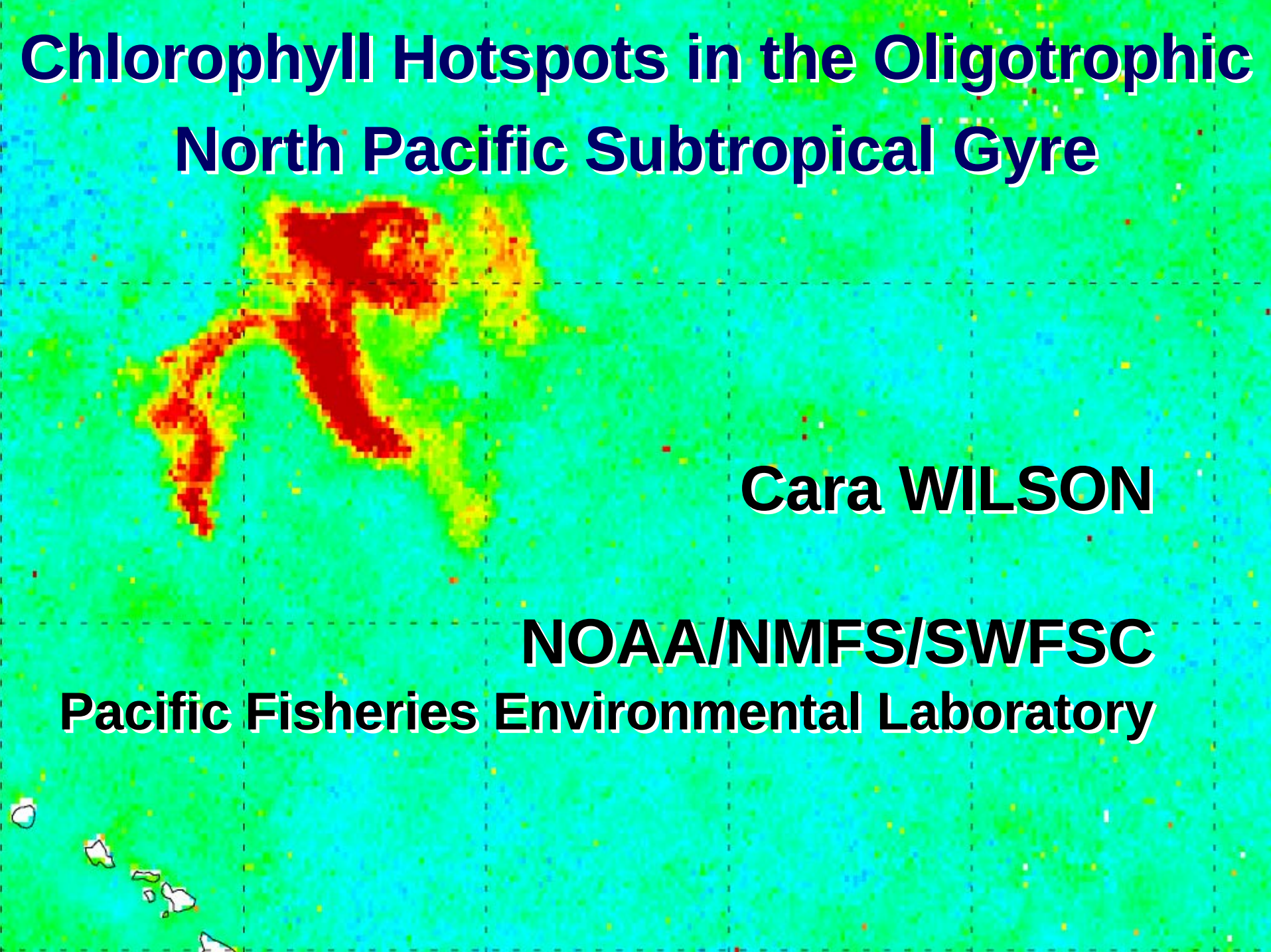
Chlorophyll Hotspots in the Oligotrophic North Pacific Subtropical Gyre



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Outline

- 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

Barbara Block	HML, Stanford Univ.
John Childers	NOAA/NMFS
Al Coen	NOAA/NMFS
R. Mike Laurs	NOAA/NMFS

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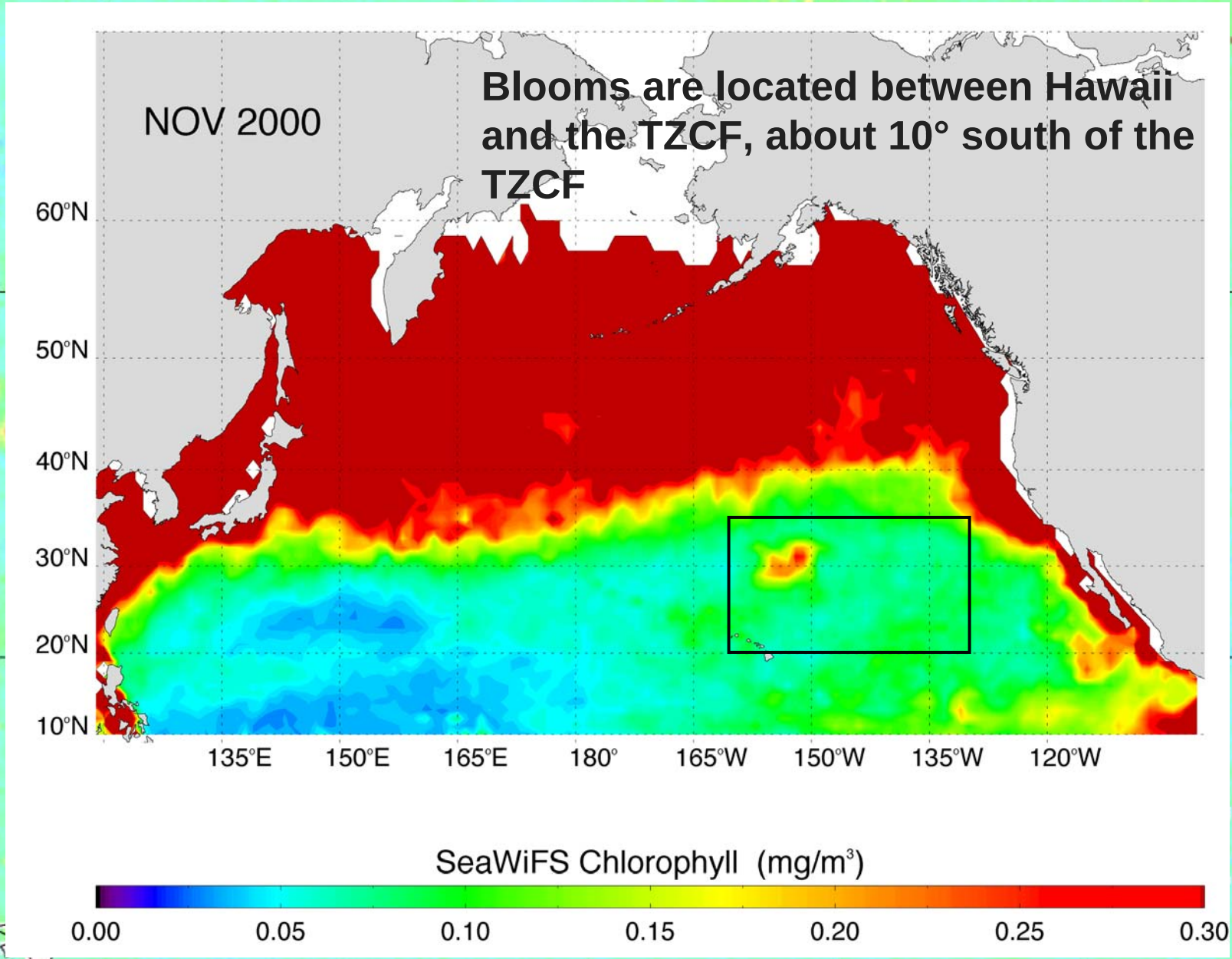
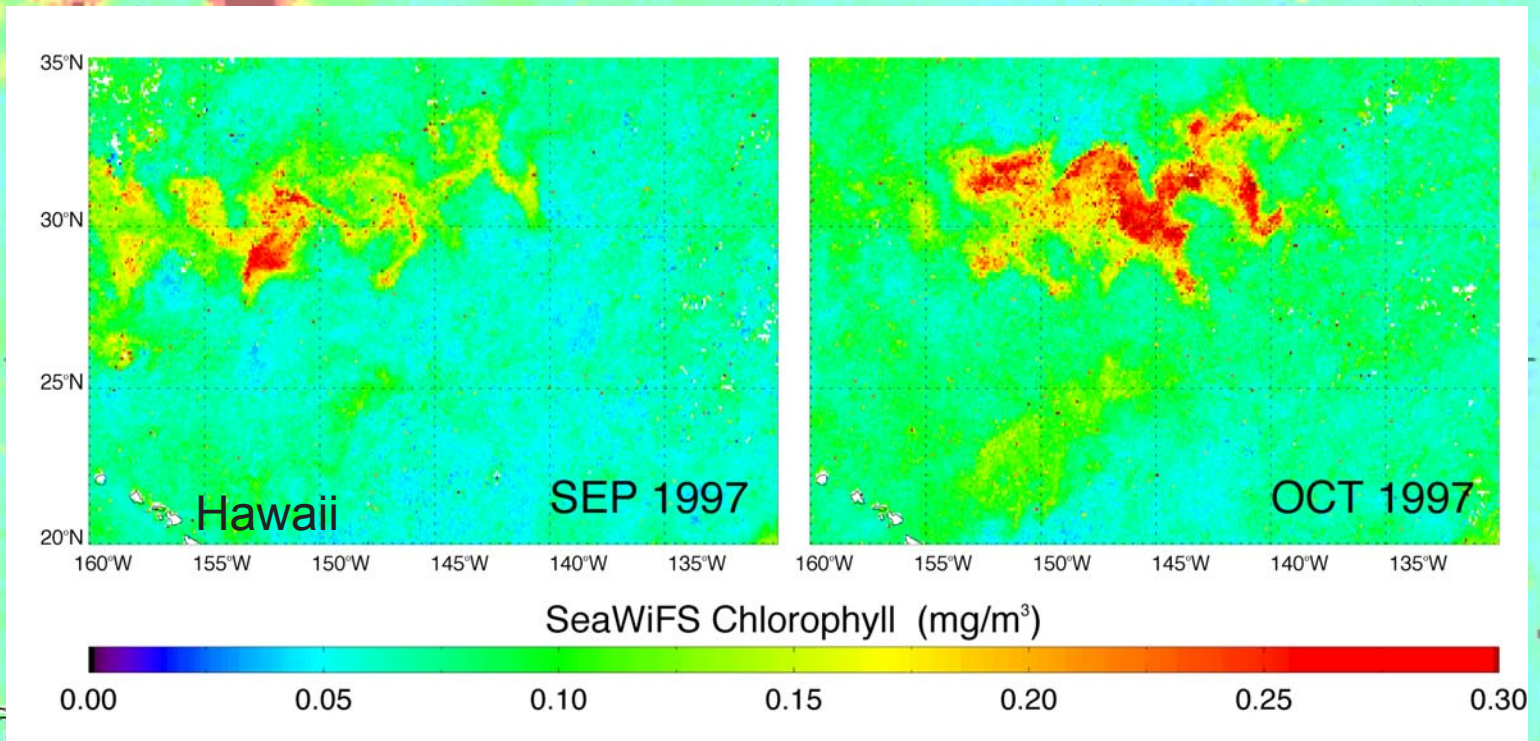
NPSG Chlorophyll Hotspots



