Fluidity - an open-source, next-generation, fluid dynamics framework

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Fluidity is an open source, general purpose, multi-phase computational fluid dynamics code capable of numerically solving the Navier-Stokes and accompanying field equations on arbitrarily unstructured finite element meshes in one, two and three dimensions. It is used in a number of different scientific areas including geophysical fluid dynamics, computational fluid dynamics, ocean modelling and mantle convection. It uses a finite element/control volume method which allows arbitrary changes to the mesh with time dependent problems, allowing mesh resolution to increase or decrease locally according to the current simulated state. It has a wide range of element choices including mixed formulations. Fluidity is parallelised using MPI and is capable of scaling to many thousands of processors on the UK national HPC service, HECToR. Other innovative and novel features are a user-friendly GUI and a python interface which can be used to calculate diagnostic fields, set prescribed fields or set user-defined boundary conditions.

Here, an outline of the features of Fluidity is given, with some examples of its use in a number of scientific areas within the Earth Sciences. The novel aspects of Fluidity, namely the adaptive mesh capabilities are the main focus. Fluidity has been recently released and is available under GNU Lesser General Public Licence from amcg.ese.ic.ac.uk.