Atmospheric Network Design in Europe

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To improve our understanding of Greenhouse Gas (GHG) sources and sinks, as well as their rebalancing due to changes in climate and human impacts, long-term observations of atmospheric GHG made at representative locations over the continent will be an essential source of information. Atmospheric inverse systems provide the link between observed spatiotemporal patterns of atmospheric concentrations to surface fluxes based on the use of atmospheric transport models. As surface-atmosphere exchange fluxes of CO_2 and CH_4 exhibit significant variability in time and space, and as atmospheric mixing is not a reversible process, a priori information is required to regularize the inversion. This information is provided in the form of gridded inventories for anthropogenic emissions, and in the form of diagnostic or prognostic models for biospheric fluxes. Within the upcoming years ICOS and Earth Networks will largely increase the density of the atmospheric network in Europe. Coordinated efforts on planning, model aided network design, as well as data and instruments quality control have already been started. To assist decision-making with respect to the location and density of observing stations to be deployed, a quantitative network design is focused on optimizing the atmospheric constraint on specific targeted quantities given a fixed number of sites. The assessment uses multiple inversion modelling systems with different transport models and different definitions of the flux space to account for the uncertainties. In this paper an overview of the network design efforts and recommendations for synergetic deployment of stations in Europe is discussed.

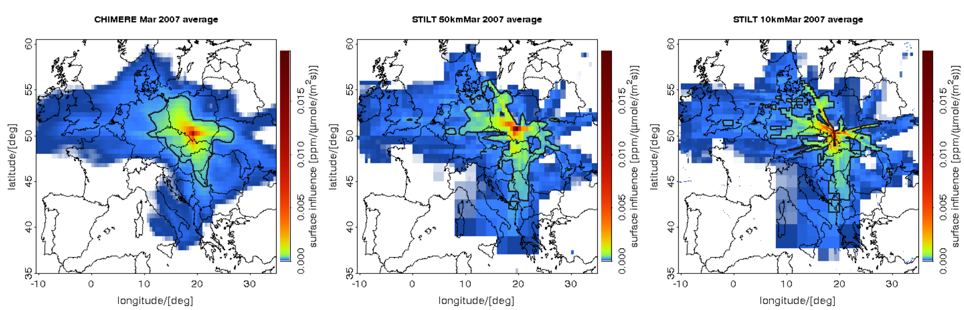

Figure 1. Sensitivities of monthly mean observations at 15:00 to surface fluxes (day and night) for the month of March 2007 for a tall tower in Poland calculated with ECMWF-CHIMERE (left), ECMWF-STILT with 0.5x0.5 deg (middle) and STILT with 1/12 x 1/8 deg resolution (right). Note: the values for the high resolution STILT case were scaled down by the grid area ratio. The black contour line indicates the 50% largest sensitivities.

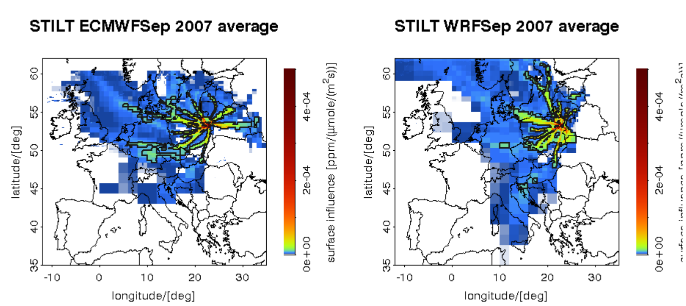

Figure 2. Sensitivities of monthly mean observations to surface fluxes for a tall tower in Poland for the month of September 2007 calculated with ECMWF-STILT (left) and WRF-STILT(right). Notation as in Figure 1.