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)

IPWG International Precipitation Working Group

IWSSM-5 Fifth International Workshop on Space-based Snowfall Measurement

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**

IPWG
International Precipitation Working Group

WMO: World Meteorological Organisation
CGMS: Coordination Group for Meteorological Satellites
IPWG: International Precipitation Working Group

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-operational 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

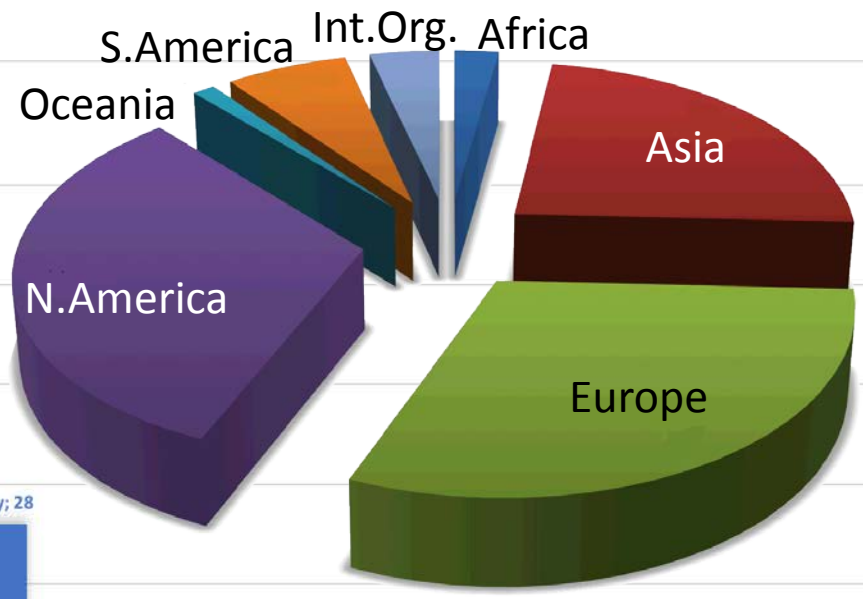
- (IPWG-7 - Japan, Nov 2014; IWSSM-4 - U.S, May 2013)
  - This is first joint meeting, unifies precipitation!
- IPWG-8 / IWSSM-5 - Bologna, Italy 3-7 October 2016
- 158 participants, 23 countries
  - 63 oral/88 posters
    - Prizes for early career scientists
- ~30 students/3-day training course
- 5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

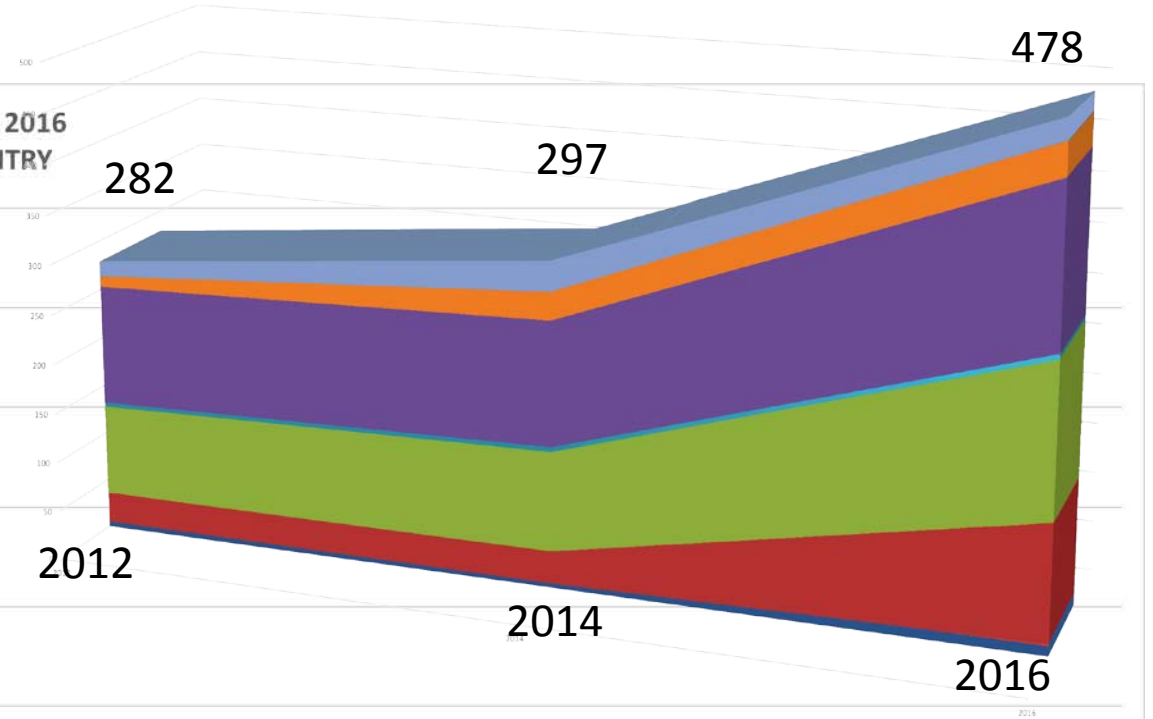
Growing participation: Joint meeting with NWP Dec 2015

