

Supplemental Information for “Recent developments within NOAA’s AirCore atmospheric sampling program and insights from its long-term observational record over Boulder, CO”.

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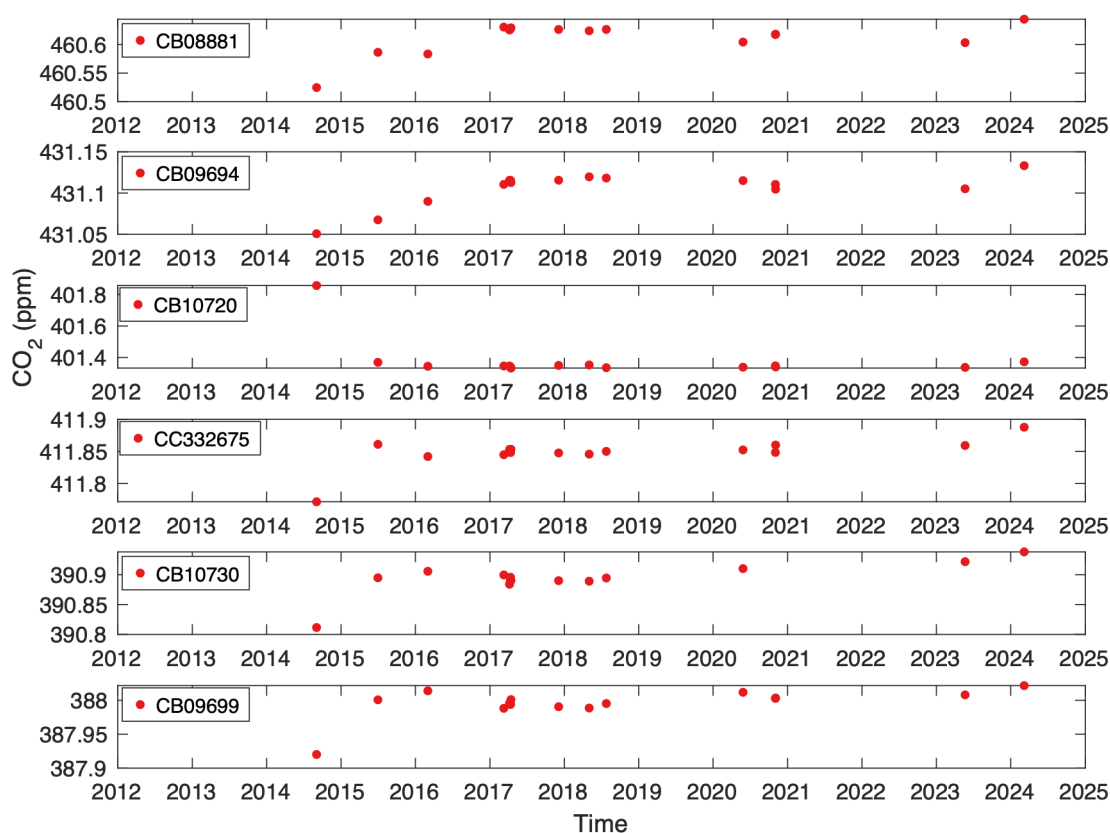


Figure S1. Time history of measurements of CO₂ from Picarro serial number CFKBDS2007 from six NOAA calibration standards on to the WMO CO₂ X2019 scale: CB08881, CB09694, CB10720, CC332675, CB10730 and CB09699. Each subplot shows the raw Picarro measurements of each standard during a calibration. Each point represents a separate calibration run on CFKBDS2007. Variability noted in the text is calculated as the 1 σ standard deviation of all measurements shown from 2014-2024 for CO₂ (N = 19 measurements).

