# Supplementary Material

*Suitability of gridded climate datasets for use in environmental epidemiology*

**Keith R. Spangler[a,b,c], Kate R. Weinberger[b,c], and Gregory A. Wellenius[b,c]**

[a] Department of Earth, Environmental, and Planetary Sciences, Brown University, Providence RI, USA

[b] Department of Epidemiology, School of Public Health, Brown University, Providence, RI, USA

[c] Institute at Brown for Environment and Society, Brown University, Providence RI, USA

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**S1: Calculating Relative Humidity**

A detailed overview of current best-practices in calculating relative humidity can be found in Lawrence [1] and is briefly summarized here (see also: Davis et al. [2] for an overview of humidity metrics in epidemiologic studies). Relative humidity is calculated as the ratio between the actual vapor pressure, *e(T)*, and saturation vapor pressure, $e_s(T)$, at temperature *T* (Equation 1).

$$RH = 100\% \cdot \frac{e(T)}{e_s(T)} \tag{1}$$

Since $0 \leq e \leq e_s$, RH has a minimum of 0% (when $e$ = 0 Pascals) and increases as T approaches the dew-point temperature ($T_D$) up to 100% (when $T = T_D$ and thus $e = e_s$). Vapor pressure can be expressed in terms of ambient temperature (˚C) and empirical constants ($a_1$ = 610.94 Pa, $a_2$ = 17.625, and $a_3$ = 243.04˚C; [1]) by Equation (2), and *saturation* vapor pressure ($e_s$) is calculated with Equation (3).

$$e(T) = a_1 \cdot e^{\frac{a_2 \cdot T_D}{(a_3 + T_D)}} \tag{2}$$

$$e_s(T) = a_1 \cdot e^{\frac{a_2 \cdot T}{(a_3 + T)}} \tag{3}$$

Notice that the only difference between (2) and (3) is that the former uses dew-point temperature ($T_D$) and the latter uses the ambient temperature ($T$); the equations are equivalent for $T = T_D$. Therefore, substituting Equations (2) and (3) into Equation (1) yields the general form for *RH* given in Equation (4). Note that the constants $a_1$ could cancel out in this format, but have been left in the equation for when *e(T)* is known but $e_s(T)$ is unknown (or vice versa). This is relevant in the context of Daymet, which reports the vapor pressure directly, but not $e_s(T)$.

$$RH = 100\% \cdot \frac{e(T)}{e_s(T)} = 100\% \cdot \frac{a_1 \cdot e^{\frac{a_2 \cdot T_D}{(a_3 + T_D)}}}{a_1 \cdot e^{\frac{a_2 \cdot T}{(a_3 + T)}}} \tag{4}$$

We used equation (4) to calculate hourly *RH* for the first-order stations in ISD-Lite using hourly ambient temperature (˚C) for $T$, dew-point temperature (˚C) for $T_D$, and empirical constants ($a_1$ = 610.94 Pa, $a_2$ = 17.625, and $a_3$ = 243.04˚C; [1]). The only humidity variable provided by Daymet, however, is daily mean vapor pressure, which is interpreted as the vapor pressure at the mean temperature for the day, $e(T_{mean})$. The daily mean relative humidity ($RH_{mean}$) for Daymet is estimated using Equation (5), which starts with Equation (4) and substitutes the Daymet-provided vapor pressure value, $e(T_{mean})$ in units of Pascals (Pa), for the numerator and the mean temperature for $T$ in the denominator, using slightly different empirical constants for consistency with the methodology of Daymet ($b_1$ = 610.78 Pa, $b_2$ = 17.269, and $b_3$ = 237.3˚C supplanting $a_1$, $a_2$, and $a_3$, respectively; [3]).

$$RH_{mean\,(Daymet)} = 100\% \cdot \frac{e(T_{mean})}{b_1 \cdot e^{\left(\frac{b_2 \cdot T_{mean}}{b_3 + T_{mean}}\right)}} \tag{5}$$

In Daymet's calculation of $e(T_{mean})$, $T_{mean}$ is specified not as the average between minimum and maximum temperatures, but by Equation (6) [3]. For consistency, the mean temperature calculated with (6) is used in the estimation of $RH_{mean}$ in (5).

$$T_{mean} = 0.606 \cdot T_{max} + 0.394 \cdot T_{min} \tag{6}$$

In contrast to Daymet, PRISM provides mean dew-point ($TD_{mean}$) and ambient ($T_{mean}$) temperatures instead of $e(T_{mean})$; the $RH_{mean}$ is therefore calculated slightly differently, instead following Equation (7), which uses $T_{mean}$ (˚C) values and empirical constants ($a_2$ = 17.625 and $a_3$ = 243.04˚C) substituted into (4), as described elsewhere [4]. Notice that $a_1$ cancels out and has thus been omitted from the equation.

$$RH_{mean\,(PRISM)} = 100\% \cdot \frac{e^{\left(\frac{a_2 \cdot TD_{mean}}{a_3 + TD_{mean}}\right)}}{e^{\left(\frac{a_2 \cdot T_{mean}}{a_3 + T_{mean}}\right)}} \tag{7}$$

It should be reiterated that the constants differ slightly between (5) and (7); this was done to ensure consistency with the methodologies of the respective GCD, but the difference is negligible.

