

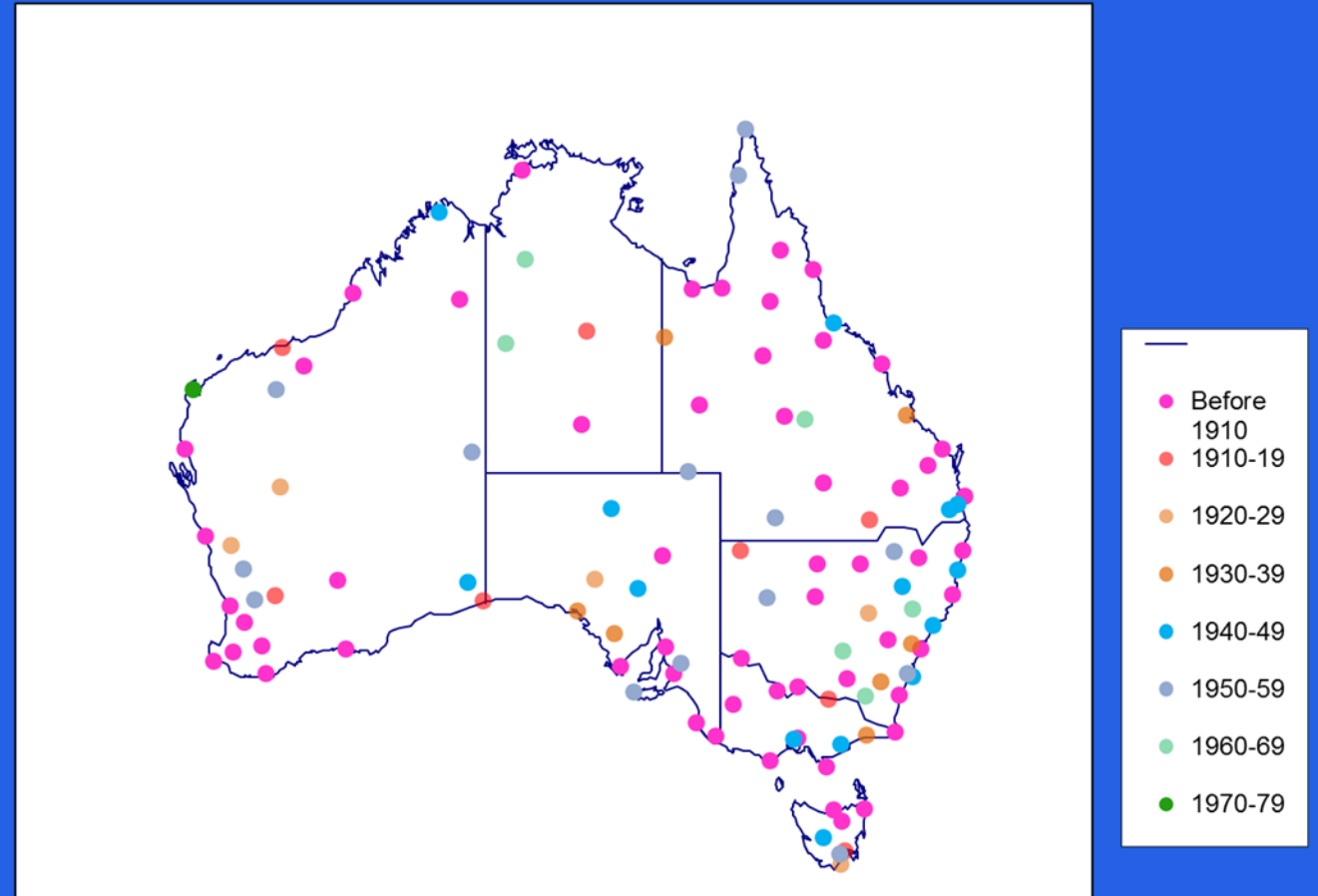


# An operational homogenised temperature data set in Australia

*Blair Trewin, Simon Grainger, Alex Evans*

