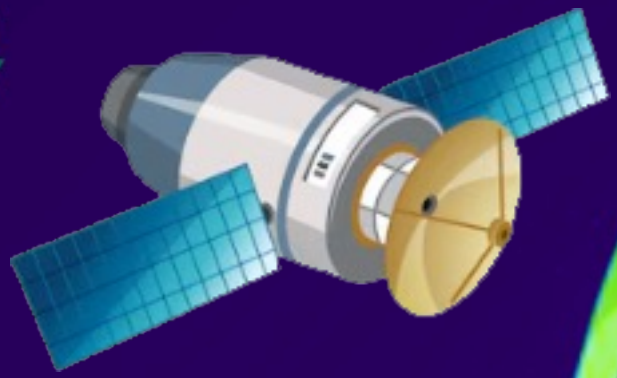

Evaluation of Atmospheric Correction Methods for the SGLI/GCOM-C Instrument and Their Effect on Chlorophyll-a Products for Ocean Color

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- Introduction
- Objectives
- Data & Methods
- Results
- Discussion & Conclusion

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Water Quality Monitoring: Why?

70% OF THE EARTH IS WATER.

Harmful Algal Blooms

+

Pollution

=

Environmental Issues

Health Issues

Water Quality Monitoring: How?

What should we monitor?

Water Quality Parameters:

Chlorophyll-a (Chla)

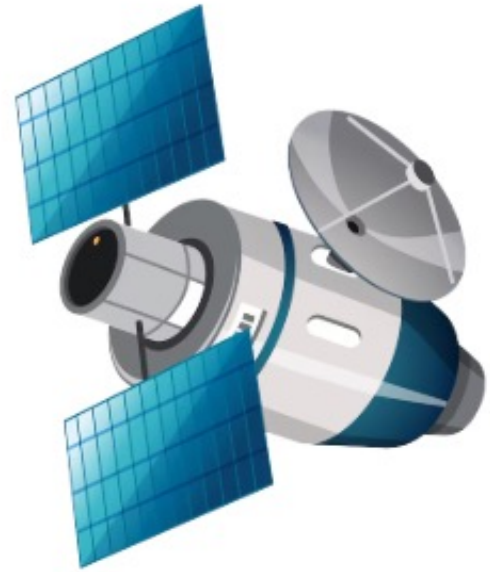
Total Suspended Matter (TSM)

Colored Disolved Organic Matter (CDOM)

•••

How can we monitor?

Two Methods:



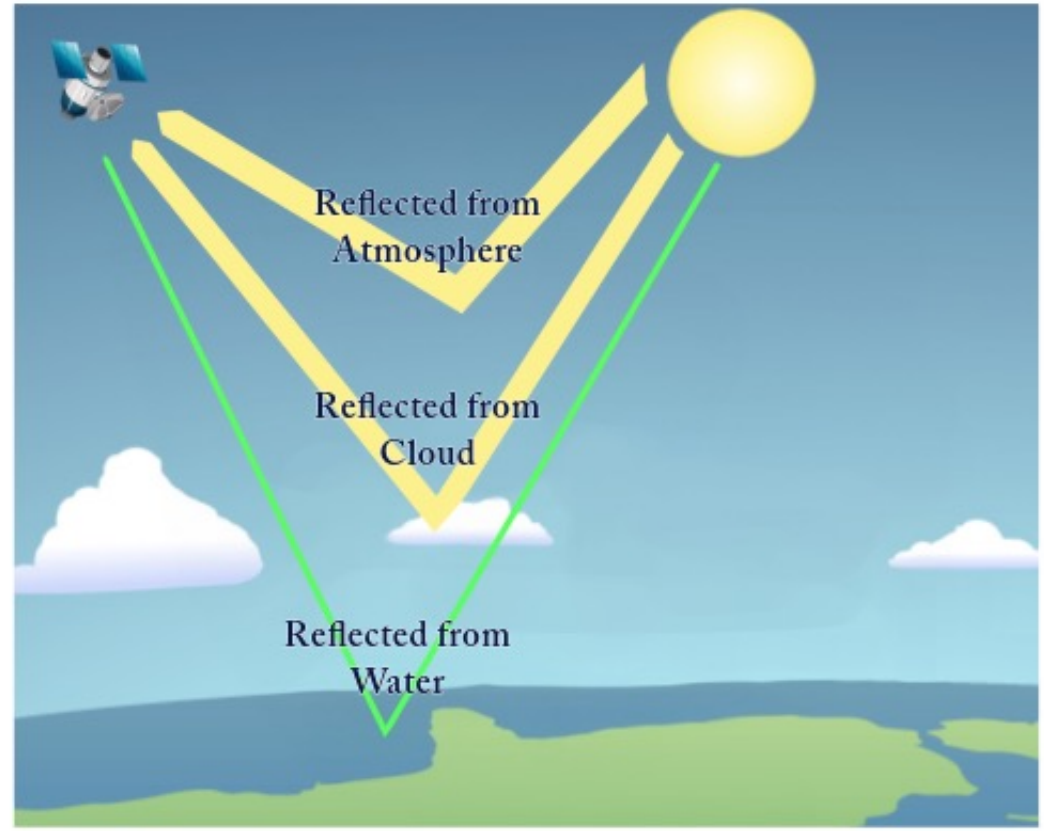
Satellite Data

Field Measurements (In the Lab)

Water Quality Monitoring: Challenges?

