

Assessing VIIRS for Coastal Water Quality Monitoring in the Hawaiian Islands

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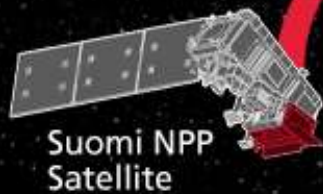


What is VIIRS?

VIIRS

Next Generation Environmental Monitoring from Space

Onboard the Suomi NPP Satellite, VIIRS provides superior imagery and data for next generation civil and military weather, climate and disaster monitoring.



Sun-synchronous
polar orbit



2X longer
operational
lifetime

Calibrated
low light level
imagery

375 meter
visible-infrared
imagery at nadir

Fire detection
and monitoring
Vegetation index
Land and ice
temperature
Cloud properties

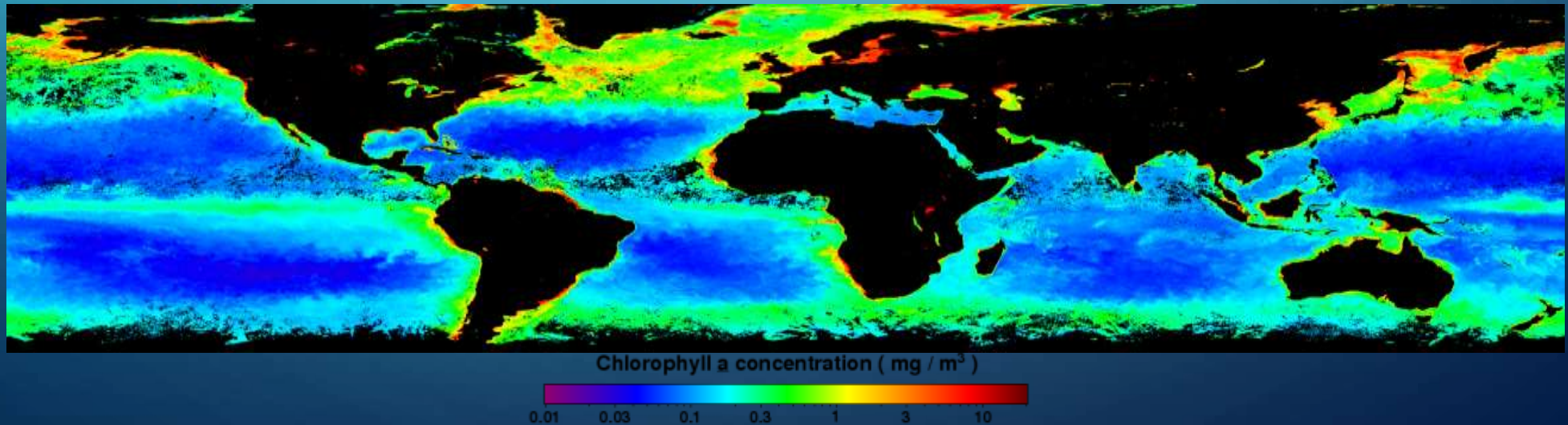
Ocean color
Sea surface
temperature
Ocean currents
Aerosol
characteristics

Images taken by VIIRS
on Nov. 21, 2011

Click an icon below for a larger image

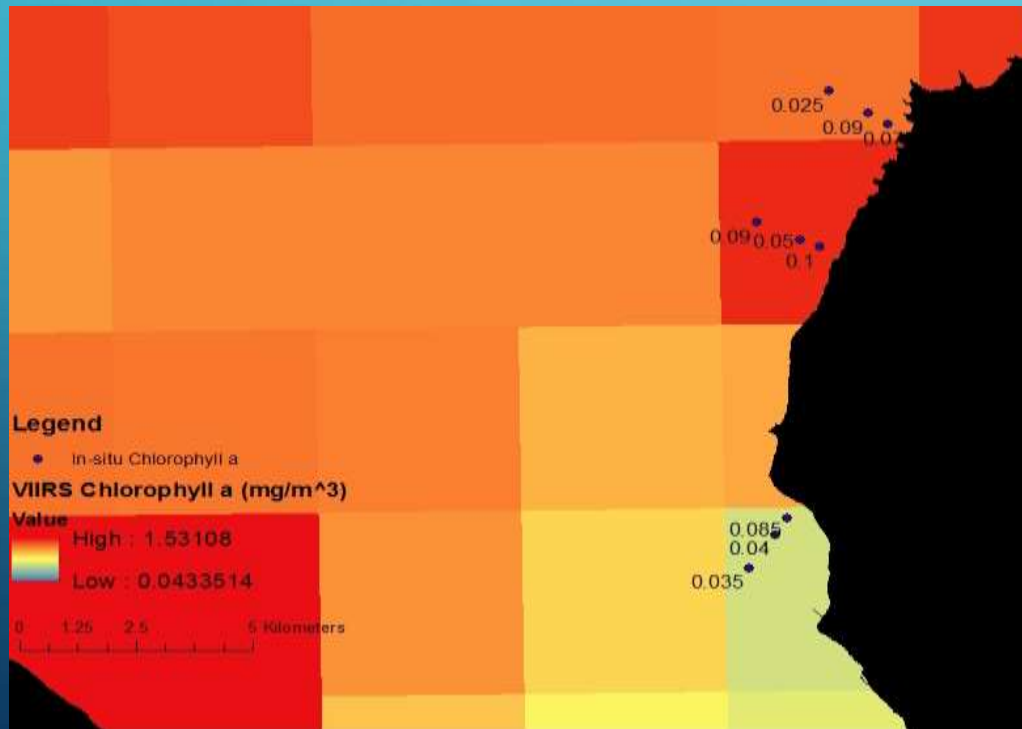
Motivation for this Work

- Ocean Color products commonly used for water quality monitoring:
 - **Chlorophyll-a** (Chl-a) is a pigment created by algae to perform photosynthesis and therefore used to monitor algae concentration
 - **Turbidity** is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates
- Heightened sediment and algae levels can stress coral reefs and other aquatic life



Project Expectations

- Assess VIIRS data for coastal waters
- **Is VIIRS a currently a reliable water quality monitoring tool for the state of Hawaii?**



