Table S1: Tagged tracer contributions (ppbv) to CO from GEOS-5 averaged over each ATom-1 Flight. The columns represent total CO (totCO), other BB (bbot), N. American BB (bbna), S. American BB (bbsa), African bb (bbaf), Eurasian BB (bbea), other non-BB (nbot), Asian non-BB (nbas), N. American non-BB (nbna), and European non-BB (nbeu).

flight	totCO	bbot	bbna	bbsa	bbaf	bbea	nbot	nbas	nbna	nbeu
0	77.3	0.910	2.50	1.08	4.66	0.722	42.7	8.38	14.6	1.79
1	87.7	1.79	1.74	0.506	1.29	8.61	23.7	29.1	11.4	9.54
2	81.1	1.89	0.712	0.504	1.49	4.29	29.9	31.4	5.76	5.12
3	63.1	1.34	0.368	1.20	4.45	0.644	41.5	9.43	2.66	1.42
4	57.0	1.52	0.162	2.04	4.88	0.189	40.4	5.79	1.12	0.768
5	54.2	1.59	0.134	2.15	4.18	0.112	40.7	3.86	0.864	0.594
6	71.0	1.54	0.199	4.24	12.0	0.284	43.8	6.33	1.47	1.11
7	103	1.18	1.12	1.21	21.8	2.28	45.7	13.2	12.3	4.12
8	86.6	1.34	2.68	0.397	1.46	7.19	24.0	21.9	19.1	8.63
9	91.2	1.37	2.85	0.367	1.21	5.80	23.7	25.4	23.0	7.64
10	107	1.14	18.6	0.678	2.44	2.09	31.7	21.7	25.7	3.34

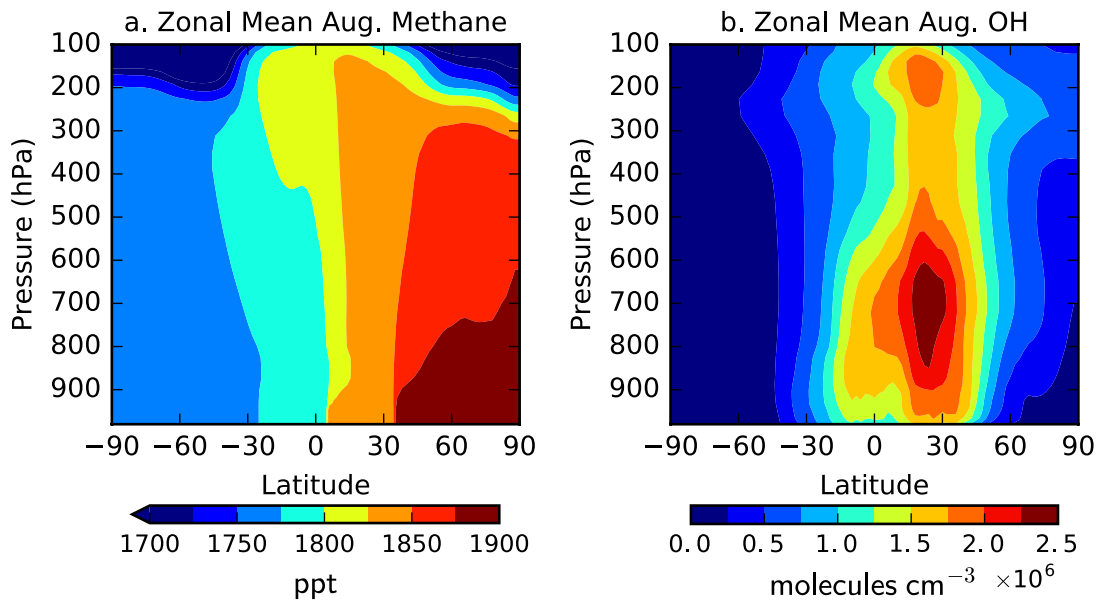
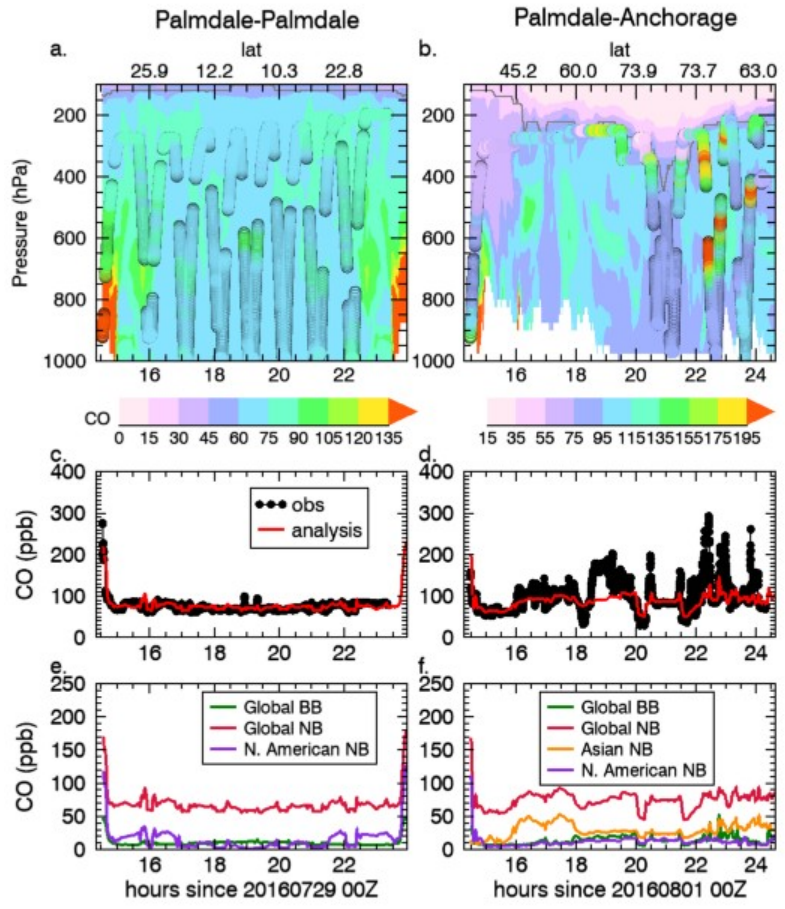



