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Introduction to NEAT : NOWPAP Eutrophication Assessment Tool

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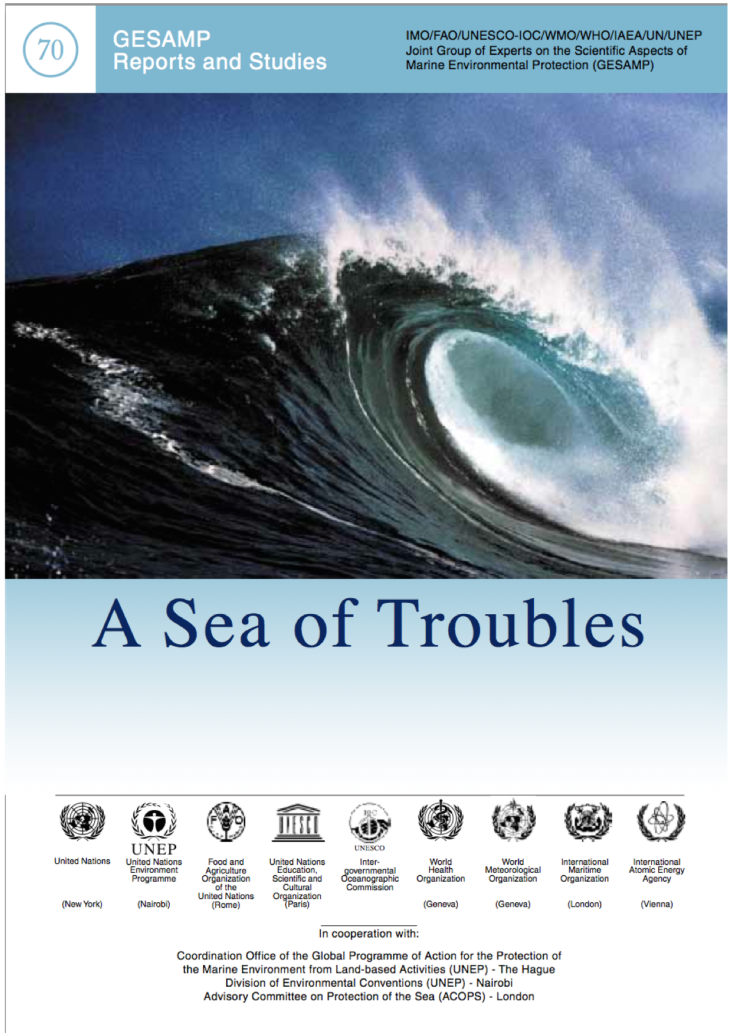
NOWPAP CEARAC

March 20, 2019

Marine and coastal eutrophication



GESAMP (2001)

Increasing Eutrophication

Excessive growth of marine plant life, is seriously Disrupting ecosystems and threatening health throughout the worlds: coral reefs, seagrass beds and other vital habitats are suffering.

Eutrophication can trigger explosive blooms of toxic algae which can blight tourism, contaminate seafood and poison people.

Marine eutrophication as a global concern

Participants : Scientific experts in regional seas programmes and earth observation specialists working on the science of marine pollution indicators, data capture and dissemination.

Potential of remotely sensed Chlorophyll-a for assessment of eutrophication

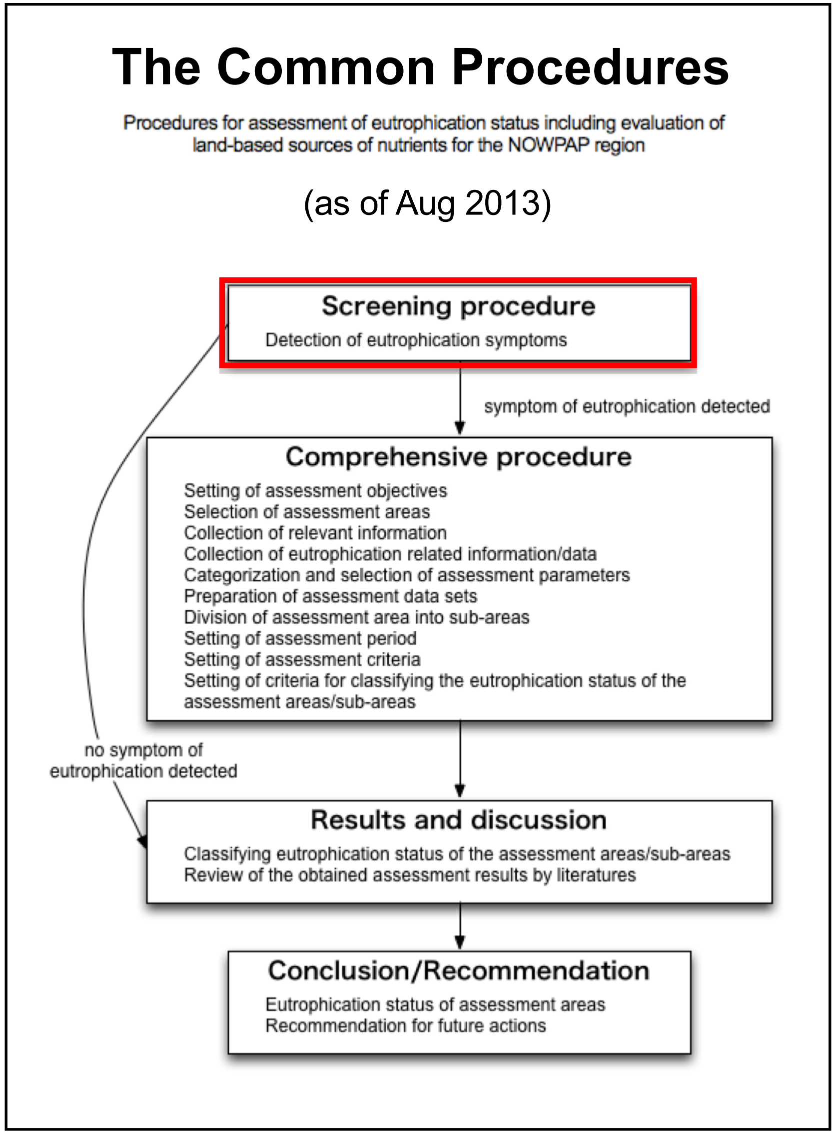
Strength and weakness of satellite and shipboard measurements

Means of observation	Strength	Weaknesses
Satellite Remote Sensing Preliminary Assessment for screening	•Wider area and higher temporal coverage •Objectively detect relative change •Free data access over the Internet	•Low accuracy in estimation of Chl-a in coastal area •No data obtained under cloud •Data is available only at sea surface
Ship board measurements Holistic Assessment	•Obtain data under sea surface •Can obtain actual measured value	•Data represent only point of information •Analysis of Chl-a need expertise •Costly

Refinement of the common procedure for eutrophication assessment

- Procedures for assessment of eutrophication status including evaluation of land-based sources for nutrients for the NOWPAP region (refined in 2013)

  Use of selected parameters including the **<u>remotely sense</u> data** is proposed as a screening tool



Assessment of eutrophication using remotely sensed chlorophyll-a concentration in the Northwest Pacific region (NOWPAP Eutrophication Assessment Tool : NEAT)

PROCEEDINGS OF SPIE

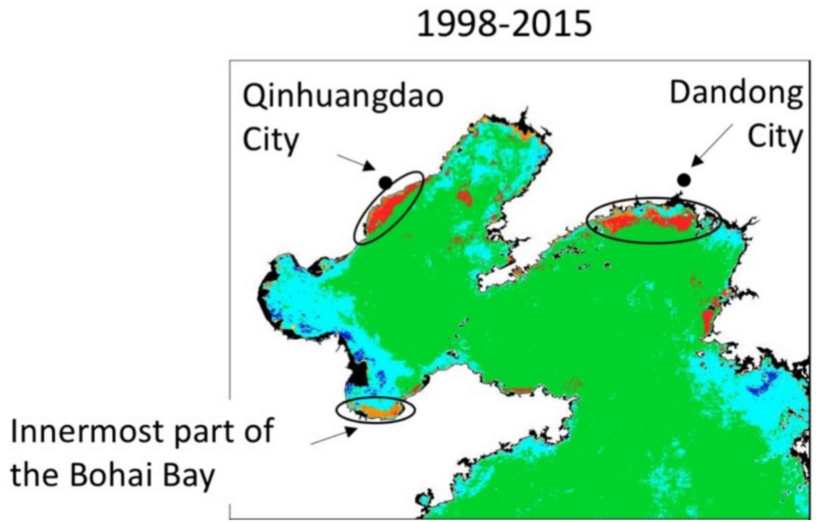
SPIEDigitalLibrary.org/conference-proceedings-of-spie

