

ISB Commission 6 for the development of a Universal Thermal Climate Index (UTCI)

Meeting Report, June 7-8, 2001, Freiburg, Germany

Participants:

Jendritzky, Gerd, Germany, Deutscher Wetterdienst, Freiburg: Chair

Maarouf, Abdel, Canada, Environment Canada, Toronto: Co-chair

Höppe, Peter, Germany, ISB and University of Munich

Blazejczyk, Krzysztof, Poland, University of Warszawa

Bluestein, Maurice, USA, Purdue University, Indianapolis

de Dear, Richard, Australia, Macquarie University, Sydney

Havenith, George, UK, Loughborough University

Holmér, Ingvar, Sweden, National Institute for Working Life, Solna

Nicol, Fergus, UK, Oxford Brookes University

Schwerdt, Rich, USA, NOAA-National Weather Service, Kansas City

Steadman, Robert, Australia, La Trobe University, Melbourne

Invited Guests:

Toftun, Jørn, Denmark, Technical University, Copenhagen

Matzarakis, Andreas, Germany, University of Freiburg

Staiger, Henning, Germany, Deutscher Wetterdienst, Freiburg

1. Opening Remarks:

Gerd Jendritzky opened the meeting by welcoming all participants on behalf of the World Meteorological Organisation (WMO), Deutscher Wetterdienst, DWD (German Weather Service) and Gesellschaft zur Förderung Medizin-Meteorologischer Forschung, GzFMMF (German Society of Medical-Meteorological Research). He stated that this meeting took place under the umbrella of WMO-ISB collaboration, and hopefully at a later date the activities of this Commission could be endorsed by the WMO/WHO/UNEP Interagency Network on Climate and Human Health. Peter Höppe, President of ISB, welcomed the participants on behalf of ISB and hailed this commission as being the most active one in the Society. The ISB, S.W. Tromp Travel Fund, and the German Society of Medical-Meteorological Research provided funding for this meeting.

2. General Introduction:

Gerd Jendritzky gave a brief introduction to the basic concepts and requirements of a UTCI and demonstrated the "Klima-Michel-Model" of the Deutscher Wetterdienst as an example of a complete operational tool that has been useful for many years in numerous applications (Annex 1). His presentation was based on a paper (by Jendritzky, Maarouf & Staiger) presented at the Windsor conference in the UK, April 2001.

3. Summary of Email Discussions:

Abdel Maarouf explained the brief history of ISB Commission 6, and its mandate to develop a UTCI following the dialogue in Environment Canada's Internet workshop on windchill, April 2000. He then summarised the discussions that took place by email among core members of the commission from late Nov. 2000 until present (Annex 2).

4. Short presentations:

Bluestein: Improved Wind Chill Index for US and Canada: A new face-model by Oszczewski and Bluestein accounting for radiation effects 3

Holmér: Standards for assessment of cold environments, whole body and local cooling, required clothing insulation, wind studies (thermal manikin and head, human subjects), ISO guidelines 4

Havenith: Heat stress indices, the new Predicted Heat Strain (PHS) index, ISO guidelines for heat stress prevention 5

de Dear: Overview of OUT_SET index, multi-node physiological models, concept of acclimatisation / adaptation 6

Nicol: Summary of the objectives and results of Windsor Conference, April 2001 7

Höppe: Physiological Equivalent Temperature (PET), heat balance modelling inclusive of body

and skin temperatures 8

Steadman: Development of Apparent Temperature (AT), physiological base, meteorological input especially extra (solar) radiation 9

Matzarakis: RayMan software for Tmrt, available on the web, user-friendly and downloadable, bioclimatic assessment especially for urban studies 10

5. Applications of UTCI:

Participants agreed that a UTCI be developed for applications to humans only. Animals and plants are excluded because of different physiology and exposure conditions. Application is further restricted to outdoor conditions in a steady state. Two general groups of applications have been suggested: forecasts and climatological purposes.

