765

Figure S1. AMICA CO profiles for individual flights against geometric altitude (left) and potential temperature (right).
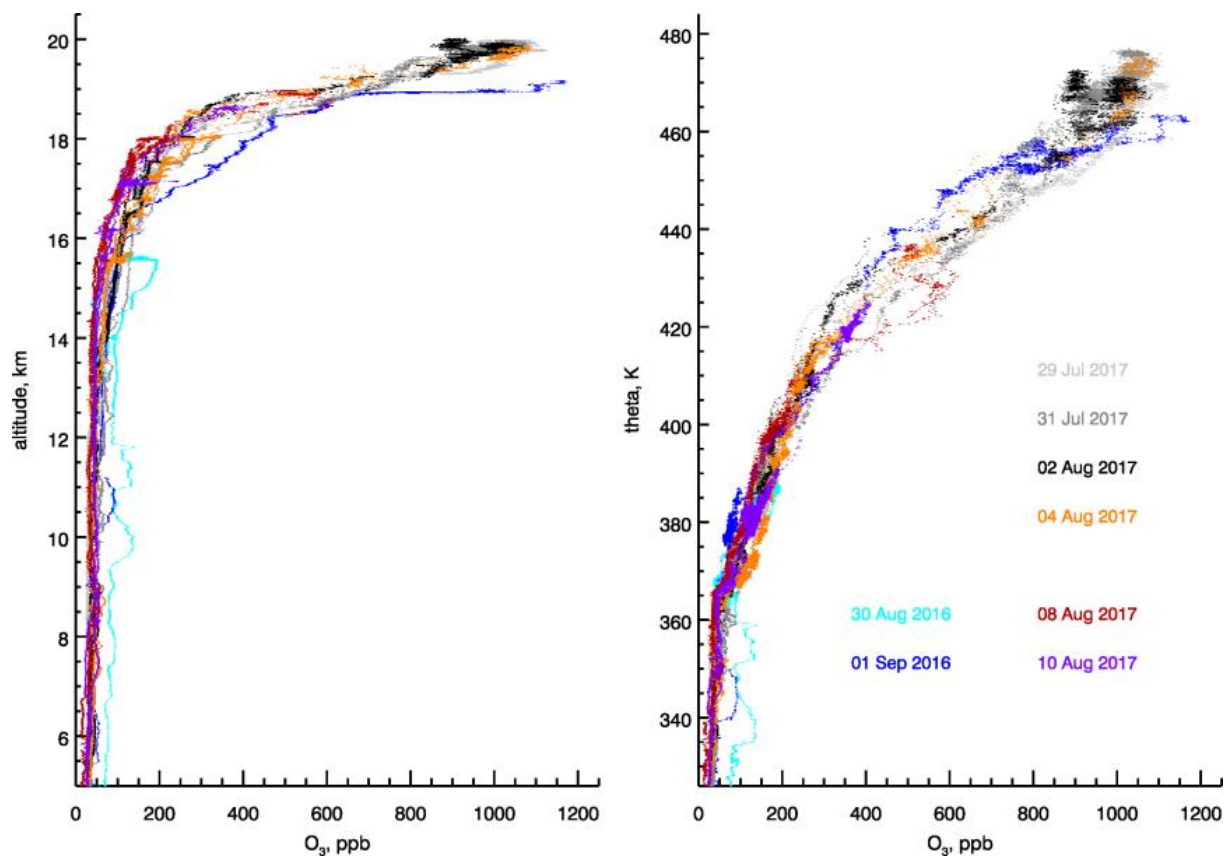
Figure S2. FOZAN O_3 profiles for individual flights against geometric altitude (left) and potential temperature (right).

