Temperature Correction for LHC Copper Bus Resistances

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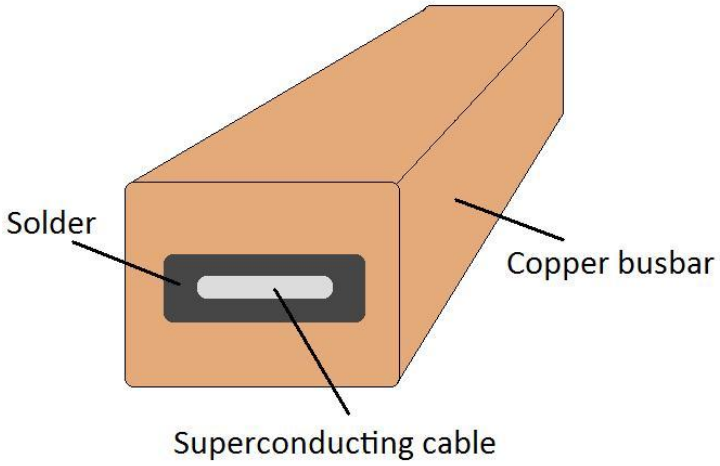
Reminder..

- General purpose of TE-MPE:
  - Understand dipole magnet and quadrupole magnet copper bus resistances
  - Identify buses with excess resistance
    - Caused crash on 19 September 2008
- My project within group:
  - Help identify temperature effects on measurements
  - T gradient within subsectors

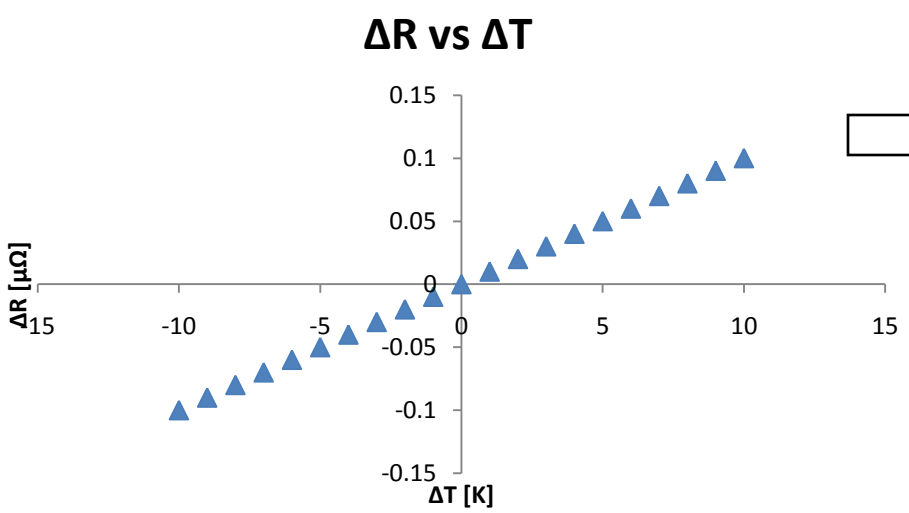


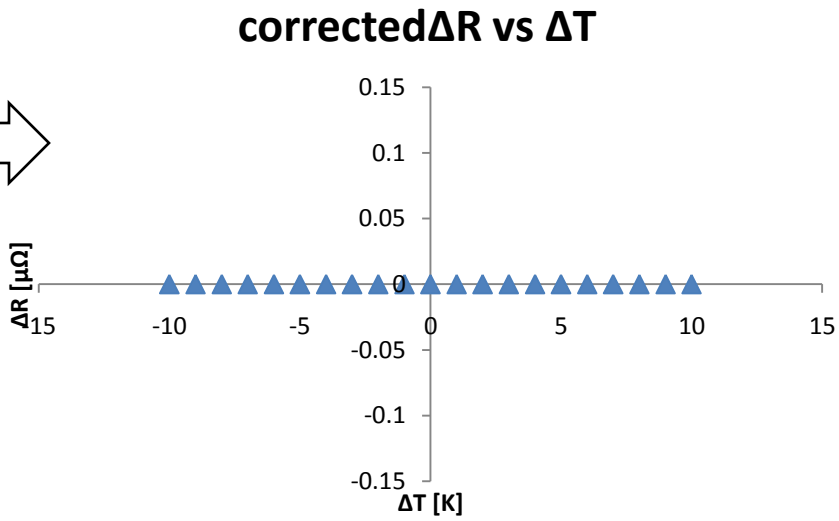
The Basics

- In copper, Resistance is linear in Temperature
  - dR/dT is constant
  - Plot of ΔR vs ΔT for multiple buses should form a line
  - Plot of ΔcorrectedR vs ΔT should be flat

