TOPIC:Spatial variation analysis of chlorophyll concentration using Sentinel-3 OLCI Imagery in the Bay of Bengal along the shores of the Chennai district, India.

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Guided by:

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Marine Debris /Marine Pollution

Measurements of chlorophyll-a, used as an estimate of phytoplankton biomass.

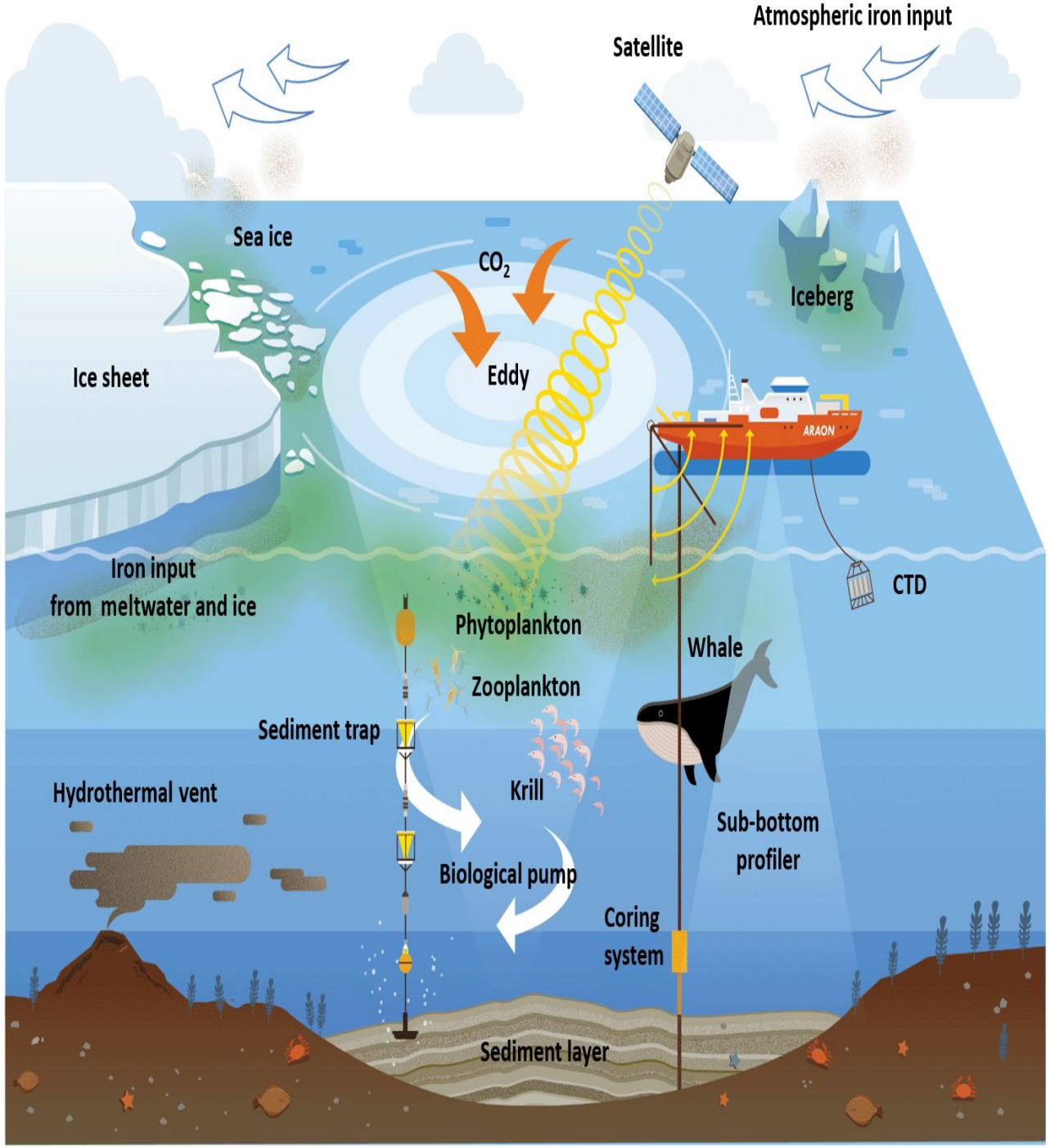
Chlorophyll-a represents the biological eutrophication indicator.

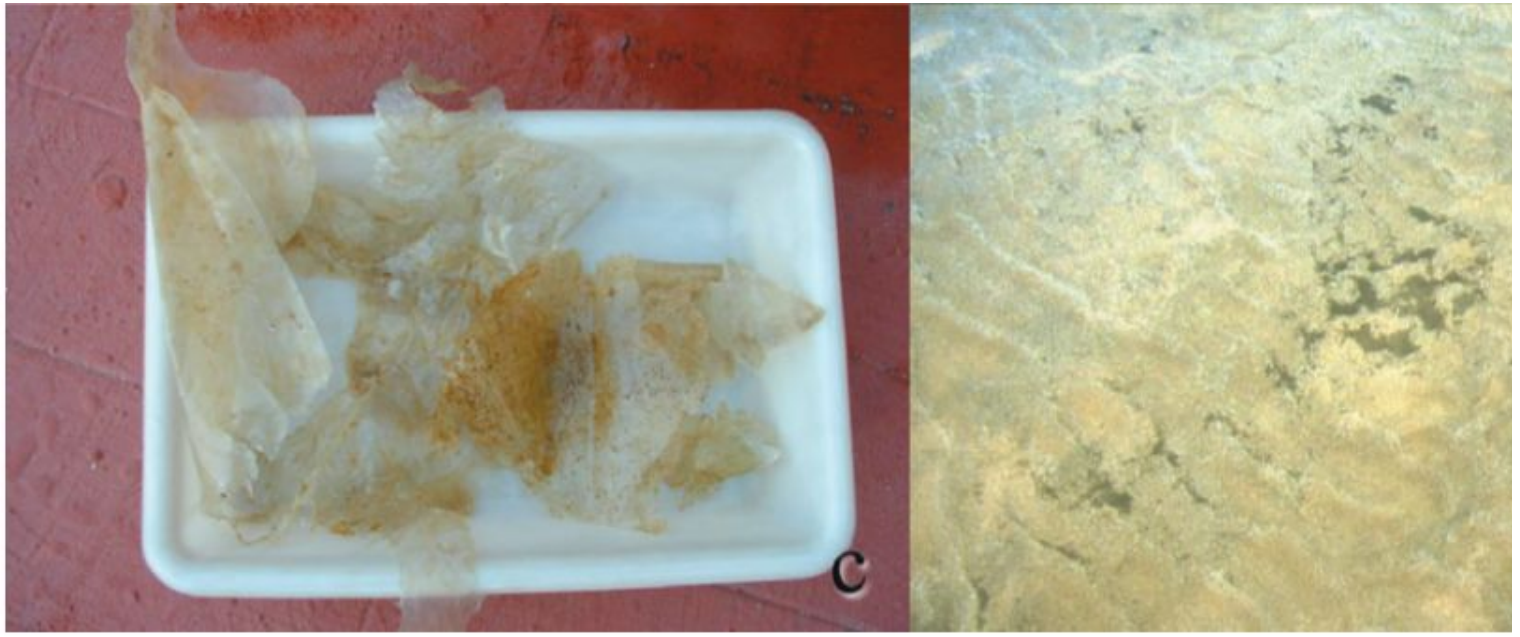
The negative effects of excessive phytoplankton growth are

1) changes in species composition and functioning of the pelagic food web.

