First Results on Solar Irradiance Variability from PROBA2/LYRA/SWAP

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Abstract

The Sun is the primary source of energy responsible for governing both the weather and climate of Earth. For that reason alone one would expect that changes in the amount and type of energy Earth received from the Sun could alter weather and climate on the Earth. The variations in the UV irradiance are produced by surface manifestation of solar magnetic activity. Considering the variations in the solar UV flux may cause significant changes in the Earth's climate, understanding the physical origin of UV irradiance changes is an extremely important issue in Solar and Space Physics.

We have analysed the time series of irradiance measurements from PROBA2/LYRA in Channel 3 (Aluminium Filter Channel: 170 - 500 A, including strong HeII 304 A) and full-disk integrated intensity values observed with PROBA2/SWAP 174 Å . We found that there is good correlation between the LYRA irradiance values (observed Sun as a Star) and spatially resolved full-disk intensity values of SWAP 174 Å . This clearly explains that the LYRA irradiance variations are due to the various magnetic features which are contributing significantly. The detailed analysis and the important results will be discussed in this paper.

Scientific Background

The long-term irradiance variations are attributed to the changing emission of bright magnetic elements and the short-term irradiance variations are directly associated with active regions as they evolve and move across the solar disk.

The current irradiance models are based on full-disk surrogates, such as the 10.7 cm radio flux (Barth *etal.*, 1990), the full-disk CaII K index (Livingston, 1993), and the HeI line equivalent width at 1083 nm (Foukal and Lean, 1988, Pap, 1992), therefore they cannot provide adequate information on the In order to understand the physical mechanisms of solar irradiance variability and to determine the contributions of individual features of Sun, a detailed analysis of spatially resolved data is essential.

A two-dimensional image of the Sun (spectroheliogram) in the CaII H or K line under high spatial resolution shows that the three agencies responsible for CaII emission are:

i. plages, which are most conspicuous by virtue of the emission that far exceeds the emission from other features and represent the active regions on the Sun; ii. the network elements, which are co-spatial with the boundaries of supergranular cells in the underlying photospheric levels; and iii. the intranetwork elements with dimensions of 1-2 arc sec that populate the interior of the supergranular cells.

It is important to know how the LYRA irradiance measurements related to full-disk intensity values determined from SWAP 174 Å spatially resolved images. We made an attempt in this preliminary work.

Observations and Analysis of PROBA2/LYRA/SWAP Data

For day to day variations:

LYRA irradaince observations for June 2010 measured in Channel 3 (Aluminium Filter Channel: 170 - 500 A, including strong HeII 304 A) are used;

Full disk SWAP (174 Å) integrated intensity values for June 2010;

Compared LYRA Irradiance values with full-disk integrated intensity values determined from spatially resolved images of SWAP in 174 Å .

For short term variations:

We have used LYRA irradiance and SWAP full-disk integrated intensity values for June 10, 2010 from 00.00 hours to 12.00 hours.