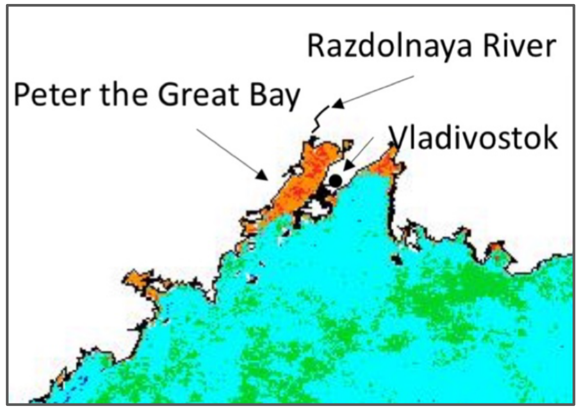
Assessment of eutrophication using remotely sensed chlorophyll-a in the Northwest Pacific region

Genki Terauchi, Eligio de Raús Maure, Zhiming Yu, Zaixing Wu, Changkyu Lee, Vasiliy Kachur, Joji Ishizaka, "Assessment of eutrophication using remotely sensed chlorophyll-a in the Northwest Pacific region," Proc. SPIE 10778, Remote Sensing of the Open and Coastal Ocean and Inland Waters, 107780H (24 October 2018); doi: 10.1117/12.2324641

Event: SPIE Asia-Pacific Remote Sensing, 2018, Honolulu, Hawaii, United States

SPIE.

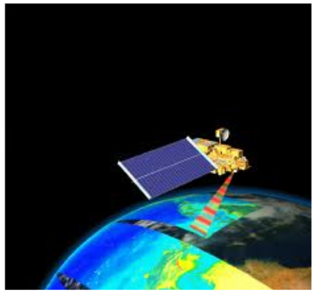




Satellite Chl-a used to assess eutrophication in the NOWPAP region

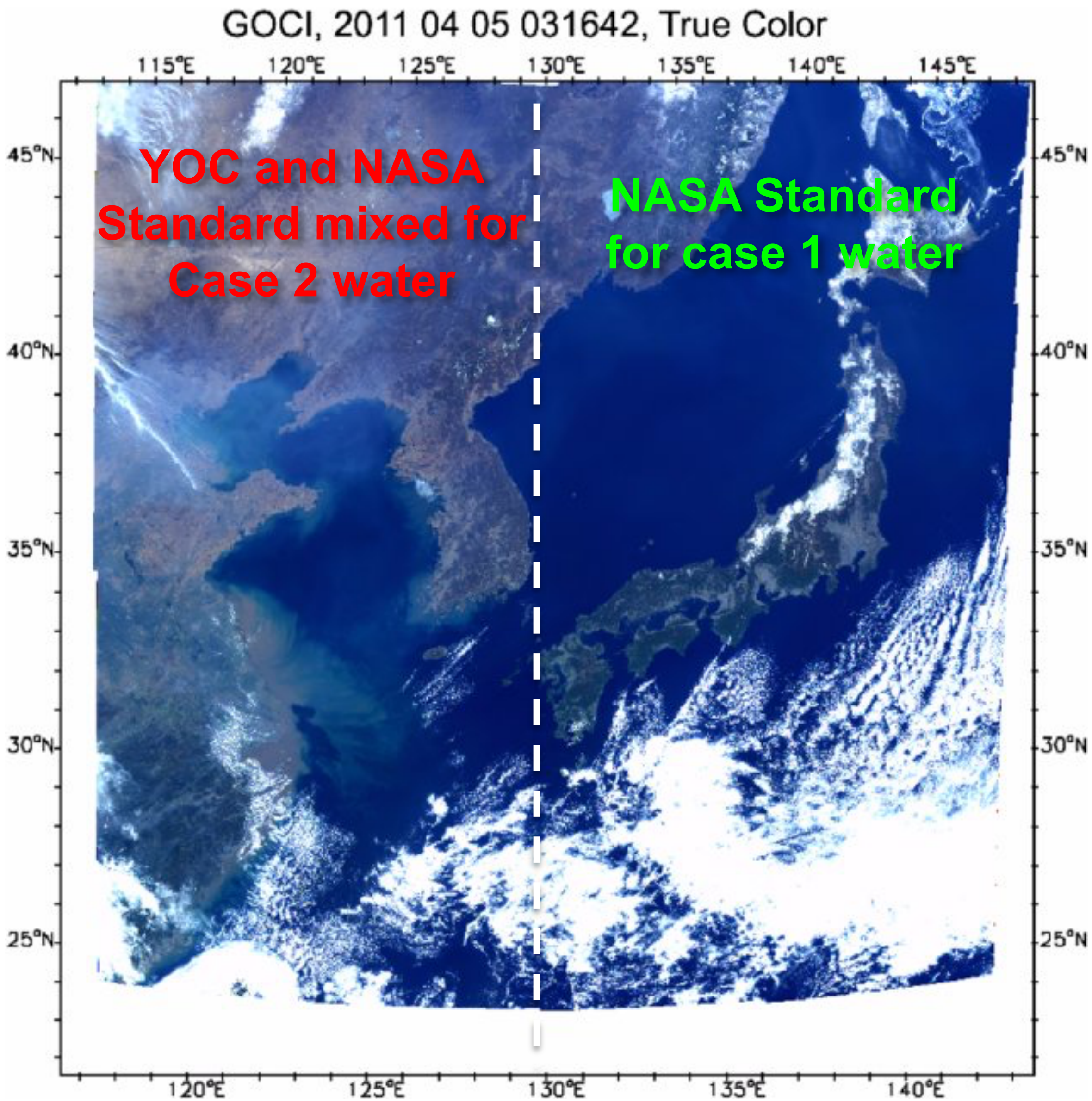
- **Satellite Sensors**

SeaWiFS (1998-2004)
MODIS-Aqua (2002-2015)

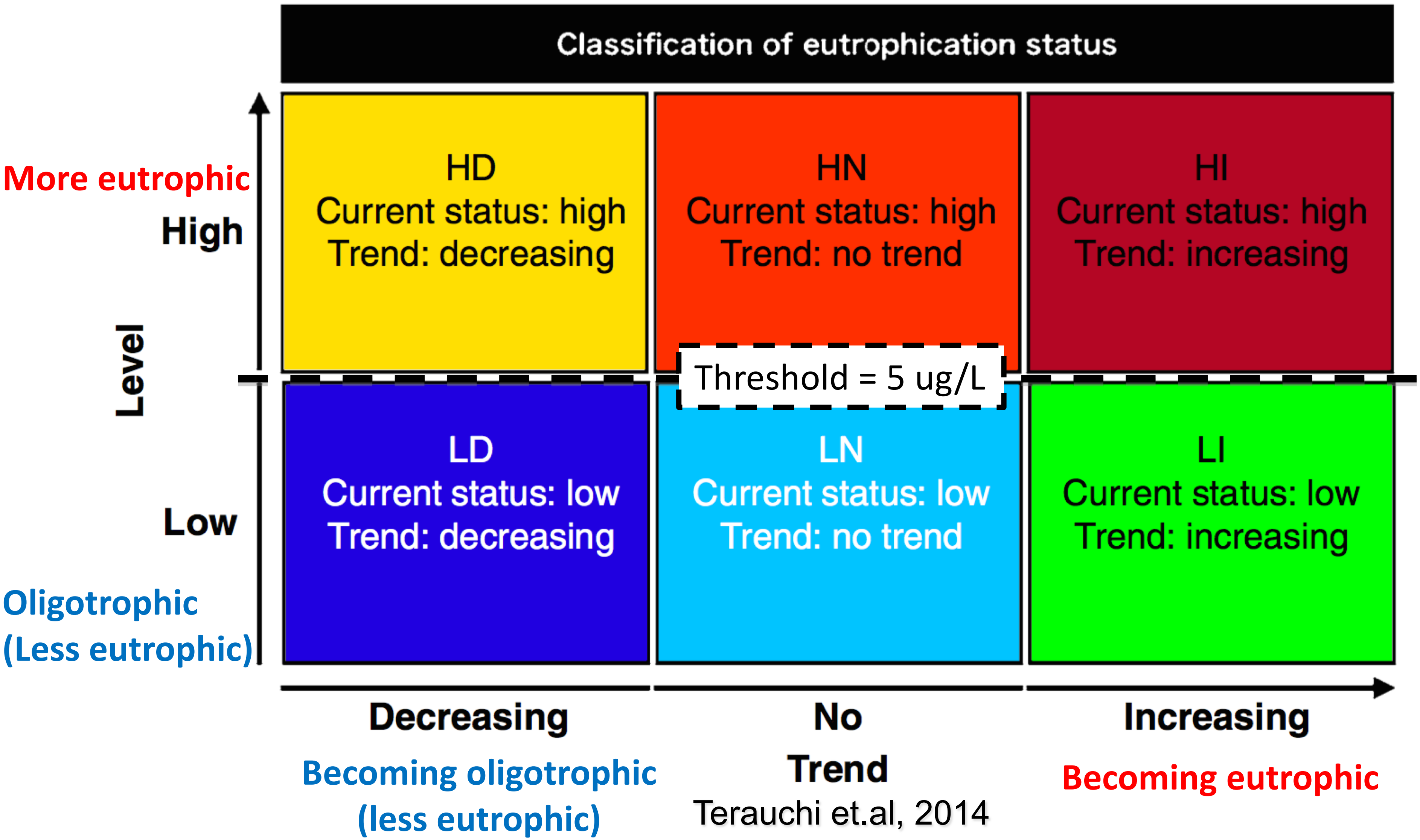


- **OC Data Processing version**

Reprocessing 2014



Assessment of eutrophication by the NOWPAP Common Procedure (NEAT: NOWPAP Eutrophication Assessment Tool)



