

## WARMING UP AUCKLAND

NIWA has recently provided a web page on how it combined the temperature records from weather stations at Albert Park and Mangere, to produce the 'Auckland' component of the Institute's Seven-station Series (7SS). This page displays a simple but fundamental flaw in NIWA's methodology.

The Albert Park weather station was established in 1909, when both the region and the park were young. But, as the population grew and the saplings became large trees, the site became progressively less suitable for measuring the temperatures of greater Auckland. Concerns long expressed by the NZ MetService were finally met in 1976 by a transfer to Mangere, then on the outskirts of the City.

The problems of Albert Park are discussed by senior meteorologist JWD Hessell in a peer-reviewed paper published shortly after the move to Mangere:

*"Visitors to this central city park today cannot fail to be impressed by the many large exotic trees, many of which were planted about the turn of the century and some of which, more especially those planted later, are still growing. The instrument enclosure is surrounded on all sides by trees and buildings which shelter the site to a great degree. Sheltering was much less in the years preceding 1940. This fact has been commented on by Finkelstein (1955) who pointed out that in no year since 1930 has the annual wind achieved the mean of those before. The decrease in wind is a result of site trend, as ten year mean winds at Whenuapai ... show an increase rather than the decrease indicated at Albert Park...."*

*Clearly the site, at least up to 1970, was being subjected to increasing sheltering.... Arai (1967) has evaluated errors of up to 1°C for a similar screen under differing ventilation conditions."*

The extensive shelter from growing trees meant that Albert Park had gradually become a "heat island". It was no longer representative of the region, and there could be no valid comparison of its temperatures in the 1970s with those recorded 30 or 60 years earlier – when the shelter effect was much less.

But this wasn't the only problem:

*"Another major cause of apparent climatic change is urbanisation, which also produces an increase in observed mean temperature by both sheltering and radiation effects.... The urban area population of Auckland increased by 60% between 1936 and 1966, this percentage giving an index of urbanisation there."*

And there was a third concern:

*"Perusal of the Albert Park files revealed that the screen was changed in 1950 ... There is strong evidence that the screen change has also contributed to the trend in the [1945-55] observations... probably accounting for about 0.4°C... The three considerations of sheltering, screen change, and urbanisation all tend to increase reported maximum temperatures."*

Here is a major conundrum. There are no other weather stations north of Masterton which have continuous temperature records running back to the early part of the century. It would seriously strain credibility if the Auckland is simply jettisoned. That would mean most of the North Island would be unrepresented in the official New Zealand temperature record for

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the twentieth century (the Seven-station Series). So could the most serious flaws in the Albert Park series be somehow “corrected”, to make the record usable?

Hessell again:

*“Quantitative assessments of sheltering and of urban “heat island” effects cannot be satisfactorily resolved unless either or both can be shown to be negligible. The Albert Park ... indications are that sheltering and urbanisation have contributed to the apparent mean temperature increase [of 0.55°]”*

Well, that’s a strong statement – “cannot be satisfactorily resolved” – but surely we can do something! That would be better than simply jettisoning the whole series.

If we assume a break-point in 1940, and note that the 1941-76 mean daily range was 0.42°C higher than 1910-40 (as a result of sheltering and urbanisation), then we could subtract that figure from the former period. That’s pretty crude, of course, as the problems were getting progressively worse over the period, and they probably started back around 1920. But it’s a start, and some clever statistical analysis could surely sharpen it up.

The Auckland site is covered in a “Schedule of Adjustments” NIWA published last February, which expressly talks about urban warming (footnote 3) as the reason for the transfer from Albert Park to Mangere.

It is astonishing, then, that NIWA seems to entirely ignore the impacts of the shelter and urban warming problems that brought about Albert Park’s demise. They’ve done nothing at all to redress the progressive false warming signal imbedded in decades of Albert Park records. Instead, they have harnessed that false signal to buttress their claims of gradual warming throughout New Zealand!

On their web page re Auckland, NIWA says -

*“The Albert Park data have been adjusted downwards to allow for the different climates of the two sites (Albert Park is about 0.6°C warmer) before the Albert Park data are joined to the Mangere data”.*

No mention of the fact that Albert Park SEEMS warmer because its data is seriously contaminated by shelter and urbanisation. Not a word about the MetService decision that Albert Park was fatally defective, or the Hessell finding that its data flaws “cannot be satisfactorily resolved”.

Because NIWA made no attempt to offset the gradual deterioration of the site, and carried the downward adjustment of –0.6°C all the way back to 1909, the full impact of the false warming signal has been put to use.

And then NIWA added icing to the cake.