770
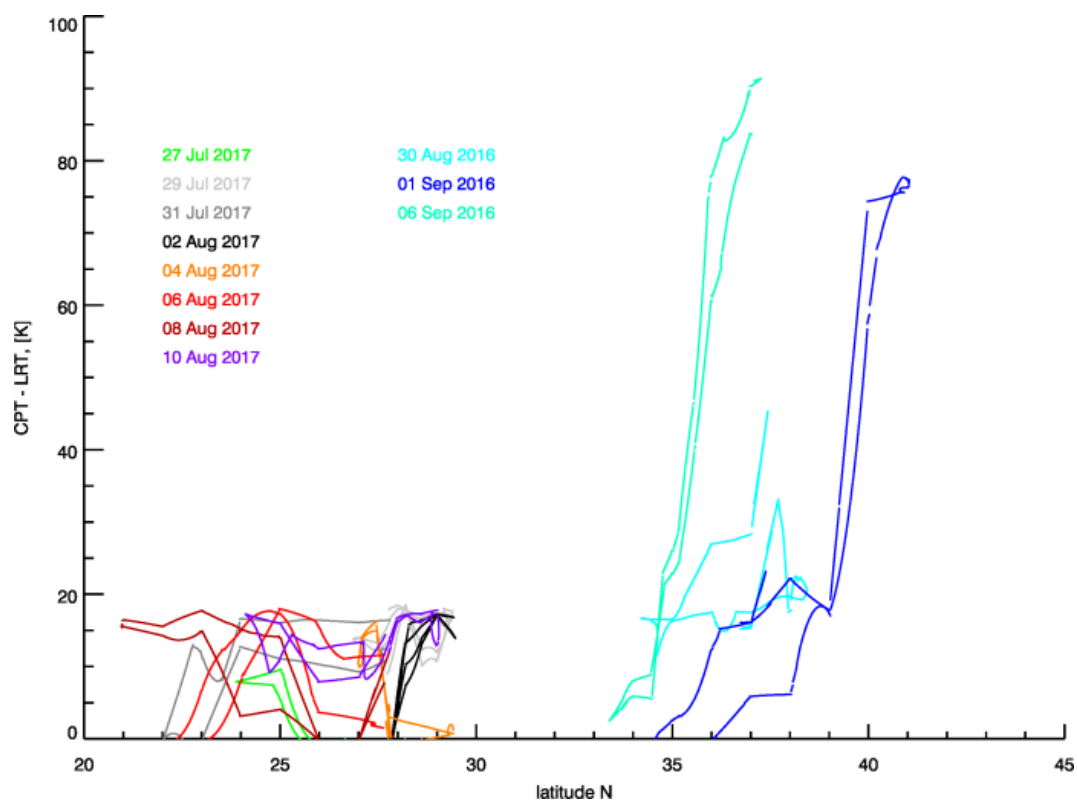
Figure S3. Difference in Δθ between CRT and LRT along (i.e. above or below) each flight path deduced from ERA-Interim reanalysis data as a function of latitude. The change to large differences with Δθ > 20 K over a small latitude range observed during the Kalamata flights denotes the transition from the tropical to the extratropical regime. Note that outside of the tropics, the cold point is not normally used as a representation of the tropopause.

