Cutting-edge activities in the International Precipitation Working Group (IPWG)

IPWG co-chairs: Philippe Chambon[1], Viviana Maggioni[2]
IPWG rapporteur to CGMS: Joe Turk[3]

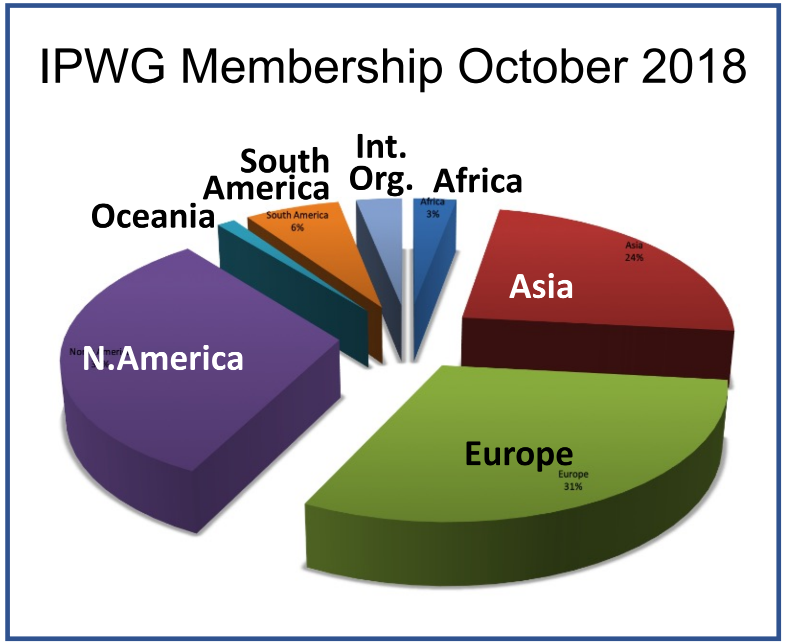
1. CNRM, Météo-France & CNRS, Toulouse, France
2. George Mason University, Fairfax, VA, USA
3. JPL, California Institute of Technology, California, USA

WMO OCP Innovation Webinar, 14 December 2021

What is IPWG ?

IPWG
International Precipitation Working Group

- IPWG was established as a permanent Working Group of the Coordination Group for Meteorological Satellites (CGMS) in 2001.
- The IPWG is co-sponsored by CGMS and the World Meteorological Organization (WMO).
- Focused on operational and research satellite based quantitative precipitation measurement issues and challenges.

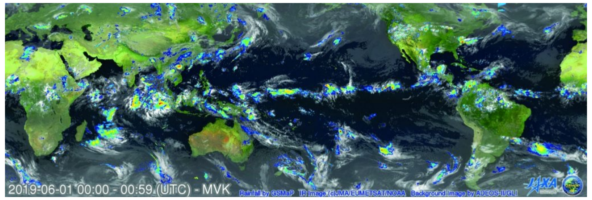


> 500 members

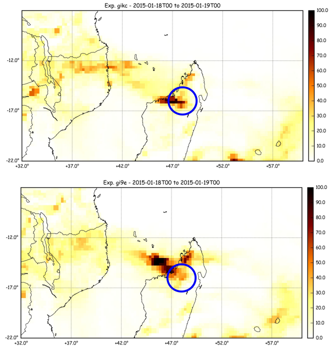
A key community of users of passive and active MW data

IPWG provides a forum of discussion to scientists and users of precipitation products and fosters :

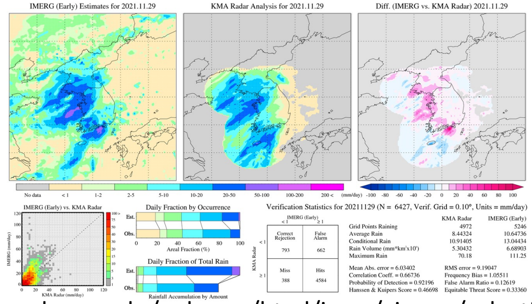
- The development of better measurements of precipitation through retrieval algorithms improvements.
- The documentation of products deficiencies through validation techniques.
- The development of better forecasts of precipitation through assimilations algorithms improvements.
- The usage of satellite precipitation measurements through discussions with users to improve their utilization.
- The improvement of scientific understanding of precipitation science.



