Figures for ARCTAS paper

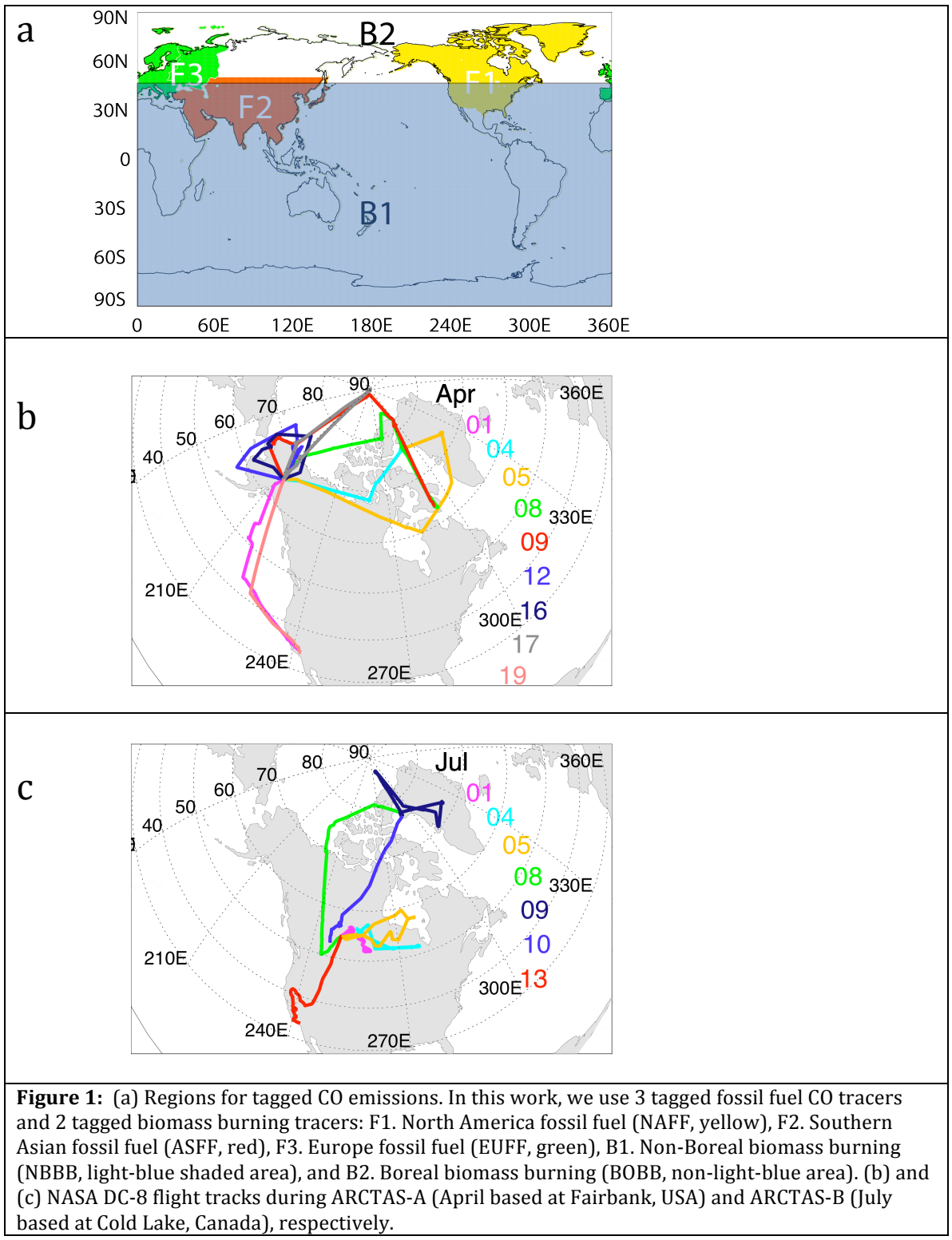

Figure 1: (a) Regions for tagged CO emissions. In this work, we use 3 tagged fossil fuel CO tracers and 2 tagged biomass burning tracers: F1. North America fossil fuel (NAFF, yellow), F2. Southern Asian fossil fuel (ASFF, red), F3. Europe fossil fuel (EUFF, green), B1. Non-Boreal biomass burning (NBBB, light-blue shaded area), and B2. Boreal biomass burning (BOBB, non-light-blue area). (b) and (c) NASA DC-8 flight tracks during ARCTAS-A (April based at Fairbank, USA) and ARCTAS-B (July based at Cold Lake, Canada), respectively.