Technical Approach

Compile
state-wide
chlorophyll-a
field data



Organize and
reformat data
for ArcGIS



Map state-
wide field vs
VIIRS
chlorophyll-a
data



Assess the
capability of
VIIRS as a
water quality
monitoring tool

Data Analysis

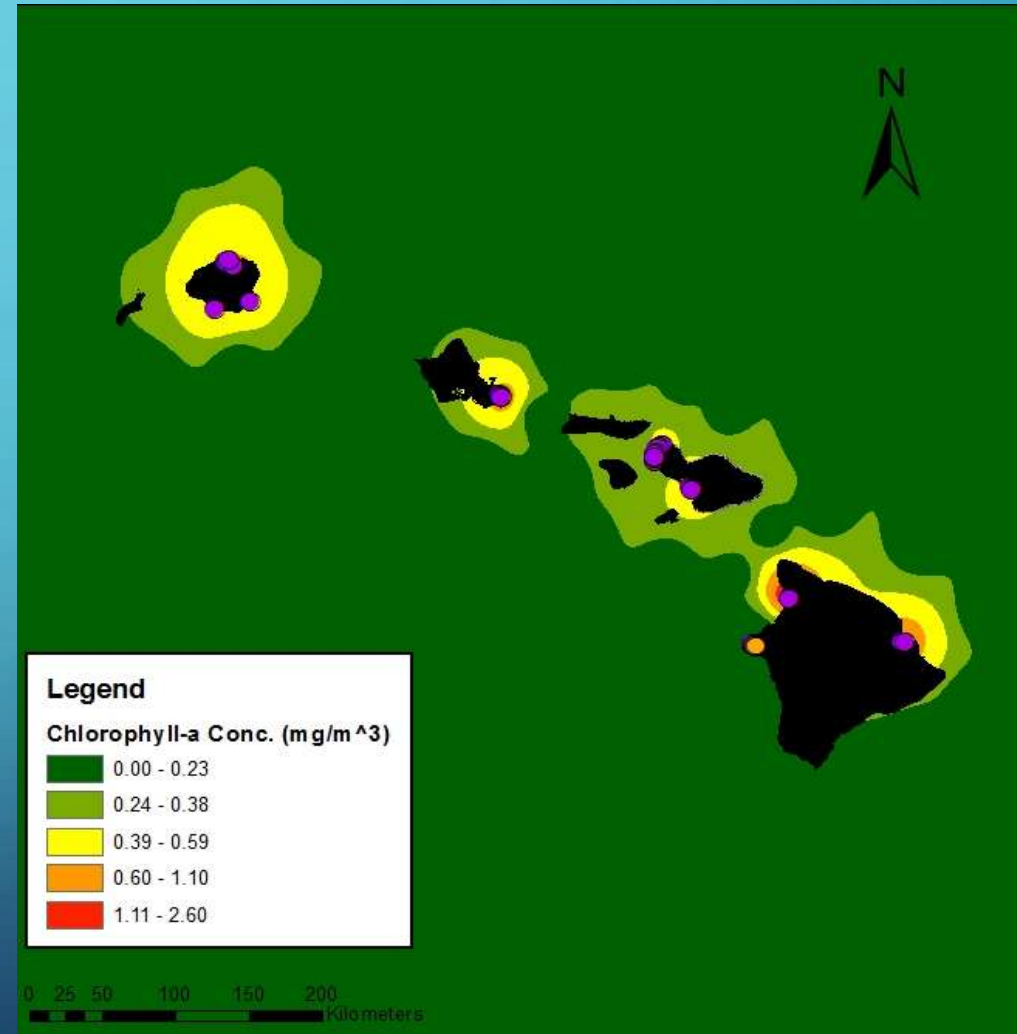
Java program to handle large data sets & formatting issues for ArcMap