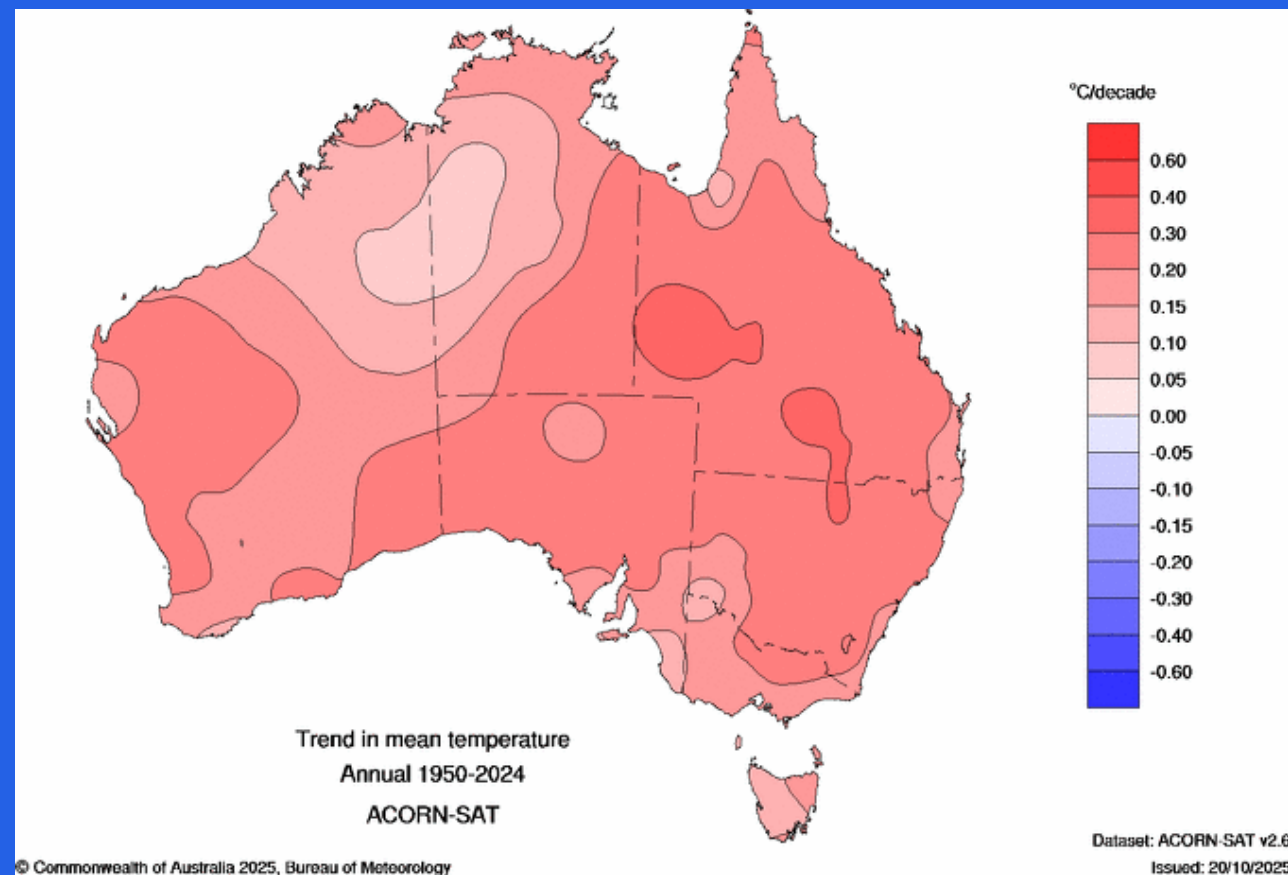
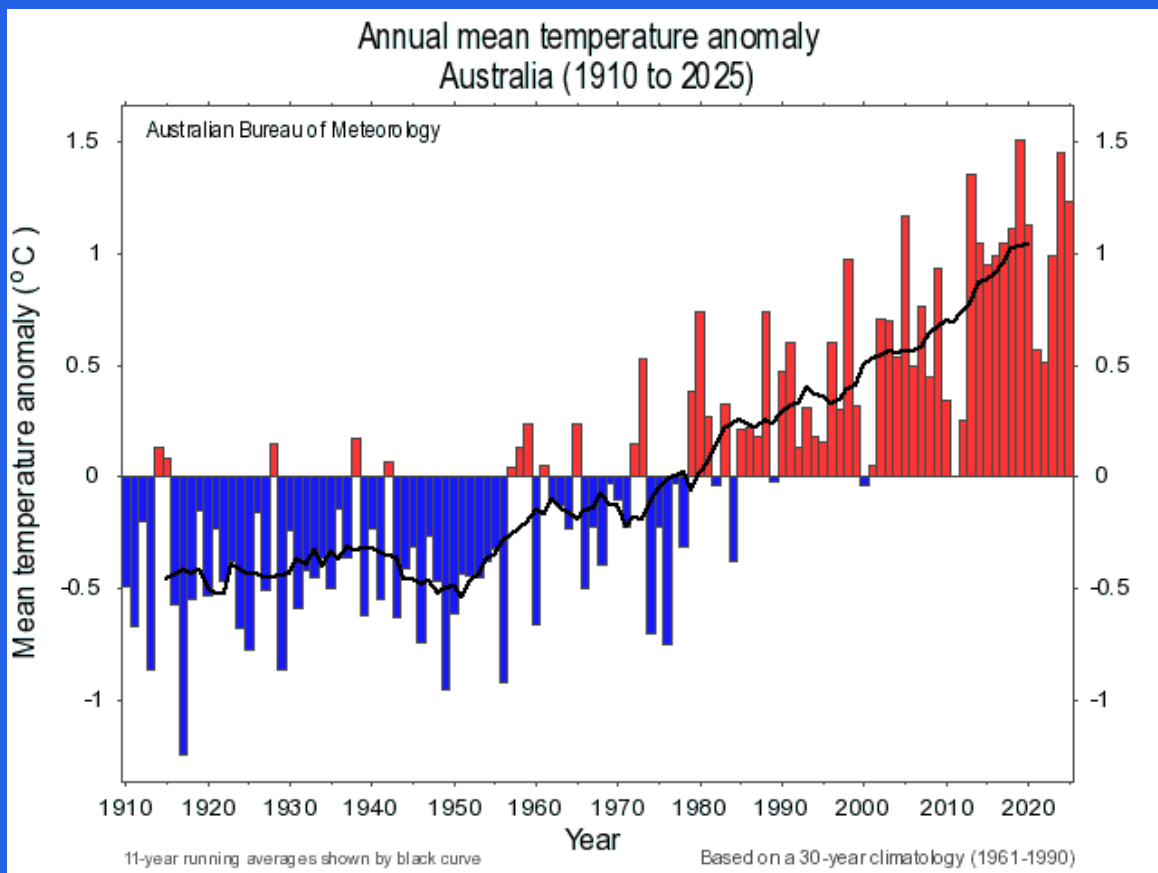
# The ACORN-SAT data set and network

