

# Report on the ROB contribution to SOTERIA Work Package 2

F. Clette, 10/4/2009

## Goals

Our SOTERIA participation includes three main work items:

- The global digitization of the Uccle collection of sunspot drawings, and possibly thereafter other drawing series.
- The production of whole-disk CCD images in white-light, H-alpha and CaII-K to support studies of the solar cycle (WP2) and in addition, in support to chromospheric flares and waves (WP3) and of proxies of solar spectral irradiance (WP5).
- The study of new image-based activity indices derived from solar images of the photosphere (CCD, photographic): initial data sets (USET, SOHO/MDI).

## Progress so far (November 2008 to March 2009)

### *Participation to joint WP2 activities*

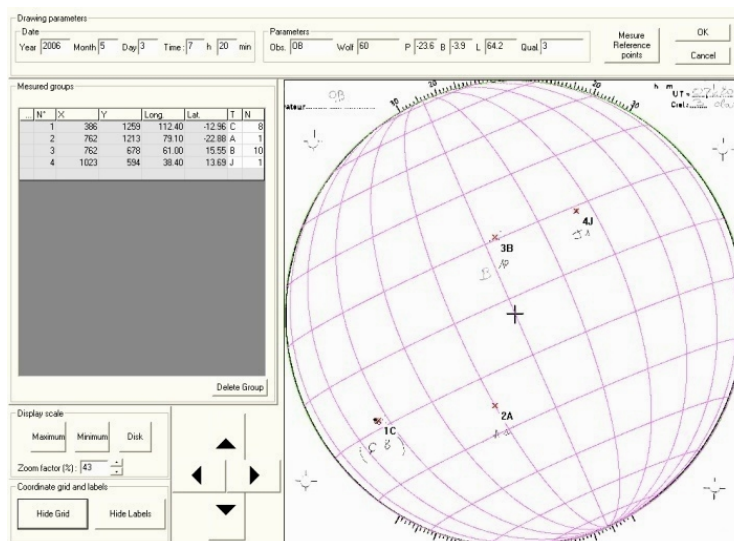
In November 2008, at the occasion of the European Space Weather Week, we actively took part in the SOTERIA kick-off meeting that was organized during the 5th ESWW. F. Clette presented a talk outlining the ROB contribution to WP2.

In March 2009, following the 3<sup>rd</sup> Space Climate Symposium in Lapland, F. Clette participated to the special SOTERIA coordination meeting. He summarized the ROB progresses and presented also the initial selection of sunspot and faculae parameters to be measured or collected to address the SOTERIA goals (index definition, databases, irradiance proxies).

### *Global digitization:*

The existing DIGISUN program, already used routinely for the current Uccle drawing digitization and encoding, was rewritten and improved: better user interface and flexibility in the output format of data files.

This work also forms the first step of the development of a



**Figure 1: Graphical user interface of the DIGISUN application developed for the measurement and coding of the Uccle visual sunspot drawings. This software will be expanded in 2009 in order to digitize the full collection of the Uccle drawings and contribute one of the new WP2 sunspot catalogs.**

new version of this application that will be adapted to the bulk digitization of drawing collections. This application should be adaptable to other drawings collections in the SOTERIA context and beyond. It will be commissioned by mid-2009 in parallel with the training of the operator team that will carry out the global scanning and sunspot group encoding work at ROB. A new A3-format flatbed scanner was purchased in March 2009 on the SOTERIA equipment budget. The actual scanning work will start by July 2009.

The visual data exploitation and active region database mainly involves the development of a new program for the group tracking, connecting successive observations of the same active regions and thus retracing the full chronological evolution of individual sunspot groups. The old program currently used at the ROB for the Uccle sunspot drawings will progressively be replaced by a new program. This transition requires an extensive study in order to document it and recover the base algorithms inherited from the last 25 years for the publishing of the Uccle indices in the SIDC Sunspot Bulletin. In December 2008, an initial draft document was prepared outlining the logic and algorithm of new group-tracking software. Further implementation of the new algorithms will proceed in 2009. The resulting methods should be general enough to be applied to other data than visual drawings and to other active region records than visual sunspot observations. This work can thus contribute to the construction of several of the databases and meta-data to be created in the SOTERIA framework.