2) increased sedimentation of organic material .

3) increase in oxygen consumption that may lead to oxygen depletion and the consequent changes in community structure or death of benthic fauna.



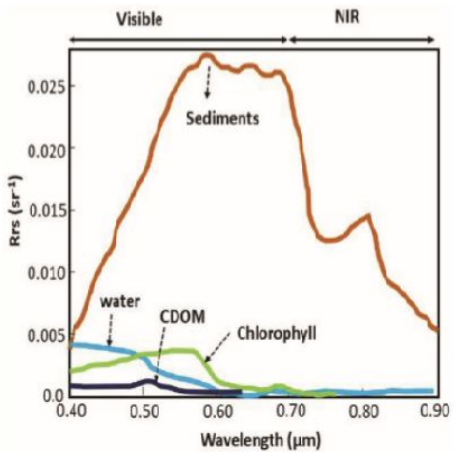


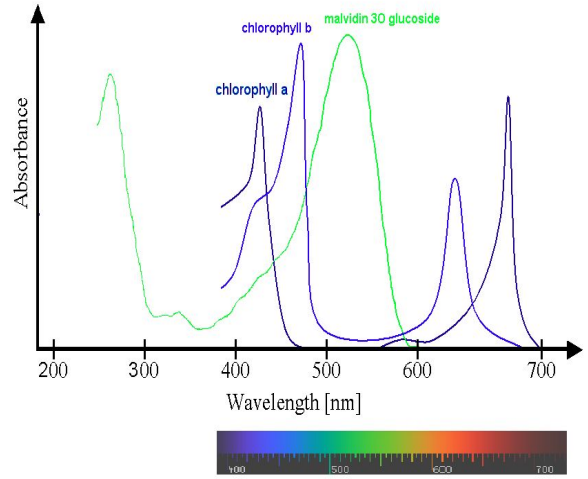
Marine debris

Introduction

- Phytoplankton's concentration on the surface of sea reflects the marine ecosystem health.
- Chennai is city which as big shore line comes under Bay of Bengal sea.
- High tides, ocean currents and storms are regularly occurring in this region.
- Study focus on the change in the chlorophyll concentration over a year using spatial analysis by Sentinel-3 OLCI satellite.(remote sensing technology)

