GCOS

GLOBAL CLIMATE OBSERVING SYSTEM

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# Report of the Ninth GCOS Reference Upper Air Network Implementation and Coordination Meeting (GRUAN ICM-9)

**Helsinki, Finland**

**12 to 16 June 2017**

**GCOS-211**

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# GRUAN ICM-9 Short-form Report

**Contents**

## 1. Introduction

The 9th GRUAN Implementation and Coordination Meeting (ICM-9) was hosted by the Finnish Meteorological Institute (FMI) from 12 to 16 June 2017 in Helsinki, Finland. It benefitted from support by the local hosts, NOAA, and from the NOAA US GCOS office. The meeting included:

- A special session on Arctic research relevant to GRUAN.
- A special session dedicated to management of the change from RS92 radiosondes to alternative sondes.
- An optional visit to the Vaisala factory outside Helsinki.
- A break-out session on GAIA-CLIM outreach.
- An optional MeteoMet training course.
- An optional visit to the GRUAN site at Sodankylä during the weekend following ICM-9.

A GRUAN dinner, open to all attendees, was held on the evening of Thursday 15 June.

## 2. Attendees

The 57 attendees of ICM-9 are listed in Table 1.

**Table 1: ICM-9 attendee list**

| Name | Country | Affiliation |
|---|---|---|
| Seydi Ababcar Ndiaye | Senegal | Cheikh Anta Diop University, Dakar |
| Arnoud Apituley | The Netherlands | Royal Netherlands Meteorological Institute (KNMI) |
| Leif Backman | Finland | Finnish Meteorological Institute (FMI) |
| Greg Bodeker | New Zealand | Bodeker Scientific |
| Lori Borg | USA | University Wisconsin |
| Dan Brewer | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Xavier Calbert | Spain | Agencia Estatal de Meteorología (AEMET) |
| Fabien Carminati | UK | Met Office |
| Belay Demoz | USA | Howard University |
| Howard Diamond | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Galina Dick | Germany | GeoForschungsZentrum (GFZ) |
| Ruud Dirksen | The Netherlands | Deutscher Wetterdienst (DWD) |
| Hiram Escabi | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Stephanie Evan | France | University of Reunion |
| John Eyre | UK | Met Office |
| Alessandro Fasso | Italy | Università degli studi di Bergamo |
| Jennifer Fowler | USA | University of Montana |
| Tom Gardiner | UK | National Physical Laboratory (NPL) |
| Pauli Heikkinen | Finland | Finnish Meteorological Institute (FMI) |
| Martti Heinonen | Finland | VTT Technical Research |
| Ben Ho | USA | University Corporation for Atmospheric Research (UCAR) |
| Peggy Hoch | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Donna Holdridge | USA | Argonne National Laboratory |
| Stephen Hudson | Norway | Norwegian Polar Institute |
| Dale Hurst | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Bruce Ingleby | UK | European Centre for Medium-Range Weather Forecasts (ECMWF) |

| | | |
|---|---|---|
| Masami Iwabuchi | Japan | Japan Meteorological Agency (JMA) |
| Hannu Jauhiainen | Finland | Association of Hydro-Meteorological Equipment Industry (HMEI) and Vaisala |
| Jonathan Jones | UK | Met Office |
| Juha Karhu | Finland | Finnish Meteorological Institute (FMI) |
| Rigel Kivi | Finland | Finnish Meteorological Institute (FMI) |
| Rob Kursinski | USA | University of Arizona |
| Thierry Leblanc | USA | Jet Propulsion Laboratory (JPL) |
| Shwei Lin | Singapore | National Environment Agency (NEA) |
| Aleksey Lykov | Russia | Roshydromet |
| Fabio Madonna | Italy | Institute of Methodologies for Environmental Analysis (IMAA/CNR) |
| Juan Carlos Antuna Marrero | Cuba | Grupo de Óptica Atmosférica de Camagüey (INSMET) |
| Giovanni Martucci | Switzerland | MeteoSwiss |
| Marion Maturilli | Germany | Alfred-Wegener-Institut (AWI) |
| Andrea Merlone | Italy | Istituto Nazionale di Ricerca Metrologica (INRIM) |
| Johannes Nielsen | Denmark | Danish Meteorological Institute (DMI) |
| Tim Oakley | UK | Met Office |
| Roberta Pirazzini | Finland | Finnish Meteorological Institute (FMI) |
| Richard Querel | New Zealand | National Institute of Water and Atmospheric Research (NIWA) |
| Tony Reale | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Christoph von Rohden | Germany | Deutscher Wetterdienst (DWD) |
| Marco Rosoldi | Italy | Institute of Methodologies for Environmental Analysis |
| Doug Sisterson | USA | Atmospheric Radiation Measurement programme |
| Herman Smit | The Nether-lands | Forschungszentrum Jülich |
| Michael Sommer | Germany | Deutscher Wetterdienst (DWD) |
| Martin Stuefer | Austria | University of Alaska Fairbanks |
| Bomin Sun | USA | National Oceanic and Atmospheric Administration (NOAA) |
| Caterina Tassone | USA | GCOS Secretariat |
| Peter Thorne | Ireland | Maynooth University (NUIM) |
| Jordis Tradowsky | New Zealand | Bodeker Scientific |
| Rongkang Yang | China | China Meteorological Administration |
| Axel von Engeln | Germany | EUMETSAT |

