

Observing the impact of Calbuco volcanic aerosols on South Polar ozone depletion in 2015

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S.1 Aerosol vertical progression

Figure S1 shows the Calbuco aerosol progression from May to November as latitude-pressure maps of extinction based upon the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) 532 nm backscatter data and Whole Atmosphere Community Climate Model (WACCM) MAM 550 nm extinction values using the same approach as Figure 1 in the main text.

S.2 Temperature normalized anomalies

Considering that 2015 was an abnormally cold year. Figure S2 shows the normalized anomalies in temperature, similar to Figure 3, except as latitude-pressure maps from September to November.

S.3 Ozone normalized anomalies

Figure S3 shows latitude-pressure maps of the normalized ozone anomalies for September through November. Plotted over the normalized ozone model anomaly maps are MAM and VC-MAM 550 nm aerosol extinction values for the year of 2015, while CALIPSO 532 nm backscatter scaled by a value of 50 are plotted over the MLS data. Thus this plot shows how the modeled and observed ozone anomalies map to the respective model and observed aerosol information.

S.3 Ozone normalized anomalies

Figure S4 compares MAM October average ozonesonde measurements of the well documented Pinatubo-induced low ozone events of 1992 and 1993, to 2015, and the more volcanically quiet periods of 1996–2000 and 2012–2014, similar to Figure 6.

