An investigation of the biophysical oceanography in coastal waters of north-western Australia and photo-physiological response of phytoplankton to tidal mixing.

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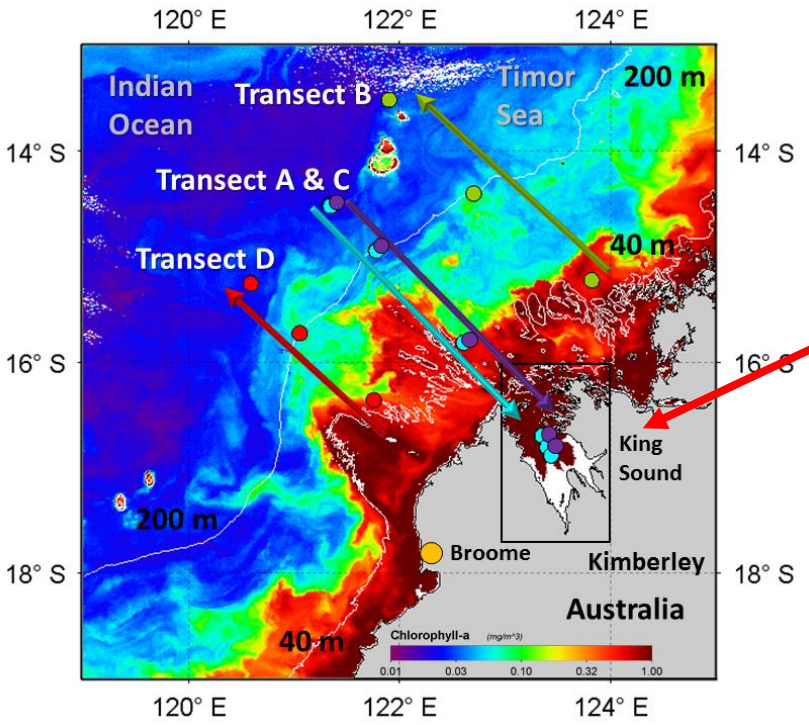
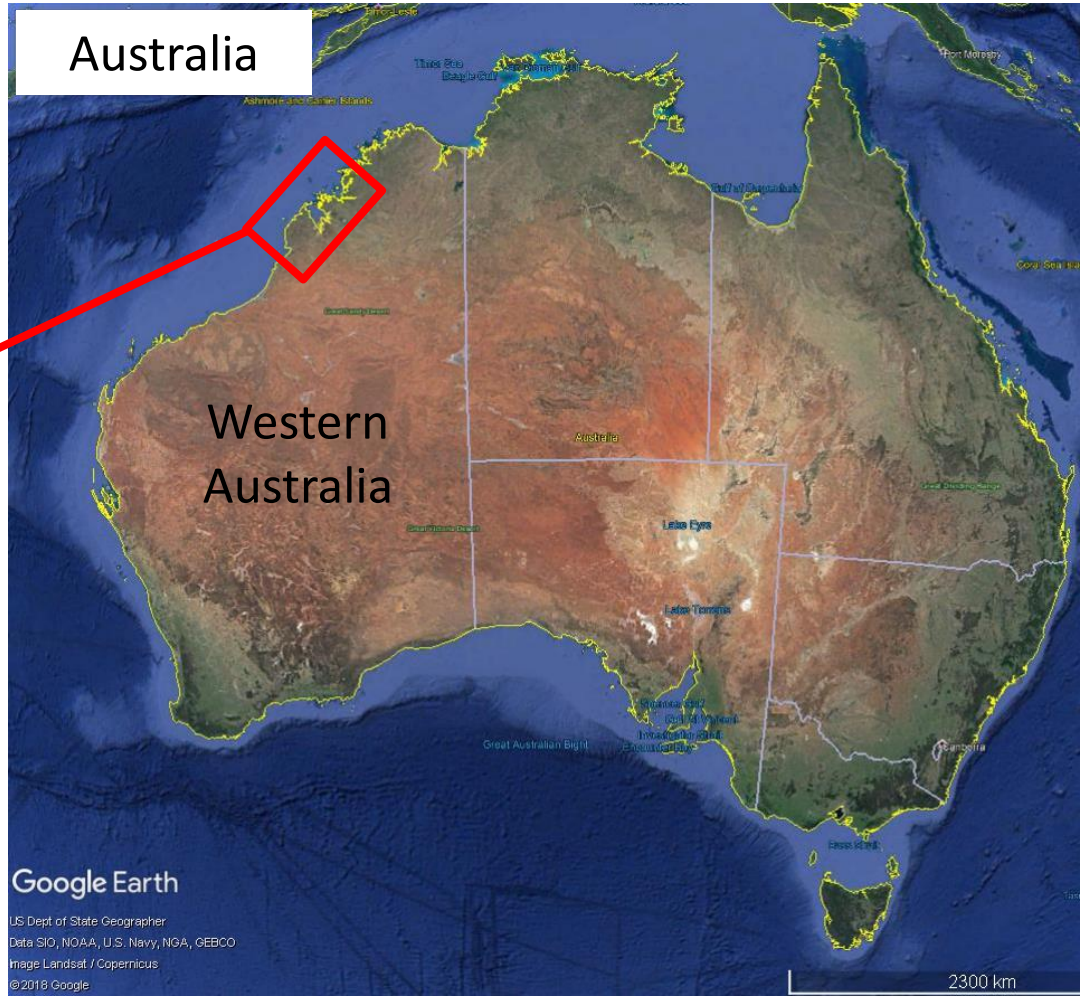
OCEANS & ATMOSPHERE
www.csiro.au

