Automated Detection of Sargassum in OLI Data

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Objectives and Tasks Completed

Work Objectives

- Identify, adapt, and automate *Sargassum* algorithms in Landsat-8 OLI data (an extension of Chuanmin Hu's Floating Algae Index (FAI) algorithm with additional cloud masking)
- Automatically produce geographical locations of the *Sargassum* mats
- Produce a user-friendly computer code for transition.
- Produce documentation to accompany the computer code

Tasks Completed

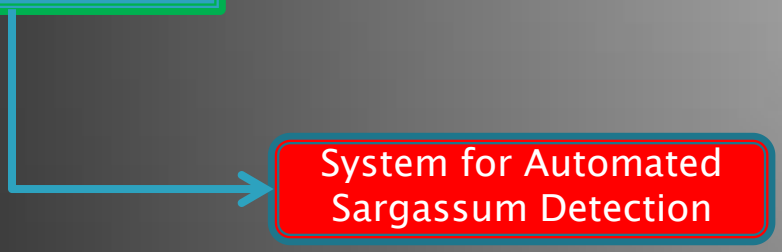
- OLI data was acquired and processed.
- *Sargassum* algorithm was implemented and automated for OLI data.
- Geographical locations for *Sargassum* mats in OLI imagery were automatically produced
- A new method to fuse high resolution imagery to low resolution numerical models was developed and implemented
- The software user's guide was developed and is now under review
- The first version of the computer code containing the automated detection was produced

System Flow

System for Automated Sargassum Detection

System Flow

Landsat files containing
- True color
- Lr
- rhot



System Flow

Landsat files containing
- True color
- Lr
- rhot

$$rhot = \frac{\pi Lt}{F_0 cos\theta_0}$$

- rhot is Lt with solar angle correction
- Lt is calibrated sensor radiance after adjustment for ozone and other gaseous absorption
- F_0 is the extraterrestrial solar irradiance at data acquisition time
- Θ_0 is the solar zenith angle

System for Automated Sargassum Detection

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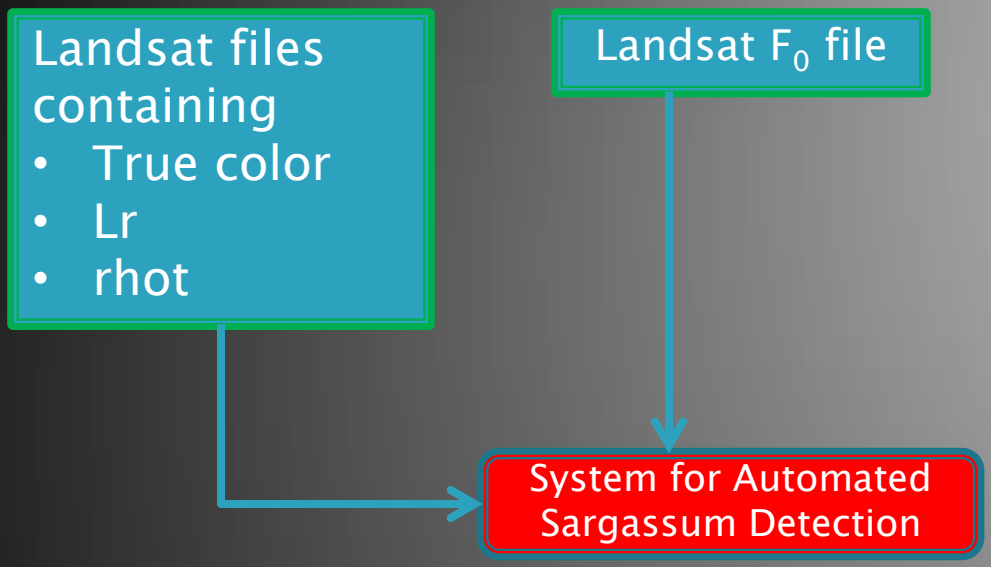
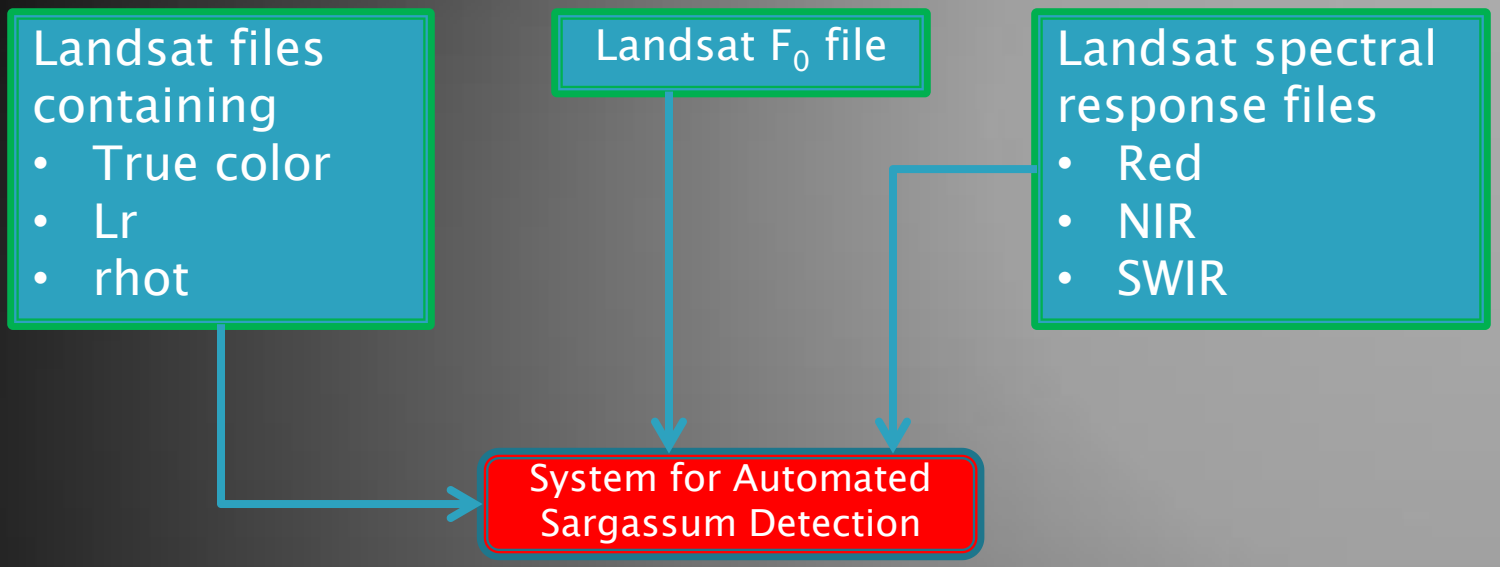
System for Automated Sargassum Detection

