



Supplement of

Multidecadal increases in global tropospheric ozone derived from ozonesonde and surface site observations: can models reproduce ozone trends?

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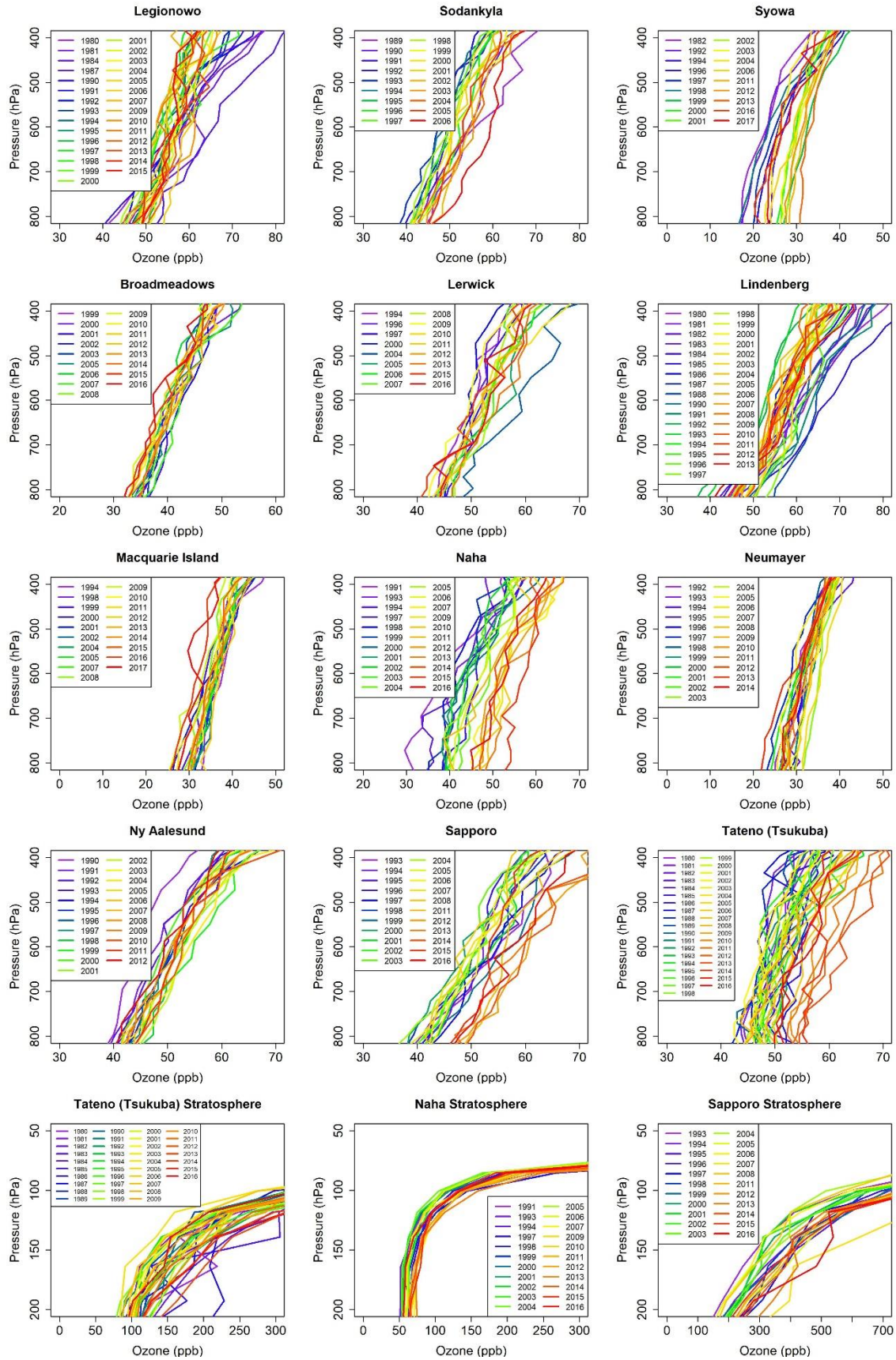


Figure S1. Annual median ozone profiles for ozonesonde data from the 12 non-homogenized sites from 1990-2017. No step changes are apparent in the data, with the exception of the Japanese sites (Naha, Sapporo, Tateno (Tsukuba)). These step changes are not apparent in the stratosphere.

