



IALA GUIDELINE

G1039-2 HANDBOOK FOR METEOROLOGICAL DATA FOR IALA SOLAR POWER SYSTEM CALCULATION TOOL

Edition 2.1

December 2017

urn:mrn:iala:pub:g1039-2:ed2.1



DOCUMENT REVISION

Revisions to this document are to be noted in the table prior to the issue of a revised document.

Date	Details	Approval
December 2017	First issue.	Council 65
July 2022	Edition 2.1 Editorial corrections.	



CONTENTS

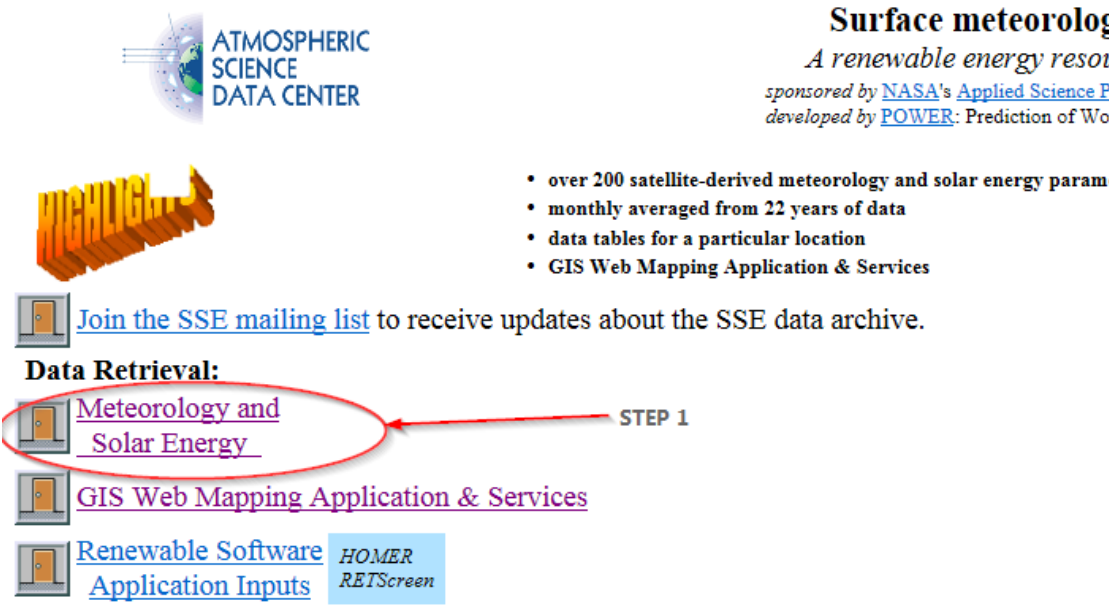




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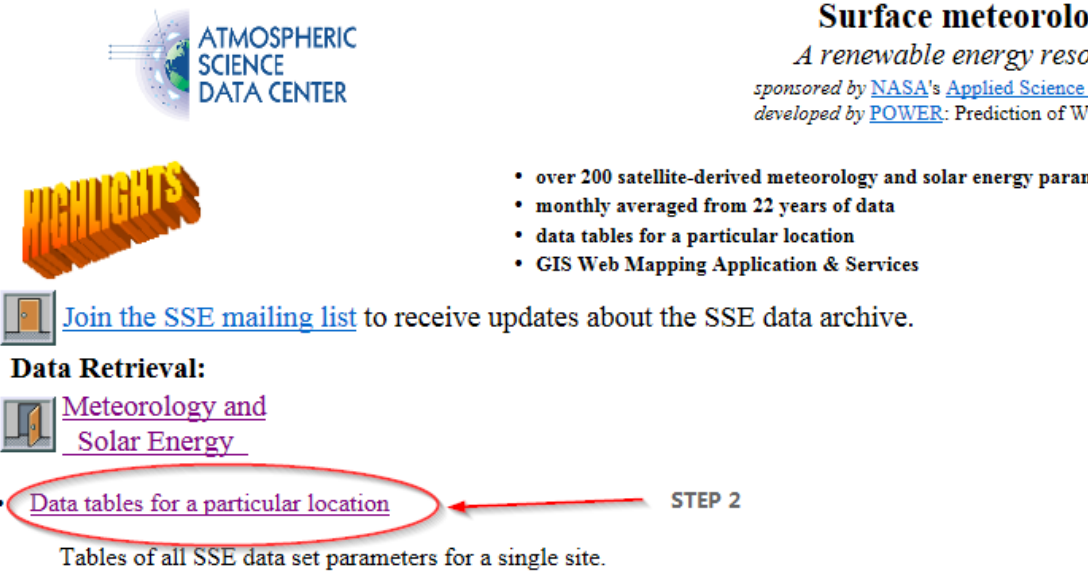
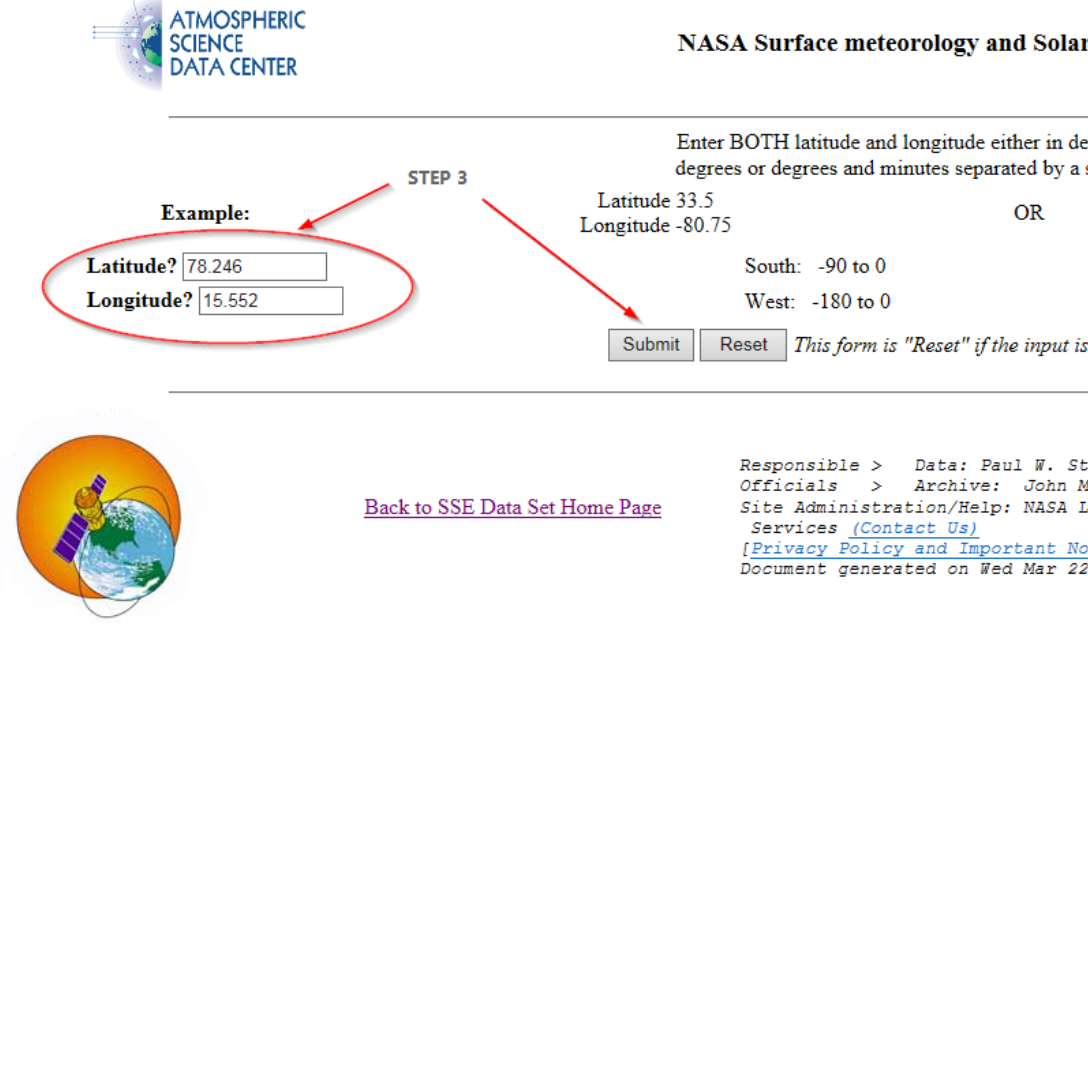
1. INTRODUCTION