Oct 2019 – PICES Meeting, Victoria, British Columbia

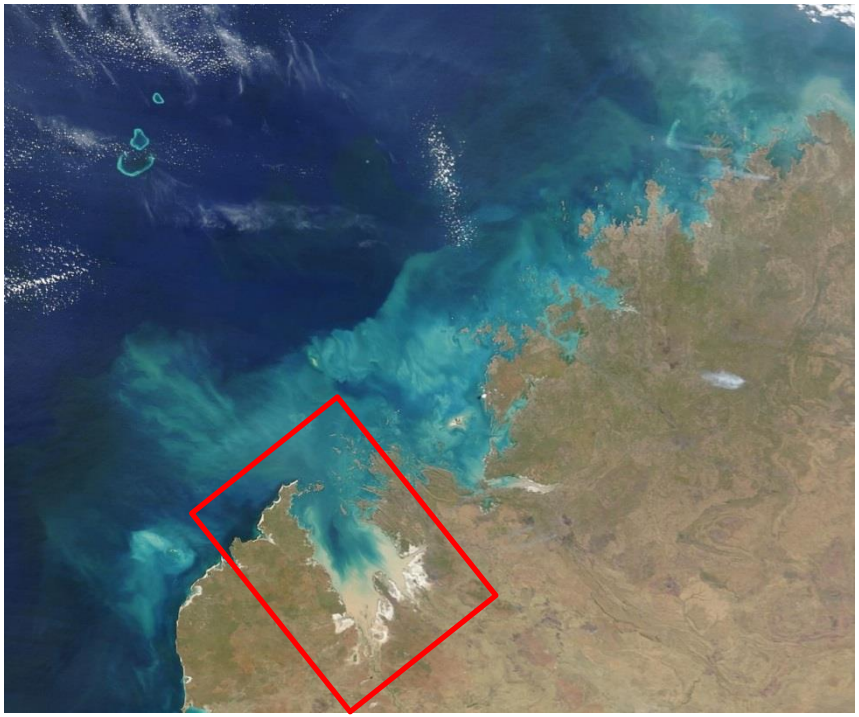
Voyage SS2010_v03



Ocean surface chlorophyll-*a* from MODIS

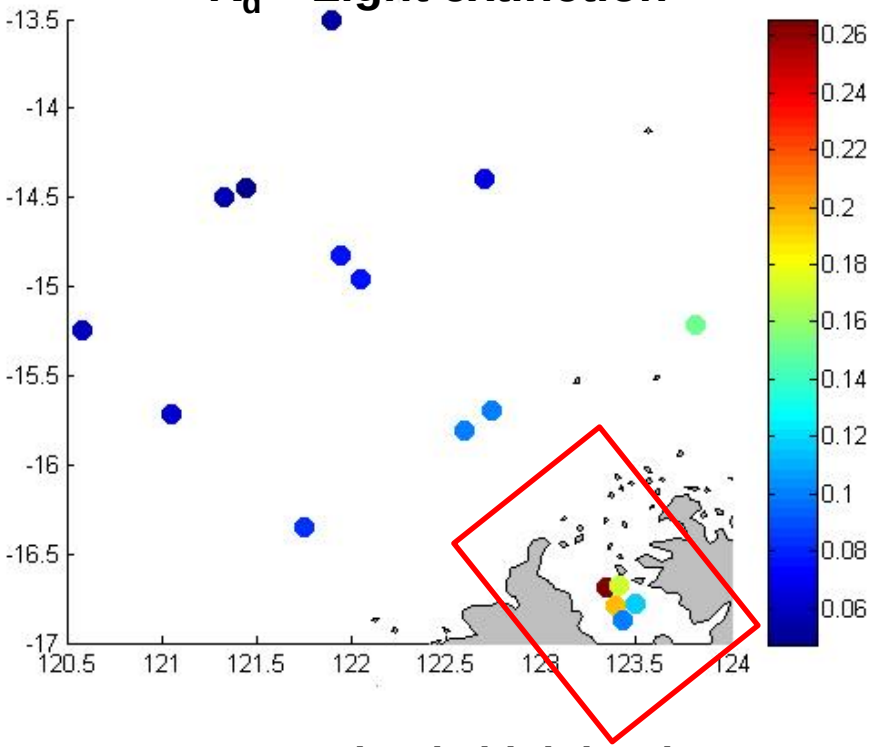


Light climate and suspended particulate matter



Turbidity is fairly high in King Sound

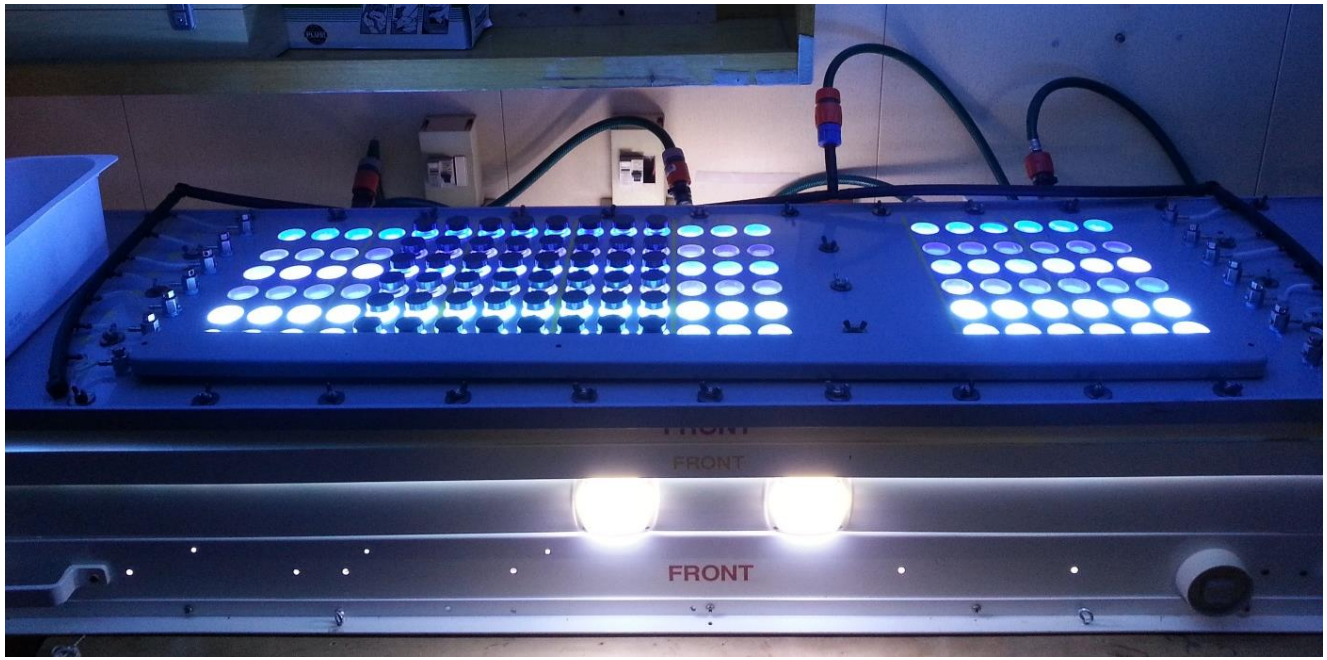
K_d – Light extinction

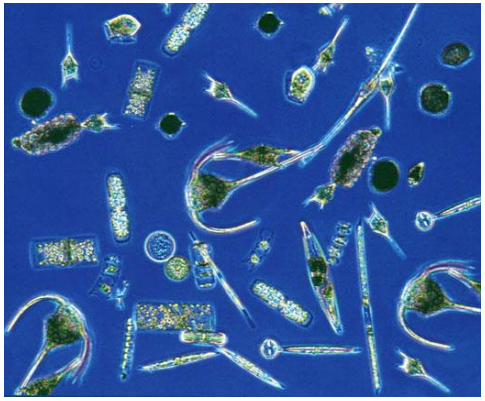


Attenuation is high in King Sound

Primary Production: Photosynthesis vs. Irradiance

^{14}Carbon uptake method

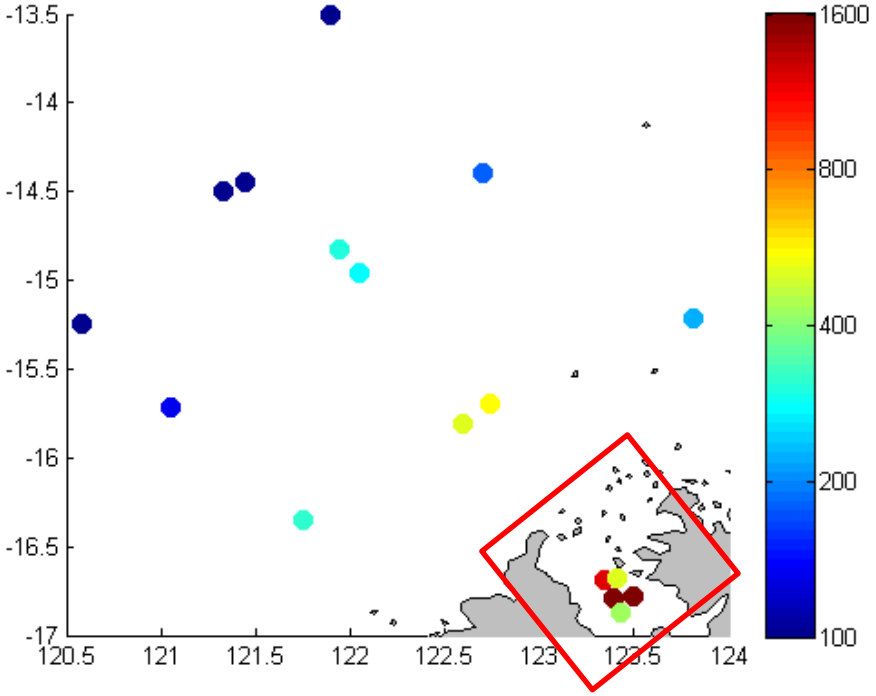