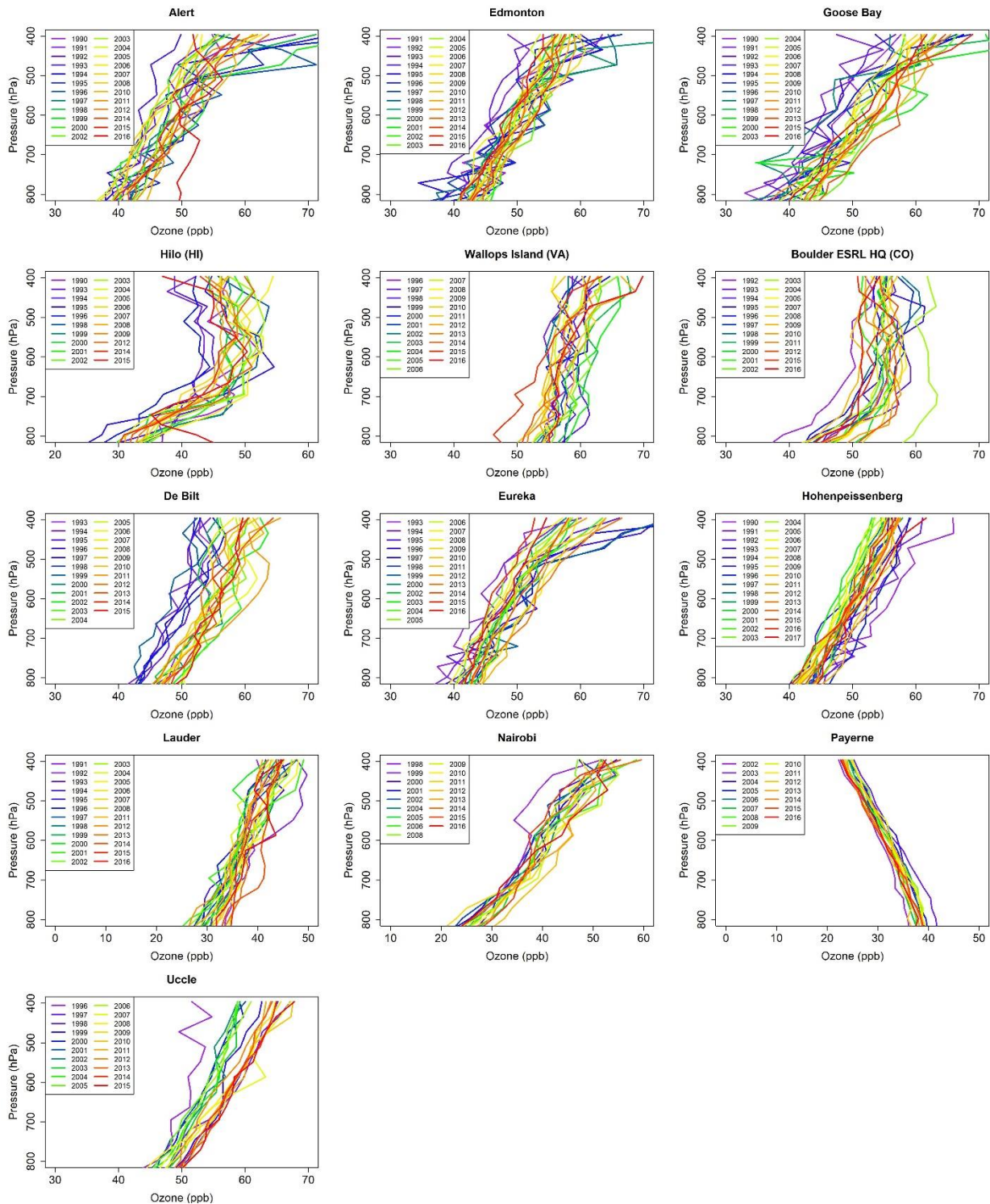


Figure S2. Annual median ozone profiles for ozonesonde data from the 13 homogenized sites from 1990-2017. No step changes are apparent in the data.