Neither Daymet nor PRISM provides minimum or maximum values for vapor pressure or dew-point temperature, so derivations and assumptions are needed to get estimated values of $RH_{max}$ and $RH_{min}$. Daymet's algorithm assumes that $T_D$ is equal to the daily $T_{min}$ for the entire day [3], an assumption that has been demonstrated to be invalid in semiarid and arid climates of the southwest United States [5]. Nonetheless, consistent with this assumption, $RH_{min}$ was calculated for Daymet using Equation (8), which is derived from (4), substituting $T_{min}$ (˚C) for $T_D$ in the numerator and $T_{max}$ (˚C) for $T$ in the denominator, and using the constants in (5) for $b_2$ and $b_3$ ($b_2$ = 17.269 and $b_3$ = 237.3˚C; [3]).

$$RH_{min\ (Daymet)} = 100 \cdot \frac{e^{\left(\frac{b_2 \cdot T_{min}}{b_3 + T_{min}}\right)}}{e^{\left(\frac{b_2 \cdot T_{max}}{b_3 + T_{max}}\right)}} \qquad (8)$$

PRISM, by contrast, gives minimum and maximum vapor-pressure deficits (VPD), which facilitate calculating minimum and maximum relative humidity [4]. Vapor-pressure deficit is the absolute difference between the saturation vapor pressure at temperature $T$, $e_s(T)$, and the actual vapor pressure at the same temperature, $e(T)$ (Equation 9). VPD is greater than or equal to zero for all temperatures because the actual vapor pressure cannot exceed the saturation vapor pressure.

$$VPD = e_s(T) - e(T) \qquad (9)$$

The Clausius-Clapeyron equation indicates that the relationship between temperature and $e_s$ is exponential, meaning that warmer air requires greater amounts of water vapor to reach saturation. If the absolute humidity (i.e., the mass of water vapor per unit volume of air) does not change appreciably throughout the day, then it is expected that $VPD$ would increase throughout the morning and reach a maximum at $T_{max}$. With this assumption that $VPD_{max}$ occurs at $T_{max}$, and following the approach of Daly et al. [4], Equation (9) can be solved for *e(T)* and substituted into the numerator of Equation (4). This then allows for the calculation of relative humidity at $T_{max}$ (as an estimate of $RH_{min}$) using Equation (10) with only $T_{max}$ (˚C) and $VPD_{max}$ (Pa), as provided by PRISM, as well as the empirical constants as in (7). Similarly, relative humidity at $T_{min}$ (as an estimate of $RH_{max}$) is calculated with Equation (11). Table S3 summarizes all of the equations used for each dataset.

$$RH_{min\ (PRISM)} = 100 \cdot \frac{\left[a_1 \cdot e^{\left(\frac{a_2 \cdot T_{max}}{a_3 + T_{max}}\right)}\right] - VPD_{max}}{a_1 \cdot e^{\left(\frac{a_2 \cdot T_{max}}{a_3 + T_{max}}\right)}} \tag{10}$$

$$RH_{max\ (PRISM)} = 100 \cdot \frac{\left[a_1 \cdot e^{\left(\frac{a_2 \cdot T_{min}}{a_3 + T_{min}}\right)}\right] - VPD_{min}}{a_1 \cdot e^{\left(\frac{a_2 \cdot T_{min}}{a_3 + T_{min}}\right)}} \tag{11}$$

**S2: Calculating Absolute Humidity**

In contrast to relative humidity, which reflects the amount of water vapor in the air relative to the maximum amount that could be present, absolute humidity is a *direct* measure of atmospheric water vapor. The general equation provided by Showalter [6] is given by Equation (12): *AH* is a function of the vapor pressure, *e(T)* (hPa), ambient temperature, *T* (˚C), and the inverse of the gas constant for water vapor ($c_1$ = 216.68 g K hPa$^{-1}$ m$^{-3}$), in units of g/m$^3$.

$$AH = \frac{c_1 \cdot e(T)}{T + 273.16^{\circ}C} \tag{12}$$

Neither observation network provides *e(T)* directly, so this value must first be calculated and substituted into (12). First-order stations in ISD-Lite report dew-point temperature, which means that (2) can be substituted for *e(T)*, after multiplying the leading constant by a factor of 0.01 to convert to hPa (Equation 13); empirical constants are the same as in (12) and (2), with the exception of $a_1$, which was converted to hPa: $c_1$ = 216.68 g K hPa$^{-1}$ m$^{-3}$ [6], $a_1$ = 6.1094 hPa, $a_2$ = 17.625, and $a_3$ = 243.04˚C [4].

$$AH = \frac{c_1 \cdot a_1 \cdot e^{\left(\frac{a_2 \cdot T_D}{a_3 + T_D}\right)}}{T + 273.16^{\circ}C} \tag{13}$$

The USCRN stations do not provide dew-point temperature but, rather, the relative humidity. Rearranging (4) and substituting for *e(T)*, again scaling to convert to hPa, yields Equation (14), in terms of *RH* (%), *T* (˚C) , and the same empirical constants as above ($c_1$ = 216.68 g K hPa$^{-1}$ m$^{-3}$ [6], $a_1$ = 6.1094 hPa, $a_2$ = 17.625, and $a_3$ = 243.04˚C [4]).

$$AH = \frac{c_1 \cdot 0.01 \cdot RH \cdot a_1 \cdot e^{\left(\frac{a_2 \cdot T}{a_3 + T}\right)}}{T + 273.16^{\circ}C} \tag{14}$$

