

Report for 2001GU1342B: Development of Monthly and Seasonal Rainfall Climatologies and Distribution Maps for Guam

There are no reported publications resulting from this project.

Report Follows:

PROJECT SYNOPSIS REPORT

Project Title: Development of Monthly and Seasonal Rainfall Climatologies and Distribution Maps for Guam

Problem and Research Objectives:

Guam is characterized by one of the highest levels of rainfall variability in the world, with the highest annual rainfall nearly three times the amount of the lowest rainfall. This makes the region extremely susceptible to significant droughts and floods. Much of this variability can be traced to inter-annual climate variability such as El Niño and La Niña events and to the occurrence of typhoon and monsoon events that affect the island. This climatic variability and the occurrence of tropical weather systems determine the character of the rain, which is a reflection of rainfall intensity, rainfall frequency, and rainfall duration.

Despite its small size, the island has a very complex annual rainfall distribution pattern. The high rainfall variability and complex distribution directly affect ground and surface water supplies, water quality, erosion, pollution from run-off, and local flooding. In order to adequately and credibly deal with these issues, users on Guam need an accurate and representative rainfall database, rainfall climatology, and a representative set of rainfall distribution maps, both for monthly and seasonal (rainy season, dry season) periods.

The study of rainfall distribution on Guam using new information sources (e.g., new databases, Doppler radar, etc.) was identified at the 1998 Guam-WERI Water Advisory Council meeting as one of the critical needs of the Island. The need was reiterated at the 1999 Guam-WERI Water Advisory Council meeting. Accurate rainfall databases and representative rainfall climatology are fundamental to an accurate analysis of rainfall distributions. Rainfall distribution charts are critical for water management, research, and the development of public water policy.

Methodology:

This study entailed updating a recently completed 50-year rainfall database for 150 locations on Guam. Where there were occasional missing months of data in an otherwise complete data set, rainfall was estimated by correlating it with nearby data. However, this was not done in the conventional sense, but correlations were determined based on the synoptic weather regimes (general atmospheric processes) producing the rain. This eliminated the past practice of clumping all rainfall types together without concern for the rainfall character. The complete database is now available to WERI and USGS scientists in a shared database.

Annual rainfall was divided into regimes (e.g., the El Niño year, El Niño + 1 year, La Niña year, and “normal” year groups) that best reflected the rainfall variability on Guam. This produced a climatology from which major portions of the variance in rainfall could be explained. From this climatology and the earlier developed annual rainfall distribution

map, we developed a set of monthly and “seasonal” rainfall distribution maps for Guam using the primary synoptic regimes.

Doppler radar data, microwave rainfall data, and other, more conventional meteorological satellite data was used to determine the rainfall patterns in data sparse areas, especially those in the immediate off-shore areas around Guam. The radar data was available upon request from the National Weather Service at Tiyan, Guam, and the satellite data was available half-hourly at WERI. In addition, microwave rainfall data was available via the internet and through our involvement with the Tropical Rainfall Measuring Mission (TRMM). Further, additional rain gauges managed by WERI for the TRMM experiment were used for fine-tuning rainfall rates and gradients.

Principal Findings and Significance:

Accurate and representative rainfall climatology and a corresponding set of rainfall distribution maps are fundamental to hydrologic studies of Guam. This project took a recently completed 50-year rainfall database developed for 150 locations on Guam (Figure 1) and the annual rainfall distribution map (Figure 2) developed by the PI under an earlier USGS proposal and derived accurate and representative monthly and seasonal rainfall climatologies and rainfall distribution maps. This process was the next logical step after developing the comprehensive database and annual rainfall distribution map. The resulting products will allow researchers, water managers, and land use planners to select a representative rainfall climatology segment on which to base critical environmental decisions. This is essential in an area with so much rainfall variability exists. To a large extent, this variability can be explained, but this knowledge has neither been conveyed in published rainfall climatology nor in existing monthly rainfall distribution maps. The results of this research have added credibility to regional hydrologic studies, and will give water resource managers and rainfall forecasters a much more accurate understanding of rainfall processes. The study also greatly benefits the Guam Hydrological Survey program and will ultimately benefit those making public water policy.

