Prepared by IPWG
IPWG-WP-01
Agenda Item: G3.4,WG II/5
Discussed in Plenary/WGII

# SUMMARY REPORT OF THE SEVENTH WORKSHOP OF THE INTERNATIONAL PRECIPITATION WORKING GROUP (IPWG-7)

Working paper IPWG-WP-01 was written by the two co-chairs of the International Precipitation Working Group (IPWG), Dr. Nai-Yu Wang and Dr. Kazumasa Aonashi. The report summarizes the outcome of the IPWG-7 meeting. Furthermore, it highlights the recent achievements of IPWG and provides an outlook for the planned activities over the next two years. The report also cites specific recommendations for CGMS members and IPWG comments on the current HLPP.

The IPWG-7 was held at the Tsukuba International Congress Center and hosted by the Japanese Aerospace Exploration Agency (JAXA) Earth Observation Research Center (EORC), Tsukuba, Japan during 17-21 November 2014. The meeting was attended by 125 participants from over 20 countries that included 49 oral and 57 poster presentations. It consisted of nearly three full days of plenary sessions (12 oral, 3 poster), one full day of working group discussions and a final group plenary, and then closed with a special session dedicated to Dr. Arthur Hou, NASA Global Precipitation Measurement (GPM) Project Scientist, who passed away in late 2013. Additionally, a satellite training course was given, which took place in parallel to the IPWG workshop; 28 participants attended the course.

Two new co-chairs were selected; Remy Roca (CNRS, France) and Tufa Dinku (IRI, USA). IPWG-8 will be held in the fall of 2016, with an African venue being targeted, however, former co-chair Vincenzo Levizzani has offered to host the meeting at his ISAC/CNR facility in Bologna, Italy as a secondary option.

Action/Recommendation proposed:

1. **For all CGMS Members** - Ensure continuity of geostationary coverage (over Indian Ocean) and data access over the current METEOSAT-7 coverage area.

2. **For CMA and IMD –** Provide institutional support to develop IPWG validation sites over China and India.

3. **For all CGMS Members** - Continue an operational constellation of conically-scanning microwave platforms to guarantee sustained support for the current level of capability. In particular, specific plans for the following missions are requested: JAXA for the GCOM-W/AMSR-2 follow-on; NOAA for the SSMIS F20 launch plan/DMSP follow on program; NASA/potential use of GMI#2; specific plans by EUMETSAT for EPS-SG/MWI.

4. **For ITWG, ICWG (and other ISWG's)** – To foster more close collaboration on common topics, subgroups and parallel group reports should be shared at respective subgroup meetings, as well as potential specialty meetings (i.e., emissivity, snowfall, data assimilation) and other meetings of opportunity (e.g., AGU, EGU, etc).

5. **For all CGMS Members** – IPWG encourages cross-agency coordination of satellite assets into "A-train-like convoys" of instruments with sensitivities to distinct aspects of precipitation processes. IPWG requests plans for such coordination from CGMS members, specifically, plans beyond CloudSat, EarthCare and GPM, etc.

6. **For all CGMS Members** – Provide specific plans (e.g., sensors, timelines, etc.) and user requirements regarding the reprocessing of all L1 radiance data, L2/L3 derived precipitation products, and their intercalibration (i.e., SCOPE-CM, NOAA CDR, etc.).

7. **For all CGMS Members** – To the extent possible, provide free and open access to satellite and ground validation data/products to IPWG members with minimal latency.

8. **For all CGMS Members** - Coordinate crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of the diurnal cycle, convective system lifecycles and severe storms. This might include aging satellites that serve in a backup mode.

9. **For all CGMS Members** – There are emerging new technologies that can enhance precipitation retrievals by improved measurement of physical properties related to precipitation, in particular, cloud properties. IPWG requests that specific plans for any news sensors (e.g., Doppler radar, cloud radars, GEO MW sensors, etc.) be made available, including those relevant to ICWG.

Additionally,

- CGMS-43 is invited to confirm Remy Roca (CNRS, France ) and Tufa Dinku (IRI, USA) as the new IPWG co-chairs and to thank the outgoing co-chairs Nai-Yu Wang from the University of Maryland (USA) and Kazumasa Aonashi from the Japanese Meteorological Agency (Japan);

- CGMS-43 is requested to provide information to the IPWG Rapporteur on areas for future consideration by the IPWG;

- CGMS members are requested to continue to provide financial support for the activities related to IPWG, including workshop support and associated travel for new participants (including those at any associated training activity), travel support for CGMS member participation, and support for IPWG co-chairs (or designated representatives) to participate at other relevant meetings (e.g., WMO, CEOS, etc.).

# SUMMARY REPORT OF THE SEVENTH WORKSHOP OF THE INTERNATIONAL PRECIPITATION WORKING GROUP (IPWG-7)

## 1 INTRODUCTION

The purpose of the report is to summarize the 7th Workshop of the International Precipitation Working Group (IPWG-7). In the following sections, the report will provide general information about the meeting, accomplishments of IPWG since IPWG-6, summaries of each of the five working groups, and recommendations to CGMS. The report also contains a section on other topics relevant to IPWG and CGMS. It should be noted that details of the meeting, as well as all activities of IPWG are maintained through its web page - http://www.isac.cnr.it/~ipwg/IPWG.html. ***For further reference, the workshop and training course agendas are provided in Appendix A and B, at the end of the report.***

## 2 OVERVIEW AND HIGHLIGHTS

The IPWG-7 was held at the Tsukuba International Congress Center and hosted by the Japanese Aerospace Exploration Agency (JAXA) Earth Observation Research Center (EORC), Tsukuba, Japan during 17-21 November 2014. Tsukuba is one of the biggest research centres in Japan and is the home to the Japanese Meteorological Agency (JMA) Meteorological Research Institute (MRI) and JAXA's Tsukuba Space Center. Tsukuba is located approximately 40 km north east to Tokyo. The local organizing committee included Riko Oki, Misako Kachi and Takuji Kobota (EORC/JAXA); Kazumasa Aonashi and Kozo Okamoto (MRI/JMA); Shoichi Shige (Kyoto Univ.); Tommo Ushio (Osaka Univ.). They were also supported by local staff that collectively provided tremendous support throughout the entire week that lead to a highly successful workshop. The outgoing co-chairs, Nai-Yu Wang (Univ. of Maryland, USA) and Kazumasa Aonashi (MRI/JMA, Japan) would also like to thank financial contributions by EUMETSAT and JAXA to support travel and other logistical costs and acknowledge the support by other CGMS members to allow for participation by their scientists at the workshop.

