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NORWEGIAN NATIONAL THERMOMETER SCREEN INTERCOMPARISON

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Summary and purpose of document

This document provides information and preliminary results of national intercomparison of different screen designs at the Norwegian Meteorological Institute.

Action proposed

The meeting is invited to take into account information presented in this document when discussing combined intercomparison of thermometer screen/shields with humidity measurements.

Norwegian National Thermometer Screen Intercomparison

- Information and preliminary results -

The Norwegian Meteorological Institute (DNMI) started a *National Thermometer Screen Intercomparison* in January 2000. A preliminary report from the intercomparison was presented at TECO-2000 in Beijing. The intercomparison period is planned to last until spring 2002.

1. Introduction

Various types of thermometer screens have been used at DNMI since official start of observations at around 1850. DNMI now manufactures two types of thermometer screens that are in operational use at observing stations in Norway, namely:

- A wooden double-louvered screen MI-46 (approximately 1m x 1m x 1m). This type is used as DNMI's standard screen since 1946 at conventional observing stations.
- A plastic cylindrical double-louvered screen MI-74 is used at airports and AWS installations since 1974.

Some of the different types of thermometer screen, operationally applied before 1946, were also included in the intercomparison.

Since both, the costs and labor involved in manufacturing the NMI thermometer screens, have extensively been increased during the last decade, the Observation Division of DNMI decided to introduce commercially available thermometer screens in the Norwegian observing network.

2. Objectives

The main objective of this *Thermometer Screen Intercomparison* is to investigate the magnitude of temperature differences caused by the change of screen types. It is hoped that resulting from the test the Climatological Division of DNMI will be able to distinguish between real climate changes and virtual ones caused various types of screens.

Considering the information already given in Section *1. Introduction* above, the intercomparison, the following main objectives have been defined:

- Comparing measurements in two old types of wall mounted thermometer screens that were used in the 1920ies and 30ies with those obtained from the MI-46 screen;
- Comparing the characteristics of the MI-74 with MI-46 type;
- Comparing some types of commercially available thermometer screens with those previously manufactured by DNMI.

3. Test field

Due to lack of a big undisturbed area for testing instruments, DNMI has chosen a very compact set-up of the screens to be compared. All screens are mounted in a height of approximately 2 m above short cut grass (snow covered in winter time). The distance between neighbouring screens is approximately 2 m.

4. Screen types included in the intercomparison

The following types of thermometer screen are under test in the intercomparison:

- Commercially available cylindrical screens from Vaisala and Young – one from each manufacturer;

- MI-74 cylindrical screens – 4 screens of this type are included, mainly to substantiate homogeneity of the test field with regard to temperature measurements;
- MI-46 (used as comparison reference) – this one is DNMI's reference for climatological temperature measurements;
- Two ancient wall and window mounted screens (for historical reasons).

In addition to these screens two types of artificially ventilated screens are included only part time of the intercomparison period, namely the Met3A from Paroscientific and the THYGAN from Meteolabor. The testing of Met3A was terminated in the autumn 2000 already. More information on this part of the intercomparison can be found in the proceedings of TECO-2000.

5. Influencing parameters

In addition to the temperatures measured within the different screen types, the intercomparison also includes at the test field specific observations of the wind-speed and -direction (2 m above ground), relative humidity, global radiation and atmospheric pressure while precipitation amount observations are taken from the operationally used AWS.

6. Sensors

The temperature is generally measured with Pt 100 sensors according to the specification of IEC-751 Class A. They were calibrated in the laboratory of DNMI with an uncertainty better than ±0.1 °C within the required temperature range from -30 °C to +35 °C). Wind data are measured by a Vaisala standard wind sensor and the Vaisala HMP45D is used for relative humidity measurements while a Kipp & Zonen solarimeter measures the global radiation.

