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| **World Meteorological Organization**  **CIMO Management Group**  **Fifteenth Session** Geneva, Switzerland, 26 – 29 March 2018 | **CIMO/MG-15/Doc. 2.2(3)** |
| Submitted by: B. Hartley (& E. Vuerich)  20.03.2018 |

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# Report on progress, recommendations

# and future activities of Expert team ON

# INSTRUMENT INTERCOMPARISONS (ET-II-A3)

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| **Summary and purpose of document**  This document provides information on the progress of tasks assigned to the ET, identifies achievements and problems encountered, and provides recommendations for consideration by CIMO MG-15. |

**Action proposed**

The Meeting is invited to review this report, and to comment on and approve the updated Work Plan.

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**Appendices:** I [Updated Workplan](#Appendix1)

II [SPICE project report - status](#Appendix2)

III [Feasibility Study of Thermometers and Radiation Shield Intercomparison](#Appendix3)

IV [Upper-Air Instrument Intercomparison – Report to WMO/CIMO](#Appendix4)

V [Topics and deliverables for after CIMO-17](#Appendix5)

**EXECUTIVE SUMMARY**

* During the intersessional period higher level group collaboration has consisted of two significant opportunistic meetings (while attending other planned events), and one Webex held early in each of the years 2016, 2017 and 2018. There was initial enthusiasm after each of these interactions however due to work loads and limited stimulation the work programs did not progress as well as planned. It is recommended that there be a requirement for ET meetings (Webex, opportunistic, other) at least once every 6 months, with potentially an official ET meeting 1.5 years after the ET establishment.
* The resignation and lack of timely replacement of several ET-II members later in the intersessional period has significantly slowed progress.
* Task 1 - WMO Solid Precipitation Intercomparison Experiment (SPICE):
  + Publication of the final SPICE Report on the WMO web site is expected in August 2018. Production of CIMO Guide updates and guidance material will follow after that. Additional details about the SPICE project are included in Appendix II.
  + It is recommended that the task for production of CIMO Guide updates and guidance material resulting from SPICE be carried over to the next intersessional period.
* Task 2 - Outcomes of the national China solid precipitation intercomparison:
  + No results or papers have yet been able to be supplied to the ET for review. The ET Chair has now taken the lead for this task and will make one more attempt (Q2 2018) to progress this task.
  + It is recommended that this task be carried over to the next intersessional period if no results or papers can be reviewed in this intersessional period.
* Task 3 - Liaison with other ETs, RAs and communities (BSRN, GAW, WCRP, etc.) on results of and intentions for intercomparisons:
  + A survey has been conducted and a table of plans with some web links has been created - see ET-Chair report 1.6. Further plans are expected to be added to the table in the coming months.
  + There will be no CIMO Guide updates.
  + It is recommended that the table of plans be presented at CIMO-17 for discussion.
* Task 4 - Potential Future Intercomparisons:
  + The results of task 3 above have been combined with the list of potential International Instrument Intercomparisons recorded at CIMO-16 (WMO n. 1138 Annex II), and presented in a table that is now prioritized - see ET-Chair report 1.7.
  + One new potential future intercomparison has been identified and a feasibility study prepared, namely: "Feasibility Study of an Intercomparison of Thermometers and Radiation Shields", refer Appendix III.
  + It is recommended that the feasibility study "Feasibility Study of an Intercomparison of Thermometers and Radiation Shields" be presented at CIMO-17 for discussion.
  + It is recommended that the new Potential Future Intercomparisons prioritised table be presented at CIMO-17 for discussion.
  + It is recommended that Potential Future Intercomparisons titles be reviewed and that all include "WMO..." or have this removed, except for those conducted by other independent organisations.
* Task 5 - WMO Radiation Intercomparisons
  + The 4th WMO Regional Pyrheliometer Comparison (RPC) of RA II, jointly held with RA V has been reviewed and an IOM publication is expected very soon.
  + A table of planned radiation regional intercomparisons has been created and is included, see ET-Chair report 1.8.
  + It has been identified that the mechanism of regular IPCs is a key element for traceability and homogeneity of radiation measurements around the world, however the frequency of such events may be inadequate. It is recommended that a task be included for the future ET to review the adequacy of the current program and if necessary propose a new mechanism and/or intervals.
* Task 6 - Instrument Intercomparison for upper air and remote-sensing measurements
  + The previous feasibility study was reviewed and the subsequently re-reviewed by a new project leader (D. Ruffieux, MeteoSwiss, not a member of the ET), and a report prepared, see Appendix IV. There is a tentative plan in place by DWD, using the Lead Centre Lindenberg facility, to perform the project in 2019.
  + It is recommended that the feasibility study "WMO-CIMO Upper-Air Instrument Intercomparison TT-UAII Report to WMO-CIMO" be presented at CIMO-17 for discussion.
* Task 7 - Instrument Intercomparison for volcanic ash/aerosol detection
  + The Task Team is preparing a project feasibility study and the report is 95% complete. There are some final discussions between experts about the role of dust in detecting ash, the outcome of which are required to finalize the report.
  + Experts from Japan have signalled a potential location, Kagoshima, to perform an intercomparison. It is recommended the in the next intersessional period this offer be followed up by the ET.
  + The proposal/plan for conducting an intercomparison will not be completed in this intersessional period.
  + It is recommended that the feasibility study (soon to be completed) be presented at CIMO-17 for discussion.
  + It is recommended that this task be carried forward to the next intersessional work program, noting that some preparatory work was carried out that will be available to the future ET.
* Future Work Program - To create efficiencies in the operation of the ET
  + It is recommended that a dataset of principal contact points and stakeholders in ETs, RAs, RICs, TBs/LCs, RAs, BSRN, GAW, etc. be created. The dataset to be designated as a deliverable and updated during the intersessional period by the ET.
  + It is recommended that the ET carry out a survey with the objective of creating a dataset (with web links and contact points) of concluded/on-going/planned/intentions of instrument intercomparisons. The dataset to be designated as a deliverable and updated during the intersessional period by the ET.

