Trial application of the screening procedure of the NOWPAP Common Procedure to the NOWPAP sea areas in Japan

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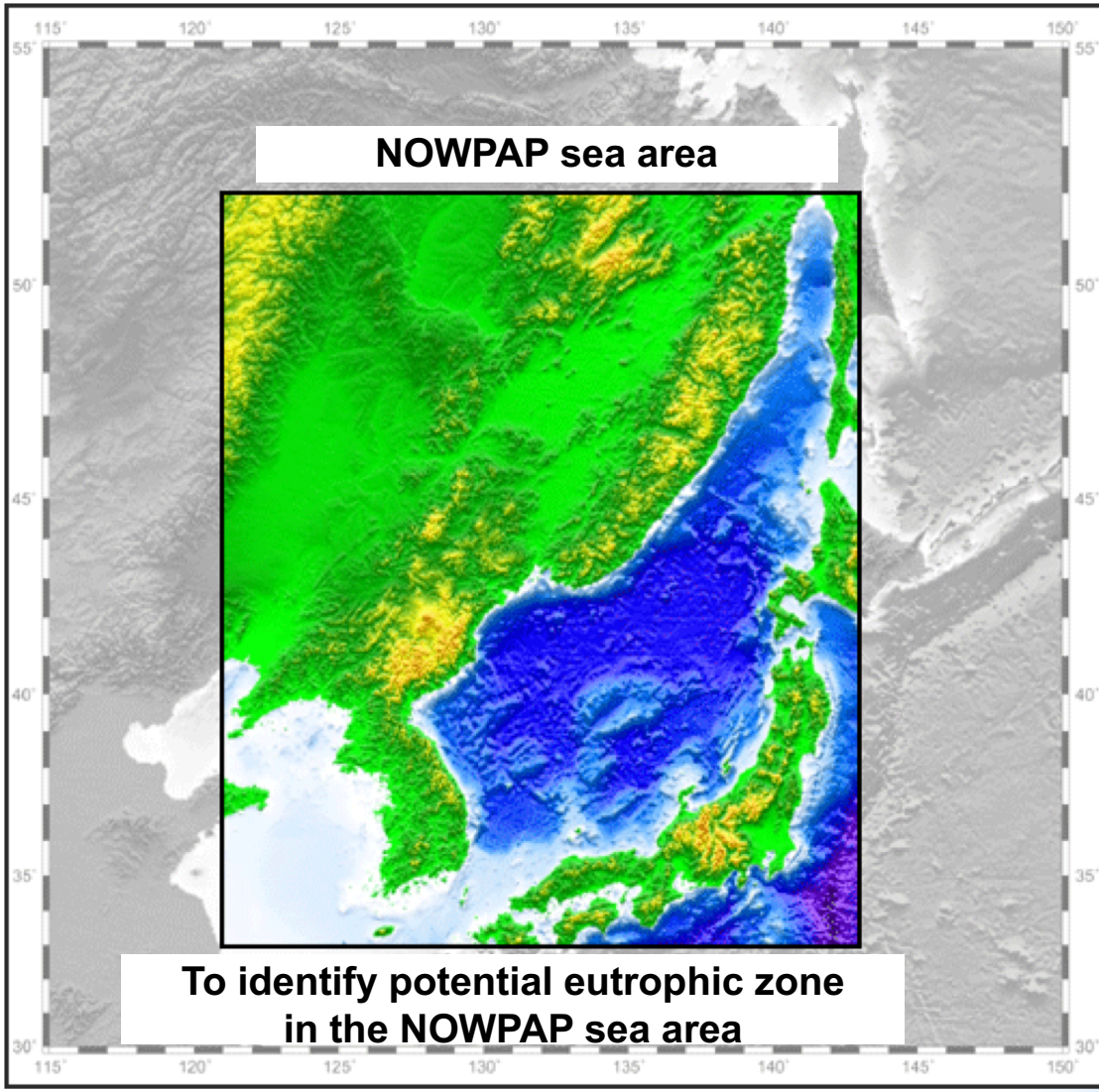
1. NOWPAP Sea Area in Japan

Coastal water of 16 prefectures facing the NOWPAP sea area were included

Hokkaido, Aomori, Akita, Yamagata, Niigata, Toyama, Ishikawa, Fukui, Kyoto, Hyougo, Tottori, Shimane, Yamaguchi,Fukuoka, Saga and Nagasaki Prefecture (From North to South)

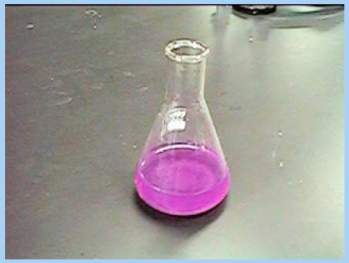


2. Screening Procedure

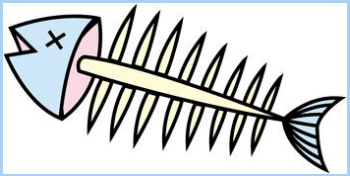
Refined NOWPAP Common Procedure (2015-Feb)