NPSG Chlorophyll Hotspots



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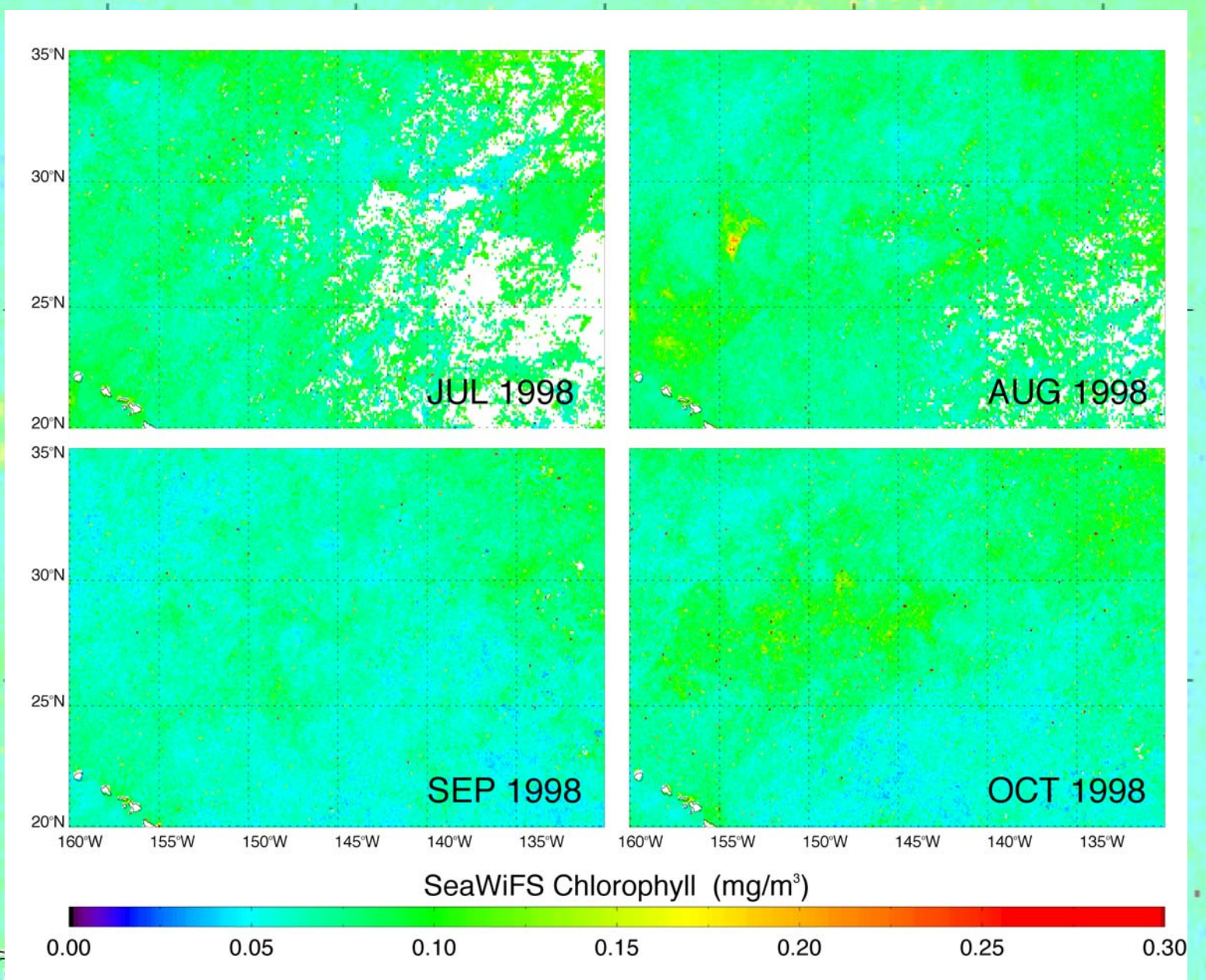

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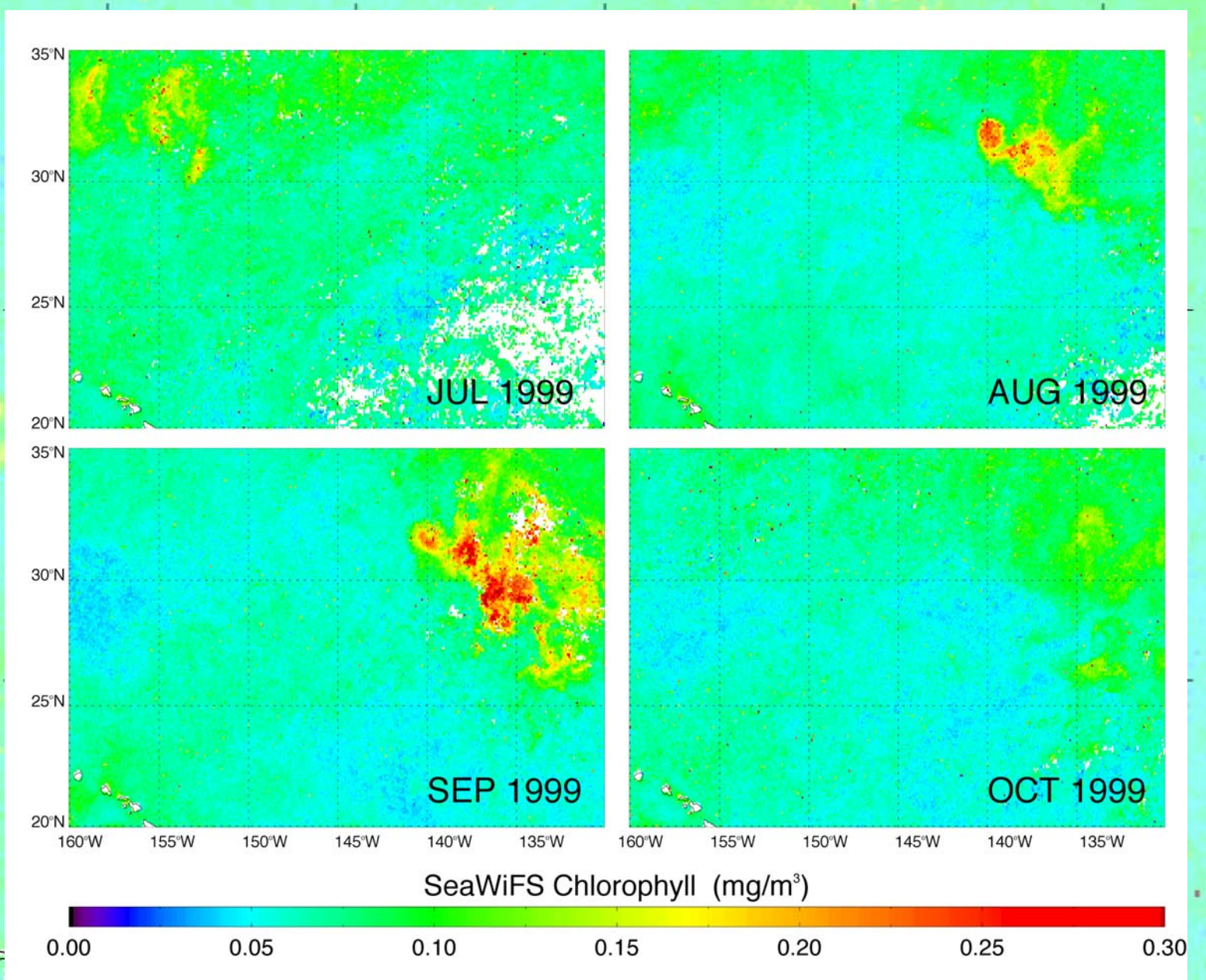

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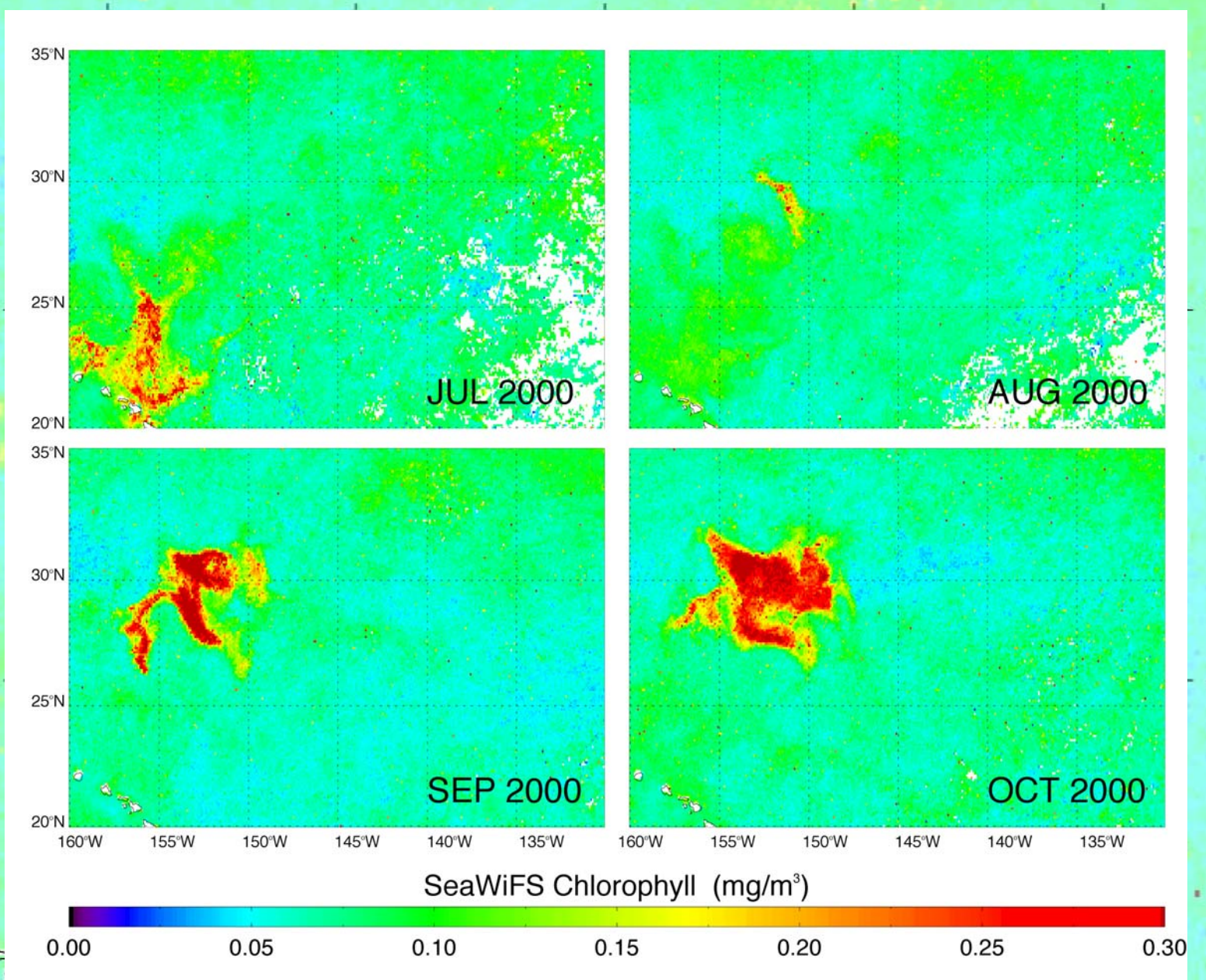