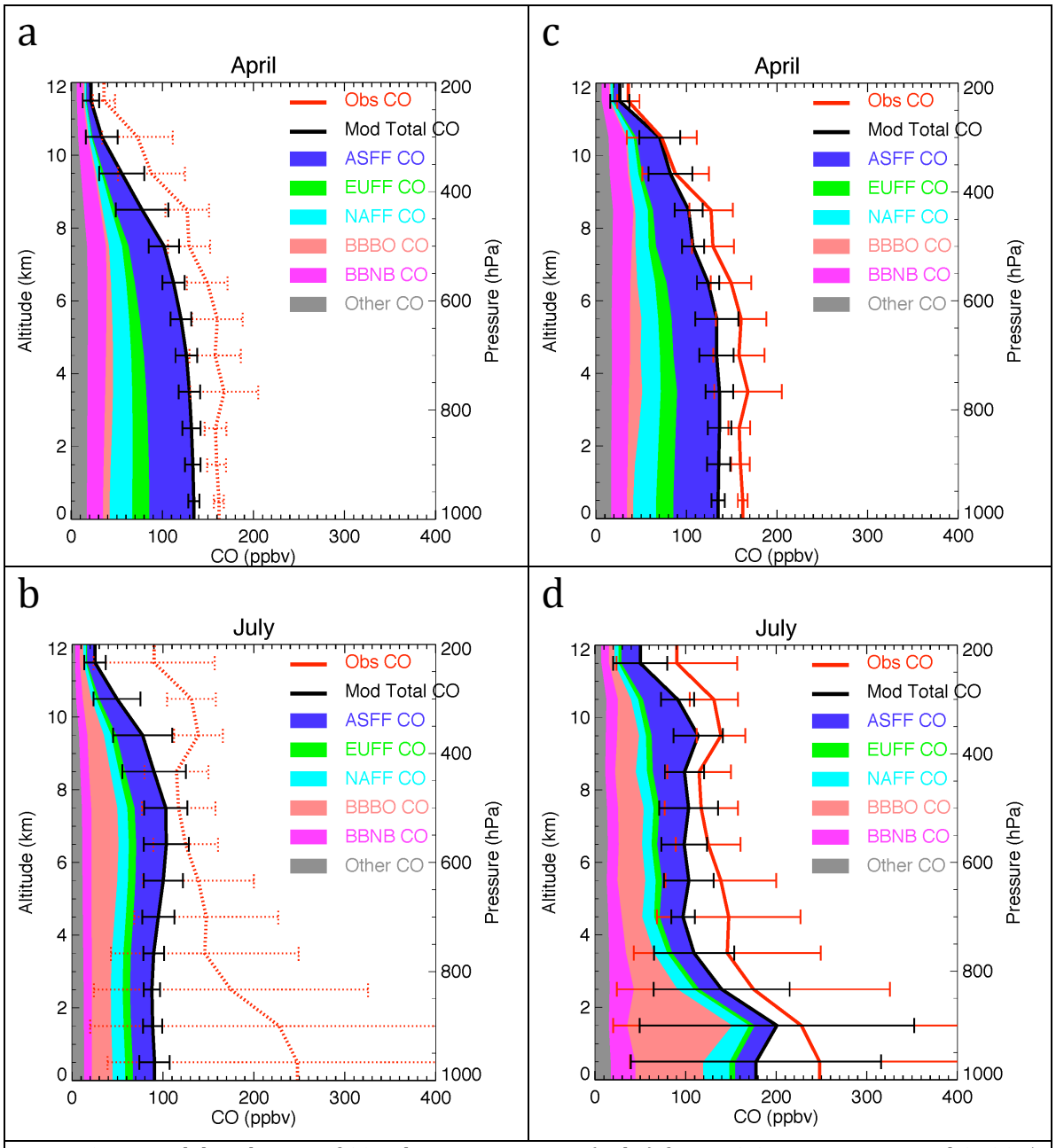

Figure 2. Vertical distribution of CO volume mixing ratio (ppbv) from DC-8 measurement and GEOS-5 simulation when the GEOS-5 model is the Arctic regional mean over 50N-90N and 40W-170W for April (2a) and July (2b). The DC-8 CO along flight tracks is shown by the dotted thick red line with standard deviation shown by horizontal bars. GEOS-5 CO is shown by the thick black line for total and by the color shaded areas for the corresponding tag components. The 'Other CO' refers to the global CO other than the five tagged COs defined in Figure 1a. Figures 2c-d are similar as 2a-b but the GEOS-5 results were sampled by all flights during April ARCTAS-A (c) and July ARCTAS-B (d) campaigns.

