IPWG Orographic Precipitation Focus Group

Breakout Session

co-chairs: Dr. Shoichi Shige and Dr. Yagmur Derin

IPWG Orographic Precipitation Focus Group

Goals and Expected Outcomes

Aim of Orographic Precipitation Focus Group: To serve as a focus and unite the community who are doing research in this area.

Goal of Orographic Precipitation Focus Group: Poll the IPWG members to find out who is interested in orographic precipitation, identify problems, and hold periodic telecons to share information so that the community is aware of what others are doing.

The Expected Outcome of the Orographic Precipitation Focus Group: Prepare a unified presentation for IPWG-11 that summarizes the work that is ongoing in orographic precipitation.

IPWG Orographic Precipitation Focus Group
Agenda

Start Time	Topic
2 min	Introduction of the Orographic Precipitation Focus Group
10 min	Go around the room and everyone introduces themselves
3 min	Agenda Review
60 min	Go over the each science question targeted by our FG and ask everyone's input by considering "What can be done more, better, and different? "
15 min	Gather everyone's input and discuss about future directions

1) Explore physical mechanism for understanding orographic/shallow precipitation

2) Algorithm validation

2) Hydrological applications over complex terrain

3) Weather radar networks and small weather radar QPE's to study orographic precipitation

4) How to bridge the gap in between observations (in-situ and remote sensing) and numerical models in order to improve orographic precipitation detection and quantification

What is your main research area?

- Orographic precipitation processes
- Validation and field campaigns
- Data assimilation methods
- Hydrology in mountainous regions
- Remote sensing of orographic precipitation
- Numerical weather prediction for orographic precipitation
- Impact of climate change on orographic precipitation
- Extreme weather events in mountainous areas
- Other:

If you are attending in-person are you interested in giving a 2-5 minutes introduction about your work at the Orographic Precipitation FG breakout session?

- Yes

  Janice Bytheway

  Masafumi Hirose

  Munehisa Yamamoto

IPWG_file_submission_URL_list.xlsx

Session 12_Breakout session_FG1

https://www.dropbox.com/request/jZxfJTT0p4fuIxHlfv5H

- No

What can be done more, better, and different to explore physical mechanisms for understanding orographic precipitation?

- Extracting high-resolution temporal and spatial variability from satellites would increase contact with ground-based observations and modelling studies.
- Synchronous observation from satellite and ground
- An effort to collect more data over the mountainous region is still one of the key and most challenging components to explore our understanding of orographic precipitation

What can be done more, better, and different for algorithm validation over mountainous terrain? How can we make sure these outcomes are useful for algorithm developers?

