

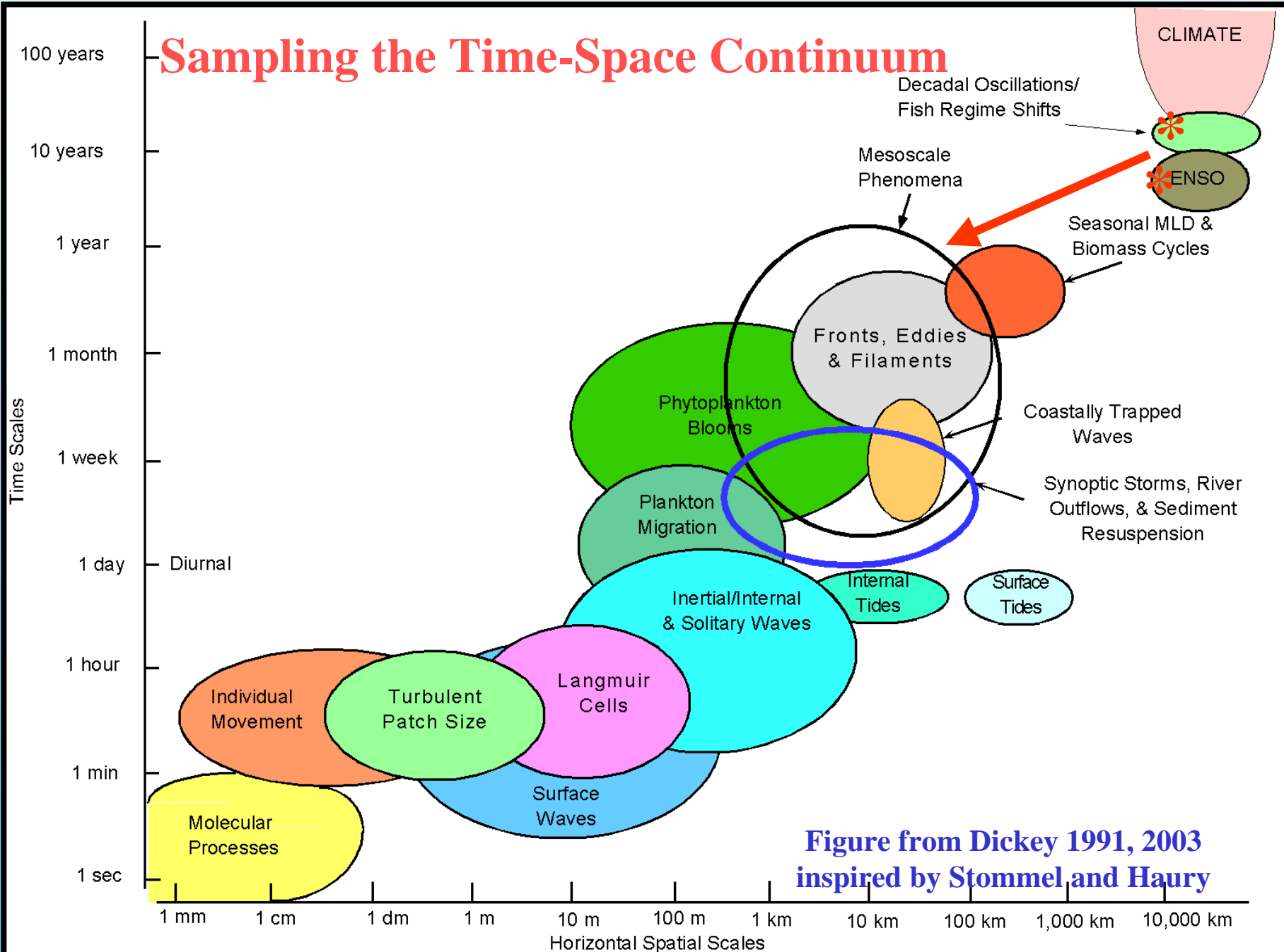
# **Temporal Variations in Phytoplankton Community Structure and Physical Forcing at Station ALOHA**

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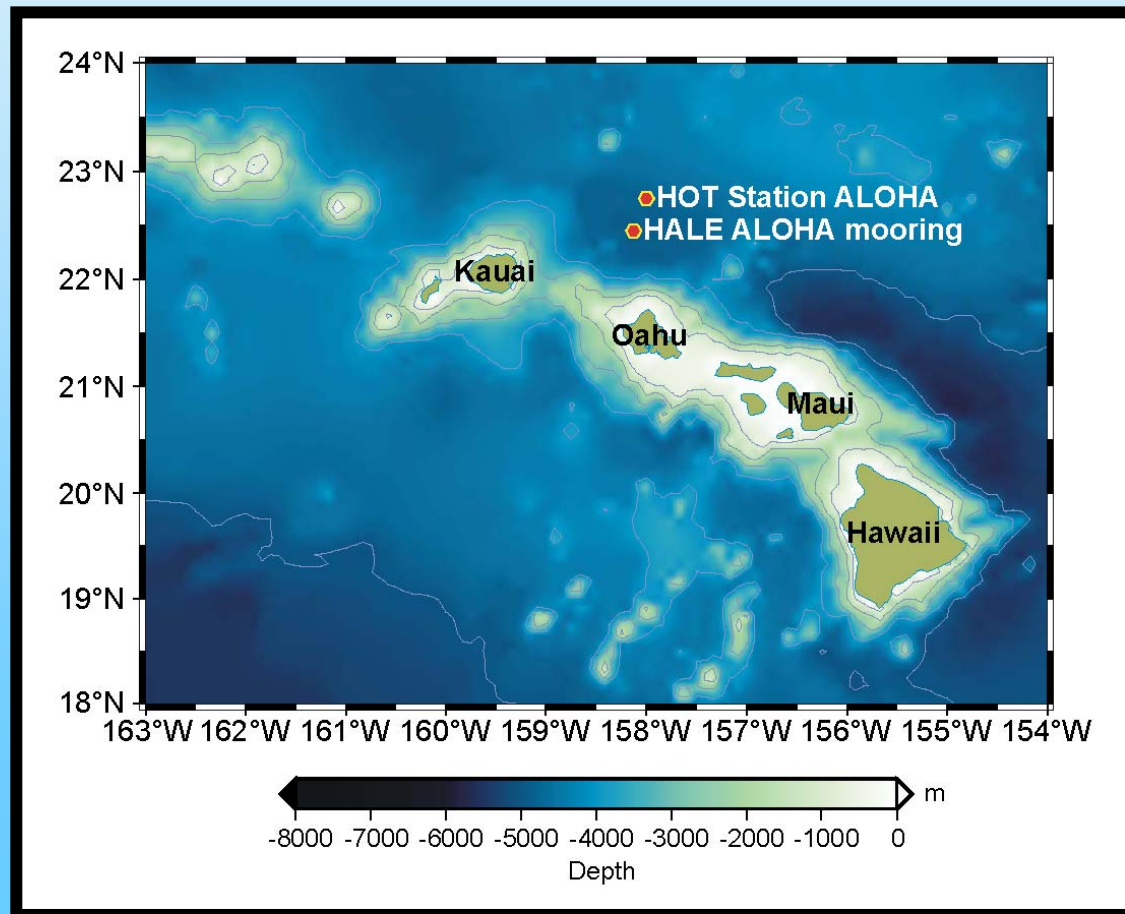
# Sampling the Time-Space Continuum



