The Vision for USCRN

Sustain a national climate observing network that in the future, with the highest degree of confidence, can answer the following question:

How has the climate changed over the past 50 years?

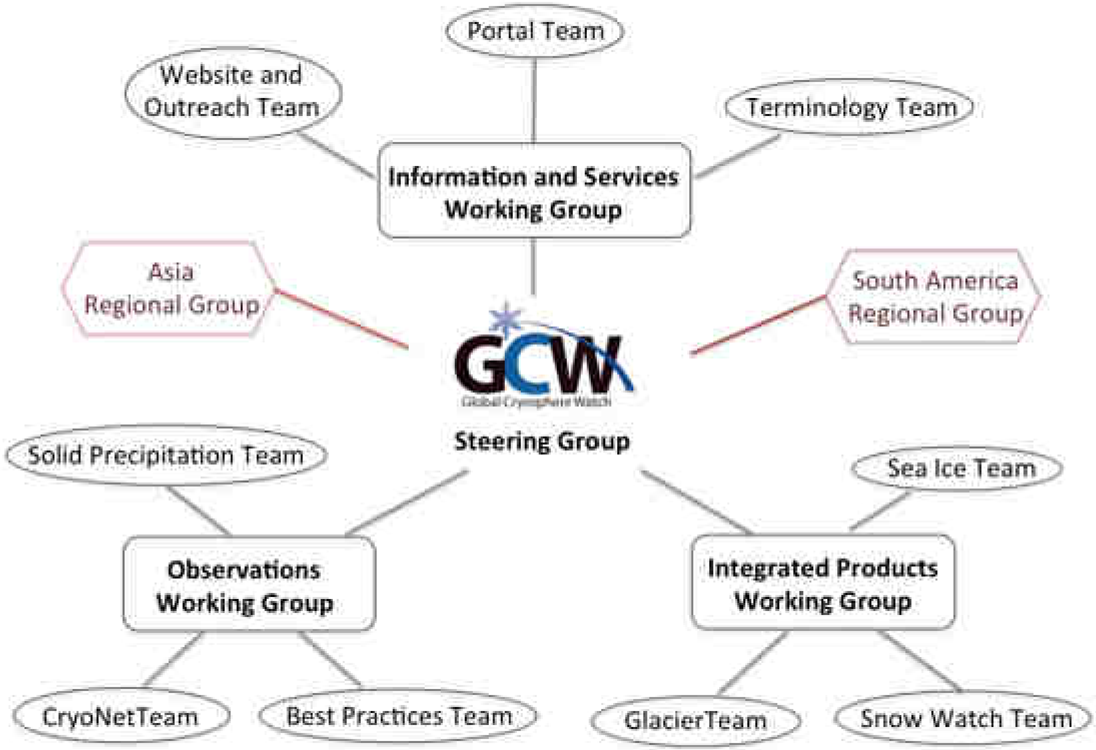
Achievements 2013-2017	Future Scan 2018-2022	Future Scan 2023-2027
Environment		
The RECOMMENDATION T3 (2010) to the CIPM entitled *"On climate and meteorological observations measurements"* is the basis for establishing long terms collaboration with the scientific community involved in research on climate and environmental monitoring and motivates specific projects and actions from the NMIs being increasingly diffused worldwide.	• The relationships with key world and international Institutions such as WMO, GCOS, and IAPWS will be sustained to provide channels for impact in the work of the WG ENV. • CCT recommends NMIs to create Metrology Networks to become reference institutions for the interacting and collaborating with the stakeholders and to preserve, improve and disseminate the experience achieved in thermal metrology for climate and environment. • CCT WG ENV members to continue to contribute as experts in WMO, GCOS task team.	CCT recommends NMIs to include in their vision documents all possible actions within the expertise of the thermal metrology community contributing to improve measurement quality and knowledge on observation and monitoring of the environment and climate
The "Metrology for Meteorology and Climate" – MMC Conference series and associated workshops and satellite events • were fully participated in and endorsed by CCT WG ENV members • represent world top level events for increasing the collaboration between thermal metrologists and the stakeholder communities.	• Data comparability: Include as reliable as possible uncertainty analysis in historical data; study and assess traceability. • Spatial and temporal comparability: Systematic evaluation of environmental and instrumental influences on measurement results; complete knowledge on measured quantity. • Temperature measurements: Improved measurement techniques, calibration procedures and develop, supervise and harmonise guides. • Water content measurements (air and soil): Develop suitable measurement techniques and guides. • Impact: CCT members continue to organize events, meetings, workshops, conferences and training to discuss and plan common activities with the climate and environmental communities.	• **Air temperature measurements** still present open issues in identifying the components of the uncertainties budget and in their evaluation. The evaluation of the uncertainty in atmospheric air temperature measurements, both at ground level and in upper atmosphere, together with a fully documented traceability, is the fundamental condition to achieve data comparability within and among observing networks, in space and time and for the validation of different techniques. • WG Environment to initiate studies and publication on this subject. • In a long-term vision, it is expected that the joint work of metrologists and the user community will improve the knowledge on this key measurement for atmospheric studies and climate monitoring.
	The planned creation of a GCOS Surface Reference Network (GSRN) of observing stations on land[5] will require a continuous support from the thermal metrology community, being temperature and humidity of air and soil key observables.	• CCT WG ENV, together with operational meteoro-logists, climatologists and metrologists, to contribute with studies and activities to GCOS for the definition of the key aspects of GSRN in terms of station features, data characteristics and target uncertainties. • Provide roadmap to address needs of data quality arising from possible new climate evolution scenarios.