The following description shows how to extract relevant meteorological and solar energy data from a public NASA website.

Another website to derive data from is <http://re.jrc.ec.europa.eu/pvgis/apps4/pvest.php>.

2. SHORT HANDBOOK FOR METEOROLOGY AND SOLAR ENERGY

Description	Action
<p>http://eosweb.larc.nasa.gov/sse/</p>	<p>Step 1:</p> <p>Click on the link at the left side to access NASA's website.</p>
 <p>ATMOSPHERIC SCIENCE DATA CENTER</p> <p>Surface meteorology <i>A renewable energy resource</i> sponsored by NASA's Applied Science Program developed by POWER: Prediction of Worldwide Energy Resources</p> <ul style="list-style-type: none"> • over 200 satellite-derived meteorology and solar energy parameters • monthly averaged from 22 years of data • data tables for a particular location • GIS Web Mapping Application & Services <p> Join the SSE mailing list to receive updates about the SSE data archive.</p> <p>Data Retrieval:</p> <p> Meteorology and Solar Energy STEP 1</p> <p> GIS Web Mapping Application & Services</p> <p> Renewable Software Application Inputs HOMER RETScreen</p>	<p>Step 2:</p> <p>Click on the link shown on the left side.</p>

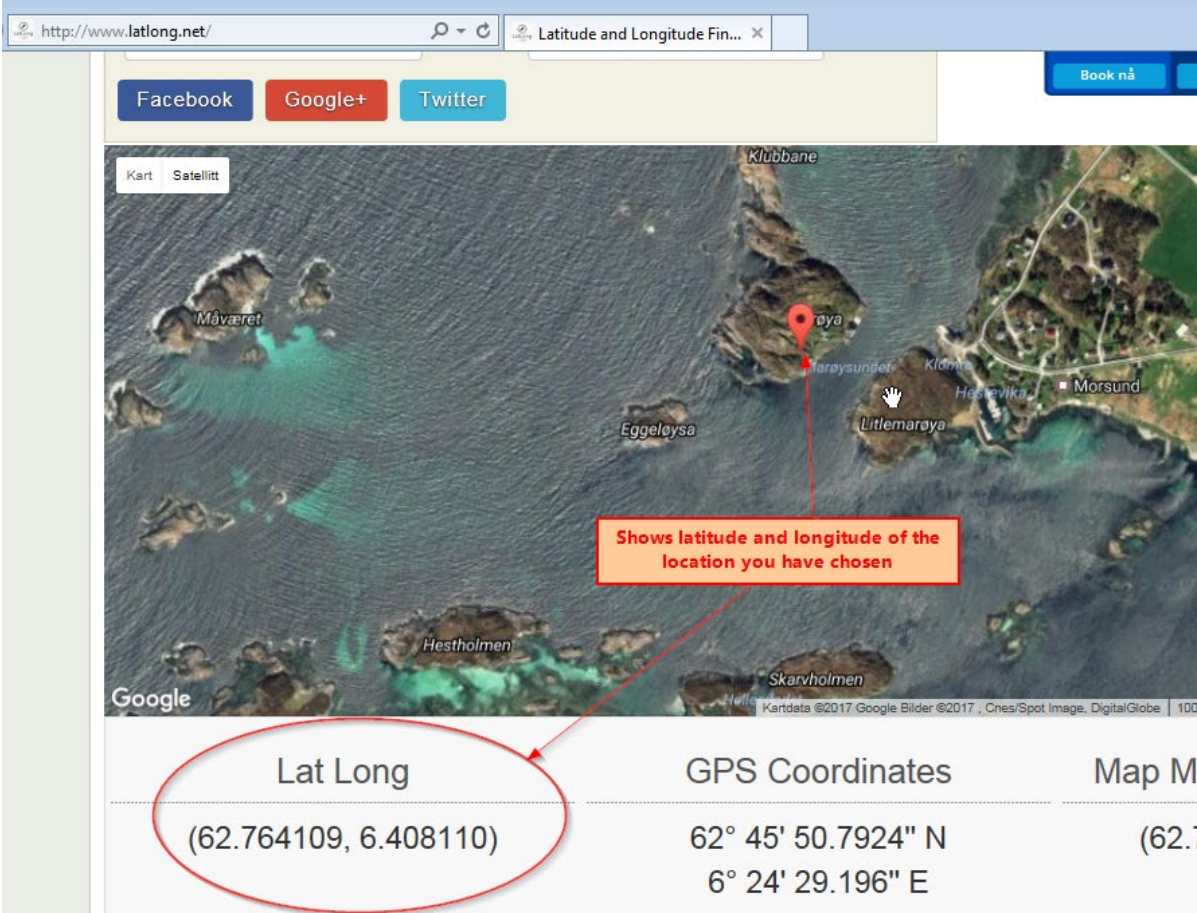
Description	Action
