Quality Checks offered by the BSRN Toolbox

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Alfred Wegener Institute

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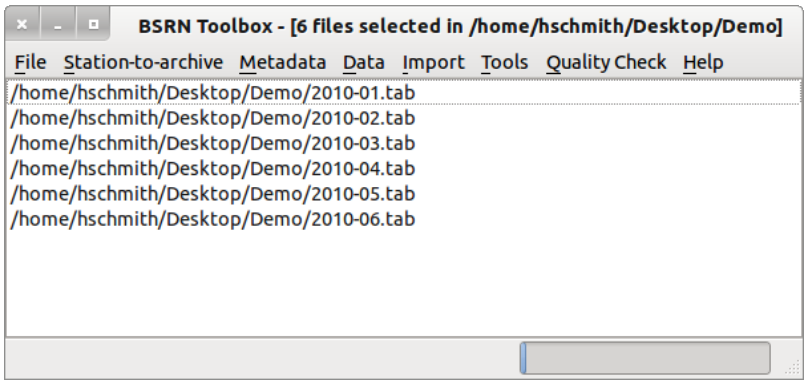
Outline

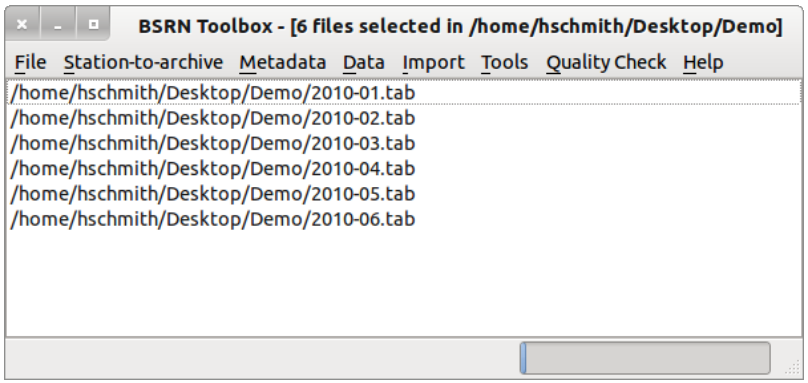
Introduction to the BSRN Toolbox

- Provided by WRMC to station scientists, data users and data curators



Introduction to the BSRN Toolbox

- Provided by WRMC to station scientists, data users and data curators
- Open source (licensed under GPL)



Introduction to the BSRN Toolbox

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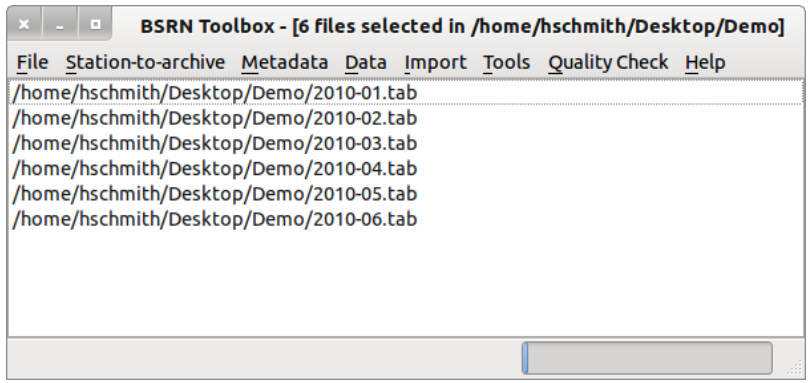
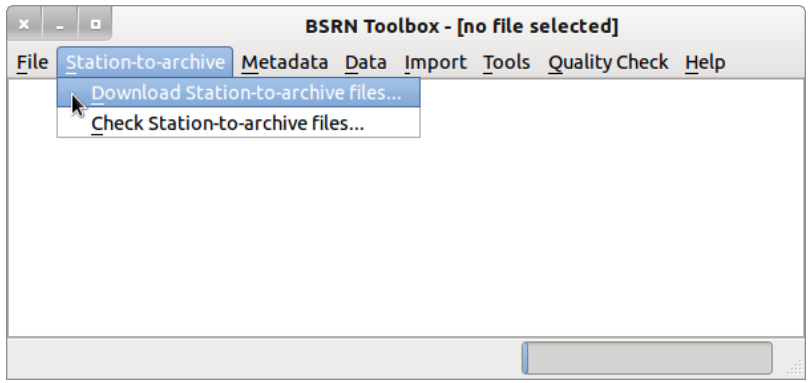
- Main features:



Introduction to the BSRN Toolbox

- Provided by WRMC to station scientists, data users and data curators
- Open source (licensed under GPL)
- Main features:
  - Download manager for StationToArchive files



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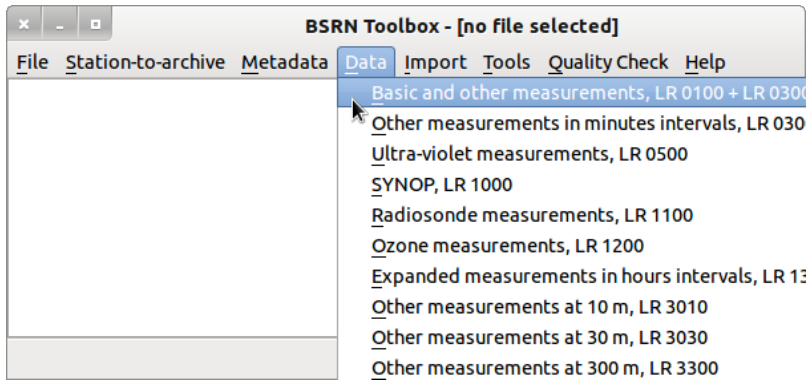

