IPWG Working Groups and Benchmarking Activity

Towards Well-documented Products with Predictable Uncertainties

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Coordination Group for Meteorological Satellites

IPWG International Precipitation Working Group

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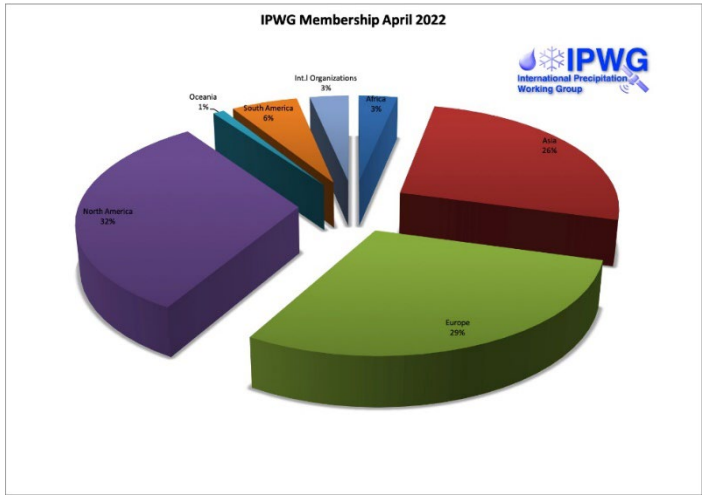
Background: Positive Developments for Space-Based Precipitation

- Growing usage of AI/ML techniques is improving products
- Advancements in passive MW techniques specifically for estimating frozen (snow) precipitation from operational satellites (e.g. ATMS, MetOp)
- Continued effort/improvement in orographic precipitation
- More Cubesats with microwave sounders and increasing participation of colleagues from the private sector
- Growing interest in precipitation in general. IPWG membership > 500



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Background: Issues for Space Based Precipitation

- Growing usage of AI/ML techniques in algorithms and growth of unverified global products of questionable provenance
- Cubesat/Smallsat often lack QC/Intercalibration efforts needed for consistent precipitation applications
- Precipitation products have limited ability to predict uncertainties in regions w/o validation data. Users struggle with uncertainties provided by products.
- The community has no OSSE equivalent that allows it to assess the benefit of proposed future observations.
- With GPM beginning to wind down, leadership will be needed to ensure that precipitation products retain the quality, accessibility, and documentation that forms the essential backbone for research and applications.

Background: Working Groups and Focus Groups

In order to provide better overall recommendations that are reported to CGMS, since IPWG-10 the efforts are broken into four Working Groups to address community needs and five Focus Groups to foster community discussions:

Working Groups (WG)	Focus Groups (FG)
WG 1: Baseline Surface Precipitation Network	FG 1: Orographic Precipitation
WG 2: Multi-Satellite Precipitation Products	FG 2: Snowfall
WG 3: Machine Learning	FG 3: Particle Scattering
WG 4: CubeSat/SmallSat	FG 4: Data Assimilation
	FG 5: Land Surface

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⇒ The **Multi-satellite precipitation** Working Group has been active in soliciting user needs – especially related to orographic precipitation and uncertainty

Goal: To develop a roadmap for what is needed rather than what is available in order to better align research and applications

Goal: Decide if IPWG should be home of ” IPWG products” that meet a set of IPWG standards for documentation, comparisons vs BSPN, open access, etc. If so, need WG to develop these standards.

⇒ **The Baseline Surface Precipitation Network** (BSPN) Working Group completed drafting a strategy for a uniform quality radar/gauge database, with inputs from QPE experts. Feeds into Machine Learning and Uncertainties. Working with Expert Group on Meteorological Radars.

Goal: One year (or so) of uniformly QC'ed, gauge corrected radar rainfall (snowfall) from as many different sites as possible. Archived locally but networked by BSPN for IPWG community

Provide relatively uniform data from across the globe for 2 purposes

(1) Provide reference dataset that IPWG products should compare to as a standard reference

(2) Provide a representative dataset from across the globe to test uncertainty prediction schemes under different environmental conditions.

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Executive summary of the WP

⇒ **The IPWG Machine Learning Working Group** has made progress on development of a benchmarking dataset to help diagnose algorithm performance

Has provided benchmark data to test ML schemes. Training is different from verification to assess robustness. Need to discuss next steps

Executive summary of the WP

⇒ The **CubeSat/SmallSat Constellation** Working Group has focused on OSSE framework to properly address CGMS Future Direction 2022+ strategic theme, "Future Observation Hybrid Space Infrastructure

Goal: Discuss what instruments are coming and how to deal with them. Just like algorithms should perhaps follow have a set of standards that make them IPWG-compliant, should new radiometers have Cal/Val standards that make then IPWG compliant. If so, what are those standards?

Key Issues of Relevance to CGMS

The IPWG "benchmarking" activity is the IPWG's equivalent of a weather OSSE, to assess the overall quality of the precipitation product generated from a suite of imagers, sounders and precipitation radar.

HLPP Item 1.2.7 "CGMS Gap Analysis": The IPWG Precipitation Benchmarking Activity

In general, global precipitation data products can be roughly parsed into three categories:

1) Real time, high resolution, rapid refresh data for societal/commercial applications, disaster monitoring, and weather forecasting (via data assimilation).

2) Standard research products that need good radiance intercalibration but can have longer time latency. Additional sampling is beneficial as long as uncertainties from various sensors are properly understood. These products benefit many studies dealing with current conditions that do not require immediate action.

3) Climate monitoring products which rely primarily on a few, high quality, very well characterized, long-lasting sensors (e.g. GMI on the GPM Core spacecraft, AMSR-series, SSMI/SSMIS series. SSMI-R series?).

IPWG Precipitation Benchmarking Activity Efforts

- Need 1 year of high resolution (4km, 10 min.), global model output with enough fidelity to simulate credible IR and microwave Tb.

  Currently working with US DOE and NASA to realize such a simulation. Other data sets should be possible also. Need to generate model and validate fidelity of precipitation fields.

- Develop fast ML radiative transfer to simulate any instrument from geostationary IR to commonly used active/passive microwave frequencies and link to model.

  Currently using existing simulator codes but hoping that ML will be developed in parallel. Lots of DA applications.

- Develop a consistent framework for rainfall retrievals.

  GPM codes more or less do this. Need only modest investment to generalize.

- Develop analysis tools to query above data for specific questions.

  Can/should be part of agencies efforts to optimize future observations.

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