775

34
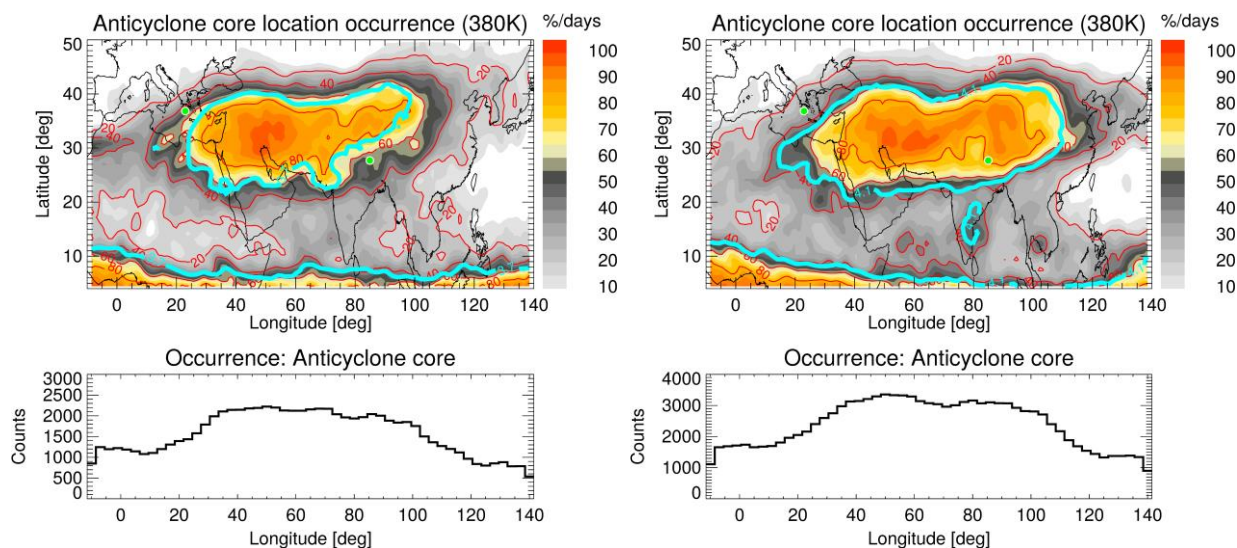
Figure S4. Occurrence frequency of the ASM anticyclone for the periods between 1 July and 31 August in 2016 (left) and 2017 (right) according to the PV-based criteria proposed by Ploeger et al. (2015). Red contours show selected percentage values (20, 40, 60, 80 %), the thick cyan contour shows the average PV value of the barrier in the average PV field over the periods considered (3.7 PVU in 2016 and 4.1 PVU in 2017). The StratoClim campaign bases Kalamata and Kathmandu are marked by the green dots. Bottom panels show the projections of anticyclone occurrence frequency onto the longitude axis (bin size 2.5∘). The figure is analogous to Figure 13a in Ploeger et al. (2015).
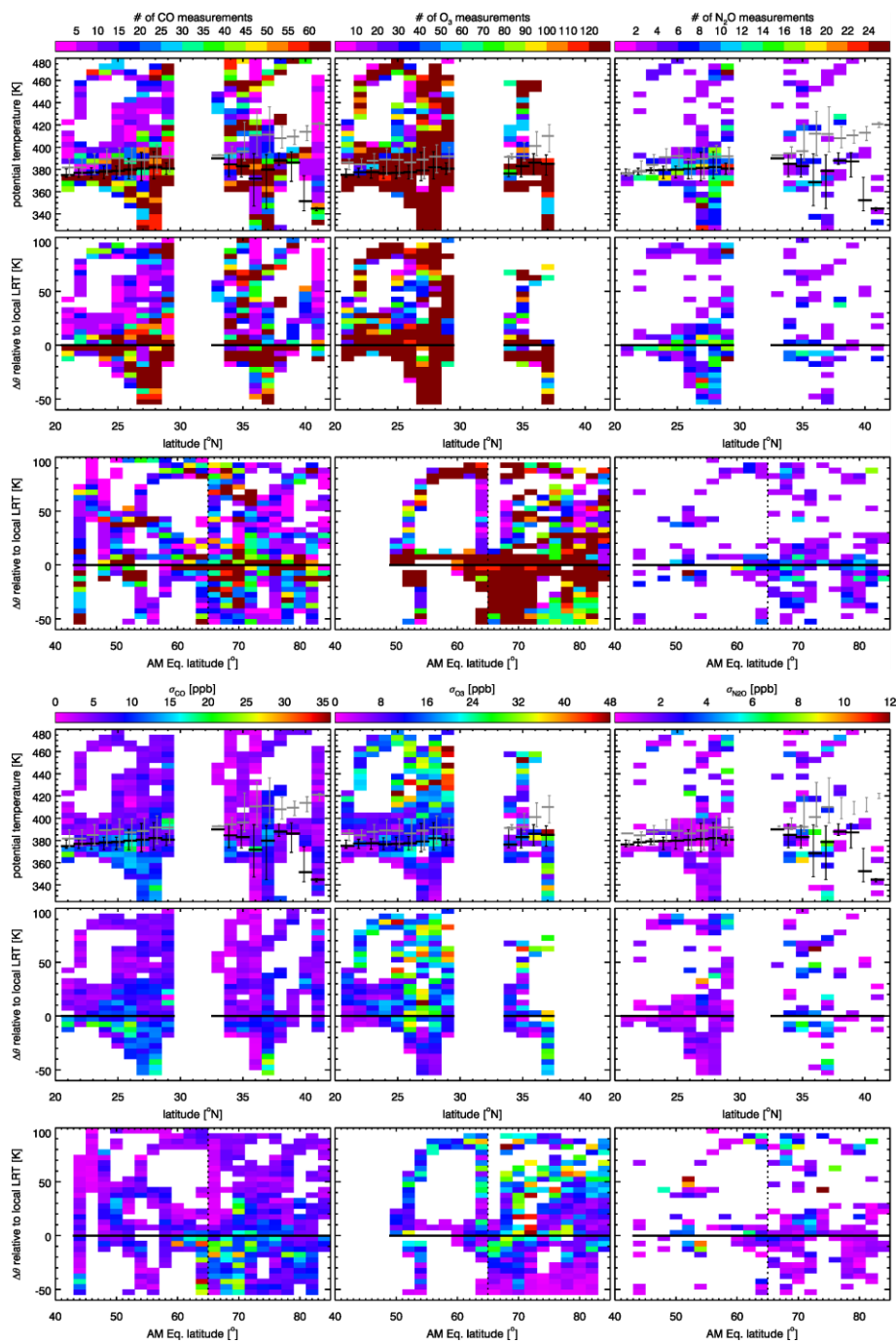
Figure S5 Number of observations (top 6 panels) and standard deviations (bottom 6 panels) on different coordinates for each bin corresponding to the averaged CO, O_3 and N_2O mixing ratios shown in Figure 3.

