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A finite element stabilization method for advection-diffusion, non-hydrostatic flow and the shallow water equations

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A stabilized finite element method is presented which inherits features of both discontinuous and continuous Galerkin finite element methods. A field is defined on interior element boundaries connecting functions on elements that are discontinuous between elements. The approach allows the incorporation of natural upwinding at element boundaries, which is typical of discontinuous Galerkin methods, with the same number of global degrees of freedom as for a continuous Galerkin method. The element matrices to be computed before assembly are very similar to those for the continuous Galerkin method. For linear elements, only minor modifications are therefore required to existing continuous finite element codes. The method is developed for the advection-diffusion problem, non-hydrostatic incompressible flows with a free surface and the shallow water equations. The talk will elaborate on the link to other stabilized methods and present a range of numerical examples, with particular emphasis on coastal and estuarine applications. These examples confirm that the method is optimally stable with only minimal numerical dissipation.