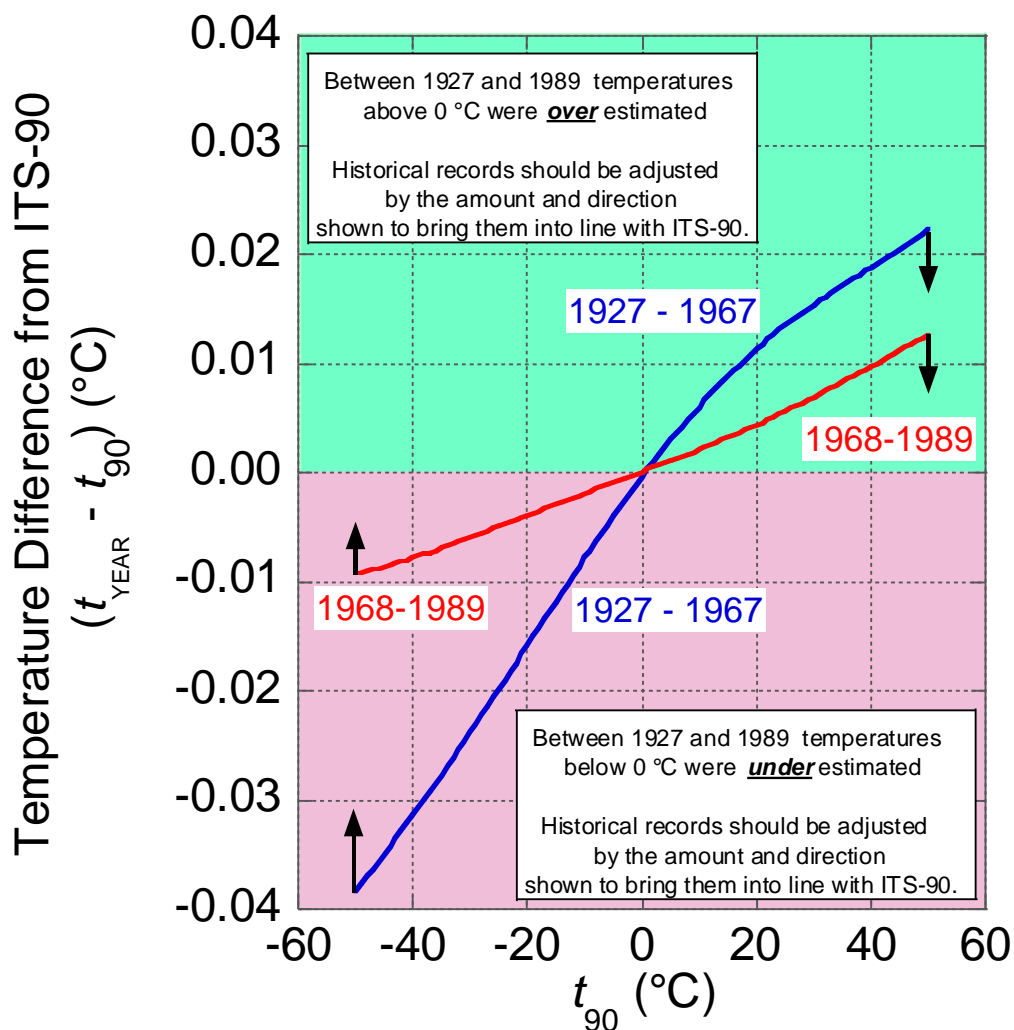


Summary of output of 'T to ITS90' from *Meteomet* Project

The program 'ToITS90.exe' calculates so-called 'scale errors' for calibrated thermometers in the last 87 years. 'Scale errors' occur because all practical temperature scales are conventions – and these conventions change with time as we understand how to measure thermodynamic temperature with lower uncertainty. There were significant re-adjustments of the convention in 1968 and 1990 – when the current temperature scale, the *International Temperature Scale of 1990* (ITS 90), was adopted.

