

Assimilation, Analysis and Dissemination of Pacific Rain Gauge Data: PACRAIN

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1. Project Summary

Tropical rainfall data taken over both land and ocean is particularly important to the understanding of our climate system. Not only is it a tracer of latent heat, it is vital to the understanding of ocean properties as well, such as latent and sensible heat flux, salinity changes and attendant local ocean circulation changes. In addition, rain gauge observations from low-lying atolls are required to conduct verification exercises of nearby buoy-mounted rain gauges, most of which are funded by NOAA's Office of Climate Observations' (OCO) program.

This project supports effort to "build and sustain the global climate observing system that is needed to satisfy the long-term observational requirements of the operational forecast centers, international research programs, and major scientific assessments". We also are continuing in our role as the Surface Reference Data Center (SRDC), a core program that supports the Global Precipitation Climatology Project (GPCP) and the Global Energy and Water Cycle Experiment (GEWEX). Our current and future efforts include expanding our mission to collect, analyze, verify and disseminate global rainfall data sets and products deemed useful for Operational Forecast Centers, International Research Programs and individual researchers in their scientific endeavors. Housed in the Environmental Verification and Analysis Center (EVAC) at the University of Oklahoma, the EVAC/SRDC has built upon work from past NOAA-supported projects to become a unique location for scientists to obtain scarce rain gauge data and to conduct research into verification activities. These data are continually analyzed to produce error-assessed rainfall products and are easily assessable via our web page (<http://pacrain.evac.ou.edu/>).

2. Base Project

Scientists need only to access the EVAC/SRDC web site <http://www.evac.ou.edu/pacrain> to obtain the most comprehensive Pacific rainfall data set anywhere in the world and <http://www.evac.ou.edu/srdc> to obtain critical world-wide regional rain gauge data sets. Many of these regional data sets are impossible or impractical to obtain elsewhere. The EVAC/SRDC serves the research community by actively working with individual countries in environmentally important locations to help provide them with infrastructure, education and other short and long-term support. The return on this investment by NOAA has been significant in terms of enabling EVAC/SRDC to provide the scientific community with critical, one-of-a-kind rain gauge data sets and to have established ongoing mutually beneficial relationships that should lead to future collaborations. Past successes with this strategy have proven very worthwhile on a cost-benefit basis.

Due to the importance of tropical Pacific rainfall data to climate research and operational and climate forecasting we work collaboratively with the Pacific Island

Global Climate Observing System (PI-GCOS) program to effectively and efficiently match the areas of commonality among both OCO's and PI-GCOS's objectives. One of these common areas is the strengthening of the existing Pacific observation climate network for both atmosphere and ocean.

Specifically, we seek to collect all available rain gauge data 1) in environmentally critical locations (e.g. tropical Pacific), 2) where dense rain gauge networks exist and 3) where agreements can be made to help construct rain gauge networks in these critical locations. These data are assimilated, homogenized, error-checked and then made available to the general research community.

To create the most comprehensive Pacific base possible it is necessary to continue work with the Pacific meteorological services individually and collectively to help them sustain high quality gauge networks. One of our most successful efforts during 2006 was (and is) the implementation of a large network of hundreds of new manual-read rain gauges and automatic data-logger equipped tipping bucket rain gauges located on various atolls and islands managed by the local Pacific meteorological services. Our Pacific educational program, SPaRCE (<http://sparce.evac.ou.edu/>) contributes in a direct way to the PACRAIN database through the contribution of Pacific schools taking manual read daily rain gauge measurements while learning about the importance of weather and climate. In total we now have approximately 55 high quality, tipping bucket gauges and hundreds of manual read gauges operated by most of the Pacific Island Meteorological Services (PIMS) and local education organizations. Underlying this project is the long-term effort to help build the capacity of all the PIMS to better serve their constituents. This will ultimately result in the PIMS being able to self-sustain their data networks. We continue to contribute to this effort by providing what we can in terms of needed supplies, education and communication infrastructure (e.g. involvement in the RANET project) until the PIMS become completely self-sustainable. This project is continually in the process of implementation with a portion of the total number of gauges on operational status, some currently being shipped to the Pacific and some needing maintenance. We work particularly close with the New Zealand Meteorological Service and the attached PI-GCOS Technical Support Project to accomplish the later objective.

It is our belief that by working directly with local Pacific Island meteorological services, we bring tangible benefits to the global climate research community through data base enhancement. In turn, the local meteorological services also benefit directly through enhanced forecast products developed by the scientific community using these critical data sets.

3. Deliverables

- A. Deliver vital rainfall data to the research community through on-line access of the PACRAIN database.

Rain rate measurements over open ocean regions are very important in the assessment of satellite rain algorithm, climate change and modeling of physical processes. Until recently no Pacific island rainfall measurements have been available at resolutions less than one hour. Our new MetONE rain gauges tipping bucket gauges are

equipped with data loggers and have been donated by the University of Oklahoma for this project. In turn, they have been given to the PI-GCOS Coordinator for distribution to the various PIMS. We are currently receiving tip data back from many PIMS and these data are inserted into the PACRAIN database. These data are particularly important in the understanding of basic tropical rain systems and consequently, more accurate global climate models. These data are included in the PACRAIN database.

The achievement of this objective could not be accomplished without the close collaboration of the PI-GCOS Steering Group and the current PI-GCOS Coordinator. Other important collaborative groups are the Global Ocean Observing System (GOOS), the Secretariat for the Pacific Regional Environmental Programme (SPREP), the New Zealand Meteorological Service, the New Zealand Institute for Research in Water and Atmosphere, the Australian Bureau of Meteorology, Meteo-France and the US National Weather Service.