- 112 stations distributed through Australia
- Daily maximum and minimum temperatures
- Data set begins in 1910, with 61 stations having data back to 1910
- Most recent addition to network is 1975
- Most of network now automated, but 10 manual sites remain



ACORN-SAT network with start dates

# ACORN-SAT underlies Australian climate change assessment

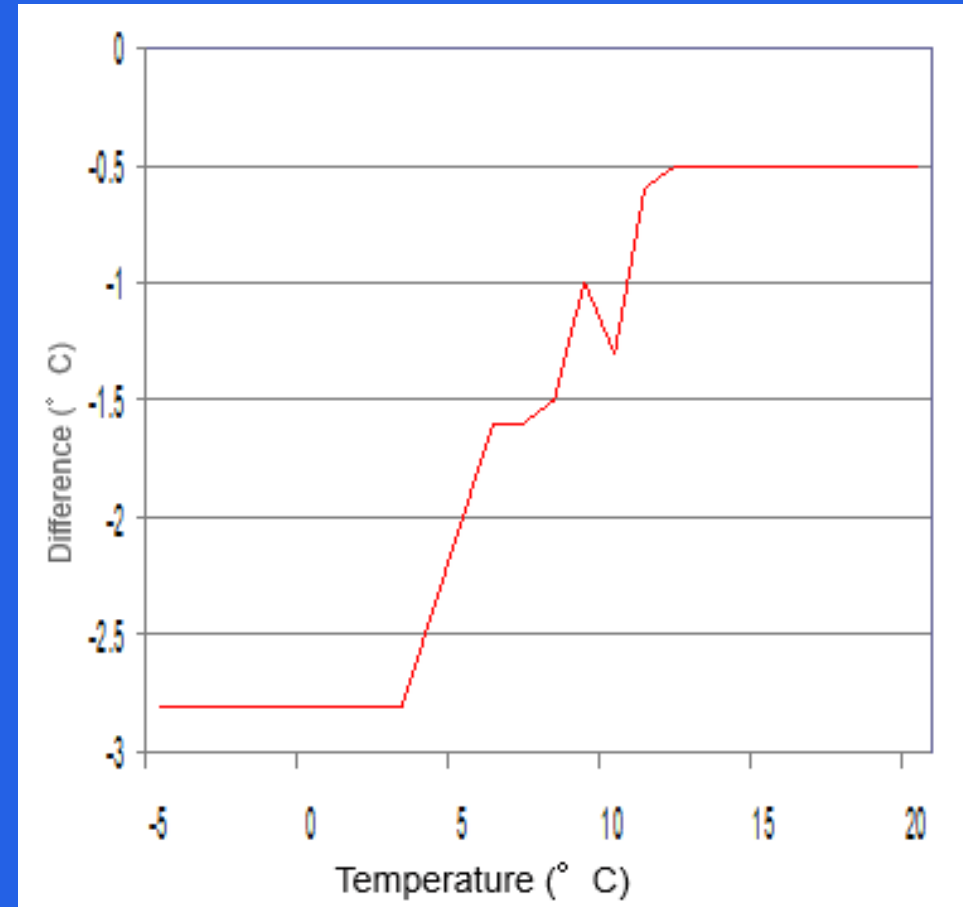


# Detection of inhomogeneities

- Combines metadata and statistical testing
- In ACORN-SAT, statistical testing used candidate station compared one-by-one with its 40 best-correlated neighbours (modified version of the US pairwise algorithm)
- Annual and seasonal series tested separately
- Metadata relatively complete since 1990s, but increasingly sparse further back in time