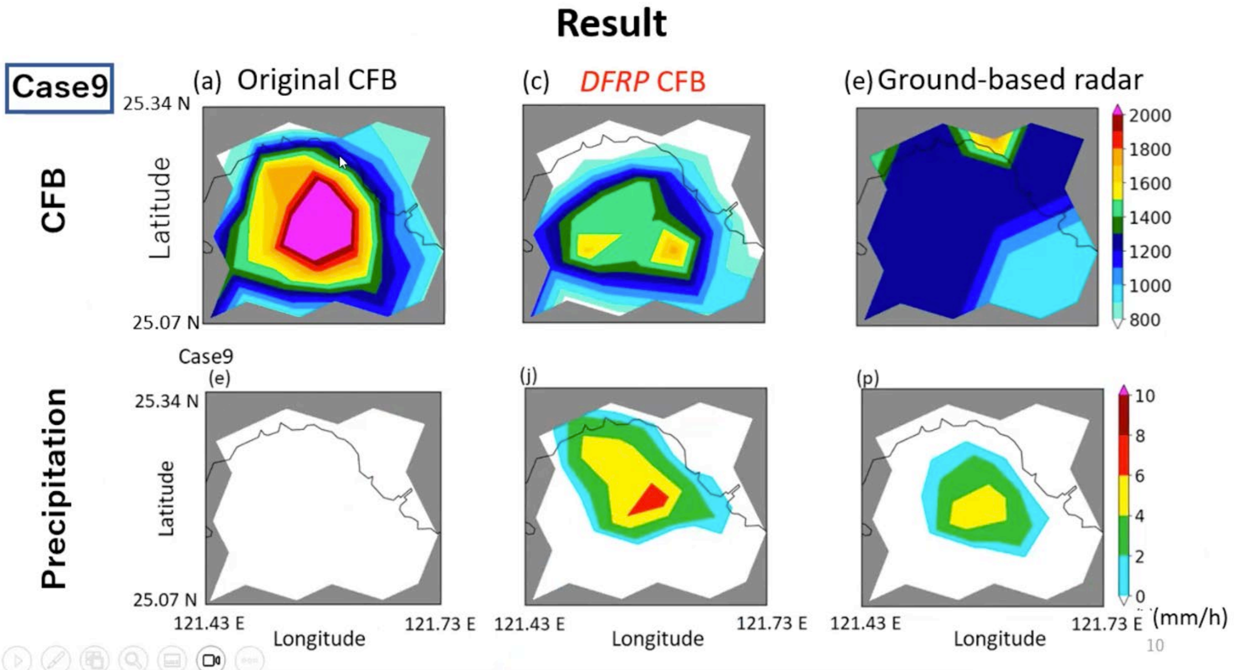
- We need to reconcile the nominal resolution of reference products with their representativeness. There are several radar and gauge-based products with nominally high resolution output, but which have known weaknesses and large uncertainties in complex terrain that make them less trustworthy references without an additional coarsening step. This is also an issue in validating NWP models that are producing forecasts at ever higher resolutions. Put simply, we need to find a way to provide reliable QPE at spatiotemporal resolutions of interest to both the satellite algorithm development and NWP model development communities.
- Validation of assumptions about precipitation structure near the surface and the occurrence of very weak echoes can help quantify the limitations of the product. A better understanding of uncertainties will lead to more appropriate criteria for data comparison and validation.
- Accumulation of satellite over pass cases particularly for large discrepancy between satellite and ground over wide areas
- To make the validation reliable, these relevant works should be better focused on those mountainous regions with relatively dense observing networks. A global and comprehensive survey may be required to identify the geographical locations of these particular mountainous regions

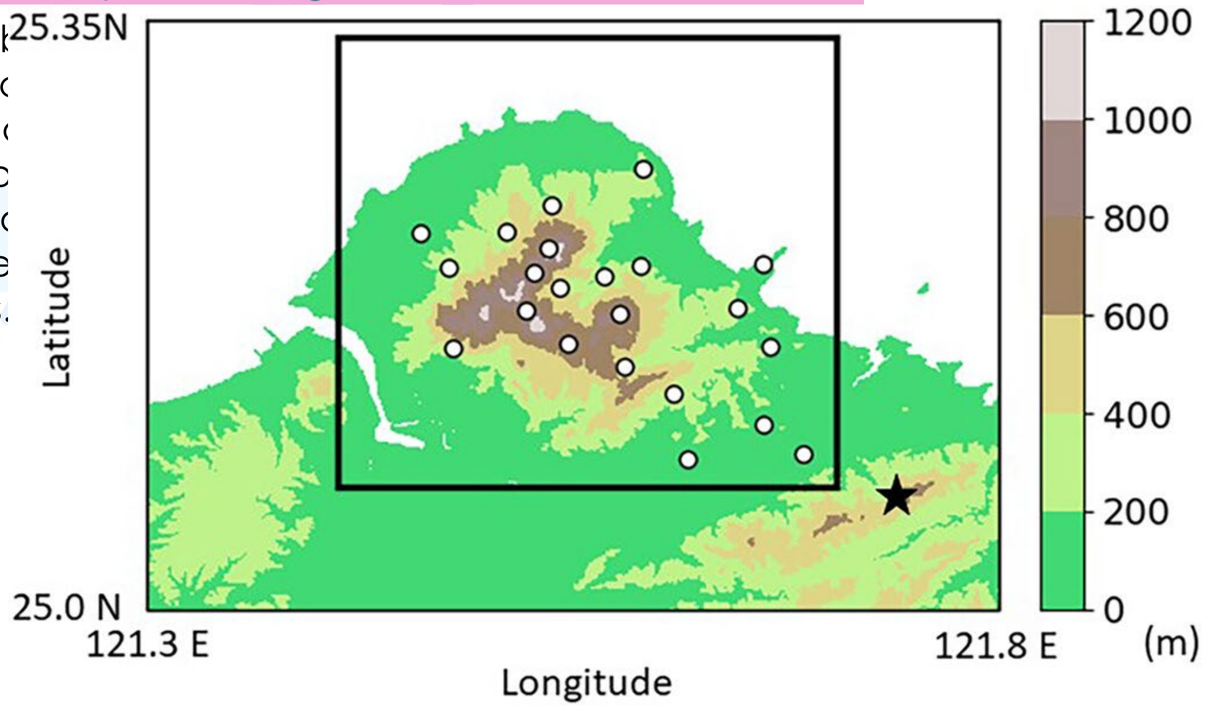
IPWG OPFG – 2nd Telecon, October 04, 2023

