

A measure of sultriness derived from Perceived Temperature

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Public weather forecasts in Germany frequently apply the term "sultriness (German: Schwüle)" in conjunction with warm and moist air masses advected from south-west, and with thunderstorms developing under unstable air-layering. Sultriness is a special case in thermal perception. It cannot be categorised into the usual scale between warm and hot neither from the physiological point of view nor from the climatological characterisation. At the body surface a sluggish, humid-warm milieu persists, which epitomises thermal uncomfortable feeling. Based on observations of A. Lancaster in 1898, the threshold for sultry atmospheric conditions was set at a dewpoint temperature of 16.5°C (referred to as Td-sultriness).

The Deutscher Wetterdienst (DWD) uses the Perceived Temperature (PT) (German: Gefühlte Temperatur) to evaluate the thermal environment. PT is defined as the air temperature of a reference environment in which the thermal perception would be the same as in the actual environment. The assessment of thermal perception is based on Fanger's Predicted Mean Vote (PMV). However, additional model extensions account for stronger deviations from thermal neutrality. In contrast to Fanger's model, they allow in the warmth ($\text{PMV} > 0$) the enthalpy of sweat-moistened skin and of wet clothes to be assessed. These enthalpy values are associated with the skin wettedness and, therefore, are a measure of the relative activity of the sweat glands and the evaporative potential of the environment. The effect of the model extension compared to Fanger's PMV is assessed for two German lowland sites. The standard deviation from the mean is a measure of typical variations in the interdependency of the relevant meteorological variables determining the German climate. A perception of sultriness is defined for subjects adapted to the climatological conditions in Germany, if the actual values exceed the long-term mean by more than one standard deviation (referred to as PT-sultriness).

If dew point temperatures are high the PT-sultriness coincides with the Td-sultriness. Regarding the whole range of values the frequency of PT-sultriness is reduced by 23% compared to the Td-sultriness due to an increased number of cases with Td-sultriness at night. In the rare cases the PT method identifies sultriness at night-time it is rather triggered by higher ambient temperatures combined with markedly reduced wind speeds than by dewpoint temperatures above 16.5°C . In the late afternoon PT-sultriness is somewhat more frequent and linked to enlarged ambient temperatures associated with slightly reduced wind speeds.

In contrast to the Td-sultriness the PT-sultriness accounts for all environmental variables that impact the sensible and latent heat flow from skin. It is in accordance with all described properties in the perception of sultriness. It extends over a wide range of ambient temperatures and is valid for subjects adapted to the climatological conditions of Central Europe. It is restricted to environmental conditions that require sweat evaporation to balance the human heat budget, which, especially at night-time, can not so strictly differentiated by the dewpoint derived definition.

DWD forecasts PT-sultriness on the COSMO-EU model area and publishes results via its web site.