

Supporting Information for

**The role of midlatitude cyclones in the emission, transport, production, and removal of aerosols in the Northern Hemisphere**

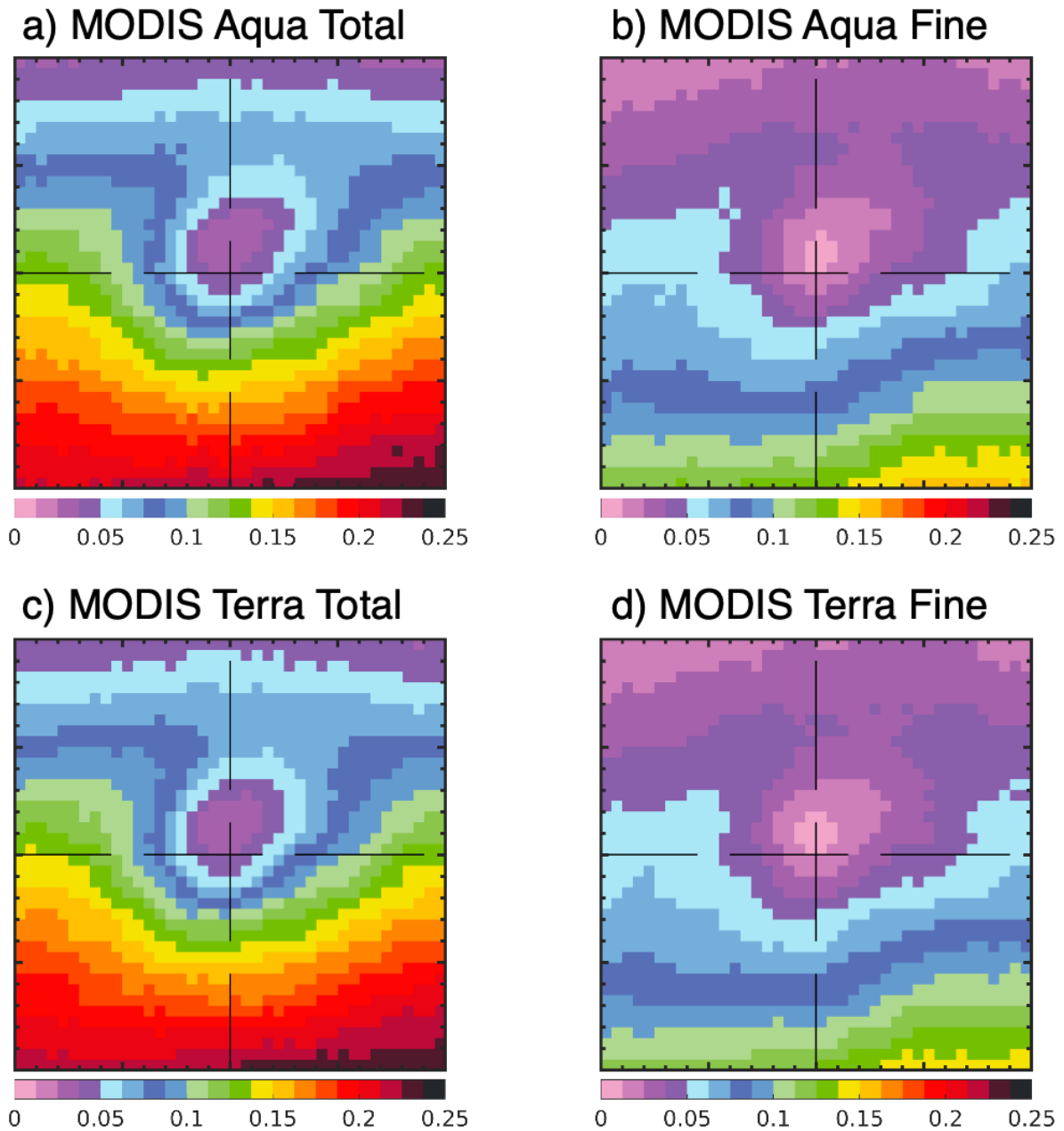
Joseph Robinson

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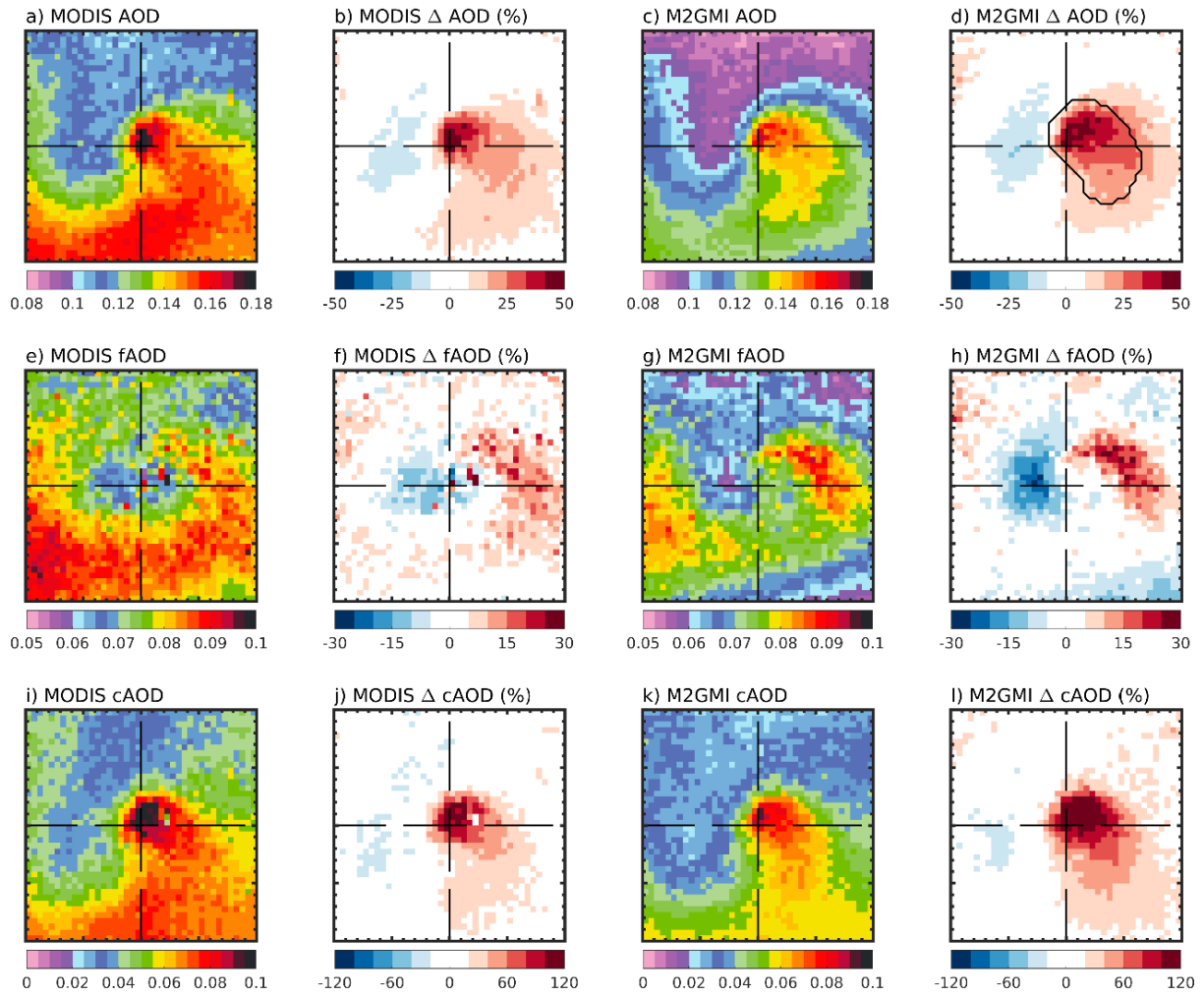
Figures S1 to S7

