WORLD METEOROLOGICAL ORGANIZATION

COMMISSION FOR INSTRUMENTS AND METHODS OF OBSERVATION

EXTRAORDINARY MEETING OF THE LABORATORIES INVOLVED IN THE WMO LABORATORY INTERCOMPARISON OF RAINFALL INTENSITY GAUGES

De Bilt, The Netherlands

13 September 2005

FINAL REPORT
## CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agenda</td>
<td>ii</td>
</tr>
<tr>
<td>Executive summary</td>
<td>iii</td>
</tr>
<tr>
<td>General summary of the work of the meeting</td>
<td>1-20</td>
</tr>
<tr>
<td>Annexes:</td>
<td></td>
</tr>
<tr>
<td>List of participants</td>
<td>ANNEX I, p.1 – p.2</td>
</tr>
<tr>
<td>Data Policy</td>
<td>ANNEX II, p.1</td>
</tr>
<tr>
<td>Final report (draft contents, outline, and layout)</td>
<td>ANNEX III, p.1 – p.2</td>
</tr>
<tr>
<td>Planning stages of the Field intercomparison</td>
<td>ANNEX IV, p.1</td>
</tr>
</tbody>
</table>
AGENDA

1. ORGANIZATION OF THE SESSION
   1.1 Opening of the session
   1.2 Adoption of the agenda
   1.3 Working arrangements for the session

2. REPORT OF THE PRELIMINARY RESULTS OF THE INTERCOMPARISON HELD IN LABORATORIES INVOLVED

3. INTERCOMPARISONS DATABASE

4. PREPARATION OF THE FINAL REPORT

5. PREPARATIONS FOR THE WMO FIELD INTERCOMPARISON OF RI GAUGES

6. ANY OTHER BUSINESS

7. CLOSURE OF THE SESSION
EXECUTIVE SUMMARY

The extraordinary meeting of the three laboratories involved in the WMO Laboratory Intercomparison of Rainfall Intensity Gauges was organized immediately after the end of the laboratory tests to agree on the intercomparison database and to facilitate early preparation of intercomparison results. The meeting agreed on the contents, outline, and layout of the Final report and the responsibilities of individuals in drafting the report.

In order to proceed with the request of the EC-LVII, June 2005, the meeting discussed the preparation of the Field Intercomparison of Rainfall Intensity Gauges. It agreed on the detailed programme and a timetable of the intercomparison.
GENERAL SUMMARY

1. ORGANIZATION OF THE SESSION

1.1 Opening of the session

1.1.1 The session was held in De Bilt, the Netherlands on 13 September 2005.

1.1.2 The session was opened by Dr F.J.J. Brouwer, the Permanent Representative of Netherlands with WMO. He welcomed the participants, recalled the WMO responsibilities in organizing the intercomparisons and wished everyone a fruitful and productive meeting. The list of participants is given in Annex I.

1.2 Adoption of the agenda

1.2.1 The participants adopted the Agenda for the meeting, which is reproduced at the beginning of this report.

1.3 Working arrangements for the session

1.3.1 The working hours and tentative timetable for the meeting were agreed upon.

2. REPORT OF THE PRELIMINARY RESULTS OF THE INTERCOMPARISON HELD IN LABORATORIES INVOLVED

2.1 The representatives of the laboratories involved presented results of the third phase of the laboratory intercomparison held in the DIAM laboratory of the University of Genoa, Italy, in the laboratory of Météo France, Trappes and in the laboratory of KNMI, De Bilt, the Netherlands.

2.2 It was agreed that the results achieved are consistent with the objectives set-up by the ET/IOC. The laboratories officially announced the end of the intercomparison tests and the Chairperson concluded that this part of the intercomparison was successful.

2.3 In the discussion proposals were made on the best way to represent the results in the final report, especially in relation to the second order polynomial interpolation for the error curve.

