Geophysical Research Abstracts
Vol. 20, EGU2018-5038, 2018
EGU General Assembly 2018

On the factors determining the eruptive character of solar flares

Christian Baumgartner, Julia K. Thalmann, and Astrid M. Veronig
Institute of Physics & Kanzelhöhe Observatory, University of Graz, Austria (astrid.veronig@uni-graz.at)

We investigated how the magnetic field in solar active regions (ARs) controls flare activity, i.e., whether a flare will be confined or eruptive. We analyzed 44 flares of GOES class M5.0 and larger that occurred during the years 2011–2015. We used 3D potential magnetic field models to study their location (using the flare distance from the flux-weighted AR center d_{FC}) and the strength of the magnetic field in the corona above (via decay index n and flux ratio). We also present a first systematic study of the change of orientation of the coronal magnetic field with height, using the orientation φ of the flare-relevant polarity inversion line as a measure. We analyzed all quantities with respect to the size of the underlying dipole field, characterized by the distance between the opposite-polarity centers, d_{PC}. Flares originating from underneath the AR dipole ($d_{\mathrm{FC}}/d_{\mathrm{PC}} < 0.5$) tend to be eruptive if launched from compact ARs ($d_{\mathrm{PC}} \leq 60$ Mm) and confined if launched from extended ARs. Flares that occur in the periphery of ARs ($d_{\mathrm{FC}}/d_{\mathrm{PC}} > 0.5$) are predominantly eruptive. In confined events, the flare-relevant field adjusts its orientation quickly to that of the underlying dipole with height ($\Delta\varphi \gtrsim 40^{\circ}$ for reaching the apex of the dipole field), in contrast to eruptive events where it changes more slowly with height. The critical height for torus instability, $h_{\mathrm{crit}} = h(n = 1.5)$, discriminates best between confined ($h_{\mathrm{crit}} \gtrsim 40$ Mm) and eruptive flares ($h_{\mathrm{crit}} \lesssim 40$ Mm). It discriminates better than $\Delta\varphi$, implying that the decay of the confining field plays a stronger role than its orientation at different heights.