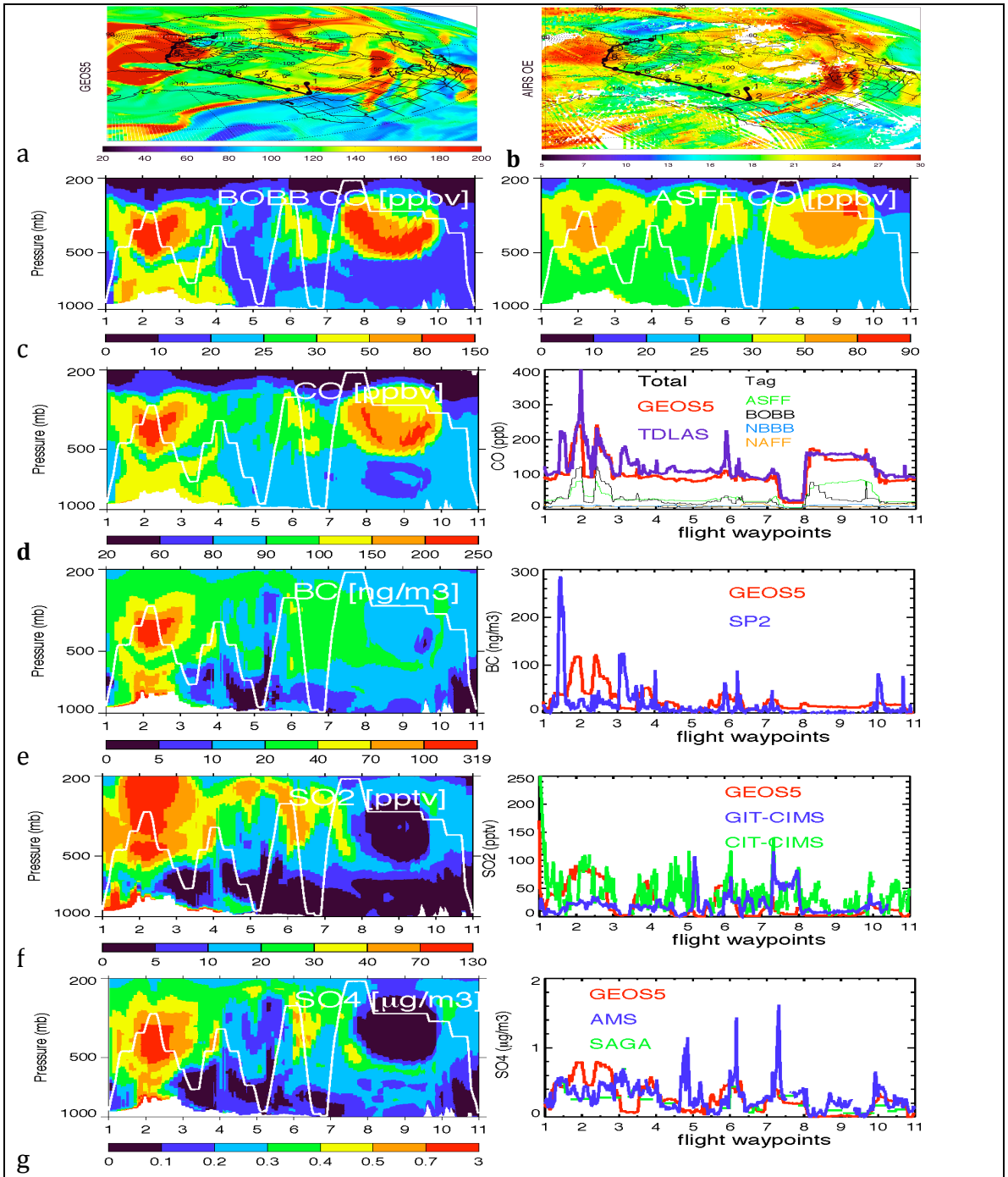

Figure 3: The modeled and measured CO and aerosols during the ARCTAS flight 21 on July 8 from Cold Lake, Canada, terminating in Thule, Greenland. The CO mixing ratio distribution at 400 hPa from GEOS-5 is shown in (a) and the column CO amount (x10^{17} molecules/cm^2) from AIRS is in (b). The solid line with dots and numbers shows the actual flight track of DC8. (c) is the curtain plots for tagged CO to BOBB (left) and ASFF (right), with the white line representing the flight track. (d) left shows total CO curtain plot along the flight track and right shows measured and modeled total CO (thick lines) as well as modeled tagged CO (thin lines), during the flight 21. (e)-(g) are similar to (d) but for BC, SO_2, and SO_4, respectively

