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Scaling C fluxes from point to region using observational constraints from flux and mixing ratio measurements

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An improved quantitative understanding of the geographical distribution of CO2 sources and sinks can be gained by using top down constraints from atmospheric measurements. Such top down approaches are an effective way to interpret or assess the longer-term changes in CO2 fluxes, including those induced by climate change. A global network of observations, together with atmospheric transport models, is currently used to infer the source-sink distribution of CO2 (via inversion technique). Long-term measurements in the planetary boundary layer over continents, such as those made from tall tower observatories, are currently being implemented to augment the network of background stations and to provide more information on fluxes. However, these measurements are often influenced by the strong variability of surface fluxes and by atmospheric transport on scales that are not resolved by current global transport models. Further more, fluxes in the near-field of the observatories are highly variable, calling for a-priori fluxes to be specified at high spatial resolution.

We use the inversion technique at the mesoscale through a framework consisting of the models: WRF (the “Weather Research and Forecasting Model”, a weather Prediction tool), VPRM (a Diagnostic Biosphere Model driven by MODIS indices) and STILT (a Lagrangian Particle Dispersion Model), to derive regional biosphere-atmosphere fluxes from measured CO2 mixing ratios. WRF is used with several nests, with the outermost using lateral tracer boundary conditions from global model runs. The biosphere model VPRM uses a set of parameters, for which prior values are pre-optimized

using eddy covariance measurements of CO_2 fluxes, and which are finally optimized in the inversion. This approach has the potential to provide flux estimates that are consistent with both mixing ratio and eddy flux measurements. The first results for regional scale fluxes are presented and discussed in the light of potential uncertainties within the different components of our framework.