

Modeling the Synoptic Atmospheric Interaction with Anthropogenic and Biospheric CO₂ Emissions

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CO₂ concentration measurements at continental sites typically show strong synoptic variability. Figure 1 shows the CO₂ concentration time series at the various sites in Canada. There are significant differences in the synoptic variability at these sites. In this study we used a dynamic atmospheric model Global Environmental Multiscale (GEM) with variable horizontal resolution (with minimum delta x of ~15 km) to examine the atmospheric synoptic interaction with the regional anthropogenic and biospheric CO₂ fluxes. The results (Figure 2) show the atmospheric transport varies at these sites and the interaction of atmospheric transport and surface CO₂ emissions (all sources) leads to different synoptic variability at different sites. Furthermore, the atmospheric interaction with anthropogenic emissions is distinct from the interaction with biospheric emissions, leading to different synoptic characteristics in the CO₂ concentrations. Thus the synoptic CO₂ concentration characteristics at a site contain information on the regional emission. The model and observations can be used to evaluate different emission estimates.

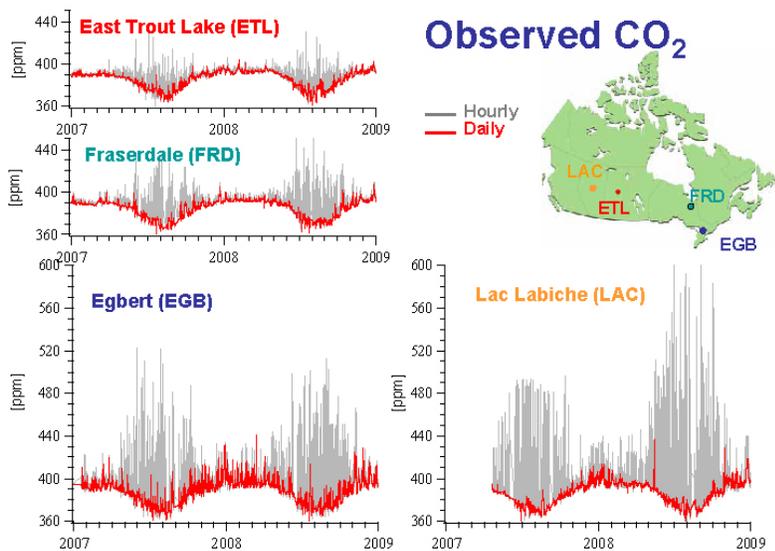


Figure 1. The Observed CO₂ concentration time series at the different continental sites on the map, the gray curve is the hourly concentration, and the red curve is the afternoon (3-6 pm local time) concentration. The synoptic variability varies with locations, indicating different atmosphere and source emission interaction.

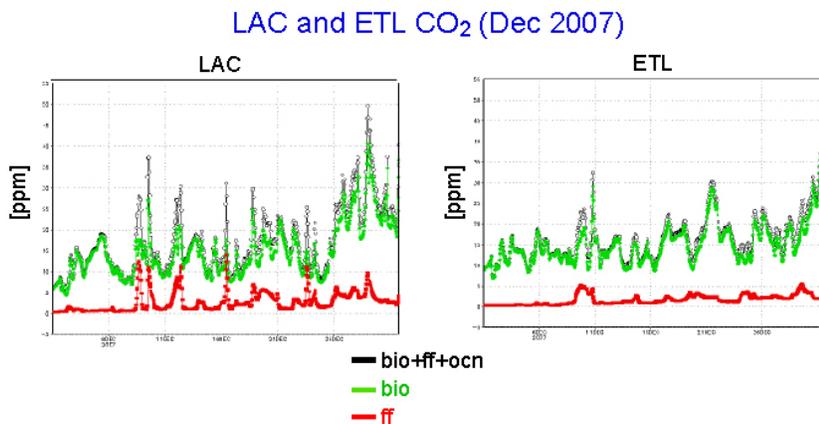


Figure 2. Time series from GEM model for December 2007 at the Lac Labiche and East Trout Lake sites. Black curve includes all sources bio+ff+ocn (biosphere + fossil fuel + ocean), green curve is for bio only, and red curve is for ff only. Bio CO₂ concentration shows more variability than ff concentration. GEM was initialized with 0ppm CO₂ concentration at the initial model integration time, November 1, 2007.