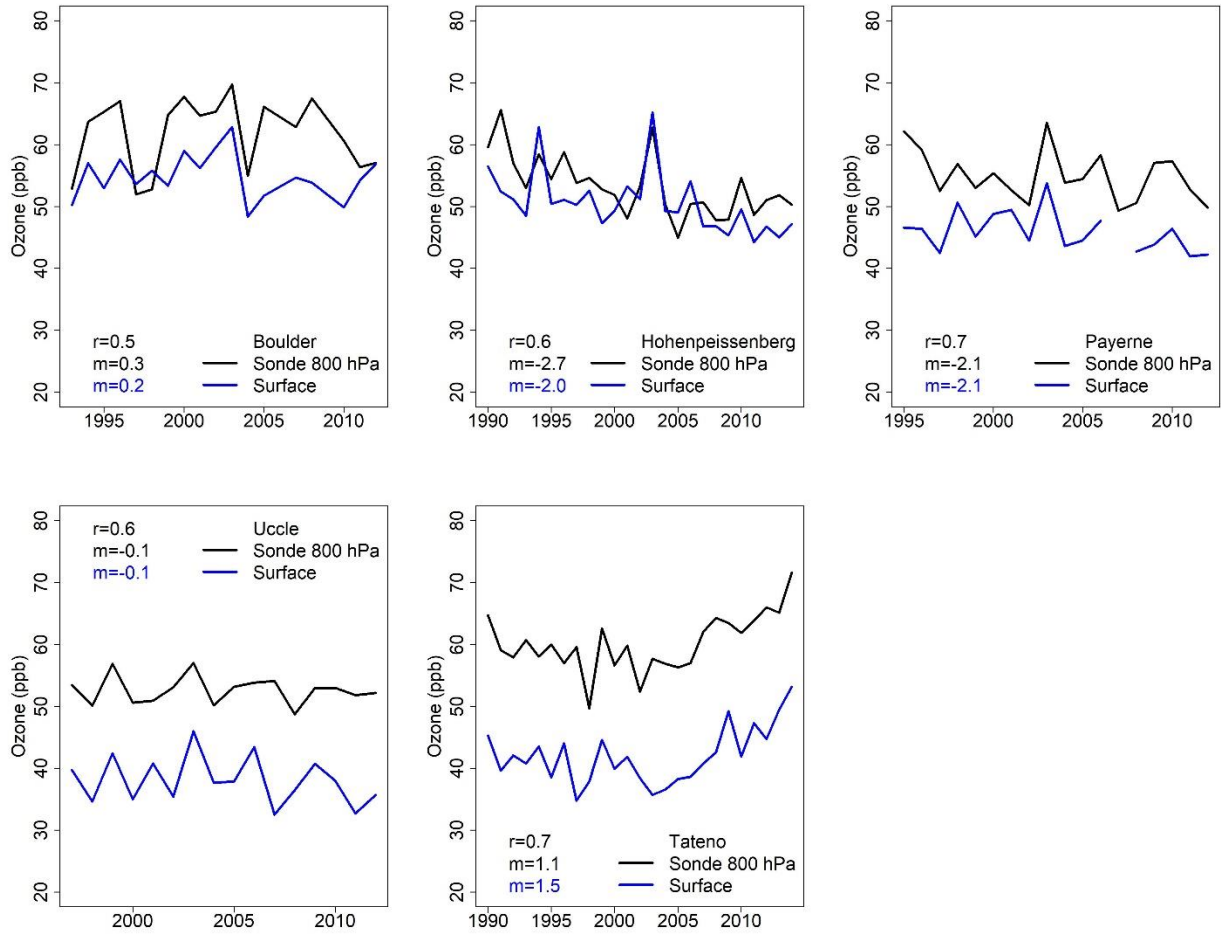


Figure S3. Trends in mean summertime ozone between the lowest sonde pressure (800 hPa, black line) and co-located surface sites (blue line). Correlations (r) and slopes (m) showing the trend over time are shown in each panel.

