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Online deployment of pre-trained machine learning components within Earth System models via OASIS

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The combination of Machine Learning (ML) with geoscientific models is an active area of research with a wide variety of applications. A key practical question for those models is to define how high level languages ML components can be encoded and maintained into pre-existing legacy solvers, written in low level abstraction languages (as Fortran). We address this question through the strategy of creating pipes between a geoscientific code and ML components executed in their own separate scripts. The main advantage of this approach is the possibility to easily share the inference models within the community without keeping them bound to one code with its specific numerical methods. Here, we chose to focus on OASIS (<https://oasis.cerfacs.fr/en/>), which is a Fortran coupling library that performs field exchanges between coupled executables. It is commonly used in the numerical geoscientific community to couple different codes and assemble earth-system models. Last releases of OASIS provided C and Python APIs, which enable coupling between non-homogeneously written codes. We seek to take advantage of those new features and the presence of OASIS in the community codes, and propose a Python library (named Eophis) that facilitates the deployment of inference models for coupled execution. Basically, Eophis allows to: (i) wrap an OASIS interface to exchange data with a coupled earth-system code, (ii) wrap inference models into a simple in/out interface, and (iii) emulate time evolution to synchronize connexions between earth-system and models. We set up a demonstration case with the European numerical code NEMO in which the pre-existing OASIS interface has been slightly modified. A forced global ocean model simulation is performed with regular exchanges of 2D and 3D fields with Eophis. Received data are then sent to inference models that are not implemented in NEMO. Performances of the solution will finally be assessed with references.