Status and implementation plan of BSRN in GCOS

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Contents

1. Background

2. Recent progress of BSRN activities reviewed in the GCOS status report

3. New GCOS implementation plan related to BSRN

4. Summary
# 1. Background

Surface radiation budget is a fundamental component for climate monitoring and designated one of the GCOS ECVs. BSRN: global baseline network for surface radiation budget obs.

<table>
<thead>
<tr>
<th>Domain</th>
<th>GCOS Essential Climate Variables</th>
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</thead>
</table>
| **Atmospheric** (over land, sea and ice) | Surface: Air temperature, Wind speed and direction, Water vapour, Pressure, Precipitation, **Surface radiation budget**.  
                                          | Upper-air: Temperature, Wind speed and direction, Water vapour, Cloud properties, Earth radiation budget (including solar irradiance).  
                                          | Composition: Carbon dioxide, Methane, and other long-lived greenhouse gases, Ozone and Aerosol, supported by their precursors. |
| **Oceanic**             | Surface: Sea-surface temperature, Sea-surface salinity, Sea level, Sea state, Sea ice, Surface current, Ocean colour, Carbon dioxide partial pressure, Ocean acidity, Phytoplankton.  
                                          | Sub-surface: Temperature, Salinity, Current, Nutrients, Carbon dioxide partial pressure, Ocean acidity, Oxygen, Tracers. |
| **Terrestrial**         | River discharge, Water use, Groundwater, Lakes, Snow cover, Glaciers and ice caps, Ice sheets, Permafrost, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf area index (LAI), Above-ground biomass, Soil carbon, Fire disturbance, Soil moisture. |
Use of the data for climate research

Estimate and monitor of radiative energy balance

1) Global mean energy balance

Update the value of each elements → IPCC AR5

Schematic diagram of the global mean energy balance of the Earth at the beginning of the 21st century. (Wild et al. 2012 / IPCC 2013)
2) Long-term variation of surface radiation

**Shortwave**

Long-term variations of global solar radiation (average of 5 Japanese BSRN stations)

**Longwave**

Long-term variations of downward longwave radiation (BSRN Tateno station)

Deviation of surf. air temp. from 20th century average (Land) (Wild, 2009)

CMIP5 projections 21st century (Wild et al. 2014)
Validation of climate models

1) Downward Shortwave

Almost all climate models overestimate global solar radiation.

Climate model calculations (left) and comparisons between climate model calculations and observations (right) (Wild et al. 2013)

Comparisons between climate model calculations and observations (Wild et al. 2013)
2) Downward Longwave

Almost all climate models underestimate downward longwave radiation.

Climate model calculations (left) and comparisons between climate model calculations and observations (right) (Wild et al. 2013)

Comparisons between climate model calculations and observations. (Wild et al. 2013)
Validation of satellite SRB data sets

Shortwave

Comparisons between satellite SRB data sets and BSRN data (GEWEX 2012)

Shortwave: GEWEX SRBQSW-Ed025, Longwave: GEWEX-SRBGLW
2. Status of surface radiation budget observation reviewed in the GCOS status report

Action for Parties operating BSRN stations in IP-10

Action A14: Ensure continued long-term operation of the BSRN and expand the network

**Action:** Ensure continued long-term operation of the BSRN and expand the network to obtain globally more representative coverage. Establish formal analysis infrastructure.

**Who:** Parties’ national services and research programmes operating BSRN sites in cooperation with AOPC and the WCRP GEWEX Radiation Panel.

**Time-Frame:** Ongoing (network operation and extension); by 2012 (analysis infrastructure).

**Performance Indicator:** The number of BSRN stations regularly submitting data to International Data Centres; analysis infrastructure in place.

**Annual Cost Implications:** 1-10M US$ (20% in non-Annex-I Parties).

Category C: Moderate progress overall, though progress may be good on some part of the action.
Status of archived data at WRMC in the period of IP-10 (2010-2015)

The total data amounts archived in the WRMC have been growing steadily although data scarce area remain, especially over oceans, eastern Africa and central Asia.
Data archive status (as of Sep 2015)

About 8400 station-month (700 years) in the archive
60 stations providing data

Citation to “BSRN” in Web of Science

Citations to BSRN in Web of Science has been strongly increasing with time

Data archive status from WRMC website operated by AWI (http://bsrn.awi.de/)

3. New GCOS implementation plan related to BSRN

The implementation plan for GCOS including BSRN activity will be updated this year in support of the UNFCCC.

**Recommendation for Parties operating BSRN stations in updated GCOS implementation plan**

**Recommendation:** Ensure continued long-term operation of the BSRN and expand the network to obtain globally more representative coverage.

**Who:** Parties’ national services and research programmes operating BSRN sites in cooperation with AOPC and the WCRP GEWEX Radiation Panel.

**Time-Frame:** Ongoing

**Performance Indicator:** The number of BSRN stations regularly submitting valid data to International Data Centres.

**Benefits:** Continuing baseline surface radiation climate record at BSRN sites.
ECVs related to the energy cycle will be also identified in the new GCOS implementation plan.

Surface energy budget is fundamental variable to understand the energy cycle, completely.
Direct solar irradiance includes information of aerosol concentration in the atmosphere. The figure shows sudden increase of aerosol concentration in the atmosphere after several years of large volcanic eruptions.
Diffuse solar irradiance includes information of aerosol optical properties. The figure shows decrease in AOD and increase in SSA due to recent decrease in Black Carbon emissions into the atmosphere.

Trend of Long-term Variations in Black Carbon Aerosols
Downward longwave radiation is very important to monitor GHGs concentration in the atmosphere.

CMIP5 projections 21st century (Wild et al. 2014)

Long-term variations of DL (BSRN Tateno station)
4. Summary

- Surface radiation budget is a fundamental component for climate monitoring.
  BSRN is designated as a GCOS global baseline network.
- The data are effectively used for climate research.
- Recent progress of surface radiation budget observation was reported in "Status of the Global Observing System for Climate" in 2015;
  - The total data amount archived at data centres has significantly increased.
  - Data scarce areas also remain in some regions.
- New GCOS implementation plan will be updated this year in support of the UNFCCC;
  BSRN is a fundamental network for climate monitoring and required to continue long-term operation and expand the network.
Thank you for your attention!