

meteoLCD Weblog

A weblog on climate, global change and climate measurements

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Heat stress: when warm is too hot!

As a heat wave is expanding through Western Europe (and Luxembourg), I would like to give some comments on the heat stress that is measured at meteoLCD since May 2001 (see paper by Charles Bonert and Francis Massen [here](#)). We are still the one and only station which shows this important parameter in real live time on the web.

1. Some technical details on the apparatus.

The ISO standard defines how the heat stress is measured:

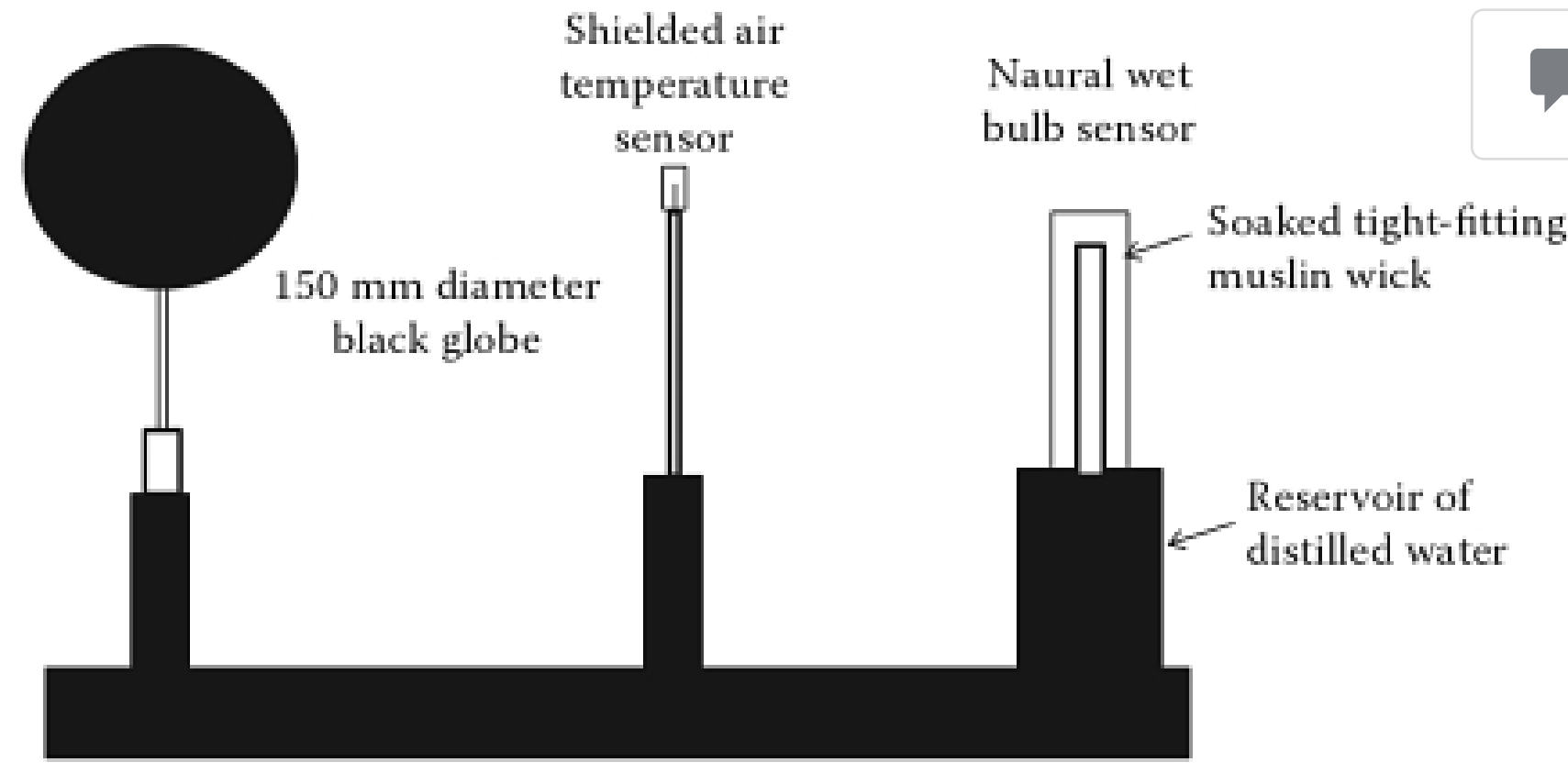
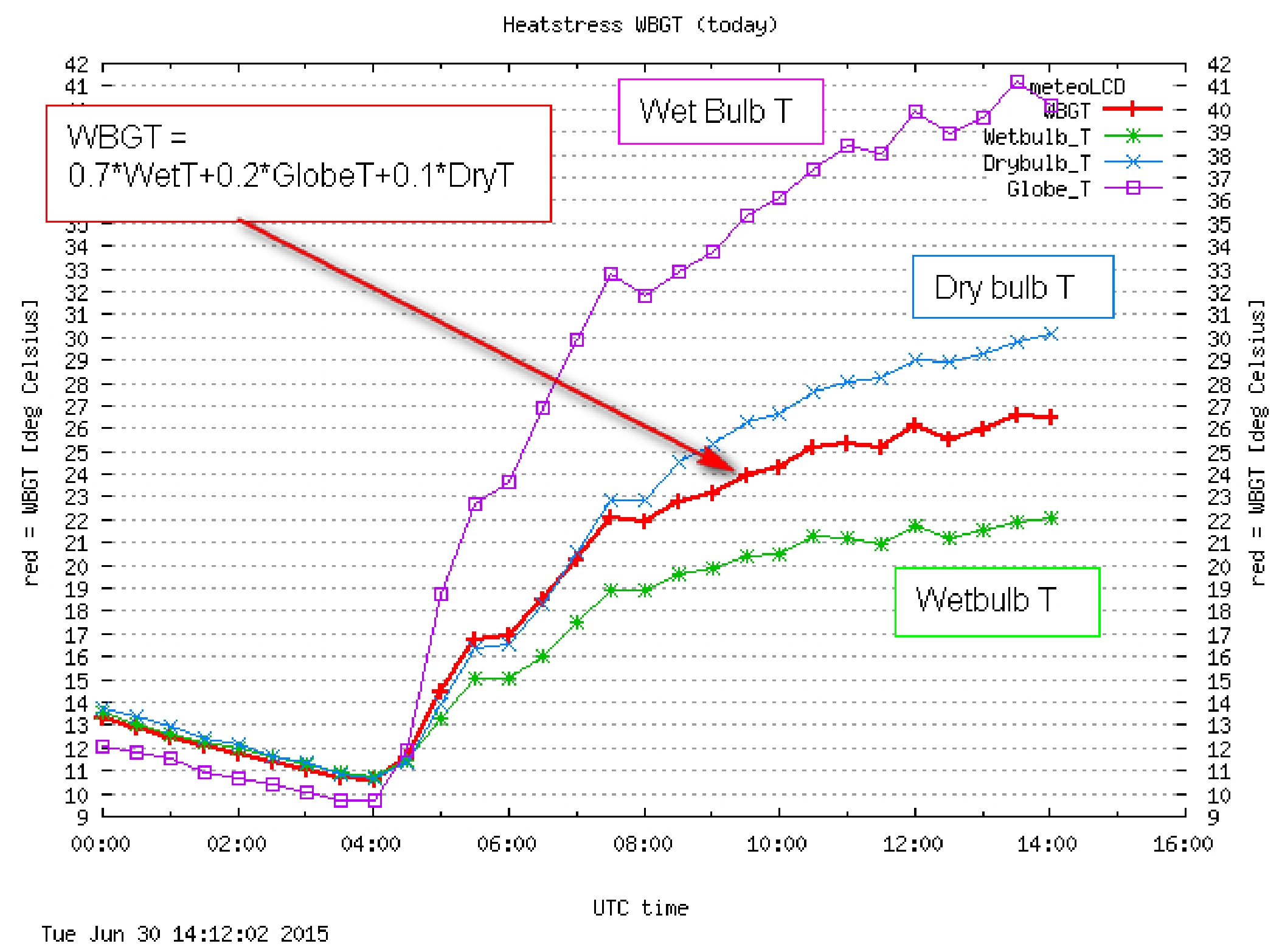