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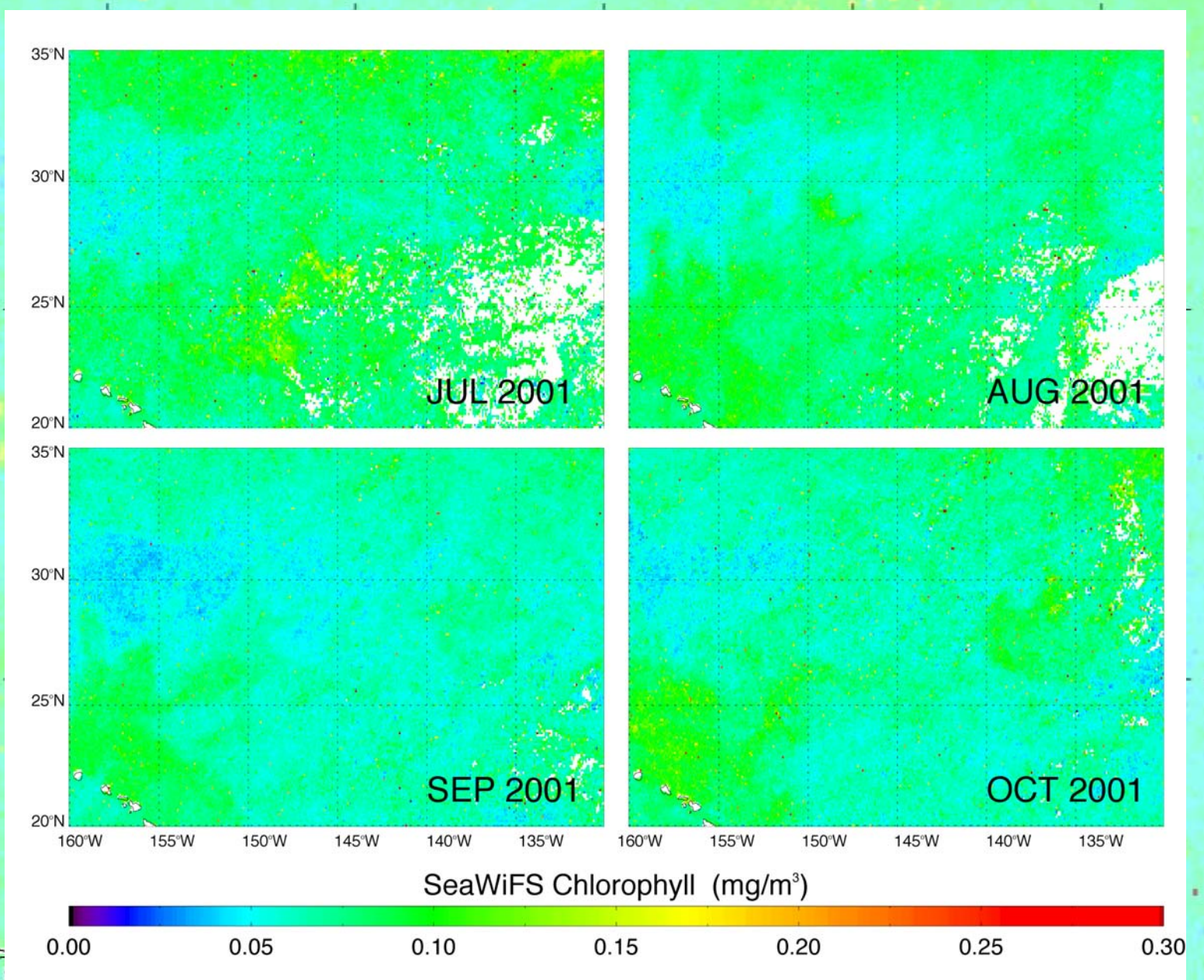

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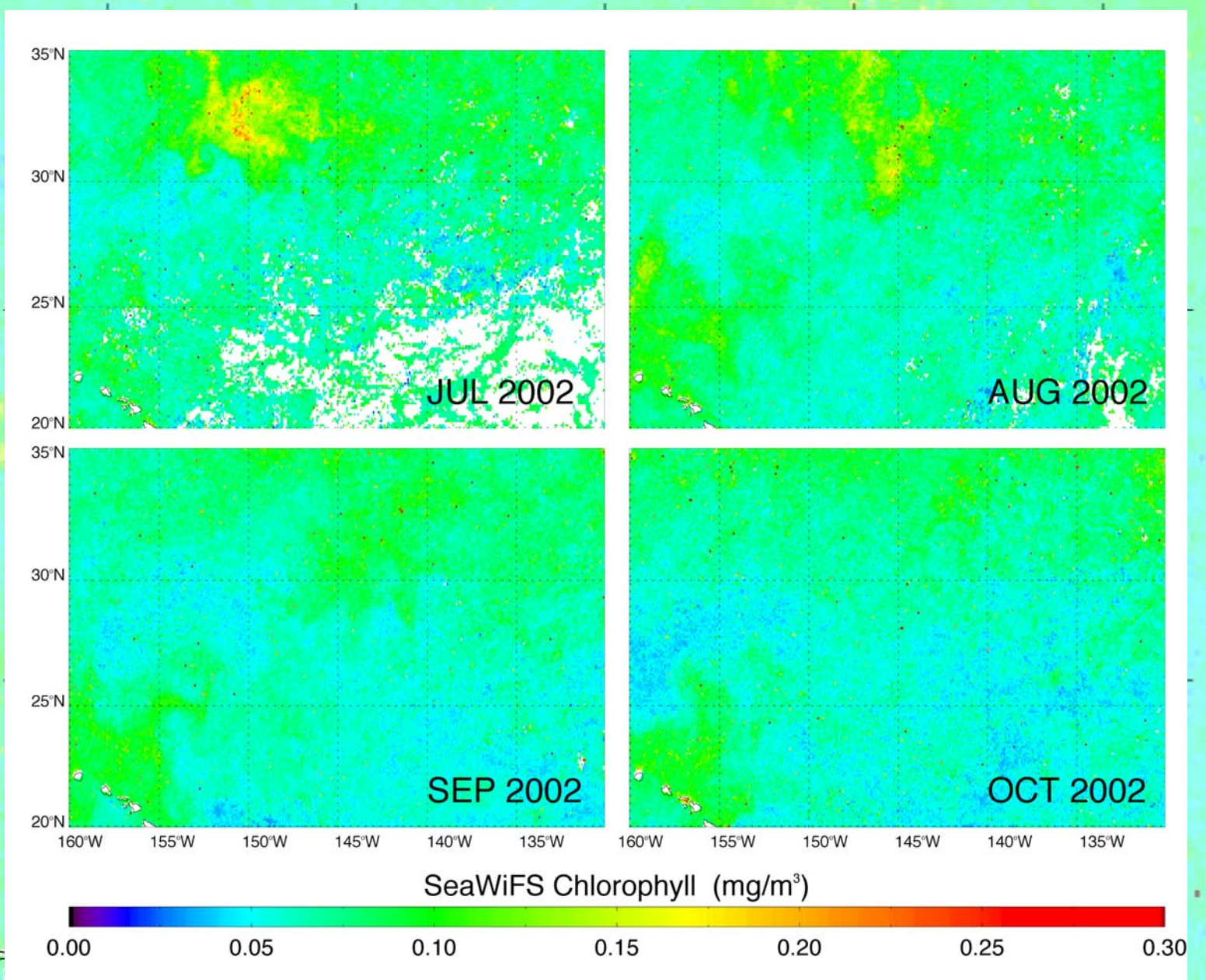

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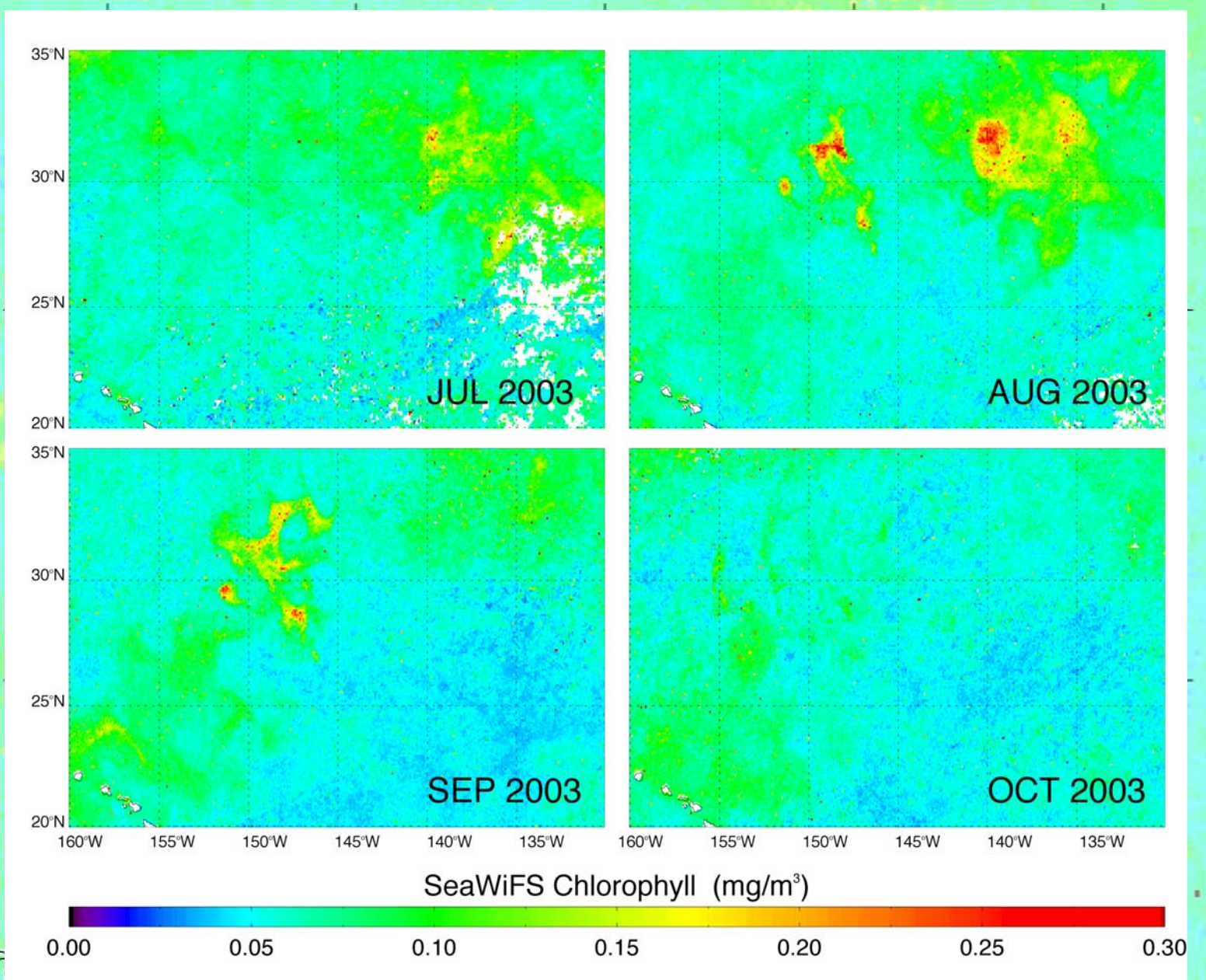

