

EUROCOM: The intercomparison of regional CO₂ atmospheric inversions over Europe

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There are large uncertainties in the net CO₂ land ecosystem fluxes over continental to regional scales that still hamper our understanding of the land carbon sink. The current estimates from global coarse-grid inversions of the net CO₂ flux of European ecosystems range from a small source to a sink of more than 1PgC/yr during the last decade (Peylin et al. 2013, Chevallier et al. 2014, Reuter et al. 2017). Intercomparisons of global scale inversions, in particular in the frame of TRANSCOM, have helped diagnose the robustness of large-scale CO₂ flux estimates and the range of uncertainties. Regional mesoscale atmospheric inversions are expected to better exploit the relatively dense atmospheric measurement network in Europe and thus to provide improved estimates of the CO₂ fluxes at the continental scale as well as providing reliable estimates at the subcontinental scale.

The EUROCOM project aims to quantify the CO₂ ecosystem fluxes at continental to subnational scales over Europe, the contribution of different drivers and processes (such as climate, biophysical, human activity etc.), and their associated uncertainties, over the previous decade. To achieve this, an intercomparison of regional CO₂ atmospheric inversions using ground-based in-situ CO₂ measurements is being performed over Europe, with various guidelines (i.e. prescribed fossil fuel emissions) to ensure comparability between various inversions. The comparison and synthesis of these inversions, which will be presented here, provide state of the art estimates of the European CO₂ fluxes, together with an estimate of associated uncertainties. A comparison to the estimates from global coarse-grid inversion will be provided to highlight the gain of using regional approaches.

These atmospheric inversions have used a variety of data assimilation methods, ranging from variational methods to ensemble Kalman filter-based methods and MCMC methods. Different prior estimates of the biospheric fluxes (from ecosystem models like VPRM, LPJ-GUESS and ORCHIDEE) have been used to assimilate various CO₂ concentration data streams, including pre-ICOS data.

In this presentation, we shall outline the EUROCOM protocol, and results from the first intercomparisons of the atmospheric inversions produced by seven partnering institutions over the period of 2006-2015.