Pixel Based Model For High Latitude Dust Detection

Georgios Priftis[1], Brian Freitag[1], Muthukumaran Ramasubramanian1, Iksha Gurung[1], Santiago Gassó[2], Manil Maskey[3], and Rahul Ramachandran[3]

1 – University of Alabama in Huntsville, 2 – NASA Goddard Space Flight Center, 3 – NASA Marshall Space Flight Center

IMPACT
Interagency Implementation and Advanced Concepts Team

Introduction

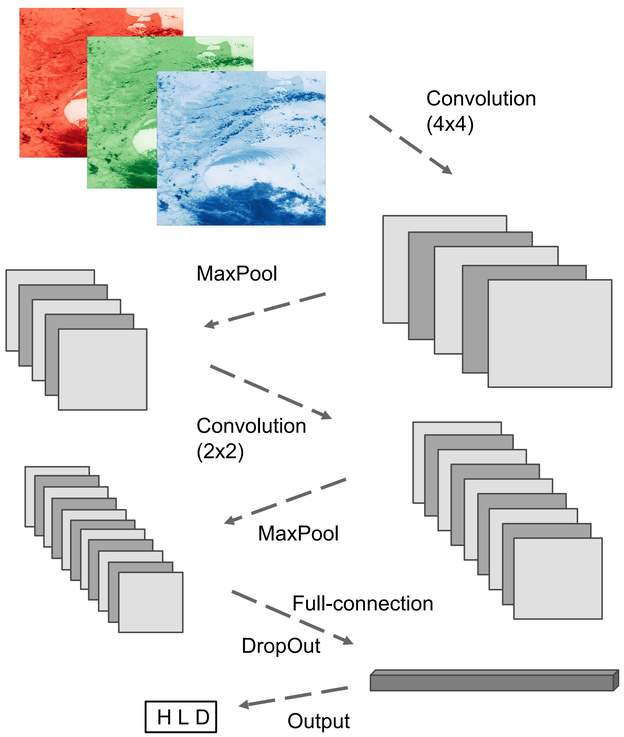
Current methods of dust detection rely on spectral sensitivity at visible (RGB) and infrared wavelengths. However, their application on different regions needs to be tuned to mitigate errors associated with background properties. High latitude dust (HLD) regions are characterized by surface with variable albedos and land cover, thus further complicating the dust detection. Leveraging supervised machine learning (ML) methods, we propose a new method accounting for regional differences of dust occurrence.

Methods

PRE-PROCESSING

- Tiles are explored for the presence of dust events and polygons are manually drawn along their perimeter.
- Visible pixels for true and false events are obtained for training (80%) and validation (20%).

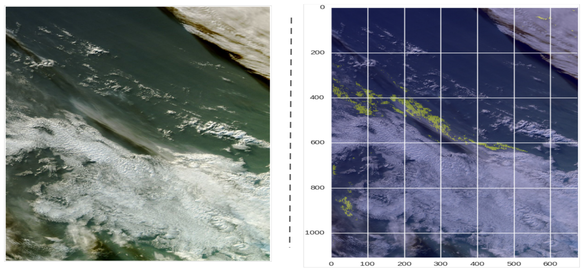
PIXEL MODEL BASED ON KERAS



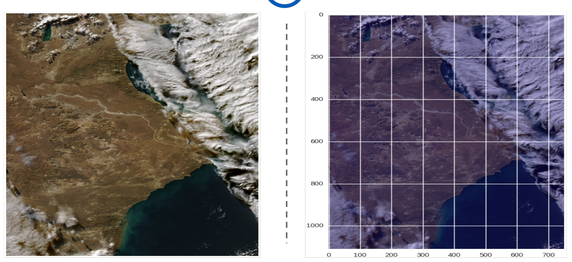
Data Analysis

Previous research indicates that a combination of visible and infrared wavelengths has the highest performance in dust detection. The **MODIS** instrument, onboard Aqua and Terra satellites, provides high spectral and spatial resolution (500 m), at a sun-synchronous orbit around the Earth. **True color tiles** are obtained by a NASA web-based analysis tool that incorporates Worldview and Global Imagery Browse Services (GIBS) and extracts shapefiles.

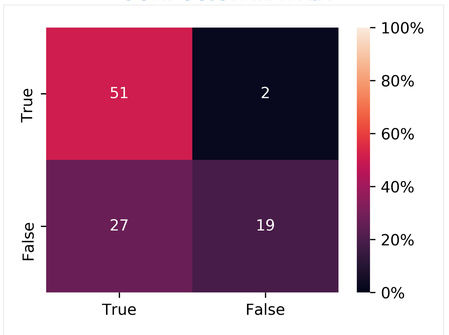
A



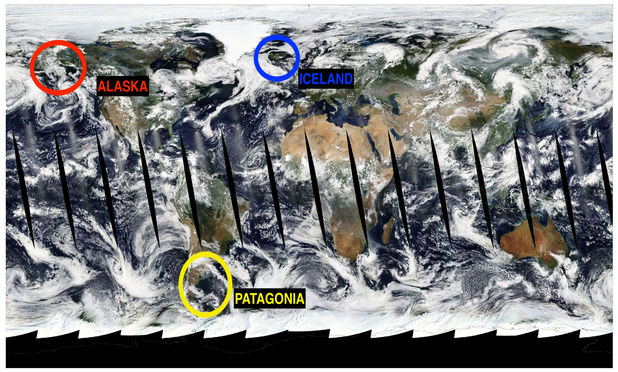
B



CONFUSION MATRIX

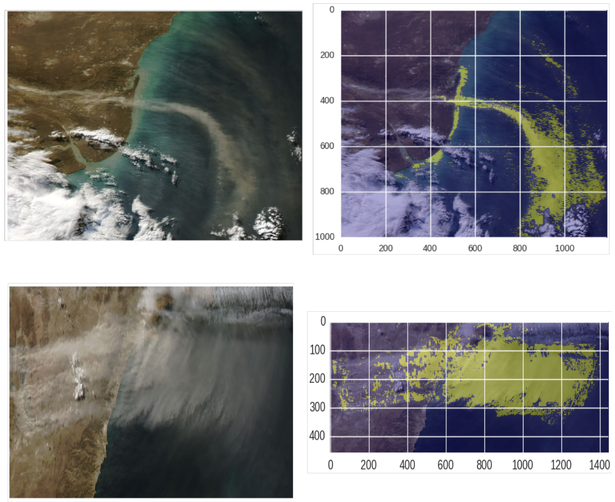


MODIS TRUE COLOR



Results

Strengths	Weaknesses
Detection of dust over the ocean	Sedimentation near the coast leads to false detection
Ability to distinguish between clouds and dust	Over land detection efficiency decreases
The detection efficiency doesn't degrade over different areas	Sunglint enhances false detection
	RGB bands alone might not provide enough spectral discrimination



Conclusion

High latitude dust load has implications on the energy budget, ocean biodiversity and economy on a regional and global scale. The detection of HLD events can be facilitated by leveraging deep learning techniques. The pixels based model has the following characteristics:

- Training data are obtain from different regions where HLD occurs to account for varying properties of the background.
- CNN pixel classifier works reasonably well for the detection of HLD events.
- False cases due to sunglint and background effects might reduce the robustness of the model.

Performance Metrics

Accuracy	0.7
Precision	0.91
F1_score	0.57
Recall	0.41

References

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2. Middleton, N. (2017), Desert dust hazards: A global review. Aeolian research, 24, 53–63.

Contact: gp0014@uh.edu

THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

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