Riku Shimizu (Div. Earth & Planetary Sci., Graduate School of Science, Kyoto University):

Narrowing the Blind Zone of the GPM Dual-Frequency Precipitation Radar to Improve Shallow Precipitation Detection in Mountainous Areas *DOI: https://doi.org/10.1175/JAMC-D-22-0162.1*

Authors were motivated to improve shallow precipitation detection i
Mountainous Areas. DPR estimates the clutter free bottom (CFB) whic
estimates precipitation at altitudes higher than CFB. Authors reveale
CFB was estimated to be higher than the lower bound range free fro
operational CFB estimation algorithm of DPR by estimating the CFB t
clutter. Their study region is Da-Tun mountain of northern Taiwan whe
even though rain gauges captured strong precipitation magnitudes.





Da-Tun Mountain of northern Taiwan represents an excellent natural laboratory for exploring the problem of the CFB, not only because Da-Tun Mountain is the area in Taiwan with the most concentrated area of heavy rainfall during typhoons and wintertime northeasterly monsoons (Yu and Cheng 2008, 2014; Cheng and Yu 2019), but also because a high-density, automatic rain gauge network (Cheng and Yu 2019) has been deployed over this mountain barrier since 2011 (white circles).

What can be done more, better, and different for hydrological applications over complex terrain?

- Higher resolution and an understanding of the limitations of satellite observations of rain and snow are needed.

What can be done more, better, and different for weather radar networks and small weather radar QPE's to study orographic precipitation?

- More gap fill radar deployments in complex terrain are needed to assess regional similarities and differences in precip processes. These deployments should be multi-year in order to assess interannual variability
- Accompanying these gap fill radar deployments should be an adequate network of in-situ instrumentation (gauges) to validate the radar QPE and disdrometers to develop appropriate radar-rainfall relationships across different terrain regions (e.g., valley, slope, elevated plateau, etc)
- When possible, deploying 2 or more gap fill radars in the same region is useful for multiple Doppler synthesis to allow retrieval of kinematic information for the assessment of different flow processes that drive precip generation (e.g., the role of turbulence vs upslope flow). This info is also useful for model validation

How to bridge the gap in between observations (in-situ and remote sensing) and NWP models in order to improve orographic precipitation QPE?

- Careful attention needs to be paid to the location of the estimation target and the treatment of sensitivity to avoid deriving gaps between different targets.

Please suggest additional discussion topics for the Orographic Precipitation FG breakout session.