Wavelength at which Chlorophyll is observed

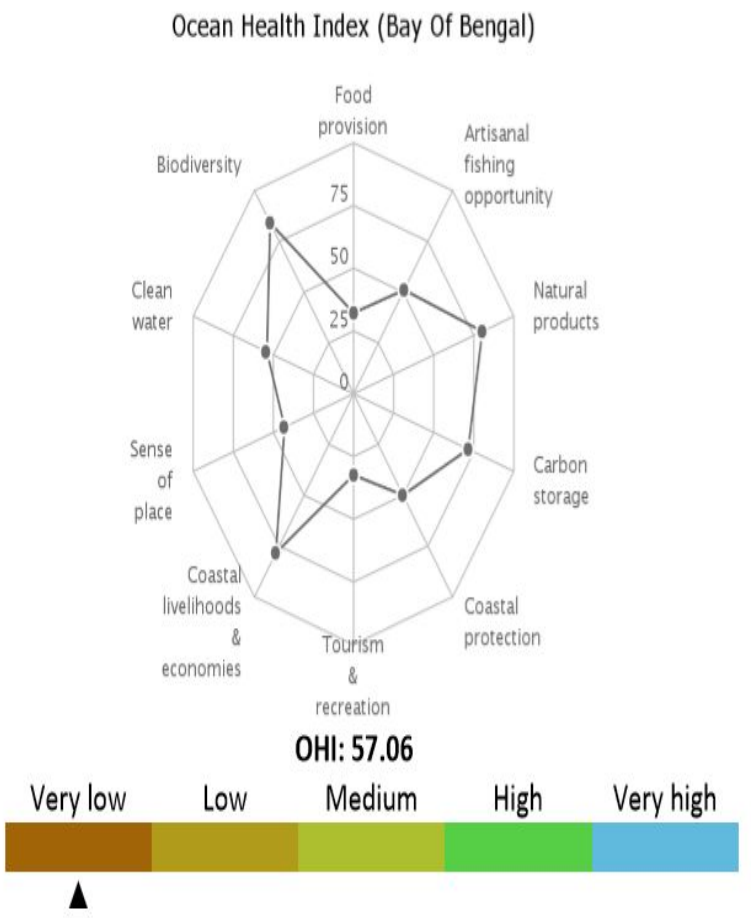




Phytoplankton's presence in Bay of Bengal

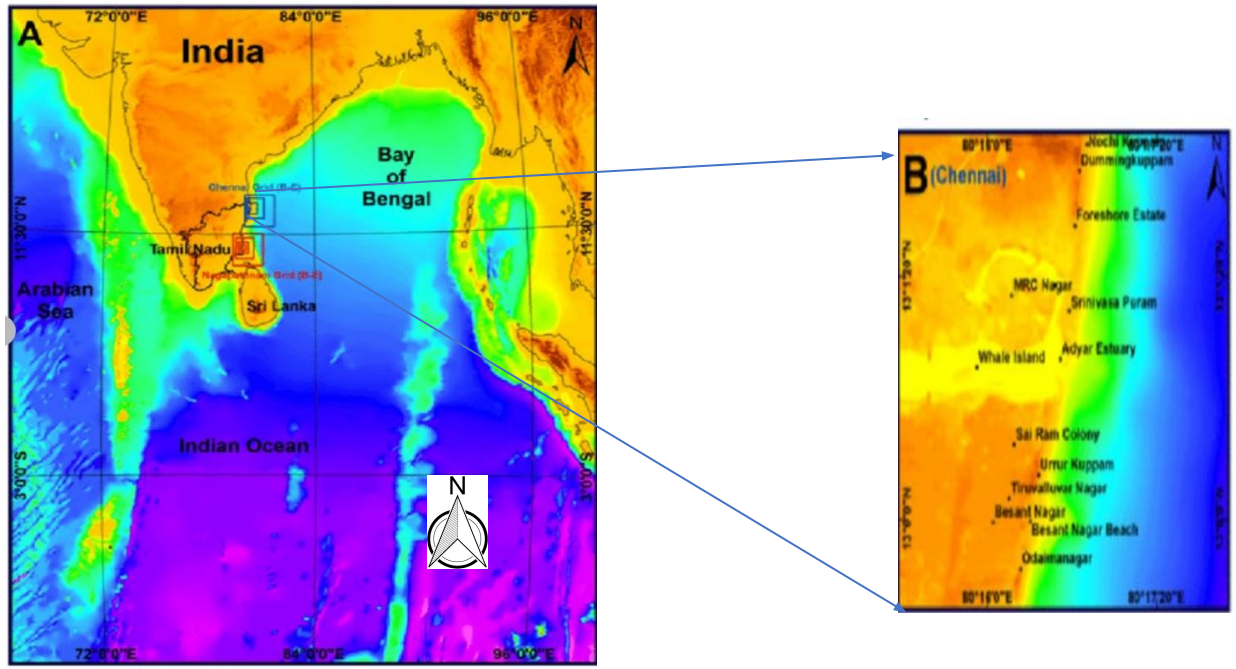
Aim of the study

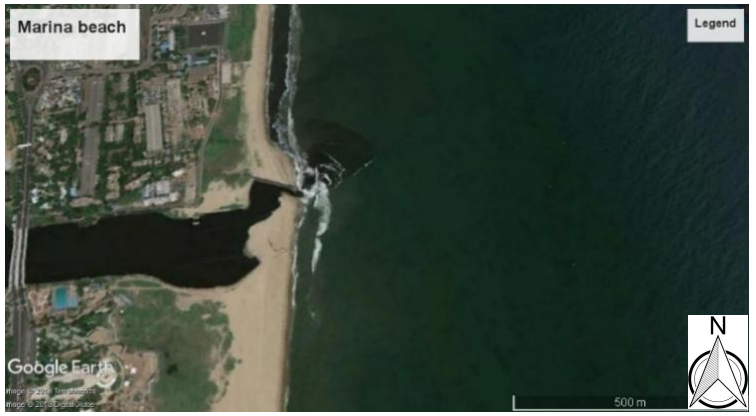
- To evaluate whether the Sentinel – OLCI L2 Imagery can give scientifically significant results on chlorophyll concentration in Bay of Bengal region with respect to other well-known satellites like MERIS, MODIS and SeaWiFS.
- To use Sentinel-3A Ocean and Land Color Instrument (OLCI) imagery satellite for detecting changes in chlorophyll concentration over an year in the selected region of Chennai coastal line in Bay of Bengal sea.
- To analyze results obtained by Sentinel-3 OLCI L2 over a large area which is affected by anthropogenic activities and environmental pollution. The areas with an intensive amount of phytoplankton blooms shows a high concentration of chlorophyll.



Study Region

The study was conducted in the shores of Chennai region
Site -1 Marina beach
Site- 2 Palavakkam beach
Distance between site nearly 15 kms





Location First: Marina Beach

Coordinates 13.0500° N, 80.2824° E

Location Second Palavakkam Beach

Coordinates 12°57′13″N 80°15′26″E

Data And Methodology

The Sentinel-3 OLCI(ocean land colour Imagery) satellite L-2 data products were used to obtain the monthly data.

The Sentinel-3 OLCI has MERIS Heritage bands in cooperated in the satellite (blue in table).

The NN file(neural net) data was used ranging from 0.01-100 mg/m³ concentration of chlorophyll.

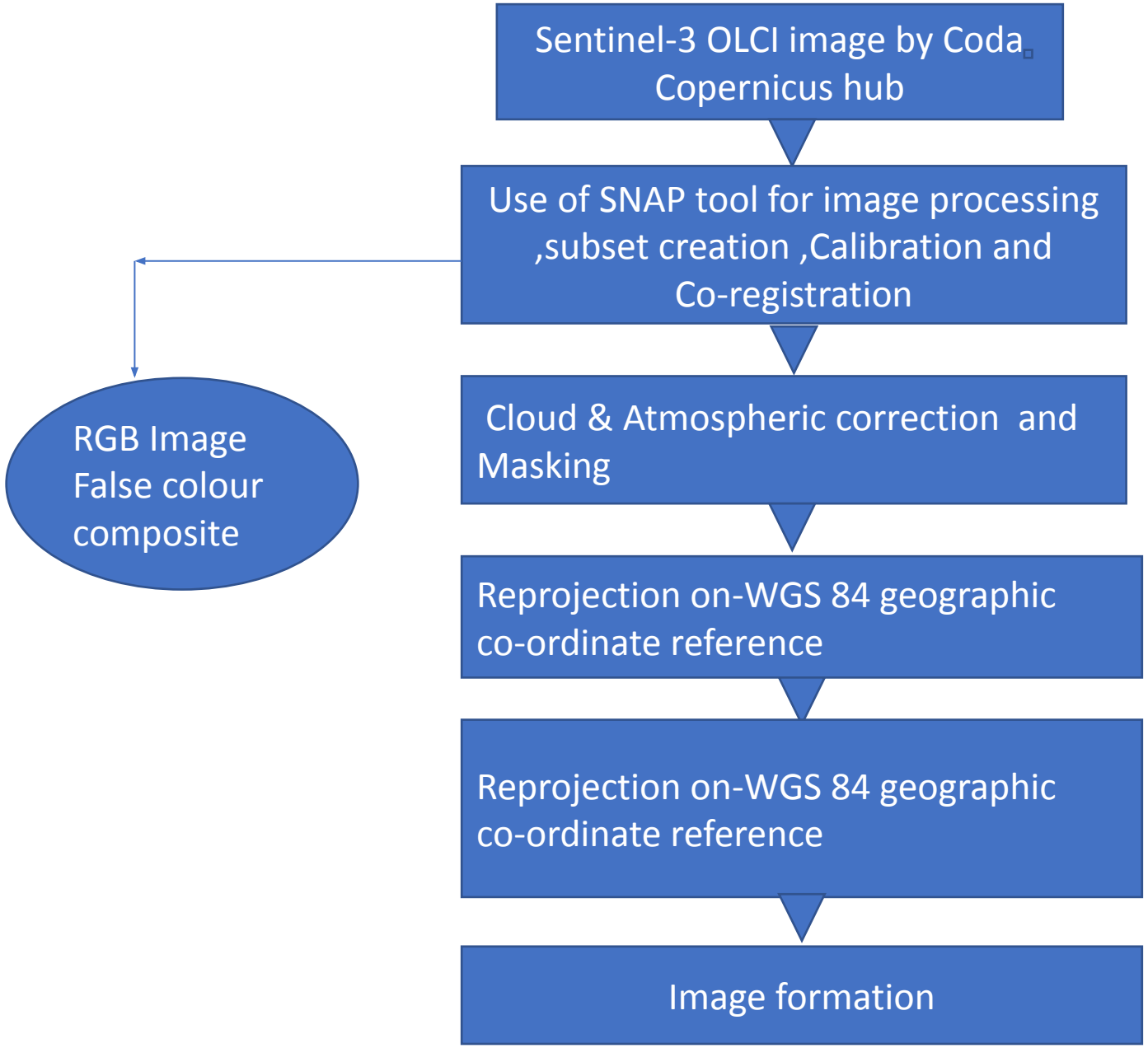
The data processing was achieved using sentinel application platform (SNAP).

CODA Copernicus hub was used for image processing.

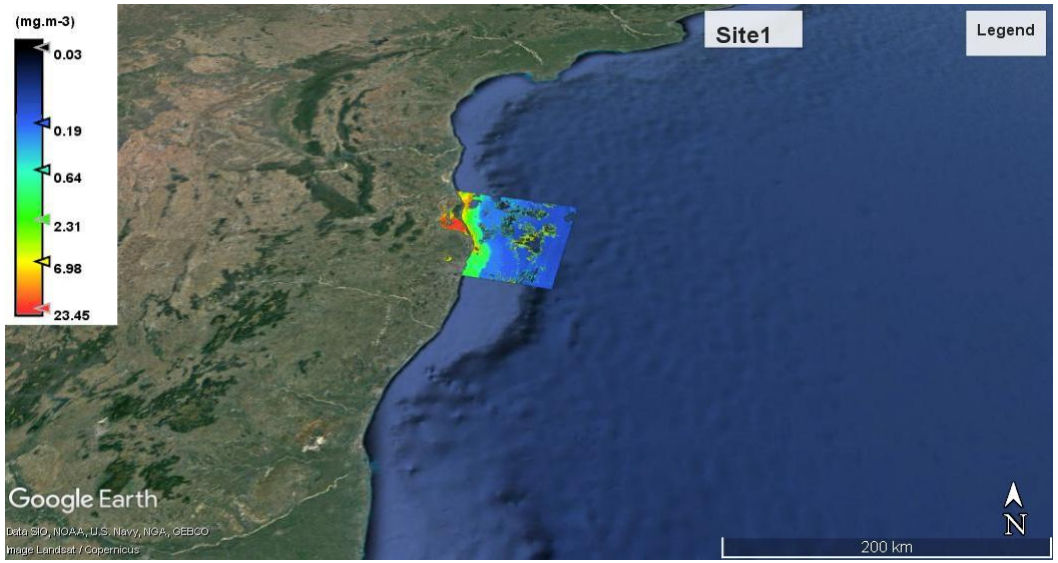
Shape files (.shp) for the selected study region were created in ArcGIS 10.5