**Figure from Dickey 1991, 2003  
inspired by Stommel and Haury**

# Hawaii Ocean Time-series Program

- Sta. ALOHA: 22.75°N, 158°W
- Monthly sampling during 1988-present



# Pigment-based Chemotaxonomy

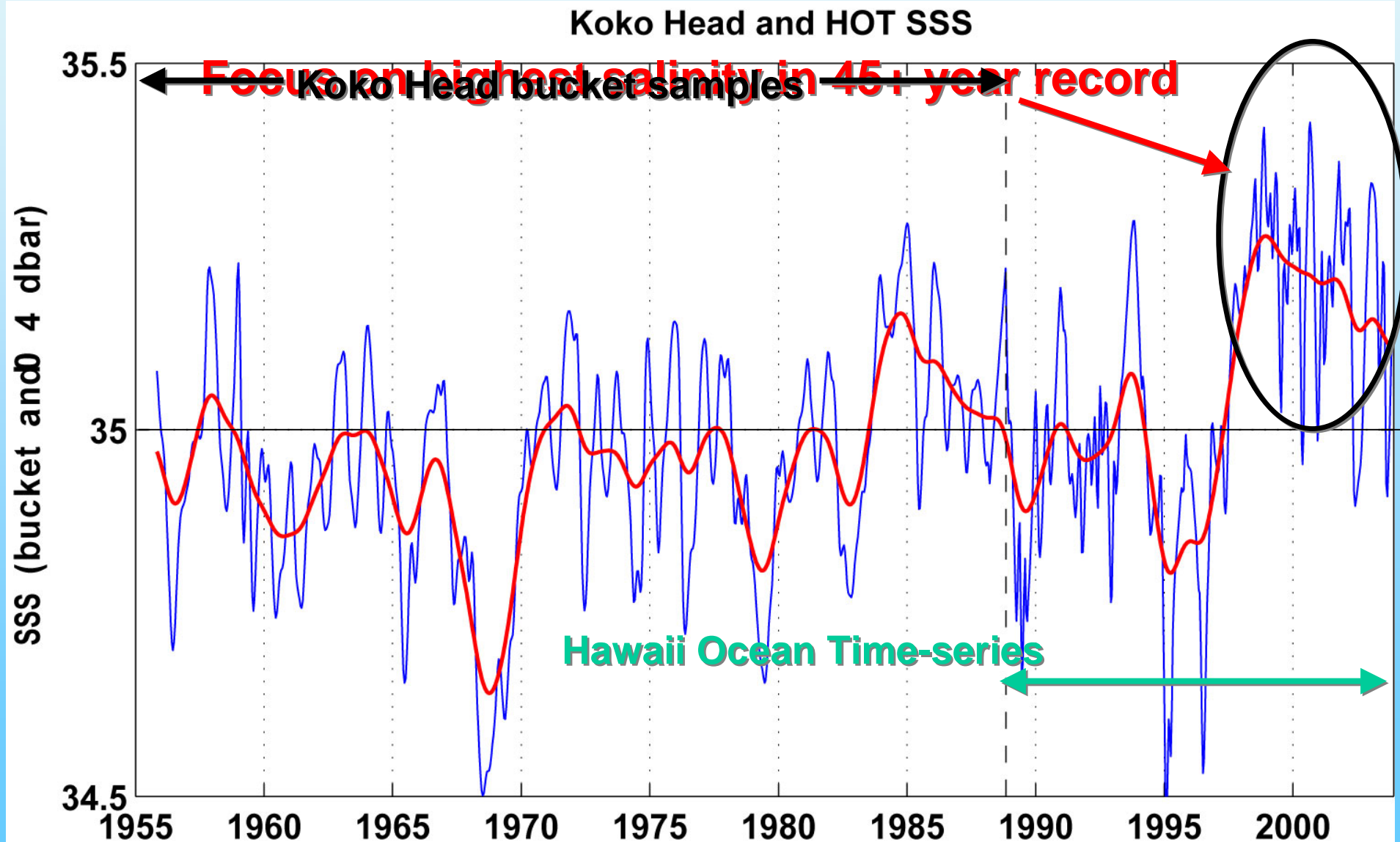
Phytoplankton Pigment	Taxonomic Group
Total chlorophyll <i>a</i>	Phytoplankton biomass
Chlorophyll <i>b</i>	<i>Prochlorococcus</i> spp.
Chlorophyll <i>c</i>	Chromophyte microalgae
Zeaxanthin	Photosynthetic bacteria
Fucoxanthin	Diatoms
19'-Hex-fucoxanthin	Haptophytes
19'-But-fucoxanthin	Pelagophytes

