Productivity and Respiration

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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/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 pCO2, 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).