Outline for the progress report on
Rapid Detection Technology for Harmful Algal Blooms (WG)

1. Introduction and justification

In the past decades Harmful Algal Blooms (HABs) have expanded globally and drawn a great attention of coastal countries worldwide, because of their multiple effects on marine ecosystems and the public health. The HABs studies have been done much in the last several decades, especially on their taxonomy, biodiversity and geographical distribution. However, there still remains a big gap towards the early warning and effective management of HABs, especially in the West Pacific region.

With the scientific and technological progress, molecular probe or diagnosis has been significantly developed. Remote sensing can also be applied in many fields with a high resolution. Although more and more new rapid detection technologies for HAB were developed, there is still some distance for the application of these technologies to HAB monitoring and detecting on an operational basis, due to technical constraints of each technology, such as efficiency, accuracy, manpower.

Therefore, the working group aims, through focused group discussions and pilot studies, explore, to promote, adapt and apply rapid detection technology for HABs towards the early warning and effective management of HABs in the West Pacific Region, by means of via not only using traditional microscopy methods, but also combining with molecular probes and quantitative PCR essays, high-throughput sequencing and remote sensing technique etc. Thus, the WESTPAC WORKING GROUP ON Rapid Detection Technology for Harmful Algal Blooms (RDT-HAB) was established and conducts a joint study on rapid detection technology.

2. Timeframe and objectives

2.1 Timeframe
2021-2025

2.2 Objectives
The aim of Rapid Detection Technology for Harmful Algal Blooms of IOC-WESTPAC (RDT-HAB-IOC-WESTPAC) is to include, modify and apply the rapid detection technology for HABs base on molecular and remote sensing technique etc. So that a capability can be developed to detect the HABs at its earlier stage, and thus towards the early warning of HABs and its effective management.

3. Major activities, outputs & outcomes over the last intersessional period (May 2021- April 2023)

3.1 Harmful Algal Blooming Information System of West Pacific Region
Under review the harmful algal blooming status, developing and establishing the Harmful Algal Blooming Information System of West Pacific Region, collecting and loading the HAB events and biogeographic information in the system. Currently, partial data were uploaded in the system and can be shown virtually, including the data from China (1980-2021), Korea (2017-2022), Philippines (1991-2021), Thailand (1995-2021), which were contributed by the working group members from the related countries (Figure 1-2).
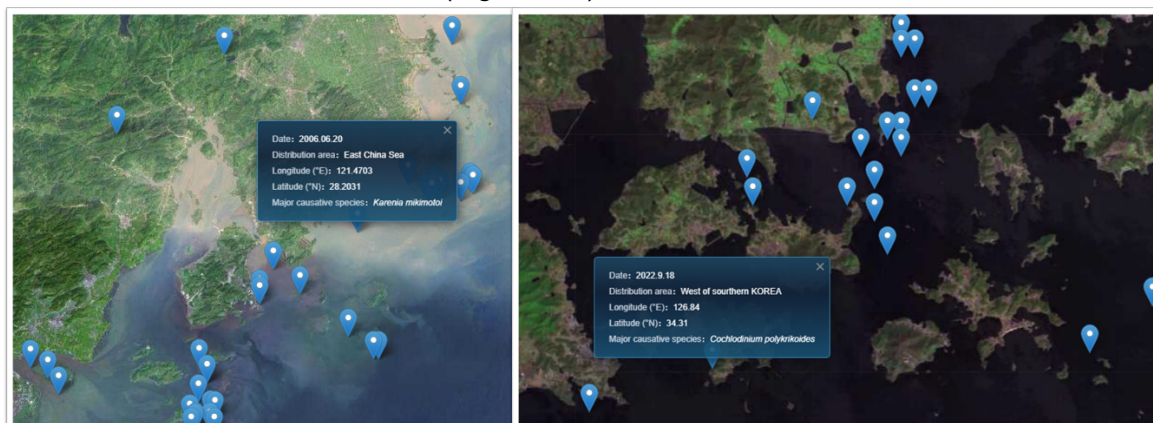