# Adjustment uses a percentile-matching algorithm

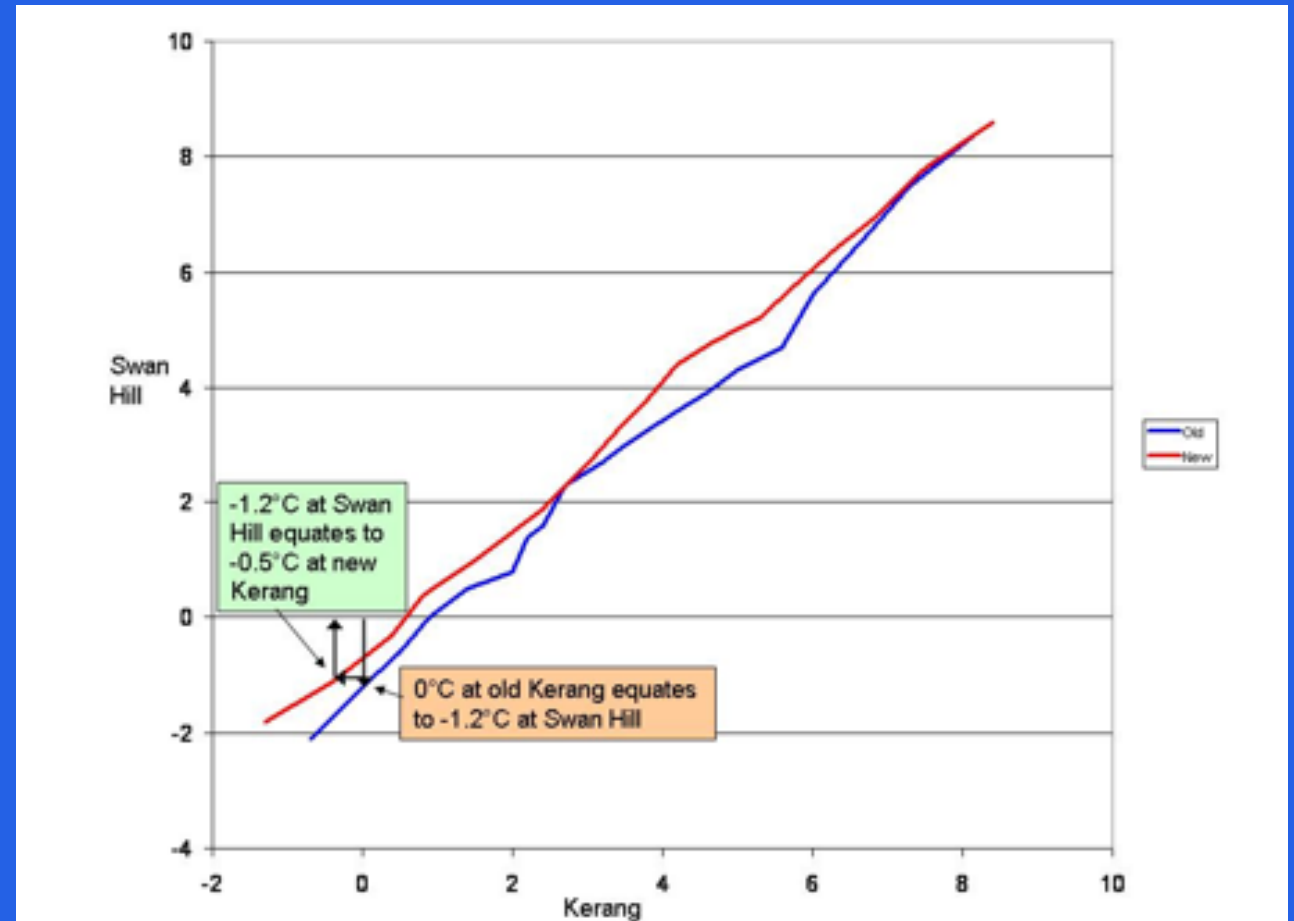
- If sites overlap, 5th, 10th, ..., 95th percentile points calculated for each site in overlap period for 3-month season
- These points used to develop transfer function
- Constant inter-site differences assumed below 5th, above 95th percentile



Overlap case example – winter Tmin at Port Macquarie

# Two-step process used where no overlap exists

- Transfer functions calculated for old site-reference, reference-new site
- Normally uses 5 years before and 5 years after inhomogeneity
- Final outcome taken as median of estimate from all reference sites (typically 10 if available)
- Outlier reference sites removed and replaced



Non-overlap case example – winter Tmin at Kerang for 2000 inhomogeneity

# Each site has detailed online documentation

## Adelaide



### Site information

Site name: ADELAIDE  
 Site number: 23000  
 Latitude: 34.93 °S  
 Longitude: 138.58 °E  
 Elevation: 29 m  
 Locality: Adelaide, SA  
 Data available from: 1910