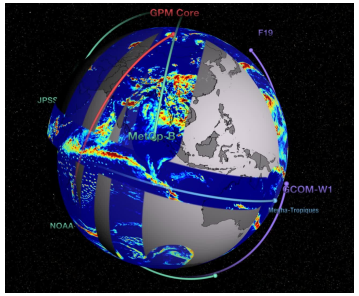
(https://sharaku.eorc.jaxa.jp/GSMaP/index.htm)



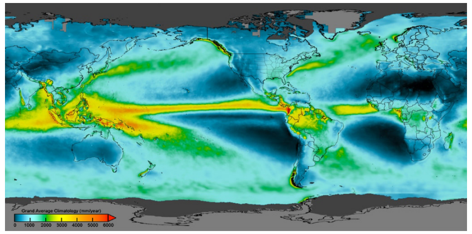
(Chambon and Geer, 2017)



(http://nmsc.kma.go.kr/enhome/html/ipwg/viewer/selectIpwg.do)

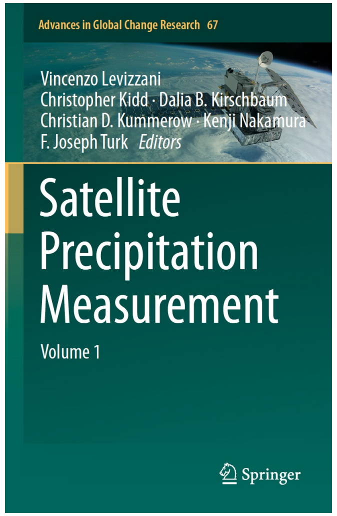


(https://gpm.nasa.gov)

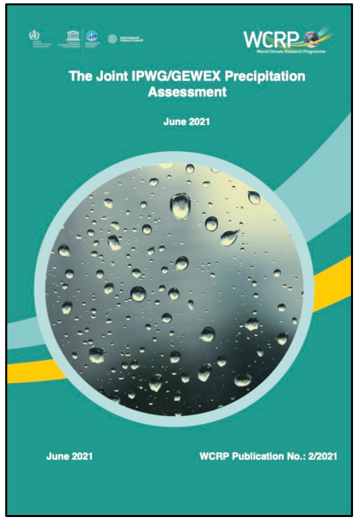


(https://gpm.nasa.gov/data/imerg/precipitation-climatology)

A few recent references highlighting the need for continuity and enhanced spaceborne radar coverage

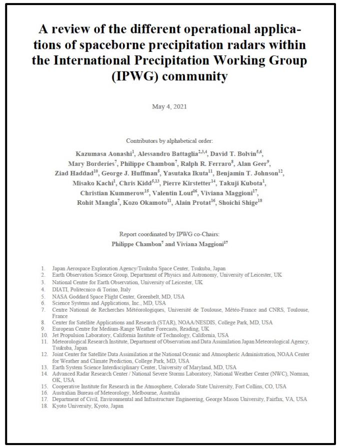


Satellite Precipitation Measurement, Volumes 1 & 2
(https://doi.org/10.1007/978-3-030-24568-9)



The Joint IPWG/GEWEX Precipitation Assessment (DOI: 10.13021/gewex.precip)

- Chapter 1 : Assessment of the Sub-Daily Global Satellite Precipitation Products
- Chapter 2 : Climate applications
- Chapter 3 : Emerging directions



A review of the different operational applications of spaceborne precipitation radars within the International Precipitation Working Group (IPWG) community

May 4, 2021

Contributors by alphabetical order:

Kazumasa Aonashi[1], Alessandro Battaglia[2,3,4], David T. Bolvin[5,6], Mary Borderies[7], Philippe Chambon[7], Ralph R. Ferraro[8], Alan Geer[9], Ziad Haddad[10], George J. Huffman[5], Yasutaka Ikuta[11], Benjamin T. Johnson[12], Misako Kachi[1], Chris Kidd[5,13], Pierre Kirstetter[14], Takuji Kubota[1], Christian Kummerow[15], Valentin Louf[16], Viviana Maggioni[17], Rohit Mangla[7], Kozo Okamoto[11], Alain Protat[16], Shoichi Shige[18]

Report coordinated by IPWG co-Chairs:
Philippe Chambon[7] and Viviana Maggioni[17]

