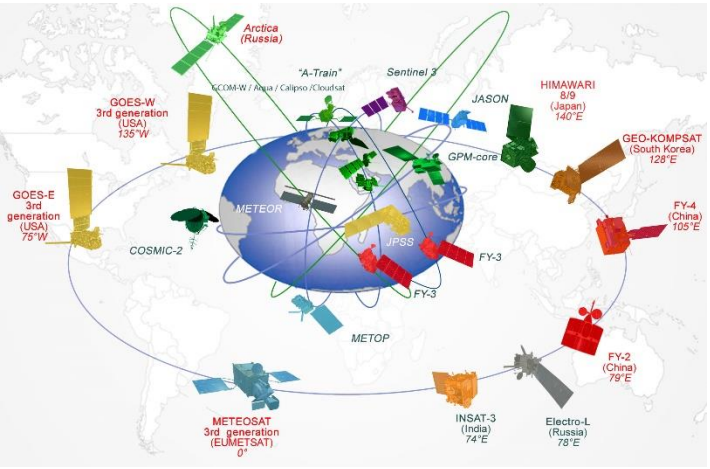


Summary/Highlights from the IPWG

Presented to CGMS47 Plenary

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

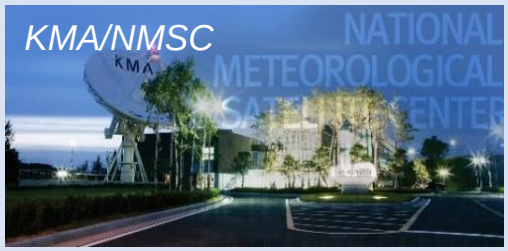
Outline

- **Summary from IPWG-9**
  - Meeting summary
  - New co-chairs
  - WG reports (backup slides)
  - New proposed recommendations to CGMS
  - Science highlights
- **IPWG Scientific Outreach**
- **Progress on actions/recommendations (backup slides)**
  - CGMS-46
  - HLPP 2018-2022
  - Proposed additions to HLPP 2018-2022
- **Planning for IPWG-10**

Summary of IPWG-9

- Previous meetings - IPWG-8/IWSSM-5, Italy, Oct. 2016
- 102 participants
  - 66 oral/89 posters
  - Prizes for early career scientists
- ~15 students/3-day training course
- 4 working groups
  - Research
  - Applications
  - Validation
  - Snow Scattering and Data Assimilation
- Interactive session on the joint GEWEX/GDAP IPWG Assessment of Global Precipitation Products
- Special Issue in *APJAS*
  - Editors: Shin, Haddad, Ferraro
  - Submission deadline: June 30

Hosted by Yonsei University and KMA Seoul, South Korea 5-9 November 2018



http://www.isac.cnr.it/~ipwg/meetings/seoul-2018/Seoul2018.html

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IPWG International Precipitation Working Group

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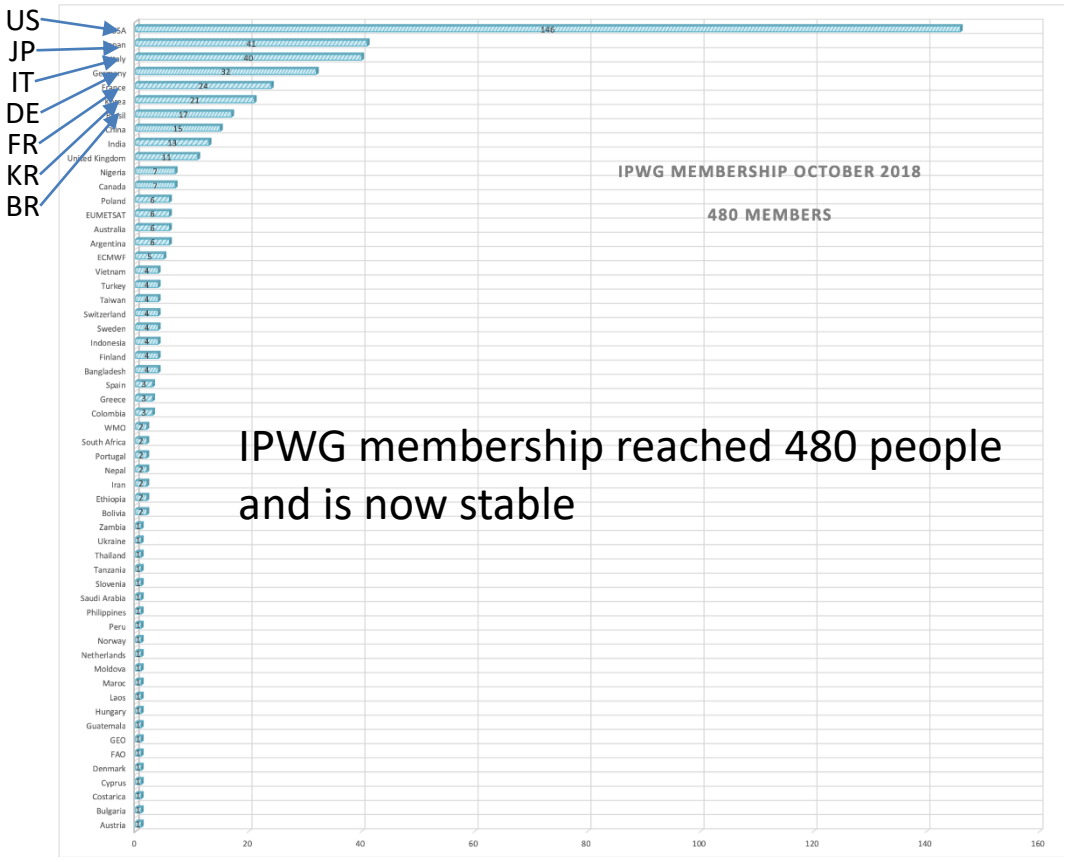
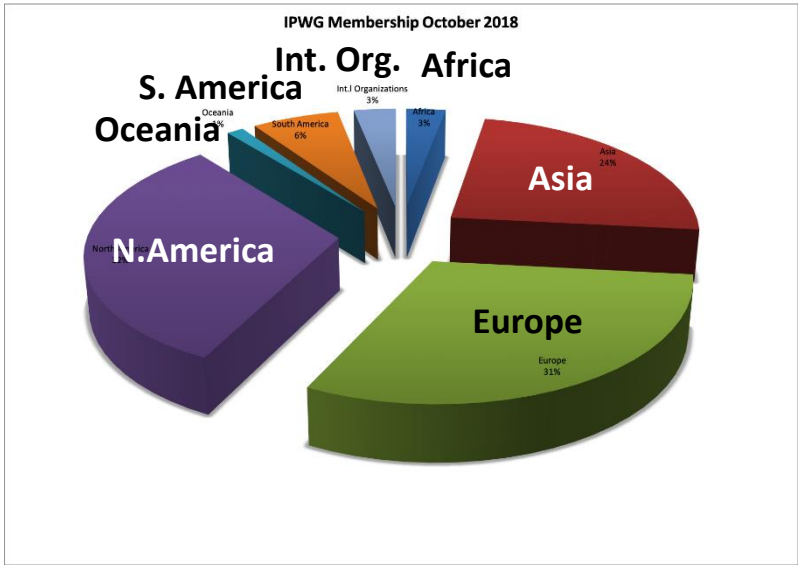
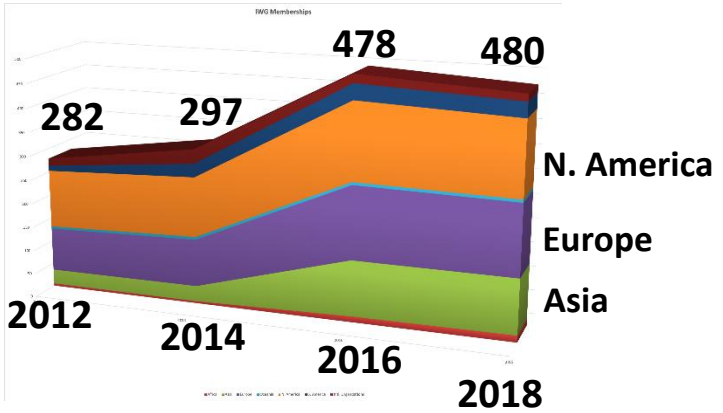
IPWG Membership and Attendance