### Stations incorporated

23000 / 23090 / 23000

### Adelaide

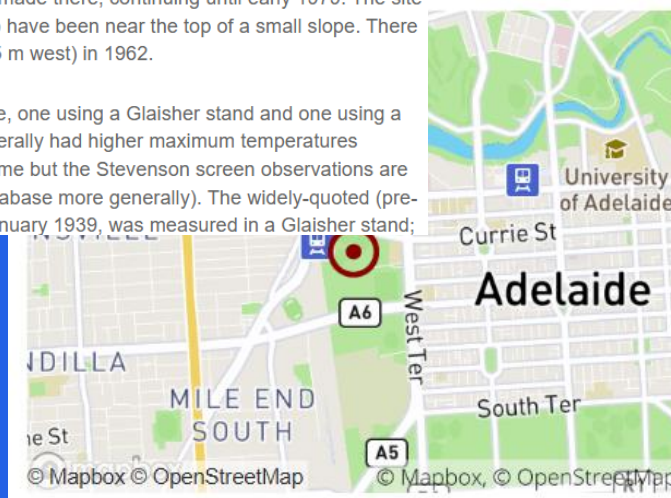
The current site (23000) is located in the Adelaide Parklands, approximately 300 metres west of the western boundary of the CBD and 100 metres from the nearest road. It is located over grass, with some trees 20 to 30 metres away, particularly on the west side. It is near the foot of a small slope to the east. It is relatively close to the pre-1977 site, which was approximately 200 metres to the east. Observations at this location commenced in June 2017 but minimum temperatures from there are only used from July 2018 onwards.

### History

Between 1977 and 2018, the site (23090) was located over grass in the grounds of the Bureau's then South Australian Regional Office, which is in the inner eastern suburb of Kent Town. There were no buildings or roads in the immediate vicinity (within 10 m) of the site, which was near a back street and away from heavy traffic, but it was still a built-up area.

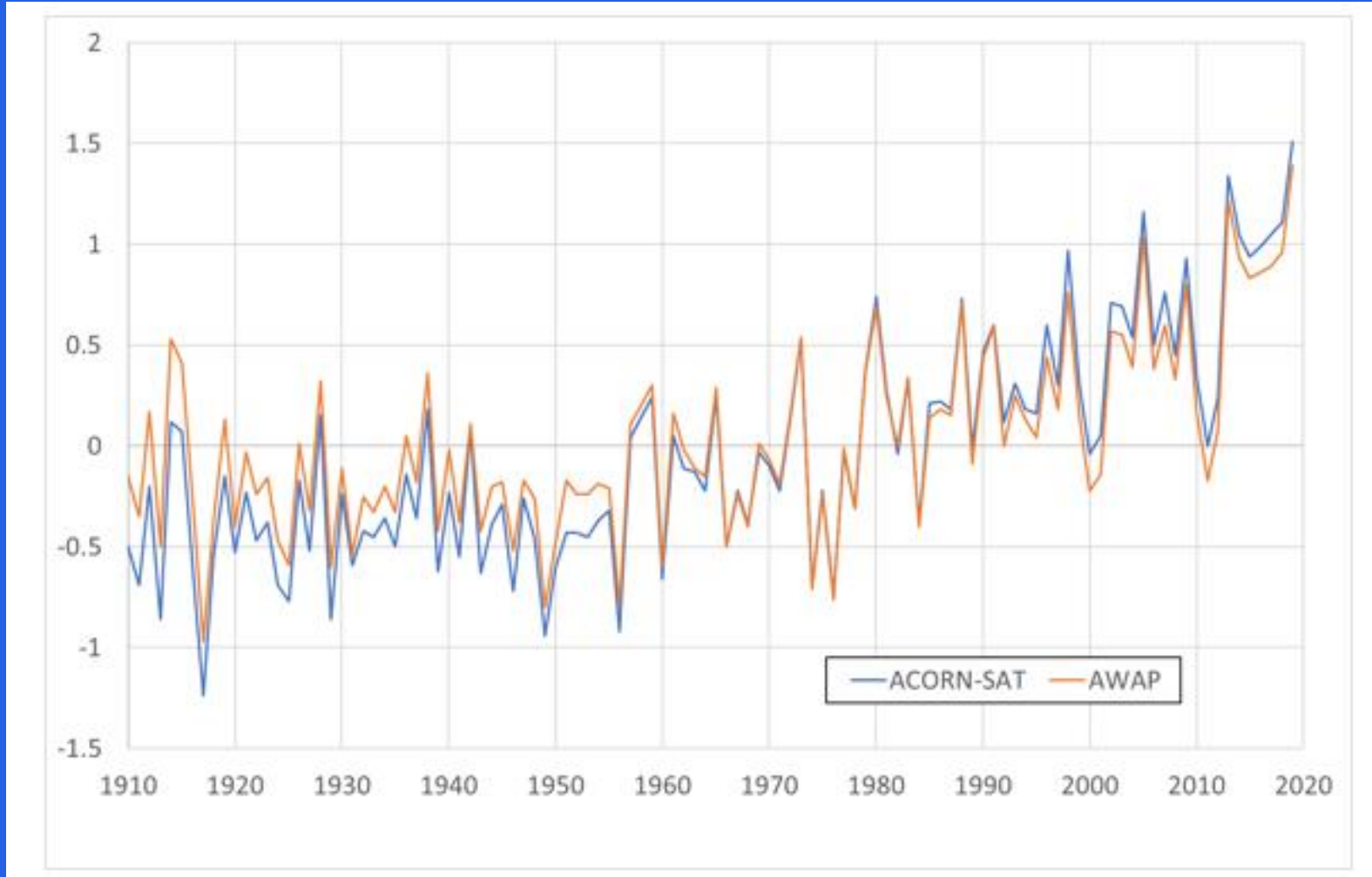
Prior to 1977, the Regional Office (23000) was located at West Terrace, on the western edge of the central city and 3.2 km west of the 1977–2018 site, and observations were made there, continuing until early 1979. The site was on the edge of the main Adelaide parklands and appears to have been near the top of a small slope. There were site moves in 1944, November 1951 and a small move (15 m west) in 1962.