Hessell’s paper highlighted that the 1950 screen change caused an artificial jump of 0.4°C in the Albert Park record. Therefore, to compare the periods on either side of this change it was necessary to ADD 0.4°C to the pre-1950 records (or subtract 0.4°C post-1950). He sets out a Table with the 1945-50 readings and shows that they all jumped about 0.5° in 1950-55 after the new screen was fitted.

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But NIWA's Schedule of Adjustments shows that they SUBTRACTED 0.5°C in December 1950 – and carried this subtraction all the way back to the commencement of Albert Park in 1909, and then even further back to September 1868. (Does anyone believe the non-standard locally-made screen was in continuous use for over 80 years at four different sites?)

As a result of using the wrong sign for their 1950 adjustment, NIWA were able to portray the first half of the century as being 0.9°C cooler than the MetService records (including Hessel) actually showed. Along with the uncorrected false warming signal created by Albert Park's urbanisation/shelter "heat island", the Auckland series made a major contribution to the alleged 1.0°C warming in the Seven-station Series.

Were these two bloopers in the Albert Park record just unfortunate errors? It's truly amazing that every station in the official New Zealand temperature record seems to contain unfortunate errors – and they all bias the record in the same direction.

### The Salinger Thesis

When asked about the in-house adjustments which introduced 1°C of cooling during the early decades of the 20th century, NIWA invariably state that the adjustments were taken from a student's thesis written in 1977-80. That thesis is very sanguine in its assessment of Albert Park:

- "Although the trees affect sunshine and wind exposure to a limited extent, they reached their maximum height by 1930 and it is not expected that they will further affect the exposure."
- "The city is maritime in exposure and thus the urban warming effects ... should be of little importance".

The problem with this roseate view, is that Hessel went to the trouble of applying sophisticated statistical tests to detect the presence of a trend bias. He found 'a highly significant result' that there was only a 0.5% likelihood that the observed warming trend was due to actual climatic effect. He found that the trees were still growing, and that sheltering was much less in the years preceding 1940.

If Salinger's "see no evil" approach was justified, then why was it necessary to close down the station and move it to Mangere? He seems unaware that this happened in 1976.

Salinger appears to agree that the 1950 screen change had a heating effect, requiring an UPWARD adjustment to pre-1950 temperatures. So it was obviously not the thesis which inspired NIWA to adjust the readings in the wrong direction.

But rather than the +0.4° which Hessel calculated from on-site studies, Salinger derived a figure by before-and-after comparisons with a host of other unrelated stations -viz: Whenuapai, Tauranga, Wellington, Te Aroha, Oratia, and Waihi. He came up with +0.1°C, but nobody knows how as his worksheets have been lost.

### Methodology

The NIWA "Schedule of Adjustments" sets out three substantial early-year reductions in the Auckland record, being -0.4° pre-1868, -0.5° pre-1950 and 0.6° pre-1975. None of

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these are supported by the Salinger thesis – which tends to suggest that NIWA used some other source, as yet undisclosed.

There are very good reasons for declining to follow Salinger's methodology. It is startling in its stark simplicity – being based on the crude and untested belief that the temperature anomaly of any New Zealand station should equate to the simple unweighted average of the anomalies at any other New Zealand stations which were operating at that time. No preference is given to proximity, or climate zones, or stations with well-correlated temperature patterns. A coastal station 300 metres away gets the same weighting as a mountain station 300 kilometres distant.

In fairness to Dr Salinger, he was a pioneer in this field of replacing missing or suspect temperature data by notional data inferred from other sites. In 1980, there was no international literature on the subject, nobody else was doing it, and there was clearly much room for improvement in his initial techniques. This is highlighted by the vastly more sophisticated framework proposed in the Rhoades & Salinger paper published some 12 years later.

But thirty years have now passed. There have been extensive peer-reviewed writings on techniques which might allow data to be legitimately inferred from neighbouring stations, and much better statistical tests to check probability intervals. Why has NIWA not taken advantage of these twenty-first century methods?

### Conclusions

1. As a result of urbanisation and sheltering, the Albert Park weather station (1909-76) suffered from progressive 'heat island' effects. This accounted for warming in excess of 0.4°C during 1940-70, and probably a similar amount during 1910-30.
2. The NIWA adjustment of – 0.5°C to 1868-1950 readings went in the wrong direction. It wrongly assumed that the old screen was over-reading temperatures.
3. When these errors are corrected, there was no material warming trend in Auckland during the last 100 years.
4. The NIWA Schedule of Adjustments does not reflect the adjustments suggested in the Salinger thesis – and no other source has been disclosed.
5. The Salinger thesis (and the NIWA figures) directly contradicts the contemporaneous Hessel paper. Salinger's figures are speculative, and said to be based on comparisons with distant stations (although the worksheets are lost), whilst Hessel's figures are based on statistical analysis of the Albert Park station, which can readily be replicated.