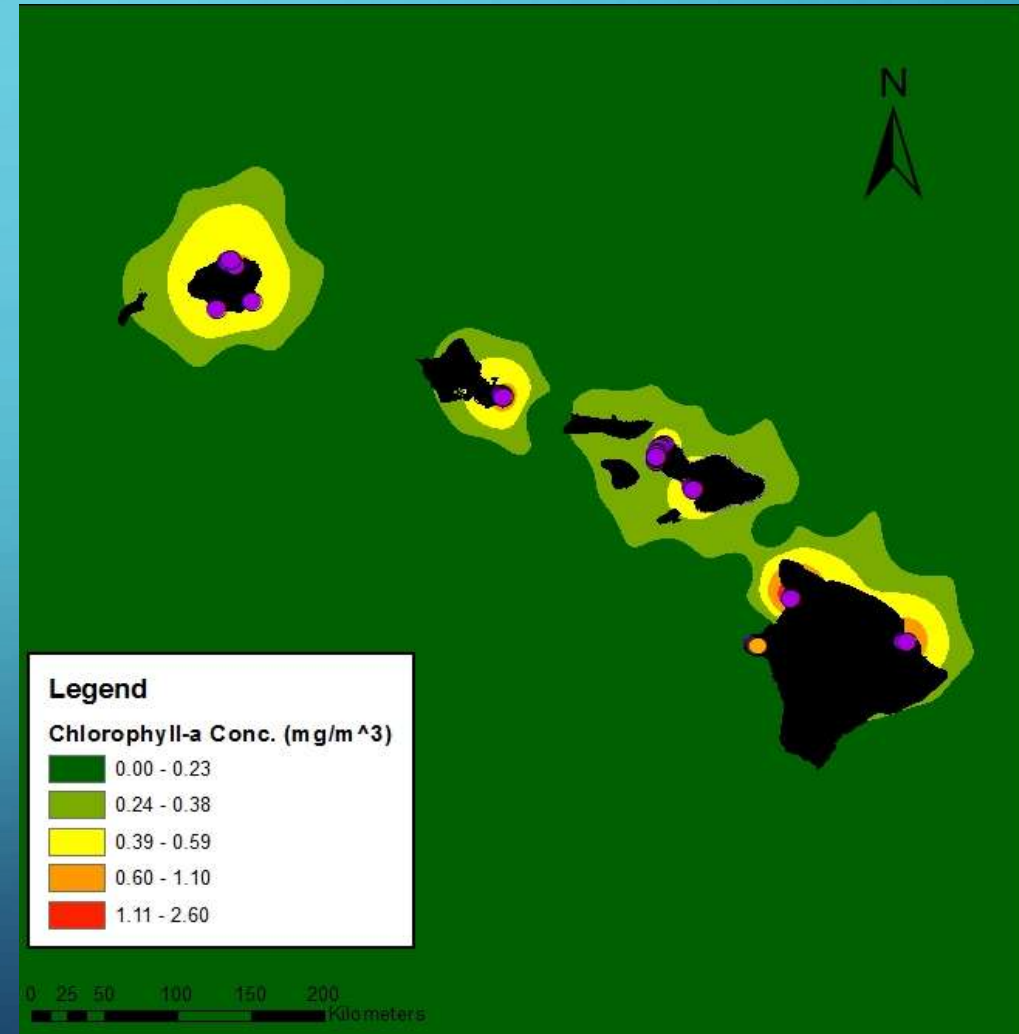
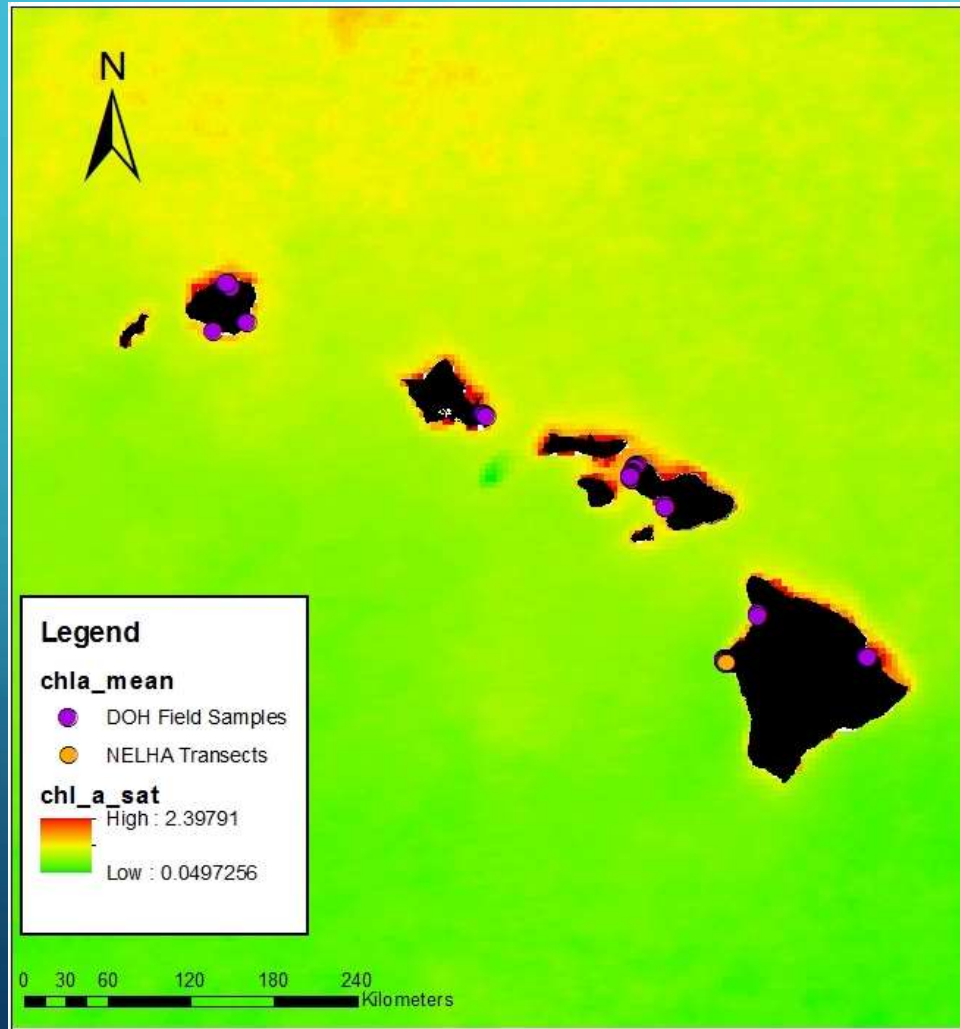
Location Name	Lat Decimal Degrees	Long Decimal Degrees	1-Jan	1-Apr	1-Jul	1-Nov	1-Jan	1-Apr	1-Aug	1-Oct	1-Feb	1-May	1-Aug	1-Dec
T1-1m	19.731944	-156.056944	3.6	3.4	3.3	14.7	3.3	5.6	4.1	4.9	6.6	7	3.6	2.7
T1-10m	19.731944	-156.056944	5.1	6.3	9	16.8	2.5	5.3	3.3	4.8	5.8	7	3.7	2.2
T1-50m	19.732222	-156.057222	4.2	3.7	6.9	15.4	0.1	6.5	4.2	2.9	5.6	8.3	5.2	2.2
T1-100m	19.732778	-156.0575	7.1	3	5.2	11	0.1	2.6	4.7	3.5	7.5	4.5	3.4	2.9
T1-500	19.733611	-156.058111	8.3	4	8.3	8.3	8.1	8.6	8.3	8.5	4	8.3	4	1.9

