

Satellite remote sensing of marine litter floating in open ocean and coastal waters

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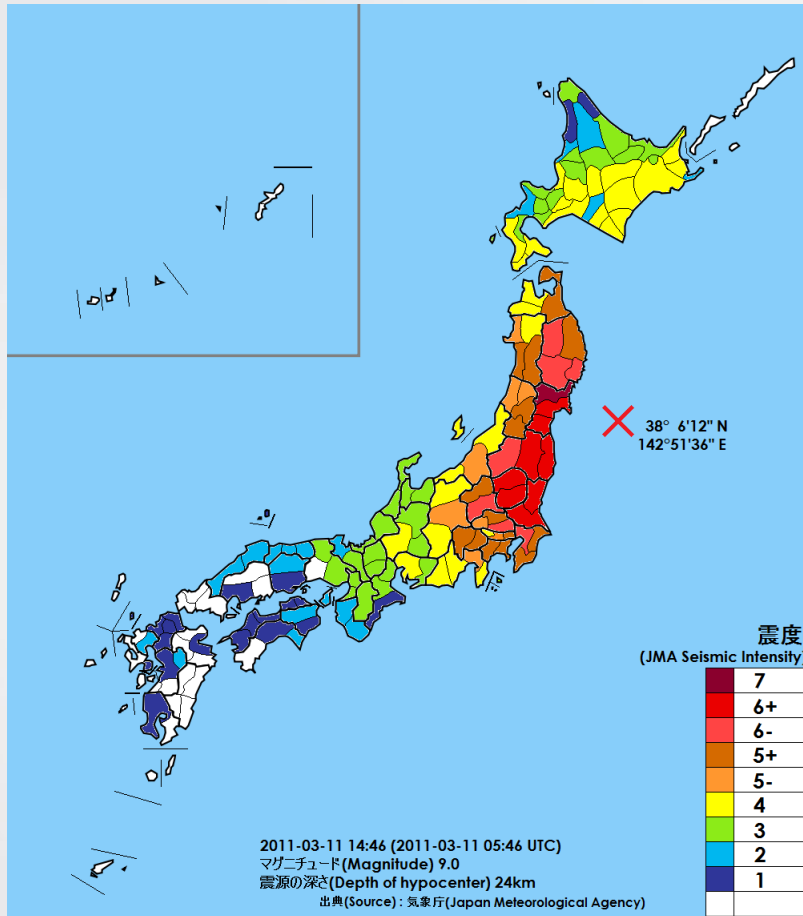
In this talk, we look at:

1. **East Japan Tsunami on 11 March, 2011**
 - **GOCI (500m GSD with 6 VIS and 2 NIR)**

2. **Severe flooding Aug, 2018 in Southern part of Korea**
 - **MSI (10m GSD for 3 VIS and 1NIR , 20m GSD for 3VIS and 2 SWIR)**
 - **OLI (30m GSD for 4 VIS, 1NIR, 2 SWIR)**
 - **PS2 (4m GSD for 3 VIS and 1 NIR)**

3. **Ocean Cleanup System deployment in the North Pacific Ocean Sept, 2018**
 - **Worldview-3 (0.31m pansharpened 5 VIS and 3 NIR)**

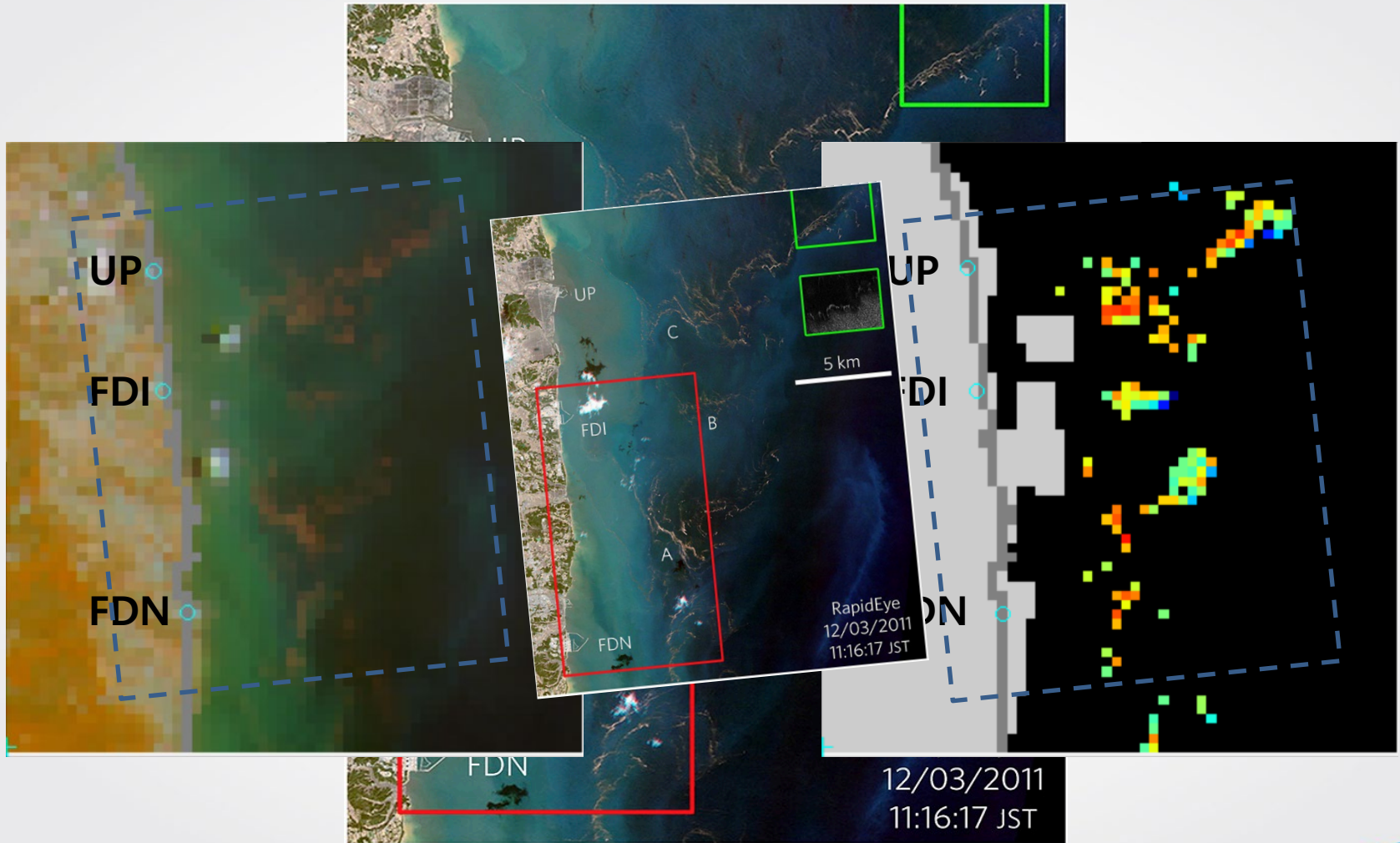
Mar-2011 East Japan Tsunami



Helicopter flying over the aftermath of the tsunami, 12 March 2011(source: Wikipedia)