 <p>Surface meteorology and Solar Energy <i>A renewable energy resource</i> sponsored by NASA's Applied Science developed by POWER: Prediction of Weather</p> <ul style="list-style-type: none"> • over 200 satellite-derived meteorology and solar energy parameters • monthly averaged from 22 years of data • data tables for a particular location • GIS Web Mapping Application & Services <p>Data Retrieval:</p> <ul style="list-style-type: none"> • Data tables for a particular location <p>Tables of all SSE data set parameters for a single site.</p>	<p>Step 3:</p> <p>Click on the link shown on the left side.</p>
 <p>NASA Surface meteorology and Solar Energy</p> <p>Enter BOTH latitude and longitude either in degrees or degrees and minutes separated by a space</p> <p>Example: Latitude 78.246 Longitude 15.552</p> <p>Latitude 33.5 Longitude -80.75 OR South: -90 to 0 West: -180 to 0</p> <p><input type="button" value="Submit"/> <input type="button" value="Reset"/> <i>This form is "Reset" if the input is</i></p> <p>Back to SSE Data Set Home Page</p> <p>Responsible > Data: Paul W. St... Officials > Archive: John M... Site Administration/Help: NASA Le... Services (Contact Us) (Privacy Policy and Important Not) Document generated on Wed Mar 22</p>	<p>Step 4:</p> <p>Enter the geographical position where your AtoN is located.</p> <p>To derive coordinates from a map you can use http://www.latlong.net/ (see short description at the end of the table).</p> <p>Then press the button "Submit".</p> <p>In this example, a location in Svalbard is used.</p>