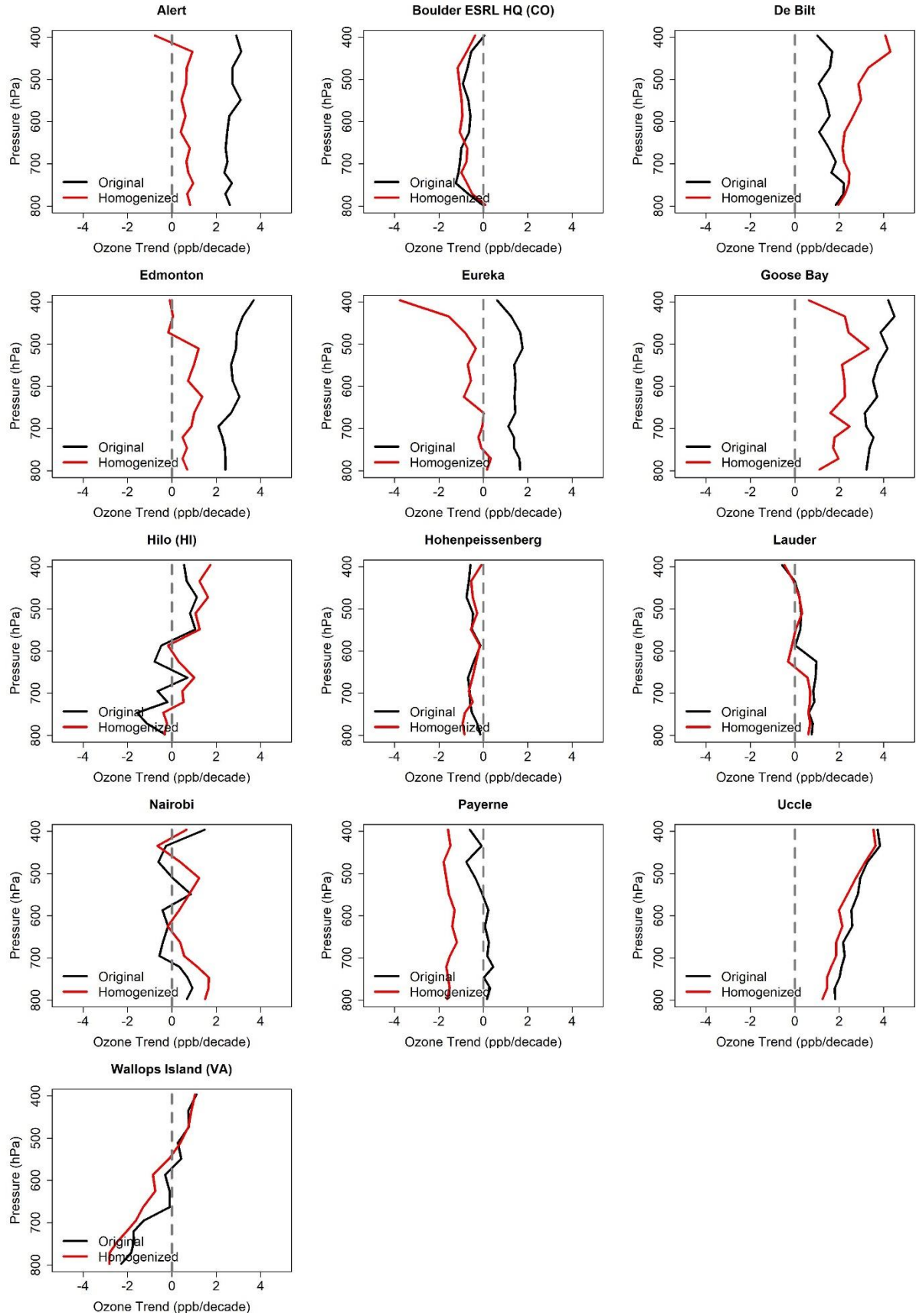


Figure S4. Differences in trends between homogenized (red) and non-homogenized (“Original”, black) data. The impact is to modify the magnitude of trends, but the sign of the trends stays the same at most locations.

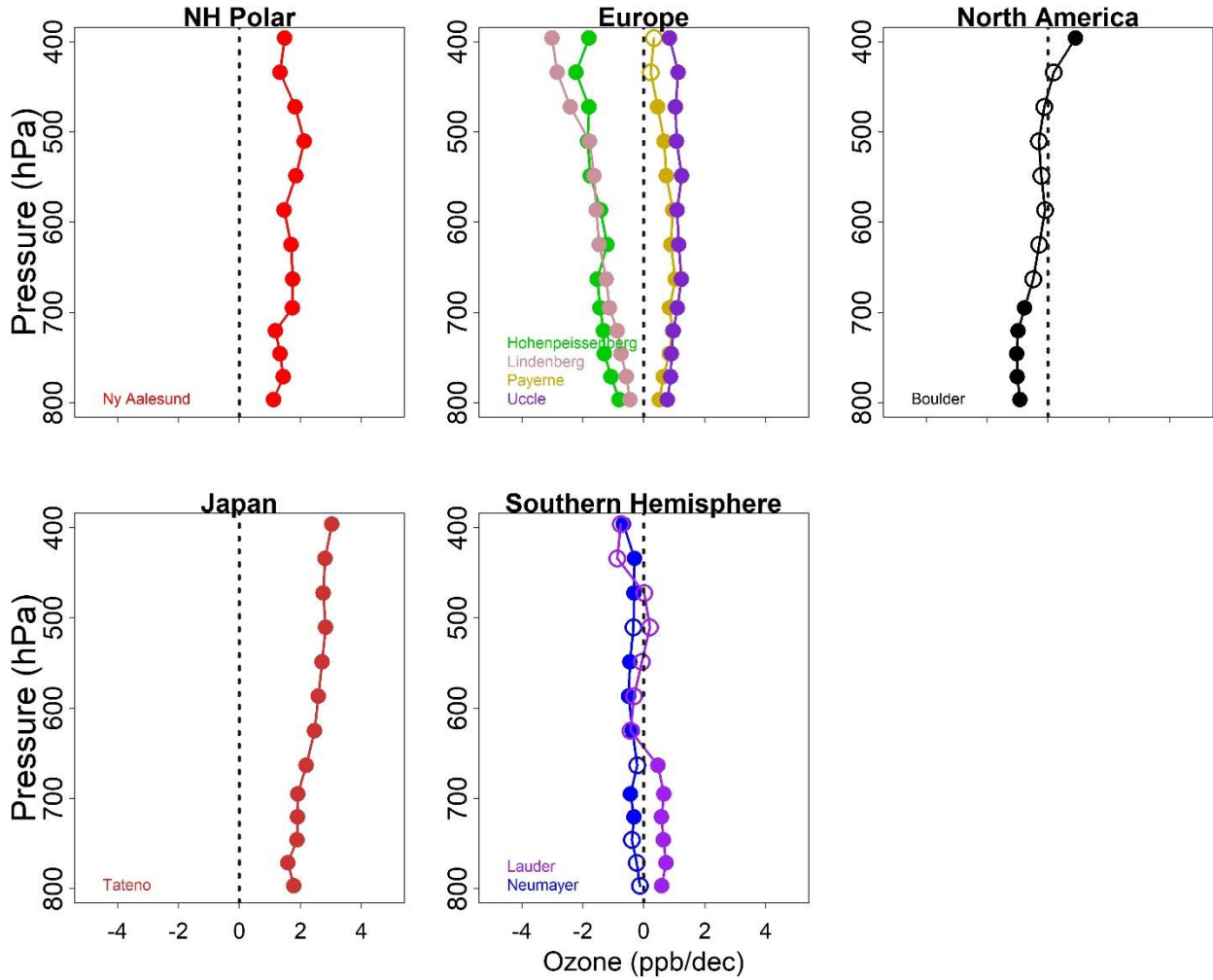


Figure S5. Trends (ppb decade^{-1}) throughout the vertical column (800-400 hPa) at the 9 global ozonesonde sites with data from 1980-2017, divided into five regions. Solid circles indicate that the trends are statistically significant ($p < 0.1$), while open circles are statistically insignificant.