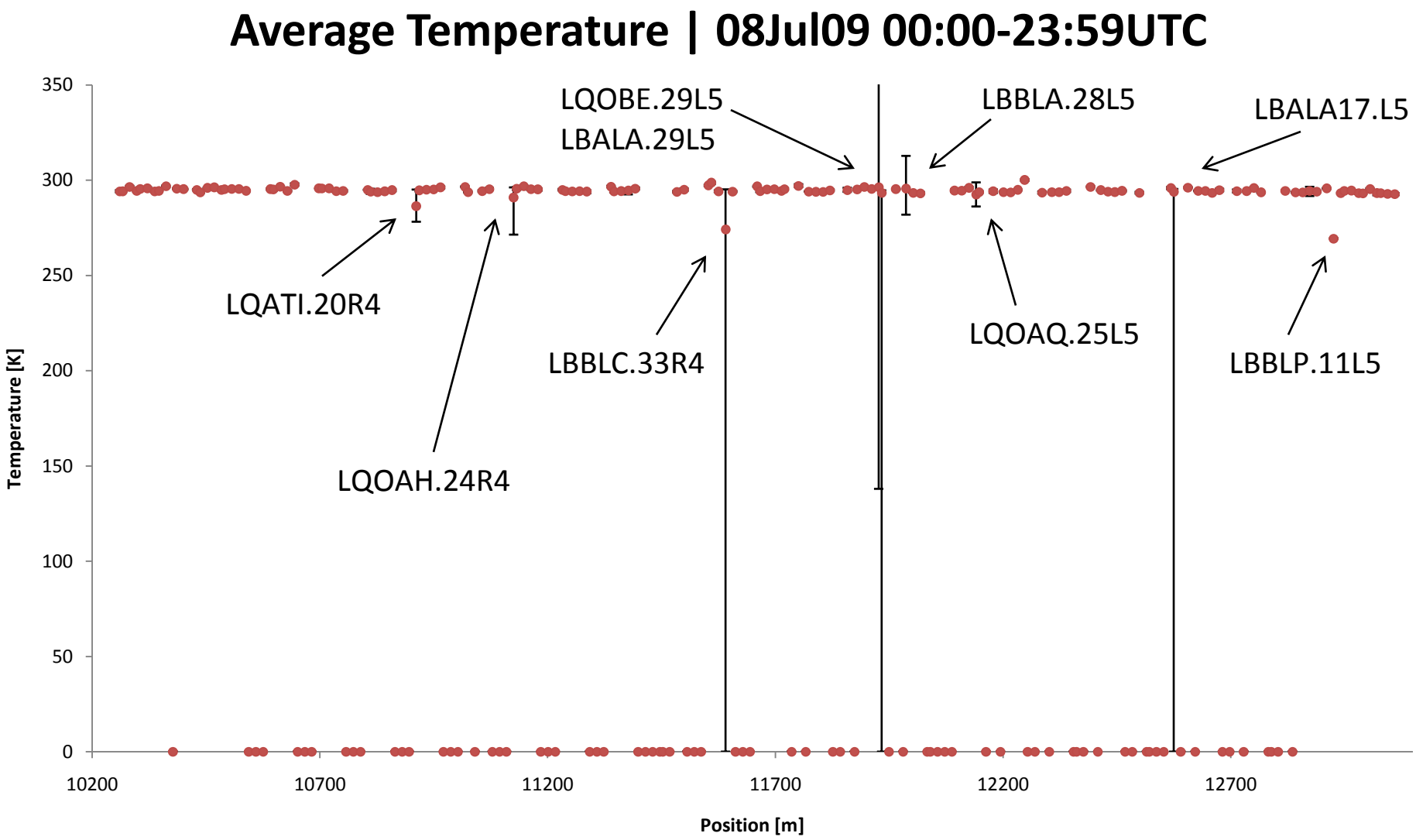
For example…

- Suppose dR/dT = .01
  - We can correct for temperature accordingly:
    - 3.0μΩ @ 300K scales to approx 2.95μΩ @ 295K
    - 2.9μΩ @ 290K scales to approx 2.95μΩ @ 295K