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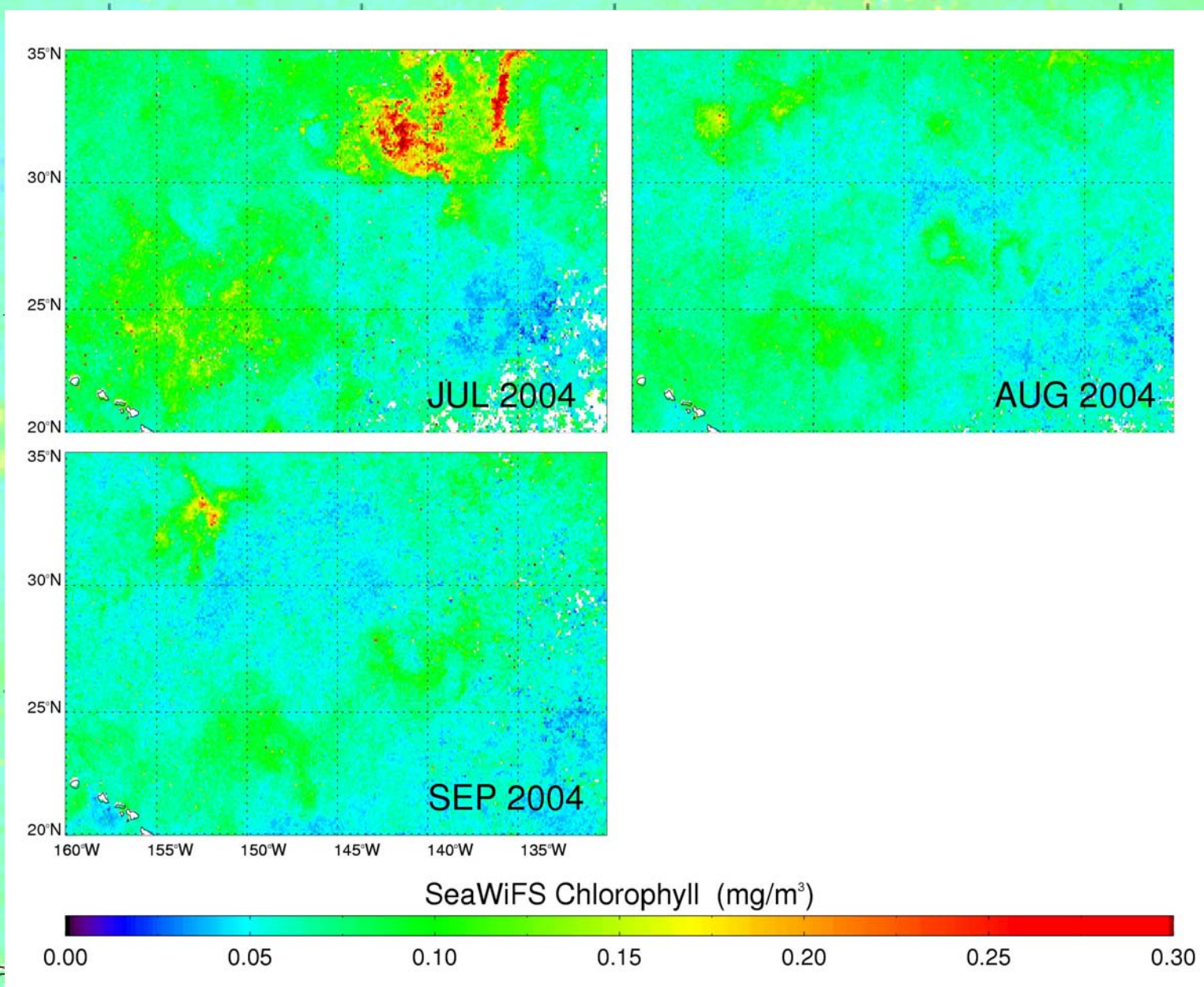
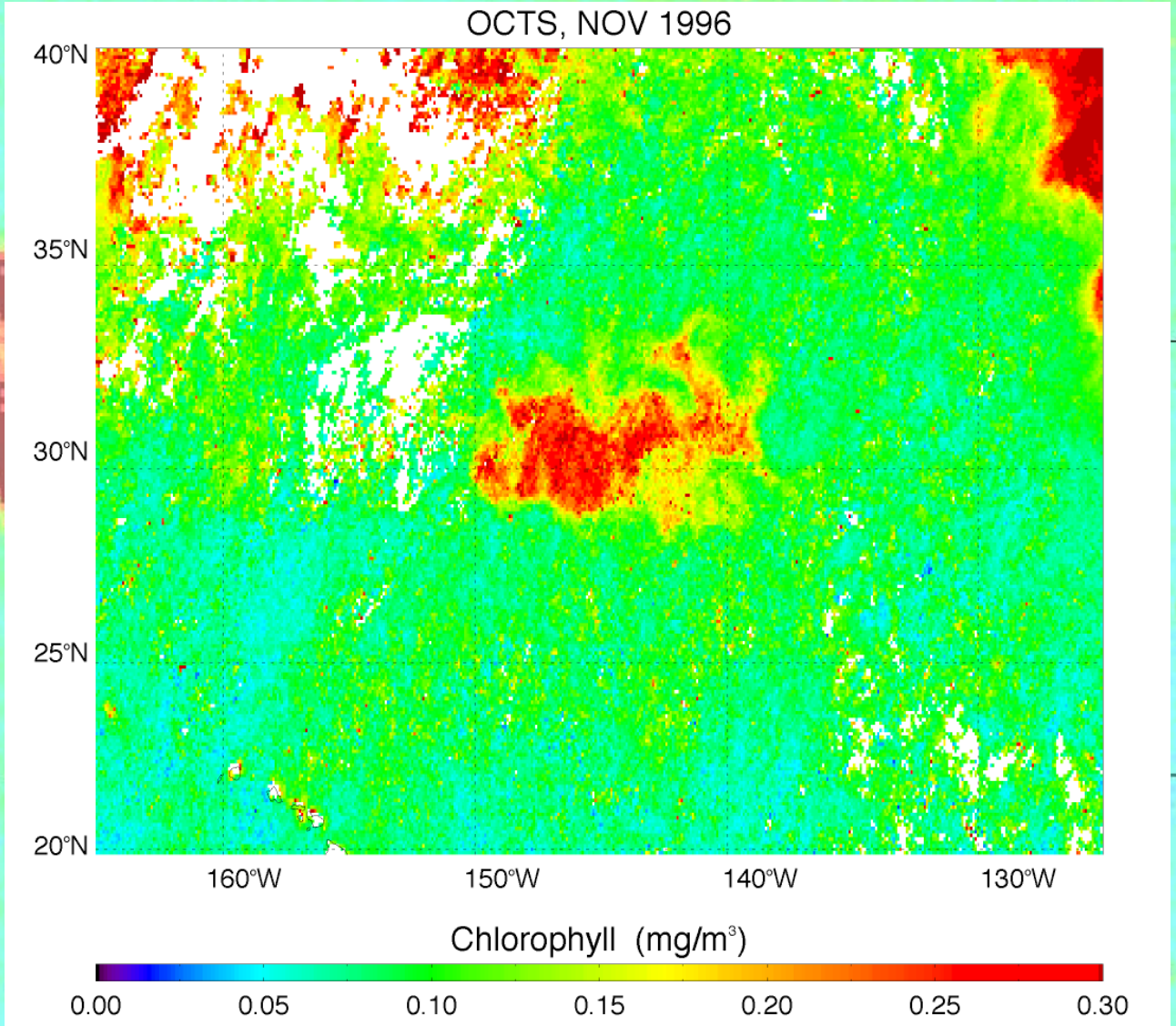


