NPL
National Physical Laboratory

The CCT K10 radiation thermometry comparison – update on progress

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CCT-K10 - ITS-90 realisations above the silver point

CCT-K10 covered the temperature range from 962 °C to 3000 °C

Transfer artefacts were:

- Two radiation thermometers (an IKE LP3 and a Chino radiation thermometer IR-RST65)
- A transfer copper fixed-point source (for monitoring thermometer drift)
- A set of high temperature fixed-point cells (HTFPs) which were doped Ni-C, doped Co-C, Ru-C and WC-C

CCT-K10 participants and timescales

Region	Participants
EURAMET	NPL (Pilot) (UK), LNE-Cnam (FR), PTB (DE), CEM (ES)
SIM	NRC (CA), NIST (US)
APMP	KRISS (KR), NMIJ (JP), NIM (CN)
COOMET	VNIIM (RU)

The circulation was a semi-collapsed star with instruments being returned to NPL for re-measurement after looping round each region

Measurements were started summer 2014 and completed January 2022

The (Interim*) Draft B report has been approved for publication by CCT WG-KC

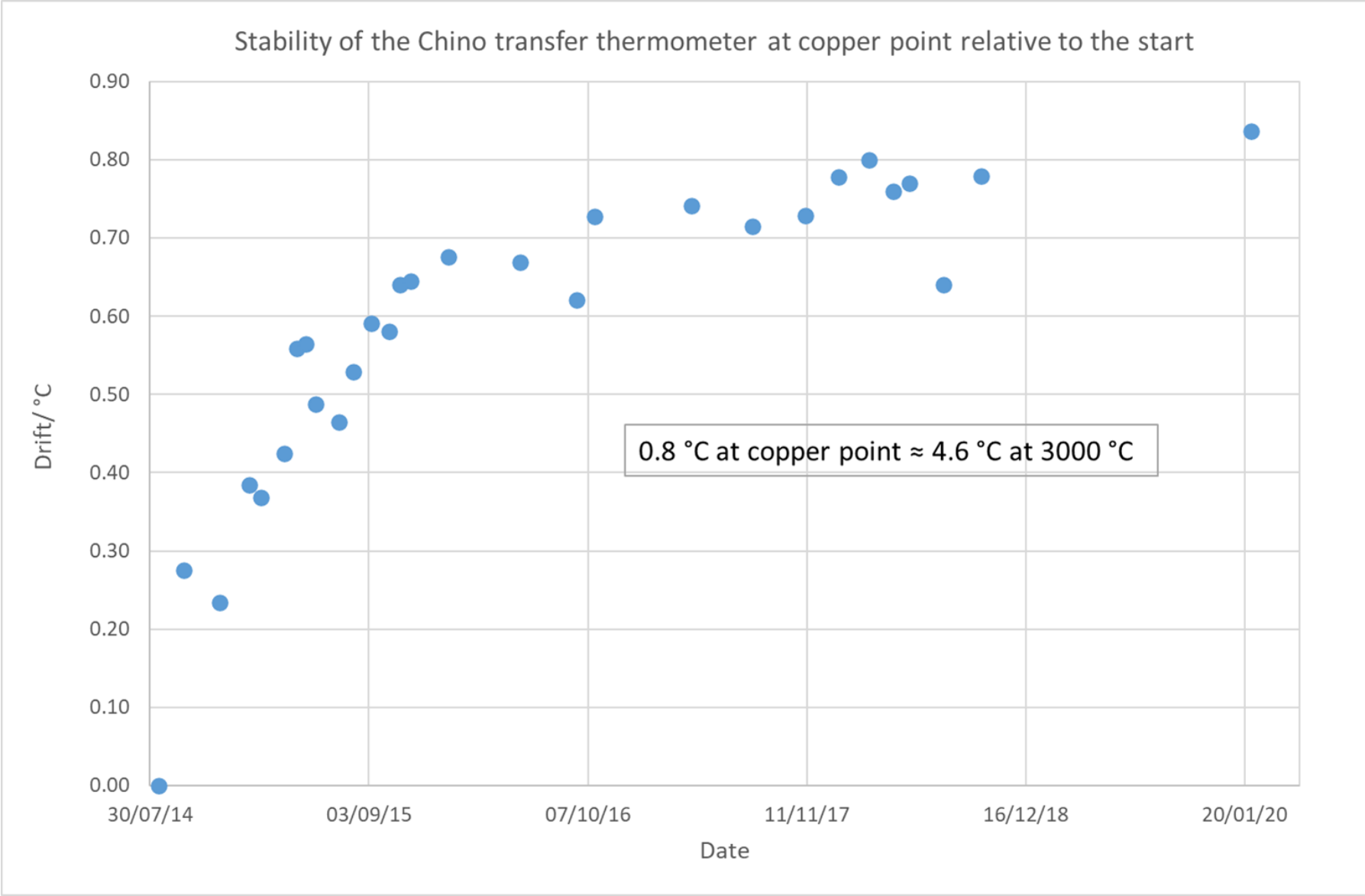
(*The results of VNIIM have been removed from the report and the analysis)

