Contents

1. Quality Control: exceptions and visualisation
2. Multi station shortwave residual (“global minus sum”)
3. Applications
4. Status Cabauw
5. Considerations on 2.
Exceptions

Maintenance and incidents

(Regular) maintenance

Incidents
Exception handling
Cleaning event
Exception handling

Cleaning event
BSRN Quality Control

Quality website

---

BSRN overview for station Cabauw – May 2018

**Quality Report**

- Script executed at Thu May 31 09:45:06 2018 CET
- ftp error status: 0
- Timestamp submit file: Thu May 31 09:09:00 2018 CET
- Station Cabauw
- Latitude 51.971°N
- Longitude 4.927°E
- Refraction: yes
- Processing May 2018
- Missing days in LR8100: 0
- Missing days in LR8300: 0
- Missing records in LR8100: 0
- Missing records in LR8300: 0

**BSRN quality flags and sunshine duration for May 2018**

<table>
<thead>
<tr>
<th>Date</th>
<th>SD MAX (h)</th>
<th>SD ACT (h)</th>
<th>SD REL (%)</th>
<th>DSGL2 QFPL Fla=1</th>
<th>DSGL2 QFERL Fla=1</th>
<th>DSDS QFPL Fla=2</th>
<th>DSDS QFERL Fla=2</th>
<th>DSDIR QFPL Fla=4</th>
<th>DSDIR QFERL Fla=4</th>
<th>Ratio QFCCMP Fla=1</th>
<th>Ratio QFCCMP Fla=2</th>
<th>Ratio QFCCMP Fla=4</th>
<th>Ratio QFCCMP Fla=8</th>
<th>LMD QFCCMP Fla=16</th>
<th>SMU QFPL Fla=16</th>
<th>SMU QFERL Fla=16</th>
<th>LWUP QFCCMP Fla=64</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>15.8</td>
<td>0.4</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>30</td>
<td>15.7</td>
<td>8.9</td>
<td>57</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>15.7</td>
<td>9.6</td>
<td>61</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>28</td>
<td>15.7</td>
<td>13.9</td>
<td>89</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>15.6</td>
<td>4.8</td>
<td>31</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>26</td>
<td>15.6</td>
<td>13.9</td>
<td>89</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>25</td>
<td>15.6</td>
<td>10.9</td>
<td>70</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>15.5</td>
<td>2.5</td>
<td>16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
BSRN Quality Control

Quality website

BSRN overview for station Cabauw – May 2018

Quality plots

05–2018 BSRN–QFPPLQFERL Flag=1

05–2018 BSRN–QFPPLQFERL Flag=2

05–2018 BSRN–QFERL Flag=4

05–2018 BSRN–QFCMP Flag 1&2

Difference: 0.56% (SZA <= 80°)

05–2018 BSRN–QFCMP Flag 4&8
BSRN Quality Control

Quality website

BSRN overview for station Cabauw – May 2018

Global radiation 2 (pyranometer)
BSRN Quality Control

Quality website
BSRN Quality Control

Quality website

BSRN overview for station Cabauw - May 2018

RATIO (DSGL2/DSGL1)

Report Quality DSGL2 DSGLR DSDFS Ratio Ratio scat Ratio(t) SWUP Alb Alb(t) DL LWUP Temp RH Pres SD Header Flags
BSRN Quality Control

Quality website
Shortwave residual

Definitions

\[ \text{SumSW} = \text{DIF} + \text{DIR} \times \cos(z) \]

\( z = \) solar zenith angle
\( \text{DIF} = \) diffuse sky irradiance (shaded pyranometer)
\( \text{DIR} = \) direct normal irradiance (pyrheliometer)
\( \text{SWD} = \) global irradiance (unshaded pyrheliometer)

\[ \text{Residual} = \text{Global} - \text{Sum} \]
\[ \text{Ratio} = \frac{\text{Global}}{\text{Sum}} \]

Quote from BSRN website @AWI: “In an ideal world Global and Sum should be identical. All deviations from identity denote errors.”
Shortwave residual

Background

...is a complex function of

- 2 pyranometers and 1 pyrheliometer characteristics:
  - calibration
  - cosine response
  - temperature response
  - response time

- Tracking/shading devices:
  - Tracker quality
  - Shading method (sphere, band?)
Shortwave residual