#1: DIFFERENT WATER BODIES HAVE DIFFERENT PROPERITIES

#2: Atmospheric Correction



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WE AIM FOR TWO OBJECTIVES

#1: Global Scale Model for Chla Retrieval Using Satellite Data

#2: Evaluate Different Atmospheric Correction Algorithms and Their Effect on Chla Retrieval

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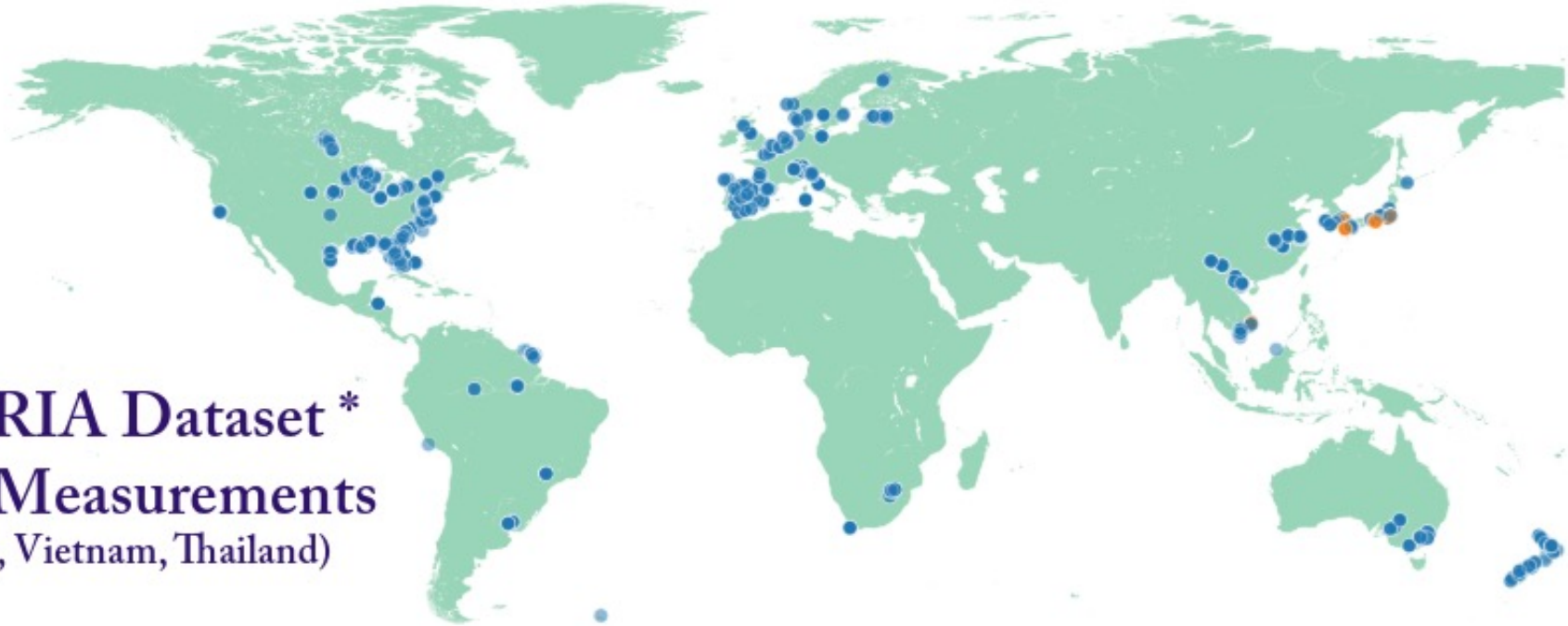
Data: In-situ



- GLORIA Dataset *
- Field Measurements
  (Japan, Vietnam, Thailand)

5610 GLOBAL FIELD MEASURMENTS

Remote Sensing Reflectance (Rrs) (1/sr) ⟷ Chlorophyll-a Concentration (Chla) (mg/m3)

* M. K. Lehmann et al., "GLORIA - A globally representative hyperspectral in situ dataset for optical sensing of water quality," Sci Data, vol. 10, no. 1, p. 100, Feb. 2023 doi: 10.1038/s41597-023-01973-y

Data: Satellite Matchups

We developed SGLICollect for Matchups collection

SGLICollect

383 Matchups

- In-situ Measurments
- × Satellite Matchups (SGLI)