# Variability at Sta. ALOHA:

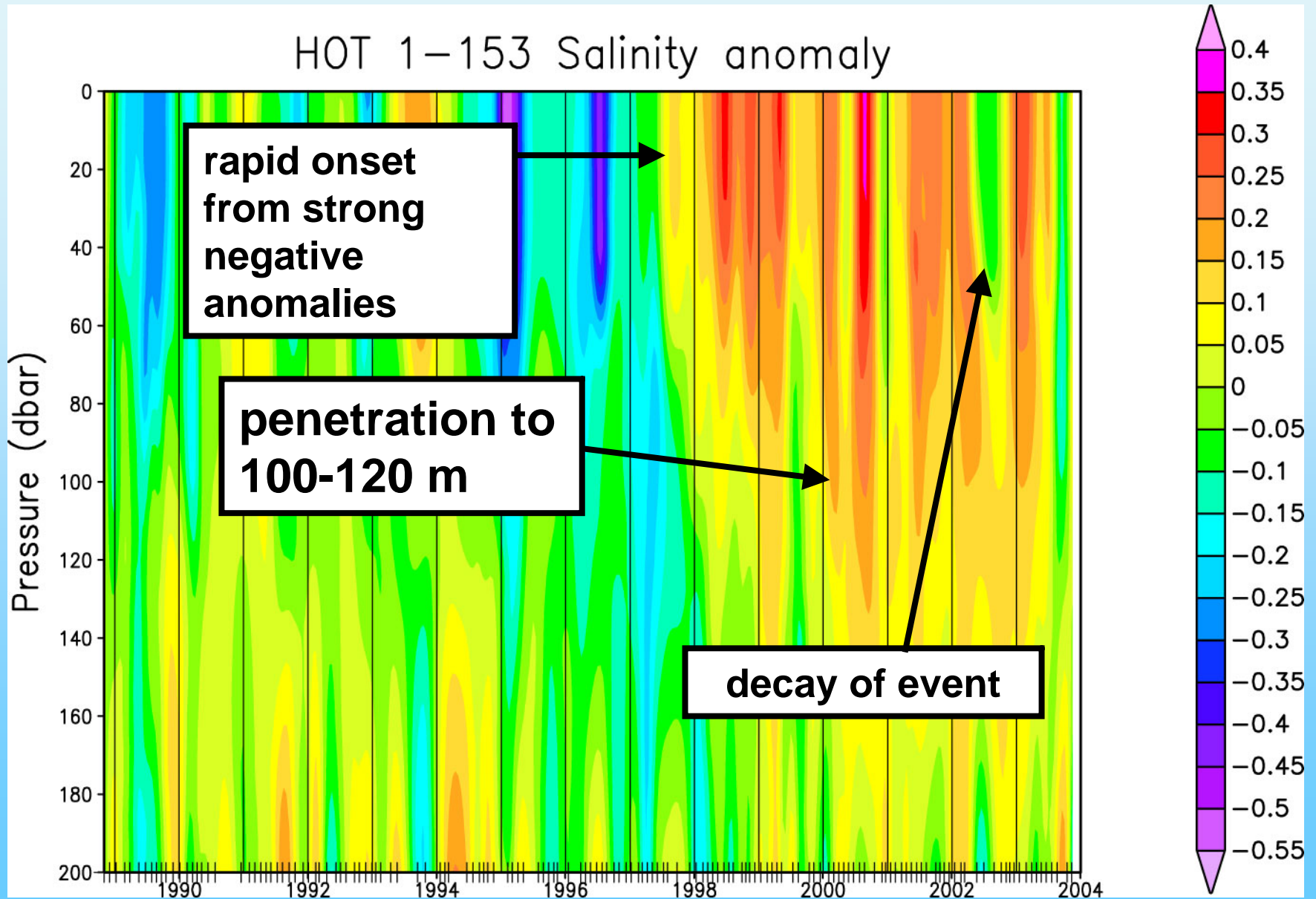
## Interannual Time-scale

- Data set: 1990 – 2002
- Significant interannual differences ( $P \leq 0.001$ ) observed for all pigments in the upper 200 m
- Salinity anomaly observed in the upper 120 db at Station ALOHA during 1997-2003 (El Niño and PDO drought)
- Pigment “*regime shift*” observed in 1996-1997