Background

...is a complex function of

- Field conditions:
  - Pointing and tilt errors
  - Distance between instruments

- Actual radiation field:
  - clouds
  - aerosols

- Data acquisition
Global vs Sum scatter plots
Cabauw
Daily cycles of Global/Sum Cabauw
Cloudless day
Cabauw, 1 July 2018

Radiation components BSRN Cabauw - 1 July 2018

Irradiance (W/m²)

Time (UTC)
Global – Sum (W/m²)
Cabauw, 1 July 2018

Shortwave absolute residual BSRN Cabauw - 1 July 2018

Time (UTC)
Global/Sum
Cabauw, 1 July 2018

Shortwave relative residual BSRN Cabauw - 1 July 2018
Tilt error
Cabauw, 1 July 2018, RT model

- Calculate full model residual
- + cosine/azimuth response
  pyranometer needed

![Global irradiance response to 1° pyranometer tilt](image)
Carpentras - France

Absolute difference (W/m²)

Relative difference (%)
Cener - Spain
Florianopolis - Brasil

Absolute difference (W/m²)

Relative difference (%)
Ishigakijima - Japan

Absolute difference (W/m²)

DSCL2 - DSGL1 (W/m²)

Relative difference (%)

2013/11/22: DSCL2 - DSGL1 (%) = 0.515
Palaiseau - France

- Absolute difference (W/m²)
  - DSGL2 - DSGL1 (W/m²)

- Relative difference (%)
  - DSGL2 - DSGL1 (%)
Paramaribo - Suriname

Absolute difference (W/m²)

Relative difference (%)

Expanded scales!
BSRN applications
Forecast of solar radiation (0 – 2 h)

Advection of MSG-SEVIRI cloud properties
Using Atmospheric Motion Motion Vectors
BSRN applications
Forecast of solar radiation (0 – 48 h)
BSRN applications
Forecast of solar radiation (kWh/m$^2$)
BSRN applications
Forecast of solar radiation (kWh/m²)

Period: April 2017 – now
BSRN station: Cabauw

Daily integrated irradiance (kWh/m²)

- Mean BSRN = 3.57 kWh/m²
- Mean HARM = 3.42 kWh/m²
- Bias = -0.15 kWh/m² (-4.1 %)
- RMSE = 0.71 kWh/m² (20.0 %)
- N = 444

\[ y = -0.05 + 0.97x \]
\[ R^2 = 0.91 \]

Histogram (kWh/m²)

- Mean = -0.15 kWh/m²
- Sigma = 0.70 kWh/m²
BSRN applications
Validation of satellite products

- OMI-SCIAMACHY SSI product
- Monthly mean SSI 2005-2006
- 15 BSRN stations

![Graph comparing BSRN SSI and OMI-SCIAMACHY SSI](image-url)
BSRN applications
Validation of satellite products

- OMI-SCIAMACHY SSI product
- Monthly mean SSI 2005-2006
- 15 BSRN stations
BSRN applications
Validation of satellite products

- OMI-SCIAMACHY SSI product
- Monthly mean SSI 2005-2006
- 15 BSRN stations
Cavity radiometry
HF to AHF conversion (shutter)
Pyranometer intercomp.
1-year period (xx – xx)
2015-05-06: Cabauw

On 3 November 2011 there has been a change of instruments used for the measurement of the downward longwave irradiance (DL in LR0100). This change of instruments was accompanied by a calibration change, removing a bias of $+3.85 \pm 1.48 \text{ W/m}^2$ that exists in DL before 3 November 2011. After 3 November 2011, the values of DL are traceable to the WISG. We plan to correct the data (remove the bias) before 3 November 2011 and resubmit the station-to-archive files (February 2005 – November 2011).

For further information please contact Wouter Knap.

Calibrations:
K&Z – PMOD

Bias: $3.85 \pm 1.48 \text{ W/m}^2$

BSRN DL bias (W/m$^2$)

- CG4 s/n 020611
- CG4 s/n 040736

2005
3 November 2011
2018
Considerations:

- Global/Sum and Global – Sum contain a lot of valuable information
- Daily cycles and (in particular) time series potentially reveal problems
- Stations should look at the data
- Central processing?
Final slide: highlight

Shortwave residual