Until 1948 there were two sets of observations made at Adelaide, one using a Glaisher stand and one using a Stevenson screen. The Glaisher stand observations, which generally had higher maximum temperatures (especially in summer), were the ones publicly reported at the time but the Stevenson screen observations are the ones used in the ACORN-SAT data (and in the Bureau's database more generally). The widely-quoted (pre-2019) record high temperature for Adelaide of 47.6 °C, set in January 1939, was measured in a Glaisher stand;



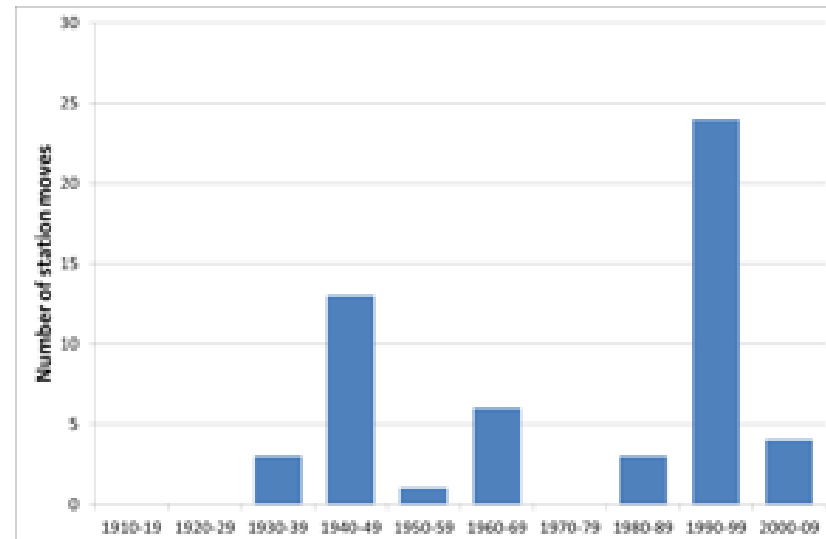
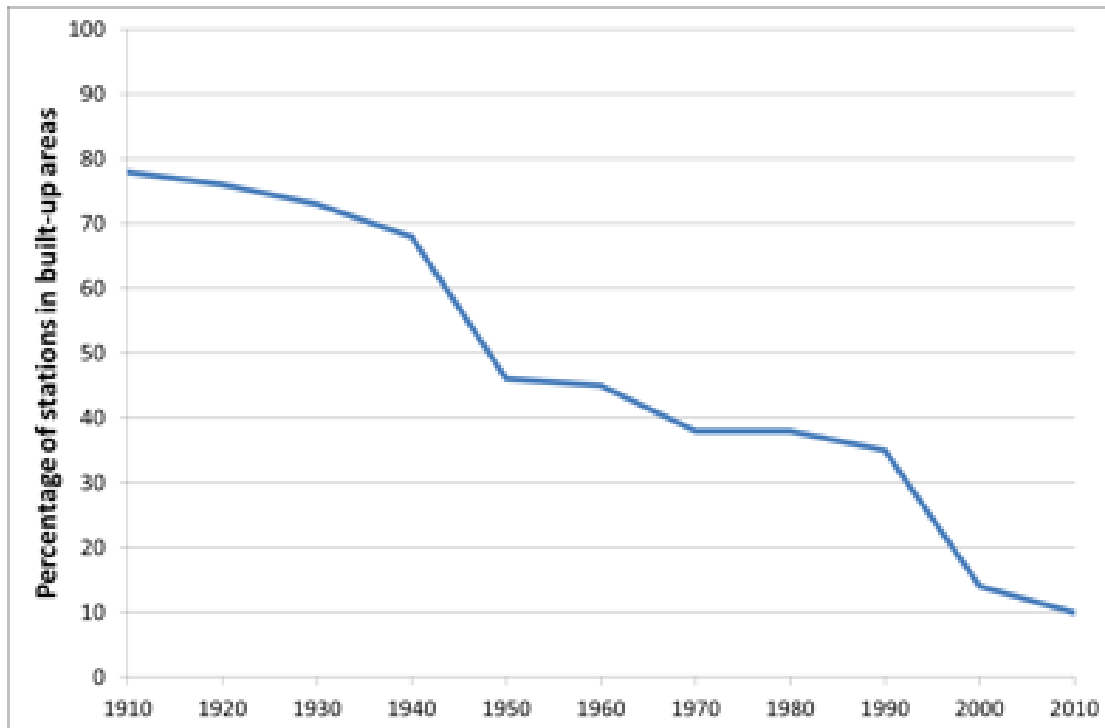
Station