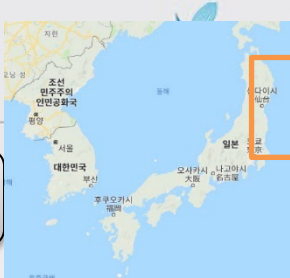
Maximum JMA Seismic Intensities for the 11 March 2011 Tōhoku Earthquake (Source: Wikipedia)

Mar-2011 East Japan Tsunami: Images



Source: Matthews et al.(2017) Dynamics and early post-tsunami evolution of floating marine debris near Fukushima Daiichi. *Nat. Geosci.* 10, 598–605

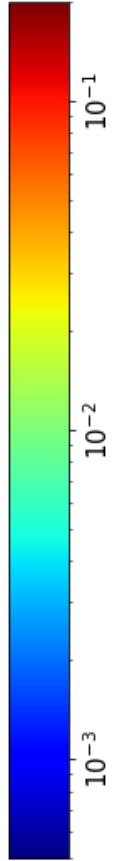
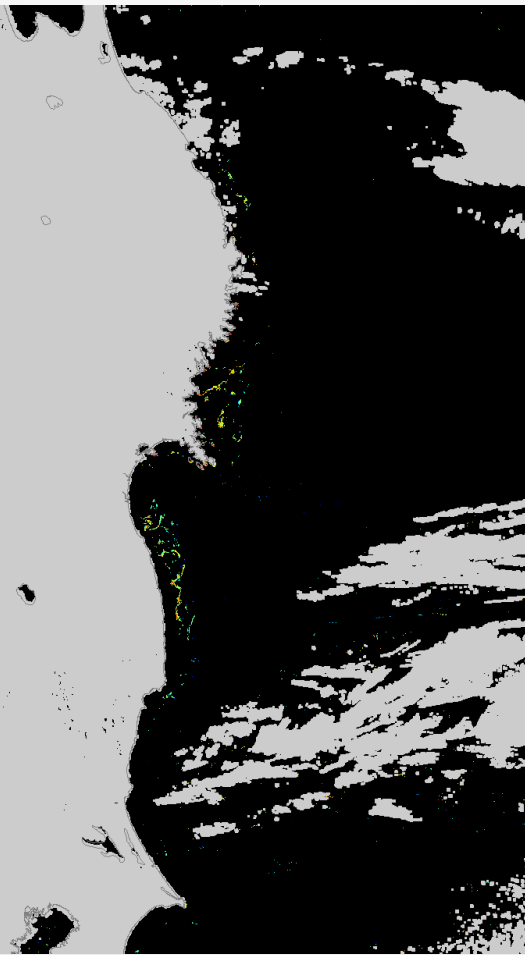
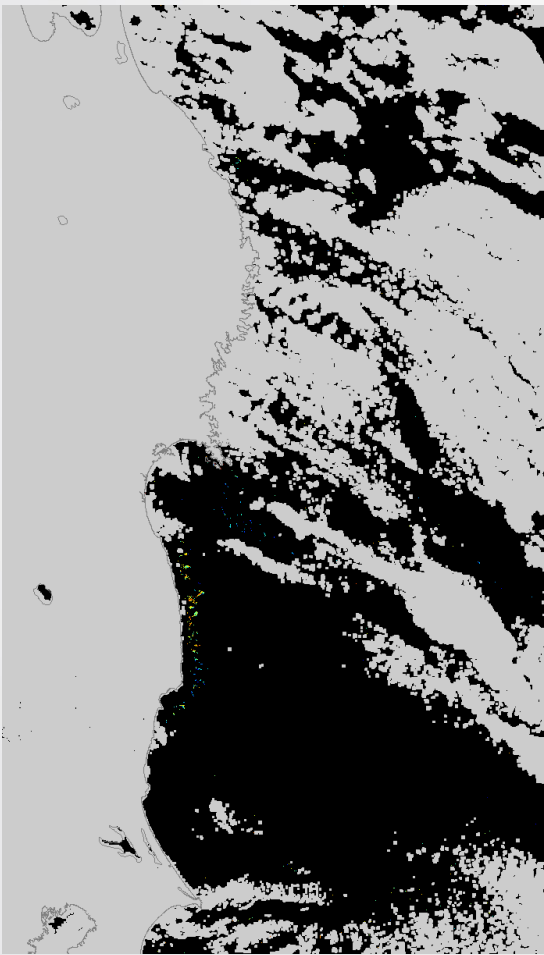
GOCI Images over East Japan Mar.2011