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Outgoing Co-Chairs (Left) – Dong-Bin Shin/Ziad Haddad
Incoming Co-Chairs (Right) – Viviana Maggioni/Philippe Chambon

Dr. Viviana Maggioni
George Mason Univ.
Fairfax, VA USA

Dr. Philippe Chambon
Météo-France
Toulouse, France

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

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Working Groups (Details available in backup)

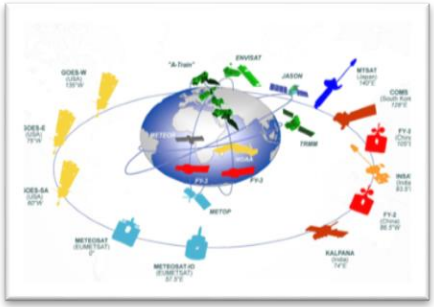
Title	Co-Chair	Co-Chair
Validation	Chris Kidd *NASA/GSFC, USA*	Marielle Gosset *OMP/GET, France*
Research	Ali Behrangi *NASA/JPL, USA*	Yeji Choi *KMA, Korea*
Applications	Ziad Haddad *NASA/JPL, USA*	Daniel Vila *CPTECH/INPE, Brazil*
Data Assimilation	Benjamin Johnson *NOAA/NESDIS, USA*	Philippe Chambon *Météo-France, France*
Scattering	Ian Adams *NASA/GSFC, USA*	Alan Geer *ECMWF, UK*

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

NEW RECOMMENDATIONS TO BE CONSIDERED BY CGMS (1/2)



- **For all CGMS Members** – 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. Additionally, IPWG would like to be kept informed of longer term plans for subsequent launches of microwave sensors to ensure continuity of long-term observations that meet the documented needs of the user community.

- **For all CGMS Members** – IPWG also recommends that there be a CGMS-wide coordination of the crossing times of precipitation relevant satellites in an effort to improve the temporal sampling of diurnal cycle, convective systems lifecycles, and severe storms.

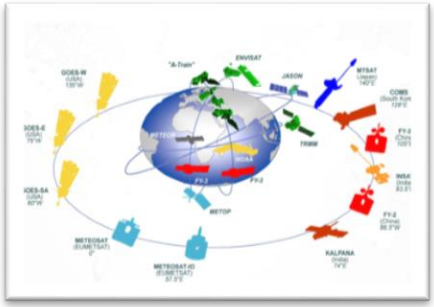
- **For all CGMS Members** – As precipitation moves to higher temporal rates, we recommend to CGMS members to synchronize full-disk geostationary sampling schedules which will optimize GEO scans to improve temporal sampling of precipitation products and unknown future PMW imager availability for merged products.

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

NEW RECOMMENDATIONS TO BE CONSIDERED BY CGMS (2/2)



- **For all CGMS Members** - Collaboration between space programs and data assimilation centers should be specifically encouraged to incorporate DA requirements as part of scientific requirements when developing new satellite / observing systems. This would reduce barriers for operational assimilation of observations, and potentially provide a greater range of utility for various sensors.

- **For all CGMS Members** - Higher spatial and temporal (sub-hourly) resolution and higher spectral sampling in the microwave measurement of clouds and precipitation should be considered in future observing systems.

- **For all CGMS Members** - Latency and quality of satellite data should be improved, from both operational and research missions, to fit in the DA high temporal resolution cycle.