Description	Action
<p style="text-align: center;"> SSE Homepage Find A Different Location Accuracy Methodology </p> <p style="text-align: center;">  </p> <p style="text-align: center;"> NASA Surface meteorology and Solar Energy - Choices Latitude 78.246 / Longitude 15.552 was chosen. </p> <p style="text-align: center;"> Select parameters and press Submit (Default is ALL types) </p> <p style="text-align: right;"> <input type="button" value="Submit"/> <input type="button" value="Reset"/> </p> <p><i>Geometry</i> Latitude and longitude (center s</p> <hr/> <p><i>Parameters for Solar Cooking</i> STEP 4 <input type="checkbox"/> Average insolation <input type="checkbox"/> Midday insolation <input type="checkbox"/> Clear sky insolation <input type="checkbox"/> Clear sky days</p> <hr/> <p><i>Parameters for Sizing and Pointing of Solar Panels and for Solar Thermal Applications</i> <input type="checkbox"/> Insolation on horizontal surface (Average) <input type="checkbox"/> Diffuse radiation on horizontal surface <input type="checkbox"/> Direct normal radiation (Average, Min <input type="checkbox"/> Insolation at 3-hourly intervals <input type="checkbox"/> Insolation clearness index, K (Average <input type="checkbox"/> Insolation normalized clearness index <input type="checkbox"/> Clear sky insolation <input type="checkbox"/> Clear sky insolation clearness index <input type="checkbox"/> Clear sky insolation normalized clear <input type="checkbox"/> Downward Longwave Radiative Flux</p> <hr/> <p><i>Solar Geometry</i> <input type="checkbox"/> Solar Noon <input type="checkbox"/> Daylight Hours <input type="checkbox"/> Daylight average of hourly cosine solar zen <input type="checkbox"/> Cosine solar zenith angle at mid-time betw <input type="checkbox"/> Declination <input type="checkbox"/> Sunset Hour Angle <input type="checkbox"/> Maximum solar angle relative to the horizon <input type="checkbox"/> Hourly solar angles relative to the horizon <input type="checkbox"/> Hourly solar azimuth angles</p>	<p>Step 5:</p> <p>Select the headlines.</p> <p>Click on the link "Parameters" for more information and definition</p>
<p><i>Parameters for Tilted Solar Panels</i> <input type="checkbox"/> Radiation on equator-pointed tilted <input type="checkbox"/> Minimum radiation for equator-poi <input type="checkbox"/> Maximum radiation for equator-poi</p> <hr/> <p><i>Parameters for Sizing Battery or other Energy-storage Systems</i> <input type="checkbox"/> Minimum available insolation as % of average values over consecutive-day period <input type="checkbox"/> Horizontal surface deficits below expected values over consecutive-day period <input type="checkbox"/> Equivalent number of NO-SUN days over consecutive-day period</p> <hr/> <p><i>Parameters for Sizing Surplus-product Storage Systems</i> <input type="checkbox"/> Available surplus as % of average values over consecutive-day period</p> <hr/> <p><i>Diurnal Cloud Information</i> <input type="checkbox"/> Daylight cloud amount <input type="checkbox"/> Cloud amount at 3-hourly interv <input type="checkbox"/> Frequency of cloud amount at 3</p> <hr/> <p><i>Meteorology (Temperature)</i> STEP 5 <input type="checkbox"/> Air Temperature at 10 m <input type="checkbox"/> Daily Temperature Range at 10 m <input type="checkbox"/> Cooling Degree Days above 18° C <input type="checkbox"/> Heating Degree Days below 18° C <input type="checkbox"/> Arctic Heating Degree Days below <input type="checkbox"/> Arctic Heating Degree Days below <input type="checkbox"/> Earth Skin Temperature <input type="checkbox"/> Daily Mean Earth Temperature (M <input type="checkbox"/> Frost Days <input type="checkbox"/> Dew/Frost Point Temperature at 1</p> <p>Temperature data may be lapse rate adjusted for differences in the elevation at your site versus the regional average over which the data set was developed. <i>Elevation at site in meters above sea level (optional)?</i> <input type="text"/> A web site that may help you determine your site elevation is the EarthTools web site. Alternatively, you may have to research local topographic maps </p> <hr/> <p><i>Meteorology (Wind)</i> <input type="checkbox"/> Wind Speed at 50 m (Average, N <input type="checkbox"/> Percent of time for ranges of Wir <input type="checkbox"/> Wind Speed at 50 m for 3-hourly <input type="checkbox"/> Wind Direction at 50 m <input type="checkbox"/> Wind Direction at 50 m for 3-hou <input type="checkbox"/> Wind Speed at 10 m for terrain s</p>	<p>Step 6:</p> <p>Add more choices to suit your location</p> <p>Select all parameters and press "Submit" button at the bottom</p>