# Hawaii Salinity Time-series



# HOT 1-153 Salinity anomaly

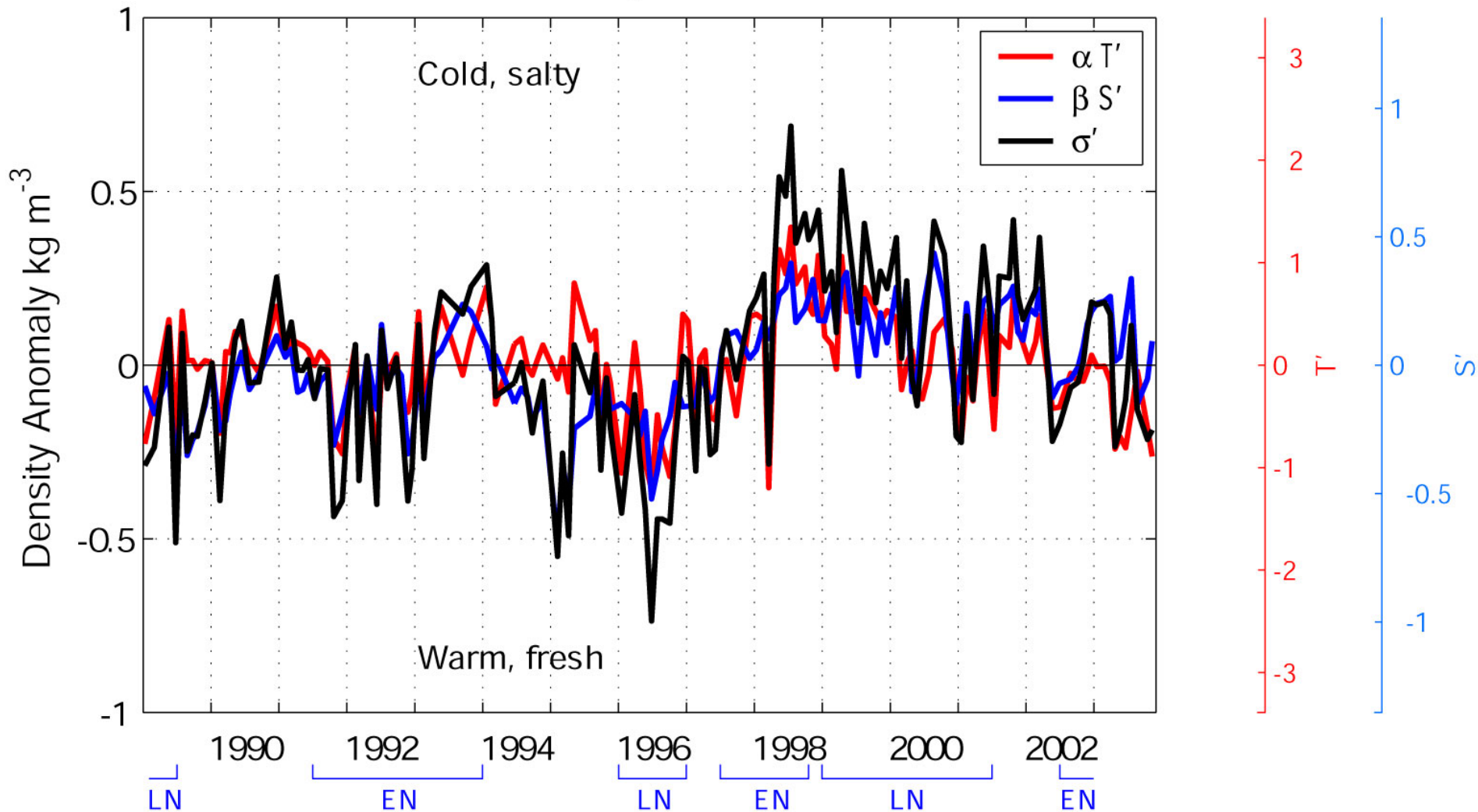




# Mixed Layer T reinforces S anomaly:

→ decreased stability

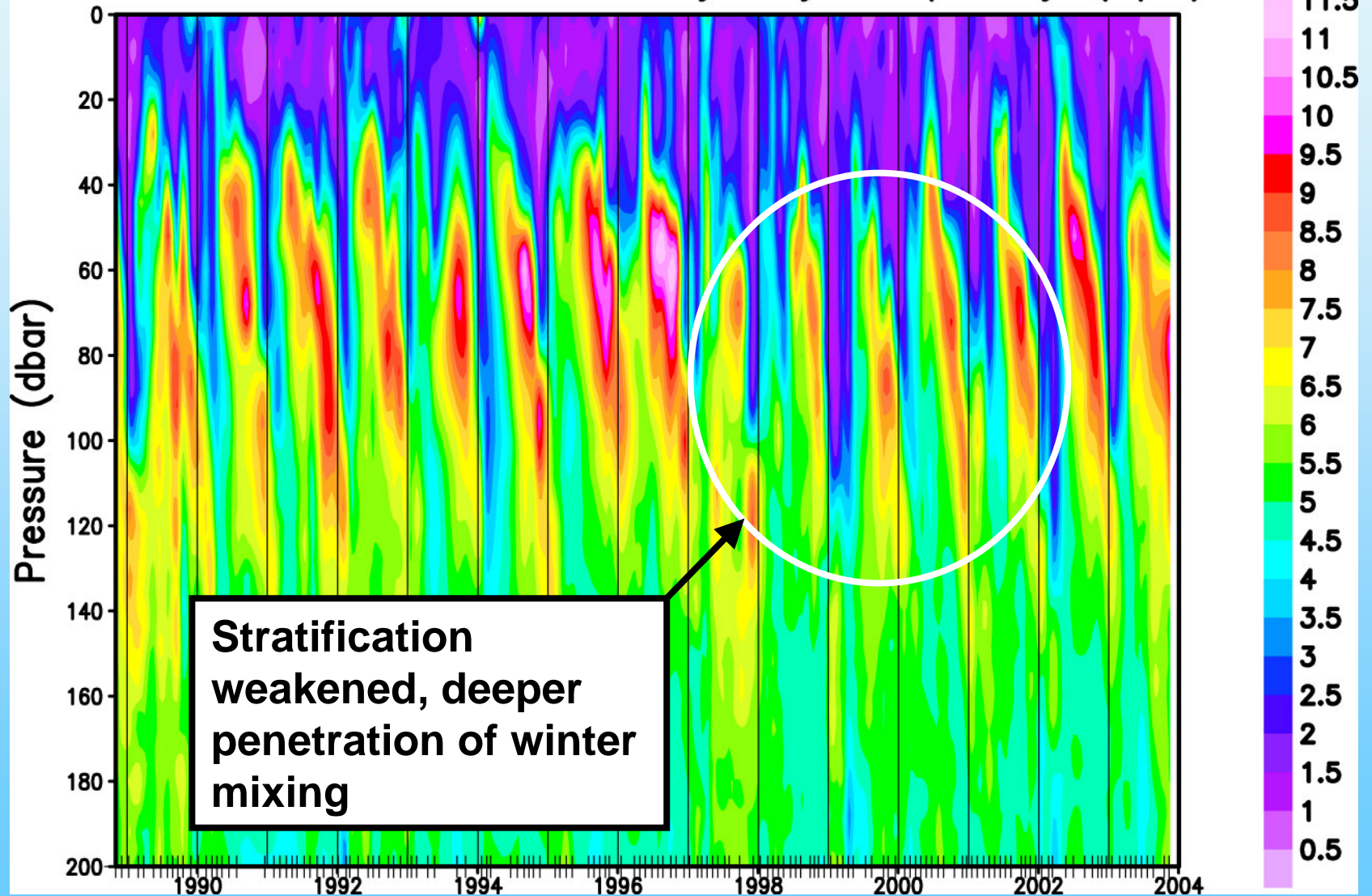
Seasonal cycle removed



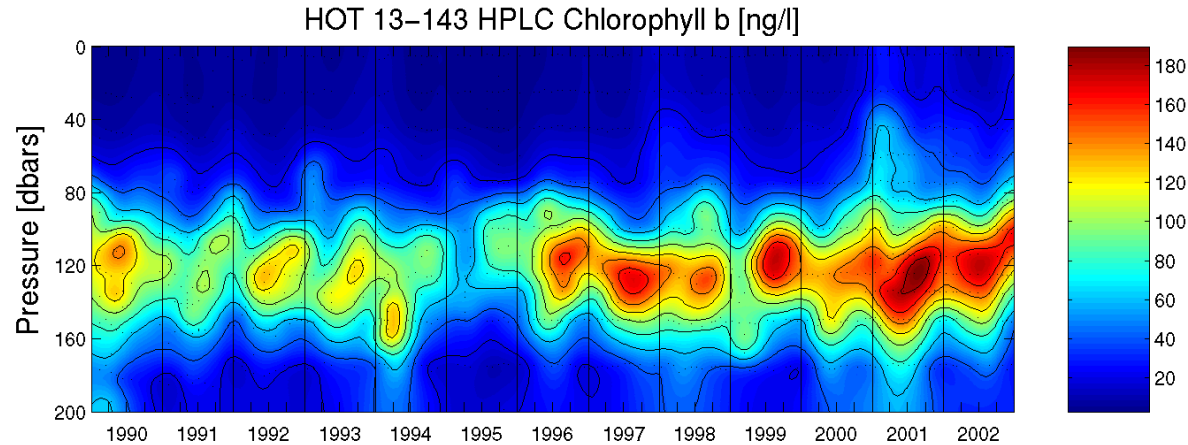


HOT 1-153

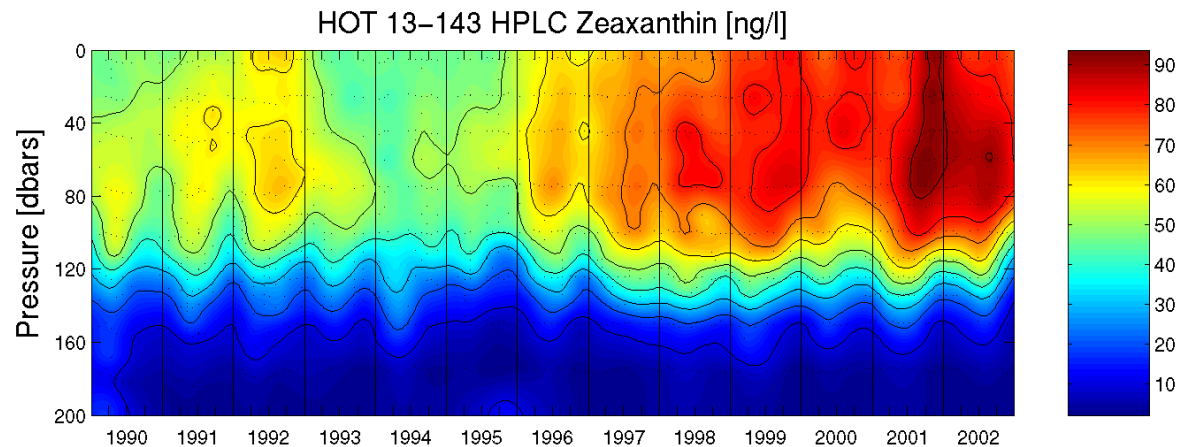
buoyancy frequency (cph)



