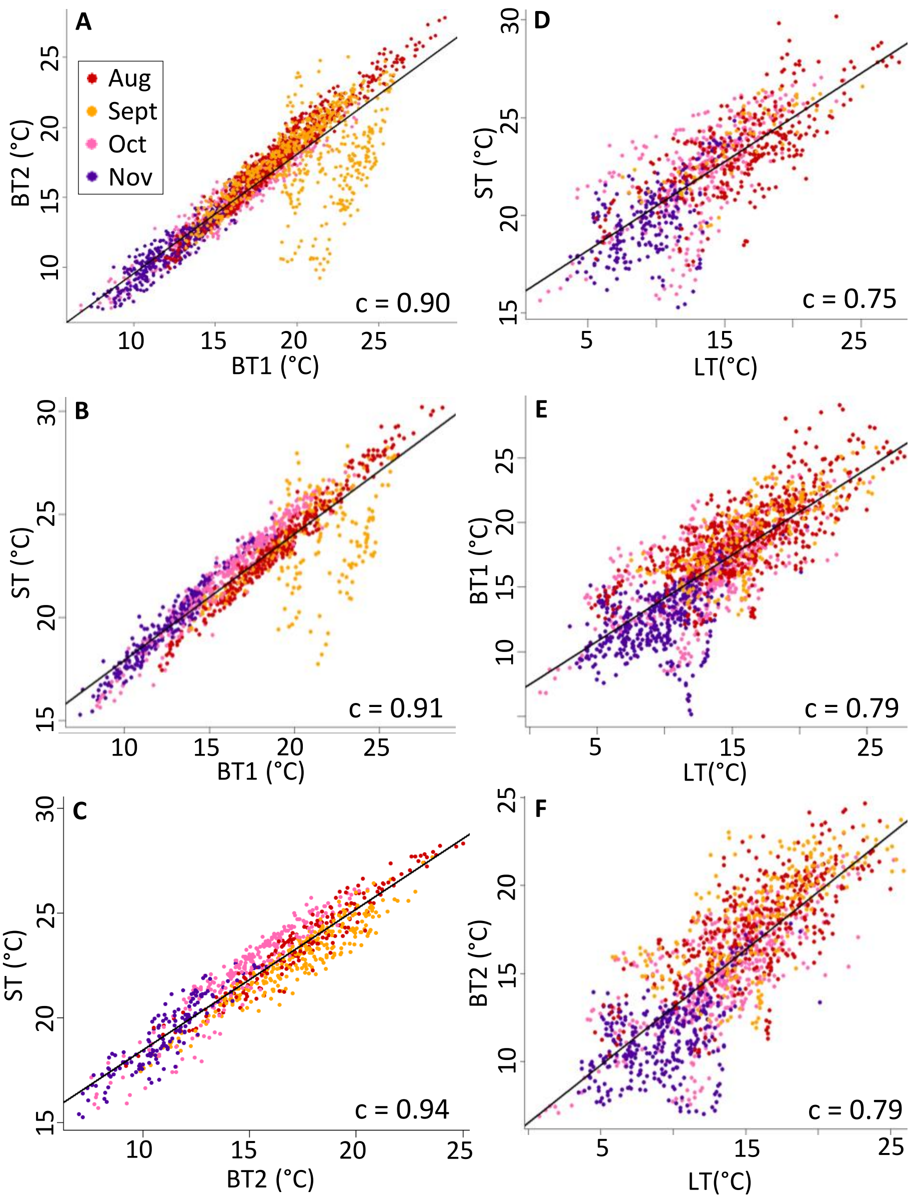
Supplemental File S1. Temperature

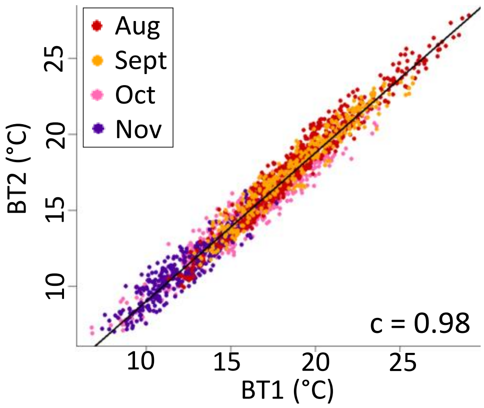
Here, we aim to provide additional details on the sensors and data that were used to calculate hourly ambient barn temperature (BT). We also further discuss temperature data derived from cow-equipped sensors (ST; Oms500 sensors) (Omnisense Ltd; http://www.omnisense.co.uk/) and local temperature (LT) recordings obtained from Harold Hill weather station (Weather Underground, 2014a) that were not used in the main analysis.

Barn temperature was recorded by both wall mounted Oms500 sensors (BT2; n = 22) and Tinytag sensors (BT1; n = 4; TK-4014) (Tinytag; https://www.geminidataloggers.com/) every eight seconds and hourly respectively. We found that the mean hourly barn temperature measures from both the BT1 and BT2 sensors are highly correlated throughout the study duration (Supplemental Figure S1.1; Pearson's correlation coefficient (c) = 0.90). Both hourly barn temperature measures are correlated to hourly ST (Supplemental Figure S1.1A-B: c = 0.91 for BT1 and c = 0.94 for BT2). Despite the animal-mounted sensors being enclosed in an insulated mounting, a buffering (increased temperature) effect is reflected in the differences in temperature ranges between hourly ST and hourly barn temperature (Supplemental Figure S1.1; ST = 15.26°C to 30.50°C, BT1 = 6.77°C to 29.08°C, BT2 = 6.87°C to 27.81°C). Hourly LT is correlated to hourly ST, BT1 and BT2 (Supplemental Figure S1.1D-F; c = 0.75, 0.79 and 0.79, respectively). The weaker relation between hourly barn temperature and hourly LT confirms LT as the most unreliable temperature measure. BT1 and BT2 are reliable, independent measures of temperature, so were combined for the subsequent analysis (henceforth referred to as barn temperature).

Although BT1 and BT2 are well correlated overall, Supplemental Figure S1.1A shows outliers in the BT1 measures (September 18th to September 29th), also evident when comparing BT1 to ST in Supplemental Figure S1.1B. The correlation between hours is higher at 0.98 without these days, as shown in Supplemental Figure S1.2. These outliers are likely due to a temporary malfunctioning of the BT1 sensors, potentially due to battery life. For these days, we use BT2 (n = 22 sensors) alone.



Supplemental Figure S1.1. Relation between temperature measures: barn temperature 1 (BT1), barn temperature 2 (BT2), sensor temperature (ST) and local temperature (LT) in C. (A) = BT1 and BT2, (B) = BT1 and ST, (C) = ST and BT2, (D) = LT and ST, (E) = LT and BT1 and (F) = LT and BT2. Months are color coded: August = red, September = orange, October = pink and November = purple. Pearson correlation coefficients (c) are given in each subplot. All plots exclude periods during which the BT and ST sensors reset (23:00 to 00:00), and B-D exclude milking periods whereas A and E-F include milking periods.



Supplemental Figure S1.2. Relation between temperature measures: barn temperature 1 (BT1), barn temperature 2 (BT2), with outliers in September excluded (September 18th to September 29th). Months are color coded: August = red, September = orange, October = pink and November = purple. The Pearson correlation coefficient (c) is shown within the plot. Data does not include periods during which the data reset and includes times during which the cows were being milked.

REFERENCES

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