CLOUD IDENTIFIER

An Autonomous Approach for Lake Effect Snow Morphology

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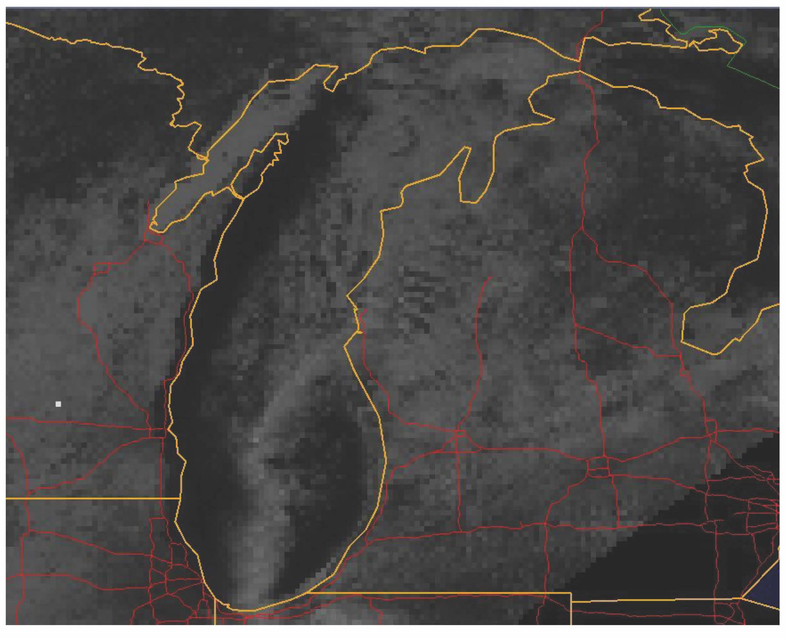
1 Introduction

We aim to develop a simple classifier program which can identify existing lake-effect snow represented in the selected area. The program is capable of giving suggestions on the type of specific cloud and the formation of the cloud.

We want to learn and predict the cause and the pattern of the weather phenomenon, which mostly bring not unpredictable damage to citizens around the lake area physically and economically.



Michigan Lake

2 Installation Method

Our tool was built on Python 3, Matlab, and C++, which enables us to provide operations on all major systems. For major users, please install the following softwares:

1. Python 3, or Matlab R2●●● or newer
2. NOAA's Weather and Climate Toolkit https://bit.ly/2KLx5k3
3. Cloud Identifier Toolkit from link down below

Post installation, please navigate to the Cloud Identifier folder and run "python3 -m pip install -U -r requirements.txt". Once done, you can simply run "run_GUI.py" or "run_NO_GUI.py" depending on your need.

For Matlab edition, simply run "run.m" to start the process.

If you have any further questions, or you encountered any errors during set-up, please consult with our project page at http://atmossci.sws.uiuc.edu/project/cloud/index.html

Toolkit providers

3 Results

We were able to design an effective cloud identifier tool, along with image processor and image super-resolution tools.

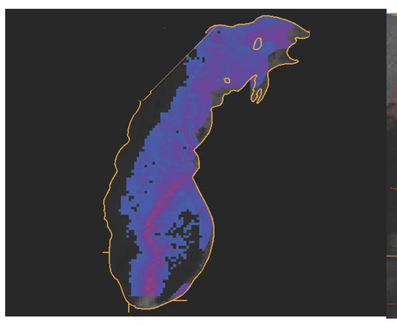
The image processor tool is designed to align the lake area which you are interested in, and extract the target frame out from the Band 1/5 image sets.

Once the raw images are extracted with the reference of the same framework, We can utilize the image super-resolution tool to upscale the low-resolution band data from deprecated GOES system to match with the current GOES 16 system resolution. By doing so, we will be able to perform cloud animation and universal statistical analysis with the same reference scale.

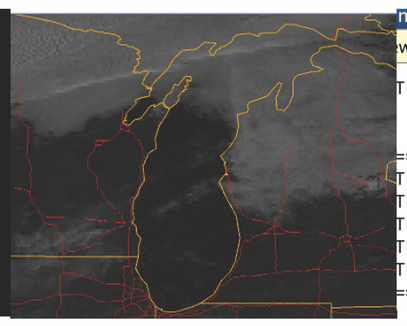
The cloud identifier can perform batch analysis on each individual image input under the given file directory. It is able to identify the existence of the snow represented in the lake area.