The meeting was attended by 125 participants from over 20 countries that included 49 oral and 57 poster presentations. It consisted of nearly three full days of plenary sessions (12 oral, 3 poster), one full day of working group discussions and a final group plenary, and then closed with a special session dedicated to Dr. Arthur Hou, NASA Global Precipitation Measurement (GPM) Project Scientist, who passed away in late 2013. Additionally, a satellite training course was given, which took place in parallel to the IPWG workshop; 28 participants attended the course. A direct link to the presentations can be found at http://www.isac.cnr.it/~ipwg/meetings/tsukuba-2014/Tsukuba2014-pres-post.html.

The IPWG co-chairs also announced that a special collection issue in the American Meteorological Society *Journal of Hydrometeorology* will be developed where papers summarizing mature scientific topics presented at IPWG-7 can be submitted (tentative deadline is September 2015).

## 2.1 IPWG objectives and accomplishments over the past two years

At the beginning of the workshop, the co-chairs reminded the participants of the primary objectives of the IPWG; these include:

- Promote standard operational procedures and common software for deriving precipitation estimates from satellites;
- Establish standards for validation and independent verification of precipitation estimates;
- Foster the exchange of data on inter-comparisons of operational precipitation estimates from satellites;
- Stimulate increased international scientific research and development in this field;
- Provide recommendations to national and international agencies regarding the utilization of current and future satellite instruments on both polar and geostationary platforms;
- Encourage regular education and training activities.

They also pointed out key contributions and accomplishments of the IPWG over the past two years, which included:

- Maintain and update the IPWG web page (http://www.isac.cnr.it/~ipwg/IPWG.html);
- Promote IPWG, expand membership and update membership database;
    - Over the past two years, membership increased by 47 (now at 325 members from over 40 nations/organizations);
- Develop an IPWG focused publication;
    - Lead by former co-chairs Paul Kucera and Vincenzo Levizanni, a special issue of *Atmospheric Research* dedicated to scientific progress reported at IPWG-6 is nearly completed. 14 papers will be part of this issue that will be completed by April 2015.
- Engage with CGMS on topics of interest, including participation at CGMS sponsored meetings;
- Engage with other entities like CEOS and GEO, including participation at relevant meetings;
- Organize and convene the 4$^{th}$ International Workshop on Space-based Snowfall Measurement – Developing Requirement and Framework for a Space-Based Missions, 6-8 May 2013, Mammoth Mountain, CA (USA);
- Hold Biennial IPWG workshops and concurrent training courses;
    - It was noted that the training course at IPWG-7, “New and Emerging Remote-Sensing Technologies for Precipitation Data Sets and their Applications and Validation”, had 28 students

Finally, to officially open the workshop, the co-chairs reminded the participants of the specific goals of IPWG-7 that included:

- To exchange information on the latest progress and results related to precipitation measurement, including those from the recently launched missions like GPM, GCOM and S-NPP;

- To provide a forum for collegial exchanges between algorithm developers, product generators and operational users;
- Through working groups, discuss and define future IPWG activities, including specific recommendations to be given to CGMS members;
- In honour of Arthur Hou, hold a special session devoted to his scientific contributions and leadership to GPM and NWP assimilation of precipitation observations.

## 2.2 Summary of Working Group Reports

At IPWG-7, five working groups (WG) were formed and met for nearly one day to discuss the status of previous actions (from IPWG-6) and to discuss the future challenges on their topic. There were five WG's: Validation, Applications, Research, New Technology and Data Assimilation. The following sections highlight the recommendations from each WG.

### 2.2.1 Research Activity Working Group (RAWG)

The RAWG was chaired by Shoichi Shige (Kyoto Univ., Japan) and its rapporteur was Benjamin Johnson (NASA/GSFC, USA). The primary recommendations from the RAWG include:

- Community Related
    - Strive to increase connections between application/validation and research with respect to spatial and temporal scale interactions; including both ancillary and "direct" observations, simulations, and retrieval algorithms, for both ground and space-based paradigms.
    - Recommend that CGMS subgroups and parallel group share reports at IPWG and vice-versa, to identify connections and deficiencies in inter-group activities (e.g., ITOVS, ICWG, snowfall workshop, etc.).
- Observation Related
    - Encourage use of scatterometers (and other active observations) to improve total-scene retrievals with a goal of increasing observational accuracy of the entire spectrum of precipitation type, intensity, distribution, and location in order to quantify how the weather and climate are changing regionally and globally.
    - Ensure over-ocean precipitation processes are consistently observed, encourage communication and interaction with broader research community, taking advantage of specialized knowledge
- Retrieval Related
    - Improve understanding of 4-D precipitation processes, rather than independent 1-D individual pixel retrievals
    - Support activities that promote physically consistent physical basis between ground, aircraft, and satellite based simulations and retrievals
    - Encourage multi-parameter column retrievals (versus surface-only precipitation), maximizing information content available from remote sensing platforms
    - Exploit visible and IR observations (or VIS/IR based-retrievals) to identify precipitation processes to guide microwave-based retrievals

    - Reduce PSD-related uncertainties by exploiting process knowledge within aerosol, cloud, and precipitation interactions (e.g., 4-D scale, lifecycle, regional characteristics), and quantify impact on retrieved precipitation parameters
- Product/User Related
    - Identify and encourage data availability and communicate with community to improve understanding of how to access and utilize various datasets.
    - Encourage interaction, training, and communication with user and peripheral communities with a mind toward developing user-need based products (e.g., Hydrology, aerosol, cloud, operations, etc.)
    - Investigate and quantify influence of consistency, accuracy, and uncertainty between individual sensor (e.g., level 2) products on merged (e.g., level 3) products
    - Encourage precipitation products to be more applicable toward climate applications, or at least quantify uncertainties under the assumption that products may be used in climate applications.
    - Preserve long term data records from heritage satellites, e.g., TRMM for Climate Data Record / FCDR (observations and retrieval) type applications, and encourage understanding the variability of the instruments themselves, improved accessibility.