- 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

IPWG-8/IWSSM-5 Working Groups

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

IPWG
International Precipitation Working Group

Joint IPWG/IWSSM Training Event

http://ipwg.isac.cnr.it/meetings/bologna-2016/Bologna2016_Training_Lectures.html

Science Committee

Ralph R. Ferraro (Chair)	*NOAA/NESDIS/STAR, College Park, MD, USA*
Ralf Bennartz	*Vanderbilt University, Nashville, TN, USA*
Tufa Dinku	*IRI, Columbia University, Palisades, NY, USA*

Instructors

Kazumasa Aonashi	*Japan Meteorological Agency (JMA), Meteorological Research Institute (MRI), Tsukuba, Japan*
Pietro Ceccato	*Columbia University, International Research Institute for Climate and Society (IRI), Palisades, NY, USA*
Philippe Chambon	*Météo France, Toulouse, France*
Eugene E. Clothiaux	*Department of Meteorology and Atmospheric Sciences, Penn State University, University Park, PA, USA*
Tufa Dinku	*Columbia University, International Research Institute for Climate and Society (IRI), Palisades, NY, USA*
Marielle Gosset	*Institut de Recherche pour le Développement (IRD), Toulouse, France*
George J. Huffman	*National Aeronautics and Space Administration (NASA), Goddard Space Flight Center (GSFC), Greenbelt, MD, USA*
Robert J. Kuligowski	*National Oceanic and Atmospheric Administration (NOAA), Center for Satellite Application and Research (STAR), College Park, MD, USA*
Christian D. Kummerow	*Department of Atmospheric Sciences, Colorado State University, Ft. Collins, CO, USA*
Sante Laviola	*National Research Council of Italy (CNR), Institute of Atmospheric Sciences and Climate (ISAC), Bologna, Italy*
Davide Melfi	*Italian Air Force Met Service, Operational Center for Meteorology (COMet), Pomezia (Rome), Italy*
Dmitri Moisseev	*Department of Physics, University of Helsinki, Helsinki, Finland*
Stephen J. Munchak	*National Aeronautics and Space Administration (NASA), Goddard Space Flight Center (GSFC), Greenbelt, MD, USA*

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 (JQSRT paper)
Eugene E. Clothiaux

4 Active microwave remote sensing/principles
Dmitri Moisseev

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
Sante 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 (57.9 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 Melfi

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

14 Assimilating Satellite Observations of Clouds and Precipitation into Numerical Weather Prediction Models
Philippe Chambon

ACTIONS TO BE CONSIDERED BY CGMS FROM WG's (NOT Final)

- 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.

RECOMMENDATIONS TO BY CGMS FROM WG's (NOT Final)

- 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)