With the given threshold values, the program can help user to automatically find out the position of vacancy non-snow cloud area located in the lake. By counting on the possible snow cloud pixels and axis position calculation, the program is able to tell the basic type of the cloud.

Major snow cloud area is labeled with red color and potential cloud coverage will be painted as blue color. Each individual input will be labeled and output for future usage.



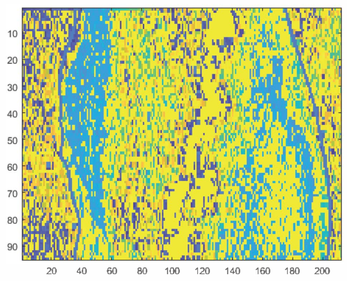
Labeled Snow Area in Lake



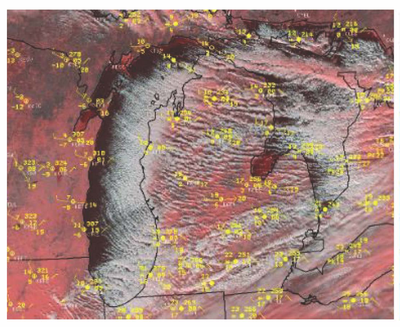
Raw Band Data Conversion

```
mmand Window
w to MATLAB? See resources for Getting Starte

This [is] a [cloud] with [left] most

=====================================
There are 341 none cloud vacancy pixe
The mean value of which is 1.041.
The standard deviation of the none cl
The mean value of the cloud is 63.115
The standard deviation of the cloud :
=====================================
```

Sample Statistical Output



Batch Layer Accumulate Analysis



Cross-frame Detection

Wavelength Micrometers	0.47
Band number	1
Baseline Products	
Aerosol Detection	√
Aerosol Optical Depth	√
Clear Sky Masks	
Cloud & Moisture Imagery	√
Cloud Optical Depth	
Cloud Particle Size Distribution	

Band Information

4 Conclusion

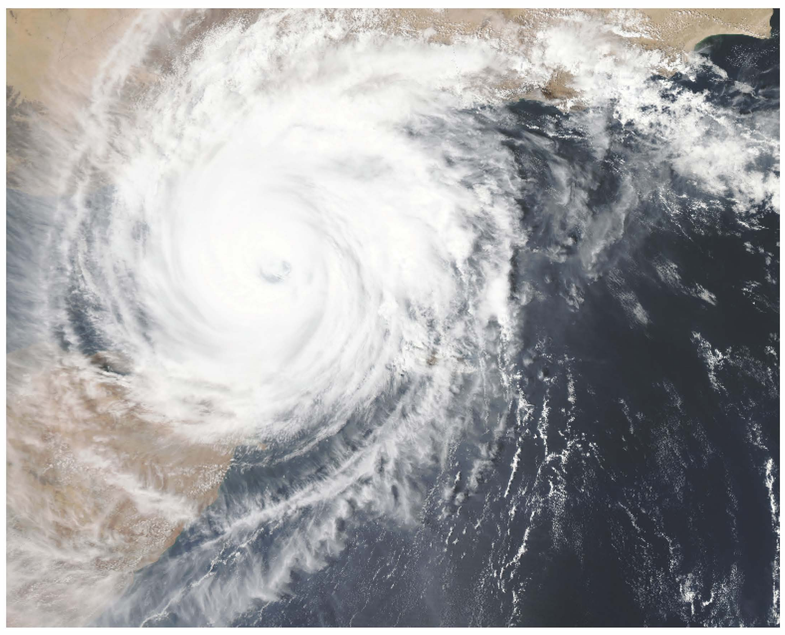
This is the first step of autonomous batch analysis performed based on the lake snow cloud effect. With the given amount of scientific studies, we are able to provide some fundamental analysis for the given climate data.

Since the program is designed with an open-mind to the future studies. You may easily tune the most directly affective variables to fit your specific needs. This makes our toolkit highly adaptable for varies seasonal conditions and suitable for all similar climate image analysis purposes.

All the program APIs are well-documented and can be run across all the platforms. We are excited to see if any researchers and enthusiasts can integrate and transform the toolkit into on-line tools and a part of forecast modeling system.

For more information, please visit our cloud identifier Github Page. The program is hosted under MIT Open Source License.

Nature by the Lake



Sample Snow Storm