12 Mar 2011

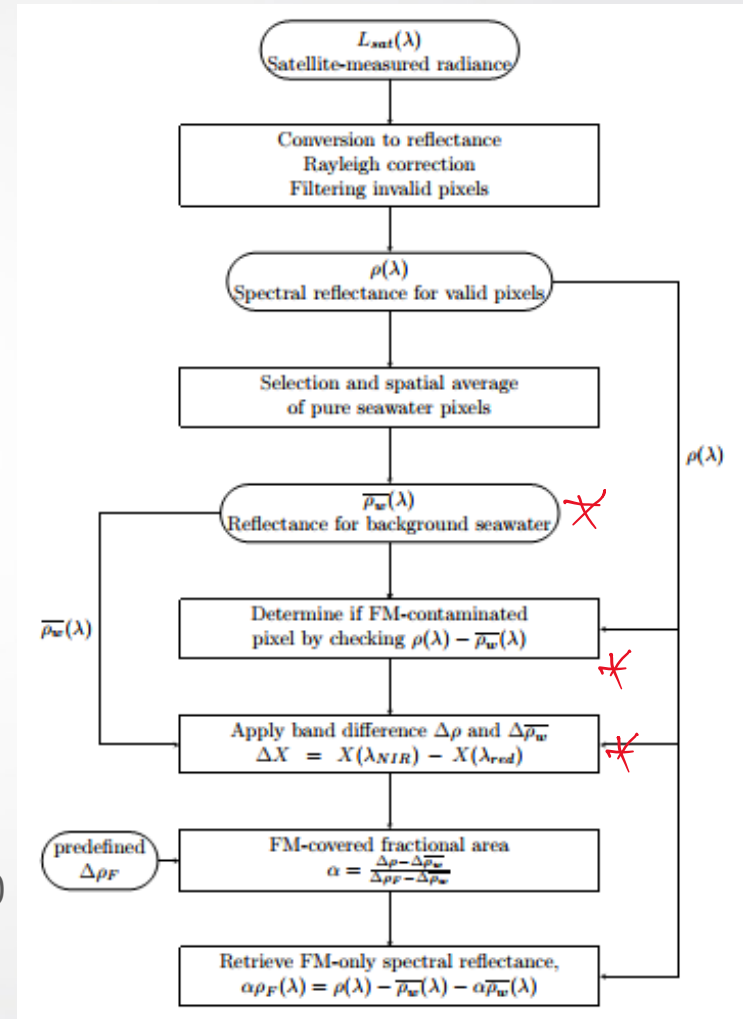
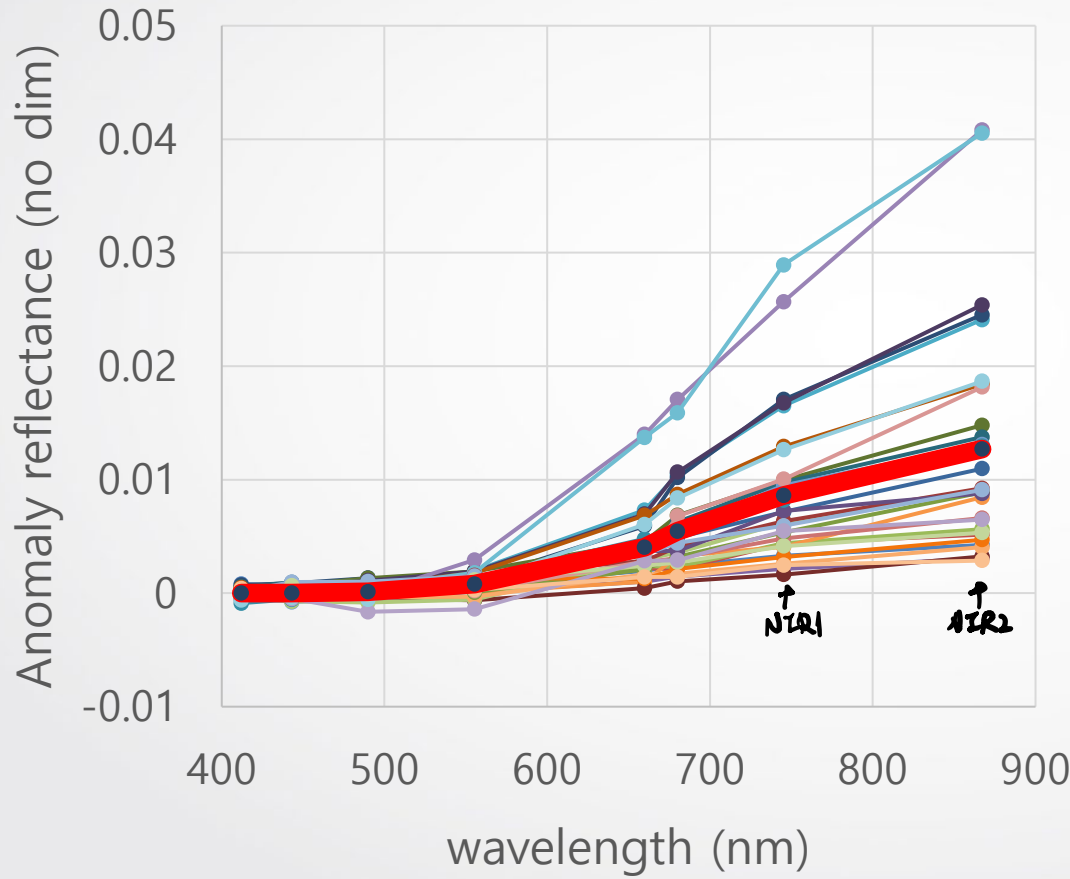
13 Mar 2011

18 Mar 2011

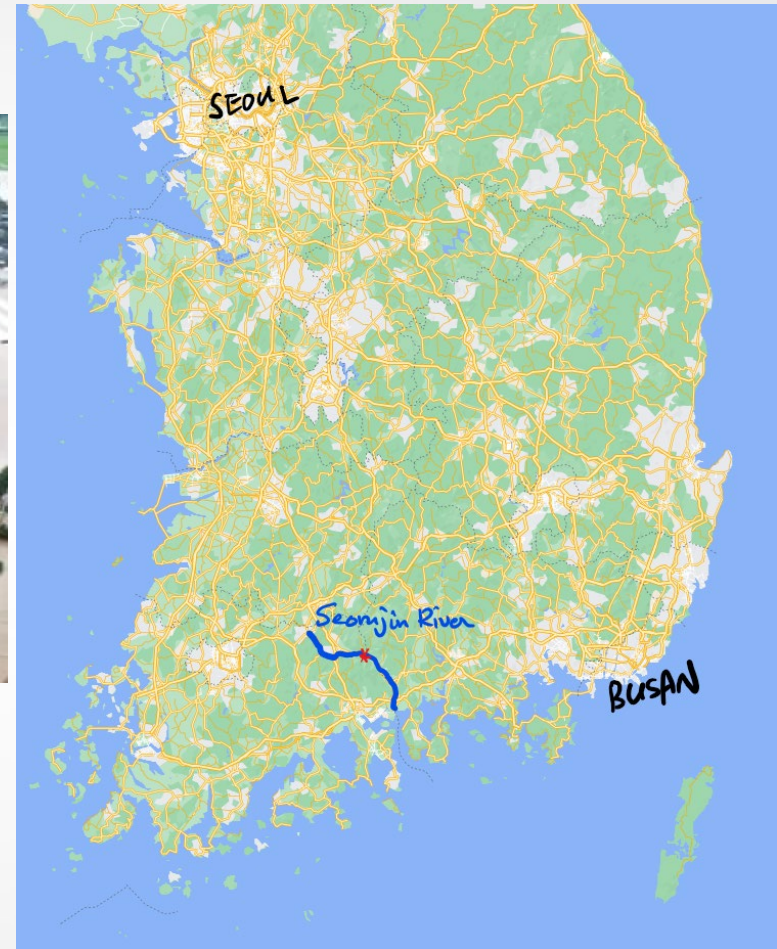


Basic idea of floating debris detection

Anomaly spectra of floating debris based on GOCI image of 13 Mar 2011



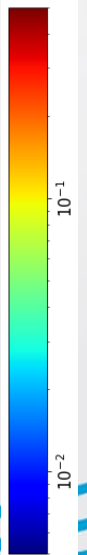
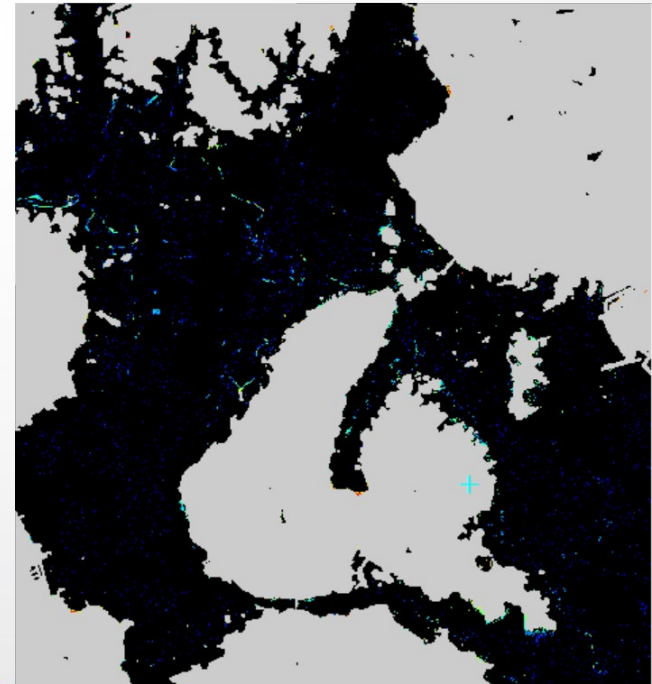
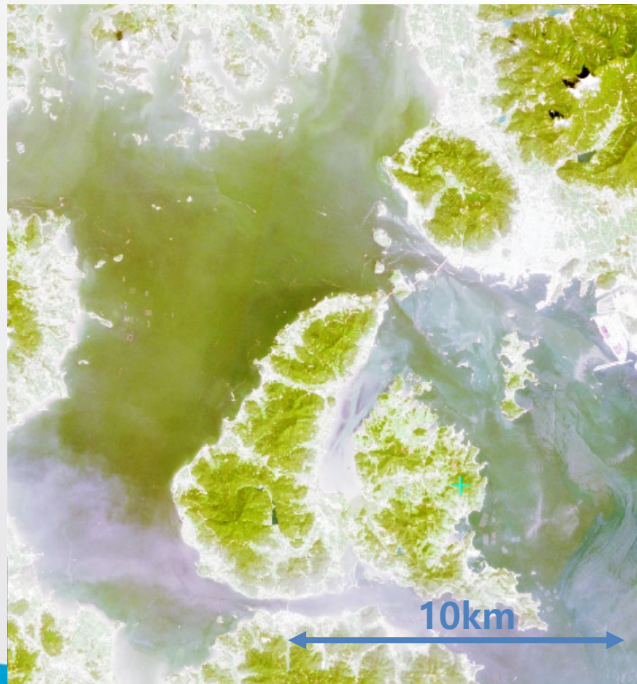
Heavy rainfall in South Korea Aug. 2020



