Chlorophyll Hotspots in the Oligotrophic North Pacific Subtropical Gyre

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Chlorophyll blooms developing in late summer have been observed by satellite ocean color data:

- SeaWiFS: 1997-2004 (and MODIS)
- OCTS: 1996
- CZCS: 1979-1985

- Briefly discuss forcing mechanisms
- Impacts on higher trophic levels?

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Acknowledgements

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<tr>
<th>Barbara Block</th>
<th>HML, Stanford Univ.</th>
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<td>John Childers</td>
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<td>Al Coen</td>
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NPSG Chlorophyll Hotspots

Blooms are located between Hawaii and the TZCF, about 10° south of the TZCF

NOV 2000

SeaWiFS Chlorophyll (mg/m³)

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NPSG Chlorophyll Hotspots

JUL 1998

AUG 1998

SEP 1998

OCT 1998

SeaWiFS Chlorophyll (mg/m³)

0.00 0.05 0.10 0.15 0.20 0.25 0.30

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CZCS Blooms

Sept-Dec
1979-1985

Blooms in 4 out of 7 years

• 1981
• 1982
• 1984
• 1985

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Percentage of time Chlorophyll > 0.15 mg/m³ during Jul.-Oct 1997-2004

N = 105

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Topography

Region of blooms

Hawaii

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Seasonal Chlorophyll Cycle
(within study area, south of the TZCF)

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At 30°N

Negative $\Delta$SSH and cool SST should accompany upwelling...

and no indication of that...
NPSG Chlorophyll Hotspots

Blooms observed in 10 out of 16 years of satellite ocean color coverage

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NPSG Chlorophyll Hotspots

Blooms observed in 10 out of 16 years of satellite ocean color coverage

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What causes the Blooms?

- The mechanisms causing the blooms remain unknown.
- The lack of coincident SSH and SST anomalies suggests the blooms are not forced by subsurface upwelling of nutrient-rich water.
- Blooms occur in deep water, ruling out topographic forcing.
- Possible mechanisms include [Wilson, 2003]:
  - Nitrogen fixation
  - Vertical flux of nitrate from *Rhizosolenia* mats

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Blooms are consistently located along 30°N, within the target area of several fisheries, including albacore and swordfish.

Do these blooms have an impact on higher trophic levels?
Caveat:

Peak fishing activity occurs in winter-spring, which is not when the blooms appear.

Region of blooms

From Seki et al., Fish. Ocean., 2002.
Release & recovery locations of tagged albacore

Region of blooms

Figure courtesy of NOAA/NMFS/SWFSC  http://swfsc.nmfs.noaa.gov/albacore_tag

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Catch per unit effort (CPUE) data for N. Pacific albacore fishery between 25-35°N and 160-130°W

Large bloom in 2000

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Distribution of US albacore catch in 2000

Figure from Childers [2001]
Density distribution of TOPP animals

Region of blooms

Figure courtesy of Barbara Block, Stanford Univ., HML

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Future results from TOPP could provide more information on the extent to which these blooms impact higher trophic levels.
Conclusions

- The blooms have a consistent seasonality, developing in late summer (Jul.-Aug), but significant interannual variability, having occurred in 10 of the 16 years observed by ocean color satellite data.

- The blooms are consistently located near 30°N. There is more variability in their longitude, which varies between 140°-160°W.

- The blooms do not appear to be forced by local physical ocean dynamics or by topography.

- The blooms occur within an important fisheries ground, but their impact on higher trophic levels is uncertain.