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**REPORT ON ACHIEVEMENTS, RECOMMENDATIONS AND FUTURE ACTIVITIES OF CIMO EXPERT TEAM ON INSTRUMENT INTERCOMPARISONS (ET-A3-II)**

(Submitted by ET-II Chairperson ITAF Lt.Col. (Dr) Emanuele Vuerich)

1. ***Major achievements with respect to Workplan***
   1. (**Function recall and meetings**). The Expert Team on Instrument Intercomparisons (ET-A3-II) is coordinated by the OPAG In-Situ Technologies and Instrument Intercomparison to assist the CIMO Management Group in planning, prioritize, coordinate implementation, review and evaluate global and regional instruments intercomparisons (ToRs in WMO no. 1138 Annex III). The ET’s members have not convened in official meetings up to now, except from “task or opportunity meetings” (some examples: annual SPICE-meetings for WP task no.1, ILRC New York opportunity meeting for instruments intercomparison for volcanic ash/aerosol detection WP task no. 7, Task Team meetings and teleconferences for Feasibility Study on an upper-air intercomparison WP task no. 6). The last three Webex telephone conferences have been held on:

* 3rd March 2016
* 8th March 2017
* 25th January 2018

Next webex teleconference has been planned after the CIMO MG-15 meeting for implementing indications and decisions from MG.

* 1. (**Updated Membership**). After several resignations of original ET’s members the actual composition of the team is:

(Actual Members – WP Tasks responsibility assigned by CIMO-16)

* + - Emanuele Vuerich (Italian Air Force – Met Service, Italy), ET-Chair;
    - Yatian Guo (Meteorological Observation Centre, CMA, CINA);
    - Marijn De Haij (KNMI, The Netherlands);
    - Wolfgang Finsterle (PMOD/WRC, Switzerland).

(Representative Members)

* + - Carmen Garcia Izquierdo (Representative of BIPM/CCT);
    - Johanna (Ms) Lentonen (Representative of HMEI);
    - Monika (Ms) Klocova (Representative of HMEI);
    - Brian Day (Representative of HMEI);
    - Timo Ryyppö (Representative of Sodankylä (Finland) Testbed);
    - Young-San Park (Representative of Boseong (Republic of Korea) Testbed).

By decision of CIMO MG-14 (2016), there was or will be replacement of resigned members, therefore special or additional support was requested to other ET-II members or even non ET-II members (only if directly involved into the matter in subject). For the last two years, Ms Izquierdo has been kindly requested to serve as supporting member in accomplishing some WP tasks and Dr Yves-Alain Roulet (MeteoSwiss, ET-A1-OIST Chairperson) has been responsible for the Task 1 (Report of Solid Precipitation Intercomparison Experiment – SPICE).

* 1. (**Workplan - WP**) According to the deliverables of approved tasks, the task – by – task major achievements are reported in the following paragraphs. The Workplan has been updated accordingly and provided in Appendix I.
  2. **Task 1 - WMO Solid Precipitation Intercomparison Experiment (SPICE)**

The field experiments were completed in 2015 and the data analysis has been completed in 2016. Dr Yves-Alain Roulet (MeteoSwiss) is coordinating the drafting of the final report. All sensors under test have been assessed, and results compiled in separate Instrument Performance Report (IPR), presented as annex to the final report. Adjustment factors (transfer functions) have been developed (papers published). The major outcomes will be some recommendations for updating the CIMO Guide and best practices regarding the operational use of automatic instruments, developing Siting and Sustained Performance Standards for the measurement of Solid Precipitation and Snow on Ground, scientific papers and availability of fully quality-checked datasets. Lessons learned and recommendations for future works on the subject will be also documented in the report.

From April to July 2018 a final review has been planned by the project team and the publication of the SPICE Report on the WMO web site is expected in **August 2018**. Recommendations for CIMO Guide’s update and guidance material will be available after report’s publication (Q4 2018).

Additional details about SPICE are reported in Appendix II.

* 1. **Task 2 - Outcomes of the national China solid precipitation intercomparison**

After the first contacts in 2014 and 2015, it was not possible to receive feedbacks about the outcomes of the national China solid precipitation intercomparison. During the last ET webex teleconf, it was highlighted the importance of such intercomparisons within WMO Regions that represent a priority for network performances and standardization. Considering the wide range of benefits deriving from sharing the outcomes of such intercomparison, the ET Chair decided to take the lead of this Task 3 and to make a last attempt with Y. Guo and/or with China National Meteorological Agency (through WMO Secretariat) and/or with the RIC-China in order to have access to available results and outcomes of the above-mentioned intercomparison but not later than June 2018 and before CIMO-17.