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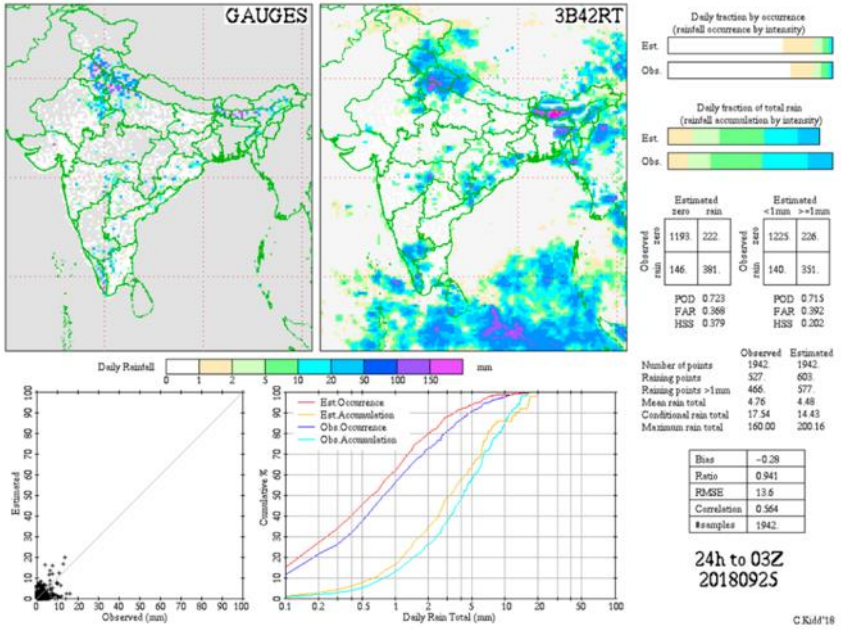
Science Highlight: Validation

Establishing an IPWG validation site for satellite precipitation products over India.

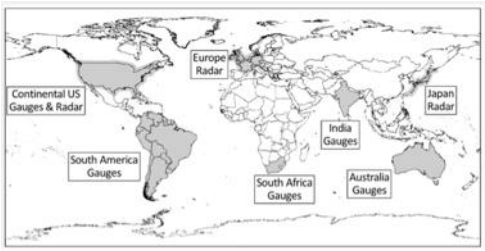
UNIVERSITY OF MARYLAND

chris.kidd@nasa.gov
chriskidd.home@gmail.com

Chris Kidd[12], Virendra Singh[3], A K Mitra[3], Amit Kumar[3] and S K Mukherjee[3].
[1] *Earth System Science Interdisciplinary Center, University of Maryland, College Park,*
[2] *NASA/Goddard Space Flight Center, Greenbelt, USA.*
[3] National Meteorological Satellite Centre, India Meteorological Department, New Delhi, India.



A new validation site over India for the satellite rainfall products in addition to the US, South America, Japan, Europe, Australia



⇒ Validation codes running on Raspberry Pi-3

Coordination Group for Meteorological Satellites

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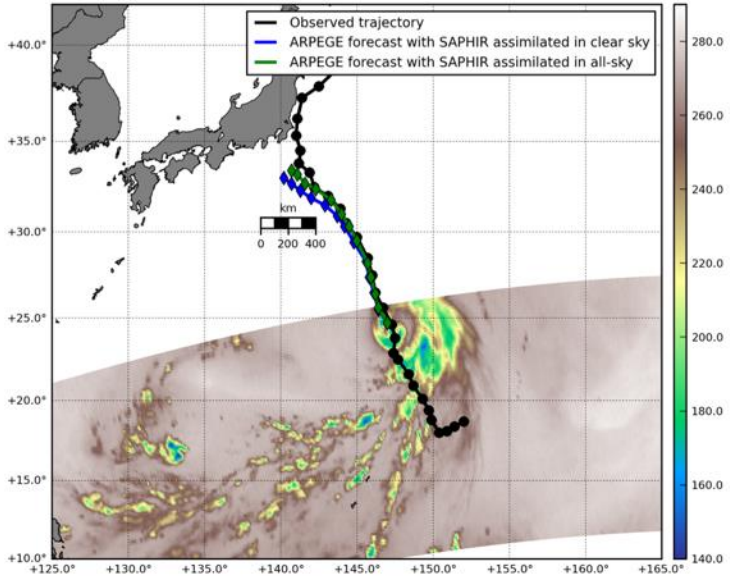
CGMS

Science Highlight: Data Assimilation

Assimilating cloudy and rainy microwave observations from SAPHIR on-board Megha-Tropiques

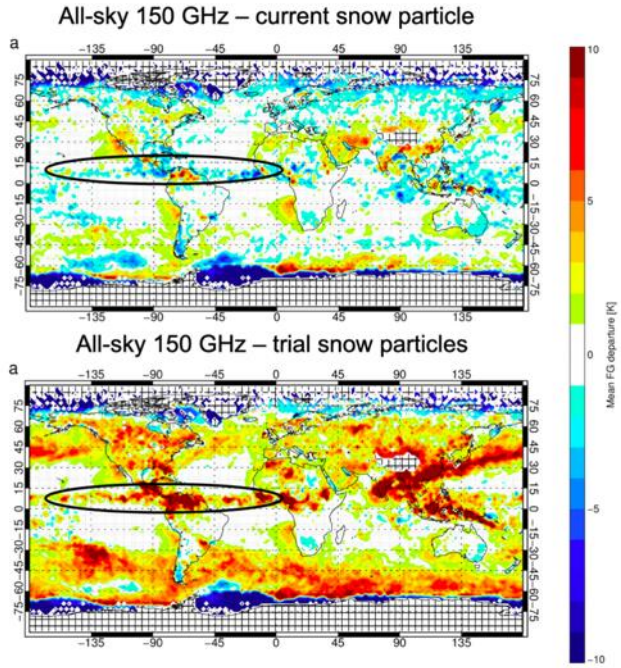
Philippe Chambon, Fabrice Duruisseau, Éric Wattrelot, Marylis Barreyat, Jean-François Mahfouf



⇒ *These efforts on Radiative Transfer in scattering conditions allow the assimilation of cloudy microwave radiances, improving extreme events forecasting*

Prospects for assimilating micro- and macrophysical details of precipitation in global weather forecasting

Alan Geer, Richard Forbes, Philippe Lopez, et al



⇒ *Mode advanced radiative transfer can also highlight forecasting model biases which need improvements in their representation of clouds and precipitation*

Science Highlight: Validation

Universität Hamburg
DER FORSCHUNG | DER LEHRE | DER BILDUNG

oceanRAIN

MARANAT

Ocean Rain And Ice-phase precipitation measurement Network

The Global Ocean Surface Reference Dataset for all Water Cycle Components

Christian Klepp[1,2,3], Simon Michel[2], Paul Kucera[4], Alain Protat[5], Jörg Burdanowitz[2,3]

OceanRAIN Release 1.0:

Jun 2010 to April 2017, > 6.83 million minutes of data from 8 ships

A **unique** dataset to validate satellite precipitation retrievals over oceans

⇒ *Support letter from IPWG sent to institutions involved for continuation of these activities*