Fig. S1: The August zonal mean (a) methane concentrations and (b) OH concentrations used in the GEOS-5 FP CO simulation.

11
12 **Fig. S2: Curtain plot of CO (ppb) from the GEOS-5 analysis as a function of time and pressure overplotted with**
13 **QCLS CO observations (top row) for the a) Palmdale to Palmdale flight and b) Palmdale to Anchorage flight.**
14 **The top x-axis indicates the latitudes of the flight track. c-d) The GEOS-5 CO interpolated to the flight track**
15 **(red line) is compared to the observations (black circles). e-f) Tagged tracer contributions to the GEOS-5 CO.**

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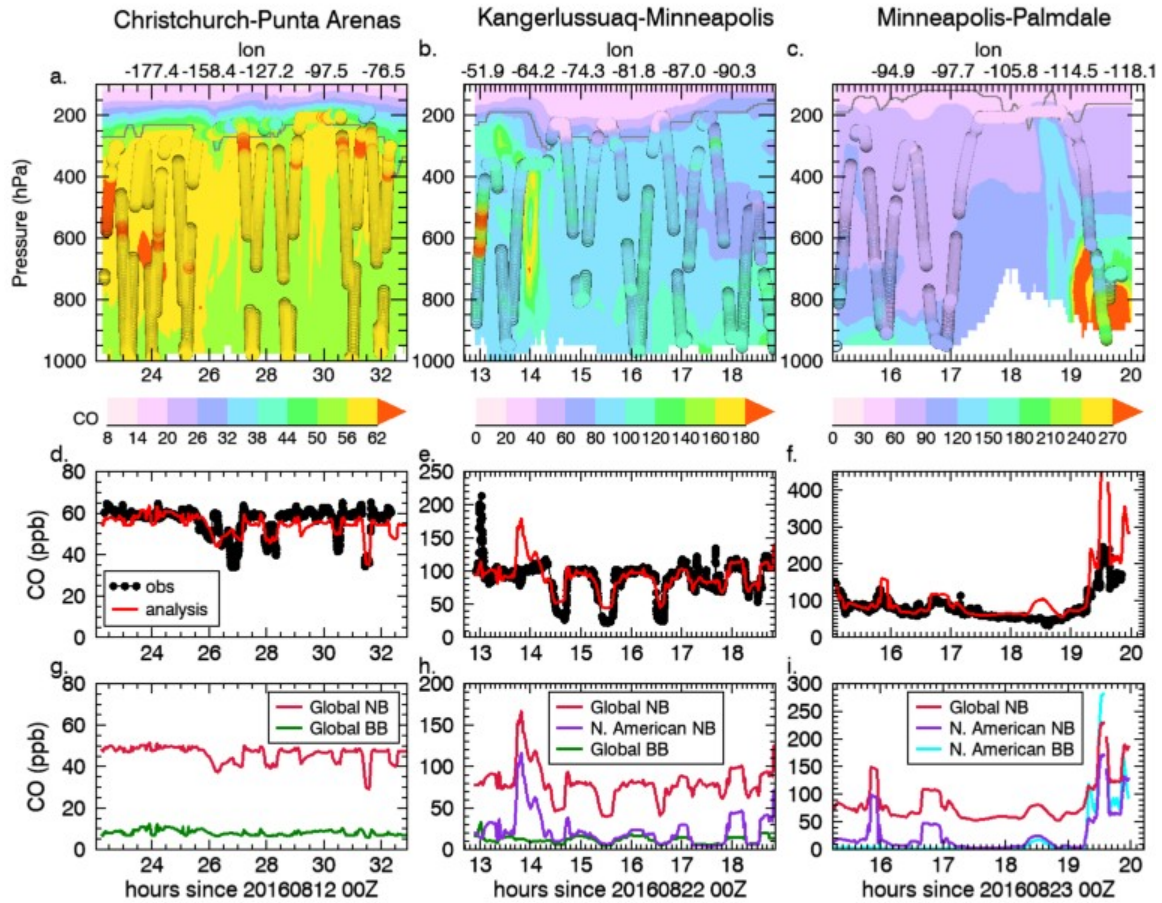
