CGPM

Consultative Committee for Thermometry

27e réunion de la Conférence générale des poids et mesures

Yuning Duan, CCT President

November 2022

Consultative Committee for Thermometry

☐ Temperature

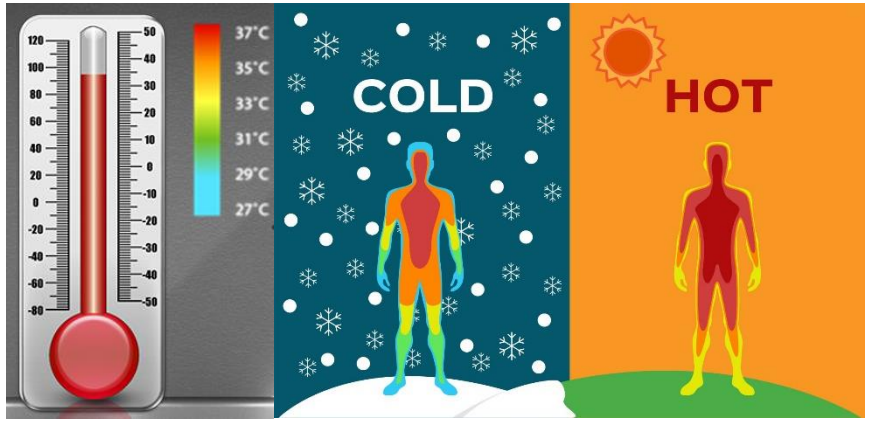
- **Temperature scales**
  - Fixed points and interpolation equations
- **Primary thermometry**
  - Thermodynamic temperature, new definition of the kelvin and its realization
- **Secondary contact thermometry**

☐ Humidity and moisture

☐ Thermophysical quantities

☐ Thermal energy (heat)

CCT



CCT WG & TG

Working Groups

- **CCT-TG-DIG**
  CCT TASK GROUP ON DIGITALIZATION
- **CCT-WG-CMC**
  CCT WORKING GROUP FOR CALIBRATION AND MEASUREMENT CAPABILITIES
- **CCT-WG-ENV**
  CCT WORKING GROUP FOR ENVIRONMENT
- **CCT-WG-KC**
  CCT WORKING GROUP FOR KEY COMPARISONS
- **CCT-WG-SP**
  CCT WORKING GROUP FOR STRATEGIC PLANNING
- **CCT-TG-THQ**
  CCT TASK GROUP FOR THERMOPHYSICAL QUANTITIES
- **CCT-WG-CTH**
  CCT WORKING GROUP FOR CONTACT THERMOMETRY
- **CCT-WG-HU**
  CCT WORKING GROUP FOR HUMIDITY
- **CCT-WG-NCTH**
  CCT WORKING GROUP FOR NON-CONTACT THERMOMETRY

CCT

The importance of thermometry

- ***Temperature issues involved in ALL areas of high precision metrology***
- ***CCT can contribute to CIPM'S seven key priority areas***

Climate change and environment

- ***Humidity, temperature and global warming***

Energy

- ***Energy efficiency, renewable energy such as solar thermal measurements***

Health and life sciences

- ***Clinical thermometers, body temperature measurements***

Food safety

- ***Temperature, humidity and moisture in medicines and food production***

CCT

Advanced manufacturing

"New" metrology

Digital transformation

CCT Recommendation T1(2021)

- **Requirement for new determinations of thermodynamic temperature above 400 K**
- that Member State NMIs improve their capabilities in primary thermometry, by various means, above 400 K to improve determination of $T - T90$, accompanied by appropriate research to ensure that International Temperature Scale realization remains fit for purpose, allowing access to lower uncertainty thermodynamic temperature values over a wide range for a broader community

CCT

Progress since last CGPM

- **Strategic Planning CCT 2021-2030**
- **Definition of the kelvin and *MeP*-K-19**
  - CCT played a key coordinating role in achieving a successful outcome for the redefinition of the kelvin based on the Boltzmann constant.
  - In 2019, CCT published the *mise en pratique document* that guides the realization of the kelvin.
- **Activities in "New" metrology**
  - TG-CTh-ET: thermometry techniques based on optics, nanophotonics et al.
- **Contribution to the fight against COVID-19**
  - WG-CTh, WG-NCTh, TG-NCTh-BTM: clinical and non-clinical thermometers
- **Contribution in climate change and environment**
  - WG-ENV, WG-HU,TG-THQ, TG-Env-AirT (established in 2020): air temperature
- **Contribution in digitalization**
  - TG-DIG (established in 2022)
- **24 KCs (from 1999 to 2021), 8 KCs in progress**
  - 51 RMO KCs registered in KCDB and 35 of these have been approved and published
  - 2915 CMCs entries in the KCDB are supported by the CCT