Coordination Group for Meteorological Satellites

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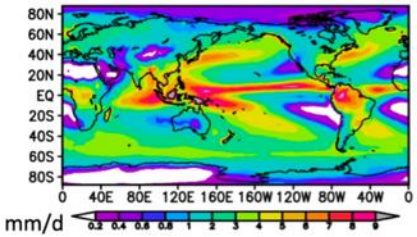
Science Highlight: Research

Climate Monitoring of Global Precipitation

Means, Trends and Intensity Changes Over the Satellite Era

Robert Adler, Guojun Gu, Jian-Jian Wang (University of Maryland)
George Huffman (NASA Goddard Space Flight Center)



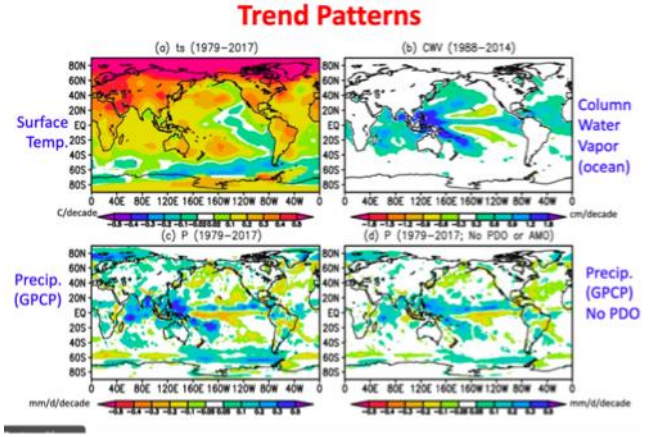
Climatology 1979-2017

Global Precipitation Climatology Project (GPCP)

GPCP is an international (GEWEX) collaborative effort resulting in an often-used analysis based on satellite and gauge data (1979-near present). *Adler et al., 2017 Rev. Geophysics; Adler et al., 2018 Atmosphere*

⇒ *Need continuity of conical scanning microwave imagers for a homogeneous climate data record*

GPCP Monthly Analysis provides high quality, long-term global precipitation information, including a "real-time" climate monitoring product



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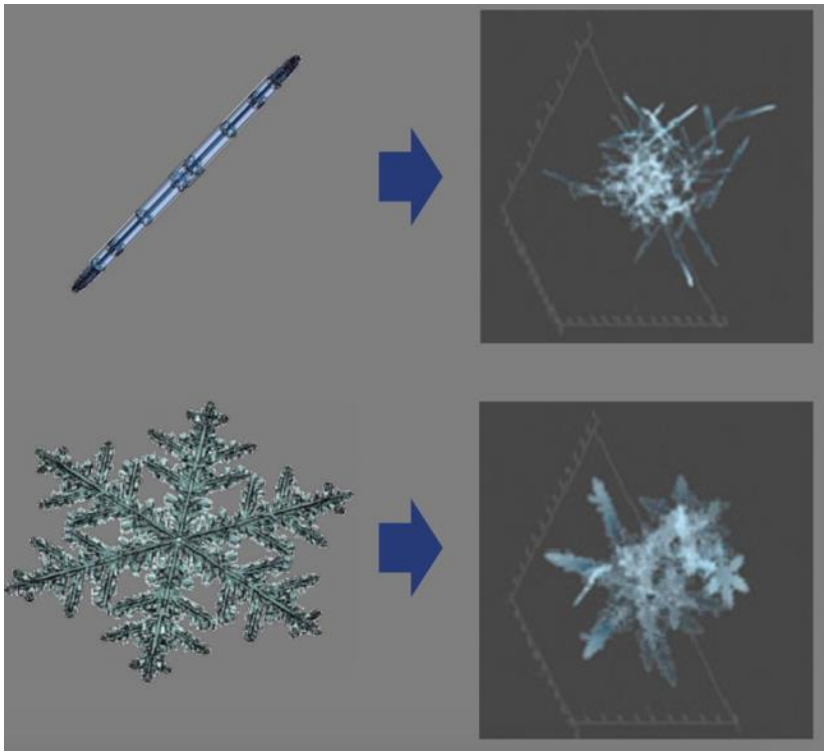
Science Highlight: Scattering

Three-Dimensional Sensor Forward Modeling of Clouds and Precipitation in the Multi-Instrument Inverse Solver Testbed

Ian S. Adams, S. Joseph Munchak, Kuo-Sen Kuo, Craig Pelissier, Thomas Clune, and Rachael Kroodsma



⇒ *The computation of single scattering properties of frozen hydrometeors reaches a high degree of fidelity (e.g. 3D aggregates) for accurate and consistent forward modeling of multi-frequency observations*

⇒ *Being coordinated with ICWG*

Coordination Group for Meteorological Satellites

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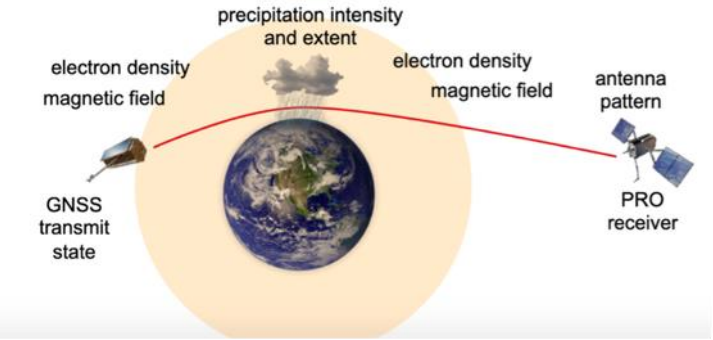
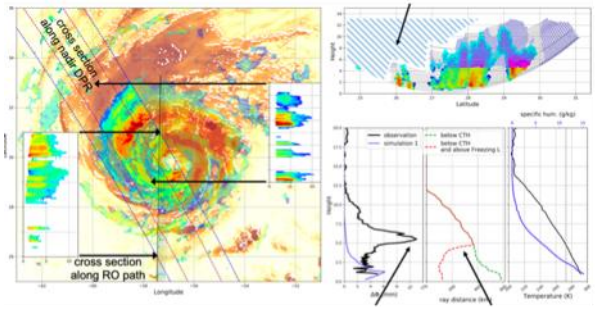
Science Highlight: New ways of observing precipitation, complementary to satellites