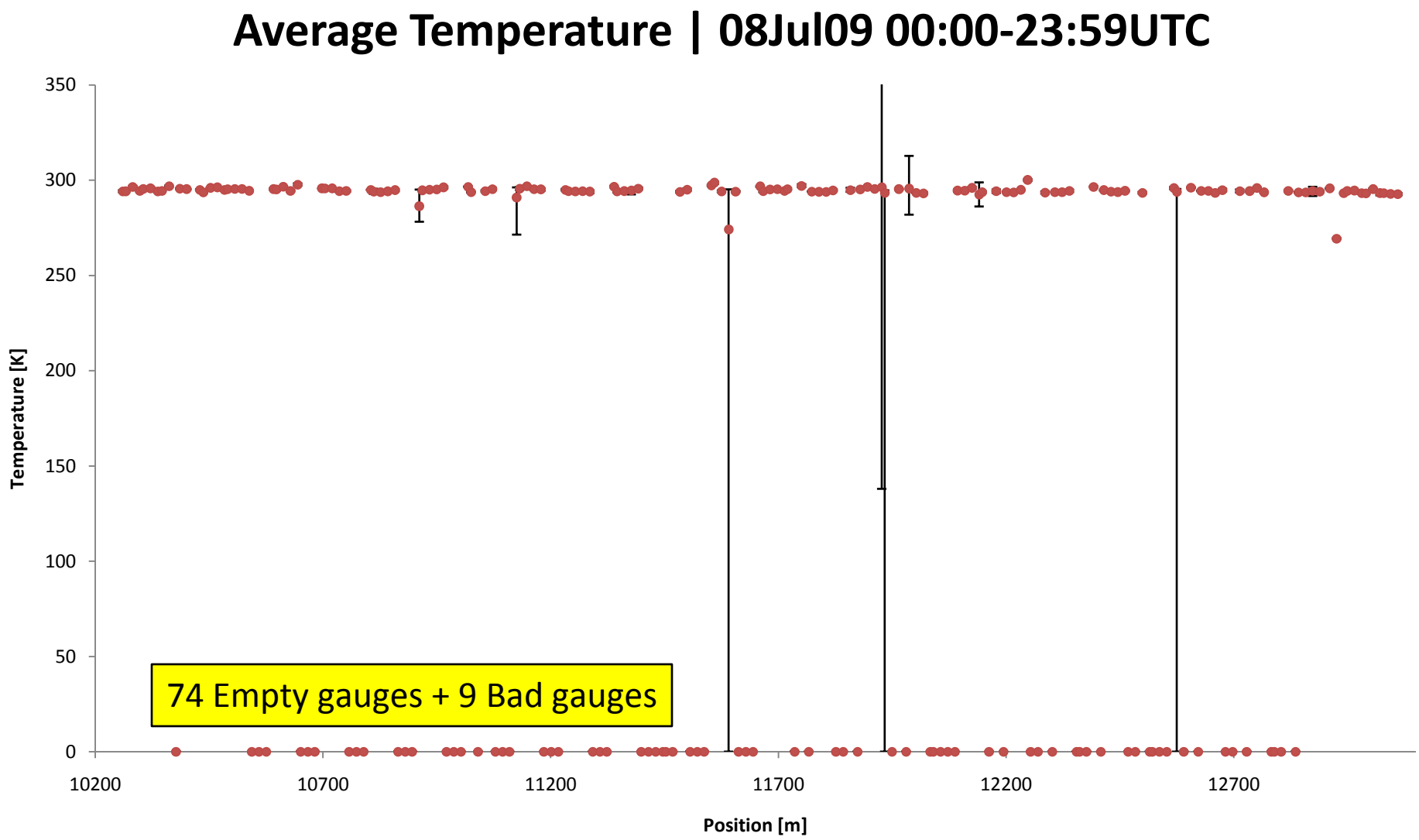




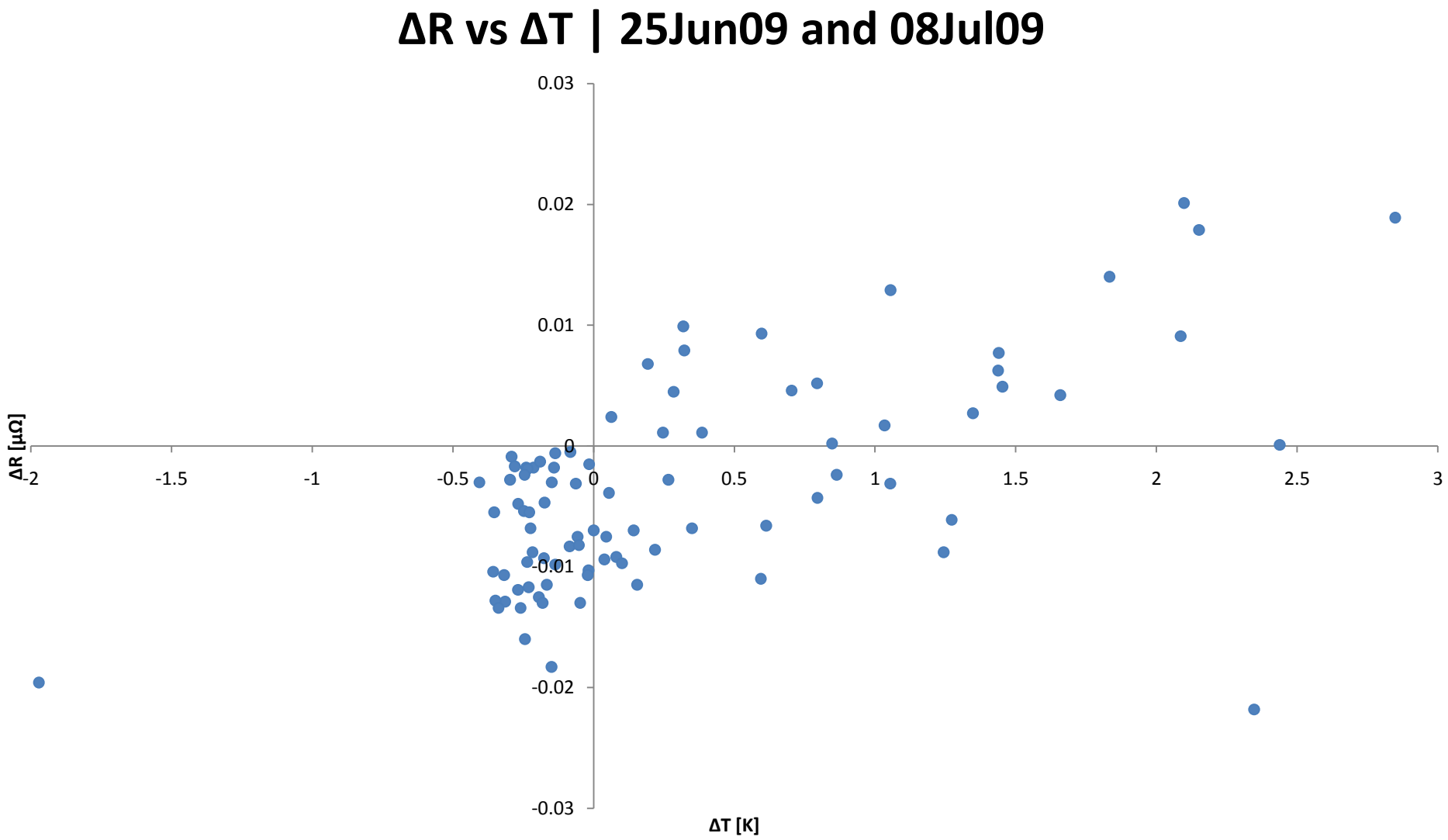
Problems: Bad temperature meas.



Problems: Missing temperature meas.



Problems: Multiple populations



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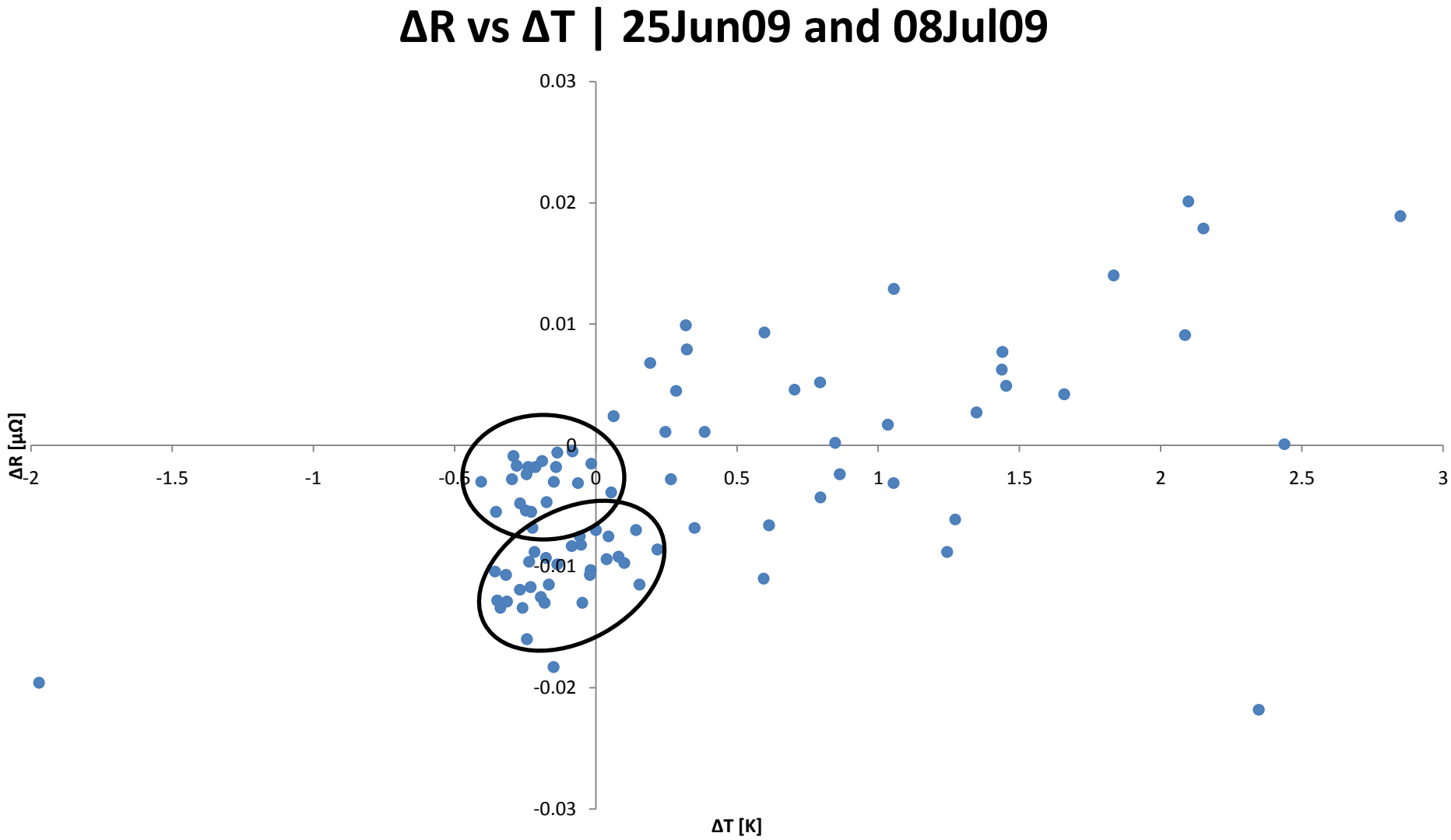

