Analysis of phytoplankton community change according to continuous observation pattern of chlorophyll-*a* concentration

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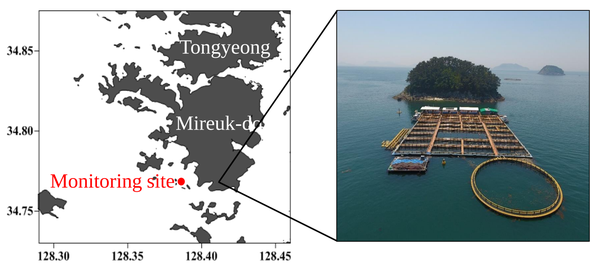
Abstract

To understand the changes in chlorophyll-*a* concentration and phytoplankton community in Tongyeong coastal waters, South Korea, we continuously monitored chlorophyll-*a* concentration using a fluorescence sensor from July 29 to September 28, 2017 and from July 13 to September 6, 2018. Furthermore, phytoplankton analyses were conducted periodically to monitor changes in dominant species affected by variations in chlorophyll-*a* concentrations. In the presented study, chlorophyll-*a* concentrations increased rapidly three times in 2017(event 1~3) and twice in 2018(event 4, 5). During the event 1(August 6 to 14, 2017) and 4(July 29 to August 6, 2018), rapid and repeated increase pattern of chlorophyll-*a* concentration during 14:00 to 16:00 pm were the result of the diel vertical migration of *Alexandrium affine* and *Cochlodinium polykrikoides*(the dominant species during each peak) in 2017 and 2018, respectively. During event 2(August 24 to 30, 2017), 3(September 12 to 17, 2017) and 5(August 11 to 18, 2018), increases in chlorophyll-*a* concentration were caused by diatoms(common species: *Chaetoceoros curvisetus*, *Skeletonema marinoi-dohrnii* complex, *Psuedonitzschia* spp. etc.). Unlike event 1 and 4, we did not observe any characteristic changes such as vertical migration during these events. Therefore, the continuous monitoring of chlorophyll-*a* concentrations using a real-time detection device, such as a fluorescence sensor, is necessary and important because of the variations that occur in chlorophyll-*a* concentration and phytoplankton community in the short-term.

Study site & materials and methods



◈ Real-time measuring and receiving of data using LoRa network based IoT systems

◈ Chlorophyll-*a* analyses : Environmental multi-parameter (YSI EXO2) & Acetone extraction method

◈ Surface continuous monitoring in 2017 and 2018
- ▶ 2017.07.29 - 09.28 (62 days)
- ▶ 2018.07.13 - 09.06 (56 days)
- ▶ time interval : every 10 minutes

◈ Vertical continuous monitoring in 2018
- ▶ time interval : every 1 hour

◈ Phytoplankton analyses: temporal and spatial
- ▶ total 12 times(1~2 times every week) in 2017
  - time : 9:00, 12:00, 16:00
  - depth: surface(1.5m), 5, 10, 15, 20m
- ▶ total 7 times(overnight once a week) in 2018
  - time : 9:00, 15:00, 21:00, 3:00
  - depth: surface(1.5m), 5, 10, 15, 20m, 25m

