Is climate change affecting the biotic pump of the Pacific Ocean?

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Outline

1. Introduction/Research question
2. Methods
3. Results
4. Preliminary conclusions/discussion
5. Future strategy
Introduction

- Atmospheric CO₂ mole fractions suggest trends towards earlier autumn/winter shrinking (respiring) of terrestrial biosphere.
- Suggests a shorter net carbon uptake period, correlated with increasingly warmer autumn temperatures. [Piao et al, Nature, 2008]
Introduction

How about the marine biosphere? What can we tell from our APO records?
Methods

- APO flask data from Scripps network (Pacific focus)
- De-trend with CCGCRV curve fitting routines (Python version)
- “zero-crossing” analysis:
  Up, Down, Difference (i.e. season length)
- Also for model output: **NEMO-PISCES*** + TM3

*Nucleus for European Modelling of the Ocean Pelagic Interactions Scheme for Carbon and Ecosystem Studies*
Methods

Curve fitting

[APO graphs for ALT, CBA, LJO, KUM, MLO, SMO, CGO, PSA, SPO]
Methods

Curve fitting

Calculate mean date for UP & DOWN
Calculate anomalies (difference to mean date)
Apply linear regression of anomalies over time
Method/Results

long term trend anomaly up & down

Graphs showing long-term trend anomaly with data points for different years and locations, indicating upward and downward trends.
Observations 1990-2015
long term trend anomaly up (O₂ release) & down (O₂ uptake)
Observations 2000-2015

long term trend anomaly **up** (O₂ release) & **down** (O₂ uptake)

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**tcdown_anom_trend**
**tcup_anomTrend**
Observations 1990-2015
long term trend season length POS (O₂ release) & NEG (O₂ uptake)
Observations 2000-2015
long term trend season length POS (O₂ release) & NEG (O₂ uptake)
Preliminary conclusions/discussion

• O\textsubscript{2} uptake season (winter) is coming (increasingly) earlier
• O\textsubscript{2} release period is getting smaller and O\textsubscript{2} uptake period is getting longer
• Is oceanic O\textsubscript{2} uptake increasing? (need to check amplitude)

• Something seems to be going on in the pacific and perhaps even globally (MLO)

-> Can we model this and investigate the driving processes?
Model vs Observations
long term trend anomaly **up** (O₂ release) & **down** (O₂ uptake)

1990-2015 model

2000-2015 model

1990-2015 obs

2000-2015 obs
Model vs Observations
long term trend season length POS (O_2 release) & NEG (O_2 uptake)

1990-2015 model

1990-2015 obs

2000-2015 model

2000-2015 obs
Where to go from here..(?)

• (Footprint based?) correlations SST, PDO, SSTNINO3.4 chlorophyll

• Model-sensitivity tests (winds etc.)

• $N_2O$, ventilation correction

• Other?
Is it related?

Lanschutzer et al 2015, Science