Project Web site and related web sites:

. <http://www.evac.ou.edu/pacrain> (PACRAIN site)

<http://www.evac.ou.edu/srdc> (SRDC site)

<http://sparce.evac.ou.edu> (Schools of the Pacific Rainfall Climate Experiment, SPARCE)

<http://www.pi-gcos.org/> (the P.M. initiated the PI-GCOS web site in collaboration with the GOSIC project at the University of Delaware. It now under the auspices of the NOAA National Climatic Data Center).

Figure 1 METONE Tipping Bucket Gauge at the Samoa Meteorological Service



B. Provide high spatial density world regional raingauge datasets for use in satellite rainfall algorithm verification

EVAC maintains a database of selected high density raingauge network data for use in satellite rainfall algorithm assessment. Part of our responsibilities include

operating the Surface Reference Data Center (SRDC), which is associated with the Global Precipitation Climatology Project (GPCP). Our tasks in this capacity include identifying and collecting these data sets and making them available to researchers for this purpose. We also conduct studies on the errors involved when comparing satellite and raingauge data.

C. Maintain and Improve an Error-assessed PACRAIN Database

The core asset of PACRAIN and SPaRCE programs is the online rainfall database. This database contains historical data from several sources, and is updated monthly with the latest data from three sources: the National Climatic Data Center (NCDC), the National Institute for Water and Atmospheric Research (NIWA) in New Zealand, and the SPaRCE program. Additional updates are done as needed. The *pacusers* mailing list is maintained as a way to disseminate information and provide support to PACRAIN users (<http://pacrain.evac.ou.edu/pacusers.html>). Database changes are also cataloged online (<http://pacrain.evac.ou.edu/changes.html>). Some database statistics:

- ~2 million observations
- ~8 thousand observations added each month
- 839 sites
- monthly begin in 1874
- daily begin in 1942

Over the past few years the PACRAIN database has undergone a number of upgrades, and this trend continued in FY 2005. Previous upgrades focused on infrastructure, but the most recent improvements have been to the underlying data. The quality control of PACRAIN data is an ongoing process, and errors are corrected as they are discovered. A comparison of PACRAIN records to satellite data was performed in May to evaluate the accuracy of PACRAIN timestamps.

In addition to specific database upgrades, other routine activities continued throughout the year. The PACRAIN database continues to be upgraded on a monthly basis with data from the SPaRCE project, NCDC, NIWA, and the island of Niue. For the period October 2004 – September 2005, approximately 85000 new records were added to the database. Also, work has begun to expand both of these presentations into journal articles.

D. Enhance Educational Outreach Component of the SPaRCE Program

For the past 14 years the Schools of the Pacific Rainfall Climate Experiment (SPaRCE) project at the University of Oklahoma has been working directly with elementary and high school teachers around the Pacific. During this time, we have also worked informally with the Pacific island meteorological services to aid them with their own local educational outreach projects. However, given the age of the SPaRCE materials there is a need to upgrade them to include more relevant information, e.g. the PI-GCOS program, Global Warming, cyclones, cyclone preparation brochure, etc.

As the meteorological services in the Pacific islands continue to expand and enhance their technological capabilities, there is an increased awareness and appreciation

by meteorological service personnel for the need of an educated public. For example, more cooperative climate observer networks are being proposed and implemented in these countries, modeled after the U.S. Cooperative Observers Network (e.g. in Vanuatu, Samoa, and Tonga). There are many challenges in implementing a sustainable cooperative observer program in the developing tropical Pacific island nations, one of which is the availability of easily understood educational materials that can be used by meteorological service personnel in recruiting and training potential observers. In addition, disasters such as the December 2004 tsunami have emphasized the need for a basic understanding of any potentially dangerous phenomenon, such as a hurricane, by the general public. The SPaRCE program is uniquely situated to be able to both continue collaborations directly with schools, and to aid the meteorological personnel in the islands to develop easily understood educational materials that can be used in a variety of circumstances. Additional funding for the SPaRCE program would be used to provide Pacific island meteorological services with low-cost rain gauges for their cooperative observer networks, and to hire a student to work with meteorological service personnel to develop and deliver educational materials aimed at both potential cooperative observers as well as the general public. In addition, these additional materials would be available through the Pacific-RANET project's satellite/internet broadcasts.

Papers, Conferences

“Upgrades to and expansion of the Comprehensive Pacific Rainfall Database (PACRAIN)” ,Jnuary 2005, presented at the 85th AMS Annual Meeting in San Diego, CA.

“Temporal comparison of the Comprehensive Pacific Rainfall Database (PACRAIN) with satellite rainfall estimates”, September 2005, accepted for presentation at the 86th AMS Annual Meeting in Atlanta, GA.

Automated Weather/Climate stations in the Pacific, May 2006: Conference organized by the Mark Morrissey held in concert with the 11th RMSD in New Caledonia.

JS Greene, M Klatt M Morrissey, and S Postawko, The Comprehensive Pacific Rainfall Database: An enhanced tool for research and education, submitted to Journal of Atmospheric and Oceanic Technology.

JS Greene, B Paris, M Morrissey, Analysis of Historical Changes in Extreme Precipitation Events in the Tropical Pacific, Climate Research, in press.

Morrissey, M. and J. S. Greene, 2006: Measuring Precipitation from Space, EURAINSAT and the Future, *Title of the contribution: Ground validation for the Global Precipitation Climatology Project*, V. Levizzani, P. Bauer, T. J. Turk Editors.