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Advances in CBL budgetting and inverse modelling using a mesoscale model

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The methods currently used to derive the surface flux of carbon dioxide from atmospheric concentration changes, the Convective Boundary Layer (CBL) method and inverse modeling, cover the heterogeneity on spatial scales of kilometers and hundreds to thousands of kilometers, respectively. In the middle is the meteorological 'meso-scale', it is shown that processes occurring on this scale can generate significant concentration gradients, which are not represented in the above methods. This study applies a meso-scale atmospheric circulation model, RAMS, in an attempt to bridge the gap between those methods. On the part of the CBL budget side, the meso-scale model quantifies the three dimensional variability, thereby addressing major limitations of this method. On the inverse modeling part, the meso-scale model quantifies the reduction of representation error associated to a refinement of the model grid. The model results also indicate the degree of sensitivity to meso-scale surface flux heterogeneity. We propose a strategy to restore the link between atmospheric concentration gradients and surface fluxes, that was disturbed by the meso-scale processes. Only relatively simple simulations may be required.