2.4 Delivery of the instruments back to manufacturers was organized on a timely manner. The exception is a raingauge that is held by the customs in the Netherlands for unknown reasons. The KNMI and respective manufacturer are working together to solve the problem, with a possible return of the sensor to Météo-France, for shipping it back to USA, to overcome the Dutch custom problems.

3. INTERCOMPARISONS DATABASE

3.1 The project manager will put the intercomparison database together using the inputs from the laboratories. The Site managers will provide their partial databases (raw data and processed data) to the project manager before the end of September. The ET/IOC Chair, the Project manager and WMO will keep the intercomparison database for the future reference purposes and possible queries.

3.2 The meeting proposed that ET/IOC chair decides on the Data Policy on behalf of the ET/IOC. The draft Data Policy is attached in Annex II.
4. PREPARATION OF THE FINAL REPORT

4.1 The meeting agreed on the contents, outline, and layout and the responsibilities for the preparation of the final report of the intercomparison. The Project leader, using the inputs from the Site managers, ET/IOC Chair and WMO Secretariat, will prepare the final report within the following time frame:

- Inputs by responsible person to Project leader by 13 October 2005;
- First draft of the report ready by 13 November 2005;
- Comments on the first draft to Project leader by 1 December 2005;
- Second draft ready for the ET/IOC Meeting by 5 December 2005;
- Final draft ready by 20 December 2005.

4.2 The contents, outline, and layout of the final report and the responsibilities of contributors are in Annex III. The Project manager has the overall responsibility for drafting the Final report, which is subject to an approval by the ET/IOC Chair before publication.

5 PREPARATIONS FOR THE WMO FIELD INTERCOMPARISON OF RI GAUGES

5.1 The meeting endorsed the decision of the ET/IOC chair to organize the WMO Field Intercomparison of Rainfall Intensity Gauges in Vigna di Valle, Italy and agreed on the time frame of the intercomparison taking into account the time needed for the identification of the reference instrument for the field intercomparison, the local climatological conditions of the testing site and the need to conduct necessary adaptations of the testing site. The planning is in Annex IV.

5.2 The WMO Secretariat will identify a suitable expert who would be responsible for the intercomparison database, the quality control of data throughout the intercomparison, the data analysis, and the preparation of the final report. The expert will assist the local organizer to set-up the acquisition system that suits best to WMO Field Intercomparison of RI gauges. Mr Lanzinger, the Project manager approved by the ET/IOC for the filed intercomparison, will also provide advice and assistance in designing and functioning the acquisition system.

5.3 The invitation to Permanent Representatives and HMEI will be accompanied by the Questionnaire on proposed instruments and basic information on the acquisition system to be used at the site. The Questionnaire and the information on the acquisition system will be prepared within 2 weeks by the Project manager in consultation with the representative of the testing site.

5.4 WMO will inform the Permanent representative of the host country with WMO on the updated planning and will request nomination of the Site manager(s) who would then become a part of the International Organizing Committee.

6 ANY OTHER BUSINESS

6.1 The ET/IOC Chair informed the meeting on the results of the preliminary agreement with Algeria in hosting the WMO Combined Intercomparison of Thermometer Screens/Shield with the Humidity Measuring Instruments. Algeria will inform WMO on their intention to conclude the agreement with WMO. The details will be provided to the second session of the CIMO ET/IOC, Geneva, 5-9 December 2005.

7 CLOSURE OF THE SESSION

7.1 The session was closed on 13 September 2005 at 18h15.
List of participants

Mr Jitze van der MEULEN
Royal Netherlands Meteorological Institute
R & D Observations Division
Wilhelminalaan 10
P.O. Box 201
NL-3730 AE de BILT
Netherlands
Tel: +31 30 220 6432
Fax: +31 30 221 0407
E-mail: Jitze.van.der.Meulen@knmi.nl