Screening Procedures

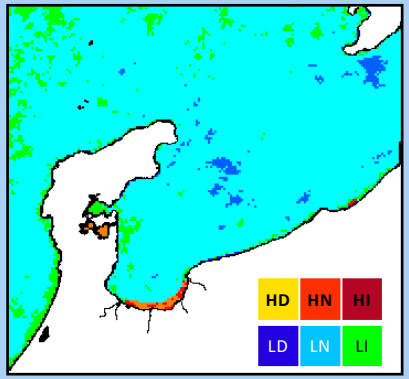
Minimum required parameters for detection of eutrophication symptoms



1. COD Trend



2. Red tides and hypoxia events and frequency



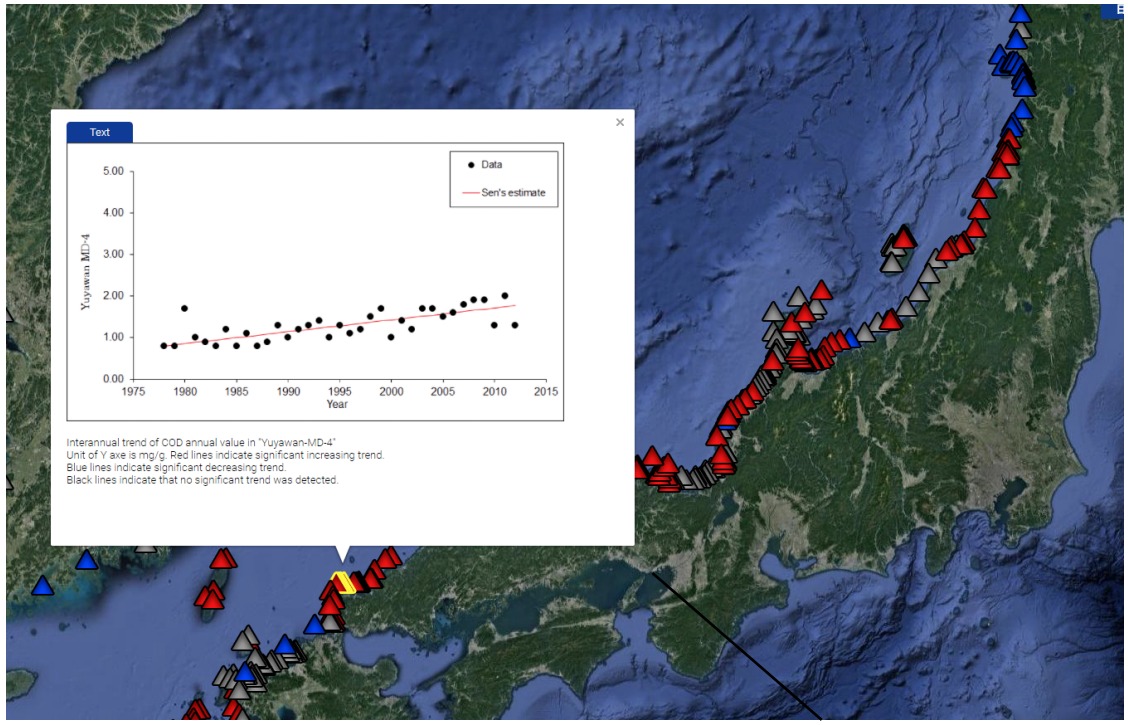
3. Level and trend of satellite Chl-a

When two parameters show symptoms of eutrophication, the comprehensive procedure should be applied to the selected sea areas.

Comprehensive Procedure

2.1. Collection and analysis of COD

Period	1970s to 2012
Data	Annual mean of COD at 331 water sampling stations
Method	Testing a long term trend against annual mean value with Mann Kendall Test

