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Wavelet spectral analysis of the ENIGMA magnetometer array and solar wind time series around the strongest magnetic storms of solar cycle 24

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Magnetic storms are undoubtedly among the most important phenomena in space physics and also a central subject of space weather. The HellENIc GeoMagnetic Array (ENIGMA) is a network of 4 ground-based magnetometer stations in the areas of Thessaly, Central Greece, Peloponnese and Crete in Greece that provides geomagnetic measurements for the study of pulsations, resulting from the solar wind - magnetosphere coupling. ENIGMA magnetometer array enables effective remote sensing of geospace dynamics and the study of space weather effects on the ground (i.e. Geomagnetically Induced Currents - GIC). ENIGMA contributes data to SuperMAG, a worldwide collaboration of organizations and national agencies that currently operate approximately 300 ground-based magnetometers. Here we study the Earth's magnetic field time variations measured by ENIGMA, when the most intense magnetic storms (i.e. Dst < -150 nT) of solar cycle 24 occurred (i.e. March, June and December 2015, and August 2018), along with the corresponding variations of solar wind parameters and geomagnetic activity indices. We apply spectral analysis techniques based on wavelet transforms and calculate the Hurst exponent of these time series. Our results show the existence of two different patterns: (i) a pattern associated with the intense magnetic storms, which is characterized by higher Hurst values, and thus, higher organization of the magnetosphere; (ii) a pattern associated with the quiet-time magnetosphere, which is characterized by lower Hurst values, and thus, lower organization of the magnetosphere.