Mr Michel LEROY
Météo France DSO/DOS
7, rue Teisserenc de Bort
B.P. 202
F-78195 Trappes
France
Tel.: +(33 1) 3013 6405
Fax: +(33 1) 3013 6020
E-mail: michel.leroy@meteo.fr

Mr Luca LANZA
DIAM – Department of Environmental Engineering
University of Genoa
Via Montallegro
1 16145 Genova
Italy
Tel.: +(39 010) 353 2123
Fax: +(39 010) 353 2481
E-mail: luca@diam.unige.it

Mr Christophe ALEXANDROPOULOS
Météo France DSO/DOS
7, rue Teisserenc de Bort
B.P. 202
F-78195 Trappes
France
Tel.: +(33 1) 3013 6577
Fax: +(33 1) 3013 6020
E-mail: christophe.alexandropoulous@meteo.fr

Mr Luigi STAGI
DIAM – Department of Environmental Engineering
University of Genoa
Via Montallegro
1 16145 Genova
Italy
Tel.: +(39 010) 353 2480
Fax: +(39 010) 353 2481
E-mail: luigi@diam.unige.it

Mr Wiel WAUBEN
Royal Netherlands Meteorological Institute
Instrumentation Division
Wilhelminalaan 10
P.O. Box 201
NL-3730 AE de BILT
Netherlands
Tel: (+31 30) 220 6482
Fax: (+31 30) 221 0407
E-mail: Wiel.Wauben@knmi.nl

ANNEX I
Mr Eckhard LANZINGER  
Deutscher Wetterdienst  
Frahmredder 95  
D-22393 Hamburg  
Germany  
Tel.: (+49 40) 6690 2455  
Fax: (+49 40) 6690 2499  
E-mail: eckhard.lanzinger@dwd.de

Ms Muriel Lacombe  
Météo France DSO/DOS  
7, rue Teisserenc de Bort  
B.P. 202  
F-78195 Trappes  
France  
Tel.: +(33 1) 3013 6530  
Fax: +(33 1) 3013 6020  
E-mail: muriel.lacombe@meteo.fr

Dr Emanuele Vuerich  
Italian Air Force Met Service - Experimentation Centre of Met Instrumentation  
Via Braccianese km18  
00062 Vigna di Valle, Bracciano  
Rome  
Italy  
Tel.: +39 0699801013  
Fax: +39 +39 069987297  
E-mail: vigna@meteoam.it

WMO Secretariat  
7 bis, avenue de la Paix  
CH-1211 Geneva 2  
Switzerland

WMO website: www.wmo.int

WWW website: www.wmo.int/web/www/www.html

Dr Miroslav Ondras  
Senior Scientific Officer  
Observing System Division  
World Weather Watch – Basic Systems Department  
Tel.: +(41) 22 730 8409  
Fax: +(41) 22 730 8021  
E-mail: MOndras@wmo.int
WMO Laboratory Intercomparison of RI Gauges

Data Policy
(draft)

1. All data collected by the WMO Project Team during the intercomparisons are entered into a comparison database and validated by the agreed procedure. After validation no change are allowed in the comparison database.

2. The WMO has the copyright of the comparison database.

3. After the intercomparison, every participant will get a copy of the comparison database related to its own instrument(s).

4. The complete comparison database will be kept by WMO Secretariat, the ET/IOC chair, the project leader and site managers. WMO may, if requested by the IOC, export whole or part of the comparison database on to CIMO/IMOP website.

5. The comparison database may be provided to other parties for the purpose of scientific studies on the subject. This requires an approval of the ET/IOC chair.

6. The WMO authorizes the project leader, with the agreement of the ET/IOC chair, to publish full results of the intercomparison on behalf of the IOC.