NOTE: All products needed for this algorithm are pre-atmospheric correction products. This means that atmospheric correction routines do not need to be established for this algorithm to work.

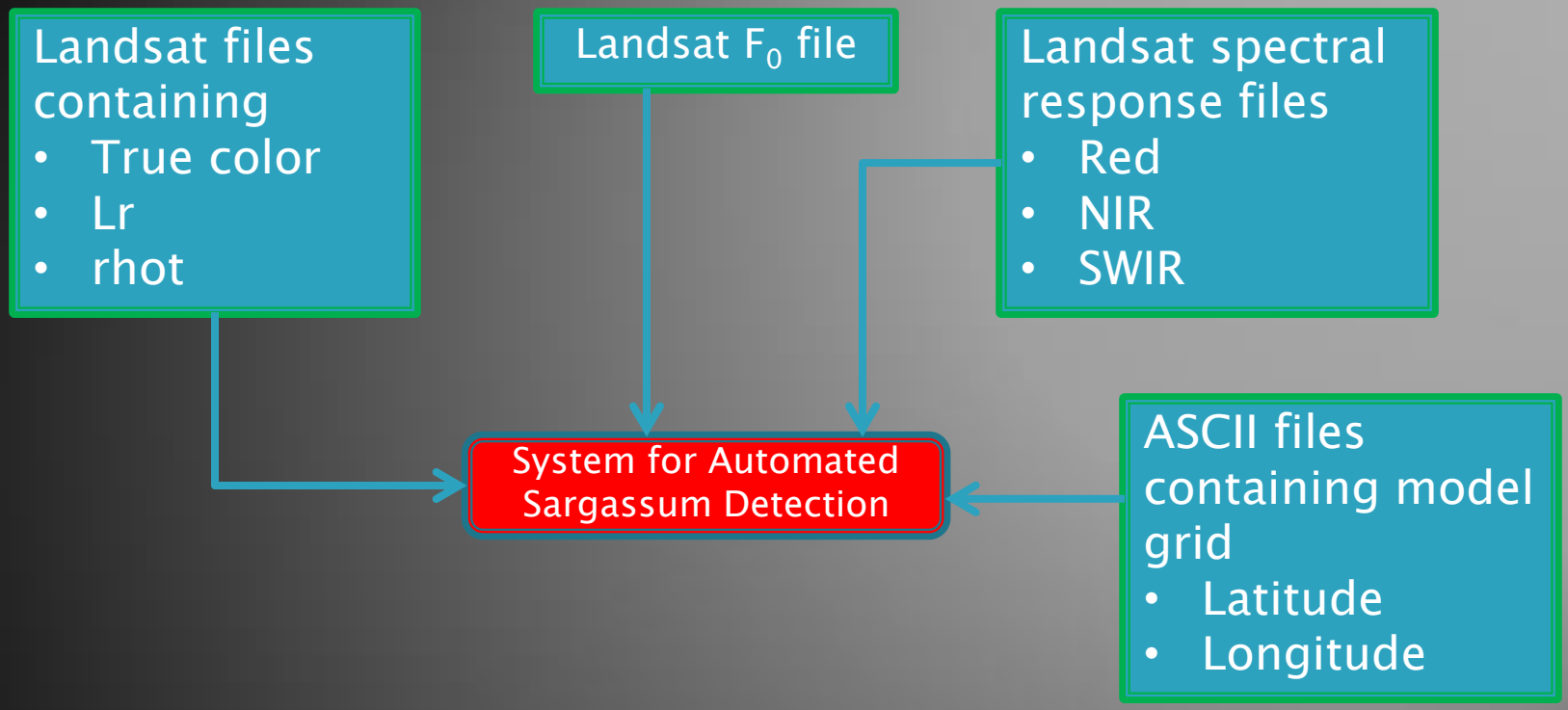
System Flow


Landsat files containing
• True color
• Lr
• rhot
Landsat F_0 file
System for Automated Sargassum Detection