The RAWG suggested potential actions to CGMS include:

- IPWG recognizes the need for improved global measurement of precipitation for both weather and climate monitoring, recommends continued multi-national cooperation in ensuring comprehensive observation and precipitation datasets are available to the community with transparency and efficiency.
- IPWG recognizes that active microwave observations of precipitation strongly enhances the value of CGMS passive assets, and recommends CGMS members take responsibility for sustaining these capabilities.
- Recommend an operational constellation of conically-scanning microwave platforms to guarantee sustained support for the current level of capability.
- IPWG recognizes the value in constellation-based (e.g., A-Train) active and passive multi-parameter observations in improving precipitation process understanding and its role in the climate system, recommends continued science-driven international cooperation and collaboration in preparation for future missions.
- Ensure continuity of geostationary coverage and data access over the current METEOSAT-7 coverage area.
- Recommend CGMS subgroups and parallel group reports are shared at respective subgroup meetings, to identify connections and deficiencies in communication (e.g., ITOVS, ICWG, snowfall workshop, etc.).

### 2.2.2 Applications Working Group (AWG)

The AWG was chaired by Ali Behrangi (NASA/JPL, USA) and its rapporteur was Paul Kucera (NCAR, USA). The primary recommendations from the AWG include:

- Explore the possibility of developing a global 4-km water vapour channel dataset to improve satellite rainfall estimates;
- Revise the IPWG website data introduction and summaries by improving the data table headers, converting algorithm descriptions to product descriptions, and revising the introduction to dataset documentations;
- Develop a new document on data formats, meta data, and best practices for dataset developers to help the user community better use the precipitation datasets;
- Survey the IPWG community
    - Conduct a survey of available software tools to use the satellite precipitation data
    - Conduct a survey of available data recipes for using satellite precipitation data
    - Conduct a survey to develop a list of example applications that uses satellite precipitation data
- Provide links to user requirements and link them to the IPWG home page
- Develop/provide bias corrections of satellite products for use in hydrologic applications and document them

The AWG suggested potential actions to CGMS include:

- IPWG strongly recommends to CGMS members to continue the constellation of PMW sensors to ensure quality satellite precipitation products for weather, climate, and hydrological applications
    - Confirmation for currently planned satellites
    - Develop plans for subsequent launches of microwave sensors to ensure continuity of long-term observations that meet the documented needs of the user community
    - Coordinate crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of diurnal cycle, convective systems lifecycles, and severe storms.
- IPWG recommends that CGMS members should provide free access of geostationary (IR window and WV channels) satellite data with complete global coverage (including Indian Ocean) to developers of the precipitation products in a timely fashion with a latency of one hour or less to better support short-term applications (e.g., flash flooding, nowcasting, etc.)

### 2.2.3 Validation Working Group (VWG)

The VWG was chaired by Viviana Maggioni (George Mason Univ., USA) and its rapporteur was Patrick Meyers (Univ. of Maryland, USA). The primary recommendations from the VWG include:

- From outstanding action items from IPWG-6, an general recommendation is to data from the IPWG validation sites be sustained and shared freely with all IPWG members

- Improve communication with users by redesigning/updating the validation page on the IPWG website
    - Created subsections for the GV data sets, validation in hydrologic modelling, etc.
    - Track site usage
- Coordination with CGMS on the V-LAB for Training and Education in satellite meteorology
- Benchmark satellite precipitation products in regions with high density/high quality GV data sets
- Establish a relationship between GPM-GV and IPWG for snowfall validation best practices
- Expand GV acquisition and dissemination efforts over data sparse regions
    - Ocean
    - Promote new technologies (e.g., commercial MW links/cellular phone network)
    - China and India will establish IPWG routine daily validation
- Assessment of uncertainty associated with satellite precipitation products in extreme events, different surfaces and elevation; various time/space scales, etc.

The VWG suggested potential actions to CGMS include:

- Solicit agencies to reprocess ground validation data with current algorithms for consistent validation, with the addition of quality flags
- Emphasize the importance of uncertainty estimates associated with satellite precipitation products

### 2.2.4 Data Assimilation Working Group (DAWG)

The DAWG was chaired by Sid Boukabara (NOAA/NESDIS, USA) and its rapporteur was K. Okamoto (MRI/JMA, Japan). The primary recommendations from the DAWG include:

- Encourage the GPM program to work more closely with the Data Assimilation (DA) community and make it a core activity within GPM
- Because of the close linkages between DA of cloud hydrometeors and precipitation
    - The DAWG recommends the organization of a joint IPWG and NWP workshop explicitly focused on the DA of satellite data in cloudy/rainy conditions.
    - Additionally, there should be closer coordination between ITWG and ICWG, including a common theme of DA.
- CGMS members should close the observational gap to improving the retrieval of cloud microphysical properties, including vastly improved vertical profiling and sub-hourly temporal sampling

The DAWG suggested potential actions to CGMS include:

- Improve the spatial resolution of future sensors to keep up with foreseen DA system resolutions (e.g., vertical, horizontal, and temporal)

- Arrange for improved temporal sampling by staging orbits to avoid the current overlap and go beyond the current three satellite polar configuration
- Data latency should be improved
- Pre-launch information on new sensor characteristics are needed well before actual launch