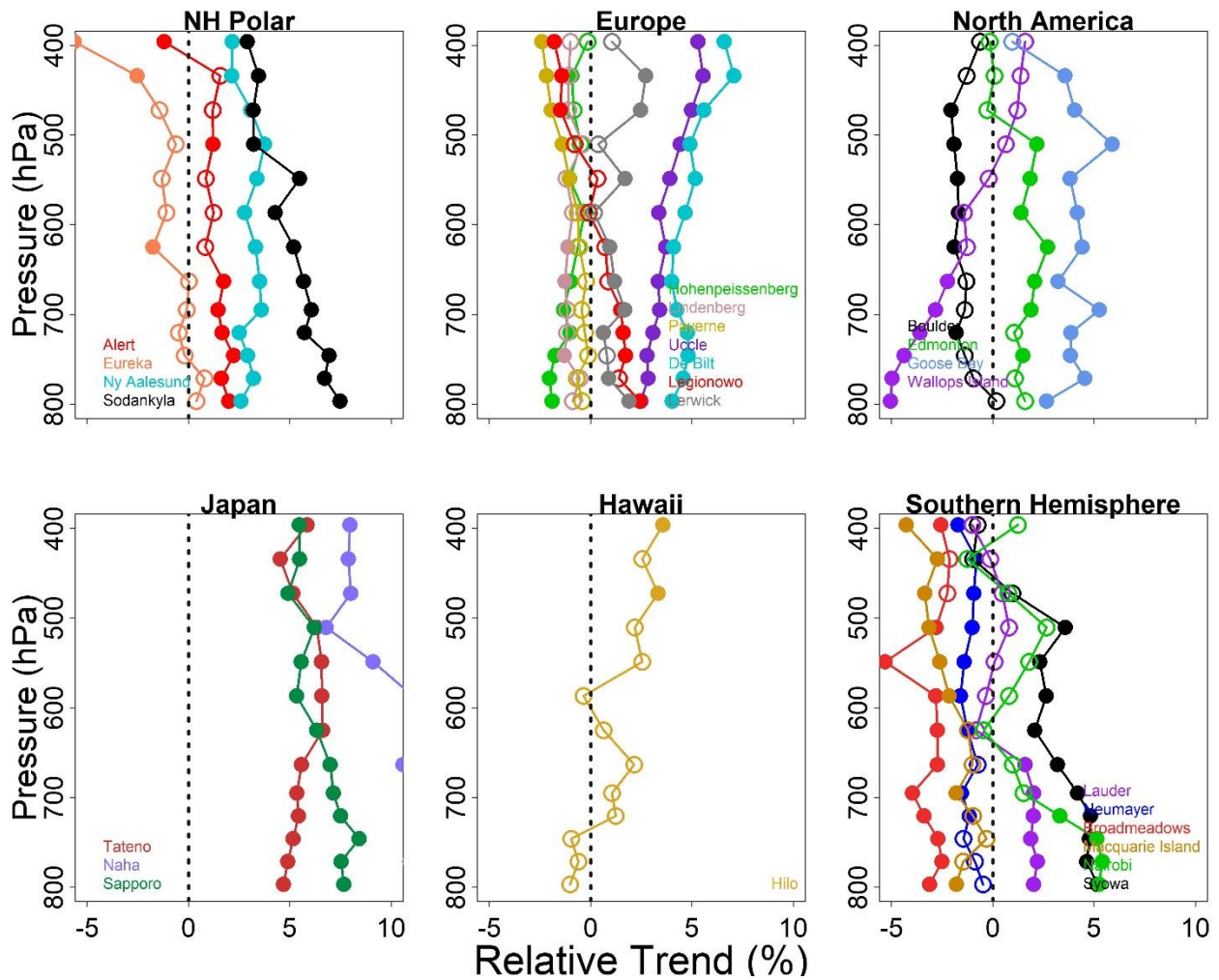


Figure S6. Relative trends ($\% \text{ decade}^{-1}$) throughout the vertical column (800-400 hPa) at the 25 global ozonesonde sites with data from 1990-2017, divided into six regions. Trends are calculated relative to the mean ozone concentration at each pressure level from 1990-2017. Solid circles indicate that the trends are statistically significant ($p < 0.1$), while open circles are statistically insignificant.

