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The active Sun and its implication for the heliosphere
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Magnetic Field Topology and Energetics in the Flaring Active Region 11158

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We report on the evolution of magnetic field topology and pertinent free energy of NOAA AR 11158 over a period of 5 days. Flux emergence and strong shear motion created a complex quadrupolar structure which led to multiple eruptions, including the first X-class flare of the current solar cycle. We analyze a series of vector magnetograms from the Helioseismic and Magnetic Imager (HMI) on board the Solar Dynamic Observatory (SDO) and reconstruct the coronal field by using a non-linear force-free (NLFF) field extrapolation. The estimated free magnetic energy shows a great increase that accompanies flux emergence, while a significant decrease is found after the X-class flare. We relate this decrease to a rapid coronal field reconfiguration during the flaring process, which is supported by coronal loop observation and manifests itself through a previously reported, sudden change of the photospheric flux distribution. Due to the loss of energy, the coronal magnetic structure becomes more compact after the flare, with lower layers more stressed but overall less energetic.