

# A SATELLITE ALGORITHM TO RETRIEVE RAINFALL RATE FOR THE CARIBBEAN BASIN

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Infrared satellite rainfall retrieval algorithms have been developed to retrieve rainfall rate from cold clouds. However, warm clouds occur frequently over tropical regions and consequently those algorithms are inefficient for estimating rainfall rate over those climate conditions. Thus, we developed a new rainfall rate retrieval algorithm that takes into account the estimation of rainfall rate over warm and cold clouds. The proposed algorithm has two major components one for determining rainy cloud pixels and the second component for estimating the amount of rainfall rate. The projection algorithm was used to detect cloud rainy pixels and the time and spatial lags model was used to estimate the rainfall rate.

The projection algorithm to detect rain cloud pixels in visible and infrared satellite data is introduced in this work. The algorithm is based on the angle formed by two vectors in the  $n$ -dimensional space. This algorithm takes advantage of the geometrical projection principle: when two vectors are collinear the radiative variables may exhibit similar properties, and when the vectors are orthogonal the radiative variables may have no elements in common. Rain/no rain pixels are identified by using radar rain rate over the study area. Satellite data from visible and infrared channels are used to create rain and no rain pixel populations. The central tendency of each population is used to generate rain and no rain calibration vectors. A pixel from an independent data set is used to create a third vector, which is projected into the previously calibrated vectors, with the purpose of classifying the third vector in one of the two populations, rain or no rain. Classification is made depending of the magnitude of the projection angle and the distribution-free interval of the visible and infrared radiation variables

The time and spatial lags algorithm for estimating rainfall rate is introduced in this research. It estimates rainfall rates by taking into account the temporal and spatial variability of the rainfall process, whereas existing satellite rainfall retrieval algorithms generally use only current satellite imagery. The time and spatial lags model uses a sequence of visible and infrared GOES-13 imagery to take into account cloud advection and rainfall evolution for estimating rainfall rate. Weather radar data are used to calibrate the model. Empirical analysis of radar and satellite data showed that a linear model between reflectivity and radiative variables could be developed and a nonlinear transformation then applied to convert the estimated reflectivity to a rain rate. The radiative properties were organized into four groups and a centroid vector was developed for each class. Thus, during the validation process every pixel was assigned to a group, and each group was associated with a time and spatial lags model that was evaluated to estimate the rainfall rate for the underlying pixel. The time and spatial model was developed and successfully implemented to estimate the rainfall rate over Puerto Rico. Results show that the new algorithm over warm clouds exhibits a larger probability of detection and smaller false

alarm rate than the Hydro-Estimator algorithm. The general performance of the new algorithm exhibits a slight improvement over the Hydro-Estimator. Thus, an additional effort is required to implement the cloud rainfall motion vector that may derive a significant improvement.