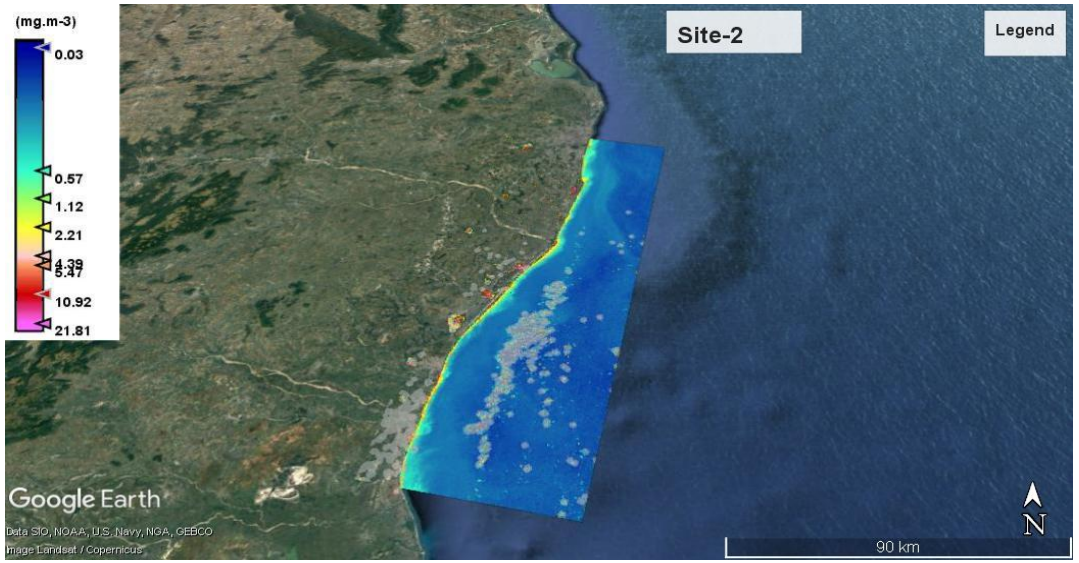
Band #	λ center	Width	Lmin	Lref	Lsat	SNR@Lref
	nm	nm	W/(m².sr.µm)	W/(m².sr.µm)	W/(m².sr.µm)	
Oa1	400	15	21.60	62.95	413.5	2188
Oa2	412.5	10	25.93	74.14	501.3	2061
Oa3	442.5	10	23.96	65.61	466.1	1811
Oa4	490	10	19.78	51.21	483.3	1541
Oa5	510	10	17.45	44.39	449.6	1488
Oa6	560	10	12.73	31.49	524.5	1280
Oa7	620	10	8.86	21.14	397.9	997
Oa8	665	10	7.12	16.38	364.9	883
Oa9	673.75	7.5	6.87	15.70	443.1	707
Oa10	681.25	7.5	6.65	15.11	350.3	745
Oa11	708.75	10	5.66	12.73	332.4	785
Oa12	753.75	7.5	4.70	10.33	377.7	605
Oa13	761.25	2.5	2.53	6.09	369.5	232
Oa14	764.375	3.75	3.00	7.13	373.4	305
Oa15	767.5	2.5	3.27	7.58	250.0	330
Oa16	778.75	15	4.22	9.18	277.5	812
Oa17	865	20	2.88	6.17	229.5	666
Oa18	885	10	2.80	6.00	281.0	395
Oa19	900	10	2.05	4.73	237.6	308
Oa20	940	20	0.94	2.39	171.7	203
Oa21	1020	40	1.81	3.86	163.7	152

General methodology for image formation for chlorophyll detection



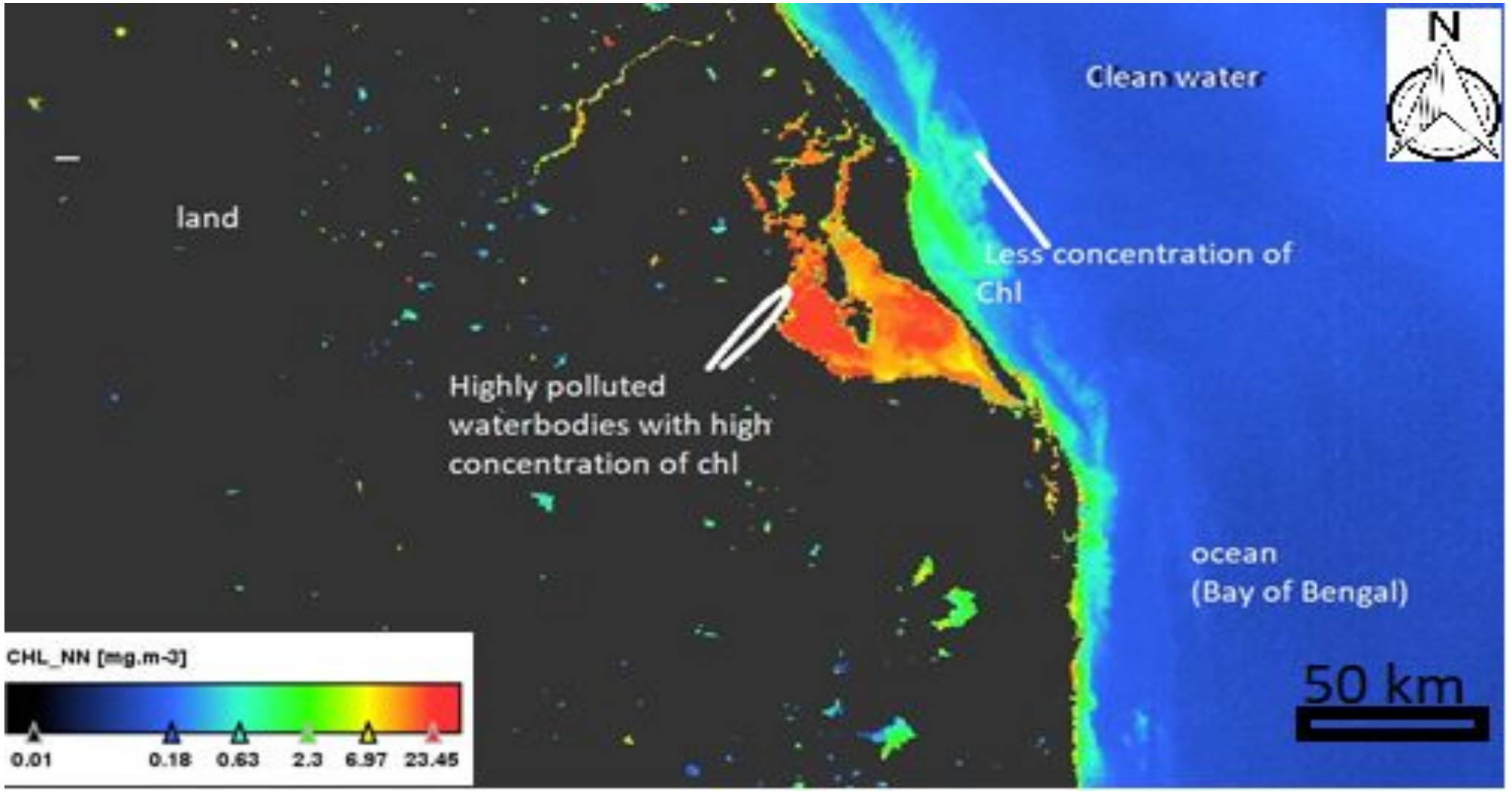
KMZ image formation for Site -1 and Site-2 using SNAP tool describing location on Google Earth Pro.