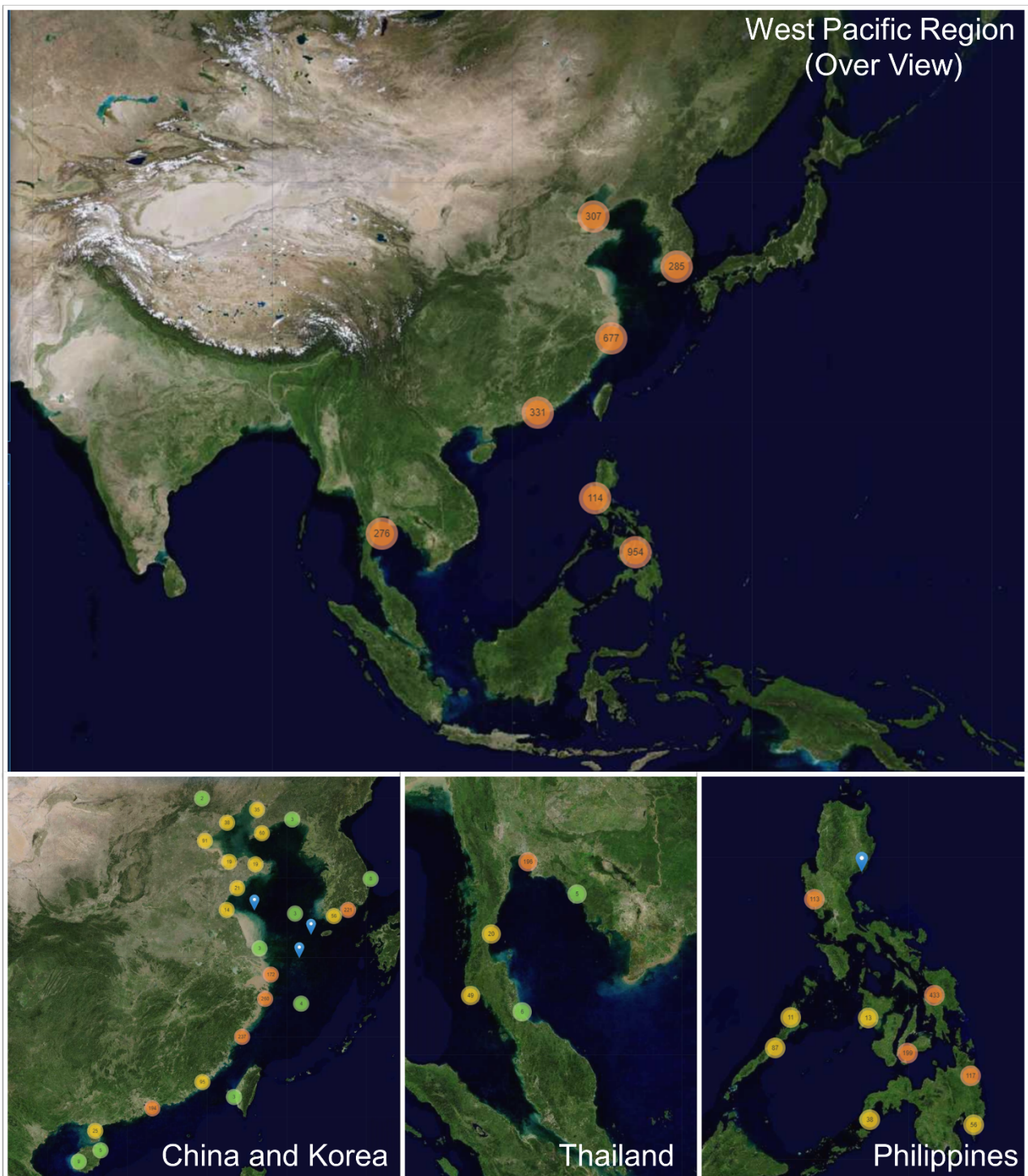Figure 1. Detailed and biogeographic information of each bloom events.

Figure 2. Over view bloom events of West Pacific Region and related countries.

