EVALUATION OF RAINFALL ESTIMATION ALGORITHMS FOR PERU USING SATELLITE IMAGERY

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ABSTRACT

A first approximate rainfall estimation using infrared (11-μm) satellite imagery was carried out using two algorithms evaluated for the United States: The Auto-Estimator, using data adjusted by an exponential equation; and the GOES Multispectral Rainfall Algorithm (GMSRA), using values adjusted by a quadratic equation, from which, although all five channels were used to carry out the flow evaluation, only the infrared channel values were used. Calibration data was produced from the estimated values of these algorithms and observations were carried out hourly at the automatic stations of the National Hydrometeorology Service of Peru (SENAMHI). The evaluation was carried out during August and September 2001. The main objective of this work is that of evaluating the methods of estimating rainfall and determining the best way of adjusting them to our conditions.

1. INTRODUCTION

It is extremely important to emphasize the part that the various satellite remote-sensing technologies have played in rainfall evaluation, using the different channels of the spectral band detected by the GOES satellite.

Further research, verifying the algorithms is being carried out at the moment, to evaluate two technologies: the Auto-Estimator for the infrared channel and GOES Multispectral Rainfall Algorithm (GMSRA), which uses a combination of the five channels for filtering rain clouds and non-rain clouds.

In our case, this study only covers the algorithm using the infrared channel for analysis and, therefore, both methods can be compared and we can determine which is better suited to our geographical conditions.

2. MATERIALS AND METHODS

Materials: The following materials were used:

- Daily infrared (channel 4) imagery from the GVAR;
- C programs for reading the images and estimating rainfall using the following techniques: The Autoestimator, adjusting data to an exponential curve (Figure 1), and The GOES Multispectral Rainfall Algorithm (GMSRA), adjusting the data to a quadratic equation (Figure 2).

- Data observed by the SENAMHI automatic stations in August and September 2001;
- Excel software for dispersion analysis.

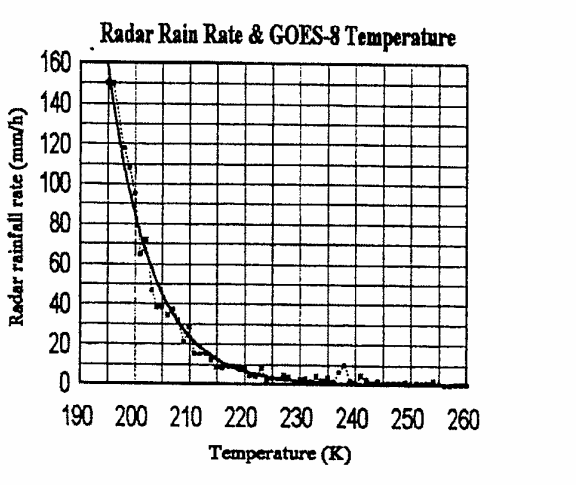

Figure 1. The Autoestimator, which adjusts infrared data to an exponential curve.

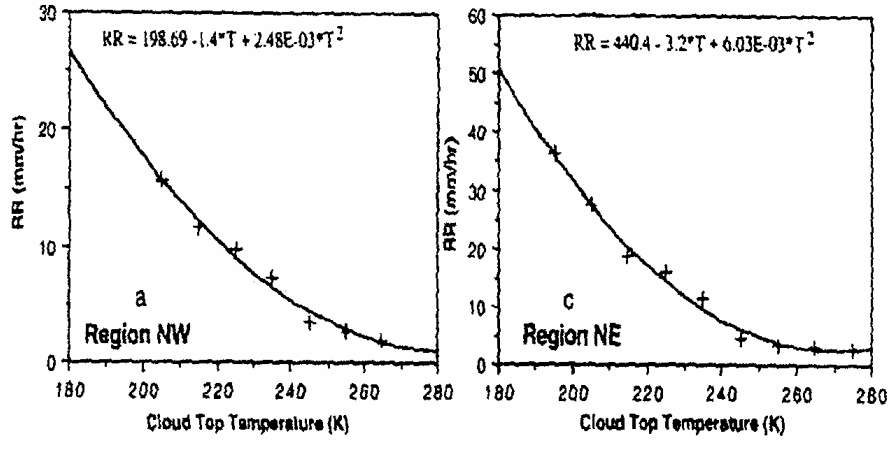

Figure 2. The GOES Multispectral Rainfall Algorithm (GMSRA), which adjusts infrared data to an exponential curve.

Methods*:*

- Obtaining satellite imagery from GVAR;
- Reading the gray scale images from the infrared channel, using a C programme ;
- Calculating the Cloud Top Temperature;
- Estimating rainfall based on the Cloud Top Temperature, and using the above techniques;
- Correcting cloud growth or reduction if the Cloud Top Temperature has increased relative to two consecutive images, then the cloud cover is reduced; the opposite is

true when cloud cover increases and it is highly likely that rain will be produced by this cloud;

- Analysing past observation data and estimated data for the selected stations for both techniques.

3. RESULTS

The results obtained in the United States are given, for each technique, in Figures (3) and (4) and these were then compared with the values obtained for Peru, in Figures (5) and (6).

