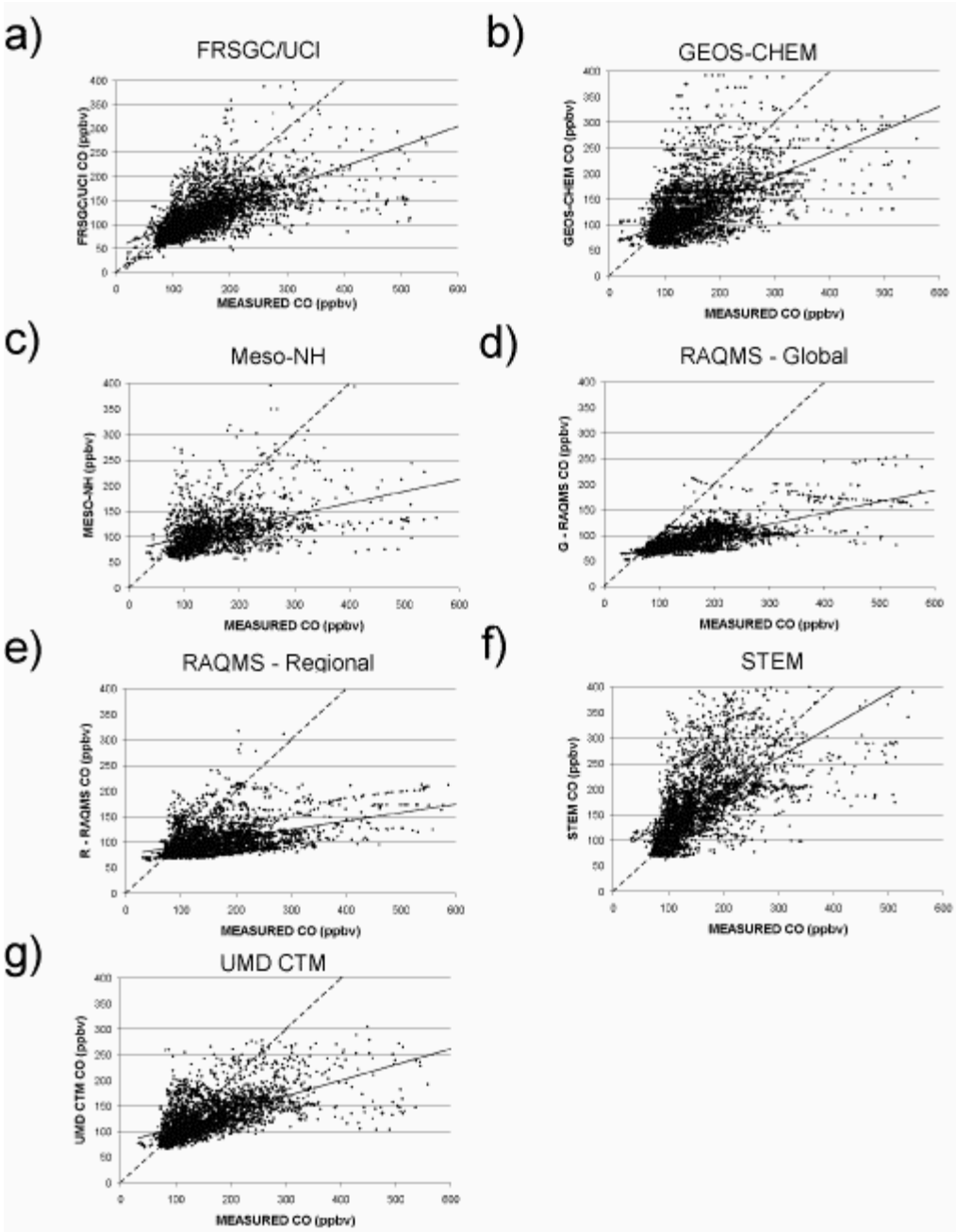


Figure 1. Scatter plots of modeled versus aircraft-derived CO for the combination of DC-8 Flights 7 - 17; (a) FRSGC/UCI, (b) GEOS-CHEM, (c) Meso-NH, (d) STEM, (e) RAQMS - Global, (f) RAQMS - Regional, and (g) UMD CTM. Linear least square fits of the data (solid line) and 1 to 1 lines (dashed) are shown in each plot. Statistics for each panel are given in Table 3.

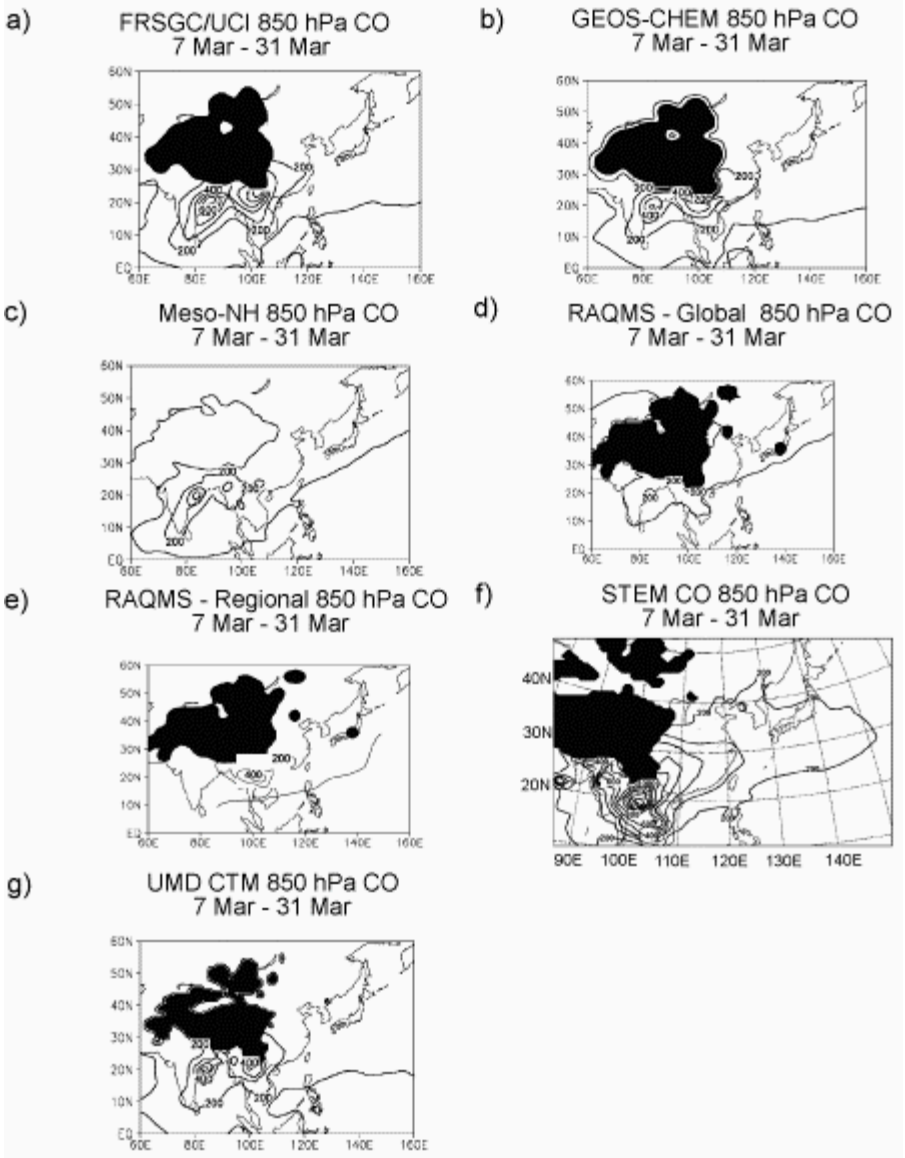


Figure 2. Spatial fields of model-derived CO (ppbv) at 850 hPa for the period March 7 - 31. (a) FRSGC/UCI, (b) GEOS-CHEM, (c) Meso-NH, (d) RAQMS-Global, (e) RAQMS-Regional, (f) STEM, and (g) UMD CTM. The dark areas denote regions where the surface pressure is below 850 hPa.