RGB image of the location using band 11,8,4

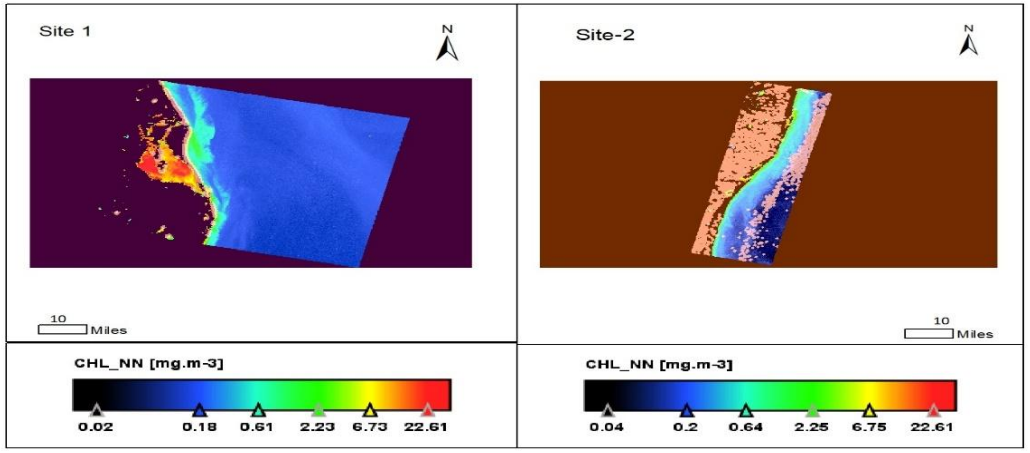
Depiction of Image formed with Legend



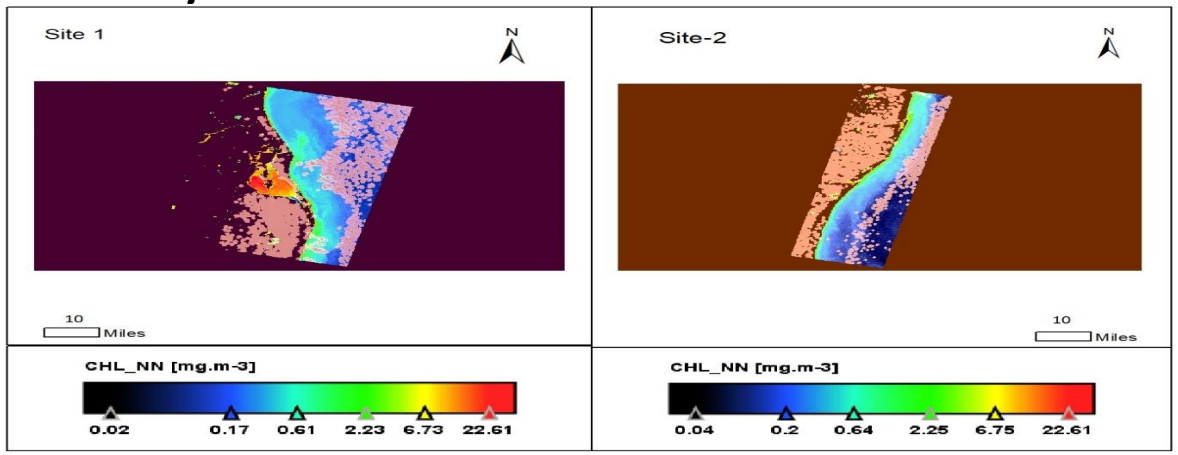
RESULTS

Annual chlorophyll concentration for Site-1 And Site-2 using Sentinel- L2 OLCI imagery

