The International Precipitation Working Group (IPWG)

Adapted from a presentation to SWCEM and CGMS46
Original Authors: Ralph Ferraro (NOAA NESDIS), Ziad Haddad (NASA JPL) and IPWG contributors

Presented by: Ben Johnson (UCAR/JCSDA)
Outline

• IPWG-8/IWSSM-5 Highlights
  • Summary
  • Science Highlights
  • Key Action Items and Recommendations

• IPWG-9 Planning and Coordination
  • Agenda
  • Working Groups Tracking

• IPWG & ICWG Coordination
CGMS: Coordination Group for Meteorological Satellites

**CGMS** members include: CNES, CMA, CNSA, EUMETSAT, IMD, ISRO, IOC/Unesco, **JAXA**, JMA, KMA, **NASA**, **NOAA**, ROSHYDROMET, ROSCOSMOS, ESA, and WMO; observers include CSA, ENV CAN, GCOS, KARI, KIOST, and SOA.

**CGMS** has five International Science Working Groups (ISWGs):

- *International TOVS Working Group: ITWG*
- International Precipitation Working Group: IPWG (400+ members)*
- *International Radio Occultation Working Group: IROWG*
- *International Winds Working Group: IWWG*
- *International Clouds Working Group: ICWG*

*Meet every 2 years*
IPWG Objectives

1) Promote standard operational procedures and common software for deriving precipitation measurements from satellites

2) Establish standards for validation and independent verification of precipitation measurements

3) Foster the exchange of data on inter-comparisons of operational precipitation measurements from satellites

4) Stimulate increased international scientific research and development in this field

5) Provide recommendations to national and international agencies regarding the utilization of current and future satellite instruments on both polar and geostationary platforms

6) Encourage regular education and training activities
IPWG activities

Provide recommendations to CGMS regarding precipitation missions, and the development, assessment and utilization of precipitation algorithms and products.

Working groups to co-ordinate recommendations:
- Research working group
- Data assimilation working group
- Applications working group
- Scattering working group
- Validation working group

Continuing intercomparison of satellite-derived precipitation products over diverse validation regions
Examples of Accomplishments through IPWG activities:

GPM 166&183 GHz channels for light rain/snowfall

Continuation of coverage over the Indian Ocean (*Meteosat-8 will now be positioned at 41.5°E, 2017*)

Utilization of post-operative satellites – *once METOP-C is operational, METOP-A will be allowed to drift*

Extension of inter-comparisons to other regions – *development and operation of site over South Africa and South America; India hopefully soon*

Training sessions for students and users

Special journal issues (*e.g. JHM, 21 papers*)
Overview – Summary of IPWG-8/IWSSM-5

- (IPWG-7 - Japan, Nov 2014; IWSSM-4 - U.S, May 2013)
  - This is first joint meeting, unifies precipitation!
- IPWG-8 / IWSSM-5 - Bologna, Italy 3-7 October 2016
- 158 participants, 23 countries
  - 63 oral/88 posters
  - Prizes for early career scientists
- ~30 students/3-day training course
- 5 working groups
  - Research
  - Applications
  - Validation
  - Snow Scattering
  - Data Assimilation
- Special Issue - QJRMS
  - Roca and Kidd, Editors

WMO Special recognition to V. Levizzani for his scientific achievements and 15 years of dedication to IPWG
IPWG Membership and Attendance – both increasing!

IPWG-8 attendees
By country

USA: 41
Italy: 28
France: 19
Korea: 10
Japan: 9
India: 8
Germany: 5
Int. Org.: 4
Sweden: 3
UK: 4
China: 3
Finland: 3
Argentina: 2
Iran: 2
Poland: 2
Switzerland: 2
Bolivia: 1
Brazil: 1
Canada: 1
Colombia: 1
Greece: 1
Moroc: 1
Netherlands: 1
Taiwan: 1