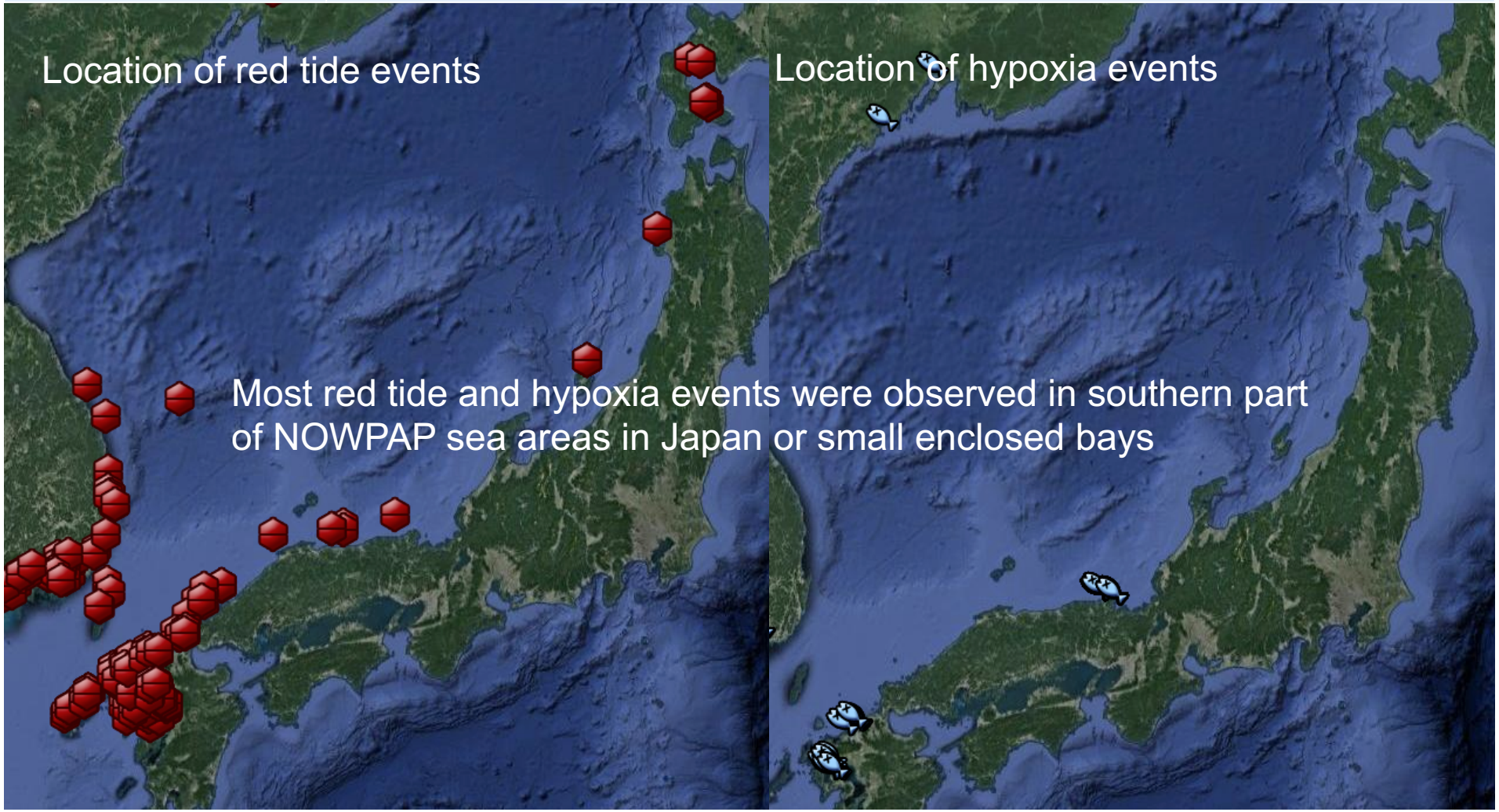


-Assessment results-

Trend	Number of stations
Increasing	121
No trend	174
Decreasing	36

2.2 Frequency of redtide events

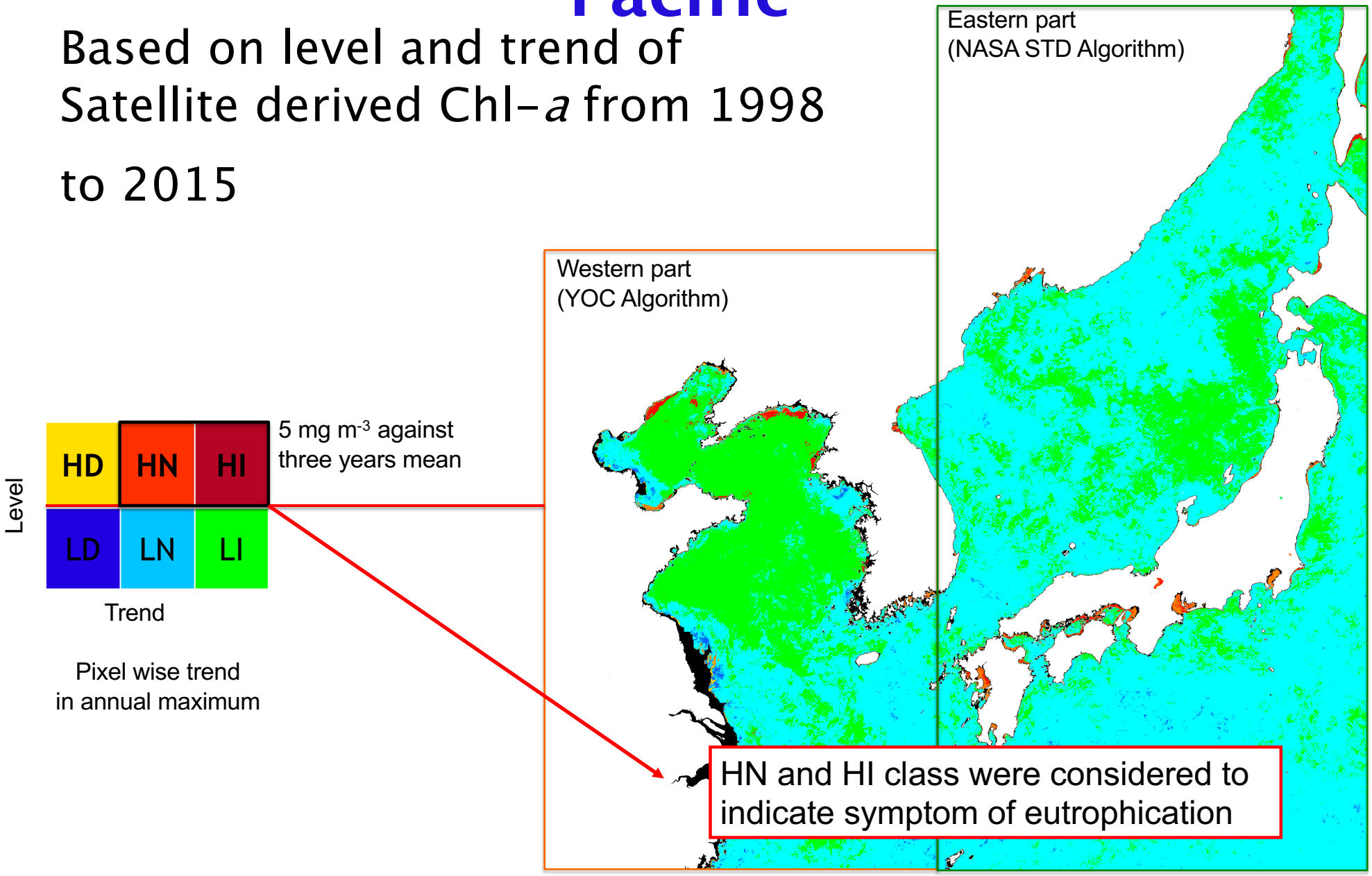
Years	Number of red tide events	Number of hypoxia events (DO less than 3.6 mg/L)
2010 to 2012	117	73



