Bight ‘08 Offshore Water Quality:

Comparison of Natural and Anthropogenic Nutrient Sources and Their Influence On Algal Blooms In SCB

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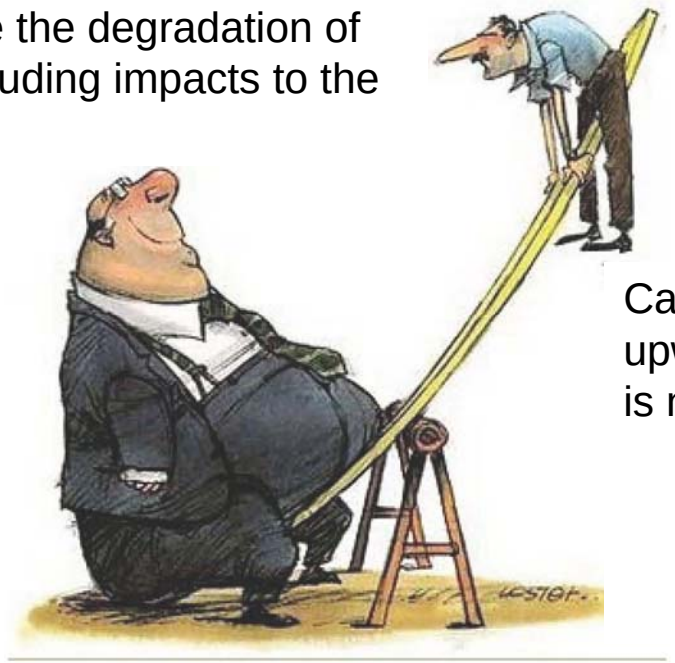
Background

- SCB has periodic algal blooms
  - Evidence that they are intensifying
- U.S. West Coast has natural sources that are known algal bloom drivers
- SCB also has anthropogenic sources that could potentially be drivers
  - Wastewater effluent
  - Terrestrial runoff
  - Atmospheric deposition

Are Anthropogenic Nutrients Important in an Upwelling Dominated System? Two Opposing Views

Global increases in human population, fertilizer use, oil consumption etc. inevitably lead to the the degradation of the environment including impacts to the coastal ocean



California is dominated by coastal upwelling therefore eutrophication is not a primary concern

Are Anthropogenic Nutrients Contributing to Algal Blooms in SCB?

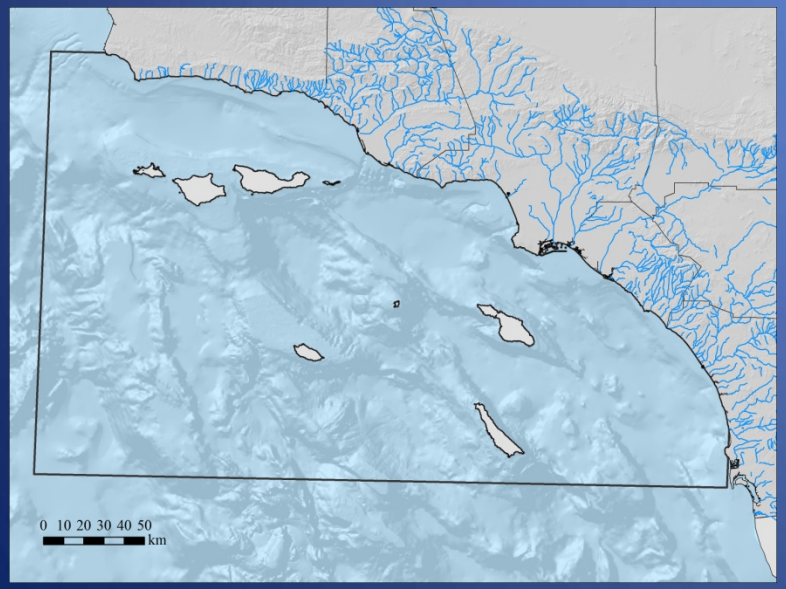
- Determine the relative magnitudes of major nutrient sources
  - Upwelling
  - Effluent
  - Terrestrial Runoff
  - Atmospheric Deposition
- Characterize the spatial and temporal patterns of algal blooms and determine if consistent with anthropogenic sources
  - Wastewater and runoff are localized; upwelling is regional
- Characterize development, progression and dissipation of an algal bloom in SCB