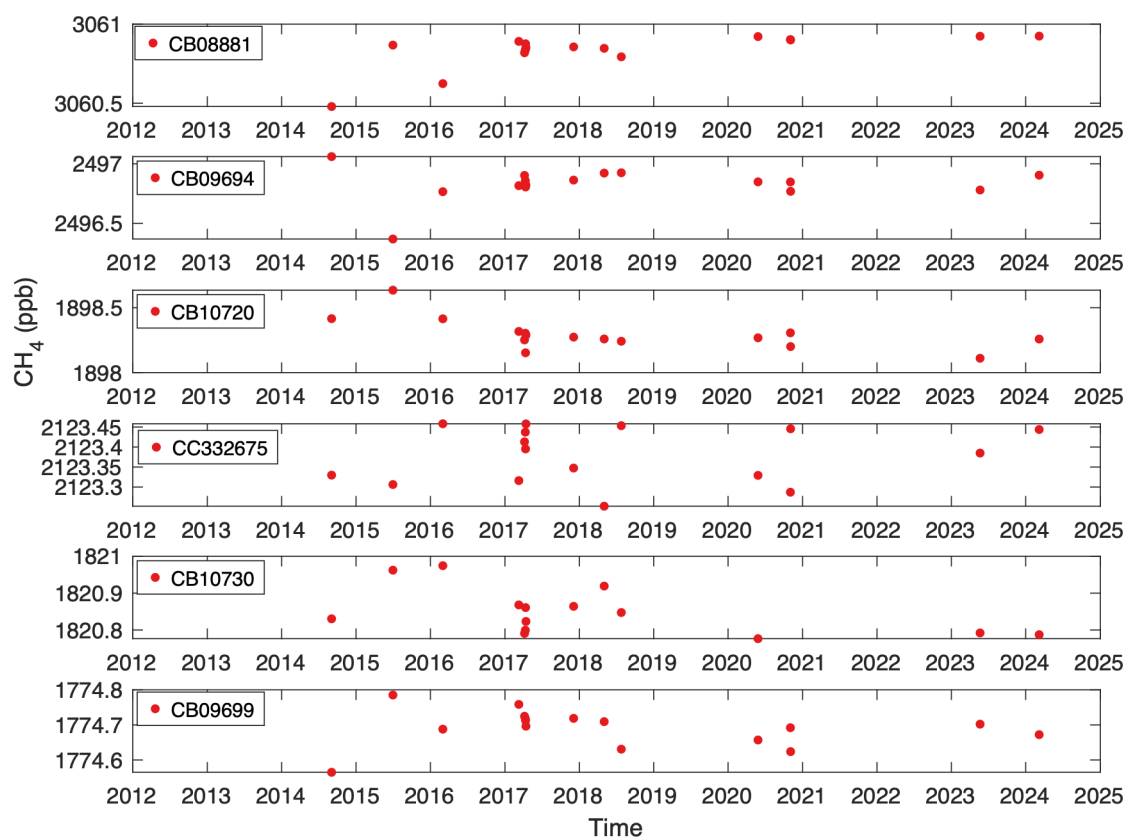


Figure S2. Same as Figure S1 but for CH_4 .