### 2.2.5 New Technology Working Group (NTWG)

The NTWG was chaired by Tristan L'Ecuyer (Univ. Wisconsin, USA) and its rapporteur was Takuji Kubota (EORC/JAXA, Japan). The primary recommendations from the NTWG include:

- Encourage the continued commitment by EUMETSAT on the development and launch of the EPS-SG satellites, containing the full complement of cloud and precipitation sensors, including MWS, ICI and MWI
- Encourage the continued plans by JAXA and ESA? on EarthCARE. Additionally, IPWG encourages further development of advanced active MW sensors, including GPM/CloudSat type follow on capabilities, Doppler radars, etc.
- Endorse research directed toward optimally combining process missions and mapping constellations to improve high temporal resolution global precipitation data sets (e.g., use Doppler radars to improved databases used in passive MW retrievals)
- Other future activities that the WG recommends include:
    - Encourage the development of both passive and active MW geostationary concepts with sensitivity and resolution suitable for precipitation measurement in combination with planned GOE lightning mappers
    - Cross agency coordination of satellite assets into A-Train like convoys with sensors sensitive to precipitation processes
    - Perform trade studies into the benefits of convoys of similar instruments (e.g. CubeSats or SmallSats) with revisit times suitable for sampling time-evolution of precipitating systems
    - Constellation of MW radiometers with optimized equatorial crossing times for precipitation mapping, with real-time data distribution
    - Encourage the development of sub-orbital technologies for testing new precipitation measurement concepts
- Recommend the development of launch technologies with improved sensitivity to falling snow in high inclination orbits to improve sampling in polar regions

The NTWG suggested potential actions to CGMS include:

- Deployment of new space-based multi-frequency Doppler radar technologies with improved precision, spatial, spectral and temporal sampling
- Development of active and passive MW concepts with the sensitivity and resolution needed for precipitation measurement in combination with planned GEO lightning mappers

## 2.3 Arthur Hou Special Session

The final session of IPWG was entitled "Arthur Y. Hou Memorial Session on Precipitation Data Assimilation" and consisted of six scientific presentations by the IPWG membership on the progress of cloudy/precipitating data assimilation.

Preceding those talks, Gail Skofronick-Jackson, new GPM Project Scientist at NASA/GSFC, presented a touching tribute to Arthur, noting his wonderful scientific contributions as well as reminding us all about how Arthur was such a beautiful person; he is greatly missed by his peers.

# 3 OTHER MATTERS

## 3.1 Changes in Co-Chairs

As is customary in IPWG, the chairmanship is changed every two years. Through a committee consisting of the outgoing chairs and previous co-chairs, Remy Roca (CRNS, France) and Tufa Dinku (IRI, USA) were selected as the new co-chairs. Transition will begin in 2015, with the outgoing co-chairs remaining active to complete any remaining actions from their tenure, including wrap up items from IPWG-7.

## 3.2 IPWG Web Site - Information Portal

The IPWG web site continues to be the main information portal to its membership; several updates were made over the past several months. It is maintained by former co-chair, Vincenzo Levizzani. The main features of the web site include information on current/past meetings (including reports and presentations), a summary of mature precipitation algorithms, validation (methodologies and links to various regional sites), training, etc. Several actions emerged from the different WG's that will lead to further enhancement to the web site over the upcoming year.

## 3.3 Fostering closer collaboration with other ISWG's

As was discussed within several WG's and during plenary sessions, it was strongly suggested that closer links be made with other ISWG's, most notably ITWG and ICWG. Previous interactions with the ITWG lead to a close engagement by the microwave surface emissivity community to the GPM program, leading to substantial improvements to the overland precipitation retrievals. It was suggested that future joint meetings be considered and cross ISWG participation at their respective meetings.

## 3.4 New validation site participants

One of the highlights at IPWG-7 was two new member nations – China and India – expressing a strong desire to contribute ground validation assets and develop regional validation sites similar to those already in existence. Subsequent to the meeting, the China representative, Yan Shen from CMA, expressed concern that without a more formal request through WMO, she might not be able to fulfil this obligation. It's possible that India might need the same level of request.

## 3.5 IPWG Comments on HLPP (2014-18)

Each WG was asked to review and comment on the CGMS HLPP (2014-18) and subsequently, the HLPP was examined closely by the WG co-chairs, current IPWG co-chairs, and past co-chairs. A summary of the comments are provided in Appendix C.

### 3.6 Financial Support

Obtaining financial commitments from CGMS members continues to be an ongoing challenge for IPWG; at best it can be described as ad hoc. Financial support is needed to sustain the activities related to IPWG, including workshop support and associated travel for new participants (including those at any associated training activity), travel support for CGMS member participation (it was noted that without "core" member participation, the impact of IPWG is greatly diminished). Additionally, support for IPWG co-chairs (or designated representatives) to participate at other relevant meetings (e.g., WMO, CEOS, etc.) is sometimes lacking.

### 3.7 New Logo

Through the efforts of former co-chair Vincenzo Levizzani, and via concurrence from all previous co-chairs, a new logo was selected.

### 3.8 Future meetings

IPWG-8 will be held in the fall of 2016, with an African venue being targeted, since IPWG has never been held on the African continent. However, it was recognized that there are challenges ahead to secure a venue that can host the meeting and be easily accessible by the broad IPWG membership. Thus, as an alternative, former co-chair Vincenzo Levizzani has offered to host the meeting at his ISAC/CNR facility in Bologna, Italy.

## 4 ACTIONS AND/OR RECOMMENDATIONS FOR CONSIDERATION BY CGMS43 PLENARY SESSION (AND WORKING GROUP II)

CGMS Members are requested to:

- Provide information to the IPWG Rapporteur on areas for future consideration by the IPWG;
- Confirm the new Co-Chairs for the IPWG;
- Continue to provide financial support for the activities related to IPWG, including workshop support and associated travel for new participants (including those at any associated training activity), travel support for CGMS member participation, and support for IPWG co-chairs (or designated representatives) to participate at other relevant meetings (e.g., WMO, CEOS, etc.).