Celsius temperatures measured according with ITS 90 are labelled t_{90} , and the extent of the differences between historical data and t_{90} is shown in the Figure below.



So historical readings should be corrected to the extent shown in the Figure above. By convention, corrections to quantities are always considered to be added to the original quantity

- Temperatures above 0°C were historically overestimated and so historical temperature estimates should be decreased i.e. the correction to be added will be a negative number
- Temperatures below 0°C were historically underestimated and so historical temperature estimates should be increased i.e. the correction to be added will be a positive number

The Table and Figure below shows the extent of the corrections for six typical temperatures in the meteorological range 25 °C, 15 °C, 5 °C, -5 °C, -15 °C, -25 °C.

	Correction in mK to be applied to historical data					
Year	@25 °C	@15 °C	@5 °C	@-5 °C	@-15 °C	@-25 °C
1927 - 1966	-13.5	-8.8	-3.0	4.0	11.8	19.8
1967 - 1989	-5.6	-3.2	-1.1	0.9	2.9	4.9

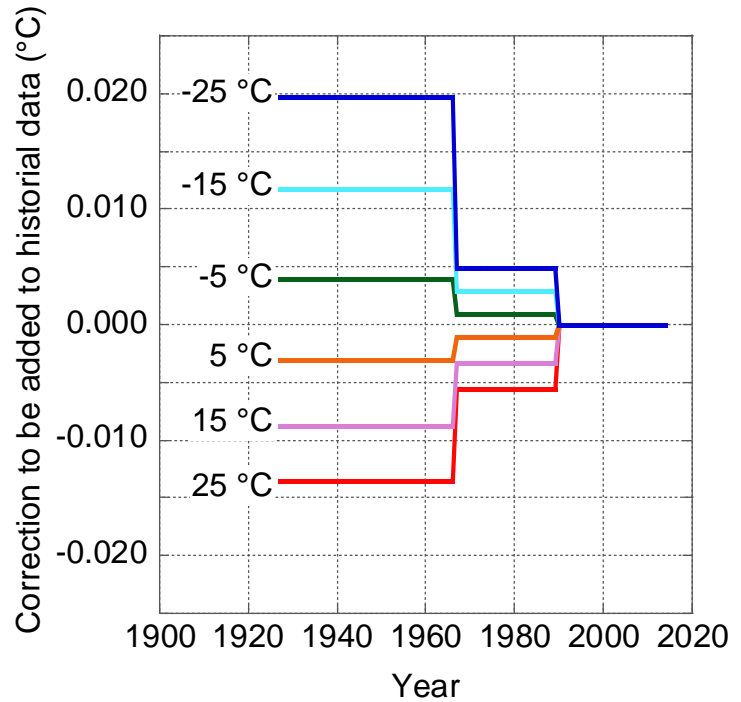
To find the ITS-90 temperature, t_{90} , the correction is added to the historical data.

$$t_{90} = t_{\text{Historical}} + [\text{Correction}]$$

So for a historical reading of 25 °C measured in 1940, the calculation is:

$$t_0 = 25 \text{ °C} + [-0.0135 \text{ °C}]$$

$$t_{90} = 24.9865 \text{ °C}$$



The correction in the range -50 °C to +50 °C can be estimated within $\pm 0.0005 \text{ °C}$ using the polynomial:

$$\text{Correction} = a_0 + a_1 t_{90} + a_2 t_{90}^2 + a_3 t_{90}^3 + a_4 t_{90}^4$$

	Prior to 1968	1968 to 1989
a_0	0.4171	-0.083191
a_1	-0.68587	-0.20776
a_2	0.0048459	-0.00037404
a_3	3.4439e-5	-5.7815e-6
a_4	-7.245e-7	-1.0954e-7

Summary by Michael de Podesta, NPL, April 2014

Software by Peter Pavlasek and funded by *Meteomet*