# Pigment Biomarkers

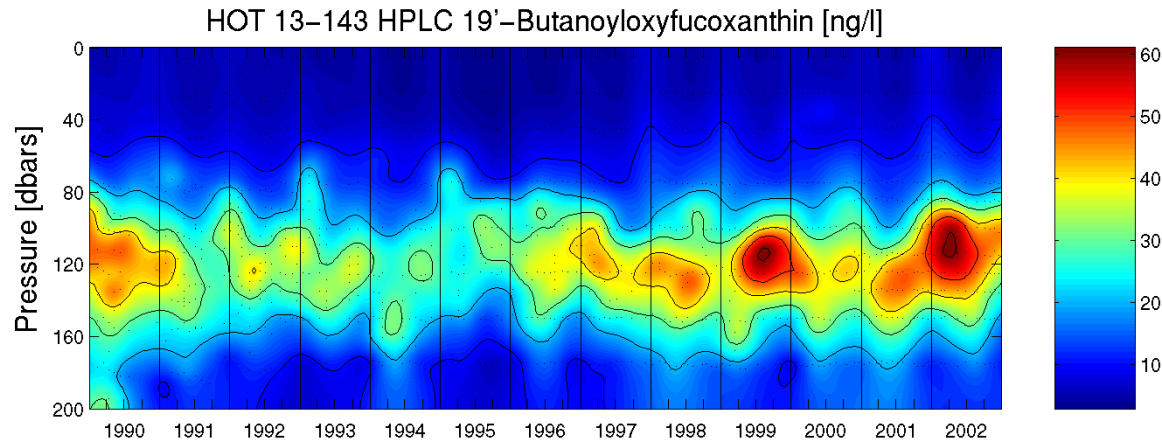


*Prochlorococcus*  
spp.