FIGURE 18.2 WBGT transducers (not to scale).

(figure from [here](#))

The globe temperature is the highest under usual sun-shine conditions, the dry air thermometer gives an intermediate temperature and the wet bulb thermometer shows distinctively lower values. The next figures gives the situation today (30 June 2015, 14:00 UTC) at Diekirch:



If we take the last rightmost values, we have GlobeT = 40°C, DryT = 30°C and WetT = 22°C. Using the formula given in the figure we get WBGT = 0.7*22 + 0.3*40 + 0.1*30 = 26.4 °C, shown by the last red point.

The differences between the three thermometer readings are enormous, and the very low wet bulb temperature shows how efficient evaporation is for cooling. The next picture shows the wet bulb device as used at meteoLCD: it is essentially a Pt100 sensor covered by a cotton wick whose other end plunges into a pot of distilled water. Two times a day this water reservoir is filled by a peristaltic pump. We use distilled water to avoid hardening of the wick by the dissolved lime which is abundant in tap water. A grillage (not shown here) is needed to keep thirsty or curious birds from picking at or stealing the wick (yes, this happened several times).



2. When is warm too hot?

Normally, the body temperature (measured in the rectum) should not exceed 37°, with 38°C set as the upper limit. Too hot is a situation, where the WBGT pushes the internal body temperature above this limit. Now, depending on physical activity (and clothing), this limit is reached sooner or later. A heavy worker, or a soldier making strong physical efforts (in heavy clothing) will reach this dangerous situation much earlier than a tourist resting on the sea-shore. The metabolic rate gives in W the heating power produced by the working body. For a body at rest it is about 65 W, for hard work it can exceed 300 W. So compared to the man-at-rest, a worker will reach the WBGT limit much sooner, as shown by the following figure (same ref. as above):