Specific actions include:

1. **For all CGMS Members** - Ensure continuity of geostationary coverage (over Indian Ocean) and data access over the current METEOSAT-7 coverage area.

2. **For CMA and IMD –** Provide institutional support to develop IPWG validation sites over China and India.

3. **For all CGMS Members** - Continue an operational constellation of conically-scanning microwave platforms to guarantee sustained support for the current level of capability. In particular, specific plans for the following missions are requested: JAXA for the GCOM-W/AMSR-2 follow-on; NOAA for the SSMIS F20 launch plan/DMSP follow on program; NASA/potential use of GMI#2; specific plans by EUMETSAT for EPS-SG/MWI.

4. **For ITWG, ICWG (and other ISWG's)** – To foster more close collaboration on common topics, subgroups and parallel group reports should be shared at respective subgroup meetings, as well as potential specialty meetings (i.e., emissivity, snowfall, data assimilation) and other meetings of opportunity (e.g., AGU, EGU, etc).

5. **For all CGMS Members** – IPWG encourages cross-agency coordination of satellite assets into "A-train-like convoys" of instruments with sensitivities to distinct aspects of precipitation processes. IPWG requests plans for such coordination from CGMS members, specifically, plans beyond CloudSat, EarthCare and GPM, etc.

6. **For all CGMS Members** – Provide specific plans (e.g., sensors, timelines, etc.) and user requirements regarding the reprocessing of all L1 radiance data, L2/L3 derived precipitation products, and their intercalibration (i.e., SCOPE-CM, NOAA CDR, etc.).

7. **For all CGMS Members** – Provide free and open access to satellite and ground validation data/products to IPWG members with minimal latency.

8. **For all CGMS Members** - Coordinate crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of the diurnal cycle, convective system lifecycles and severe storms. This might include aging satellites that serve in a backup mode.

9. **For all CGMS Members** – There are emerging new technologies that can enhance precipitation retrievals by improved measurement of physical properties related to precipitation, in particular, cloud properties. IPWG requests that specific plans for any news sensors (e.g., Doppler radar, cloud radars, GEO MW sensors, etc.) be made available, including those relevant to ICWG.

## APPENDIX A:

## IPWG7 Agenda
## 17-21 November 2014
## Tsukuba International Congress Center, Tsukuba, Japan

**Monday, 17 November 2014**

0830 Registration
0850 Miscellaneous Announcement

**0900 Session 1: Introduction (Chair: G. Huffman)**

0900-0920 **1.1:** Welcome and Introduction: R. Oki
0920-0940 **1.2:** Overview of IPWG goals: N-Y. Wang and K. Aonashi
0940-1000 **1.3:** Update on CGMS activities: R. Ferraro and S. Bojinski

**1000 Session 2: GPM overviews (Chair: G. Huffman)**

1000-1020 **2.1:** GPM Science Status Nine Months after Launch: G.Skofronick-Jackson
1020-1040 **2.2:** Early Results and Expectations for the GPM Science: Y. N. Takayabu

**1040-1110 Coffee break**

**1110 Session 3: Satellite program Status (Chair: V. Levizzani)**

1110-1130 **3.1:** Observation of water-related parameters by GCOM-W/AMSR2: M. Kachi
1130-1150 **3.2:** The status of NOAA/NESDIS precipitation algorithms and products: R.Ferraro
1150-1210 **3.3:** Impact of Megha-Tropiques data in GPM constellation based rainfall estimate using the TAPEER algorithm: R. Roca
1210-1230 **3.4:** Prospects for the Microwave Constellation: G. Huffman

**1230-1430 Lunch**

**1430 Session 4: Algorithm I (Chair: R. Ferraro)**

1430-1450 **4.1:** Comparison of DPR and GMI precipitation rate estimates: S. Seto
1450-1510 **4.2:** Initial GPROF results using a GPM derived database: C. Kummerow
1510-1530 **4.3:** Multiplatform Rain Retrieval Intercomparison: N.Viltard
1530-1550 **4.4:** Global Satellite Mapping of Precipitation (GSMaP) product in the GPM era: T. Kubota
1550-1610 **4.5:** Towards the Consideration of Surface and Environment variables for a Microwave Precipitation Algorithm Over Land: N-Y. Wang
1610-1630 **4.6:** Shallow Orographic Heavy Rainfall in the Asian Monsoon Region Observed by TRMM PR: S. Shige.

**1630-1830 Session 5: Poster I**

**1830-2030 Ice Breaker**

**Tuesday, 18 November 2014**

**0900 Session 6: Validation I (Chair: C. Kidd)**

0900-0920 **6.1:** Analysis of satellite monthly precipitation time series over East Africa: V. Levizzani
0920-0940 **6.2:** Comparison analysis between radar-based QPE and High Resolution Satellite Precipitation Products around the Korean Peninsula: S-D. Yang
0940-1000 **6.3:** Introduction of radar data quality control procedure in Poland and its impact on validation of H-SAF precipitation products: B. Lapeta
1000-1020 **6.4:** GoAMAZON – CHUVA: GPM Ground Validation Activities: D. Vila
1020-1040 **6.5:** CloudSat and multi-sensor information to assess and improve high latitude precipitation retrievals from space A. Behrangi

**1040-1110 Coffee break**

**1110 Session 7: Precipitation Datasets (Chair: P. Kucera)**

1110-1130 **7.1:** Recent Advances in Interpreting Cloudsat Precipitation Observations: T. L'Ecuyer

1130-1150 **7.2:** Reprocessed and Bias-Corrected CMORPH H Global High-Resolution Precipitation Estimates for Weather, Climate, and Hydrometeorological Applications: P. Xie

**1150 Session 8: Application I (Chair: P. Kucera)**

1150-1210 **8.1:** Evaluation of Satellite Precipitation Products Using Global Flood Calculations: R. Adler

1210-1230 **8.2:** The Critical Role of Satellite Rainfall Estimates for Enhancing National Climate Services Across Africa: T. Dinku