## 3. Review of ICM-8 actions

Actions agreed on during ICM-8 were reviewed at the start of ICM-9 by Peter Thorne. 36 actions had been agreed on at ICM-8. Of those:

- 12 were completed.
- 20 were still in progress.
- 4 remained unaddressed.

The status (St) of individual ICM-8 actions is shown in Table 2.

**Table 2: ICM-8 actions**

| # | Action | Owner | Due | St |
|---|---|---|---|---|
| High priority actions | | | | |
| 1 | **Autosondes:** An assessment of the advantages and disadvantages of manual vs. autosonde launches written up and submitted to the peer reviewed literature. | TT radiosondes (Rigel Kivi, Fabio Madonna) | June 2017 | |
| 2 | **Multi-payload launches:** A document detailing the operational challenges related to multi-payload soundings submitted either to peer-reviewed literature (first choice) or to the WG for review as a GRUAN report. To be augmented by quantitative analysis of existing multi-payload flights. | TT radiosondes, NOAA NWS, Lead Centre, TT Sites, Science Coordinators | May 2017 | |
| 3 | **Radiosonde documentation:** Develop first draft of GRUAN radiosonde generic technical document omnibus. | Lead Centre, TT Radiosondes, non-instrument experts, WMO Expert Team (to review). | November 2016 | |
| 4 | **RS92 product V3:** Revise the RS92 data stream: revised version 3 including quality control flags + data in different vectors (good, questionable, missing), including implementation of performance feedback to the sites. Validate new radiation correction using ancillary measurements, including GAIA-CLIM NWP feedback, to build confidence. Document version 3 appropriately in peer-reviewed literature. | Lead Centre, TT Radiosondes, TT Ancillary measurements | March 2017 | |
| RS92 transition actions | | | | |
| 5 | **ARM campaign proposal:** Put in an intensive observations campaign proposal to ARM to run dual launch programmes at their sites of RS92 and RS41 to help quantify the effects for one year. | WG chairs, Ruud Dirksen, Doug Sisterson, Lori Borg, Tony Reale, TT sites | March 2017 | |
| 6 | **Interim analysis of initial RS92 results:** Initial analysis of current dual launch data to be reported to GRUAN ICM-8 participants by email. | Alessandro Fasso, Lead Centre | June 2016 | |
| 7 | **Payload configurations (dual launches):** Lead Centre to ascertain consistency or otherwise of payload configurations being undertaken by sites performing a dual sounding programme and, to the extent possible, make recommendations as to how to set the rigs to assure comparability. | Lead Centre and TT Sites | June 2016 | |
| 8 | **Darwin dual launches:** Lead Centre to work with BoM to instigate an intercomparison campaign for RS92-RS41 transition at Darwin site. | Lead Centre, BoM, TT Radiosondes | July 2016 | |
| 9 | **Scheduling including golden match-ups:** Lead Cen- | Lead Centre, TT radi- | December | |

