Current status of self-consistent 3D radiative-MHD simulations of the solar atmosphere

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In recent years, there has been major progress in the development of self-consistent models of the solar atmosphere. These simulations aim to capture the physics from the convection zone to the corona. However, the solar chromosphere, which is an interface layer between the photosphere and corona, has been difficult to model realistically. This is because the chromosphere is dominated by transitions: from optically thin to optically thick radiation, from continuum to energetically important atomic transitions, from gas pressure to magnetic pressure dominance. In addition, the chromosphere is where non-LTE and non-grey radiative transport are important, hydrogen ionization is time dependent, the plasma is partially ionized, etc. As a result, the chromosphere is highly dynamic and complex, and filled with dynamical features that may play a significant role in the mass and energy balance of the corona and solar wind. I will describe the physics included in current state-of-the-art numerical codes, and their importance for the thermodynamics of the solar atmosphere. I will focus on recent work that investigates the formation of spicule-like features, and the effects of partial ionization on the dynamics and energetics of the chromosphere.