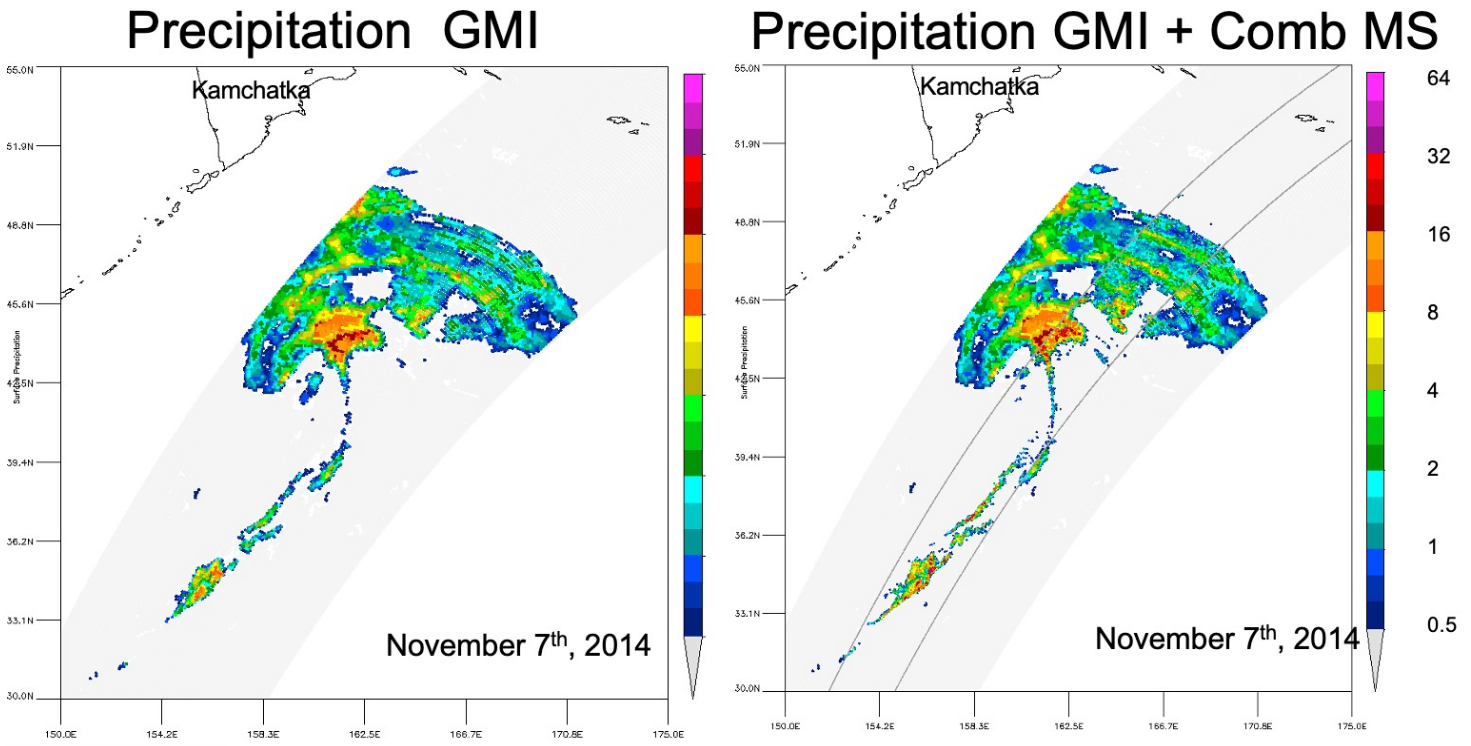
1. Japan Aerospace Exploration Agency/Tsukuba Space Center, Tsukuba, Japan
2. Earth Observation Science Group, Department of Physics and Astronomy, University of Leicester, UK
3. National Centre for Earth Observation, University of Leicester, UK
4. DIATI, Politecnico di Torino, Italy
5. NASA Goddard Space Flight Center, Greenbelt, MD, USA
6. Science Systems and Applications, Inc., MD, USA
7. Centre National de Recherches Météorologiques, Université de Toulouse, Météo-France and CNRS, Toulouse, France
8. Center for Satellite Applications and Research (STAR), NOAA/NESDIS, College Park, MD, USA
9. European Centre for Medium-Range Weather Forecasts, Reading, UK
10. Jet Propulsion Laboratory, California Institute of Technology, California, USA
11. Meteorological Research Institute, Department of Observation and Data Assimilation Japan Meteorological Agency, Tsukuba, Japan
12. Joint Center for Satellite Data Assimilation at the National Oceanic and Atmospheric Administration, NOAA Center for Weather and Climate Prediction, College Park, MD, USA
13. Earth System Science Interdisciplinary Center, University of Maryland, MD, USA
14. Advanced Radar Research Center / National Severe Storms Laboratory, National Weather Center (NWC), Norman, OK, USA
15. Cooperative Institute for Research in the Atmosphere, Colorado State University, Fort Collins, CO, USA
16. Australian Bureau of Meteorology, Melbourne, Australia
17. Department of Civil, Environmental and Infrastructure Engineering, George Mason University, Fairfax, VA, USA
18. Kyoto University, Kyoto, Japan

The IPWG Report on Space Radar Applications, endorsed by CGMS-49
(http://ipwg.isac.cnr.it/reports/IPWG_review_applications_space-borne_precipitation_radars.pdf)

- Section 1 : Use of precipitation radars for operational retrieval algorithms
- Section 2 : Use of precipitation radars for numerical weather prediction applications
- Section 3 : A perspective of operational applications: development of techniques to monitor the calibration of ground radar networks
- Section 4 : Conclusions and recommendations for future spaceborne precipitation radars

Use of precipitation radars for operational retrieval algorithms (1/2)

Precipitation retrievals from passive MW instruments require databases of co-located passive and active microwave observations. **These databases will need to be repeatedly updated to account for an evolving climate**. Multiplatform combined products also benefit from a **continuous intercalibration** of precipitation retrievals from the various radiometers before merging and therefore constantly require recent radar observations.