Fig. S3: Curtain plot of CO (ppb) from the GEOS-5 analysis as a function of time and pressure overplotted with QCLS CO observations (top row) for the a) Christchurch to Punta Arenas flight, b) Kangerlussuaq to Minneapolis flight, and c) Minneapolis to Palmdale flight. Axis ranges vary between panels due to the large range of concentrations encountered. The top x-axis indicates the longitudes of the flight track. d-f) The GEOS-5 CO interpolated to the flight track (red line) is compared to the observations (black circles). g-h) Tagged tracer contributions to the GEOS-5 CO.

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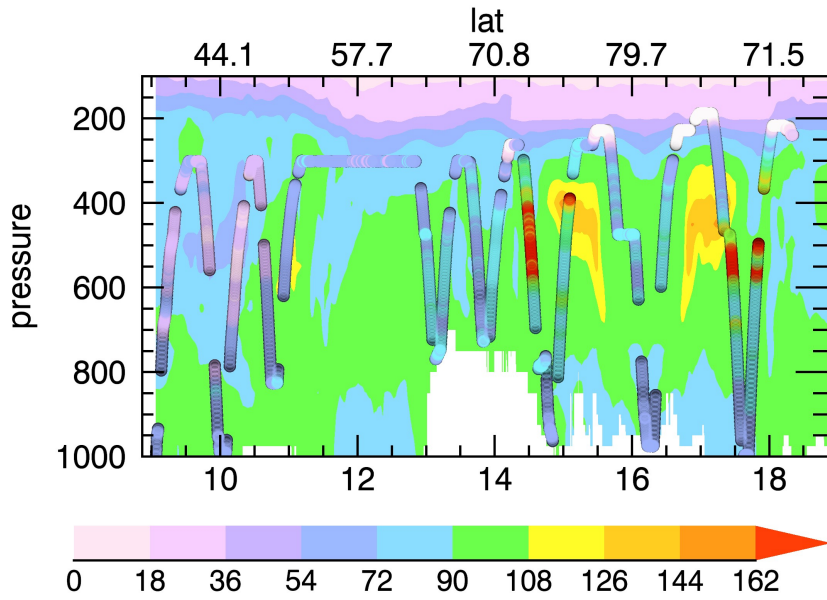
a. CO, 2016-08-20T06 UTC (30-hr fcst)

