DSD project

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Kawamura's Discomfort Index (DIK) [1] to quantify the daily temperature and humidity :

$$DIK = (0.99 \times T) + (0.36 \times T_d) + 41.5$$

T is the mean air temperature (°C)
T_d is mean dew point temperature (°C)

Three thermal comfort zones:

- Cold ($DIK \leq 60$)
- Comfortable ($60 < DIK \leq 75$)
  - Comfortable-hot ($DIK > 60$)
  - Comfortable-cold ($DIK \leq 75$)
- Hot ($DIK > 75$)

Cities with cold climate the planning behaviour of residents increases as the weather gets colder, while in cities with hot climate the planning behaviour of residents decreases as the weather gets colder.

Comfortable months were defined as those months with average high temperature between 20 and 24 °C. At most 4 comfortable months are included into the analysis with average high monthly temperature close to 24 °C. The selection of 20–24°C was based on the characterization of the range 22–24 °C as comfortable[2] and we slightly broaden this range to be 20–24 in order to enlarge the size of comfortable months in some cities and facilitate further analysis.We also consider cold months as those 3 months with the lowest average high temperature that is below 20 degrees.

$$R_H = 100 \times \frac{E}{E_s}$$

R_H is relative humidity (in percent) According to an approximation of the Clausius-Clapeyron equation:

$$E = E_0 \times \exp\left[\left(\frac{L}{R_v}\right)\left(\frac{1}{T_0} - \frac{1}{T_d}\right)\right]$$

$$E_s = E_0 \times \exp\left[\left(\frac{L}{R_v}\right)\left(\frac{1}{T_0} - \frac{1}{T}\right)\right]$$

where $E_0 = 0.611kPa$, $\left(\frac{L}{R_v}\right) = 5423\ K$(in Kelvin, over a flat surface of water), $T_0 = 273\ K\ (\ Kelvin\ )$. T_d is dew point temperature also in Kelvin.

$$T_d = \left[\frac{1}{T} - \frac{1}{5423}\ln\left(\frac{R_H}{100}\right)\right]^{-1}$$

A simpler calculation that gives an approximation of dew point temperature if you know the observed temperature and relative humidity, the following formula was proposed in a 2005 article by Mark G. Lawrence in the Bulletin of the American Meteorological Society [3]:

$$T_d = T - \left(\frac{100 - R_H}{5}\right)$$

Both T_d & T are in degree celsius. Apparently this relationship is fairly accurate for relative humidity values above 50%.

References

[1] Kawamura T (1965) *Distribution of discomfort index in Japan in summer season.* J Meteorol Res 17: 460–466.

[2] Pfafferoot JU, Herkel S, Kalz D, Zeuschner A (2007) *Comparison of low-energy office buildings in summer using different thermal comfort criteria.* Energy and Buildings 39: 750–757.

[3] Lawrence, Mark G., 2005: *The relationship between relative humidity and the dewpoint temperature in moist air: A simple conversion and applications.* Bull. Amer. Meteor. Soc., 86, 225-233. doi: http;//dx.doi.org/10.1175/BAMS-86-2-225