CCT

Strategic Planning CCT 2021-2030

- **Draft finished in September 2021**
- **Discussed at 30th meeting of CCT (online) in January 2022**
- **Categorized stakeholder's needs in the seven key areas**
- **Summarized the achievements of CCT and its working groups and the future scan in details**
- **Seven working groups & eight (2022) flexible task groups**
- **CCT Key comparisons and pilot studies 2021-2030+**
  - Discussed the status of past and progress of currently active KCs
  - CCT Guidelines for comparisons
  - Approved CMC review protocol for thermal diffusivity measurements and infrared spectral emissivity measurements

CCT

CCT TG for Body Temperature Measurement (2020-2022)

- Core group of: NPL (chair), CEM, UL, NIM, A*STAR
- Established in response to COVID-19 pandemic to address need to improve body temperature measurement globally
- Published on the BIPM website:
  - Metrology focused guides for ear and forehead thermometry
  - Thermal imaging and shorter clinical focused guides
- The TG has also prepared the protocol for the Key Comparison of IR clinical thermometer calibrators
- Provided on-going metrology input into clinical thermometer standards

CCT

CCT Working Group on Environment

- **Atmospheric air temperature** still presents underrated scientific open issues.

In 2021 the CCT WG Environment established the new Task Group on air temperature.

- The key contribution from the metrology community: improve knowledge to evaluate measurement uncertainty to produce better quality data

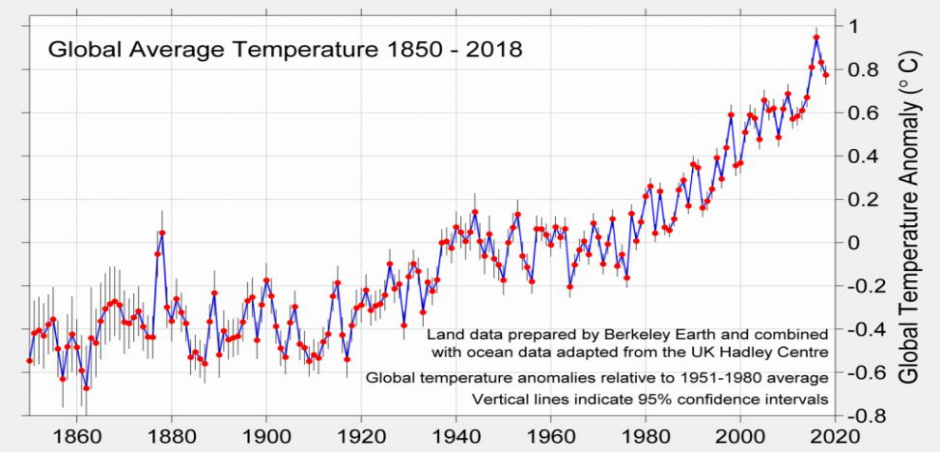
METROLOGY FOR CLIMATE ACTION
26–30 SEPTEMBER 2022

Bureau International des Poids et Mesures

WORLD METEOROLOGICAL ORGANIZATION

CCT

Environmental influences:
Precipitation
Wind speed
Solar radition...



Work priorities

- **kelvin's Realization (*MeP*-K-19)**
- **ITS-90** continues to remain important, with eventual incremental improvements, but supplemented by thermodynamic temperature at **high and low temperatures**.
- ***In situ*** calibration and ***in situ*** primary thermometry
- **Humidity and moisture metrology** continues to be driven by issues such as climate, advanced processing, and energy gases such as hydrogen.
- **Body temperature measurements**
- **Thermophysical quantities → energy and advanced manufacturing**
- **World Meteorological Organisation (WMO)**
  - ***WMO-CIMO*** (Commission for Instruments and Methods of Observation)
- **International Association on Properties of Water and Steam (IAPWS)**

CCT

Thank you for your attention

duanyn@nim.ac.cn