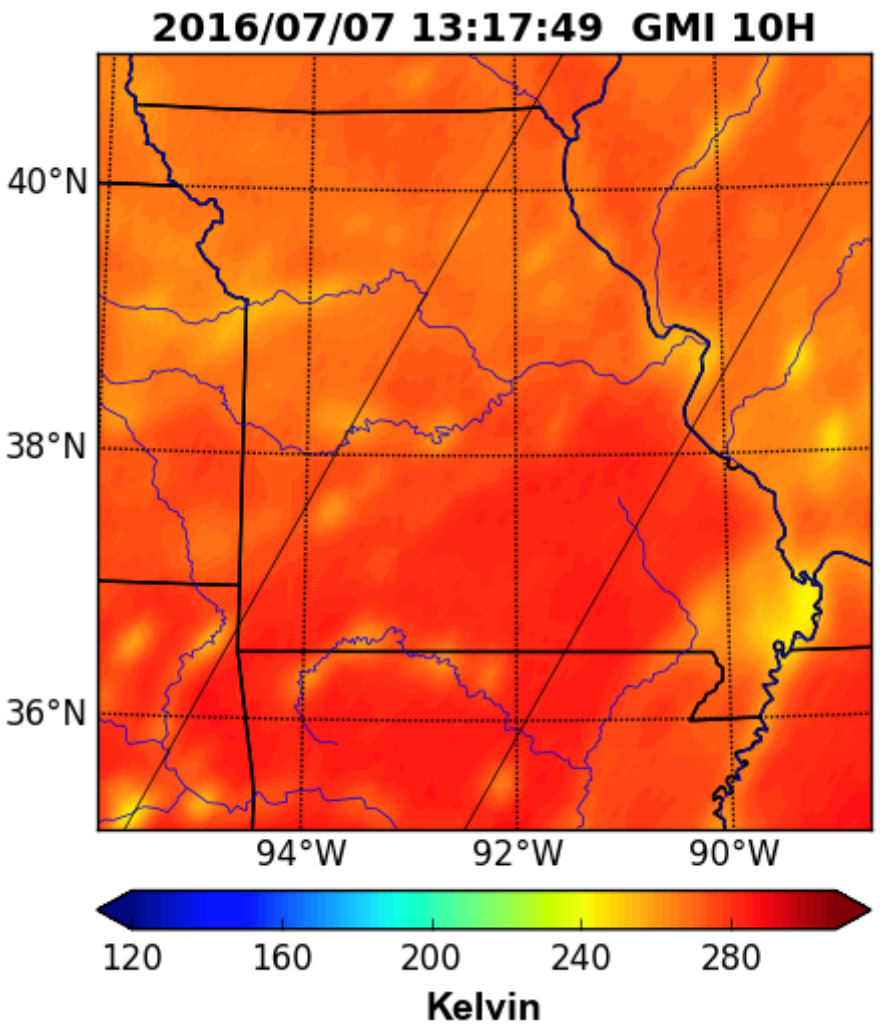
Combination Data Sets (Sometimes w/Gauge Climatology)

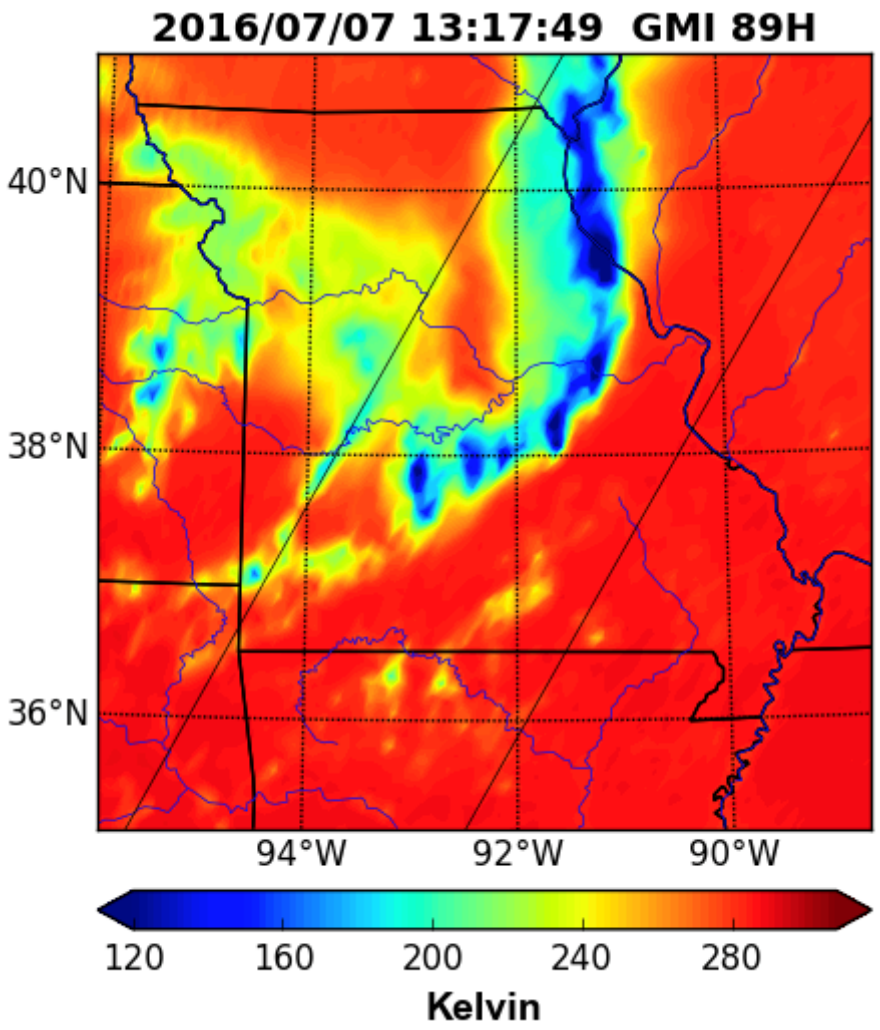
2BCMB
AIRG2SSD
AIRX2SUP
AIRX2SUP_NRT
AIRX3SPD, AIRX3SP8, AIRX3SPM
CMORPH
CMORPH V1.0 RAW
GSMaP Near-real-time (GSMaP_NRT)
GSMaP Realtime (GSMaP_NOW)
GSMaP Standard (GSMaP_MVK) V7
GSMaP Reanalysis (GSMaP_RNL) V7
H03
IMERG Early Run V3
IMERG Late Run V3
MPE
MSWEP NRT
NRL Real TIme
PERSIANN
PERSIANN-CCS
SCAMPR
TOVS
TRMM Real-Time HQ Version 7 (3B40RT)
TRMM Real-Time VAR Version 7 (3B41RT)
TRMM Real-Time HQVAR Version 7 (3B42RT)