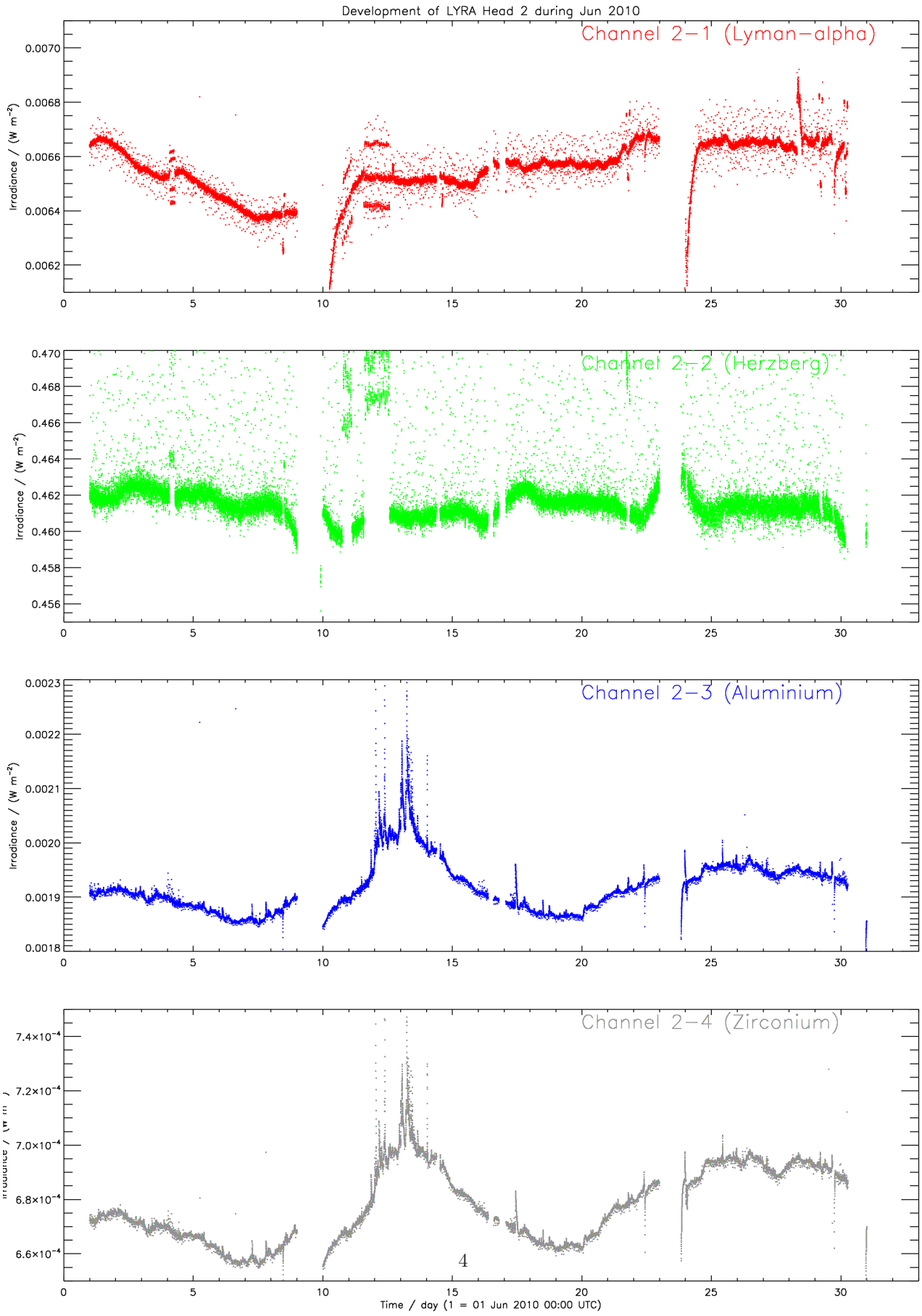

Figure 1: Time series of LYRA irradiance values for June 2010.