System Flow


Landsat files containing
• True color
• Lr
• rhot
Landsat F_0 file
Landsat spectral response files
• Red
• NIR
• SWIR
System for Automated Sargassum Detection

System Flow


Landsat files containing
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• Lr
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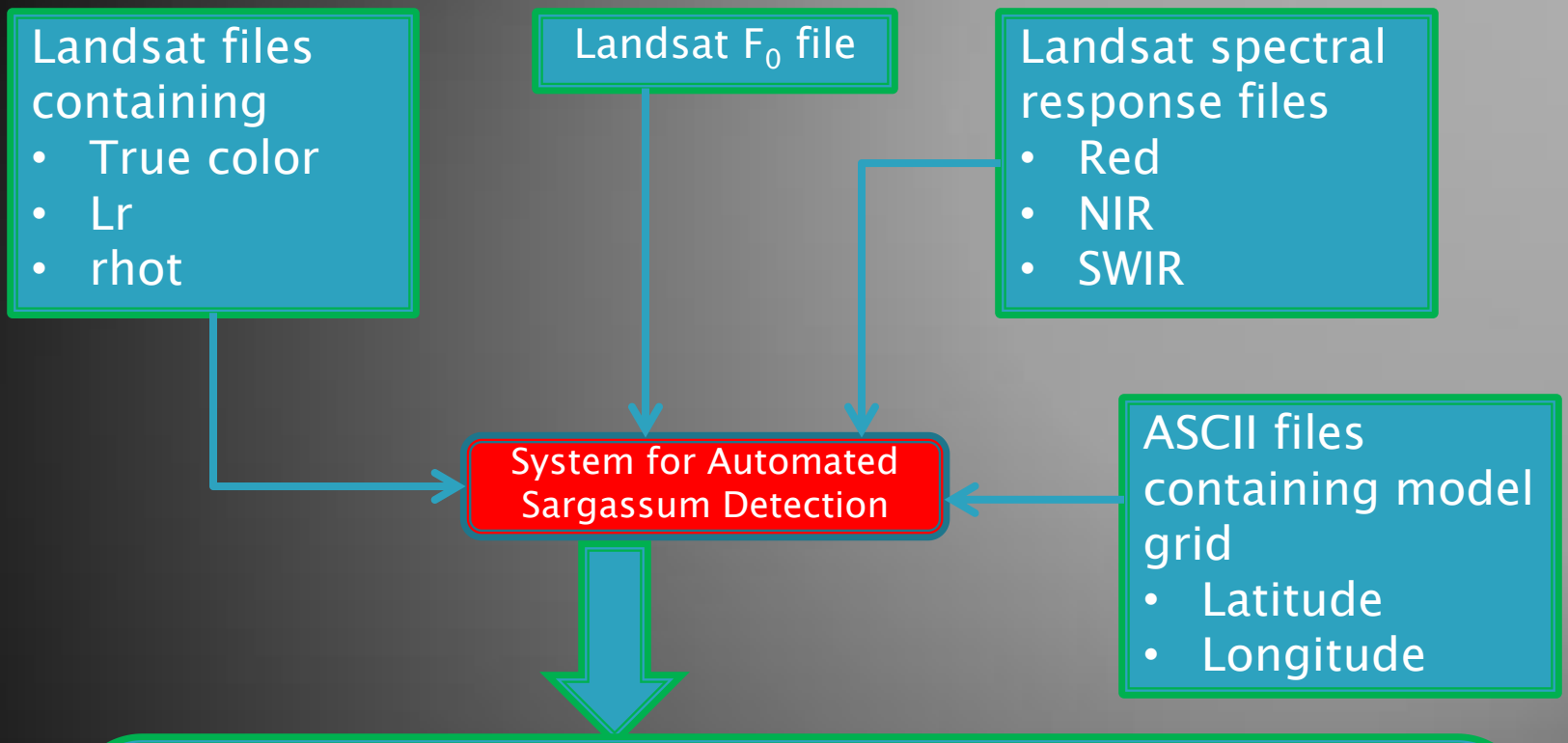
Landsat F_0 file
Landsat spectral response files
• Red
• NIR
• SWIR
System for Automated Sargassum Detection
ASCII files containing model grid
• Latitude
• Longitude

System Flow



Chuanmin Hu's algorithm for automated detection of sargassum:

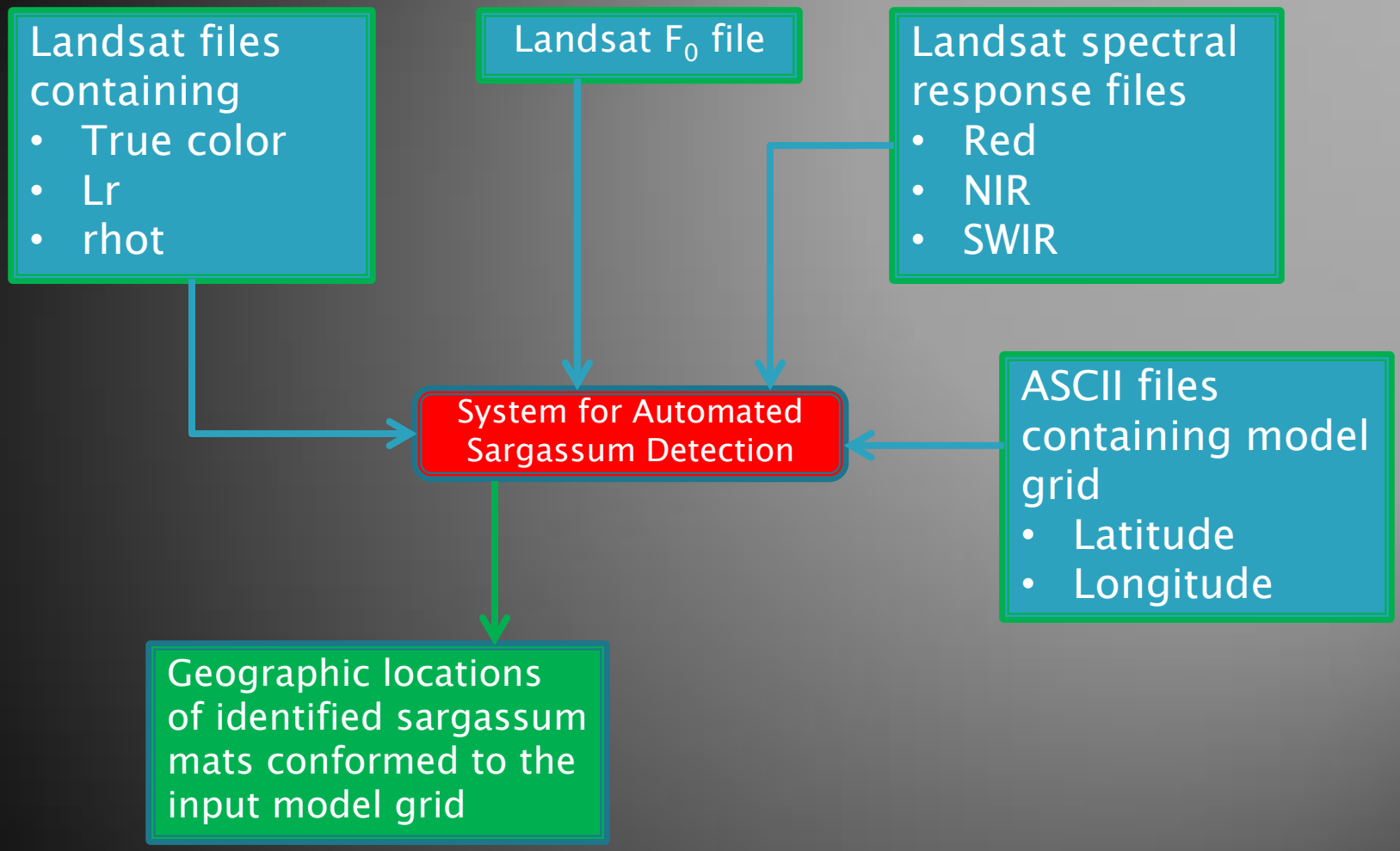
Rrc = rhot – Lr, where Lr is Rayleigh radiance

$R'_{rc,NIR} = R_{rc,RED} + (R_{rc,SWIR} - R_{rc,RED}) * ((\lambda_{NIR} - \lambda_{RED})/(\lambda_{SWIR} - \lambda_{RED}))$

