

Productivity and Respiration

Steve Lohrenz (Leader), David Munro (Rappoteur),
Galen McKinley, Francis Wilkerson, Francisco
Chavez, Jeremy Mathis, Dick Dugdale, Laurie
Juranek, Peter Griffith, Cindy Chandler

What are the key processes and sub-processes involved?

What is the value of productivity/respiration to regional coastal C budgets?

- Prod/resp provide understanding of processes mediating changes
 - E.g., Equatorial vs coastal upwelling: P/R balance results in much different air-sea C flux
 - Necessary to predict future changes to C budgets due to climate change/ocean acidification
- We don't understand respiration as well as we need to
- Decoupling of productivity and respiration
 - Both horizontally and vertically
 - E.g., Great Lakes-PP homogenous, Resp is heterogeneous
- Understanding respiration requires knowledge of the whole system, whereas PP is restricted to the photic zone
- Key aspect of coastal systems in terms of carbon balance is the episodic variability of the involved processes

Parameters

- Gross Primary Production (GPP)
- Net Primary Production (NPP)
- Net Ecosystem Production (NEP) or net community production (NCP)
- Respiration
 - Autotrophic vs heterotrophic
 - Allochthonous vs autochthonous
- Export production: vertical or horizontal
- Partitioning of carbon fixed by NPP into pools and trophic groups
 - DOC, POC, and higher trophic levels
- Resolving DOC microbial processes
 - Different DOC pools: refractory, labile
 - Microbial C pump
- Mixed layer depths and water column structure
- **There is a need to prioritize the above parameters**

Regulatory mechanisms

- Surface entrainment of nutrients
 - Fe and Silicate
- Importance of feedbacks as a result of climate change/ocean acidification
- Temp effects on respiration

Methods/measurements

- Remote sensing
 - How do we use measurements to tweak satellite algorithms?
- Short term bottle incubations
- Budget-based approaches
 - Direct gas/and isotope tracers
 - Nutrient and DIC drawdown
 - Dependent on accurate representation of physical circulation
- Autonomous vehicles/moored sensors
 - Gliders – huge coverage in time and space
- FRRF and other optical approaches
- Photosynthesis and irradiance approaches for productivity
- How do we measure respiration?
 - Chamber measurements
 - Microsensors/microelectrodes for dissolved oxygen

Can individual measurements be scaled up?

- Models can be used to scale up from short term/small spatial scales to larger scales
- Must also scale measurements across key boundaries: benthic/water column and offshore/coastal/estuarine

Model parameterization

- How well are the processes parameterized for models?
 - Currently just primary production, respiration, export production
- Models can be made to capture observations and, to some degree, their variability in space and time. But, because we lack fundamental mechanistic understandings, regional tuning is required to fit a particular system.
 - Tuning has many degrees of freedom.
- Getting some measure of carbon cycling right (e.g. surface $p\text{CO}_2$, CHL) can be achieved with many different underlying "carbon cycles" in a system.
- Parameterizations are only as good as the data, and its synthesized understanding, on which they are based.
- Rate measurements are more valuable than stocks (e.g., chl, C).