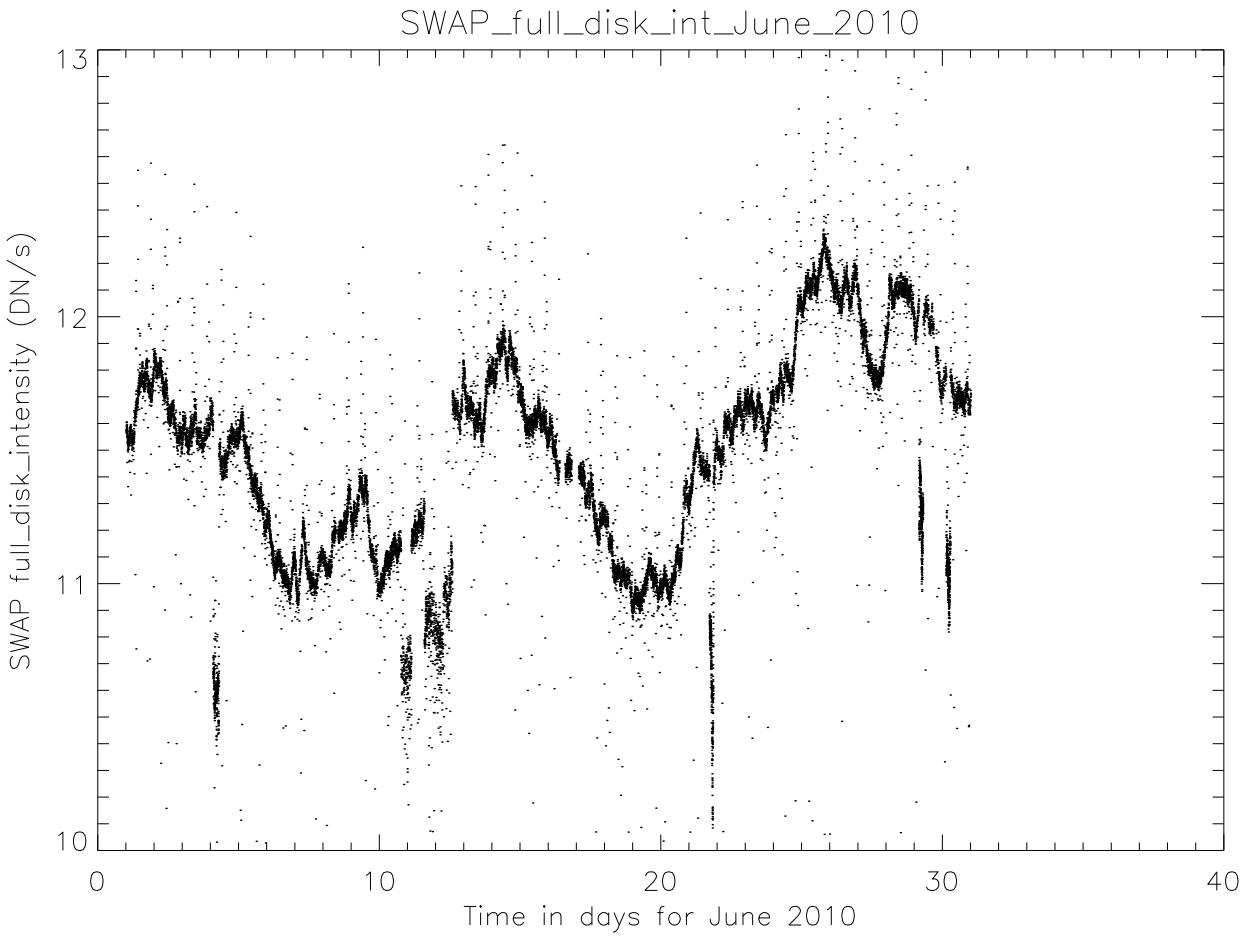

Figure 2: Time series of full-disk integrated intensity values of SWAP in 174 Å for June 2010. Note that there is a good correlation between the full-disk intensity of 174 Å and LYRA channels 3 & 4.