$FAI = R_{rc,NIR} - R'_{rc,NIR}$

Mask for cloud pixels using true color imagery thresholding

System Flow


Landsat files containing
• True color
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Landsat F_0 file
Landsat spectral response files
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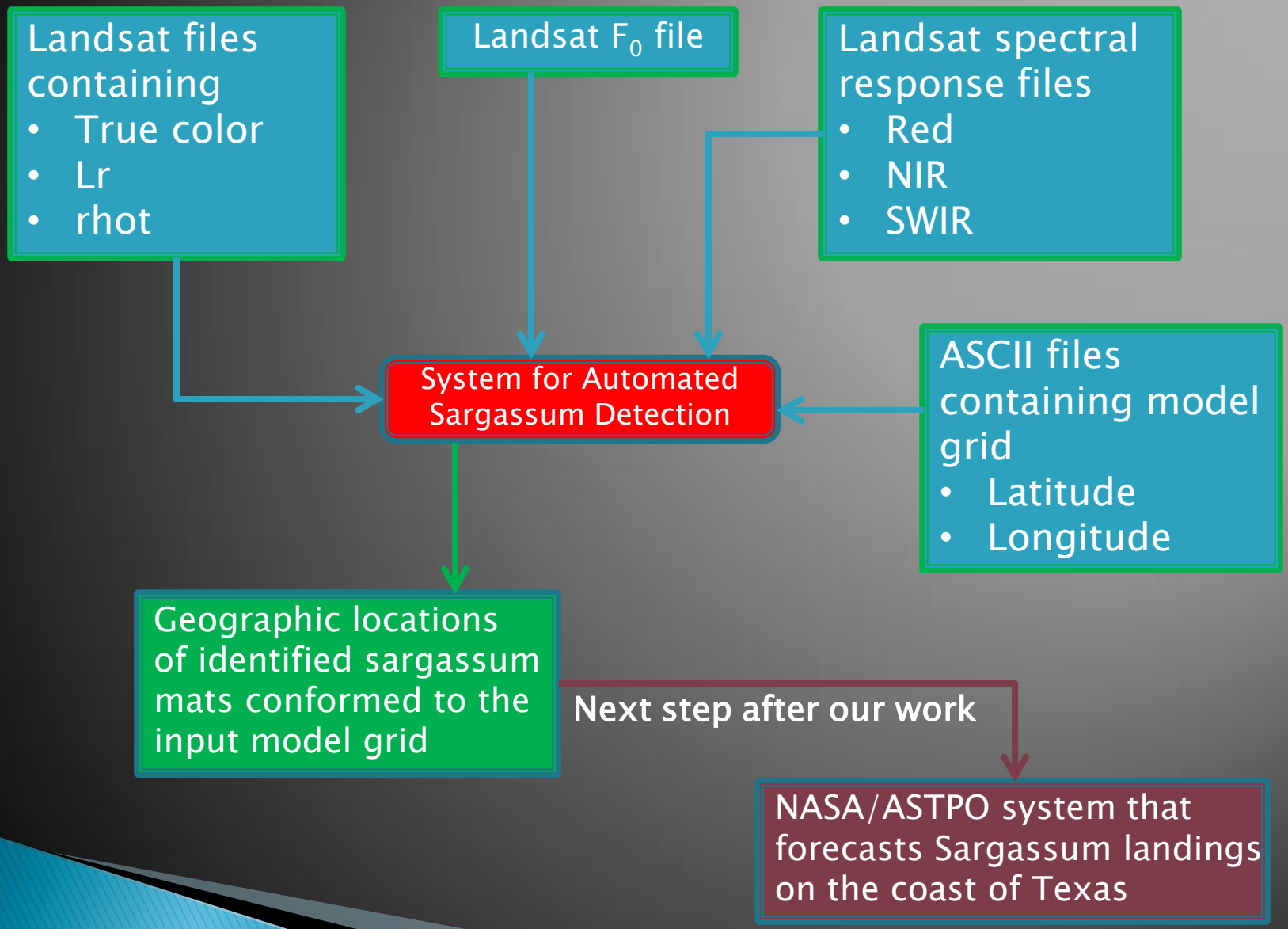
System for Automated Sargassum Detection
ASCII files containing model grid
• Latitude
• Longitude
Geographic locations of identified sargassum mats conformed to the input model grid

System Flow


Landsat files containing
• True color
• Lr
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System for Automated Sargassum Detection
ASCII files containing model grid
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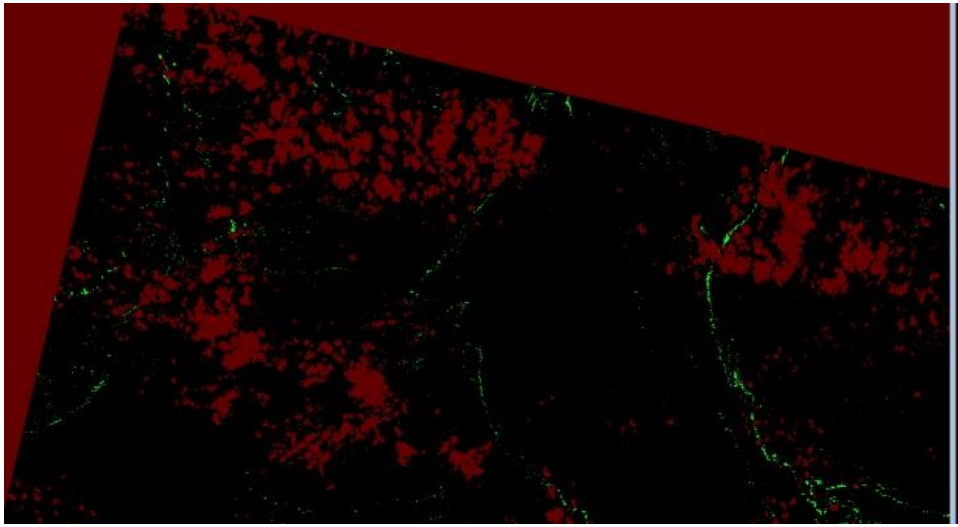
Geographic locations of identified sargassum mats conformed to the input model grid
Next step after our work
NASA/ASTPO system that forecasts Sargassum landings on the coast of Texas