Andrea
Merlone

The WMO Global Cryosphere Watch

The World Meteorological Organization's Global Cryosphere Watch (GCW) is an international mechanism for supporting all key cryospheric in-situ and remote sensing observations. To meet the needs of WMO Members and partners in delivering services to users, the media, public, decision and policy makers, ***GCW provides authoritative, clear, and useable data, information, and analyses on the past, current and future state of the cryosphere***.

GCW includes observation, monitoring, assessment, product development, prediction, and research[…] to deliver quality-assured global and regional products and services.




Global Cryosphere Watch
World Meteorological Organization
Search
Home About News Cryosphere Now Surface Satellites Activities Reference Data Portal Outreach
Highlights
GCW surface network continues to grow.
There are now over 140 stations either approved or awaiting approval for inclusion in the GCW surface network. Some are CryoNet stations; some are contributing stations.
CryoNet is growing
Cryosphere in the News
North American Arctic is failing compared to Russia, Nordics, warns think tank
3 February 2018, 6:05 am
rcinet.ca
Polar bears filmed themselves while hunting seals on sea ice, revealing why they are so at risk from global warming
3 February 2018, 2:34 am
feeds.feedburner.com
The LINK Online, Feb 2,3,4 2018
2 February 2018, 8:40 pm
rcinet.ca
Climate threats to polar bears: new study
2 February 2018, 7:13 pm
rcinet.ca
Polar bear videos reveal impact of melting Arctic ice
2 February 2018, 3:23 pm
feeds.cbsnews.com
More Cryosphere in the News »
The Cryosphere Now
Sea and Freshwater Ice
Snow and Solid Precip
Glaciers & Ice Caps
Ice Sheets
Greenland Cumulative Melt Days
Jan 1 - Jun 25
2017
GCW News
New eastern Greenland photos in gallery (2018-02-03)
Sites are now Clusters (2018-02-03)
GCW Data Protocol for CryoNet is now available (2017-12-04)
Urumqi Glacier No. 1 in the News (2017-10-28)
Global Cryosphere Watch (GCW) - Arctic Polar Regional Climate Centres (PRCC) Planning meeting (2017-10-15)

The core of the GCW surface observing network is called

CryoNet.

This network is comprised of *stations* and *sites* which meet certain requirements. The GCW surface network is a component of the WMO Integrated Global Observing System (WIGOS).

CRYONET TEAM

globalcryospherewatch.org/cryonet/site_types.html

Immediate priority: Establish the core standardized GCW surface observation network - CryoNet

- Network builds on existing cryosphere observing programmes
- Promotes the addition of standardized cryospheric observations
- Covers all components of the cryosphere (glaciers, ice shelves, ice sheets, snow, permafrost, sea ice, river/lake ice) through an extensive approach of standardized in situ observations
- Currently pre-operational with 36 sites and stations globally

CryoNet STATIONS

- measure at least one variable of a cryosphere component (e.g. snow, permafrost, sea ice...)
  - have to fulfill CryoNet minimum requirements
  - must have ancillary meteorological measurements
- have the target of long-term operation(primary) or long-term operational commitment with 10+ years record (reference)

Attributes: primary, reference *Potential attributes: cal/val, research*

CryoNet SITES

- contain two or more coordinated stations (at least one is a CryoNet station) with varying capabilities that are coordinated as a local cluster
- must have a concept describing the scope of the research approach and the site management

Attributes: basic, integrated

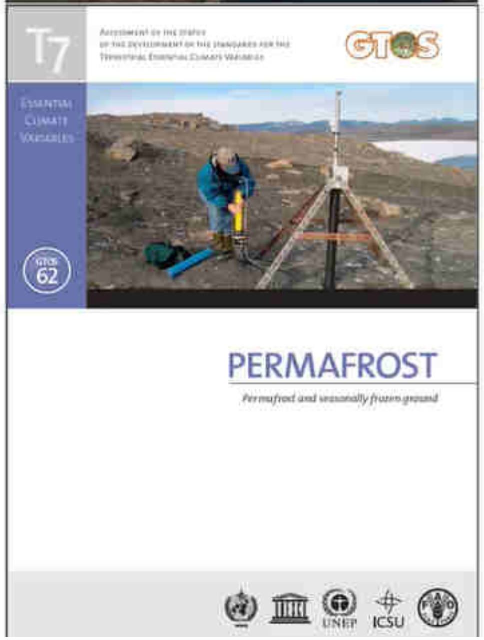
Andrea Merlone

BEST PRACTICES TEAM

globalcryospherewatch.org/bestpractices/methods.html

- GCW standards and best practices for cryospheric measurements are currently being compiled
- Drawing on existing measurement methods
- Reach scientific consensus
- An initial inventory of existing documents describing measurement practices is available.