CALIPSO 532 nm backscatter and MAM estimation

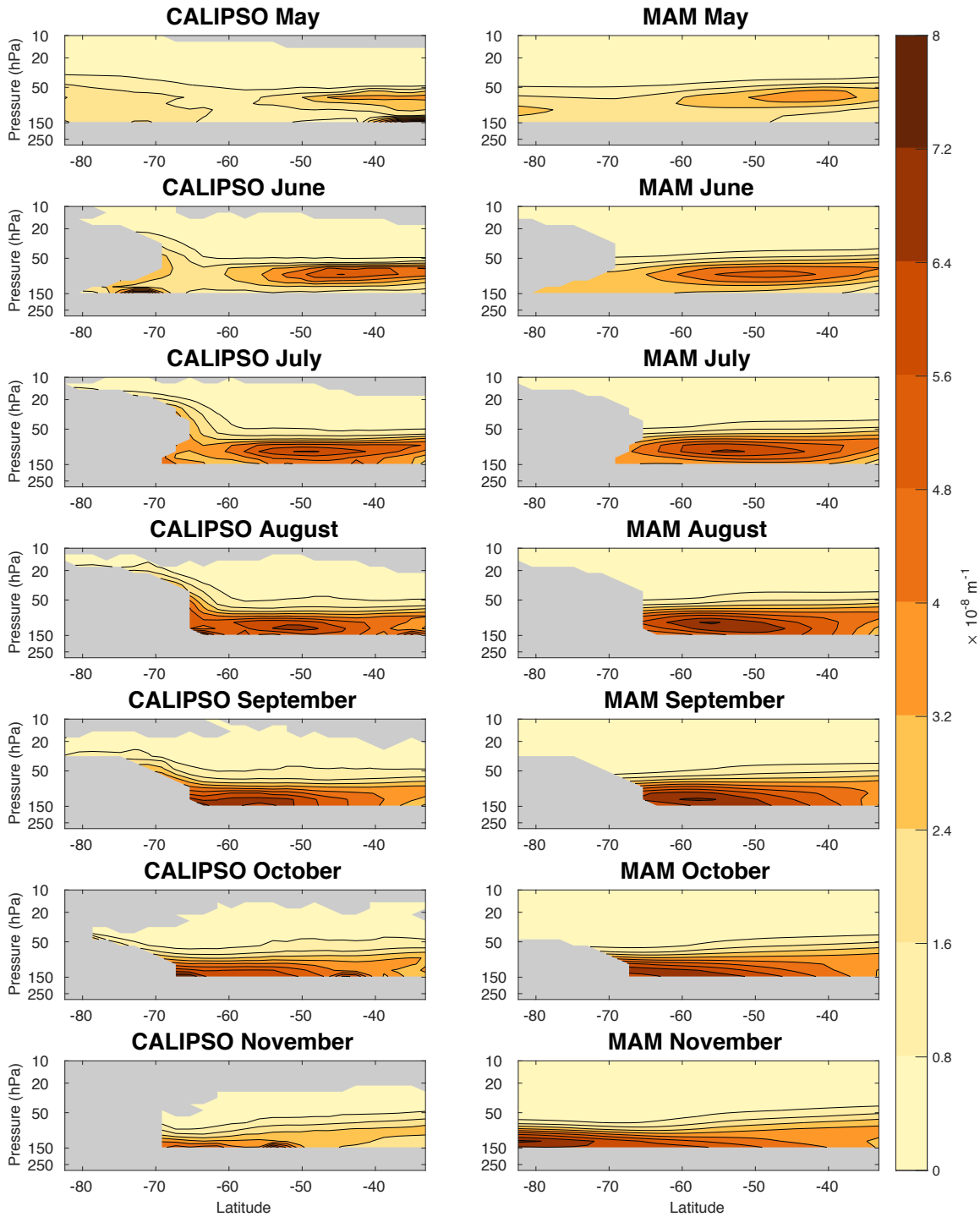


Figure S1. CALIOP and MAM 532 nm backscatter latitude pressure maps showing the southward progression and descent of Calbuco sulfur aerosols. The MAM values are estimated by an extinction to backscatter ratio of 50.