**1230-1430 Lunch**

**1430 Session 9: Algorithm II (Chair: N-Y. Wang)**

1430-1450 **9.1:** Using TRMM Observations and Synthetic Retrievals to Examine the Sensitivity of a Passive Microwave, Bayesian-based Precipitation Retrieval to Land Surface Properties: J. Turk

1450-1510 **9.2:** Early results of precipitation retrievals from cross-track sensors for the Global Precipitation Measurement mission constellation: C. Kidd

1510-1530 **9.3:** Improvements to the GOES-R Rainfall Rate Algorithm: R. Kuligowski

1530-1550 **9.4:** Precipitation Estimation using Combined Radar and Microwave Radiometer Observations from GPM - Initial Evaluation: W. Olson

1550-1610 **9.5:** Early Examples and Plans for the Integrated Multi-Satellite Retrievals for GPM (IMERG): G. Huffman

1610-1630 **9.6:** Second Generation CMORPH:Winter Hemisphere Experiments: R. Joyce

**1630 Session 10: New Technology (Chair K. Aonashi)**

1630-1650 **10.1:** Multi-frequency Radar: S. Talleli

1650-1710 **10.2:** Millimeter Imager: C. Kidd

1710-1730 10.3 The CaPPM concept G. Skofronick-Jackson

**1730-1930 Session 11: Poster II**

**Wednesday, 19 November 2014**

**0900 Session 12: Validation II (Chair: B. Lapeta)**

0900-0920 **12.1:** Precipitation Error Structure and Representation: Y. Tian

0920-0940 **12.2:** Ground Validation of the TAPEER-BRAIN daily accumulations from Megha-Tropiques program over the Tropics and comparison with other rain products: M. Gosset

0940-1000 **12.3:** Comparison between GPM Core GMI GPROF precipitation estimations and ground data over Europe by the H-SAF Precipitation Product Validation Group: B. Lapeta

1000-1020 **12.4:** Evaluation of satellite-based rainfall products over the Brahmaputra basin: S. Bajracharya

1020-1040 **12.5:** Global View of Real-time TRMM Multi-satellite Precipitation Analysis: B.Yong

**1040-1110 Coffee break**

**1110 Session 13: Application II (Chair: J. Turk)**

1110-1130 **13.1:**Rinfall Estimation Using Spatiotemporal Evolution of GEO Multispectral Imagery k. Hsu

1130-1150 **13.2:** Evaluation of Raindrop Size Distributions to Improve Satellite Rainfall Estimation during the Colorado Flood: P. Kucera
1150-1210 **13.3:** Towards an object-oriented validation system for high-resolution NWP models: J.L. Bytheway
1210-1230 **13.4:** Toward downscaling the Megha-Tropiques rainfall products: detection issues over West Africa: C. Guilloteau
1230-1250 **13.5**: Investigating the usability of TRMM satellite based precipitation products for flood monitoring over Riyadh Region in Kingdom of Saudi Arabia: A. E. Tekeli

**1250-1430 Lunch**

**1430-1630 Session 14: Poster III**

**1630-1645 Working Groups (WG) Instructions**
**1645-1830 WG Breakout Session 1**

**1830-2030 Workshop Dinner**

**Thursday, 20 November 2014**

**0900-1040 WG Breakout Session 2**

**1040-1110 Coffee break**

**1110-1230 WG Breakout Session 3**

**1230-1430 Lunch**

**1430-1600 WG reports**
**1600-1630 IPWG7 Wrap Up**

**1630 Arthur Hou Memorial Session on Precipitation Data Assimilation (Chair: G. SkofronickJackson)**
1630-1650 **19.1:** Microphysics, Cloud resolving models, PMM and Arthur Hou: W-K. Tao
1650-1710 **19.2:** Model errors in tropical cloud and precipitation revealed by the assimilation of microwave imagery: K. Lonitz
1710-1730 **19.3:** Initial evaluation of GPM microwave imager observations in the JMA NWP systems: M. Kazumori
1730-1750 **19.4:** Physical Inversion and Data Assimilation of Cloud and Rain-Affected Passive Microwave Satellite Observations: S. Boukabara
1750-1810 **19.5:** Dual-Scale Neighboring Ensemble Variational Assimilation Scheme for a Cloud-Resolving Model: K. Aonashi
1810-1830 **19.6:** A data-assimilation technique to account for the nonlinear dependence of satellite observations of precipitation on variables that are not explicitly resolved by the model: Z. Haddad

**Friday, 21 November 2014 - IPWG Technical Tour**

**Poster I**
**P1.1:** K. Aonashi The next-generation GSMaP MWI precipitation retrieval algorithm
**P1.2:** J. Burdanowitz Towards an automatic phase distinction algorithm of optical disdrometer data over the ocean
**P1.3:** D. Casella CDRD and PNPR passive microwave precipitation retrieval algorithms: extension to the MSG full disk area.

**P1.5:** G. Skofronick-Jackson Performance Evaluations of Falling Snow using the Global Precipitation Measurement (GPM) Radiometer Retrieval Algorithm

**P1.6:** B. T. Johnson GPM Passive and Combined Precipitation Algorithm Testing and Improvement
**P1.7:** S. Kacimi On the vertical profiling of precipitation from space