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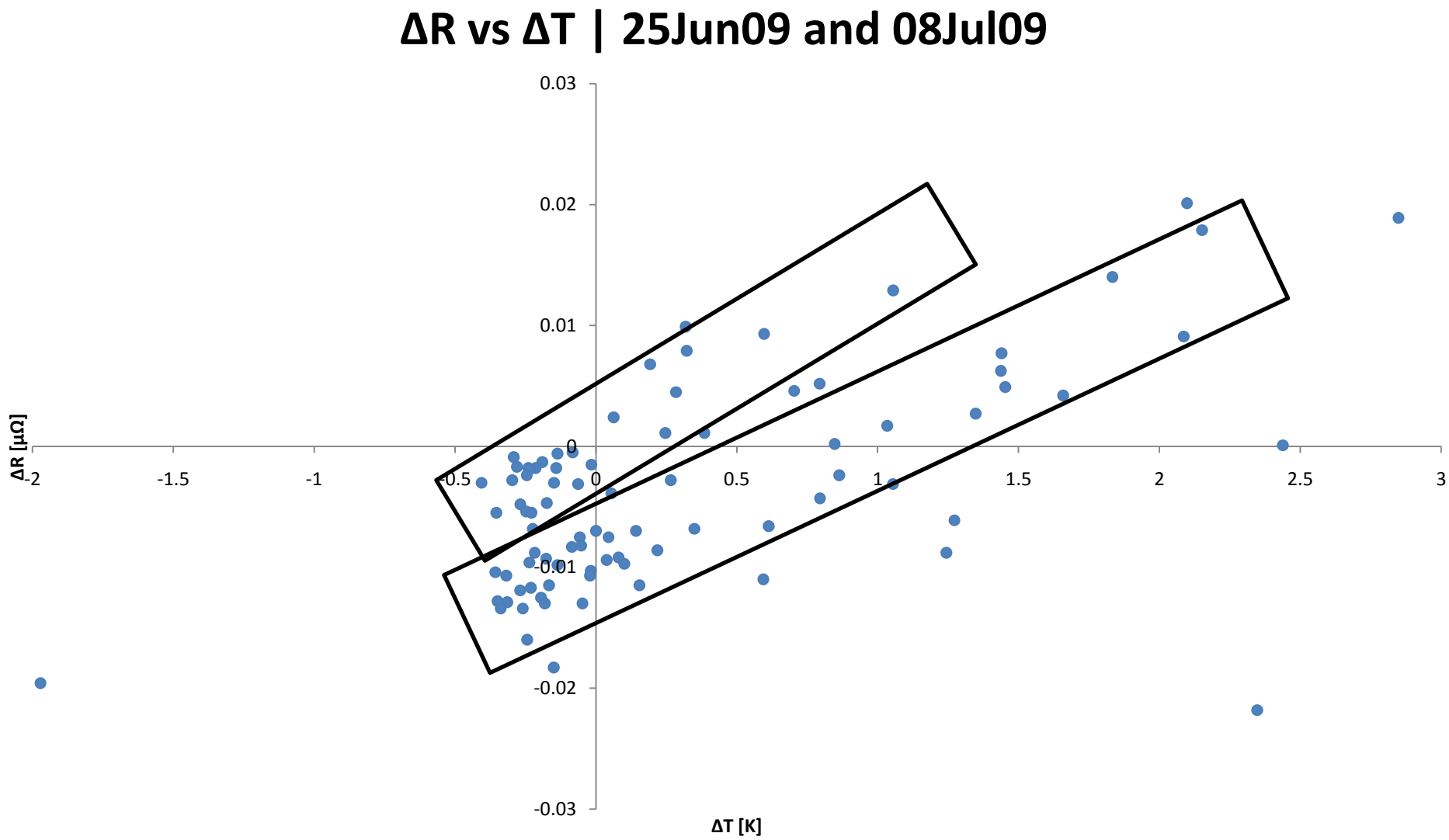
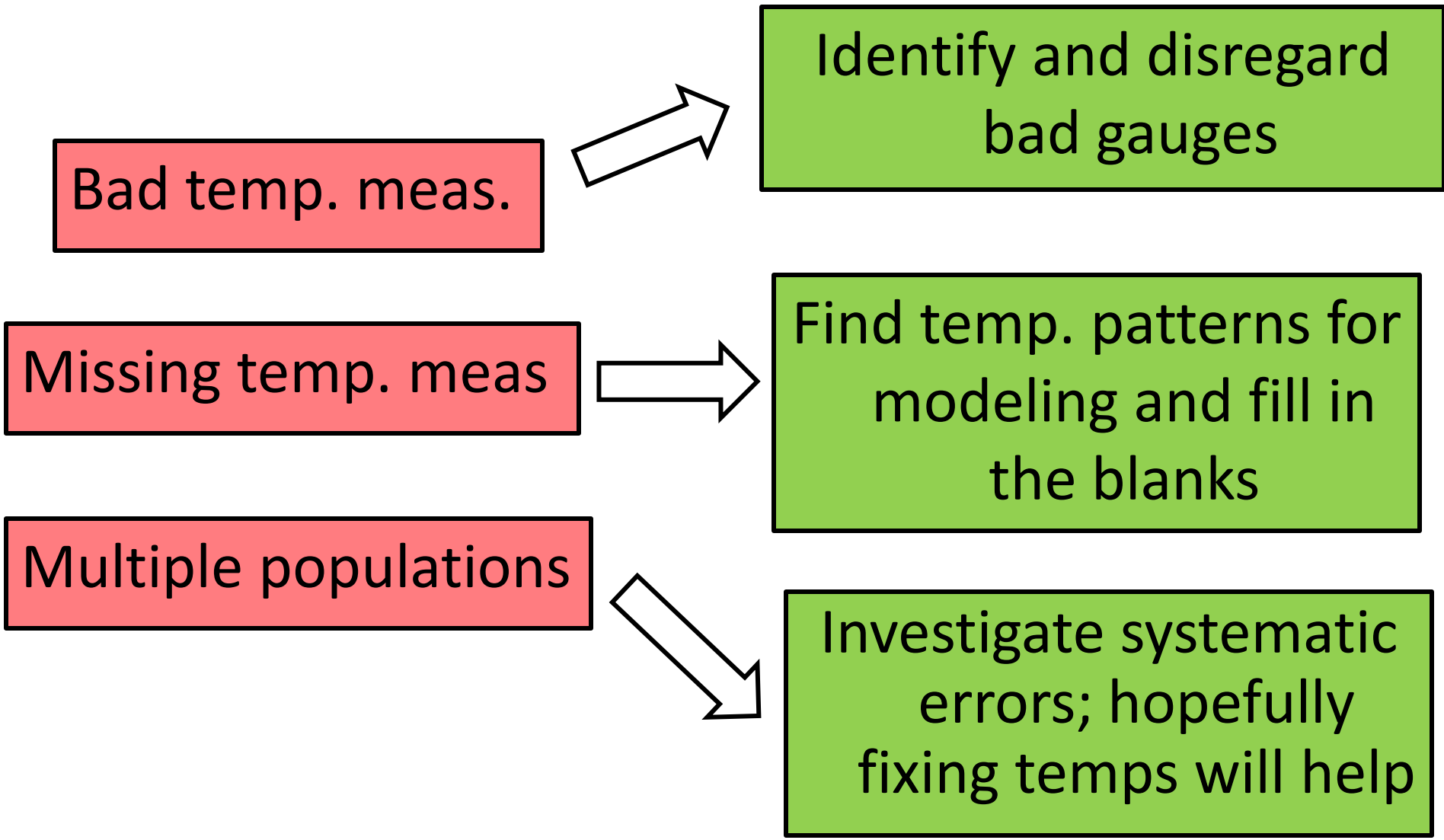
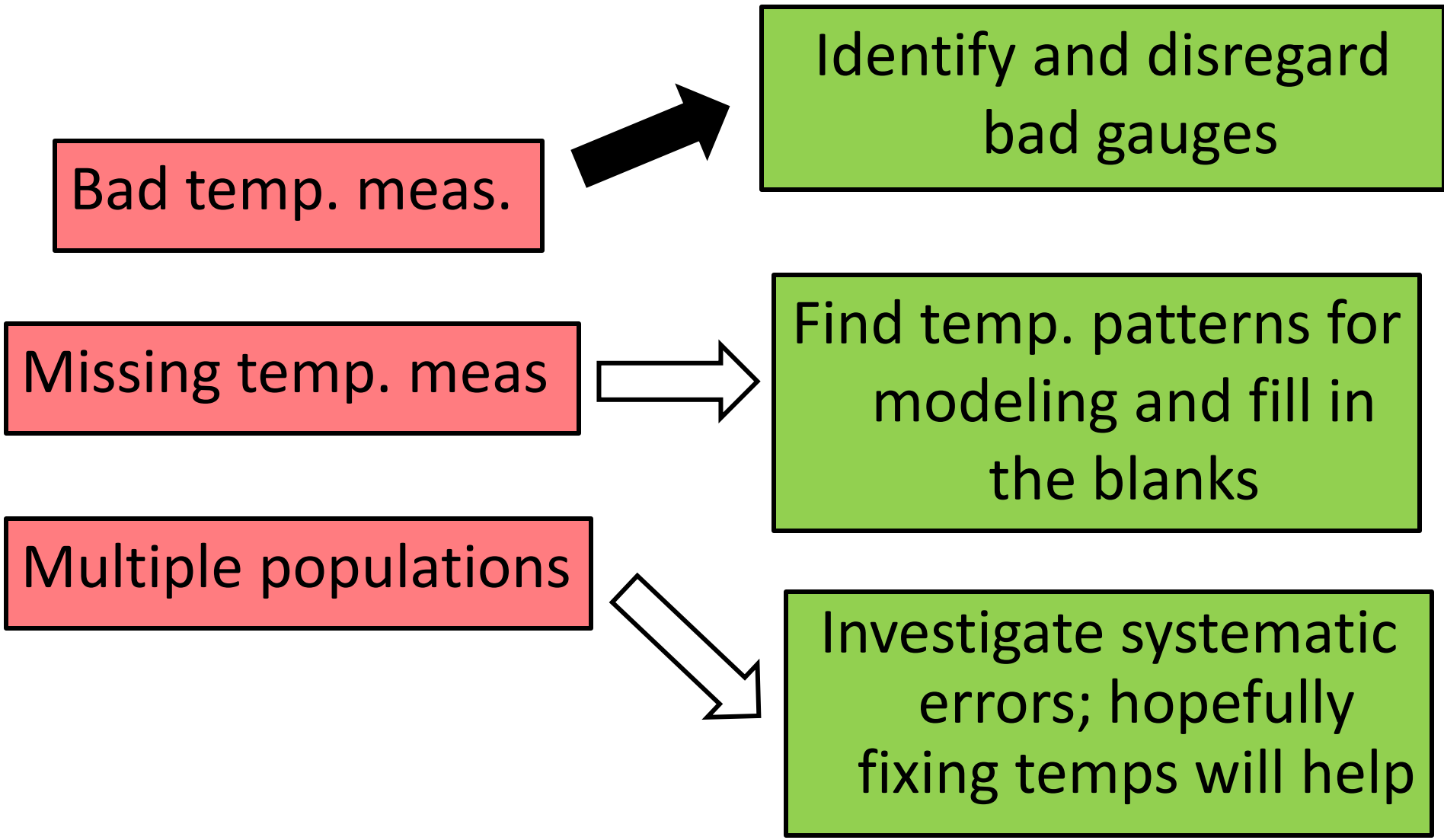