CCT-K10 issues

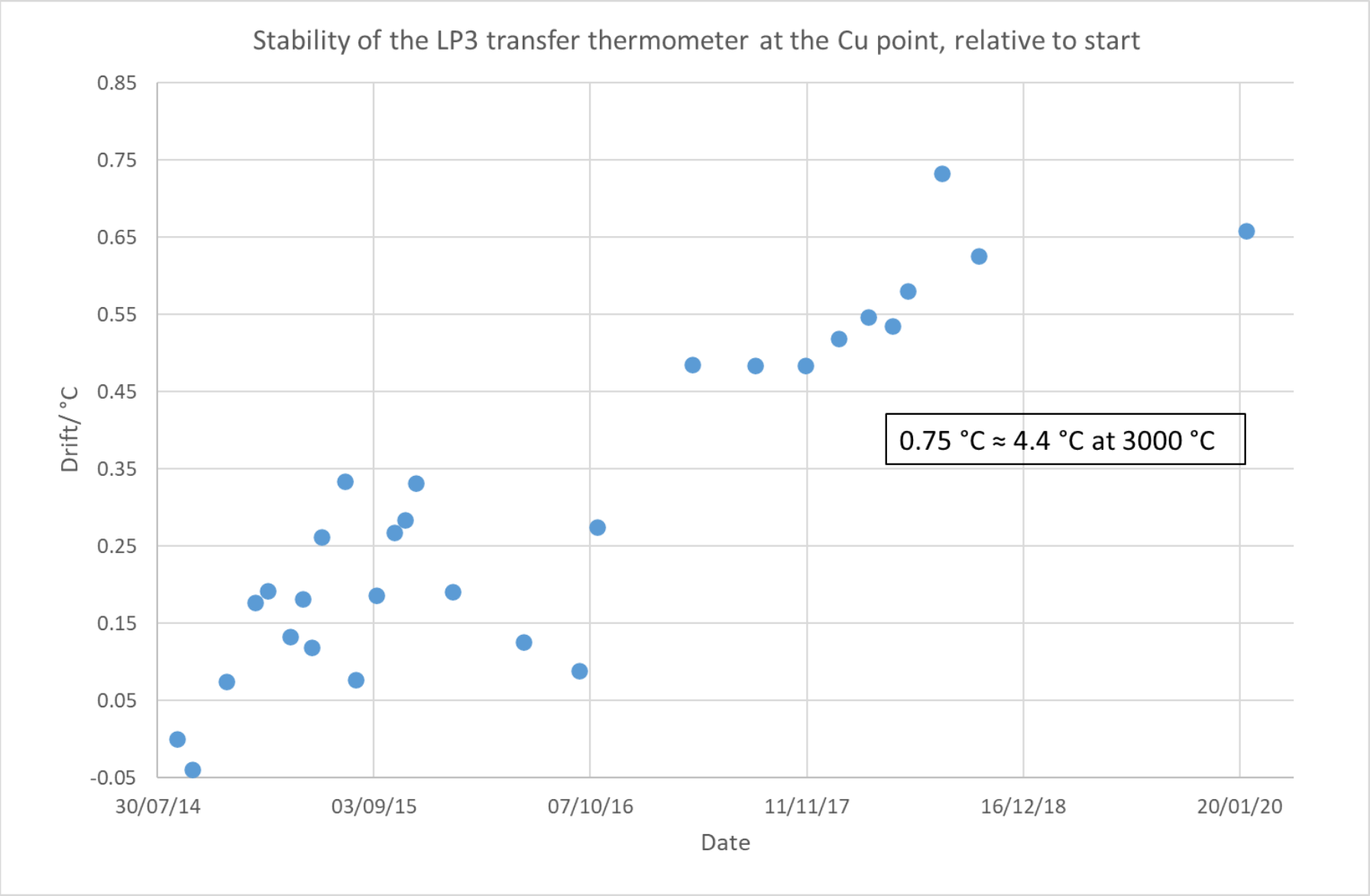
Previous updates have highlighted some of the issues that were experienced including:

- Breakage of cells, particularly the Ni-C cells which had to be replaced with Co-C cells part way through the circulation (Co-C more robust)
- Delays (participant and customs)
- Drift of the transfer thermometers

