



Nonlinear magnetohydrostatic modeling of an active region based on a SUNRISE/IMaX vector magnetogram

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For modelling the upper solar photosphere and chromosphere, plasma forces are important. Therefore a nonlinear magnetohydrostatic (NLMHS) model is a better approximation of the physical state in these layers than a nonlinear force-free (NLFF) model. The latter one is only valid in the low plasma-beta corona. The magnetohydrostatic model computes self-consistently the magnetic field and plasma distribution. We intensively tested the new code with exact equilibria (Zhu & Wiegelmann, 2018, ApJ, 866, 130) and the NLMHS code has been able to meaningfully recover the plasma density, pressure and magnetic field. Here we present a first application of our new code to an active region (AR 11768), which was observed by IMaX during the second flight of the balloon-borne SUNRISE solar observatory in 2013. The high spatial resolution IMaX vector magnetogram was embedded in SDO/HMI data to cover the entire active region. We were able to model the non-force-free layer in the lower atmosphere. Our model shows strongly localized electric currents and Lorentz forces and self-consistently the corresponding plasma distribution. Such features require the use of a NLMHS model and cannot be reconstructed with linear MHS or NLFFF models.