IPWG Orographic Precipitation Focus Group

Summary of Break out Room Outcomes

Summary of breakout session

Zoom information for OP FG breakout session

Orographic Precipitation Focus Group

2024/7/17 01:30 PM

Zoom meeting link:

https://kyoto-u-edu.zoom.us/j/99129289243?pwd=fXx5BwlrHrtbSLGDR9pEQf5toFXBer.1

Meeting ID: 991 2928 9243

Passcode: 359716

IPWG Orographic Precipitation Focus Group
Future Directions

- Reach out to more researchers who are interested
- Our focus group will keep meeting approximately every six months, with 2 presentations each time followed by a discussion.
- List of field campaigns will be updated with DPR and PR overpasses information
- Keep working on the review paper with the support of the focus group.

Orographic precipitation cases overpassed by TRMM PR

Case #	Orbit #	Time	Location	References
1a 1b	03182 03195	Jun 17, 1998 Jun 18, 1998	Tibetan Plateau	Yamamoto et al. (2017, GRSL)
2	33207	Sep 12 2003	Korea	Kwon et al. (2008, JAMC) Yamamoto & Shige (2015, AR) Yamamoto et al. (2017, JAMC)
3	38228	Jul 30 2004	Kii Peninsula, Japan	Kubota et al. (2009, JMSJ) Shige et al. (2013, JAMC)
4a 4b 4c	48644 54714 54821	29 May 2006 23 Jun 2007 30 Jun 2007	Western Ghats, India	Shige & Kummerow (2016, JAS) Shige et al. (2014, AGU monogr.) Yamamoto et al. (2017, JAMC)
5a 5b 5c	56758 57017 67631	1 Nov 2007 18 Nov 2007 Sep 29 2009	Annam Range, Vietnam	Shige & Kummerow (2016, JAS) Yamamoto & Shige (2015, AR)
6	66832	Aug 8 2009	Taiwan	Taniguchi et al. (2013, JH) Yamamoto et al. (2017, JAMC)
7	71260	May 19, 2010	Meghalaya Plateau	Murata et al. (2024, JMSJ)
8a 8b	72346 72347	1531&1709 UTC July 28 2010	Pakistan	Houze et al. (2010, BAMS)