(Source: C. Kummerow)

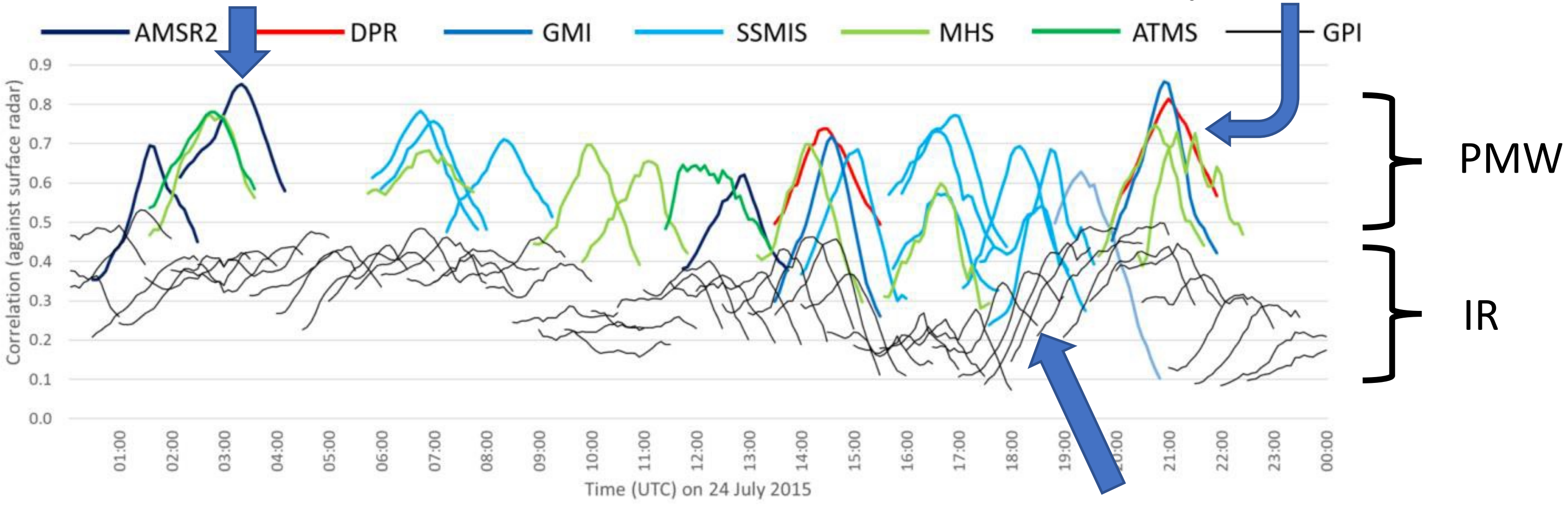
Use of precipitation radars for operational retrieval algorithms (2/2)

Two examples from Kidd et al. (2021) highlighting the successful training of passive instruments on active ones for surface rain retrievals.

Example for a one-day period over the UK with the PRPS algorithm :

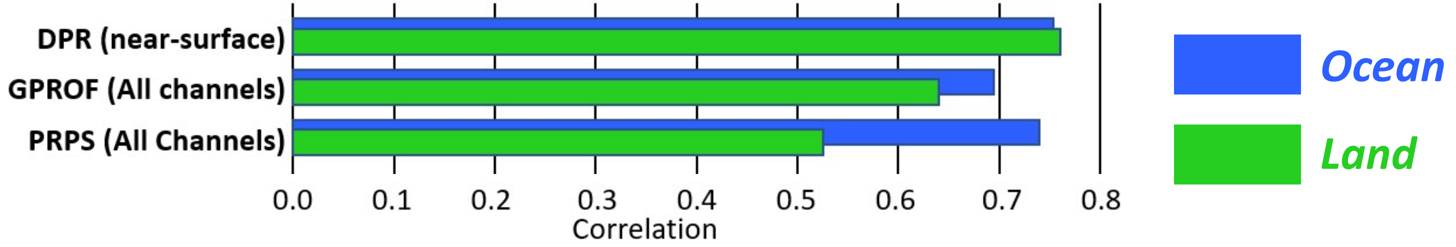
Satellite vs surface correlations peak at time of observation

