

Preface

The Moderate Resolution Imaging Spectro-radiometer (MODIS) instrument aboard the NASA Earth Observing System (EOS) Aqua and Terra platform with 36 spectral bands provides valuable information about cloud microphysical characteristics and therefore precipitation retrievals. Additionally, CloudSat, selected as a NASA Earth Sciences Systems Pathfinder (ESSP) satellite mission, is equipped with a 94 GHz radar that can detect the occurrence of surface rainfall. The CloudSat radar flies in formation with Aqua with only an average of 60 s delay. The availability of surface rain occurrence based on CloudSat observation together with the multi-spectral capabilities of MODIS makes it possible to create a training data set to distinguish false rain areas based on their radiances in satellite precipitation products (e.g. Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN)). The brightness temperature of 6 MODIS water vapor and infrared channels are used in this study along with surface rain information from CloudSat to train an Artificial Neural Network model for no-rain recognition. The results suggest a significant improvement in detecting non-precipitating areas and reducing false identification of precipitation.

The second approach to identifying no-rain regions, developed in this study, is to find the areas covered with non-precipitating clouds. The cloud type data available from CloudSat is used as a target value to train an artificial neural network model to identify non-precipitating clouds such as cirrus and altostratus. Application of the trained model on two case studies investigated in this research, show significant improvements in near real-time PERSIANN rain estimations.

In addition, a cloud type classification algorithm was developed to classify clouds into seven different classes (cumulus (Cu), stratocumulus (Sc), altocumulus (Ac), altostratus (As), nimbostratus (Ns), high cloud and deep convective cloud). The classification model uses a self organizing features map to classify clouds based on multi-spectral MODIS data and CloudSat cloud types. The result of the classification model shows acceptable results for summertime. The winter season cloud classification is challenging due to dominance of low and middle level clouds. A better cloud classification algorithm for wintertime is achievable using active radar data and is beyond the capabilities of currently available remotely sensed multi-spectral information.

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Algorithms Using Multi-Spectral Satellite Imagery

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