* 1. **Task 3 - Liaison with other ETs, RAs and communities (BSRN, GAW, WCRP, etc.) on results of and intentions for intercomparisons**

With regard to this task, significant progresses have been done recently. During the last teleconferences, C. (Ms) Izquiedo (ET-II member representing BIPM/CCT, no original ET-II tasks assignee) was invited to take the lead of Task 3, supported by M. De Haij (ET member from KNMI). Even if not yet completed, a preliminary list of liaisons (relevant ETs, RIC, communities) has been prepared and the related contacts have been established to prepare the expected deliverables. A preliminary survey has been conducted by the ET-A3-II to provide a view of other relevant institutions/communities (NMHS, ETs, RICs/Testbeds/Lead Centres) perspectives on the subject, specifically a point of situation of “on going/intentions of/completed” instrument intercomparisons. Although not yet completed (survey), it is possible to provide CIMO-MG with the following schematic table according to those ones who have replied to the survey:

|  |  |  |  |
| --- | --- | --- | --- |
| **Liaisons** | **Instrument Intercomparison** | **Status** | **Link/Info** |
| RIC Japan | 1. Inter-lab comparison pressure- humidity-temperature, cooperation with (RA VI) RIC Slovenia and RIC Philippines 2. Wind tunnels/anemometer 3. Precipitation gauges | PS  Iof  Iof | 2018, link available[[1]](#footnote-2) |
| RIC Argentina | Activities of training/capacity building and AWS comparisons for pressure, temp, hum, wind | / | / |
| RIC Slovakia | 1. Brewer Spectrophotometers intercomparison for Central Europe Region (Hungary, Slovakia, Poland) in Ganovce 2. Radiation shields for weather sensors at national level in Bratislava-Keliba | PS  PS | 2019  2018-2020 |
| RIC France | 1. Instrument intercomparison of lidars/celiometers on the measurements of aerosol and volcanic ash | Iof (see Task 7) | Scientific Reference Doc (soon available),  by F. Besson, J-L. Lampin, O. Peyrat, F. Ruiz, P. Keckhut |
| RIC China | 1. 4th WMO Regional Pyrheliometer Comparison of RAII, jointly held with RAV 2. Reference thermometers and reference barometers at national level (National Centre Metrology) | O  Iof | Jan-Feb 2017, waiting IOM publication  Next years |
| RIC Philippines | See n.1 |  |  |
| RIC Slovenia | 1. WMO Regional Pyranometer Intercomparison | PS | DHMZ Croatia and RIC Ljubljana |
| DWD | 1. Comparison of manual and automatic measurements of temperature at 2 m (national level, climate reference network) 2. Ceilometer Performance Experiment at Lindenberg | C  O | 29 Nov 2016, link available[[2]](#footnote-3)  2015, link available[[3]](#footnote-4)  (related to Task 7) |
| MeteoSwiss | 1. Instrument intercomparison of Upper Air Measurements (intention of cooperation with DWD) | Iof (see Task 6) | 2019, Feasibility Study by D. Ruffieux |

***Legend,*** *Status: OG (on going), C (completed), Iof (intentions of), PS (planned/scheduled).*

The completion of the survey is expected in June 2018 in order to complete task deliverables n. 1 and 2 and provide CIMO-17 a complete “picture” for its decisions.

Critical Point: to coordinate updates of relevant CIMO Guide chapters (deliverable n.3 of Task 3) before the end of ET-A3-II’s mandate

Proposals of future instrument intercomparisons have been considered in the next task no. 4 achievements.

* 1. **Task 4 -** **Potential Future Intercomparisons**

Combining the results of the above-mentioned preliminary survey conducted by ET-II task responsible members and considering the list of potential International Instrument Intercomparisons reported in WMO no. 1138 Annex II (CIMO-16 list), the requested assessment of priorities is summarized in the following **updated and commented potential future intercomparisons list** which is proposed to CIMO-MG-15 for revision, approval and recommendations to CIMO-17:

|  |  |  |  |
| --- | --- | --- | --- |
| **Highest priority**  (x) position in list from CIMO-16 (2014) | **CIMO-16**  **List n.** | **Proponent** | **Comments** |
| (2) Radiosonde performance intercomparison  (ET-A3-II Workplan Task 6 – WMO Upper Air and remote sensing instrument intercomparison) | 2 | CIMO  Switzerland  Germany (?) | Feasibility study available[[4]](#footnote-5).  (?) scheduled in 2019[[5]](#footnote-6).  Preferably on regular base in future (5/7 years) |
| (3) Vertical Aerosol and volcanic ash concentration by optical remote-sensing intercomparison  (ET-A3-II Workplan Task 7) | 3 | CIMO  France | Scientific Reference Document (end of March 2018) |
| **Of Interest** | | | |
| (New) Intercomparison of Thermometers and Radiation Shields | new | Meteomet  BIPC/CCT  ET-A3-II | Feasibility study available[[6]](#footnote-7). Proposal during CIMO-17 |
| (New) Intercomparison of non-catchment type instruments for solid and liquid precipitation measurement (remote-sensing/new technologies) | new | ET-OIST  LeadCentre Italy  NCAR USA  RIC Japan | Dual purpose: follow-up of SPICE and comparison of visibility and present weather sensors (optical) for AWS.  Proposal during CIMO-17 |
| **Regularly scheduled** (to be inserted in a separated list) | | | |
| (1) International Pyrheliometer Intercomparison (IPCs) | 1 | CIMO  ET-A3-II | Every 5 years |
| (New) International Pyrgeometer Comparisons (IPyCs) |  | CIMO  ET-A3-II | In conjunction with IPCs |
| (7) WMO Regional Pyrheliometer Comparisons (RPCs) | 7 | CIMO  RAs | Multi-regional, not international  Every 2/3 years |
| (5) Regional intercomparison of reference pyranometers of the WMO RA VI Members (global irradiance) | 5 | RA VI | In conjunction with RPCs. |
| **On-going** (to inserted in a separated list) | | | |
| (6) WMO SPICE[[7]](#footnote-8) | 6 |  | Final Report in August 2018 |
| **Completed** | | | |
| (14) WMO High Quality Radiosonde Regional Intercomparison, Region II, China | 14 |  | It may be deleted from list |
| **Lowest priority or no priority** | | | |
| (4) Surface aerosol concentration intercomparison | 4 |  | Is CIMO pertinent? |
| (8) WMO combined intercomparison of thermometer screens/shields in conjunction with humidity-measuring instruments in Artic Region | 8 | Canada (2008) | To be included in “*Intercomparison of Thermometers and Radiation Shields*” |
| (9) WMO intercomparison of Present Weather Sensors in Tropical conditions | 9 |  | To be included in a general campaign of PW sensors in various climatic regions |
| (10) WMO Pilot Intercomparison of sea-level and Tsunami Monitoring Instruments | 10 |  | Is CIMO pertinent? |
| (11) WMO Intercomparison of Hydrological gauges to cover both normal conditions and extreme events | 11 |  | Is CIMO pertinent? |
| (12) WMO Intercomparison of Celiometers in support of the ET on Upper Air Systems Intercomparisons | 12 |  | To be re-formulated of possibly included in n. 2 or n.3. See an on-going national experiment[[8]](#footnote-9) |
| (13) WMO Combined Intercomparison of pyranometers, sunshine duration instruments, UV sensors | 13 | Former ET-II  Italy  RIC China | To be possibly combined with n.5 and organized on regular base  Similar completed intercomparison comparisons[[9]](#footnote-10)  Preferably under WMO RRCs |
| (15) Weather radar workshops to examine differences on signal and data processing using common signal data set | 15 |  | The International Intercomparison **RQQI**[[10]](#footnote-11) (weather radar) certainly supersedes this. It can be deleted. |
| (16) WMO International Evaluation of AMDAR Water Vapor Sensor | 16 |  | No feedbacks from ET-II survey |
| (17) WMO Evaluation of wind profiler wind measurement quality and quality control | 17 |  | To be included in n.2 (WMO UA&remote-sensing II) |
| (18) International Test-bed Experiments and Pilot Studies for integrated in-situ remote-sensing upper-air networks (including tropical and subtropical tests) | 18 |  | To be clarified. There is a task in ET-OIST linked with the integration of observing technologies for precipitation measurement (Japan to lead)[[11]](#footnote-12) |
| (19) Intercomparison of automatic radiosonde launching systems to be hosted and organized by Denmark in Greenland | 19 |  | Not sure an intercomparison of (co-located) automatic launcher is really needed (and feasible). |
| (20) Regional radiosonde intercomparison to be hosted and organized by India | 20 | India | Regional, not international.  Old proposal, under tasks of former ET-II. No more applicable, it may be deleted from list |

The feasibility study of the new proposal of a WMO Intercomparison of Thermometers and Radiation Shields has been recently developed, reviewed by ET-A3-II and submitted in Appendix II (and separately, pdf) for CIMO-MG-15 revisions, approval and recommendation to CIMO-17 for accepting such proposal in the list of future intercomparison and assigning the proper priority.

As proof of concept, the thermometers and Radiation Shields intercomparison or other proposal such the “dual purpose”[[12]](#footnote-13) intercomparison of non-catchment type instruments for solid and liquid precipitation measurement (remote-sensing/new technologies for both precipitation and visibility/present weather measurements for AWS) may be firstly organized at a regional/bi-lateral level (pilot study or first phase, etc.) and secondly at international level (establishment of an IOC).

* 1. **Task 5 - WMO Radiation Intercomparisons**

As previously reported, the 12th International Pyrheliometer Comparison (IPC – XII) was regularly conducted by PMOD-WRRC in Davos between September and October 2015. The final report has been published as the IOM n. 124 and as a keynote presentation during the TECO 2016 (IOM 125). The second International Pyrgeometer Comparison was conducted in parallel to IPC-XII and its final report was not published as IOM but a keynote presentation during TECO-2016, precisely oral presentation no. O2(8) in IOM 125 (CIMO IMOP web site). However the publication of IOM 120 “*Pyrgeometer Calibration Procedure at the PMOD/WRC-IRS*” is of significant importance and a milestone for future comparison and traceability assessment of longwave radiation measurements around the world.

Considering the efforts in IPgC, an appropriate single IOM publication would be beneficial for radiation community. ET encouraged the organization of IPgCs on regular basis, preferably in conjunction with IPCs.

ET members, specifically W. Finsterle (task owner) and C. Izquierdo (support), evaluated and reviewed the 4th WMO Regional Pyrheliometer Comparison (RPC) of RA II, jointly held with RA V after its completion. IOM publication is expected very soon.

Throughout the above-mentioned survey conducted by ET-II task responsible members, the editing of a list of planned radiation regional intercomparisons.

