# Validation Working Group

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## Validation Needs of Users of Precipitation Estimates

Different types of users of precipitation products have different needs with regard to the type of validation information required to make best use of the products. This main users of satellite precipitation products are (a) algorithm developers, (b) hydrological applications, (c) climate applications, (d) numerical weather prediction (data assimilation), and (e) operational nowcasting.

There is a clearly a need for ongoing and comprehensive validation of the more widely used "operational" satellite precipitation algorithms to benefit both the developers and the users of those algorithms. It would be wise to consult with representatives of the user groups to better define which validation products are of greatest interest and usefulness to them. WMO may be able to assist in connecting members of IPWG with members of these other communities.

Direct validation against high quality surface reference data such as rain gauges and radars may not be possible in many regions of the globe, and that alternative approaches such as physical error modeling and validation of rain PDFs may be required to characterize the errors in the algorithms.

During the last two years significant validation effort has begun, with 24 h rain accumulations from several operational and semi-operational algorithms being validated on a daily basis in near real time in Australia, the United States, and Western Europe. Some NWP validation results are included for intercomparison. Web sites showing these results are:

http://www.bom.gov.au/bmrc/wefor/staff/eee/SatRainVal/sat_val_aus.html (Australia)
http://www.cpc.ncep.noaa.gov/products/janowiak/us_web.shtml (United States)
http://Kermit.bham.ac.uk/~kidd/ipwg_eu/ipwg_eu.html (Europe)

Feedback on the current validation sites would be extremely helpful, particularly from algorithms developers, who are anticipated to be its most important users. Analysis of the large number of validation results is underway, with the findings to be reported in meetings, on the web, and in the referred journals. We hope this will encourage a convergence of the satellite algorithms toward the most successful methodologies.

As users require satellite precipitation estimates on increasingly finer space and time scales, validation at these scales will also become important. For sub-daily time scales radar data is required for validation over large regions, but the errors associated with radar data are too great to accurately measures the satellite errors. For this, high quality gauge datasets (e.g. Oklahoma Mesonet, Korean gauge network) must be used. Both PDF (probabilistic) and traditional point-to-point validation methods may be appropriate, depending on the needs of the user. Some of the newer diagnostic validation techniques developed for mesoscale QPFs can be applied to satellite precipitation estimates.

**Recommendation 1:**

**Provide baseline standards (i.e. a minimum set of metrics) for validating satellite precipitation algorithms that meet the need of the users in the algorithm development, NWP data assimilation, hydrology, climate, and nowcasting communities.**

**Actions:**

- Define validation metrics algorithm developers –B. Ebert (Continuing)
- Define validation metrics for NWP
  WGNE (Working Group on Numerical Experimentation), established by WCRP and WMO commission for Atmospheric Science, is responsible for fostering the development of atmospheric circulation models for weather and climate studies. WGNE promotes numerical experimentation for validating model results, such as the Atmospheric Model Intercomparison Project, AMIP. Validation matrics can be provided from this group. (P. Arkin)
- Define validation metrics for hydrology—Piotr Struzik. (Continuing)
- Define validation metrics for climate—Wes Berg. (Continuing)
- Define validation metrics for nowcasting—B. Ebert. (Continuing)
  Suggest including recent improved techniques, such as pattern recognition, for analyzing skill and implement the methods in regional verification.

**Recommendation 2:**

**Encourage the inclusion of members of the NWP data assimilation, nowcasting, hydrology, and climate communities at future IPWG meetings, and encourage IPWG members to attend meetings of these user groups.**

**Actions:**

- **Deliver experts from user areas to the next IPWG meeting**—IPWG co-chairs J. Turk and P. Bauer worked on this. (Continuing)
  We appreciate two co-chair's continuing promotion of IPWG activities in the user group meetings

**Recommendation 3:**

**Monitor performance of operational precipitation algorithms on a large scale on a daily basis, preferably in connection with NWP forecast validation. Validation metrics suggested by user groups (recommendation 1) should be considered for incorporation into the performance monitoring.**

**Actions:**

- Continue to monitor performance of operational precipitation algorithms on a large scale on a daily basis, in connection with NWP forecast validation—B. Ebert, J. Janowiak, C. Kidd, A. Gruber (Expending).
  Take advantage of current existing and new established observations. Also see recommendation 6.
- Standardized the information included in the daily validation products, including estimated and observed precipitation distribution "stripes", and develop a "main" validation web page linking the individual validation sites and providing some overall summary results—B. Ebert, J. Janowiak, C. Kidd (Done)
  Standardized web pages in several regions were established:
  See http://www.bom.gov.au/bmrc/SatRainVal/validation-intercomparison.html to connect to the validation/intercomparison of daily satellite precipitation estimates over Australia, United States, Europe, South America, and Japan.

