

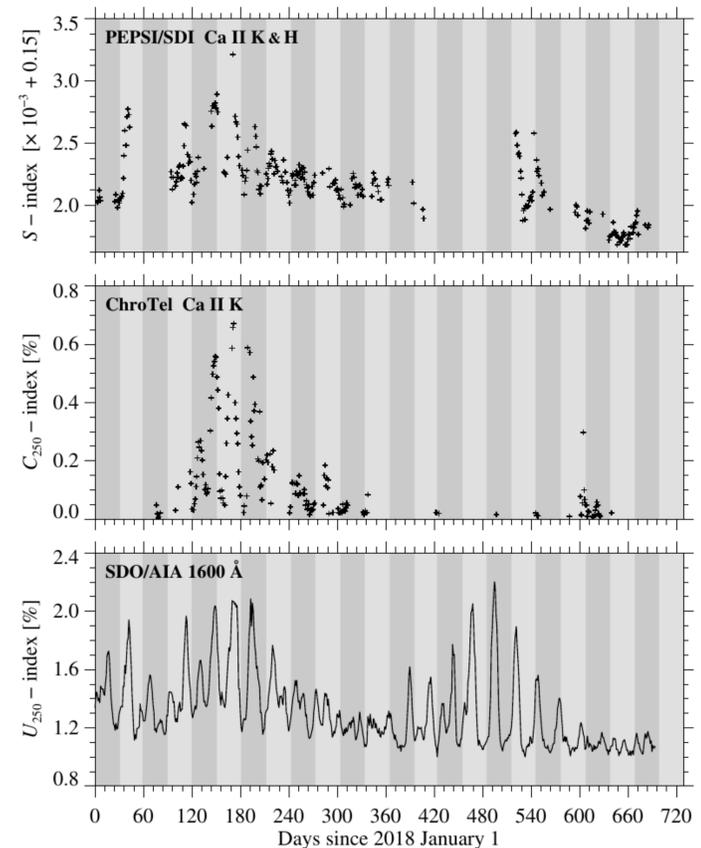
Global Solar Magnetic Variations Characterized by Excess Brightness Indices and Spectroscopic Proxies

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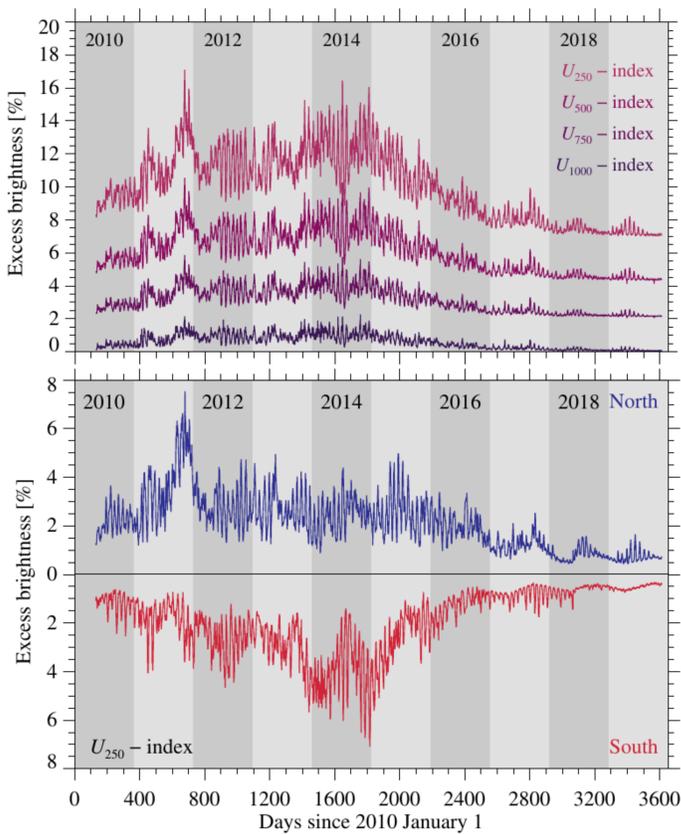
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Activity Across the Spectrum

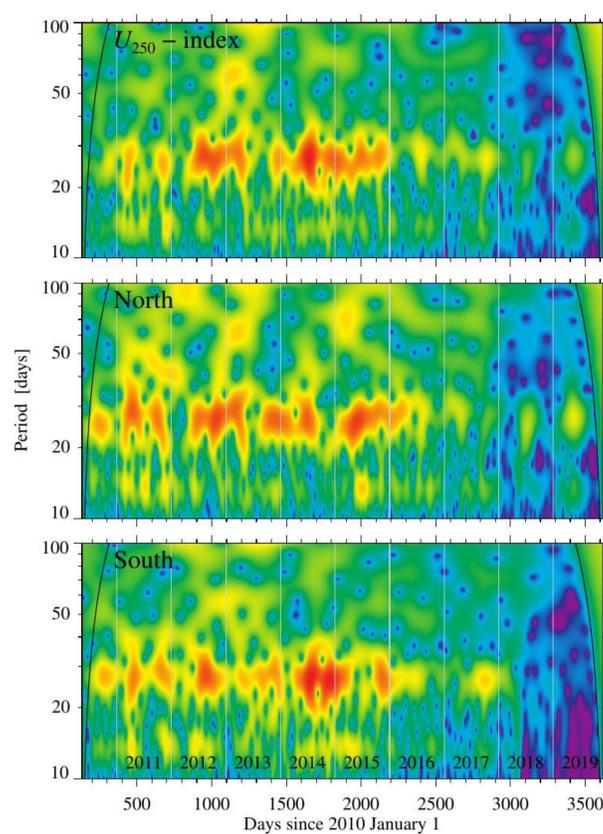
On a global scale chromospheric magnetic activity is represented by plages and enhanced chromospheric network. These phenomena significantly contribute to the variation of the solar UV radiation and the enhancement in chromospheric emission in the two strong resonance Ca II H & K lines. We present a set of excess brightness and area indices based on disk-resolved UV 1600 Å images of the Atmospheric Imaging Assembly (AIA) on board the Solar Dynamics Observatory (SDO) and full-disk Ca II K line-core filtergrams of the Chromospheric Telescope (ChroTel) at Observatorio del Teide, Tenerife, Spain. In addition, we compute the spectroscopic S-index based on the quasi-synoptic observations in 2018 and 2019 with the Potsdam Echelle Polarimetric Spectroscopic Instrument (PEPSI) of the Large Binocular Telescope (LBT) at Mt. Graham International Observatory (MGIO), Arizona, U.S.A. All indices display signatures of rotational modulation, even during the very low magnetic activity in the minimum of Solar Cycle 24. The UV 1600 Å and Ca II K image-based excess brightness indices reveal as strong peak of activity in 2011 and the double-peaked maximum in 2014. These features are driven by complex and large active regions. Furthermore, both spectral- and image-based indices demonstrate that the Solar Cycle 24 concludes with a deep minimum. Moreover, the SDO/AIA UV excess brightness indices reveal an intriguing aspect of activity asymmetry between the two hemispheres. In particular, starting in 2018, the rotational modulation in the southern hemisphere vanishes, indicating exceptionally low solar activity representing the basal activity level of the Sun.