Polarimetric Radio Occultations

F. Joseph Turk, E. Cardellach, R. Padulles,
C. O. Ao, M. de la Torre Juarez, S. Hristova-Veleva, J. David Neelin

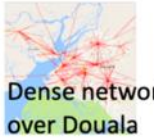




⇒ "New kinds" of remote sensing tools for observing precipitation are under investigation within the IPWG community

Rainfall retrieval from commercial microwave links

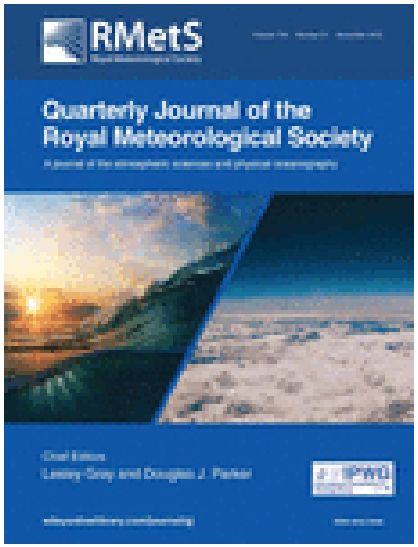
Marielle Gosset, Matias Alcoba, Frederic Cazenave, Maxime Turko, ApolineYapi, Modeste Kacou, François Bella, Evrad Kamtchoum, Armand Nzeukou

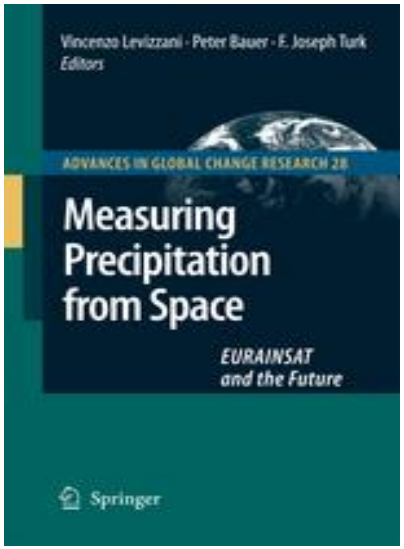


Coordination Group for Meteorological Satellites

IPWG Scientific Outreach

- IPWG-8 Special Issue in November 2018 QJRMS
  - Roca, ed.
  - 29 papers!
- "Satellite Precipitation Measurement" – Springer – later this year
  - Levizzani, ed.
    - Update from similar book published in 2017
  - 6 Chapters, ~40 articles
- IPWG Web Site





http://www.isac.cnr.it/~ipwg/index.html

Coordination Group for Meteorological Satellites

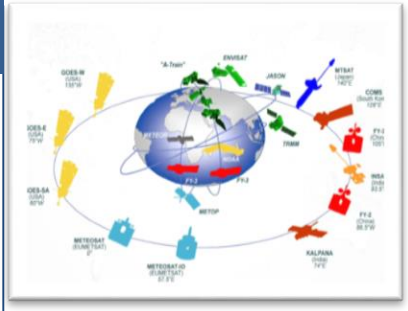
Planning for IPWG-10

10th International Precipitation Working Group.

- Meeting date: 1-5 June 2020
- Meeting location: Fort Collins, USA
- Host: Cooperative Institute for Research in the Atmosphere, Colorado State University

BACKUP

CGMS ACTIONS AND RECOMMENDATIONS TO IPWG – STATUS (1/3)



PLENARY – A45.02: *CGMS International Science Working Groups and CGMS space agency members to formulate science questions, including the impact of data latency, in view of the 7th Impact WS 2020 (ref. CGMS-45-WMO-WP-02) and provide these to lriishojgaard@wmo.int. Questions are needed for CGMS-46 for the analysis to be made and results provided to the workshop in 2020.*

STATUS – Closed. IPWG evaluated and had no specific comments on the report.

PLENARY – R45.02: *Recognising that IPWG has considerable expertise in precipitation science and applications, IPWG requests the WMO (likely via VLAB) to establish regular training events on precipitation data sets and applications, for which IPWG will provide disciplinary expertise.*

STATUS – Ongoing. IPWG held a training session as part of IPWG-9. IPWG has been actively pursuing the WMO VLAB and has been unsuccessful in receiving any concrete guidance on a path forward.

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

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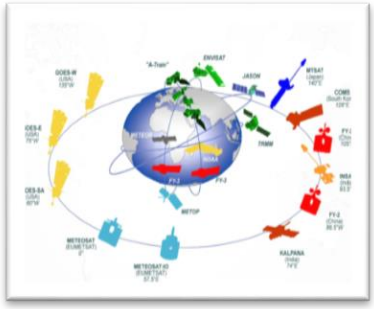
CGMS-ACTIONS AND RECOMMENDATIONS TO IPWG – STATUS (2/3)



PLENARY – A45.07: *IPWG co-chairs and rapporteur to provide guidance on the estimation of uncertainties and representativeness of the short-latency precipitation products related to the Space-based Monitoring of Weather and Climate Extremes project (CGMS-45-WMO-WP-05).*

STATUS – Closed. IPWG co-chairs developed a white paper summarising the uncertainties in the most widely used precipitation products generated by CGMS members. The paper addresses the needs of the broad based precipitation user community, including SWCEM.

WGII – A46.04: *IPWG to produce documentation on precipitation climate data record generation and related activities worldwide, including prospects for continuity*

STATUS – Ongoing. In conjunction with GEWEX, a precipitation assessment is underway and was discussed in detail at IPWG-9 through a dedicated session. The goal is to have the assessment competed in 2020.

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

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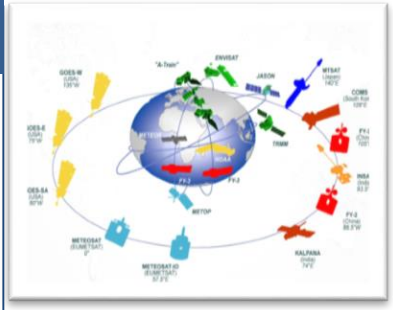
CGMS-ACTIONS AND RECOMMENDATIONS TO IPWG – STATUS (3/3)



PLENARY – A45.04: *IPWG to produce documentation on precipitation climate data record generation and related activities worldwide, including prospects for continuity.*

STATUS – Closed. IPWG maintains updated information on its web page regarding CDR quality data sets (and solicits this from its members). See http://www.isac.cnr.it/~ipwg/data.html This is done in concert with other groups such as CEOS, GEWEX, etc.

