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Interrogating Solar Flare Models with IRIS Observations and Looking to the Future

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Solar flares are transient yet dramatic events in the atmospheres of the Sun, during which vast amounts of magnetic energy is liberated. This energy is subsequently transported through the solar atmosphere or into the heliosphere, and together with coronal mass ejections flares comprise a fundamental component of space weather. Thus, understanding the physical processes at play in flares is vital. That understanding often requires the use of forward modeling in order to predict the
hydrodynamic and radiative response of the solar atmosphere. Those predictions must then be critiqued by observations to show
us where our models are missing ingredients. While flares are of course 3D phenomenon, simulating the flaring atmosphere including an accurate chromosphere with the required spatial scales in 3D is largely beyond current computational capabilities, and certainly performing parameter studies of energy transport mechanisms is not yet tractable in 3D. Therefore, field-aligned 1D loop models that can resolve the relevant scales have a crucial role to play in advancing our knowledge of flares. In recent years flare loop models have revealed many interesting features of flares. For this review I highlight some important results that illustrate the utility of attacking the problem of solar flares with a combination of high quality observations, and state-oft-the-art flare models, demonstrating: (1) how models help to interpret flare observations, (2) how those observations show us where we are missing physics from our models, and (3) how the ever increasing quality of solar observations drives model improvements.

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