3.2 Pilot test via quantitative real-time PCR in Chinese coastal water

Margalefidinium polykrikoides (*Cochlodinium polykrikoides*), as a marine ichthyotoxic dinoflagellate, have caused mass mortalities of fish worldwidly. In Korea alone, fishery losses associated with the blooms exceed $100M annually. Compared with other countries, such as Japan and Korea, there are few reports regarding, *M. polykrikoides* in Chinese coastal waters, and there is still a lack of reports on the detailed distribution of *M. polykrikoides* in the China Sea. According to South Korean members in our working group, they thought quantitative real-time PCR (qPCR) has higher sensitivity, specificity, and a more accurate quantitative effect via compared with the above detection methods, like microarrays with molecular probes, restriction fragment length polymorphism (RFLP), high throughput sequencing, and fluorescent in situ hybridization (FISH-probes) etc. Basing the methods of qPCR from South Korean members, a pilot test via quantitative real-time PCR on *M. polykrikoides* in Chinese coastal water were

conducted to used to study the distribution of *M. polykrikoides* in the coastal areas of China, which can be thought as a rapid identification of the target species (Figure 3).
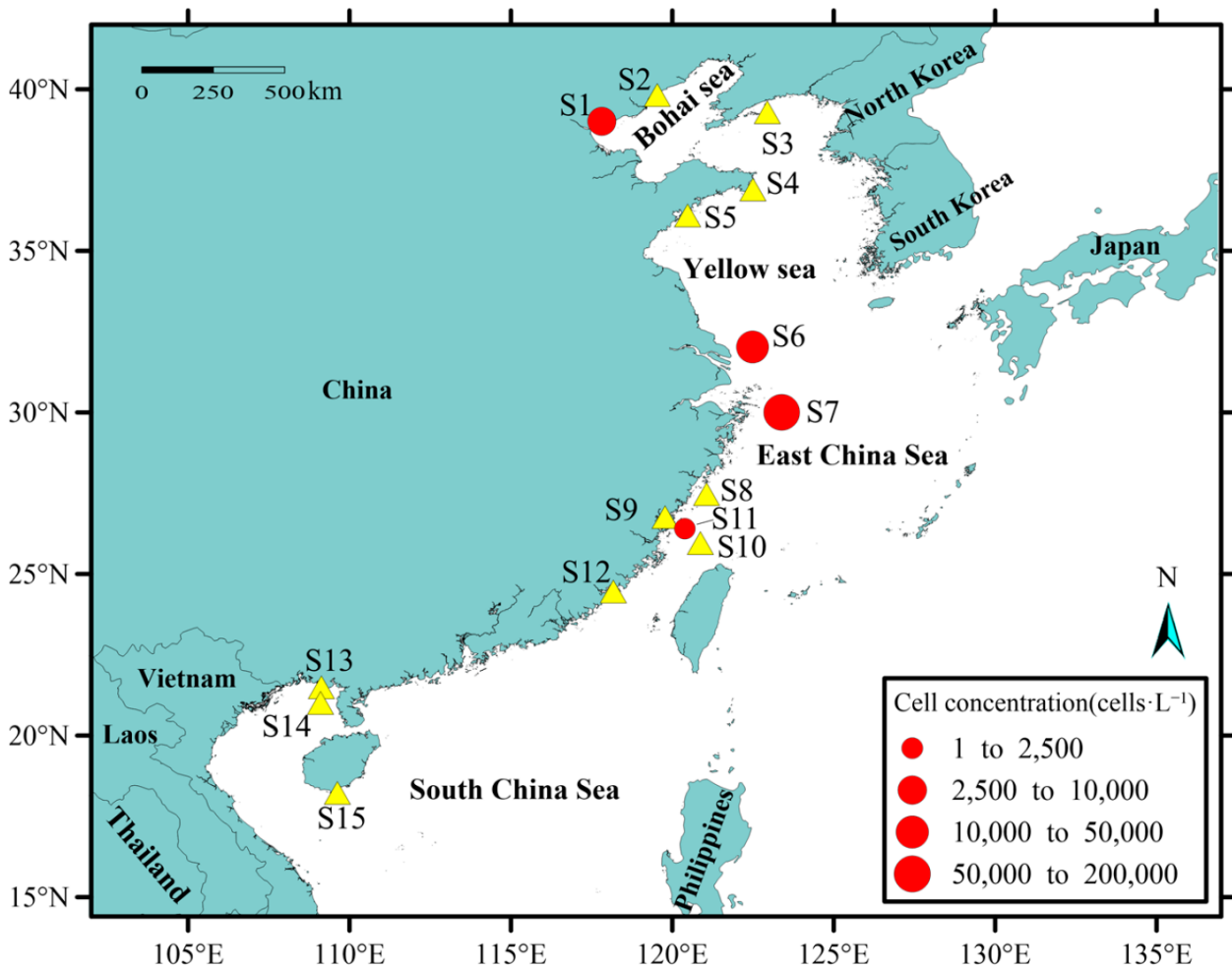

Figure 3. Distribution of *M. polykrikoides* (EAr) in coastal China based on qPCR.

