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Global optimization of an observing system design for the North Atlantic meridional overturning circulation

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Three methods are analyzed for the design of ocean observing systems to monitor the meridional overturning circulation (MOC) in the North Atlantic. Specifically, a continuous monitoring array is 'deployed' into a numerical model. We compare array design methods guided by (i) physical intuition (heuristic array design), (ii) sequential optimization, and (iii global optimization. Global optimization technique can recover the true global solution for the analyzed array design, while gradient based optimization would be prone to isconverge. Both global optimization and heuristic array design yield considerably improved results over sequential array design. Global optimization always outperforms the heuristic array design in terms of minimizing the root mean square error. However, whether the results are physically meaningful is not guaranteed; the apparent success might merely represent a solution in which misfits compensate each other accidentally. Testing the solution gained from global optimization in an independent data set can provide crucial information about the solution's robustness.