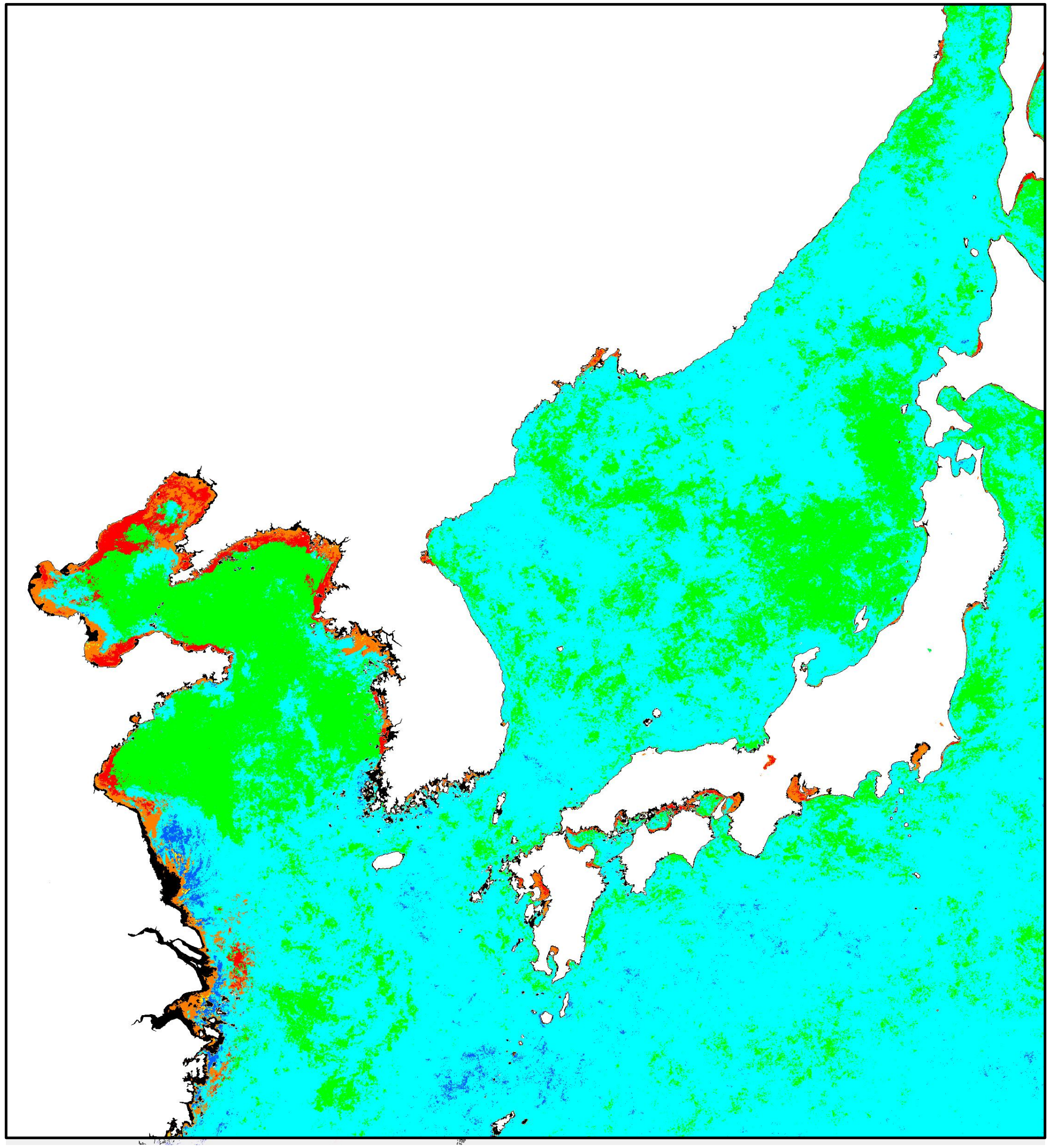
Terauchi et.al, 2014

Assessment of eutrophication with the NASA STD Chl-*a*

Period :1998-2015

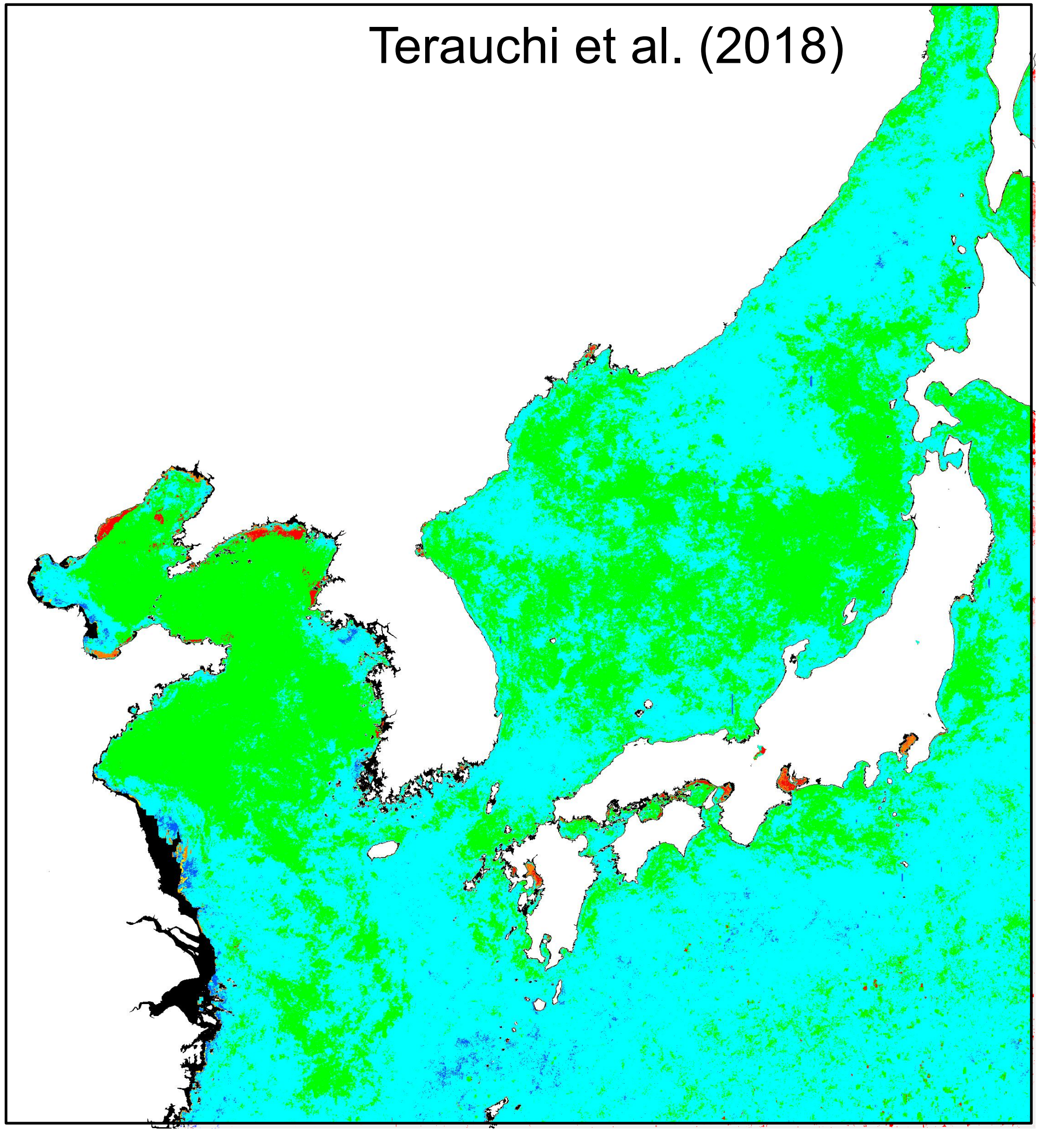
Sensors: SeaWiFS and MODIS (Aqua)