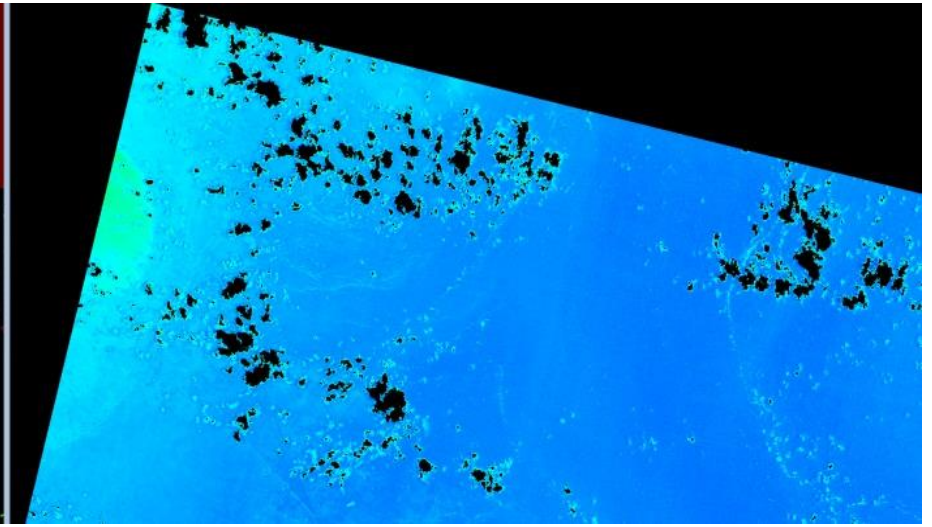
Results

- When testing our implementation of Hu's FAI algorithm, we created a FAI product that could be viewable within SeaDAS.
- Unlike Hu's algorithm, our FAI product has only 3 options for values:
  - 0: not a sargassum pixel (colored black on the next set of slides)
  - 1: flagged as a sargassum pixel (colored green on the next set of slides)
  - 2: flagged as a cloud pixel (colored red on the next set of slides)
- For one of our test sets, we looked at four areas in the same image, for the same day, June 1, 2014, 16:51:02. This OLI imagery is for the east coast of Texas.