Typhoon/Hurricane case

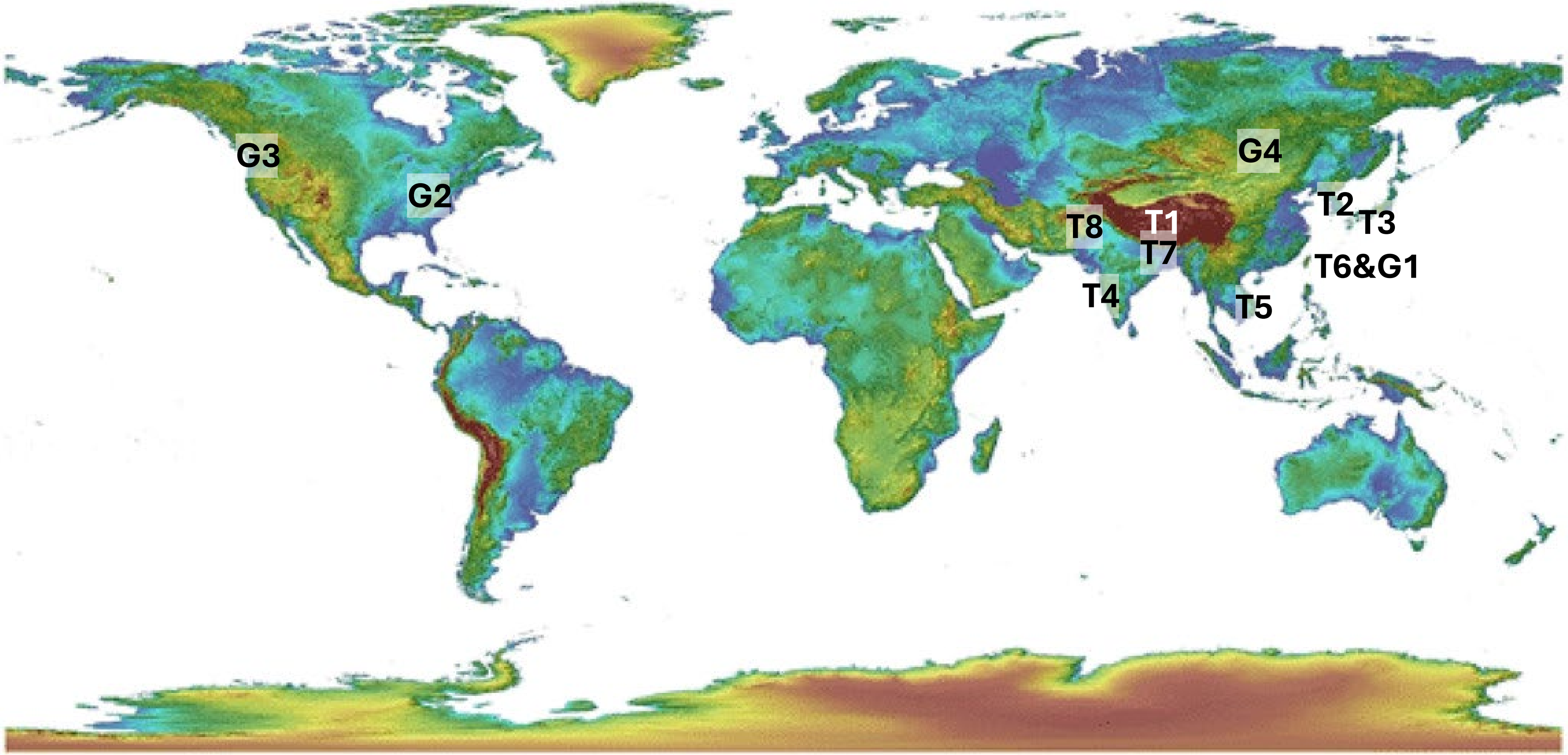
Orographic precipitation cases overpassed by GPM DPR

Case #	**Orbit #**	**Time**	**Location**	**References**	
1a 1b 1c 1d 1e 1f	01564 03962 04085 14660 20875 21336	8 Jun 2014 9 Nov 2014 17 Nov 2014 Sept 26, 2016 31 Oct 2017 30 Nov 2017	Taiwan	1a,b,c,e,f: Shimizu et al. (2023, JAMC) 1d: Hirose et al. (2021, JMSJ)	Blind Zone
2a 2b 2c	02916 05591 26241	September 2, 2014 February 22, 2015 October 11, 2018	Southern Appalachian Mountains, USA	Arulraj & Barros (2019, RSE) Barros & Arulraj (2020, Springer) Arulraj & Barros (2021, RSE)	Blind Zone
3	10019	3 December 2015	Olympic Mountain range, USA	Houze et al. (2017, BAMS) Chase et al. (2021, JAMC)	
4	13432	July 9 2016	Ulaanbaatar, Mongolia	Komatsu et al. (2021, JMSJ)	

Typhoon/Hurricane case

- The lists show that in the TRMM era, there was a lot of research on improving orographic rainfall estimation for microwave radiometers, but in the GPM era, more research is focusing on radar blind zones.
- This list would be a useful test bed for improving satellite algorithms (in particular, microwave radiometer algorithms) and will be posted on our group's website.

Location of cases added to Fig. 20.5 in Smith (2018)



Terrain map of the world in geographic (i.e., latitude–longitude) coordinates. (Source: GMTED 2010, U.S. Geological Survey; Danielson and Gesch 2011.)

Most of the cases are from the Asian region, so we need cases in different environmental conditions from other regions. Input from local people is essential to collect cases of orographic rainfall. It is desirable to indicate the orbit number so that it can be shared.