| | | | | |
|---|---|---|---|---|
| | tre to provide guidance on when and under what conditions to undertake flights if not to a regular schedule. Night/day/cloud/clear, informed by early lab results. Provide schedules for 'golden' launch times with polar orbiters/GNSS-RO. | osonde, Axel von Englen | 2016 | |
| 10 | **Parallel soundings database:** Lead Centre to instigate and populate a database of parallel soundings of RS92-RS41, including where possible satellite colocations, raw and black-box processed radiosonde profiles. Served through the Lead Centre and available to GRUAN community for analysis. | Lead Centre, TT Radiosondes, Tony Reale | August 2016 | |
| 11 | **Community approach paper:** Paper describing the GRUAN change management replacement strategy submitted to a peer-reviewed journal (GI) to increase visibility of an effort and get broad community buy-in. | Lead Centre, TT Radiosondes, WG-GRUAN | September 2016 | |
| 12 | **Lead Centre-Sterling collaboration:** Lead Centre and Sterling facility to undertake coordinated lab characterisation of the RS92 and RS41. Formal report at ICM-9. | Lead Centre, NWS sterling | June 2017 | |
| 13 | **First comprehensive analysis:** Interim analysis of the radiosonde overlap observations completed and reported at ICM-9. | Lead Centre, TT Radiosondes, Science Coordinators, Alessandro Fasso | June 2017 | |
| 14 | **Satellite inferences:** Interim analysis of the insights that can be bought by the use of satellite data to the characterisation of the change between RS92 and RS41 based upon the paired launches. | Lead Centre, TT Ancillary measurements | June 2017 | |
| Remaining actions | | | | |
| 15 | **Reporting over the WIS:** All sites with capability to report BUFR over GTS in NRT. Advice and technical support to be provided by Lead Centre/WMO/GCOS on a site-by-site basis to all certified and candidate sites not currently reporting BUFR to attempt to enable. | Lead Centre, GCOS, WMO, TT Sites | ICM-9 | |
| 16 | **Promotional video:** Complete and disseminate promotional video for GRUAN. | Greg Bodeker and Lead Centre | May 2017 | |
| 17 | **Stratospheric water vapour trends:** Extend trend sensitivity studies to stratospheric water vapour. | Task Team Scheduling | December 2016 | |
| 18 | **Site photos:** Site photo surveys to be uploaded to new website. Lead Centre to instigate mechanism to remind sites to submit new photos. Several snapshot series available from each site on web at time of ICM-9. | Task Team Sites and Lead Centre | June 2017 | |
| 19 | **New modem product:** Develop GRUAN data product and processing stream for Modem radiosondes. First | CNRS, Lead Centre, TT Radiosondes | March 2017 | |

| | | | | |
|---|---|---|---|---|
| | draft of technical document describing processing streams for all Modem radiosondes. | | | |
| 20 | **Standard Humidity Chamber justification:** Technical Note on the appropriate techniques for manufacturer independent ground checks using the Standard Humidity Chamber. Paper submitted to peer reviewed journal documenting scientific rationale. | Lead Centre, Science Coordinators | December 2016 | |
| 21 | **Lidar:** Technical document for GRUAN lidar stream (lidar Guide) submitted for review by WG. | TT Ancillary measurements | December 2016 | |
| 22 | **GNSS-PW (I):** Develop a GRUAN GNSS-PW product. Technical documentation completed for GNSS-PW measurements (GNSS-PW Guide) | TT, GNSS-PW | December 2016 | |
| 23 | **GNSS-PW (II):** Define the GNSS-PW data collection client requirement, initiate data flow. | GFZ, Lead Centre, TT GNSS-PW, TT sites | April 2017 | |
| 24 | **Ozonesonde (I):** Develop a GRUAN ozonesonde data product in consultation with NDACC and GAW. Completed technical documents. | Greg Bodeker, Jacquie Witte, Lead Centre | October 2016 | |
| 25 | **Ozonesonde (II):** Define the ozonesonde data collection client requirement, identify the central data processing facility, and initiate data flow. | Greg Bodeker, Lead Centre | April 2017 | |
| 26 | **Aerosols:** Determine how best to work with NDACC and GAW to bring measurements of aerosol properties into GRUAN. Produce short document outlining a proposed strategy. | WG Chairs, WG members, TT Ancillary measures, Potenza, EARLINET | June 2017 | |
| 27 | **GRUAN data transmission via BUFR:** Complete proposal for transmitting GRUAN uncertainties over BUFR and required modification of BUFR tables and report to IPET-DRMM. | Sasha Kats, Kizu-San, TT Radiosondes, TT Sites, Lead Centre, CBS | November 2016 | |
| 28 | **Uncertainty structures in RS92 version 3 product:** Version 3 release of RS-92 to include correlated uncertainty information and subsequent work to consider an emulator that can create N profiles consistent with the uncertainty information | Lead Centre, TT Radiosondes, Science Coordinators | March 2017 | |
| 29 | **Task Teams ToR:** Task Teams to revise terms of reference to reflect current status and required work plans and submit to WG for approval. | TT Chairs and members | June 2016 | |
| 30 | **Certified site audits:** Greg to draft and circulate guidelines for the certified site auditing to WG and TT site reps. Agreed version to become a GRUAN Technical Note. | Greg Bodeker | July 2016 | |
| 31 | **GRUAN Implementation Plan:** Complete and publish new GRUAN Implementation Plan after publication of the GCOS Implementation Plan to ensure consistency with this 'parent' document. | Peter Thorne with input from WG-GRUAN, Lead Centre, chairs of all TTs. | December 2016 | |
| 32 | **Ecosystem of upper-air systems:** Paper on the eco- | WG Chairs, principals | November | |

