Uncovering multi-scale variations in NCP in the Kuroshio Extension in spring and summer

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Dissolved gas tracers of net community production

Net Community Production (biological carbon export) = Photosynthesis (Gross primary prod.) - Respiration (Auto + heterotrophic)

O₂/Ar ratios
Dynamics of community production occur at fine scales

**Length scale**
- 10 m
- 1 km
- 10 km
- 100 km
- 1000 km

**Time scale**
- 1 d
- 1 m
- 1 yr
- 10 yr
- 10 yr

**Phytoplankton patch**
- cell division
- grazing
- competition
- bloom dynamics

**Basin scale patterns**

Mesoscale 10-100km
Submesoscale 1-10km

Adapted from Dickey, 1991
Dynamics of community production occur at fine scales

- physical-biological interactions at scales where ocean physics and plankton most tightly coupled

- fine time/space scales challenging to observe and model

- Gyre
- Seasonal cycle
- Eddies
- Fronts

- length scale:
  - 10 m
  - 1 km
  - 10 km
  - 100 km
  - 1000 km

- time scale:
  - 1 d
  - 1 m
  - 1 yr
  - 10 yr

adapted from Dickey, 1991
Non-incubation-based dissolved gas tracers provide the means to get **synoptic, high-resolution** estimates of biological carbon export in dynamic regions.

\[ \Delta x \sim 1 \text{km}, \tau \sim 1 \text{ week} \]

combine underway gas measurements with TSG and Fluo
Data collected from container ships in spring and summer

May 2011

steep T front crosses main stream of KE

July 2012

bypasses main stream of KE
Relating NCP to sea level anomaly
NCP strongly correlates with SLA in sub polar waters in spring

May 2011

\[ r = -0.77 \]
\[ p < 0.05 \]

July 2012

no significant correlation

Similar to results of Kouketsu et al, 2016
High NCP coincides with the density surfaces that outcrop in the Kuroshio Extension.
High resolution underway NCP and Chlorophyll highlight regional and seasonal differences.
NCP and Chl are decoupled in spring in the KE

$r = 0.01$
$p < 0.05$

mesoscale features

advective vs. biological time scales
NCP and Chl are coupled in summer across transition zone

May 2011

May 2011

July 2012

large scale feature

steady situation

$r = 0.85$

$p < 0.05$
Consistent decoupling of NCP and Chlorophyll in aggregate

NCP hotspot just north of KE front

Chl increases with density and latitude

…it would be great to add more data here!
Concluding thoughts

1. Underway measurements provide a high resolution synoptic view of biogeochemical properties.

2. Mesoscale processes strongly modulate NCP in KE in spring. **KE is NCP hotspot.**

3. Seasonal and regional decoupling of NCP and Chl. *Chl isn’t always a great proxy for PP or NCP!***