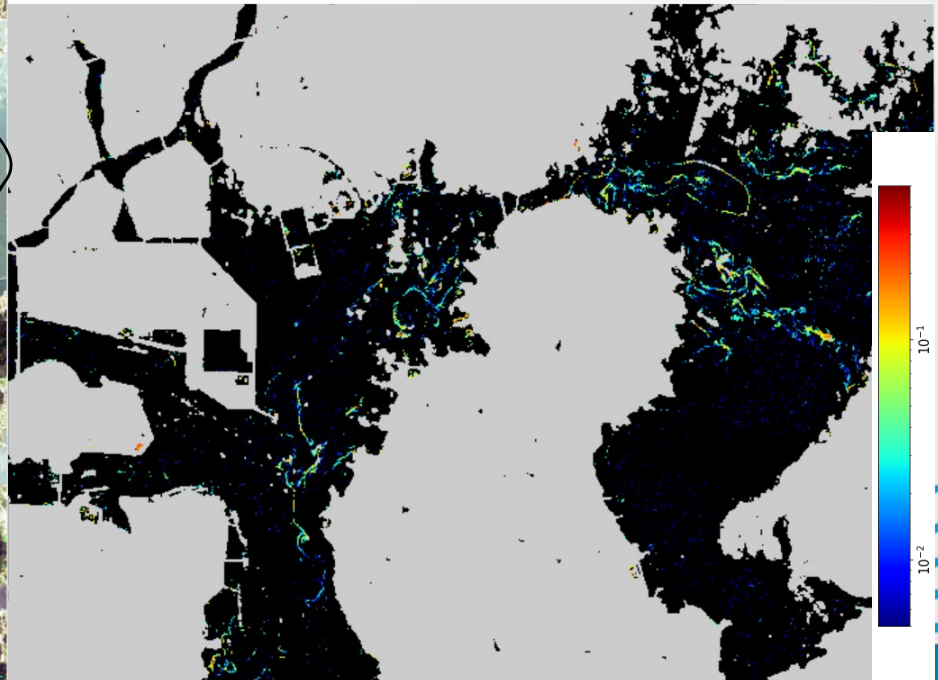
A traditional market town(화개장터) was totally inundated by water 'bomb' (up to 500mm in 2 days)

Source: Joongang daily 2020.08.08 19:18

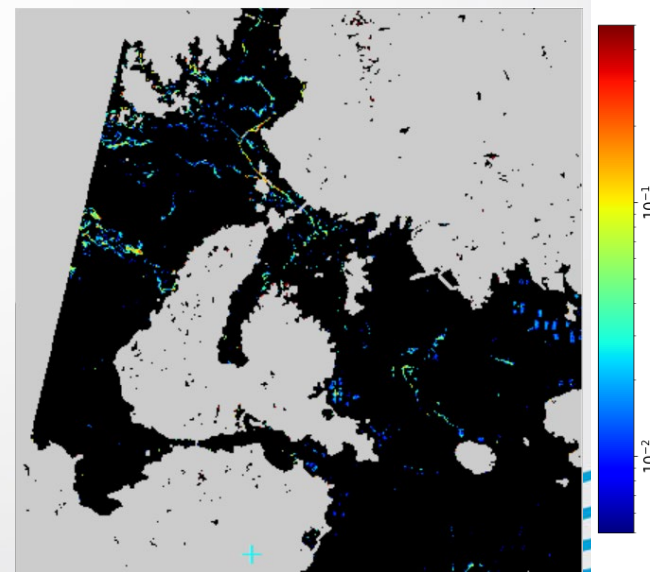
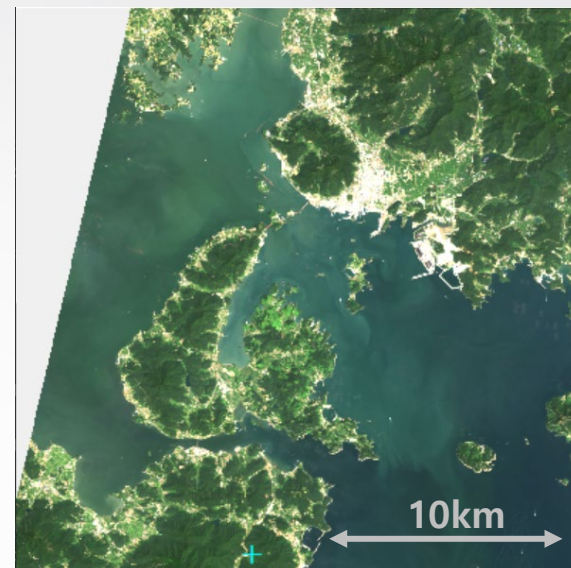
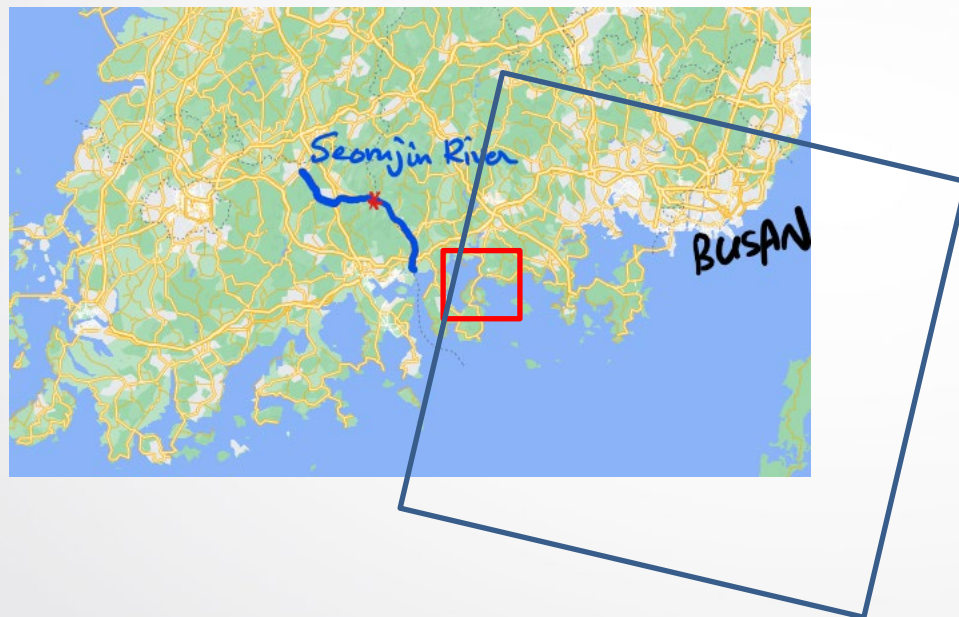
MSI-20m 2020.08.17(+10 days)