IPWG-8
A Few Science Highlights

GPM Overpass 7 July 2017 1317 UTC Central US

Provided by J. F. Turk, NASA/JPL

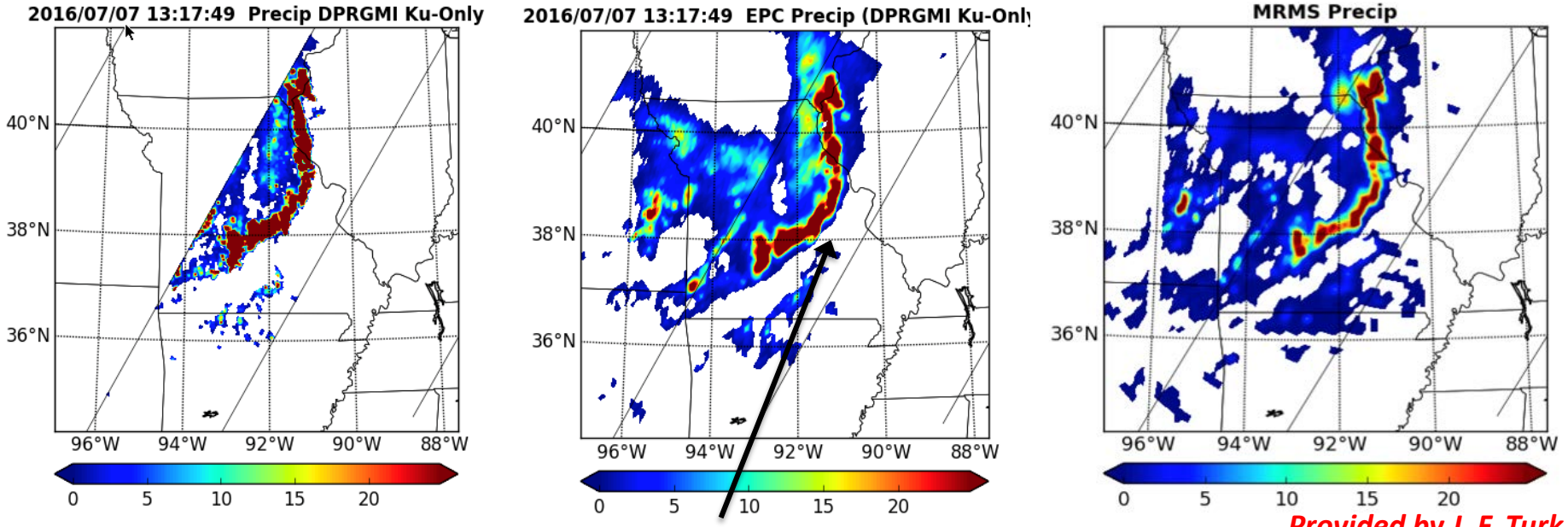




DPR (radar+radiometer) Combined GPM

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

Provided by J. F. Turk, NASA/JPL

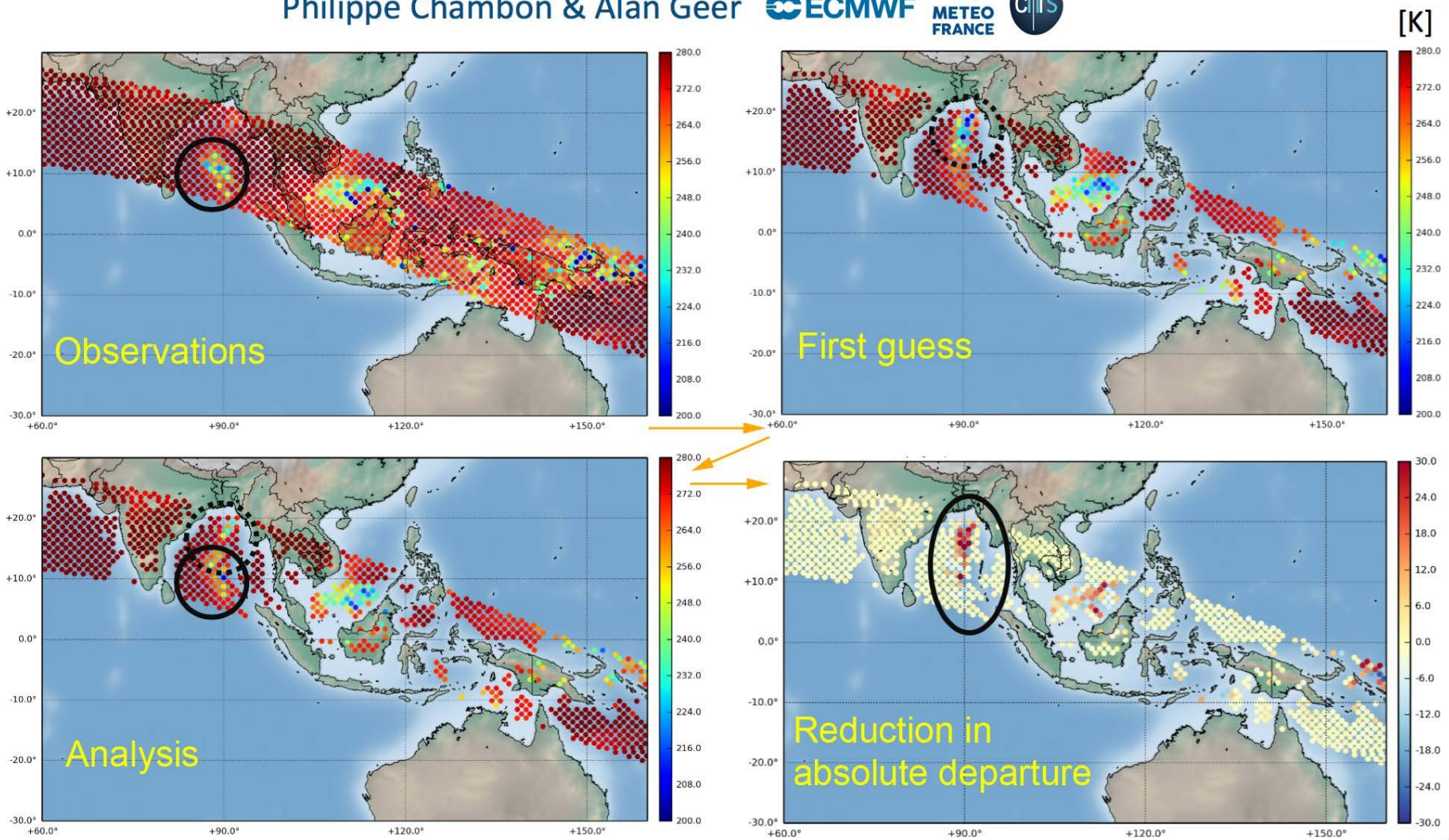
*Turk, F.J., Haddad, Z.S. & You, Y., 2016, Estimating Non-Raining Surface Parameters to Assist GPM Constellation Radiometer Precipitation Algorithms, *J. Atmos. Oceanic Technology*, 33(2016), pp. 1333-53.

**Turk, F.J., and co-authors, 2017: An Observationally-Based Method for Stratifying *a-priori* Passive MW Observations in a Bayesian-based Precipitation Retrieval Framework, to be submitted.