7 light levels ranging from 0 to 750 µE m^{-2} s^{-1}

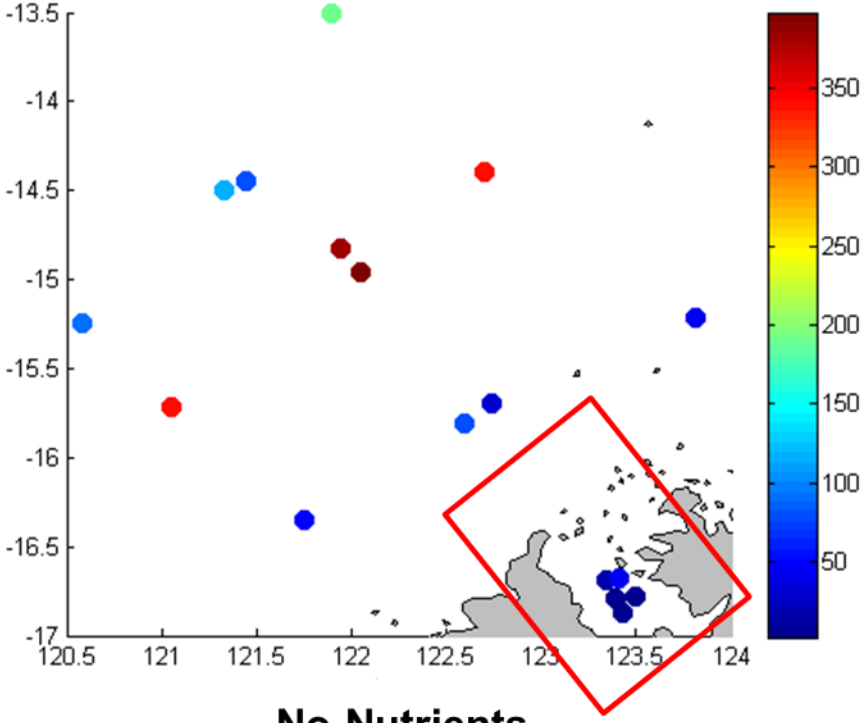
Phytoplankton Production

PP



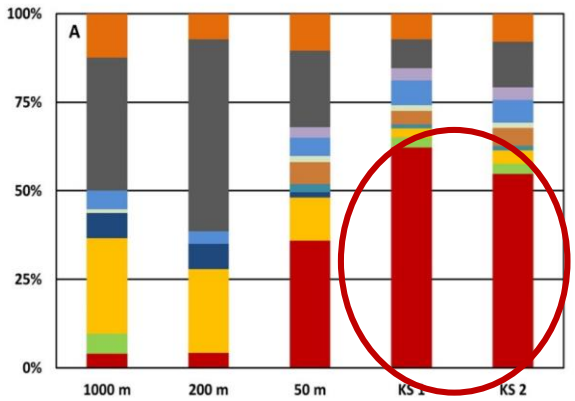
Production is high in King Sound

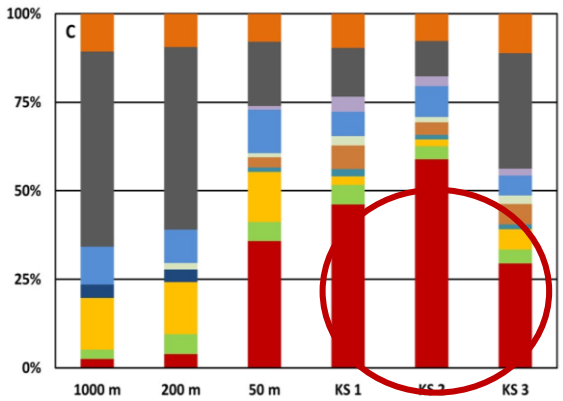
Dissolved Nitrogen



No Nutrients

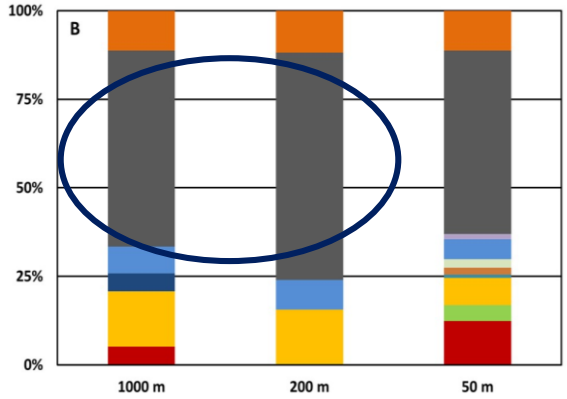
Phytoplankton community

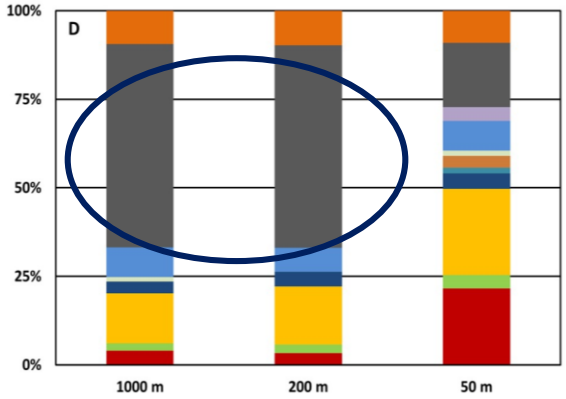




King Sound

- **Community dominated by fucoxanthin = Diatoms – Large Cells**



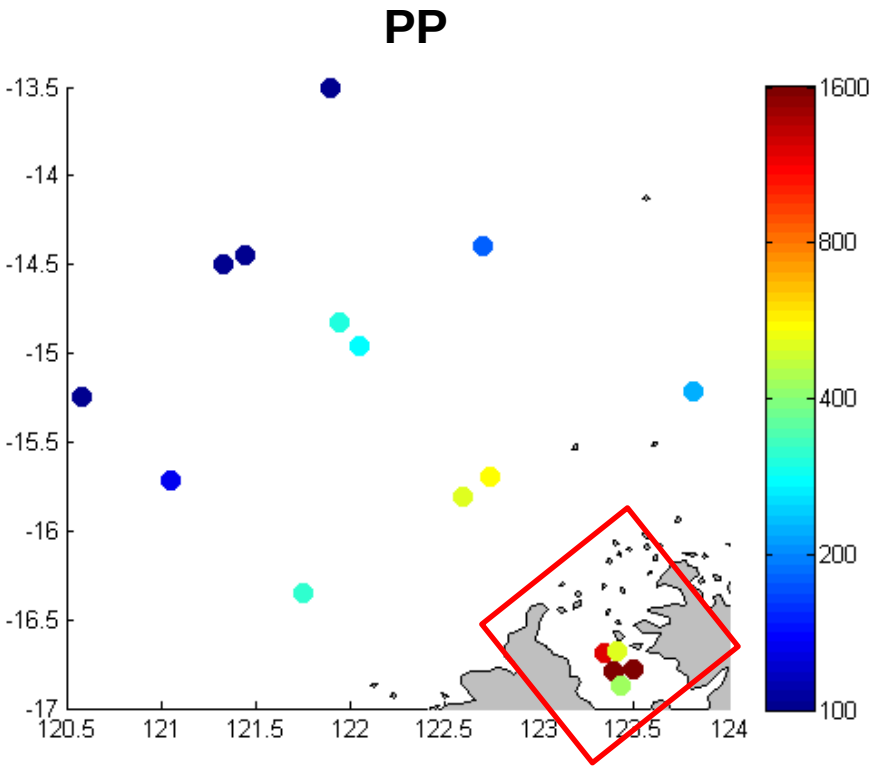


Offshore

- **Transitions to Smaller Cells**

  Zeaxanthin = Synechococcus

Production Comparisons



Production is high in King Sound

How does King Sound and the Kimberley Coast compare to other regions in Western Australia?

Kimberley	PP (mg C m^{-2} d^{-1})	Other Regions	PP (mg C m^{-2} d^{-1})
King Sound	**420 - 1690**	Ningaloo/Capes Currents	840 - 1310
50m	220 - 560	Leeuwin Current	110 - 530
200m	130 - 300		
1000m	45 - 80		

Data from
Hanson *et al* 2005
same method used!

Summary – Part 1

1. Light extinction is quite high inshore and decreases at the shelf edge.

2. Nutrient standing stocks inshore are low, at 200m there is a band of nutrients possibly supplied by tidal pumping action

3. The phytoplankton community shifts from large cells inshore to small cells offshore and on the shelf there is a distinct deep chlorophyll maximum (~70 m)

4. Production rates very high in King Sound (despite low nutrients and turbidity) decreasing offshore

Continental Shelf Research 173 (2019) 1–12

Contents lists available at ScienceDirect

Continental Shelf Research

journal homepage: www.elsevier.com/locate/csr

Biophysical oceanography of tidally-extreme waters of the southern Kimberley coast, Western Australia

