California Current Ecosystem: Are there inter-annual changes in primary production, mesozooplankton grazing & export efficiency?

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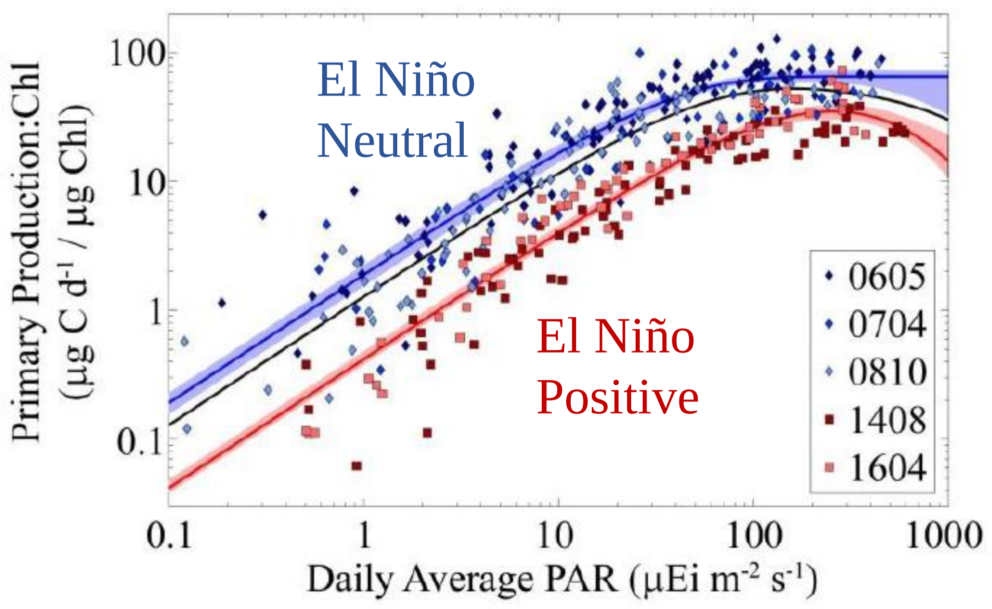
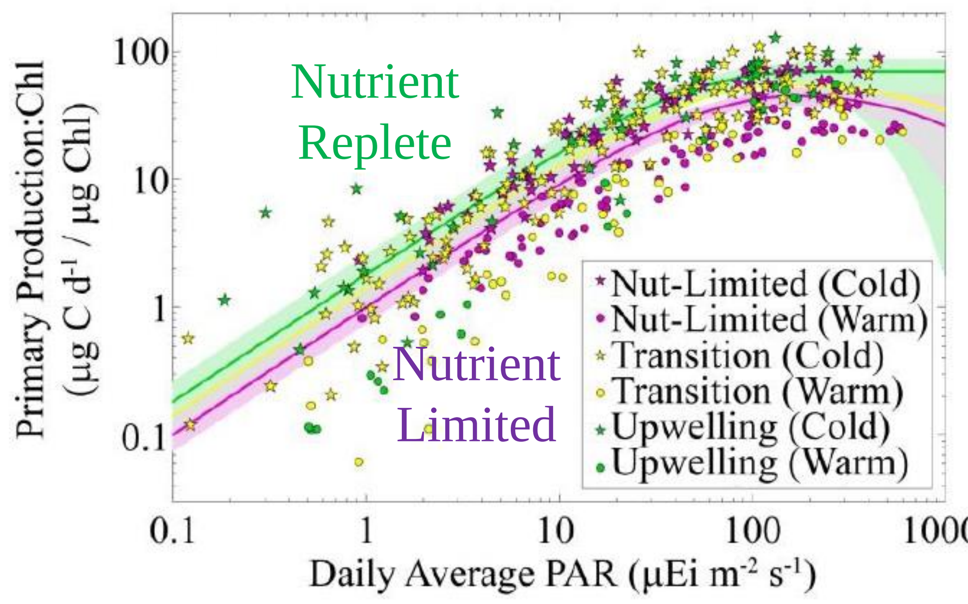
Primary Productivity

Data from El Niño neutral and El Niño positive years were used to parameterize a common Primary Productivity functional form:

$$\frac{PP}{Chl} = V_{0m}\left(1 - e^{-\alpha \cdot \frac{PAR}{V_{0m}}}\right) \cdot e^{-\beta \cdot \frac{PAR}{V_{0m}}}$$