Daymet provides $e(T_{mean})$ directly, so mean absolute humidity ($AH_{mean}$) can be determined directly with (12), with $T_{mean}$ (˚C) calculated with (6) substituted for *T* and with $e(T_{mean})$ substituted for *e(T)* after converting from Pa to hPa. PRISM, by contrast, gives $TD_{mean}$ instead of mean vapor pressure, allowing for the calculation of $AH_{mean}$ using (13), with $TD_{mean}$ (˚C) for *TD*, $T_{mean}$ (˚C) for *T*, and the same empirical constants ($c_1$ = 216.68 g K hPa$^{-1}$ m$^{-3}$ [6], $a_1$ = 6.1094 hPa, $a_2$ = 17.625, and $a_3$ = 243.04˚C [4]). Table S3 summarizes all of the equations used for each dataset in the analysis.

**Table S1: List of First-Order Weather Stations in Climatically Representative Sample**

| Station Name | State | WBAN | Lat (˚N) | Lon (˚E) | Climate[a] |
|---|---|---|---|---|---|
| Birmingham International Airport | AL | 13876 | 33.5656 | -86.7450 | Cfa |
| Mobile Regional Airport | AL | 13894 | 30.6883 | -88.2456 | Cfa |
| Montgomery Regional Airport | AL | 13895 | 32.2997 | -86.4075 | Cfa |
| Phoenix Sky Harbor International Airport | AZ | 23183 | 33.4277 | -112.0038 | BWh |
| Tucson International Airport | AZ | 23160 | 32.1313 | -110.9552 | BSh |
| Winslow-Lindbergh Regional Airport | AZ | 23194 | 35.0281 | -110.7208 | BWk |
| Fresno Yosemite International Airport | CA | 93193 | 36.7800 | -119.7194 | BSk |
| Los Angeles International Airport | CA | 23174 | 33.9380 | -118.3888 | Csb |
| Meadows Field Airport | CA | 23155 | 35.4344 | -119.0542 | BWh |
| Sacramento Executive Airport | CA | 23232 | 38.5069 | -121.4950 | Csa |
| San Diego International Airport | CA | 23188 | 32.7336 | -117.1831 | BSk |
| Stockton Metropolitan Airport | CA | 23237 | 37.8891 | -121.2258 | BSk |
| City of Colorado Springs Municipal Airport | CO | 93037 | 38.8100 | -104.6884 | BSk |
| Grand Junction Regional Airport | CO | 23066 | 39.1342 | -108.5400 | BSk |
| Pueblo Memorial Airport | CO | 93058 | 38.2901 | -104.4983 | BSk |
| Bradley International Airport | CT | 14740 | 41.9375 | -72.6819 | Dfa |
| Jacksonville International Airport | FL | 13889 | 30.4950 | -81.6936 | Cfa |
| Key West International Airport | FL | 12836 | 24.5550 | -81.7522 | Aw |
| Miami International Airport | FL | 12839 | 25.7881 | -80.3169 | Am |
| Orlando International Airport | FL | 12815 | 28.4339 | -81.3250 | Cfa |
| Palm Beach International Airport | FL | 12844 | 26.6847 | -80.0994 | Af |
| Tampa International Airport | FL | 12842 | 27.9619 | -82.5403 | Cfa |
| Athens/Ben Epps Airport | GA | 13873 | 33.9480 | -83.3275 | Cfa |
| Hartsfield-Jackson Atlanta International Airport | GA | 13874 | 33.6301 | -84.4418 | Cfa |
| Boise Air Terminal/Gowen Field Airport | ID | 24131 | 43.5666 | -116.2405 | BSk |
| Lewiston-Nez Perce County Airport | ID | 24149 | 46.3747 | -117.0156 | BSk |
| Pocatello Regional Airport | ID | 24156 | 42.9202 | -112.5711 | BSk |
| Abraham Lincoln Capital Airport | IL | 93822 | 39.8447 | -89.6839 | Dfa |
| Greater Peoria Regional Airport | IL | 14842 | 40.6675 | -89.6839 | Dfa |
| Greater Rockford Airport | IL | 94822 | 42.1927 | -89.0930 | Dfa |
| Quad City International Airport | IL | 14923 | 41.4653 | -90.5233 | Dfa |
| South Bend Regional Airport | IN | 14848 | 41.7072 | -86.3163 | Dfa |
| Des Moines International Airport | IA | 14933 | 41.5338 | -93.6530 | Dfa |
| Sioux Gateway/Colonel Bud Day Field Airport | IA | 14943 | 42.3913 | -96.3791 | Dfa |
| Blosser Municipal Airport | KS | 13984 | 39.5514 | -97.6508 | Dfa |

