Measuring dissipation in implicit large-eddy simulations of solar convection

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Abstract

Implicit large eddy simulations of solar magnetohydrodynamical convection have allowed to reproduce a a number of observed solar behaviors, most notably a regular, large-scale magnetic polarity reversal cycle taking place with a period much longer than typical convective turnover times [1,2]. The amazingly large Reynolds and Rayleigh numbers in the convective interior of the Sun present a formidable challenge and pushes us to minimize as much as we can the influence of dissipation in our models. The adaptive dissipation introduced by the MPDATA advection algorithm of the EULAG simulation protocole plays a key role in assuring stability in strongly turbulent regimes, even working on the relatively coarse spatial meshes required to carry out simulations extending on centennial timescales [3]. In this talk we present estimates of effective dissipation coefficients obtained by analyzing spectral decompositions of the conservative anelastic equations solved by EULAG. The derived dissipation properties are then used in the large-eddy simulation code ASH and show a very good agreement with the implicit large-eddy simulation of EULAG. The comparison highlights the strong scale dependence of the numerical dissipation introduced by MPDATA [4].

References

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