Solutions


Bad temp. meas.
Identify and disregard bad gauges
Missing temp. meas
Find temp. patterns for modeling and fill in the blanks
Multiple populations
Investigate systematic errors; hopefully fixing temps will help

Solutions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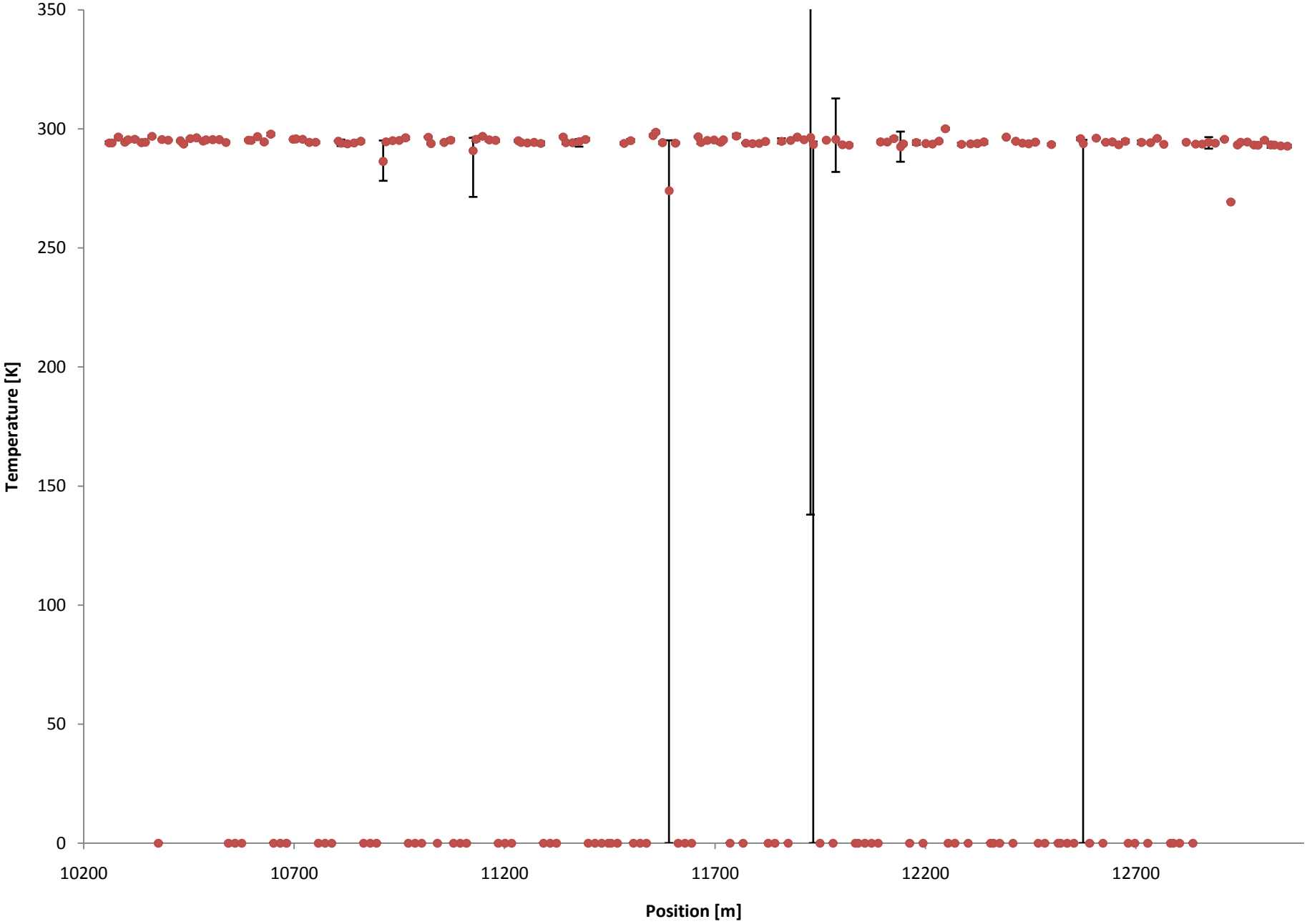
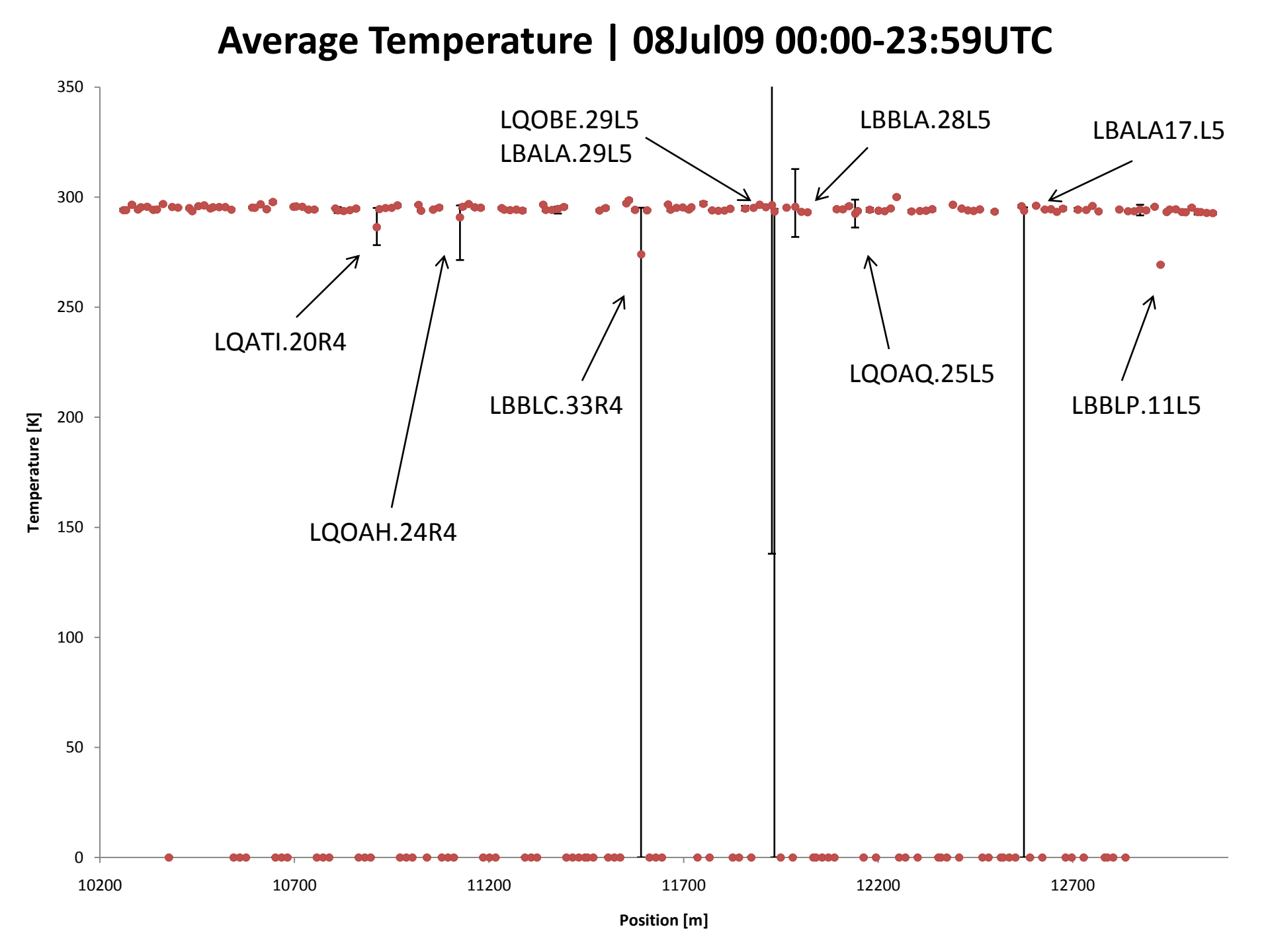
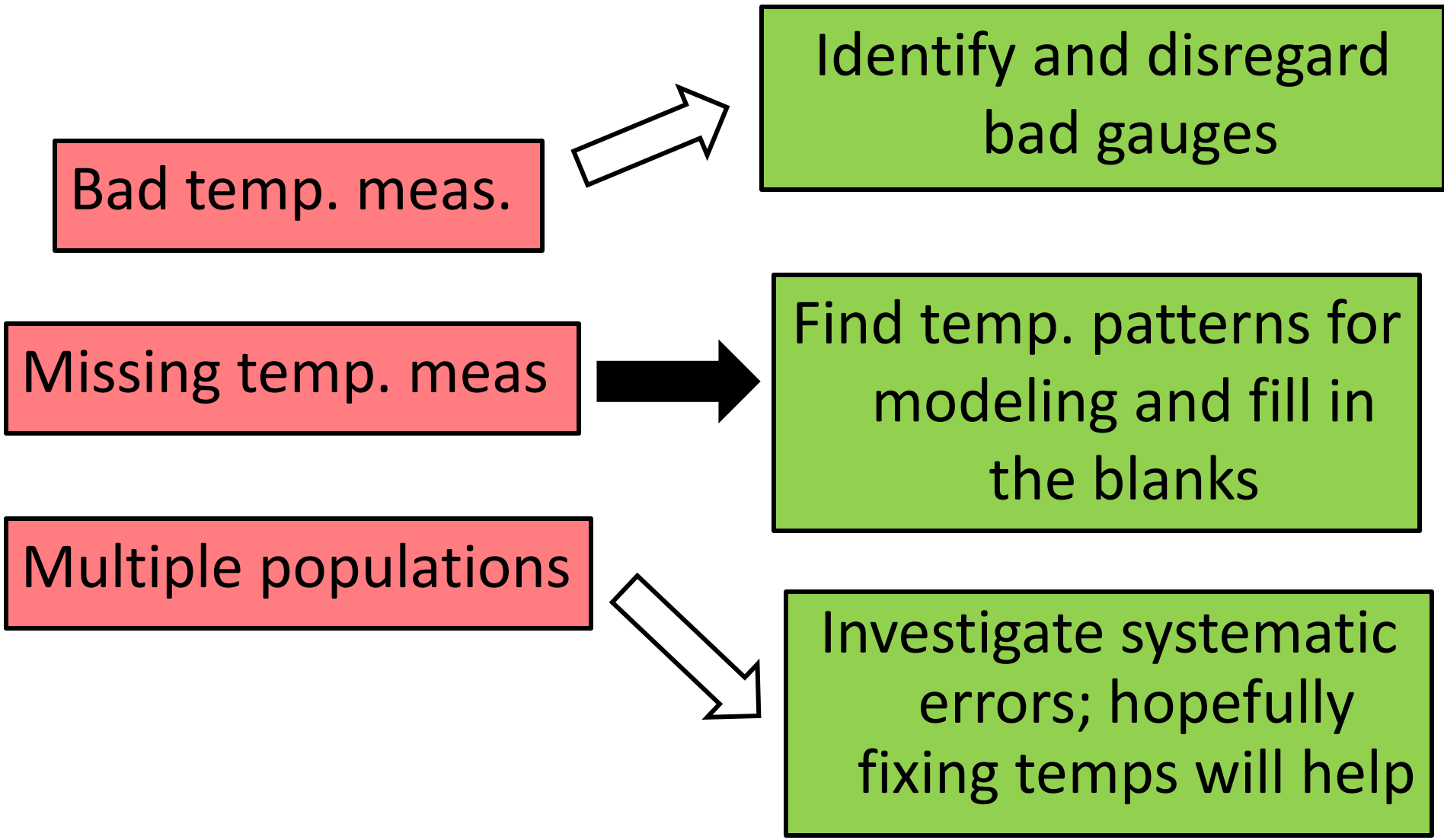
Average Temperature | 08Jul09 00:00-23:59UTC