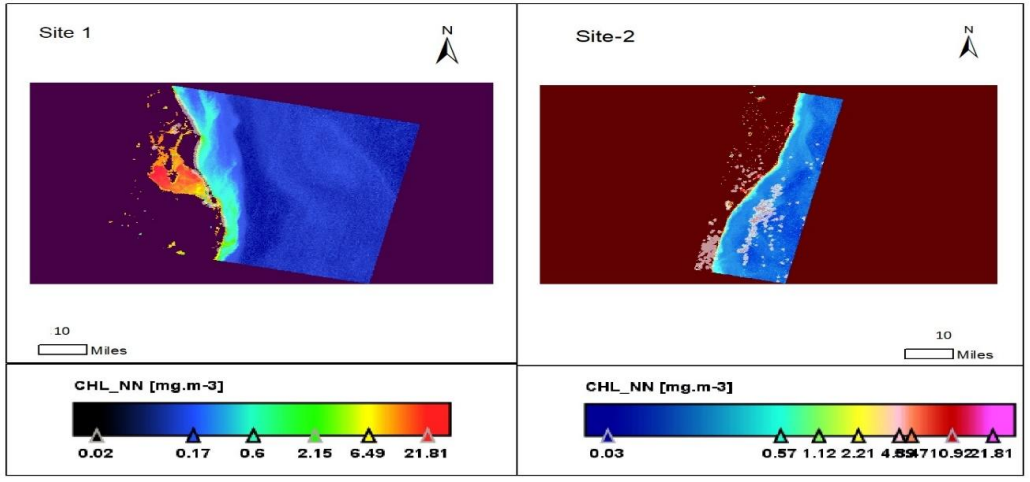
January 2018



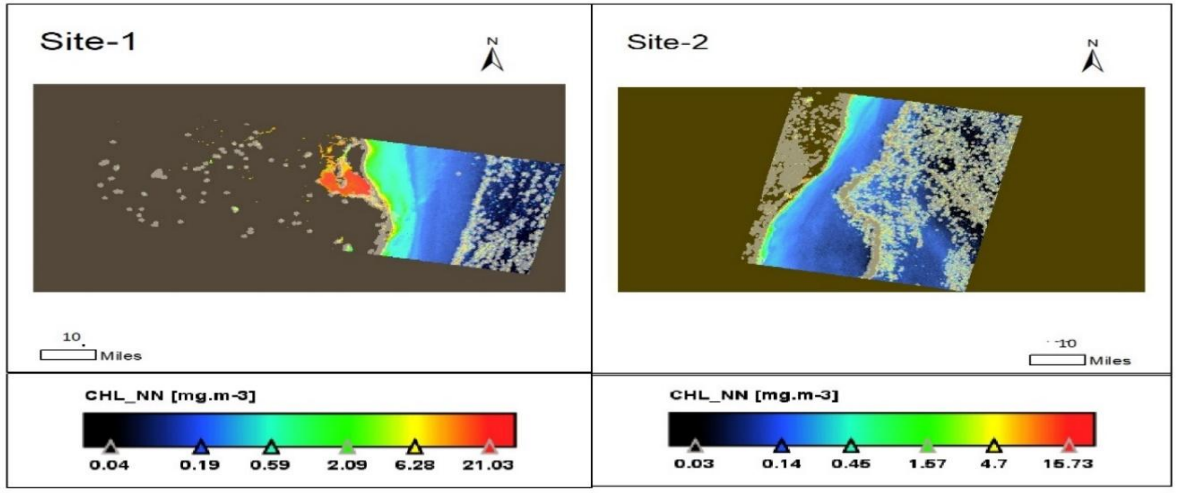
February 2018



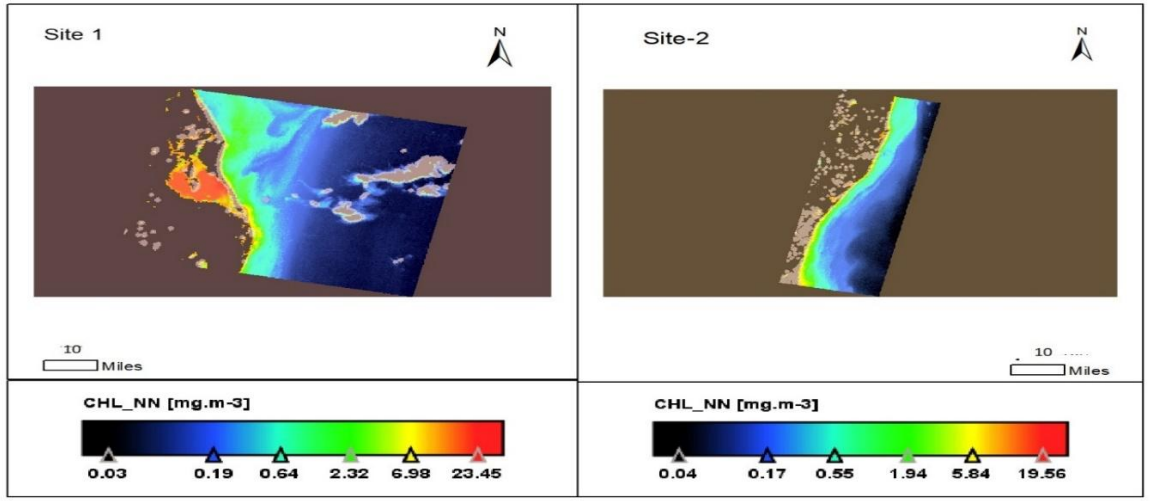
March 2018



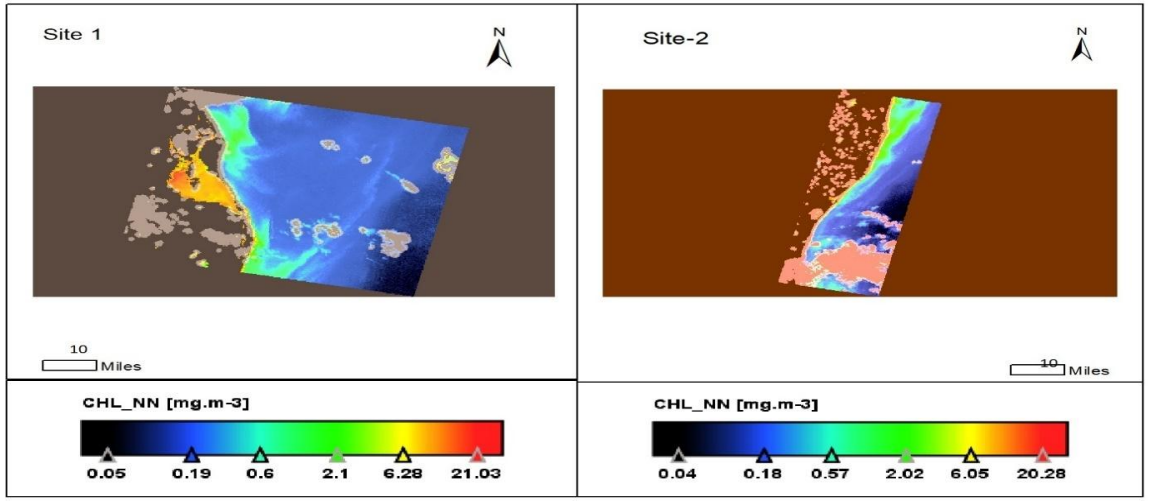
April 2018



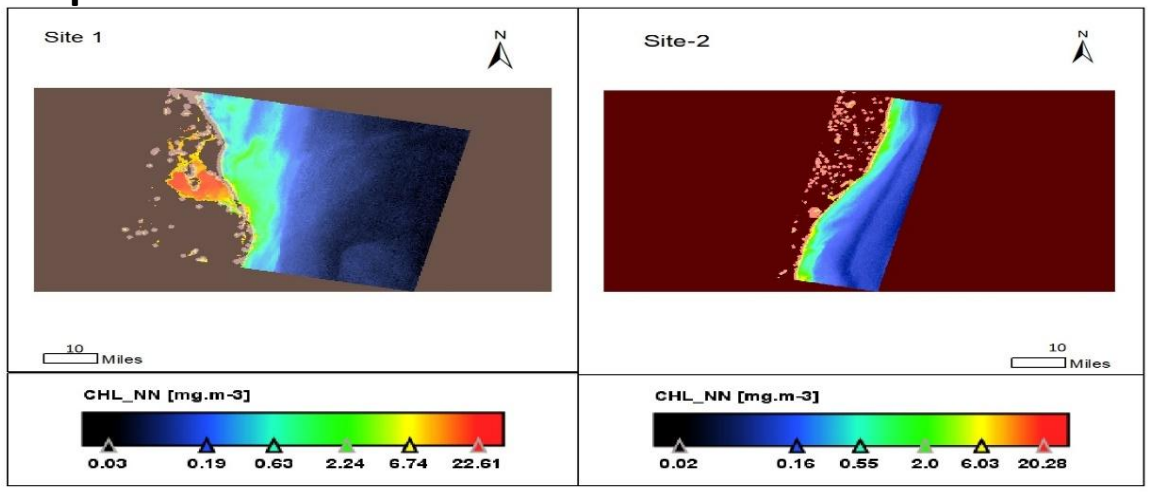
May 2018



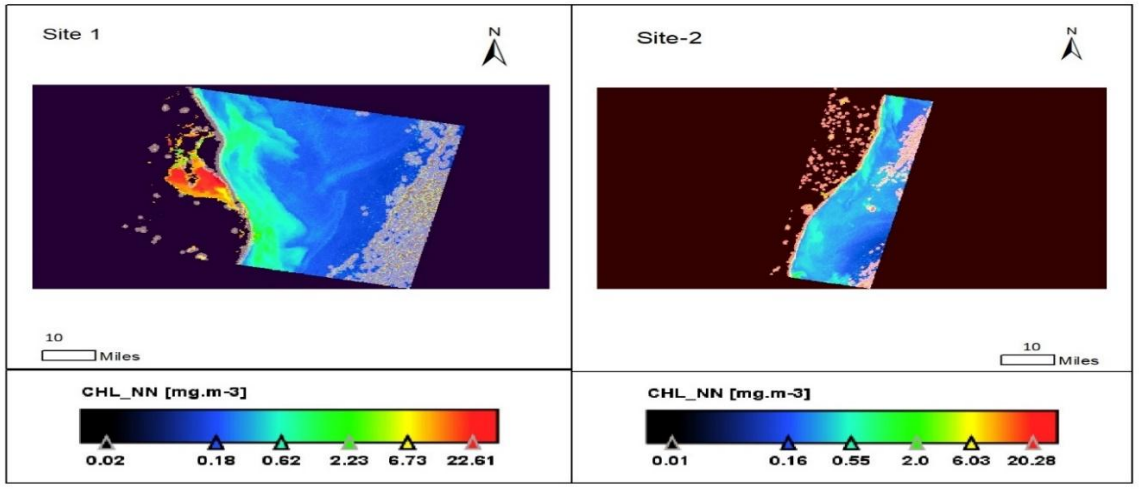
June 2018



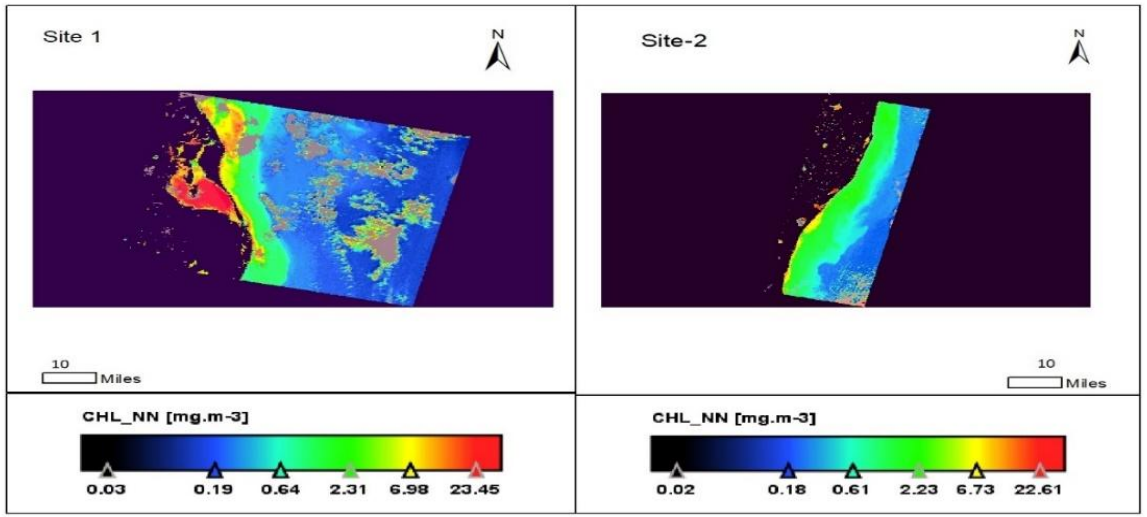
September 2018

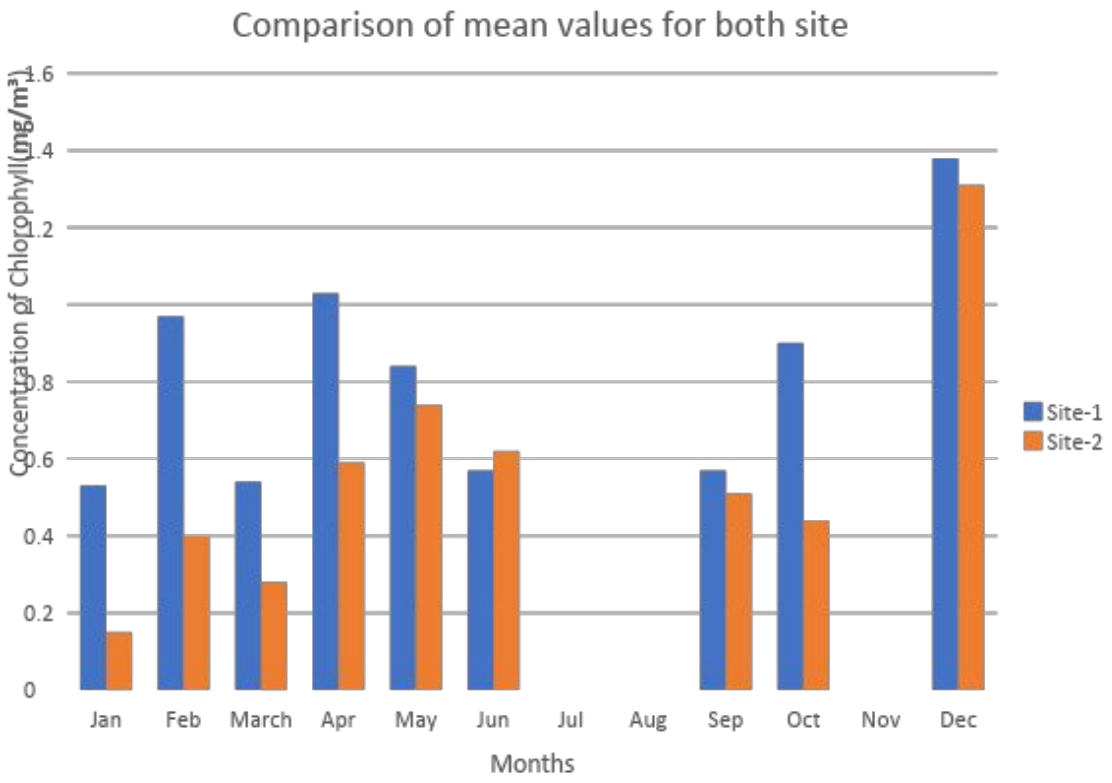


October 2018



December 2018





Annual values obtained for chlorophyll concentration at study location

Site-1

Month	Min (mg/m^3)	Max (mg/m^3)	Mean (mg/m^3)	Median (mg/m^3)	Coefficient of variation	Standard Deviation
Jan	0.01	22.61	0.53	0.13	7.29	3.86
Feb	0.01	26.14	0.97	0.24	5.89	5.71
Mar	0.01	21.80	0.54	0.08	6.46	3.49
Apr	0.03	21.82	1.03	0.15	4.81	4.95
May	0.04	23.44	0.84	0.06	5.50	4.62
Jun	0.04	21.02	0.57	0.12	5.85	3.33
Jul	NA	NA	NA	NA	NA	NA
Aug	NA	NA	NA	NA	NA	NA
Sep	0.01	22.61	0.57	0.07	7.03	4.0
Oct	0.01	22.61	0.90	0.19	5.26	4.73
Nov	NA	NA	NA	NA	NA	NA
Dec	0.01	23.44	1.38	0.20	4.42	6.09