b. CO, 2016-08-20T12 UTC (36-hr fcst)

c. CO 2016-08-20

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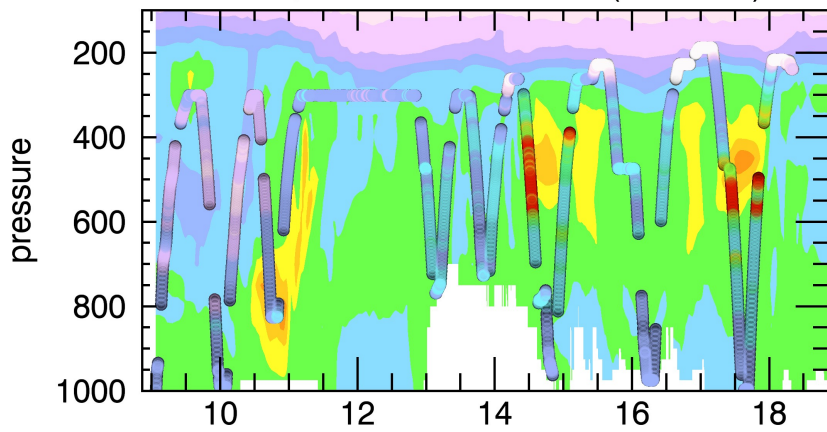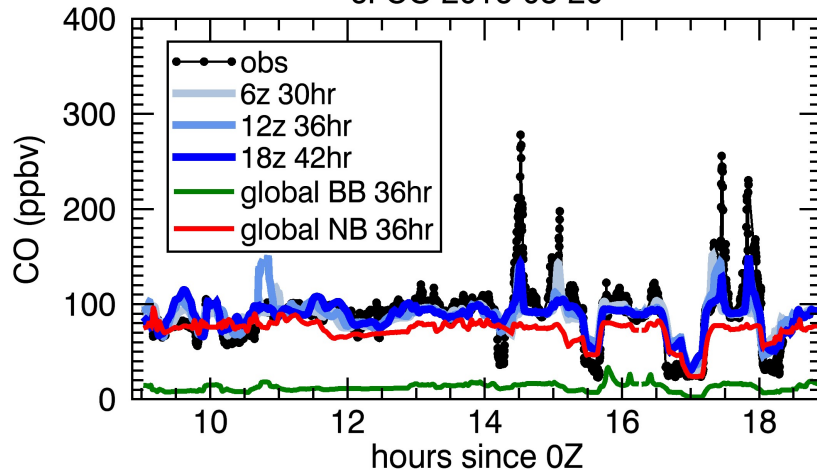
Figure S4: Color contours of the GEOS-5 forecasted CO along the flight path of RF09 from Azores to Kangerlussuaq. The 30-hr forecast at 2016-08-20T6:00 (top) is compared with the 36-hr forecast (2016-08-20T12:00, middle). The ATom CO observations (circles) are pasted on both of these forecasts. (Bottom) time series of observed (black) and forecasted CO (blue) at different snap shot times (2016-08-20T6:00, 2016-08-20T12:00, 2016-08-20T18:00). It also shows the CO from global non-BB emissions (NB, red) and global biomass burning emissions (green).

