Measurements of Night Sky Brightness in Veneto region: sqm network implementations and results

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Night Sky - Capraia - September 2018
One of the most light polluted country in the world!

Falchi et al.: The new world atlas (2016)
A continuous light carpet....

VENETOSTELLATO, 2014
ARPAV activities

- **Controlling** the territory of existing public and private installations, in particular for upward direct emission
- **Investigation** of design, from large installations (highways, hospitals, shopping malls) to residential ones
- **Regional committee on light pollution**, checking law effectiveness, reporting to the regional administration, and promoting studies and initiatives on the issue, in collaboration with research institutions
- **Training and education**
Monitoring light pollution in Veneto

• An effective and reliable network to monitor light pollution

• Measurements by professional institutions supplemented by amateur astronomers

• ARPAV is collecting all the data and ensures the quality of the data with appropriate calibration (carried out by means of a shared reference SQM)
elaborated by Falchi et al.: The new world atlas (2016)
<table>
<thead>
<tr>
<th>SQM Station</th>
<th>Altitude (m)</th>
<th>Global Mode (mag&lt;sub&gt;SQM&lt;/sub&gt; arssec&lt;sup&gt;-2&lt;/sup&gt;)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>urban center</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Padova (imm)</td>
<td>12</td>
<td>18.2</td>
</tr>
<tr>
<td><strong>suburban</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nove (VI)</td>
<td>77</td>
<td>19.6</td>
</tr>
<tr>
<td>Montebello (VI)</td>
<td>212</td>
<td>19.7</td>
</tr>
<tr>
<td><strong>Rural</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cattignano (VI)</td>
<td>505</td>
<td>20.0</td>
</tr>
<tr>
<td>Pennar (VI)</td>
<td>1050</td>
<td>20.7</td>
</tr>
<tr>
<td><strong>Montane</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monte Baldo (VR)</td>
<td>1208</td>
<td>20.5</td>
</tr>
<tr>
<td>Cima Ekar (VI) (imm)</td>
<td>1366</td>
<td>20.7</td>
</tr>
<tr>
<td>Passo Valles (BL) (imm)</td>
<td>2032</td>
<td>21.2</td>
</tr>
</tbody>
</table>
NSB distributions

PADOVA

PENNAR Observatory

EKAR Observatory

VALLES
NSB nocturnal development

VENETO SQM NETWORK - 14/2/2018

The graph illustrates the NSB (mag/arcsec²) levels over a 24-hour period for various sites in the Veneto SQM network. The sites include EKAR, PENNAR, PADOVA, NOVE, CATTIGNANO, MONTEBALDO, and PASSOVALLES. The data shows a consistent decrease in NSB levels as the night progresses, with each site showing a slight variation in their time to reach the lowest NSB level.
Discussion

• Great NSB differences between urban, rural and mountain stations

• The NSB decreases during the night in all the sites, but with a different slope

• In very dark sites the presence of the Milky Way in the sky increases the NSB
Long term trends of NSB

**NSB*\_month** - EKAR Observatory

\[
\text{NSB} = 0.0017 \times \text{time} + 20.64
\]

**NSB*\_month** - PENNAR Observatory

\[
\text{NSB} = 0.0028 \times \text{time} + 20.57
\]
The sky brightness in the studied sites in the last 7 years, within uncertainties, does not seem to increase, eventually it show a slight decrease

WHY ????
“Source” factors

<table>
<thead>
<tr>
<th></th>
<th>2010</th>
<th>2016</th>
<th>Difference</th>
<th>Difference %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption for inhabitant (kWh)</td>
<td>93</td>
<td>84</td>
<td>- 4</td>
<td>- 10 %</td>
</tr>
<tr>
<td>Electric Power for luminarie (W)</td>
<td>121</td>
<td>98</td>
<td>- 23</td>
<td>- 19 %</td>
</tr>
<tr>
<td>Public luminaries</td>
<td>893900</td>
<td>1009640</td>
<td>+ 115740</td>
<td>+ 13 %</td>
</tr>
<tr>
<td>LED</td>
<td>--</td>
<td>162000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Survey ARPAV in municipalities in **Veneto** 2010-2013-2016

- All new light points have no direct emission upwards…
  .... but the total flux does not decrease with the new LEDs installations, instead it should increase!
Environmental parameters

PADOVA: $<\text{PM10}>_{\text{month}}$ and $<\text{NSB}>_{\text{month}}$

- $<\text{PM10}>_{\text{month}}$ (µg/m$^3$)
- $<\text{NSB}>_{\text{month}}$ (mag arcsec$^2$)

PADOVA: $<\text{UR}>$ vs $<\text{NSB}>_{\text{month}}$

- $R^2 = 0.75$
Discussion

• The sky brightness for the dark mountain stations depends mainly on the light coming from cities (at the sea level). The local lights have a limited contribution.

• Considered an increase of about 15% of the public lights (and supposing the same for the private ones) the sky brightness should increase by about 0.15 mag. But we don't see it!

• Is there any influence of the environment?
Conclusion and suggestions

• An SQM network allows to have a large amount of data available to correlate the sky brightness with environmental and meteorological parameters.

• Veneto Sky Brightness, within uncertainties, does not seem to increase, eventually it seems slightly decreasing.

• The regional law on light pollution is very effective particularly in limiting the upward emission.

• In order to better understand the light pollution mechanism, correlations with environmental parameters must be considered, including humidity and atmospheric particulate, and also others (...)

• Spectral role? (see tomorrow presentation by prof. Ortolani)

• Use of all sky photometry
THANK YOU FOR ATTENTION!

For further details and information

http://www.arpa.veneto.it/temi-ambientali/luminosita-del-cielo

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