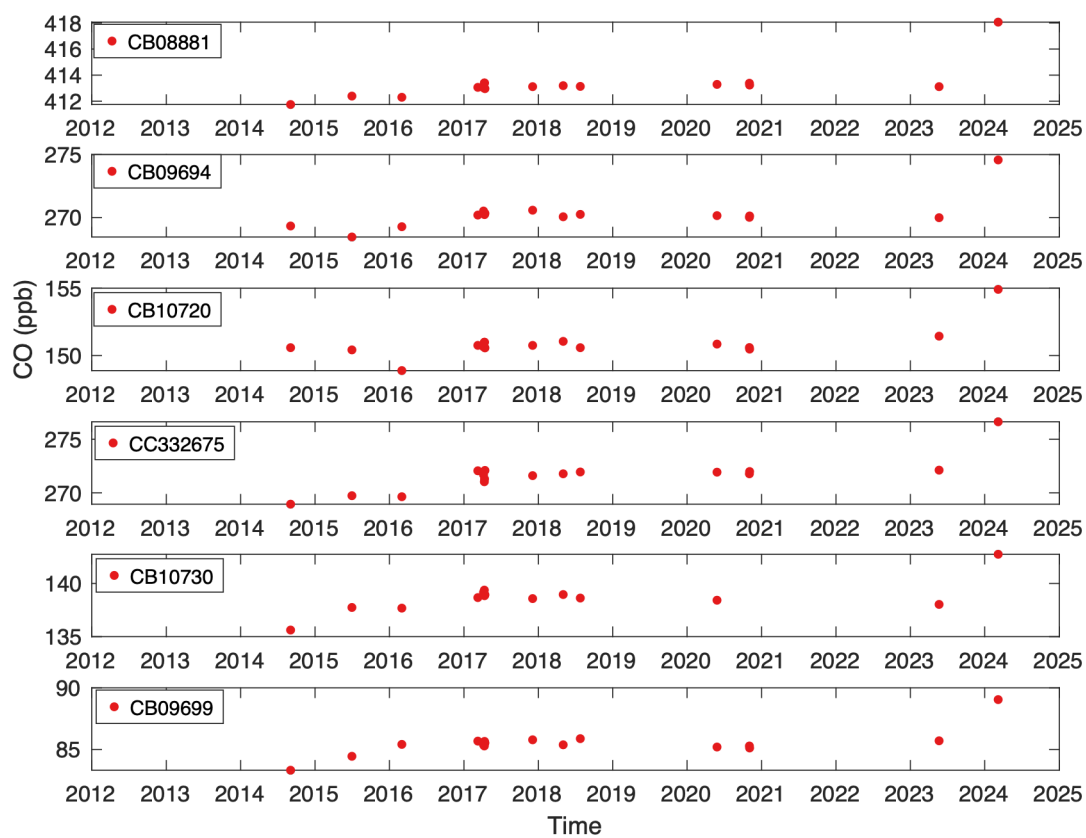


Figure S3. Same as Figure S1 but for CO.

