Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

Dynamic time scale for the Lagrangian subgrid-scale model based on Rice's formula[1] CLAIRE VERHULST, CHARLES MENEVEAU, Mechanical Engineering and CEAFM, Johns Hopkins University — The dynamic formulation of Smagorinsky's subgrid-scale model for Large Eddy Simulations (LES) requires averaging to avoid instability due to extreme fluctuations. For complex-geometry flows a Lagrangian approach is often useful [see Meneveau, Lund, and Cabot, JFM 319 (1996)]. However, an ad-hoc choice of the relaxation timescale must be made, often based on resolved strain-rates and stresses at the grid- scale. Recently, Park and Mahesh [Phys. Fluids 21, 065106 (2009)] proposed the attractive notion of using statistics of the error signal itself to determine a timescale dynamically. We extend this approach by using Rice's formula to dynamically estimate the time between mean-crossings of the error signal and set the averaging timescale to be twice this value. The approach requires accumulating Lagrange-averaged square error and its time-derivative squared, which is done using the Eulerian approximation as proposed in the original model. For validation, LES of flow in a channel and through an array of cubes are compared with experimental results. Distributions of the dynamic coefficient, error, and dynamic timescale are shown as a function of distance from the wall. Computational efficiency and memory requirements are also discussed.

[1]Supported by NSF (GRFP and AGS-1045189).

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Date submitted: 04 Aug 2011 Electronic form version 1.4