OCTS Bloom

Nov 1996



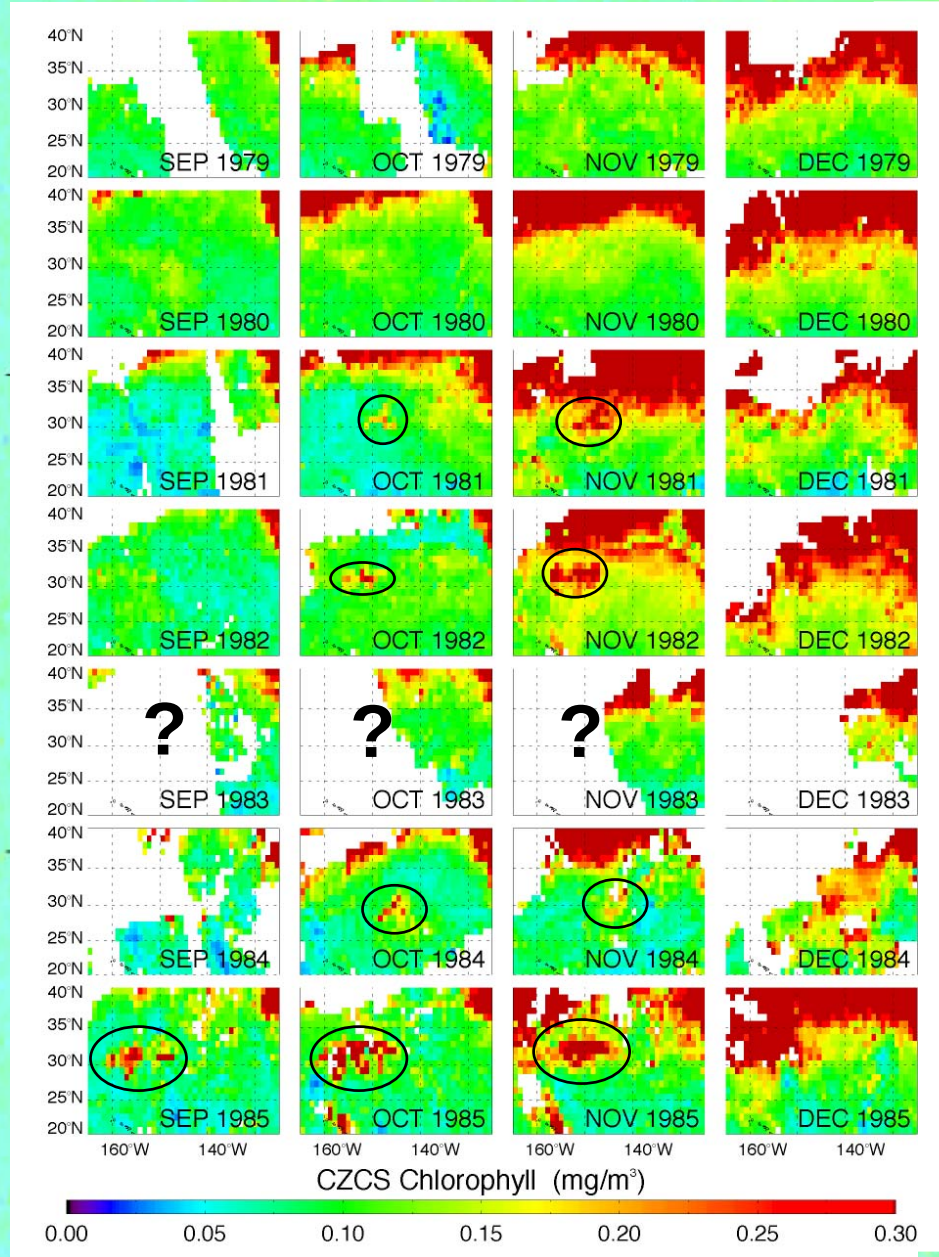
OCTS flew between Oct 1996-June 1997

CZCS Blooms

Sept-Dec 1979-1985

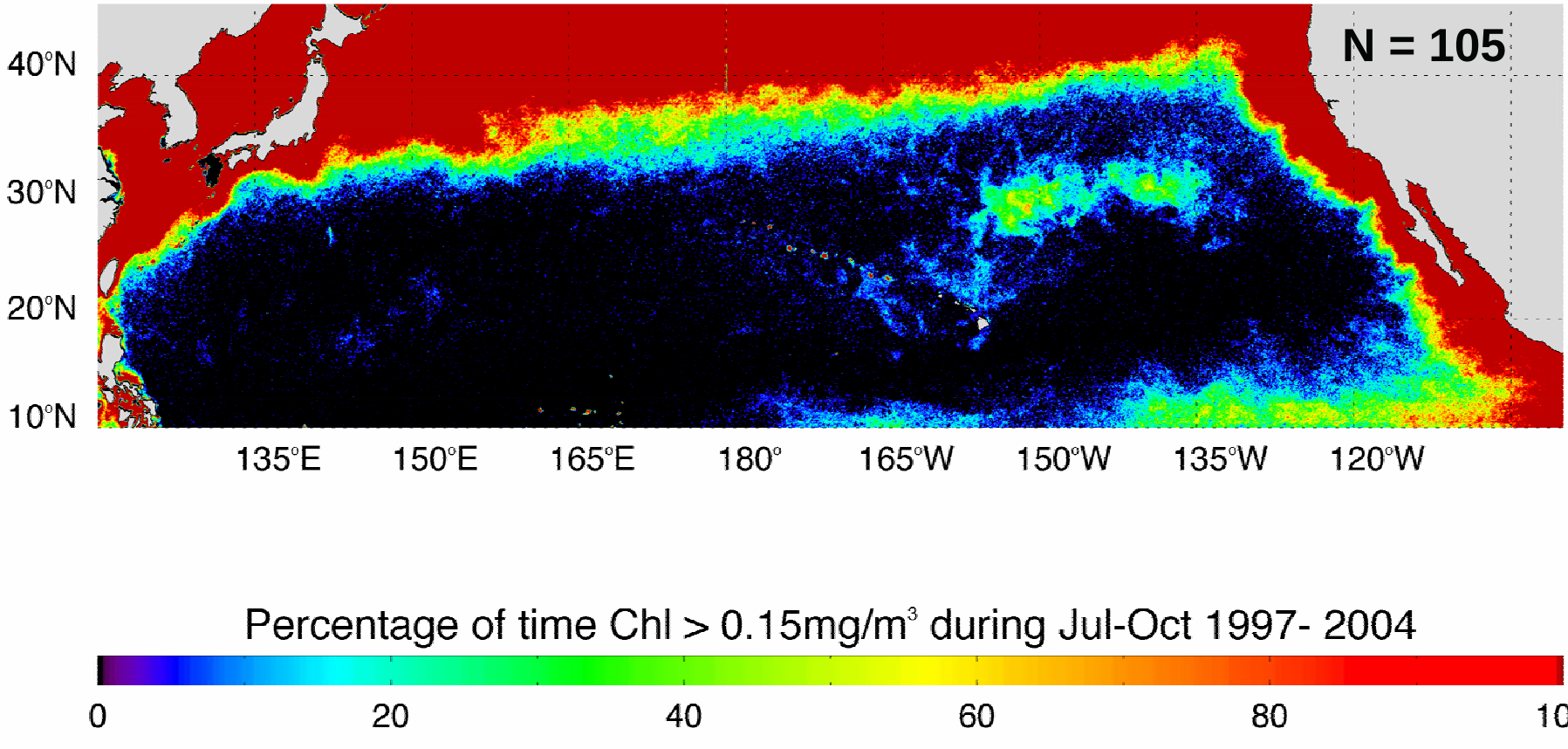
Blooms in 4 out of 7 years

- 1981
- 1982
- 1984
- 1985



NPSG Chlorophyll Hotspots

Percentage of time Chlorophyll > 0.15 mg/m^3 during Jul.-Oct 1997-2004



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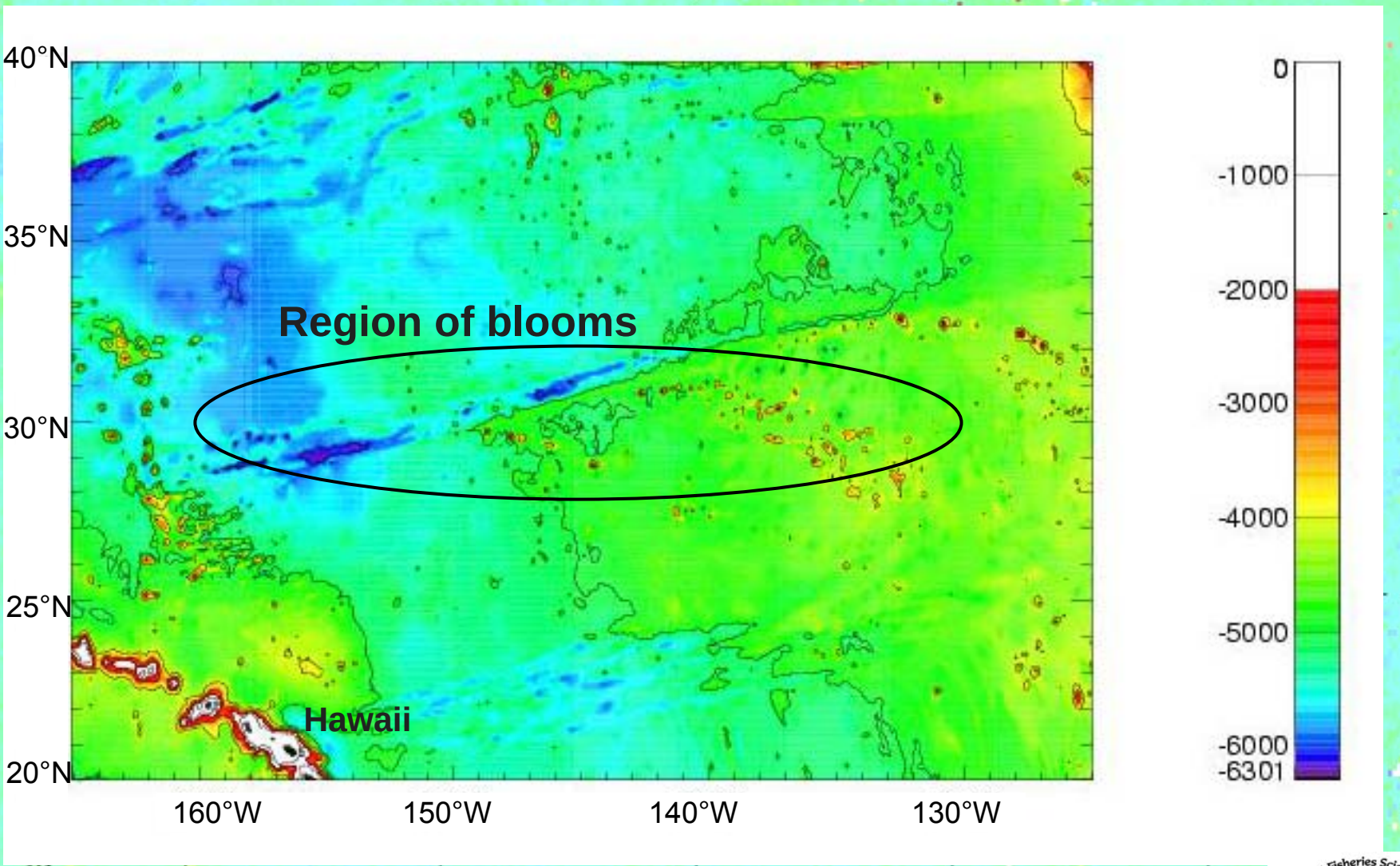
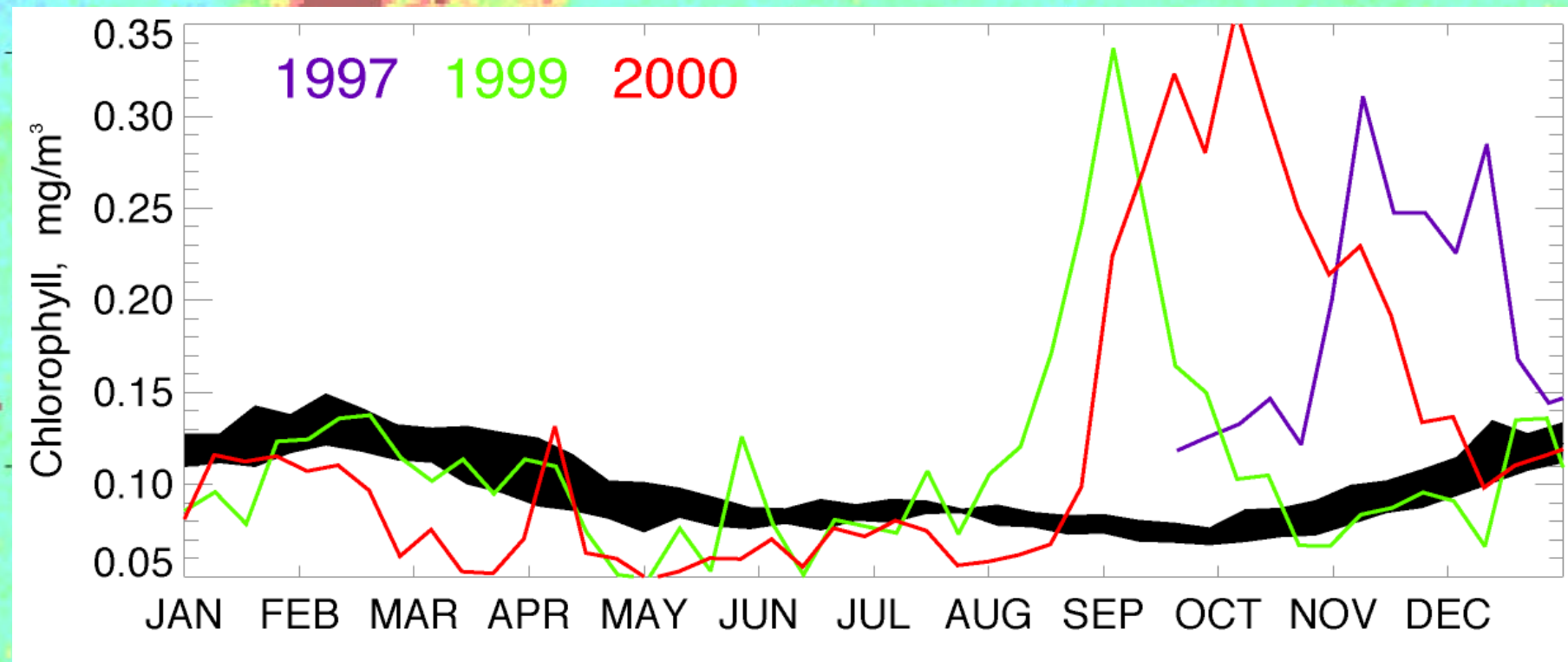
Topography



