CURRENT AND PLANNED ACTIVITIES OF THE INTERNATIONAL PRECIPITATION WORKING GROUP (IPWG)

IPWG Online: www.isac.cnr.it/~ipwg

About the IPWG

The formation of the IPWG originated as a result of a recommendation put forth by the World Meteorological Organization (WMO), who had strongly encouraged the formation of IPWG with active participation by the WMO and the Global Precipitation Climatology Project (GPCP), within the framework of the Coordination Group for Meteorological Satellites (CGMS). The first workshop was held in September 2002 in Madrid, Spain, hosted by the National Meteorological Institute (INM) of Spain, and the second in October 2004 in Monterey, California, hosted by the Naval Research Laboratory. While the goals of the first meeting were more broadly aimed (surveying satellite-based rainfall estimation techniques, understanding related research efforts, and establishment of validation efforts), the goals for this second IPWG meeting were focused on four main topics:

- To obtain an update of operational and quasi–operational satellite-based estimates of precipitation for weather, hydrometeorological and climate applications, including the status of current and future satellite missions, both experimental and operational (TRMM, GPM, AMSR, DMSP, etc.)
- To perform an in-depth analysis of the issues underlying precipitation retrievals, such as retrievals over complex terrain, frozen precipitation, hydrometeor characterization, vertical structure, etc.
- To report on the analysis of the performance of current forecast models and satellite techniques over various seasons, rainfall regimes, and space-time scales (e.g., under what conditions do models outperform satellite?) and how they relate to the requirements and applications ranging from mesoscale to climate.
- To update and further plan satellite and model precipitation validation and research activities.

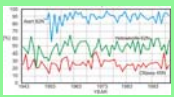
The IPWG is organized into three distinct working groups: Operational Applications, Research Activities, and Validation Activities. The working group reports from the first IPWG meeting were reviewed, and action items reported on, updated, or (where appropriate) discarded. New action items were added as needed. This second meeting of the IPWG was made possible with gracious support from the Naval Research Laboratory, NOAA, EUMETSAT, and the WMO.

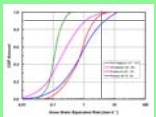
1-Robert Kuligowski 2-Thomas Nauss 3-Christian Klepp 4-George Huffman 5-Chris Kidd 6-Ralf Bennartz 7-Kyle Hilburn 8-Alessandro Battaglia 9-Joerg Schulz 10-Shannon Brown 11-Tomoo Ushio 12-John Janowiak 13-Ralph Ferraro 14-Daniel Vila 15-Francisco Tapiador 16-Toshio Inoue 17-Deborah Smith 18-Cristian Mitrescu 19-Vincenzo Levizzani 20-Anke Thoss 21-Jason Nachamkin 22-João Teixeira 23-Amy Doherty 24-Thomas Smith 25-Peter Bauer 26-Ben Jong-Dao Jou 27-Geoff Pegram 28-Una O'Keeffe 29-Michael Goodman 30-Joe Turk 31-Clara Oria Rojas 32-Rosario Alfaro 33-Bizzarro Bizzarri 34-Elizabeth Ebert 35-Arthur Hou 36-Chris Kummerow 37-Yang Hong 38-Donald Hinsman 39-Carlos Frederico Angelis 40-Thomas Nauss 41-Robert Joyce 42-Arnold Gruber 43-Philip Arkin 44-James Purdom 45-Bruno Rudolf 46-Eric Smith

IPWG-2004 Attendees 25-28 October 2004, Monterey, California

Active and Passive Remote Sensing of Precipitation at High Latitudes and Over Complex Terrain

Efforts Coordinated by R. Bennartz (Univ. Wisconsin) and R. Ferraro (NESDIS)



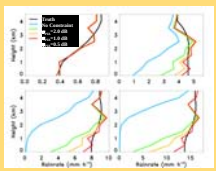


At mid to high latitudes, snowfall represents a substantial portion of thee precipitation. For higher latitudes at least 90% of the precipitation occurs at rates < 3 mm/hr and 60% < 1 mm/hr. The IPWG has ongoing research efforts related to improving satellite-based estimates of precipitation using the sounding channels on the AMSU-B (and upcoming SSMIS) satellites, where millimeter-wave imaging and sounding channels are less sensitive to the underlying surface and provide a more direct measurement of in-cloud precipitation.