Cryosphere Element	Existing Documents
Snow	CEN (2010), Fierz et al. (2009), Armstrong et al. (2009), MSC (2012, 2013), UNESCO, IASH and WMO (1970)
Glaciers, ice sheets, ice caps	Kaser et al. (2003), Ostrem and Brugmann (1991), Paul et al. (2009), UNESCO and IASH(1970a), UNESCO and IASH (1970b), WGMS (2012), Zemp et al. (2009)
Sea ice	JCOMM (2004), MSC (2005), NOAA (2007), WMO (2004), Johnson and Timco (2008)
Solid precipitation	Goodison et al. (1998), MSC (2012, 2015), Nitu and Wong (2010), WMO (2012)
Permafrost	Smith and Brown (2009), GTN-P (2012)



WORLD METEOROLOGICAL ORGANIZATION
GCW Global Cryosphere Watch

To
Dr. Andrea Merlone
Istituto Nazionale di Ricerca Metrologica
EURAMET Task Group Environment Convenor
And
EURAMET Task Group Environment Members
Strada delle Cacce, 91
10135 TORINO
Italy

Geneva, 10 November 2017

Subject: Expression of interest for the EMPIR Environment call 2019

The World Meteorological Organization's Global Cryosphere Watch (GCW) is an international mechanism for supporting all key cryospheric in-situ and remote sensing observations. To meet the needs of WMO Members and partners in delivering services to users, the media, public, decision and policy makers, GCW provides authoritative, clear, and useable data, information, and analyses on the past, current and future state of the cryosphere. GCW includes observation, monitoring, assessment, product development, prediction, and research. It provides the framework for reliable, comprehensive, sustained observing of the cryosphere through a coordinated and integrated approach on national to global scales to deliver quality-assured global and regional products and services. GCW organizes analyses and assessments of the cryosphere to support science, decision-making and environmental policy.

To meet these objectives, GCW implementation encompasses, among the others, a clear statement on

Standardization: Enhance the quality of observational data by improving observing standards and best practices for the measurement of essential cryospheric variables. This includes developing measurement guidelines and best practices; engaging in, and supporting, intercomparison of products, formulating a set of best practices for product intercomparisons.

The GCW surface observation network is comprised of a core component, called CryoNet, and contributing stations that are not part of CryoNet. The GCW network builds on existing cryosphere observing programmes and promotes the addition of standardized cryospheric observations to existing facilities in order to create more robust environmental observatories.

It is under this framework, that GCW has deep interest in implementing metrology and metrological approach. It is therefore of high relevance for GCW that the next EURAMET call on Environment includes support for studying the metrological aspects linked with data quality, including measurement and target uncertainties. In particular, GCW would strongly recommend the inclusion in next metrology joint research activities, networks and projects topics such as:

- measurements in extreme environments, key climate regions and challenging conditions;

In particular, GCW would strongly recommend the inclusion in next metrology joint research activities, networks and projects topics such as:

- measurements in extreme environments, key climate regions and challenging conditions;
- studying reference methods for the Global Cryosphere Watch;


EMPIR Work Programme
Call Scope – Metrology for Environment (2018)
EURAMET

The Call is answering to changes in economy and life style dictated by environmental causes, namely climate change and reduction of the existing resources. The priorities given in the H2020 Work Programme 2018-2020 focus on a climate action in support of the Paris Agreement and on a greener economy where the use of natural resources is reduced and managed sustainably.

- improving the performance and reducing the uncertainty of measurement techniques to meet tighter limit values for pollutants of air and water quality;
- the development and traceable validation of new and emerging technologies, including low cost sensors and satellites.

EMPIR

- identifying measurands and measurement methods for indoor air quality
- atmospheric science measurements of particulates, aerosols, GHG, ammonia, short lived compounds (such as VOCs) and emerging particulate air quality pollutants (especially black carbon, speciated particulate and non-exhaust emissions)
- developing new techniques for automated and remote controlled measurements for water analysis in support of water monitoring in Europe
- improving knowledge and undertake innovations in radiative-transfer modelling
- validation of environmental and climate data (such as remote sensing data) and monitoring equipment (including ground based instrumentation networks), essential for the quality assurance of satellite derived products
- non-satellite monitoring techniques of key parameters to detect local climate evolution with special focus on near surface thermal quantities, striving for traceable, reference quality, (logical) measurement series to robustly check the 2 °C goal
- the creation of the GCOS Global Surface Reference Network
- measurements in extreme environments, key climate regions and challenging conditions,
- studying, evaluating and comparing reference methods for the Global Cryosphere Watch,
- … temperature, pH, pCO2, salinity and fluorescence-based chlorophyll-a.

METEOMET
Metrology for Meteorology

EURAMET

Arctic Metrology Workshops series






1st Torino April 2015
2nd Oslo May 2016
3rd Ny-Ålesund 2017

•Break out session @ Arctic Circle 2015

REYKJAVÍK • ICELAND
ARCTIC 2015 CIRCLE
OCTOBER 16 - 18

JOIN OUR MAILING LIST | ARCTIC NEWSWIRE | + SHARE

REGISTER FOR THE 2015 ASSEMBLY 16 - 18 OCTOBER

2015 PROGRAM

ABOUT | BOARD | PARTNERS | SECRETARIAT | PRESS & MEDIA | 2014 | IMAGES | VIDEO

HÁSKÓLINN Í REYKJAVÍK
REYKJAVIK UNIVERSITY

THE FUTURE OF ENERGY SECURITY IN THE ARCTIC

The Iceland School of Energy will organize a session on Thursday, October 15th, about the future of Arctic energy, with considerations of environmental and human security. The session will be organized in cooperation with the Harvard Kennedy School of Government and the Fletcher School of Law and Diplomacy at Tufts University.