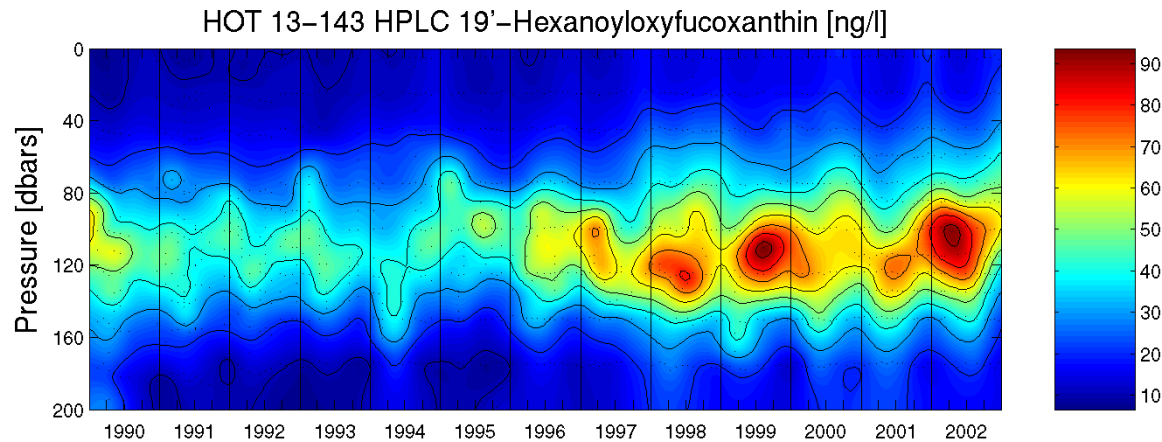


**Cyanobacteria**

# Pigment Biomarkers

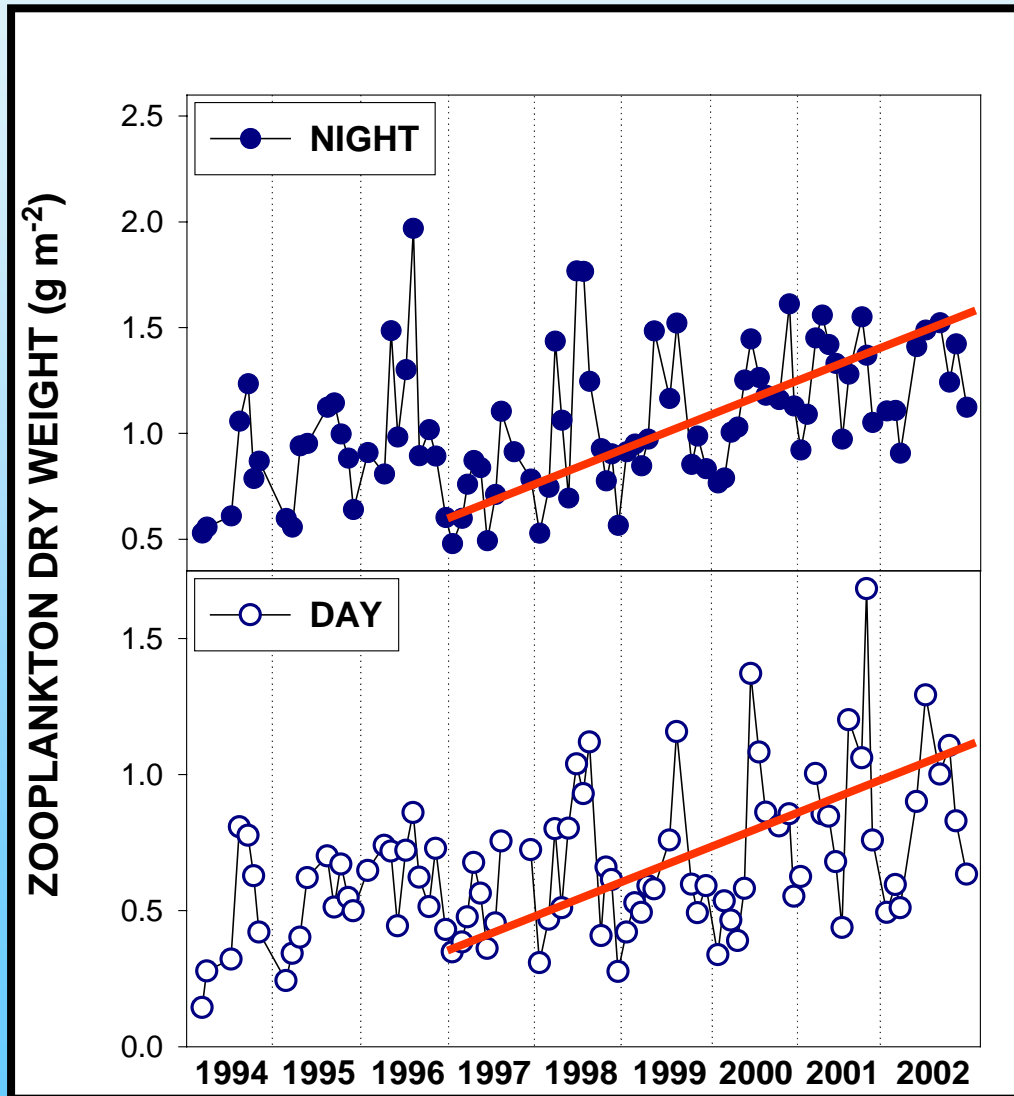


**Pelagophytes**



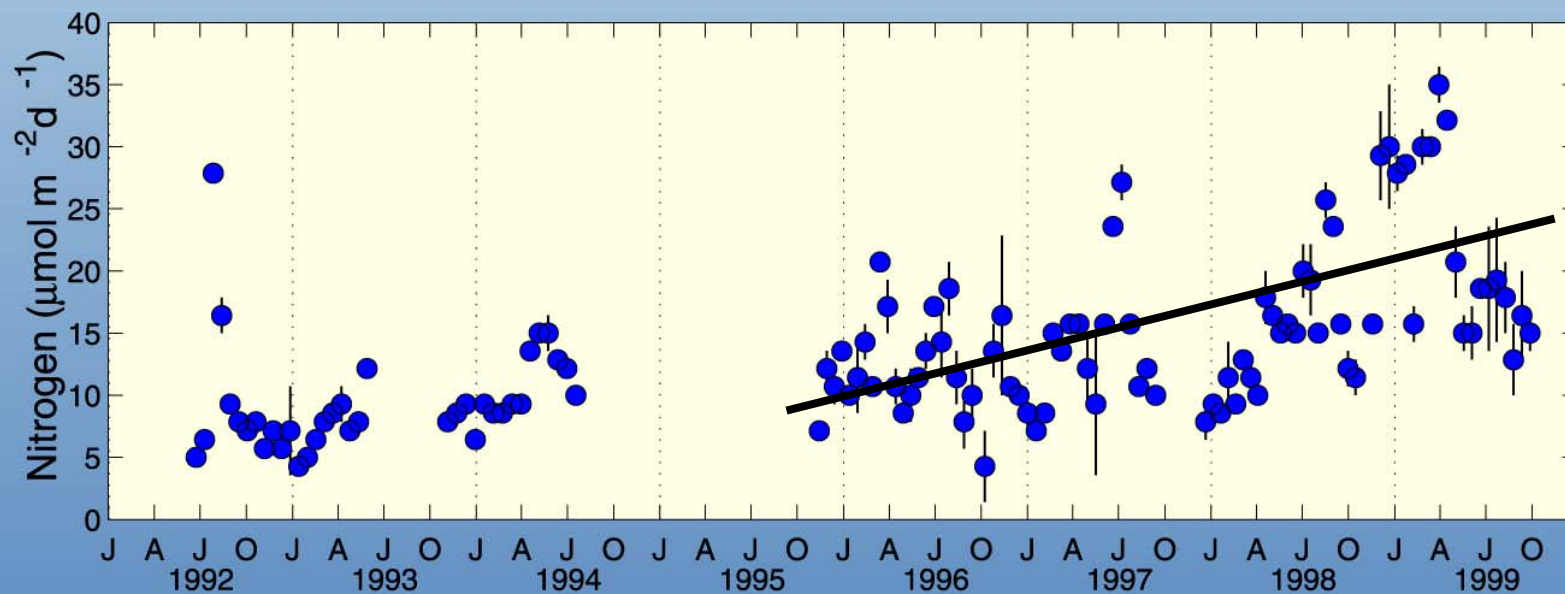
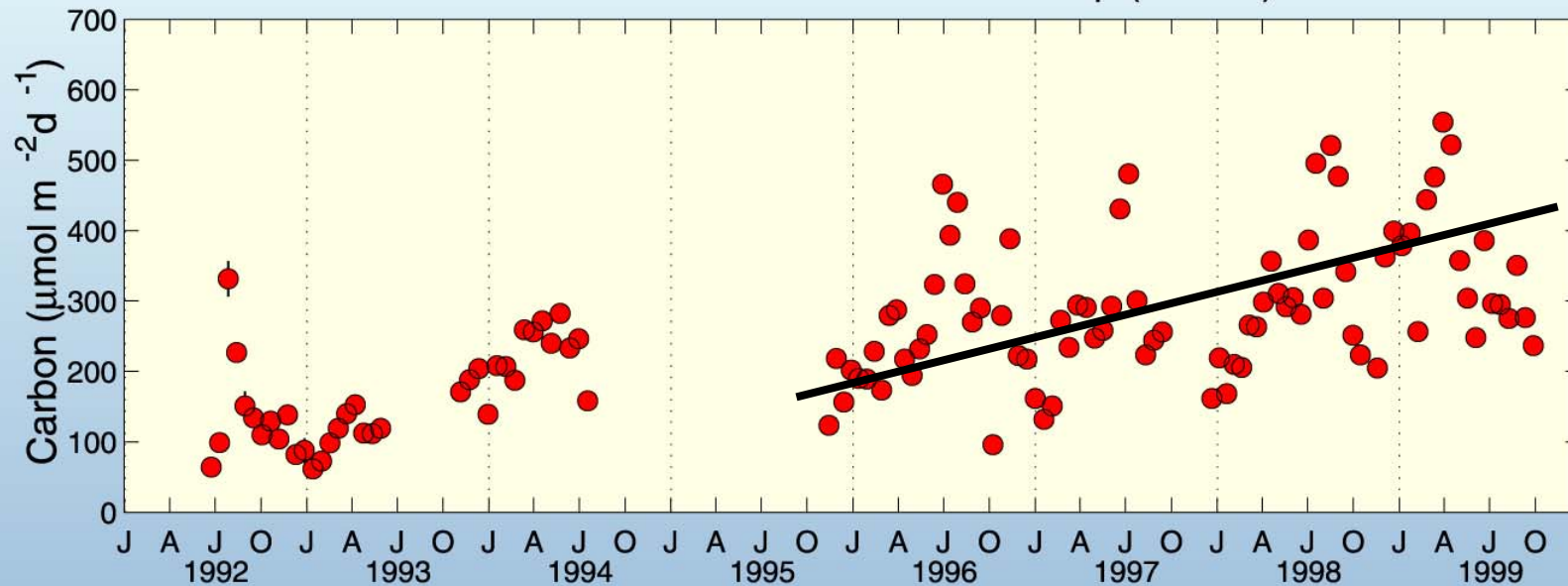
**Haptophytes**

# Temporal Variations in Zooplankton ( $> 0.2$ mm, 0-160 m)



(Sheridan & Landry, 2004)

