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Constraining the acoustic wave flux in the solar chromosphere with observations and simulations

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This study presents a comparison of the high frequency wave power found in 3D numerical MHD models of the solar atmosphere (Bifrost and MURaM) with real observations of chromospheric lines. We also discuss the systematics originating from using different models to calculate the acoustic wave flux in the solar chromosphere. In particular, we synthesize from the MHD models spectral lines sampling the lower chromosphere (Mn I 280.1 nm, Na D1), middle chromosphere (Ca II 854.2 nm) and the upper chromosphere (Mg II h&k) with the RH15D code. We compare the synthetic observations with data from the IRIS observatory and the IBIS instrument at the DST. We also study the emerging lack of high frequency phase differences between the observed velocity diagnostics and how is this phenomenon affected by the rapidly changing line formation height. Based on these results, we investigate the systematics of inferring acoustic wave flux in the solar chromosphere. We find that the main uncertainty in determining the wave flux in the chromosphere is due to the changing height of formation and the associated changes in the plasma density. This effect leads to uncertainties of the inferred flux on the order of magnitude. Furthermore, the dynamic time-dependent chromospheric models also show significantly lower attenuation of the detected wave signals, compared with the previously used 1D semi-empirical models. The main takeaway from this study is that we need numerical chromospheric models that resemble closely the solar wave properties, to be able to infer the acoustic wave flux accurately.

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