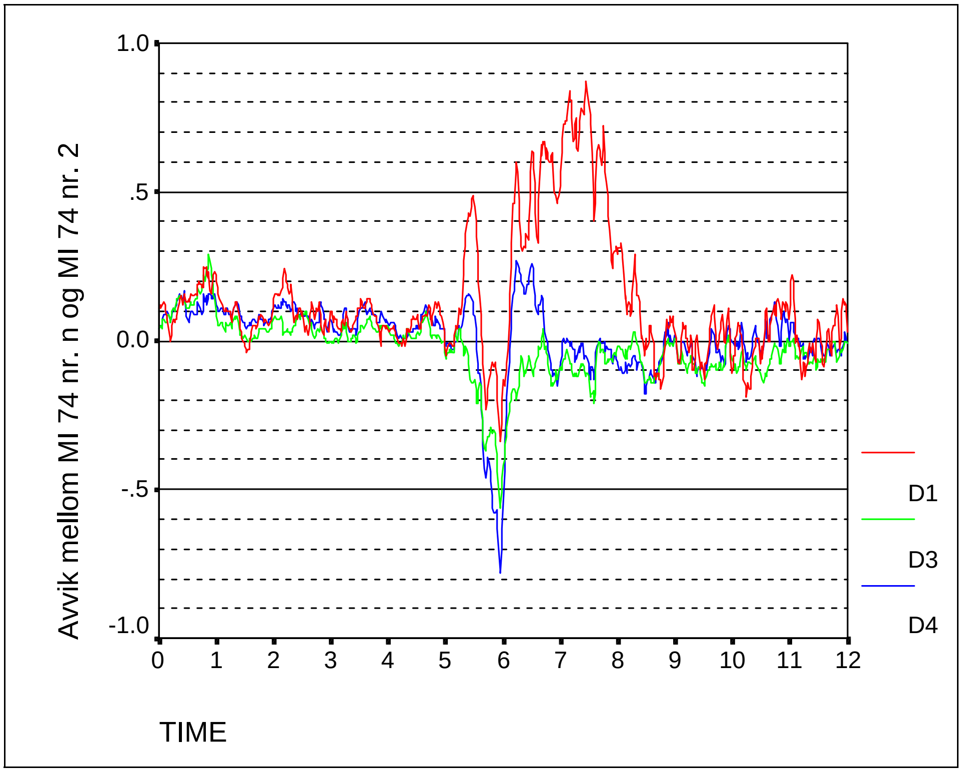
7. Data acquisition and storing

By means of an electronic switch and a digital multimeter, all temperatures are measured 12 times a minute, while one-minute average values, calculated from these frequent measurements, are stored. The influencing parameters are collected by a separate datalogger. Both the datalogger and the digital multimeter are connected to a PC where the data acquisition and storing software runs. The data are monitored in real-time on the PC-screen, both as absolute values and as differences.

8. Some results

Since the results obtained from the still ongoing intercomparison are reflecting preliminary evaluations only, one may note that no official publication is available yet.

To underline the importance of real-time monitoring of the temperature measurements in connection with the observation of influencing variables at the comparison site, such as rain, a very specific result is given below to clearly demonstrate this need. The diagram shows the differences between temperature measurements obtained within 3 of the tested MI-74 screens over 12 hours in the morning. From being quite small until 5.00 a.m., suddenly the deviations increased significantly, as visible.



In preliminarily analysing this event, it seemed that the sudden deviation might have been caused by the start of rainfall at exactly this time. This assumption was in the end true, however in a quite different manner than one could expect. Further investigations unveiled that it was caused by a mistake in the construction when modifying the design of the MI-74 screen in the early 1990ies. This made it possible that rain water could drip from the roof of the screen directly onto the temperature sensor! No further explanation on this surprising "temperature effect" is necessary while it is an essential, but completely unexpected, result of the test.

Finally, taking into account the measurements obtained so far, it can briefly be reported that no significant deviation in the temperature measurements could be explored when inter-comparing the 3 different cylindrical types of screens tested. However, as expected the wall-mounted screen type, which was previously used, showed, a substantial deviation up to probably more than 3 K compared with the reference screen MI-74. More detailed results of the intercomparison will be published after the termination of the Intercomparison in 2002. A paper was presented at TECO-2002 in Bratislava.