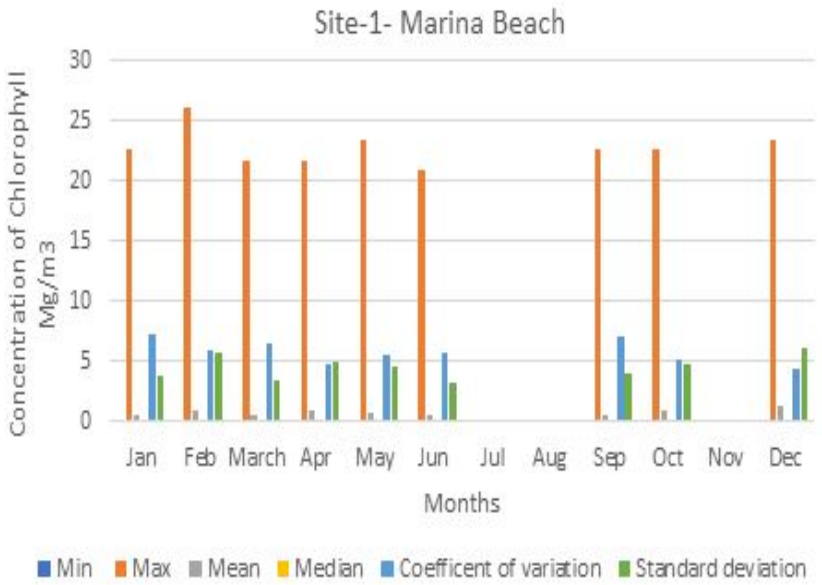
Site-2

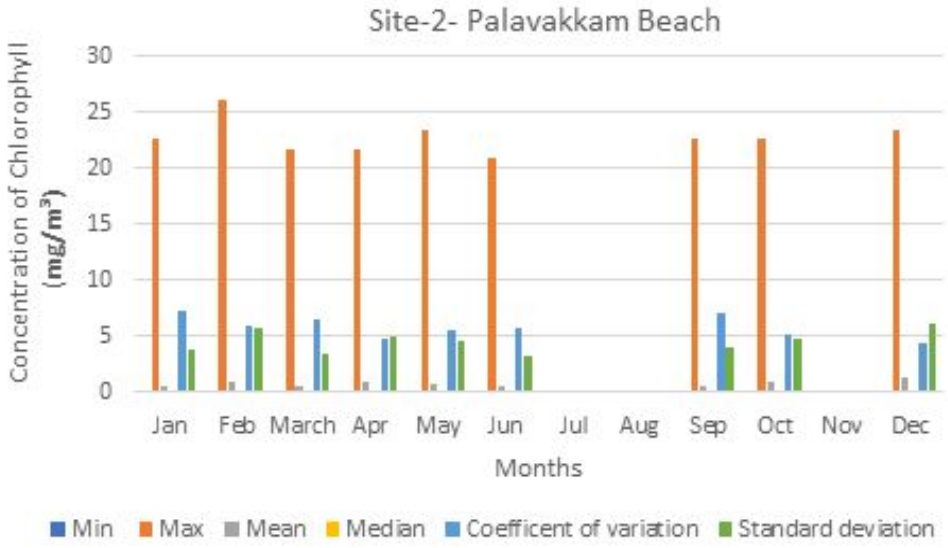
Month	Min (mg/m^3)	Max (mg/m^3)	Mean (mg/m^3)	Median (mg/m^3)	Coefficient of variation	Standard Deviation
Jan	0.02	22.61	0.15	0.10	21.26	3.18
Feb	0.04	22.61	0.40	0.16	10.54	4.22
March	0.01	18.86	0.28	0.07	8.77	2.45
Apr	0.03	21.02	0.59	0.14	5.46	3.22
May	0.01	20.28	0.74	0.14	4.99	3.7
Jun	0.02	20.28	0.62	0.18	5.98	3.7
Jul	NA	NA	NA	NA	NA	NA
Aug	NA	NA	NA	NA	NA	NA
Sep	0.01	20.28	0.51	0.11	6.88	3.50
Oct	0.01	21.02	0.44	0.23	8.15	3.6
Nov	NA	NA	NA	NA	NA	NA
Dec	0.01	26.14	1.31	0.27	5.08	6.65

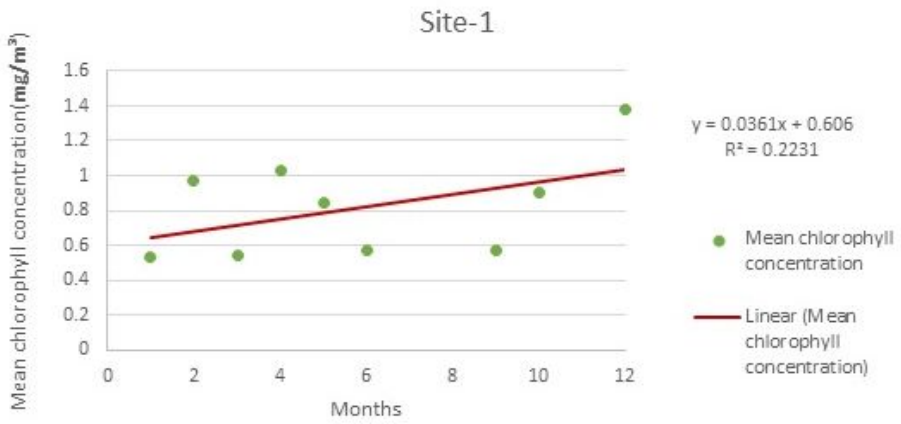
Conclusions from the study

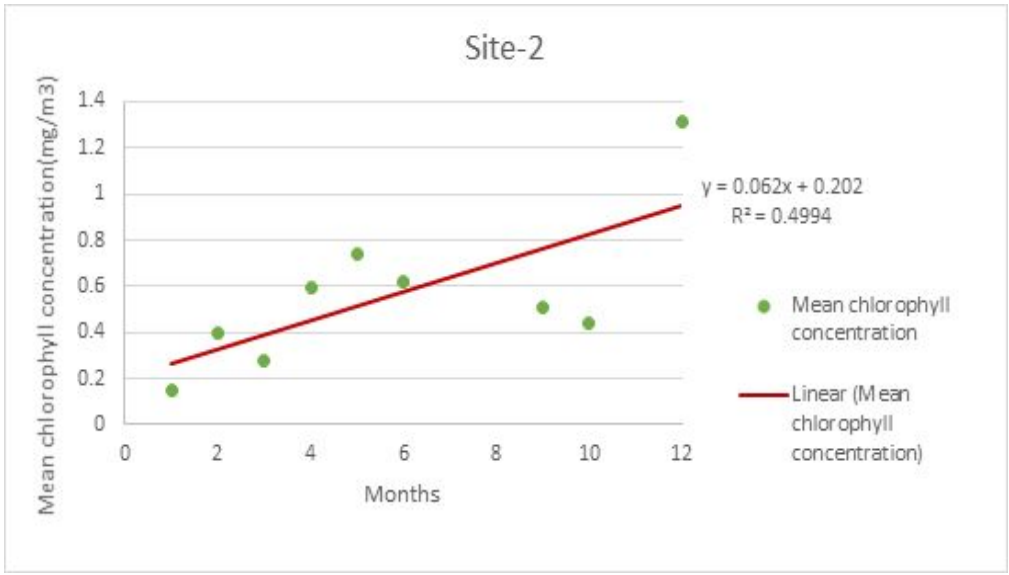
- The changes in chlorophyll concentration are visible in month of December and April 2018 for both the sites
- Mean value of chlorophyll concentration obtained for site -2 remains low annual as compared to site-1 through out the year.
- The impact of events like cyclone Gaja is visible on concentration of chlorophyll, that can be easily explain by rise of chlorophyll concentration in the month on December for Site-2.
- Sentinel-3 OLCI proved to be a great tool for analysis of different parameters in ocean at large scale.
- SNAP shows great results for Sentinel-3 satellite.

Comparison of the annual result obtained for site-1 and site-2









Thank you.