

WORLD METEOROLOGICAL ORGANIZATION

**COMMISSION FOR INSTRUMENT AND
METHODS OF OBSERVATION
*OPAG-SURFACE***

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MEASUREMENT TECHNIQUES
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**THE STATE-OF-THE-ART OF INSTRUMENTS AND
AUTOMATED SURFACE OBSERVING SYSTEMS (ASOS)**

Instruments for Harsh Climatological Conditions

Submitted by the Chairman

Summary and Purpose of Document

The document contains an introduction on the requirements for instruments for observations in harsh climatological conditions.

ACTION PROPOSED

The meeting is invited to take notice of the document and to supply suggestions or recommendations on how to provide documentation and guidelines on recommended practices for measurements in a harsh environment.

References:

1. CIMO-XIII, abridged final report
2. CIMO MG (2003) final report
3. Reports EUMETNET SWS Project (Specification of Severe Weather Sensors): Improvements of Severe Weather Measurements and Sensors, (Tammelin, B., *et al.*, FMI, 2003) with recommendations for WMO/CIMO

Background

1.1. Introduction

When considering requirements for instruments for use in harsh climatological (or environmental) conditions reference is made to sensors/instruments which can reliably work under severe weather conditions. However not only severe weather conditions (extreme weather like hurricanes) but also the nominal daily conditions have to be regarded for harsh climatological environments. Typical examples are:

- Extremely cold mountainous/Arctic climates
- Very dry desert and other dusty environments.
- Humid and hot tropical conditions
- Harsh ocean environment (ocean based monitoring both above and below the sea surface)

CIMO-XII (Casablanca, 1998) recommended to continue with collecting information on requirements for the development of new sensors/instruments and on instruments which can reliably work under severe weather conditions. The *Instrument Development Inquiry* should be the basic method in providing such information. In this connection, the continuing difficulties of measuring meteorological variables of extreme events and under extreme conditions for various applications are recognized by CIMO. Moreover CAgM already requested CIMO for the development of guidelines to overcome these difficulties. However, the requirements still needed to be defined better so that the initiated activities could be continued as necessary.

In particular Cg XIII (1999) requested CIMO to study the requirements of operating equipment, in particular, automatic weather stations, under harsh environmental conditions and develop guidance material for use by Members and manufacturers.

The first draft of an IOM report of guidance material on equipment for use in harsh environmental conditions was announced at CIMO XIII. This draft is based on a paper by M.D. Gifford, entitled "*Operation of Automated Surface Observing Systems in Harsh Climatological Environments*" as presented at TECO-2000 (see ANNEX). It expands to the fields, which are not yet fully covered, with special attention to siting and exposure as well as related to critical maintenance issues. However, this draft was never finalized for further publication and the request from Cg remains.

Apart from this activity EUMETNET has started end 1990's a project "*Specification of Severe Weather Sensors*" (E-SWS). For this project an extensive intercomparison was organized in 2001/2002 to investigate the behavior of sensors in icing conditions (see the EUMETNET SWS II reports "*Meteorological Measurements under Icing Conditions*" (Tammelin, B. *et al.*, FMI, Reports 2001:6) and "*Improvements of Severe Weather Measurements and Sensors*" (Tammelin, B. *et al.*, FMI, 2003). Results of this project are also presented at TECO 2002 (see IOM report 75). Moreover EUMETNET has organized two workshops on Severe Weather Sensors.

The EUMETNET SWS II report "*Improvements of Severe Weather Measurements and Sensors*" is of special interest because of a number of recommendations addressed to WMO/WMO. This report contains the following proposals to WMO/CIMO for needed activities:

1. *Effects of cold climate and low air temperature are taken into account in requirements concerning meteorological measurements given by the WMO, but not atmospheric icing.*
2. *As detailed requirements on accuracy and reliability of meteorological measurements are very poorly described by authorities representing areas outside meteorology, the WMO/CIMO guidelines are very commonly used by manufacturers producing sensors and*

also for other applications. Thus it is important that more care to produce correct measurements under harsh conditions and measurements of icing is given within the meteorological community.

3. *The EUMETNET SWS II project represents hopefully a major contribution to support the WMO to include considerations on cold climate problems and their influence on meteorological measurements and on measurements of atmospheric icing. The project and its results were presented at the TECO-2002 by 3 oral presentations and 1 poster. In the following CIMO conference, it was recommended to add either a special chapter about effect of icing on meteorological measurements or to include such aspects in specific chapters (wind, temperature, radiation, etc).*
4. *It is obvious that a general documentation on requirements on accuracy, reliability and availability of meteorological measurements for different applications is needed. This documentation can be then used for presentation of different sensors by the manufacturers in a customer friendly way. To produce such a document, close cooperation between different authorities is needed, where the meteorological community could have a leading role. A preliminary proposal for such documentation is presented in this report.*

Furthermore the following recommendations are stated:

To improve the quality of meteorological measurements under cold climate conditions, to provide manufacturers data for design of ice- free sensors, to provide customers and operators of meteorological information better bases for selection of suitable sensors for their purposes and to improve the general knowledge on icing and icing climatology, the following recommendations for further activities are given:

1. *Improve the design of the instrument (mechanical) and heating system to optimize the needed heating power*
2. *Promote the development of icing observation instruments (e.g. Rosemount)*
3. *Promote the results of the present experiment*
4. *Promote a follow-up action for the characterization of icing*
5. *Promote national " icing maps"*
6. *Promote a classification for "meteorological" sensors taking into account accuracy, climatic conditions and reliability of data required for different applications*
7. *Promote the improvement of the WMO/CIMO Guide 8 for measurements in severe icing conditions*
8. *Promote WMO-proved test sites for ice- free sensors*

It must be noted that most activities on developing requirements for instruments in harsh climatological environments focus on icing conditions only (*i.e.* in extremely cold mountainous/Arctic climates). In particular equipment for dusty and dry deserts, humid and hot tropics and oceans with a harsh climate needed further investigation. For these climates only very limited guidance material is available on the implementation and maintenance of automatic observing systems and, therefore, further studies are necessary. Moreover, not only the performance and maintenance issues of a system are a point of concern but also destruction of instruments caused by extreme weather should be considered (*e.g.* tropical cyclones reaching 300 km/h or more.)

1.2. Further development

In line with past developments and published material on this matter, documentation on the requirements for instruments for observations in harsh climatological conditions has to be generated. In particular the IOM report, as announced at CIMO XIII should be finalized and published. Moreover, as stated in the recommendations in the SWS II report (see above) more attention to this topic should be given in a future revision of the CIMO Guide (WMO-No. 8). The discussion is open if this information should be given in each chapter related to a specific variable or in a separate chapter.

Activity plan

2.1. Planned activities

In line with CIMO XIII, the CIMO management group has decided to continue the work on the provision of guidance material on implementation of instruments in harsh climatological environments as requested by Congress and Technical Commissions.

To realize this, further study on already existing test reports should be carried out. Moreover the already announcement IOM report has to be finalized and published. A decision should be made on how to implement requirements on the instruments capable to measure a harsh environment in a new revision of the CIMO Guide. Moreover intercomparisons should be considered of such equipment to be carried out in such environments. Preceding such intercomparison an inquiry should be carried out along the Members facing shortcomings of today's equipment due to harsh and extreme weather.

2.2. Time Table

	<i>Deliverable</i>	<i>Deadline</i>
a.	IOM Report on the Requirements for Instruments under harsh climatological conditions.	December 2005
	Updated chapters of the CIMO Guide <i>or</i> a new Chapter	December 2005

Attachments: **ANNEX** (available as PDF only)