| | | | | |
|---|---|---|---|---|
| | system of upper-air systems co-drafted with principals of NDACC, TCCON, etc. as submission to NDACC special issue | of remaining networks | 2016 | |
| 33 | **Failsafe backup:** Lead Centre and processing centres to evaluate options with regard to failsafe back-up to ensure data archival and processing software redundancy. Technical Note produced. | Lead Centre, Processing Centres | December 2016 | |
| 34 | **Website review:** WG members to review the website, discuss, and provide feedback on any necessary structural innovations to Lead Centre. Then to provide feedback at ICM-9 based on use (WG-GRUAN to identify 2-3 volunteers to do this more in-depth review). | WG-GRUAN | June 2017 | |
| 35 | **CIMO TECO:** GRUAN abstracts to be submitted to CIMO TECO and MMC2 in Madrid in late September. | WG co-chairs | September 2016 | |
| 36 | **SASBEs:** Report on SASBE development activities at ICM-9. | TT Scheduling, TT Ancillary Measurements, Science Coordinators | June 2017 | |

## 4. Meeting agenda

## Monday 12 June

***Section 1 - Opening session and keynotes***

| | | |
|---|---|---|
| 8:00 - 8:40 | Registration | |
| 8:40 - 8:50 | Welcome, local logistics, outline of events and adoption of agenda | Local hosts & WG chairs |
| 8:50 - 8:55 | Introductory talk from FMI | Professor Yrjö Viisanen |
| 8:55 - 9:10 | FMI air quality and climate studies | Dr. Iolanda Ialongo |
| 9:10 - 9:25 | GRUAN Fundamentals | Ruud Dirksen |
| 9:25 - 9:40 | Remarks from GCOS including relevant AOPC outcomes | Caterina Tassone |
| 9:40 - 10:05 | Lead Centre progress report | Ruud Dirksen |
| 10:05 - 10:20 | In memory of Sasha Kats | Ruud Dirksen |

**10:20 - 10:40 Coffee break**

***Section 2 - ICM-8 action items review***

| | | |
|---|---|---|
| 10:40 - 11:05 | Assessment of progress against action items arising from ICM-8 | Peter Thorne |

***Section 3 - Discussion of topics raised by Task Team reports***

| | | |
|---|---|---|
| 11:05 - 11:15 | Brief summary (2 slides) on discussion points arising from Radiosonde Task Team report | Hannu Jauhiainen |
| 11:15 - 11:30 | Discussion of Radiosonde TT topics | To be led by day chair |

| | | |
|---|---|---|
| 11:30 - 11:40 | Brief summary (2 slides) on discussion points arising from Sites Task Team report | Belay Demoz and Dale Hurst |
| 11:40 - 11:55 | Discussion of Sites TT topics | To be led by day chair |
| 11:55 - 12:05 | Brief summary (2 slides) on discussion points arising from Scheduling Task Team report | Tom Gardiner and Fabio Madonna |
| 12:05 - 12:20 | Discussion of Scheduling TT topics | To be led by day chair |
| 12:20 - 12:25 | Poster summary: Temperature-SASBE version 2 | Jordis Tradowsky |
| 12:25 - 12:30 | Poster summary: A multi-mission RO-GRUAN comparison | Johannes Nielsen |

**12:30 - 13:30 Lunch**

| | | |
|---|---|---|
| 13:30 - 13:40 | Brief summary (2 slides) on discussion points arising from Ancillary Measurements Task Team report | Tony Reale and Thierry Leblanc |
| 13:40 - 13:55 | Discussion of Ancillary Measurements Task Team topics | To be led by day chair |
| 13:55 - 14:05 | Brief summary (2 slides) on discussion points arising from GNSS-PW Task Team report | Galina Dick |
| 14:05 - 14:20 | Discussion of GNSS-PW Task Team topics | To be led by day chair |
| 14:20 - 14:45 | Report from GRUAN science coordinators and subsequent discussion | Tom Gardiner and Richard Querel |
| 14:45 - 15:00 | General discussion of topics arising from task teams | To be led by day chair |

**15:00 - 15:30 Coffee break**

***Section 4 - Advances in the development of new GRUAN data products***

| | | |
|---|---|---|
| 15:30 - 15:50 | Meisei | Masami Iwabuchi |
| 15:50 -16:10 | Modem | Stephanie Evan |
| 16:10 - 16:30 | Ozonesonde | Richard Querel |
| 16:30 - 17:05 | The future of balloon-borne reference water vapor measurements in GRUAN: Motivation/GCOS IP-Thorne , P-CFH-Dirksen, Japanese FP-Fujiwara, FLASH B-Lykov, Air Labs CBH-Bodeker | Dale Hurst to coordinate |
| 17:05 - 17:25 | Lidar | Thierry Leblanc |
| 17:25 - 18:00 | Discussion on progress on GRUAN product development | Day chair |
| 18:00 - Done | Discussion and resolution on the size, composition, and terms of reference for the Working Group (WG members only) | Greg Bodeker discussion lead |

