Adaptive time stepping with two coupled fluids

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ABSTRACT

A model of natural heat convection for two fluids coupled across an interface is used to investigate adaptive time stepping, motivated by air-sea interaction for climate, regional modeling or weather forecasting applications. The model retains the key mathematical structure of the boundary conditions used for air-sea coupling. Numerical approximations of the boundary conditions can introduce spurious energy and create instabilities. A condition is derived to identify this phenomenon during simulation, which provides a criterion for adaptivity. Techniques considered to mitigate instabilities include changing the local order of approximation for the boundary conditions, changing the length of a coupling interval and iterating to better resolve the coupling effects. In [1], all of these choices were observed to impact stability; provably, iteration with a sufficiently small coupling interval will stabilize the algorithm. Computational tests are performed to compare the adaptive approaches, using both sequential and concurrent configurations of the two fluid modules.

REFERENCES

[1] Connors, J.M. and Dolan, R.D. Stability of two conservative, high-order fluid-fluid coupling methods, *submitted*.