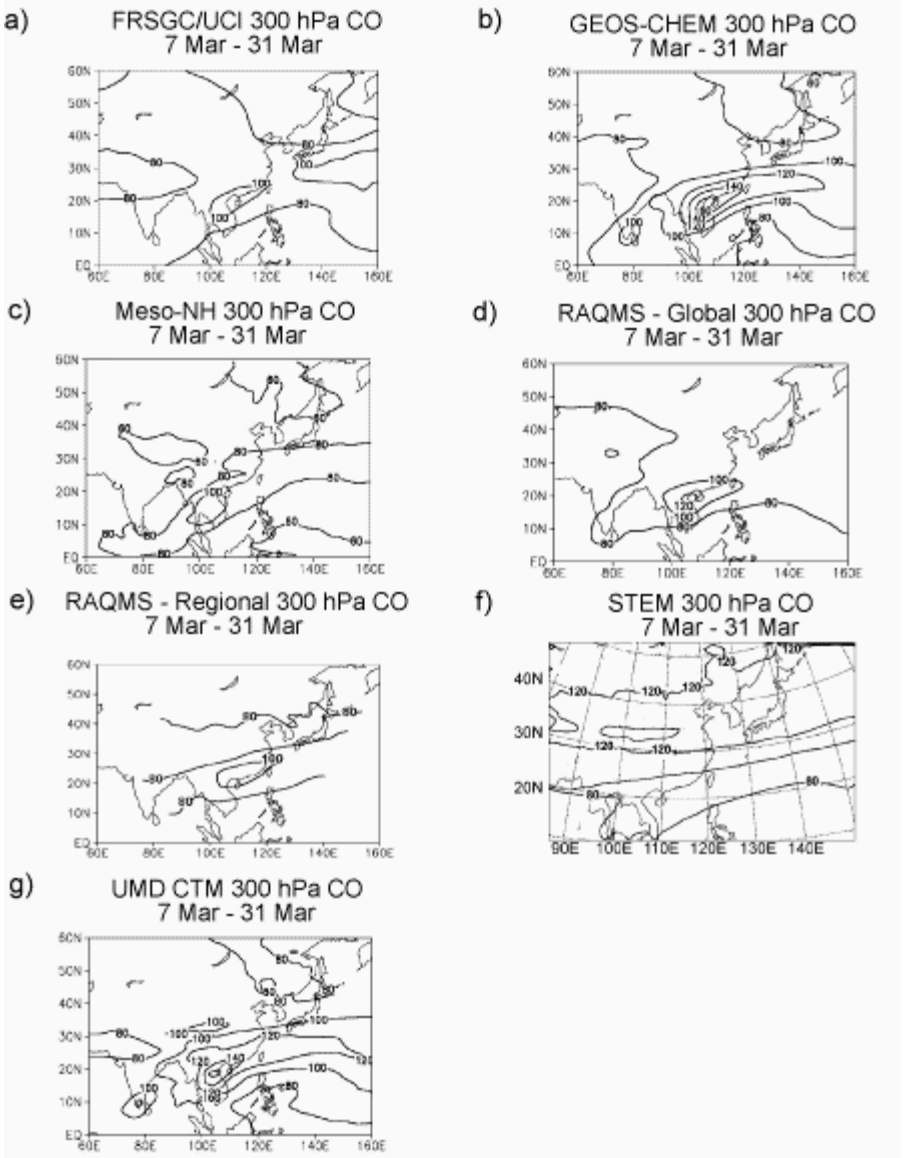


Figure 3. Spatial fields of model-derived CO (ppbv) at 300 hPa for the period March 7 - 31. (a) FRSGC/UCI, (b) GEOS-CHEM, (c) Meso-NH, (d) RAQMS-Global, (e) RAQMS-Regional, (f) STEM, and (g) UMD CTM.

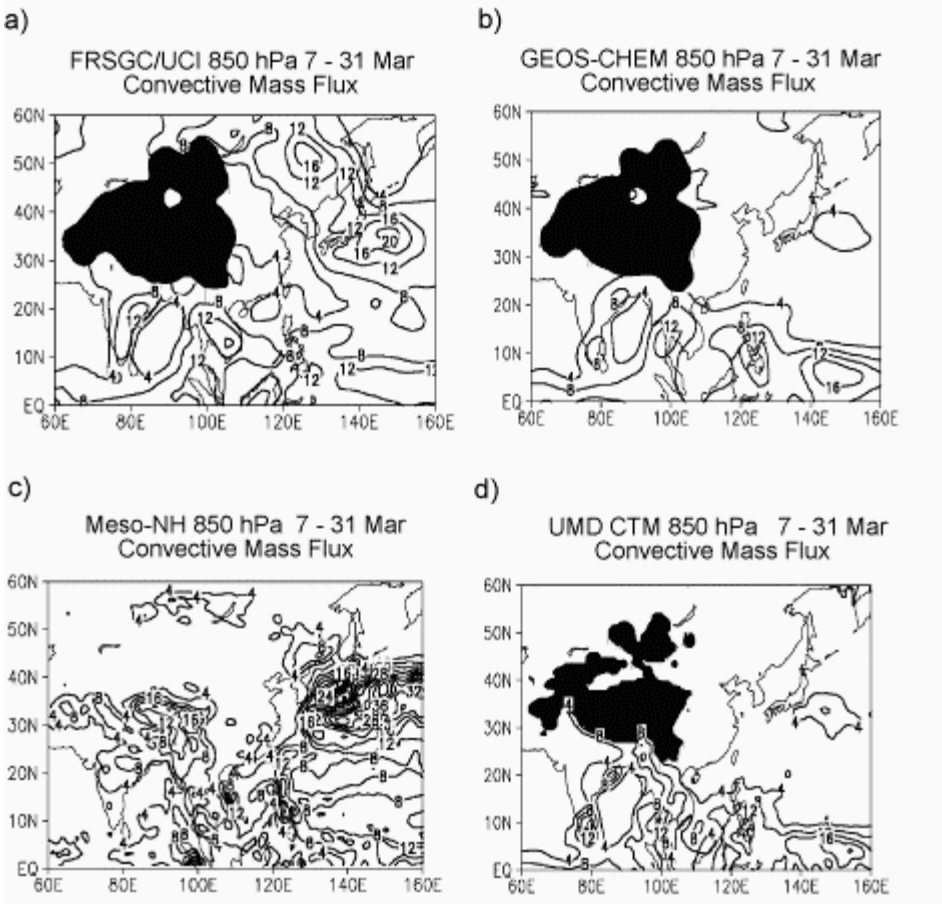


Figure 4. Spatial fields of model-derived convective mass flux (x 10^{-3} kg/m^2/s) at 850 hPa for the period March 7 - 31. (a) FRSGC/UCI, (b) GEOS-CHEM, (c) Meso-NH, and (d) UMD CTM. The dark areas denote regions where the surface pressure is below 850 hPa.