## Tuesday 13 June

***Section 5 - Special session on the Arctic***

| | | |
|---|---|---|
| 08:30 - 08:50 | Research activities at Sodankylä | Rigel Kivi |
| 08:50 - 09:15 | INTAROS, integration of the existing Arctic observing systems into a common data frame | Roberta Pirazzini |
| 09:15 - 09:45 | ARM, ASR, and UAF Activities at the NSA | Martin Stuefer and Douglas Sisterson |
| 09:45 - 10:05 | Ny-Ålesund: Update & Atmosphere flagship programme | Marion Maturilli |
| 10:05 - 10:20 | Arctic Council | Johanna Ekman |

**10:20 - 10:45 Coffee break**

***Section 5 - Special session on the Arctic (continued)***

| | | |
|---|---|---|
| 10:45 - 11:05 | Satellite-borne observations of GHGs in the Arctic | Hannakaisa Lindqvist |
| 11:05 - 11:25 | Atmospheric methane in the Arctic | Leif Backman |
| 11:25 - 11:45 | Arctic stratosphere dynamical response to global warming | Alexey Karpechko |
| 11:45 - 12:05 | The N-ICE campaign | Stephen Hudson |
| 12:05 - 12:30 | General Discussion | |

**12:30 - 13:30 Lunch break**

***Section 6 - GRUAN management of the RS92-other sondes transition***

| | | |
|---|---|---|
| 13:30 - 14:00 | A summary of developments to date | Ruud Dirksen |
| 14:00 - 14:20 | The Met Office/British Antarctic Survey experience of managing a transition from RS92 to RS41. | Tim Oakley |
| 14:20 - 15:00 | Initial analysis results | Alessandro Fasso |

**15:00 - 15:30 Coffee break**

***Section 6 - GRUAN management of the RS92-other sondes transition (cont)***

| | | |
|---|---|---|
| 15:30 - 15:40 | Testing radiosondes in the EDDIE tunnel at INRiM | Andrea Merlone |
| 15:40 - 16:05 | RS92-RS41 transition at Cabauw | Arnoud Apituley |
| 16:00 - 16:20 | Assessment of the radiation-induced temperature error for RS92-RS41 using NPROVS | Bomin Sun |
| 16:20 - 16:40 | Global correction of the radiosonde temperature biases in the upper troposphere and lower stratosphere using GPS RO data | Ben Ho |
| 16:40 - 17:15 | Discussion and development of agreed way forward for GRUAN transition from RS92 to other radiosondes | Ruud Dirksen to coordinate |

**17:15 - 18:00 Poster viewing**

Jordis Tradowsky: An improved Site Atmospheric State Best Estimate for the temperature above Lauder, New Zealand

Johannes Nielsen: ROM SAF CDR v1 temperature profiles compared to GRUAN v2.0

## Wednesday 14 June

***Section 7 - GRUAN sites day***

| | | |
|---|---|---|
| 8:30 - 9:00 | GRUAN data flow | Michael Sommer |
| 9:00 - 9:15 | Lauder Site Update | Richard Querel |
| 9:15 - 9:30 | Developments at Singapore on the way to GRUAN implementation | Shwei Lin |
| 9:30 - 9:45 | Updates from Tateno and introducing the new candidate sites | Masami Iwabuchi |
| 9:45 - 10:00 | GRUAN activities at La Reunion | Stephanie Evan |

**10:00 - 10:30 Coffee break**

| | | |
|---|---|---|
| 10:30 - 10:45 | ARM SGP CFH operations status | Martin Stuefer |
| 10:45 - 11:00 | ARM Sites report/instrument uncertainties update | Doug Sisterson |
| 11:00 - 11:15 | ARM Sites radiosonde operations status and upgrades | Doug Sisterson |
| 11:15 - 11:30 | CMA plans for the Xilinhot site | Rongkang Yang |
| 11:30 - 12:00 | The GRUAN Mid-Atlantic Consortium: Vision, Composition, Activities, Plans | GMAC Team |
| 12:00 - 12:30 | Discussions of station reports | Lead Centre |

**12:30 - 13:30 Lunch break**

| | | |
|---|---|---|
| 13:30 - 13:50 | A novel automatic calibration system for water vapour Raman lidar | Giovanni Martucci |
| 13:50 - 14:15 | The 2019 WMO radiosonde intercomparison campaign, GRUAN's scientific requests | Ruud Dirksen and Giovanni Martucci |
| 14:15 - 14:30 | Aspects of GPS-RO water vapour retrieval | Rob Kursinski |
| 14:30 - 14:45 | Partnering with operational met sites: Lauder's new Invercargill-based data stream | Richard Querel |
| 14:45 - 15:00 | GNSS data processing | Galina Dick |