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| --- | --- | --- | --- |
| **Liaisons** | **Instr. Interc.** | **Status** | **Link/Info** |
| RRC Japan | 1. 4th WMO Regional Pyrheliometer Comparison of RA II, jointly held with RA V 2. Pyrgeometers intercomparison RA II+RA V 3. Regional Pyrheliometers Comparison (RPC) | C  PS  O | Jan-Feb 2017, waiting IOM publication  2022  2017 – 2018 |
| BSRN | 1. An intercomparison was performed in Payerne to assess the performance of Radiation Sensors for the Solar Energy Sector | C | 2017, Vuilleumier, L., C. Félix, F. Vignola, P. Blanc, J. Badosa, A. Kazantzidis, and B. Calpini |
| Sweden Met Hydro Institution | 1. Baltic Regional Pyrheliometer Comparison, BRPC | PS | May-June 2018 |

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Members strongly believe that the mechanism of regular IPCs (preferably in conjunction with IPgCs) at the international level (WRRC) and RPC (preferably in conjunction with RPgC and other radiation instruments) is the key element for traceability and homogeneity of radiation measurements around the world. Despite of this fundamental role, their frequency is still low and CIMO-17 should stress this aspect and encourage/support their organization at regional level. The future ET-II should establish contacts with Regional Radiation Centres (RRCs) since the beginning of its mandate and monitor their activities for providing assistance when appropriate and a status report every six months (future deliverable deadline, see paragraph 4 of this document).

* 1. **Task 6 - Instrument Intercomparison for upper air and remote-sensing measurements**

As requested by CIMO-MG-14, the previous feasibility study have been reviewed by the nominated Task Team[[13]](#footnote-14) (CIMO-MG-13, Dec. 2014). The ET-II task responsible member Rolf Philippona resigned in 2017. The new project leader D. Ruffieux (MeteoSwiss, not ET member) submitted an updated feasibility study on upper-air intercomparison, that has been reported in Appendix II (and separately, as pdf).

There is urgency for the organization of this type of intercomparison as this is very valuable topic for CIMO and for GRUAN’s scientific purposes. There is a tentative schedule for 2019 and a potential involvement of DWD and the Lead Centre Lindenberg (probably hosting facility) but these aspects will be confirmed in next months.

* 1. **Task 7 - Instrument Intercomparison for volcanic ash/aerosol detection**

The Task leader, F. (Ms) Besson recognized the need to have a scientific publication for WMO before proceeding with the proposal of a Task Team to CIMO-MG for the developing of the feasibility study for the intercomparison in subject, in other terms a scientific reference document (also suitable to be published as an IOM document). Jean-Luc Lampin, Meteo France expert, informs that some discussion amongst experts are still in progress about the role of dust in detecting ash and recommendations related these aspects. However, such document is 95 % developed and almost ready to be delivered for publication that is expected at the end of March. Meteo France also informed that several experts from Japan have been already contacted and a potential location for intercomparison would be Kagoshima, but this should be further investigated and then confirmed.

ET-A3-II will promptly advice CIMO-OPAG and MG on the availability of the scientific document and will request its publication as IOM. ET-A3-II will also propose the composition of a Task Team for starting the development of the feasibility study and intercomparison plan that should be preferably closed before next CIMO session (October 2018) in order to permit its evaluation and approval for intercomparison organizational process.

On F. Besson’ indications, ET-A3-II would propose to CIMO-MG-15 the establishment of the Task Team to carry out the feasibility study of the volcanic ash/aerosol detection intercomparison that should be preferably composed of Philippe Keckhut (LATMOS, France), Jean-Luc Lampin (Meteo France), Olivier Peyrat (successor of F. Besson in Meteo France), and Françoise Ruiz (Meteo France).

1. ***Problems encountered*** 
   1. ET members resignations during the intersessional period and no approved replacement mechanism to be adopted.
   2. The number of telephone conferences was less than the one planned at the beginning (for several reasons). The normal frequency should be one webex telephone conference at least every 6 months or on-demand prior a CIMO-MG meeting or CIMO sessions.
   3. Even if we are perfectly aware of WMO budgets limitations and constraints, at least one short ET general meeting (workplan, TT, feasibility studies, monitor of instruments intercomparisons all around the world, not only those WMO-listed, future actions) is necessary around the mid of mandate.
2. ***Recommendations***
   1. (WP Task 1) Evaluate the status of SPICE and provide suggestions (if any) for the final phase before and after CIMO-17.
   2. (WP Task 2). Evaluate and provide suggestions (see par. 1.5).
   3. (WP Task 3, 4 and 5). Comment on work done and make suggestions for final phase of ET-II’s mandate before CIMO-17. In particular:

* Evaluate the updated, prioritized and commented list of future potential instrument intercomparisons for recommending its adoption by CIMO-17 during the session discussions.
* Evaluate the feasibility study prepared by C. Izquierdo and reviewed by ET on a WMO instrument intercomparison of thermometers and radiation shields (Appendix II).
  1. (WP Task 6). Evaluate and provide indications on the feasibility study of a WMO intercomparison on upper-air (radiosondes) and remote-sensing measurements prepared by the UA-II task team (Appendix II) and reviewed by ET (Task 6 deliverable). Make a recommendation to CIMO-17 for the approval of the feasibility study and the beginning of the intercomparison (after the refinement of a detailed organizational plan).
  2. (WP Task 7). Comment on paragraph 1.10 and make suggestions about next activities related to the WMO intercomparison of lidars/celiometers instruments for the measurements of volcanic ash and aerosols (Task 7).
  3. (Proposed by the ET Chair). Evaluate the opportunity to have at least one ET meeting during intersessional period even if not specifically related to IOC activities for an approved/ongoing intercomparison. ET members needs to meet at least one time every 4 years (we suggest not later 1.5 years after ET’s establishment) to discuss face-to-face the development of the workplan, consider task teams establishment and activities, discuss and review feasibility studies and make plans.

