On quality control procedures for solar radiation and meteorological measures, from subhourly to monthly average time periods
Bella Espinar, Philippe Blanc, Lucien Wald, Carsten Hoyer-Klick, Marion Schroedter Homscheidt, Thomas Wanderer

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### Long-term radiation and meteorological measurements are available from a large number of ground measuring stations. However, close examination of the data often reveals a lack of quality, often for extended periods of time. Quality Control Procedures (QCPs) are a measure of how well data serve the purpose for which they were produced. We have searched in the bibliographic references the QCPs that are available for the solar radiation and meteorological data series which are of interest in the field of renewable energies, grouping them together by average time periods, checking them and modifying them if necessary. All of the QCPs that are presented in this document are applicable for all latitudes; they are not optimized regionally nor seasonally with the aim of being generic. The research leading to those results has partly received funding from the European Union’s Seventh Framework Programme (FP7/2007-2013).

### TYPES OF QUALITY CONTROL PROCEDURES (QCPs)

- **Range QCPs**: verify that values are within a specific range (based on extrema for physically possible values and based on rare observations for possible but extremely rare values).
- **Step QCPs**: aimed at detecting unrealistic increments or stagnations in the time series, with respect to their sampling and integration period.
- **Consistency QCPs**: verify the consistencies between two or more independent time series.

#### Monthly

<table>
<thead>
<tr>
<th>Global Horizontal Irradiance (GHI)</th>
<th>Beam Normal Irradiance (BNI)</th>
<th>Diffuse Horizontal Irradiance (DHI)</th>
<th>Temperature (°C)</th>
<th>Humidity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>QCP based on extrema [3,7]</td>
<td>QCP based on extrema [3,7]</td>
<td>QCP based on extrema [3,7]</td>
<td>0 &lt; WS &lt; 80</td>
<td>0 &lt; Hum &lt; 100</td>
</tr>
<tr>
<td>0.03 GHI &lt; GHI &lt; 1.2 I₀</td>
<td>0.03 GHI &lt; GHI &lt; 1.2 I₀</td>
<td>0.03 GHI &lt; DHI &lt; 0.8 I₀</td>
<td>0 &lt; Temp &lt; +60</td>
<td>0 &lt; Hum &lt; 100</td>
</tr>
<tr>
<td>QCP based on rare observations</td>
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<td>[3,13]</td>
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<td>[3,13]</td>
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<td>0 &lt; Hum &lt; 100</td>
</tr>
<tr>
<td>0.03 GHI &lt; GHI &lt; GHItoa</td>
<td>0.03 GHI &lt; GHI &lt; GHItoa</td>
<td>0.03 GHI &lt; DHI &lt; 0.75 GHItoa</td>
<td>Maximum step for two following measures: 3 °C</td>
<td></td>
</tr>
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#### Daily

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<tr>
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#### Hourly

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#### Sub-hourly (1-minute average except for WS which is 2-minute)

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</thead>
<tbody>
<tr>
<td>QCP based on extrema [3,4,7]</td>
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<td>QCP based on extrema [3,4,7]</td>
<td>0 &lt; WS &lt; 80</td>
<td>0 &lt; Hum &lt; 100</td>
</tr>
<tr>
<td>0.03 GHI &lt; GHI &lt; min (1.2 I₀, 1.5 I₀ cos(SZA)1.2 + 100)</td>
<td>0.03 GHI &lt; GHI &lt; min (1.2 I₀, 1.5 I₀ cos(SZA)1.2 + 100)</td>
<td>0.03 GHI &lt; DHI &lt; min (0.8 I₀, 0.95 I₀ cos(SZA)1.2 + 10)</td>
<td>0 &lt; Temp &lt; +60</td>
<td>0 &lt; Hum &lt; 100</td>
</tr>
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### References

[1] MINES ParisTech, CEP – Centre énergétique et procédés, BP 207, 1 rue Claude Daunesse, 06904 Sophia Antipolis Cedex France
[2] DLR, German Aerospace Center DLR, Wessling, Germany

**Quality Control (QC) Output Report:** After checking the plausibility of the data, some graphs, histograms and figures of flagged values may help in the interpretation of the result of QC and also to detect some other features of data.