3.3 Developing the satellites based (remote sensing) HAB rapid detection technology

Remote sensing is a good way to detect high biomass HAB, thus our working group is trying to develop and test the application on satellite based remote sensing method to detect HAB in west pacific region. The business operation HAB information system is under construction (Figure 4).
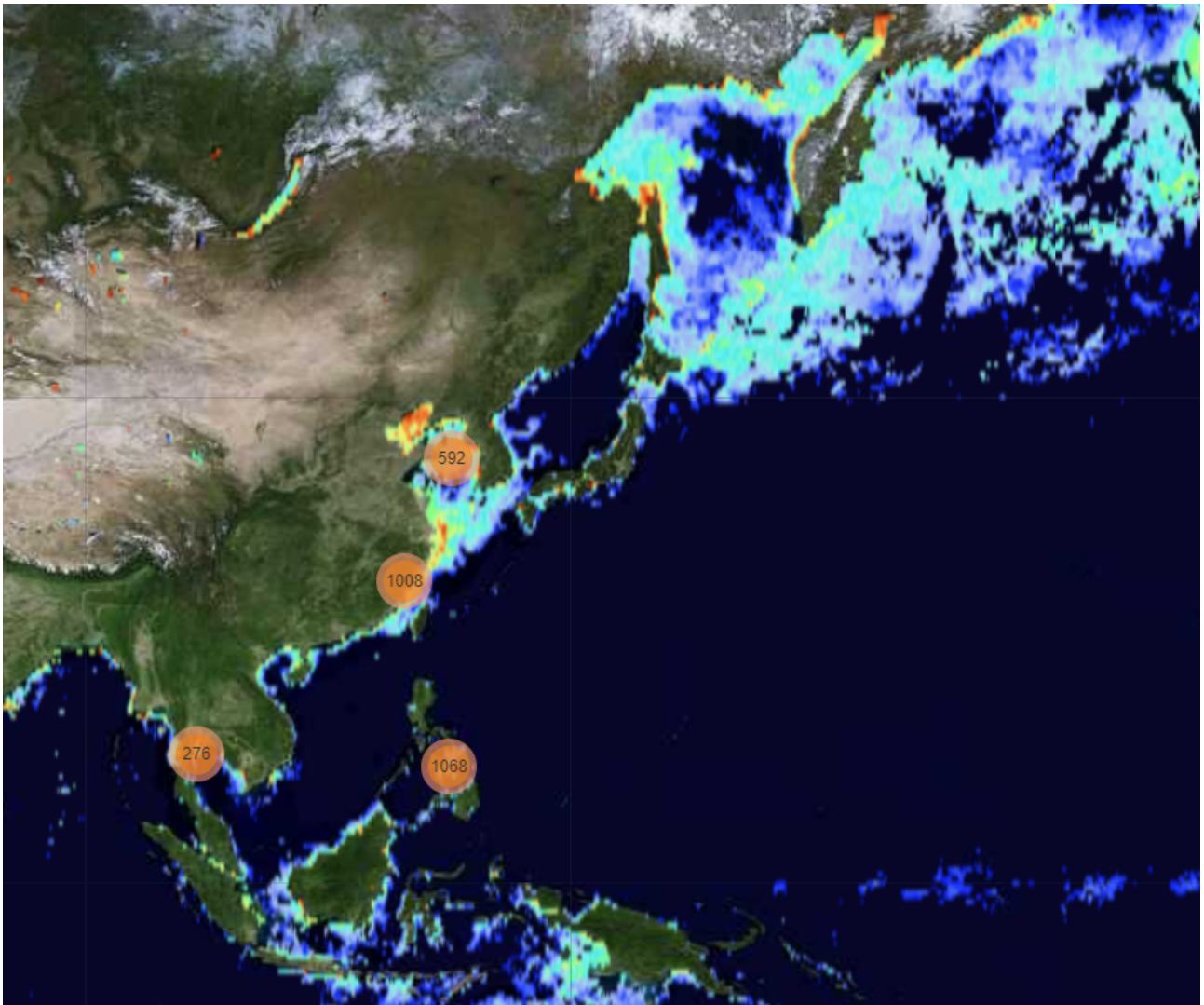
Figure 4. Developing and testing the application on satellites based remote sensing method to detect HAB in west pacific region.