WGII – R46.02: *ICWG to liaise with IPWG to explore common interests in the area of cloud microphysics and scattering libraries of hydrometeors (liquid, ice).*

STATUS – Ongoing. ICWG invited IPWG representative Ben Johnson to present at ICWG-2 and engagement is developing.

WGII – R46.04: *IPWG to maintain close relationship with GEWEX in its work, and at its next workshop (e.g. through a joint session)*

STATUS – Closed.

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

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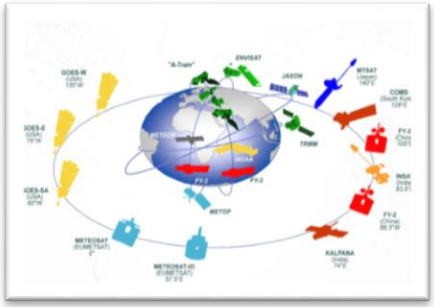
STATUS on RELEVANT HLPP 2018-22 TOPICS (1/2)



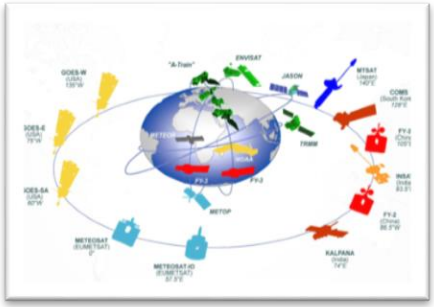
HLPP 4.3.1 – *Apply the IPWG validation protocol (as defined on its web page) to precipitation combination datasets generated using multiple satellite and in-situ data sources, and expand the number of participating agencies to broaden the validation domain.*

> **Status –** *Through the guidance of the IPWG validation working group, tremendous progress has been made with the Indian Meteorological Department (IMD) in the development of a satellite precipitation validation site over India that follows the IPWG validation protocol (see www.isac.cnr.it/~ipwg/calval.html). The web site is close to becoming operational. Despite our best attempts, progress to develop a site over China has stalled. We are pleased to report that Korea is highly interested in developing a site using there dense in-situ rain network; we will be pursuing this further in the upcoming year.*

HLPP 4.5.3 – Enhance the use of satellite precipitation datasets through an IPWG-led user workshop where training on visualization and analysis tools will be one of the topics.

> **Status –** *IPWG held a training session as part of IPWG-9. IPWG has been actively pursuing the WMO VLAB and has been unsuccessful in receiving any concrete guidance on a path forward.*

STATUS on RELEVANT HLPP 2018-22 TOPICS



HLPP 4.6.3 - Through coordination between IPWG, 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;

Status – *This is always an ongoing topic and challenge but we are pleased to report some headway this year. Although there are several common topics between IPWG, ITWG and ICWG (and potentially IWWG and IRWG), the only true way to improve collaborations amongst the groups is for attendance at relevant meetings. The outgoing and incoming co-chairs feel that a greater financial commitment is needed by CGMS in order to allow for their attendance at these meetings; because of the growing size of IPWG, the resources provided are generally needed to support those meetings. During the past year, IPWG was able to identify "champions" to represent the precipitation community within ICWG and ITWG because of mutual interests in the focus topics such as radiative transfer and land surface modelling. For the next two years, we expect that Dr. Benjamin Johnson (NOAA/Joint Center for Satellite Data Assimilation) will provide IPWG linkage to ICWG and Dr. Philippe Chambon, incoming co-chair, linkage to ITWG.*

Validation Working Group

V1: Extend IPWG GV analysis to new regions

IPWG Report: IPWG has currently extended GV analysis to the Indian region

IPWG Action: Interact with and implement GV analysis over Korea.

GCMS Action: Letter of thanks to be sent to IMD to recognise their involvement and encourage further/future involvement and interaction with the IPWG community.

Notes: release of data sets for individual assessment of precipitation products.

V2: extend IPWG GV analysis to instantaneous products

IPWG Report: Near real-time GV analysis of instantaneous products over the European region.

IPWG Action: extension to other regions, where and when data available.

Notes: Can we validate the 'cheap' missions? IPWG can validate precipitation products from these quite easily using the existing instantaneous analysis system when such data products become available.

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

Validation Working Group

V3: explore ocean datasets (buoy data)

IPWG Action: Encourage the coordinated effort to explore the OceanRAIN data set for ocean validation, particularly at the instantaneous scale, as well as for 'climate' scale verification: useful for characterizing the precipitation rather then 'validation' *per se.*

CGMS Action: Letter *to whom it may concern* regarding community concern for continuing financial and logistical support for the OceanRAIN program and data sets.

V4: make better use of hydrological data and other non-traditional sources of validation

IPWG Action: Indirect validation, e.g. river discharge, to be further explored.

IPWG Action: Direct validation through new technology, i.e. MW links, particularly in data-poor regions.

CGMS Action (or TWIMC): Support for access to MW link data sets.

Validation Working Group

V5: Errors and uncertainties

IPWG Report: There is ongoing work investigating errors and uncertainties in ground-based precipitation products.

IPWG Action: develop standard scores for errors and uncertainties: Consideration of standards for both ground and satellite data sets.

IPWG Action: Explore implications of error and uncertainty scores upon IPWG validation – how to implement precipitation values that include these scores.

IPWG Action: 'Prediction' of errors and uncertainties in regions beyond that of the normal validation regions through characterisation of key precipitation parameters.

Notes: Example study: How do we incorporate and extend the errors and uncertainties from single gauges through to multiple gauges at different temporal and spatial scales?

Applications WG (1/3)

Chairs: Ziad Haddad, Daniel Vila

Rapporteur: George Huffman

Attending: Xavier Calbet, Tufa Dinku, Nooriah Helda, Hyungjun Kim, Pierre Kirstetter, Vincenzo Levizzani, Zhong Liu, Dave Melfi, Huan Meng, Sveta Hristova-Velew, Nai-yu Wang, Berry Wen

Who is impacted by reduced constellation?

Use Case 1

What: Augment existing geo-IR nowcasting algorithm (Rapidly Developing Convection, Rapidly Developing Thunderstorm, ForTraCC, which forecast size and intensity of convective storms based on IR history), by injecting microwave information when it exists:

a) demonstrate statistical improvement in forecast with microwave, and

b) choose four real Tropical-Cyclone cases when microwave was / was not available for case demonstration.