- Source of information -:Information on the occurrence of red-tide in the sea area of Kyushu region. Kyushu Fisheries Coordination Office, Annual Report 2009-2013 (in Japanese)

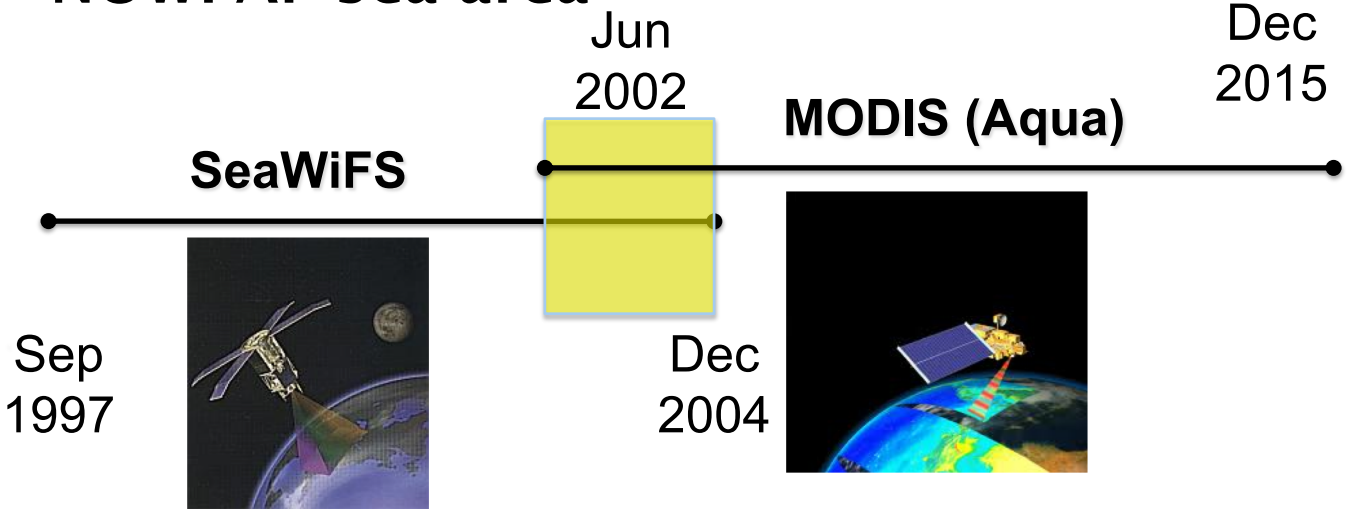
2.3 Preliminary assessment of eutrophication in the Northwest Pacific