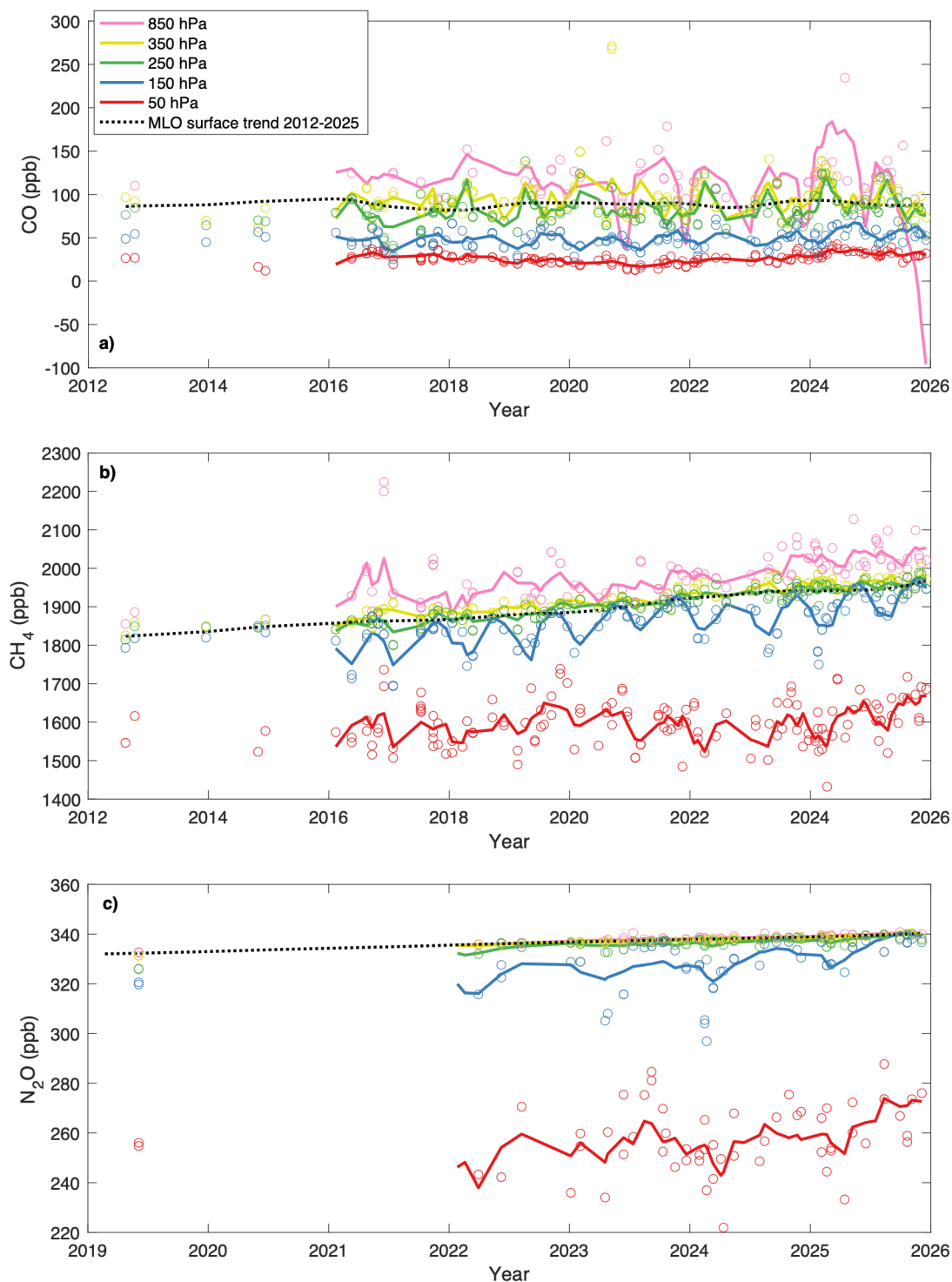


Figure S4. Time trend of measured CO (a), CH₄ (b) and N₂O (c) in NOAA AirCores launched from Boulder, CO from 2012 through 2025. AirCore data (individual points) are averaged in 100 hPa pressure bins, centered at the average of each bin and plotted for pressure levels at 850, 350, 250, 150, and 50 hPa levels. Smooth-curve fits of binned data in each pressure level are shown in corresponding solid lines. The trend in NOAA surface flask data from 2012 through 2025 at MLO is shown in the black dotted line. Note that, for N₂O, scale and calculated MLO trend ranges from 2019-2025.