THE FOREIGN MINISTER OF CHINA

The Opening Session of the 2015 Arctic Circle Assembly will include an address by the Foreign Minister of the People's Republic China, Wang Yi.

EURAMET

METROLOGY FOR ENVIRONMENT IN THE ARCTIC

High-accuracy measurements are needed to understand the evolution of the Arctic environment in its many extremes. EURAMET, the European Association of National Metrology Institutes, is hosting a breakout session promoting common activities between metrology and Arctic scientific research to improve data quality.

Farnesina
Ministero degli Affari Esteri e della Cooperazione Internazionale

Esteemed participants in the Arctic Metrology Workshop,

I am particularly pleased to address my greetings to you from Oslo and my best wishes in your work.

I believe metrology and EURAMET are bound for keeping a key role in this crucial region.

Giorgio Novello, Italian Ambassador in Norway and Iceland

Ministero degli Affari Esteri e della Cooperazione Internazionale
www.esteri.gov.it

MMC 2016 Spain

METROLOGY FOR METEOROLOGY AND CLIMATE

26-30 September 2016
Spain (Madrid)

& CIMO-TECO

World Meteorological Organization

ENVRIPlus Meeting
Soil Moisture Workshop
MeteoMet2 plenary meeting

BIPM

TC-T Thermometry EURAMET

IMEKO TC12

GRUAN

APMP

World Meteorological Organization

METEOMET
Metrology for Meteorology

Metrology for Essential Climate Variables.

International Workshop and roundtable on

Metrology for High Mountains Climate Observational Issues

15 February 2017

Venue:
Società Meteorologica Italiana
Via Real Collegio, 30, Moncalieri (Torino), Italy

Wokshop outcomes

- More comparability required (in time, among different stations and sensors)
- Need to evaluate measurement uncertainty and a common evaluation process
- Dedicated calibration procedures
- Reduce variety of principles, sensors, instruments, systems, dataloggers,
- Standard methods to be defined (in line with GCW recommendation)
- Specific requirements for reference sites

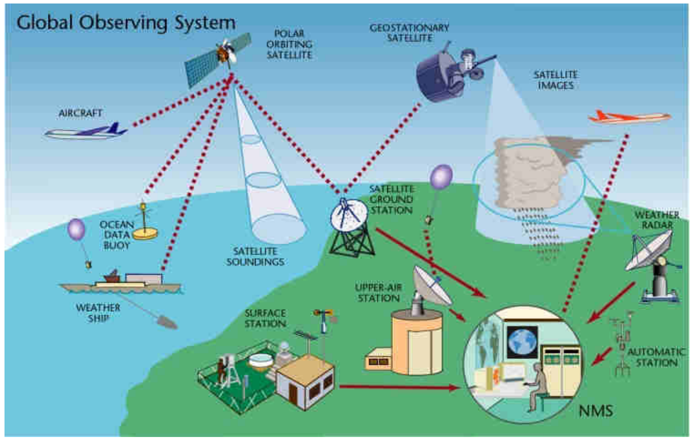
- Opening the discussion for planning a roadmap is strongly suggested

Thank you

Calibrations and Uncertainties evaluations
to establish complete traceability

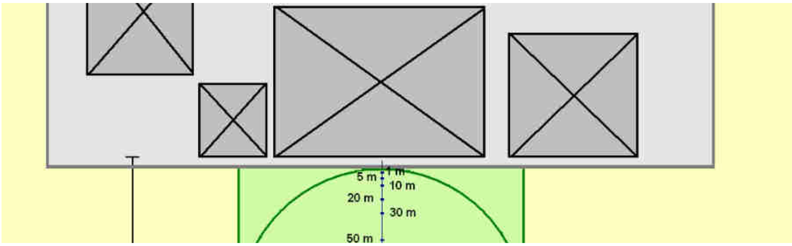
Traceability is the key conditions for comparability

- Comparability on climate-change scales
- Comparability to fundamental physical models
- Comparability across generations
- Comparability across borders & organizations
- Comparability across instrument/measurement types