Science Highlights – Data Assimilation

Activating SAPHIR in all-sky assimilation

Philippe Chambon & Alan Geer ECMWF METEO FRANCE cnrs



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

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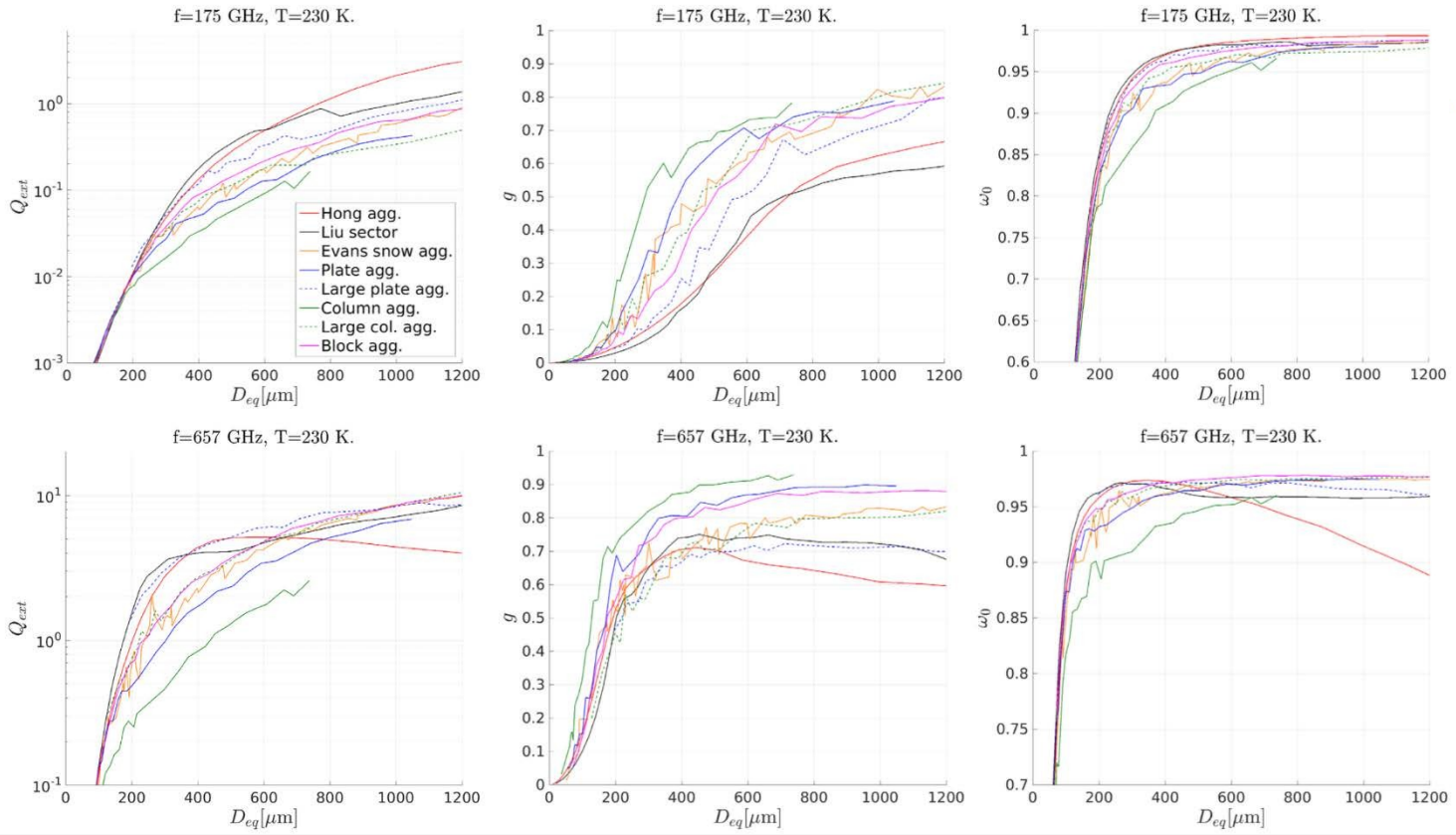
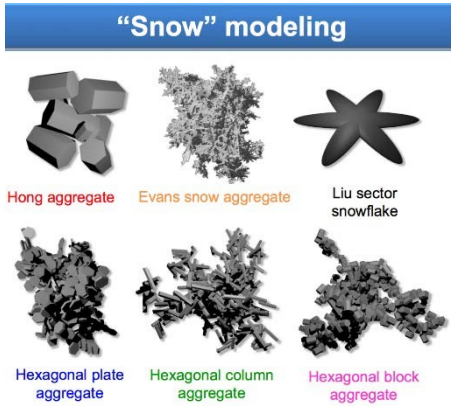
Science Highlights - Scattering

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.





