Detection of Clouds in Visible Band Nighttime Imagery

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Start Date: 1st July 2020
End Date: 9th August 2020

Abstract

Accurate information on cloud occurrence is of great importance for a wide range of remote-sensing applications and analyses. Numerous studies have been conducted on infrared bands and other multiple sensors carried by the satellites to detect clouds. However, it will be valuable for existing and planned night satellites to identify cloudy areas in visible band nighttime imagery from space. This algorithm will further assist the astronomers to identify the amount of light pollution at various locations.

Problem Statement

Define a cloud mask based on visible band nighttime imagery from space, to assist researchers in remote sensing applications, light pollution applications and analyses.

Proposed Solution

Analyze and compare several image processing techniques and computer vision methods using machine learning and deep learning to come up with a basic cloud mask algorithm on the Loujia-1 dataset. Luojia 1 is a CubeSat (6U) sized earth observation satellite built by the Wuhan University.

Once we design a basic algorithm, we will try it on images from different nights and compare the results with the Visible Infrared Imaging Radiometer Suite (VIIRS) dataset that has already removed all the clouds from the image datasets using cloud mask algorithms from Infrared band nighttime imagery.

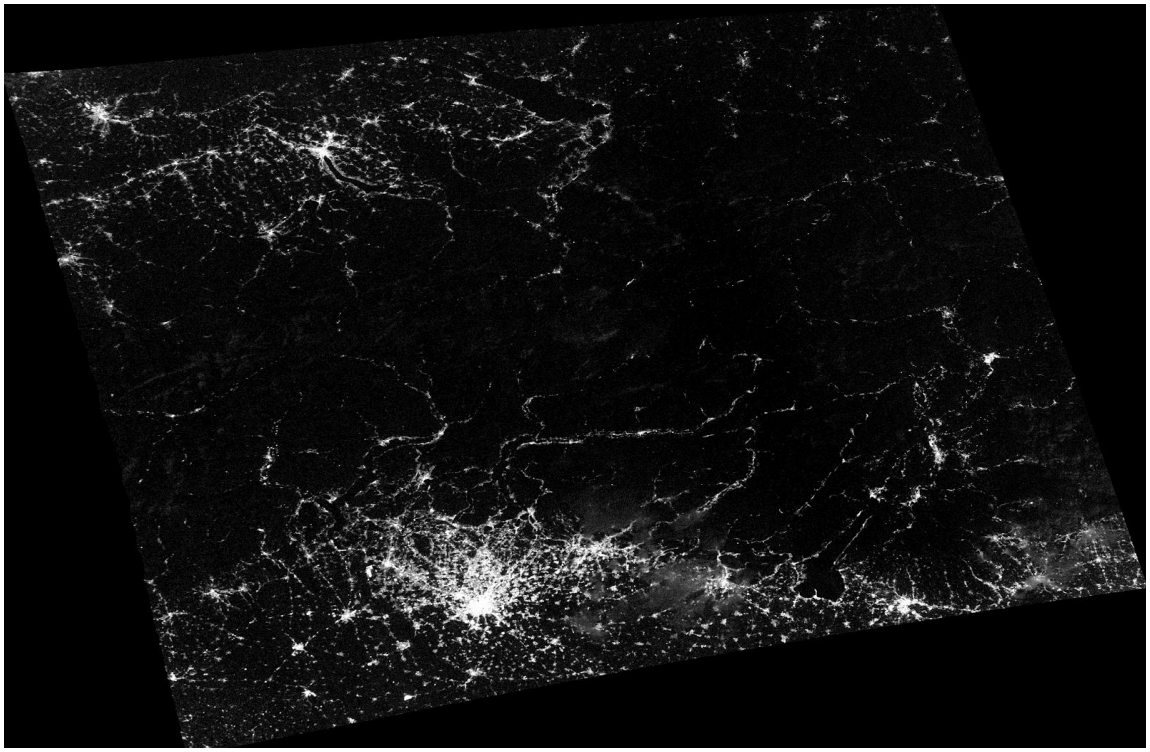
Further analysis will be done by projecting the images to the maps of the corresponding regions in order to better understand the areas where the probability of night light is high because of the street lights. This analysis will make the algorithm robust and will ensure that the techniques used in the cloud mask provide a high accuracy on a large dataset of images.

Datasets

1) Loujia-1 dataset: Grayscale dataset.

2) Cities at night dataset: Coloured dataset.

Sample image of regions in Germany from the Loujia-1 dataset.



Timeline:

1st July - 7th July: Setting up the environment and getting familiar with the problem statement.

7th July - 15th July: Trying out the different filtering algorithms and evaluating the results based on the ground truth values.

15th July - 21st July: Run the basic algorithm on more images to evaluate the performance on a relatively large dataset.

21st July - 1st August: Projection of images on top of maps of various regions to better understand the performance of the algorithm.

1st August - 9th August: Comparison of the results with the VIIRS dataset and projection of images from different datasets.

Future Work:

Develop a computer vision deep learning algorithm to automatically use the image processing filters and segment clouds from the night sky. This technique will be evaluated on a large dataset to see the accuracy of this deep learning algorithm. I will be collaborating with Peiqi Liu and Raymond Xiao to develop a robust algorithm for cloud detection and also try for a publication on the algorithm if we get satisfactory results.