Stability of the Chino thermometer



Stability of the LP3



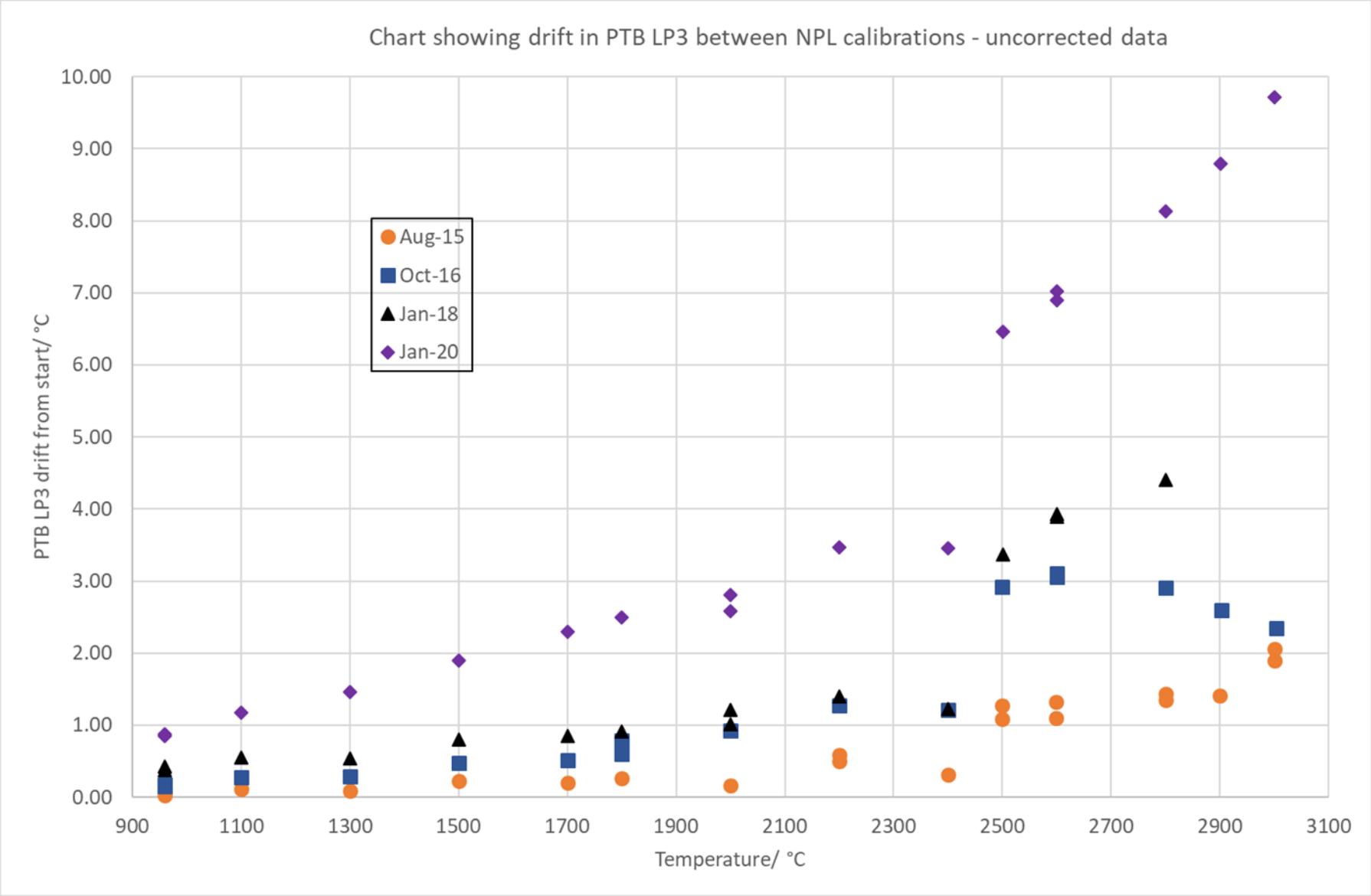
CCT-K10 – data analysis (I)

The results for the two transfer thermometers were corrected for:

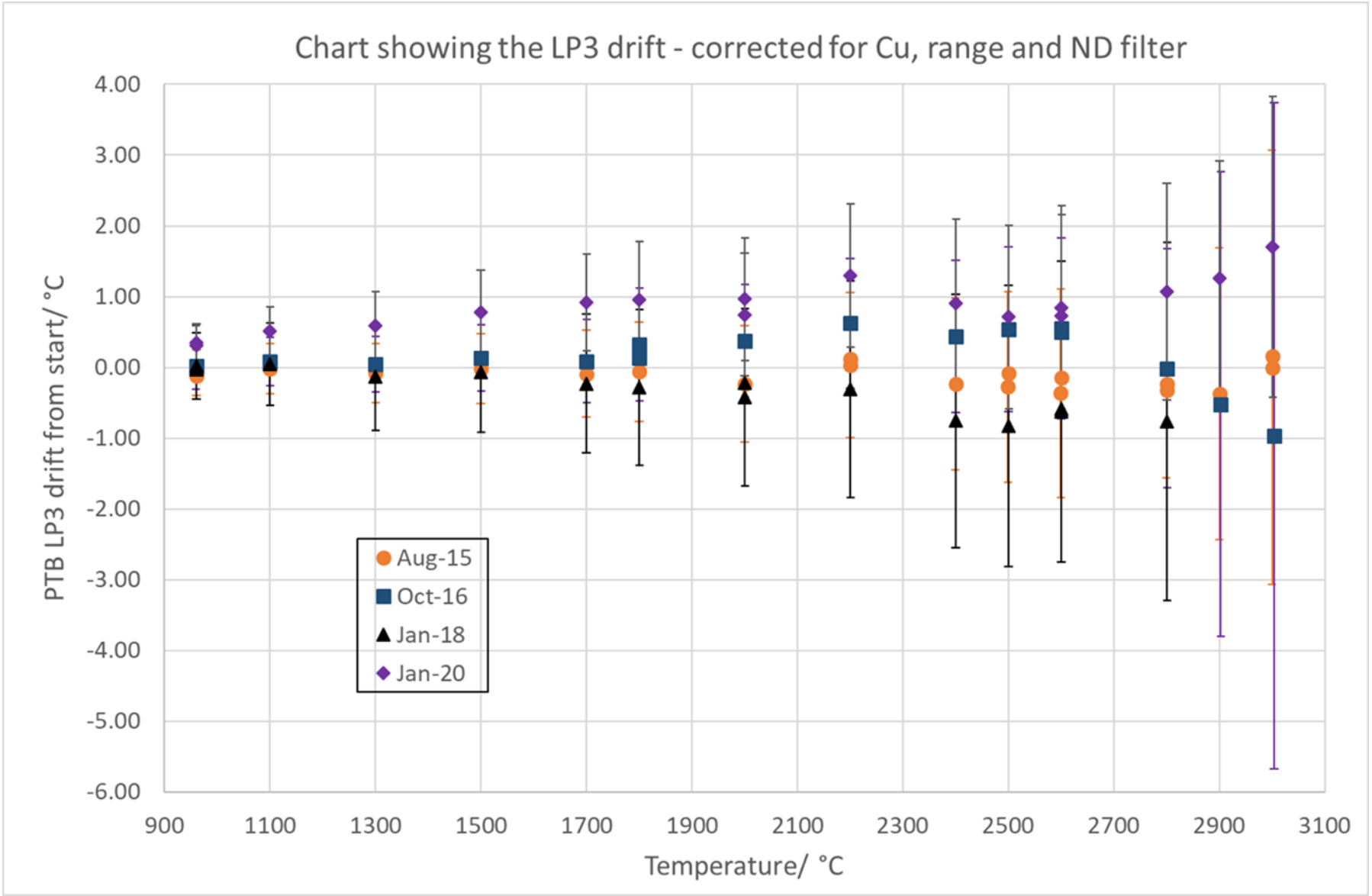
- drift at reference copper point (scaled as ratio of T_X^2 / T_{Cu}^2)
- drift in range/ gain ratio values
- drift in neutral filter transmission (LP3)