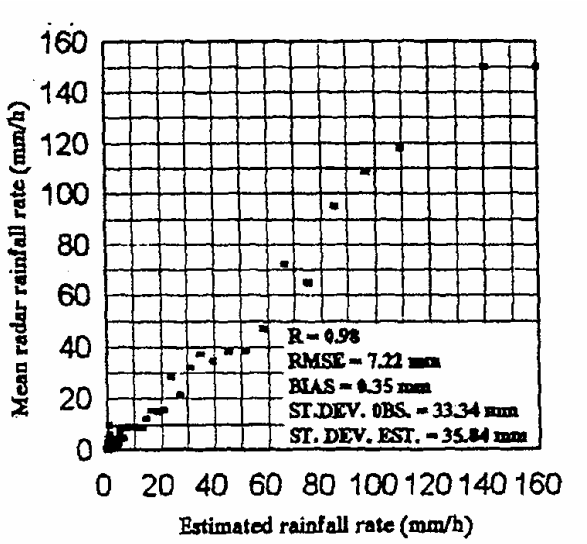

Figure 3. Autoestimator results for the United States.

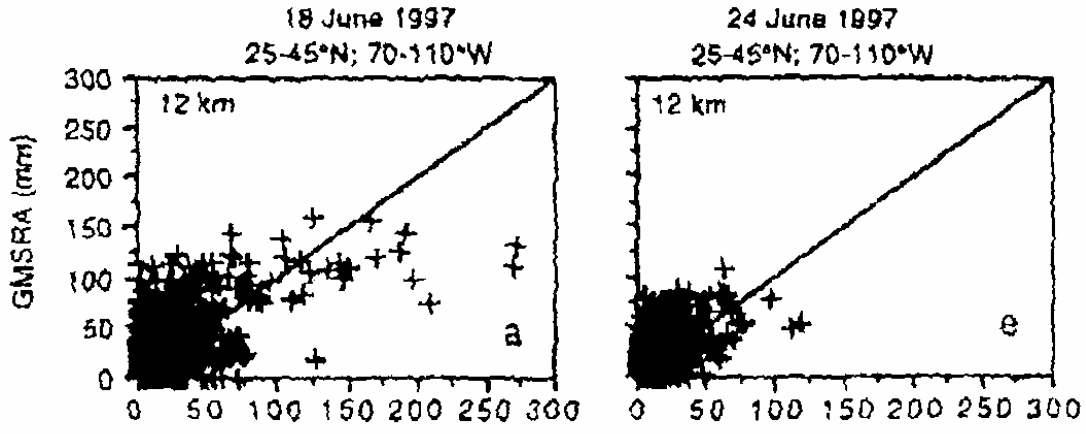

Figure 4. GMSRA results for the United States.

From Figures (5) and (6) we can see that many rainfall values (near the y-axis) were overestimated. These values were for cirrus clouds, for which satellite imagery gives a false idea

of possible cloud cover due to the considerable convection activity, consequently, it is necessary to make corrections on this data and thus arrive at an equation that better represents the facts.

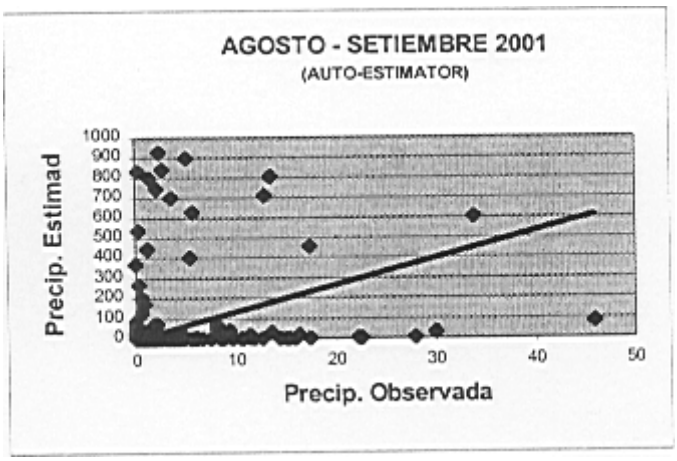

Figure 5. Autoestimator results for Peru.

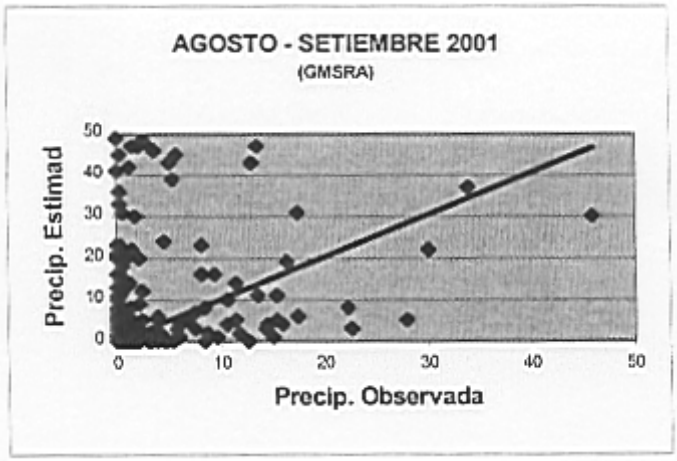

Figure 6. GMSRA results for Peru.

4. CONCLUSIONS

- The best results for Peru are obtained using the algorithm for GMSRA;
- The Auto-Estimator algorithm over- and under- estimates rainfall to a large extent;
- It is necessary to correct the estimation algorithms by:
  - Using a combination of channels;
  - Cirrus filtering;
  - Calculating the potential of precipitable water.
- It is important to establish calibration curves for the regions (catchment areas, basins)

5. REFERENCES

Vincente, Gilberto, 1998, "The Operational GOES Infrared Rainfall Estimation Technique", Bulletin of the American Meteorology Society, Vol. 79, No. 9, September 1998;

Mamadou, B, Ba, *et al*., 2001, "GOES Multispectral Rainfall Algorithm (GMSRA)", Journal of Applied Meteorology, Vol.40, August 2001.