Then assemble into collections of different sizes (but same fractal mass-size relation)

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

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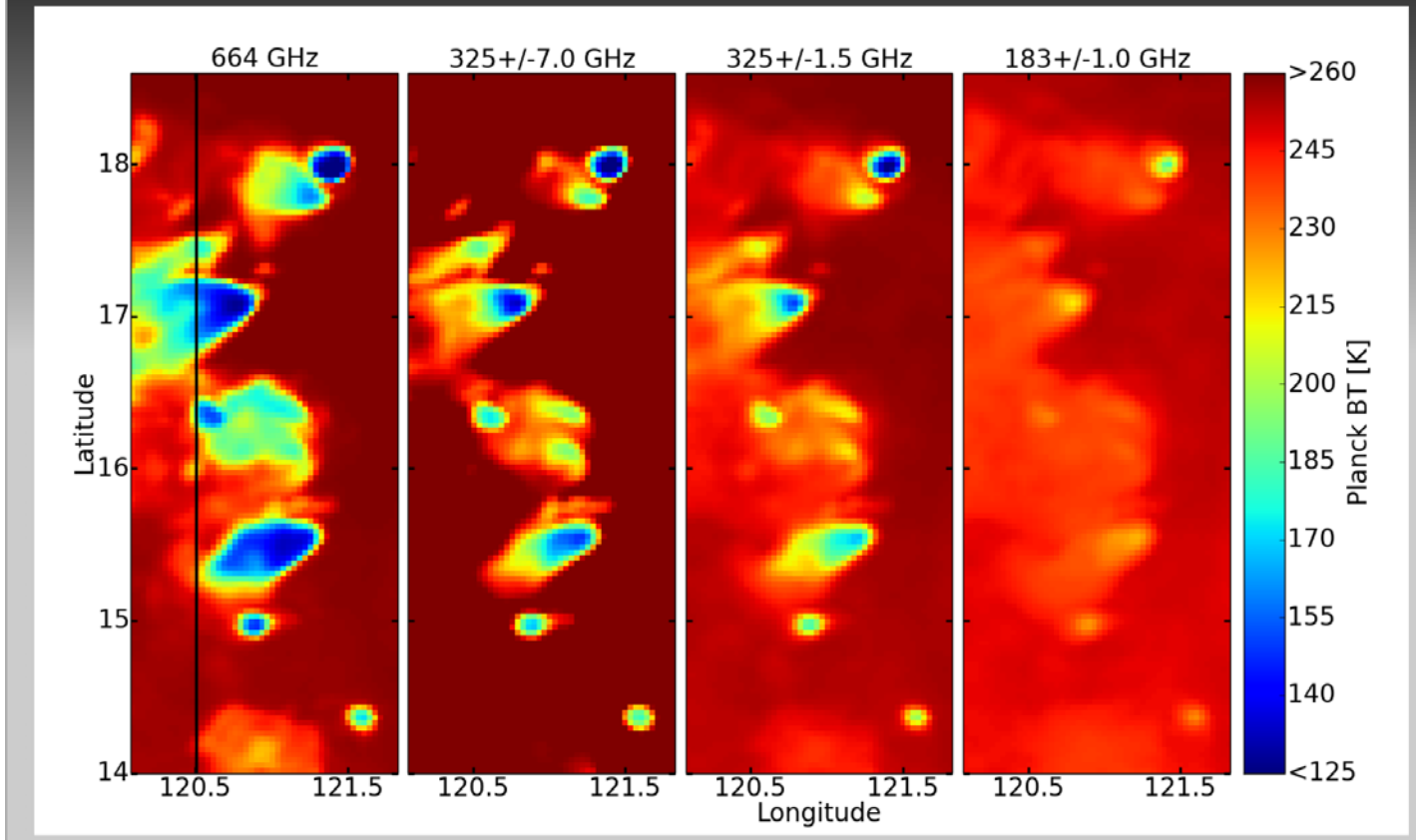
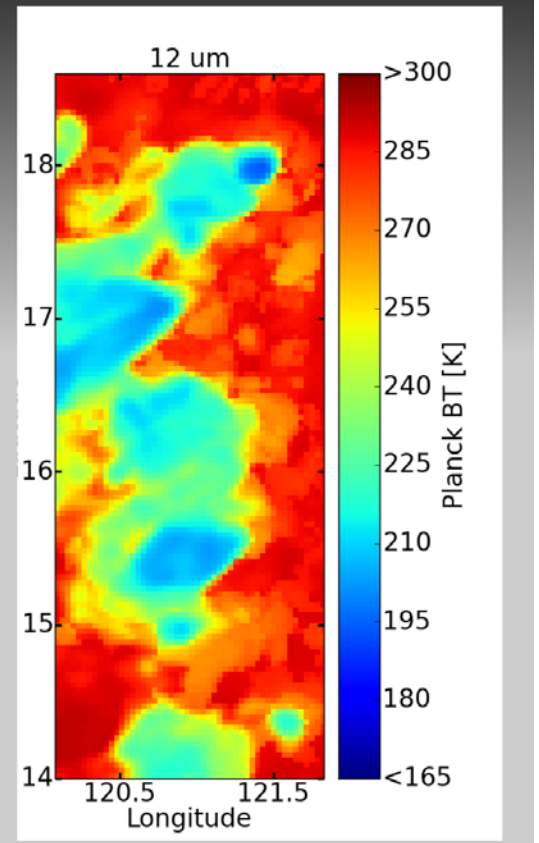
Why sub-mm? Some example simulations

