

VConstruct: Filling Gaps in Chl-a Data Using a Variational Autoencoder

Chlorophyll-a measurements

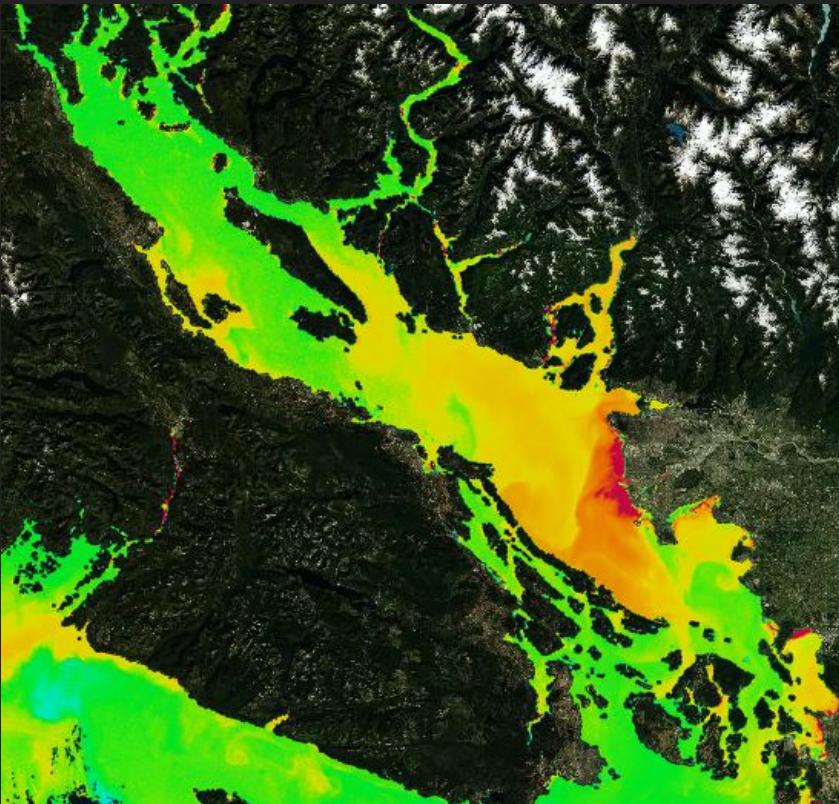


Image from algaeexplorer.ca

- “Essential Climate Variable”
- Useful for measuring phytoplankton
- Measured through satellites (i.e Sentinel-3 or Modis)
- Useful for tracking harmful algae blooms

Missing Data - Clouds

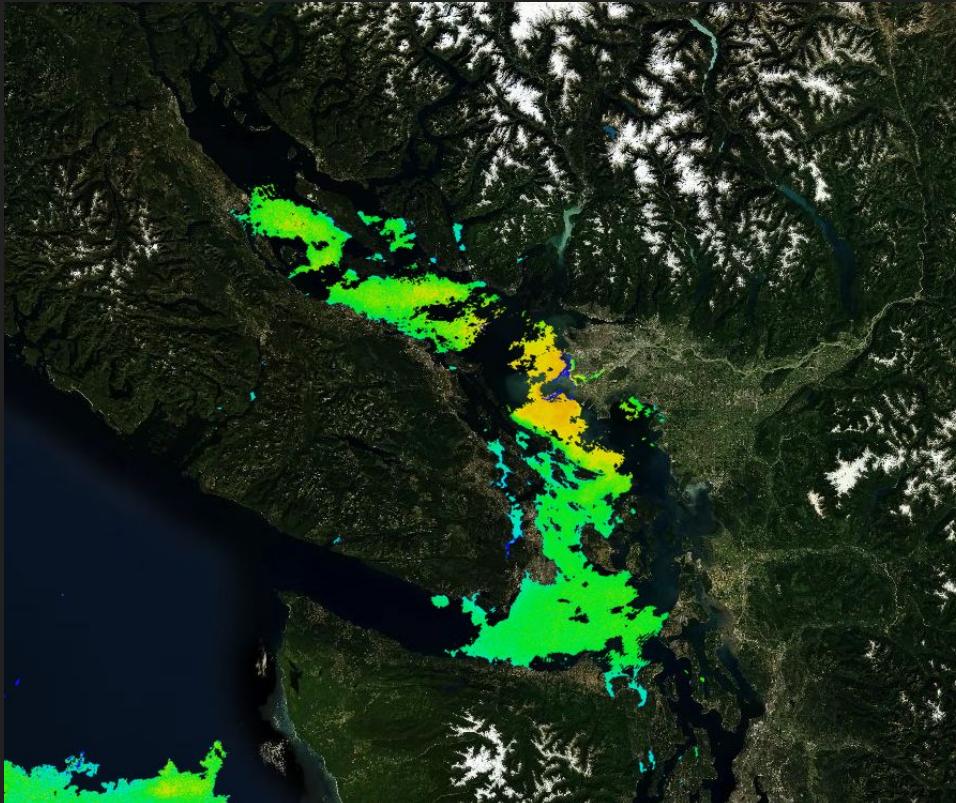


Image from algaeexplorer.ca

- Chl-a measurements based off visible light
- Commonly obstructed by clouds or lost due to other factors