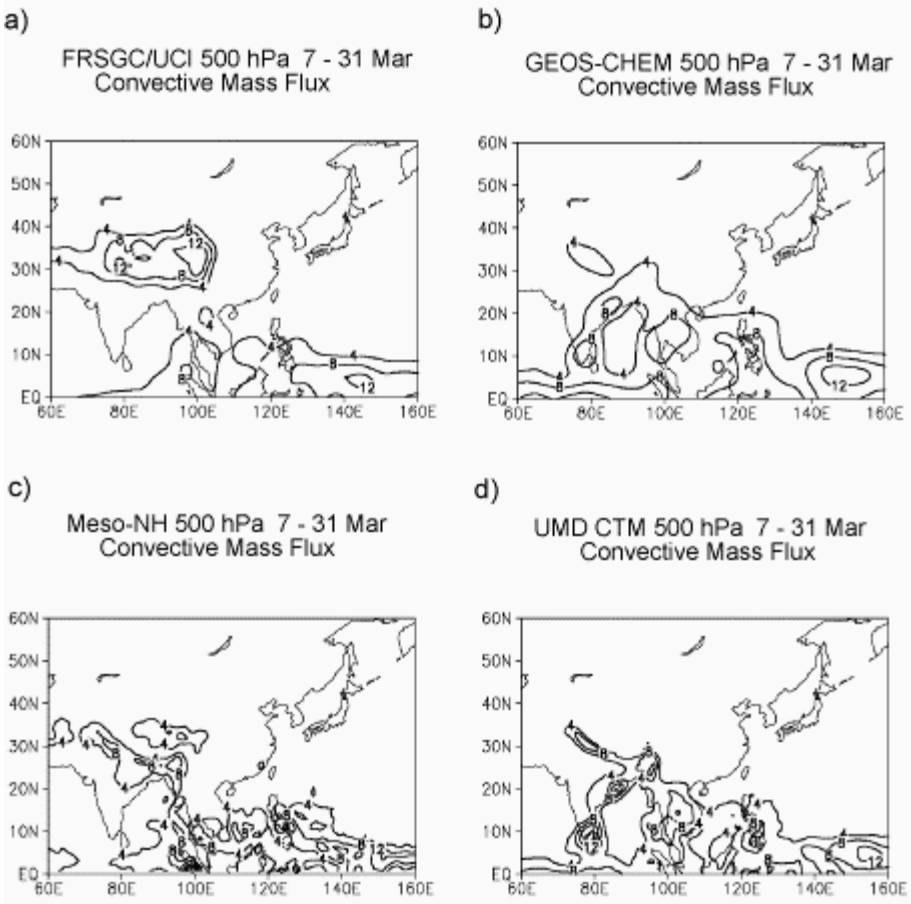


Figure 5. Spatial fields of model-derived convective mass flux (x 10^{-3} kg/m^2/s) at 500 hPa for the period March 7 - 31. (a) FRSGC/UCI, (b) GEOS-CHEM, (c) Meso-NH, and (d) UMD CTM.

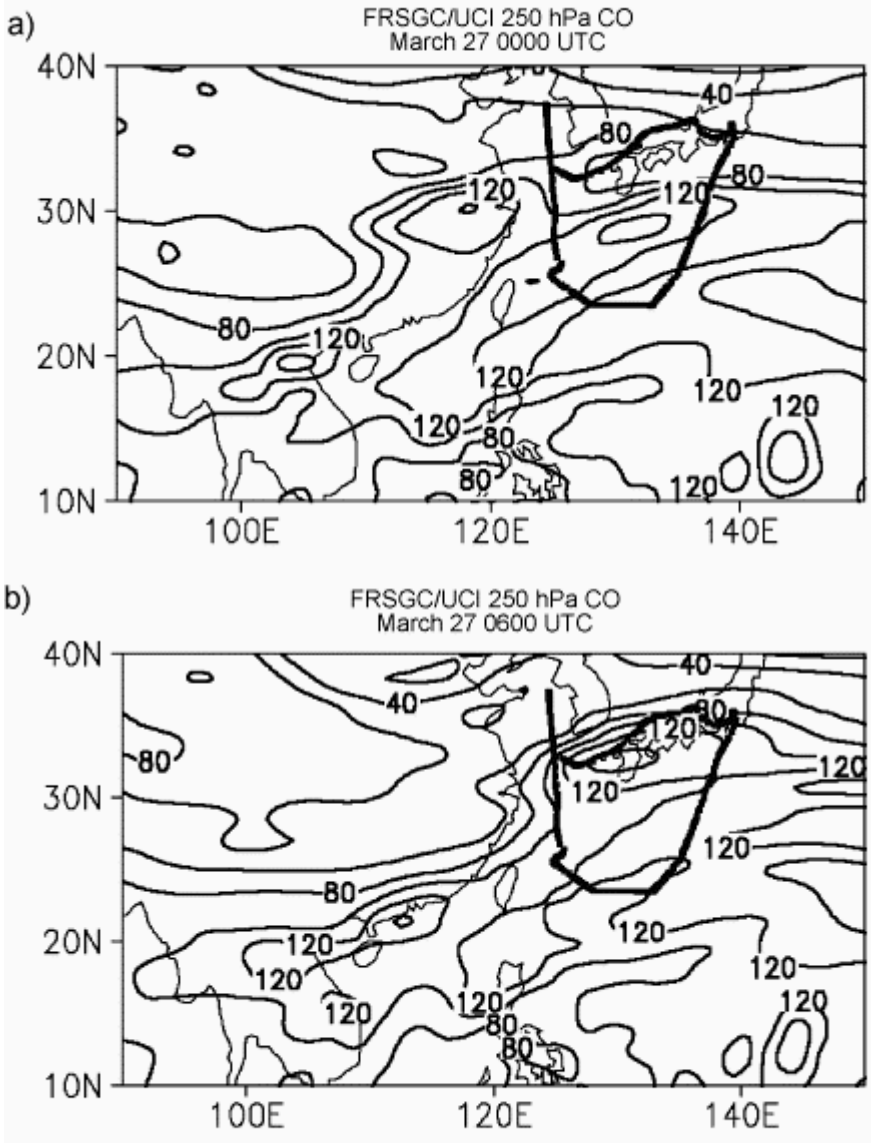


Figure 6. Spatial fields of FRSGC/UCI model-derived CO (ppbv) at 250 hPa for (a) March 27 at 0000 UTC and (b) March 25 0600 UTC. DC-8 Flight 15 track is superimposed on the figure.

