Baseline Surface Radiation Network (BSRN)

Report on the Activities 2022

GCOS AOPC-28 Meeting, 26-30 June 2023

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Current Status/Objectives/Activities

BSRN - a project of the Global Data and Analysis Panel (GDAP) from the Global Energy and Water Cycle Experiment (GEWEX) under the umbrella of the World Climate Research Programme (WCRP) - is aimed at measuring the surface radiation budget with the most accurate instrumentation and screening procedures to provide the model and satellite communities with a better benchmark for validation purposes. It also contributes to detecting any important change in the surface-based Earth's radiation field. The Global Climate Observing System (GCOS) renewed its endorsement to BSRN by flagging it as a recognized GCOS network during 2022 (https://gcos.wmo.int/en/networks/gcos-networks-accreditation, Figure 1). BSRN contributes to the Global Atmospheric Watch (GAW) and the Network for the detection of Atmospheric Composition Changes (NDAAC). Since 2008 the BSRN archive (World Radiation Monitoring Center, WRMC) is hosted by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany (AWI).

Figure 1: Since September 2022 BSRN officially is a „GCOS recognized network".

The BSRN core staff consists of the Project Manager Christian Lanconelli (since Oct. 2018), the deputy Laura Riihimaki (since 2020) and the WRMC Director Amelie Driemel (since 2017).

Status of the affairs

At the end of 2022, a total of 76 stations contributed to the BSRN data archive (compared to 74 in 2021) in contrasting climatic zones, covering a latitude range from 80°N to 90°S

* Station ENA is counted here (status inactive, data status still unclear), but the candidate station is not counted

(Figure 1). Of them, 16 stations are closed, 13 have been marked as inactive (no data submitted for more than 2 years), one station (Terra Nova Bay, Antarctica - WMO 89859) is still in candidate status (data submission pending). Stations from Thailand, Indonesia, Cyprus, Ireland, Chile and Lampedusa are in "pending" status. They were considered potentially important to cover geographical gaps, although they were asked to complement the set of instrumentation to fulfill the BSRN requirements.

Status of the archive and data collection

About **13,000 months of radiation data** (May 2023) are made available either via PANGAEA or via the BSRN ftp server (https://dataportals.pangaea.de/bsrn/?q=LR0100 or http://bsrn.awi.de/data/data-retrieval-via-ftp/), and downloadable upon a password request to the WRMC director. To make citing these monthly datasets easier, the WRMC plans to create collection datasets for each station. For the time being, individual site collections are available for 29 stations through PANGAEA website.

The link to the available collections can be found in the last column here: https://wiki.pangaea.de/wiki/BSRN#Sortable_Table_of_Stations.

Additionally, a new BSRN data snapshot was published in March 2023: Lanconelli, C. et al. (2023): Baseline surface radiation data snapshot 2023-03-31. PANGAEA, https://doi.org/10.1594/PANGAEA.957398. This snapshot contains the data as well as the QC codes produced using the BSRN Toolbox over the whole archive. The snapshot has been created in the frame of a collaboration with the Italian National Research Council to support an initiative aimed at releasing temporally aggregated data of the downwelling radiative components through the Copernicus Climate Data Store (https://cds.climate.copernicus.eu/#!/home). The products are under development and debugging and it is foreseen to have a first version published in early next fall. It is foreseen to update the status of the QC with a three months interval schedule, and to publish the QC flag files along with the data files. The format of the files is under discussion within the Data Quality WG.

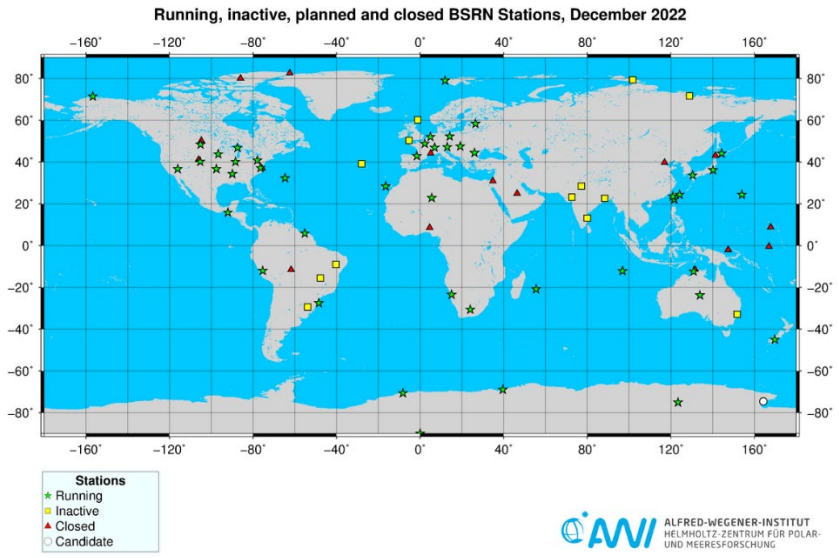

Figure 2. status of the network (Dec 2022).

Meetings

The 17th BSRN scientific review and workshop was held in hybrid form during 27-30 June 2022 in Ispra, Italy, hosted by the Joint Research Centre of the European Commission. About 40 presentations were given across several sessions dedicated to station operations, data analysis towards value-added-products, modelling, remote-sensing, campaigns (instrument inter-comparison), Working Group roundtable and reports. New challenges in term of stakeholders' requirements (space agencies and climate services in particular), compliance with GCOS monitoring principles, Fiducial Reference Measurements metrological concepts, FAIR principles, measurements on harsh environments, harmonization of the practices with the ocean community, and gaps coverage were discussed. The agenda and the presentations are available through the BSRN webpages (https://bsrn.awi.de/meetings/2022/).

