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## Acoustic-gravity wave propagation characteristics in 3D radiation hydrodynamic simulations of the solar atmosphere

There has been tremendous progress in the degree of realism of three-dimensional radiation magneto-hydrodynamic simulations of the solar atmosphere in the past decades. Four of the most frequently used numerical codes are Bifrost, CO5BOLD, MANCHA3D, and MURaM. Here we test and compare the wave propagation characteristics in model runs from these codes by measuring the dispersion relation of acoustic-gravity waves at various heights. An earlier study (<https://doi.org/10.1098/rsta.2020.0170>) used model runs with vastly differing setups (box size, cell size, cadence, duration, radiative transfer, average magnetic field strength). Here we compare model runs with an identical setup. There is much better agreement between the different models now than in the previous study, although there are still considerable differences in certain aspects. The cause of the high-frequency phase ridges in the convection zone is now understood. They result from standing waves in a cavity between the lower boundary and the bottom of the photosphere.

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