Atmospheric observation-based estimation of fossil fuel CO_2 emissions from regions of central and southern California

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Background: Combustion of fossil fuel is the dominant source of greenhouse gas emissions to the atmosphere in California.

Methods: The authors used radiocarbon ($^{14}CO_2$) measurements and atmospheric inverse modeling to estimate fossil fuel CO_2 ($ffCO_2$) emissions for 2009–2012 from a site in central California and for June 2013–May 2014 from two sites in southern California. A priori predicted $ffCO_2$ mixing ratios were computed based on regional atmospheric transport model (WRF-STILT) footprints and an hourly $ffCO_2$ prior emission map (Vulcan 2.2).

Results:

- Inversions suggest emissions within 10 ± ~ 30% (at 95% confidence) of California Air Resources Board (CARB) inventory.
- Emissions from the San Francisco Bay Area (SFBA) are higher in winter and lower in summer.
- Seasonal variations were not detected the Los Angeles South Coast Basin (SoCAB).
- Inter-annual variation or trend is not significant in SFBA.

Significance: Emissions from the SFBA and SoCAB urban regions contain about 50% of prior emissions from California and are constrained by the observations in this study. Emissions from the remaining regions are less constrained. Additional observations will be valuable to more accurately estimate total $ffCO_2$ emissions from California as a whole.

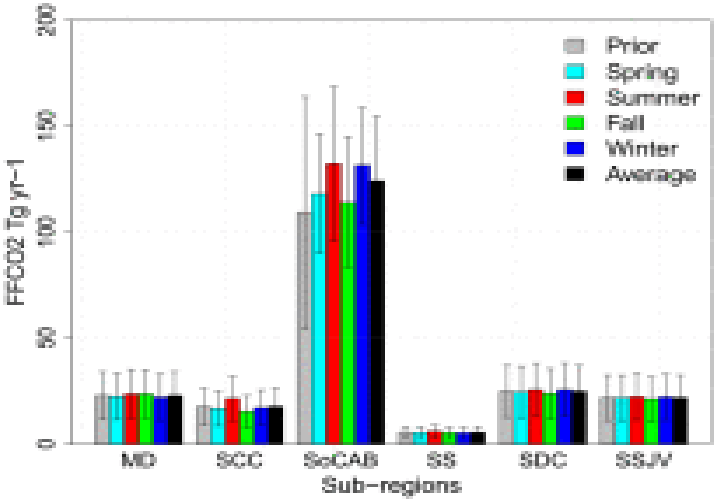

Figure: Seasonal posterior $ffCO_2$ emissions from scaled Vulcan map (posterior uncertainty at 95% confidence) in regions of southern California using combined measurements from CIT and SBC towers (factor for the R matrix = 0.5; ocean flag used). MD, SCC, SoCAB, SS, SDC and SSJV represent the Mojave Desert, South Central Coast, South Coast Air Basin, Salton Sea, San Diego County, and southern San Joaquin Valley air basins, respectively.