- Create a survey using a webpage download form to fill in to collect feedback from developers and users on the daily algorithm validation—B. Ebert, J. Janowiak, C. Kidd, A. Gruber (Continuing)
- Distribute survey directory to IPWG members, algorithm developers, specific users, WMO members—D. Hinsman
  Now is included in the above action by M. Sapiano and B. Ebert
- Write news items for newsletters of relevant societies (e.g. BAMS, EOS, WMO newsletter)—C. Kidd, J. Janowiak, B. Ebert. (Done)
  BAMS acticle written, published in February 2007

**Recommendation 4:**
**Support research on new error estimation approaches**

**IMPROVEMENT OF REFERENCE DATA SETS USED TO VALIDATE PRECIPITATION ESTIMATES**

High quality reference data sets are necessary and important in being able to measure and characterize errors in the satellite precipitation estimates. Since no reference dataset is perfect, it is also necessary to understand the errors associated with the validation data itself.

For rain gauge networks, the errors include instrument error, undercatch due to wind effects, and sampling and representativeness errors. Radar observation provide indirect measurement of rainfall, and are effected by beamfilling, attenuation, noise, calibration error, anomalous propagation, bright band contamination, and conversion of reflectivity to rain rate. To measure the errors in spatial rain estimates from gauge and radar data it is necessary to compare against an extremely high density gauge network. Studies of this nature are underway and are expected to provide valuable information on the nature in the reference data.

Orographic precipitation, solid precipitation, and very light precipitation are types that are particularly difficult to measure, both for the satellite algorithms and for conventional instruments. Special data sets may be needed for validating these "difficult" types of precipitation, as rainfall measurements from the standard rain gauge and radar networks may not be sufficiently accurate to be useful. Some improvement is possible by adjusting gauge measurements for wind-related undercatch and including orographic enhancement effects in gauge analyses. The International Polar Year in 2007, which will address the challenge of (among other things) creating multidisciplinary observing networks in the polar regions, may provide some good high latitude precipitation information.

There exist a number of good and high quality reference data sets, but they may be difficult to obtain in many cases. IPWG can play a role in making these data more widely available. It may be necessary in some cases to provide justification, i.e., the characterization of errors in the satellite precipitation estimates. As routine error characterization of some future rainfall missions (GPM in particular) will be based on international partnerships with "supersites", every effort should be made to make these data available to scientists.

There is a strong need for reference data to validate oceanic satellite precipitation estimates. Therefore the winter-time field campaign LOFZY (LOfotes Cyclones) was carried out in March 2005 aboard the R/V "Celtic Explorer" offshore Norway. The snowfall data using a Disdrometer, detector and 24hour observations of the precipitation are available for the IPWG community. A small amount of coastal radar data is available (for example, both of the daily validations over the US and Europe use radar data that extend offshore) and could be used to validate mid-latitude oceanic estimates. Tropical rainfall measurements are available from the

Pacific atoll rain gauge network, the TOGA/TAO and PIRATA moored buoys, and the Kwajalein radar; these have been used to validate satellite precipitation estimates in the past.

**Recommendation 5:**
**Create a list with links on the IPWG web page of existing high quality reference data, and encourage the sharing of data from Intensive Observation Periods in Large-scale experiments with the IPWG community to enable improved validation of satellite rainfall estimates.**

**Actions**

- Determine location and availability of dense gauge networks, Disdrometer data and radar data from national networks, international experiments, the Global Precipitation Climatology Center (GPCC), experimental test sites such as the Oklahoma Mesonet, ARM site, Arizona Walnut Gulch Experimental Watershed of Agricultural Research Service (ARS) and TRMM validation sites, and oceanic rain gauge and radar networks –B. Ebert (Continuing)
- Publish a non-satellite data web link in the validation section and contact information for obtaining these data on the IPWG web sites – B. Ebert, M. Diederich (Continuing)
- Make contact with Steve Williams at the UCAR JOS, which keeps/accesses experimental data, to establish a web link with IPWG. – B. Kuligowsky (Status Unknown)
- IPWG members who are involved in such large-scale experiments as BALTEX. MAP, etc., should encourage the collectors of reference radar and gauge data to make these data available to the wider scientific community. – IPWG (Continuing)

**Recommendation 6:**
**Investigate the quality and availability of surface reference networks for the validation of difficult precipitation (orographic, light, solid) precipitation.**

