Analysis of the urban thermal fingerprint of the city of Trento in the Alps

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Aviemore, 23-27 May 2011
31\textsuperscript{th} International Conference on Alpine Meteorology
Study area: the city of Trento
Study area
Measurement
Sites
Data Analysis
Conclusions and outlook

Measurement sites

**Time period:**
October 2002 - December 2008

**Weather stations used in UHI analysis:**

<table>
<thead>
<tr>
<th>NAME</th>
<th>CLASSIF.</th>
<th>m MSL</th>
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<tr>
<td>Molino Vittoria</td>
<td>urban</td>
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Wind speed data → Molino Vittoria
Cloud cover data → Mt. Paganella
Measurement sites

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Wind speed data → Molino Vittoria
Cloud cover data → Mt. Paganella
## UHI intensity: average values

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### UHI INTENSITY [°C]

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<tr>
<th>Sites</th>
<th>ALL THE DAY</th>
<th>DAYTIME</th>
<th>NIGHTTIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>GARDOLO</td>
<td>0.76</td>
<td>0.03</td>
<td>1.67</td>
</tr>
<tr>
<td>RONCAFORT</td>
<td>1.07</td>
<td>0.49</td>
<td>1.79</td>
</tr>
<tr>
<td>TRENTO SOUTH</td>
<td>0.58</td>
<td>-0.06</td>
<td>1.37</td>
</tr>
<tr>
<td>COGNOLA</td>
<td>1.48</td>
<td>0.74</td>
<td>2.39</td>
</tr>
<tr>
<td>LASTE</td>
<td>0.65</td>
<td>0.54</td>
<td>0.79</td>
</tr>
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</table>

- Average UHI intensity of order 1°C
- UHI is stronger during nighttime
- Laste exhibits a ’quasi-urban’ behavior

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UHI intensity: diurnal cycle

- **Gardolo**
  - Strong and quite constant UHI intensities at night
  - 'Urban cool island' effect in the central hours of the day

- **Cognola**
  - Flatter diurnal cycle at Laste

- **Laste**
  - Strong and quite constant UHI intensities at night
  - 'Urban cool island' effect in the central hours of the day
  - Flatter diurnal cycle at Laste
Diurnal maximum UHI intensity

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Diurnal maximum UHI intensity

Frequency [%]

Hour

Gardolo  Roncafort  Trento Sud  Cognola  Laste
UHI intensity: daytime seasonal variations

- On the valley floor the seasonal variations of UHI intensity are negligible over daytime.

- On the slopes the yearly cycle is controlled by the seasonal variations of the mean lapse rate.
UHI intensity: nighttime seasonal variations

- On the valley floor, nighttime UHI intensity is slightly stronger during 'dry' months.

- On the slopes, the same behavior as during daytime is observed, controlled by the seasonal mean lapse rate.

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Analysis of the urban thermal fingerprint of the city of Trento in the Alps
UHI intensity: dependence on cloud cover

- Cloud cover measured in oktas at Mt. Paganella weather station
- Data divided in five cloud cover classes
- Analysis on a hourly basis
  - Influence of cloud cover on the diurnal cycle of the UHI
- Presented here the results for Gardolo, on the valley floor
UHI intensity: dependence on cloud cover

Gardolo: 0-1 Oktas

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UHI intensity: dependence on cloud cover

Gardolo: 1-3 Oktas
UHI intensity: dependence on cloud cover

Gardolo: 3-5 Oktas

![Box plot showing UHI intensity over hours of the day for Gardolo with 3-5 Oktas cloud cover.](image-url)
Gardolo: 5-7 Oktas

UHI intensity: dependence on cloud cover

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UHI intensity: dependence on cloud cover

Gardolo: 7-8 Oktas

![Graph showing UHI intensity vs. hour with data points and error bars]
UHI intensity: dependence on wind speed

- Reference wind speed measured at Molino Vittoria weather station
- Data divided in six wind speed classes
- Analysis on a hourly basis
  
  Influence of wind speed on the diurnal cycle of the UHI

- Presented here the results for Gardolo, on the valley floor
UHI intensity: dependence on wind speed

Gardolo: 0-1 ms$^{-1}$

![Graph showing UHI intensity over hours for Gardolo with wind speed range 0-1 ms$^{-1}$]
UHI intensity: dependence on wind speed

Gardolo: 1-1.5 ms$^{-1}$
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UHI intensity: dependence on wind speed

Gardolo: 1.5-2 ms$^{-1}$

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UHI intensity: dependence on wind speed

Gardolo: 2-3 ms$^{-1}$
UHI intensity: dependence on wind speed

Gardolo: $3-4 \text{ ms}^{-1}$
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UHI intensity: dependence on wind speed

Gardolo: 4 ms$^{-1}$
Conclusions and future outlooks

Conclusions

- Quite strong UHI after sunset and at night
- 'Urban cool island' effect in the central hours of the day
- Higher nocturnal UHI intensities during 'dry' months on the valley floor
- Cloud cover is the meteorological factor which most influences UHI intensity in Trento

Outlook

- Investigate the interaction between the urban area and local phenomena with a mesoscale model coupled with an urban parameterization

Poster here at ICAM
THANKS FOR YOUR KIND ATTENTION!