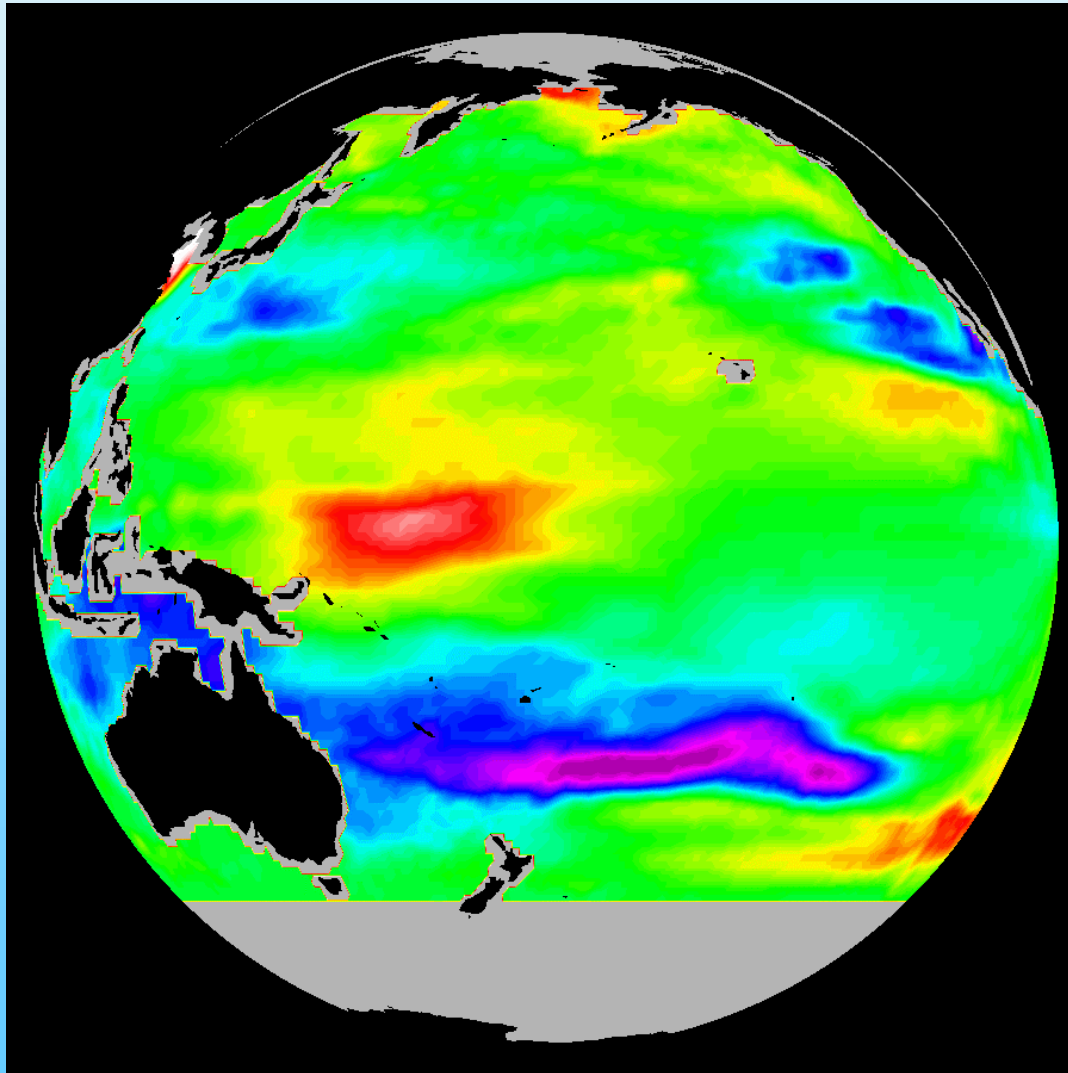
# Bottom-moored ALOHA Sediment Trap (2800m)