795
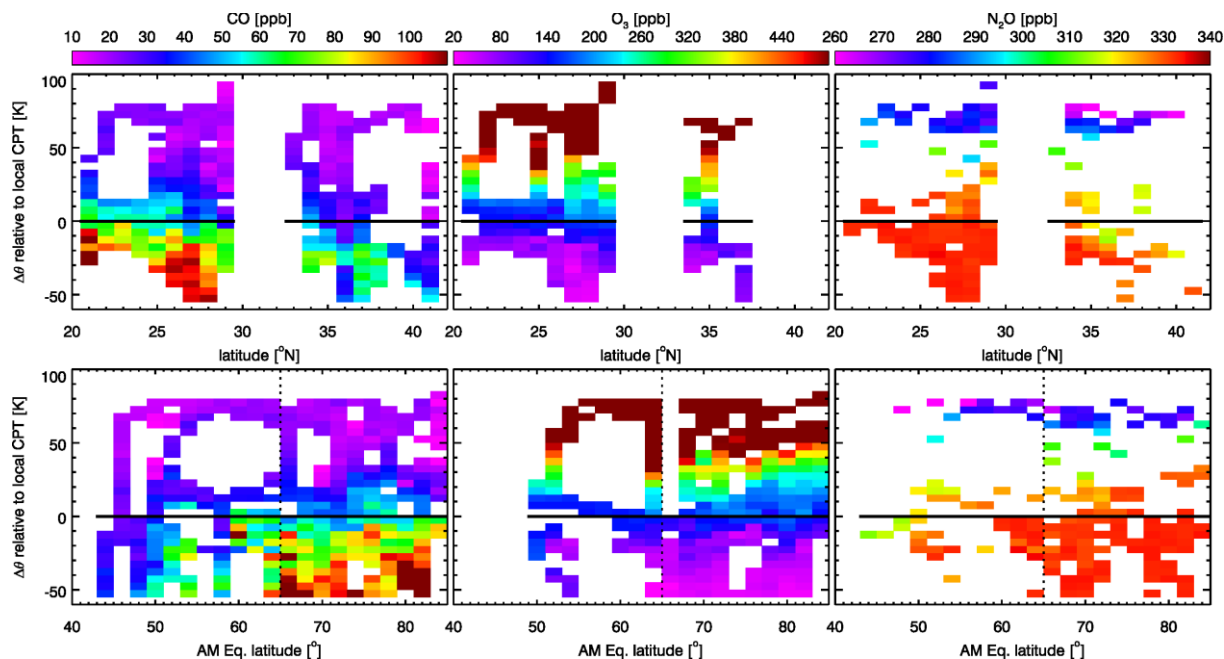
Figure S6. Analogous to Figure 3, middle and bottom row, but with the vertical coordinate designated as potential temperature differences relative to the CPT rather than the LRT.