1. ***Major topics for future work with expected associated deliverables***
   1. The description of major topics for future work must be intended for activities to be carried out within the mandate of the future established ET-A3-II, after CIMO-17 sessions. Before CIMO-17 the ET members tasks, related deliverables and associated workplan are reported in Appendix I.
   2. In the list below, the **proposed 3 major topics** are reported for next intersessional period (2018 – 2022):
      1. Monitor the progress of ongoing/started WMO instrument intercomparisons reported on the ET workplan (deliverable 1). Coordinate the **review of relevant CIMO Guide chapters** (deliverable 2), delivery of guidance materials/standards (deliverable 3) and IOM publications (deliverable 4) with those project leaders/IOC chairpersons responsible for instrument intercomparisons before and soon after the completion of their intercomparisons.
      2. Coordinating development of **feasibility study/organization plan** of the workplan-approved instrument intercomparisons (deliverable).
      3. Implement and make operative a more efficient and structured **monitoring task[[14]](#footnote-15)** **for collecting information about concluded/ongoing/planned/intentions of/need of instrument intercomparisons** **not reported in ET workplan** in order to assist the CIMO Management Group in planning, prioritizing, coordinating implementation, reviewing and evaluating global and regional instruments intercomparisons and update CIMO Guide. These objectives will be targeted through the achievement of a the following activities and pertinent deliverables:
         1. Prepare a suitable **dataset** of principal contact points of stakeholders: ETs, RAs, RICs, TBs/LCs, RAs, BSRN, GAW, etc. This dataset will be passed from the former ET to the next one after each quadrennial CIMO session and updated soon after with the new contact points as a consequence of CIMO session’s new nominations of experts/team leaders/contact points. The dataset will be updated during intersessional period when appropriate (deliverable 1).
         2. Carry out a **survey** to collect information about concluded/on-going/planned/intentions of/need of instrument intercomparisons. If available, collect web links and prepare a list. Regular recurrence of surveys during intersessional period: 6 months (deliverable 2).
         3. **Report** on survey’s results every 6 months (deliverable 3) and prepare recommendations for CIMO-MG on meetings occurrence (deliverable 4).
         4. Prepare a prioritized and updated list of potential future instrument intercomparisons (regional, international) to asses priorities for next CIMO sessions.

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**APPENDIX I****: UPDATED WORKPLAN**

| **No.** | **Task description** | **Person responsible** | **Action/Milestone** | **Deliverables** | **Deadline for deliver.** | **Status** | **Comments** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1. | **WMO Solid Precipitation Inter-Comparison Experiment (SPICE)** | **Y-L. Roulet** (Final Report responsible, no ET-II member)  E. Vuerich | 1. Monitor progress of SPICE 2. Incorporate guidance material from SPICE Final Report into updates of CIMO Guide | 1. Report to OPAG Chair  2. Updated CIMO Guide **(expected after SPICE Report official publication planned for August 2018)** | 1. Q2 2016 & Q1 2018   2. Q3 2018 | 1. 95%  2. **50%** | CIMO-16 §4.11, 4.21-22, 4.31, 7(7).6, 8.7  Main SPICE milestones:  - Field experiment completed 2015  - Data analysis completed 2016  - April to July 2018: completion of final report  - August 2018: WMO publication  **- Availability of CIMO Guide updates and guidance material after publication** |
| 2. | **Outcomes of the national China solid precip intercomparison** | **Guo Yatian** | 1. Share results and outcomes of China solid precipitation intercomparison | Document on China intercomparison outcomes | Mid 2015  (last proposal: June 2018) | 1. **0%** | **No other contacts or communication after ET teleconf 3rd March 2016** when a draft was announced in few months after. A last attempt will be conducted by ET Chair. |
| 3. | **Liaison with other ETs, RAs and communities (BSRN, GAW, WCRP, etc.) on results of and intentions for intercomparisons** | **C. Izquierdo** (BIPM/CCT representative, originally no ET-II tasks assignee)    M. de Haij,  with support of all | 1. Liaise with other CIMO ETs and external communities on plans/on-going/completed instrument intercomparisons 2. Collect links to published reports of national/regional intercomparisons 3. **Coordinate updates of relevant CIMO Guide chapters related to inter-comparisons with these groups and CIMO Editorial Board as required** | 1. Report to OPAG-A Chairs regarding plans for intercomparisons  2. List of relevant web links and ongoing projects  **3. Update of relevant CIMO Guide Chapters** | 1. Q2 2016 & Q1 2018 (June 2018) 2. Yearly April (June 2018) 3. Q2 2018 (June 2018) | 1. 80%  2. 80%  3. **0%** | CIMO-16 §4.11, 4.28, 4.29, 4.30, 4.31, 4.33  Updated Deadlines for deliverables due to technical difficulties.  Critical before the end of ET mandate: deliverable 3 within CIMO Guide EdB time limits. |
| 4. | **Potential Future Intercomparisons**  (original title modified by decision CIMO MG-14) | **C. Izquierdo** (BIPM/CCT representative, originally no ET-II tasks assignee)    M. de Haij,  with support of all | 1. Assess priorities for future CIMO intercomparisons | 1. Updated list of future intercomparisons (deliverable name modified by decision CIMO MG-14) | 1. Dec. 2017 | 1. 90% | CIMO-16, §4.29, 4.33, 7(12).6  Use CIMO-approved shortlist as the basis  ET conducted a survey (still in progress):  An updated and commented potential future intercomparisons list has been drafted and proposed to CIMO-MG-15 for revision, approval and recommendation to CIMO-17.  In June 2018, small changes may be provided after survey completion. |
| 5. | **WMO  Radiation Intercomparisons** | **W. Finsterle** | 1. Monitor progress of International Pyrheliometer Comparison XII (28 Sept. – 16 Oct. 2015) 2. Monitor progress of International International Pyrgeometer Comparison II (in tandem with IPC XII) 3. Ensure that final reports of intercomparisons are published as an IOM report 4. Liaise with Regional Radiation Centres on plans for reg. rad. interc. | 1. Report to OPAG Chairs 2. Report to OPAG Chairs 3. IOM Report 4. Report to OPAG Chairs | 1. Q2 2016 2. Q2 2016 3. Q2 2016 4. Q2 2016 | 1. 100%  2. 100%  3. 100%  4. 90% | CIMO-16 §4.11, 4.23-25, 4.29,4.31  IPC-XII, publication IOM n. 124  II Pyrgeometer International Intercomparison, keynote presentation n.O3(8) in IOM n. 125.  Pyrgeometer Calibration Procedure at the PMOD/WRC-IRS  IOM 120 |
| 6. | **Instrument Intercomparison for upper air measurements** | **D. Ruffieux (MeteoSwiss, not ET member, new project leader**  & Task Team | 1. Carry out feasibility study | 1. Propose TT membership 2. Proposal(s)/ plan for conducting an intercomparison | 1. Nov. 2014   2. Q4 2015 (effectively Q2 2016, final Q1 2018) | 1. 100%  2. 90% | CIMO-16 §4.11, 4.27, 4.28, 4.29,4.31, 4.33, 7(12).5   1. CIMO-MG 13 §3.1.10: TT approved 2. First draft Feasibility study delivered in March 2016 3. Updated version of Feasibility Study delivered in March 2018 (CIMO-MG-15) |
| 7. | **Instrument Intercomparison for volcanic ash/aerosol detection** | **O Peyrat (Meteo France, new project leader from 1 march 2018, no ET member)**,  M. de Haij,  & Task Team | 1. Carry out feasibility study | 1. Propose TT membership 2. Proposal(s)/ plan for conducting an intercomparison | 1. Nov. 2014   Postponed to April 2018     1. Q2 2016   Postponed to Q3 2018 (after deliv. n.1) | 1. 90%  2. **20%** | CIMO-16 §4.11, 4.28, 4.29,4.31, 5.24  1. CIMO-MG 13 §3.1.10: proposal for TT to be resubmitted  - Ad hoc meeting: NY, USA, July 2015, for ILRC  **2. A Scientific Reference Document is about to be published by the working group (end of March 2018). First step before TT and feasibility Study**  3. Feasibility Study study/proposal to be developed after TT establishment. |

