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Numerical experiments of the 2006 Dec. 13 flare based on Hinode vector magnetograms

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Abstract. The detection of three-dimensional (3D) structure and dynamics of coronal magnetic field is crucially important for the understanding of solar eruption. However, due to the limitation of magnetic sensitive lines in the corona, it was unrealizable so far. In this paper, we have developed new simulation study of solar eruption based on Hinode vector magnetogram, in order to reveal the 3D dynamics of solar eruption in terms of the collaboration between observation and 3D MHD simulation. The initial condition of the simulation is given by nonlinear force-free field, which was extrapolated from Hinode vector magnetogram, and flare is initialized by imposing virtual plasma motion on the photospheric boundary. We applied the simulation on the X-class flare occurred in the active region NOAA10930 on Dec. 13, 2006. As a result, we can successfully simulate the formation of post-flare loop, and plasmoid ejection, which are well consistent with the observations. Using the numerical experiment, we also study the detail process of energy propagation out of the active region caused by the solar flare. As a consequence, we found that the substantial magnetic free energy could be loaded to a large scale magnetic loop, which was rooted near the flaring region, through magnetic reconnection and magnetic helicity propagation due to twisting motion. It suggests that the core of coronal mass ejection originates from the loop placed lateral to the active region, rather than the center of flare. Finally, we investigate the vulnerabilityEof active region by imposing different trigger motion on the photosphere in order to reveal the physical condition of flare onset. Based on the results, we discuss about the predictability of solar eruption as well as about the potency of Hinode observation for space weather prediction.