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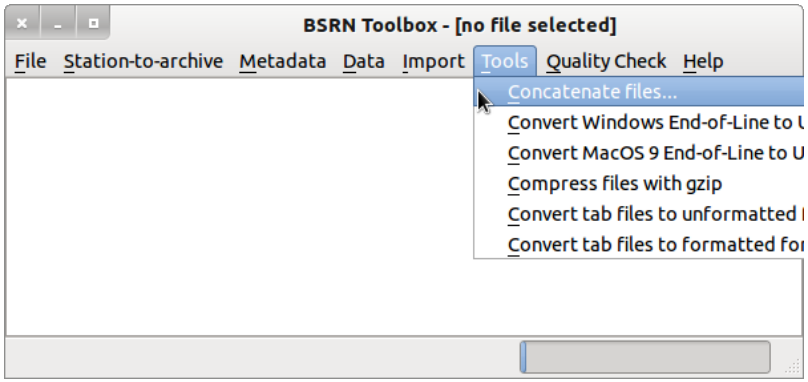

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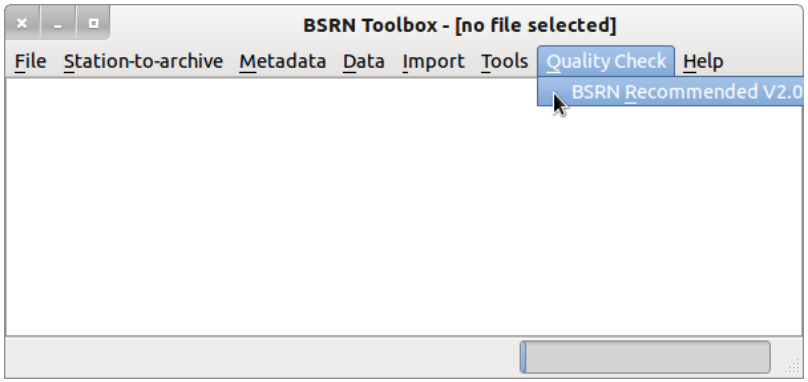
- Main features:
  - Download manager for StationToArchive files
  - Format converter (StationToArchive, Pangaea)
  - Basic file operations
  - Quality Checks for BSRN data



Applied Quality Checks

Current version of BSRN Toolbox provides one set of quality checks:

`C. N. Long and E. G. Dutton:`
`BSRN Global Network recommended QC tests, V2.0`

- *Physically possible* limit tests
- *Extremely rare* limit tests
- Intercomparisons between different parameter

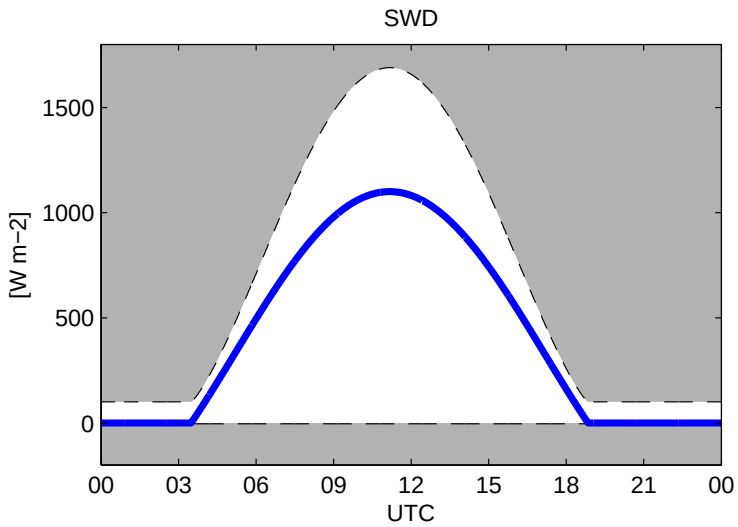
Physically Possible Limits

Theses parameter are checked for *physically possible* values:

Physically Possible Limits

Theses parameter are checked for *physically possible* values:

- **SW downwards**



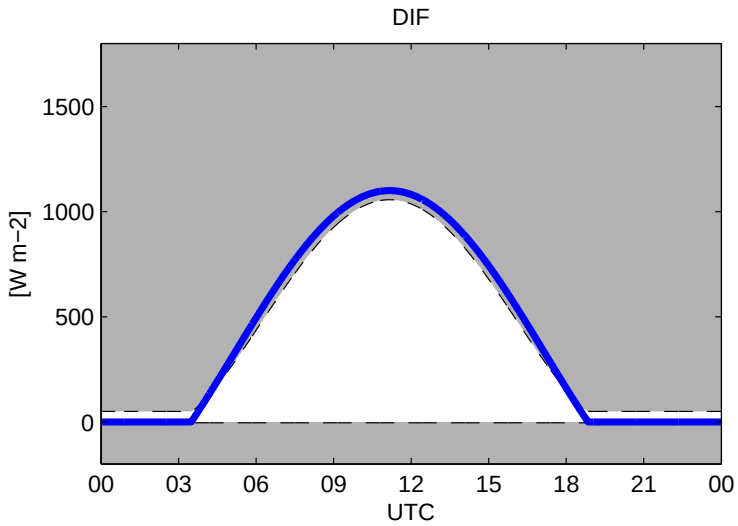
$$\text{Max: } 1.5\, S_a \cdot cos(SZA)^{1.2} + 100 \frac{W}{m^2}$$

$$\text{Min: } -4 \frac{W}{m^2}$$

Physically Possible Limits

Theses parameter are checked for *physically possible* values:

- **SW downwards**
- **SW diffuse**

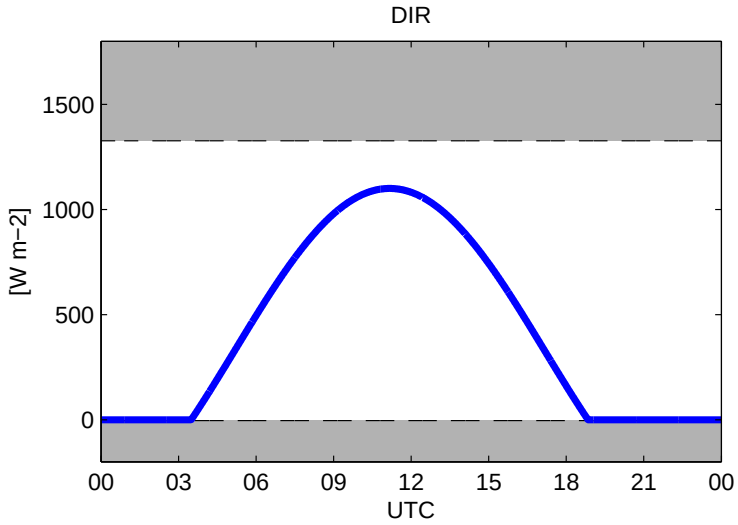


$$\text{Max: } 0.95\, S_a \cdot cos(SZA)^{1.2} + 50\frac{W}{m^2}$$
$$\text{Min: } -4\frac{W}{m^2}$$

Physically Possible Limits

Theses parameter are checked for *physically possible* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**



Max: S_a

Min: $-4\frac{W}{m^2}$

Physically Possible Limits

Theses parameter are checked for *physically possible* values:

- **SW downwards**
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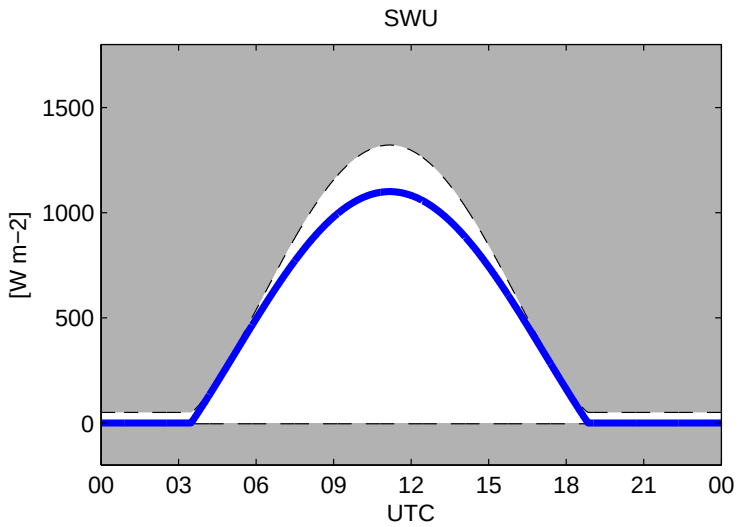
- **SW direct normal**
- **SW upwards**

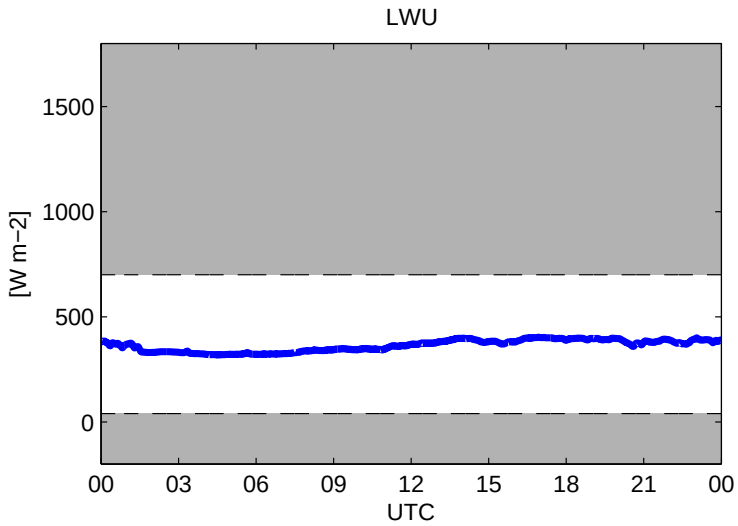


$$\text{Max: } 1.2\, S_a \cdot cos(SZA)^{1.2} + 50\frac{W}{m^2}$$
$$\text{Min: } -4\frac{W}{m^2}$$

Physically Possible Limits

Theses parameter are checked for *physically possible* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**
- **SW upwards**
- **LW downwards**



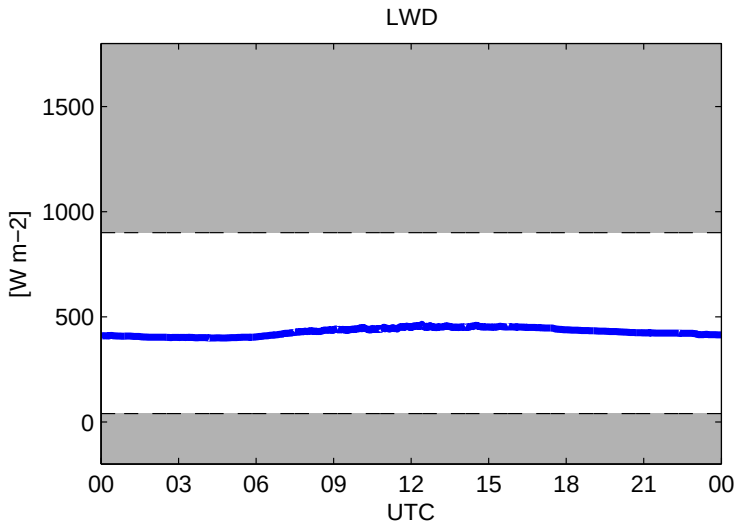
Max: $700 \frac{W}{m^2}$

Min: $40 \frac{W}{m^2}$

Physically Possible Limits

Theses parameter are checked for *physically possible* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**
- **SW upwards**
- **LW downwards**
- **LW upwards**