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<p style="text-align: center;">Western boundary Center Eastern boundary 15 Latitude 78.5 16 Longitude 15.5 Southern boundary 78</p> <p>Parameters for Sizing and Pointing of Solar Panels and for Solar Thermal Applications:</p> <p style="text-align: center;">Monthly Averaged Insolation Incident On A Horizontal Surface (kWh/m²/day)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Lat 78.246</td> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td><td>Sep</td> </tr> <tr> <td>Lon 15.552</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>22-year Average</td> <td>0.00</td><td>0.02</td><td>0.55</td><td>1.70</td><td>3.90</td><td>4.99</td><td>4.47</td><td>2.99</td><td>1.11</td> </tr> </table> <p style="text-align: center;">Minimum And Maximum Difference From Monthly Averaged Insolation (%)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Lat 78.246</td> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td> </tr> <tr> <td>Lon 15.552</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>Minimum</td> <td>n/a</td><td>n/a</td><td>-15</td><td>-33</td><td>-20</td><td>-13</td><td>-13</td><td>-9</td> </tr> <tr> <td>Maximum</td> <td>n/a</td><td>n/a</td><td>18</td><td>41</td><td>15</td><td>15</td><td>16</td><td>14</td> </tr> </table> <p style="text-align: center;">Parameter Definition</p> <p>Solar Geometry:</p> <p style="text-align: center;">Monthly Averaged Daylight Hours (hours)</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>Lat 78.246</td> <td>Jan</td><td>Feb</td><td>Mar</td><td>Apr</td><td>May</td><td>Jun</td><td>Jul</td><td>Aug</td> </tr> <tr> <td>Lon 15.552</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>Average</td> <td>0.00</td><td>1.45</td><td>11.4</td><td>20.4</td><td>24.0</td><td>24.0</td><td>24.0</td><td>24.0</td> </tr> </table> <p style="text-align: center;">Parameter Definition</p>	Lat 78.246	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Lon 15.552										22-year Average	0.00	0.02	0.55	1.70	3.90	4.99	4.47	2.99	1.11	Lat 78.246	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Lon 15.552									Minimum	n/a	n/a	-15	-33	-20	-13	-13	-9	Maximum	n/a	n/a	18	41	15	15	16	14	Lat 78.246	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Lon 15.552									Average	0.00	1.45	11.4	20.4	24.0	24.0	24.0	24.0	<p>Step 7:</p> <p>Use parameters in "Monthly Average..." and subtract the percentage difference according to "Minimum" column below.</p> <p>This must be done manually.</p> <p>The result is passed into the IALA excel sheet.</p>																																																																																																																																																																																																																																																																																																																																																																																																													
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<p>A5 Paris</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td></td><td>A</td><td>B</td><td>C</td><td>D</td><td>E</td><td>F</td><td>G</td><td>H</td><td>I</td><td>J</td><td>K</td><td>L</td><td>M</td> </tr> <tr> <td>1</td><td></td><td colspan="12">This link will provide further information on how to get solar data from web based sources.</td> </tr> <tr> <td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>3</td><td>Name</td><td colspan="2">Location</td><td colspan="10">Estimated monthly means of daily global radiation Gm-South on inclined planes [kWh/m²/day]</td> </tr> <tr> <td>4</td><td></td><td>Lat</td><td>Long</td><td>Jan</td><td>Feb</td><td>Mar</td><td>April</td><td>May</td><td>June</td><td>July</td><td>Aug</td><td>Sep</td><td>Oct</td> </tr> <tr> <td>5</td><td>Paris</td><td>48.9</td><td>2.3</td><td>1.04</td><td>1.73</td><td>2.78</td><td>3.95</td><td>5.04</td><td>5.39</td><td>5.36</td><td>4.79</td><td>3.39</td><td>2.04</td> </tr> <tr> <td>6</td><td>Norderney 90° tilt</td><td>53.6</td><td>7.0</td><td>0.97</td><td>1.87</td><td>2.80</td><td>3.27</td><td>3.10</td><td>3.24</td><td>3.10</td><td>3.37</td><td>2.87</td><td>2.11</td> </tr> <tr> <td>7</td><td>LH