and adjusted (if required) to give the corresponding signal at the actual comparison temperature (e.g., 1100 °C, 1300 °C)

CCT-K10 – e.g., LP3 data before corrections



CCT-K10 – e.g., LP3 data after corrections



CCT-K10 – data analysis (II)

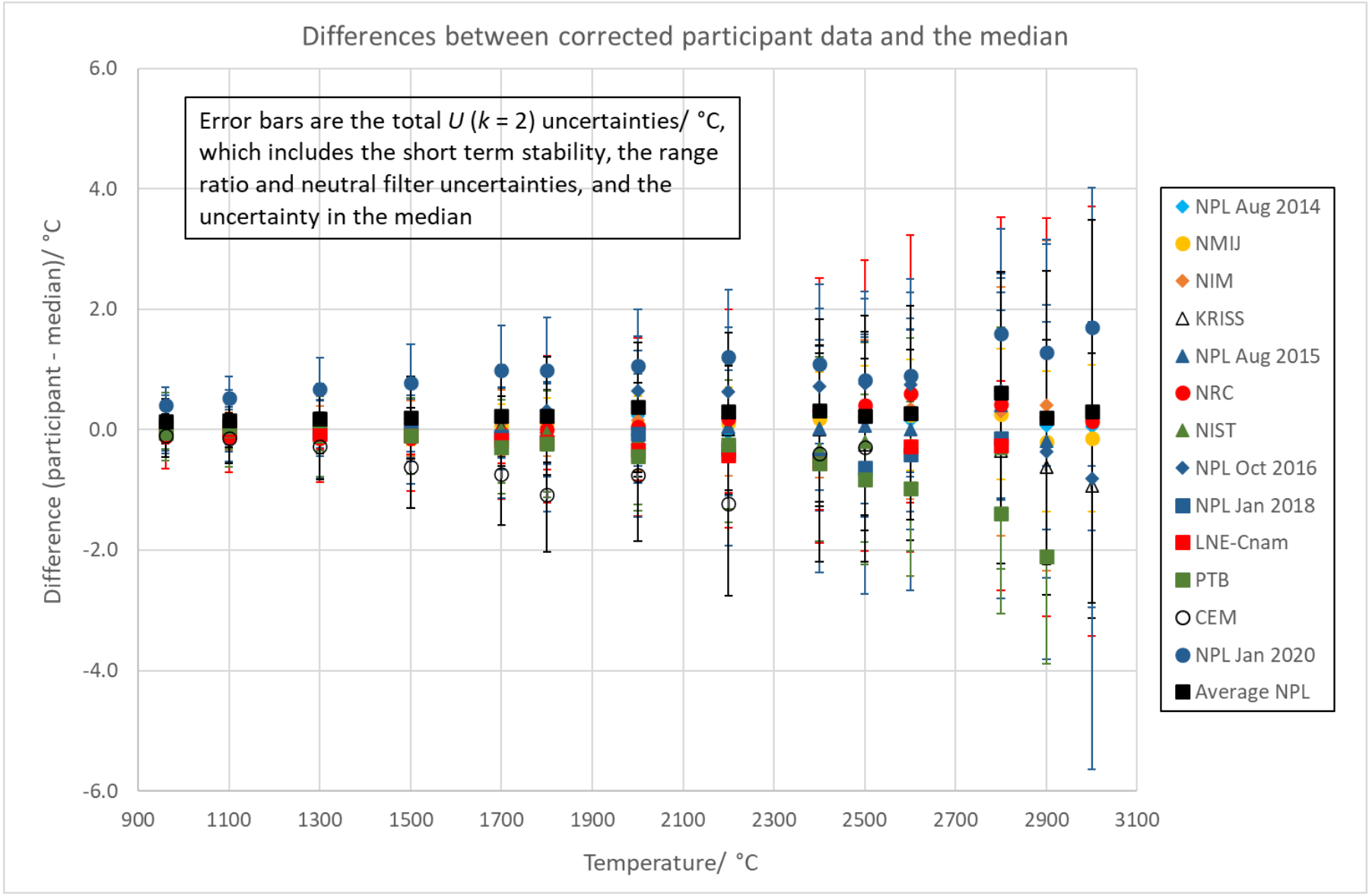
For each of the transfer thermometers the median of the results was used as the reference value for that thermometer

