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Balancing efficiency and user-friendliness in model development: The case of the Parcels Lagrangian Ocean framework

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Lagrangian particle tracking is an increasingly popular tool to analyse ocean general circulation model (OGCM) outputs. It is used in a large variety of applications, from physics to biology to archeology, that each have their own specifications. Consequently, the need of a flexible tool is larger than ever. At the same time, just as OGCMs deal with up to hundreds of terabytes data, this tool needs to be efficient to process such enormous amount of data.

Parcels (oceanparcels.org) is a new Lagrangian Ocean Analysis framework, designed to process the output of state-of-the-art models. To combine modularity, user-friendliness and efficiency, the model API is implemented in Python before being just-in-time compiled in C and executed as a library. More than a Lagrangian particle model, Parcels is a framework, based on the Domain Specific Languages paradigm. It aims to decouple the model defined by the user from the low-level implementation.

For that purpose, the model is split into different quasi-independent modules: grids, fields, particles and execution kernels. Such design gives freedom to the user to handle data with different formats or to build kernels defining the appropriate dynamics for a specific particle. While the drawbacks of such approach are a complex object hierarchy for the developer, the advantages are a large flexibility on a high-level framework for the user. Parcels already gives promising results, but the list of issues and challenges is still long: How to handle I/O issues? How to take best advantage of HPC clusters? How to accommodate particle-particle interactions?