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Simulation of Energy Storage in the Corona for Solar Flares Using Photosphere Magnetic Field Distributions

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The principle new approach to 3D MHD calculations of energy storage above an active region for the solar flare and CME is developed. Photospheric magnetic charts, obtained several days before the flare, are introduced as boundary conditions. The potential magnetic field is obtained before appearance of noticeable changing on the photosphere, and then it is used as an initial condition in calculation of magnetic energy accumulation above an active region due to changing of the photospheric field. It is shown, that the method of approximation of the magnetic field by dipoles or charges, which has been used before, not always permits to set initial magnetic field with its singular lines correctly. For calculations it is used the last version of Peresvet code for MHD equations solving with the conservative relative to magnetic flux scheme. This scheme permits to stabilize slowly developed numerical instability. Such instability usually appears in the region of strong magnetic field gradients near the photosphere. During the analyzing of complicated active regions with asymmetric magnetic configurations, the difficulties of finding of places, where magnetic energy of a flare can be accumulated (singular lines), are appeared. For the fast registration of singular lines the methods are developed, which are based on analyzing of the matrix of magnetic field gradients and its eigenvalues and searching of the places of the maximal current density in complicated 3D magnetic field configurations. The developed methods are used for calculations of energy accumulation for the flares June 14, 2000 (Bastille flare) and May 27, 2003. These numerical experiments permit to establish the energy accumulation for these events and to find places, where energy accumulation occurs.