Which Satellite/Sensor? GCOM-C/SGLI

Satellite Data: Atmospheric Correction

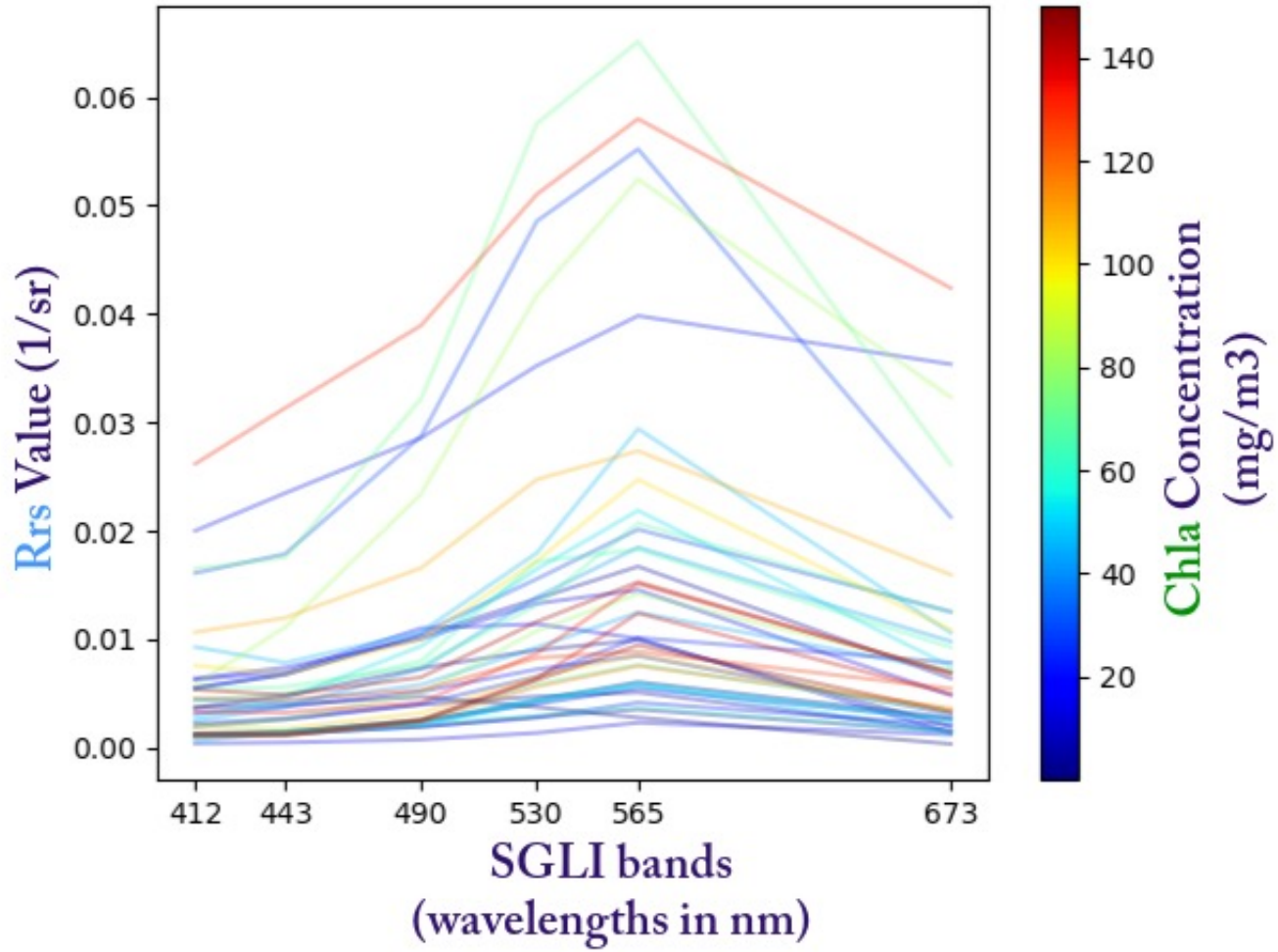
Three Different Algorithms

JAXA	OC-SMART	SeaDAS
200Valid Matchups	254Valid Matchups	6 Valid Matchups

Ideation: Sequential Nature of Rrs

Every Rrs value
is related to
other Rrs values

So, can we use
sequence modeling?
Like text, music, audio etc..