Global NO Emissions from Inventories

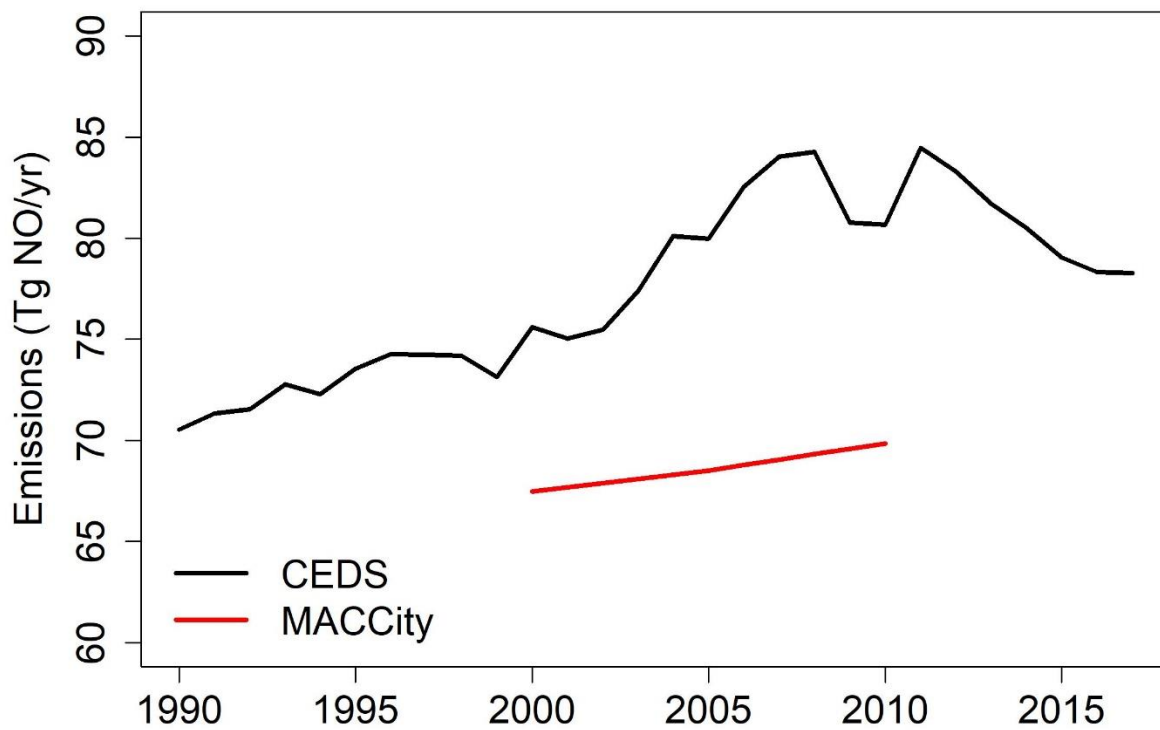


Figure S7. Trends and magnitudes (Tg NO yr⁻¹) of NO_x emissions in the CEDS (black) and MACCity (red) anthropogenic emissions inventories.