| Station Name | State | WBAN | Lat (˚N) | Lon (˚E) | Climate[a] |
|---|---|---|---|---|---|
| Dodge City Regional Airport | KS | 13985 | 37.7686 | -99.9678 | BSk |
| Philip Billard Municipal Airport | KS | 13996 | 39.0725 | -95.6261 | Dfa |
| Renner Field/Goodland Municipal Airport | KS | 23065 | 39.3672 | -101.6933 | BSk |
| Cincinnati/Northern Kentucky International Airport | KY | 93814 | 39.0444 | -84.6724 | Dfa |
| Louis Armstrong New Orleans International Airport | LA | 12916 | 29.9969 | -90.2775 | Cfa |
| Shreveport Regional Airport | LA | 13957 | 32.4472 | -93.8244 | Cfa |
| Portland International Airport | ME | 14764 | 43.6422 | -70.3044 | Dfb |
| Boston Logan International Airport | MA | 14739 | 42.3606 | -71.0097 | Dfa |
| Alpena County Regional Airport | MI | 94849 | 45.0716 | -83.5644 | Dfb |
| Bishop International Airport | MI | 14826 | 42.9666 | -83.7494 | Dfb |
| Capital City Airport | MI | 14836 | 42.7803 | -84.5789 | Dfb |
| Detroit Metro Wayne County Airport | MI | 94847 | 42.2313 | -83.3308 | Dfa |
| Muskegon County Airport | MI | 14840 | 43.1711 | -86.2367 | Dfb |
| Sault Ste Marie Municipal/Sanderson Field Airport | MI | 14847 | 46.4794 | -84.3572 | Dfb |
| Duluth International Airport | MN | 14913 | 46.8369 | -92.1833 | Dfb |
| Falls International Airport | MN | 14918 | 48.5614 | -93.3981 | Dfb |
| Minneapolis-St Paul International Airport | MN | 14922 | 44.8831 | -93.2289 | Dfa |
| Rochester International Airport | MN | 14925 | 43.9041 | -92.4916 | Dfb |
| Key Field Airport | MS | 13865 | 32.3347 | -88.7442 | Cfa |
| Billings Logan International Airport | MT | 24033 | 45.8069 | -108.5422 | Dfa |
| Glacier Park International Airport | MT | 24146 | 48.3042 | -114.2636 | Dfb |
| Great Falls International Airport | MT | 24143 | 47.4733 | -111.3822 | BSk |
| Havre City-County Airport | MT | 94012 | 48.5428 | -109.7633 | BSk |
| Helena Regional Airport | MT | 24144 | 46.6056 | -111.9636 | Dfb |
| Missoula International Airport | MT | 24153 | 46.9208 | -114.0925 | Dfb |
| Wokal Field/Glasgow International Airport | MT | 94008 | 48.2138 | -106.6214 | BSk |
| Lincoln Municipal Airport | NE | 14939 | 40.8508 | -96.7475 | Dfa |
| North Platte Regional/Lee Bird Field Airport | NE | 24023 | 41.1213 | -100.6694 | Dfa |
| Western Nebraska Regional/Heilig Field Airport | NE | 24028 | 41.8705 | -103.5930 | BSk |
| Ely Airport/Yelland Field Airport | NV | 23154 | 39.2952 | -114.8466 | BSk |
| McCarran International Airport | NV | 23169 | 36.0719 | -115.1634 | BWh |
| Reno/Tahoe International Airport | NV | 23185 | 39.4838 | -119.7711 | BWk |
| Concord Municipal Airport | NH | 14745 | 43.1200 | -71.3000 | Dfb |
| Albuquerque International Sunport Airport | NM | 23050 | 35.0419 | -106.6155 | BSk |
| Clayton Municipal Airpark | NM | 23051 | 36.4486 | -103.1539 | BSk |
| Roswell International Air Center Airport | NM | 23009 | 33.3075 | -104.5083 | BSk |
| Albany International Airport | NY | 14735 | 42.7472 | -73.7991 | Dfa |

| Station Name | State | WBAN | Lat (˚N) | Lon (˚E) | Climate[a] |
|---|---|---|---|---|---|
| Buffalo Niagara International Airport | NY | 14733 | 42.9408 | -78.7358 | Dfb |
| Greater Rochester International Airport | NY | 14768 | 43.1167 | -77.6767 | Dfb |
| Syracuse Hancock International Airport | NY | 14771 | 43.1111 | -76.1038 | Dfb |
| Raleigh-Durham International Airport | NC | 13722 | 35.8923 | -78.7819 | Cfa |
| Bismarck Municipal Airport | ND | 24011 | 46.7825 | -100.7572 | Dfb |
| Hector International Airport | ND | 14914 | 46.9253 | -96.8111 | Dfb |
| Sloulin Field International Airport | ND | 94014 | 48.1738 | -103.6366 | BSk |
| Toledo Express Airport | OH | 94830 | 41.5871 | -83.8055 | Dfa |
| Youngstown-Warren Regional Airport | OH | 14852 | 41.2548 | -80.6737 | Dfb |
| Tulsa International Airport | OK | 13968 | 36.1994 | -95.8872 | Cfa |
| Astoria Regional Airport | OR | 94224 | 46.1569 | -123.8825 | Csb |
| Eastern Oregon Regional Airport at Pendleton | OR | 24155 | 45.6983 | -118.8547 | BSk |
| Mahlon Sweet Field Airport | OR | 24221 | 44.1278 | -123.2206 | Csb |
| Rogue Valley International-Medford Airport | OR | 24225 | 42.3811 | -122.8722 | Csa |
| Philadelphia International Airport | PA | 13739 | 39.8733 | -75.2268 | Cfa |
| Erie International/Tom Ridge Field Airport | PA | 14860 | 42.0803 | -80.1824 | Dfa |
| Columbia Metropolitan Airport | SC | 13883 | 33.9419 | -81.1181 | Cfa |
| Abilene Regional Airport | TX | 13962 | 32.4105 | -99.6822 | Cfa |
| Amarillo Rick Husband International Airport | TX | 23047 | 35.2295 | -101.7042 | BSk |
| Corpus Christi International Airport | TX | 12924 | 27.7742 | -97.5122 | Cfa |
| El Paso International Airport | TX | 23044 | 31.8111 | -106.3758 | BWk |
| Lovell Field Airport | TN | 13882 | 35.0336 | -85.2004 | Cfa |
| Lubbock International Airport | TX | 23042 | 33.6656 | -101.8231 | BSk |
| Midland International Airport | TX | 23023 | 31.9475 | -102.2086 | BSk |
| San Angelo Regional/Maths Field Airport | TX | 23034 | 31.3517 | -100.4950 | BSh |
| San Antonio International Airport | TX | 12921 | 29.5443 | -98.4839 | Cfa |
| Sheppard AFB/Wichita Falls Municipal Airport | TX | 13966 | 33.9786 | -98.4928 | Cfa |
| Southeast Texas Regional Airport | TX | 12917 | 29.9506 | -94.0206 | Cfa |
| Victoria Regional Airport | TX | 12912 | 28.8614 | -96.9303 | Cfa |
| Burlington International Airport | VT | 14742 | 44.4683 | -73.1499 | Dfb |
| Norfolk International Airport | VA | 13737 | 36.9033 | -76.1922 | Cfa |
| Roanoke Regional/Woodrum Field Airport | VA | 13741 | 37.3169 | -79.9741 | Cfa |
| Ronald Reagan Washington National Airport | VA | 13743 | 38.8472 | -77.0345 | Cfa |
| Seattle-Tacoma International Airport | WA | 24233 | 47.4444 | -122.3138 | Csb |
| Spokane International Airport | WA | 24157 | 47.6216 | -117.5280 | Dsb |
| Quillayute Airport | WA | 94240 | 47.9375 | -124.5550 | Cfb |
| Yakima Air Terminal/McAllister Field Airport | WA | 24243 | 46.5683 | -120.5428 | BSk |