# Homogenised data shows more warming than raw



# Siting major reason for greater warming in homogenised data

Network has become less urbanised over time



Number of station moves out of towns concentrated in 1940s and 1990s

# History of version updates

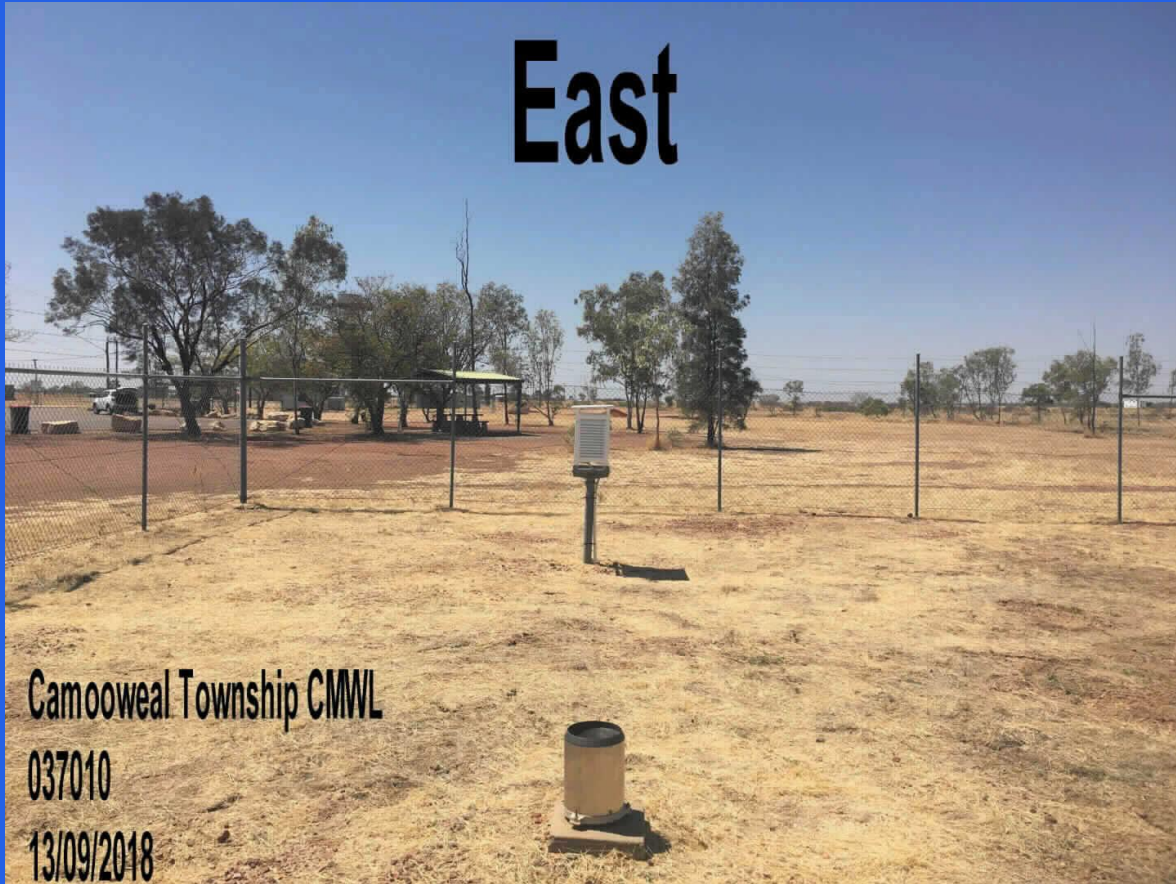
- Original ACORN-SAT release (v1.0) in 2012, building on earlier annual and daily data sets
- Major update (v2.0) released in 2018
- Since 2020, regular annual updates (most recent v2.6, released in November 2025)

# What goes into an annual update?

- Review of quality control for most recent year
- Review of metadata
- Integration of new sites (if any)
- Detection of new inhomogeneities – adjustments not implemented within 3 years of end of time series (2 years if metadata-supported)
- Review of any inhomogeneities (significant and non-significant) previously identified in last 5 years