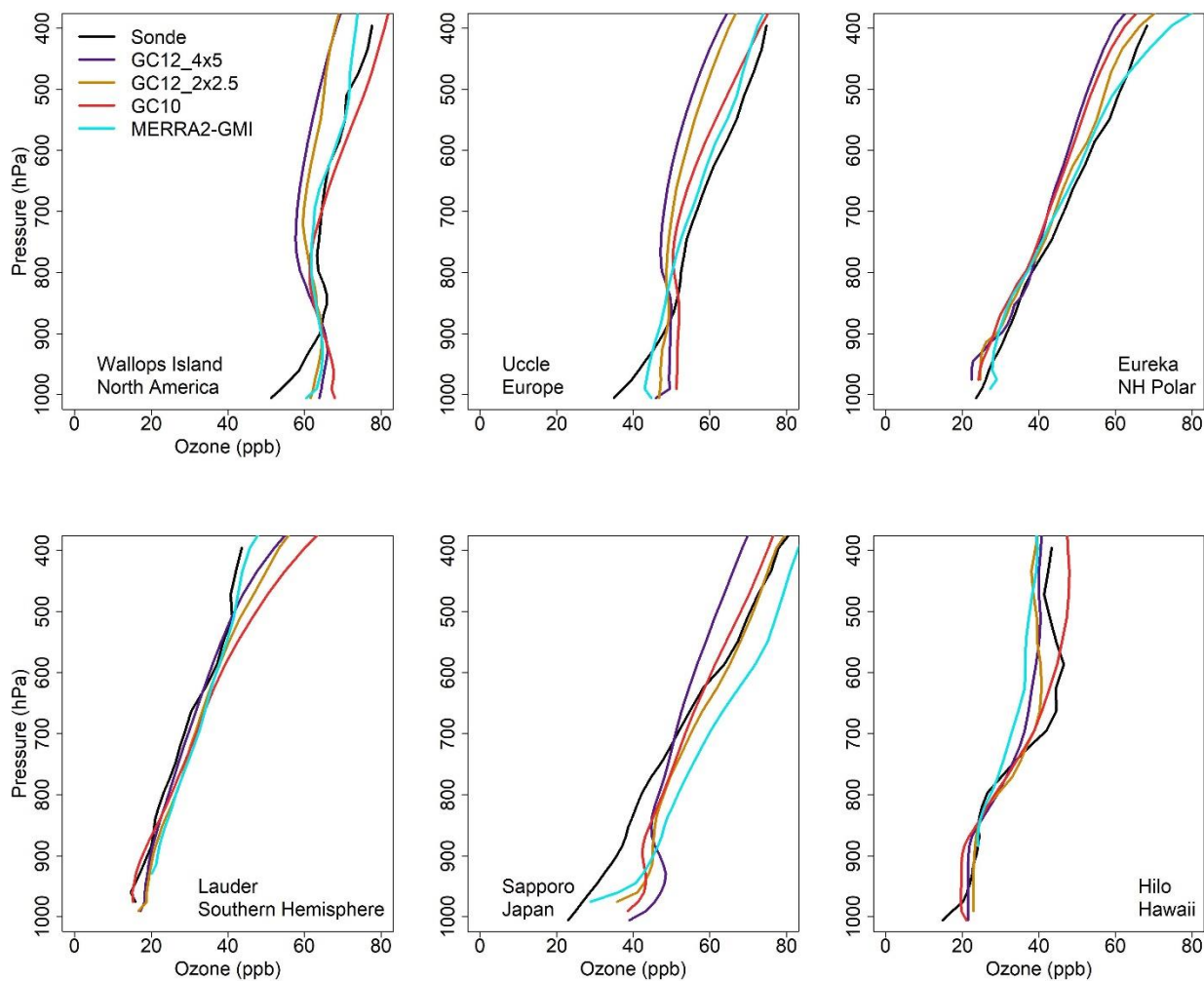


Figure S8. Vertical profiles of summertime ozone concentrations at ozonesonde launch locations around the globe averaged from 2000-2005. Sondes are shown in black, the earlier version of GEOS-Chem (v10-01) is shown in red, GC 4x5 is shown in purple, and GC 2x2.5 is shown in orange. GC 4x5 refers to the GEOS-Chem v12.9.3 simulations at the 4°x5° horizontal resolution and GC 2x2.5 is the same model at 2°x2.5°. Lauder, a Southern Hemisphere site, is shown during austral summer.