◈ Environmental factors: Temperature, Salinity

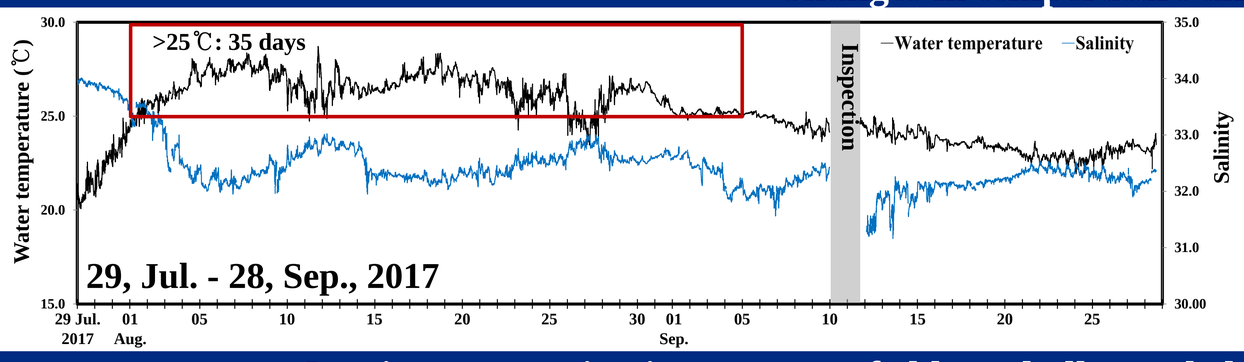
Introduction and goal

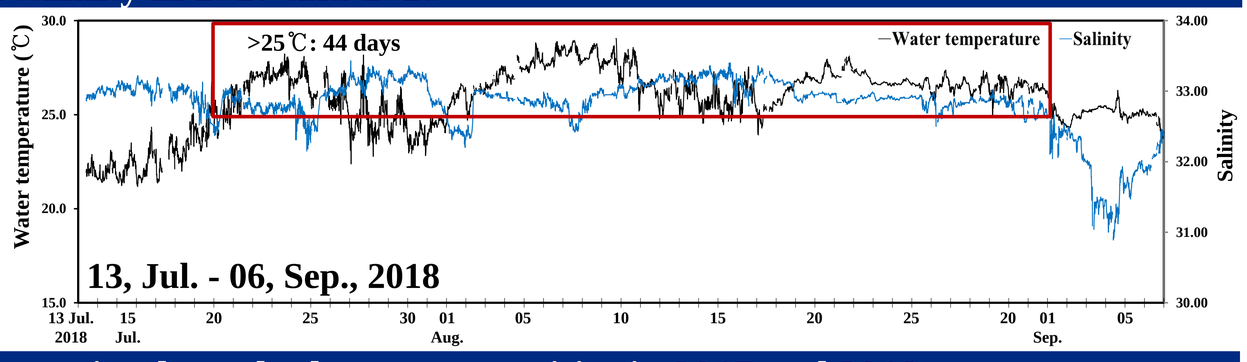
◈Importance of continuous monitoring of chlorophyll-*a* concentration.
- ▶ Analysis of the Chlorophyll-*a* concentration is one of the approaching for detecting changes in phytoplankton biomass.
- ▶ Fluorometry for chlorophyll-*a* is sensitive and fast comparing to spectrophotometry, therefore, would be available for continuously measuring the chlorophyll-*a* concentration.
- ▶ Detecting for dinoflagellate blooms(or red-tides) occurred into a small patch and short-term, continuous monitoring of chlorophyll-*a* concentration is important and useful.

◈Diel vertical migration of bloom forming dinoflagellates.
- ▶ The characteristic behavior of dinoflagellates called diel vertical migration(upward movement at the surface during day time and downward movement at the deep during night) were considered a positive phototatic response.
- ▶ However, the time of accumulation at the surface is different according to species because of preference of light intensity.
- ▶ Previous studies reported that accumulation time of *Alexandirum affine* and *Cochlodinium polykrikoides* were 14 to 16 pm(Han et al., 2018; Kim et al., 2017).