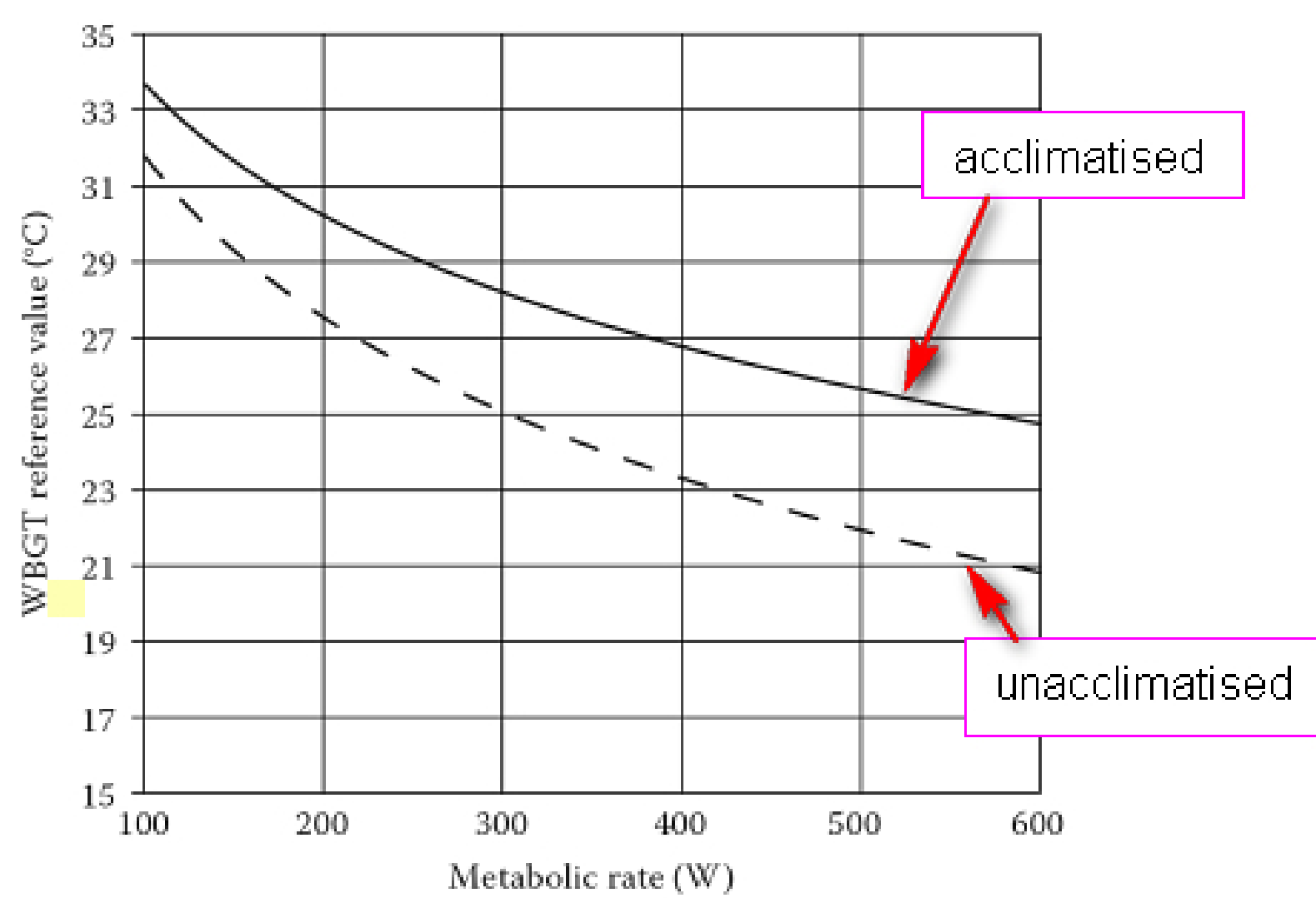


FIGURE 18.3 WBGT reference values proposed in the revision of ISO 7243. (From ISO 7243, *Hot Environments – Estimation of the Heat Stress on Working Man, Based on the WBGT Index (Wet Bulb Globe Temperature)*, International Standards Organization, Geneva, 1989.)

A difference is also made between a person acclimatized to the warm situation, and one which is not.

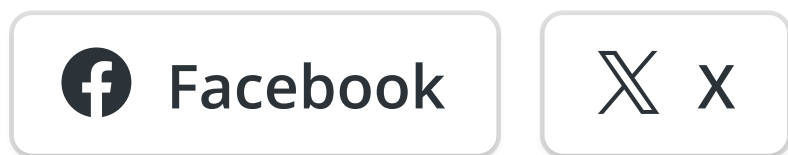
3. An example

Now lets take a person riding a bicycle at about 38 km/h. The corresponding MET (metabolic rate) is according to [here](#) about 5, which corresponds to 5*65 = 330 W. Using the above diagram for the unacclimatized person (remember: this is the first day of a heat wave!) we see that the heat stress limit is about 24°C: so a bicycler starting at 14:00 UTC (16:00 local time) exceeds the limit (as the WBGT is 26.4) and puts himself at the risk of a heat stroke.

May I suggest that he should make his cycling much earlier, for instance at 06:00 UTC (08:00 local time) and finish definitively at 10:00 local time.

Fact is that more people die from cold than from heat, but nevertheless heat can be an insidious danger. Usually normal common sense is all what is needed to remain safe, and maybe this blog comment will be of some help!

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