Why Use Old Data for New Designs?

IBPSA Sydney, April 2018
TMY Weather (IWEC)
Boxplots
Typical Weather Files

Historical Data
Number of hours above 34.5 (ASHRAE 0.4%)

- 2070 95th Percentile: 12 hours
- 2070 50th Percentile: 31 hours
- 2070 5th Percentile: 46 hours
- IWEC: 62 hours
We’re designing with weather data that is a quarter century or more out of date…
Cold temperatures becoming milder and shorter

Warm temperatures becoming more extreme and lasting longer
Predicted Weather Data: Morphing Approach

Calibration Factors: Dry Bulb Temperature

**Step 1**

Simulated Global Climate Model

**Step 2**

Morphing Approach

Future Weather Data
Present Weather Data

$\Delta T_{\text{max}}$
$\Delta T_{\text{mean}}$
$T_{\text{min}}$
$T_{\text{mean}}$
$T_{\max}$

$\Delta T_{\text{max}}$, $\Delta T_{\text{mean}}$

Present Weather Data
Present Weather Data + $\Delta T_{\text{min}}$
Present Weather Data + $\Delta T_{\text{mean}}$
Present Weather Data + $\Delta T_{\text{max}}$
Predicted Weather (Morphed)

Daily Temperature (°C)
Time of the Day
Predicted Weather Data: Morphing Approach

Calibration Factors: Solar Irradiation

Future Solar Irradiation = $\alpha \cdot$ Present Solar Irradiation

Gain Factor: $\alpha$
Global climate models

Revolution of IPCC Reports:

1. FAR – 1990
2. SAR – 1995
3. TAR – 2001
4. AR4 – 2007
5. AR5 – 2013
6. Regional Climate Models < 25 km
Emissions Scenario

Notes:
• RCP: Representative Concentration Pathways
• Scenarios developed by the Intergovernmental Panel on Climate Change (IPCC)
• As a basis for the climate projections done for its Fifth Assessment (AR5)

Additional 4.5 W/m² of Heating in 2100
(Compared to ~1,000 W/m² currently)
Probability of Model

14 Climate Change Models
Ranked by Projected Temperature Increase

Notes:
- Climate change models are applied for Chicago, IL
Predicted Weather Data: Morphing Approach

Actual Data, London 1989

Morphed Data, London 2050
Case Study – Green Star Climate Adaptation Plan

Adaptation

- To encourage and recognise projects that are resilient to the impacts of a changing climate and natural disasters.

Credit criteria
- Implementation of a climate adaptation plan

2 points

Credit in detail
Why Assess Climate Risk?

- Financial exposure
  - Directors’ duties: designed to ensure directors use their powers with a reasonable degree of care for the company’s best interests
- Financial risk of climate change – APRA
- Stakeholder and shareholder expectations
- Market drivers e.g. insurance premiums, tenant comfort, operational expenditure
Is Our Weather Data Representative?

Melbourne Weather Files - Sampled Historic Weather Data Merged

- City La Trobe Street.RMY
- Tullamarine Airport.IWEC
- Tullamarine Airport.RMY

Range of Years Considered:

- Historic Data
- Now!
- Buildings We Are Designing!
Is Our Weather Data Representative?

The Hottest Ever Melbourne Night in March on Record

- PM: 38.6, 38.6, 36.9 (Sunset), 31.6
- AM: 31.8

Overnight - very very hot!

Compared to Melbourne Weather File Data Days for March

- PM: Much hotter than the March weather data
- AM: Temperatures range from 5.0 to 40.0°C
What Risks Need to be Addressed?

Are there any **high** or **extreme** risks that have not been adequately addressed?

- **Heat**: Consider requirements of roof materials; glazing, shading; ventilation; green infrastructure; HVAC equipment etc.

- **Flooding**: Consider the location of critical plant and equipment; capacity of on-site water retention.

- **Extreme Rainfall**: roof design; the use of green infrastructure; storm water management; access and egress implications.

*Image courtesy: Woods Bagot*
| Risk ID | Climate variable | Description of impact                                                                                                                                                                                                 | Present | | Likelihood | Consequence | Risk rating | 2030 | | Likelihood | Consequence | Risk rating |
|--------|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|---|------------|----------|--------|---|----------|----------|--------|
| 1      | Temperature      | Increased temperature leads to increased HVAC system power demand to support enhanced thermal loads, resulting in more frequent peak load.                                                                                       | Unlikely | Minor | Low        | Likely   | Moderate | Medium |
| 2      | Temperature      | Increased temperatures and extreme heat days, leading to overheating of equipment.                                                                                                                                                                                                 | Very Unlikely | Minor | Low        | Unlikely | Minor   | Low     |
| 3      | Temperature      | Rising temperatures impact on thermal performance of building and reduces thermal comfort for occupants.                                                                                                                                                                         | Very Unlikely | Moderate | Low       | Moderate | Moderate | Medium |
| 5      | Temperature      | Increased temperatures leading to degradation of building material including the building façades, pavements and outdoor facilities.                                                                                                                                         | Very Unlikely | Moderate | Low       | Unlikely | Moderate | Medium |
| 6      | Precipitation    | Decreased annual rainfall will mean less water is harvested via the rainwater system and increasing reliance on mains water.                                                                                                                                                  | Very Unlikely | Minor | Low        | Unlikely | Minor   | Low     |
| 7      | Precipitation    | Decreased annual average rainfall will require more frequent cleaning of building façade, leading to higher maintenance costs.                                                                                                                                              | Likely   | Minor | Medium     | Moderate | Moderate | Medium |
| 8      | Precipitation/flooding | More intense rainfall leads to localised flooding, causing damage to the building structure and ground-based services.                                                                                           | Unlikely | Major | Medium     | Moderate | Major   | High    |
www.weathershift.com