Cloud image segmentation

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Introduction and Significance:

Clouds play a huge role in determining the Earth's climate. Clouds of different formations may imply different future climates. Therefore, by classifying different types of cloud organization, we hope to improve our physical understanding of these clouds, which in turn will help us build better climate models to help reduce uncertainties in climate projections. In this project, we will build a deep neural network model to classify cloud organization patterns from satellite images.

Objective:

Ideally, the model we construct will manage to identify the regions in satellite images that contain certain cloud formations, with label names: Fish, Flower, Gravel, Sugar. In other words, for each image in the test set, we will segment the regions of each cloud formation label. To evaluate the deep neural network, we may use MloU or Dice Coefficient as the evaluation metric.

Dataset Description:

The dataset that we choose contains 2 csv files, including train.csv and test.csv, and 2 folders, containing train images and test images. The file train.csv and test.csv have two columns, Image_Label and EncodedPixels. Each image has 4 image labels in the Image_Label column, corresponding to 4 label classes. The EncodedPixels column has an RLE string for each image label, which signifies the location of the segmentation of a certain class of pattern in an image. Therefore, to do data preprocessing, we have to decode masks from the RLE(run-length encoding) string for each image label. The potential method to decode can be found here. We will train the model based on the images in the train folder, and the ground truth segmentation results in the train.csv file. Similarly, we will test the model based on the images in the test folder, and the ground truth segmentation results in the test.csv file. To test and evaluate the model, we may use MloU or Dice Coefficient as an evaluation metric to compare the segmentation result of images in the test folder with the ground truth in the test.csv file.

Potential Algorithms to Apply:

Generally, the deep neural network that we will construct will consist of two parts, backbone and task head. Both of these two parts are based on CNN. We will use Resnet as the backbone of our model. As for the task head, we may use U-Net as the baseline model, and use PSPNet to potentially improve the performance of our model. Besides, we may use some optimization algorithms like Adam and adjust some hyperparameters inside the neural network to improve the model performances. Additionally, we may use batch normalization for preprocessing data to accelerate the convergence process and improve the classification effect.