

VAL-U-SUN

Valorization of 70 years Solar Observations from the Royal Observatory of Belgium

DURATION 15/12/2016 - 15/03/2021	BUDGET 450 240 €
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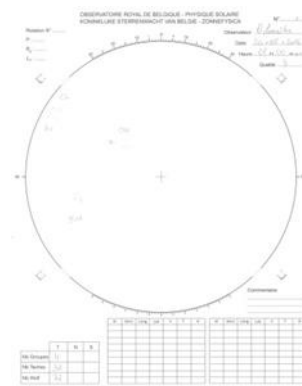
PROJECT DESCRIPTION

The Sunspot Number is the longest scientific experiment still ongoing and a crucial benchmark to study solar activity, space weather and climate change. The Royal Observatory of Belgium (ROB) plays a central role in the continuation of this experiment, as it hosts the Sunspot Index and Long-term Solar Observations World Data Center (SILSO-WDC). This World Data Center aims at collecting solar data, as well as producing and distributing the International Sunspot Number, which is used in about two hundred scientific publications on an annual basis. The purpose of this project is to valorise two sunspot collections kept at ROB, which are presently neither available online nor exploited to the level of contemporary modern scientific standards.

The first collection consists of a series of about 20.000 digitized sunspot drawings acquired at the Uccle Solar Equatorial Table station (USET – images USET1940 and 2016) since 1940 and a corresponding database that is unverified, i.e. no complete quality checks could be performed, as of today. Moreover, the database is still incomplete in terms of extracted parameters. The digitization of these drawings started in the framework of a European project but lack of subsequent funding prevented us from adding essential metadata as well as achieving proper quality control. Thus, it was never made accessible to the wider community. As this dataset extends back to 1940, exploiting such a long-term and complete dataset is extremely important in order to assess the quality of parallel solar catalogues.

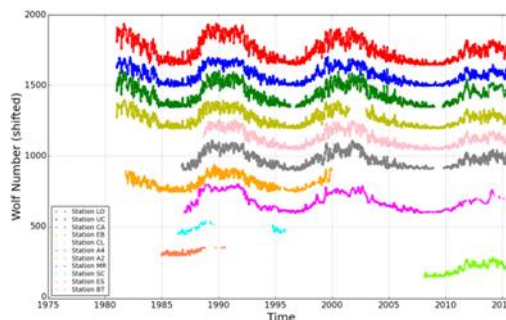


USET 1940

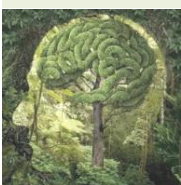


USET 2016

The second collection, the SILSO database, contains the numbers of spots and groups of spots on the Sun observed by a worldwide network since 1981 (more than 530.000 measurements – example image Sunspot Number Database). It is used on a monthly basis to compute the International Sunspot Number. Only one check is performed on each station every year, and its statistical basis dates back to the creation of the Wolf Number in the 1850's.



Sunspot Number Database



VAL-U-SUN

A complete and consistent supervision of this database is important and as SILSO is the World Data Center for the determination of this index, it is our responsibility to bring the extracted Sunspot Number into the 21st century by exploiting this existing database to its full potential.

To this end, an international effort started in 2011 and focused on the past data, from the 19th century to the end of the 20th century. Unfortunately, the study made on this specific 1981-today dataset remained limited and modern standards can only be attained through the use of more modern statistical techniques.

The objective to achieve on our two collections is threefold: (1) Bring our databases to the modern era by adding essential metadata, whether it is additional parameters or techniques for quality assessment and quality control. (2) Use the value of solar parameters recorded in these databases to address today's scientific questions and (3) disseminate the collections and added value to a predefined set of audiences.

For the exploitation of our first collection, the USET drawings, we will first extract additional parameters through a mix of advanced programming techniques and semi-automatic techniques. Extracting such parameters is paramount to the production of the real-time bulletins used in the alert system of the Regional Warning Center (RWC) of the SIDC. As a RWC, we need an alternative source of data to feed our alert system. Second, we will assess the quality level of the existing and future associated metadata by comparing the extracted solar parameters catalogue to other overlapping catalogues.

For the exploitation of our second collection, the SILSO database, we will start by adding error bars and then perform an extensive check for the stability and quality of past and present observers of the network, with the aim to define a robust subset of the network's observation stations to be used as a reliable reference multi-station pool that will replace the current single pilot station.

For this, modern methods for statistical quality control must be used and adapted. As this is a growing database that still receives data on a daily basis, the process of determining a multi-station reference needs to be done dynamically. The current processing, done every month and every 3 months, is a historical heritage based on a very slow availability of data that is no longer relevant. Hence, those novel statistical methods need to be rendered dynamic in order to provide a method that is computable in near real-time.

This project is at the crossroads between Solar Physics, scientific programming and mathematical statistics. In addition to that, its output presents a huge interest for domains outside of Solar Physics such as Space weather and Climate Science. Because of the importance to these disciplines, the modern evaluation of the Sunspot Number and the use of our local data for warning bulletins could have a non-negligible impact on decision-making.

We will ensure a wide dissemination of our final products. The drawings and their metadata will be made available to the general public and a last quality check will be performed on these data in the context of a "citizen science" project. The sunspot number database will also be made available: in particular, each observer of the SILSO network will have access to his or her real-time quality assessment delivering a much needed feedback to our faithful observers.

CONTACT INFORMATION

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