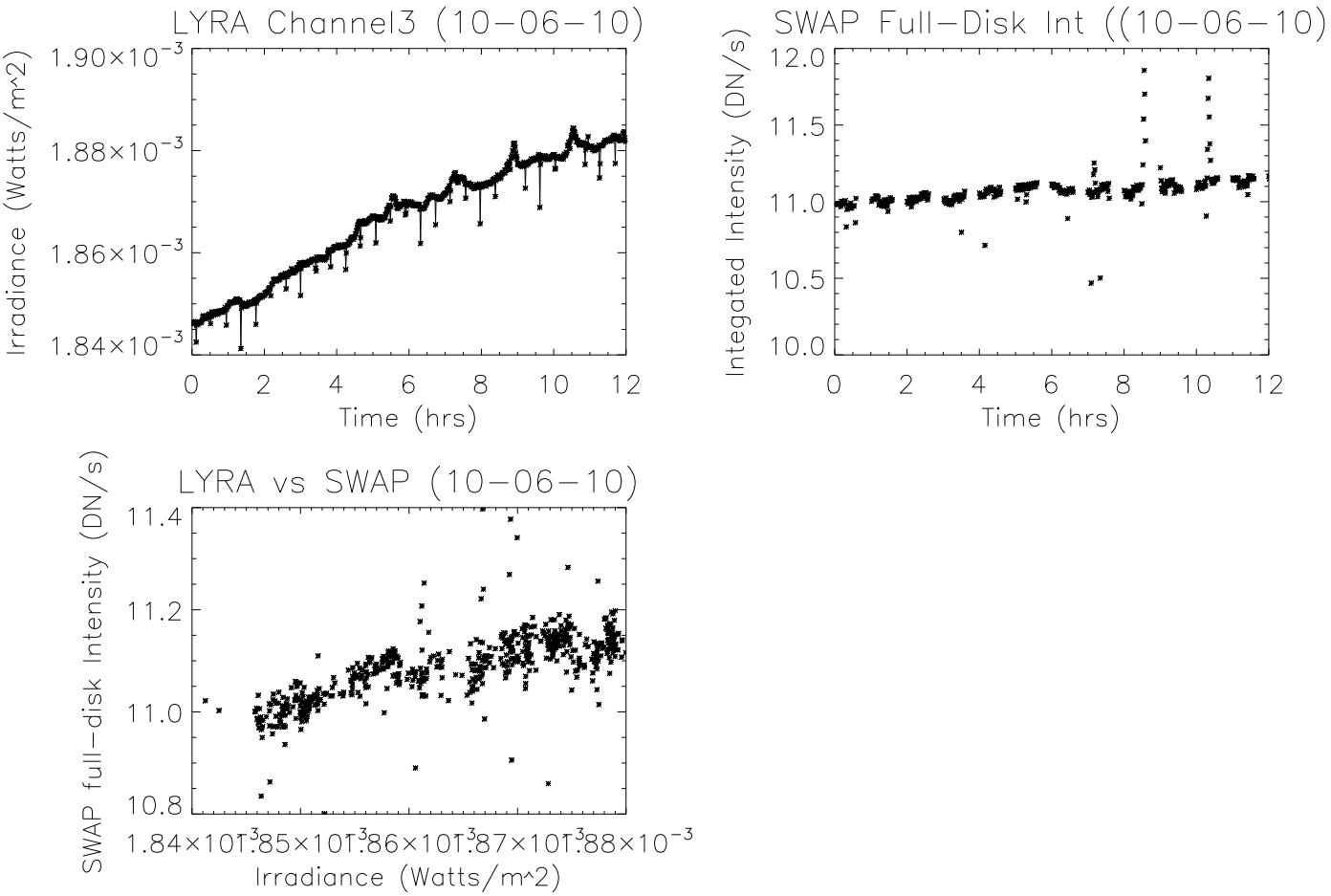

Figure 3: Short term variations in LYRA irradiance (top left panel) & SWAP 174 Å full-disk integrated intensity values (top right panel) of June 10, 2010: 00.00 hours to 12.00 hours and the scatter plot (bottom panel) between LYRA irradiance and 174 Å full-disk intensity values.

Results, Conclusions & Directions for Future Work

Compared LYRA irradiance values with SWAP 174 Å full-disk integrated intensity values to study the day-to-day variations and within a day variations;

We observed from the time series plots that there is a good correlation between the LYRA irradiance and SWAP full-disk intensity values;

It suggests that the variations in LYRA irradiance are due to the variations of solar magnetic features observed in SWAP 174 Å . The SWAP (174 Å) full-disk integrated measurements can be used to understand and explain the LYRA irradiance variations;

Separating out the different solar magnetic features from full-disk spatially resolved images obtained from PROBA2/SWAP (174 Å) and SDO/AIA (304 Å) is in progress.

This will help to understand the LYRA irradiance variations measured in all the 4 channels and to determine the actual contribution of individual solar features to LYRA irradiance variations.

Acknowledgments

This research work was carried out under PROBA2 Guest Investigators Program while R. Kariyappa (Guest Investigator) was visiting Royal Observatory of Belgium during September - October 2010. Sincere thanks to Mr. Ingolf Dammasch & Dr. Sarp Yalim for their help in using the LYRA irradiance and SWAP integrated full-disk intensity data.