Chlorophyll-a VIIRS vs. Field Mapping

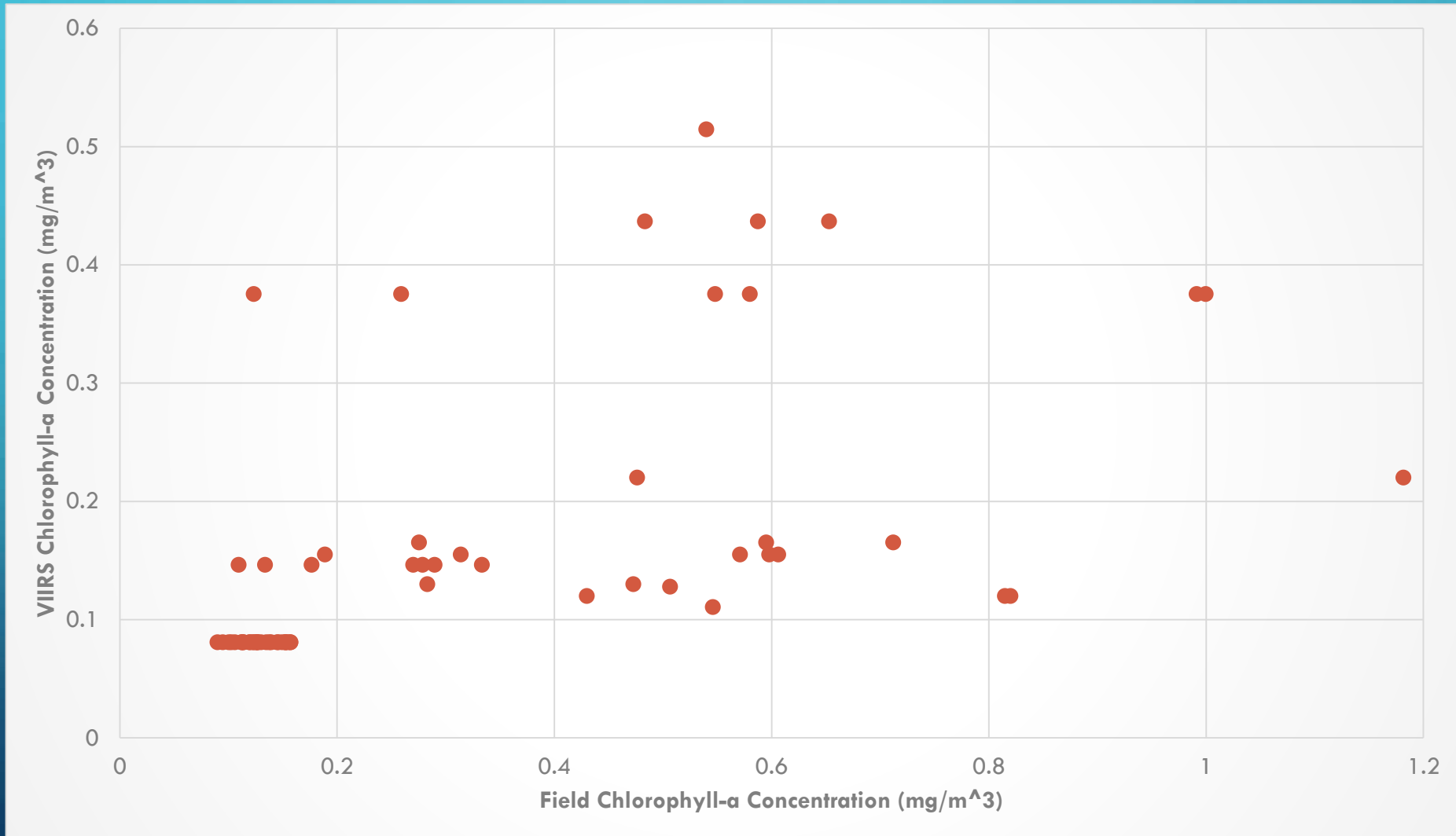
- Import Data into ArcMap
- Spatially reference field data
- Create interpolated data layers for various time periods
- Convert NetCDF VIIRS dataset into a raster layer



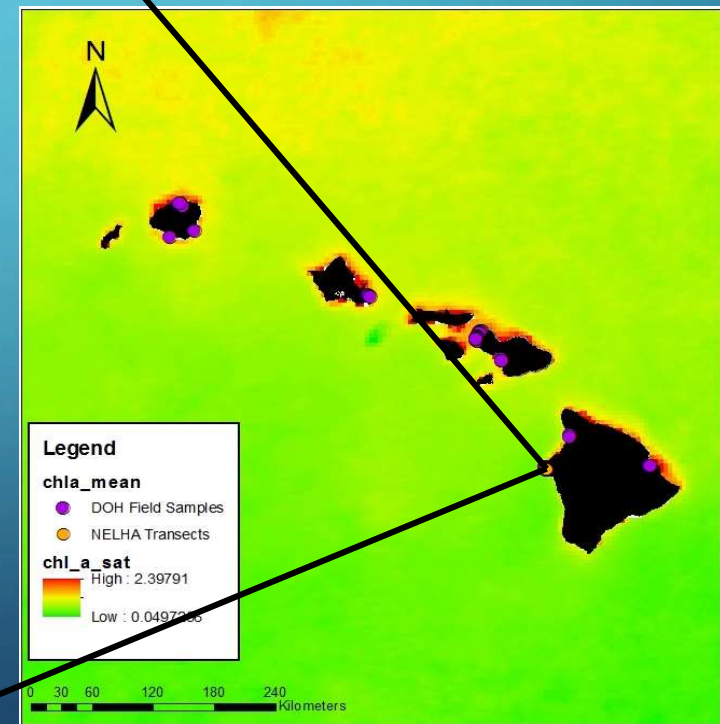
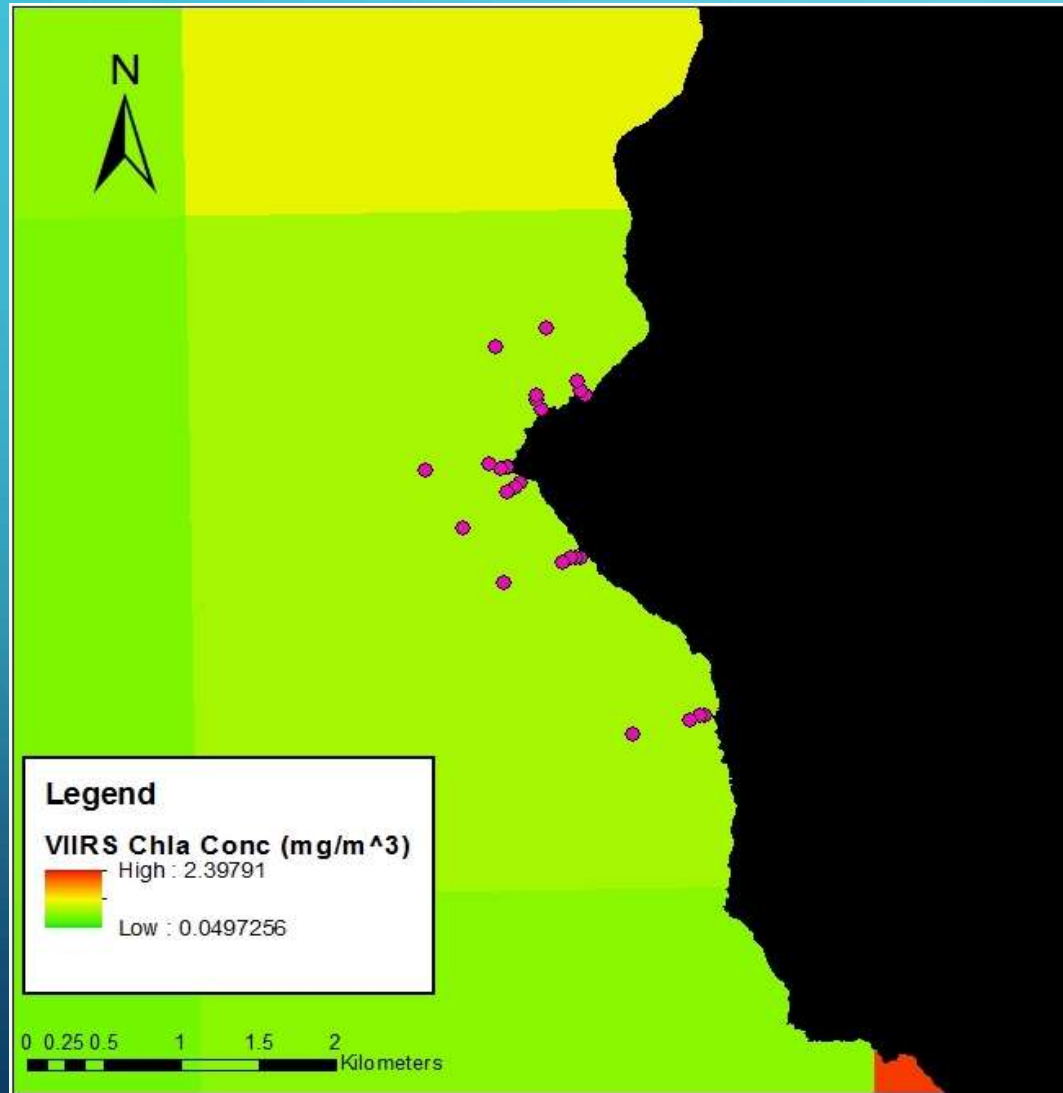
Chlorophyll-a VIIRS vs. Field Mapping



