Title

Monitoring and Detecting Harmful Algal Blooms in King Harbor, City of Redondo Beach, CA, Using a Wireless Sensor Network

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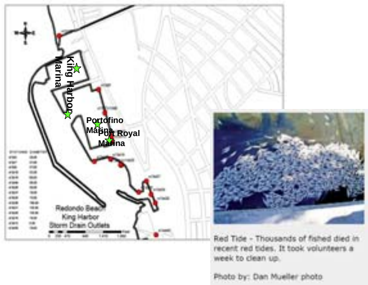
Developing a Monitoring and Early Warning System for HABs

- **Harmful Algal Blooms (HABs)**
  - Commonly known as red tide. It's the proliferation of nuisance algae.
  - It can cause dramatic adverse impact (environment, economy, and public health).
- **Negative impact of HABs at Redondo Beach**
  - Blooms frequently occurred in recent years, which might be linked to the massive fish kill in 2005.
  - Several potentially harmful algal species coexisted in the harbor.



- **Questions to be addressed in King Harbor**
  - When and where the blooms are formed (inside or outside the harbor?)
  - Solutions to avoid potential fish kill (aeration?).
  - The cause of community structure change of HABs community (environmental conditions or trophic interaction).

Approaches-- Networked Aquatic Microbial Observing System

Static Data Acquisition Platforms

A

- Four Buoy were deployed at various locations throughout the harbor
- The buoys are wirelessly connected and equipped with sensors which allows continuous real -time data acquisition:
  - Six thermistors to monitor temperature distribution at diferent depths
  - A light meter to monitor PAR
  - A fluorometer to monitor the Chlorophyll change

B

- Multisensor-equipped Sondes deployed at both surface and near bottom at different locations:
- Parameters can be measured by the sensors:
  - Conductivity
  - Temperature
  - Depth
  - Chlorophyll
  - turbidity

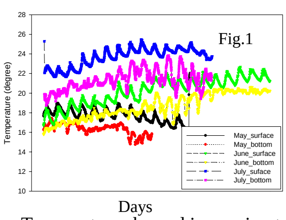
Mobile Data Acquisition System

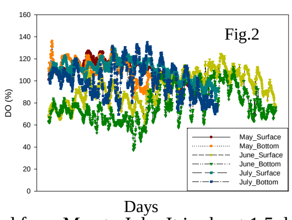
- Autonomous navigation to desired locations based on data collected from the static sensor networks.

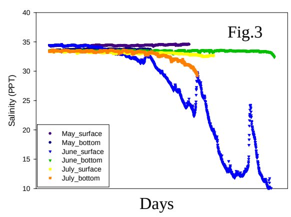
- Capable of vertical profiling
  - Conductivity
  - Temperature
  - Depth
  - Chlorophyll
  - Current speed
  - Current direction

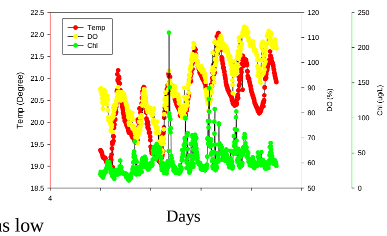
Data From Networked Sensors and Lab Experiments

Temporal and Spatial Distribution



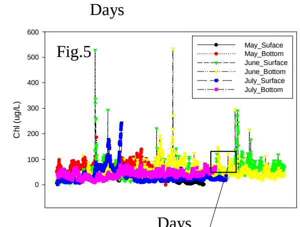


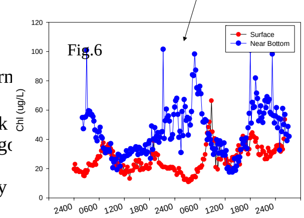




- Temperature showed increasing trend from May to July. It is about 1.5 degree higher at near surface than near bottom for all three months (Fig.1).
- Dissolved Oxygen (DO) was saturated in May and July for both surface and near bottom. However, in June, DO was relatively low with 91% at the surface and 76% at the bottom (Fig.2).
- Salinity was relatively constant in both May and July. But there was a huge variation at surface in June, which indicated a fresh water input. The fresher water at the surface may have caused a stratification in June, which led to the relatively low DO at the bottom (Fig. 3).

- Chlorophyll was low throughout the season, with an average of 40 ug/L. The average Chl was higher at the bottom that that at the surface (Fig.5)
- At surface, the pattern of DO followed more closely to temperature than to Chl (Fig.4).

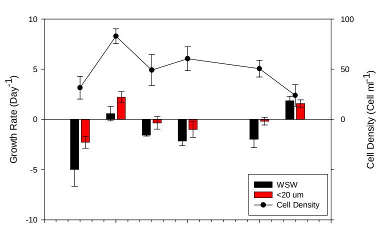


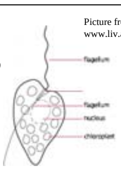


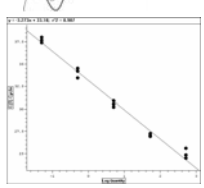
Laboratory Experiments

--Using qPCR to Detect HAB Species: *Heterosigma akashiwo*

Picture from: www.liv.ac.uk







- Species specific PCR detected the presence of *H. akashiwo*. qPCR results showed low density (~50 cell/ml) of *H. akashiwo* during the sampling time.
- Grazing experiment suggested that grazing played a significant role in controlling *H. akashiwo* density, supported by findings that the species specific growth rate in treatment with grazers was significantly lower compared to that in treatment without grazers.

Future Work

- Chl at surface and bottom showed reversed diel pattern during a 48h (Fig. 6).
- Future questions are to look into how far HAB species go to the bottom, do they ever go into sediment, if so, why (avoiding grazers? seeking vitamins, trace metals?)

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