

Report on the Soteria WP2 activities at the ROB in 2010-2011

USET sunspot drawing digitization

The digitization of the collection (20000 drawings over 71 years) has been completed in July 2011. The scanned drawings are publicly accessible through a new SIDC Web interface (<http://www.sidc.be/uset/searchFormDrawing.php>), which will be further enhanced in the future.

The measurements of the active region parameters continued, mainly with help from ROB permanent staff (partly with Soteria funding). We currently completed 75% of the work (years from 1965-2011). The output is a new catalog containing more comprehensive sunspot group information than past equivalent catalogs. This catalog has the form of a database linked with the scanned drawings, which will allow the creation of advanced on-line search tools.

Study of new image-based solar indices

Two primary catalogs, DPD (Debrecen) and NSO/SOON, were selected for their good time overlap and the complementary information that they provide. The merging of the information of both catalogs has now been completed, except for about 2% of complex active regions. In this merging process, we conducted statistical checks involving cross-comparisons with independent sunspot series, like the International Sunspot Number or Wolf numbers from individual stations or networks. This allowed to create filters that correct some global biases present in the catalogs (identification of penumbrae, group splitting). Overall, the merged catalog provides the most comprehensive and coherent sunspot catalog covering the last two solar cycles. This catalog is already publicly available at <http://soteria.oma.be:8080/laure-workshop.htm>.

The construction work of this catalog was presented in 2010 at an international IAU conference in Ventura (CA) as well as different Soteria meetings (1st and 2nd Soteria meetings, 2010) and a global review about all existing sunspot catalogs was presented at the Soteria Capacity Building Workshop organized in Brussels in February 2011.

Solar cycle research

The above work on catalogs immediately led to a new important find relevant to the anomalies of the last solar cycle. Indeed, this cycle ended with an exceptionally long and low minimum and well-established proxies and relations between standard solar indices started to drift over the course of this cycle. Among a few other scarce pieces of evidence for a possible cause of those anomalies, on the base of our new merged catalog, we established the appearance around the year 2000 of a global deficit affecting only the smallest sunspots. We validated this effect by various comparisons with different solar index series.

As this effect can naturally explain many unsolved discrepancies, this raised a lot of interest in the community. So, our results were presented at several meetings and a letter paper was submitted to Astronomy & Astrophysics Journal and is currently in final review.

We thus conclude the Soteria project with a key result that helps to improve the current solar indices, at a time when the current peculiar solar activity regime imposes a revision of the classical indices and proxies. This work rests on sunspot information and exploits a new combined catalog specially built in the framework of the Soteria project. It opens the way to future extensions of the catalog construction and of the investigation of new improved sunspot-based solar activity indices.

Data production

Like in previous years, the Uccle Solar Equatorial table contributed in 2010-2011 about 250 sunspot-drawings and about 3000 synoptic images of the photosphere and chromosphere. The images were used as complementary data (gap filling) for the construction of the DPD catalog at Debrecen, while the new drawings extend the Uccle 70-year sunspot collection and its associated catalog (cf. above).

The most recent near-real-time images as well as the entire image archive are publicly accessible through the USET Web pages (<http://www.sidc.be/uset>)

Communications:

- Lefevre, L., Sunspot catalogs survey and merging work: principles for the construction of advanced sunspot-based proxies, SoTerIA Capacity Building Workshop, Bruxelles, 15-18/02/2011 (oral)
- Lefevre, L, Clette, F., Wauters, L., Towards advanced sunspot-based indices and solar-forcing proxies, European Geophysical Union, Vienna, 4-8/04 2011 (poster)
- Lefevre, L, Clette, F., Wauters, L., A drift between R_i and other solar indices, 3rd SoTerIA general meeting, Leuven, 30/05-01/06 2011 (oral)
- Lefevre, L., Clette F., A small sunspot deficit in cycle 23, Sunspot Workshop, Sunspot, NM, 19-23/09 2011 (oral)
- Clette., F.: The International Sunspot Index R_i : a perspective on the last 50 years, , Sunspot Workshop, Sunspot, NM, 19-23/09 2011 (oral, invited review)

Publication:

- Lefevre, L. Clette, F., A global small-sunspot deficit at the base of the index anomalies of solar cycle 23, A&A Letter to the Editor, submitted (09/2011).