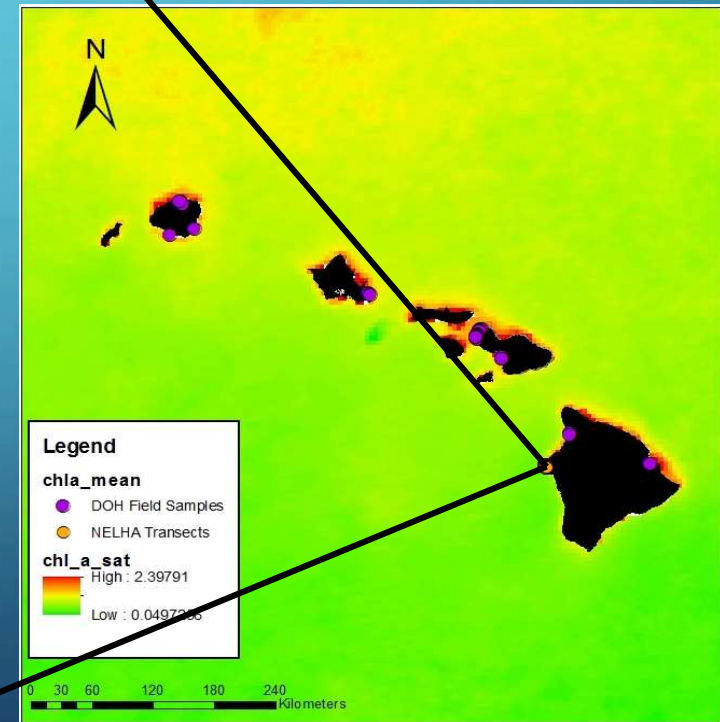
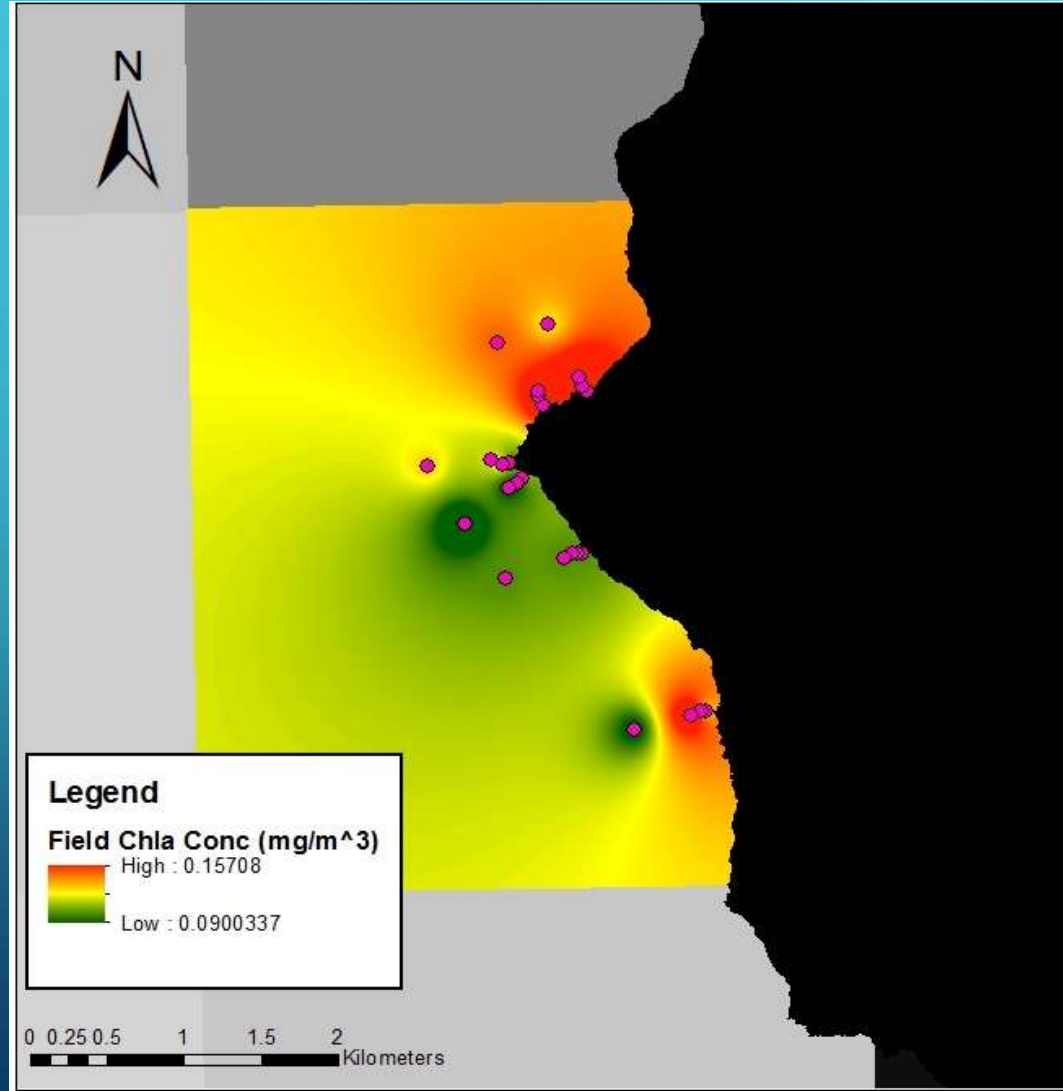
Chlorophyll-a VIIRS vs. Field Quantitative Analysis