Algorithm: NASA Standard (Hu et al., 2012)



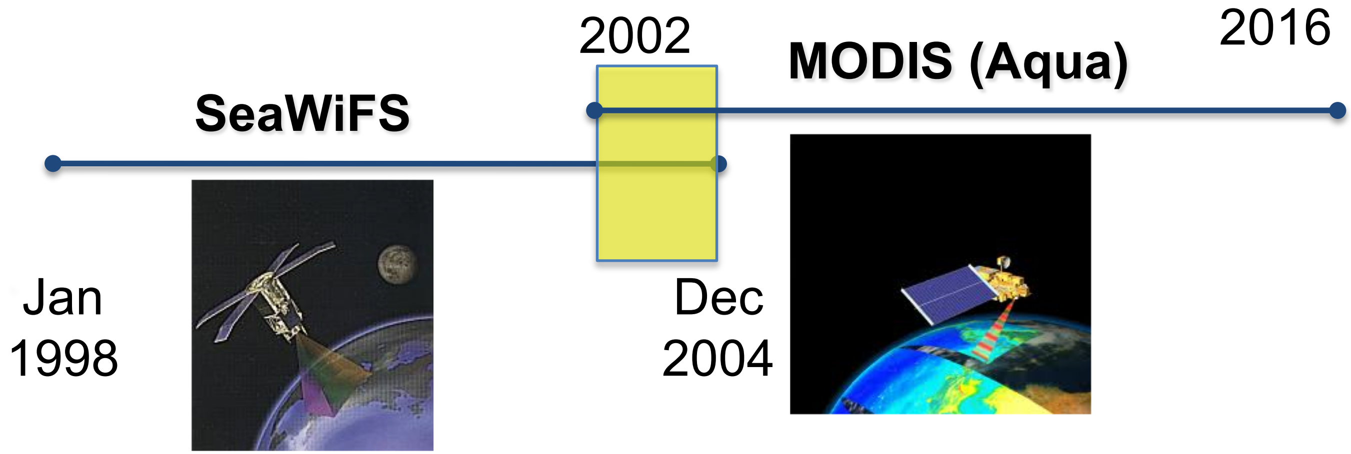
Assessment of eutrophication in the Northwest Pacific Region with the NEAT

