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INTER-DIVISION B-E / WORKING GROUP ON COORDINATION OF SYNOPTIC OBSERVATIONS OF THE SUN

COORDINATION DES OBSERVATIONS SYNOPTIQUES DU SOLEIL

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CO-CHAIR **Sabrina Bechet**

TRIENNIAL REPORT 2021-2024

1. Introduction

In late-2015, the WG on Coordination of Synoptic Observations of the Sun was designated as the Inter-Division B-E working group, and in 2016, it became Functional working group. The mission of this WG is to facilitate international collaboration in synoptic long-term solar observations, which includes past, present, and future synoptic programs, preservation, calibration, and access to synoptic solar data products. The working group provides a forum for discussion of all issues relevant to synoptic observations of the Sun including coordination between synoptic programs in different countries and a proper calibration and preservation of historical data from different sources. The WG includes 55 members from 19 countries.

2. Developments within the Past Triennium

During the 2021-2024 triennium, the WG concentrated on four major issues related to:

- support for continuation of synoptic programs threatened by budget cuts and promoting the broadening of international participation in WG activities,
- preservation and digitization of records of past solar activity,
- verification of existing sunspot number time series and developing a unified sunspot time series, and
- improving access to modern and historical data.

2.1. *Support for continuation of groundbased synoptic programs*

The working group continued supporting the activities conducted in the framework of SOLARNET-SPRING project (ground-based network for solar synoptic observations). SPRING is the EU initiative, which includes scientists' participation from some non-EU countries (e.g., Japan, USA). In their turn, US scientific community promotes development of the next generation Ground-based solar Observing Network (ngGONG). The need for long-term synoptic observations of the Sun and the importance of international collaboration were presented by the WG members at several international conferences.

Other global network that this WG supported is the Solar Activity Monitor Network – SAMNet (Erdélyi et al 2021). The WG facilitated establishing communications between the SAMNet project and potential partners in South Africa and Uzbekistan.

WG members participated in White Papers submitted to the 2024 Decadal Survey

on Heliophysics by the National Research Council of the US National Academy of Sciences, Engineering, and Medicine. These white papers promote broad international collaboration in groundbased studies of the Sun, solar irradiance, solar-stellar/sun-as-a-star research and alike (e.g., Criscuoli et al 2023, Gosain et al 2023).

During 2021-2024, the WG members participated in activities of S1 cluster in the framework of COSPAR International Space Weather Action Teams (ISWAT, `https://iswat-cospar.org/`). This Cluster is comprised of three teams on Long-term solar variability, worst-case scenario for extreme solar events, and data sets of historical observations of solar and geomagnetic activity, which significantly overlaps with interests of this IAU WG. In 2023, ISWAT S1 cluster prepared a review article in support of updated COSPAR's Roadmap on Space Weather (Pevtsov et al 2023). This review article emphasizes the development a comprehensive inventory of solar and geomagnetic datasets relevant for long term space weather and space climate research; a standardized method for processing and preservation of historical data, their quality and current state. It also raises concerns about (lack of sufficient) resources for preservation of these critical datasets. On 17 November 2023, the WG was represented at the International Space Weather Coordination Forum organized by WMO, ISES, and COSPAR at the WMO HQ in Geneva, Switzerland. The "Statement of Intent" as well as the "Top Level Meeting Summary" are available at `https://community.wmo.int/en/meetings/international-space-weather-coordination-forum`. COSPAR and WMO plan to continue these activities in 2024, and so, there would be more opportunities for the group to get involved in this initiative.

2.2. *Preservation and digitization of records of past solar activity*

One of the activities supported by the WG is related to recovery of sunspot number (SN) records. The data recovery work continued with the recovery of individual data sets in the 18th and 19th century. The members of the group also took part in digitizing the sunspot records from the U.S. Sacramento Peak observatory, including the names of all observers from 1949 till early 2000. The construction of the SN database of all past Zurich data has greatly progressed, with several important papers published. The encoding of the 300 000 data in the 1945-1980 Waldmeier archives, which were recovered in 2019, will still last several more years, given the minimal means available for this huge task. Scientists and PhD students at SILSO (the World Data Center for the production, preservation and dissemination of the international sunspot number) continue the investigations of important links in the overall SN homogeneity, exploiting modern SILSO observers for probing in-homogeneity factors, and investigating the critical 1894 Wolf-Wolfer and 1849 Schwabe-Wolf transitions.

In early 2024, the WG published the results of a survey - community input about historical astronomy/solar data that merit consideration for preservation, the current state of those data, any associated metadata, and their current location. The results could be downloaded from the WG web site at `https://gonewithsolarwind.com/index.php/links-2/`.

2.3. *Verification of existing sunspot number time series*

The WG members were also involved in recovery of historical Sunspot Number (SN) and Group Number (GN) records. The results of this activity were presented by Clette et al (2023). The report briefly describes plans for developing procedures for evaluating the new SN and GN timeseries series and selecting the next versions of SN and GN for sanction by an International Astronomical Union (IAU) reviewing body.

2.4. *Improving access to modern and historical data and other activities*

During 2021-2024, the WG continued collaboration with the Working Group on the Preservation of Astronomical Heritage (WGPAH) of the American Astronomical Society (AAS), and the "glass plates" – an informal group of archivists, librarians, and scientists concerned with the preservation and the digitization of the astronomical glass plates and the observing logs archived at universities and science museums.

In 2024, a new version of the resources webpage with a summary of existing synoptic stations has been released at `https://www.sidc.be/uset/synoptic_ressources/ground_based.php`. The idea is to have at a glance an overview of the geographical distribution of the stations, but also a comparison of their main/relevant features. This page will continue to be updated, and so, please don't hesitate to send Sabrina Bechet your feedback on the webpage. The webpage has also link to previous/current WG web page with map of Solar groundbased observatories and neutron monitors.

In 2023, co-Chair Dr. Frederic Clette stepped down. At the beginning of 2024, Dr. Sabrina Bechet took a position of the co-Chair.

3. Motivations for the continuation of this Working Group

There is a strong motivation for continuation of this Working Group. The activities in Europe and USA to create a new network for long-term synoptic observations of the Sun drew interest for possible participation from other countries albeit without a clear funding source. At the same time, the existing groundbased facilities are aging rapidly. These developments would benefit greatly from fostering a broader international collaboration, which this WG would provide. There are other aspects that were not fully explored by the current WG such as, for example, broadening the geographic collaboration to include more astronomers from African continent, South America, Asia. Some of the datasets (e.g., sunspot number time series) are reaching the level of maturity and are used broadly by other research communities, which may require developing standards for their curation. We invite all astronomers interested in long-term synoptic observations and preservation of historical data to join the discussion. The Working Group's website can be accessed via `https://www.iau.org/science/scientific_bodies/working_groups/255/`.

Alexei A. Pevtsov and Sabrina Bechet
Chair and Co-Chair of Working Group

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