| Station Name | State | WBAN | Lat (˚N) | Lon (˚E) | Climate[a] |
|---|---|---|---|---|---|
| Yeager Airport | WV | 13866 | 38.3794 | -81.5900 | Cfa |
| Austin Straubel International Airport | WI | 14898 | 44.4794 | -88.1366 | Dfb |
| General Mitchell International Airport | WI | 14839 | 42.9550 | -87.9044 | Dfb |
| Cheyenne Airport | WY | 24018 | 41.1578 | -104.8069 | BSk |
| Hunt Field Airport | WY | 24021 | 42.8154 | -108.7261 | Dfb |
| Natrona County International Airport | WY | 24089 | 42.8977 | -106.4739 | Dfb |
| Sheridan County Airport | WY | 24029 | 44.7694 | -106.9688 | Dfb |

[a] Climate classification is based on the Köppen-Geiger climate classification system (Kottek et al. 2006).

Table S1: List of first-order weather stations (i.e., those maintained directly by the National Weather Service) from the ISD-Lite database that were included in the climatically representative sample of stations in CONUS. The nomenclature for the climate zones begins with the first letter for the broad climate type ("equatorial," "arid," "warm temperate," "snow," and "polar" for A, B, C, D, and E, respectively), then denotes the intra-annual precipitation and temperature characteristics (if applicable) within those zones in the second and third letters, respectively [7].