# Arid areas are prone to vegetation changes

East



2018



2011

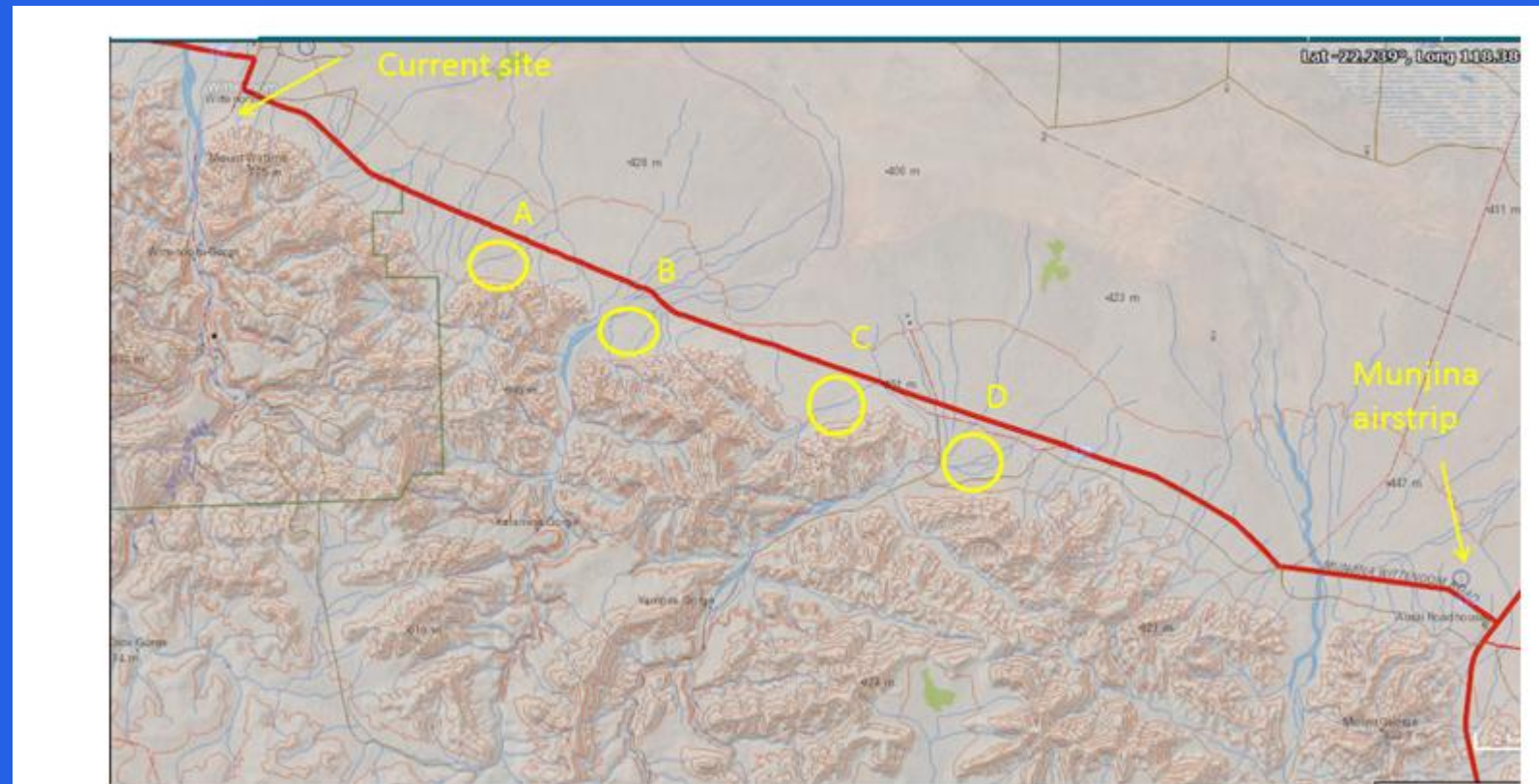
# Outcome of the 2025 annual review (v2.6)

- 6 new adjustments applied
- 4 previously applied adjustments reviewed
- 8 previously applied adjustments revised (mostly by small amounts)

Impact of annual reviews on 1910-present temperature change is typically less than 0.02 °C.

# Integration of ACORN-SAT into network planning

- Close engagement between climate and network planning staff
- 2-year overlap normal standard for planned site moves
- ACORN-SAT sites have a higher frequency of inspection (standard 2x/year)



Candidate sites for replacement of Wittenoom site – site B (12km) ultimately chosen

# The AWS replacement project

- Bureau currently replacing its AWS network
- Move to plastic screens is part of this
- 2-year comparison will be carried out at all sites
- At almost all sites, this will involve instruments being exchanged after 12 months of comparison



AWS replacement pilot site, Gayndah (Jan 2026)