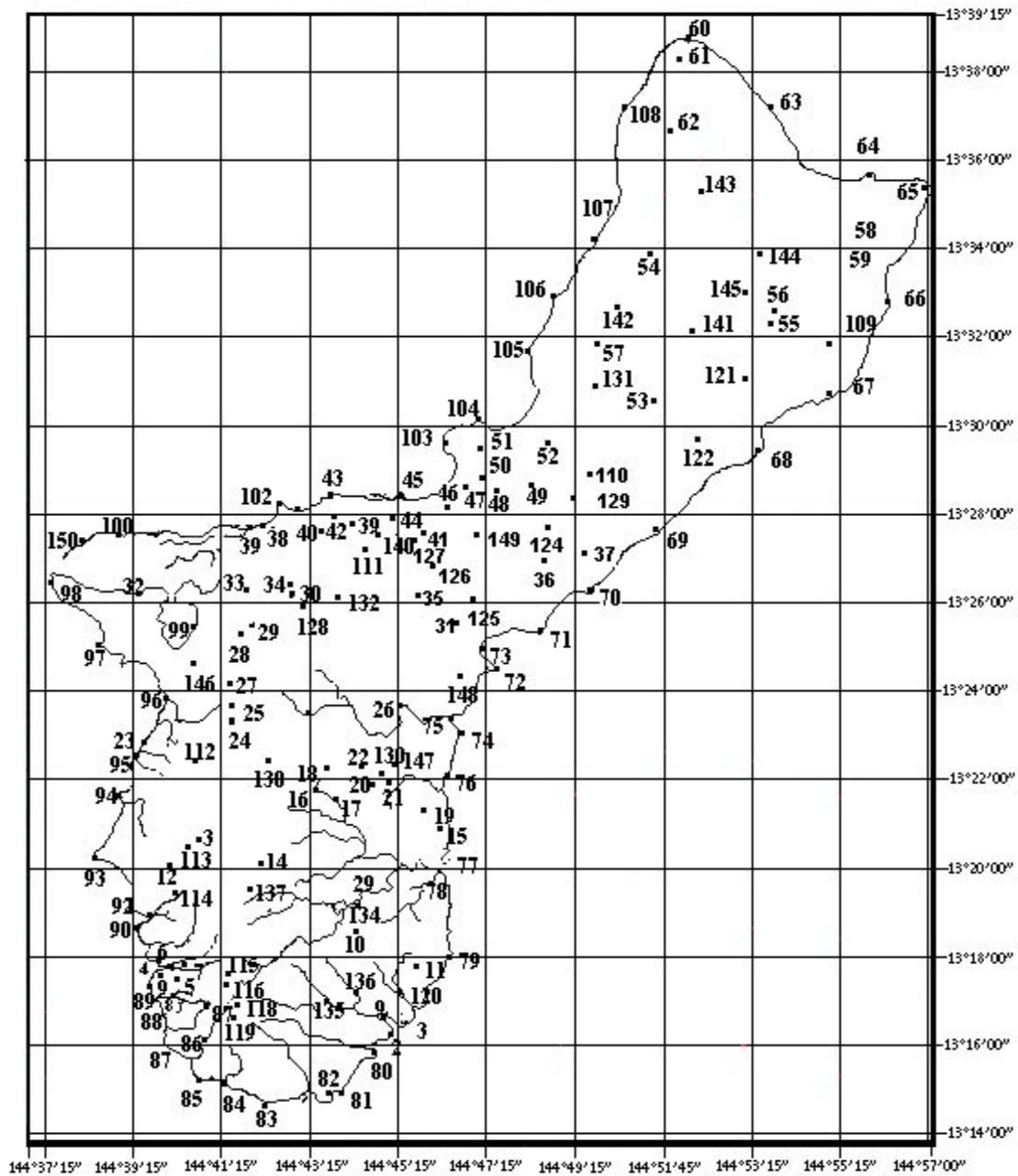


Figure 1. Locations of the 150 sites that make up the derived 1950-1999 rainfall database on which the newly developed annual rainfall distribution map for Guam is based.