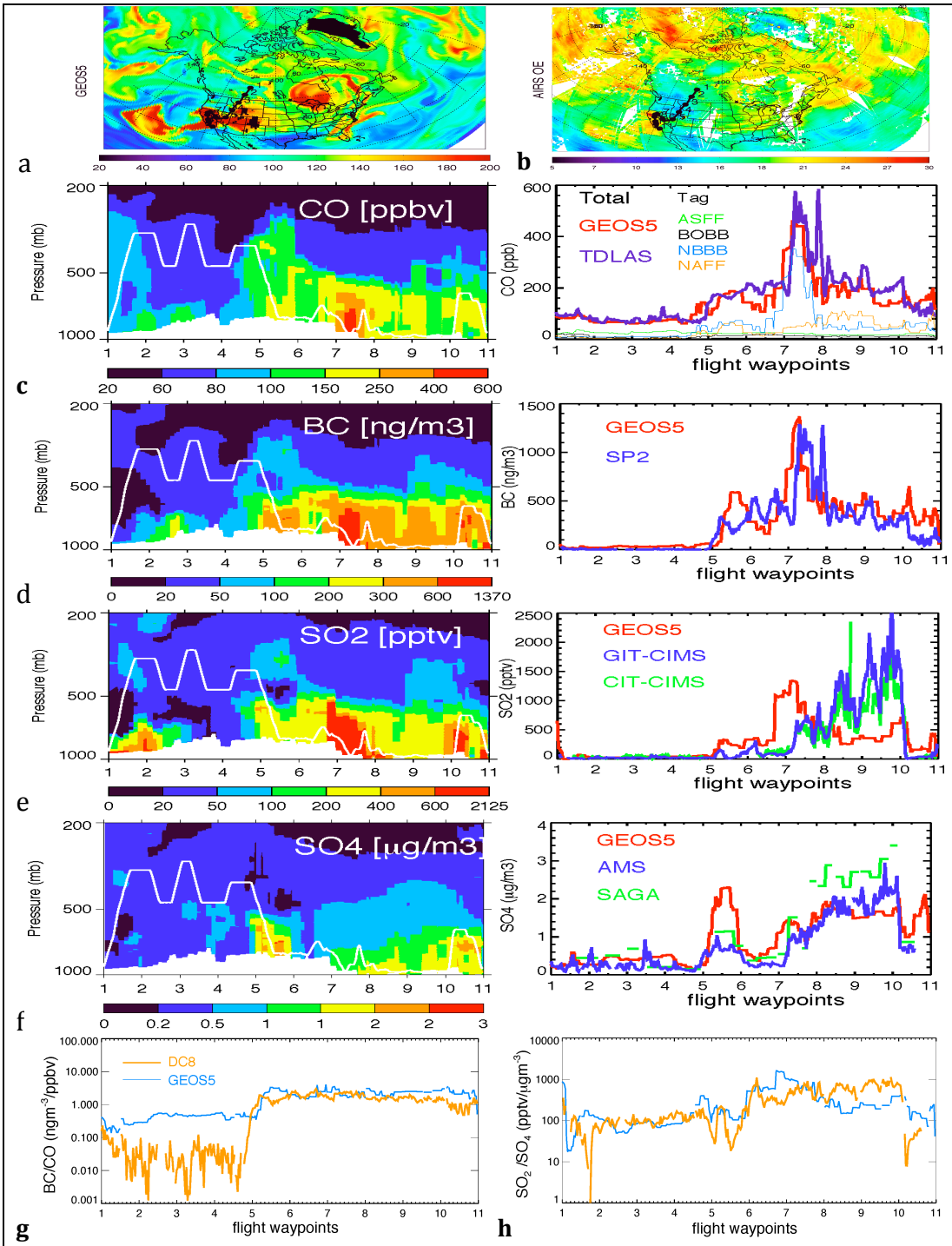

Figure 4: The modeled and measured CO and aerosols during the ARCTAS flight 24 on July 13 from Cold Lake, Canada returning to Palmdale, Califonia, USA. The CO mixing ratio distribution over 700 hPa from GEOS-5 is shown in (a) and the column CO ($x10^{17}$ molecules/cm^2) from AIRS is shown in (b). The solid line with dots and numbers shows the actual flight track of DC8. (c) left shows CO curtain plot along the flight track with the white line representing the flight track and right shows measured and modeled CO (thick lines) as well as modeled tagged CO (thin lines), during the flight. (d)-(f) are similar