Funding required!

Who: S. Goyal, Z. Haddad, D. Vila

Applications WG (2/3)

Use Case 2

What: Reduced PMW satellite numbers are presumed to degrade the utility of precip products; assemble input from users, potentially to include:

a) Indus River farmer irrigation advice (Faisal Hossain – G. Huffman contact)
b) N. Korean flooding (Len Milich - Z. Liu contact)
c) Central American flash flooding (TBD - D. Vila contact)
d) case studies with HSAF precip algorithm [uses rapid update] (D. Melfi contact)
e) 13-19 Aug. 2018 floods in India during summer monsoon (IMD - Z. Haddad contact)

"Middleware" dataset-to-user systems

How do they choose products? What advice do they need?
What advice can they give developers? what's the right forum?
What: a) Recommend engagement by developers with particular users.
b) Query dataset developers about known user communities (G. Huffman contact)
c) Engage with METEOSAT Users Forum Africa (T. Dinku contact)

Applications WG (3/3)

Old items revived

Update the page on the IPWG web page pointing to training materials. Where possible, it should point to the organizational pages containing specific training materials and opportunities, as opposed to trying to maintain a detailed list.. George Huffman

Assemble a list of links to sites that provide access to data and recipes for processing, data analysis tools, to be added to IPWG web page. Chris Funk and Paul Kucera (TBC)

Udate the IPWG tables of data products. George Huffman

Ask data providers to list applications that their products are most suitable for and those that their products may not be suitable for. Create a classification table for different applications (i.e., hydrology, drought monitoring, etc.). Giulia Panegrossi (TBC)

Create a catalog of papers on applications and case studies. Raaj (TBC)

IPWG-9 Data Assimilation and Scattering Working Group Report

Data Assimilation WG Chairs: Benjamin Johnson (benjamin.t.johnson@noaa.gov)
Philippe Chambon (philippe.chambon@meteo.fr)
Scattering WG Chairs: Alan Geer (Alan.Geer@ecmwf.int), Ian Adams (Ian.S.Adams@nasa.gov)

Attendees: Sarah Ringerud, Joe Munchak, Alan Geer, Jeff Steward, Ian Adams, Yoonjin Lee, Hiro Masunaga, Sihye Lee, Hyeyoung Kim, Hyoung-Wook Chun, Dave Duncan, Eunhee Lee, Fabrice Duruisseau, Hwayoung Jeoung

IPWG-9 Recommendations (1/3)

DA Coordination

- **R#1** (To: Space Agencies, Cloud and Precipitation Retrieval Communities, Timeframe: on-going): Collaboration between space programs and data assimilation centers should be specifically encouraged to incorporate DA requirements as part of scientific requirements when developing new satellite / observing systems. This would reduce barriers for operational assimilation of observations, and potentially provide a greater range of utility for various sensors.
- **R#2** (To: IPWG, Timeframe: regular intervals): We note the strong scientific link between retrieving cloud, rain, ice, snow and the cloudy/rainy data assimilation activities. These activities would benefit from closer interaction. We recommend a regular series of scientific workshops specifically to gather scientists in cloudy/rainy DA and scientists involved in algorithm development of rain, snow as well as modeling experts and microphysical campaign field measurements experts.

IPWG-9 Recommendations (2/3)

Sensors

- **R#3a** (To: CGMS, Space agencies, Timeframe: Long term planning): Higher spatial and temporal (sub-hourly) resolution and higher spectral sampling in the microwave measurement of clouds and precipitation should be considered in future observing systems.
  - Keep pace with the increasing resolution of models and DA systems
  - Encourage the continued development satellite programs with high temporal resolution (GOES, TROPICS, TEMPEST, geo-MW, etc.)
- **R#3b** Latency and quality of satellite data should be improved, from both operational and research missions, to fit in the DA high temporal resolution cycle.
  - Sub-hourly especially for regional NWP systems

IPWG-9 Recommendations (3/3)

Validation

- **R#4a** (Validation and research communities): We recommend that all groups characterize end-to-end errors and uncertainties, including variability in scattering and microphysics
- **R#4b** (Validation Groups (IPWG, ICWG, ITOVS(→ITWG), missions)): Coordinate with NWP experts to develop microphysics validation strategies
  - Consistency with the operational / research analysis and forecast systems
  - Make use of uncertainty characterization
- **R#5** (IPWG retrieval algorithm developers): As retrievals increasingly incorporate model information, we recommend maintaining model-independent retrievals to aid in validation of the models.

IPWG-9 Action Items [1/2]

Data Assimilation

- **A#1** (Tom Auligne, Steve English): Encourage joint ECMWF/JCSDA workshop for 2020, invite broader research community members (e.g., radar, retrieval, microphysics, nowcasting)
  - Ben Johnson will communicate this idea with Tom and Steve.
- **A#2** (CRTM and RTTOV developers): Investigate ways of addressing the variability in microphysical assumptions.
  - Facilitate the use of a variety of scattering tables to determine the uncertainty in RT

IPWG-9 Action Items [2/2]

Data Assimilation

- **A#3** (IPWG program committee with recommendations from DA and Scattering WGs): Invite specific microphysical experts to attend IPWG with explicit intent of helping to quantify and understand cloud microphysical properties of relevance to scattering and DA applications.
- **A#4** (B. Johnson, A. Geer, P. Chambon): Encourage interaction with IPWG within the DA community and at community meetings through designated liaisons at each I*WG meeting.
  - ICWG: B. Johnson
  - ITWG/ITSC: A. Geer, B. Johnson
  - IWWG: (nobody needed?)
  - ISWG (subgroup of ITWG): Ben Ruston
  - IROWG: Joe Turk (?)
  - Liaisons to attend other DA-specific meetings to represent I*WG (self-organized)

IPWG-9 Recommendations [1/2]

Scattering

- **R#1** (to Ian Adams and snow scattering group): Continue to standardize and centralize the available databases Increase the depth of standardization
  - White paper on desired standard products
  - Understand uniqueness of databases
    - Frequency coverage
    - Unique particle types
  - Motivation: This would allow for easy access and use of databases by researchers and assimilation community
  - Motivation: This would eventually lead to an assessment of the databases

