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# Weather Data and Climate Data: Updates and Enhancements

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This paper discusses the current situation with Australian weather and climate data availability, recent updates and projected enhancements in the foreseeable future.

Early work in establishing climate files for building and renewable energy systems design and evaluation in Australia began with the early work in solar radiation tables by CSIRO in the 1970s and the joint work by the CSIRO and BOM to generate the Australian Climate Data Bank (ACDB) in the mid-1980s. The Test Reference Years (TRY) were published then and distributed by the Association for Computer Aided Design – Building Services Group (ACADS-BSG). The TRYs were actual years of hourly data selected for each site to not include any months of unusually warm or cool weather. The selection was based entirely on dry bulb temperature (DBT) but included coincident values of humidity, wind speed and direction, atmospheric pressure, cloud cover and incident solar radiation.

When the TRY data was applied to house energy rating in the 1990s in the CSIRO software then called CHEATAH[i] it was noted that the selection methodology produced occasional aberrant climate files such as unusually dry and sunny or humid and cloudy months despite their being of near average temperatures. Initially that was solved by manual re-selection of indicative years by passive solar architects while solar engineers at UNSW used solar water heater performance simulation over a full range of years and chose the year of solar savings nearest to the long term average.

With the advent of the Australian Greenhouse Office (AGO) in 1998, extra attention was paid to this issue and in particular the inherent bias error in linear interpolation of hourly values from commonly 3-hourly records manually collected over the years since 1967 – the year adopted as the earliest start of reliable records for the then 28 NatHERS[ii] locations. The adoption of a quasi-sinusoidal algorithm for interpolation removed the bias error and this work was then applied to generating synthesised climate years by concatenating the 12 calendar months of best fit using a cumulative difference function based on three different weightings of the weather elements of significance (Marion and Urban, 1995; and Lee et al, 2011a). At this time, the number of NatHERS sites was increased to 69 and TMY2 format versions of the files were published along with the ACDB format versions to allow simulations of non-residential buildings and renewable energy systems. Also under the aegis of the AGO, in collaboration with the CSIRO, Ersatz Future Meteorological Years (EFMYs) were generated and are now available for commercial use (Lee et al, 2011b).

There has always been a deficiency in high accuracy solar irradiation measurement in Australia so most of the weather and climate files were constructed using daily sunshine hours data (Campbell-Stokes[iii] daily records manually measured) along with 3-hourly manual observations of cloud cover mostly pertaining to nearby airports and latterly using daily Global Horizontal Irradiation (GHI) data inferred by the Bureau of Meteorology (BoM) from hourly scans of a geostationary satellite since 1990. These observations and estimates were combined with solar geometry and sky models to infer hourly values of Diffuse (DIF) and Direct Normal Irradiation (DNI) for enhanced simulation purposes.

The BoM now publishes hourly values of GHI, DIF and DNI since 1990 for almost 270,000 “pixels” over the whole of Australia and Exemplary Energy combines these values with the BoM measurements on the ground of the other weather elements to publish weather and climate files for

201 sites distributed across the country, including the 69 sites in use for NatHERS. We also publish Real Time Year (RTY) files for Canberra, Perth and Sydney along with Exemplary Weather and Energy (EWE) Indices published monthly (Exemplary Energy, monthly since 2014).

**This paper also canvases future enhancements to the weather and climate files.**

Collector cleanliness and efficiency can be better estimated using coincident rainfall data and other aspects of sustainability in systems can also be better estimated or simulated with that data as well as dampness issues in buildings using proprietary software like WUFI in accordance with recent additional requirements of the National Construction Code (NCC) which incorporates the BCA. Early experiments in the encompassing the BoM's half-hourly rainfall data will be reported.

Despite overall reliability of the data, wild inaccuracies in individual hourly values of the BoM's satellite-inferred solar data have also been demonstrated (Lee and Ding, 2015). Since March 2018 the BoM has been receiving scans from the Himawari satellite with 10 scans per hour and on a 1 km grid (approximately) compared with the longer term record of hourly scans on a 5 km grid. This 250-fold increase in data density allows near elimination of the aberrant hourly values. It could also improve our estimation of cloud cover which is currently inferred from the generated solar estimates rather than from the cloud observations from which they are derived.

**References**

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i Through years of subsequent development this has become the CHEANATH engine in the various NatHERS software packages.

ii Nationwide House Energy Rating Scheme, subsequently adopted into the Building Code of Australia (BCA) and administered by the Commonwealth Department of Resources, Energy and Tourism on behalf of the state and territory governments.

iii The Campbell–Stokes recorder (sometimes called a Stokes sphere) is a kind of sunshine recorder. It was invented by John Francis Campbell in 1853 and modified in 1879 by Sir George Gabriel Stokes. The original design by Campbell consisted of a glass sphere set into a wooden bowl with the sun burning a trace on the bowl. Stokes's refinement was to make the housing out of metal and to have a card holder set behind the sphere. The unit is designed to record the hours of bright sunshine which will burn a hole through the card.