to (c) but for BC, SO2, and SO4, respectively. The last panel shows the ratio of BC to CO (g) and SO_2 to SO_4 (h) along the flight track with yellow line from DC-8 measurements and blue line from GEOS-5 simulation.

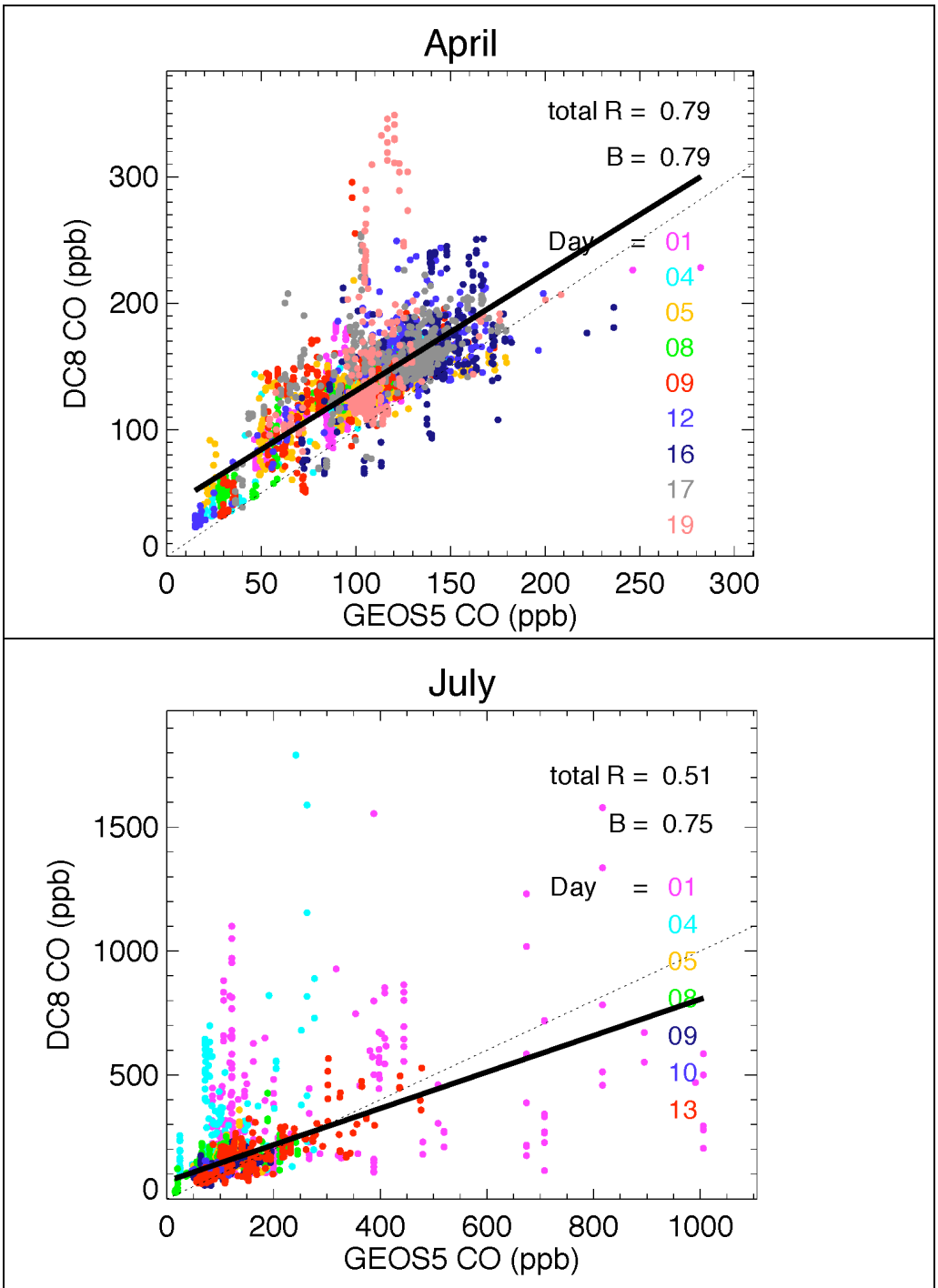

Figure 5. Scatter plot of CO volume mixing ratio (ppb) from the DC-8 aircraft measurements and the GEOS-5 simulation for April and July, with colored dots for different flights. The thick solid line is the linear regression line and the thin dotted line is 1:1 line. The data correlation coefficient (R) and the ratio (B) of average model and measurement are calculated for each campaign.