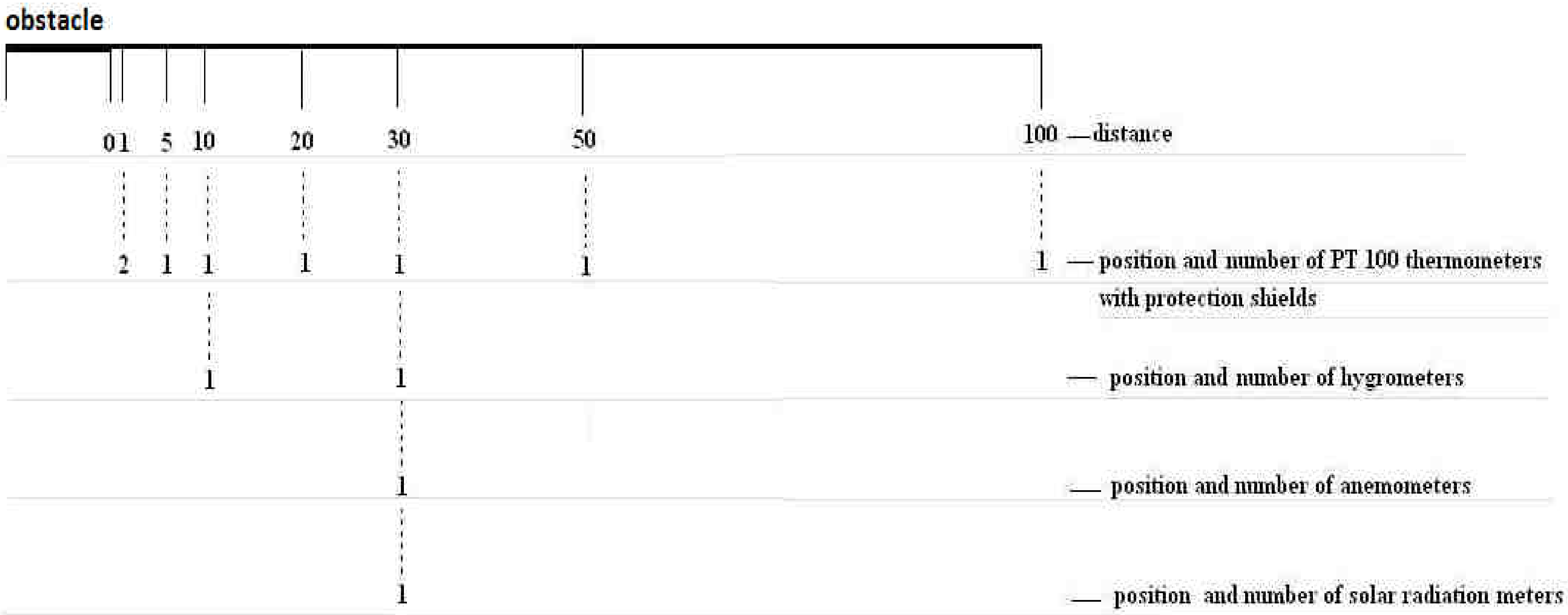


MeteoMet siting experiments

Andrea Merlone



- Three identical experiments in three nations (Italy, Spain, Czech R.)
- Only variable is the nature of the



Road

Trees

Building - CEM

Significant values in stable periods

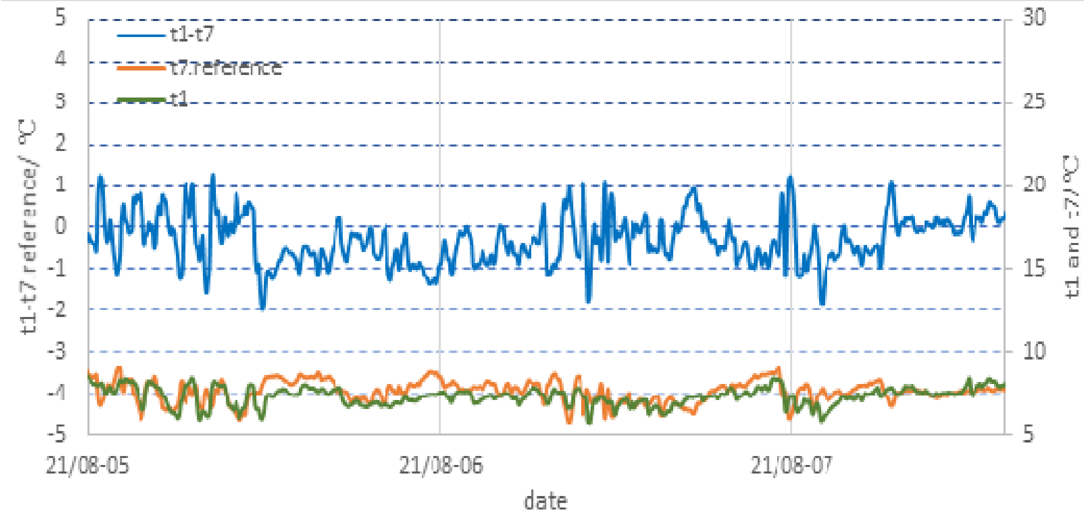
Andrea Merlone

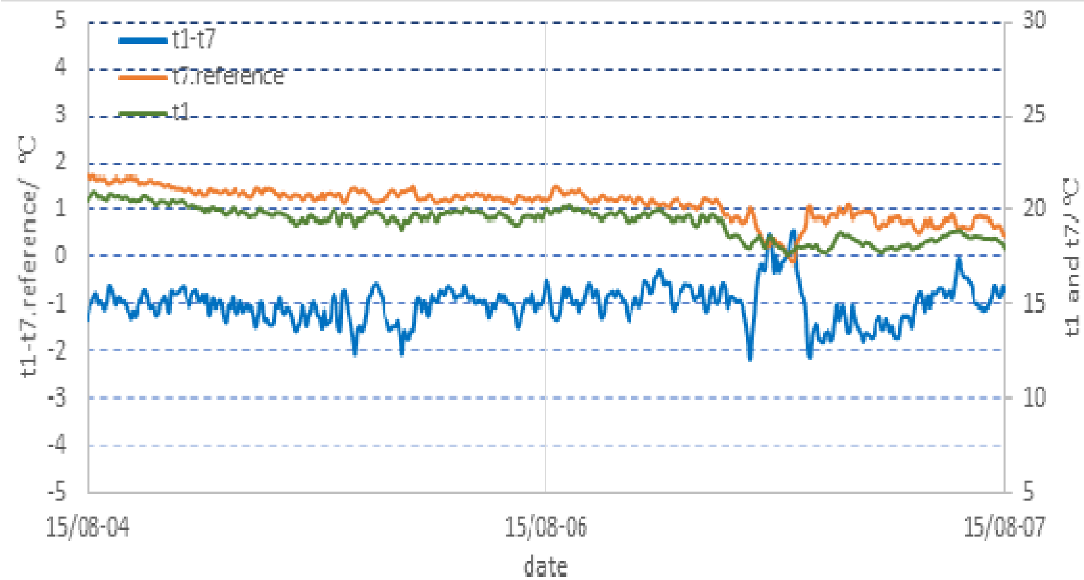
A 0.5-1 °C sustained event. It lasted more than 1 hour. Sensor #1 (orange) and #7 (yellow) show no fast transients.