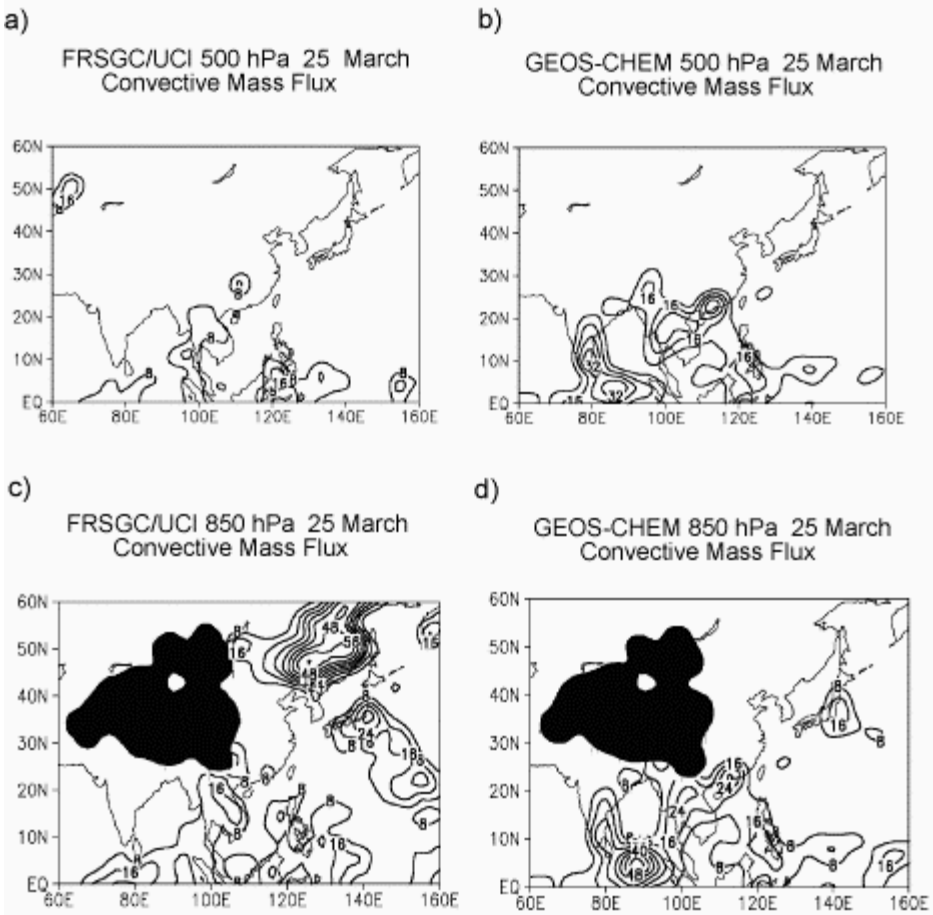


Figure 7. Spatial fields of model-derived convective mass flux (x 10^{-3} kg/m^2/s) for 0600 UTC March 25; at 500 hPa (a) FRSGC/UCI, (b) GEOS-CHEM and at 850 hPa (c) FRSGC/UCI, and (d) GEOS-CHEM. The dark areas denote regions where the surface pressure is below 850 hPa.

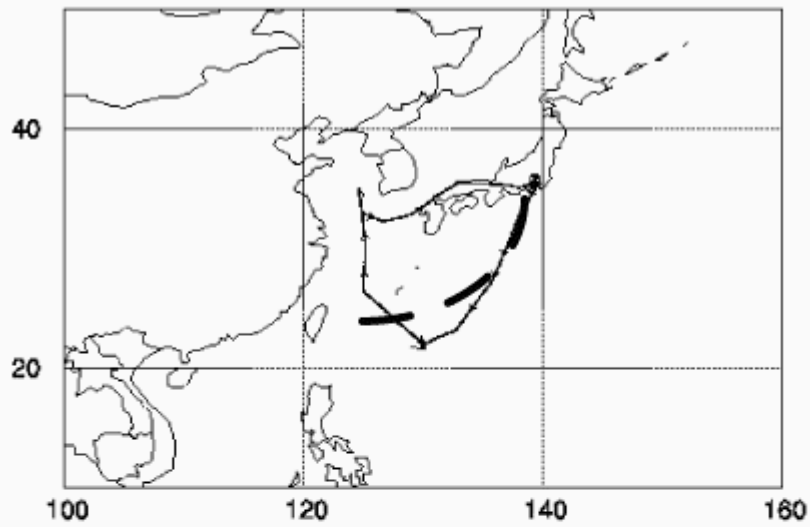
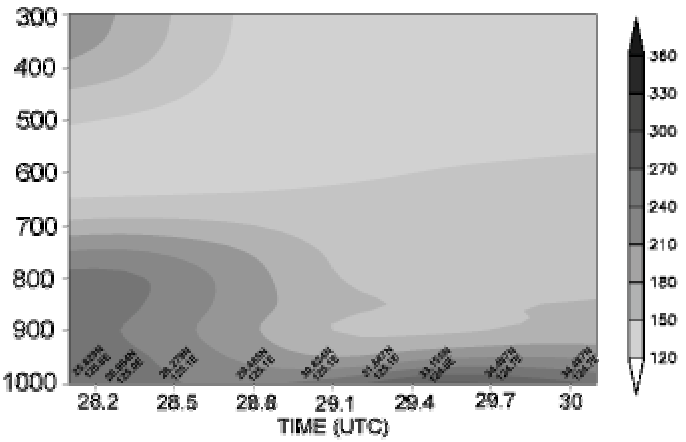


Figure 8. Flight track of DC-8 Flight 13 (Yokota Local 1). The position of the cold front is shown by the long dashed lines.

a)



b)

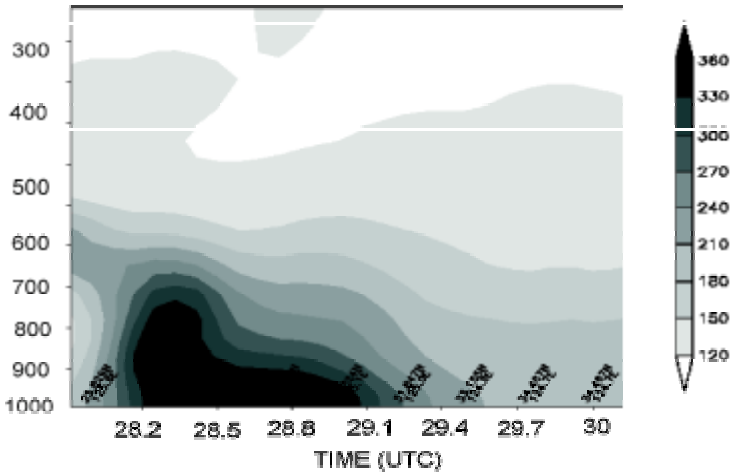


Figure 9. Vertical cross sections of CO along the northern leg of DC-8 Flight 13 from (a) GEOS-CHEM and (b) STEM.