**Introduction**

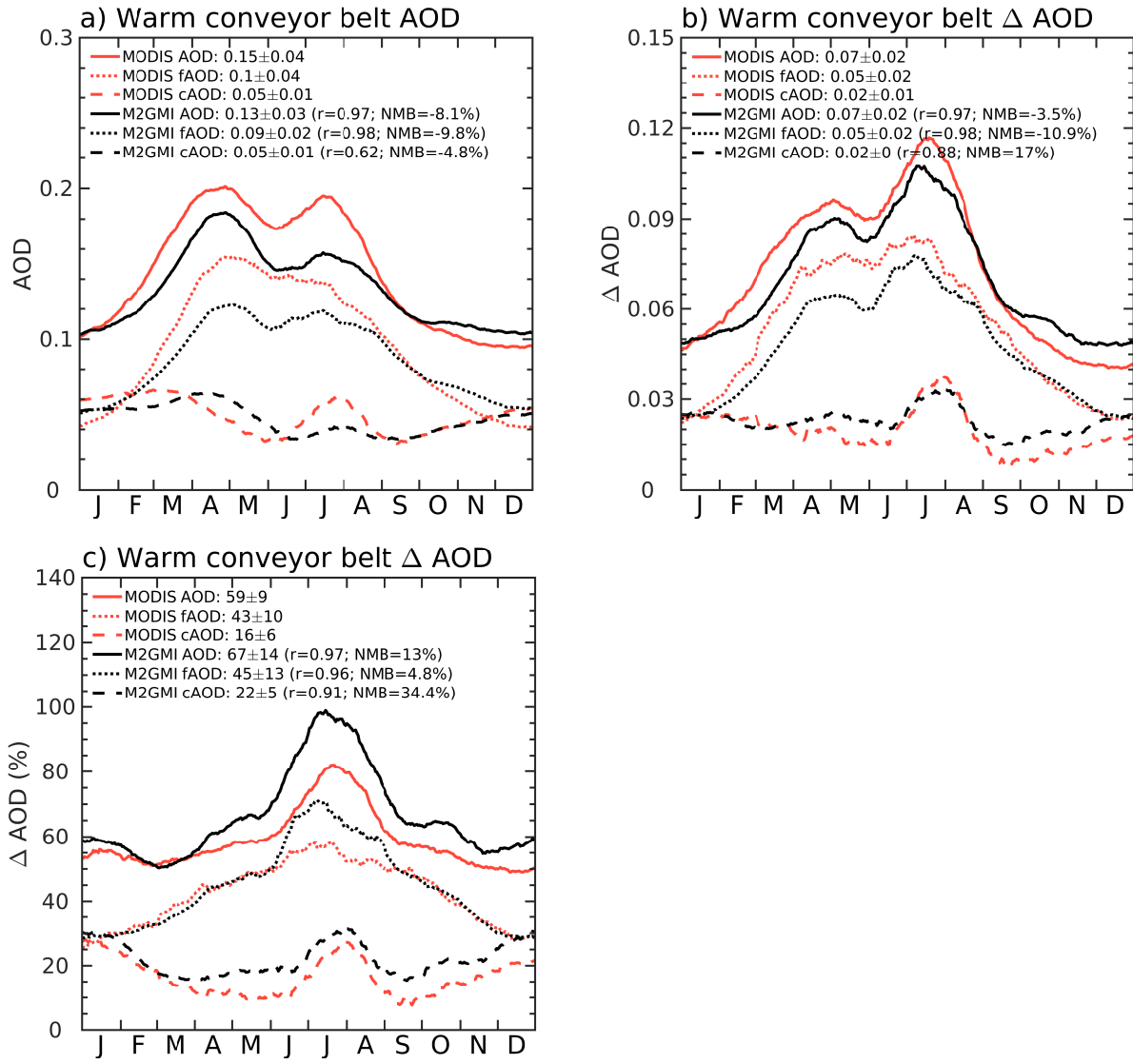
Figure S1 shows the fraction of cyclones with valid data for MODIS Aqua and Terra total AOD and fine/coarse AOD. Figure S2 shows the annual mean composites for total, fine, and coarse AOD from MODIS Terra (same as Figure 3 in the main text). Figure S3 shows the annual cycle of total, fine, and coarse AOD and their enhancements from MODIS Terra (same as Figure 4 in the main text). Figure S4 shows the annual and seasonal cumulative distributions for total and component AOD enhancements in individual cyclone WCBs. Figure S5 shows the relationship between AOD and anthropogenic pollution from the full M2GMI simulation (like Figure 7 in the main text). Figure S6 shows the annual mean enhancement composites for AOD (same as Figure 5f in the main text), weighted dry mass, and column relative humidity from M2GMI. Figure S7 shows the annual cycle of 10 m wind speed and the annual cycles of fractional sea salt aerosol emission contribution and ocean area coverage in northern hemisphere midlatitude cyclones.