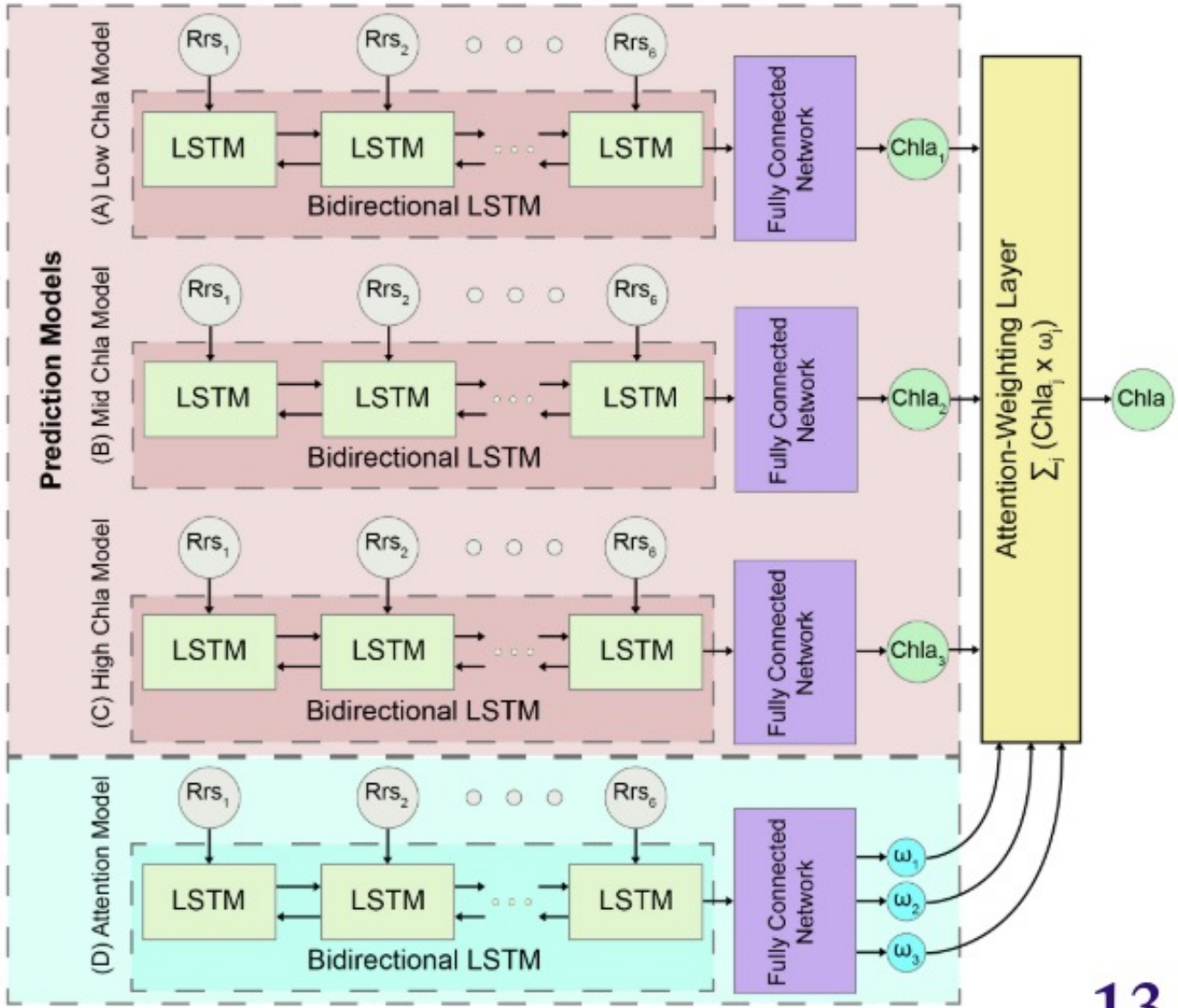
Proposed Model: 3LATNet

Sequence Modeling: LSTMs

Rrs values are not directional: Bidirectional LSTM

Different Chla ranges: Attention model

Under publication in the ISPRS Journal



Evaluation: Classical vs Deep Learning

We focus on the SGLI sensor.

Classical

- **JAXA's Chla** *Murakami 2018*
- **OC3** *O'Reilly et. al. 2019*
- **OC4** *O'Reilly et. al. 2019*
- **NASA's OCI** *Hu et. al. 2012*
- **2-band linear** *Gons 1999*
- **2-band exp** *Gilerson et. al. 2010*
- **Blend** *Smith et. al. 2018*

Deep Learning

- **3LATNet** *Salah et. al.*
- **MDN** *Pahlevan et. al. 2020*

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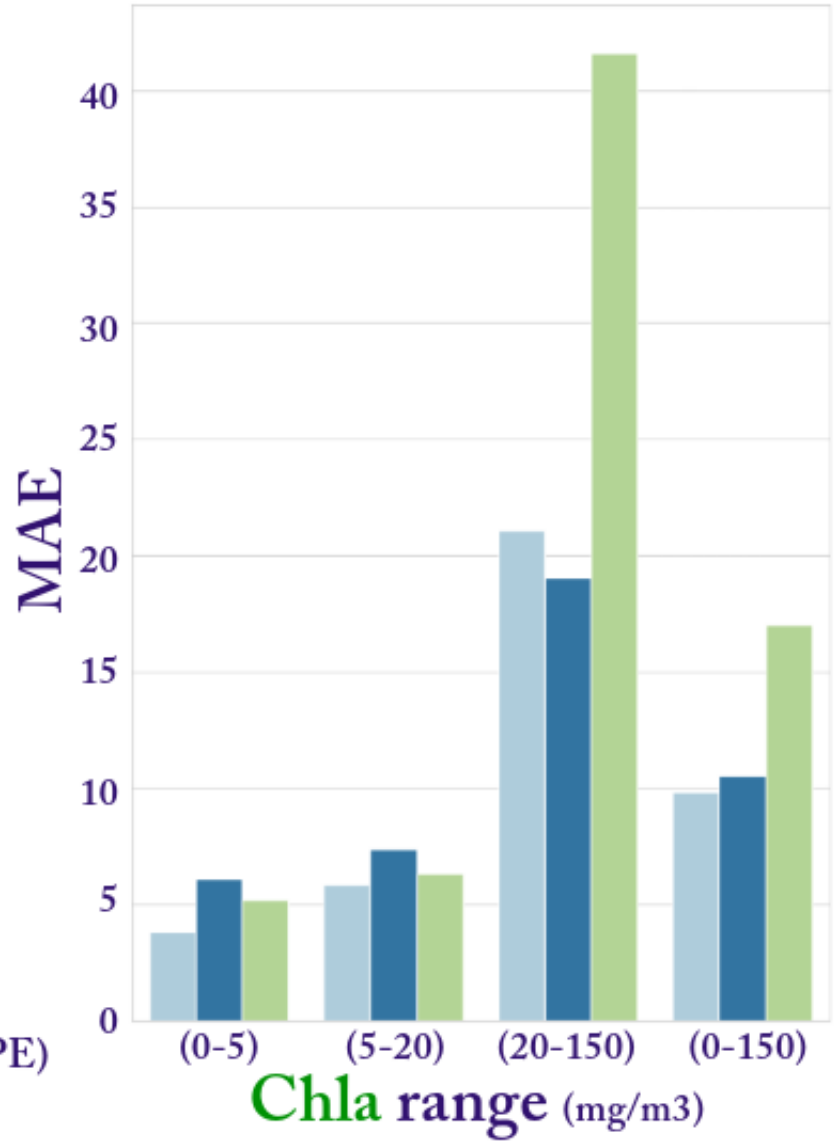
Results: Model's Performance