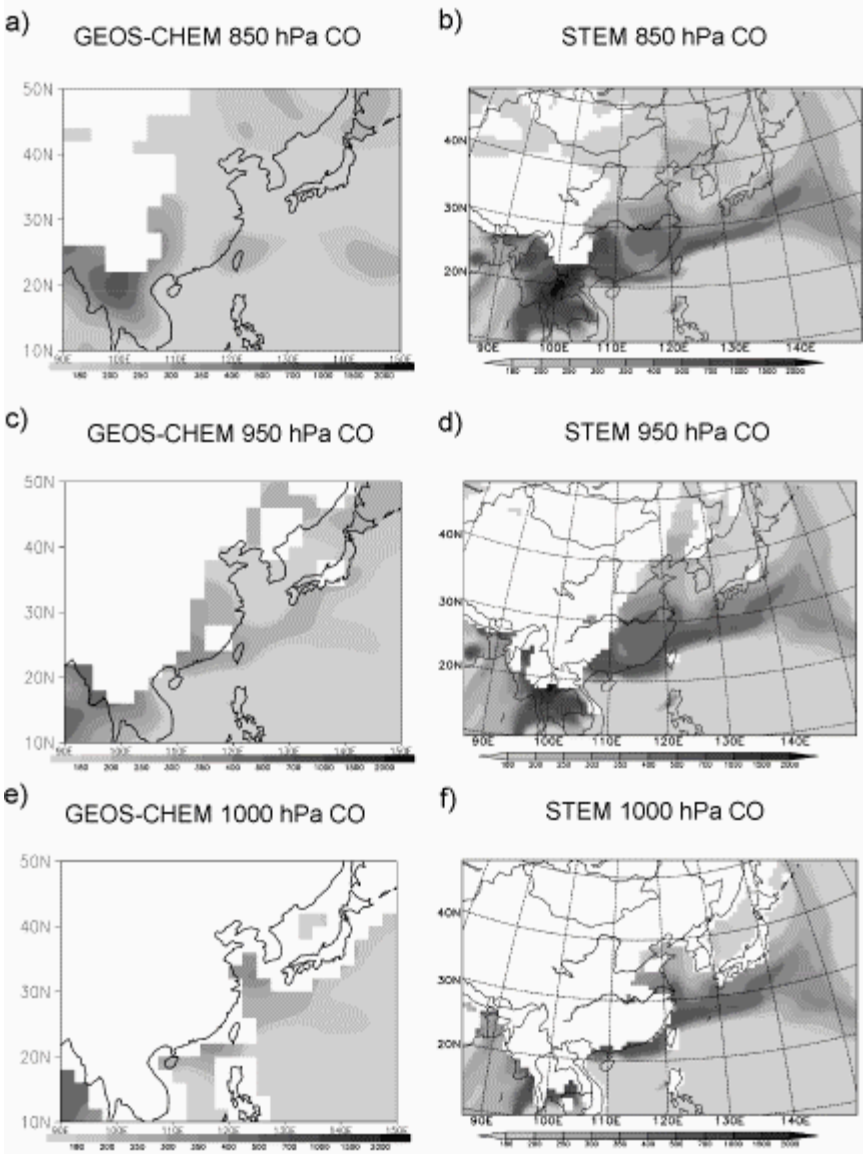


Figure 10. Spatial fields of model-derived CO (ppbv) for 0600 UTC March 21 from GEOS-CHEM at (a) 850 hPa, (c) 950 hPa, (e) 1000 hPa, and from STEM at (b) 850 hPa, (d) 950 hPa, (f) 1000 hPa.

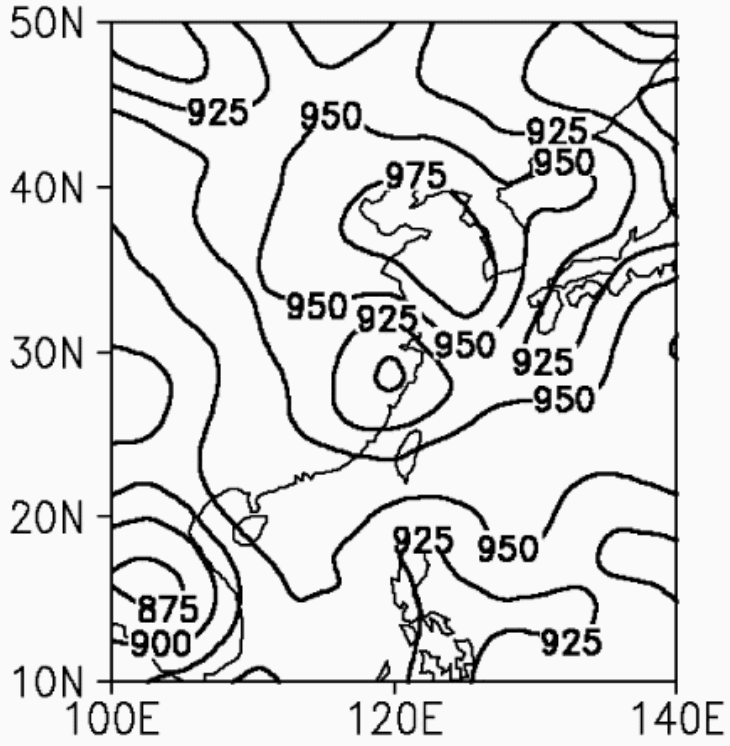


Figure 11. Simulated PBL heights (hPa) from GEOS-CHEM at 0600 UTC March 21.

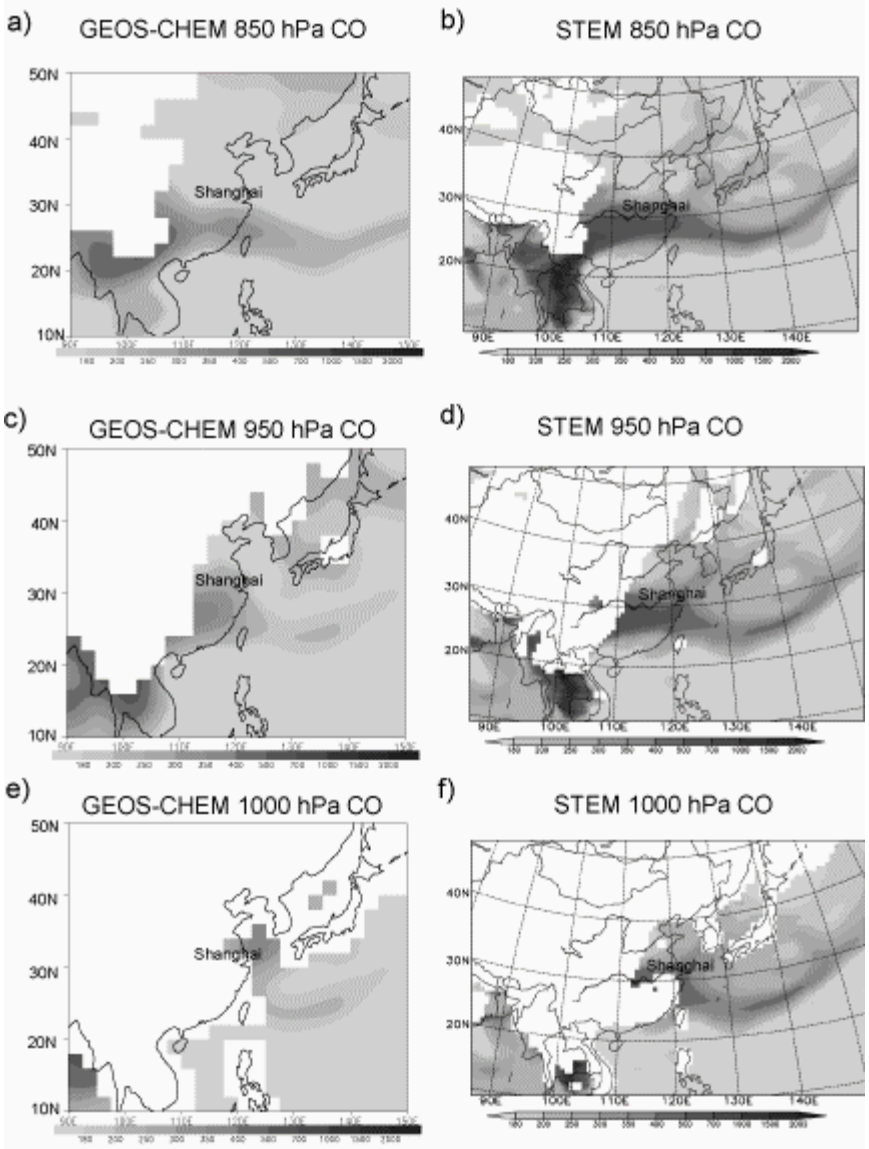


Figure 12. Spatial fields of model-derived CO (ppbv) for 0600 UTC March 19 from GEOS-CHEM at (a) 850 hPa, (c) 950 hPa, (e) 1000 hPa, and from STEM at (b) 850 hPa, (d) 950 hPa, and (f) 1000 hPa.