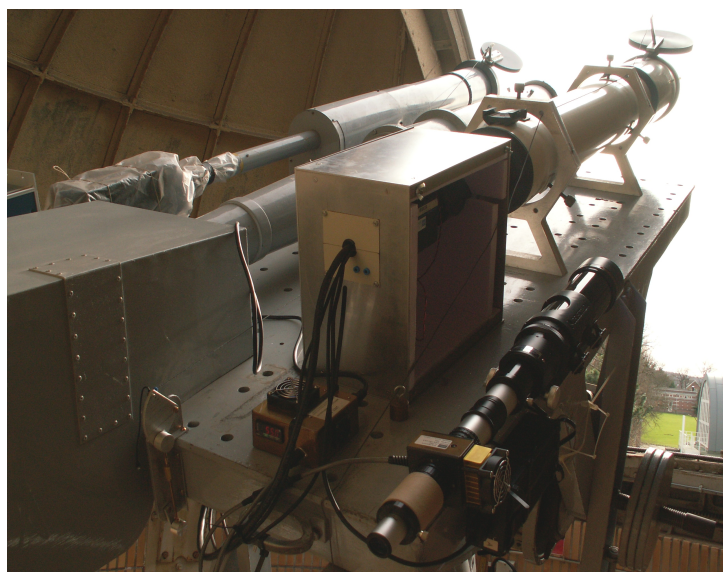
In parallel with the SOTERIA context, preliminary contacts were established with the solar team of the Astronomical Institute in Tatranska Lomnica (J. Ribak) and with the Specola Solare Ticinese (M. Bianda, S. Cortesi) in order to prepare a coordinated digitization of other drawing collections, covering complementary time intervals next to the Uccle drawings, in a more distant future (post SOTERIA).

### ***Production of solar images (USET: Uccle Solar Equatorial Table)***

The instrument upgrade work is already in progress and well advanced in the framework of an expiring LOTTO/BELSPO budget.

White-light telescope: a new 2Kx2K CCD camera is in operation since July 2008. In April 2008 a new focal reducer was designed and installed to optimize the image scale to the new CCD sensor.

H-alpha telescope: a new 2Kx2K CCD camera is in



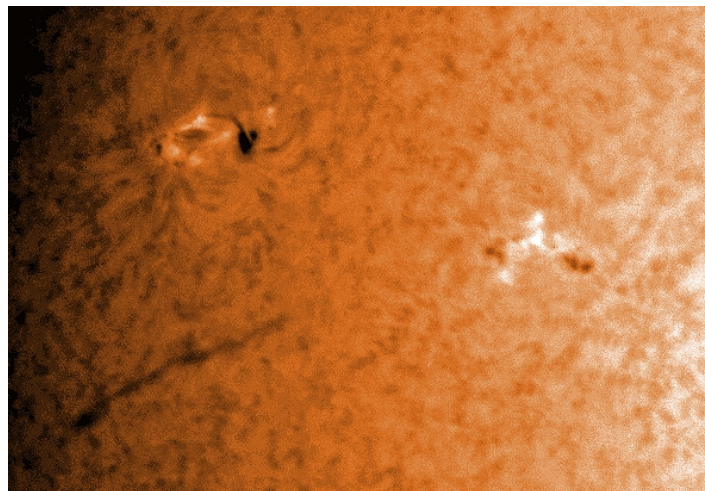
**Figure 2: View of the new compact H-alpha telescope and Fabry-Pérot monochromator installed in a test configuration on the USET in February 2007 (black optical tube on the lower right). The white-light and old H-alpha CCD telescopes in operation since 2002 can be seen on its left. The large enclosure in the center harbours the white-light CCD camera.**

operation since January 2008. The installation of this telescope on a new optical bench allow better adjustment of the telescope parallelism is in preparation and will be done by mid-2009 CaII-K telescope: the telescope optics (D=132mm) were purchased at the end of 2008 (funding: LOTTO/BELSPO). In early 2009, initial studies of the optical design of the focal section have been undertaken. The actual construction and commissioning is still planned for late 2009.

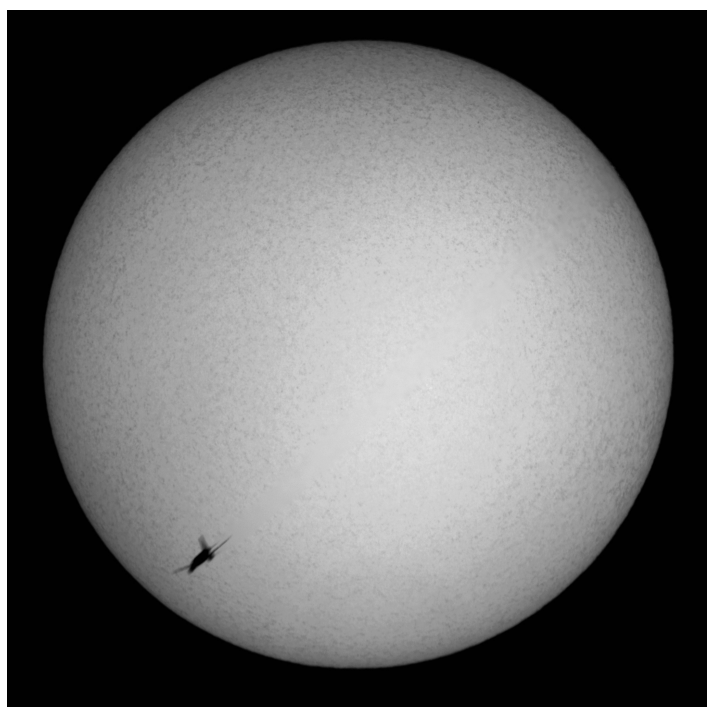
White-light and H-alpha synoptic images have been produced routinely and are accessible in the USET data base ([sidc.be/USET](http://sidc.be/USET)). The new CaII-K images will start to be produced and delivered to SOTERIA in the first half of 2010. In order to address the needs of SOTERIA and in particular Work Package 6, special efforts will be done in 2009-2010 at the level of data distribution (archive, database and WEB access).