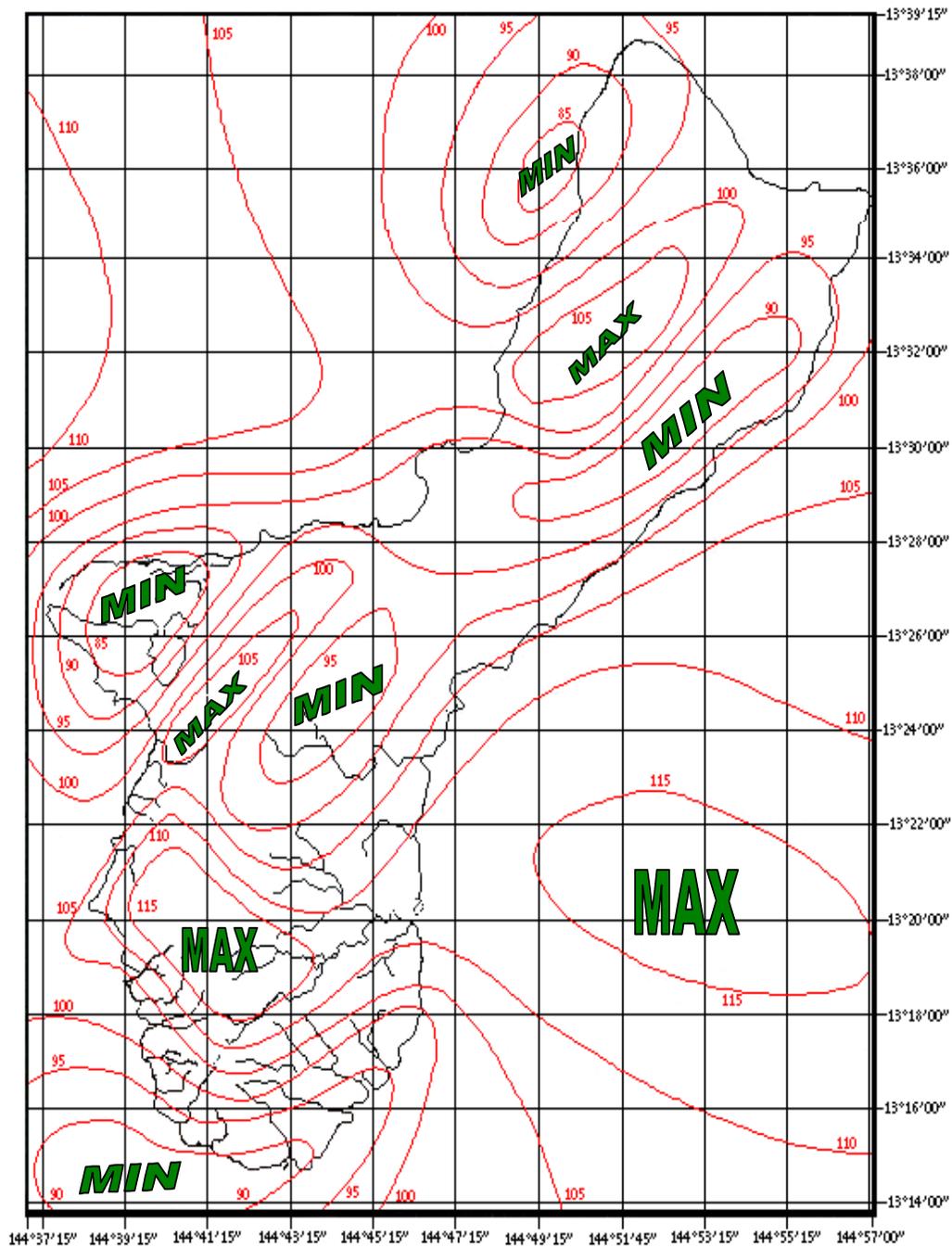


Figure 2. Newly developed annual rainfall distribution map for Guam. The analysis is based on the compositing of 50 individual annual analyses from 1950-1999. Rainfall is in inches.