**P1.10:** A. Martini Rain retrieval using the SAPHIR water vapor sounder on Megha-Tropiques
**P1.11:** T. Mega Gage Adjusted Global Satellite Mapping of Precipitation (GSMaP Gauge)
**P1.12:** D. Melfi H-SAF future developments on Convective Precipitation Retrieval
**P1.13:** H. Meng Snowfall Rate Retrieval using NPP ATMS Passive Microwave Measurements
**P1.14:**A. K. Mitra Satellite rainfall retrievals from Operational INSAT-3D satellite and its Validation for climate, weather, and hydrometeorological applications
**P1.15:** S.J. Munchak Microphysical Properties of Precipitation over Complex Terrain inferred from TRMM, GPM, and IPHEX observations
**P1.16:** S.E. Ringerud Constructing a Physically-Consistent Database for Passive Microwave Retrieval of Precipitation over Land
**P1.17:** N. Taburet The error model of the TAPEER rainfall product
**P1.18:** S. Veleva Convective/stratiform classification from passive microwave observations: Developing the PMW-CLASS algorithm and performance evaluation
**P1.19:** N. Viltard Post-GPM rain retrieval and 3-D wind retrieval: the DYCECT mission
**P1.20:** M.K. Yamamoto Improvement of the orographic/nonorographic rainfall classification scheme with a static stability information in the GSMaP algorithm

**Poster II**

**P2.1:** A. Behrangi Hydrologic application and assessment of remotely sensed high resolution precipitation products over cold-mountainous regions
**P2.2:** J. Burdanowitz The Oceanic Shipboard Precipitation Measurement Network for Surface Validation – OceanRAIN
**P2.3:** C-T. Chen Reliability of Satellite Rainfall Retrieval Against Surface Rainfall Observation under Weather Extremes
**P2.4:** Z. Chen Evaluation of Global Satellite Mapping of Precipitation (GSMaP) project daily precipitation estimates over the Chinese Mainland
**P2.5:** T. Dinku Validation of CHIRP Satellite Rainfall Estimates
**P2.6:** M. Gosset Alternative methods for providing GV in the rain-gauge-poor Tropics .
**P2.7:** R. Iwanski Investigation on H-SAF preoperational precipitation product PR-OBS-15 findings using satellite and ground based data sources
**P2.8:** R. Juca Oliveira Validation of satellite-based precipitation estimates: Preliminary results from GPROF using GPM database for the CHUVA field campaigns
**P2.9:** P-E. Kirstetter Evaluating GPM Level II Precipitation Products at fine scale over the Conterminous United States: preliminary results
**P2.10:** P. Kucera Satellite Precipitation Evaluation Tools
**P2.11:** V. Maggioni An Error Model for Satellite Precipitation Products
**P2.12:** T. Mega Ground validation of the Dual-frequency Precipitation Radar with The Phased Array Weather Radar
**P2.13:** P. Meyers Validation and Monitoring of NOAA's AMSR2 Precipitation Product
**P2.14:** Y. Shen Evaluation and Improvement of Satellite-Based Daily Precipitation Products over the Tibetan Plateau
**P2.15:** M. S. Shrestha Accuracy of Satellite-based Rainfall Estimates in Small Mountainous Catchments: A Case of Khudi Khola
**P2.16:** S. A. Sirdas Comparison Global Precipitation Products to Euro-Asian Water Basins of Istanbul
**P2.17:** S. Upadhyaya Validation of Near-Real Time Satellite Rainfall Products and Assessment of its Bias over Different Homogeneous Regions of India based on Topographical Analysis
**P2.18:** M. Mech NARVAL Airborne remote sensing of clouds and precipitation for satellite validation with HALO

**Poster III**

**P3.1:** R. Braga Aerosol effects in different types of precipitating clouds in the Amazon
**P3.2:** C. Casse Scale and uncertainties issues in Hydrological applications of satellite rain products : Case study of the Niger River floods in Niamey
**P3.3:** F. A. Furuzawa Study on the trends of microwave land surface emissivity and precipitation characteristics derived from TRMM
**P3.4:** S. Gabriele Analysis and investigation of extreme rainfall events combining different data sources
**P3.5:** A. Hamada Characteristic differences between the heaviest rainfall and the tallest storms
**P3.6:** G. Kelem Importance of Calibrated Satellite Data for Weather and Climate Monitoring and Forecasting
**P3.7:** Z. Liu Online Intercomparison of Satellite-based Global Precipitation Products: Challenges, Progress and Future Directions
**P3.8:** T. Salami Variability of Climatic Elements in Nigeria over Recent 100 years.
**P3.9:** R. Esmaili Global Tracking and Life Cycle Analysis of Storms using a Decade of Satellite Observations
**P3.11:** P. Chambon Verifying precipitation forecasts with satellite rainfall products taking into account their uncertainties
**P3.12:** P. Chambon Adaptive observation operator for microwave radiances affected by frozen precipitation in Goddard Ensemble Data Assimilation System
**P3.13:** Y. Ikuta Development of GPM/DPR Data Assimilation at JMA
**P3.14:** S. Kotsuki Comparative study of GPM-derived precipitation with the 3.5-km-resolution NICAM simulations
**P3.15:** K. Okamoto Towards the assimilation of space-borne precipitation radar in the ensemble-based variational scheme
**P3.16:** A. Andersson Recent Developments and Releases of Precipitation Products from the German Weather Service and the EUMETSAT CM SAF
**P3.17:** O. Prat Evaluation of satellite based Quantitative Precipitation Estimates (QPEs) over CONUS (2002---2012): Comparison with surface and radar precipitation datasets
**P3.18:** W. Berg Developing Consistent Precipitation Estimates from Microwave Radiometers for GPM and Long-Term Climate Applications
**P3.19:** K. Hsu PERSIANN-CDR: A Daily Precipitation Climate Data Record
**P3.20:** E. F. Stocker GPM Data Products , their availability and production status

## APPENDIX – B

## The IPWG7 training course program
## 17-20 November 2014
## Tsukuba International Congress Center, Tsukuba, Japan

## "New and emerging remote-sensing technologies for precipitation data sets and their applications and validation"

**Monday, 17 November 2014**

**0900-1230 Participation in Session 1-3 of IPWG7**

**1230-1430 Lunch**

**1430-1445 Welcome and Orientation** Kazumasa Aonashi (JMA/MRI)

**1445 Session 1: Precipitation Remote Sensing and retrieval algorithms I**

1445-1515 Infrared algorithm Kuolin Hsu (UC-Irvine)

1515-1615 Active microwave algoritm Shinta Seto (Nagasaki Univ.)