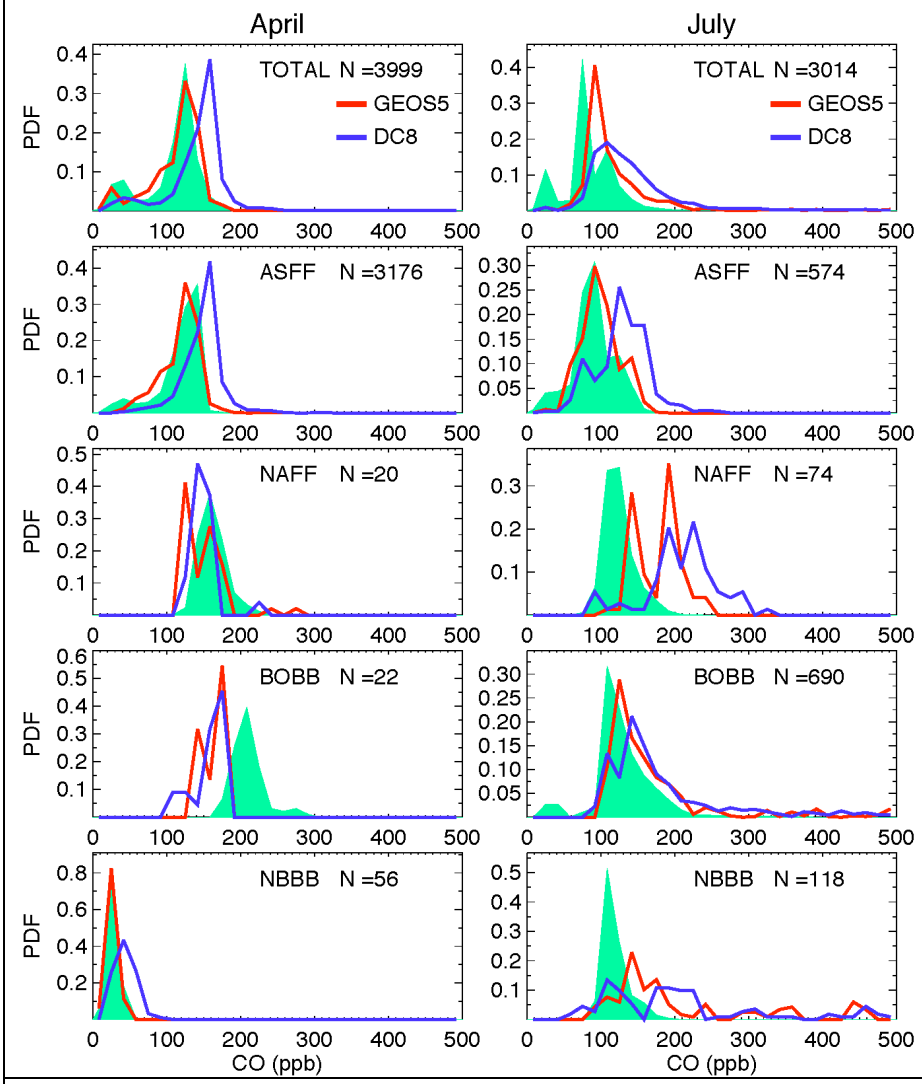

Figure 6: The probability distribution function (PDF) of total CO over two ARCTAS campaign periods and over the 4 tagged CO categories. The latter is determined by the modeled dominant tag CO (i.e. one of 5 tagged CO explained in Figure 1a) in air pollution in every 1-minute measurement period along the flight track. Please note EUFF is not shown since CO from Europe anthropogenic emission always contributed as background CO to the pollution measured during the ARCTAS campaign. The blue and red lines are the PDFs of DC-8 and GEOS-5 sampled along flight tracks and green areas are the PDFs of GEOS-5 CO over the Arctic region 50N-90N and 40W-170W and up to 200 hPa. N is number of 1-minute data point.