Results

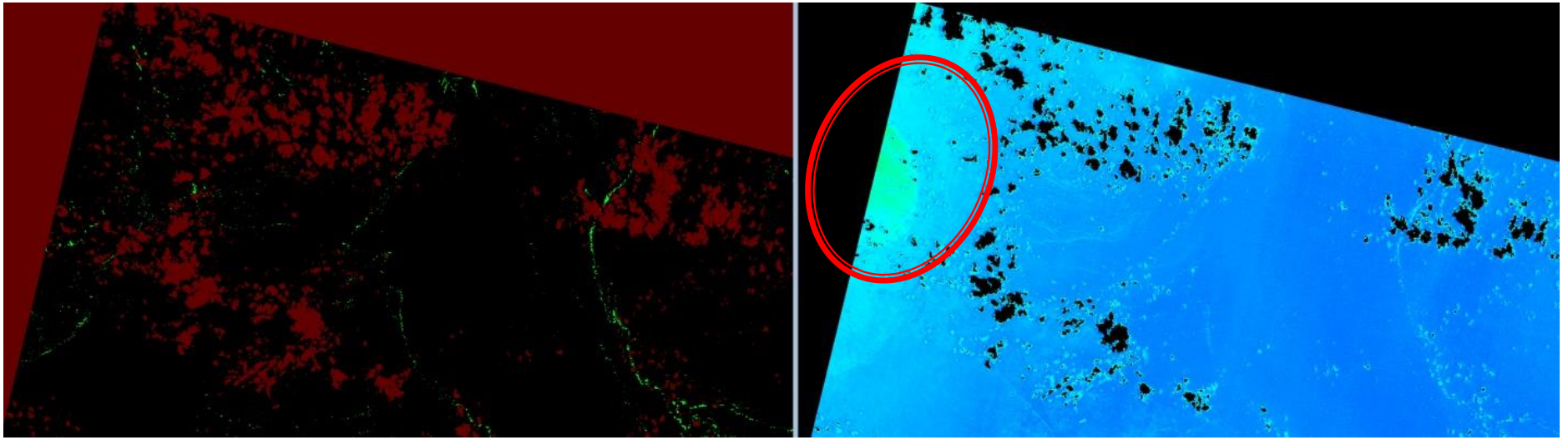


Our FAI product



Chlorophyll product

Results

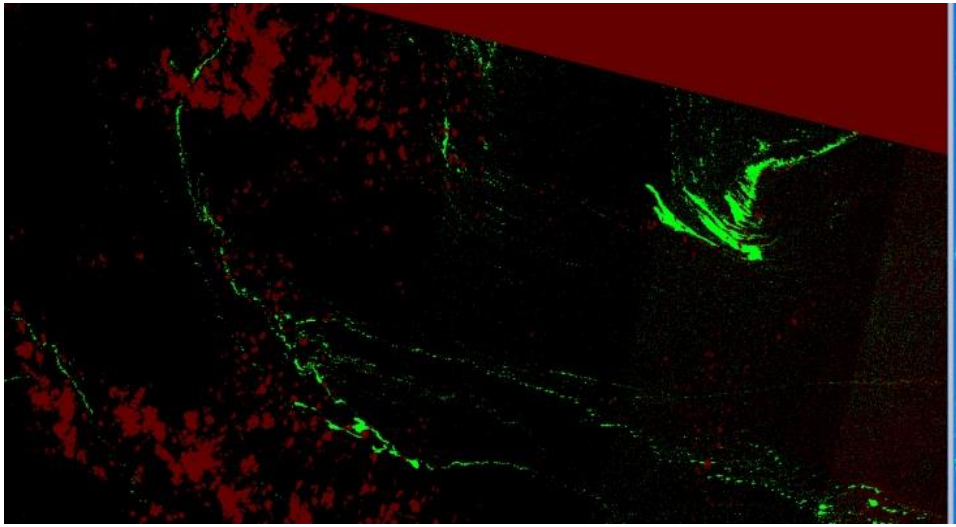


Our FAI product

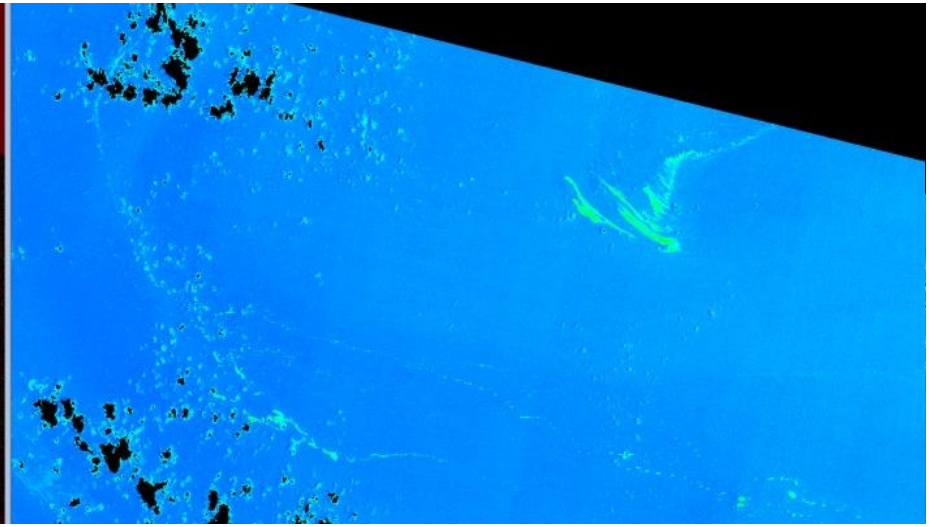
Chlorophyll product

Note: Chlorophyll pixels that are green, such as the ones on the left of the chlorophyll product image, are not always indicative of sargassum.

Results



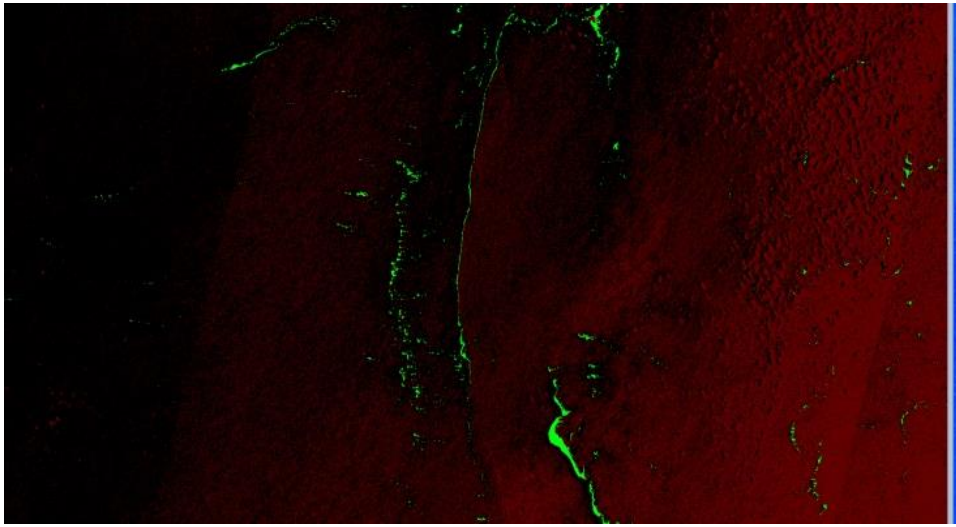
Our FAI product



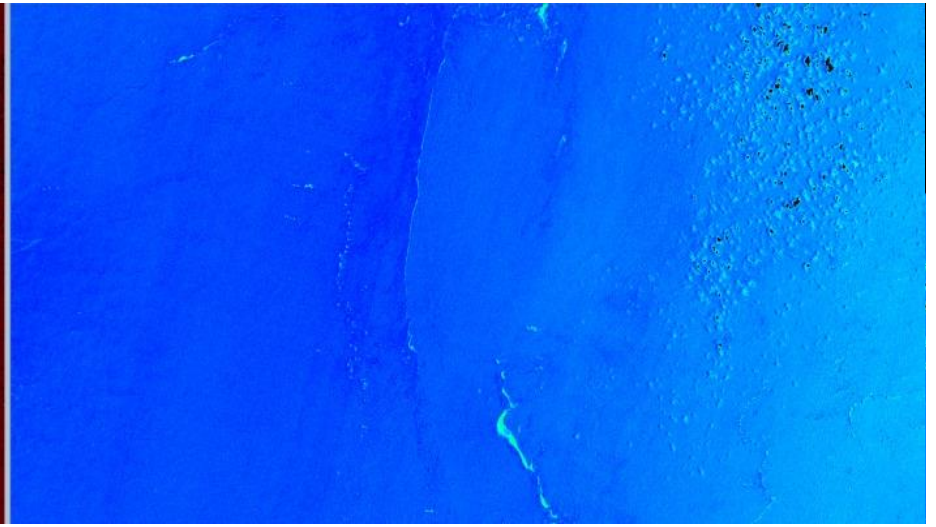
Chlorophyll product

Note: Sargassum detection works well even when clouds are nearby and also manages to not mistake cloud contaminated neighboring pixels as sargassum pixels.

