

THE DIGITAL DATABASE OF LONG-TERM SOLAR CHROMOSPHERIC VARIATION

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ABSTRACT

From 1926 to 1969, a long term solar full disk observation was done by Kyoto University. Daily Ca II K (393.4 nm) spectroheliographic images and white light images were recorded on photographic plates. In this report, we will give the current status of our project to digitize all these images and to construct a database of these images for public use through the IUGONET system. In addition, we will discuss our perspective on the scientific analysis of the database by taking the solar CaII K brightness as a proxy measure of the solar UV irradiance on the terrestrial upper atmosphere.

Keywords: Digital image database, Solar chromosphere, CaII K full disk image, UV irradiance

1 INTRODUCTION

From 1926 to 1969, a long term solar full disk observation was done by Kyoto University. Spectroheliographic images of Ca II K (393.4 nm) and white light images were taken on a daily basis. All the images were recorded on photographic plates. From the viewpoint of the long-term span of the data coverage and the scarceness of full solar disk images in the first half of the 1900s, we think that this data will have scientific importance. Because there is a risk of aging and degradation of these old photographic plates, we have just started a project to digitize all the plates. We are also developing a digital-image database for public use via IUGONET (Inter-university Upper atmosphere Global Observation NETWORK: <http://www.iugonet.org/en/>).

2 EQUIPMENT AND HISTORY OF OBSERVATION

In 1926 at the Kyoto University Observatory, solar full disk CaII K observation was begun using an Askania spectroheliograph attached to a 30cm siderostat telescope. In 1929, the spectroheliograph was moved to the newly installed Kwasan Observatory. Then, in 1941, it was moved again to the Ikoma Solar Station in Osaka Prefecture. In spite of the two relocations of the spectroheliograph, the observation itself was continued on a daily basis from 1926 to 1969 without interruption. A photograph of the spectrograph taken at the Kwasan Observatory around 1930 is shown in Figure 1. A sample of CaII K spectrograms taken by this instrument is shown in Figure 2.

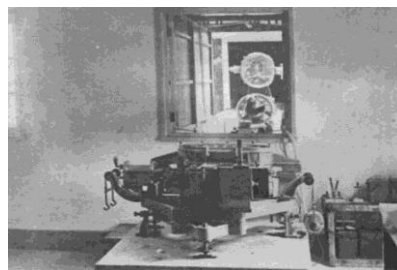


Figure 1. Spectroheliographic observation at Kwasan Observatory around 1930

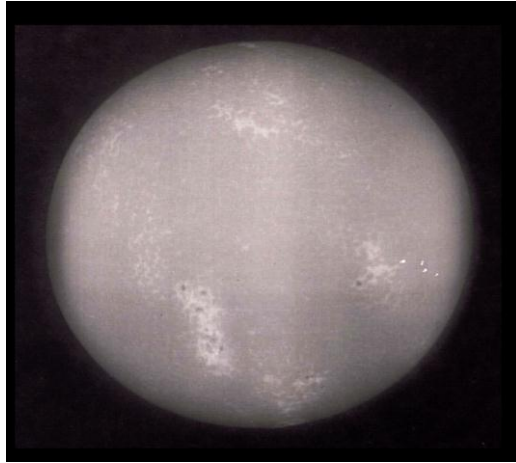


Figure 2. A sample of a CaII K spectroheliogram (positive) taken on May 24, 1967. We can see dark sunspots and bright plages on the solar disk.

3 COMPILATION OF METADATA

Now we have started to compile metadata from the spectroheliograms and have finished 50% of them. The distribution of observation dates is shown in Figure 3. Half of the photographic plates taken in the interval from 1926 to 1943 were preserved at the Yamamoto Observatory.

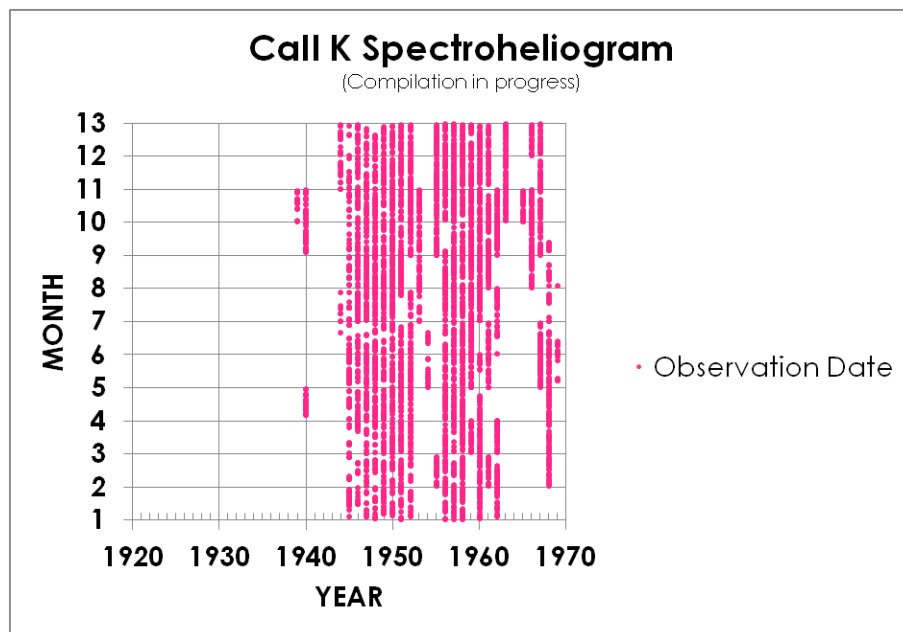


Figure 3. Coverage of CaII K spectroheliographic observations. The data for 1926-1945 are under compilation.

4 OUR PROJECT: THE DATABASE AND ITS SCIENTIFIC APPLICATION

The first target of our database project is to finish the digitization of the 44-year solar full-disk chromospheric images and to complete a database open to the public for scientific use. Our database of CaII K images will be important in complementing the existing databases of Ca II K images taken respectively at Mt. Wilson and Kodaikanal Observatories (Foukal et al., 2009) and will enable us to perform a cross-check of the trends of long term solar variability estimated from these independent datasets.

One of the scientific targets of our project is to use the database in a study of the heating process of the terrestrial upper atmosphere. A comprehensive review of current research on long-term variations in the total solar irradiance (TSI) and the spectral irradiance is given by Krivova et al. (2011). This research was based on solar magnetographic data (~40 years span), sunspot-number data (~400 years span), and ^{14}C and ^{10}Be concentration data (~ 10^4 years span). The solar UV irradiance was estimated with the help of theoretical models of the solar atmosphere. Furthermore, according to a pioneering work by Yokoyama, Masuda, and Sato (2006), the total area of CaII K plages on the solar disk is a good proxy for the solar EUV and UV irradiance on the terrestrial upper atmosphere. Although their analysis is limited to a two-week span, the presence of a positive correlation between the CaII K plage area and the UV irradiation measured by satellites is clearly seen. If we can confirm this conclusion by using our Ca II K database for the most recent 10 years, namely the interval in which satellite data of solar irradiance are available, we will be able to trace the long-term (44 years) variations of solar UV irradiance in the pre-satellite era, based on our comprehensive CaII K database.

5 ACKNOWLEDGEMENTS

This work was supported in part by a research grant for Mission Research on Sustainable Humanosphere from the Research Institute for Sustainable Humanosphere (RISH), Kyoto University.

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(Article history: Available online 10 April 2013)