**Table S2: List of USCRN Stations in Climatically Representative Sample**

| Station Name | City | State | WBAN | Lat (°N) | Lon (°E) | Climate[a] |
|---|---|---|---|---|---|---|
| AL_FAIRHOPE_3_NE | Fairhope | AL | 63869 | 30.5485 | -87.8757 | Cfa |
| AR_BATESVILLE_8_WNW | Batesville | AR | 23904 | 35.8201 | -91.7812 | Cfa |
| AZ_ELGIN_5_S | Elgin | AZ | 53132 | 31.5907 | -110.5087 | BSh |
| AZ_WILLIAMS_35_NNW | Williams | AZ | 53155 | 35.7552 | -112.3374 | Dsb |
| AZ_YUMA_27_ENE | Yuma | AZ | 53154 | 32.8350 | -114.1884 | BWh |
| CA_BODEGA_6_WSW | Bodega | CA | 93245 | 38.3208 | -123.0747 | Csb |
| CA_FALLBROOK_5_NE | Fallbrook | CA | 53151 | 33.4392 | -117.1904 | BSk |
| CA_MERCED_23_WSW | Merced | CA | 93243 | 37.2381 | -120.8825 | BSk |
| CA_REDDING_12_WNW | Redding | CA | 04222 | 40.6507 | -122.6068 | Csa |
| CA_YOSEMITE_VILLAGE_12_W | Yosemite Village | CA | 53150 | 37.7592 | -119.8208 | Csa |
| CO_BOULDER_14_W | Boulder | CO | 94075 | 40.0354 | -105.5409 | Dfc |
| CO_CORTEZ_8_SE | Cortez | CO | 03061 | 37.2553 | -108.5035 | Dfa |
| CO_DINOSAUR_2_E | Dinosaur | CO | 94082 | 40.2446 | -108.9677 | Dfb |
| CO_LA_JUNTA_17_WSW | La Junta | CO | 03063 | 37.8639 | -103.8224 | BSk |
| CO_MONTROSE_11_ENE | Montrose | CO | 03060 | 38.5440 | -107.6928 | BSk |
| CO_NUNN_7_NNE | Nunn | CO | 94074 | 40.8066 | -104.7552 | BSk |
| GA_BRUNSWICK_23_S | Brunswick | GA | 63856 | 30.8078 | -81.4596 | Cfa |
| GA_NEWTON_11_SW | Newton | GA | 63829 | 31.1923 | -84.4465 | Cfa |
| GA_WATKINSVILLE_5_SSE | Watkinsville | GA | 63850 | 33.7837 | -83.3896 | Cfa |
| IA_DES_MOINES_17_E | Des Moines | IA | 54902 | 41.5562 | -93.2855 | Dfa |
| ID_ARCO_17_SW | Arco | ID | 04126 | 43.4621 | -113.5560 | Dfb |
| ID_MURPHY_10_W | Murphy | ID | 04127 | 43.2044 | -116.7505 | BSk |
| IL_CHAMPAIGN_9_SW | Champaign | IL | 54808 | 40.0528 | -88.3729 | Dfa |
| IL_SHABBONA_5_NNE | Shabbona | IL | 54811 | 41.8430 | -88.8513 | Dfa |
| IN_BEDFORD_5_WNW | Bedford | IN | 63898 | 38.8882 | -86.5707 | Dfa |
| KS_MANHATTAN_6_SSW | Manhattan | KS | 53974 | 39.1027 | -96.6098 | Dfa |
| KS_OAKLEY_19_SSW | Oakley | KS | 03067 | 38.8701 | -100.9627 | BSk |
| KY_BOWLING_GREEN_21_NNE | Bowling Green | KY | 63849 | 37.2504 | -86.2325 | Cfa |
| KY_VERSAILLES_3_NNW | Versailles | KY | 63838 | 38.0945 | -84.7465 | Cfa |
| LA_LAFAYETTE_13_SE | Lafayette | LA | 53960 | 30.0918 | -91.8731 | Cfa |
| LA_MONROE_26_N | Monroe | LA | 53961 | 32.8833 | -92.1165 | Cfa |
| ME_LIMESTONE_4_NNW | Limestone | ME | 94645 | 46.9601 | -67.8833 | Dfb |
| ME_OLD_TOWN_2_W | Old Town | ME | 94644 | 44.9281 | -68.7006 | Dfb |
| MI_CHATHAM_1_SE | Chatham | MI | 54810 | 46.3345 | -86.9200 | Dfb |
| MI_GAYLORD_9_SSW | Gaylord | MI | 54854 | 44.9080 | -84.7203 | Dfb |

| Station Name | City | State | WBAN | Lat (˚N) | Lon (˚E) | Climate[a] |
|---|---|---|---|---|---|---|
| MN_GOODRIDGE_12_NNW | Goodridge | MN | 04994 | 48.3055 | -95.8744 | Dwb |
| MN_SANDSTONE_6_W | Sandstone | MN | 54932 | 46.1135 | -92.9936 | Dfb |
| MO_CHILLICOTHE_22_ENE | Chillicothe | MO | 13301 | 39.8668 | -93.1470 | Dfa |
| MO_JOPLIN_24_N | Joplin | MO | 23908 | 37.4277 | -94.5829 | Cfa |
| MO_SALEM_10_W | Salem | MO | 23909 | 37.6344 | -91.7226 | Dfa |
| MS_HOLLY_SPRINGS_4_N | Holly Springs | MS | 23803 | 34.8223 | -89.4348 | Cfa |
| MS_NEWTON_5_ENE | Newton | MS | 63831 | 32.3378 | -89.0703 | Cfa |
| MT_LEWISTOWN_42_WSW | Lewistown | MT | 04140 | 46.8847 | -110.2895 | BSk |
| MT_ST._MARY_1_SSW | St. Mary | MT | 04130 | 48.7412 | -113.4330 | Dfb |
| MT_WOLF_POINT_29_ENE | Wolf Point | MT | 94060 | 48.3082 | -105.1018 | BSk |
| NC_ASHEVILLE_13_S | Asheville | NC | 53878 | 35.4185 | -82.5567 | Cfa |
| ND_JAMESTOWN_38_WSW | Jamestown | ND | 54937 | 46.7702 | -99.4778 | Dfb |
| ND_MEDORA_7_E | Medora | ND | 94080 | 46.8946 | -103.3769 | Dfb |
| ND_NORTHGATE_5_ESE | Northgate | ND | 94084 | 48.9676 | -102.1702 | Dfb |
| NE_HARRISON_20_SSE | Harrison | NE | 94077 | 42.4247 | -103.7363 | BSk |
| NE_LINCOLN_8_ENE | Lincoln | NE | 94995 | 40.8484 | -96.5651 | Dfa |
| NE_WHITMAN_5_ENE | Whitman | NE | 94079 | 42.0680 | -101.4450 | Dfa |
| NH_DURHAM_2_N | Durham | NH | 54794 | 43.1716 | -70.9277 | Dfb |
| NM_LAS_CRUCES_20_N | Las Cruces | NM | 03074 | 32.6137 | -106.7414 | BSk |
| NM_LOS_ALAMOS_13_W | Los Alamos | NM | 03062 | 35.8584 | -106.5214 | Dfb |
| NM_SOCORRO_20_N | Socorro | NM | 03048 | 34.3557 | -106.8859 | BSk |
| NV_BAKER_5_W | Baker | NV | 53138 | 39.0118 | -114.2090 | BSk |
| NV_MERCURY_3_SSW | Mercury | NV | 53136 | 36.6240 | -116.0225 | BWh |
| NY_ITHACA_13_E | Ithaca | NY | 64758 | 42.4401 | -76.2462 | Dfb |
| NY_MILLBROOK_3_W | Millbrook | NY | 64756 | 41.7857 | -73.7422 | Dfb |
| OK_GOODWELL_2_SE | Goodwell | OK | 53182 | 36.5682 | -101.6097 | BSk |
| OR_COOS_BAY_8_SW | Coos Bay | OR | 04141 | 43.2718 | -124.3186 | Csb |
| OR_CORVALLIS_10_SSW | Corvallis | OR | 04236 | 44.4185 | -123.3257 | Csb |
| OR_JOHN_DAY_35_WNW | John Day | OR | 04125 | 44.5560 | -119.6459 | BSk |
| OR_RILEY_10_WSW | Riley | OR | 04128 | 43.4711 | -119.6917 | BWk |
| PA_AVONDALE_2_N | Avondale | PA | 03761 | 39.8593 | -75.7861 | Dfa |
| RI_KINGSTON_1_NW | Kingston | RI | 54796 | 41.4911 | -71.5413 | Dfb |
| SC_BLACKVILLE_3_W | Blackville | SC | 63826 | 33.3550 | -81.3279 | Cfa |
| SC_MCCLELLANVILLE_7_NE | McClellanville | SC | 03728 | 33.1532 | -79.3637 | Cfa |
| SD_ABERDEEN_35_WNW | Aberdeen | SD | 54933 | 45.7115 | -99.1296 | Dfb |
| SD_BUFFALO_13_ESE | Buffalo | SD | 94081 | 45.5160 | -103.3017 | BSk |
| SD_PIERRE_24_S | Pierre | SD | 94085 | 44.0194 | -100.3530 | Dfa |