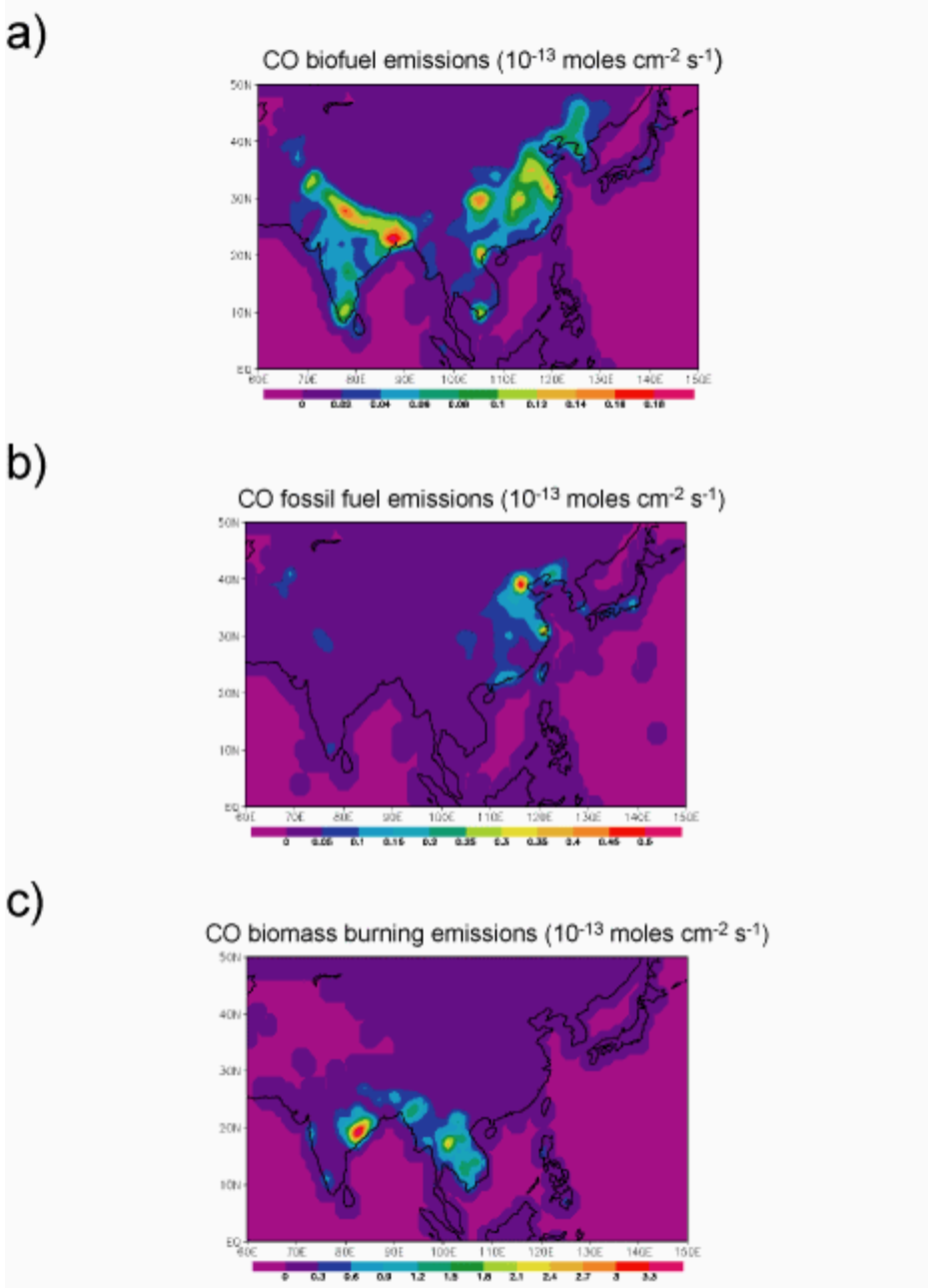


Plate 1. CO emissions used by all CTMs in this study from (a) biofuels, (b) fossil fuels, and (c) biomass burning.

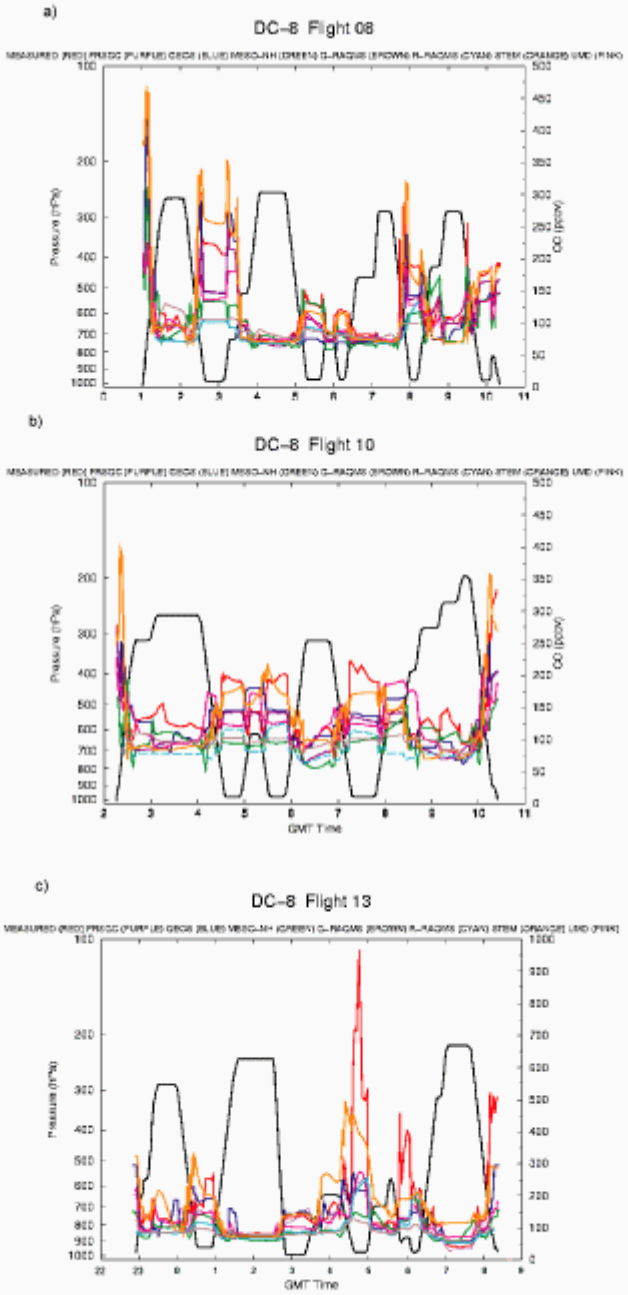
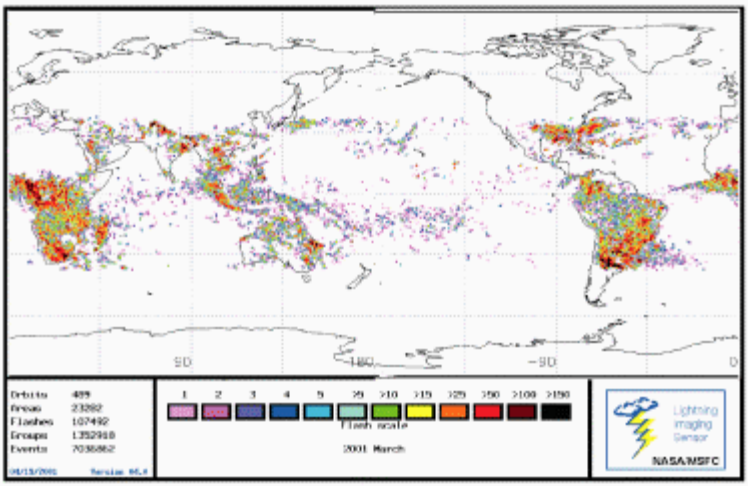