**APPENDIX II**

**WORKPLAN TASK 1 - SPICE PROJECT REPORT**

**Dr Yves-Alain Roulet, 25 January 2018**

Status:

* Field experiments concluded in 2015.
* Data analysis has been completed in 2016. All sensors under test have been assessed, and results compiled in separate Instrument Performance Report (IPR), presented as annex to the final report. Adjustment factors (transfer functions) have been developed (papers published). The IPRs also include recommendations for users and for manufacturers, as well as best operational practices. Results per instrument type (tipping bucket, weighing gauge, non-catchment and snow on the ground are presented in the final report.
* ECCC and MeteoSwiss are covering resources for final steps (Mike Earle, Audrey Reverdin), including review of the document from external editor.

Plan

* End of March 2018: Manuscript reviewed by the editor
* April to July 2018: Final review by the project team
* August 2018: Publication of the report on WMO website
* Scientific papers: specific topics published prior to and after the publication of the final report;

Risks:

* A lot of work to be done after the editor’s review
* Not all objectives will be fully addressed: resulting from the unavailability of experienced resources to conduct the analysis. A review of what has been done and not done during the experiment is included in the conclusion chapter, with recommendations for future work.

Project Outcomes:

* Recommendations for inclusion in the CIMO Guide, Precipitation
* Proposed new chapter on Snow of Ground for the CIMO Guide (linked with the development of the GCW best practice guide)
* Input to developing Siting and Sustained Performance Standards for the measurement of Solid Precipitation and Snow on Ground.
* Recommendations and best practices regarding the operational use of automatic instruments, including technical specification recommendations.
* Several scientific papers based on SPICE datasets
* A fully QCed and documented datasets, available for the community and further studies

Deliverables:

* Final Project Report published: Summer 2018
* Recommendations for the CIMO guide: in the final report (changes to the CIMO Guide to be developed after the SPICE Report publication)
* Recommendation for the Sustained Performance classification: in the final report.

