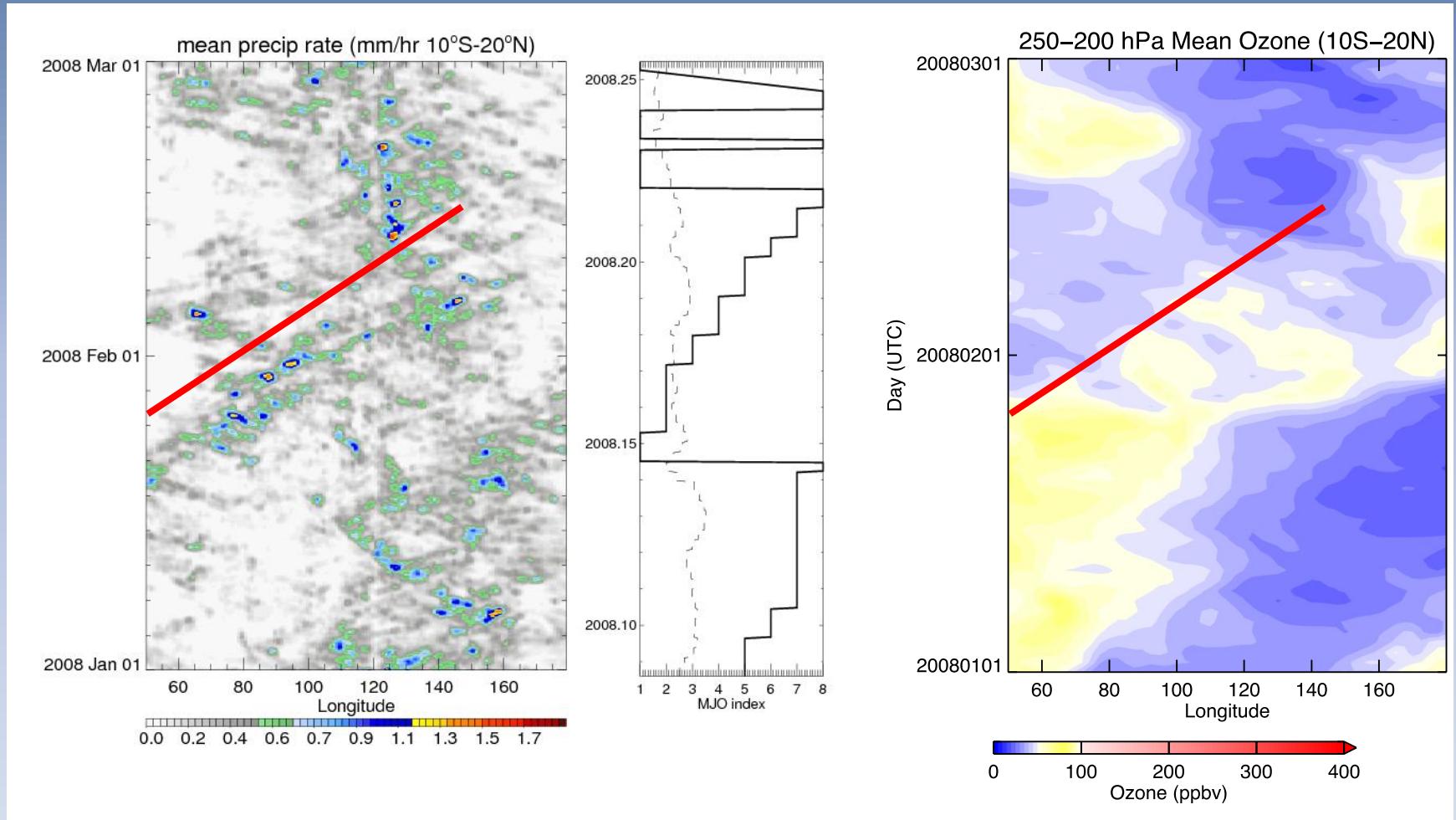
Altitude of Ozone Minimum in SD-WACCM



200 hPa Ozone & Geopotential Height (dm) valid 20080228T00Z



TRMM Rainfall vs. WACCM Ozone



Conclusions

- SD-WACCM is successful in capturing the large-scale variability of low ozone events
 - Low ozone laminae
 - MJO evolution
- 250-200 hPa layer shows lowest ozone values and often represents the central altitude of laminae
 - Hovmoller plots track well with convection
 - Maps show time evolution of low ozone plumes consistent with large-scale trajectory analysis