Based on level and trend of Satellite derived Chl-*a* from 1998 to 2015



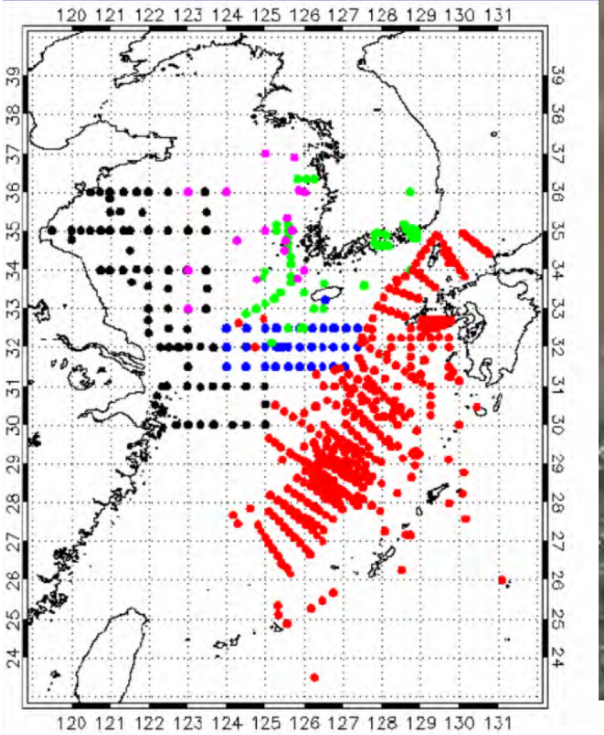
Satellite data used of assessment

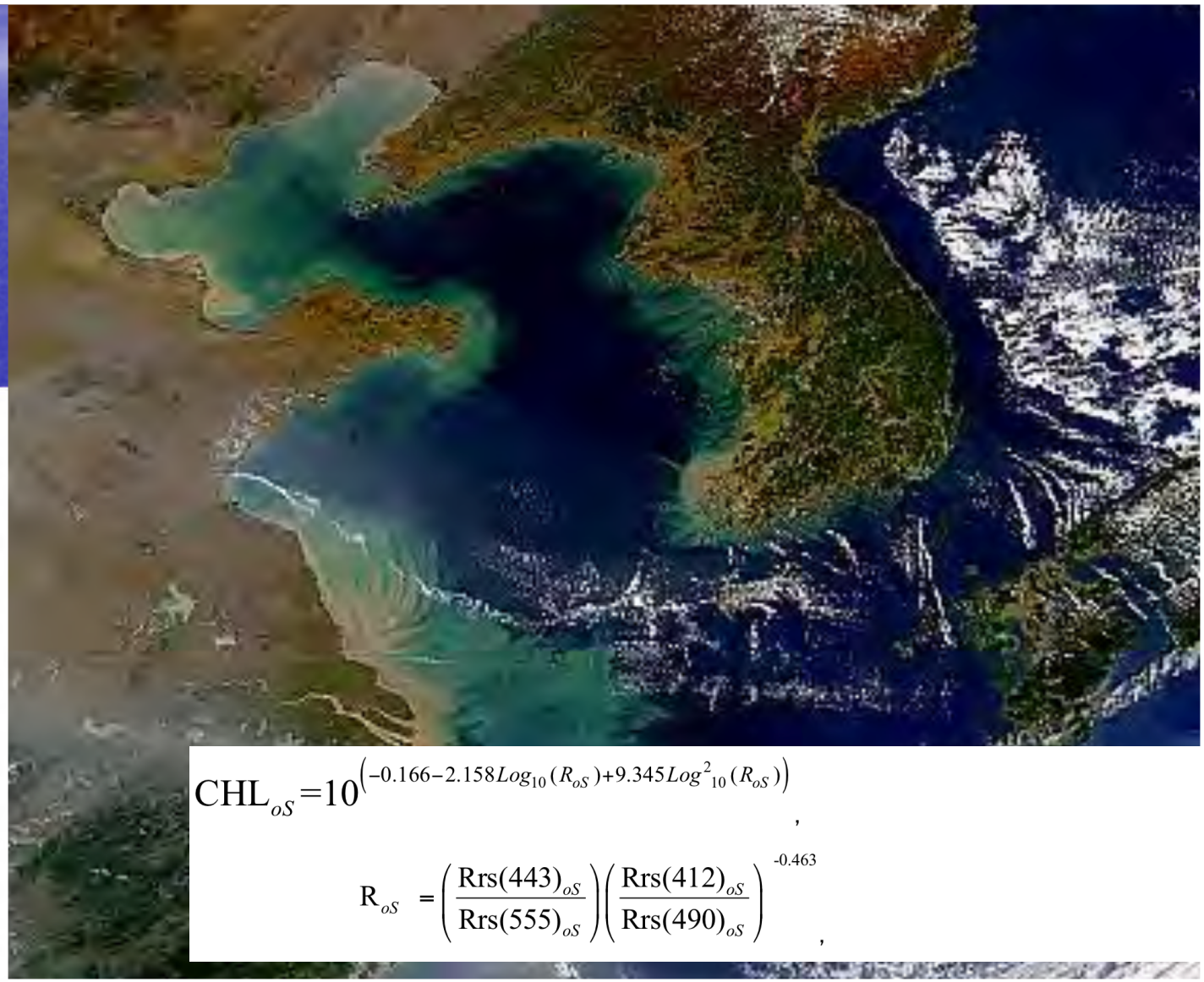
Sensor	NASA SeaWiFS on Orbview 2 NASA MODIS on Aqua
Algorithm	R2014 NASA standard for eastern part of NOWPAP YOC algorithm for western part of NOWPAP (Siswanto *et al.* 2011)
Duration	Jan 1998 to Dec 2015
Data	Monthly composite
Area	NOWPAP sea area