**15:00 - 15:30 Coffee break**

| | | |
|---|---|---|
| 15:30 - 15:50 | Consistency between GRUAN sondes, LBLRTM and IASI | Xavier Calbet |
| 15:50 - 16:10 | GRAS Occultation Forecasting Prediction: A new EUMETSAT Product? | Axel von Engeln |
| 16:10 - 16:30 | The use of AIRCORE in GRUAN | Rigel Kivi |

| | | |
|---|---|---|
| 16:30 - 16:50 | The status of the Fluorescence Lyman-a Stratospheric Hygrometer (FLASH-B) instrument | Aleksey Lykov |
| 16:50 - 17:05 | Links between GRUAN and the global radiosonde network | Bruce Ingleby |

| | | |
|---|---|---|
| 17:05 - 17:25 | Update on where we are at with bringing new sites into GRUAN. | Greg Bodeker lead |
| 17:25 - 18:00 | An open discussion for sites | Dale Hurst and Belay Demoz to moderate |

## Thursday 15 June

***Section 8 - Optional sessions***

**Option 1: Visit to Vaisala**

**Option 2: Breakout session on GAIA-CLIM outreach**

| | | |
|---|---|---|
| 8:30 - 10:00 | Discussion of GAIA-CLIM gap analysis and prioritisation activity | Peter Thorne |

**10:00 – 10:30 Coffee break**

| | | |
|---|---|---|
| 10:30 - 12:30 | Hands on session on the GAIA-CLIM Virtual Observatory | Fabio Madonna and Peter Thorne |

**Option 3: Review of GRUAN web pages**

| | | |
|---|---|---|
| 8:30 - 10:00 | A team review of the GRUAN web pages | Greg Bodeker and whoever else is interested. |

**10:00 – 10:30 Coffee break**

| | | |
|---|---|---|
| 10:30 - 12:30 | Continuation of web review | Greg Bodeker |

**12:30 – 13:30 Lunch break**

**MeteoMet Training Course**

| | | |
|---|---|---|
| 13:30 - 13:50 | Metrology for GRUAN: MeteoMet activities of interest | Andrea Merlone |
| 13:50 - 14:10 | Towards SI traceable humidity measurements with radiosondes | Martti Heinonen |
| 14:10 - 14:30 | Basic metrology, terminology, procedures | Tom Gardiner |
| 14:30 - 15:00 | MeteoMet training course Q&A | |

**15:00 to 15:30 Coffee break**

***Section 9 - GRUAN Operations***

| | | |
|---|---|---|
| 15:30 - 15:40 | Status of the GRUAN radiosonde generic technical document omnibus | Christoph von Rohden |
| 15:40 - 16:00 | Analysis of radiation temperature experiments | Christoph von Rohden |

| | | |
|---|---|---|
| 16:00 - 16:15 | Discussion of radiation temperature results | Lead by day chair |

## Friday 16 June

***Section 10 - Underpinning science for GRUAN***

| | | |
|---|---|---|
| 8:30 - 8:50 | Geophysical profile data from GRUAN radiosonde data products to a top of the atmosphere radiance and uncertainty | Fabien Carminati |
| 8:50 - 9:10 | Integration and Assessment of GRUAN v2 uncertainties using NPROVS+ | Tony Reale |
| 9:10 - 9:30 | Manual vs. autosonde launches | Rigel Kivi |
| 9:30 - 9:50 | GRUAN and RO intercomparison as done in the ROM SAF VS31 project | Jordis Tradowsky |
| 9:50 - 10:10 | Frost point hygrometers and satellite sensors for stratospheric water vapour | Dale Hurst |

**10:10 - 10:30 Coffee break**

***Section 11 - GRUAN connection to partner communities and activities***

| | | |
|---|---|---|
| 10:30 - 10:50 | Reporting from the IROWG meeting in Austria | Jordis Tradowsky |
| 10:50 - 11:10 | Discussion of results from GAIA-CLIM maturity assessment for GRUAN and what we can learn from this. | Peter Thorne |
| 11:10 - 11:30 | The new AOPC task team on GUAN | Tim Oakley |
| 11:30 - 11:50 | The new C3S BARON activity | Fabio Madonna |
| 11:50 - 12:20 | GAIA-CLIM gap analysis and prioritisation activity | Peter Thorne |
| 12:20 - 12:30 | General discussion | Day chair |

**12:30 - 13:30 Lunch**

***Section 11 - GRUAN connection to partner communities and activities (cont)***

| | | |
|---|---|---|
| 13:30 - 13:50 | Discussion of the GRUAN Science Coordinator role | Greg Bodeker |
| 13:50 - 14:10 | Update of the IAGOS-H2O ongoing aircraft measurements and QA-efforts | Herman Smit |
| 14:10 - 14:40 | GRUAN web page and other tools to coordinate Working Group communication | Michael Sommer |
| 14:40 - 15:00 | Ozonesondes in GAW and future collaboration between GAW-WCCOS and GRUAN on ozonesonde QA | Herman Smit |

