Introduction

This document provides a brief description of gridded temperature, rainfall and pan evaporation data provided by the Bureau of Meteorology (BoM) that is used by the short term residential demand forecasting model and the non-residential demand forecasting model.

Background

The short term residential model attaches local weather data to each property included in the model. The earliest versions of the model made use of daily data from 10 BoM weather stations in Sydney Water's area of operations which measure both maximum temperature and rainfall. Three of these stations also collect pan evaporation data. Station data can be downloaded free of charge from the BoM website.[1]

To estimate the local value of the weather variables at each property we used a simple weighted average. That is, for each property:

- calculate the distance to each of the 10 weather stations
- calculate the weighted average of the data from the 10 stations (3 in the case of pan evaporation) where the weight for each station is inversely proportional to the distance to the station (the closer the station, the higher the weight).

For the 2018 re-estimation and rebuild of the model we switched to using gridded weather data instead. This gridded data is prepared by the BoM using much more sophisticated methods to interpolate the station data to data at intermediate locations. The remainder of this document provides a brief description of this gridded data and how it is matched to the individual properties.

Daily maximum temperature and maximum temperature

This data is prepared by the BoM using daily rainfall and temperature data from, respectively, about 3,000 and 750 sites across Australia. Using sophisticated interpolation and statistical techniques the data is interpolated to data on a 0.05x0.05 degree grid (approximately 5x5 km). The data provides an average value for each grid square, i.e. the average value of the rainfall and maximum temperature over the grid cell area.

More detailed descriptions of the data can be found at http://www.bom.gov.au/metadata/catalogue/19115/ANZCW0503900380 (rainfall) and http://www.bom.gov.au/metadata/catalogue/19115/ANZCW0503900378 (temperature). For further details on the analysis techniques see Jones et al (2009).[2]

Every month the BoM provides Sydney Water with an extract of the gridded data for an area that completely covers Sydney Water's area of operations. The extract includes daily data for each gridcell in that area for the last six months. Every monthly extract includes data includes data for the last six months. This is because the data is updated for up to six

[1] www.bom.gov.au/climate/data. Pan evaporation data from one station was not available from the website and was provided by the BoM through a subscription service.
[2] David A. Jones, William Wang and Robert Fawcett, High-quality spatial climate data-sets for Australia. Australian Meteorological and Oceanographic Journal 58 (2009) 233-248.

months as new data becomes available and data is improved through quality control. Data is provided in .csv format. An excerpt of both the temperature and rainfall data is shown below.

Maximum temperature

149.85	-34.20	1/01/2024	21.5264
149.85	-34.15	1/01/2024	20.0918
149.85	-34.10	1/01/2024	20.502
149.85	-34.05	1/01/2024	18.1221
149.85	-34.00	1/01/2024	18.5488
149.85	-33.95	1/01/2024	18.623
149.85	-33.90	1/01/2024	18.3555
149.85	-33.85	1/01/2024	19.6846
149.85	-33.80	1/01/2024	20.3252
149.85	-33.75	1/01/2024	20.9199
149.85	-33.70	1/01/2024	21.0771
149.85	-33.65	1/01/2024	21.9551
149.85	-33.60	1/01/2024	23.3643
149.85	-33.55	1/01/2024	23.9336
149.85	-33.50	1/01/2024	24.0088

Rainfall

149.85	-34.20	1/01/2024	1.46973
149.85	-34.15	1/01/2024	1.61426
149.85	-34.10	1/01/2024	1.56934
149.85	-34.05	1/01/2024	1.61621
149.85	-34.00	1/01/2024	1.5459
149.85	-33.95	1/01/2024	1.4834
149.85	-33.90	1/01/2024	1.47559
149.85	-33.85	1/01/2024	1.36523
149.85	-33.80	1/01/2024	1.29297
149.85	-33.75	1/01/2024	1.1582
149.85	-33.70	1/01/2024	0.956055
149.85	-33.65	1/01/2024	0.670898
149.85	-33.60	1/01/2024	0.382812
149.85	-33.55	1/01/2024	0.158203
149.85	-33.50	1/01/2024	0.000977

The first two columns give the coordinates of the cell, in particular the (decimal) longitude and latitude of its centroid. The third column gives the date and the fourth column gives the maximum temperature (degrees C) and rainfall (mm), respectively. For example, on 1 April 2024 the maximum temperature for the cell with centroid coordinates of 149.85 longitude and -34.20 latitude was 21.5264 degrees Celsius and rainfall for this cell was 1.46973 mm.

It is worth noting that the gridded data follows the same recording conventions as the station data, i.e. maximum temperatures is recorded as “maximum temperature in the 24 hours from 9am” while rainfall is recorded as “rainfall in the 24 hours to 9am”. When processing the data for use in the model we shift the data so all data is recorded on a consistent basis.

Daily pan evaporation data

Unlike the maximum temperature and rainfall data, the pan evaporation data is not based on interpolation of station data. The number of stations collecting pan evaporation is simply too small to do so reliably. For example, of the, already small, number of three stations in Sydney Water’s area of operations that used to measure pan evaporation, only one still does.

Instead, the evaporation data is prepared by BoM using a hydrological model which takes gridded data on relevant inputs (temperature, wind, vapour pressure, solar radiation) and uses these to calculate gridded estimates of pan evaporation. These estimates are produced using the same 0.05x0.05 degrees grid as used for the gridded maximum temperature and rainfall data. For more detail on the model, see Frost et al (2017).[3]

[3] A.J. Frost, A. Ramchurnb and A. Okeb, Daily gridded evapotranspiration estimates for Australia. 22nd International Congress on Modelling and Simulation, Hobart, Tasmania, Australia, 3 to 8

As for temperature and rainfall, BoM provides Sydney Water with extracts showing data for the grid cells in Sydney Water's area of operations in the.csv format. An excerpt is shown below. The first column identifies the grid cell by the coordinates of its centroid and the second column gives the estimated pan evaporation in mm. During data processing we extract the numerical values of the longitude and latitude from the string in the first column to allow merging with the temperature and rainfall data.

	1/04/2024
S34.2E149.85	4.796
S34.15E149.85	4.519
S34.1E149.85	4.708
S34.05E149.85	4.316
S34.0E149.85	4.178
S33.95E149.85	4.152
S33.9E149.85	3.894
S33.85E149.85	4.277
S33.8E149.85	4.200
S33.75E149.85	4.557
S33.7E149.85	4.553
S33.65E149.85	4.702
S33.6E149.85	5.000
S33.55E149.85	5.095

Use in demand models

Short term residential model

Using the coordinates for each property we determine which cell the property is located in. This is done by finding the cell with the closest centroid coordinates. We then match the weather data for that cell to the property.

Non-residential model

The non-residential model is based on aggregate consumption data for all non-residential properties in Sydney Water's area of operations. To prepare the weather data for the non-residential model we select all the cells that are in Sydney Water's area of operations. The weather data is then averaged over the selected cells and matched to the aggregate consumption data.

December 2017. In Syme, G., Hatton MacDonald, D., Fulton, B. and Piantadosi, J. (eds) MODSIM2017, 22nd International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2017, pp. 894–900. ISBN: 978-0-9872143-7-9. http://www.mssanz.org.au/modsim2017/L2/frost.pdf.