- Median chosen due to the spread of results and number of ‘outliers’ especially for the Chino thermometer

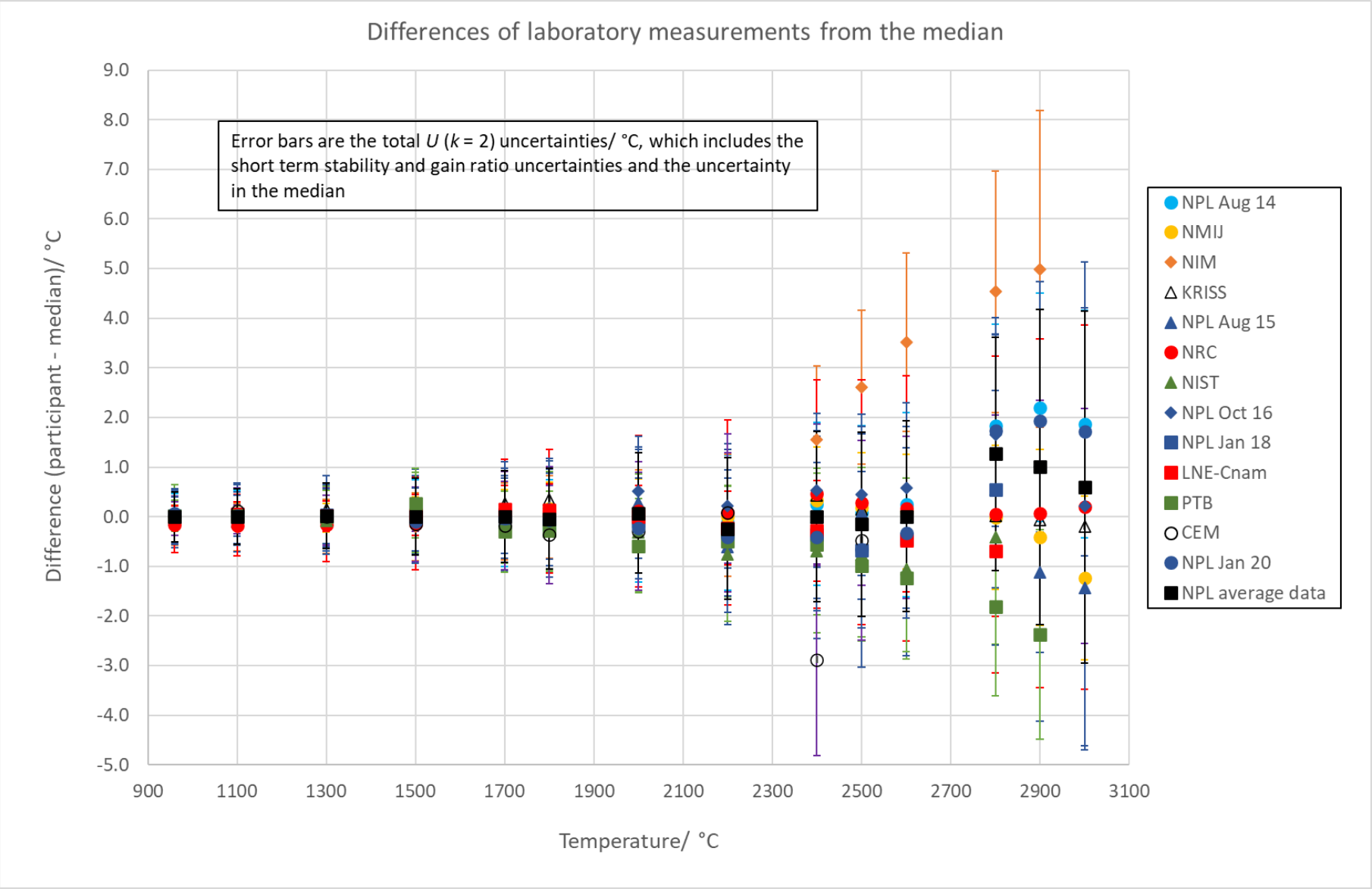
The difference of each participant’s results from the median, for each thermometer at each temperature was calculated

Error bars in charts are total $k = 2$ uncertainties (combined lab and comparison uncertainties)

CCT-K10 – the LP3 results



CCT-K10 – the Chino thermometer results



CCT-K10 – data analysis (III)

