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Analysis of Ca II K images aiming to determine long-term trends in solar irradiance variability

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The change in radiative output of the Sun on time scales longer than a day is attributed to the variability in solar surface magnetic fields. Direct irradiance measurements are only available for less than four decades. To reconstruct long term trends in solar total and spectral irradiance, proxies of solar surface magnetism like sunspot, facular and network areas are needed. Currently, sunspot records alone are used for this purpose, from which the deduction of facular and network areas is rather indirect. Historical records of full disk images of the Sun taken in the Ca II K spectral line (393.3 nm) have the potential to provide far more direct information about the distribution and evolution of faculae and network elements. The latter appear as bright regions in the Ca II K spectroheliograms and their intensity is correlated with the magnetic field strength of the features on the solar surface.

Solar full disk images in the Ca II K line have been recorded since the beginning of the 20th century at a number of solar observatories such as at Arcetri (Italy), Mount Wilson(California, US) and Kodaikanal (India). The images are available in digitized archives that contain the data processed for standard instrumental calibrations. To utilize these records for irradiance studies, the next step is to identify the bright magnetic features from the images using feature recognition techniques. We test different feature identification methods which are first applied to a set of recent images from the PSPT instrument at the Osservatorio Astronomico di Roma, taken during three periods characterized by high, medium and low levels of activity. Then the performance of these methods to historical images from Arcetri, Mt. Wilson and Kodaikanal archives is tested. The results will be presented and discussed here.