800
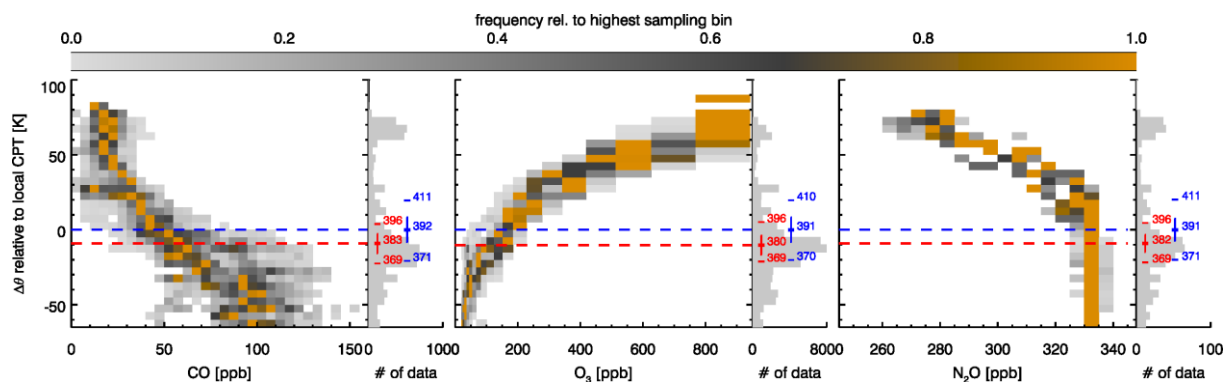
Figure S7. Analogous to Figure 3, bottom row, but with the vertical coordinate designated as potential temperature differences relative to the CPT rather than the LRT.

805

37
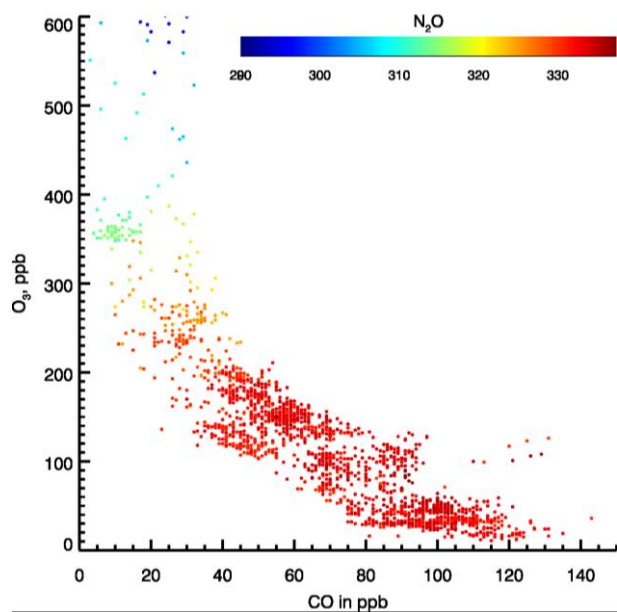
Figure S8 O_3 vs CO relationship in tracer-tracer space for Kathmandu 2017 observations coloured according to quasi-simultaneous N_2O observations: points are only displayed if the time of measurement is within 30 seconds of a HAGAR N_2O measurement, and if the difference in theta at the times of CO/O_3 and N_2O measurements is less than 2.5 K.

810