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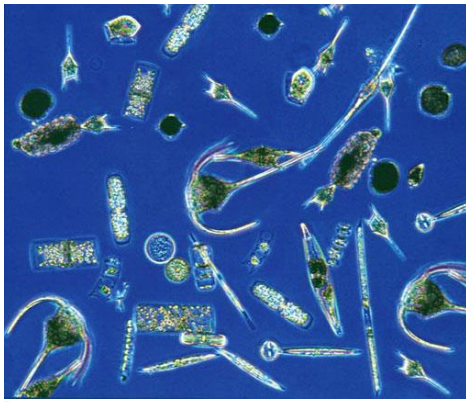
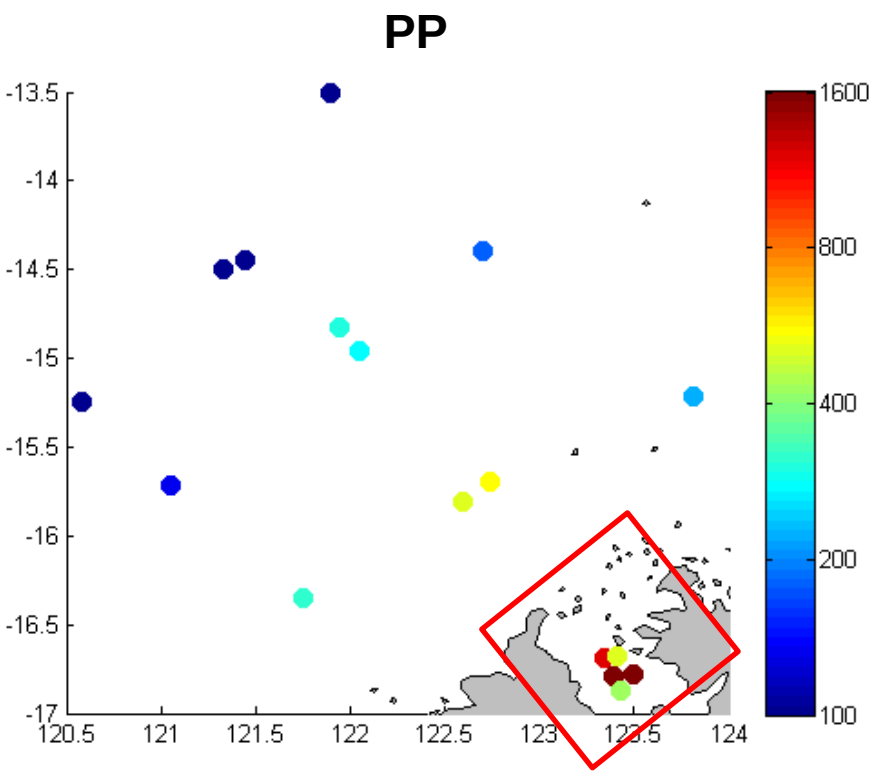
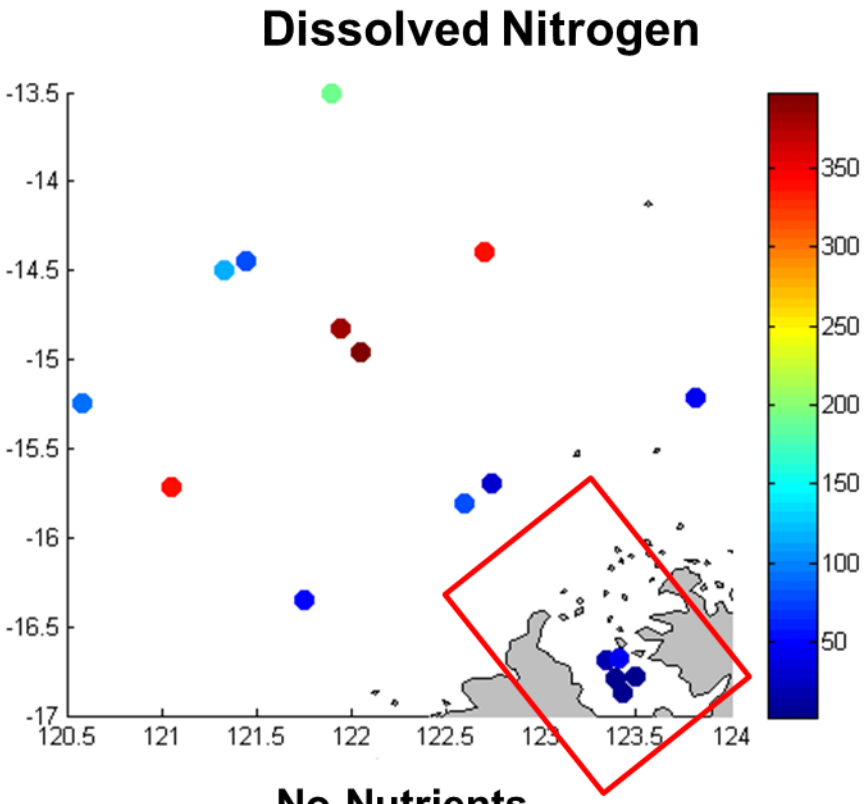