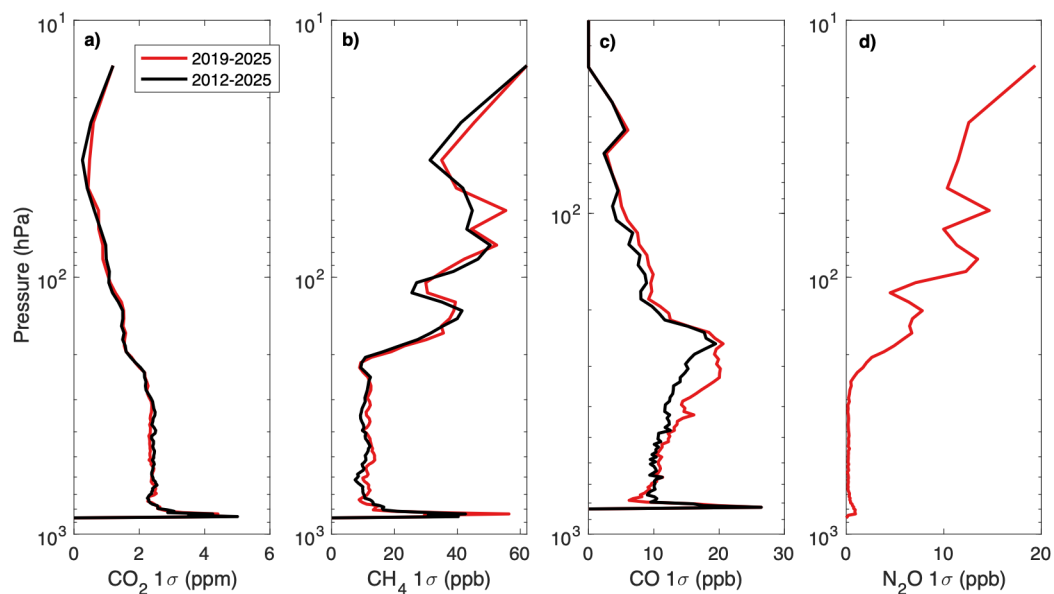


Figure S5. Standard deviation in annual detrended CO₂, CH₄, CO and N₂O median profiles from in the full Boulder, CO record (2012-2025) versus 2019-2025 (when N₂O profiles become available). Based on the available N₂O data record, N₂O variability in the full AirCore record (2012-2025) is not expected to be significantly different throughout the profiles, given the differences between variability seen in CO₂, CH₄, and CO for the full AirCore record vs. 2019 onwards.