IPWG-9 Recommendations [2/2]

Scattering

- **R#2** (scattering database community): Increase diversity of scattering tables
  - Raindrops
  - Melting
  - Graupel/Riming
  - Aligned particles (polarization)

IPWG-9 Action Items

Scattering

- **A#1** (Ryan Honeyager): Create a white paper on scattering table standardization.
- **A#2** (to IPWG chairs): Convert Scattering WG to Scattering Radiative Transfer WG
  - Motivation: This would then encompass not just the generation of scattering properties but also the use in RT
- **A#3** (Dave Duncan & Chalmers group): Investigate the necessity for raindrop shape models Find someone who represents ground radar community
    - Talk to Christopher Williams and Walt Petersen
  - Motivation: Need to determine if this matters

IPWG-9 Comments

Scattering and DA

- **C#1** We recognize the utility of time resolved measurements (e.g., TEMPEST, D-Train, geostationary) to study the evolution of precipitation

Research Working Group Recommendations and Action Items

9th IPWG 5-9 November 2018, Seoul South Korea

Chairs: Ali Behrangi , Yeji Choi ,
(also thanks to Joe Turk)

Participants 2018

Bob Adler, S. Akiyama, Dong-Bin Shin, P. Kirstetter, C. Klepp, C. Kummerow, Huang Meng, Y. Li, Z. Liu, Lisa Milani, S. Shige, W. Tao, Joe. Turk, N. Utsumi, N. Wang, Y. Wen,

Action Items to IPWG/CGMS

Topic: Converging to real precipitation estimate in High latitude

Problem: still major challenge in retrieval of high latitude precipitation exist

- ❑ Develop methods to improve high lat. (cold region) precipitation (quantity, phase, PSD …)
  - Explore what exist in Decadal survey
  - Explore what is needed (e.g., combination of multi-frequency radars? CubeSat ?)
- ❑ ICE-POP (2018) is now available. Adding a summary of the data sets and a link to the data to IPWG data sets.
- ❑ ICE-POP together with Olympex Field Campaign, OceanRAIN, and maybe EVS IMPACT needs to be explored.
- ❑ Exploring independent methods (e.g., GRACE , CloudSat, EarthCARE, etc.)
- ❑ Encourage closure of snow between snowfall, SWE, and other water budget components

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

POC: Ali Behrangi , Chris Kummerow, Huan Meng, Lisa Milani, D. Shin

Action Items to IPWG

Topic: Oceanic precipitation observation

Problem: Many datasets exist (Ship, Buoys , OceanRAIN etc). and needs to be Further explored

- ❑ Develop common observation data table (under IPWG web) for over ocean precipitation validation and retrievals.
- ❑ Quality control is an important research item
- ❑ Encourage development of snowfall algorithms over ocean, coast, and sea ice to meet user needs
- ❑ Investigate snow over/near sea ice , encourage cross-program support to advance the state of frozen precipitation (e.g. move away from single sensor thinking)
- ❑ Make a explicit statement to CGMS in support of OceanRAIN
- ❑ Further exploitation of GPM/CloudSat sensors/products

POC., C. Klepp, A. Behrangi, H. Meng, C. Kummerow

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

Action Items to IPWG

Topic : Orographic and shallow precipitation

Problem: Radars and PMW continue to have problems with capturing **orographic** and **shallow** precipitation.

- ❑ to continue to explore physical mechanism for understanding orographic/shallow precipitation.
- ❑ Study small scale mountain effect on rainfall (extending the current research)
- ❑ Collect observation data (collect data set to help address this issue), NAME, etc.
- ❑ Exploring DPR 65S-65N that extends the orographic analysis to higher latitude (new opportunity)
- ❑ Using ground radar to study orographic precipitation
- ❑ Alternative methods to estimate missing shallow precipitation

POC: Shoichi Shige, Huan Meng, P. Kirstetter, A. Behrangi, L. Milani, P. Kirstetter

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

Action Items to IPWG/CGMS

Topic: Considering different cloud microphysics in radiative transfer calculation and precipitation estimation

- ❑ Continue developing methods to evaluate the effect of different particle size distributions (PSD) on microwave radiative transfer
- ❑ Exploring physical relations between microwave signatures and each hydrometeor type.
- ❑ Improving microphysical schemes by comparing simulated and observed microwave signatures (collaboration with microphysics experts)

POC: Yeji Choi, Dong-Bin Shin,David Duncan, Ian Adams

Action Items to IPWG

Topic: Land surface and precipitation retrieval.

Problem: Uncertain emissivity and surface backscatter over heterogeneous surfaces remains a problem for over land precipitation retrieval

- ❑ Foster new techniques to incorporate non-oceanic surface properties in precipitation retrievals and data assimilation observation operators
- ❑ Encourage algorithm development that handles uncertainty estimation across surface and environmental conditions

POC: Joe Turk, Nai-Yu Wang, Sarah Ringerud, Veljko Petkovic

Action Items to IPWG

Topic: Need to focus on snowfall estimation

Problem: lack of standardized/comprehensive assessment of snowfall

- ❑ To organize a focused IPWG working group (e.g., to report in IPWG 2020) for snowfall assessment: retrieval, evaluation, (i.e., Lisa will lead?)

POC: L. Milani, H. Meng, Ryan Gonzalez, C. Kummerow, A. Behrangi, P. Kirstetter

Action Items to IPWG

Topic: High spatiotemporal sampling of multispectral VIS/IR from new generation of Geostationary satellites

Problem: This combination is not used in full capacity

- ❑ Foster Integration efforts between MW and IR community to advance more physically based precipitation retrievals and understanding of storm dynamics
- ❑ More interaction with ICWG for tying cloud and precipitation properties, focusing on case studies

POC: Bob Kuligowski , Ali Behrangi, Joe Turk, Nai-Yu Wang, Dong-bin Shin, P. Kirstetter

Recommendations to CGMS

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.

POC. George Huffman , Chris Kidd , R. Ferraro

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS

Recommendations to CGMS

As precipitation moves to higher temporal rates, we recommend to CGMS members to synchronize full-disk geostationary sampling schedules.

- ❑ This is to optimize GEO scans to improve temporal sampling of precipitation products and unknown future PMW imager availability for merged products.
- ❑ Encourage openly available full-coverage global geostationary data

POC. George Huffman , C. Kummerow

Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

CGMS