IPWG-IWSSM BOLOGNA 2016 PARTICIPANTS BY COUNTRY

2012
2014
2016

282
297
478
### IPWG-8/IWSSM-5 Working Groups

<table>
<thead>
<tr>
<th>Title</th>
<th>Co-Chair</th>
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<tbody>
<tr>
<td>Validation</td>
<td>Viviana Magioni</td>
<td>Elena Tarnavsky</td>
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<td><em>George Mason Univ., USA</em></td>
<td><em>Univ. of Reading, UK</em></td>
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<td>Research</td>
<td>Ali Behrangi</td>
<td>Yeji Choi</td>
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<td><em>NASA/JPL, USA</em></td>
<td><em>Yonsei Univ., S. Korea</em></td>
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<td>Applications</td>
<td>Daniel Vila</td>
<td>Tufa Dinku</td>
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<td><em>CPTECH/INPE, Brazil</em></td>
<td><em>Columbia Univ., USA</em></td>
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<td>Data Assimilation</td>
<td>Benjamin Johnson</td>
<td>Kozo Okamoto</td>
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<td><em>UCAR/JCSDA/NOAA, USA</em></td>
<td><em>MRI/JMA, Japan</em></td>
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<td>Scattering</td>
<td>Stefan Kneifel</td>
<td>Alan Geer</td>
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<td><em>Univ. of Cologne, Germany</em></td>
<td><em>ECMWF, UK</em></td>
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<td>Snowfall/High lat. Precip. (IPWG-9)</td>
<td>Ralf Bennartz</td>
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<td><em>Vanderbilt University</em></td>
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Monday 3 October

Remote Sensing of Precipitation - The Basics

1. Visible and IR Remote Sensing of Rainfall
   Robert J. Kuligowski

2. Passive microwave remote sensing of precipitation
   Stephen J. Munchak

3.1 Consequences of coherence and near field interactions on scattering by particles
3.2 Modeling variability in dendritic ice crystal backscattering cross sections at millimeter wavelengths using a modified Rayleigh-Gans theory (UQ4RT paper)
   Eugene E. Clothiaux

4. Active microwave remote sensing/principles
   Dmitri Moiseev

Tuesday 4 October

Retrieval Algorithms

5. The GPM Microwave Imager and combined precipitation algorithms
   Christian D. Kummerow

6. Microwave Sounder Precipitation Algorithms - A perspective on retrieval methods
   Santo Laviola

7. Global Satellite Mapping of Precipitation (GSMAP) project
   Kazumasa Aonashi

8.1 Combined Precipitation Algorithms - IMERG
8.2 Hurricane Matthew movie (21.2 MB)
8.3 GPM fleet movie (55.9 MB)
8.4 IMERG movie (19.7 MB)
   George J. Huffman

Wednesday 5 October

Products, Uses and their Performance

9. Satellite Rainfall Performance and Hydrologic Forecasting Applications
   Robert J. Kuligowski

10. EUMETSAT Satellite Application Facility on Support to Operational Hydrology and Water Management (H-SAF)
    Davide Meli

11. Application of Satellite Rainfall Estimates in Health
    Pietro Ceccato and Tufa Dinku

12. Overview of IRI Data Library
    Tufa Dinku, and Remi Cousin

13. Validation of Satellite Rainfall Products
    Marielle Gosset

    Philippe Chambois
Action for all CGMS Members – Ensure the continuity of the current constellation of passive microwave sensors (for high quality satellite precipitation products for weather, climate and hydrological applications) through proper coordination of satellites, sensors and equatorial crossing times.

Action for all CGMS Members – Ensure the continuity of existing *in situ* precipitation observation networks, promote access to those that are currently inaccessible but in operation, and explore new sources of *in situ* observations.

Action to all CGMS Members – Timely (< 1 hr) and free access to all geostationary visible, IR and water vapor data is required to improve global hydrological prediction.
Recommendation to all CGMS Members – Encourage planning and development of three frequency radar (Ka, Ku, W bands) to improve microphysical information for precipitation rate retrieval and data assimilation.

Recommendation to WMO? CGMS? - Recognizing that IPWG has considerable expertise in precipitation science and applications, IPWG requests the WMO (likely via VLAB) to establish a yearly training event on precipitation data sets and applications, for which IPWG will provide disciplinary expertise.

Recommendation for all CGMS Members – Collaboration between space programs and numerical weather prediction centers is encouraged to include data assimilation requirements for cloud/precipitation microphysical information in the development of new satellite/observing systems. Sustained R&D on this topic is also encouraged.

Recommendation for all CGMS Members – The development of higher spatial, temporal and spectral resolutions are encouraged for future microwave measurements. Synergies with emerging programs such as Cubesats is encouraged.
IPWG Data Set Listings -
Publicly Available, Quasi-Operational, Quasi-Global Precipitation Estimates

IPWG data listings: http://www.isac.cnr.it/~ipwg/data/datasets.html

**Single-Source Data Sets**
- AMP-4
- AMP-5
- GPM DPR Precip
- GPI
- GPROF2010v2
- GPROF2010 (3G68)
- GPROF2014-GMI, -partner
- GSMaP_MWR
- HOAPS-3.2
- Hydro-Estimator
- H01 (CDRD)
- H02A/B (PNPR)
- H17 (CDRD)
- H18 (PNPR)
- METH
- METH (3A11)
- MiRS
- NESDIS/FNMOC Scattering index
- NESDIS High Frequency
- OPI
- RSS
- TAMSAT
- TRMM PR Precip (3G68)