Correlations decline markedly away from time of observation



IR-only retrievals never match those of the PMW

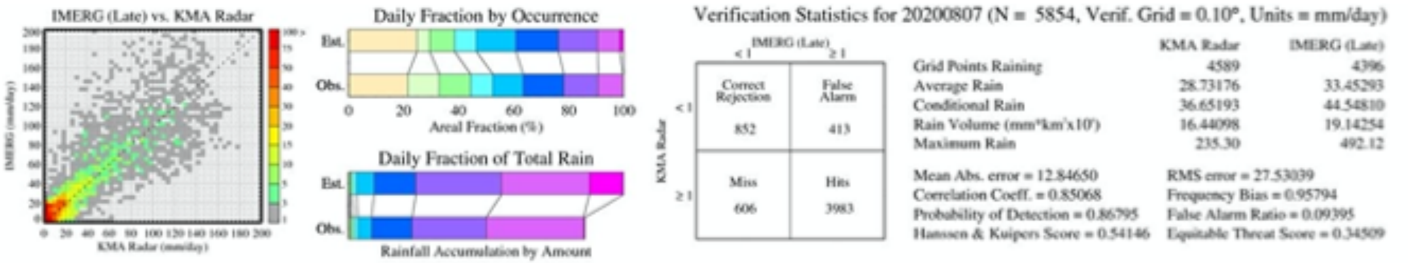
Statistical comparison between retrievals from GMI or DPR and ground-based measurements over the UK for a one-year period :

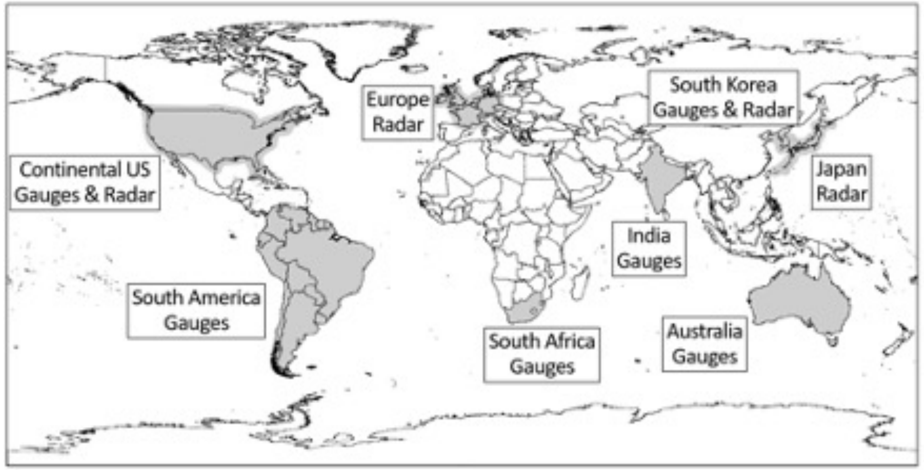


Assessing uncertainties in satellite precipitation (1/2)

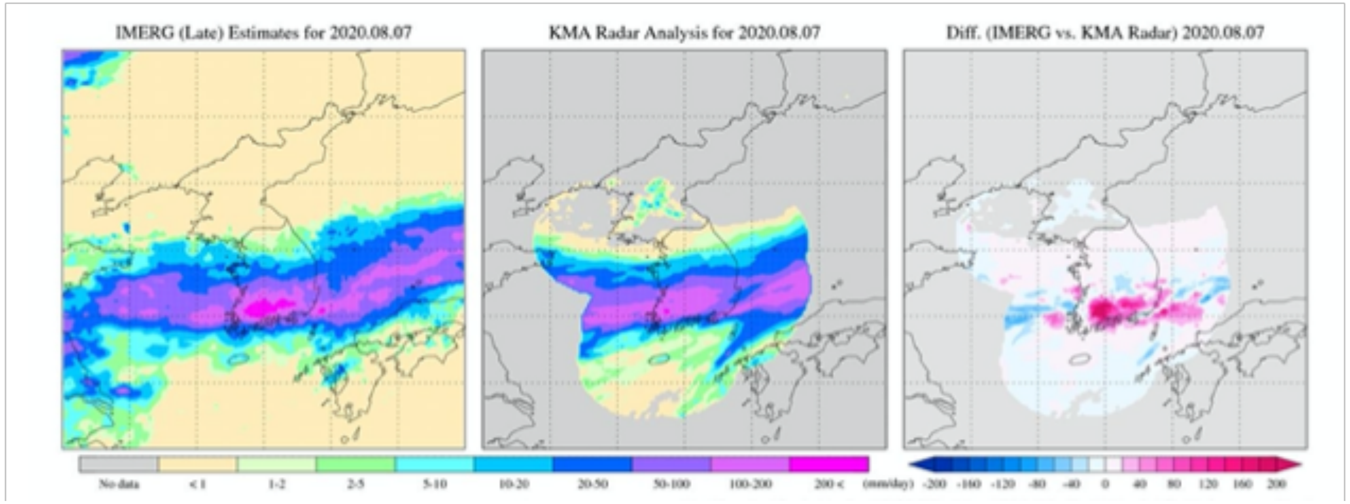
Methods to evaluate satellite precipitation products:

- Ground gauges/radars (directly sensitive to surface precipitation)





Distribution of current IPWG validation regions and their surface reference datasets