Plate 2. Time series of aircraft altitude (black), aircraft-derived CO (red), and the seven model-derived simulations for (a) DC-8 Flight 8, (b) DC-8 Flight 10, and (c) DC-8 Flight 13. FRSGC/UCI (violet), GEOS-CHEM (blue), Meso-NH (green), RAQMS Global (brown), RAQMS Regional (cyan), STEM (orange), UMD CTM (pink). .

a)



b)

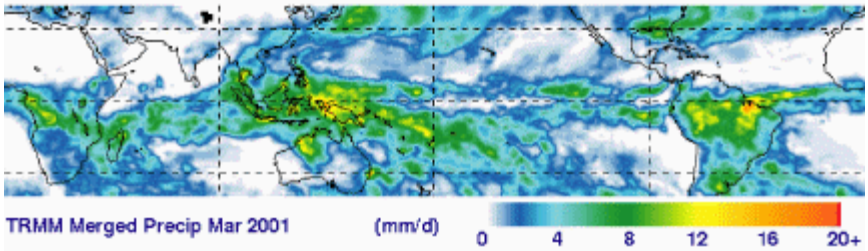
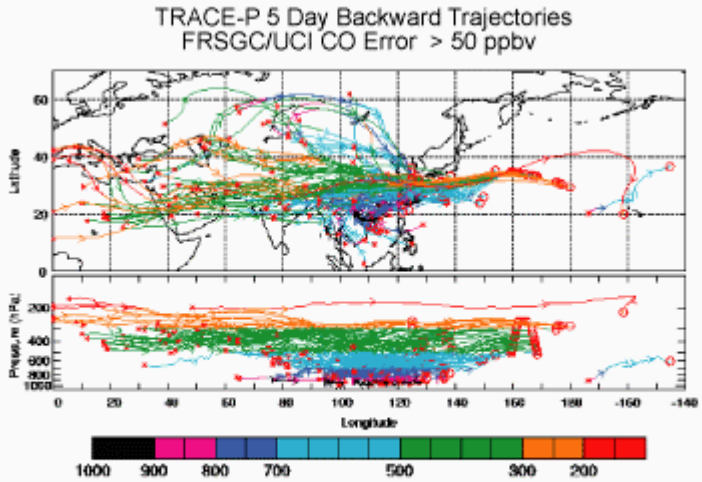


Plate 3. (a) Lightning data for March 2001 from the Lightning Imaging Sensor (LIS) (b) Precipitation data for March 2001 from the Tropical Rainfall Measuring Mission (TRMM).

a)



b)

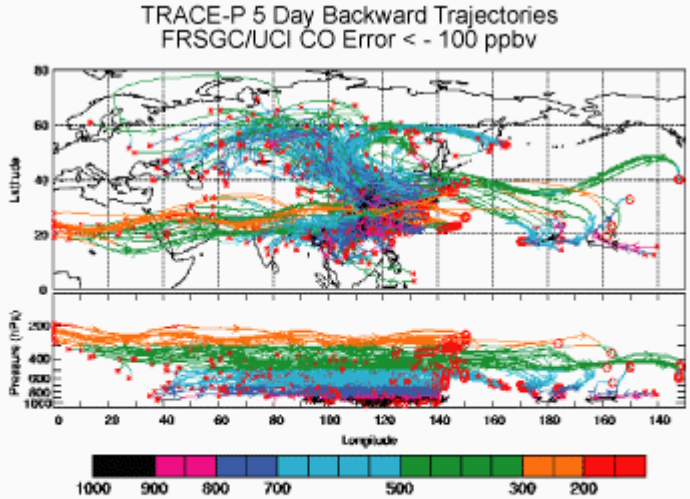


Plate 4. 5-day backward trajectories for the combination of DC-8 Flights 7 - 17 based on FRSGC/UCI model CO error. (a) FRSGC/UCI model CO is greater than aircraft-derived CO by 50 ppbv or more, (b) FRSGC/UCI model CO is less than aircraft-derived CO by 100 ppbv or more.

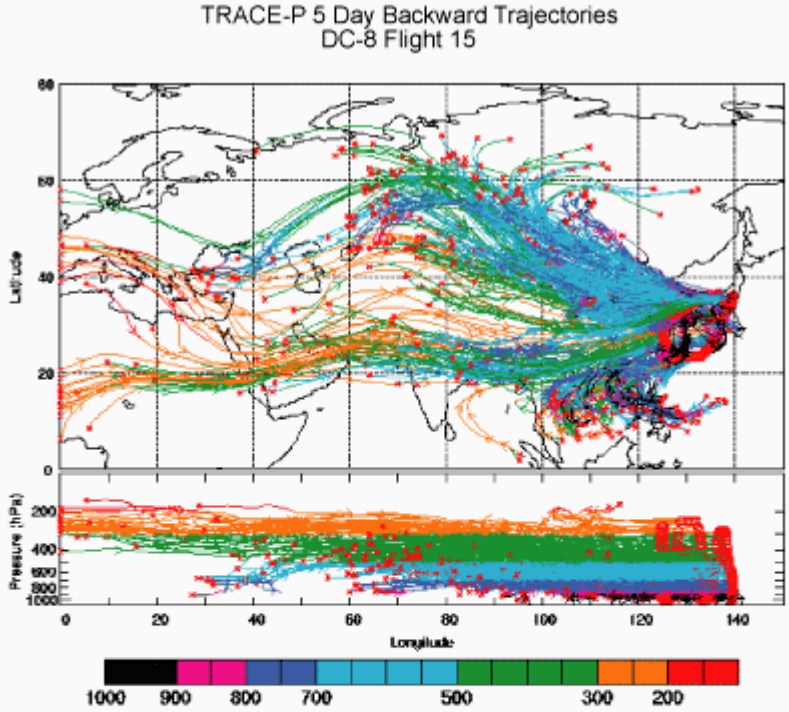
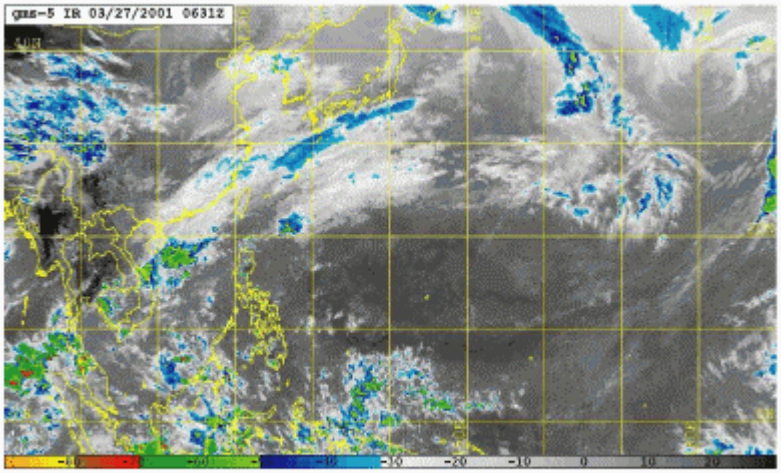


Plate 5. 5-day backward trajectories for DC-8 Flight 15.

a)



b)