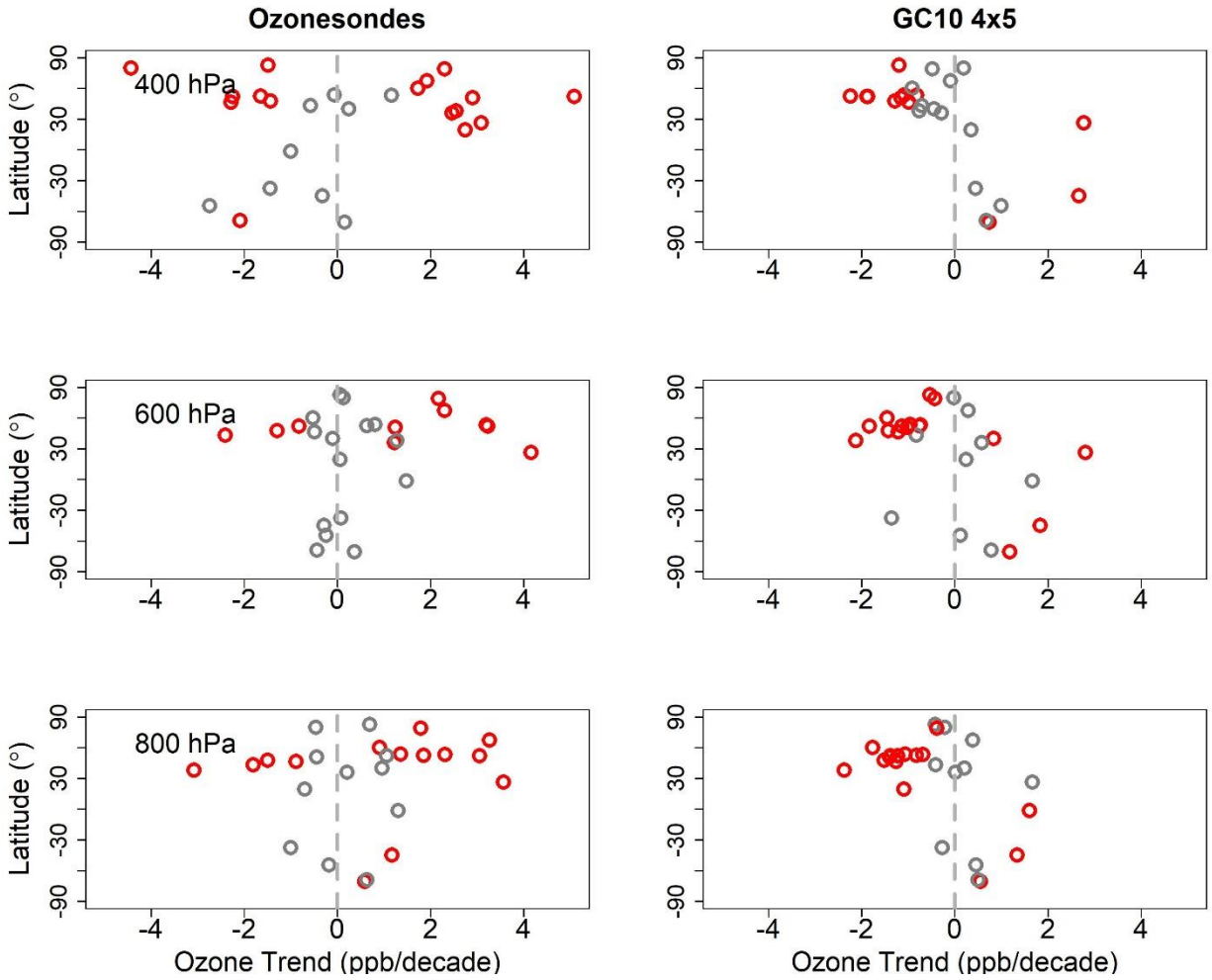


Figure S9. Summary of 1990-2010 trends in ozonesondes (left column) and the earlier version of GEOS-Chem (v10-01, right column). GC10 4x5 refers to the earlier simulation at 4°x5° horizontal resolution. The trend in ppb/decade is plotted as a function of ozonesonde launch site latitude. Red circles indicate significant trends ($p < 0.1$), and gray circles indicate insignificant trends.

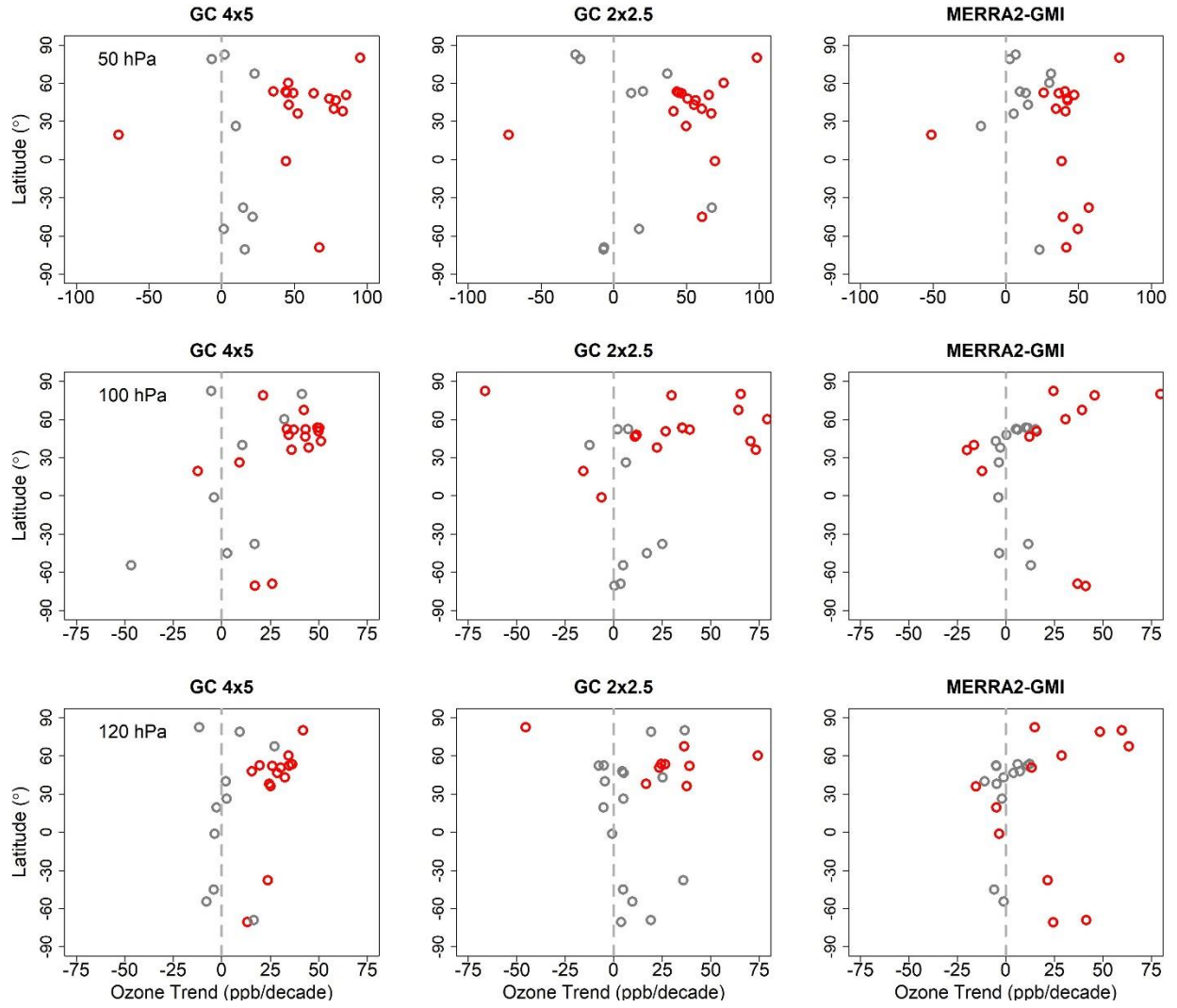


Figure S10. Stratospheric trends (ppb decade⁻¹) in GEOS-Chem and MERRA2-GMI. Trends are plotted as a function of ozonesonde launch latitude.