2015 normalized temperature anomalies

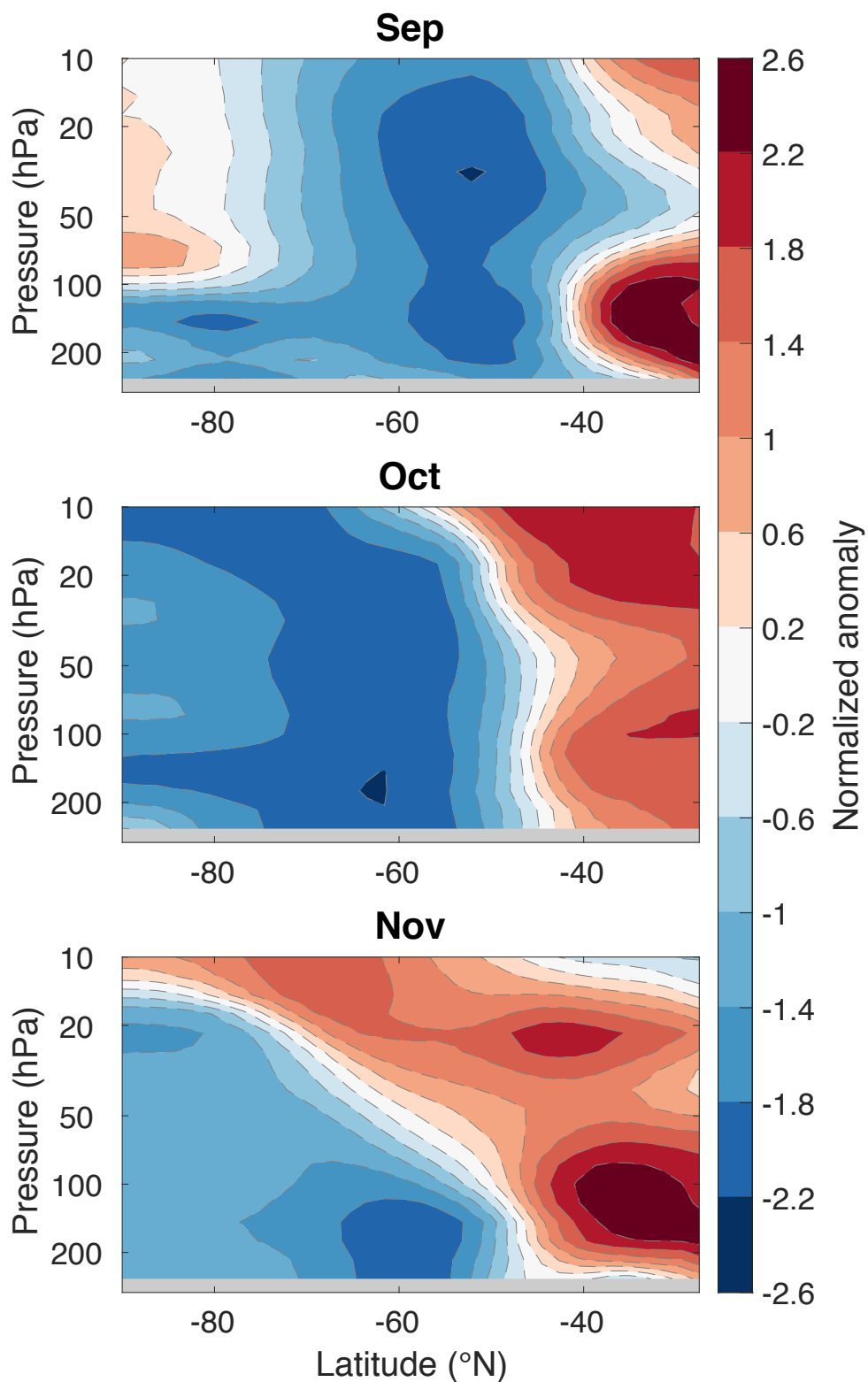


Figure S2. 2015 normalized temperature anomalies from the 2004–2015 WACCM (MERRA) time-series shown as latitude-pressure maps from September to November.

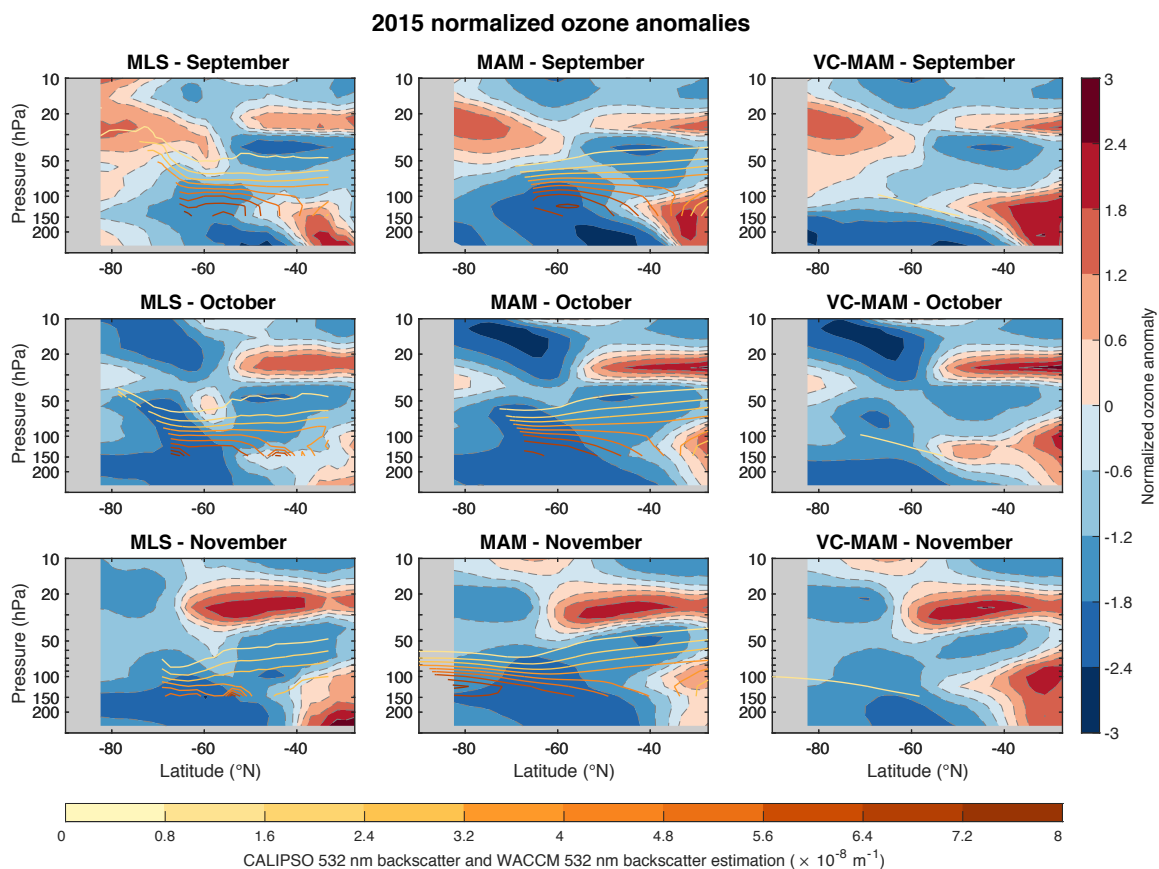


Figure S3. 2015 Normalized anomalies from the 2004–2015 MLS, MAM, and VC-MAM time series shown as zonally averaged latitude-pressure maps. 550 nm extinction coefficient values from CALIOP and MAM are plotted over the MLS and MAM anomalies, respectively, while VC-MAM 550 nm extinction coefficient values are plotted over the VC-MAM anomalies. The MAM (WACCM) backscatter values are estimated by an extinction to backscatter ratio of 50.