| Station Name | City | State | WBAN | Lat (˚N) | Lon (˚E) | Climate[a] |
|---|---|---|---|---|---|---|
| SD_SIOUX_FALLS_14_NNE | Sioux Falls | SD | 04990 | 43.7346 | -96.6222 | Dfa |
| TX_BRONTE_11_NNE | Bronte | TX | 03072 | 32.0408 | -100.2495 | Cfa |
| TX_MONAHANS_6_ENE | Monahans | TX | 03047 | 31.6219 | -102.8071 | BSh |
| TX_MULESHOE_19_S | Muleshoe | TX | 03054 | 33.9557 | -102.7740 | BSk |
| TX_PALESTINE_6_WNW | Palestine | TX | 53968 | 31.7796 | -95.7232 | Cfa |
| TX_PANTHER_JUNCTION_2_N | Panther Junction | TX | 22016 | 29.3483 | -103.2093 | BSk |
| TX_PORT_ARANSAS_32_NNE | Port Aransas | TX | 23906 | 28.3045 | -96.8230 | Cfa |
| UT_BRIGHAM_CITY_28_WNW | Brigham City | UT | 04138 | 41.6163 | -112.5437 | BSk |
| VA_CAPE_CHARLES_5_ENE | Cape Charles | VA | 03739 | 37.2907 | -75.9270 | Cfa |
| VA_CHARLOTTESVILLE_2_SSE | Charlottesville | VA | 03759 | 37.9975 | -78.4656 | Cfa |
| WA_QUINAULT_4_NE | Quinault | WA | 04237 | 47.5139 | -123.8120 | Cfb |
| WA_SPOKANE_17_SSW | Spokane | WA | 04136 | 47.4174 | -117.5264 | Dsb |
| WI_NECEDAH_5_WNW | Necedah | WI | 54903 | 44.0604 | -90.1737 | Dfb |
| WV_ELKINS_21_ENE | Elkins | WV | 03733 | 39.0130 | -79.4743 | Dfb |
| WY_LANDER_11_SSE | Lander | WY | 94078 | 42.6754 | -108.6686 | Dfb |
| WY_MOOSE_1_NNE | Moose | WY | 04131 | 43.6615 | -110.7120 | Dfc |
| WY_SUNDANCE_8_NNW | Sundance | WY | 94088 | 44.5169 | -104.4363 | BSk |

[a] Climate classification is based on the Köppen-Geiger climate classification system (Kottek et al. 2006).

Table S2: List of weather stations from the US Climate Reference Network database that were included in the climatically representative sample of stations in CONUS. The nomenclature for the climate zones begins with the first letter for the broad climate type (“equatorial,” “arid,” “warm temperate,” “snow,” and “polar” for A, B, C, D, and E, respectively), then denotes the intra-annual precipitation and temperature characteristics (if applicable) within those zones in the second and third letters, respectively [7].

