Call for PhD studies:

Study of solar activity and solar irradiance
A naptevékenység és szoláris irradiancia vizsgálata

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The amount of the solar energy output carried by the electromagnetic radiation is one of the basic data of the Sun. It is one of the longest and most fundamental of all climate data records derived from space-based observations. Variations in the spectrum of solar irradiance (the Solar Spectral Irradiance, SSI) or in the total (spectrally integrated) solar irradiance (TSI) may affect a number of radiative, dynamical, and chemical processes in the Earth's atmosphere, and the climate. TSI is required for establishing Earth's total energy input while SSI is needed to understand how the atmosphere responds to changes in the sun's output. The space-borne measurements found an irradiance variation of ~0.1-0.3%.
The TSI and SSI exhibit variations on various time scales caused by magnetic features in the solar atmosphere. Considerable international efforts are devoted to track the irradiance variations and to clarify the roles of these magnetic features in them. At present, there are no physical models available but proxy-based models and semi-empirical models have been developed to model the measured data and to extend the studies to wavelengths where no direct irradiance measurements exist and backwards to the times before the start of the irradiance datasets. The performance of proxy models that are based on daily indices representing the darkening of sunspots and the brightening by faculae and small magnetic elements strongly depends on the precision of the proxies. The Debrecen sunspot databases are widely acknowledged as the most precise and detailed empirical bases of the sunspot activity and the datasets of photospheric faculae are unique. The exploitation of these data in irradiance modeling would be a novelty. The timing of the planned research with the onset of these new high-accuracy observations also provides new opportunities. The launch of the Total and Spectral Solar Irradiance Sensor (TSIS) mission is planned at the time of the expected start of this project. The TSIS TIM will continue the high accuracy TSI record of NASA SOlar Radiation and Climate Experiment (SORCE) TIM (launched in 2003), but with even improved accuracy. TSIS SIM will continue the 13+ year record of SORCE SIM, but it will measure the spectrum from 200-2400 nm, with an ~order of magnitude improved absolute accuracy and improved stability 0.01% per year (for wavelengths > 400 nm) and 0.05%/year for wavelengths < 400 nm). The TSIS, designed for long term SSI measurements, will be very important for model validation. The planned task is to find answers to some open questions of irradiance modeling on contributions of various solar features. The supervisor's previous results show that the darkening effect of a sunspot group may not only depend on the area and contrast of spots but it may also depend on the evolutionary phase and morphology of the group. These results should be verified or falsified by using the newest irradiance and proxy data of the highest precision. The proxy of the facular contribution is usually the MgII index measured on the unresolved solar disc representing the coverage of the disc by chromospheric faculae. This full-disk spectral proxy can not accurately account for the center-to-limb variation (CLV) of facular component. The Debrecen photospheric facular data may help in modeling the CLV of the facular component as a new additional proxy. With the onset of the TSIS observations, we will be even better positioned to evaluate effectiveness of new research in quantifying the sunspot darkening and facular brightening in modeling solar variability.