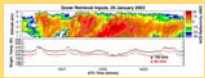
Upcoming Snowfall Workshop: 11-13 October 2005, Madison, Wisconsin
The IPWG, the GEWEX Radiation Panel (GRP) and NASA's Global Precipitation Measurement Program (GPM) will co-sponsor a workshop on passive microwave modeling and retrieval of snowfall. The aim of this workshop is to review the state of the art in passive microwave modeling and retrieval of falling snow over both land and ocean and to develop future directions and requirements for algorithm development, implementation and validation of applications ranging from short-term weather forecasting to climate data set generation.
cimss.ssec.wisc.edu/ipwg/meetings/snowfall2005

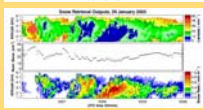
Cloud/Precipitation Vertical Profile Retrievals and Techniques

Efforts Directed by C. Kummerow (CSU), T. L'Ecuyer (CSU), W. Berg (CSU) and others



Physically-based inversion techniques developed for precipitation retrievals from TRMM-TMI, AMSR-E and other similar passive microwave sensors employ cloud model databases from which simulated brightness temperatures, path-integrated attenuation, and radar reflectivity profiles are created. These form the basis for the *a-priori* information in Bayesian formulations. Both model and observation errors must be properly accounted for. While over ocean the TMI 2A12 and PR 2A25 rainfall estimates are in close agreement, the complex and rapidly-changing nature of Earth surfaces limits the feasibility of passive microwave emission-based window channels over land. Further development is focused on retrieval of light rain and snow from the upcoming CloudSat radar, improving combined radar/radiometric retrievals, and establishment of a statistical representation for rain screening and space/time error representation.





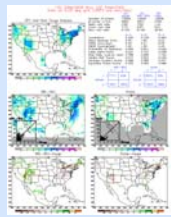
Monitoring the Quality of Operational and Semi-Operational Satellite Precipitation Estimates: The IPWG Validation and Intercomparison Study

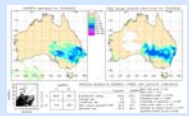
Efforts Directed by E. Ebert (BOM), J. Janowiak (NOAA/CPC) and C. Kidd (Univ. Birmingham, UK)

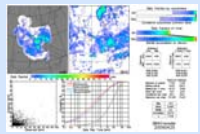
Several satellite precipitation algorithms are run operationally and semi-operationally from national centers and universities to produce rainfall estimates for time periods ranging from half-hourly to monthly. Many of these rainfall products are publically available via WWW or FTP, and are being used for a variety of meteorological, climate, hydrological, agricultural, and other applications. In order to use these rainfall estimates appropriately it is important to have an idea of their accuracy and expected error characteristics. This is done by validating the satellite precip-itation estimates against "ground truth" from rain gauge and/or high quality radar observations. (e.g.,TRMM verification sites). To get estimates of regional and spatial accuracy it is necessary to use a much larger quantity of data, for example, from national rain gauge networks. A thorough verification and intercomparison of satellite-based precipitation products should quantify their accuracy in a wide range of weather and climate regimes, give users information on the expected errors in the estimates, help algorithm developers understand the strengths and weaknesses of the satellite rainfall algorithms, including which aspects are in greatest need of improvement, monitor the performance of existing algorithms, and assist with evaluating algorithm upgrades.

In 2003, the IPWG began a project to validate and intercompare operational and semi-operational satellite-based rainfall estimates. In addition to providing users with product accuracy information, this project provides algorithm developers with an opportunity to test their algorithms and compare their outputs to other rainfall products. The focus so far has been on validating daily rainfall estimates against operational daily rainfall analyses (Australia and US) and summed radar rainfall estimates (US and Europe), with results updated on a daily basis. Rain forecasts from a few numerical weather prediction models (a potential alternative source of rainfall estimates for users) are also verified for comparison to determine where, when and under which circumstances NWP rainfall is better than satellite rainfall (and vice versa). The ongoing validation results (updated daily) can be viewed at:

www.bom.gov.au/bmrc/SatRainVal/validation-intercomparison.html







Example daily validation products over US (above), Europe (right) and Australia (upper right)

Blending and Merging Multi-Satellite, Multi-Sensor Datasets for High Temporal and Spatial Resolution Precipitation Products

Efforts Directed by R. Joyce (NOAA), G. Huffman (GSFC), F.J. Tapiador (Univ. Toledo, Spain), Y. Hong (UC-Irvine), J. Turk (NRL), C. Kidd (Univ. Birmingham, UK), R. Ferraro (NESDIS), P.Arkin (Univ. Maryland), T. Ushio (Tokyo Pref. Univ.), T. Nauss (Univ. Marburg), D. Vila (INA, Brazil), J. Schulz (DWD), R. Kuligowski (NESDIS), G. Pegram (Univ. KwaZulu-Natal) and others