HD	HN	HI
LD	LN	LI

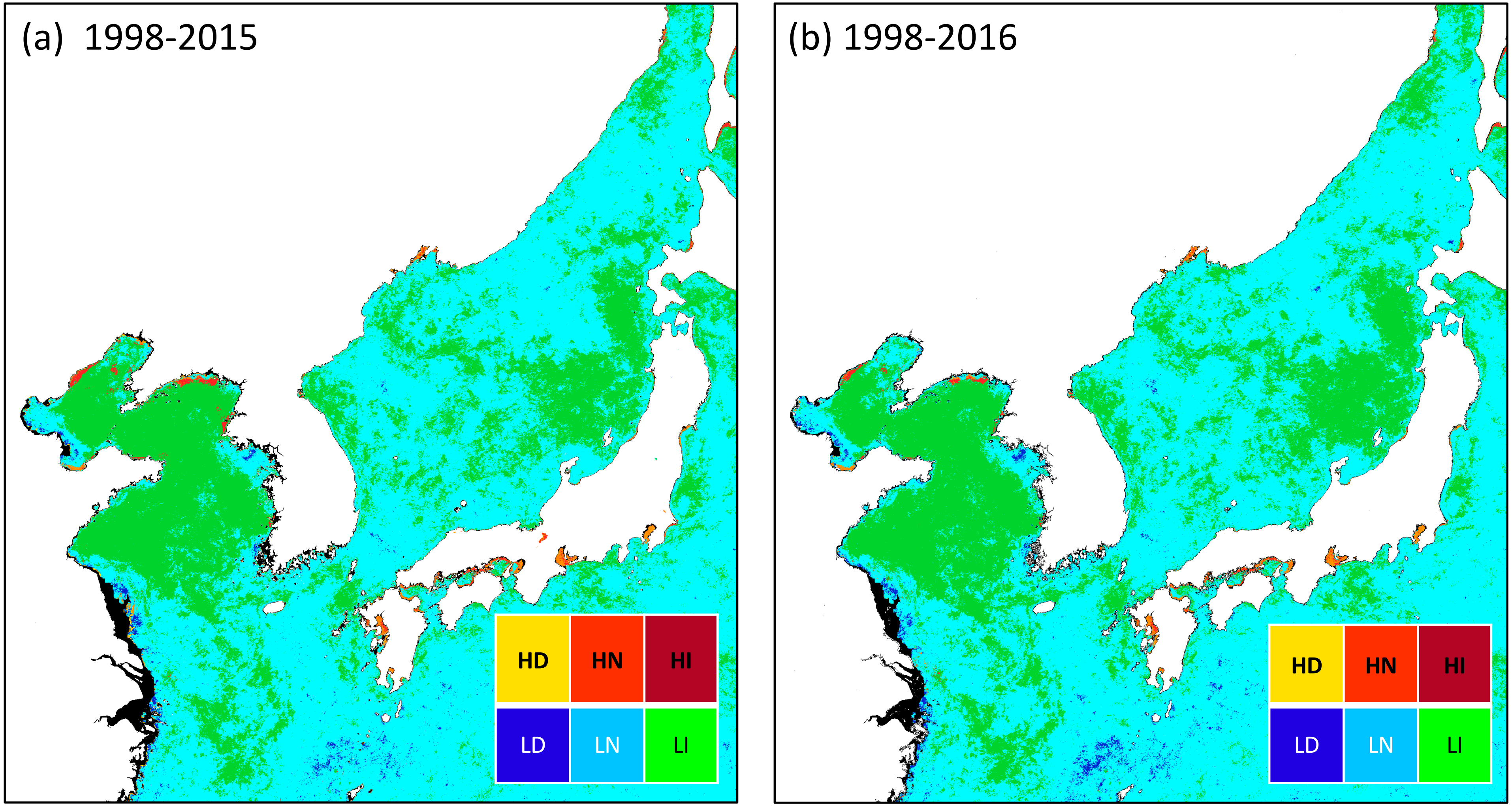


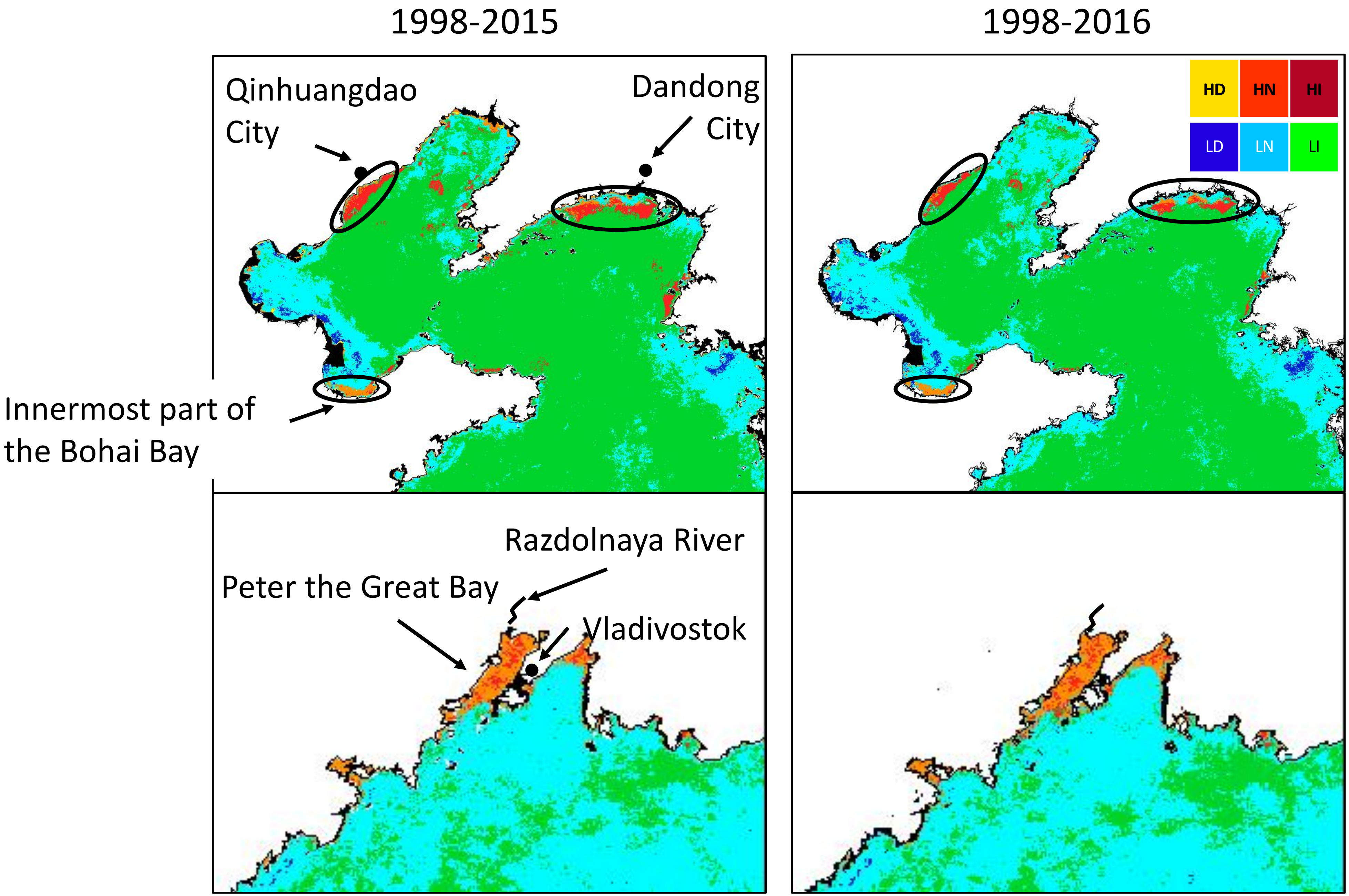
Satellite data used of assessment

Sensor	**NASA SeaWiFS on Orbview 2** **NASA MODIS on Aqua**
Algorithm	**R2014 NASA standard for the eastern part** **R2014 NASA standard and YOC algorithm for the western part** **(Siswanto *et al.* 2011)**
Duration	**Jan 1998 to Dec 2016**
Data	**Level 2**
Area	**Northwest Pacific**



Comparison of assessment results





1998-2015
1998-2016
Qinhuangdao City
Dandong City
Innermost part of the Bohai Bay
HD
HN
HI
LD
LN
LI
Razdolnaya River
Peter the Great Bay
Vladivostok

Preprocessing of ocean color data

Level 2

- Screening by level 2 flags