Missing Data

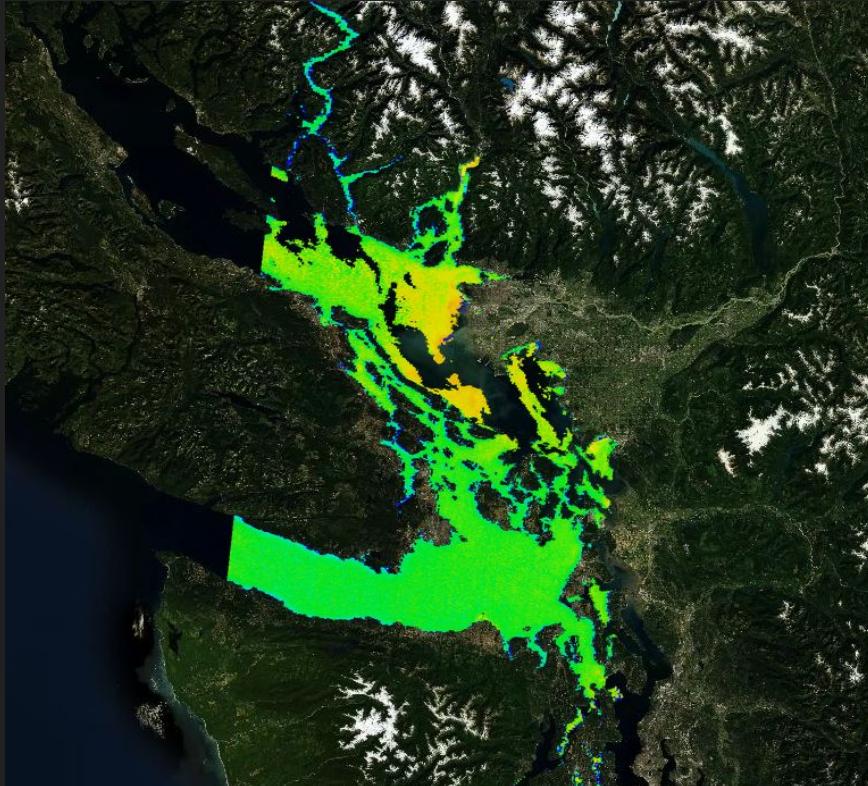


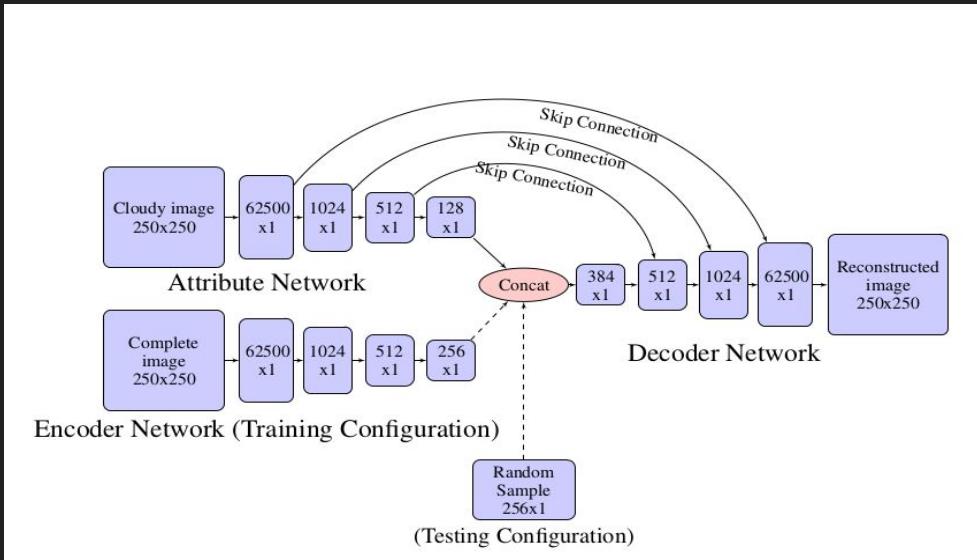
Image from algaeexplorer.ca

- Satellite's don't pass over daily
- Sentinel-3 revisit time <2 days

Data INterpolating Empirical Orthogonal Functions (DINEOF)

- Most commonly used
- Accurate
- Slow (10 minutes)

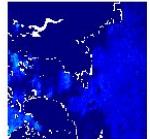
VConstruct



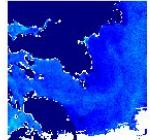
- Based off a Conditional Variational Autoencoder
- Fast (~8 ms once trained)
- Comparable accuracy
- Able to generate a range of potential reconstructions
- Atemporal

