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# Ensemble model simulations : a new tool to assess transport uncertainties in mesoscale inversions of CO2 sources and sinks

**T. Lauvaux** (1,2), K. Davis (3), C. Sarrat (2), F. Chevallier (1), M. Uliasz (4), C. Lac (2), P. Bousquet (1), P. Ciais (1), J. Noilhan (2), P. Rayner (1)

(1) Laboratoire des Sciences du Climat et de l'Environnement, Paris, France, (2) Centre Nationale des Recherches Météorologiques, Toulouse, France, (3) Pennstate, Department of Meteorology, Pennsylvania, USA, (4) Colorado State University, Colorado, USA

« Top-down » approaches for the carbon cycle understanding showed their utility to infer sources and sinks from concentration measurements. But uncertainties remain an important limit for these inverse methods to estimate the optimal solution. One of the main limitation concerns the transport, considered as perfect, although some intercomparison exercises proved that there are large differences between the different atmospheric models used.

We propose here to quantify the transport error by using an ensemble of different simulations based on perturbed initial conditions. These initial fields are generated by simulations over a larger domain obtained from the ARPEGE system developped by Meteo France. They are used to constrain an ensemble of mesoscale simulations using a fine scale model of 2km resolution (MesoNH). The spread in atmospheric transport properties between the different members of the ensemble gives the structure of the background error covariance matrix for a variationnal inversion.

CO2 being a passive tracer, the transport is a linear operator from sources to concentrations. The adjoint transport matrix is obtained by coupling the mesoscale atmospheric model (MesoNH) with a lagrangian particle dispersion model (LPDM) in a « backward in time » mode. In order to better reproduce the mixing of particles in the boundary layer, the turbulent scheme of LPDM was modified to include entrainement at the top of the boundary layer. Different schemes are used depending on the stability of the boundary layer. The limited domain of LPDM implies to constrain the lateral

boundary conditions for time varying CO2 concentration by the results of a global model (LMDz).

During the CarboEurope Regional Experiment Strategy campaign in 2005, actual C02 concentrations measurements were made on top of two towers and using small aircrafts in the SouthWest of France. Carbon hourly fluxes are estimated from these measurements by our inversion method at the resolution of the Meso-NH model grid, 2km. We will discuss the importance of the transport error on the results, and the importance of a better representativity of the boundary layer dynamics for the data interpretation.