ATMFAIL, LAND, HIGLINT, HILT, HISATZEN, STRAYLIGHT, CLDICE, HISOLZEN, LOWLW, CHLFAIL, NAVWARN, CHLWARN, NAVFAIL

Level 3 data will be masked if above flags are on.

Level 3

Eastern part

・Chl-*a* was estimated by the NASA standard algorithm (Reprocessing version 2014)

Western part

#Case 1

・Chl-a was estimated the NASA standard algorithm (Reprocessing version 2014)

#Case 2

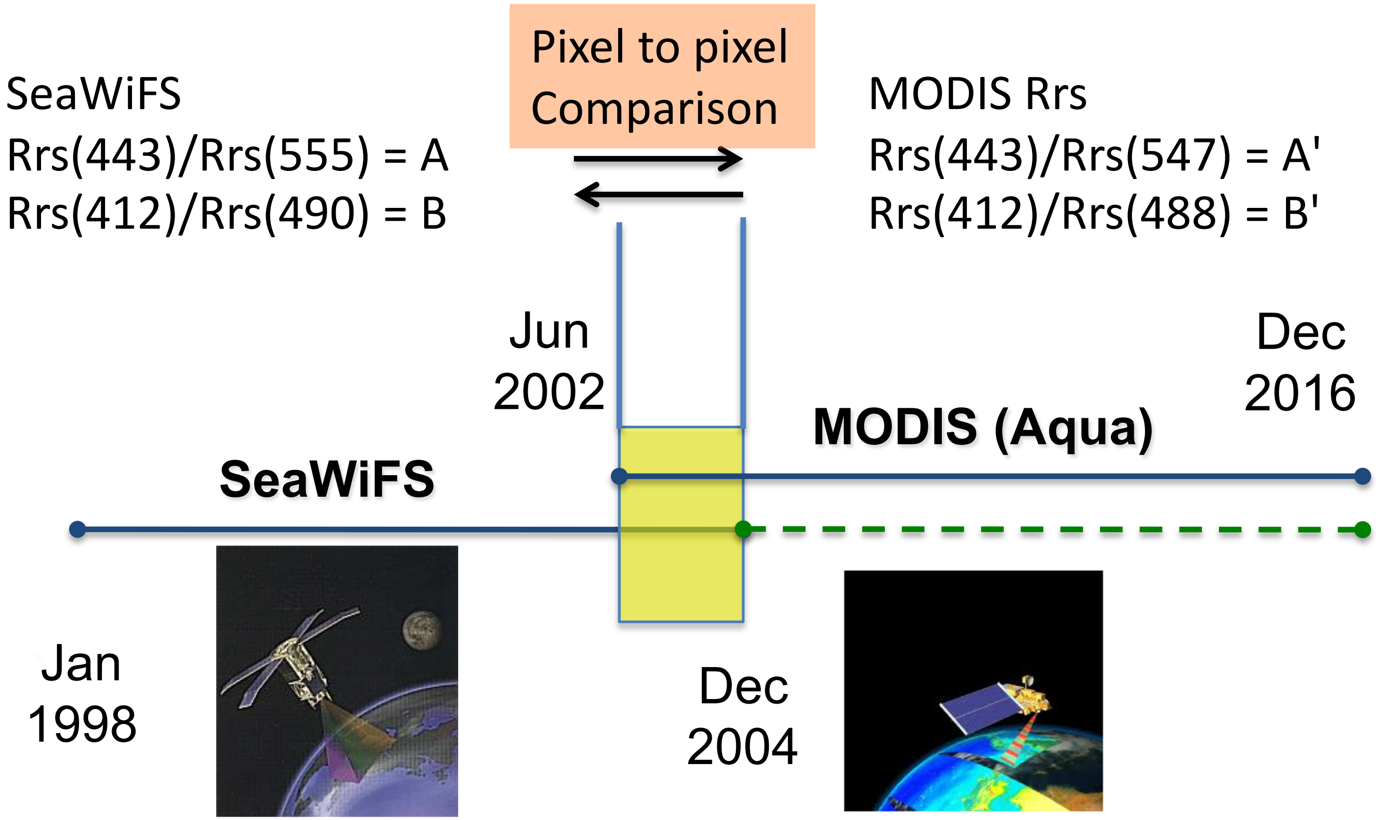
・Chl-a was estimated from the YOC algorithms from SeaWiFS and MODIS Rrs

Comparison of band ratios between SeaWiFS and MODIS Rrs

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

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

Siswanto *et al.* (2011)



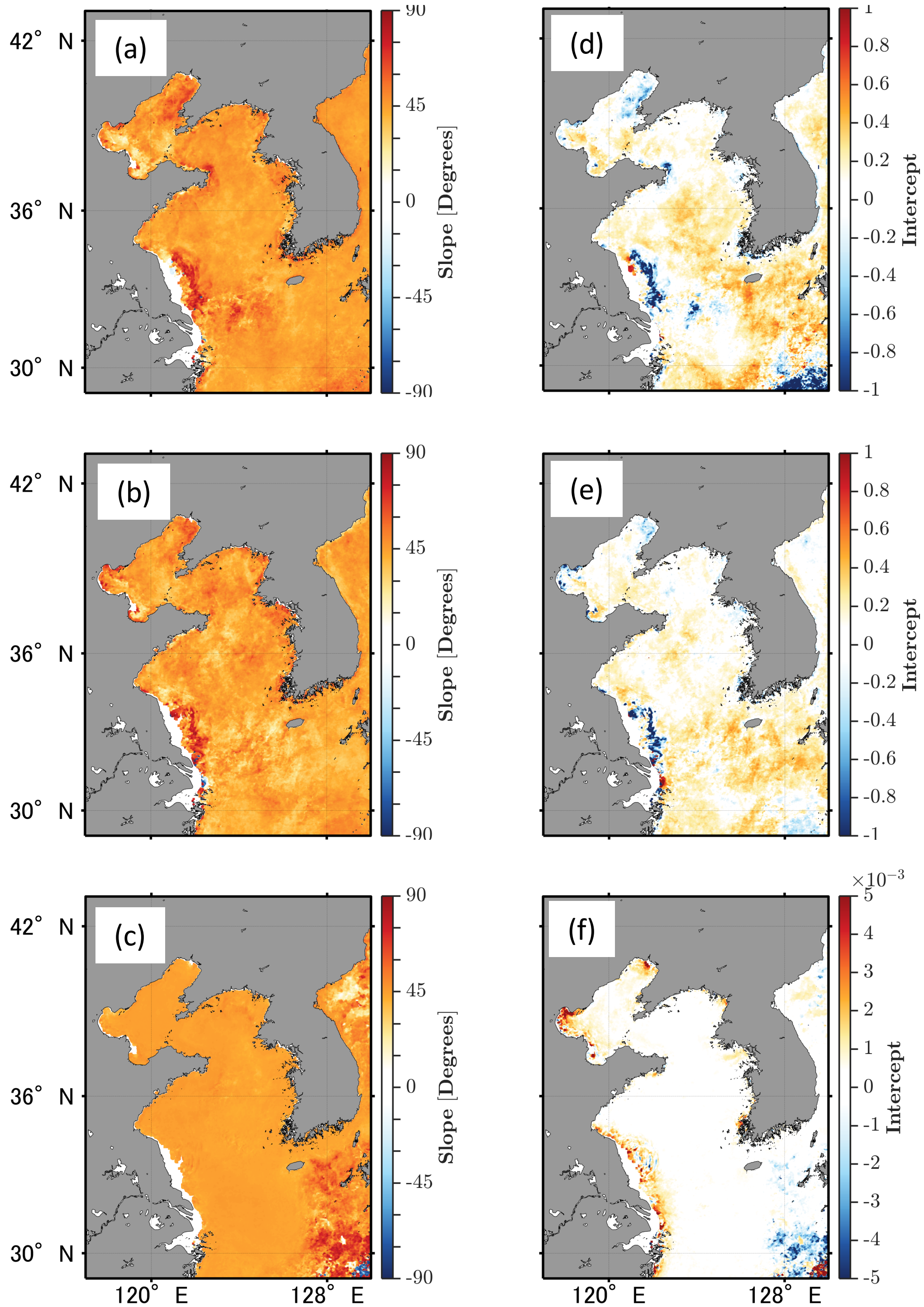
Comparison of Rrs ratios and Rrs between SeaWiFS and MODIS-A