Results



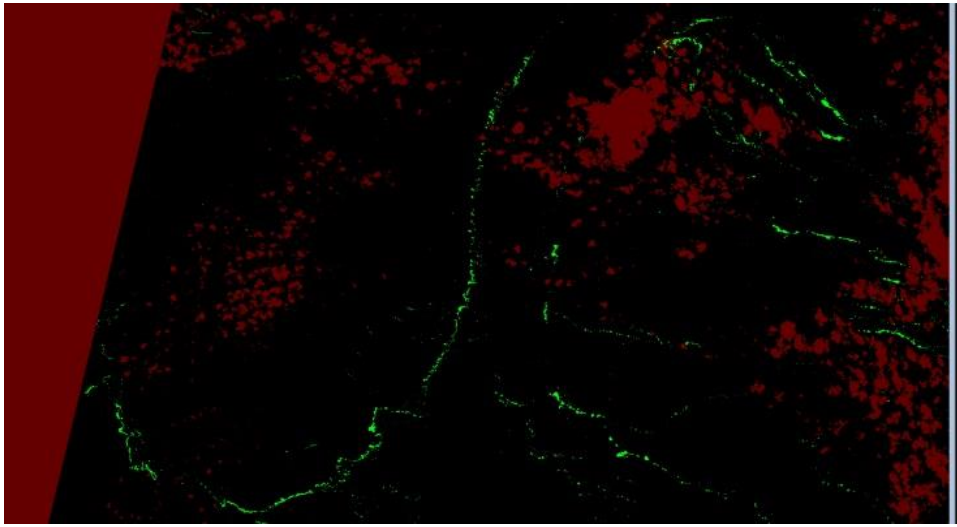
Our FAI product



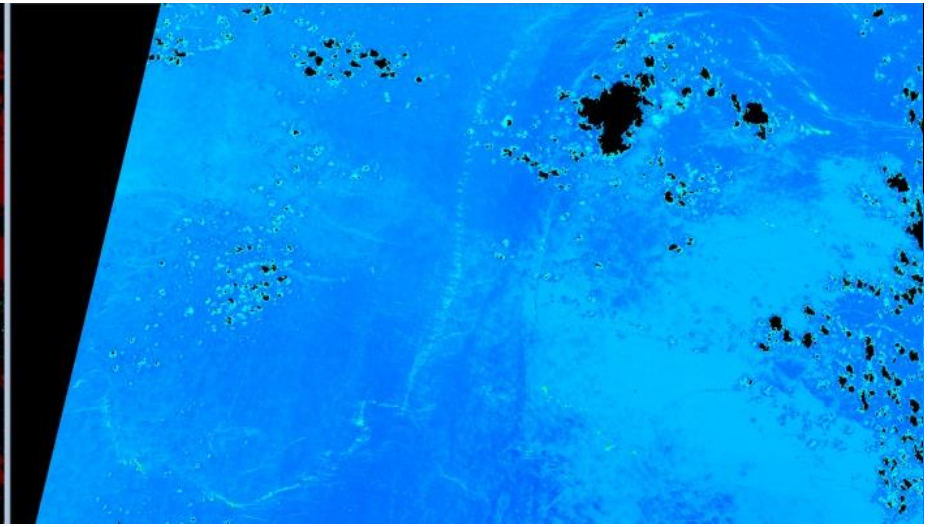
Chlorophyll product

Note: Sargassum detection works well in the middle of glint contaminated areas

Results



Our FAI product



Chlorophyll product

Note: Similarly to the previous three images, sargassum detection can differentiate between sargassum and similar chlorophyll and sun glint values (same colors in the chlorophyll image), as well as work when neighboring cloud pixels are present.

Remaining Work

Pending

- The second version of the computer code designed to ingest SeaDAS formatted files will be completed once the new version of SeaDAS is released
- Training sessions for the use of the code
- Transition of the computer code to NASA/ARTS

Issues

- Waiting on NASA/GSFC release of SeaDAS V.7.2 (will likely need to modify code to create the rhot product currently used in our software)

Collaborators

- We would like to thank Duane Armstrong, Eugene Jones, and Ted Mason for their support throughout this project.
- We would also like to thank Chuanmin Hu for having an easily extendable algorithm that can detect sargassum in high resolution imagery.

References

- Hu, Chuanmin. A novel ocean color index to detect floating algae in the global oceans. Remote Sensing of Environment 113 (2009) 2118–2129.