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Chemically reacting fluid flow in exoplanet and brown dwarf atmospheres BAYLEE BORDWELL, BENJAMIN P. BROWN, Department of Astrophysical and Planetary Sciences, University of Colorado Boulder, JEFFREY S. OISHI, Department of Physics and Astronomy, Bates College — In the past few decades, spectral observations of planets and brown dwarfs have demonstrated significant deviations from predictions in certain chemical abundances. Starting with Jupiter, these deviations were successfully explained to be the effect of fast dynamics on comparatively slow chemical reactions. These dynamical effects are treated using mixing length theory in what is known as the "quench" approximation. In these objects, however, both radiative and convective zones are present, and it is not clear that this approximation applies. To resolve this issue, we solve the fully compressible equations of fluid dynamics in a matched polytropic atmosphere using the state-of-the-art pseudospectral simulation framework Dedalus. Through the inclusion of passive tracers, we explore the transport properties of convective and radiative zones, and verify the classical eddy diffusion parameterization. With the addition of active tracers, we examine the interactions between dynamical and chemical processes using abstract chemical reactions. By locating the quench point (the point at which the dynamical and chemical timescales are the same) in different dynamical regimes, we test the quench approximation, and generate prescriptions for the exoplanet and brown dwarf communities.

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