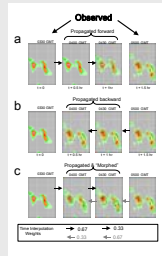
TRMM TMI/PR

SSMI/SSMIS AMSU-B AMSR-E

GOES-9/10/12 MTSAT-1R Meteosat-5 MSG-1

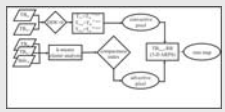
Global NWP Model Analyses and Forecasts

With the exception of TRMM, all near realtime low Earth orbiting (LEO) environmental satellites with rainfall sensing capability (passive microwave, mmwave, radar) are in sun-synchronous orbits, providing intermittent sampling at approximately the same local times each day. Various operationally-oriented and research-mode blending and merging techniques are being examined, which fuse the coarse scale, physically-based micro/mm-wave retrieval techniques with fine-scale, visible-shortwave-infrared observations available from high temporal refresh geostationary (GEO) platforms (e.g., 15-min disks from MSG), and in some cases, wind and moisture information from NWP model analyses. Inter-sensor differences (resolution, calibration, algorithm type) are being investigated as well as different methodologies to utilize the GEO data (dynamic update calibration, transport between sequential PMW overpasses, neural networks, cloud model wind diffusion, etc.). Where possible, the techniques are intercompared via the validation activities.



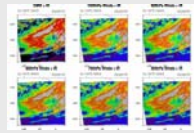
CMORPH is a method that creates spatially & temporally complete information using existing precipitation products that are derived from passive microwave observations. (R. Joyce)

Research and Application of Rainfall Analysis using a Cloud Classification Approach (Hong, Hsu)



Advective-Convective Technique (ACT) (T. Nauss)

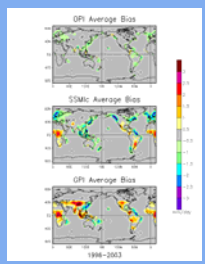
Global Satellite Mapping of Precipitation (GSMaP) (T. Ushio)



Cloud Motion Winds Diffusion Scheme for Quantitative Rainfall Estimation (F. Tapiador)

Estimating Bias of Satellite-Based Precipitation Estimates Relative to In-Situ Measurements

Effort Directed by T. Smith (NOAA), G. Huffman (GSFC), P. Arkin (Univ. Maryland) and others



Satellite-precipitation bias is defined as the bias relative to gauge data, evaluated in the neighborhood of gauge data. Biases in satellite precipitation estimates and the uncertainty they cause are evaluated, as the first step towards producing an improved merged precipitation analysis with uncertainty estimates. Since biases are not generally random, they may not be reduced by averaging, and it is particularly important to identify and minimize biases in data to be used for climate studies. Here we show how *in situ* data may be used to bias adjust monthly satellite-based precipitation estimates. Uncertainty in the bias adjustment is also estimated. We also discuss possible adjustments and their uncertainty in regions where no *in situ* data are available, by adjusting to the most reliable available satellite estimate. The large-scale biases discussed here can be used to perform a large-scale adjustment to satellite-based precipitation estimates. Because the adjustments have large scales, those satellite estimates will retain their fine-scale features.

Optimizing Channel Selection for Precipitation Remote Sensing

Effort Directed by P. Bauer, E. Moreau, S. DiMichele (ECMWF)

The retrieval errors of cloud and precipitation hydrometeor contents from spaceborne observations are estimated at microwave frequencies in atmospheric windows between 18-150 GHz and in oxygen absorption complexes near 50-60 and 118 GHz. The methodology is based on a variational retrieval framework using a priori information on cloud, atmosphere and surface state from ECMWF short-range forecasts under different weather regimes. This approach was chosen because a consistent description of model state and its uncertainties is provided that is unavailable for other methods. The results show that the sounding channels provide more stable, more accurate and less biased retrievals than window channels, in particular over land surfaces and with regard to snowfall.

This and other IPWG-2004 presentations are available online at: http://www.isac.cnr.it/~ipwg/meetings/monterey/monterey2004-pres.html

Other Sources for Precipitation Data and Information:

Climate Data Rainfall Center (Colorado State Univ.)
http://rain.atmos.colostate.edu/CRDC
Global Precipitation Climatology Center (GPCC)
http://gpcp.dwd.de
Cooperative Institute for Climate Studies (CICS)
ftp://cics.umd.edu/pub/DATA/Validation
National Snow and Ice Data Center (AMSR-E)
http://nsidc.org/data/amsre
TRMM Data Since 1997
http://lake.nascom.nasa.gov/data/dataset/TRMM
Global Precipitation Climatology Project
http://precip.gsfc.nasa.gov

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