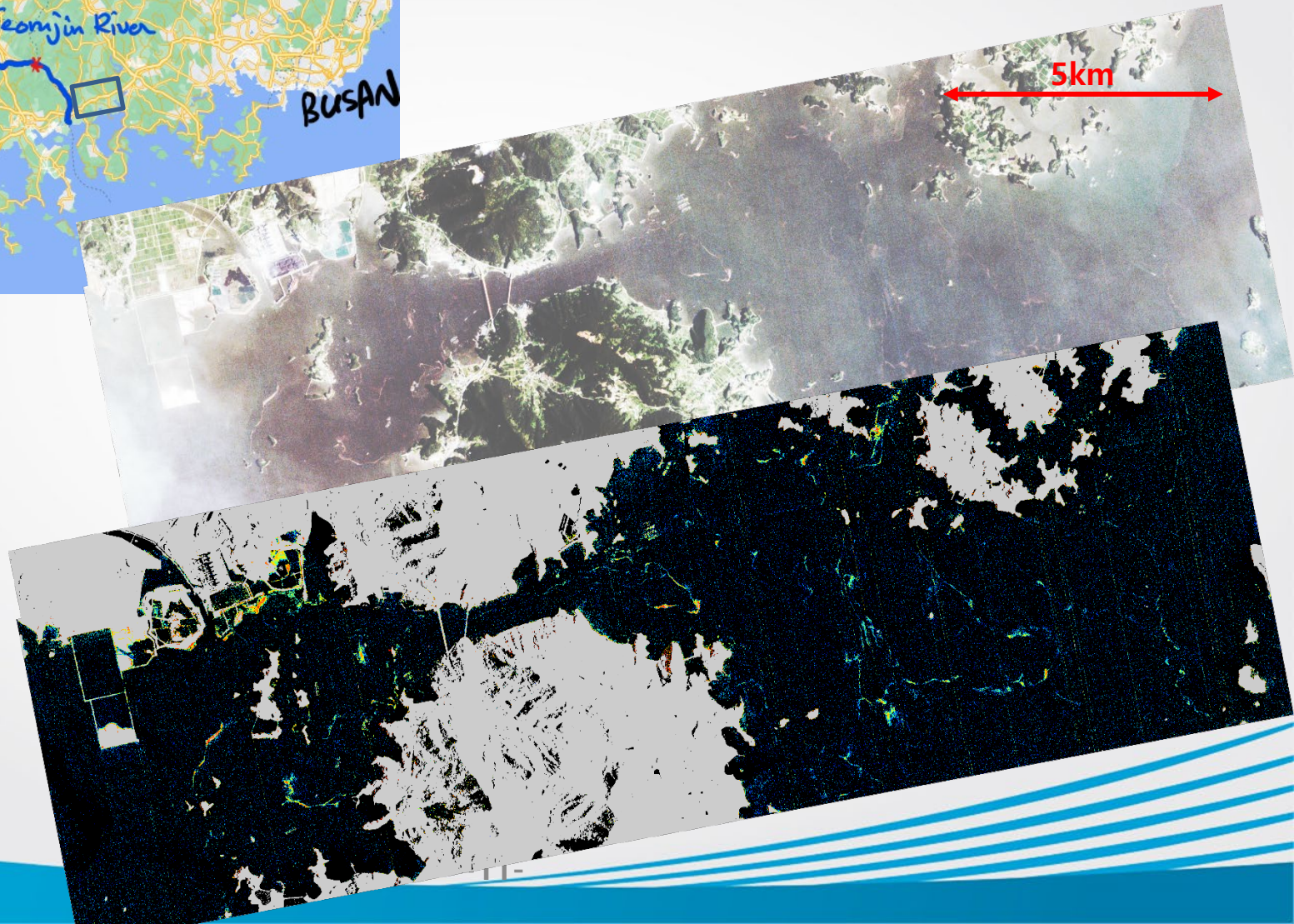
MSI-20m 2020.08.20 (+3 weeks)



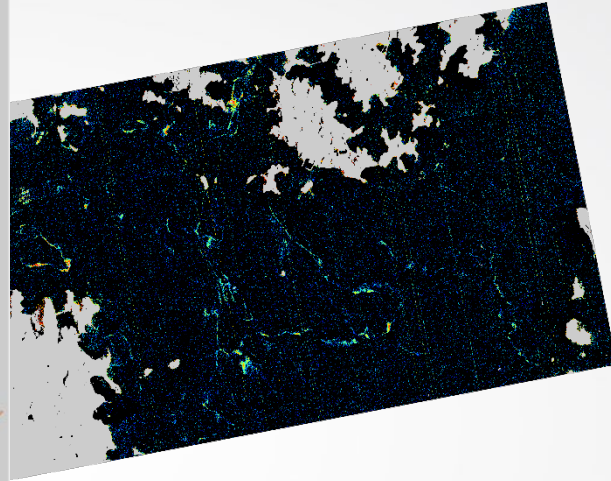
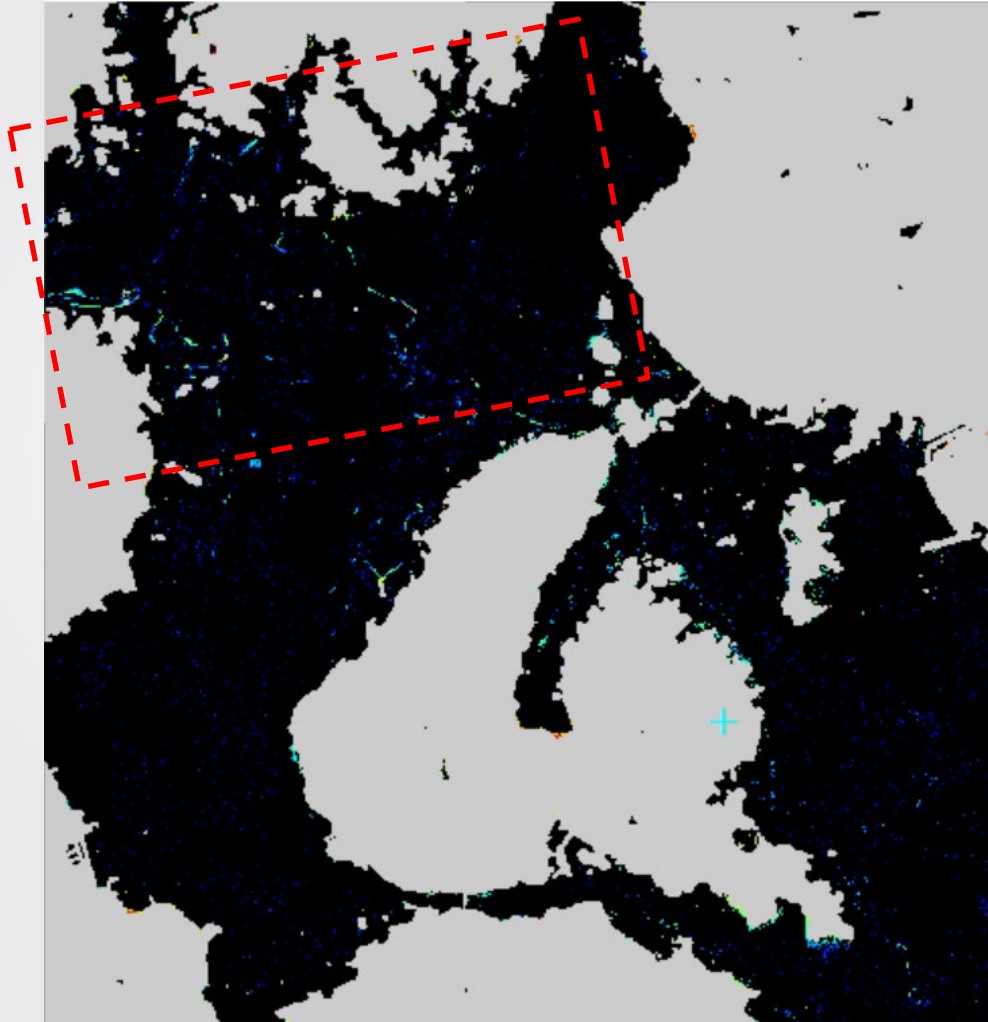
OLI image on 2020.08.20 (+3 weeks)



