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Gaussian process emulation in biogeochemical modeling

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In a changing climate, marine pelagic biogeochemistry may modulate the atmospheric concentrations of climate–relevant species such as CO_2. Among the main tools suited to explore this effect are earth system model which comprise a pelagic biogeochemical model component typically embedded into a computationally expensive 3-dimensional ocean circulation model. The biogeochemical models rely on a set of poorly constrained parameters (such as, e.g., the maximum growth rate of phytoplankton). Ideally the parameters would be known per se - which they are not - or could be assigned by employing optimization techniques that assign parameters such that the misfit between the model and observations is minimised. So far, however, the optimization process has been forestalled by the high computational cost that is associated to conventional numerical parameter optimization techniques. Here we explore the capacity of recent developments in statistical meta-models to overcome the computational limitations. The idea is that by approximating the original biogeochemical model with an emulator the associated computational cost is reduced rendering an optimization possible. We present first trials and report on the applicability of a Gaussian Process Emulator for biogeochemical ocean modeling.