### ***Image-based sunspot indices:***

Our main initial effort has been to define the full set of measurable sunspot parameters (descriptors) that are either available in existing sunspot databases or in the new sunspot data archives that will be generated in the course of the SOTERIA project. This parameter list would constitute a reference document and a common format that can address the needs of all WP2 members and will facilitate the exploration of new solar activity indices for the community at large (WP6). For this purpose, we established a comprehensive table of



**Figure 3: Close-up view of two small active regions and a filament extracted from a whole-disk  $H\alpha$  image produced with the new USET  $H\alpha$  telescope and QImaging Retiga 4000R camera (25/3/2008)**



**Figure 4: Sample whole disk  $H\alpha$  image of a very quiet Sun with a fleeting intruder captured with the new USET  $H\alpha$  telescope and camera. Thanks to the interline CCD sensor, the camera exposure is controlled electronically without any mechanical shutter, allowing continuous high-cadence imaging.**

parameters and we submitted it to the WP2 community. So far, the feedback has been rather limited. Following suggestion at the recent SOTERIA coordination meeting in Lapland, we will submit it to the whole SOTERIA community via the SOTERIA wiki. Still, by April 2009, we decided to proceed and choose a default set of sunspot parameters based primarily on the specific needs of sunspot index definition and construction.

## **Problem areas**

The main problem so far was the difficulty to recruit the proper SOTERIA staff at ROB. It is due to the fact that (too) many of the job positions are only a small fraction of a FTE and together, don't cumulate to a FTE. It is also due to the difficulty to find interested candidates with the appropriate competences. Therefore, so far, the work was done entirely by the existing ROB staff.

## **Personnel involved**

- F.Clette: lead scientist (ROB permanent staff, 30%)
- S. Vanraes: ICT, programmer (ROB permanent staff, 50%)
- O. Lemaître: operator, observer (ROB permanent staff, 50%)
- O. Boulvin: operator, observer (ROB permanent staff, 15%)

**USET archive**

- [Search of USET images](#)
- [Search of USET drawings](#)

**Images of last solar rotation**

9/02/2008 10/02/2008 11/02/2008 12/02/2008 15/02/2008 16/02/2008

- [Mosaic representation](#)
- [Animated view](#)

**Our most recent images**

White-light

19/02/2008 - 12h37

H-alpha

19/02/2008 - 12h42

**Latest drawing**

**Figure 5: Section of the main USET data query Web interface, displaying the latest images in each channel and latest Uccle sunspot drawing, as well as a sliding thumbnail image strip of the last 28 days (1 Carrington rotation). On top of the page, two links lead to query forms allowing to search and select datasets from the archive of past images and digitized drawings. NB: The blank solar disks are representative of the very low level of activity prevailing since early 2007.**



Mosaic of 28 last images Solar Influences Data Analysis Center

NO DATA			
24/01/2008	25/01/2008 - 10h59	26/01/2008 - 10h43	27/01/2008 - 11h05
NO DATA	NO DATA		NO DATA
28/01/2008	29/01/2008	30/01/2008 - 15h50	31/01/2008
		NO DATA	
01/02/2008 - 09h16	02/02/2008 - 08h54	03/02/2008	04/02/2008 - 14h39
NO DATA			
05/02/2008	06/02/2008 - 15h45	07/02/2008 - 08h51	08/02/2008 - 09h35
09/02/2008 - 09h06	10/02/2008 - 09h29	11/02/2008 - 09h29	12/02/2008 - 09h16
NO DATA	NO DATA		
13/02/2008	14/02/2008	15/02/2008 - 10h16	16/02/2008 - 09h33
			NO DATA
17/02/2008 - 08h45	18/02/2008 - 08h59	19/02/2008 - 12h37	20/02/2008

**Figure 6: One of the graphical user interfaces of the USET Web site giving direct access to quicklook images acquired over the last solar rotation. It also gives a direct overview of the days with and without observations in Uccle.**