Event attributable to road effect.

Building

Influence of the ambient temperature on building effect at **night**, without sun radiation





Summer:

Building effect with lack of sun radiation (at night) does not depend on the reference temperature:

Building effect = -1 ºC

Atmospheric air temperature measurements:

can we evaluate a complete uncertainty budget?

A thermometer measures the temperature of the air.

A thermometer measures the temperature of the air. ?

A thermometer measures the temperature of the air. ? ?

A (contact) thermometer gives an indication of its heat equilibrium at that time in that place under those conditions.

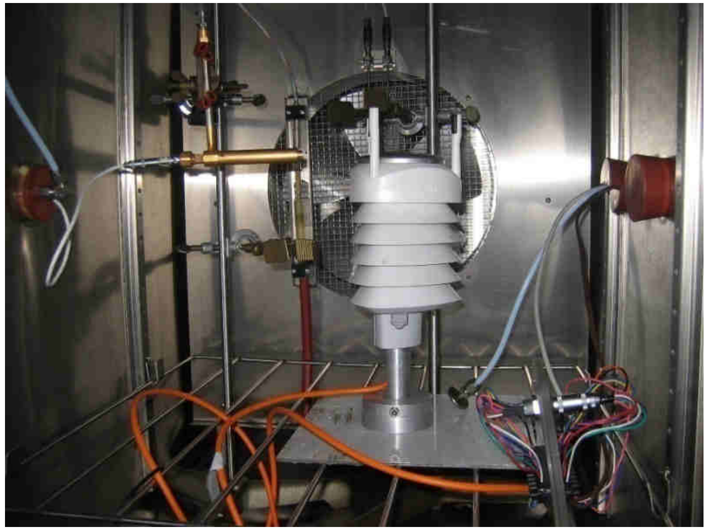
This equilibrium is influenced by:

Andrea Merlone

- **Convection heat exchange**
  - Gas (wind) speed
  - Turbulent, laminar or mixed flow
  - Heat transfer coefficient
  - Convection surface area
  - Temperature gradients
- **Conduction heat exchange**
  - Coefficient of conductivity
  - Thickness of the conduction/insulation layers
  - Temperature gradients
- **Radiation heat exchange**
  - Emissivity coefficients
  - Reflectivity coefficients
  - Diathermy
  - Sub-surface conductivity (surface temperature)
  - Temperature difference
- **Phase change and heat sources**
  - Condensation/evaporation
  - Sublimation/melting
  - Heat sources in the thermometer body
- **Transient heat transfer**
  - Specific heat capacity of the thermometer
  - Mass of the thermometer
  - Initial temperature of the thermometer
  - Gas temperature dynamics (lag)

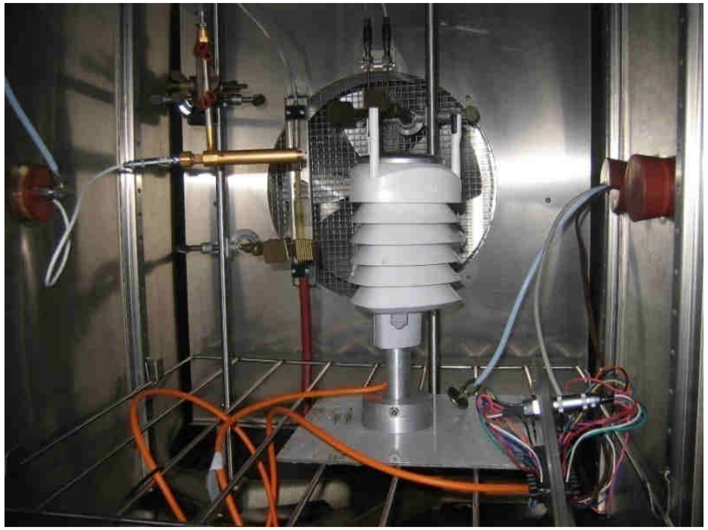
- Probe is not adiabatic
  - Radiation exchange with surrounding
  - Convection between the probe and air
  - Conduction along probe stem
- Probe has imperfect geometry:
  - Partial stagnation
  - Stagnation different in laminar, turbulent or developing flow
- Flow is compressible at stagnation locations even at mainstream velocities less then 1/3 Mach
- Probe has finite mass – therefore time lag
- Probe has relatively large heat capacity vs. air
- Probe faces enclosures/surroundings with temperature:
  - different from gas
  - different from probe
- Probe indicates mean temperature (gas, probe body), not gas temperature.
- Difference of self-heating in air to that at calibration should be considered
- Real gas does not have one single total temperature

A (contact) thermometer is calibrated in (as close as possible) adiabatic conditions.