Seasonal Chlorophyll Cycle

(within study area, south of the TZCF)



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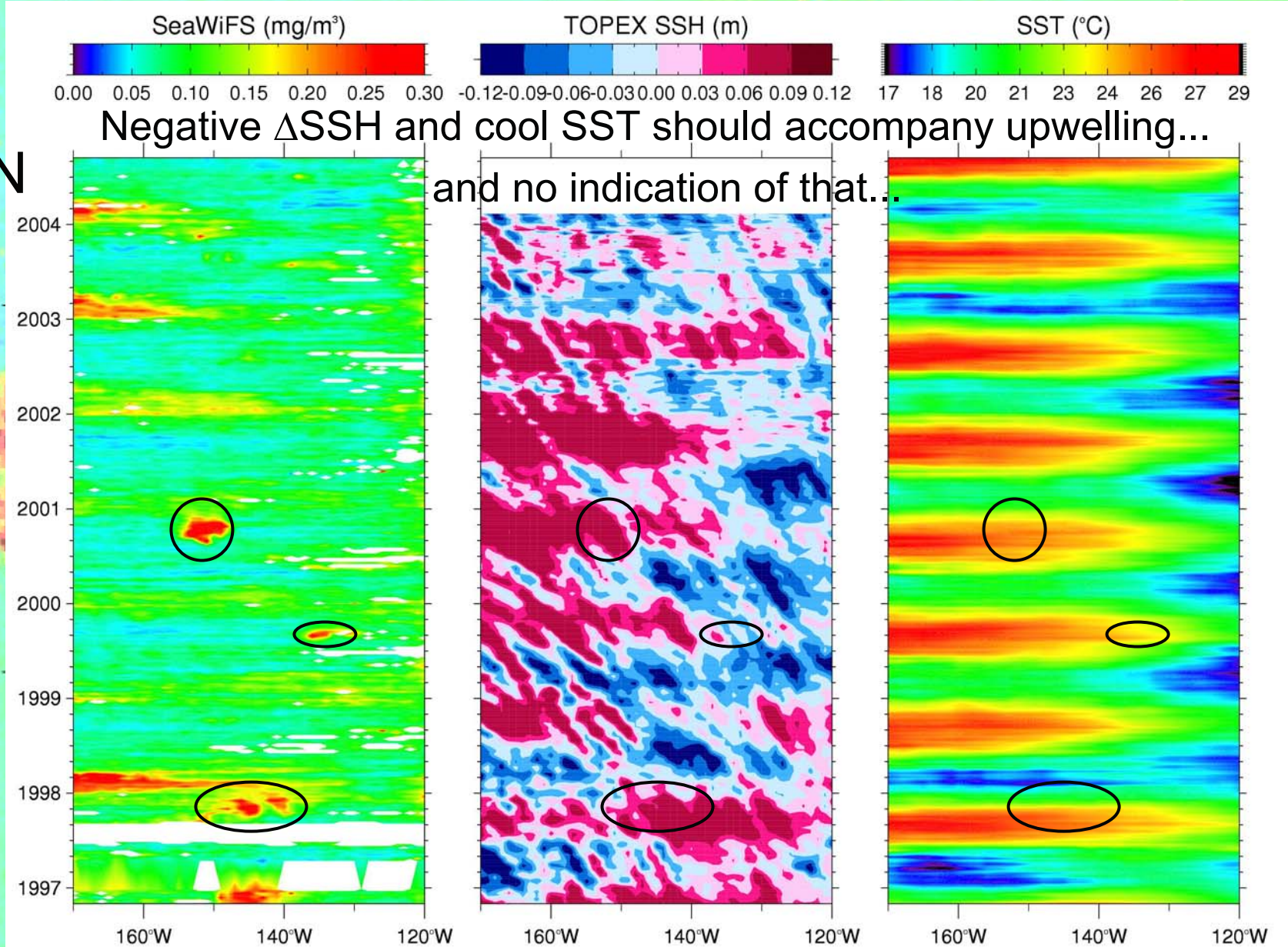
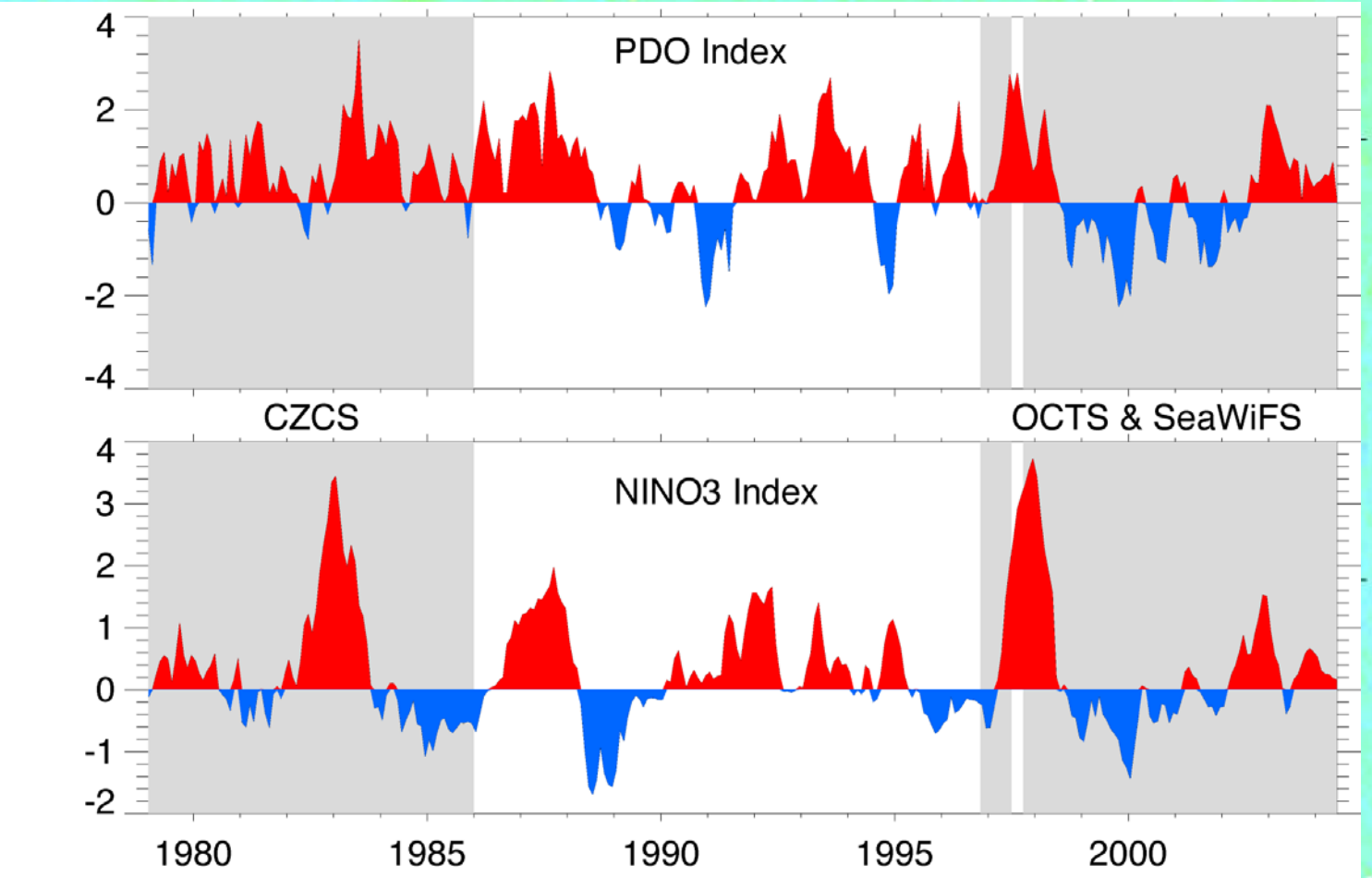


At 30°N

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



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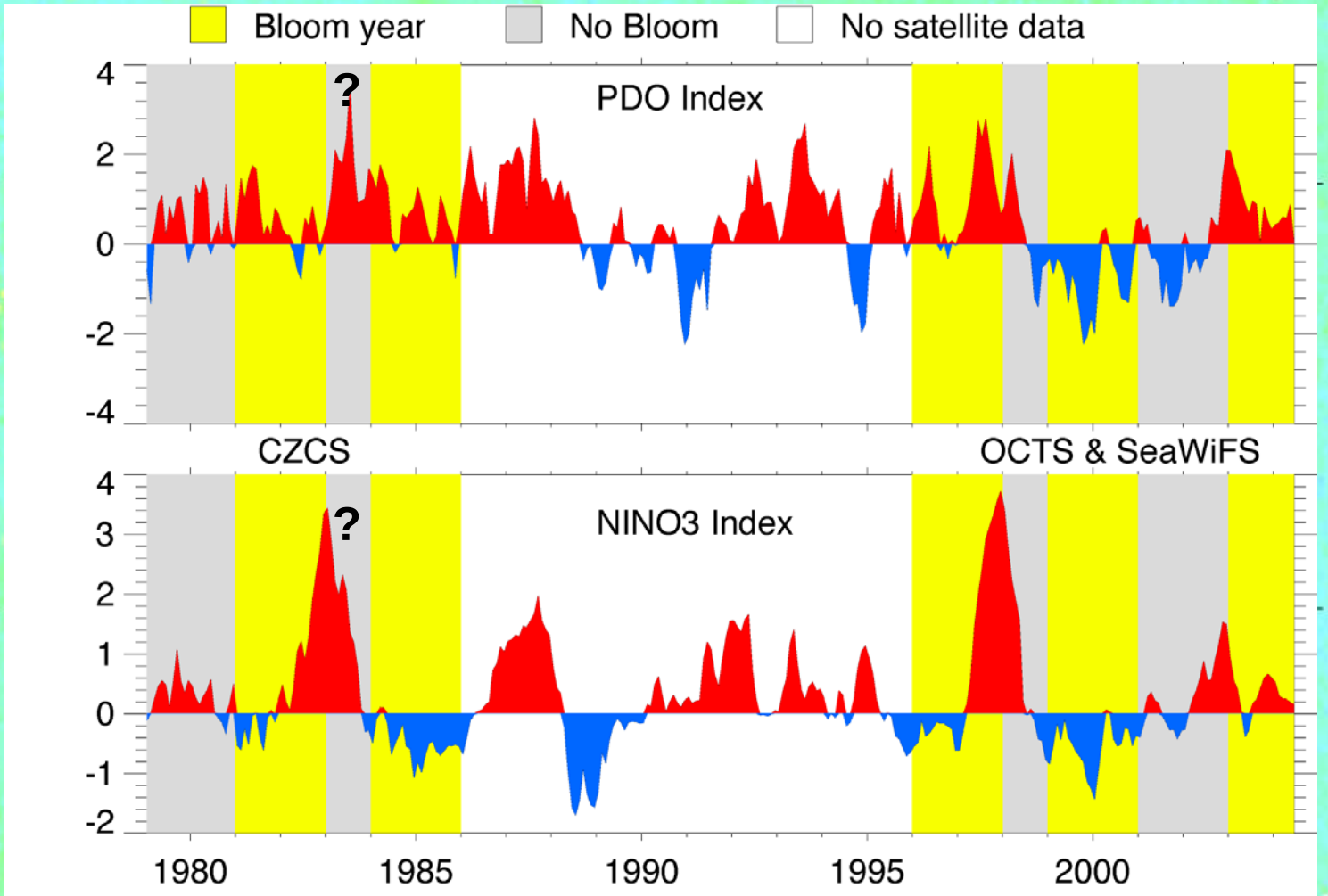


What causes the Blooms?