YOC algorithm

New Algorithm Developed by Yellow Sea Large Marine Ecosystem (YSLME) Ocean Color Project (Siswanto et al. 2011)



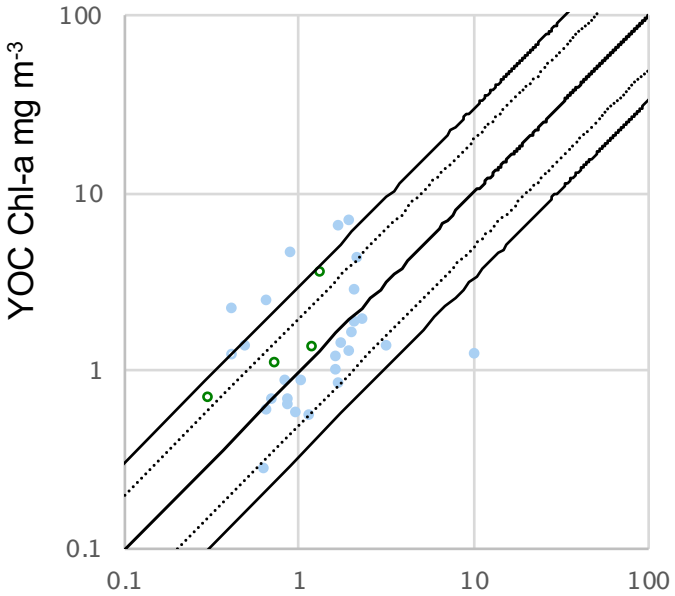


$$CHL_{oS} = 10^{\left(-0.166 - 2.158 Log_{10}(R_{oS}) + 9.345 Log^{2}{}_{10}(R_{oS})\right)},$$

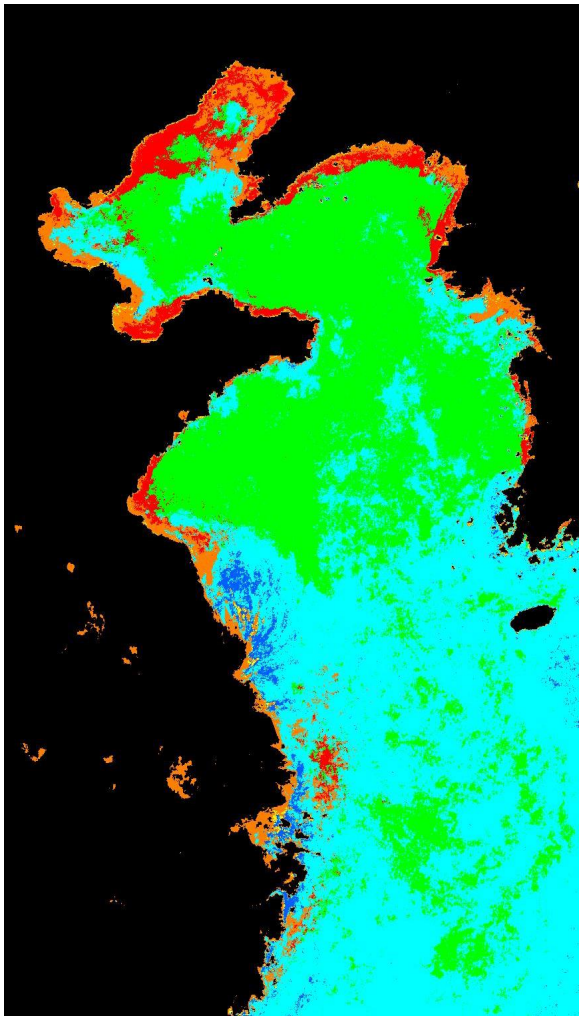
$$R_{oS} = \left(\frac{Rrs(443)_{oS}}{Rrs(555)_{oS}}\right)\left(\frac{Rrs(412)_{oS}}{Rrs(490)_{oS}}\right)^{-0.463},$$

Improvement of satellite chl-*a* map with the YOC algorithm

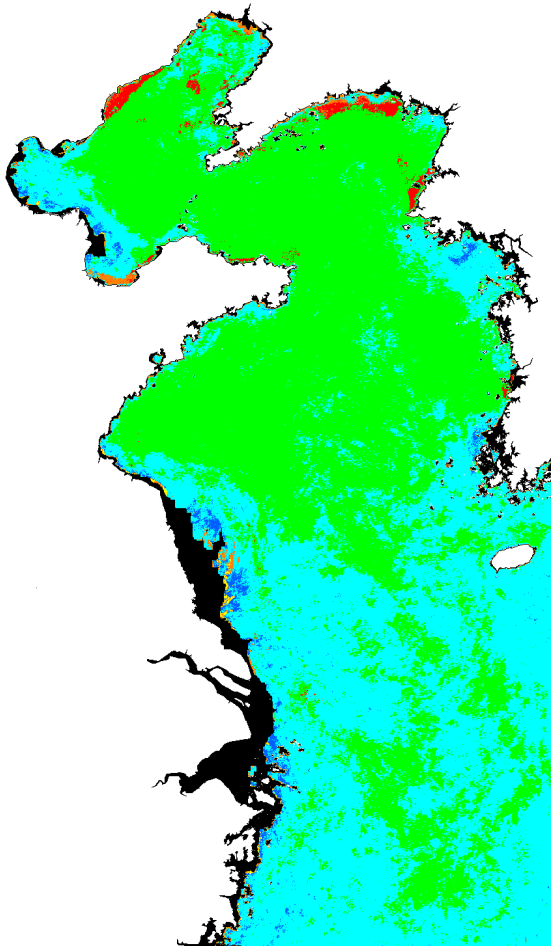
- A lot of false “HI” or “HN” classes disappeared
- Better relationship against *in situ* Chl-*a* was found in the YOC algorithm



