NCEI Normals Calculation vs. Raw Data Calculation (1991-2020)

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Short Answer

There are three main reasons why raw data temperature averages may differ from NCEI's including:

(1) Differences in the data used.
(2) Differences in approaches when handling data gaps.
(3) Homogeneity adjustments conducted by NCEI.

These methodological distinctions can result in differences as large as (if not, larger than) 1°F between raw data temperature averages and corresponding temperature normals from NCEI.

Long Answer

First, the data you are using may differ slightly from those in NCEI's Global Historical Climatology Network (GHCN) Daily dataset on which the normals are based.

Second, when computing monthly-mean temperature for an individual month, the World Meteorological Organization (WMO) rules allow up to 10 days to be missing in any month (assuming more than 5 of them are not consecutive). When more than 10 days are missing, NCEI uses regression relationships with neighboring series to estimate the monthly mean temperature for that month. If you are using a different criterion for the allowed number of missing days (here at the WFO, we only allow 5), and are not filling in missing months with the same technique, your 30-year average may differ as well.

Third, the normals are calculated by NCEI from monthly temperature time series that have been adjusted for discontinuities using the Menne and Williams (2009) Pairwise Homogenization Algorithm (PHA). After identifying time shifts in time series relative to those at neighboring stations, adjustments are determined by estimating the magnitude of change in pairwise difference series between the "target" series and highly correlated neighboring series that have no apparent shifts at the same time as the target station. Earlier segments of a time series are adjusted to eliminate discontinuities with subsequent segments, so that the segment after the last identified shift remains unchanged. In other words, the earlier part of the time series has been adjusted to match the climate at the end of the series.