**Actions**

- Investigate the possibility of obtaining precipitation measurements from Arctic and Antarctic networks—C. Simmer, B. Ebert (Continuing)
- Obtain transects of raingauge data from the NAME project via the UCAR JOS website.
  NAME project information and data are available from: http://www.eol.ucar.edu/projects/name/. Need to establish a connection from IPWG web page to the data sources (also see Recommendation 5).
- Obtain South American Monsoon Low Level Jet Experiment rain gauge data, which includes observations from the Andes (B. Kuligowski) (Done)
  The data is available and can be supplied.
- Obtain Canadian SNOWTEL snow gauge data from Paul Joe (C. Kidd)
  Canadian SNOTEL snow gauge data (Contact R. Bennartz for information)
  Some data in the US is available. J. Janowiak will provide information on this.
- Obtain Peruvian Andes and jungle rain gauge data (C. Rojas) (Continuing) J. Turk, B. Beth
- Obtain Alpine surface based measurements including precipitation in the framework of VERA (Vienna Enhanced Resolution Analysis). – B. Ebert
- Obtain the Lofotes Cyclones (LOFZY 2005) over ocean snowfall validation data. This data contains precipitation from an optical Disdrometer, a precipitation detector and 24h observations during 31 IOPs in March 2005. – C. Klepp
- Obtain African precipitation data. – M. Diederich

**Recommendation 7:**
**Develop new methods for characterizing the error o reference data sets, and for improving their reliability and quality using optimal network design.**

**Actions:**

- Continue to develop new methods for error characterization of reference datasets – Contact M. Morrissey, W. Krajewski (Continuing)
- Design criteria for improved rain gauge networks to address validation of remotely sensed rainfall estimates –W. Krajewski (Continuing)

## COMMUNICATION

**Good communication among members and working groups of the IPWG is essential to its ability to function effectively and efficiently.**

**Recommendation 8:**

**Ensure the good communication among members of the IPWG is developed and maintained.**

**Actions:**

- Coordinate and track progress of the action items and activities of the Validation Group—B. Ebert (Continuing)

**Recommendation 9:**

**Collaborate with other scientists and members of IPWG to expand the scope of current verification efforts, and enhance the ability of IPWG members to evaluate satellite precipitation estimation.**

**Actions:**

- Contact Ben Jong-Dao Jou (National Taiwan University) to see if he can contribute radar data for daily satellite algorithm validation. –B. Ebert. (Done)
- Contact Tomoo Ushio (Osaka Free University) and Toshiro Inoue (JMA) concerning daily satellite algorithm validation (Done)
  A daily evaluation webpage over the Japanese islands is now listed in the IPWG validation webpage. See: http://www.isac.cnr.it/~ipwg/validation.html)
- Instigate web forum linking groups doing validation (Continuing)
  Collaborate with scientists and members of IPWG.
- Make IPWG more visible to the public. Apply data dependent on special needs of the users. – P. Struzik
- Better information flow of projects planned or starting needed. Share new upcoming information on IPWG web page. – IPWG

## Program to Evaluate High Resolution Precipitation Products (PEHRPP)

**Validation activities have been at the core of the IPWG since its inception. At the 2004 workshop the Pilot Evaluation of High Resolution Precipitation Products (PEHRPP) was proposed and already this effort has made substantial progress and well-complements earlier IPWG validation activities.**

**Recommendation 10:**

**Validate as many data sets as available and give easy access to data sets as there is another year for PEHRPP. A special workshop on PEHRPP related research will be held in next October or December 2007 in Geneva at WMO headquarters.**

**Actions:**

- More collocated/coincident comparisons on higher time-spatial resolutions are needed along with rain intensity and frequency occurrence. This includes mid- and high-latitudes (processes) and regional scales (impact studies) – X. Lin
- More NWP model forecasted precipitation is desired within PEHRPP. Link activities with the workshop on systematic errors in February 2007 (Weather and Climate Modeling Workshop). Both communities should link to each other for evaluation purposes. - B. Ebert, P. Bauer
- Setup a link between the PEHRPP (P. Arkin, M. Sapiano) and IPWG web site (V. Levizzani).
- Include HOAPS 3 (www.hoaps.org) into PEHRPP. – C. Klepp
- Include GsMAP into PEHRPP. – M. Sappiano
- Contribute to the concluding conference on PEHRPP. – P. Arkin
- Contribute to the International Polar Year 2007 (IPY). – IPWG
- Include the over ocean Lofotes Cyclones (LOFZY 2005) snowfall data at high latitudes into the PEHRPP suite 3 data although the latitude range is not within the standard coverage of PEHRPP. – C. Klepp
- The operation of a TRMM verification site, especially KAWJALEIN site, is recommended. – propose to CGMS/WMO
- Use the GPM validation site. – M. Diederich, profile data
- Identify opportunities for PEHRPP validation sites with sub-daily (1 to 3 hourly) resolution precipitation data, such as CEOP data source – K. Hsu