Conditional Generative Adversarial Networks (cGANs) For Near Real-time Precipitation Estimation From Multispectral GOES-16 Satellite Imageries

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Introduction

- One important component to improve the accuracy of satellite-based precipitation estimation products according to Sorooshian et al. (2011) is to make the best use of available and new datasets by taking advantage of any advanced methodology that can extract valuable and useful information related to rainfall.
- A data-driven and end-to-end precipitation estimation algorithm is proposed using multiple sources of information and advanced Deep Learning algorithms in image processing.
- Performance is evaluated using a number of common performance measures, including both RNR and real-valued precipitation accuracy, and is compared with Precipitation Estimation From Remotely Sensed Information Using Artificial Neural Networks Cloud Classification System (PERSIANN-CCS).

General Flow Diagram

Methodology – conditional Generative Adversarial Networks (cGAN)

- GAN is defined as zero-sum (Min-max) game with the following objective function and flow diagram. Pr is the data distribution over real sample (x and y).
- Objective function: $\min_{\theta_G, \theta_D} \mathbb{E}_{x \sim p_{data}}[\log(D(x, y))] + \mathbb{E}_{z \sim p_z}[\log(1 - D(G(z), y))] + \mathbb{E}_{x \sim p_{data}}[\log(1 - D(x, y))]

Datasets and Study Region

- GOES-16 Advanced Baseline Imager (ABI) - Emissive Channels of Geostationary Operational Environmental Satellite-R Series.
- Elevation data: Global 5 Arc Min Resolution Elevation data for the US
- MRMS (Multi Radar Multi Sensor). (Obtained from: GPM Ground Validation Data Archive)
- PERSIANN-CCS (Precipitation Estimation From Remotely Sensed Information using Artificial Neural Network, Cloud Classification System). (Obtained from: CW3E Data Portal)
- Region: The Contiguous United States.

Evaluation

- GAN Model Output: Single Spectral Bands
- cGAN Model Output: Multiple Spectral Bands
- Infusion of elevation data along with each channel of GOES-16 satellite is showing performance enhancement in precipitation retrieval task.
- The metric evaluations are presenting the effectiveness of implementing all emission channels to improve the near real-time precipitation retrieval task.

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