A DIRECT CARBON BUDGETING APPROACH TO STUDY CO_2 SOURCES AND SINKS

C. Crevoisier[1], E. Gloor[1], J. Sarmiento[1], L. Horowitz[2], S. Malyshev[2], C. Sweeney[3], A. Andrews[3], and P.P. Tans[3]

[1]*Program in Atmospheric and Oceanic Sciences, Princeton University, Sayre Hall, Forrestal Campus, Princeton, NJ 08544-0710, USA; ccrevois@princeton.edu, emg@splash.princeton.edu, jls@splash.princeton.edu*

[2]*Geophysical Fluid Dynamics Laboratory, NOAA, Forrestal Campus, Princeton, NJ , 08540-6649, USA; Larry.Horowitz@noaa.gov, malyshev@princeton.edu*

[3]*Climate Monitoring and Diagnostics Laboratory, NOAA, 325 Broadway, Boulder, CO 80305-3328; Colm.Sweeney@noaa.gov, Arlyn.Andrews@noaa.gov, Pieter.Tans@noaa.gov*

ABSTRACT

For the purpose of exploiting upcoming measurements of atmospheric CO_2 vertical profiles by aircrafts and continuous CO_2 data recorded along tall towers as part of the North American Carbon Plan (NACP), a direct carbon budgeting approach is being developed.

Direct budgeting puts a control volume on top of North America, balances air mass in- and outflows into the control volume and solves for the surface fluxes. Different upper bounding surfaces like the PBL-free troposphere interface are imaginable. Such an approach may have the advantage of providing flux estimates independent of prior information that is generally used to infer carbon surface fluxes through top-down inversions. Another advantage of direct carbon budgeting is that problems caused by covariation of fluxes and atmospheric transport, the so-called rectification effect, may be avoided entirely.

For testing the approach use is made of the chemical transport model MOZART [Horowitz et al. 2003], with air-land fluxes given by the land vegetation model LM3 [*Shleviakova et al*. in prep.], monthly fossil fuel emissions from Blasing et al. [2004] and air-sea fluxes from Dunne et al. [in prep.]. Both models are driven by analyzed meteorological fields from NCEP.

Major components of this study are (i) a quantitative analysis of the importance of different mass exchange pathways between boundary layer and the free troposphere, (ii) tests of mass balance approaches based on tracers like SF_6, APO (Atmospheric Potential Oxygen), or Rn, to estimate transports associated with the different exchange mechanisms (iii) application of the flux estimation scheme to simulated CO_2 at planned NACP sites to assess the feasibility and the accuracy of the method, (iv) testing various measurements strategies and then designing the most appropriate measurement system, (v) possibly application of the method to NACP data.

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