A (contact) thermometer is calibrated in (as close as possible) adiabatic conditions.

But then a thermometer for atmospheric air temperature measurement is used in non-adiabatic conditions



Traceability

METEOMET
Metrology for Meteorology

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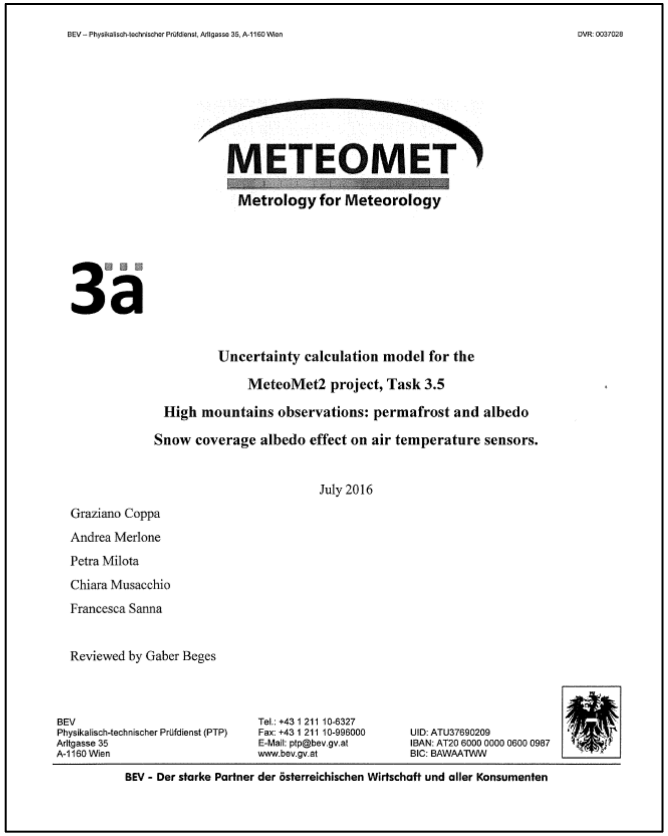
1) Preparation of the experiment protocol and method for the evaluation of all uncertainty components.

Prescriptions are given on

1)how to design the experimental setup
2)definition of site requirements
3)measuring and evaluating the quantities of influence;
4)making relative measurements to get rid of most of the influencing quantities
5)characterising the sensors in laboratory and in field
6)theoretical assumptions and practical applications


BEV – Physikalisch-technischer Prüfdienst, Arltgasse 35, A-1160 Wien DVR: 0037028

METEOMET
Metrology for Meteorology

3ä

Uncertainty calculation model for the
MeteoMet2 project, Task 3.5
High mountains observations: permafrost and albedo
Snow coverage albedo effect on air temperature sensors.

July 2016

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Petra Milota
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Reviewed by Gaber Beges

