Analysis of ten years historical weather data in Australia

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The climate is changing;
Extreme events are becoming more common;
Corresponding change in building design is required;
Building simulation techniques are required for providing quantified information.

All building simulation programs require hourly meteorological input data for their thermal comfort and energy evaluation.
The provision of suitable forecast weather data for the future climate is essential.
This requires the understanding of current weather patterns.
Research Background

This work: analysis of historical weather data

- General distribution of key weather variables.
- Comparison between TRY and multiple-years weather data.
- Comparison between the coldest and the hottest years weather data.
- Possible cross-correlation between different weather variables

Methodology: Study locations

[Map of Australia with various climate zones and cities mentioned]
Methodology:

Weather database used in this study

<table>
<thead>
<tr>
<th>W.M.O Index No.</th>
<th>Locality</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Elevation (m)</th>
<th>Years Between</th>
<th>Test Reference Year</th>
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<tbody>
<tr>
<td>94675</td>
<td>Adelaide</td>
<td>-34.9</td>
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<td>94121</td>
<td>Darwin</td>
<td>-12.5</td>
<td>130.8</td>
<td>27</td>
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<td>151.2</td>
<td>42</td>
<td>1978-1987</td>
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Method of analysis

- Descriptive statistics is employed to study and characterise the profiles of key weather variables;
- The patterns of cumulative distribution are used to graphically illustrate the similarity/difference between study cases;
- The mean dry bulb temperature is used to measure the hottest and coldest years for each location.
Methodology

Definitions

• The Test Reference Year (TRY)
  ➢ used to represent an average weather patterns

• The multiple years (MYs)
  ➢ all years weather data contained in the database

• The coldest year
  ➢ the year has the lowest mean dry bulb temperature

• The hottest year
  ➢ the year has the highest mean dry bulb temperature

Results: Comparison of TRY & MYs

Overall, the TRY tem data closely match with multiple years temperature data in all capital cities except for Darwin.
Results: Comparison of TRY & MYs

Adelaide

Brisbane

Canberra

Darwin

Hobart

Melbourne

Perth

Sydney

Results: Comparison of TRY & MYs

Humidity ratio

Relative humidity
Results: Comparison of TRY & MYs

Adelaide

Brisbane

Canberra

Darwin

Hobart

Melbourne

Perth

Sydney

Wind speed
Comparison between TRY and MYs

• TRY weather data generally match well with MYs weather data, but there are some small discrepancies between them.
• These discrepancies vary with different locations and different weather elements/variables.
• The discrepancy is generally much smaller for dry bulb temperature (DBT), relative humidity (RH) and global solar irradiance (GSI) than that for the other weather elements.
Results: Comparison between Coldest and Hottest year

With the increase of mean temperature, the humidity ratio has either remained similar, or increased, or even decreased.
Results: Comparison between Coldest and Hottest year

Relative humidity

Relative humidity has remained either similar, or has decreased to different extent for the other cities.

Atmospheric pressure

Except for Melbourne, there is no significant change in atmospheric pressure for the hot and cold years.
Results: Comparison between Coldest and Hottest year

No regularity found for wind character. The wind speed may increase or decrease at different locations.
Results: Comparison between Coldest and Hottest year

Global solar irradiance on a horizontal plane remains similar patterns for the hot and cold years. The total cloud cover, however, is different.

Cloud cover: Oktas
0: Clear sky
7: Broken clouds
8: Overcast
Comparison between Coldest and Hottest years

- The distribution patterns of weather elements are broadly similar for both the hot and cold years, but with some shift and/or distortion.
- The gap between DBT profiles does not necessarily reflect the difference of mean temperature between the hottest and coldest years.
- With the increase of mean temperature from coldest year to hottest years, the humidity ratio can either remained similar, or increased, or even decreased.
- No significant change in atmospheric pressure
- No regularity can be found for wind character. The wind speed may increase or decrease at different locations. The wind direction may also change too.
- The global solar irradiance on a horizontal plane remains similar patterns for the hot and cold years, the total cloud cover, however, is different.

Summary

- For the given set of input data, in comparison with the other weather elements, the discrepancy between TRY and multiple years is much smaller for the dry bulb temperature, relative humidity and global solar irradiance.
- The overall distribution patterns of key weather elements are also generally similar between the hot and cold years, but with some shift and/or small distortion.
- There is little common tendency of change between the hot and the cold years for different weather variables at different study locations.
References

- Guan, L. (2007). “Profiling and characterization of key weather variables and their implication on building design”. Submitted to ANZAScA 41st Annual Conference, which will be held at Deakin University, between 14-16 November 2007