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**APPENDIX III**

**Feasibility Study of an Intercomparison of Thermometers and Radiation Shields.**

**Carmen García Izquierdo (mcgarciaiz@cem.minetur.es)**

Refer to the accompanying document:

CIMO\_MG\_15\_Report 2.2(3)\_ET-II-A3\_Appendix III .pdf

**APPENDIX IV**

**WMO-CIMO Upper-Air Instrument Intercomparison TT-UAII Report to WMO-CIMO**

**Holger Vömel, Alexander Haefele, Dominique Ruffieux**

First submitted: 3 March, 2016 (Task Team UAII); updated 11 January, 2018

Refer to the accompanying document:

"CIMO\_MG\_15\_Report 2.2(3)\_ET-II-A3\_Appendix IV.pdf"

**APPENDIX V: Draft workplan for after CIMO-17**(Note: do not fill in colums Person Responsible/Deadline/Status)

| **No.** | **Task description** | **Person responsible** | **Action** | **Deliverable** | **Deadline for deliv.** | **Status**  **[%]** | **Comments** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 1. | **Monitor progress of workplan-approved or ongoing WMO intercomparisons** |  | 1. Monitor progress 2. Coordinate the review of relevant CIMO Guide chapters 3. Guidance materials and standards 4. IOM publications | 1. Status report to OPAG/CIMO-MG 2. Make proposals to CIMO Guide EdB 3. Provide proposals and documentation to OPAG/CIMO-MG for approval 4. Inform OPAG/CIMO-MG on potential IOM publications and contribute to reviews |  |  |  |
| 2. | **Coordinating development of feasibility study/organization plan of the workplan-approved instrument intercomparisons** |  | 1. Carry out the feasibility study 2. (After CIMO-MG approval of the feasibility study) Draft a detailed plan | 1. Propose Task Team membership to CIMO-MG 2. Deliver feasibility study to CIMO-MG 3. Proposal(s) plan for conducting intercomparison |  |  |  |
| 3. | **Monitoring task** **for collecting information about concluded/ongoing/planned/intentions of/need of instrument intercomparisons** **not reported in ET workplan** |  | 1. Prepare a suitable dataset of principal contact points of stakeholders (ETs, RAs, RICs, TBs/LCs, RAs, BSRN, GAW, ect) 2. Periodic surveys, report and recommendations 3. Prioritized and updated list of potential future instrument intercomparisons | 1. Prepare and update the dataset 2. Survey’s report to OPAG/CIMO-MG and list of concluded/on-going/planned/intentions of/need of instrument intercomparisons and related web links (when appropriate) 3. Make recommendations for CIMO-MG 4. Prepare a prioritized and updated list of potential future instrument intercomparisons for CIMO-MG and CIMO session |  |  |  |

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1. http://www.wmo.int/pages/prog/www/IMOP/meetings/ET-OpMet\_2/CIMO\_ET-OpMet-2-

   Doc\_5.3(2)\_Status%20and%20plans%20for%20interlaboratory%20comparisons%20in%20WMO%20RA%20II%20and%20V.docx [↑](#footnote-ref-2)
2. https://www.adv‐sci‐res.net/13/163/2016/asr‐13‐163‐2016.pdf [↑](#footnote-ref-3)
3. <https://ceilinex2015.de/> [↑](#footnote-ref-4)
4. Appendix II [↑](#footnote-ref-5)
5. An international radiosonde intercomparison is scheduled at Lindenberg for the year 2019. <https://www.gruan.org/gruan/editor/documents/meetings/icm-9/pres/pres_0713_Dirksen_WMOCampaign2019.pdf> [↑](#footnote-ref-6)
6. Appendix II [↑](#footnote-ref-7)
7. WMO Intercomparison on Solid Precipitation including Snowfall and Snow Depth Measurements in various regions of the world (multi-site experiment) at Automatic Stations. [↑](#footnote-ref-8)
8. <https://ceilinex2015.de/>. See Task 3 [↑](#footnote-ref-9)
9. An intercomparison was performed in Payerne (BSRN station) to assess the performance of Radiation Sensors for the Solar Energy Sector (4. Vuilleumier, L., C. Félix, F. Vignola, P. Blanc, J. Badosa, A. Kazantzidis, and B. Calpini (2017). Performance Evaluation of Radiation Sensors for the Solar Energy Sector, on-line pre-publication, Meteorol. Z.) [↑](#footnote-ref-10)
10. The International Radar Quality control and Quantitative precipitation estimation Intercomparison (**RQQI)** was officially launched in April 2011 in Exeter, UK by the established International Organizing Committee (project leader Paul Joe, Environmental Canada), link: <https://www.wmo.int/pages/prog/www/IMOP/reports/2011/IOC-RQQI-1_Final_Report.pdf>.

    See also CIMO-16 sec. 5.4/5.5 and ET-ORST workplan <https://www.wmo.int/pages/prog/www/CIMO/WorkingStructure/WorkPlans/CIMO-16/B1_Workplan_ET-ORST.docx> [↑](#footnote-ref-11)
11. <https://www.wmo.int/pages/prog/www/CIMO/WorkingStructure/WorkPlans/CIMO-16/B1_Workplan_ET-ORST.docx> [↑](#footnote-ref-12)
12. **Dual purpose** means that “Not catching type solid/liquid precipitation instruments” and “visibility/present weather sensors” generally coincide in many cases or all, in other words they have the same measurement principle. So it can be used as a two-in-one international intercomparison of significant importance for “precipitation measurement” sector and new technologies implemented in AWS [↑](#footnote-ref-13)
13. Rolf Philipona (Switzerland) – Chairman, Masatomo Fujiwara (Japan), Tim Oakley (United Kingdom), Holger Vömel (USA), Alexander Häfele (Switzerland). [↑](#footnote-ref-14)
14. The ET-A3-II strongly believes that this mechanism must be developed as best as possible and be a major task for future ET-II because it is the way how CIMO-MG and CIMO-xx focuses on the needs of intercomparisons, optimize resources and make the most suitable decision for intercomparison organization and development and for CIMO Guide Update, guidance material, standards publication/revision. [↑](#footnote-ref-15)