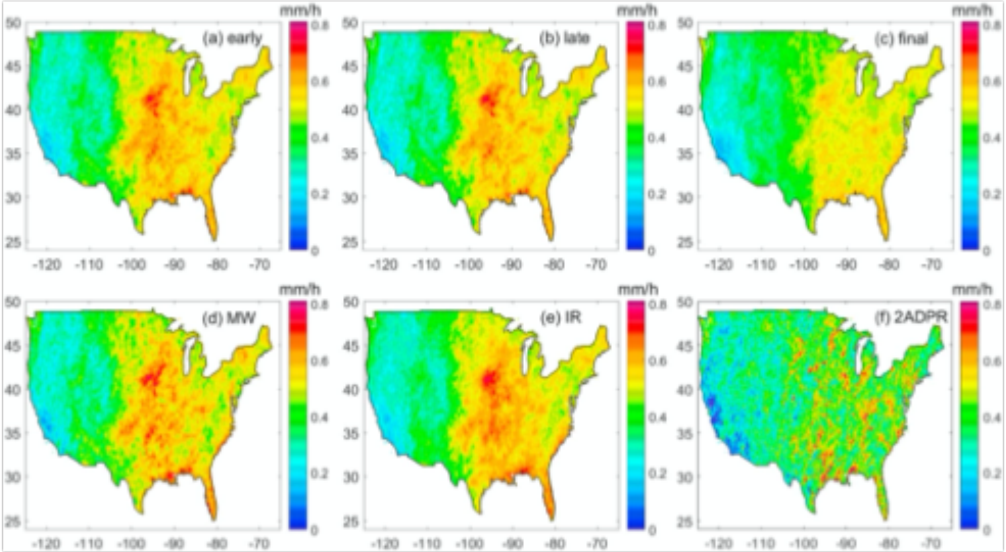
http://ipwg.isac.cnr.it/calval.html

Courtesy of Jun Park

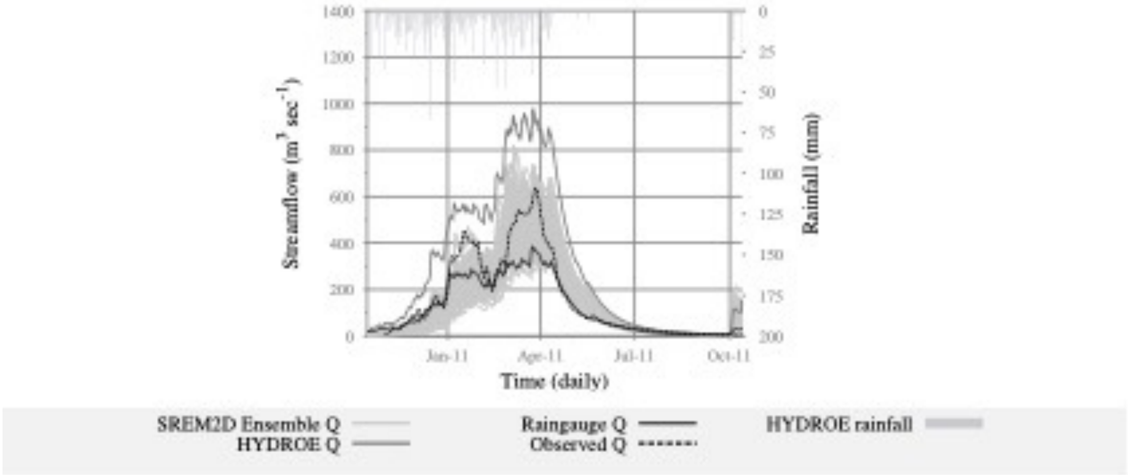
Assessing uncertainties in satellite precipitation (2/2)

Methods to evaluate satellite precipitation products:

- Ground gauges/radars (directly sensitive to surface precipitation)
- Spaceborne radars (global reference)
- Indirectly (e.g., hydrologic applications)



Average precipitation rate (mm/hr) over CONUS during April to October 2014–2015 for GPM-based products. (Khan et al., 2018)



Streamflow simulations in a basin in Brazil using input precipitation from different sources (Falck et al., 2015)

Use of precipitation radars for numerical weather prediction applications (1/2)

