# CHAPTER 6
# COOLING BEHAVIOUR IN AUSTRALIAN TROPICAL CLIMATE

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## 6.1 INTRODUCTION

To promote energy efficiency in residential buildings, the Nationwide House Energy Rating Scheme (NatHERS) has been implemented in Australia since 1992 (NatHERS National Administrator, 2012). The scheme rates the energy performance of houses from 0 to 10-star ratings, with higher star ratings representing higher energy efficiency, using building performance simulation-based rating tools to estimate the annual energy load for space cooling and heating. The simulation engine of all the rating tools, Chenath has been rigorously tested, regularly improved, and is employed to compute energy loads in houses across different climates (Delsante, 2005; Ren, 2016).

Being a nationwide scheme, NatHERS is intended to be applicable to the various climate zones of Australia. However, some variables in the scheme, such as the occupant characteristics and some metrics of occupant behaviours, are based on general assumptions that are not climate or context specific. One of the occupant behaviour variables that uses a climate-specific assumption is the cooling thermostat setting, though the estimation is based on the ASHRAE standard for

naturally ventilated spaces (ASHRAE, 2013; NatHERS National Administrator, 2019).

It is widely known that different occupant behaviours can result in substantial differences in energy consumption, even in almost identical dwellings and in identical climatic conditions (Janda, 2011; Ridley et al., 2014; Zhao & Carter, 2020). Researchers have also identified the rebound effect phenomenon, where the use of energy-efficient appliances could affect occupant behaviours, causing substantial increases in energy demand (Greene, 1992; Greening et al., 2000).

This research aimed to investigate the actual cooling behaviour of the dwelling occupants in Darwin, Northern Territory; an Australian capital city classified as a tropical savannah climate. The occupant cooling behaviour includes the operation of cooling devices, windows, and fans. Furthermore, this research aimed to compare the findings from the field study against the general assumptions on occupant cooling behaviour utilised in NatHERS.

## 6.2 PARTICIPANTS AND DWELLINGS

Research on how the occupants operate their dwellings in Darwin, Northern Territory, was conducted based on field measurement and survey. Indoor environment data were collected from 38 households in 11-months period, from March 2020 to January 2021.

The criteria for participants are people who speak English, are at least 23 years old, live in Darwin or the surrounding areas within a 25 km radius of the city centre, and have at least one air conditioning unit installed in their dwelling. The age criterion was decided based on Australian Government specifications for the age threshold for being considered independent in financial services (Australian Government Services, 2006). It is expected that people aged 23 years or older can make independent decisions about their dwellings, whether they are rented or owned, which is relevant to this study.

A total of 38 households comprising 51 participants agreed to participate in a year-long house monitoring study, which involved

devices logging indoor environmental parameters as well as surveys to record their thermo-adaptive actions, which were later correlated with the logged data. The dwellings were located throughout the Darwin region, encompassing Darwin city and its suburban areas, the exurb of Palmerston, and semi-rural properties in Wagait Beach, Humpty Doo, and Howard Springs. The approximate locations of these dwellings are illustrated in Figure 6.1 and show a good spread between high-density urban housing, classic Australian suburban homes, and semi-remote rural living.

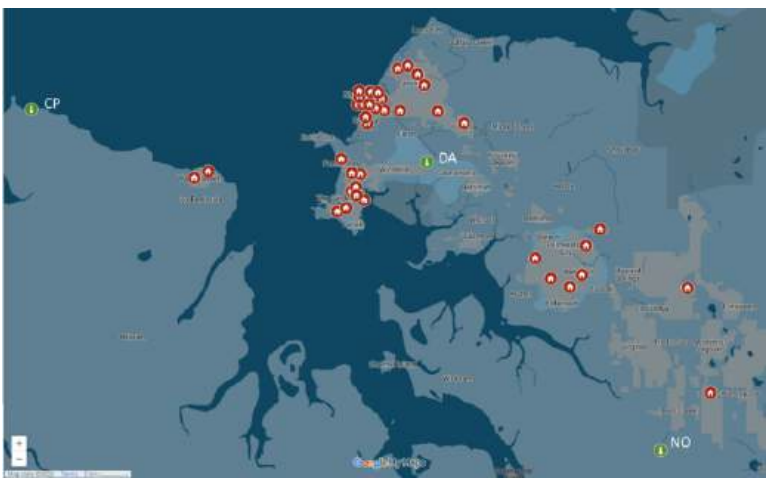


**Figure 6.1** Approximate location of the participants' dwellings is marked in red circles; and weather data stations are marked in green circles (DA =Darwin Airport, NO=Noonamah, CP= Charles Point)

The participants' dwellings were clustered into three categories. Firstly, the dwellings were grouped based on the building class. According to NCC classifications, apartments are categorised as Building Class 2, whereas any separate or semi-detached houses are recognised as Building Class 1a (Australian Building Codes Board [ABCB], 2022). Thus, the apartment units in this study were categorised as one cluster. A further dichotomy was established from the external wall material. For dwellings in Building Class 1a, they were split further