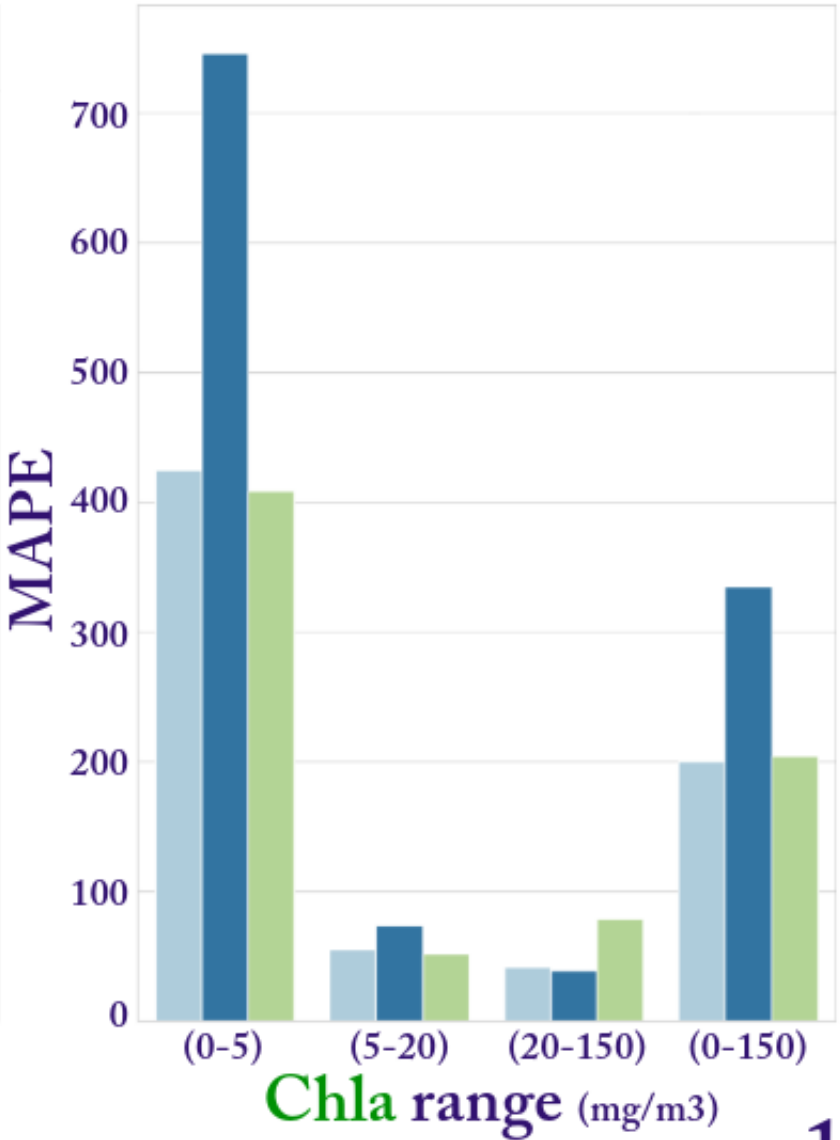
Overall, 3LATNet has the least error.

All models have significant MAPE in low Chla range.