in situ Chl-*a* around Korean peninsula from 2007 to 2014



NASA Standard



YOC

Detection of potential eutrophic zones in NOWPAP sea area of Japan

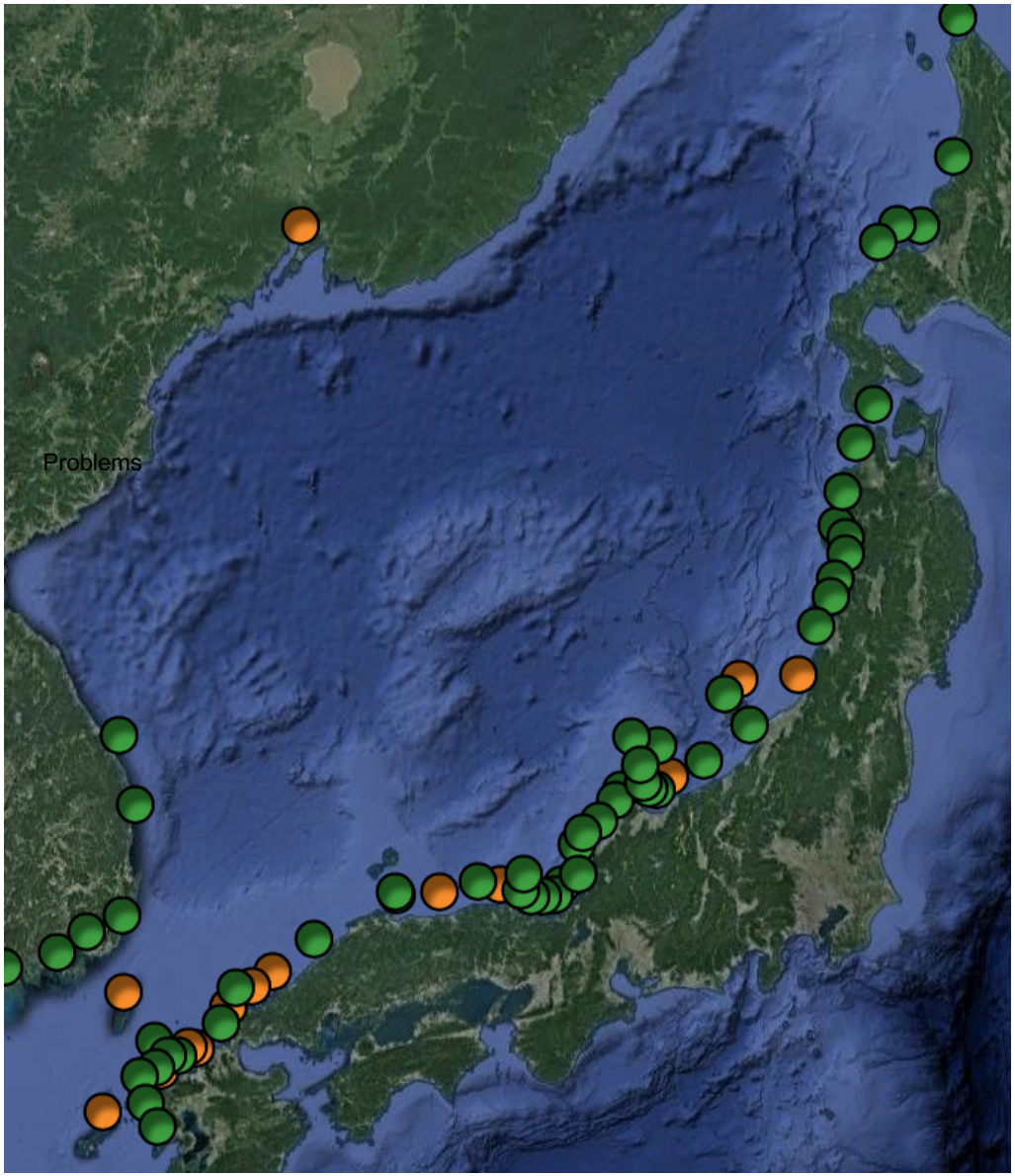
- Defining assessment area
  - 62 sub area were set based on location of COD sampling stations.
- COD trend, frequency of red tide and hypoxia, and satellite chl-a map were events Assessment criteria to detect potential eutrophic zones

Four categories of the assessment results of the eutrophication status
Defined by the screening procedure of the NOWPAP Common Procedure