- Forecasts, Warnings: Heat and cold stress warnings for all sectors of the population including special vulnerable groups
- Daily forecasts: Advice for behaviour (e.g. clothing, outdoor activity, etc.)
- Climate, Bioclimatology / bioclimate assessments: mapping in all scales (local to global), engineering applications (e.g. building design)
- Epidemiology (morbidity and mortality studies)
- Climate impact research (e.g. climate change studies)

6. UTCI general criteria:

- Thermophysiologicaly valid
- Applicable in all climates
- Independent of individual (personal) characteristics

7. Physiological effects:

- Cold -> Local: skin exposure (frostbite)
- Whole body: hypothermia, cold discomfort Face, covered hands and feet
- Heat -> Hyperthermia, heat discomfort
- Dehydration

8. Criteria of input data:

Short- and long-wave radiant fluxes Accounted for by calculating mean radiant temperature, Tmrt

Topography general: flat landscape (two hemispheres)

regional / local: e.g. street canyons for urban bioclimatic assessment

Wind: reference height 1.1 m (according to ISO 7726), 2/3 of observing station wind speed (usually measured at 10m), assume wind blows from the side (at 90 degrees of the walking subject), wind and walking velocities to be added vectorially

Meteorological input variables:

- air temperature
- water vapour pressure
- wind velocity
- mean radiant temperature

9. Reference conditions and modelling issues:

- UTCI for subjects walking outdoors
- Walking speed 1.1 m/s (4 km/h)

Meteorological reference:

- mean radiant temperature equals air temperature
- wind calm
- humidity issue for further email discussion: responsible: P. Höpfe, by Sept. 15, 2001
- "Personal" reference: metabolic rate issue for further email discussion: responsible: I. Holmér, and G. Havenith, by Sept. 15, 2001

- clothing insulation, water vapour permeability, traditional clothing issue for further email discussion: responsible: G. Havenith and I. Holmér, by Sept. 15, 2001

10. Type of index for UTCI, adaptation / acclimatisation:

General: Regional:

UTCI will be a temperature scale index.

Output values of UTCI can be classified in terms of comfort/danger scale, to be interpreted and applied regionally.

Adaptation / acclimatisation is an important aspect for interpretation and warning criteria, however it should be assessed and implemented regionally.

11. A Vision for UTCI:

In the light of the discussions, participants have agreed that a UTCI be developed:

- based on the most advanced multi-node thermophysiological models using key results from systematic simulations
- employ four input variables: air temperature, water vapour pressure, wind velocity, and mean radiant temperature
- capable of predicting local effects (e.g. facial, hands and feet cooling and frostbite)
- linked to an expert system (e.g. look-up tables, parameterisation by regression)
- generate output in the form of:
 - a temperature-scale index (name to be chosen later, and will be different from currently published and marketed indices)
 - whole body thermophysiological effects
 - local (facial, hands and feet) cooling
- UTCI will be fully developed in a time frame of 2 - 3 years, depending on funding for the necessary research, validation procedure, and production of the guideline document.

12. Interim solution:

ISB Commission 6 recognises the current joint effort by the U.S. and Canada to upgrade the Wind Chill Index as an interim solution for North America in the immediate future (next one or two winters). However, the Commission does not recommend any of the currently available indices as a replacement for a UTCI. This group emphasises that a UTCI as recommended and developed by this commission will provide a state-of-the-art solution for all year-round outdoor weather conditions, and will be useful for a wide range of applications.

13. Recommendations:

This group needs some funding for research & development, model validation and travel to meetings. Funding availability will expedite the development and delivery of UTCI. It is recommended that core members explore potential funding opportunities nationally and internationally and share the information so that joint proposals can be drafted and submitted. It is recommended that the UTCI procedure be published as a WMO guideline and distributed to all member states. Source code for basic routine applications should be made available free of charge.

In view of the potential interest by WHO/UNEP in the development of a UTCI, subject to involving developing countries, it is recommended that the Commission consider new members from Africa, Asia, and Latin America.

It is recommended that European core members meet at least once in Europe before the next general meeting/workshop in the USA.