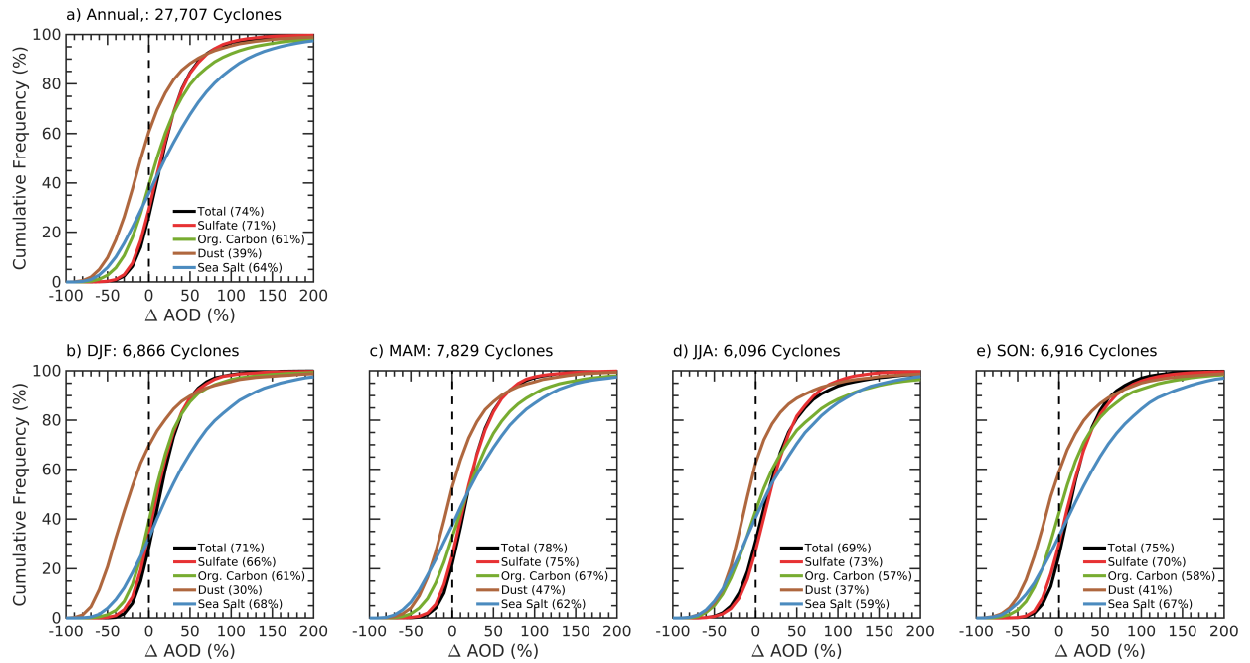
**Figure S1.** The fraction of 27,707 northern hemisphere midlatitude cyclones with valid data in the MODIS observations. (a) Fraction of cyclones with valid data for MODIS Aqua total AOD. (b) Same as (a) but for MODIS Aqua fine/coarse AOD. (c) Same as (a) but for MODIS Terra total AOD. (d) Same as (a) but for MODIS Terra fine/coarse AOD.



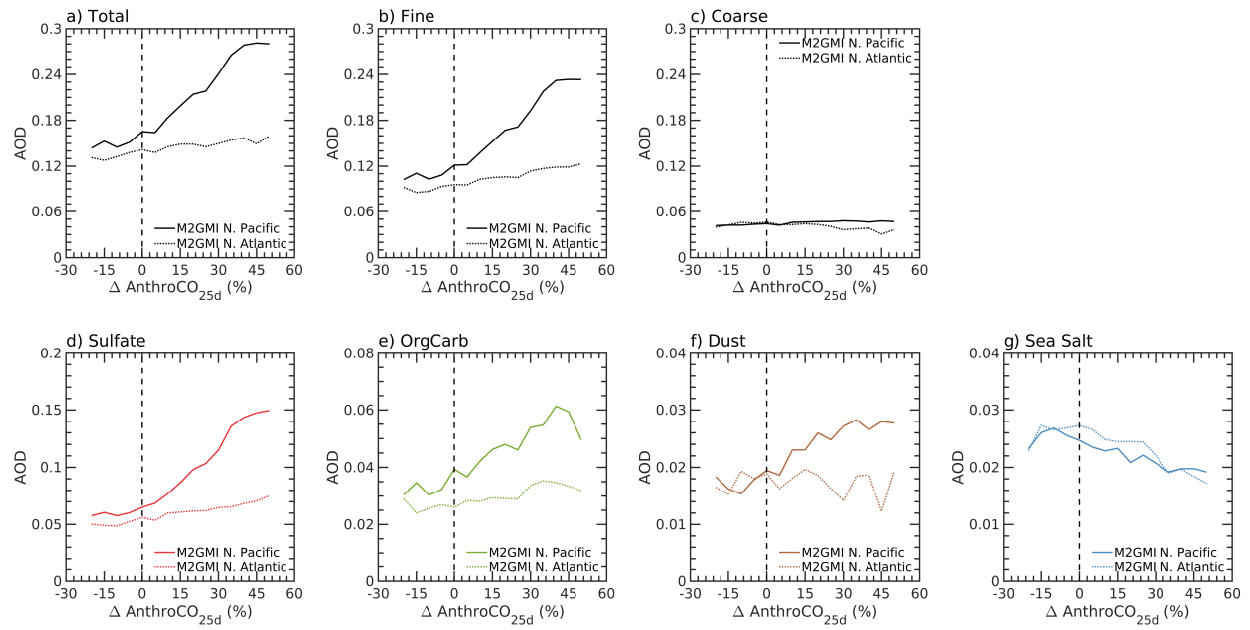
**Figure S2.** Same as Figure 3 of the main text but for MODIS Terra and the M2GMI model sampled at the Terra overpass time.