**Table S3: List of Equations for User-Derived Meteorological Variables**

| Variable | Dataset | Expression | Units | Notes |
|---|---|---|---|---|
| $RH_{min}$ (%) | ISD-Lite | $100 \cdot \frac{e^{\left(\frac{17.625 \cdot T_D}{243.04^{\circ}C + T_D}\right)}}{e^{\left(\frac{17.625 \cdot T}{243.04^{\circ}C + T}\right)}}$ | $T$, $T_D$ in ˚C | Minimum based on hourly values |
| | PRISM | $100 \cdot \frac{\left[610.94\ Pa \cdot e^{\left(\frac{17.625 \cdot T_{max}}{243.04^{\circ}C + T_{max}}\right)}\right] - VPD_{max}}{610.94\ Pa \cdot e^{\left(\frac{17.625 \cdot T_{max}}{243.04^{\circ}C + T_{max}}\right)}}$ | $T_{max}$ in ˚C<br>$VPD_{max}$ in Pa | Assumes $RH_{min}$ occurs at $T_{max}$ |
| | Daymet | $100 \cdot \frac{e^{\left(\frac{17.269 \cdot T_{min}}{237.3^{\circ}C + T_{min}}\right)}}{e^{\left(\frac{17.269 \cdot T_{max}}{237.3^{\circ}C + T_{max}}\right)}}$ | $T_{min}$, $T_{max}$ in ˚C | Assumes $T_D$ = $T_{min}$ all day |
| $RH_{max}$ (%) | ISD-Lite | $100 \cdot \frac{e^{\left(\frac{17.625 \cdot T_D}{243.04^{\circ}C + T_D}\right)}}{e^{\left(\frac{17.625 \cdot T}{243.04^{\circ}C + T}\right)}}$ | $T$, $T_D$ in ˚C | Maximum based on hourly values |
| | PRISM | $100 \cdot \frac{\left[610.94\ Pa \cdot e^{\left(\frac{17.625 \cdot T_{min}}{243.04^{\circ}C + T_{min}}\right)}\right] - VPD_{min}}{610.94\ Pa \cdot e^{\left(\frac{17.625 \cdot T_{min}}{243.04 + T_{min}}\right)}}$ | $T_{min}$ in ˚C<br>$VPD_{min}$ in Pa | Assumes $RH_{max}$ occurs at $T_{min}$ |
| $RH_{mean}$ (%) | ISD-Lite | $100 \cdot \frac{e^{\left(\frac{17.625 \cdot T_D}{243.04^{\circ}C + T_D}\right)}}{e^{\left(\frac{17.625 \cdot T}{243.04^{\circ}C + T}\right)}}$ | $T$, $T_D$ in ˚C | Mean based on hourly values |
| | PRISM | $100 \cdot \frac{e^{\left(\frac{17.625 \cdot TD_{mean}}{243.04^{\circ}C + TD_{mean}}\right)}}{e^{\left(\frac{17.625 \cdot T_{mean}}{243.04^{\circ}C + T_{mean}}\right)}}$ | $T_{mean}$, $TD_{mean}$ in ˚C | Assumes daily $RH_{mean}$ occurs at $T_{mean}$ |
| | Daymet | $100 \cdot \frac{e(T_{mean})}{610.78\ Pa \cdot e^{\left[\frac{17.269 \cdot (0.606 \cdot T_{max} + 0.394 \cdot T_{min})}{237.3^{\circ}C + (0.606 \cdot T_{max} + 0.394 \cdot T_{min})}\right]}}$ | $T_{max}$, $T_{min}$ in ˚C<br>$e(T_{mean})$ in Pa | Assumes daily $RH_{mean}$ occurs at $T_{mean}$ |
| $AH_{mean}$ (g/m$^3$) | ISD-Lite | $\frac{216.68 \frac{g \cdot K}{hPa \cdot m^3} \cdot 6.1094\ hPa \cdot e^{\left(\frac{17.625 \cdot T_D}{243.04 + T_D}\right)}}{T + 273.16^{\circ}C}$ | $T$, $T_D$ in ˚C | Mean based on hourly values |
| | USCRN | $\frac{216.68 \frac{g \cdot K}{hPa \cdot m^3} \cdot 0.061094 \cdot RH \cdot e^{\left(\frac{17.625 \cdot T}{243.04 + T}\right)}}{T + 273.16}$ | $RH$ in %<br>$T$ in ˚C | Mean based on hourly values |
| | PRISM | $\frac{216.68 \frac{g \cdot K}{hPa \cdot m^3} \cdot 6.1094 \cdot e^{\left(\frac{17.625 \cdot TD_{mean}}{243.04 + TD_{mean}}\right)}}{T_{mean} + 273.16}$ | $T_{mean}$, $TD_{mean}$ in ˚C | Assumes daily $AH_{mean}$ occurs at $T_{mean}$ |
| | Daymet | $\frac{2.1668 \frac{g \cdot K}{Pa \cdot m^3} \cdot e(T_{mean})}{T + 273.16}$ | $e(T_{mean})$ in Pa<br>$T$ in ˚C | Assumes daily $AH_{mean}$ occurs at $T_{mean}$ |

Table S3: Equations used to derive relative humidity (*RH*) and absolute humidity (*AH*) using variables provided by the four datasets. USCRN stations report *RH* directly. An equation for $RH_{max}$ is not included for Daymet because the Daymet algorithm assumes that the dew-point temperature is equal to the minimum temperature throughout the day [3]; $RH_{max}$ for every day is assumed to be 100%. All of these equations are given in their simplified forms; constants that cancel out have been removed, when applicable. Constants in the *RH* equations differ slightly for Daymet: the values are 610.94 Pa, 17.625 (unitless), and 243.04˚C for PRISM and first-order stations in ISD-Lite [1, 4], but 610.78 Pa, 17.269 (unitless), and 237.3˚C for Daymet [3]. The leading constant in the *AH* equations is the inverse of the gas constant for water vapor [6].

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