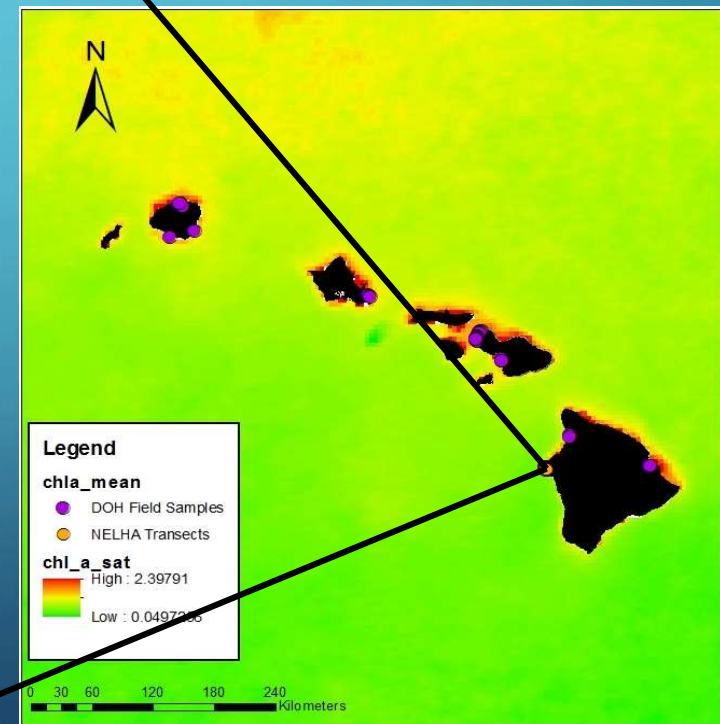
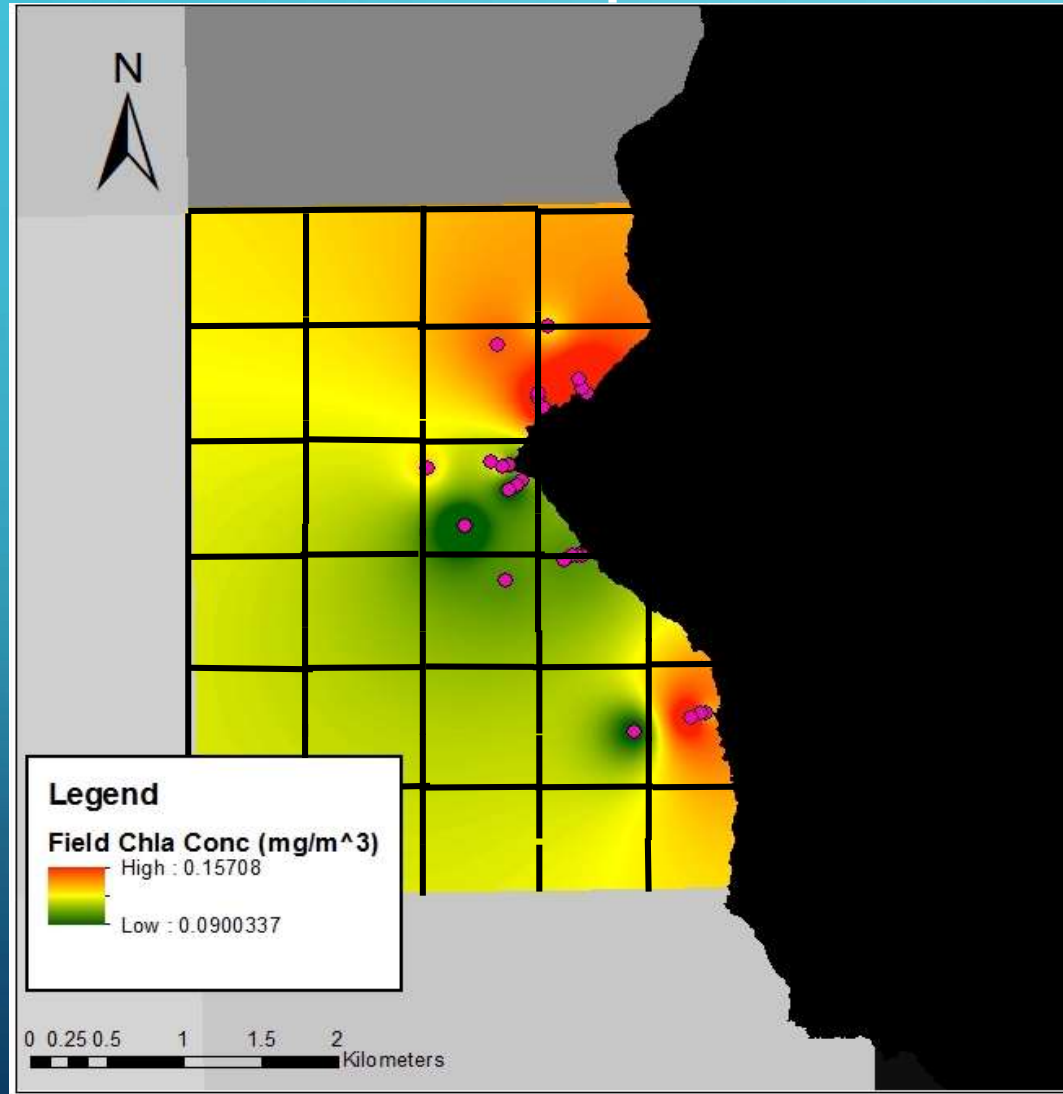
VIIRS NELHA Coastline