Results

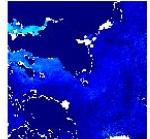
Ground Truth 2017-08-25



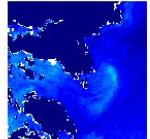
2016-09-15



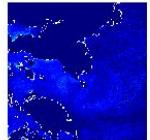
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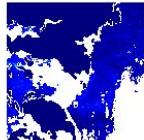
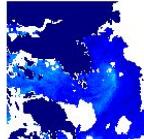
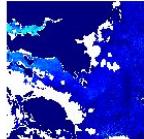
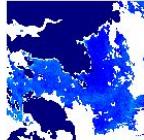
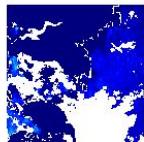
2020-03-11



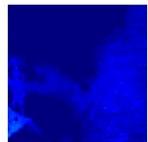
2018-10-06



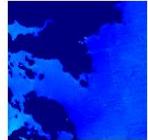
Cloudy Data



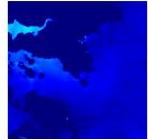
DINEOF,
RMSE = 0.104 R2= 0.247



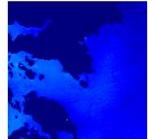
RMSE = 0.093 R2= 0.667



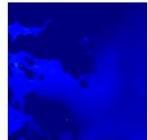
RMSE = 0.078 R2= 0.569



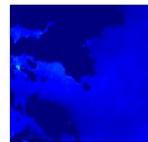
RMSE = 0.071 R2= 0.736



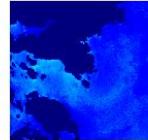
RMSE = 0.067 R2= 0.499



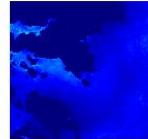
VConstruct,
RMSE = 0.125 R2= -0.089



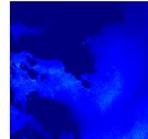
RMSE = 0.096 R2= 0.646



RMSE = 0.08 R2= 0.552



RMSE = 0.086 R2= 0.614

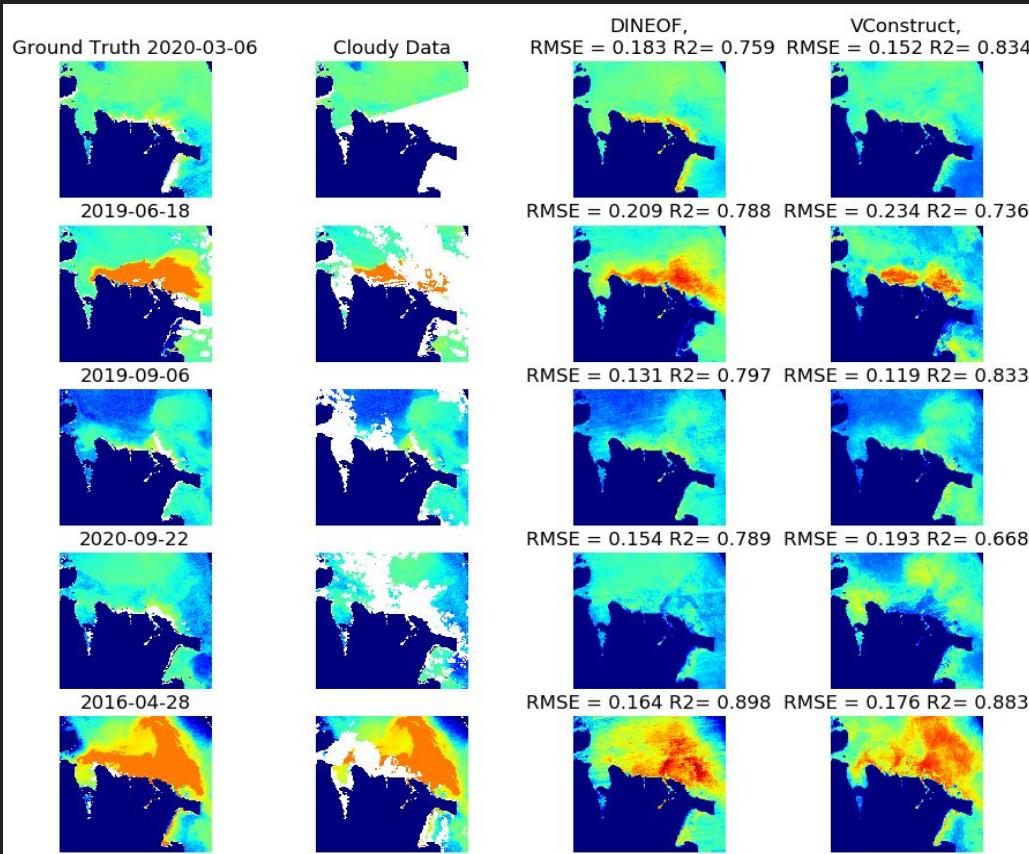


RMSE = 0.068 R2= 0.472

DINEOF RMSE = .0826
 $R^2 = .5436$

VConstruct RMSE = .091
 $R^2 = .4389$

Results



DINEOF RMSE = .1684
 $R^2 = .8064$

VConstruct RMSE = .1748
 $R^2 = .7908$

Future Work

- Improve accuracy
- In-situ testing
- Geographic testing
- SAR Data
- Other datasets