3.4 Webinar of rapid detection technology for harmful algal blooms

Webinar of rapid detection technology for harmful algal blooms was held in 2022. 08.10, Online. More than 30 participants joint the webinar and the different HAB Rapid Detection Technologies were introduced, such as molecular method, buoy or IFCB, remote sensing and smart ocean. Additionally, all participants conducted the discussion on the design of HAB rapid detection technologies in the Western Pacific Region (Figure 5).

1.1 Figure 5. Information of Webinar of rapid detection technology for harmful algal blooms

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2. A summary of key achievements since its establishment

Harmful Algal Blooming Information System of West Pacific Region (historical blooming events) and business operation HAB information system basing satellites are under developing and construction. A pilot test on quantitative real-time PCR in Chinese coastal water based on the method from South Korea was conducted.

3. Self-assessment on implementation against objectives
The implementation of the rapid detection technology for harmful algal blooms is carried out normally and meets the objectives accordingly.

4. Problems encountered and recommended actions
For the Covid-19 pandemic in last three years, the face to face communication and on site validation of HABs became less. As the global Covid-19 pandemic gradually become end, more face to face chance will arise.

5. Objectives to be achieved, if applicable, over the next intersessional period (May 2023- April 2025)
Modify and apply the rapid detection technology for HABs base on molecular and remote sensing technique etc. in west pacific region. Improve the capability to detect the HABs at its earlier stage, and thus towards the early warning of HABs and its effective management.

6. Planned activities for May 2023- April 2025
2023.04: RDT-HAB Working Group Business Meeting.
Discuss the next steps of RDT-HAB MAY 2023 - MAY 2025.
2023.10-11: RDT-HAB Training Workshop.
Organize the RDT-HAB Training Workshop to share how to conduct the studies of rapid detection technology for HABs via qPCR and other molecule methods.
2024.03: RDT-HAB 2021 Workshop.
Review, communicate and exchange the research status of rapid detection technology for HABs; co-design and modify the rapid detection technology for HABs products from our working group towards the early warning and effective management of HABs in the region.
2024.09-10: RDT-HAB Working Group Business Meeting.
Review and discuss on the pilot studies and implementation. Problems and solutions. Finish the SOP manuals.
2024. 09-10: RDT-HAB Training Workshop.
Organize the RDT-HAB Training Workshop to share how to conduct the studies of rapid detection technology for HABs via remote sensing methods.
2025.02: RDT-HAB Working Group Business Meeting.
Summarize the achievement of RDT-HAB working group. Discuss the next steps work of RDT-HAB.

[provide, in tabular form, the action items that should be included in the work plan and budget]

Program	Activities	Objectives	Expected outputs/outcomes	Date and place	Funding Required		Remark
					IOC	Other sources (i.e., from national or international)	
【Working Group】Rapid Detection Technology for Harmful Algal Blooms (RDT-HAB)	1. Workshops	Rapid Detection Technology for Harmful Algal Blooms	Review, communicate and exchange the research status of rapid detection technology for HABs; co-design and modify the rapid detection technology for HABs products from our working group towards the early warning and effective management of HABs in the region.	2024.03; Hangzhou, China	0	10K USD	
	2. Training Workshops	Study Rapid Detection Technology for Harmful Algal Blooms	Sharing the Study Method and Rapid Detection Technology for Harmful Algal Blooms	TBD	0	10K USD	
	3. Business Meetings	Discuss and summarize the progress of RDT-HAB-IOC-WESTPAC	Business discussion and decision	TBD	0	5K USD	