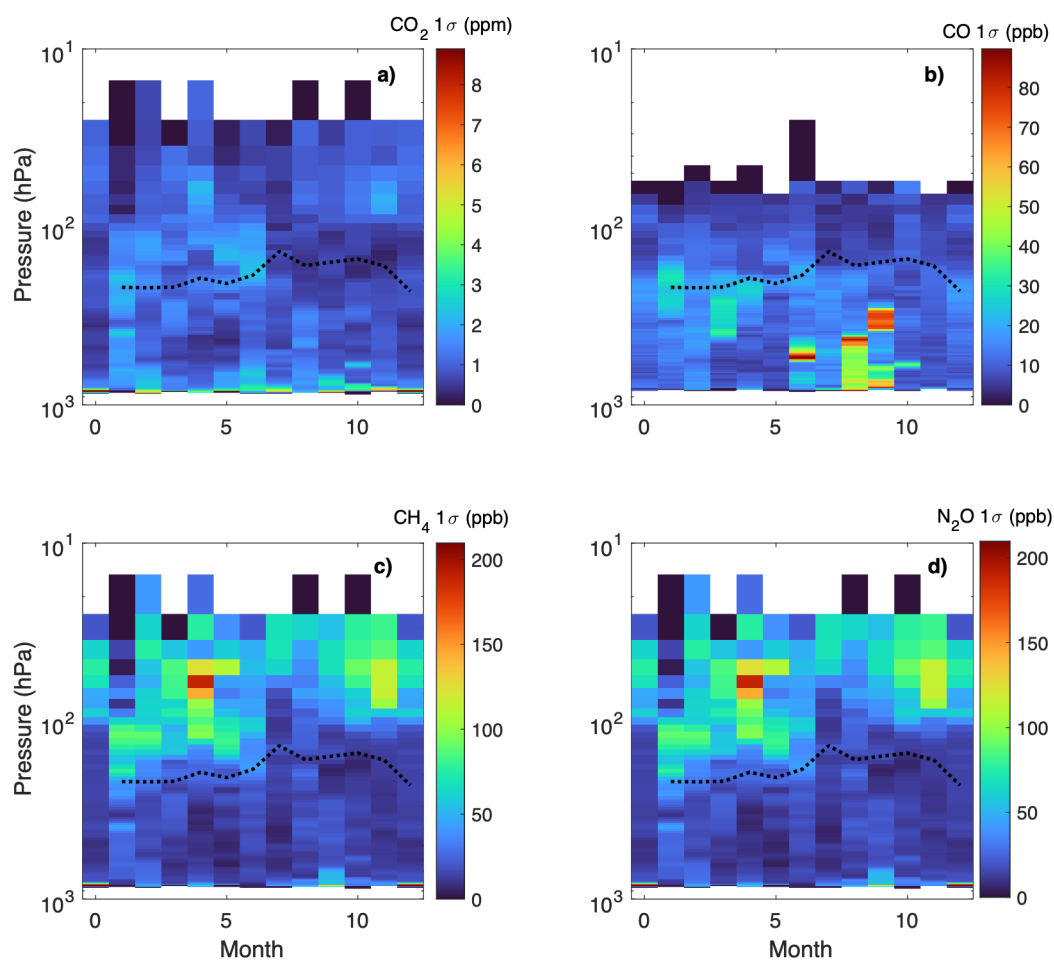


Figure S6. Standard deviations (1σ) of detrended monthly binned profiles from 2012-2025 for CO_2 (a), CO (b), CH_4 (c) and N_2O (d).

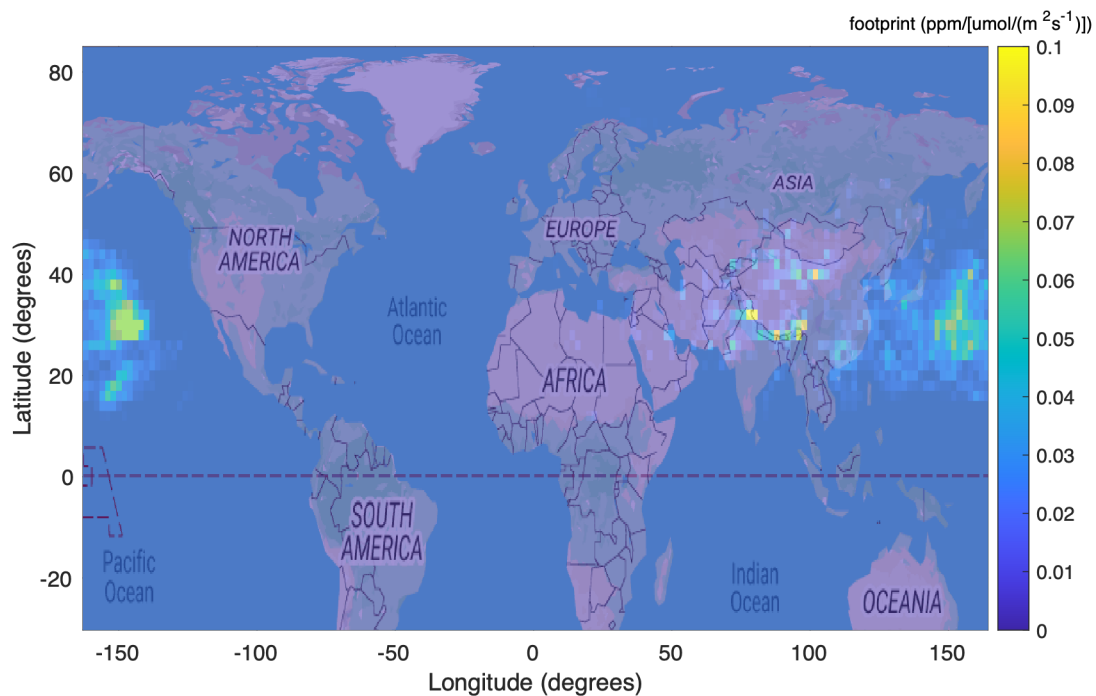


Figure S7. Cumulative footprint (surface sensitivity) calculated from NOAA HYSPLIT 10-day back trajectories initialized with 500 particles at 8500 m (~300-350 hPa) from northeastern Colorado for all springtime (March-May) AirCore balloon launches between 2012-2025. Trajectories were run using NCEP Global Data Assimilation System (GDAS) 1-degree meteorology.