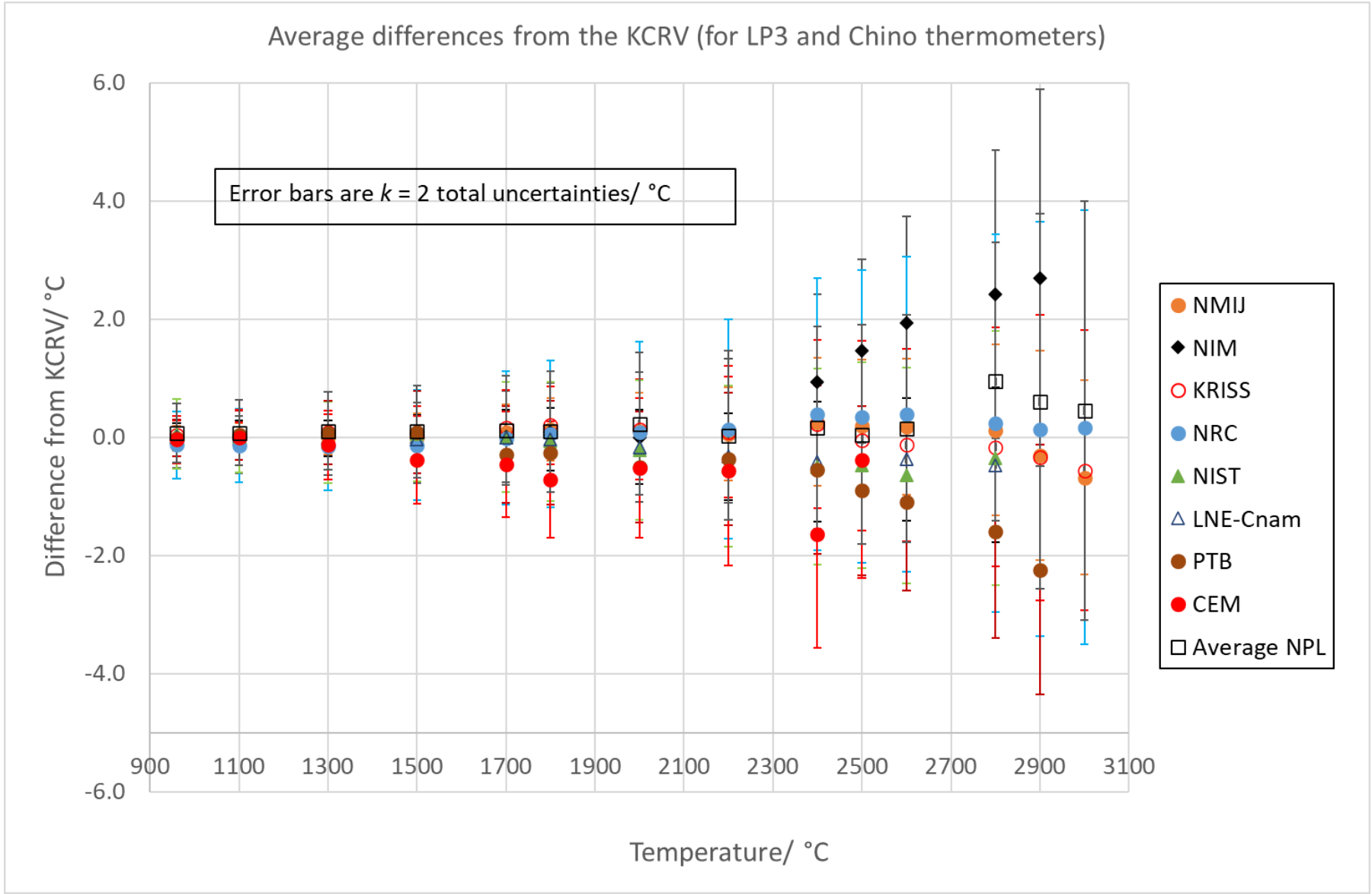
The final step was to calculate, for each participant, one difference from a KCRV at each temperature

Results of both thermometers were used (neither performed better or worse than the other)

The {participant - KCRV} difference is the average (simple mean) of the differences of the LP3 and Chino thermometers from, respectively, the LP3 and Chino reference values (medians)

Error bars in charts are total $k = 2$ uncertainties (combined lab and comparison uncertainties)