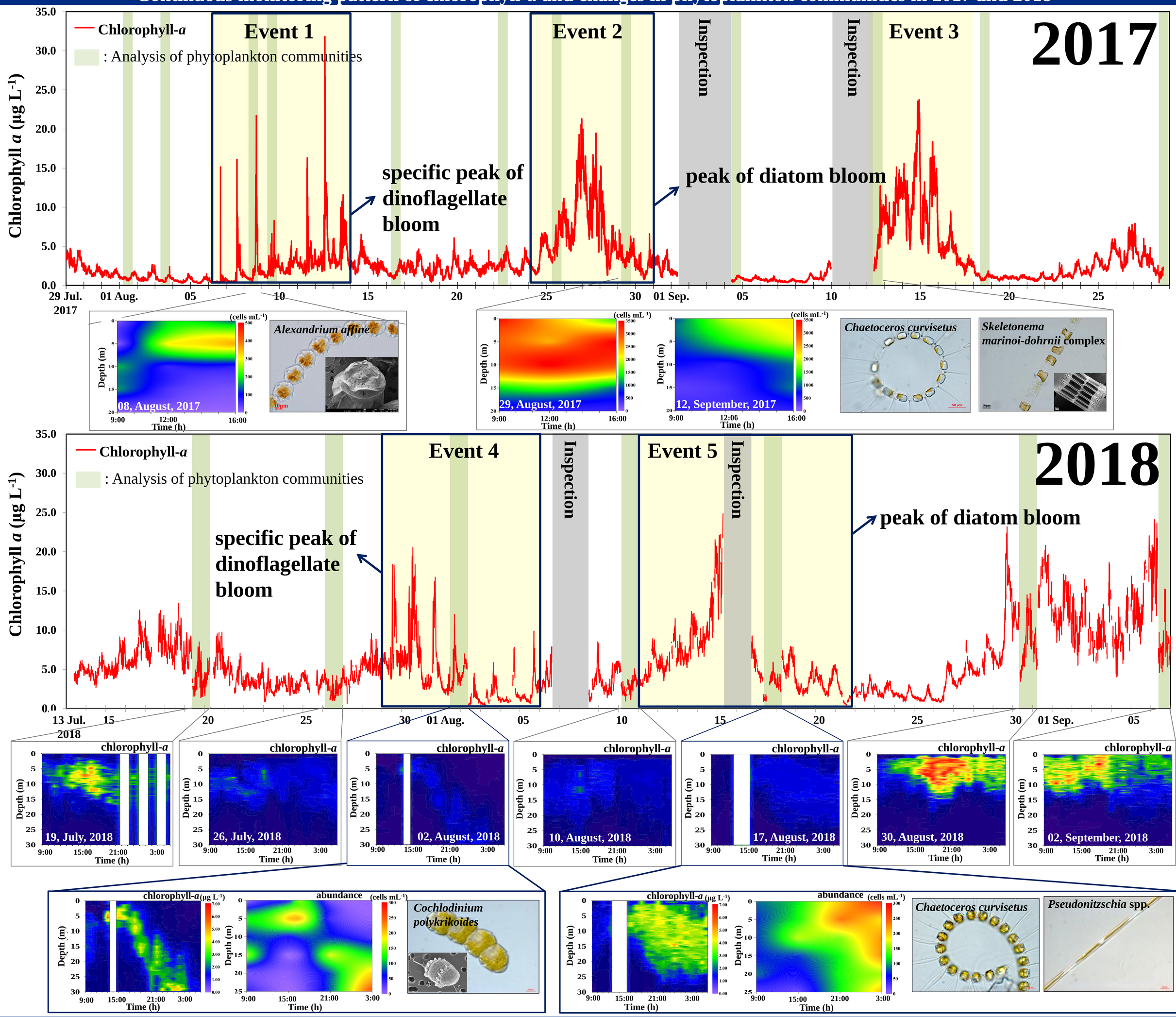
◈The goal of this study was to monitor of chlorophyll-*a* concentration continuously and determine the pattern of changes in chlorophyll-*a* concentration according to changes in phytoplankton communities.

Changes in temperature and salinity in 2017 and 2018





Continuous monitoring pattern of chlorophyll-*a* and changes in phytoplankton communities in 2017 and 2018



Summary

◆ Dinoflagellate bloom of *Alexandrium affine* and *Cochlodinium polykrikoides* were occurred during high temperature(>25℃) periods in 2017 and 2018, respectively.

◆ The temporal and spatial distributions of *A. affine* and *C. polykrikoides* were showed a diel vertical migration of dinoflagellates.

◆ Patterns of temporal and spatial change in chlorophyll-*a* were similar to that of the phytoplankton abundance.

◆ As a result of surface continuous monitoring of chlorophyll-*a* concentration, two distinct patterns of change in chlorophyll-*a* concentration were determined.
- ➢ Specific peak of dinoflagellate bloom(event 1, 4) : rapid and repeated increase of chlorophyll-*a* concentration every 14:00 to 16:00 pm that the result of the diel vertical migration of dinoflagellates.
- ➢ Peak of diatom bloom(event 2,3 and 5) : gradual increase and decrease of chlorophyll-*a* concentration during diatom bloom.

◆ Thus, this specific peak of chlorophyll-*a* concentration could be used as a signal of dinoflagellate bloom. In addition, to detect the variations of chlorophyll-*a* concentration and phytoplankton communities changing in the short-term, the intensive and continuous monitoring of chlorophyll-*a* concentration is required.