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Use of Genetic Algorithms for Ocean Model Parameter Optimisation

Marcus Falls, Martí Galí Tàpias, Raffaele Bernardello, and Miguel Castrillo
Barcelona Supercomputing Center, Earth Sciences, Spain (marcuspfalls@gmail.com)

When working with Earth system models, a considerable challenge that arises is the need to establish the set of parameter values that ensure the optimal model performance in terms of how they reflect real-world observed data. Given that each additional parameter under investigation increases the dimensional space of the problem by one, simple brute-force sensitivity tests can quickly become too computationally strenuous. In addition, the complexity of the model and interactions between parameters mean that testing parameters on an individual basis has the potential to miss key information. As such, this work argues the need of the development of a tool that can give an estimation of parameters. Specifically it proposes the use of a Biased Random Key Genetic Algorithm (BRKGA). This method is tested using the one dimensional configuration of PISCES, the biogeochemical component of NEMO, a global ocean model. A test case of particulate organic carbon in the North Atlantic down to 1000m depth is examined. In this case, two tests are run, one where each of the model outputs are compared to the model outputs with default parameters, and another where they are compared with 3 sets of observed data from their respective regions, which is followed by a cross reference of the results. The results of these analyses provide evidence that this approach is robust and consistent, and also that it provides indication of the sensitivity of parameters on variables of interest. Given the deviation of the optimal set of parameters from the default, further analyses using observed data in other locations is recommended to establish the validity of the parameters.