Interpolated NELHA Coastline



Interpolated NELHA Coastline



Conclusion/ Future Work

- Image processing and data analysis clearly demonstrated that VIIRS is **not** reliable for water quality monitoring at the moment
- However, VIIRS has the potential to be a valuable tool once:
 - Higher resolution VIIRS data is processed and available
 - More field state-wide field data is collected for further assesment

Acknowledgments



HAWAII COMMUNITY FOUNDATION
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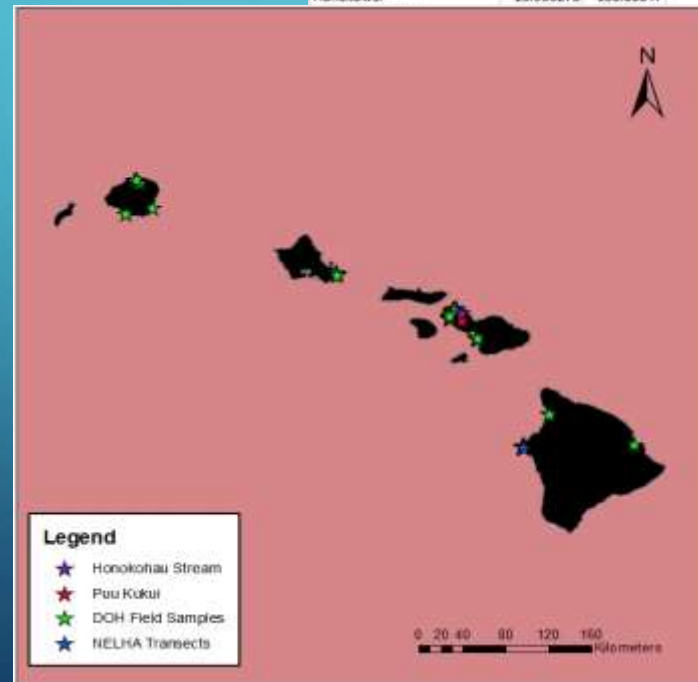


Akamai is led and managed by the Institute for Scientist & Engineer Educators at the University of California Santa Cruz. Funding for the 2016 Akamai Internship and Mentor Program is provided by: Thirty Meter Telescope International Observatory, the Air Force Office of Scientific Research (FA95501510427), the Hawai'i STEM Learning Partnership at the Hawaii Community Foundation, The Daniel K. Inouye Solar Telescope, the National Science Foundation (AST#1347767), the National Solar Observatory, the University of Hawai'i at Hilo, and the Canada-France-Hawaii Telescope.

Extended Work

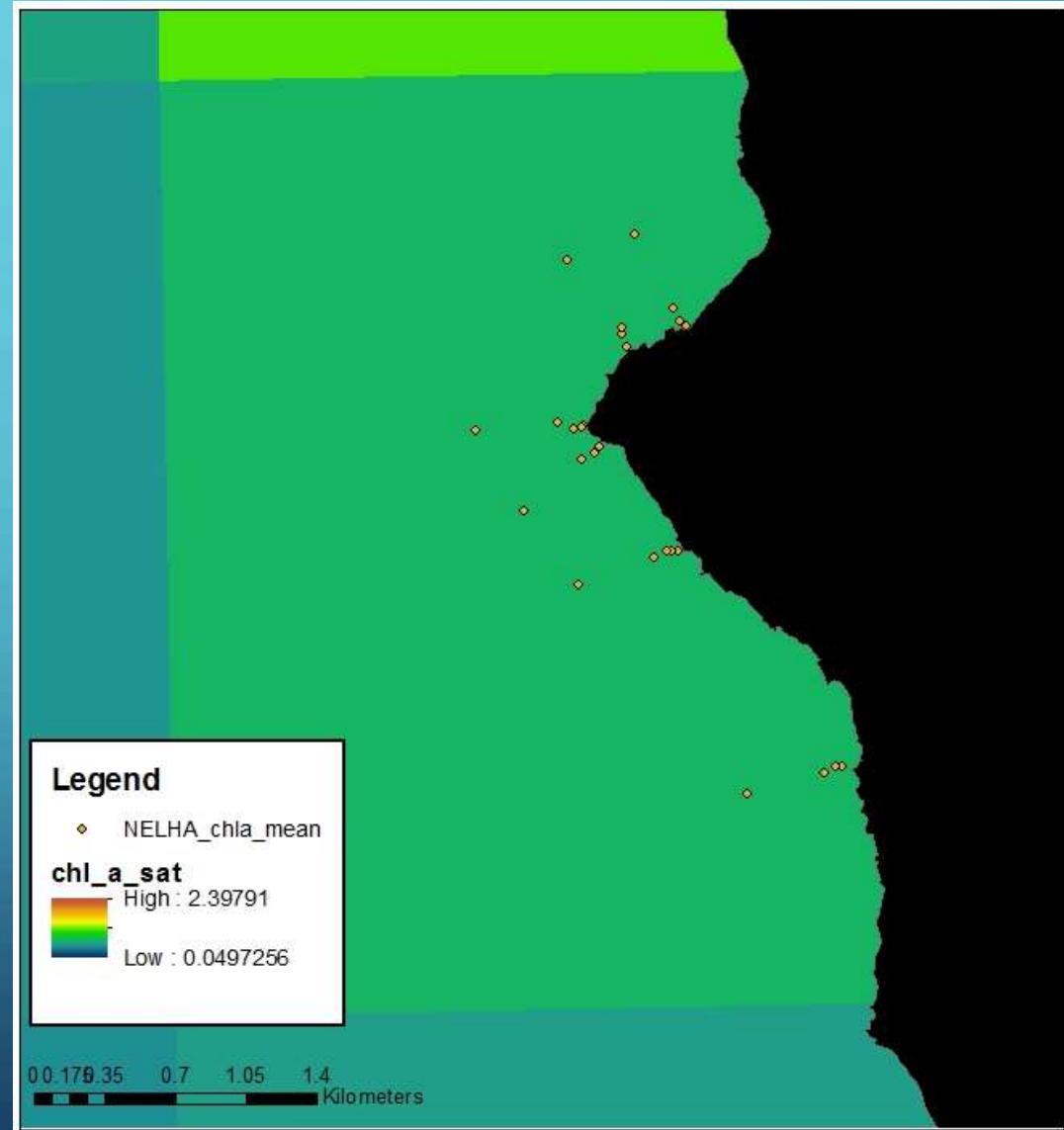
- Limited state-wide field data
- VIIRS Pixel Size (~4km)
- Cloud Cover
- Unreliable near shore resolution

