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Optimizing CO_2 observing networks in the presence of model error: results from TransCom 3

R. J Rayner
CSIRO Atmospheric Research, Melbourne, Australia

Abstract. We use a genetic algorithm to construct optimal observing networks of atmospheric concentration for inverse determination of net sources. Optimal networks are those that produce a minimum in average posterior uncertainty plus a term representing the divergence among source estimates for different transport models. The addition of this last term modifies the choice of observing sites, leading to larger networks than would be chosen under the traditional estimated variance metric. Model-model differences behave like sub-grid heterogeneity and optimal networks try to average over some of this. The optimization does not, however, necessarily reject apparently difficult sites to model. Although the results are so conditioned on the experimental set-up that the specific networks chosen are unlikely to be the best choices in the real world, the counter-intuitive behaviour of the optimization suggests the model error contribution should be taken into account when designing observing networks. Finally we compare the flux and total uncertainty estimates from the optimal network with those from the 3 control case. The 3 control case performs well under the chosen uncertainty metric and the flux estimates are close to those from the optimal case. Thus the 3 findings would have been similar if minimizing the total uncertainty guided their network choice.

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