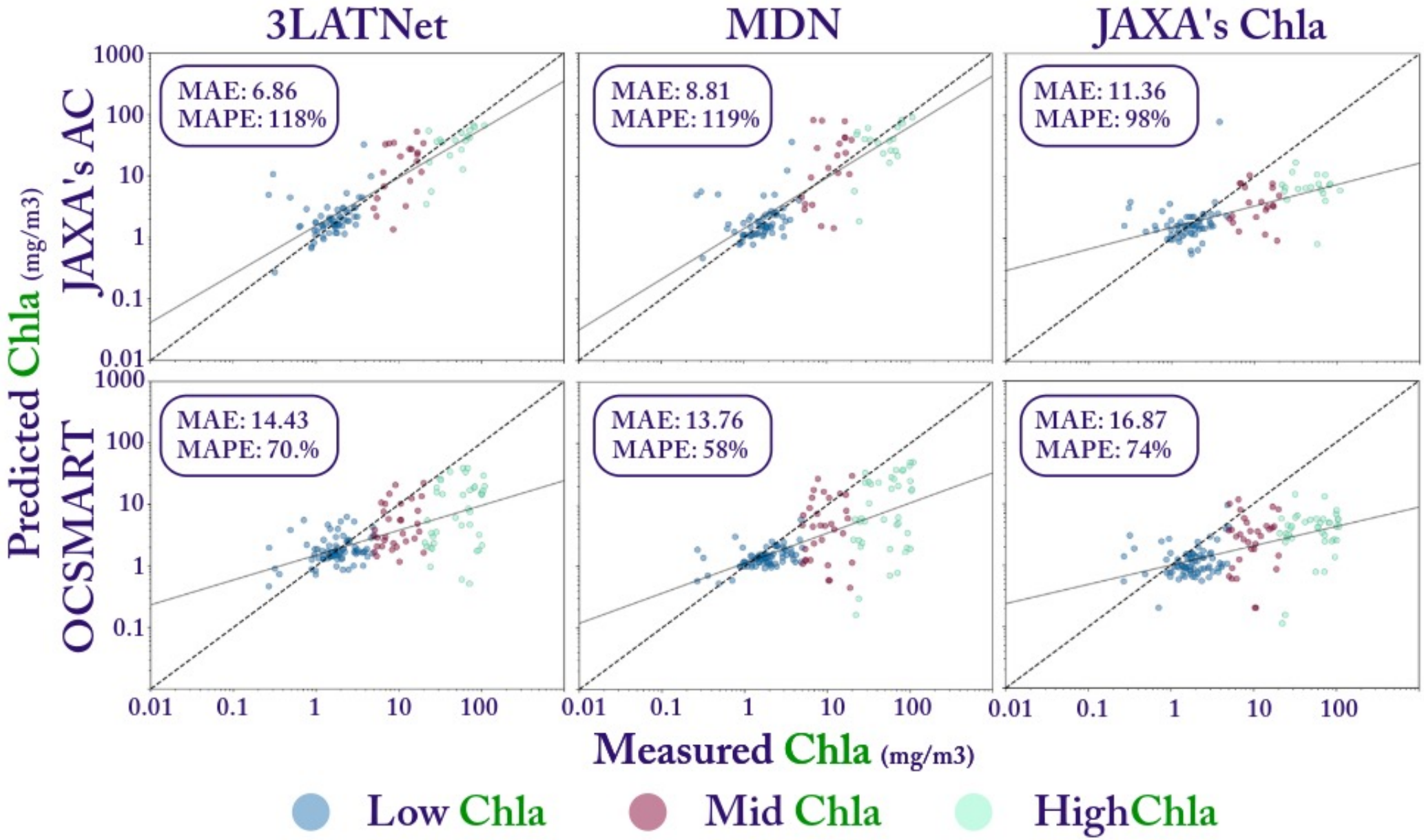
3LATNet
MDN
JAXA's Chla

Metrics:
1. Mean Absolute Error (MAE)
2. Mean Absolute Percentage Error (MAPE)