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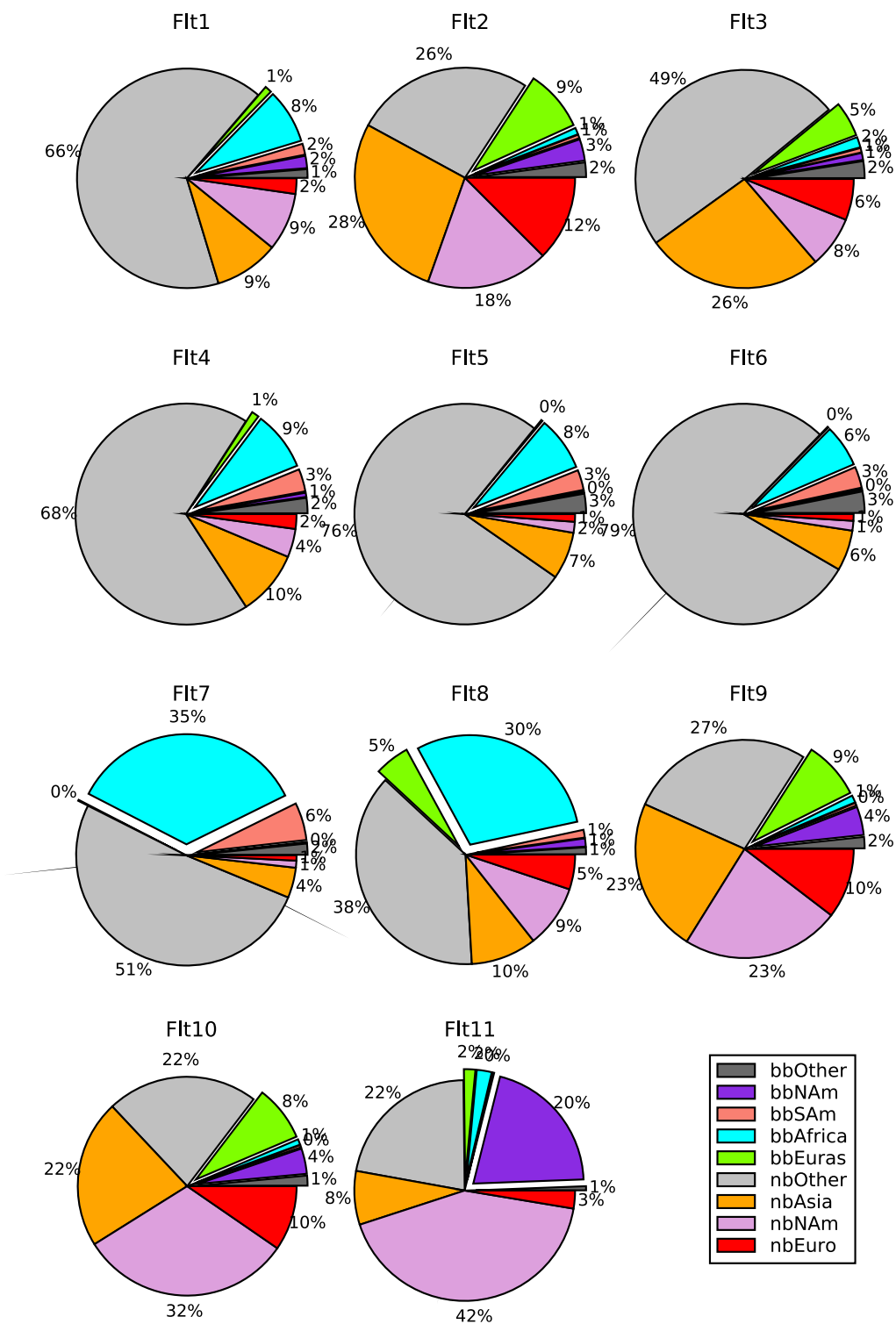
Fig. S5: Percent contributions of tagged tracers to total CO in the lower troposphere for each flight. Exploded slices represent the biomass burning tracers: North American (purple), S. American (salmon), African (cyan),

34   **Eurasian (green), and Other (dark gray). The non-biomass burning (nb) tracers are for Asia (orange), N.**
35   **America (lavender), Europe (red), and other (light gray).**