Max: $900 \frac{W}{m^2}$

Min: $40 \frac{W}{m^2}$

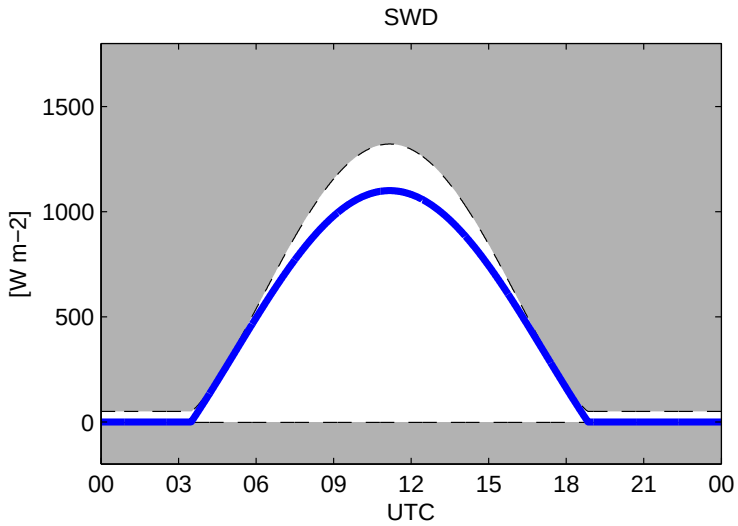
Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

- **SW downwards**

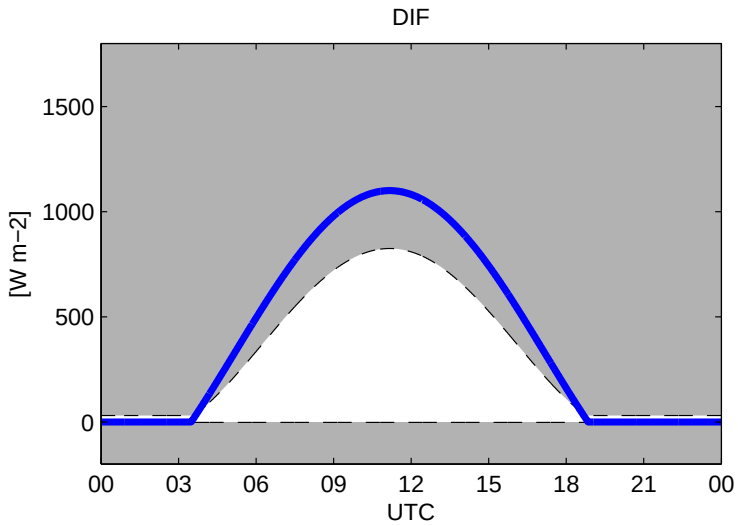


$$\text{Max: } 1.2\, S_a \cdot cos(SZA)^{1.2} + 50\,\frac{W}{m^2}$$
$$\text{Min: } -2\,\frac{W}{m^2}$$

Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

- **SW downwards**
- **SW diffuse**

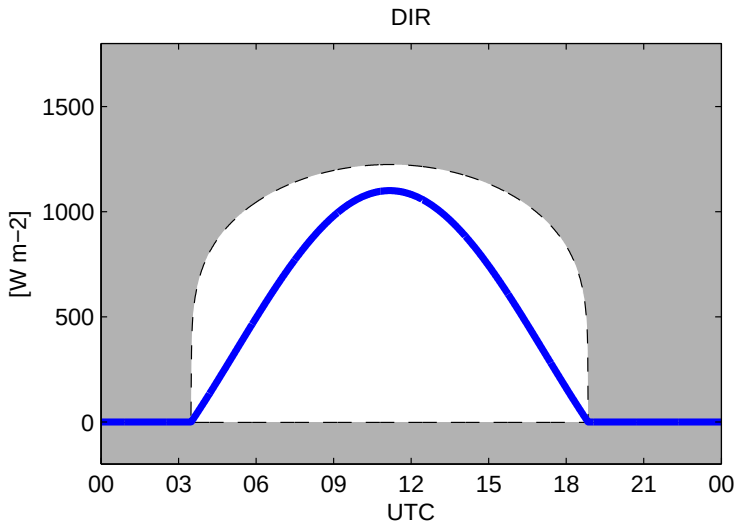


$$\text{Max: } 0.75\, S_a \cdot cos(SZA)^{1.2} + 30\frac{W}{m^2}$$
$$\text{Min: } -2\frac{W}{m^2}$$

Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**

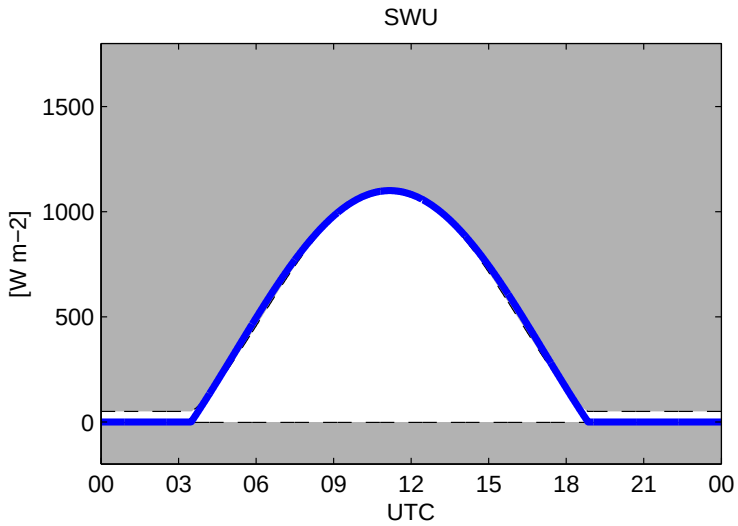


$$\text{Max: } 0.95\, S_a \cdot cos(SZA)^{0.2} + 10\frac{W}{m^2}$$
$$\text{Min: } -2\frac{W}{m^2}$$

Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**
- **SW upwards**

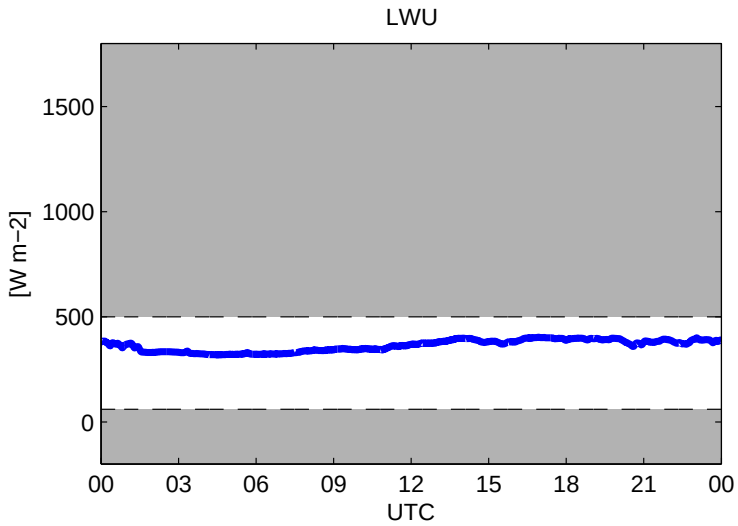


$$\text{Max: } S_a \cdot cos(SZA)^{1.2} + 50\frac{W}{m^2}$$
$$\text{Min: } -2\frac{W}{m^2}$$

Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**
- **SW upwards**
- **LW downwards**



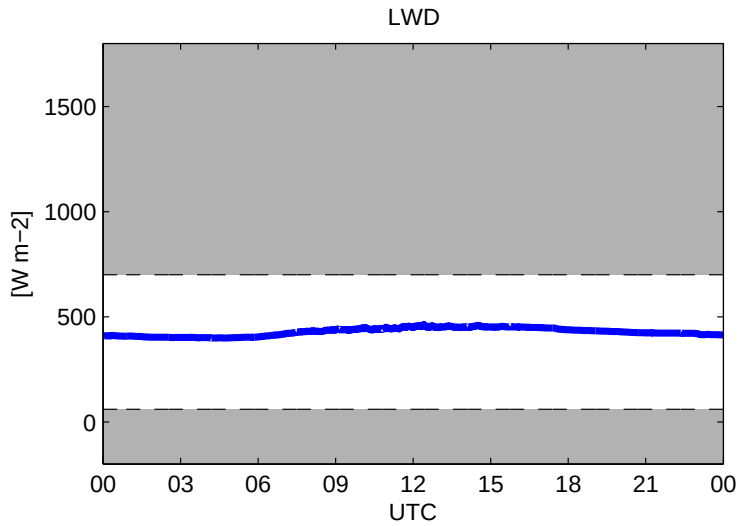
Max: $500 \frac{W}{m^2}$

Min: $60 \frac{W}{m^2}$

Extremely Rare Limits

Theses parameter are checked for *extremely rare* values:

- **SW downwards**
- **SW diffuse**
- **SW direct normal**
- **SW upwards**
- **LW downwards**
- **LW upwards**



Max: $700 \frac{W}{m^2}$

Min: $60 \frac{W}{m^2}$

Comparisons

Comparisons are done for the following parameter:

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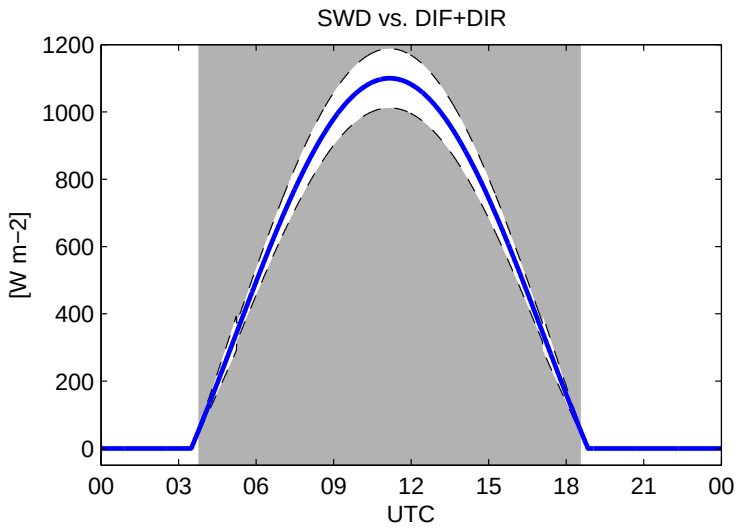
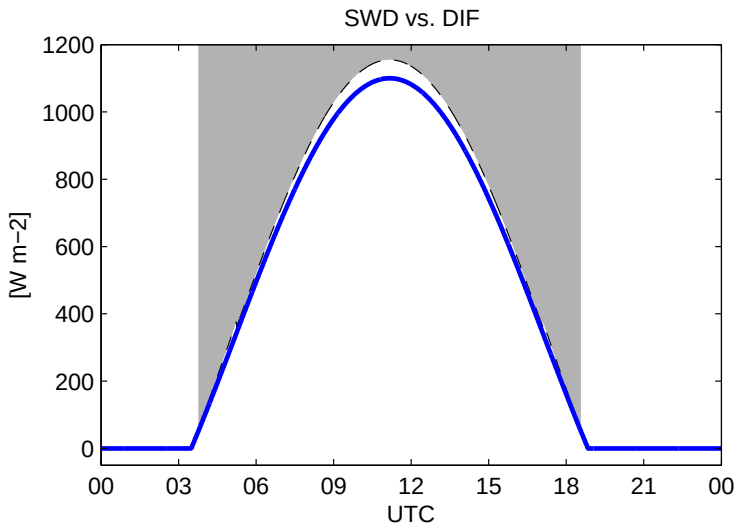
- **SWD** vs. **DIF + DIR**



Comparisons

Comparisons are done for the following parameter:

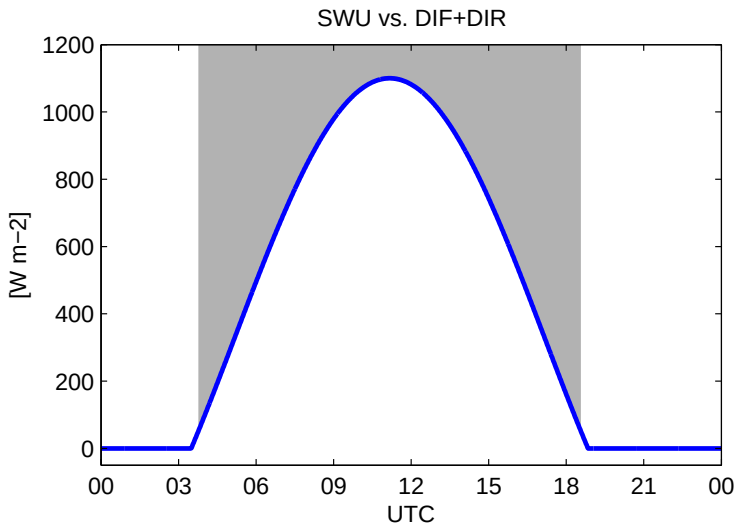
- **SWD** vs. **DIF + DIR**
- **SWD** vs. **DIF**



Comparisons

Comparisons are done for the following parameter:

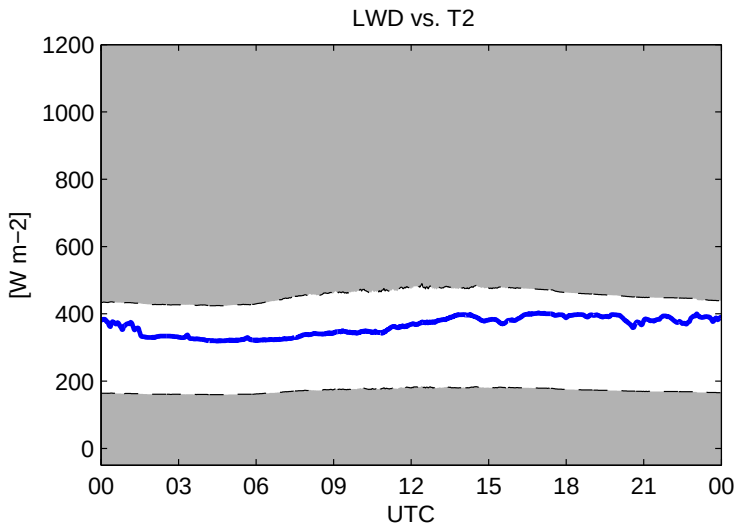
- **SWD** vs. **DIF + DIR**
- **SWD** vs. **DIF**
- **SWU** vs. **DIF + DIR**



Comparisons

Comparisons are done for the following parameter:

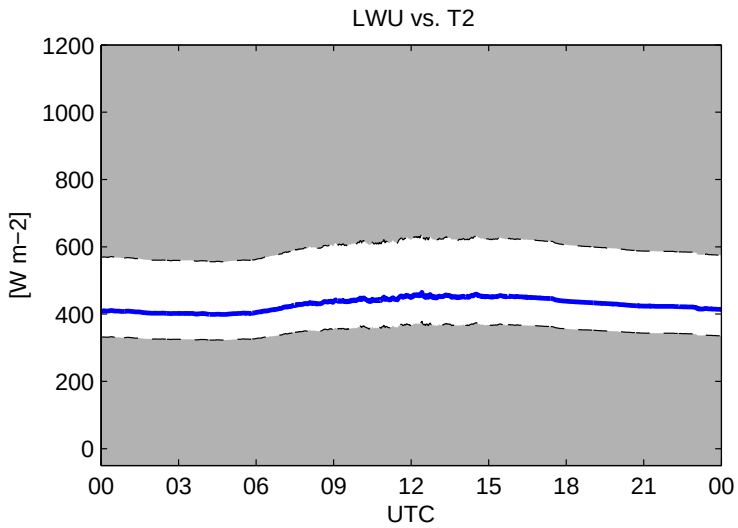
- **SWD** vs. **DIF + DIR**
- **SWD** vs. **DIF**
- **SWU** vs. **DIF + DIR**
- **LWD** vs. **T2**