Results: Matchups & Atmospheric Correction

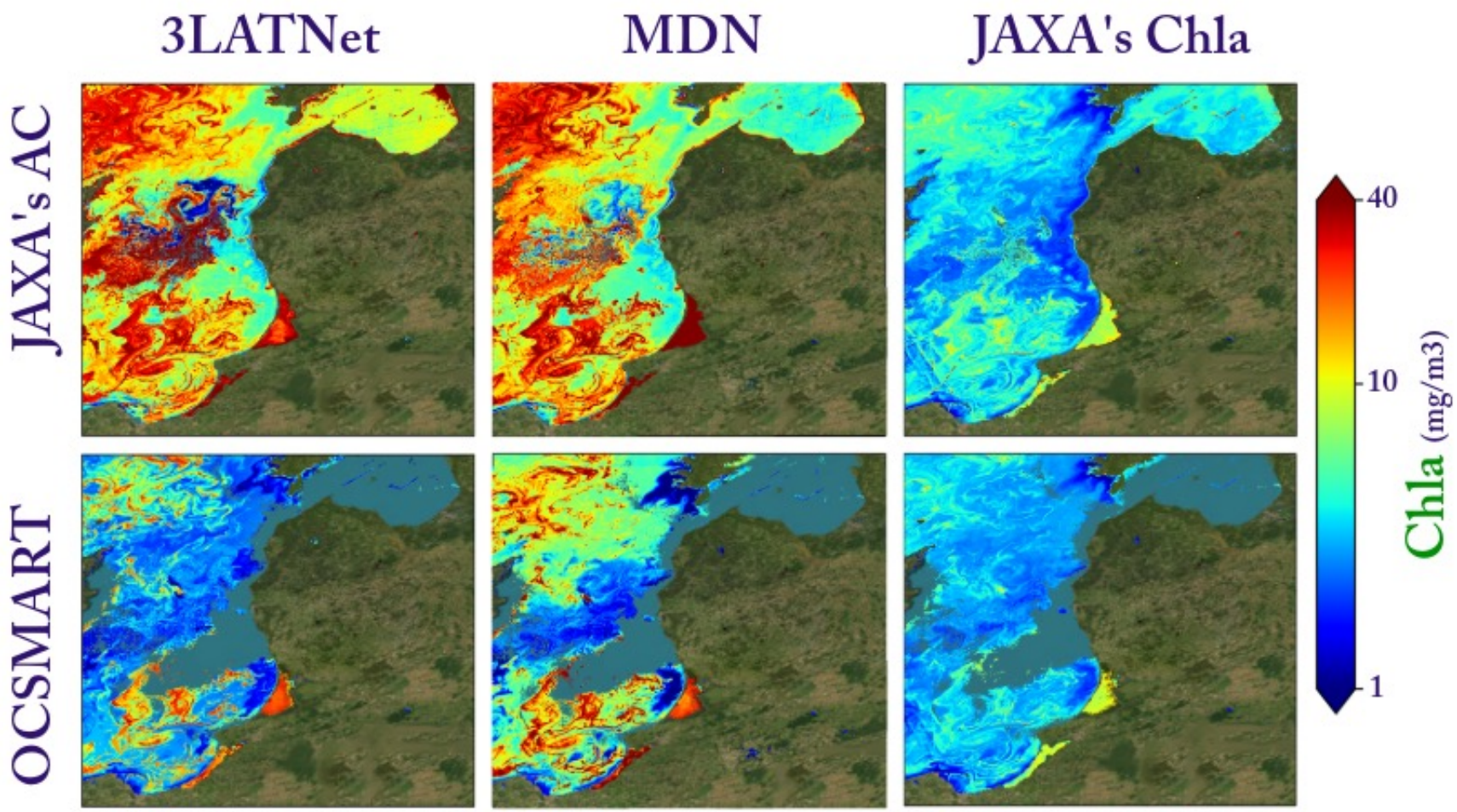


Qualitative results: Chla Spatial Maps

Observations:
JAXA's Chla is underestimated.

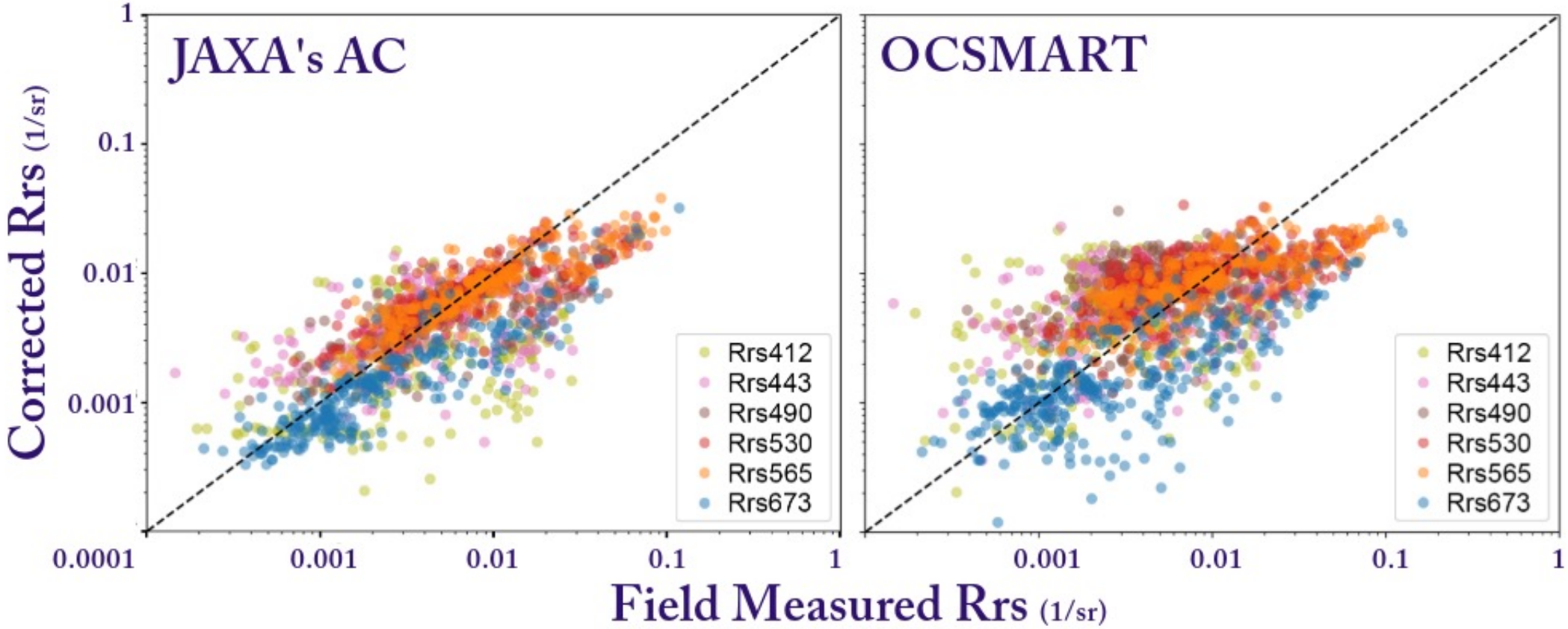
OCSMART have many missing pixels.