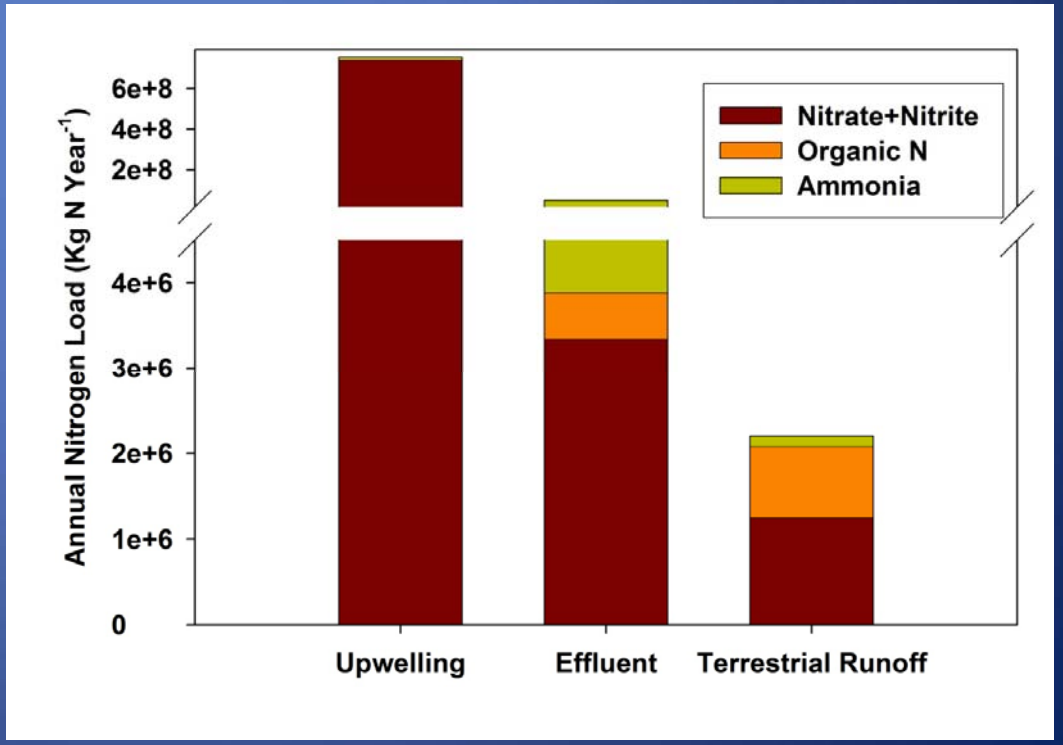
Relative Magnitude of Four Major Nutrient Sources : Approach

- Terrestrial Runoff: empirical data collected from rivers during dry and wet weather
  - Modeling to fill in data gaps
- Effluent: Quarterly sampling of 4 Large POTW effluent
  - Nutrient constituents we don't typically measure
- Atmospheric deposition: wet and dry deposition rates from published literature and SCCWRP pilot studies
- Upwelling
  - Adapted a ROMS hydrodynamic model to include nutrients

