

An Integrated Precipitation Product for the IGOS-P Global Water Cycle Observations
Theme
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The IGOS-P (Integrated Global Observing Strategy-Partners) Global Water Cycle Observations (IGWCO) Theme has identified the development and implementation of an Integrated Precipitation Product (IPP) as a high priority for its initial activities. Early investigation into the issue made it clear that no single instrument or observing system could provide precipitation at the spatial and temporal scales required with acceptable errors, but that a variety of information sources, including gauge networks, rain radars, satellite-borne instruments and models, when used with innovative analysis procedures, offered exciting potential. A number of high resolution precipitation products (HRPP) derived from satellite observations had been developed and implemented into quasi-operational production in recent years. Several of these HRPP exhibited great promise, and IGWCO determined to investigate further.

A proposal for a Program to Evaluate High Resolution Precipitation Products (PEHRPP) was developed by IGWCO and presented to the International Precipitation Working Group (IPWG) of the Coordinating Group on Meteorological Satellites (CGMS) in October 2004. IPWG agreed to recommend sponsorship of PEHRPP to its parent organization, CGMS, which approved at its subsequent meeting. PEHRPP is coordinated by an international team led by Dr. Phillip Arkin, and member of the IGWCO Scientific Advisory Group.

The overarching mission of PEHRPP in the context of IGWCO is to recommend a path toward development of an IPP. To that end, the goals of PEHRPP are to:

- Characterize errors in various high resolution precipitation products (HRPP) on many spatial and temporal scales, over varying surfaces and climatic regimes;
- Enable developers of HRPP to improve their products and potential users to understand the relevant characteristics of the products; and
- Define data requirements and computing resources needed for retrospective processing of HRPP.

PEHRPP will bring together scientists with different rainfall concerns, including developers and producers of HRPP, providers of basic data, such as satellite and surface radar observations and rain gauge reference networks, and users of high resolution precipitation fields. Five scientific hypotheses underlie PEHRPP:

1. HRPP errors can be characterized by comparing them to independent observations from rain gauges and radars.
2. Errors of and differences between HRPP are meaningful, in that they can be systematically related to precipitation characteristics and/or algorithm methodology.
3. Improved HRPP can be derived by combining products or methods based on the observed errors and differences.
4. HRPP spatial and temporal variability is realistic on scales appropriate for scientific studies (e.g., hydrology).

5. Numerical weather prediction forecasts of precipitation can be used to improve HRPP in some locations and times.

PEHRPP includes four suites of activities. Suite 1 will consist of statistical comparisons of HRPP against validating data over continental and national areas, focusing on large areas and long continuous time periods. It will treat daily totals over $0.25^{\circ} \times 0.25^{\circ}$ areas using observations from national rain gauge and radar networks. At present, eight suite 1 sites are operating, with several more about to come on line or planned. Suite 2 makes use of high quality fine resolution time series of rain gauge to make comparisons over selected limited regions. Studies using data from the Coordinated Enhanced Observing Period (CEOP) sites and the TAO/TRITON buoy rain gauges are underway at present. Suite 3 will be based upon the very high quality data sets from field programs such as the North American Monsoon Experiment (NAME) and KWAJEX, where rain radar data covering limited time periods have been combined with rain gauge observations into complete rainfall fields. At this time, the combined radar network based on the NCAR S-Pol radar and two INEMET radars has yielded a rainfall data set that is serving as the basis for evaluation studies. Suite 4 includes "big picture" comparisons, including the validation of large-scale precipitation quantities and characteristics against bulk quantities, existing products such as GPCP and CMAP, observations of streamflow, water budgets, and subjective judgment. The goal of this suite is to identify artifacts not evident in detailed statistics of suites 1, 2 and 3, with a focus on spatial scales of thousands of kilometers and monthly time scales.

In summary, PEHRPP has been established to facilitate collaborative analyses among the many scientists and institutions involved in developing and using better precipitation products. PEHRPP is diverse, with many countries and institutions involved, and is almost entirely voluntary, with participants supporting their own work for the most part. Many PEHRPP interim results were discussed at the recent meeting of IPWG in Melbourne, Australia. A large number of studies are in progress now; many will be far enough along to support meaningful conclusions and recommendations about a year from now. IPWG has recommended that a PEHRPP Workshop be organized during October – December 2007 to summarize results and develop recommendations. Dr. Arkin has agreed to chair the organizing committee for the workshop, and Dr. Donald Hinsman, the World Meteorological Organization representative to the IPWG meeting, has agreed to investigate the possibility of WMO hosting such a meeting.