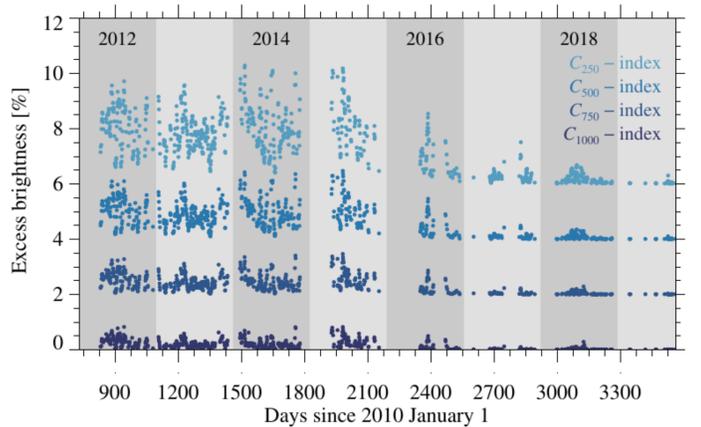
Time-series of the PEPSI/SDI Ca II H & K S-index (top), ChroTel Ca II K index C_{250} (middle), and SDO/AIA UV 1600 Å index U_{250} (bottom). The alternating dark and light gray rectangles denote one-month periods. The plus signs reflect the irregular data coverage of the S- and C_{250} -indices, while the U_{250} -index has a continuous coverage.



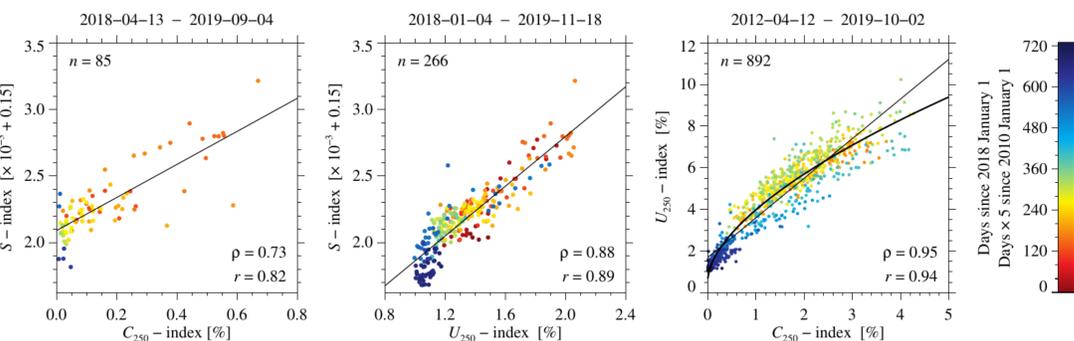
Time-series of the excess brightness indices U_k and their corresponding area indices A_k^U based on AIA 1600 Å full-disk images expressed as percentage of the quiet Sun intensity. The indices are vertically separated by a constant value for better display (top). Time-series of the excess brightness U_{250} -index computed separately for the northern and southern hemispheres based on AIA UV 1600 Å long-integration images with a 25% threshold (bottom).



Power spectrum based on the Morlet wavelet transform of the global U_{250} -index and its two hemispheric components. The two curved lines at the sides represent the cone-of-influence, i.e., outside these bounds, edge effects impinge upon the power spectrum. The rainbow-colored logarithmic scale of the power spectral density covers five decades.



Time-series of the excess brightness indices C_k and their corresponding areal indices A_k^C based on ChroTel Ca II K full-disk images. The alternating dark and light gray stripes mark successive years since 2010. The legend in the upper-left corner of the panels provides the key to the intensity thresholds of 25%, 50%, 75%, and 100% of the quiet Sun intensity (same as U_k index). The indices are vertically separated by a constant value for better display.



Scatter plots of the S-, C_{250} -, and U_{250} -indices. The diagonal straight lines represent linear fits. In addition, a geometric regression model was applied to the U_{250} -index (thick curve). The number of common data values differs in each plot, and their chronological order is color-coded. The relation between the S-index and the two excess brightness indices is clearly linear. The quadratic fit between the two excess brightness indices, is indicative of the morphological differences between bright regions seen in the K-line and 1600 Å C IV and continuum.