CCT-K10 – results with the thermometers



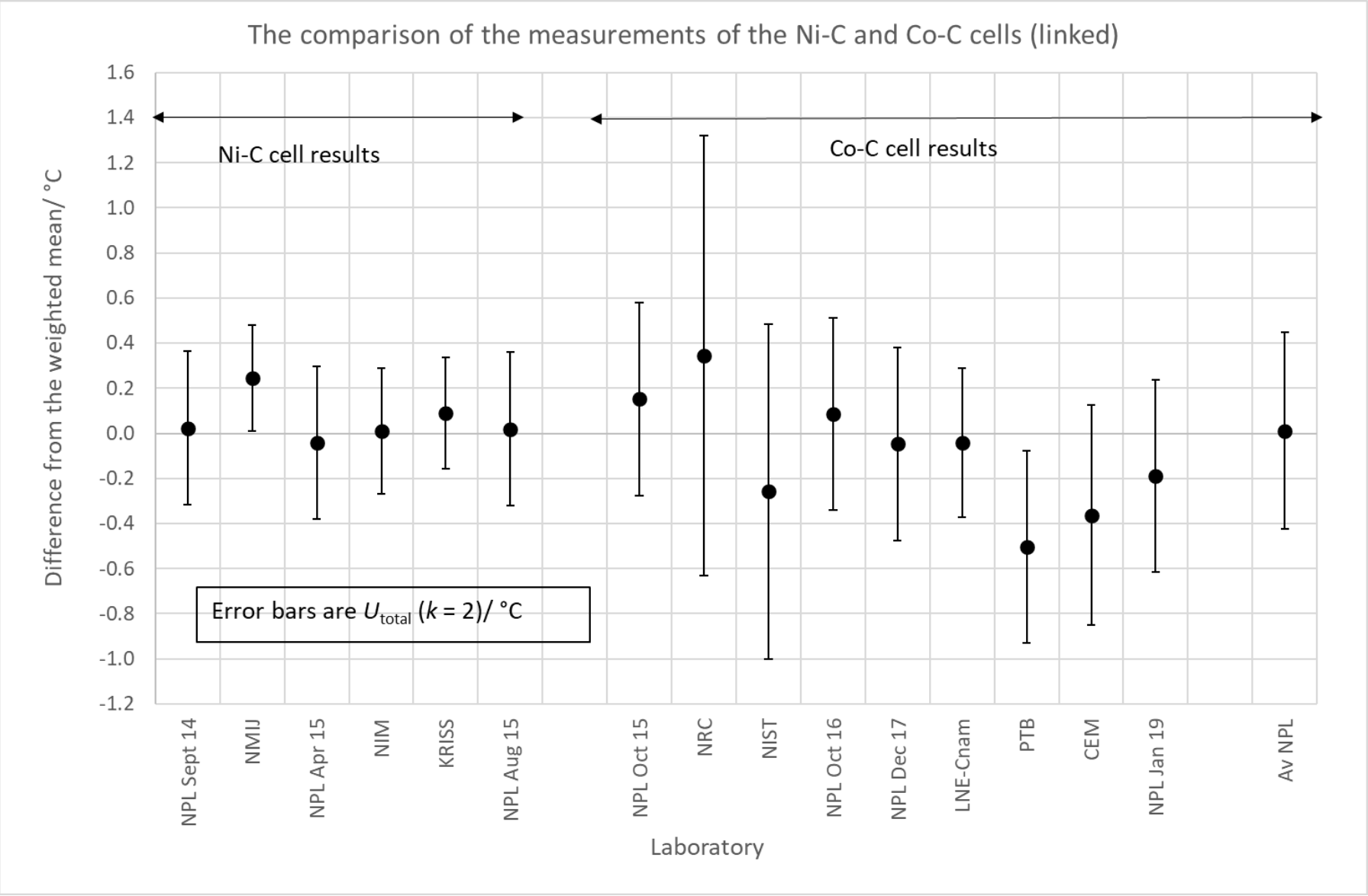
CCT-K10 – HTFP results

For each HTFP the weighted mean with cut off was used for the KCRV

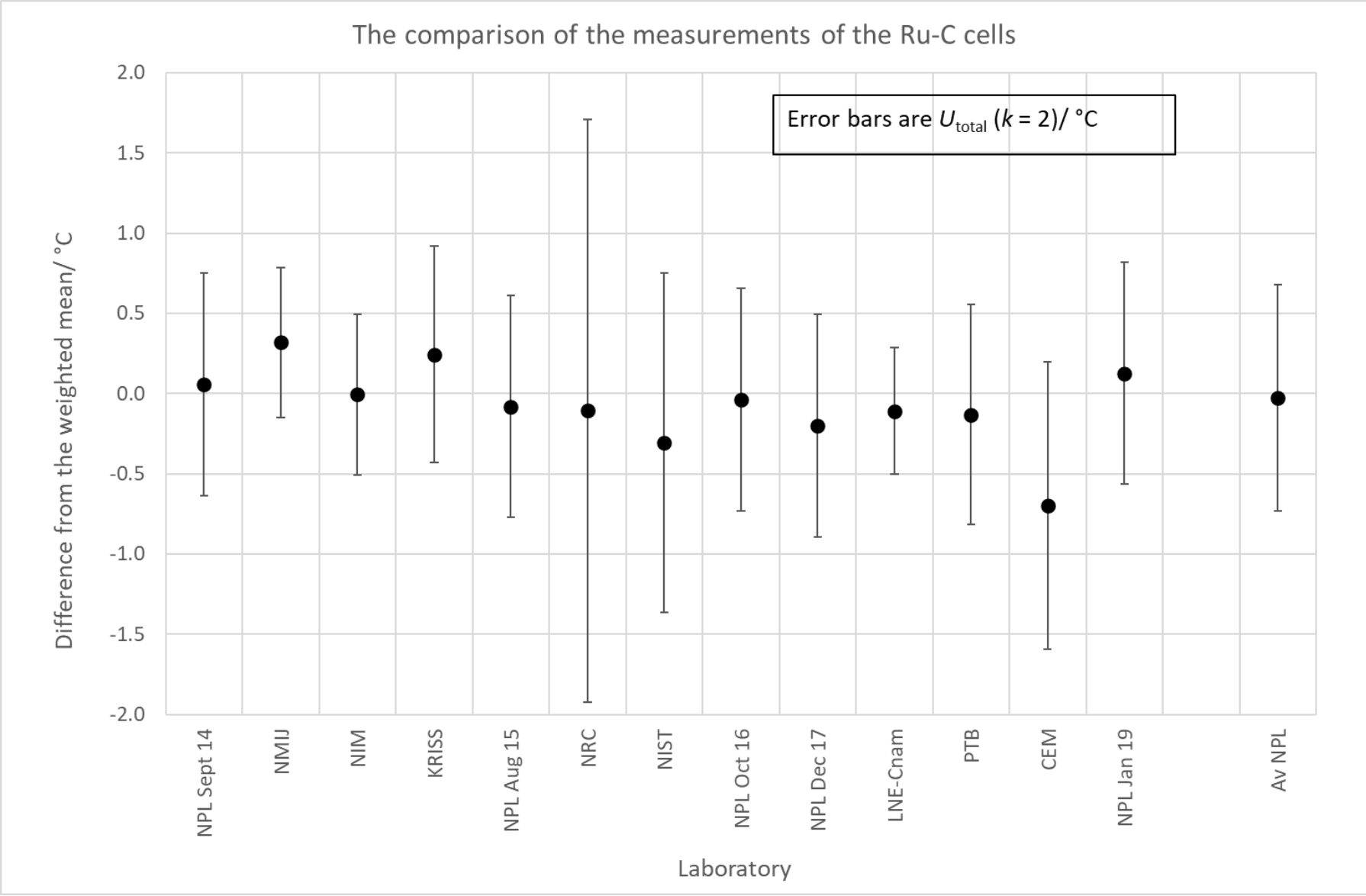
The Co-C-X and Ni-C-X cell results were treated separately, and also combined by applying a correction of -3.46 °C to the Ni-C-X cell results