Regional Scale: Upwelling > Effluent > Terrestrial Runoff

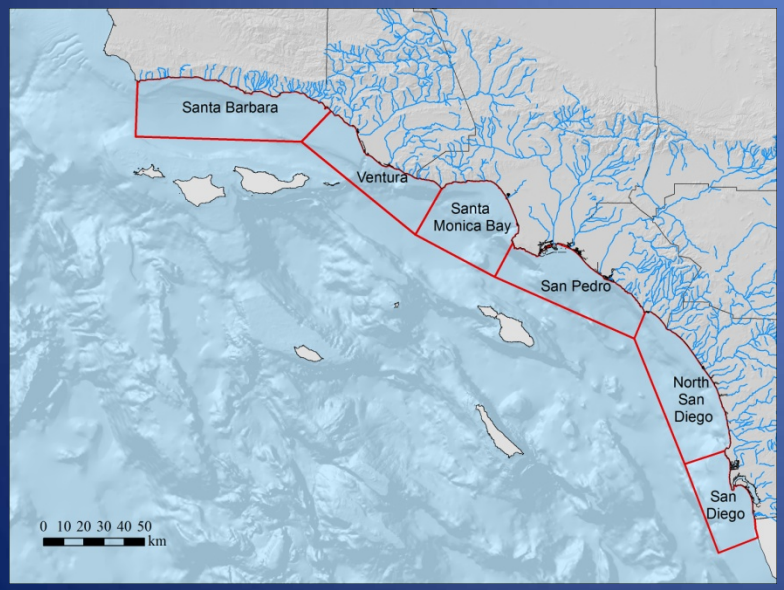
- Source loads (Kg N/Year)
  - Upwelling 10^8
  - Effluent 10^7
  - Terrestrial Runoff 10^6

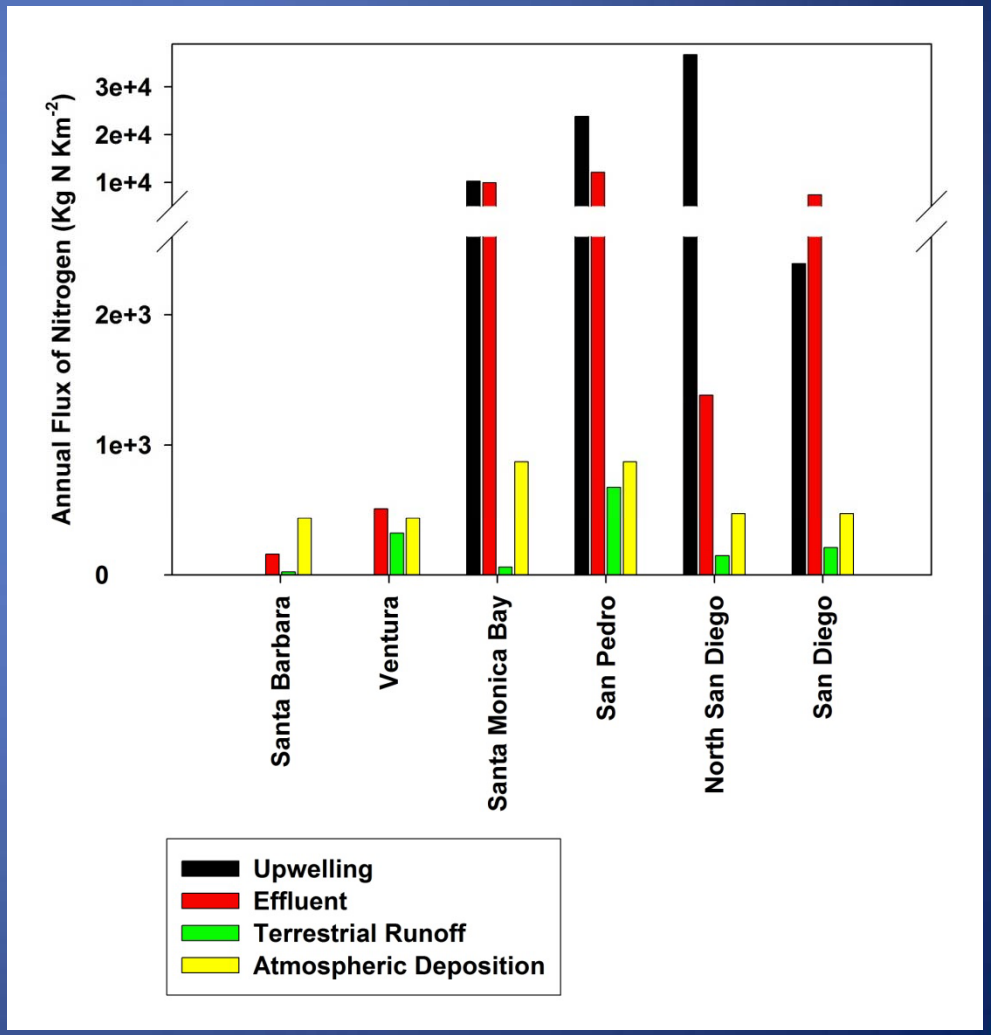




Local Scale: Anthropogenic And Natural Nitrogen Sources Equivalent

- Effluent and upwelling are dominant sources
- Terrestrial runoff, atmospheric deposition similar