Angles of the regression lines (left) and intercept (right)

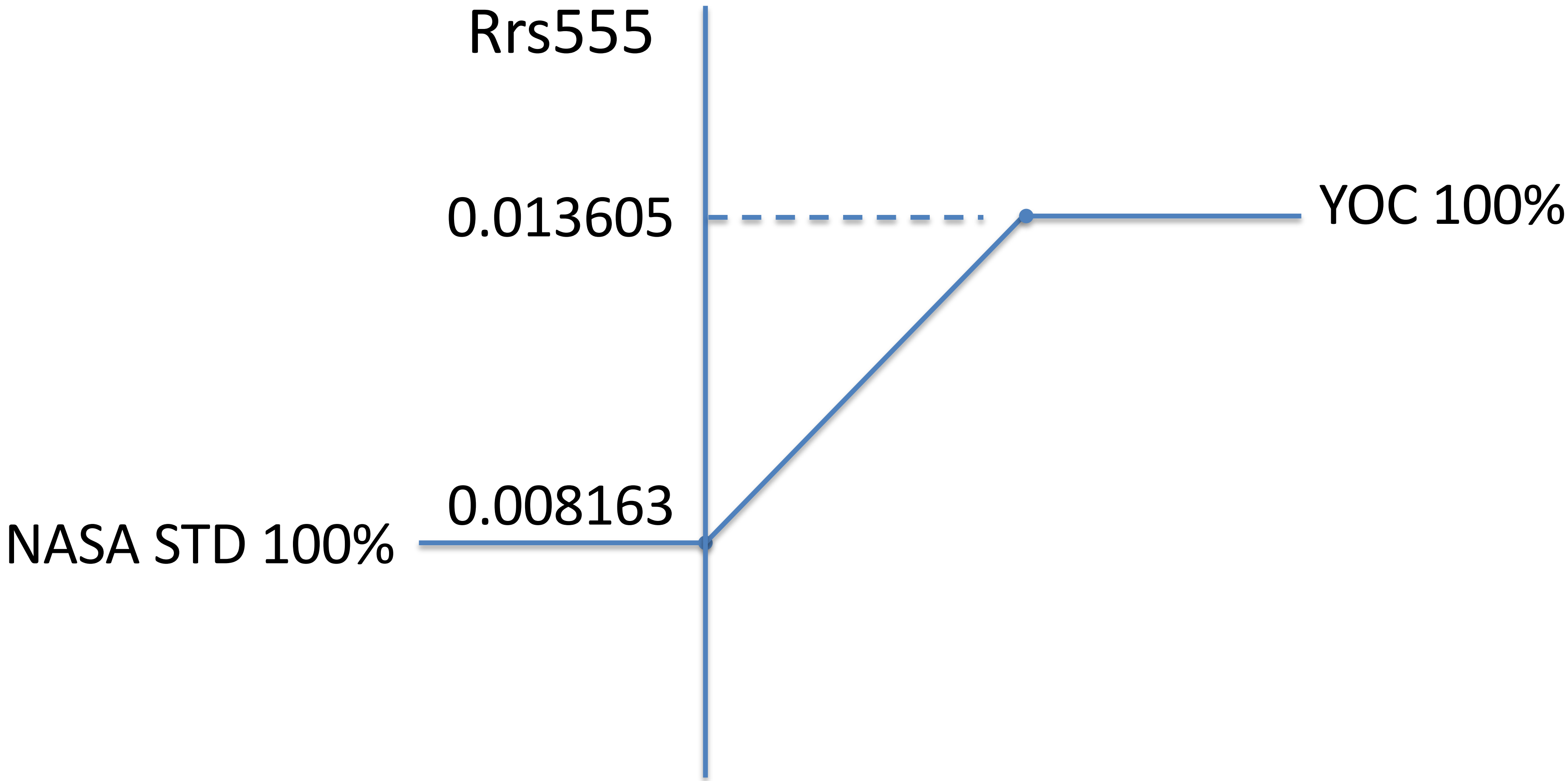
SeaWiFS Rrs(443/555) vs MODIS-A Rrs(443/547)

SeaWiFS Rrs(412/490) vs MODIS-A Rrs(412/488)

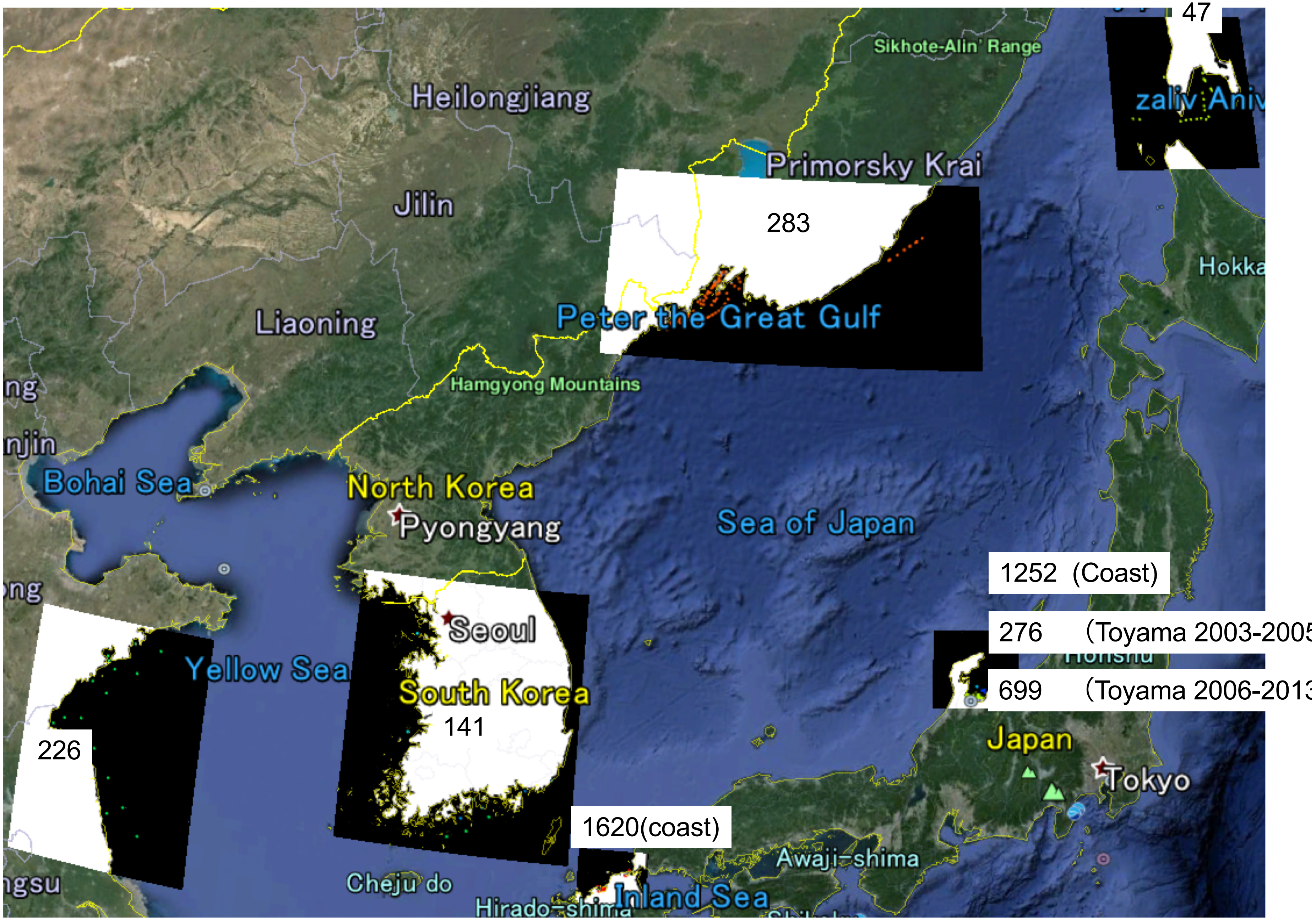
SeaWiFS Rrs(555) vs MODIS-A Rrs(547)