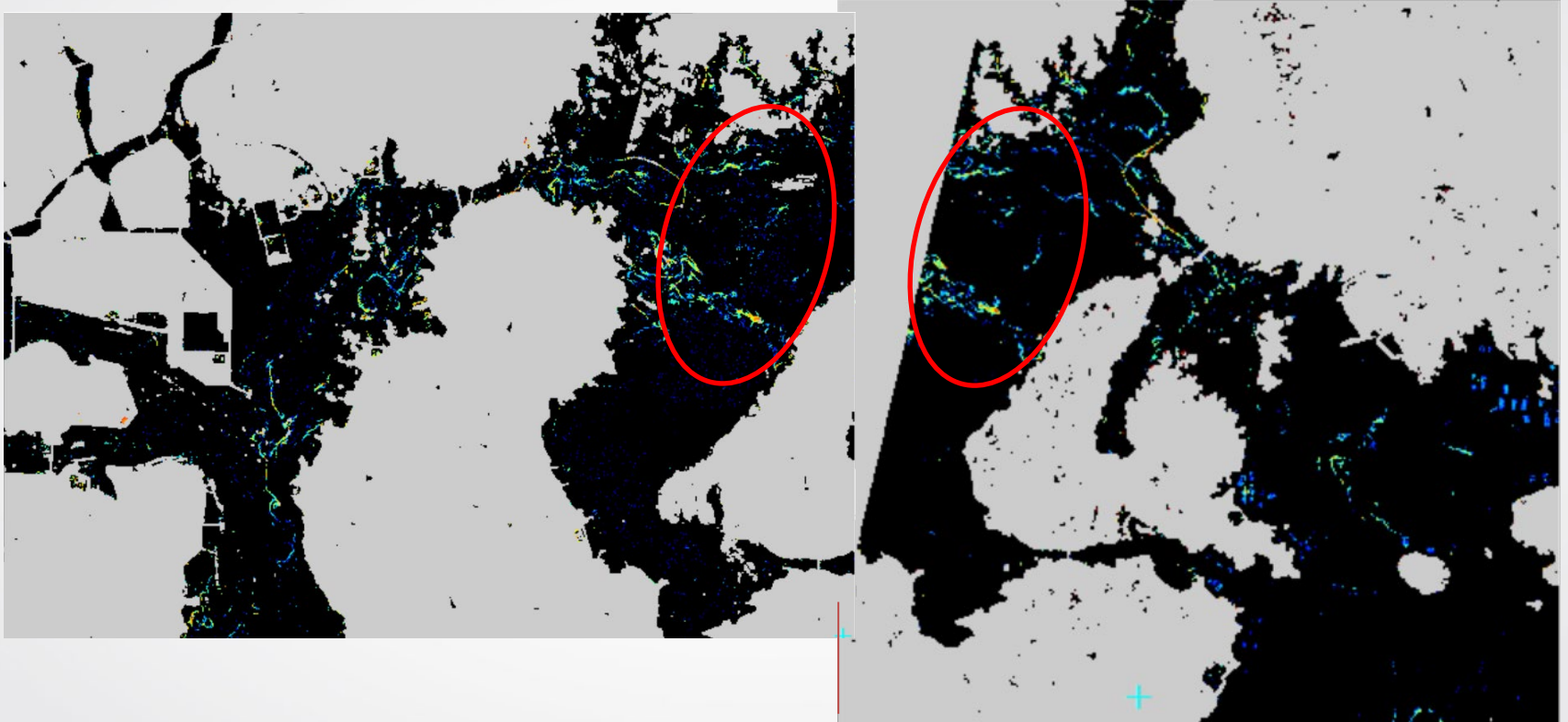
PS2-image (4m): 17 Oct 2020



MSI-20m (left) vs PS2-4m(right) 2020.08.17



MSI-20m (left) vs OLI-30m(right) 2020.08.20



Great Pacific Garbage Patch

(Source: thecoecleanaup.com)

GPGP:

The largest ocean plastic accumulation zone in the North Pacific between California and Hawaii (average center: 32°N and 145°W)

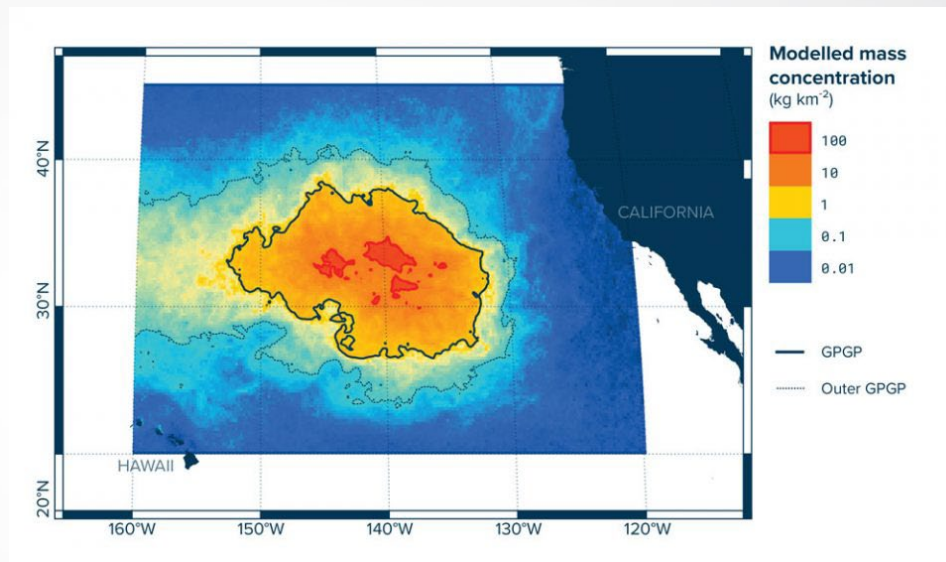
*Eastern Garbage Patch

Size: 1.6M km² (3 x France)