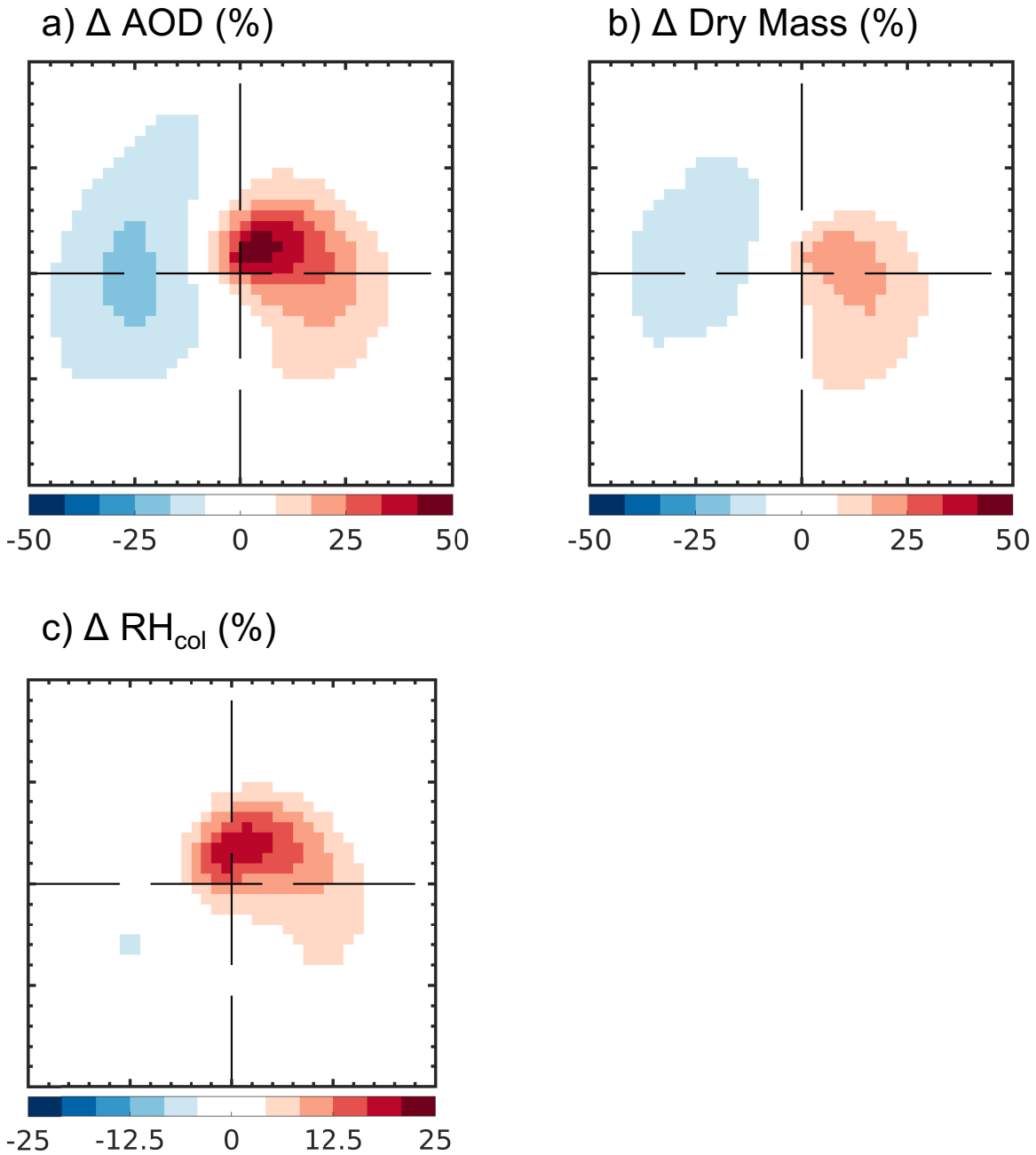
**Figure S3.** Same as Figure 4 of the main text but for MODIS Terra and the M2GMI model sampled at the Terra overpass time.