Phytoplankton Production



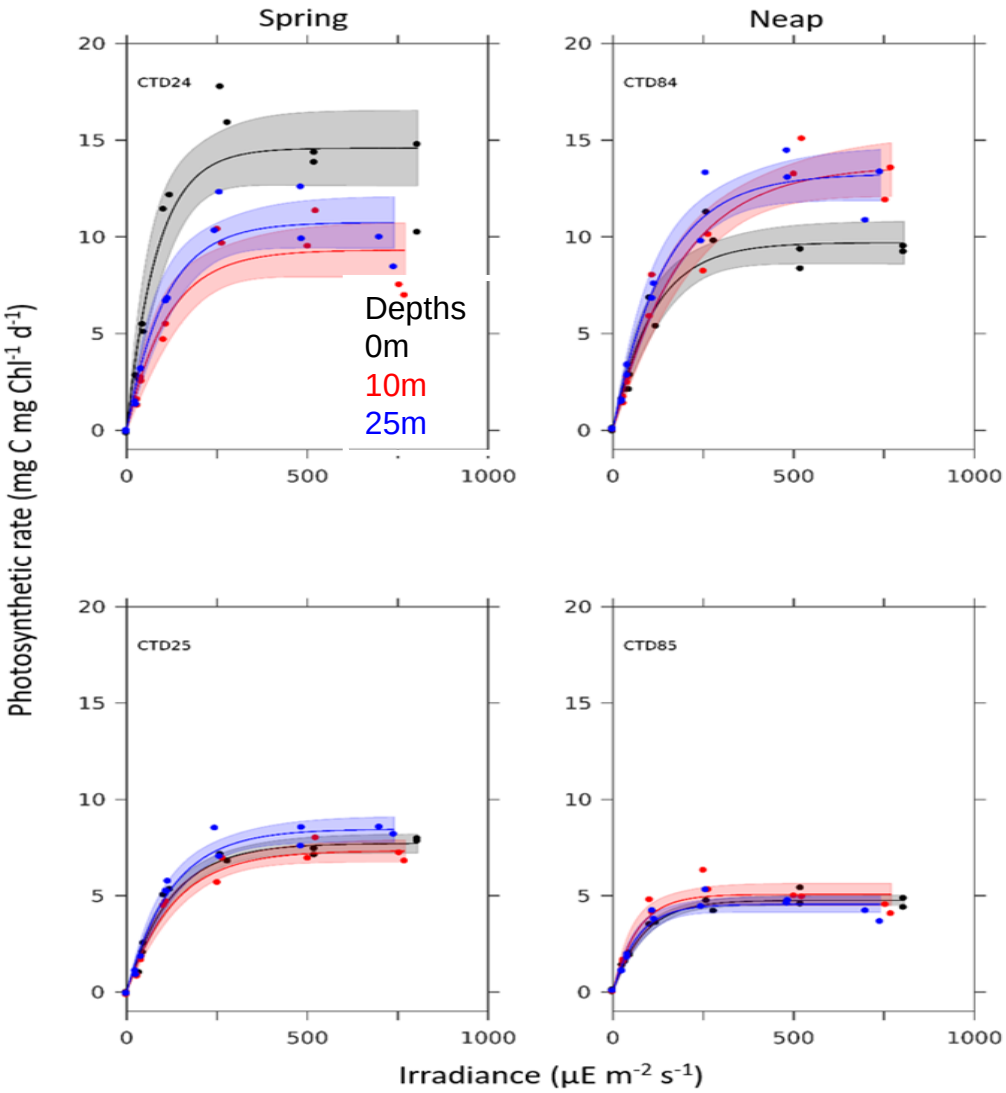
Production is high in King Sound

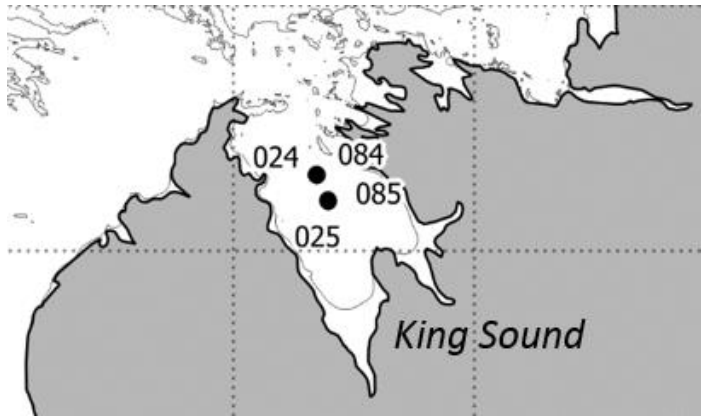


No Nutrients

"What is going on here!" – Worth a closer look

Photophysiology





King Sound

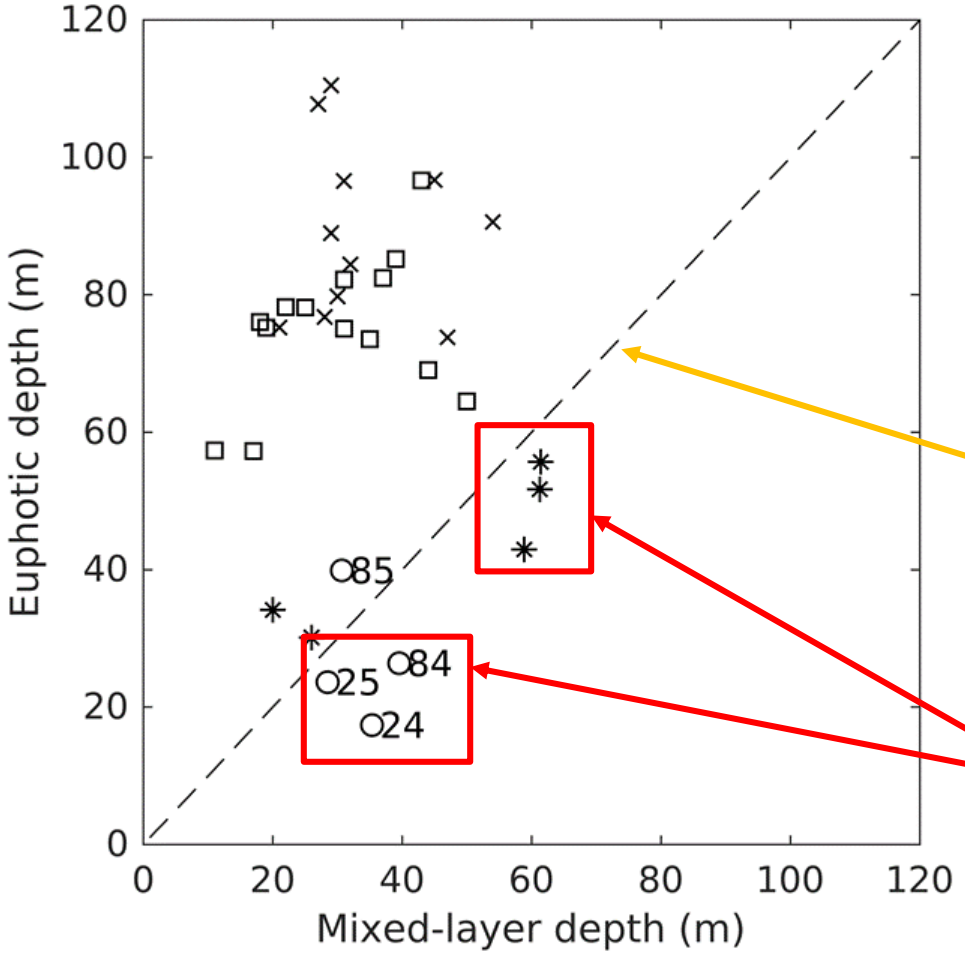
- **Cyclical changes in light intensity near the mouth**
- **High P_{max} near the mouth of KS**
- **No photoinhibition (β)**