October model

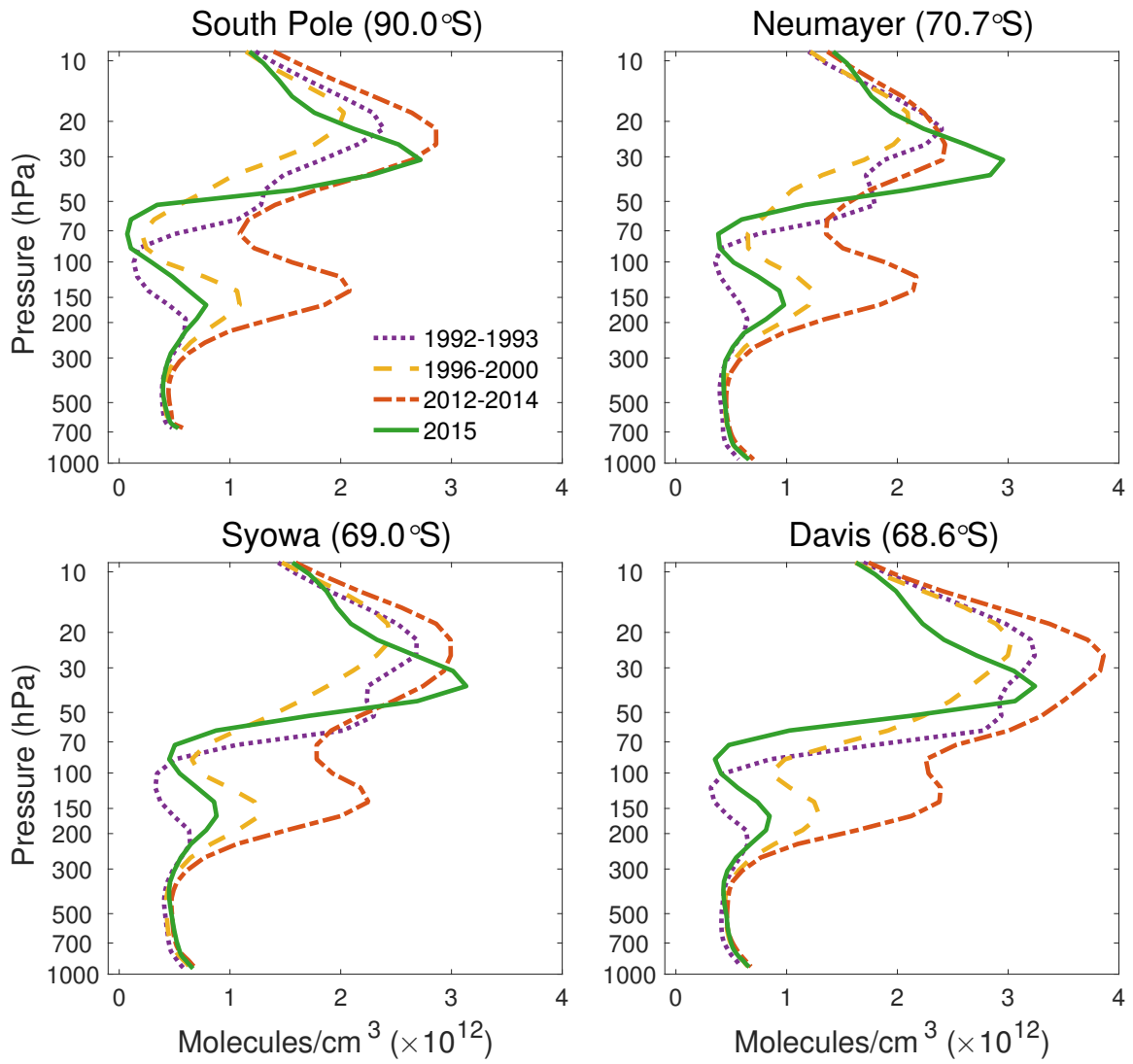


Figure S4. Same as Figure 6 in the main text, but for the model.