7. For the publication and for the third parties, the participants are only allowed to use their own data. In doing so they will avoid qualitative assessment of their instruments in comparison with other participating instruments.
WMO Laboratory Intercomparison of Rainfall Intensity Gauges

FINAL REPORT
(Draft contents, outline, and layout)

PREFACE (M. Ondras)

PART I: RAINFALL INTENSITY MEASUREMENT INSTRUMENTS AND UNCERTAINTY

1. Rainfall Intensity (J. van der Meulen)
   - Definitions
   - Space and time scales
   - Fields of application (climatology, meteorology, hydrology, …)
   - Operational requirements
2. Rainfall Intensity Gauges (M. Leroy)
   - Overview of RI measurement principles
   - Historical notes
   - Direct vs. indirect measures
   - Remote sensing of precipitation
   - Catching vs. non-catching instruments
   - Data correction algorithms
3. Uncertainty Sources and Measurement Errors (L. Lanza)
   - Types of error in RI measurements
   - Weather related errors
   - Counting vs. catching errors
   - Previous related intercomparison

PART II: LABORATORY INTERCOMPARISON RESULTS AND CONCLUSIONS

1. Rationale (M. Ondras)
   - Background and Objectives of the Intercomparison
   - Laboratory vs. Field Intercomparison
   - Selection of the laboratories
   - Brief description of each laboratory
2. Methods (L. Lanza)
   - General methodology of the intercomparison
   - Adopted testing procedures
   - Testing device
   - Brief description of test device in each laboratory (KNMI, Météo France, DIAM)
   - Uncertainty of reference intensity
3. Intercomparison Database (L. Lanza)
   - Description of the database
   - Quality control
   - Data policy
4. Participating Instruments (L. Lanza)
   - Description of the instruments
   - Tipping-Bucket Rain Gauges
   - Weighting Gauges
5. Results (L. Lanza)
   - Presentation of the results (dots connected and bars with 5% band highlighted and Ir vs. Im (only avg) in log-log with table for parameters comparison) avg 3 pts discarding extremes but bars over all 5
   - Data correction
   - Tipping-Bucket Rain Gauges
   - Weighting Gauges
   - Other Measuring Principles

6. Conclusions and Recommendations
   - Performance of the instruments. (L. Lanza)
   - Standardized procedure for laboratory calibration of catchment type rain gauges, including the uncertainty of laboratory testing devices within the range from 2 to 2000 mm/h. (M. Leroy)
   - The need to proceed with a field intercomparison of catchment type of rainfall intensity gauges. (L. Lanza)
   - The most suitable method and equipment for reference purposes within the field intercomparison of catching and non-catching types of gauges. (J. van der Meulen)
   - Information on different measurement systems relevant to improving the homogeneity of rainfall time series with special consideration given to high rainfall intensities. (L. Lanza)

ACKNOWLEDGEMENTS
REFERENCES
APPENDIX - Data Sheets (L. Lanza)
One sheet per instrument reporting synthetic data from the tests performed.
WMO Field Intercomparison of the Rainfall Intensity Gauges

Planning stages

<table>
<thead>
<tr>
<th>Action</th>
<th>End of action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Invitations to PRs and HMEI:</td>
<td>30 October 2005</td>
</tr>
<tr>
<td>2 Deadline for nominations of instruments:</td>
<td>30 November 2005</td>
</tr>
<tr>
<td>3 Selection of participating instruments:</td>
<td>10 December 2005</td>
</tr>
<tr>
<td>4 Information/instructions to manufacturers</td>
<td>30 December 2006</td>
</tr>
<tr>
<td>5 Transport of instrument to testing site:</td>
<td>15 to 30 May 2006</td>
</tr>
<tr>
<td>6 Installation:</td>
<td>15 June 2006</td>
</tr>
<tr>
<td>7 Testing:</td>
<td>30 June 2006</td>
</tr>
<tr>
<td>8 Start of the intercomparison:</td>
<td>1 July 2006</td>
</tr>
<tr>
<td>9 End of the intercomparison:</td>
<td>30 April 2007</td>
</tr>
<tr>
<td>10 Transport of instrument to manufacturers:</td>
<td>15 to 30 May 2007</td>
</tr>
</tbody>
</table>