Mass: 80,000 tonnes

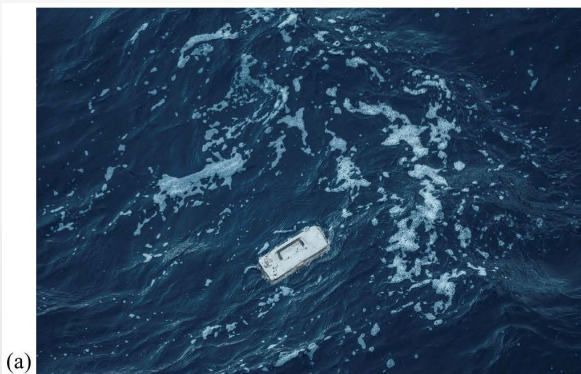
Density: 10~100 kg/km²

Size: 94% of object count microplastic (<5mm), more than total mass from megaplastic(>50cm)





Installation of System 001 at Pacific Trial test site on Sept 15 2018
(theoceancleanup.com)



(a)



(b)

Examples of floating (a) and submerged plastic litter material (b) harvested by the clean-up system in the GPGP in October 2018

WV-3 image over North East Pacific ocean

False color composite

R = 824 nm,
G = 547.1 nm,
B = 481.9 nm

Date:

17. Sept. 2018

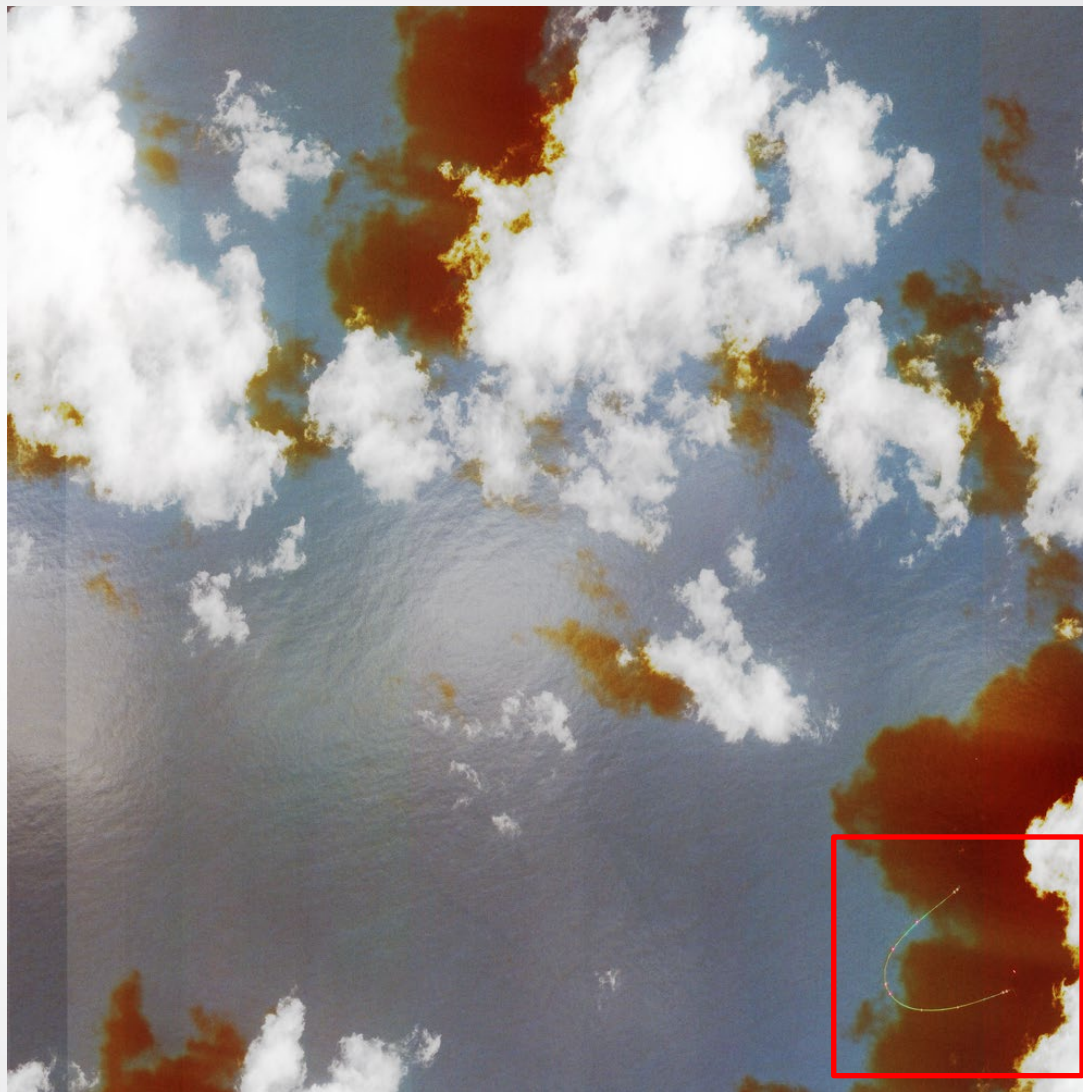
Location:

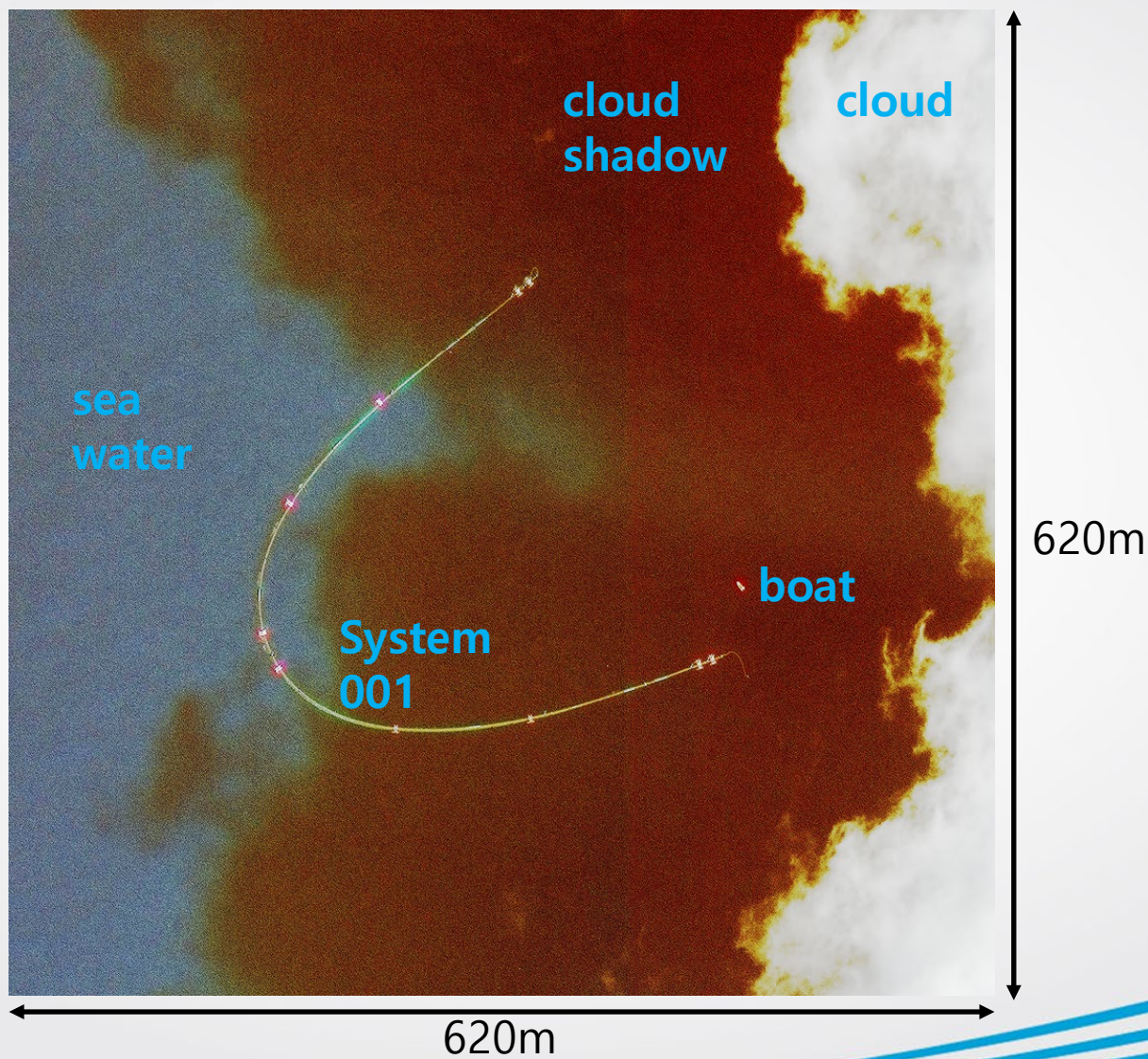
35.719N, 128.704W

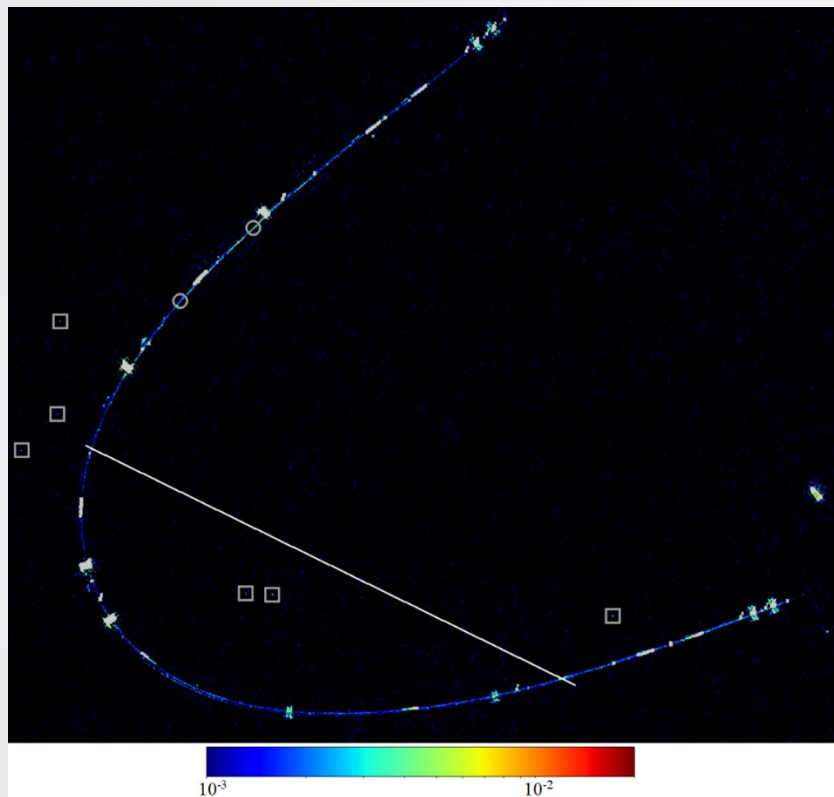
581 km away from
San Francisco toward
Hawaii

Image size:

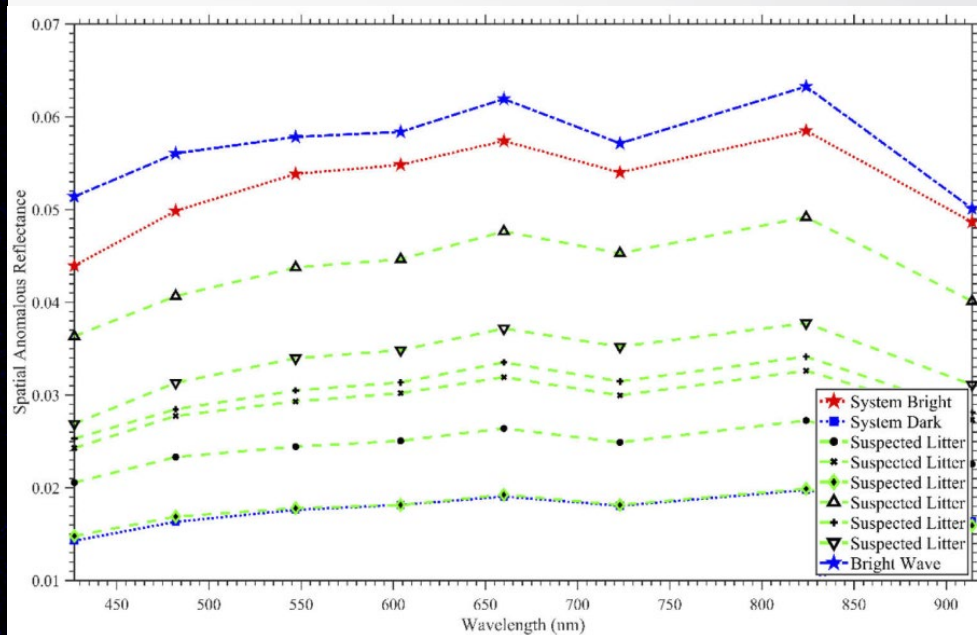
2.52km x 2.52km
8120 x 8120 pixels







Anomaly proxy image:
 Grey square - suspected floating plastic litter
 Circles - dark and bright spots of the System 001



Spatial anomaly spectra:
 Top two: white cap and bright part of the System 001
 Others: suspected litter and dark part of the System

- We looked three difference cases with multiband images from GOCI, MSI, OLI and PS2 (with NIR).
- Image pixel size requirement is critical and obviously depends on the aggregated patch size- e.g. meters for coastal water and submeter for GPGP applications.
- Image quality (S/N, sunglint) is also important for quantitative analysis of floating debris (also for coastal water quality monitoring).
- Observation frequency is also important for practical applications.