Comparisons

Comparisons are done for the following parameter:

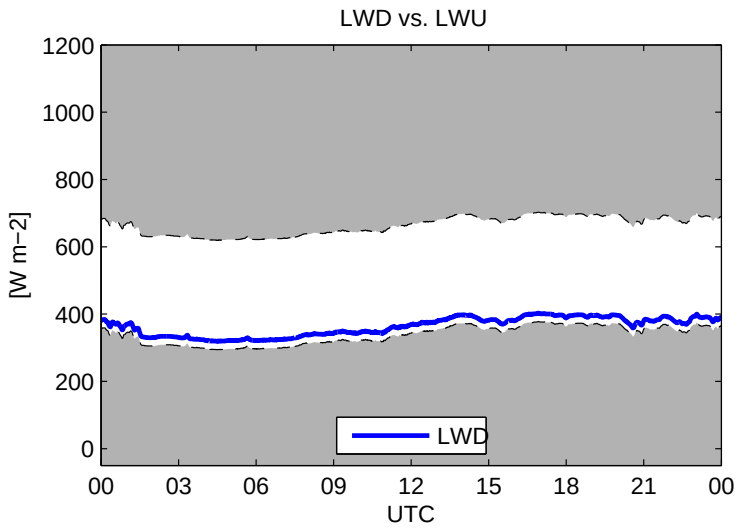
- **SWD** vs. **DIF + DIR**
- **SWD** vs. **DIF**
- **SWU** vs. **DIF + DIR**
- **LWD** vs. **T2**
- **LWU** vs. **T2**



Comparisons

Comparisons are done for the following parameter:

- **SWD** vs. **DIF + DIR**
- **SWD** vs. **DIF**
- **SWU** vs. **DIF + DIR**
- **LWD** vs. **T2**
- **LWU** vs. **T2**
- **LWD** vs. **LWU**



Produced Quality Codes

- One QC per measured value
- Designed as 6-bit array (decimal numbers $0 - 63$)
- 2 bits per
  - physical possible limits
  - extremely rare limits
  - comparisons
- extendable for additional future checks

Produced Quality Codes

	above compared measurement	below compared measurement	above extremely rare limit	below extremely rare limit	above physically possible limit	below physically possible limit	
bit position	**5**	**4**	**3**	**2**	**1**	**0**	
decimal value	32	16	8	4	2	1	

Examples

Produced Quality Codes

	above compared measurement	below compared measurement	above extremely rare limit	below extremely rare limit	above physically possible limit	below physically possible limit	
bit position	**5**	**4**	**3**	**2**	**1**	**0**	
decimal value	32	16	8	4	2	1	

Examples

$SWD = 9990 \frac{W}{m^2}$

Produced Quality Codes

	above compared measurement	below compared measurement	above extremely rare limit	below extremely rare limit	above physically possible limit	below physically possible limit	
bit position	**5**	**4**	**3**	**2**	**1**	**0**	
decimal value	32	16	8	4	2	1	

Examples

$SWD = 9990 \frac{W}{m^2}$	0	0	1	0	1	0	$= 10$

Produced Quality Codes

	above compared measurement	below compared measurement	above extremely rare limit	below extremely rare limit	above physically possible limit	below physically possible limit	
bit position	**5**	**4**	**3**	**2**	**1**	**0**	
decimal value	32	16	8	4	2	1	

Examples

$SWD = 9990 \frac{W}{m^2}$	0	0	1	0	1	0	$= 10$
$LWD = 350 \frac{W}{m^2}$ $LWU = 300 \frac{W}{m^2}$							

Produced Quality Codes

	above compared measurement	below compared measurement	above extremely rare limit	below extremely rare limit	above physically possible limit	below physically possible limit	
bit position	**5**	**4**	**3**	**2**	**1**	**0**	
decimal value	32	16	8	4	2	1	

Examples

$SWD = 9990 \frac{W}{m^2}$	0	0	1	0	1	0	$= 10$
$LWD = 350 \frac{W}{m^2}$	1	0	0	0	0	0	$= 32$
$LWU = 300 \frac{W}{m^2}$	0	1	0	0	0	0	$= 16$

Input Data

Various input formats are supported:

- Pangaea files as downloaded from www.pangaea.de

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- Pangaea files as downloaded from www.pangaea.de
- Output from Pangaea's Data Warehouse

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Various input formats are supported:

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- TAB-delimited tables as produced by the format converter

Input Data

Various input formats are supported:

- Pangaea files as downloaded from www.pangaea.de
- Output from Pangaea's Data Warehouse
- TAB-delimited tables as produced by the format converter
- StationToArchive files need to be converted first

Output Data

- Format of output files is Pangaea format

Output Data

- Format of output files is Pangaea format
- Available output:

Output Data

- Format of output files is Pangaea format
- Available output:
  - Quality codes

Output Data

- Format of output files is Pangaea format
- Available output:
  - Quality codes
  - Auxiliary data (astronomical parameter, DIF+DIR)

Output Data

- Format of output files is Pangaea format
- Available output:
  - Quality codes
  - Auxiliary data (astronomical parameter, DIF+DIR)
  - Original data set with flagged values removed