Location Name	Lat Decimal Degrees	Long Decimal Degrees	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12
Bellow's Field Beach	21.354469	-157.70723					0.35			0.51				
Waimanalo Bay Shoreline	21.341958	-157.69988					-1	0.82						
Waimanalo Beach	21.332451	-157.69342					0.98	0.21	1.15					
Fleming Beach (South)	20.998636	-156.66667												
Sheraton Kaanapali Shoreline	20.924744	-156.69502												
Fleming Beach (North)	21.005	-156.65084												
Kihei (South)	20.747233	-156.45778		0.58	0.37	0.52	0.28	2.29	0.63				0.58	
Kalama Beach	20.731111	-156.45363		1.07	0.23	0.95	0.62	0.62	0.74				0.59	
Kamaole Beach #1	20.724739	-156.44917		0.51	0.53		0.44	0.2	0.61				0.83	
Kaopala Bay	20.981967	-156.67308												
Hanalei	20.910017	-156.68917												
Airport (Kahului) Beach	20.936669	-156.69278			0.05		0.16	0.1	0.11	0.18			0.22	
Cove Park	20.727503	-156.44974		0.39	0.16	0.38	2.46	4.53	0.55				1.15	
Honolulu Bay	21.013058	-156.63834												
Mokuleia	21.011111	-156.64256												
Oneloa	21.004056	-156.65894												
Napili	20.994222	-156.66742												
Pohaku	20.967083	-156.68139												
Honokowai	20.955278	-156.68647			0.1		0.32	0.15	0.25	0.3			0.26	
					0.06		0.07	0.14	0.08	0.1			0.09	
					0.06		0.08	0.13	0.13	0.09			0.24	
			0.47	0.27	0.15	2.46	0.88	0.42	0.49	0.41	0.74	0.37	1.02	0.54
			0.75	0.77	0.48	2.03	1	0.63	0.72	3.22	1.78	0.63	0.31	0.45
						0.39	1.73	4.57	0.76	0.34	1.47	0.38	1.83	0.56
						1.18	0.74	0.83	0.47	0.21	1.36	0.21	1.14	0.15
						0.4	0.19	0.21	0.31	1.99	0.34	2.53	3.48	1.79
						0.22	0.31	0.34	0.29	0.03	0.56	0.28	0.09	0.29
						0.9	1.53	1.31	1.32	0.87	2.4	0.98	0.44	2.54
						0.12	0.14	0.41	0.43	0.23	0.38	0.17	0.42	0.03
			1.15	1.03	0.53	1.06	0.46	1.34	0.56	1.11	2.13	2.89		
			0.24	0.28	0.31	0.43	0.52	0.59	0.23	1.27	0.59	0.34		



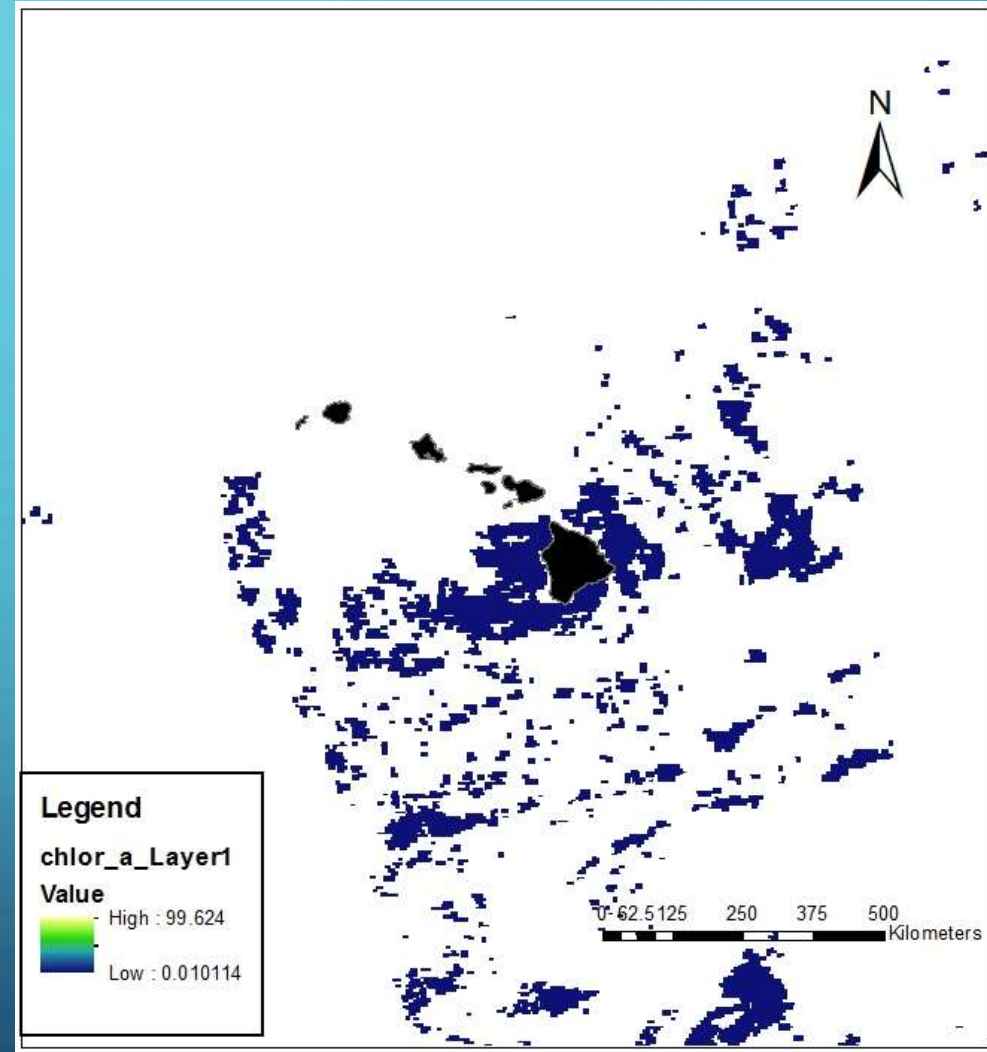
Extended Work

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- VIIRS Pixel Size ($\sim 4\text{km}$)
- Cloud Cover
- Unreliable near shore resolution



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