Upstream

- **Average light conditions**
- **No depth variation**
- **Lower P_{max}**

Shading shows the 95% confidence interval of the curve fitting

Euphotic Zone and Mixed Layer Depth

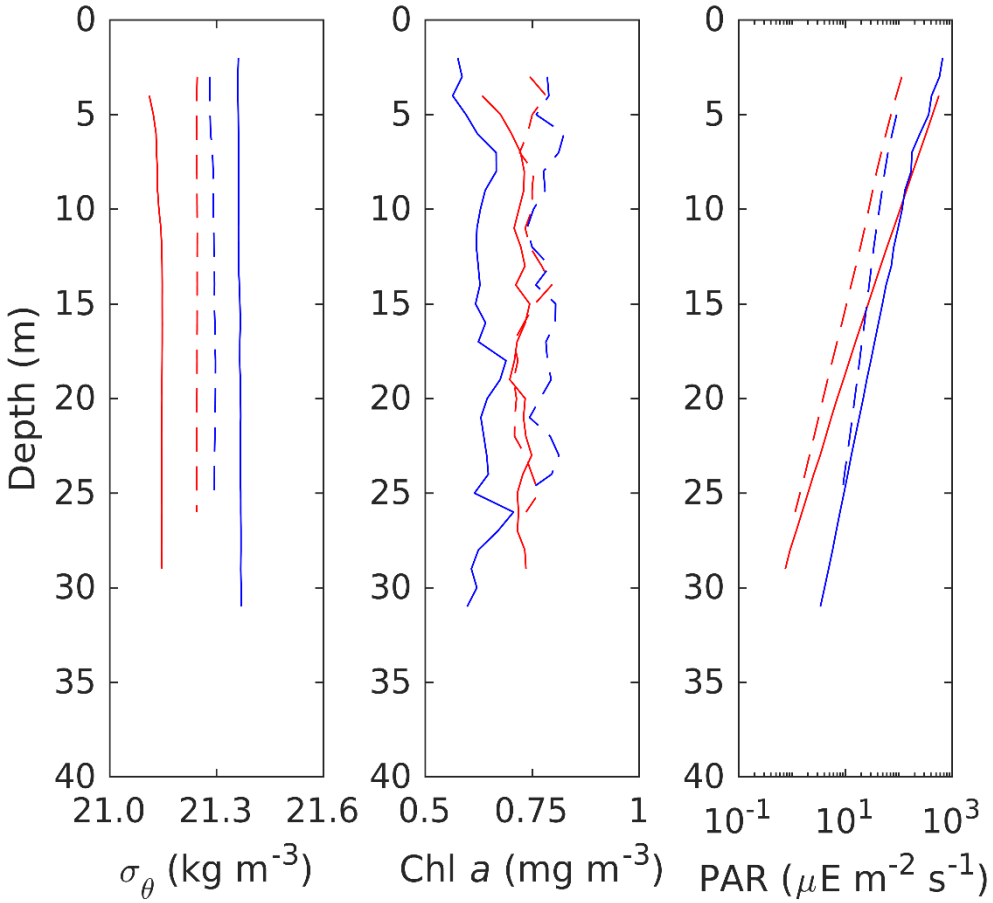


○	King Sound
*	50 m
□	200 m
X	1000 m

1:1 relationship between EZ and MLD

In most cases the Euphotic zone is shallower than the MLD in King Sound and 50m.

Euphotic Zone & MLD – King Sound



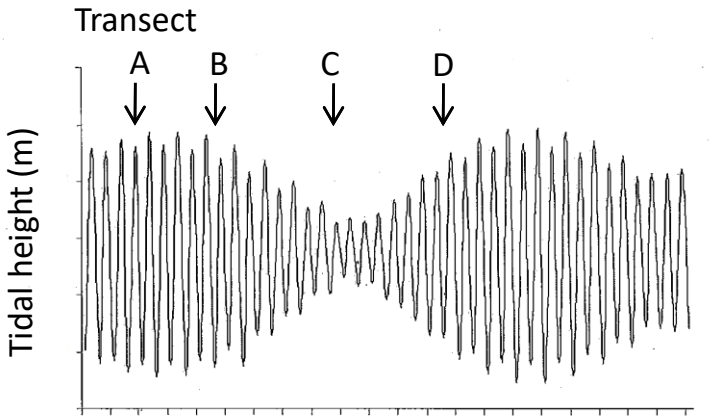
Vertical profiles of σθ, and PAR show at KS stations:

1. A lack of any significant vertical gradient in water density or chl-a concentration

2. PAR versus depth suggests differences in water clarity on different phases of the tidal cycle between the sites

3. Steeper slopes of PAR on the spring tide indicates light attenuation is higher

Summary – Part 2



Adapted from Holliday *et al* 2011

1. King Sound is well mixed, turbid, dominated by surface production with high production rates similar to upwelling systems on the WA coast
2. The photic zone is shallower than the mixed layer depth.
3. The whole of water column is mixed due to macro-tides
4. Phytoplankton are adapted to maximize photosynthesis under variable light conditions.

McLaughlin et al. In Review

Thank You

Oceans & Atmosphere
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