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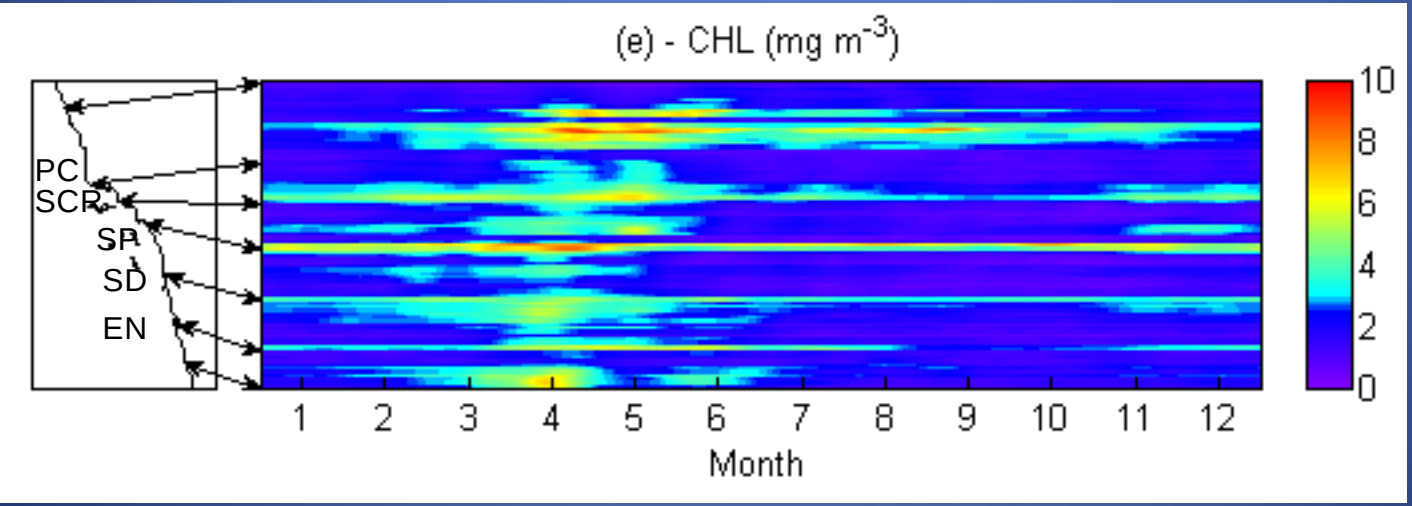
Algal Bloom Patterns Are Important

- Chronic algal bloom ‘hotspots’ identified
  - Co-located with major nutrient sources (major river mouths, effluent discharge) and longer residence times



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Multidisciplinary Approach to Investigate Algal Bloom Development

- Captured algal bloom origination and progression

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Result: There is Not One Answer

- Surface blooms observed
- Also observed subsurface blooms transported to surface by upwelling
- Unclear if subsurface bloom is stimulated by remnants of upwelled nutrients or trapped wastewater nutrients

Cannot Dismiss Anthropogenic Nutrients As Important In SCB

Multiple lines of evidence:

- Algal bloom 'hotspots' are co-located with major sources and areas of extended residence time
- Presence of sub-surface blooms during non-upwelling periods
- In some sub-regions, anthropogenic N loads equal to natural (upwelling) loads
  - This scale is more relevant to investigate algal blooms

Next Steps

- Use models to assess scenarios
  - Modeling workshop planned in fall
  - Synergy with coastal hypoxia and ocean acidification
- Further investigate subsurface algal blooms
  - Pervasiveness and timing
  - Geographic distance offshore
  - Part of CBWQ Group quarterly monitoring

Questions?

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