Based on NICAM model



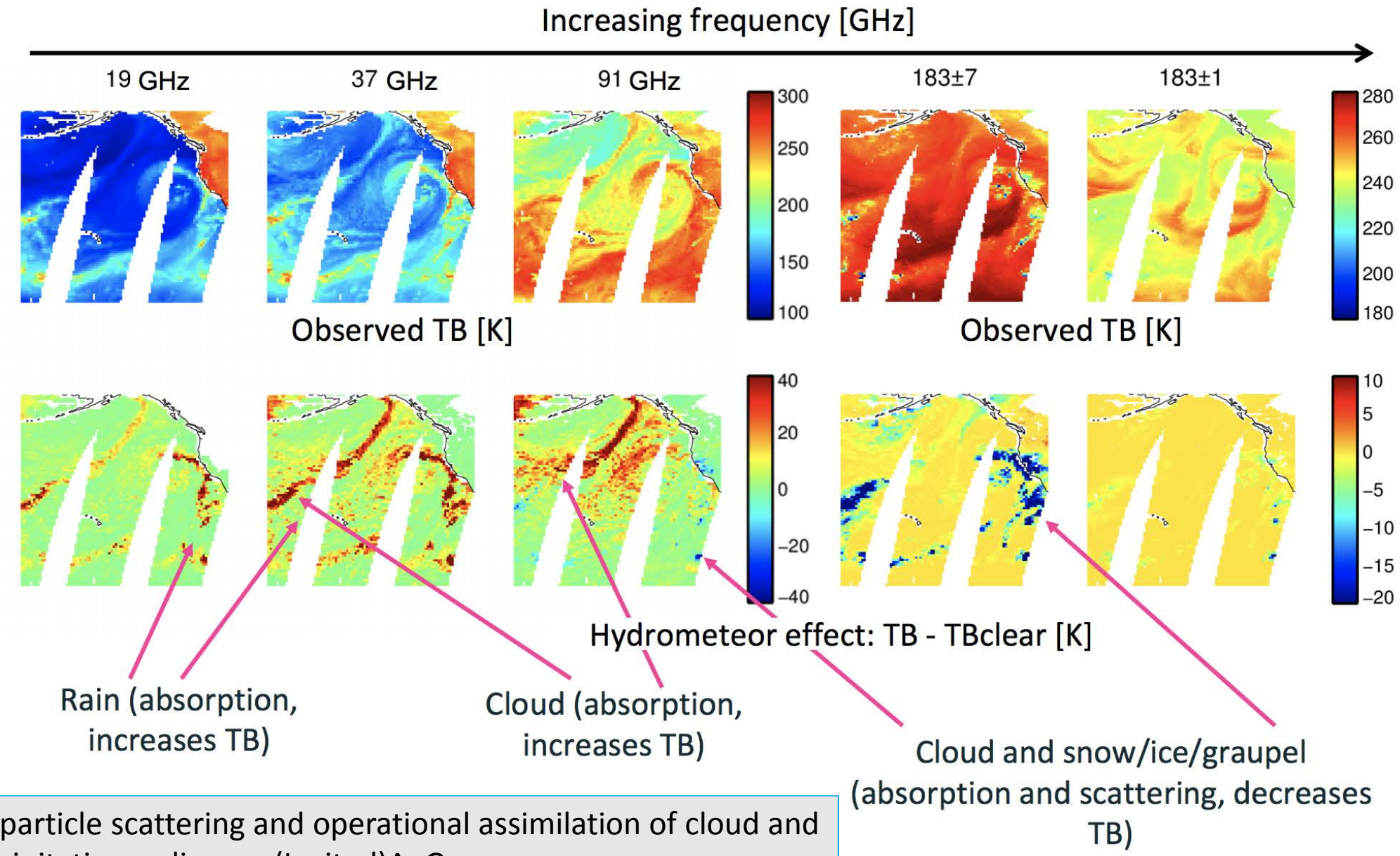


- Bridges the gap between IR and existing microwaves

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

CHALMERS
UNIVERSITY OF TECHNOLOGY

Cloud and precipitation information being assimilated



Ice particle scattering and operational assimilation of cloud and precipitation radiances (Invited)A. Geer

IPWG-9 Yonsei University, Seoul, South Korea

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/

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?