1615-1645 Passive microwave instrument Keiji Imaoka (JAXA)

**1645-1830 Participation in Poster I**

**1830-2030 Ice Breaker**

**Tuesday, 18 November 2014**

**0900 Session 2: Precipitation Remote Sensing and retrieval algorithms II**

0900-1000 Passive microwave algorithm Chris Kummerow(CSU)

1000-1045 Level 3 merged algorithms George Huffman (GSFC)

**1045-1110 Coffee break**

**1110 Session 3: Validation of Precipitation Retrievals**

1110-1155 Precipitation validation Chris Kidd (GSFC)

1155-1240 Radar and Surface Qualitaive precipitation Estimation Paul Kucera (NCAR)

**1240-1430 Lunch**

**1430 Session 4: Application of Precipitation Retrievals**

1430-1530 Flood detection Robert Adler(UMD)

1530-1600 Operational applications at NOAA Ralph Ferraro (NOAA)

1600-1630 Operational applications at JMA Kozo Okamoto (JMA/MRI)

1630-1730 H-SAF project – Current and Future Plans Davide Melfi (Italian Air Force)

**1730-1930 Participation in Poster II**

**Wednesday, 19 November 2014**

**0900 Session 5: NWP applications and Assimilation**

0900-0950 Data assimilation Kazumasa Aonashi (JMA/MRI)

0950-1040 Use of Satellite Measurements in Data Assimilation: Overview of NOAA efforts to improve the assimilation of satellite data in support of US Joint Center for Satellite Data Assimiation (JCSDA) Sid Boukabara (NOAA)

**1040-1110 Coffee break**

**1110-1240 Session 6: Emerging Technologies and Techniques**

1110-1155 CloudSat Tristan S. Lecuyer (University of Wisconsin)

1155-1240 MW Constellation/GEO MW/SAR/RADAR Levizzani

**1240-1430 Lunch**

**1430-1630 Participation in Poster III**

**1630 Session 7: Regional Focus: "Precipitation over Tropics and Monsoon Asia"**

1630-1730 TRMM/GPM Science topics Yukari Takayabu (Univ.Tokyo)

1730-1830 New Precipitation products (GPM,GCOMW) Misako Kachi (EORC)

**1830-2030 Workshop Dinner**

## APPENDIX – C

## IPWG Comments on CGMS HLPP (2014-18)

| HLPP Page/Section | IPWG Comment |
|---|---|
| Page 3, Section 1.1 | Here are two CGMS recommendations from IPWG-7 that will be presented at CGMS-43; we are wondering if there is a place for this somewhere within Section 1:<br>(a) Identify potential precipitation observation gaps and ensure appropriate contingency measures are on place. Continue an operational constellation of conically-scanning microwave platforms to guarantee sustained support for the current level of capability<br>(b) Coordinate crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of the diurnal cycle, convective system lifecycles and severe storms. This might include aging satellites that serve in a backup mode. |
| Page 3, Section 1.1.1 | IPWG is concerned about the constellation/baseline of MW imagers as well. Ideally, we have at least 3 hourly global sampling of BOTH MW imagers and sounders. |
| Page 3, Section 1.1.5 | IPWG is wondering why precipitation is not considered in this regard; there are no plans beyond GPM that we are aware of. |
| Page 4, Section 1.3 | IPWG has major concerns about the protection of microwave frequencies that are critical to precipitation retrieval and the parameters related to the precipitation processes (e.g., water vapor, cloud water and ice, etc.). We think a general statement regarding the critical frequencies needed for protection should be coordinated across IPWG, ITWG and ICWG. |
| Page 5, Section 2 | Add in "(WIS)" after "WMO Information System" |
| Page 5, Section 2.4 | IPWG suggests that the statement should be revised as follows: "Investigate the feasibility of introducing a coordinated dissemination service for meteorological information to help planning for response to disasters, including strategies for counteracting the effects of intense rain or droughts." |
| Pages 6, Section 3.1 | Please add a new item specific to MW sensor calibration: "Establish a consistent inter-calibration for passive MW window and water vapor channels on both conical and cross-track scanning instruments using a variety of Intercalibration techniques. This should leverage ongoing activities through established programs such as GSICS, SCOPE-CM and GPM. The implementation will be done successively by the individual satellite operators." |
| Page 6, Section 3.3.1 | Please revise as follows: "Apply the IPWG validation framework (as defined on their web page) to precipitation combination datasets generated using multiple satellite and in-situ data sources, and expand the number of participating agencies to broaden the validation domain." |
| Page 7, Section 3.5.1 | Please add in precipitation to the list noted in parenthesis. |
| Page 7, Section 3.6.3 | IPWG is unclear what specific data sets are being referred to in this statement and who is the responsible focal point – IPWG co-chairs? |
| Page 8, Section 3.7 | IPWG would like to see a new subsection added as follows: "Through coordination with ITWG and ICWG, continue to improve microwave radiative transfer models to include complex surfaces (e.g., snow, desert, etc.) and scattering atmospheres (e.g., frozen hydrometeors) to support improved algorithm development for current and future sensors." |

| | |
|---|---|
| Page 8, Section 3.8 | IPWG would like to see this topic expanded to include MW imagers and active MW sensors. There should be two new subtopics that state: (1) "Trade studies are needed to look beyond the current set of MW sounders, imagers and radars in order to improve spatial resolutions and add in new capabilities for the retrieval of cloud and precipitation hydrometeors" [Perhaps this could be combined with 3.8.2?] (2) "Trade studies should continue for the potential development of a Geostationary Microwave sensor that can satisfy both the NWP and hydrological communities." |
| Page 9, Section 4.1.1 | Replace "develop" with "implement" |
| Page 9, Section 4.2.1 | IPWG would like to expand the list to include "drought monitoring, water resources and landslides" |
| Page 10-11, Section 5.3 | This is a very broad list and wondering the origin of this list and whether it is current and if it should be updated by each of the ISWG's in a coordinated manner. |