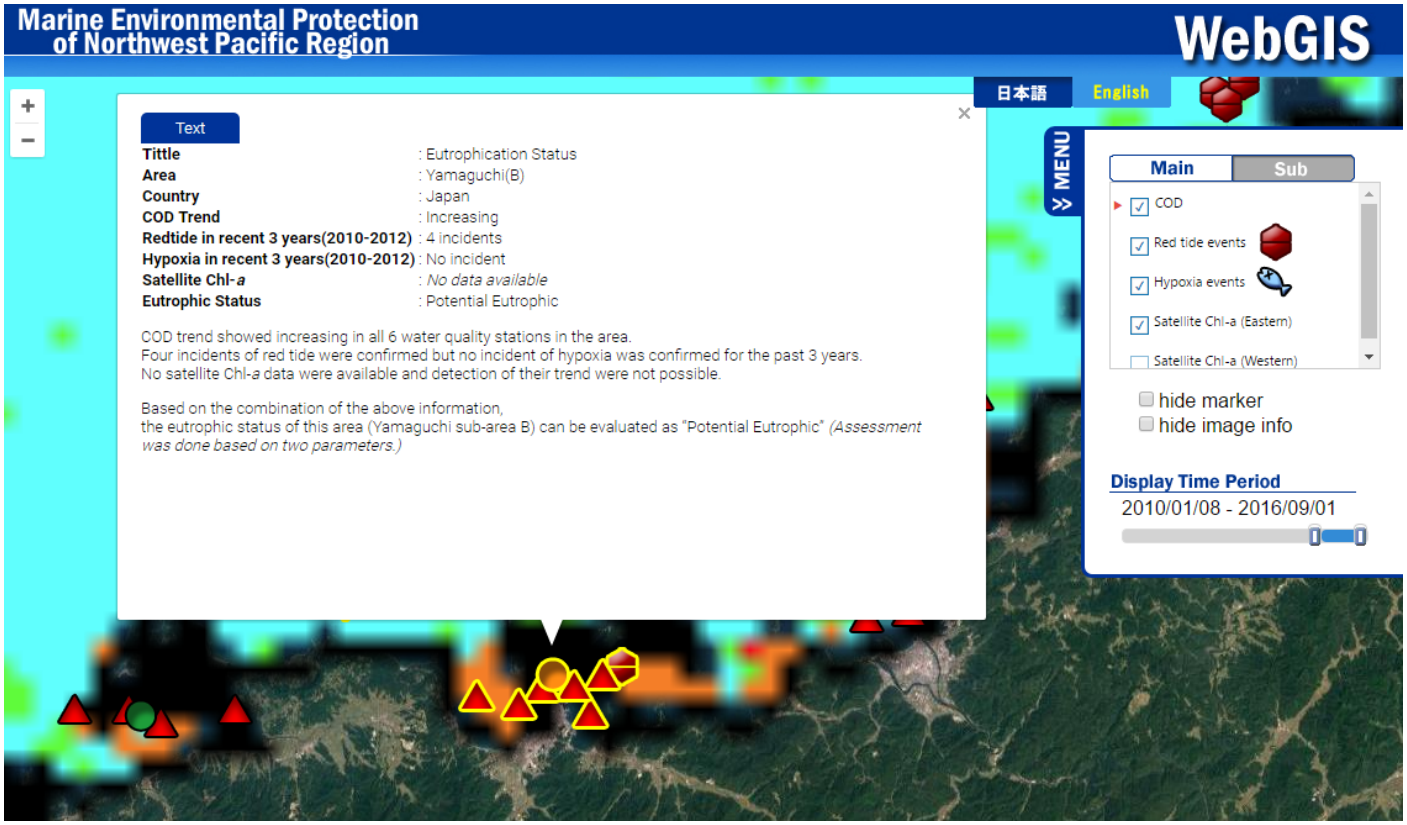
	Eutrophic area All parameters among COD, frequencies of red tides and hypoxia events and satellite chlorophyll-*a* indicate symptoms of eutrophication.
	Potential eutrophic area More than two parameters among COD, frequencies of red tides and hypoxia events and satellite chlorophyll-*a* indicate symptoms of eutrophication.
	Non eutrophic area Only one parameter among COD, frequencies of red tides and hypoxia events or satellite chlorophyll-*a* indicates symptoms of eutrophication. Or, neither of these parameters indicates symptoms of eutrophication.
	Improved area COD or frequencies of red tide and hypoxia events indicate the eutrophic status has improved.

Detection of potential eutrophic zones in NOWPAP sea area of Japan

- 23 out of 62 sub areas were identified as potential eutrophic zones
- Most potential eutrophic zones were located in the southern part of NOWPAP sea area in Japan



Limitation of the screening procedure



- Increasing COD trend
- 4 incidents of red tide in recent three years
- No satellite derived Chl-*a* information available

→ Potentially Eutrophic?

Summary

- The screening procedure was useful to detect potential eutrophic zones
- YOC algorithm decreased possibility of overestimating in situ Chl-*a*.
- Revision of assessment criteria maybe necessary in case when satellite chl-a information are not available