**15:00 - 15:30 Coffee break**

**Session 12 - Wrap-up**

| | | |
|---|---|---|
| 15:30 - 16:30 | The GRUAN work plan for 2017/2018 | Peter Thorne |

| | | |
|---|---|---|
| 16:30 - 17:00 | Close | Local hosts and co-chairs |

## 5. Agreed on actions for the coming year

Recognizing that ICM-10 is expected to follow ICM-9 by only 10 months, four high priority items (including closure of two from ICM-8), eight actions related to the transition from RS92 to RS41 radiosondes (including closure of three actions from ICM-8), and thirteen other actions (including closure of five actions from ICM-8) were agreed on. These are listed in Table 3. Following discussion, it was decided to finalise an RS92 version 3 product after the RS41 version 1 product has been completed. A number of business as usual items were not recorded as actions including:

- Review and updates of the GRUAN website.
- Backfilling membership and co-chair vacancies on task teams.
- Revision of WG terms of reference following WG meeting outcomes in consultation with AOPC and GCOS Secretariat.
- Reflect on science coordinator discussion outcomes.
- Data management and serving issues.

**Table 3: ICM-9 actions**

| # | Action | Owner | Due |
|---|---|---|---|
| High priority actions | | | |
| 1 | **First draft version of RS41:** Lead Centre to provide a first cut of the RS41 GDP by no later than ICM-10 and provide this data set to GRUAN community for analysis. Use the GAIA-CLIM traceability chain approach developed by NPL and applied to the RS92 version 2 product to guide the RS41 product creation and consideration of correlated, structured random and random components. Session on RS41 GDP preparation at ICM-10. | Lead Centre, TT Radiosondes | April 2018 |
| 2 | **Qualify new data streams:** Qualify currently available candidate data streams available via the Lead Centre (Mesei and SRS) according to the guidance in GRUAN-TN4. Requires the steps denoted in TN4 to be satisfied. Either data served via NOAA NCEI or action plan for each stream of required further steps available by ICM-10. | WG-GRUAN, Lead Centre, TT sites, TT radiosonde | April 2018 |
| 3 | **Autosondes:** An assessment of the advantages and disadvantages of manual vs. autosonde launches written up and submitted to the peer reviewed literature. First define the critical questions to answer which would appear to be at least: i) Can we create a GDP?; ii) Is there a bias between manual and auto-launched sondes?; iii) Does the random uncertainty change?; iv) impact of lifetime in launcher (quality, SHC repeatability, and height attained). | TT Radiosondes and Lead Centre | August 2017 to define small set of well posed questions to be addressed. December 2017 to submit manuscript |
| 4 | **Radiosonde documentation:** Develop first | Lead Centre, TT radio- | January 2018 |

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| | draft of GRUAN radiosonde generic technical document omnibus. Available for review. | sondes, non-instrument experts, WMO ET (to review) | |
| RS92 to RS41 transition actions | | | |
| 5 | **Community approach paper:** Paper describing the GRUAN change management replacement strategy submitted to peer-reviewed journal (GI) to increase visibility of effort and get broad community buy-in. | Lead Centre, TT Radiosondes, WG-GRUAN | July 2017 |
| 6 | **Parallel soundings database augmentation with satellite/ancillary:** Lead Centre to augment parallel soundings of RS92-RS41 with satellite co-locations and 'ancillary' measurements (CFH, FPH, lidar, MWR, satellites, cloud observations (incl. BSRN) within +/-2 hours). | Lead Centre, TT Ancillary measurements, TT Sites. | Oct 2017 (satellites plus Lindenberg)<br>Apr 2018 (all sites) |
| 7 | **Darwin dual launches:** Lead Centre and Greg Bodeker to continue to work with BoM to instigate an intercomparison campaign for RS92-RS41 transition at the tropical Darwin site recognising current lack of a sustained tropical characterisation assessment. | Lead Centre, BoM, Greg Bodeker | December 2017 |
| 8 | **UKMO/BAS ascents inclusion:** Arrange for the inclusion of Met Office and BAS parallel soundings data in the RS92-RS41 transition. Particular interest in St. Helena given paucity of tropical locations. | Lead Centre, Tim Oakley | April 2018 |
| 9 | **GUAN/GRUAN coordination:** WG-GRUAN, Lead Centre and GCOS secretariat to draft letter to send to countries hosting GUAN sites that run/ran RS92 to survey plans and advocate to undertake some degree of parallel measurements and submit to GRUAN Lead Centre collection. | WG Chairs, GCOS secretariat, Lead Centre | July 2017 |
| 10 | **Scheduling by conditions:** Lead Centre, based upon results to date to advise sites on whether particular conditions are most uncertain and therefore when (under what conditions) launches of dual configurations may derive most value. The parallel soundings, as a whole, should represent a wide variety of conditions across the network and at each site. | Lead Centre, TT Radiosonde, TT Sites, Alessandro Fasso's ad hoc group | October 2017 |
| 11 | **Updated analysis of dual launch holdings:** Several techniques to be pursued (including use of satellites, NWP, ancillary) to analyse the effects of the transition both on manufacturer processed and GRUAN processed (when available for RS41) data products arising from dual flights. Updates available for ICM-10 (2- | Science Coordinators (or TT on RS92/41 transition analysis), Lead Centre, TT Radiosondes, TT Ancillary measurements | April 2018 |