**Combination Data Sets (Sometimes w/Gauge Climatology)**
- 2BCMB
- AIRG2SSD
- AIRX2SUP
- AIRX2SUP_NRT
- AIRX3SPD, AIRX3SP8, AIRX3SPM
- CMORPH
- CMORPH V1.0 RAW
- GSMaP Near-real-time (GSMaP_NRT)
- GSMaP Realtime (GSMaP_NOW)
- GSMaP Standard (GSMaP_MVK) V7
- GSMaP Reanalysis (GSMaP_RNL) V7
- H03
- IMERG Early Run V3
- IMERG Late Run V3
- MPE
- MSWEP NRT
- NRL Real Time
- PERSIANN
- PERSIANN-CCS
- SCAMPR
- TOVS
- TRMM Real-Time HQ Version 7 (3B40RT)
- TRMM Real-Time VAR Version 7 (3B41RT)
- TRMM Real-Time HQVAR Version 7 (3B42RT)
DPR (radar+radiometer) Combined GPM

EPC method*,**, (Passive MW research product)

NEXRAD MRMS (ground-based) radar

Representation of heavy rain conditions, similar to DPR and also the ground-based radar


Even with 11 other microwave sensors also assimilated, SAPHIR still makes improvements to short-range humidity, wind and precipitation forecasts.
Science Highlights - Scattering

graphs demonstrate the calculated extinction, asymmetry and scattering albedo for 183 GHz (top row) and 664 GHz (bottom row), at temperature 270 K, for the habits shown.

R. Ekelund
Chalmers U of Technology – Göteborg (inter alia)

Then assemble into collections of different sizes (but same fractal mass-size relation)
Preparations for Metop SG Ice Cloud Imager retrievals
P. Eriksson, R. Ekelund, J. Mendrok, B. Rydberg, S. Buehler, M. Brath, A. Thoss, S. Fox, C. Accadia, and V. Mattioli

Why sub-mm? Some example simulations
Based on NICAM model

Bridges the gap between IR and existing microwaves
Cloud and precipitation information being assimilated

Increasing frequency [GHz]

19 GHz
37 GHz
91 GHz
183±7
183±1

Observed TB [K]

Observed TB [K]

Hydrometeor effect: TB - TBclear [K]

Rain (absorption, increases TB)

Cloud (absorption, increases TB)

Cloud and snow/ice/graupel (absorption and scattering, decreases TB)

Ice particle scattering and operational assimilation of cloud and precipitation radiances (Invited) A. Geer
9th workshop of the International Precipitation Working Group:

- Meeting date: 5-9 November 2018 (Next week!)
- Venue: The Commons, Yonsei University, Seoul, South Korea
- Hosts: KMA/National Meteorological Satellite Center and Yonsei University
- Important dates:
  - Abstract submission deadline: 31 July 2018
  - Registration deadline: 5 Oct. 2018
- IPWG-9 web page, [http://ipwg.yonsei.ac.kr/](http://ipwg.yonsei.ac.kr/)
IPWG-9 Overview

**IPWG-9 includes:**

- Oral and poster sessions (Day 1, 2, 3, and 4)
- Working group split meetings and reports (Day 3 and 4)
- Special sessions on the GEWEX/IPWG joint precipitation assessment and GSICS user requirements
- Training lectures (3 days lecture series from IPWG experts)
- Best Poster awards (a First Prize and two Runner-up Prizes)

**IPWG-9 Program Committee**

Ziad Haddard (Radar Science/JPL, USA)  
Dong-Bin Shin (Yonsei University, Korea)  
Ralph Ferraro (NOAA/NESDIS/STAR, USA)  
Ralf Bennartz (Vanderbilt University, USA)  
Rémy Roca (CNRS/OMP/LEGOS, France)  
Tufa Dinku (IRI, Columbia University, USA)

IPWG-9 is co-sponsored by the National Meteorological Satellite Center of Korea Meteorological Administration and the Atmospheric Remote Sensing Lab. of Dept. of Atmospheric Science of Yonsei Univ. It is also partially supported by the Institute of Natural Science (INS) of the College of Natural Science of Yonsei Univ. and the Atmospheric Remote Sensing Lab. of Kyungpook Univ.
Ideas for IPWG and ICWG Coordination

• Observations (combination datasets)
• Physical Modeling Overlap
• Retrieval Algorithm Comparisons
• Data Assimilation (obs., physics)
• Field / Aircraft Experiment Data Sharing

• Joint Meeting between IPWG and ICWG?