- 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

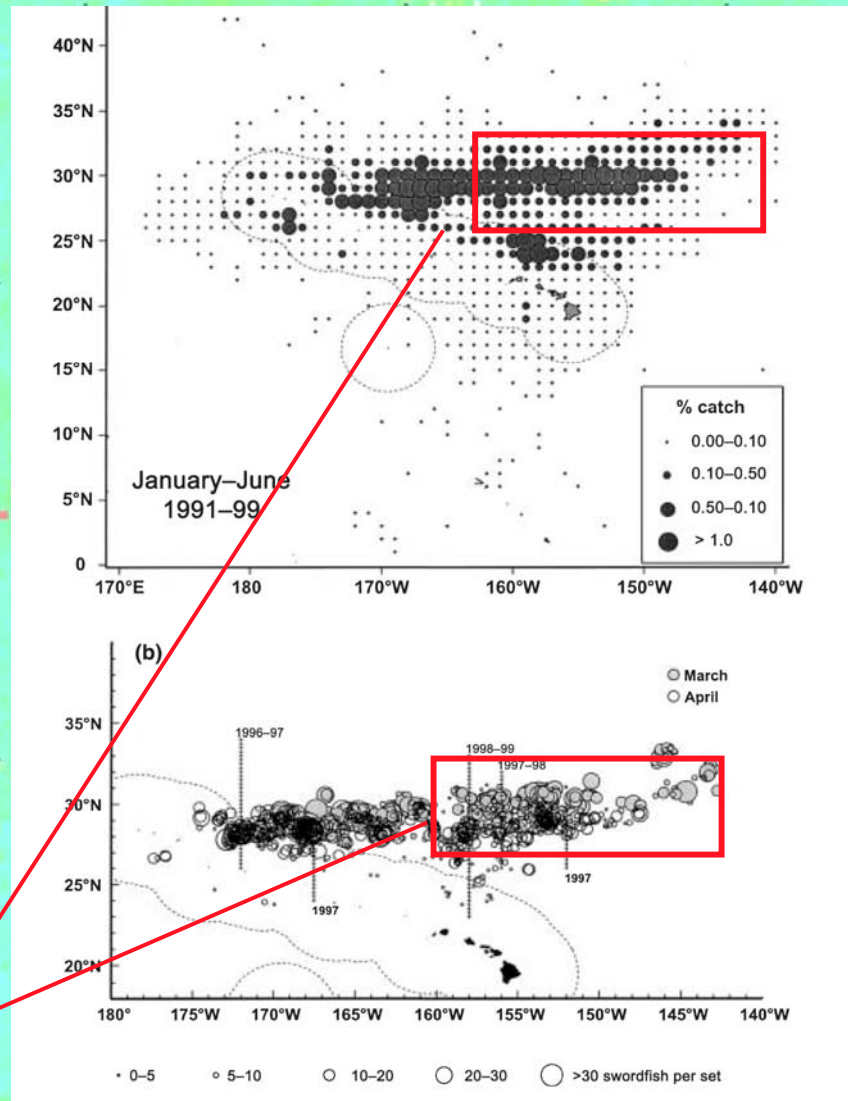
Question?

- 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?

Swordfish Catch

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.

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Release & recovery locations of tagged albacore

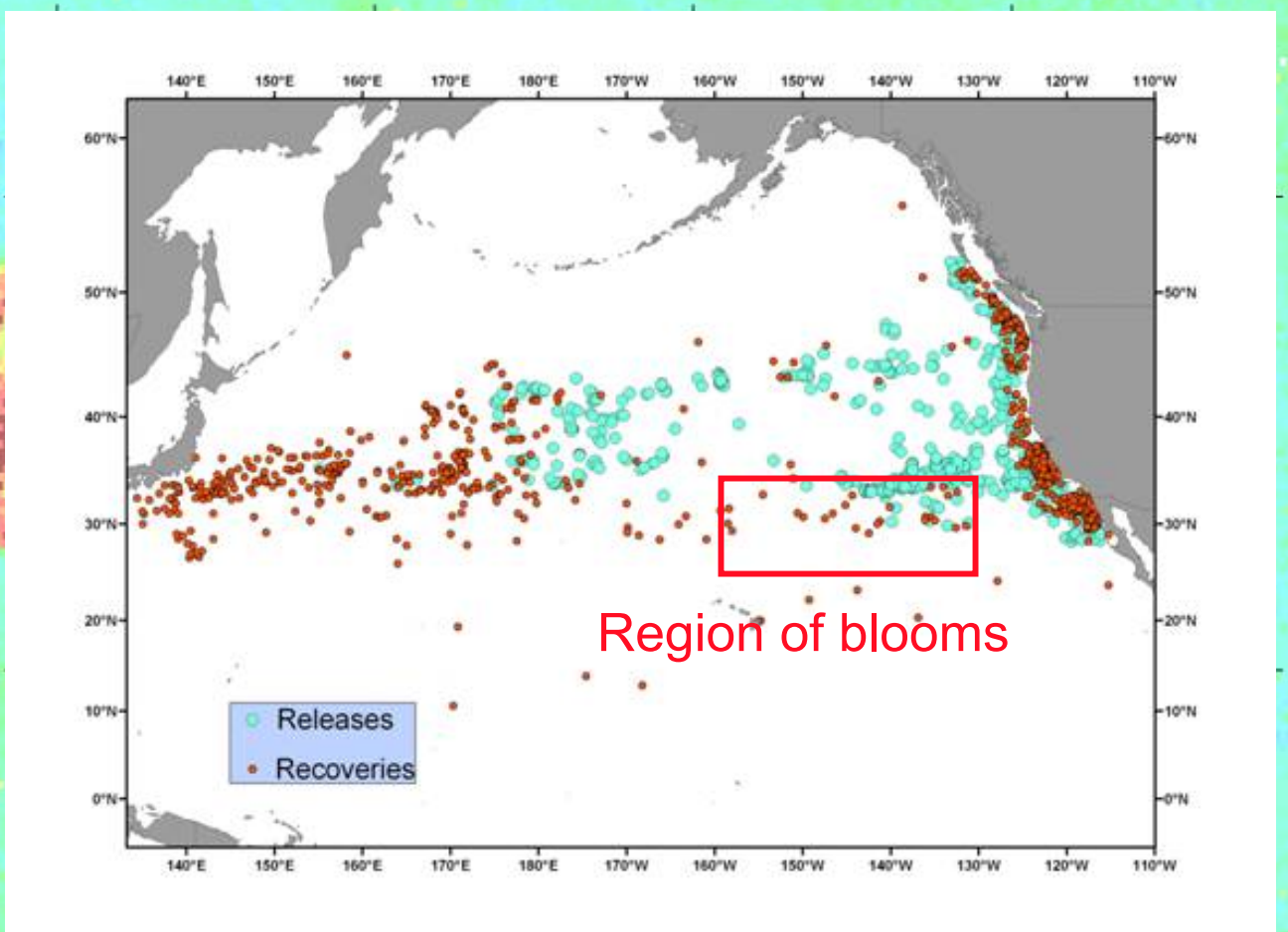

Figure courtesy of NOAA/NMFS/SWFSC http://swfsc.nmfs.noaa.gov/albacore_tag

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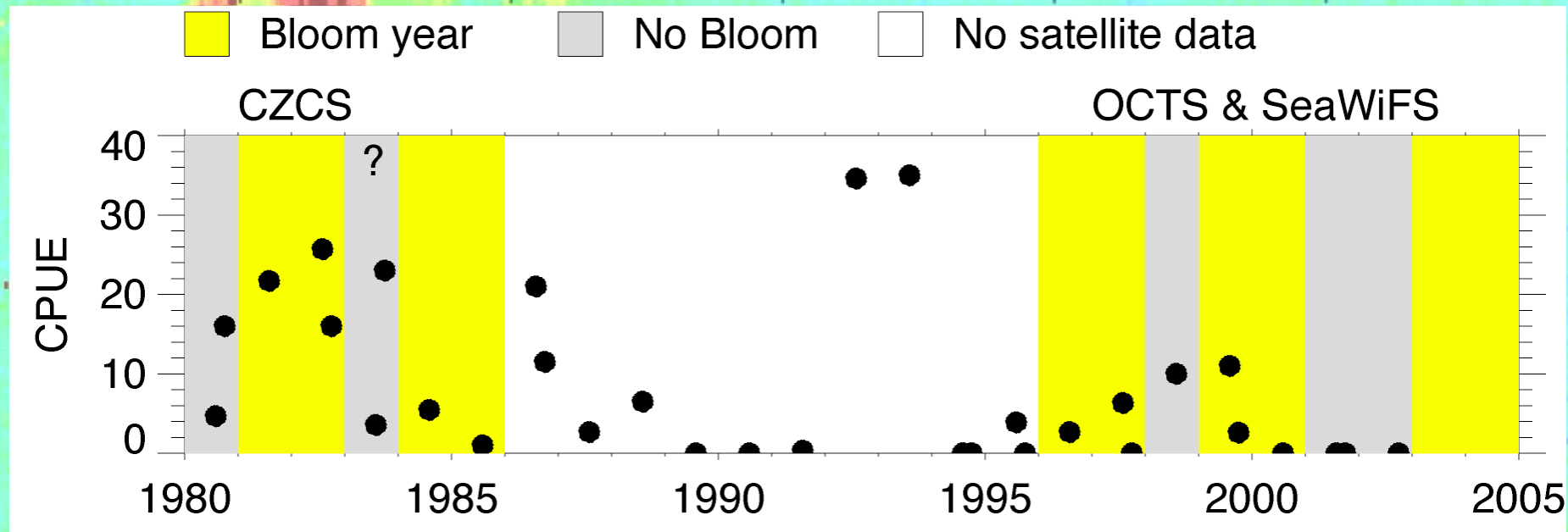
Catch per unit effort (CPUE) data for N. Pacific albacore fishery between 25-35°N and 160-130°W



Large bloom in 2000

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Distribution of US albacore catch in 2000