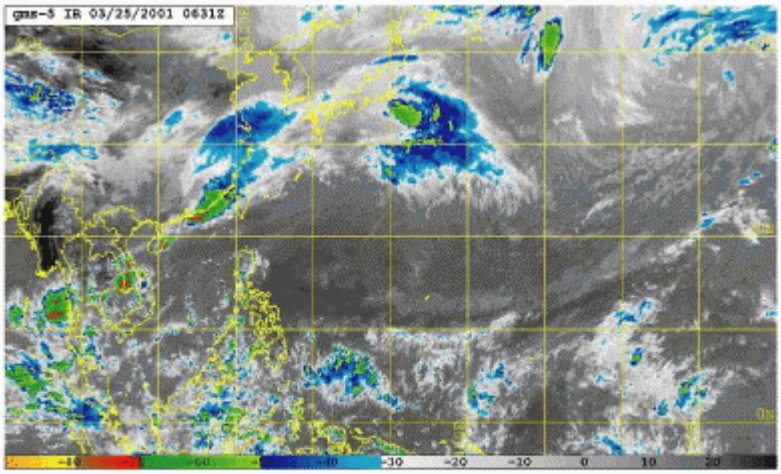
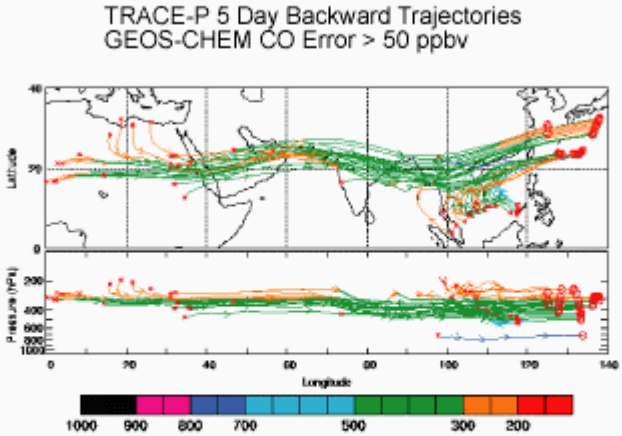


Plate 6. Infrared imagery from Geostationary Meteorological Satellite (GMS) 5 (a) at the time of Flight 15 (0631 UTC March 27) and (b) two days prior to Flight 15 (0631 UTC March 25).

a)



b)

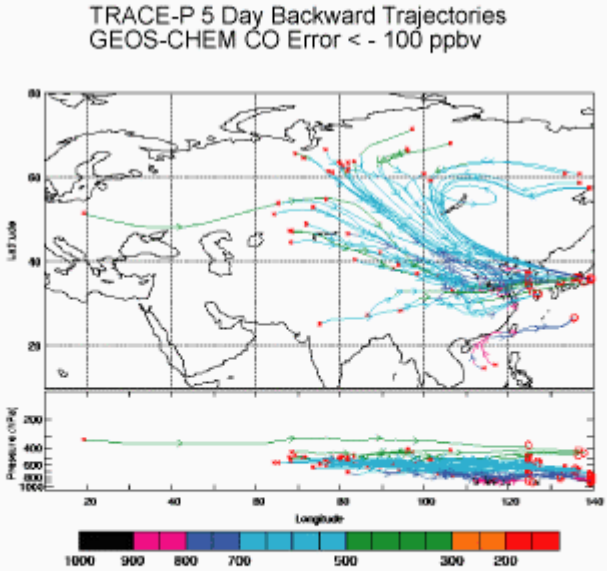


Plate 7. 5-day backward trajectories for DC-8 Flight 15 based on GEOS-CHEM model CO error. (a) GEOS-CHEM model CO is greater than aircraft-derived CO by 50 ppbv or more, (b) GEOS-CHEM model CO is less than aircraft-derived CO by 100 ppbv or more.

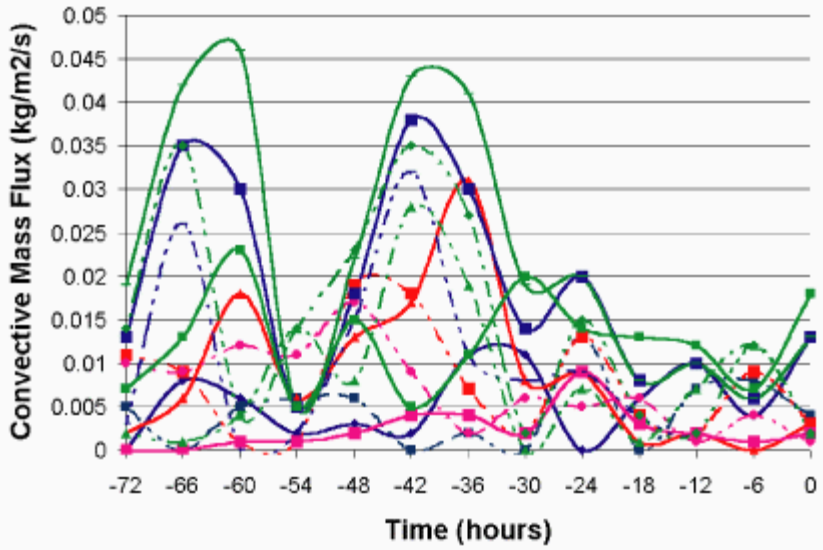


Plate 8. Convective mass flux at 6 hourly intervals for 6 representative trajectories based on GEOS-CHEM CO exceeding the measured value by 50 ppbv or more during DC-8 Flight 15. Results are shown for GEOS-CHEM (solid line) and FRSGC/UCI (dashed line). The color of each line indicates the specific trajectory. Thus, each color is used in two lines indicating the same starting point along the flight track (one for GEOS-CHEM and one for FRSGC/UCI)

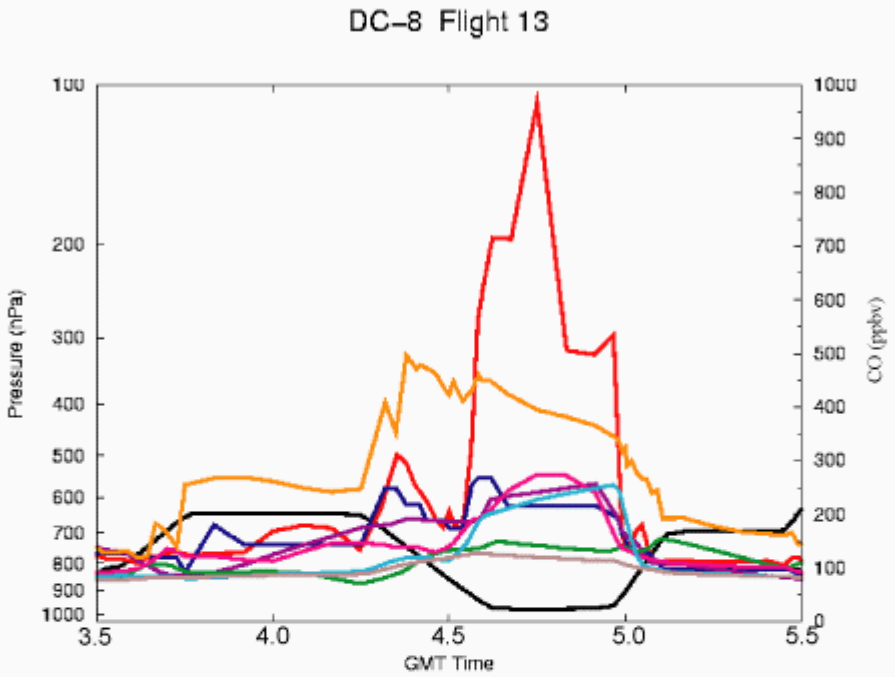


Plate 9. Time series of aircraft altitude (black), aircraft-derived CO (red), and the seven model-derived simulations during the sampling of the Shanghai plume by DC-8 Flight 13. FRSGC/UCI (violet), GEOS-CHEM (blue), Meso-NH (green), RAQMS - Global (brown), RAQMS - Regional (cyan), STEM (orange), and UMD CTM (pink).