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| | page written summaries a month in advance and talks in transition session). | | |
| 12 | **Capability to create RS92v2 GDP from MW41:** Given agreed priority of RS41 GDP over RS92 version 3 product generation, develop short-term 'fix' to enable version 2 processing to be applied to RS92 soundings lodged using the MW41 ground equipment. | Lead Centre | October 2017 |
| Remaining actions | | | |
| 13 | **Sites photos:** Technical note on guidance on site survey photos and upload instructions. Current site photo surveys to be uploaded to appropriate area of website. Lead Centre to instigate mechanism to remind sites to submit new photos. | Lead Centre, TT Sites | April 2018 |
| 14 | **New modem product:** Develop GRUAN data product and processing stream for Modem radiosondes. First draft of technical document describing processing streams for all Modem radiosondes. Initial data stream available for evaluation by Lead Centre. | CNRS, Lead Centre, TT Radiosondes | April 2018 |
| 15 | **Lidar:** Take necessary steps to be in a position to qualify the Lidar GDP starting after ICM-10. Remaining steps are finalisation and review of Technical Document and provision of a beta test data stream to Lead Centre. | TT Ancillary measure-ments | April 2018 |
| 16 | **GNSS-PW:** Take necessary steps to be in a position to qualify the GNSS-PW GDP starting after ICM-10. Remaining steps are finalisation and review of Technical Document and provision of a beta test data stream to Lead Centre. | TT GNSS-PW | April 2018 |
| 17 | **Ozonesondes:** Take necessary steps to be in a position to qualify the Ozonesonde GDP starting after ICM-10. Remaining steps are review of Technical Document, peer reviewed description of product and provision of a beta test data stream to Lead Centre. | Greg Bodeker, Jacquie Witte, Lead Centre | April 2018 |
| 18 | **Failsafe back-up:** Lead Centre and Bodeker Scientific to instigate failsafe backup of the raw data that is offsite of Lindenberg. | Lead Centre and Greg Bodeker | October 2017 |
| 19 | **Golden overpass:** Lead Centre to create a filter that spits out to each site a list of the likely overpass coincident times within a defined radius based upon the EUMETSAT occultation forecast product. Emailed weekly. | Lead Centre and TT Sites | August 2017 |
| 20 | **CFH roadmap:** Prepare a strategy document (2-sides max) to address the remaining steps required for instigation of a frostpoint hygrometers GDP for presentation and discus- | Lead Centre, TT Radio-sondes, TT Sites | April 2018 |

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| | sion at ICM-10. | | |
| 21 | **Certification and auditing:** WG-GRUAN and Lead Centre to ensure certification and auditing of sites on the agreed upon timetables and verify against these targets at ICM-10. | Greg Bodeker, Lead Centre | April 2018 |
| 22 | **Annually based reporting:** Lead Centre to provide automated reports on 2017 performance no later than 20 January of each year. Sites to append site report no later than 15 February to inform ICM-10. WG-GRUAN members to read site reports prior to ICM-10. | TT Sites, Lead Centre, WG-GRUAN | February 2018 |
| 23 | **Australian sites composition and certification:** Greg Bodeker to respond to suggestion to move Alice Springs to Brisbane and to advocate for certification. | Greg Bodeker | August 2017 |
| 24 | **Letters on behalf of sites:** WG-GRUAN chairs to review site reports and initiate letters from appropriate parties accordingly. TT Sites to be tasked with raising such requests intersessionally rather than solely at ICMs. | WG Chairs, TT Sites | August 2017 |
| 25 | **Update on radiation chamber results:** Lead Centre staff to consider the various feedback and suggestions received on the issues raised at ICM-9 on the radiation chamber results. To the extent resources, technical and practical considerations permit, perform further experimentation and report a substantive update at ICM-10. | Lead Centre | April 2018 |