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Resolvent-based modeling of passive scalar dynamics in wall-bounded turbulence[1] SCOTT DAWSON, THERESA SAXTON-FOX, BEVERLEY MCKEON, California Institute of Technology — The resolvent formulation of the Navier-Stokes equations expresses the system state as the output of a linear (resolvent) operator acting upon a nonlinear forcing. Previous studies have demonstrated that a low-rank approximation of this linear operator predicts many known features of incompressible wall-bounded turbulence. In this work, this resolvent model for wall-bounded turbulence is extended to include a passive scalar field. This formulation allows for a number of additional simplifications that reduce model complexity. Firstly, it is shown that the effect of changing scalar diffusivity can be approximated through a transformation of spatial wavenumbers and temporal frequencies. Secondly, passive scalar dynamics may be studied through the low-rank approximation of a passive scalar resolvent operator, which is decoupled from velocity response modes. Thirdly, this passive scalar resolvent operator is amenable to approximation by semi-analytic methods. We investigate the extent to which this resulting hierarchy of models can describe and predict passive scalar dynamics and statistics in wall-bounded turbulence.

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