Interannual Variability

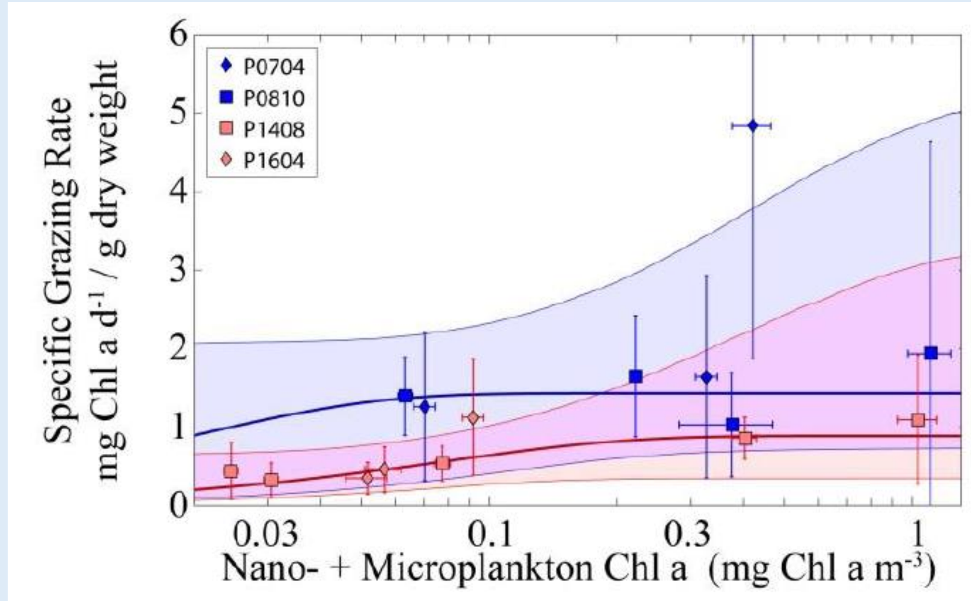


Intraregional Variability

Primary Production during warm years was reduced at similar nutrient and PAR levels relative to El Niño neutral years.

Perhaps related to community composition?

Mesozooplankton Grazing



Comparing mesozooplankton grazing to protistian plankton abundance.

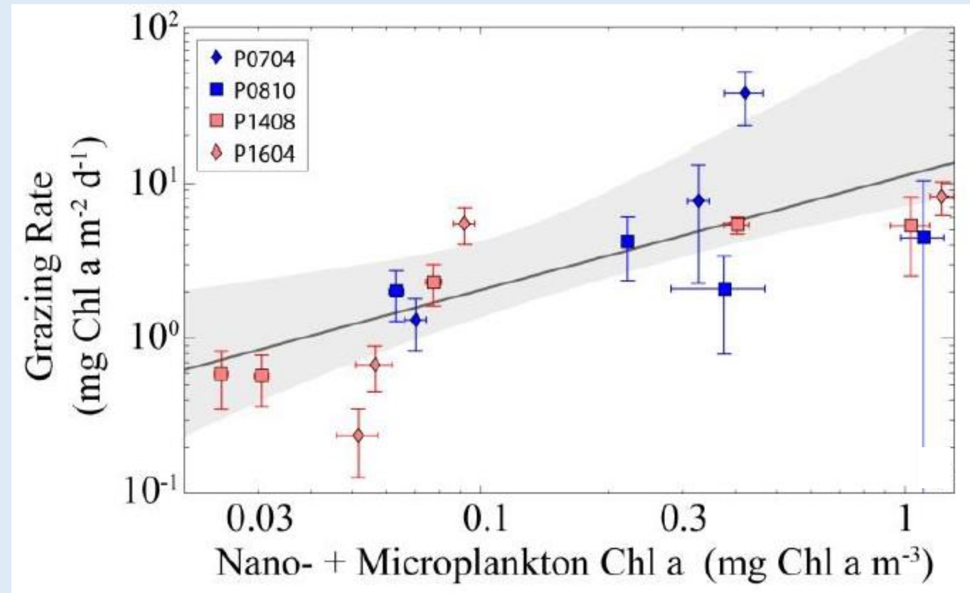
Fit Ivlev relationship to data:

$$Gr_{sp} = A(1 - e^{-\gamma \cdot Chl})$$

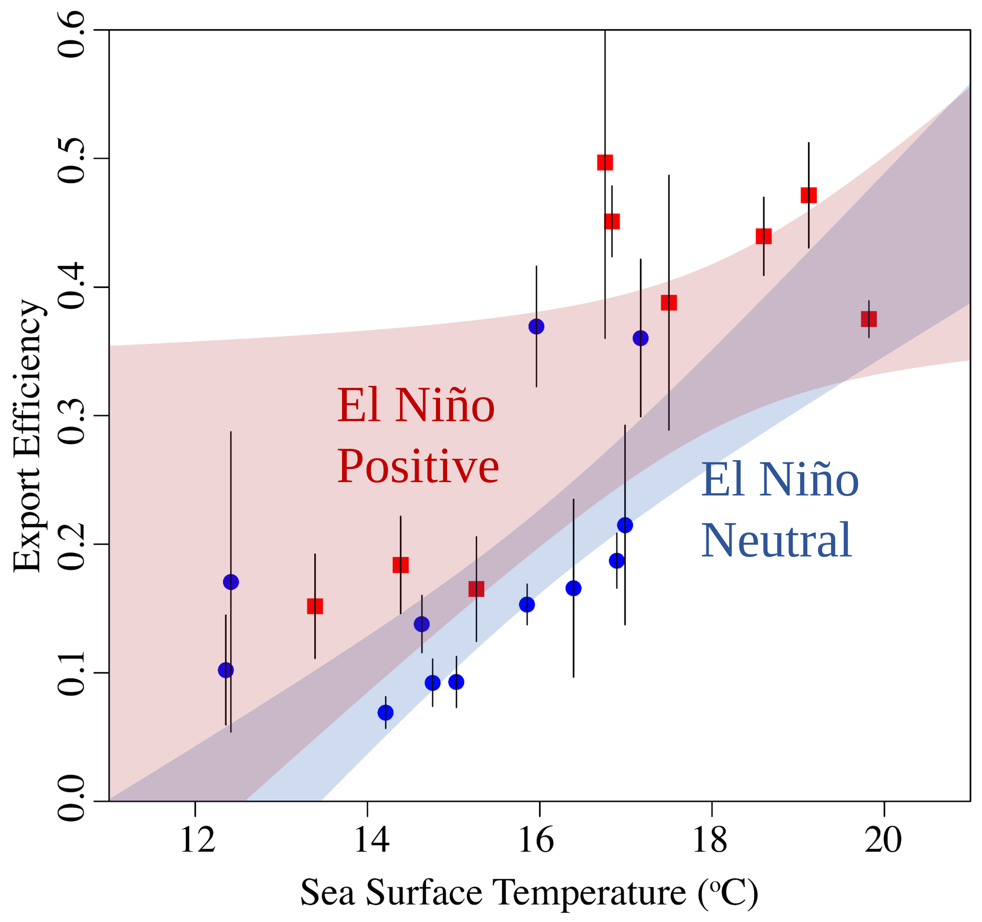
Relationships show no statistically significant differences

No significant inter-annual changes

Total mesozooplankton grazing rate vs protistian abundance also shows no systematic differences.