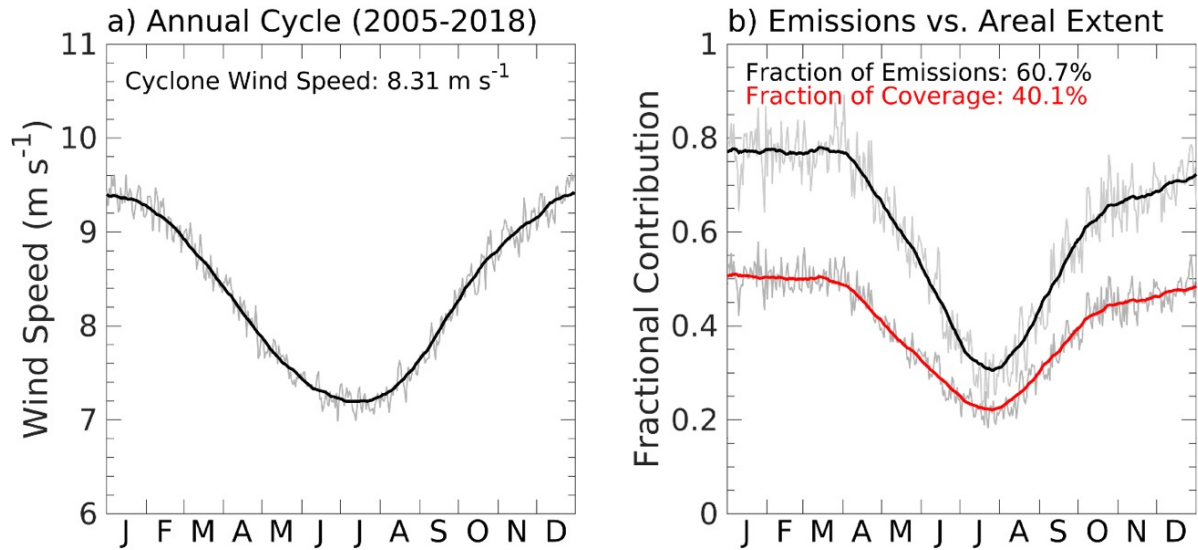
**Figure S4.** (a) Annual cumulative distributions of AOD enhancements from individual cyclone WCBs across the entire northern hemisphere. (b) same as (a) but for winter cyclones; (c) same as (a) but for spring cyclones; (d) same as (a) but for summer cyclones; (e) same as (a) but for fall cyclones.



**Figure S5.** (a-c) Same as Figure 7 in the main text but for the full, daily-averaged M2GMI simulation. (d) Same as (a) but for sulfate AOD. (e) Same as (a) but for the organic carbon AOD. (f) same as (a) but for dust AOD. (g) same as (a) but for sea salt AOD.



**Figure S6.** Annual mean composites of 27,707 midlatitude cyclones from M2GMI (2005-2018). (a) Total AOD anomaly (%; same as Figure 5f of the main text). (b) Total dry mass anomaly (%). Each aerosol component's dry mass has been weighted by its contribution to the background AOD (section 5 of the main text). (c) Column average relative humidity anomaly (%).



**Figure S7.** (a) Annual cycle of NH midlatitude cyclone 10 m wind speed (daily values are in gray while the black line shows wind speeds smoothed with a 40-day boxcar average). (b) Annual cycle of fraction of sea salt aerosol emissions due to midlatitude cyclones (daily values in gray with the black line showing the contribution smoothed with a 40-day boxcar average). Also shown is the fraction of NH ocean area covered by the strong wind speed regions of midlatitude cyclones (daily values in gray with the red line showing the area coverage smoothed with a 40-day boxcar average).