SHORTCASTING OF ONE HOUR MICRO SCALE CLOUD FRACTION TREND THROUGH CLOUD INFRARED RADIOMETER DATA

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Research of the adequate physical phenomenon

Thermal infrared Emission 9-14 µm.
Ways of measurement

✓ Pyrometers
✓ Validated by previous authors
✓ Low cost
✓ Limited FOV
✓ Possibility considering the cost to gather several sensors on a common turret

Conclusion: SELECTED
Instrument designed using this principle

CIR-13 scanning instrument

CIR-4V Time serie instrument
Ground temperature measurement

\[ T_{\text{air}} = T_{\text{measured}} \pm \Delta T_{\text{probe}} \pm \Delta T_{\text{radiative}} \]

With naturally ventilated shields:
\[ \Delta T_{\text{radiative}} = f (\text{wind speed, solar irradiance}) \]

With motor aspirated shields:
\[ \Delta T_{\text{radiative}} \approx \text{constant} \]
Transfer function $T_{\text{air}}$ vs $T_{\text{ground}}$ CIR
Cloud altitude versus $T_{\text{ground}} - T_{\text{brightness}}$
Kinetics of cloud cover variations

- Decrease durations

![Histogram of transition durations](image)
Kinetics of cloud cover variations

✓ Stability durations
Kinetics of cloud cover variations

✔ Growth durations
Impact of cloud cover on photovoltaic production

Photovoltaic farm field of view → micro scale measurement of cloud cover

<table>
<thead>
<tr>
<th>Cloud cover status at t time</th>
<th>Cloud cover shortcasted at t+1 hour</th>
<th>Production trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear sky</td>
<td>Clear sky</td>
<td>Growth according to growth of solar elevation</td>
</tr>
<tr>
<td>Overcast</td>
<td>Overcast</td>
<td>Steady production. No significant impact of solar elevation growth</td>
</tr>
<tr>
<td>Clear sky</td>
<td>Overcast</td>
<td>Decrease of photovoltaic production during the coming hour</td>
</tr>
<tr>
<td>Overcast</td>
<td>Clear sky</td>
<td>Growth of photovoltaic production during the coming hour</td>
</tr>
</tbody>
</table>

N.B. Difficulty to model broken clouds conditions considering solar spot position versus clouds
# Shortcast rate of success

<table>
<thead>
<tr>
<th>Station location</th>
<th>Period of data record</th>
<th>Rate of success (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uccle</td>
<td>2010-2015</td>
<td>71.7</td>
</tr>
<tr>
<td>Virton</td>
<td>2008-2015</td>
<td>74.8</td>
</tr>
<tr>
<td>Redu</td>
<td>2007-2015</td>
<td>72.9</td>
</tr>
<tr>
<td>Mol</td>
<td>2010-2015</td>
<td>72.7</td>
</tr>
<tr>
<td>Ostende</td>
<td>2009-2015</td>
<td>73.1</td>
</tr>
<tr>
<td>Mont Riggi</td>
<td>2012-2015</td>
<td>71.9</td>
</tr>
</tbody>
</table>
Perspectives

- Test present algorithm under different lattitudes and longitudes
- Add basic pyranometer and/or sunshine duration meter to CIR-4V
- Approach other mathematical methods to improve shortcast
Thank you for your attention