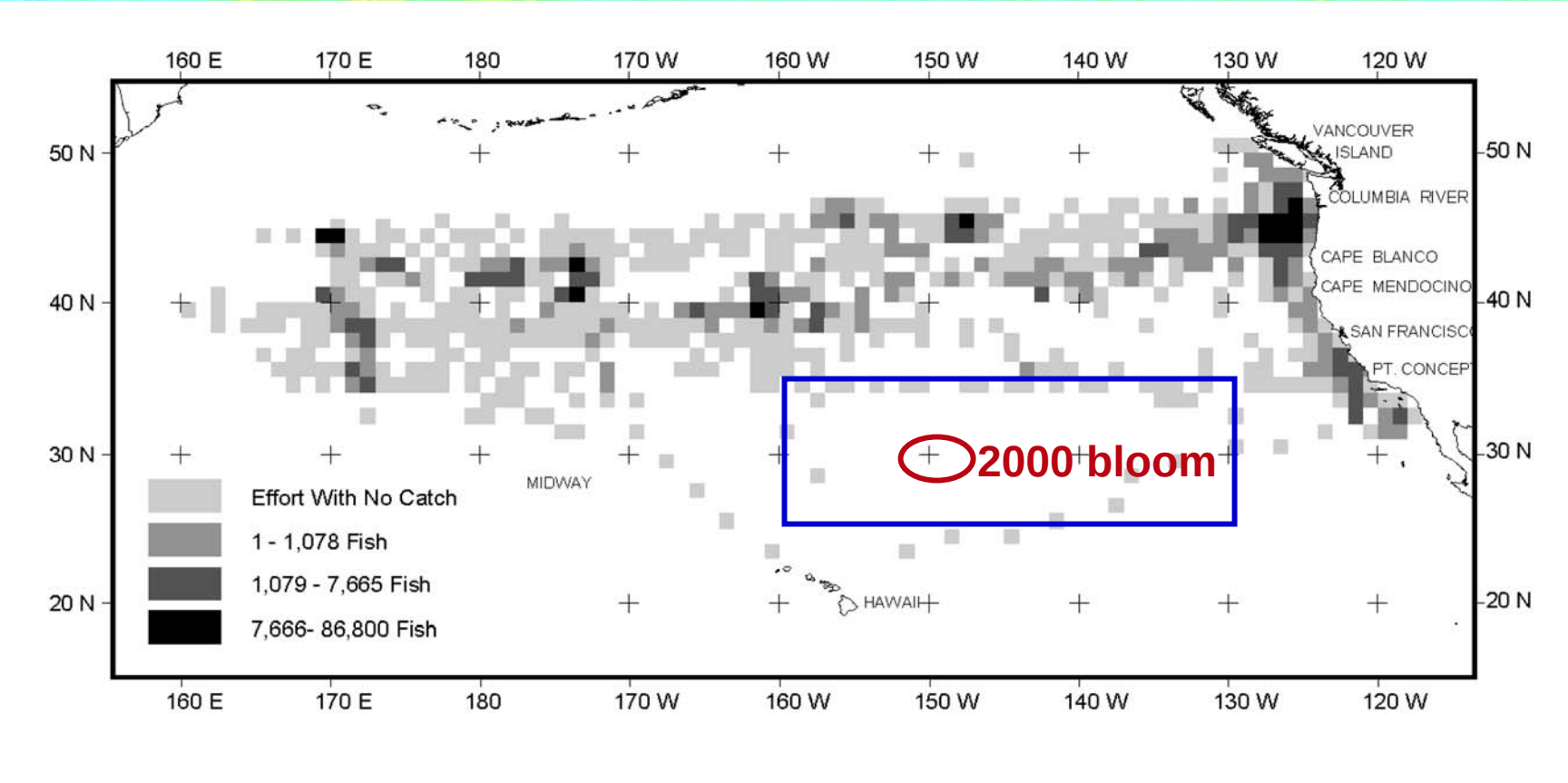

Figure from Childers [2001]

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Density distribution of TOPP animals

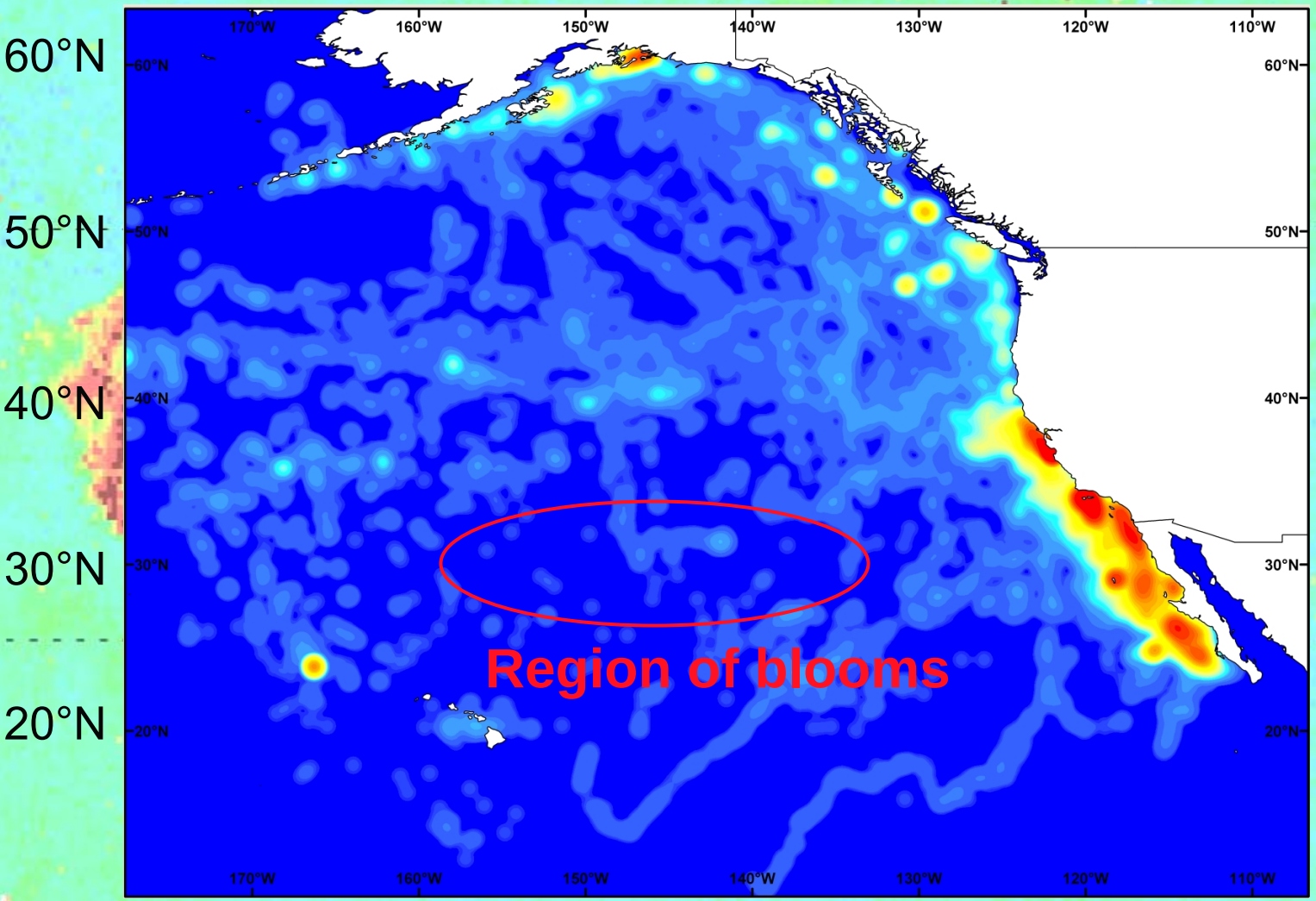

Figure courtesy of Barbara Block, Stanford Univ., HML

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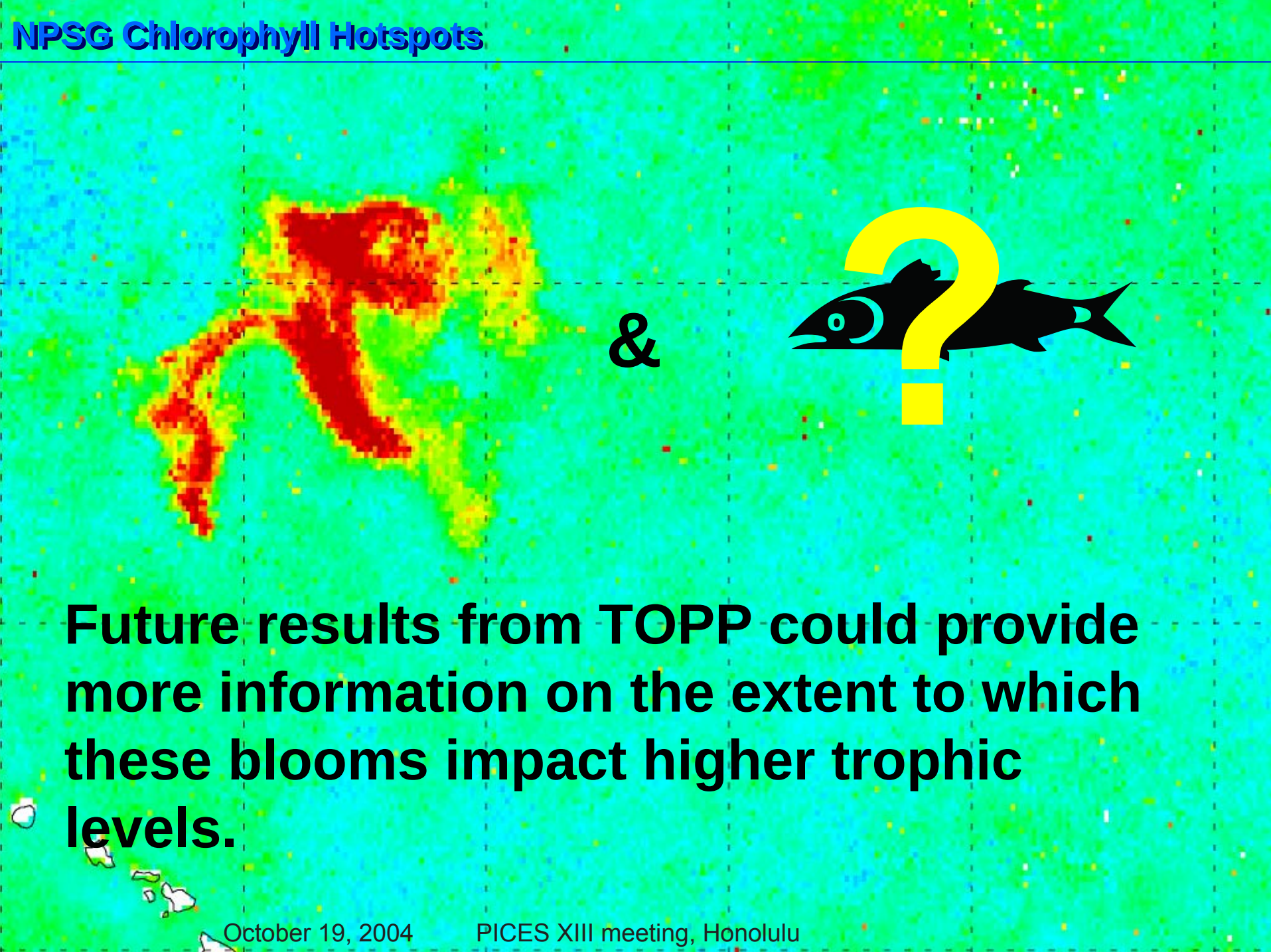

Future results from TOPP could provide more information on the extent to which these blooms impact higher trophic levels.

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.

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