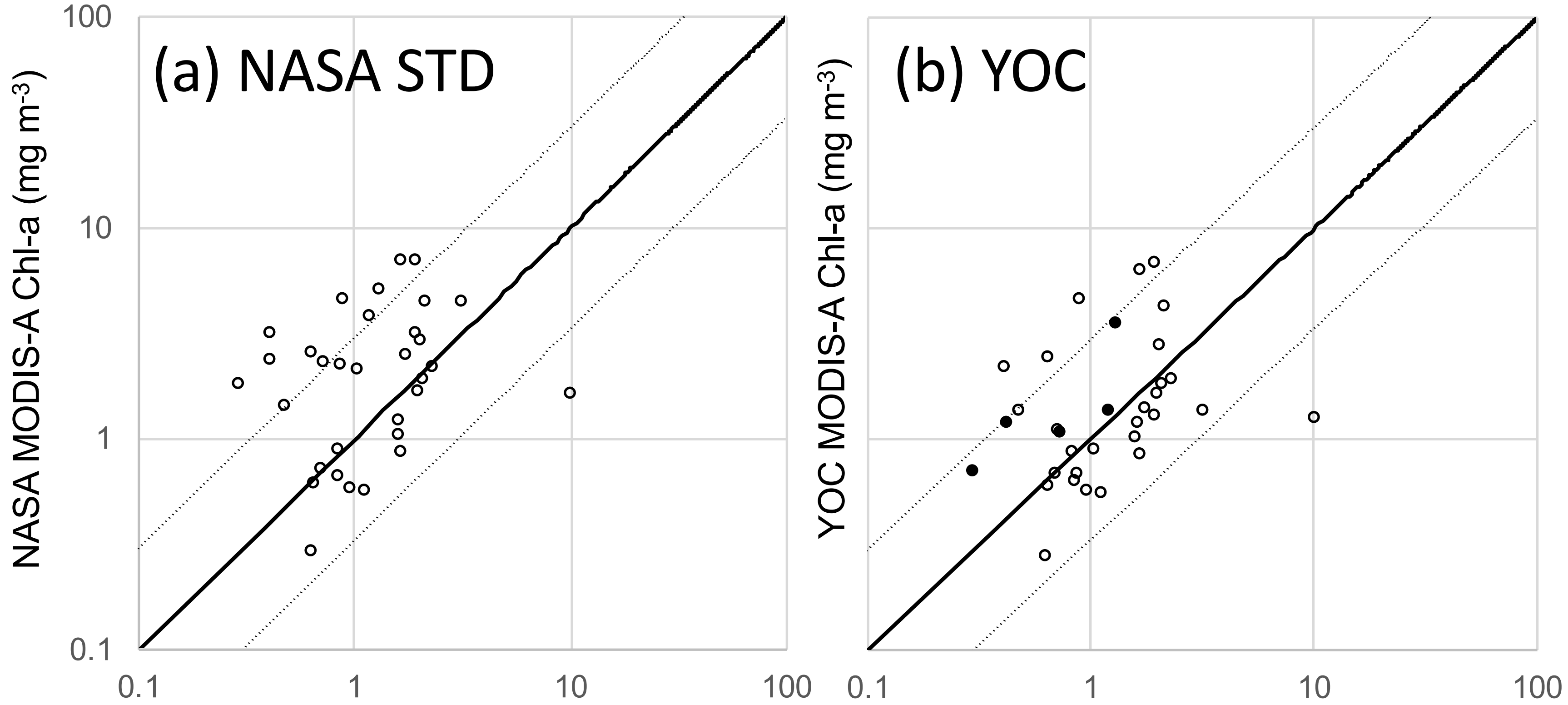
Switching OC algorithms



Validation of satellite Chl-a with in situ Chl-a

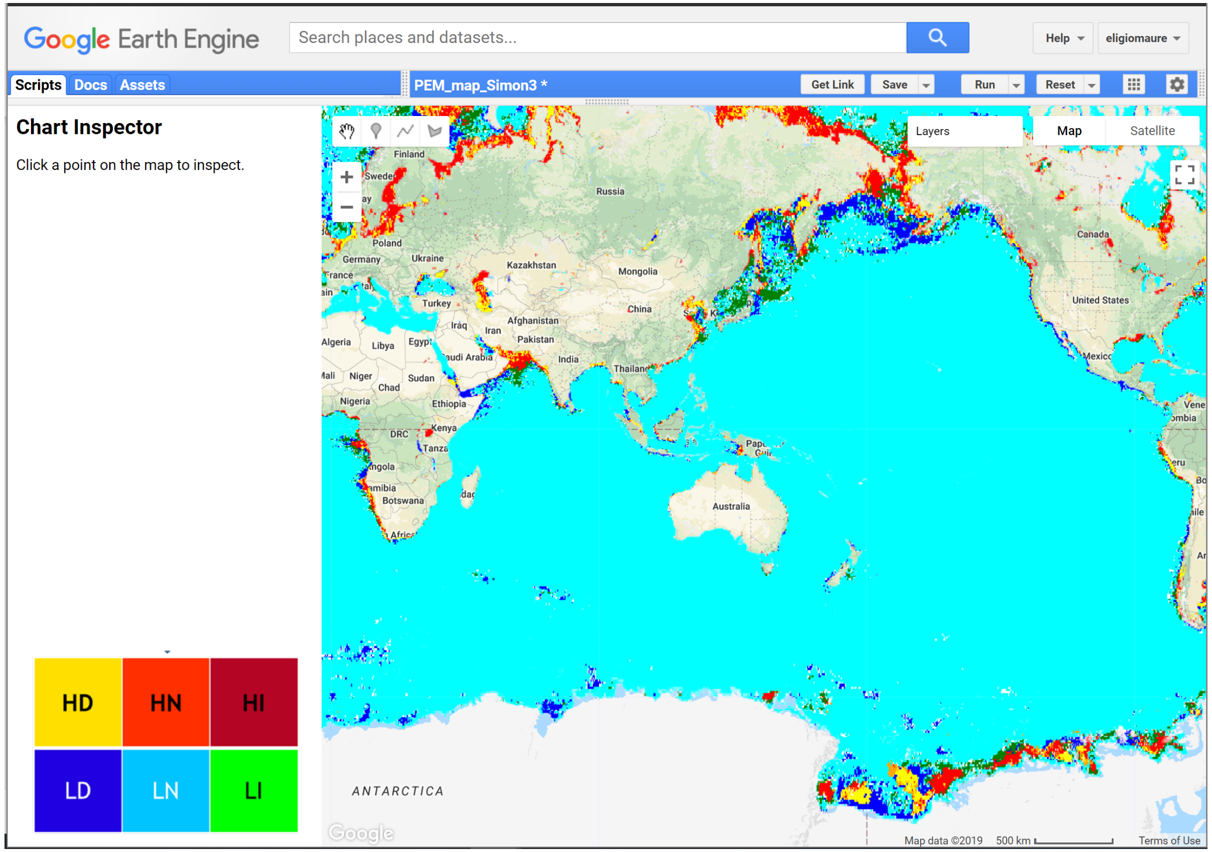


Comparison of satellite and in situ Chl-a with the two different algorithms



In situ Chl-a in southern and western coastal area around Korean Peninsula

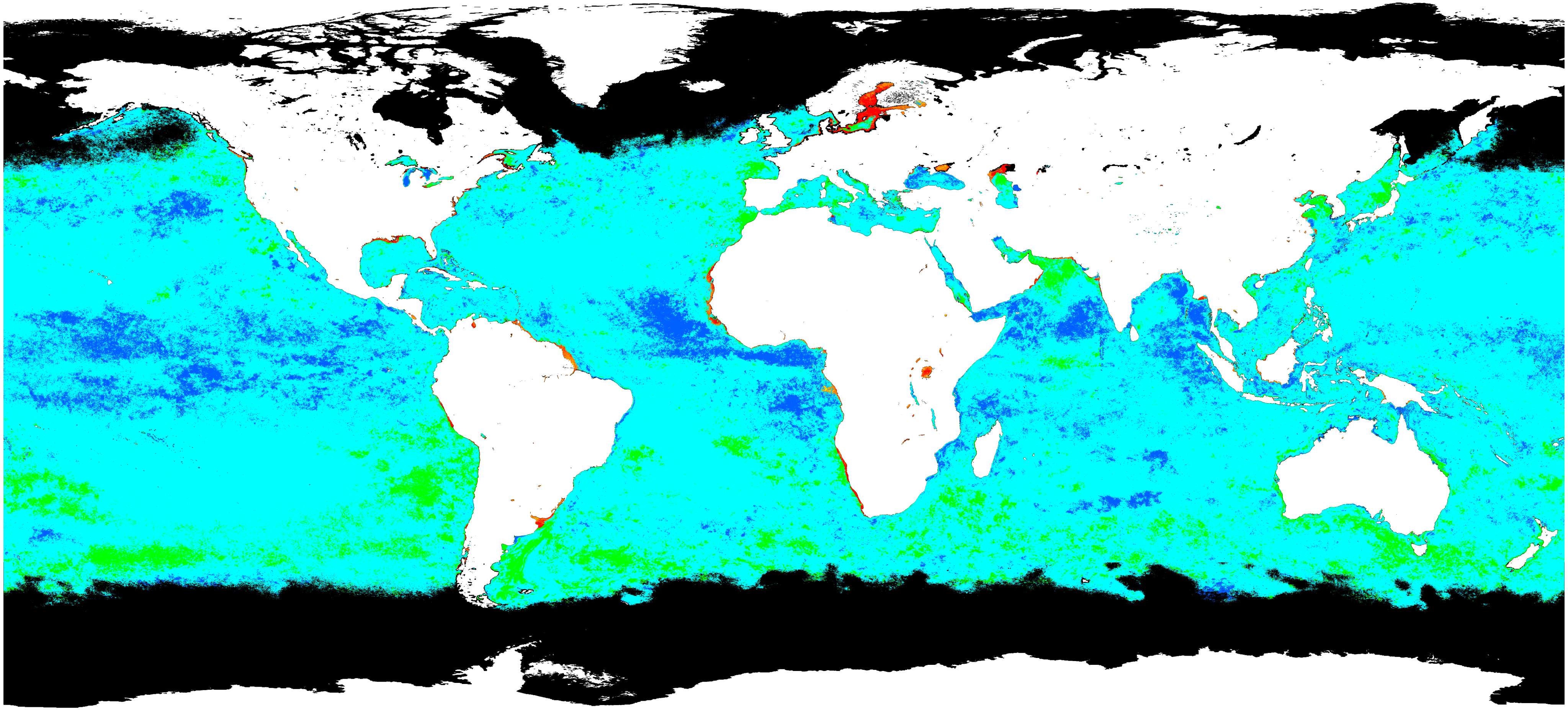
Exploring potential of Google Earth Engine, a planetary geo-spatial analysis tool, for assessing eutrophication in a global scale



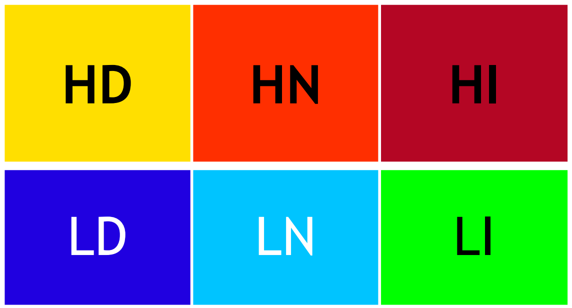
•Eutrophication assessment based on Google Earth Engine

- Easy to update by non-expert
- Always provides the most recent information
- Only focus on the interpretation of results

Global assessment of marine and coastal eutrophication by the NEAT



G. Terauchi and E. R. Maúre (2018)



- **Satellite Sensors and OC Data processing version**

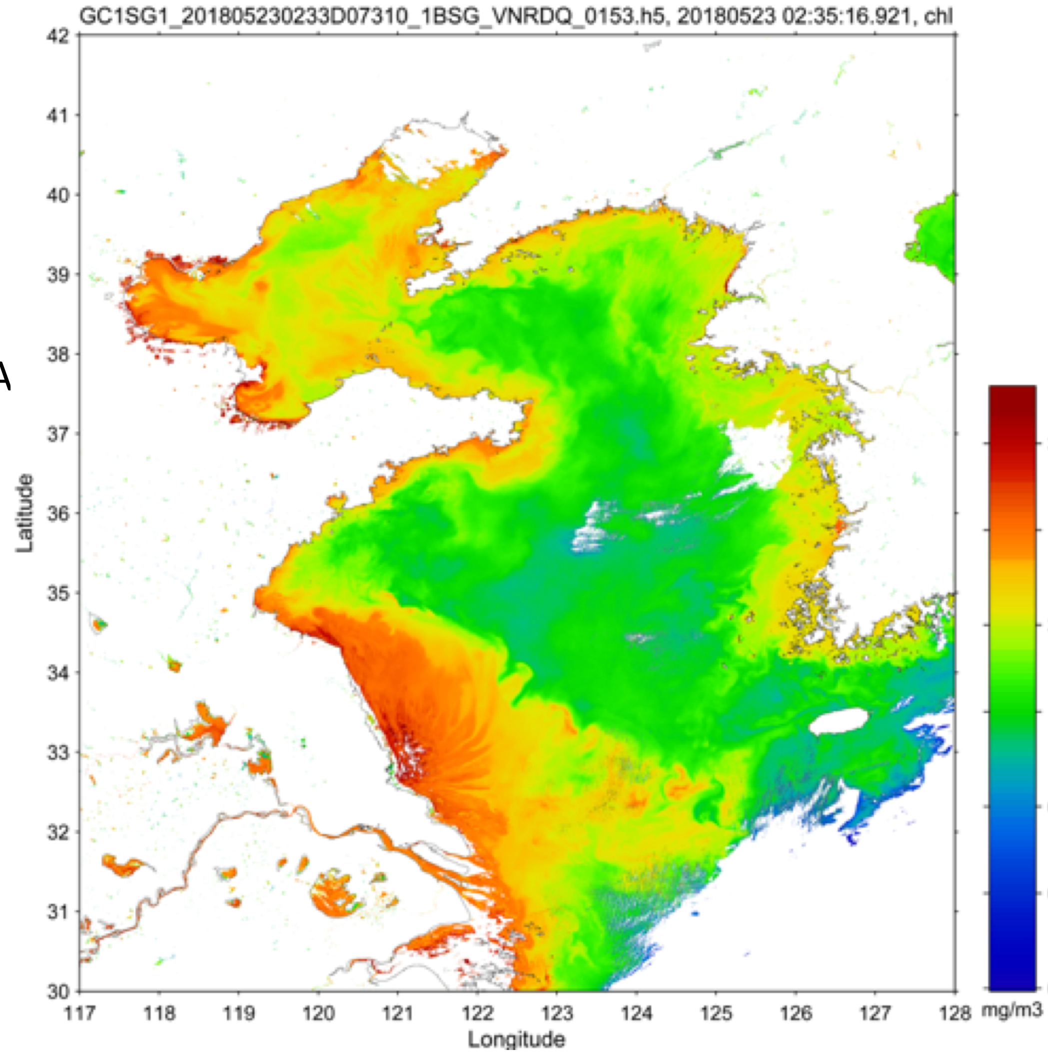
SeaWiFS (1998-2004) and MODIS-Aqua (2002-2017)

Reprocessing version 2018

Use of SGLI of the GCOM-Mission will enhance the applicability of satellite Chl-a in eutrophication assessment in coastal zone

Chlorophyll-a concentration on May 23, 2018
observed by SGLI on board GCOM-C mission.
Image provided by Dr. Hiroshi Murakami, JAXA

JAXA



Conclusion

- Regionally tuned Chl-a algorithms is helpful and necessary to improve accuracy in turbid water
- Merging satellite Chl-a from different ocean color sensors are necessary to carry out a long-term assessment
- Increase in resolution of recent ocean color sensors will give better picture in coastal zones
- Use of cloud computing will enhance applicability of the NEAT in wider spatial scale