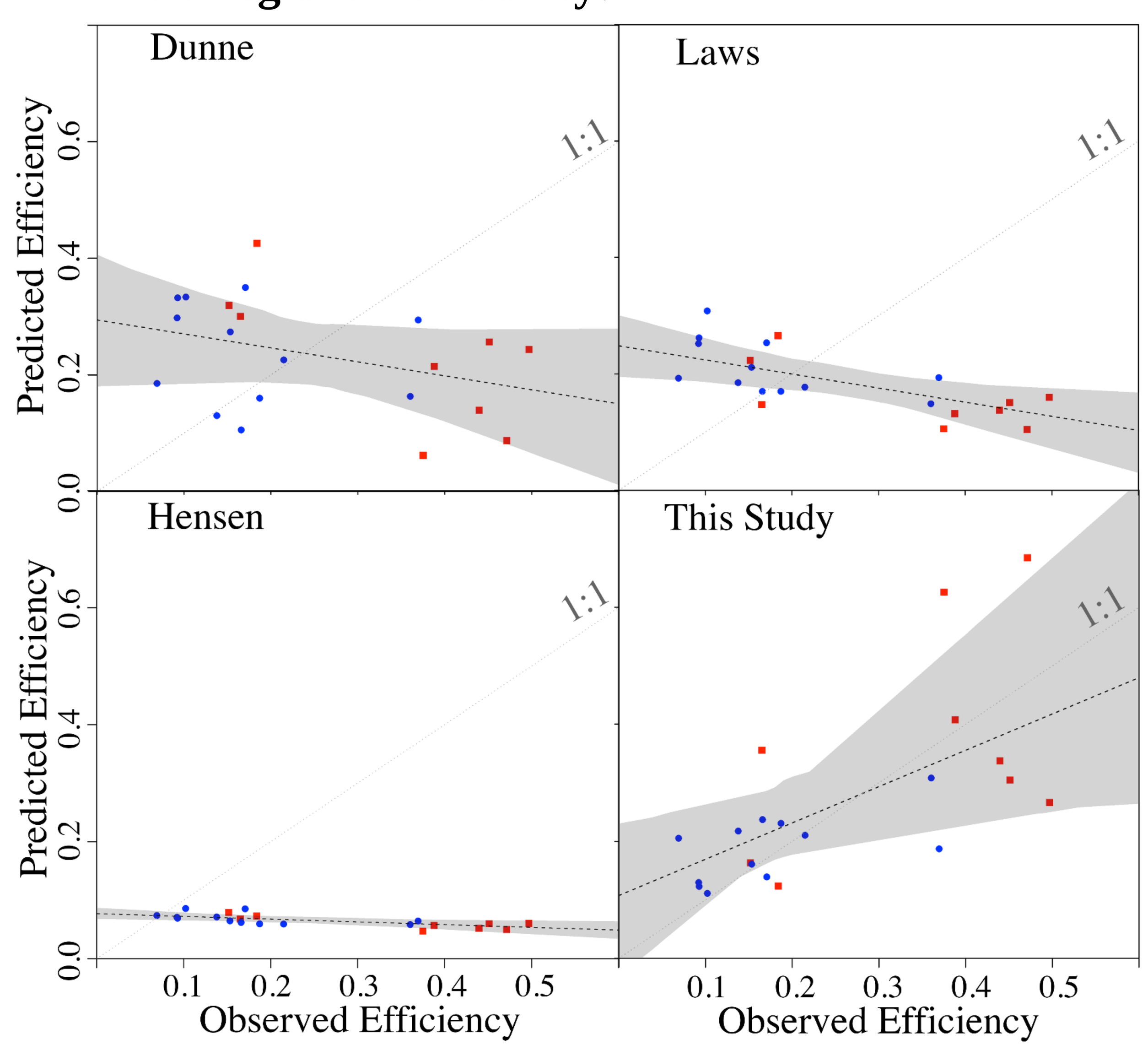
Carbon Export



No significant change in the relationship between Export Efficiency and SST in positive and neutral years. But,

Inverse relationship from expected!

In fact, global remote sensing models **fail to capture intra-regional variability**!

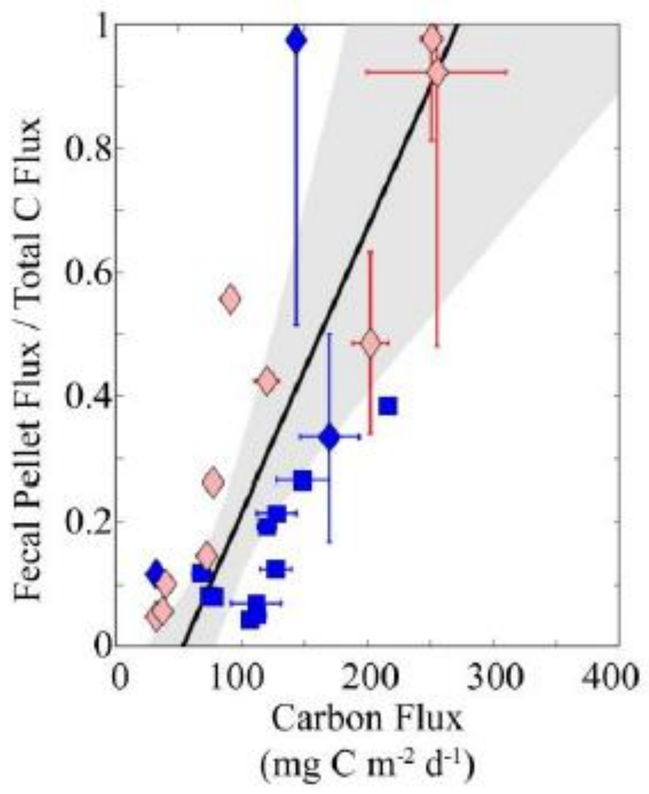


We developed an optimized remote sensing algorithm for predicting Carbon Export in the CCE.