Christian Lanconelli attended the annual GEWEX-GDAP and NDACC meetings (September 2022), and IRC Business meeting (July 2023) to report on the status and plans of the network and its active cooperations. Laura Riihimaki (NOAA CIRES) has continued to reinforce the interaction with the ocean community in the fame of OBPS activities (https://www.oceanbestpractices.org/).

Amelie Driemel reported on the BSRN status during the national German GCOS meeting in March 2023 (hybrid). During this meeting, an initiative was started by Stefan Rösner (German GCOS Coordinator) involving Tim Oakley (GCOS Network Manager) and the Tamanrasset station scientist Sidi Baika to get funding for the Tamanrasset tracker, which broke in 2018.

Figure 2. Group photo of the 17th Biannual BSRN Scientific review and Workshop (Ispra, Italy).

Working Groups activities

The active BSRN working groups (WG head) are: Infrared measurements (Wacker), Spectral measurements (Lantz), Broadband (McComiskey) measurements, Uncertainties (Vuilleumier), Renewable Energies (Pereira), Data Quality (Knap), Ocean (Riihimaki), Value Added Product (VAP WG) (Lanconelli, interim), and Albedo/Satellite CAL/VAL WG (Wang). Within the Data Quality WG, regular meetings continued to take place every 4-8 weeks.

BSRN quality checked data feed initiatives such as the "Ground Based Observation for the Validation of Copernicus Products" (GBOV/Copernicus Global Land Service) with solar irradiance (diffuse and global), albedo and skin temperature (as obtained from LW upwelling and downwelling combined measurements). The management is interacting with the "Copernicus CAL/VAL Solution" (CCVS) project to reinforce the role of the network, in synergies with other partners, for better support to space agencies.

An addendum to the Update of the Technical Plan for BSRN Data Management (GCOS-174) describing the format of the **new logical record LR4000** has been published on-line. A full revision of GCOS-174 is underway. LR4000 contains the pyrgeometer raw data (signal and temperatures) and it was needed to recalculate the longwave component on any eventual variation of the international standard (under discussion within the WMO Radiation Task-Team). All stations were requested to start submitting the new LR4000 for any new station to archive file within 2023. A software to verify the consistency between LR4000 and the processed data stored in LR0100 and LR0300 logical records has been implemented.

BSRN now **stores relevant calibration certificates in a centralized way** to guarantee better traceability. This will be expanded to shortwave components.

The **raw data system** was further developed though it is currently used by few stations. Candidate and pending stations are encouraged to use it, along to the pilot BSRN Data-Quality web-based tool developed in the frame of the DQWG activities, which serves as a further support to station scientists in quality checking operations.

Research Results

A list of **publications related to BSRN** can be found at http://bsrn.awi.de/other/publications/. Within the Web of Science the topic "BSRN" is cited more than 5800 times (excluding self-citations) within >4000 articles (excluding self-citations, see Figure 3). About 189 BSRN articles have been published in total (compared to 175 in June 2022), and many more scientists used BSRN data e.g. in student courses, for renewable energy research or in grey literature.

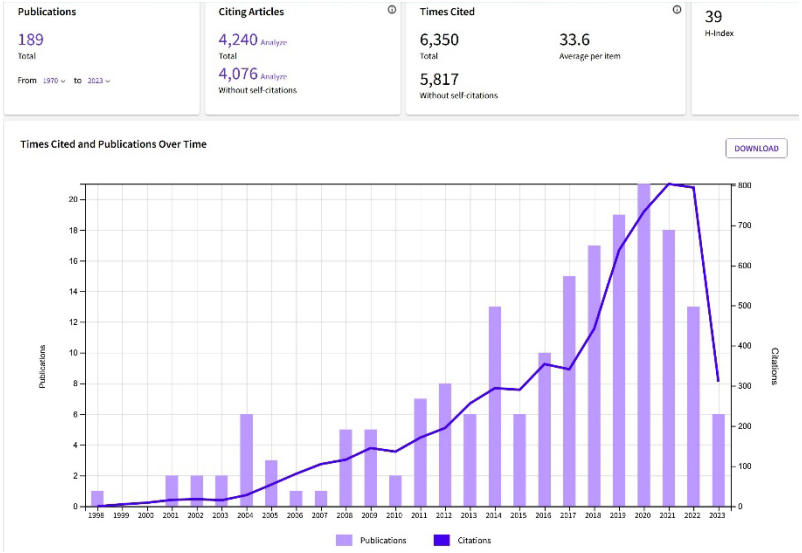

Figure 3. *Web of Science Citation Report for the Topic "BSRN" (2023-05-24)*

Ongoing activities and Plans

1. Manual review, continue with established activities and drafted content (Manuel Review committee)
2. Release Time Aggregated data through the Copernicus CDS (Value Added Product WG)
3. Interaction with Ocean community initiatives (Radiation measurements best practice white paper lead by Riihimaki NOAA) (Ocean WG).
4. Release QC files and update them with a three-month schedule (DQWG).
5. Define quantitative indicators to determine when data submission can be ingested into BSRN archive (DQWG).
6. Associate quantitative estimation of the uncertainty to each component following metrological approach whenever possible, or indicators obtained from redundant measurement (Uncertainty WG).
7. Expand albedo measurements (tower/drones?) (Albedo WG)
8. Associate spatio/temporal presentiveness indicator to each BSRN site for irradiance, albedo and cloudiness validation (Albedo WG, JRC).
9. Harmonize measurements, implement ground meteorological traceability (T, p, RH) (delayed).