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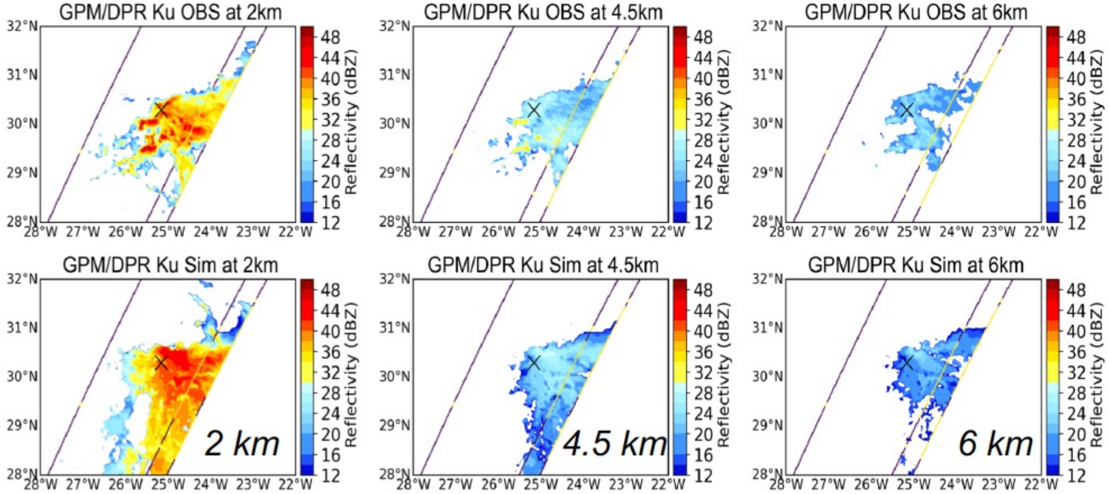
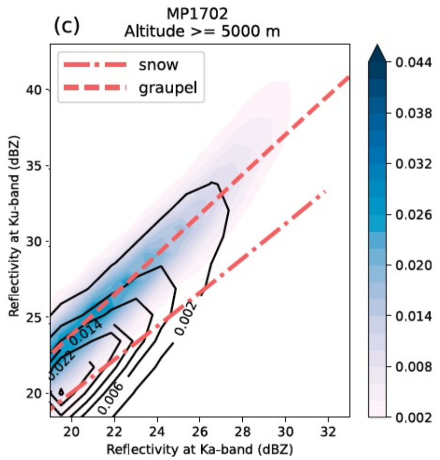
Assessing the cloud microphysics scheme of the Météo-France global model ARPEGE (Mangla et al., 2021)

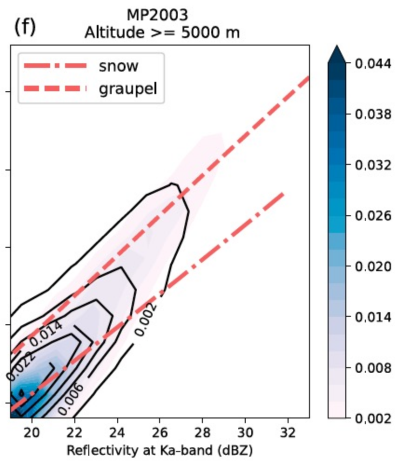
Example of one sub-tropical cloud observed by the DPR on January 2nd, 2021

Simulations with RTTOV V13 with the ARPEGE model



Original microphysics scheme





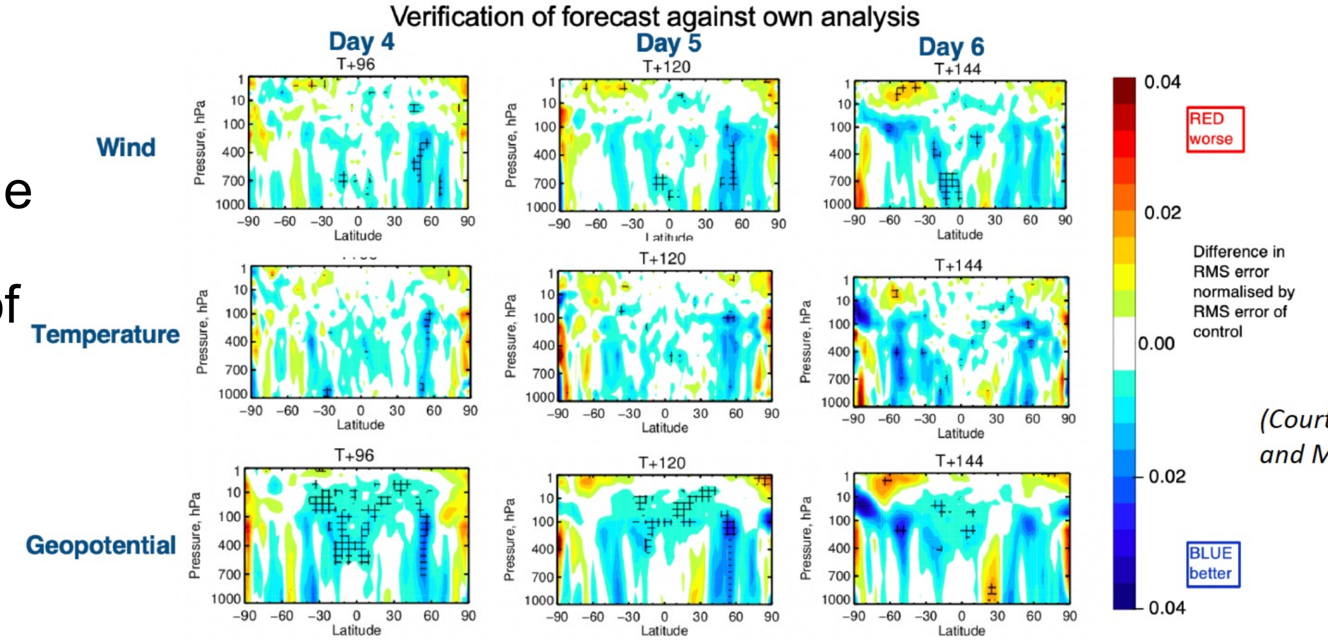
Improved microphysics scheme

Improvement of the Cloud Microphysics Scheme of the Mesoscale Model at the Japan Meteorological Agency Using Spaceborne Radar (Ikuta et al., 2021, MWR)