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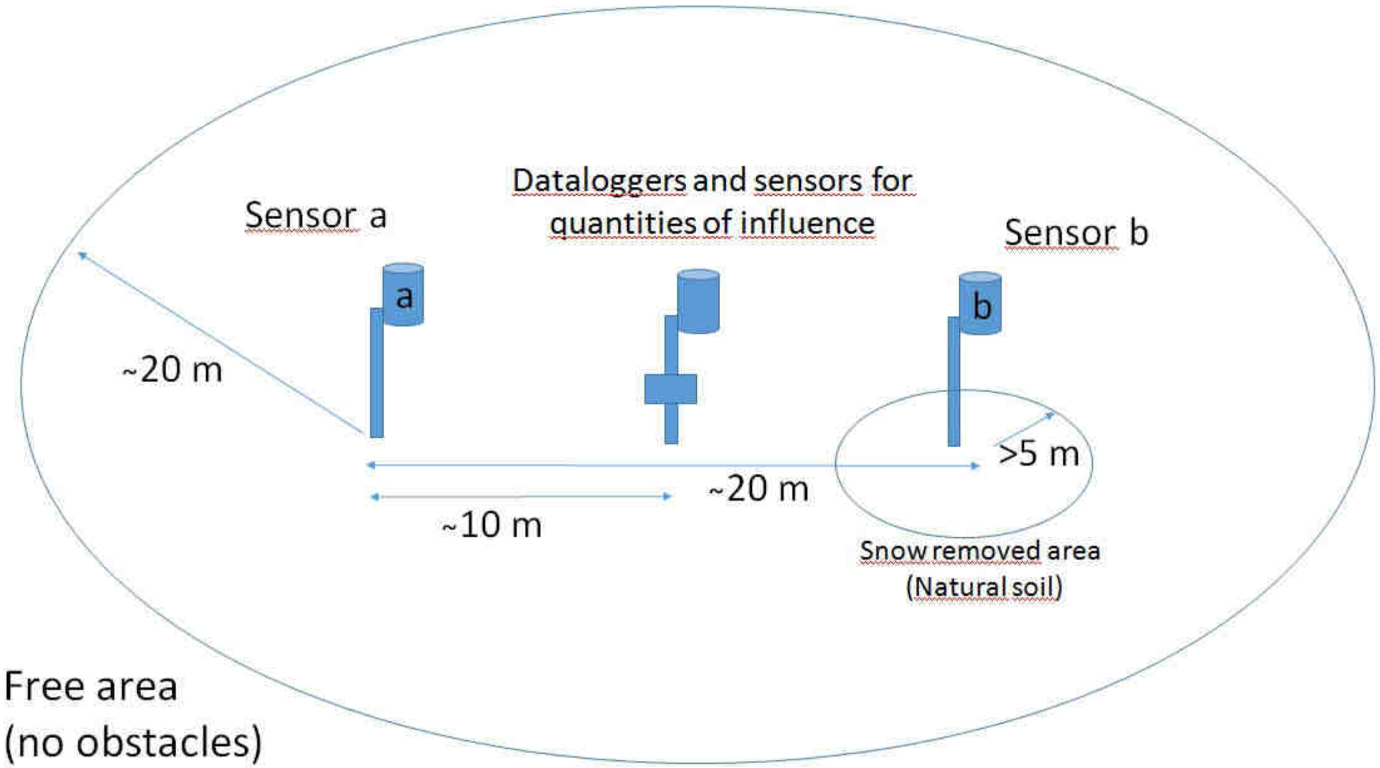
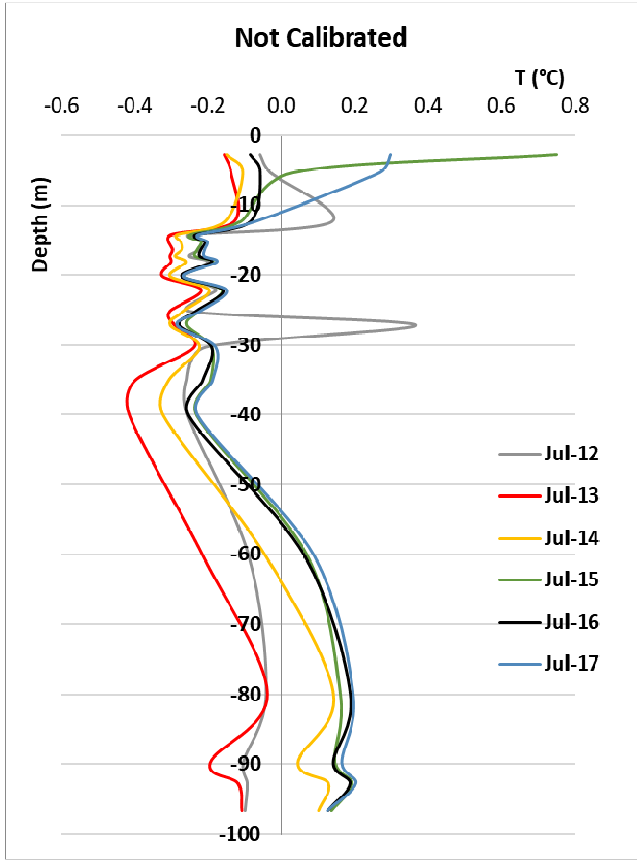
UID: ATU37690209
IBAN: AT20 6000 0000 0600 0987
BIC: BAWAATWW

BEV - Der starke Partner der österreichischen Wirtschaft und aller Konsumenten

1) Preparation of the experiment protocol and method for the evaluation of all uncertainty components




Not Calibrated
T (°C)
-0.6
-0.4
-0.2
0.0
0.2
0.4
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0
-10
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Depth (m)
Jul-12
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Jul-14
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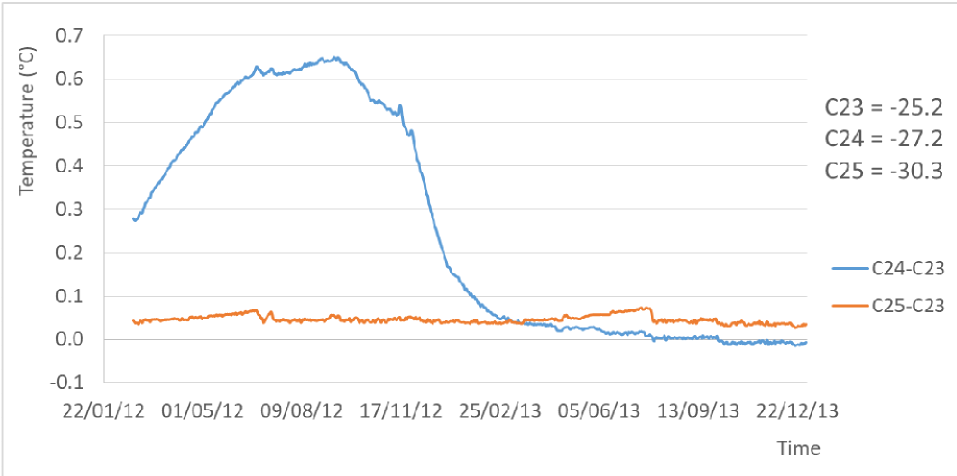
Jul-16
Jul-17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Temperature (°C)
22/01/12
01/05/12
09/08/12
17/11/12
25/02/13
05/06/13
13/09/13
22/12/13
Time
C23 = -25.2
C24 = -27.2
C25 = -30.3
C24-C23
C25-C23