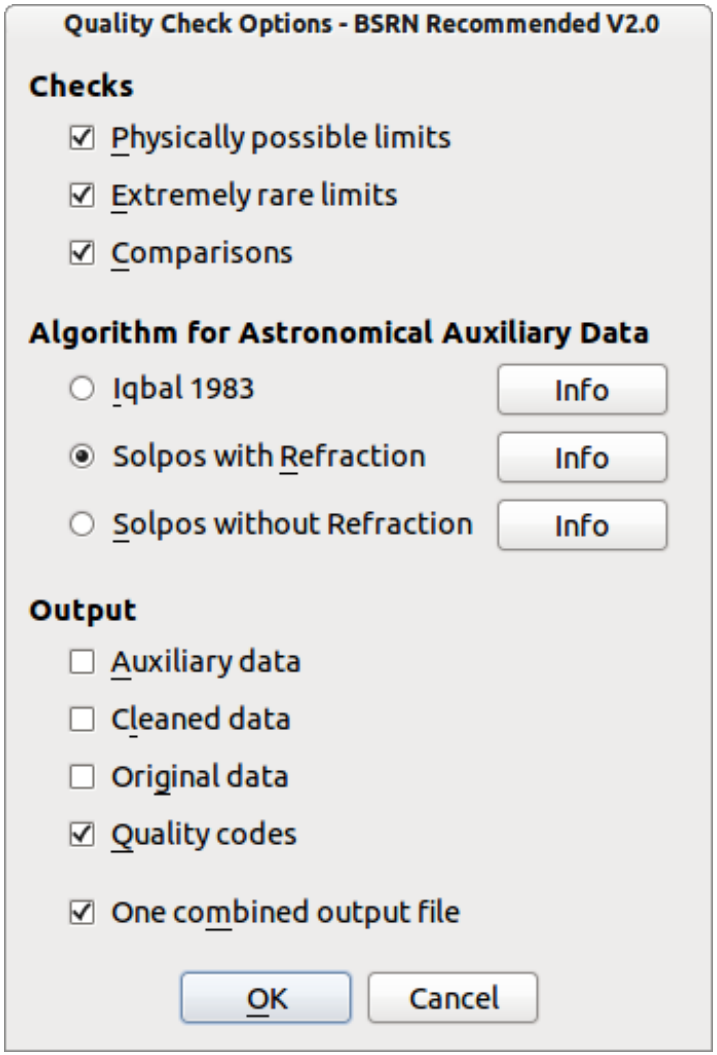
Output Data

- Format of output files is Pangaea format
- Available output:
  - Quality codes
  - Auxiliary data (astronomical parameter, DIF+DIR)
  - Original data set with flagged values removed

```
/* DATA DESCRIPTION:
Applied quality checks: BSRN Recommended V2.0 - Physical Possible Limits
                        BSRN Recommended V2.0 - Extremely Rare Limits
                        BSRN Recommended V2.0 - Comparisons
Coverage:               LATITUDE: -70.650000 * LONGITUDE: -8.250000
                        DATE/TIME START: 2012-01-01T09:09:00 * DATE/TIME END: 2012-01-31T23:59:00
                        MINIMUM HEIGHT above ground: 2.0 m * MAXIMUM HEIGHT above ground: 2.0 m
Event(s):               GVN (Georg von Neumayer) (URI: http://www.awi.de/en/infrastructure/stations/neumayer_station/observatories/meteorological_observatory/) * LATITUDE: -70.6
Project(s):             Baseline Surface Radiation Network (BSRN) (URI: http://bsrn.awi.de)
Parameter(s):           DATE/TIME (Date/Time)
                        Short-wave downward (GLOBAL) radiation Quality code (SWDQc)
                        Direct radiation Quality code (DIRQc)
                        Diffuse radiation Quality code (DIFQc)
                        Long-wave downward radiation Quality code (LWDQc)
                        Short-wave upward (REFLEX) radiation Quality code (SWUQc)
                        Long-wave upward radiation Quality code (LWUQc)
                        Air temperature at 2 m height Quality code (T2Qc)
*/
```

Date/Time	SWDQc	DIRQc	DIFQc	LWDQc	SWUQc	LWUQc	T2Qc
2012-01-01T09:09:00	0	0	0	0	0	0	0
2012-01-01T09:10:00	0	0	0	0	0	0	0
2012-01-01T09:11:00	0	0	0	0	0	0	0
2012-01-01T09:12:00	0	0	0	0	0	0	0
2012-01-01T09:13:00	0	0	0	0	0	0	0
2012-01-01T09:14:00	0	0	0	0	0	0	0
2012-01-01T09:15:00	0	0	0	0	0	0	0
2012-01-01T09:16:00	0	0	0	0	0	0	0
2012-01-01T09:17:00	0	0	0	0	0	0	0
2012-01-01T09:18:00	0	0	0	0	0	0	0
2012-01-01T09:19:00	0	0	0	0	0	0	0
2012-01-01T09:20:00	0	0	0	0	0	0	0
2012-01-01T09:21:00	0	0	0	0	0	0	0
2012-01-01T09:22:00	0	0	0	0	0	0	0
2012-01-01T09:23:00	0	0	0	0	0	0	0
2012-01-01T09:24:00	0	0	0	0	0	0	0
2012-01-01T09:25:00	0	0	0	0	0	0	0
2012-01-01T09:26:00	0	0	0	0	0	0	0
2012-01-01T09:27:00	0	0	0	0	0	0	0
2012-01-01T09:28:00	0	0	0	0	0	0	0
2012-01-01T09:29:00	0	0	0	0	0	0	0

Configuration Dialogue



Visualisation