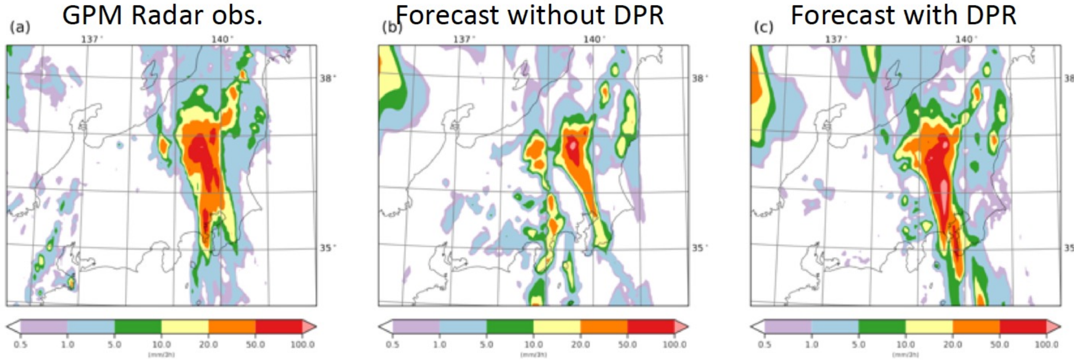
Use of precipitation radars for numerical weather prediction applications (2/2)

Forecast scores improvements of the ECMWF model when Cloudsat and Calipso are assimilated on the top of the observing system of 2007 (OSE period Aug.2007 and Feb.2008).

(Fielding and Janiskowa, 2021)



(Courtesy of Mark Fielding and Marta Janiskova)



(Courtesy of Yasutaka Ikuta)

Precipitation forecast improvements of the JMA model when GPM/DPR data are assimilated on the top of the observations assimilated operationally. (Ikuta et al., 2021)

Recommendations for future spaceborne precipitation radars (1/2)

The highlighted applications require a **continuity of precipitation radar observations in the future to sustain development and/or operations**. A number of aspects of the current generation of radars which could be improved in future instruments have also been highlighted. In particular, several applications would benefit from:

- An **improved sampling** through a wider swath compared to the TRMM, GPM, and CloudSat instruments, or a constellation of such radars with their current swaths.

=> Improving the sampling increases time/space coincidences with PMW and potential impacts in NWP.

- An **improved sensitivity**, resolution, and multi frequency capabilities.

=> Improving the sensitivity can help to capture drizzle or light snowfall.

Recommendations for future spaceborne precipitation radars (2/2)

The highlighted applications require a **continuity of precipitation radar observations in the future to sustain development and/or operations**. A number of aspects of the current generation of radars which could be improved in future instruments have also been highlighted. In particular, several applications would benefit from:

- Capabilities to **observe closer to the surface**.

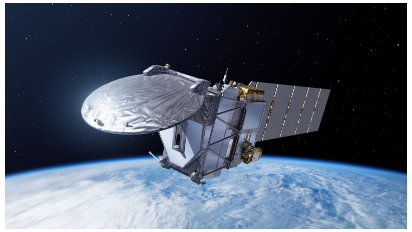
=> Mitigating the contamination by side-lobe clutter would help the sample of shallow precipitation

- **Doppler capabilities**

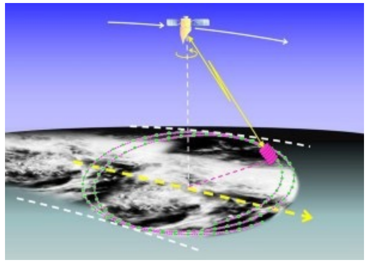
⇒Constraining together physical (condensed water mass)

and dynamical (winds) fields together to improve long range forecasts

(already demonstrated with ground-based and airborne cloud radars).



(EarthCare, ESA/JAXA)



(WIVERN, ESA Earth Explorer 11 Phase 0)

IPWG-10

- Joint meeting with the **IWSSM community**
- **June 13 - June 17, 2022**
- Host: Cooperative Institute for Research in the Atmosphere, CSU, Fort Collins, CO
- The abstract submission just opened on December 1st 2021 (deadline January 15th, 2022) :

=> https://www.cira.colostate.edu/conferences/2022_ipwg/