DIGITAL DATABASE OF LONG-TERM SOLAR CHROMOSPHERIC VARIATION

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ABSTRACT

From 1926 to 1969, a long term solar full disk observation had been done in Kyoto University. Daily Ca II K (393.4 nm) spectroheliographic images and white light images had been recorded on photographic plates. In this report, we will give the current status of our project to digitize all the 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~~to~~ 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 had been done in Kyoto University. Spectroheliographic images of Ca II K (393.4 nm) and white light images had been taken on a daily base. All the images were recorded on photographic plates. From the viewpoints of the long-term span of the data coverage and the scarceness of full solar disk images in the first half of 1900s, we think that the data will have a scientific importance. Since we have a risk of aging and degradation of these old photographic plates, we have just started a project to digitize all the plates. We are developing also 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, solar full disk CaII K observation was started with an Askania spectroheliograph equipped to a 30cm siderostat telescope at the Kyoto University Observatory. 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 two relocations of the spectroheliograph, the observation itself was continued on daily base from 1926 to 1969 without interrunption. A photograph of the spectrograph taken at Kwasan Observatory around 1930 is shown in Figure 1. A sample of CaII K spectrograms taken by this instrument is shown in Figure 2.

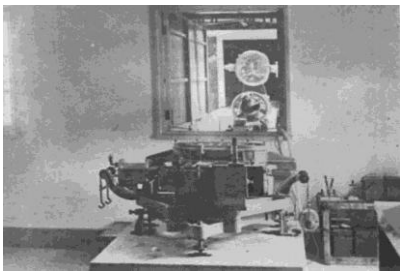

Figure1. Spectroheliographic observation at Kwasan Observatory around 1930.

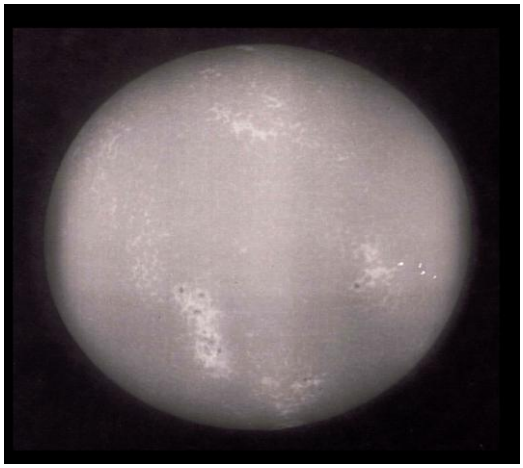

Figure2. A sample of CaII K spectroheliogram (positive) taken on May 24, 1967. We can see dark sunspots and bright plages on the solar disk.

3 COMPILATION OF METADATA

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

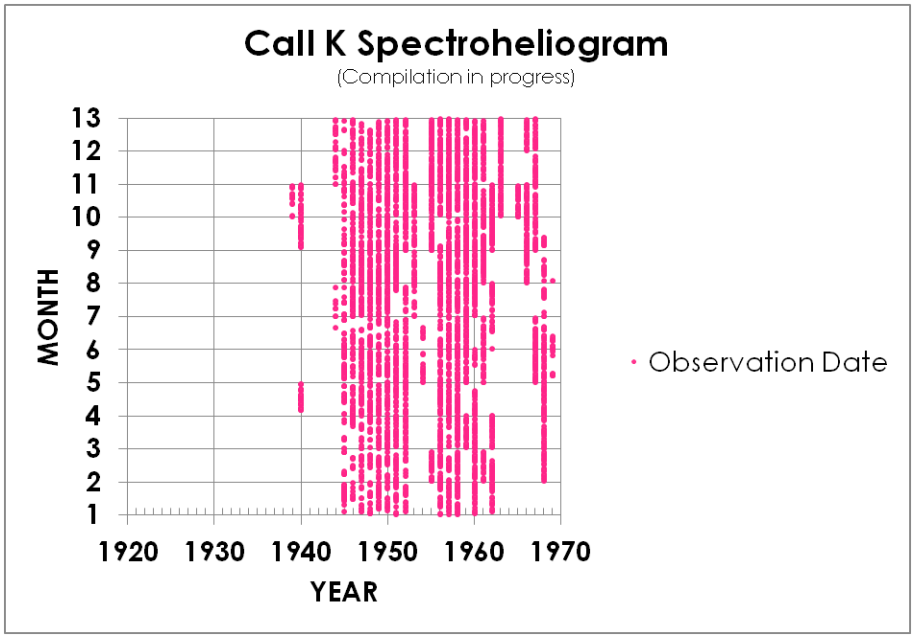

Figure 3. Coverage of CaII K spectroheliographic observations. The data for 1926-1945 are under compilation.

4 OUR PROJECT: DATABASE AND ITS SCIENTIFIC APPLICATION

The first target of our database project is to finish the digitization of 44-year solar full-disk chromospheric images and to complete an open database to the public for scientific use. Our database of CaII K images will be important to complement the existing databases of Ca II K images respectively taken at Mt. Wilson and Kodaikanal Observatories (Foukal et al., 2009) and 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 researches on long-term variations of the total solar irradiance (TSI) and the spectral irradiance is given by Krivova et al. (2011). These researches were 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), and the solar UV irradiance was estimated with the help of theoretical models of the solar atmosphere. On the other hand, 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 of the solar EUV and UV irradiance on the terrestrial upper atmosphere. Although their analysis is limited only 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 their conclusion by using our Ca II K database for 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 the solar UV irradiance in the pre-satellite era, basing on our comprehensive CaII K database.

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6 REFERENCES

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