Patterns are captured more using JAXA's AC.



Baltic Sea: Harmful Algal Bloom Event in July 20, 2019

Atmospheric correction: Assessment



Observations:

- JAXA's Atmospheric correction is more accurate than OCSMART
- Both methods tend to underestimate higher Rrs values.

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- **Discussion & Conclusion**

Discussion & Conclusion: Performance

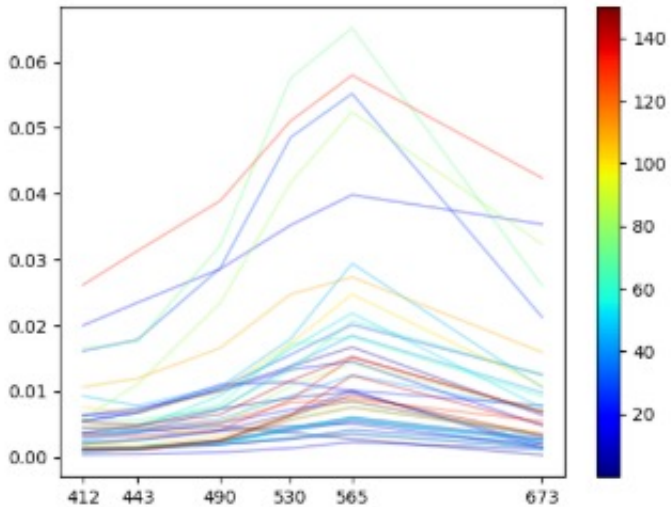
The Models' achieved state-of-art results using sequential modeling.

Deep learning models have higher average performance than classical due to their ability to generalize.

All models have supstantial relative error (MAPE) in the low Chla range. This is due to the lack of data in the extreme ends of Chla range.

JAXA's Chla severely underestimate Chla in the baltic sea's harmful algal bloom. indicating less generalization.

Remember?



Rrs data can be seen as a sequence.

Discussion & Conclusion: AC

JAXA | OC-SMART | SeaDAS

200Valid Matchups | 254Valid Matchups | 6 Valid Matchups

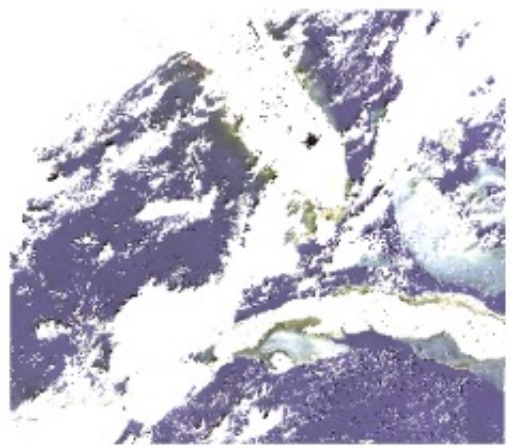
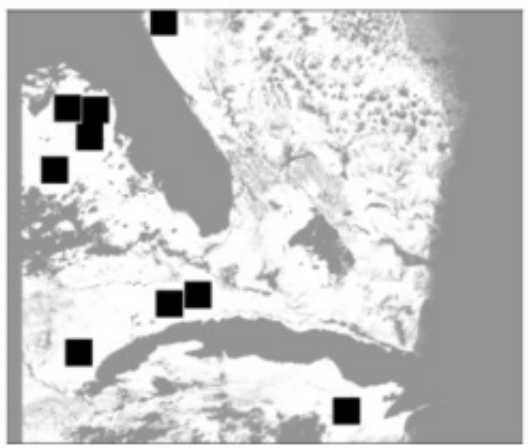
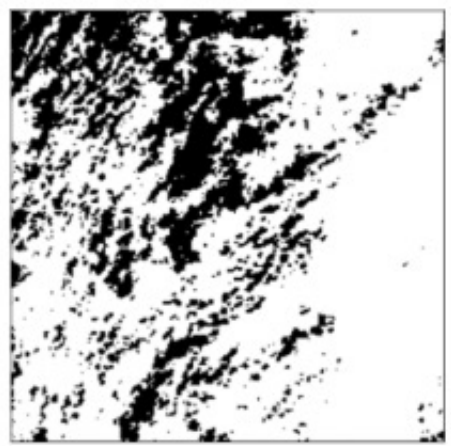
- JAXA's Atmospheric Correction outperforms OCSMART.
- OCSMART has lower MAPE than JAXA's Atmospheric Correction
- NASA's SeaDAS atmospheric correction yet needs improvments for other satellite sensors like JAXA's SGLI.
- Using OCSMART for atmospheric correction increases the error for all the models significantly. This is atributed to the inaccurracy in correcting Rrs.

On going research

- **Inter-satellite deep learning models comparison: GCOM-C, Sentinel-2, Sentinel-3**

3LATNet	1D-CNN	B1D-CNN	MDN
Salah et. al.	*Salah et. al.*	*Salah et. al.*	*Pahlevan et. al. 2020*

- **Ocean Color Satellite Data Cloud Inpainting.**

THANK YOU

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Contact Me!

SGLICollect