Robust over multiple modes of variability.

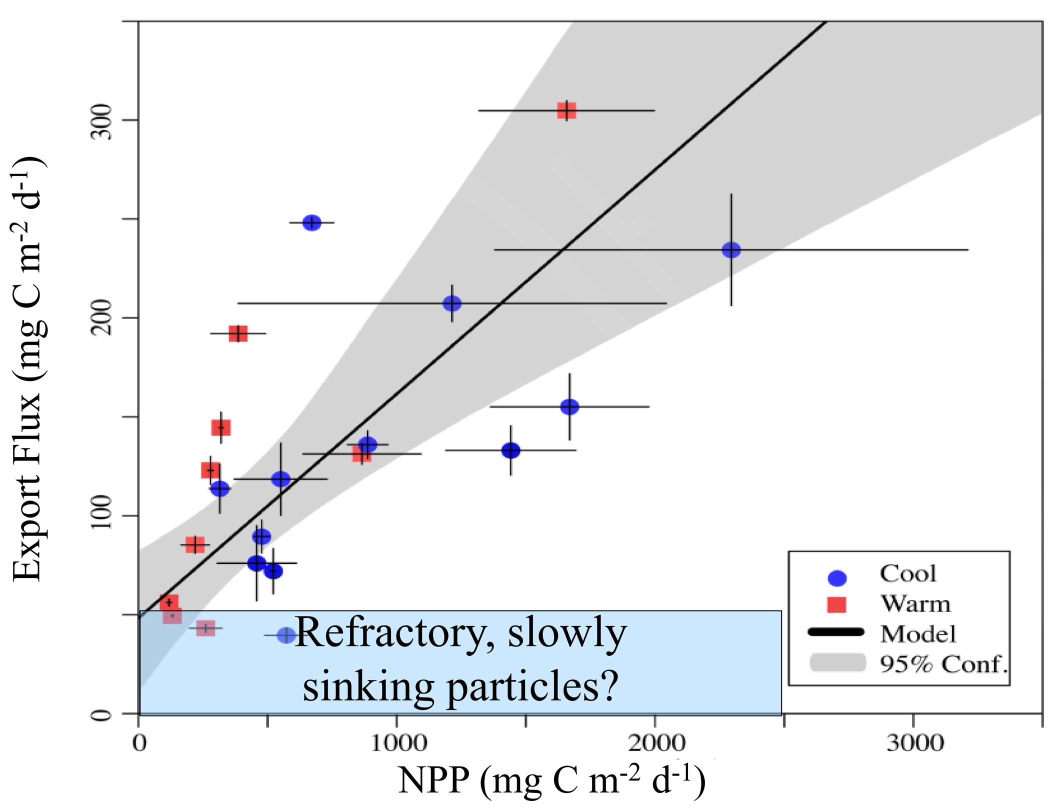
Our new relationship:

Exp = 0.081 × NPP + 71.9



The fraction of export made up of fecal pellets tends towards zero as carbon export tends towards ~50 mg C m^{-2} d^{-1}

Consistent non-FP export signature



Instead, the intra-regional export data suggests the presence of at least two types of particles:

- Quickly settling particles (**coupled** to ecosystem)
- Slowly sinking particles (**decoupled** from *in situ* ecosystem)

Conclusions

Changes in Primary Production were significant and extend beyond nutrient availability.

Mesozooplankton grazing was unaffected by interannual variability

Relationships in carbon export were unaffected by interannual variability, but a new model was developed to resolve intra-regional variability.

Methods

Primary Production
- NPP: In situ ^{14}CPP, 6-8 depths, 24h
- Chl-*a:* Acidification method

Mesozooplankton
- Mesozoo Biomass: Oblique bongo (day & night)
- Mesozoo Grazing: Gut pigment content & gut turnover (Dam & Peterson)

Carbon Export
- Carbon Export: 3-5 day VERTEX Sediment Traps
- Remote Sensing: 5 day composite of 4km MODIS

Acknowledgements

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