Average Temperature | 08Jul09 00:00-23:59UTC
Temperature [K]
350
300
250
200
150
100
50
0
10200
10700
11200
11700
12200
12700
Position [m]
LQOBE.29L5
LBALA.29L5
LBBLA.28L5
LBALA17.L5
LQATI.20R4
LQOAH.24R4
LBBLC.33R4
LQOAQ.25L5
LBBLP.11L5

Solutions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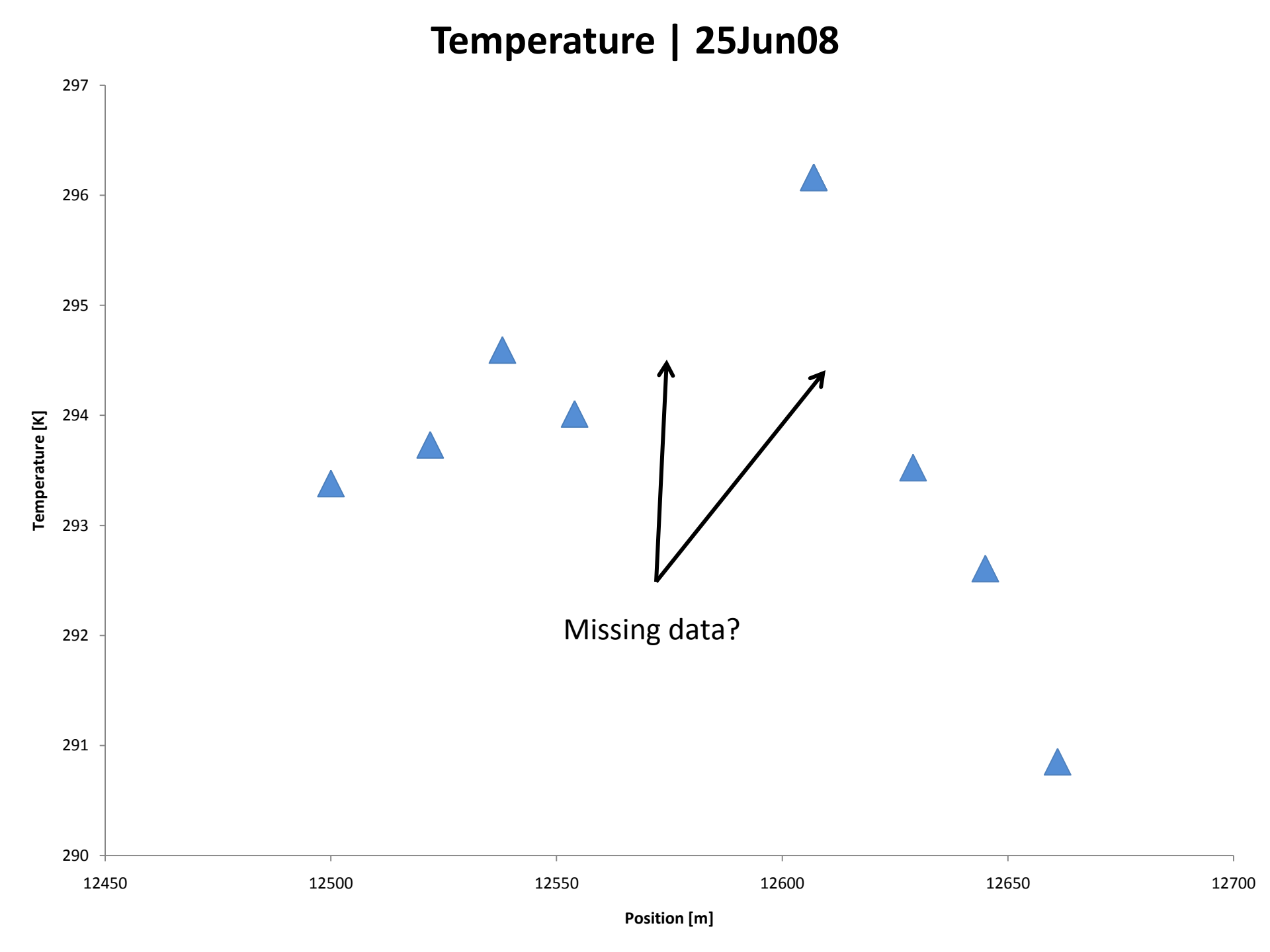
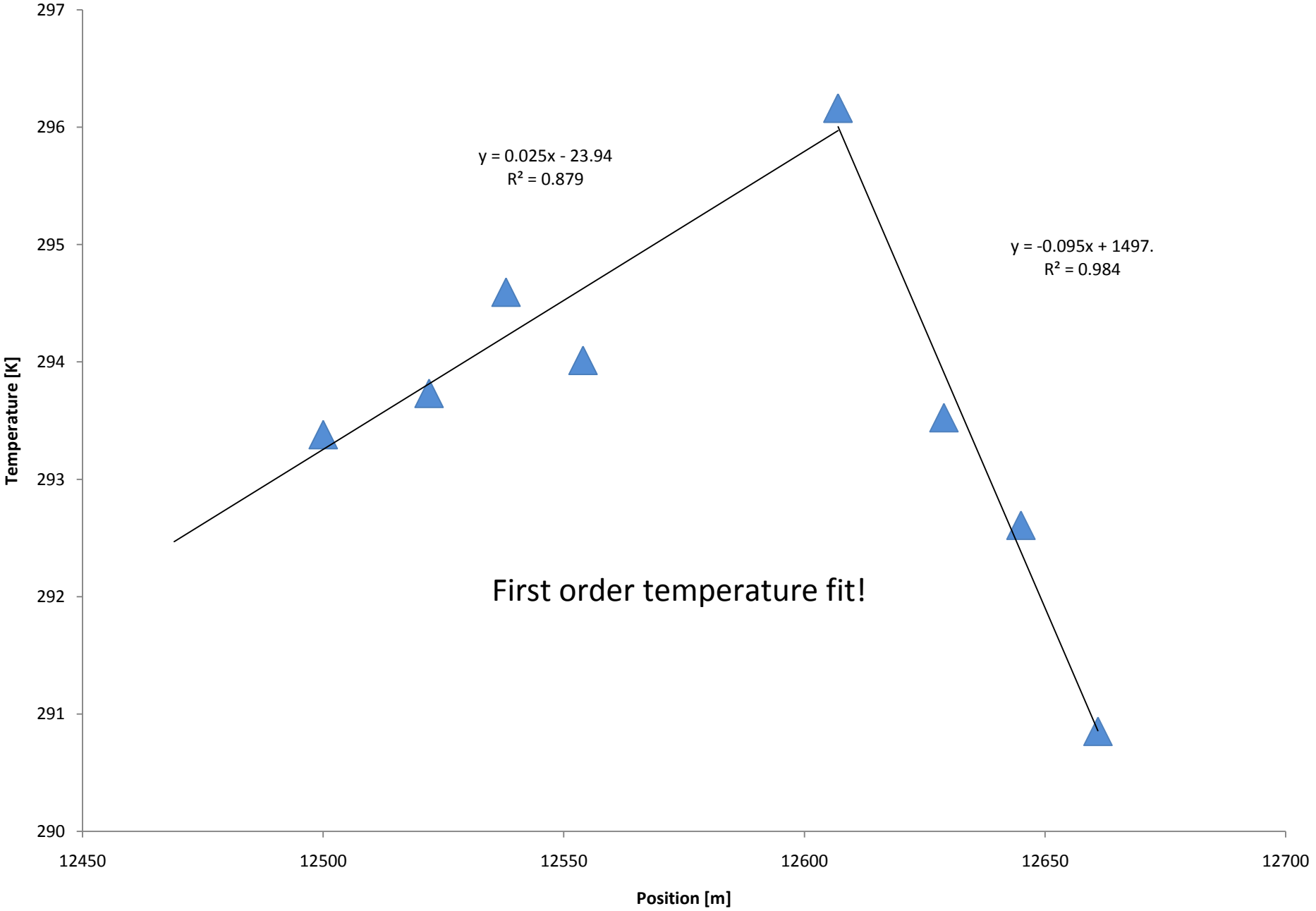