Mumbles</td><td>51.6</td><td>4.0</td><td>1.16</td><td>1.93</td><td>3.00</td><td>3.93</td><td>4.29</td><td>4.23</td><td>4.10</td><td>3.81</td><td>3.27</td><td>3.23</td> </tr> <tr><td>8</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>9</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td>10</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> 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Mumbles	51.6	4.0	1.16	1.93	3.00	3.93	4.29	4.23	4.10	3.81	3.27	3.23	8														9														10														11														12														13														14														15														16														17														18														19														20														21														22														23														24														25														26														27														28														29														30														31														32														33														34														<p>Step 8:</p> <p>Data from step 7 is to be copied in this section of table 'radiation & duration of night' of the Excel sheet.</p>
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5	Paris	48.9	2.3	1.04	1.73	2.78	3.95	5.04	5.39	5.36	4.79	3.39	2.04																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
6	Norderney 90° tilt	53.6	7.0	0.97	1.87	2.80	3.27	3.10	3.24	3.10	3.37	2.87	2.11																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
7	LH Mumbles	51.6	4.0	1.16	1.93	3.00	3.93	4.29	4.23	4.10	3.81	3.27	3.23																																																																																																																																																																																																																																																																																																																																																																																																																																																																																														
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Description											Action
Western boundary Center Eastern boundary 15 Latitude 78.5 16 Longitude 15.5 Southern boundary 78											Step 9: Use the value of NASA table for the monthly average hours of daylight, convert it into duration of night (= 24 – daylight hours) and copy them into the IALA excel sheet. Example for the month of June is shown here.
<i>Parameters for Sizing and Pointing of Solar Panels and for Solar Thermal Applications:</i>											
Monthly Averaged Insolation Incident On A Horizontal Surface (kWh/m²/day)											
Lat 78.246 Lon 15.552	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
22-year Average	0.00	0.02	0.55	1.70	3.90	4.99	4.47	2.99	1.11	0.00	
Minimum And Maximum Difference From Monthly Averaged Insolation (%)											
Lat 78.246 Lon 15.552	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Minimum	n/a	n/a	-15	-33	-20	-13	-13	-9	-9	-9	
Maximum	n/a	n/a	18	41	15	15	16	14	14	14	
Parameter Definition											
<i>Solar Geometry:</i>											
Monthly Averaged Daylight Hours (hours)											
Lat 78.246 Lon 15.552	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	
Average	0.00	1.45	11.4	20.4	24.0	24.0	24.0	24.0	24.0	24.0	
Parameter Definition											
<i>Parameters for Sizing Battery or other Energy-storage Systems:</i>											

3. GET LATITUDE AND LONGITUDE OF A SITE FROM A WEB-BASED MAP

Description	Action						
<p>http://www.latlong.net/</p>	<p>Click on the link at the left side to access a free program online, to find a certain location</p>						
 <p>Shows latitude and longitude of the location you have chosen</p> <table border="1"> <thead> <tr> <th>Lat Long</th> <th>GPS Coordinates</th> <th>Map M</th> </tr> </thead> <tbody> <tr> <td>(62.764109, 6.408110)</td> <td>62° 45' 50.7924" N 6° 24' 29.196" E</td> <td>(62.7</td> </tr> </tbody> </table>	Lat Long	GPS Coordinates	Map M	(62.764109, 6.408110)	62° 45' 50.7924" N 6° 24' 29.196" E	(62.7	<p>Click the map and the position with respect. Latitude and longitude of the location you have selected is displayed.</p>
Lat Long	GPS Coordinates	Map M					
(62.764109, 6.408110)	62° 45' 50.7924" N 6° 24' 29.196" E	(62.7					