Error bars in charts are total $k = 2$ uncertainties (combined lab and comparison uncertainties)

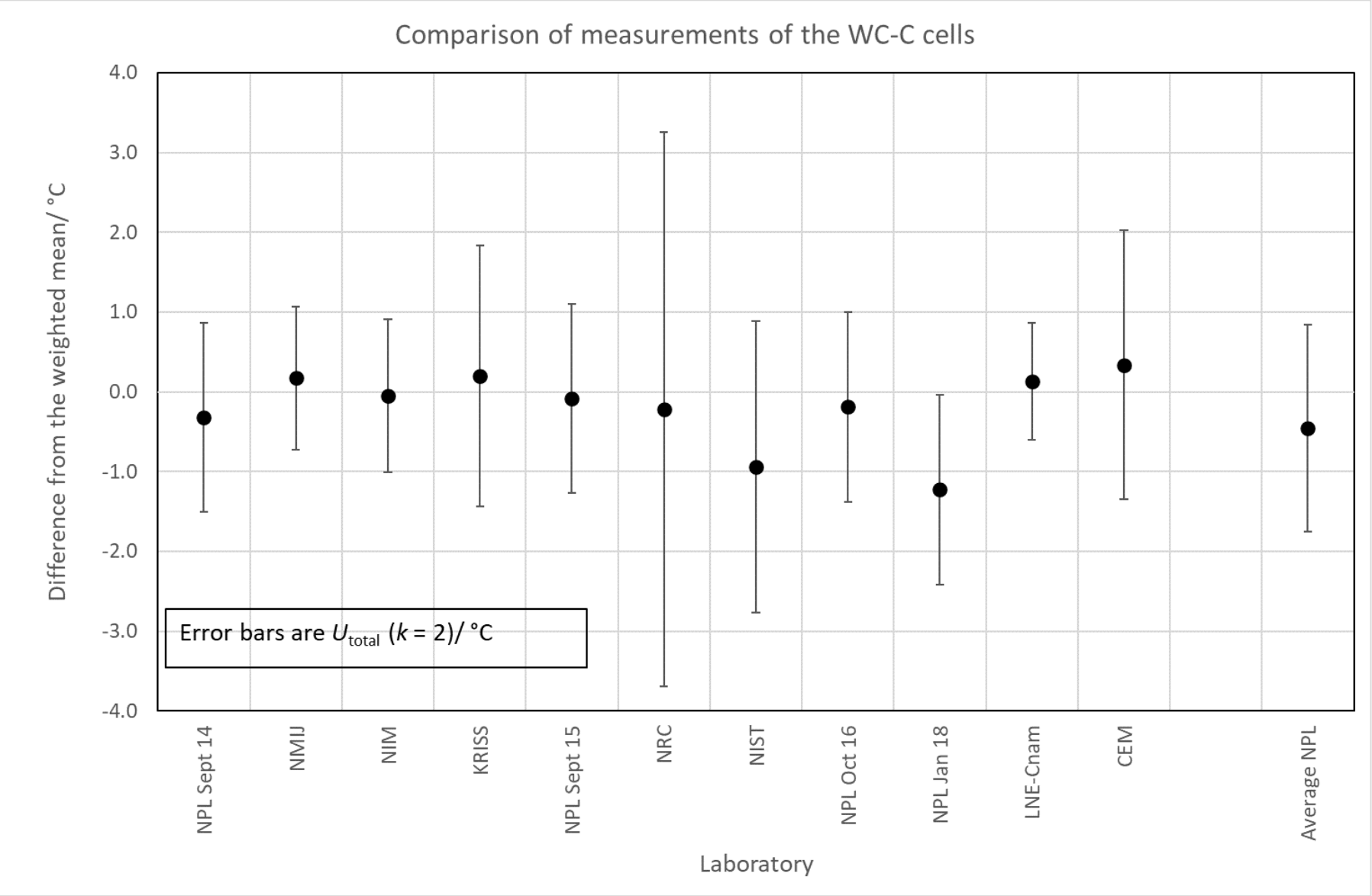
CCT-K10 – Co-C and Ni-C results



CCT-K10 – Ru-C results



CCT-K10 – WC-C results



Conclusion

The CCT-K10 comparison has been completed and the Interim Draft B report is being prepared for publication

The results will be used to underpin claimed CMCs of the participants

The results using the HTFPs have allowed participants' claimed uncertainties to be probed more thoroughly

It is hoped that, at some future point, the results from VNIIM can be included again and the final Draft B report published

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