Temperature | 25Jun08
297
296
295
294
293
292
291
290
Temperature [K]
12450
12500
12550
12600
12650
12700
Position [m]
Missing data?

Temperature | 25Jun08



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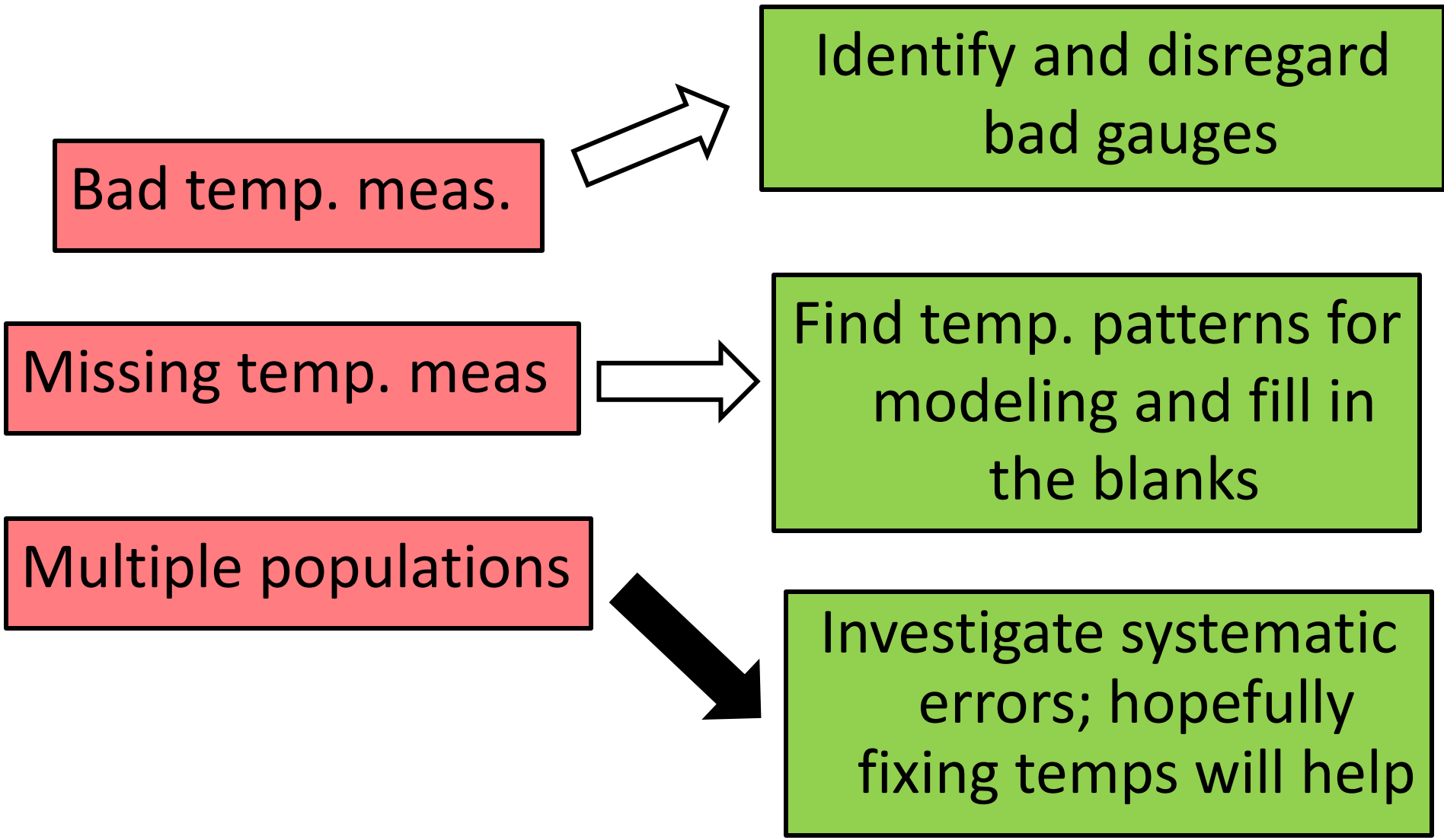
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