# Regional Ocean Model System (ROMS)

## $\Delta$ SSS [(1996-2002) *minus* (1990-1995)]



**Min = -1**

**Max = 1**

*(practical salinity scale)*

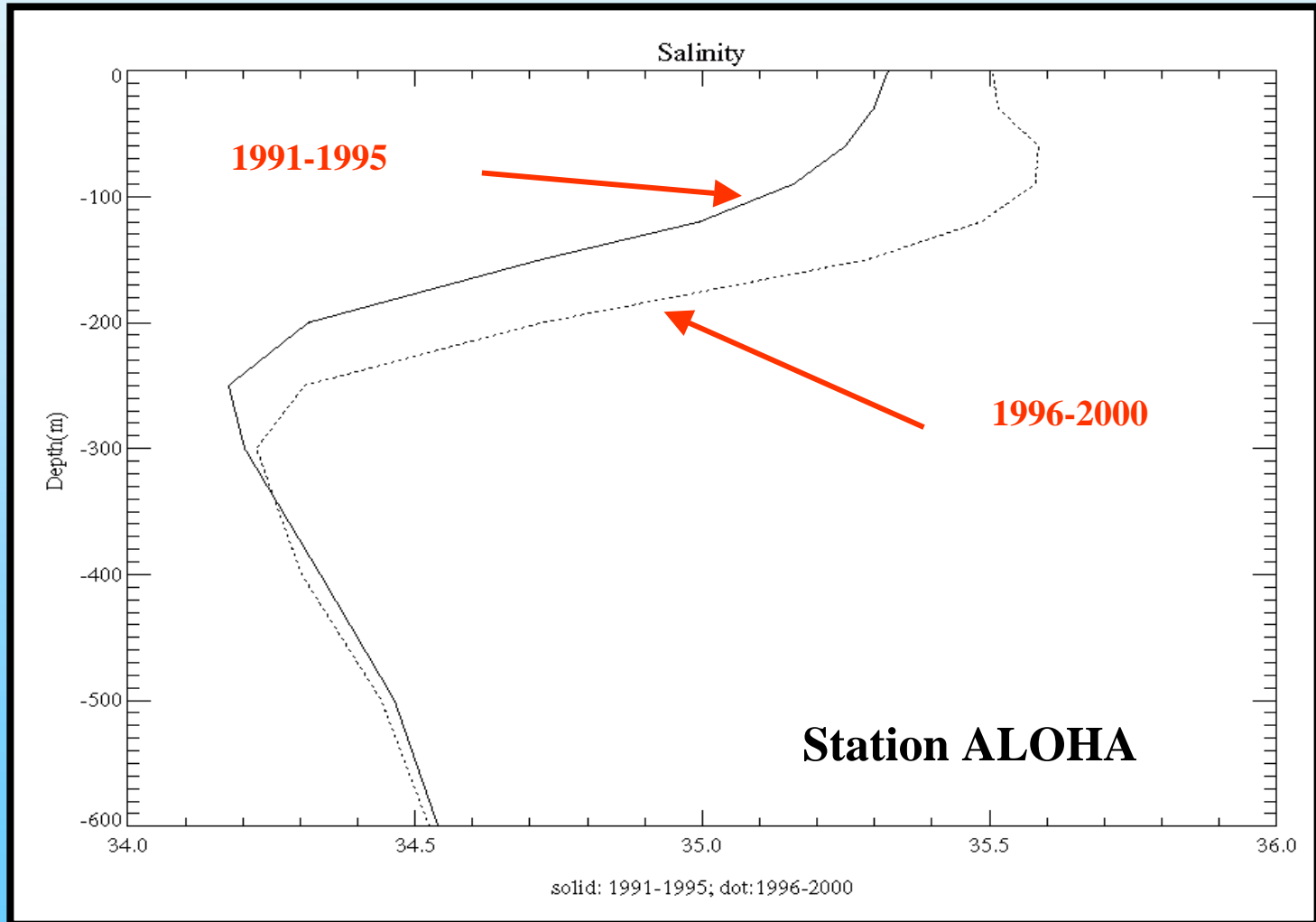
**ROMS:**

**50-km resolution**

**20 vertical layers**

**NCEP daily forcing  
during 1990s**

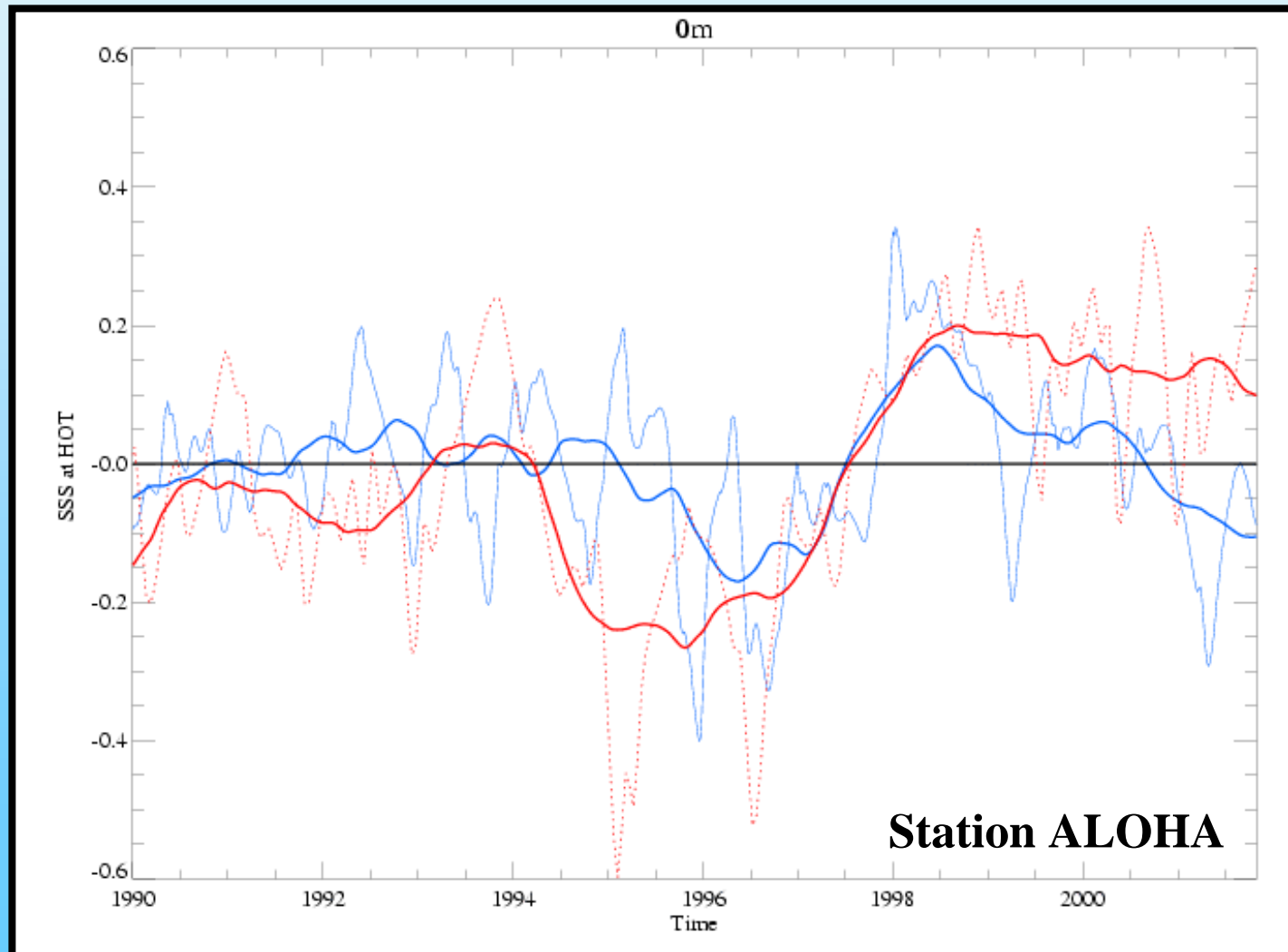
# ROMS Simulation: Salinity



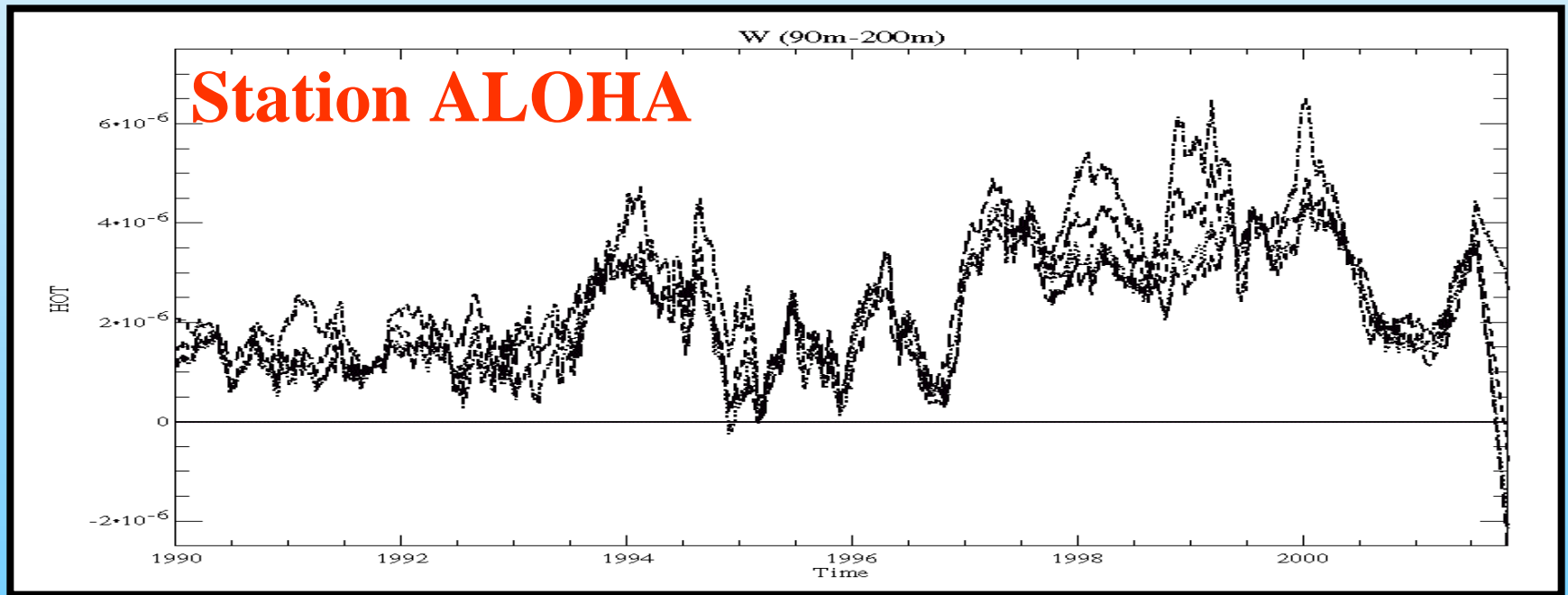


# ROMS Simulation: SSS anomaly

(OBSERVED-red, ROMS-blue)

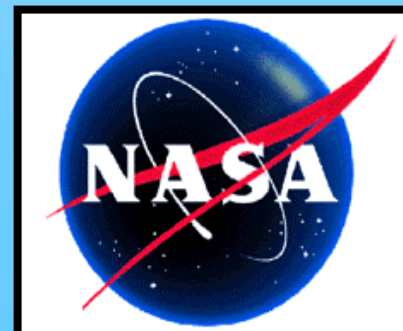


# ROMS Simulation: Vertical velocity

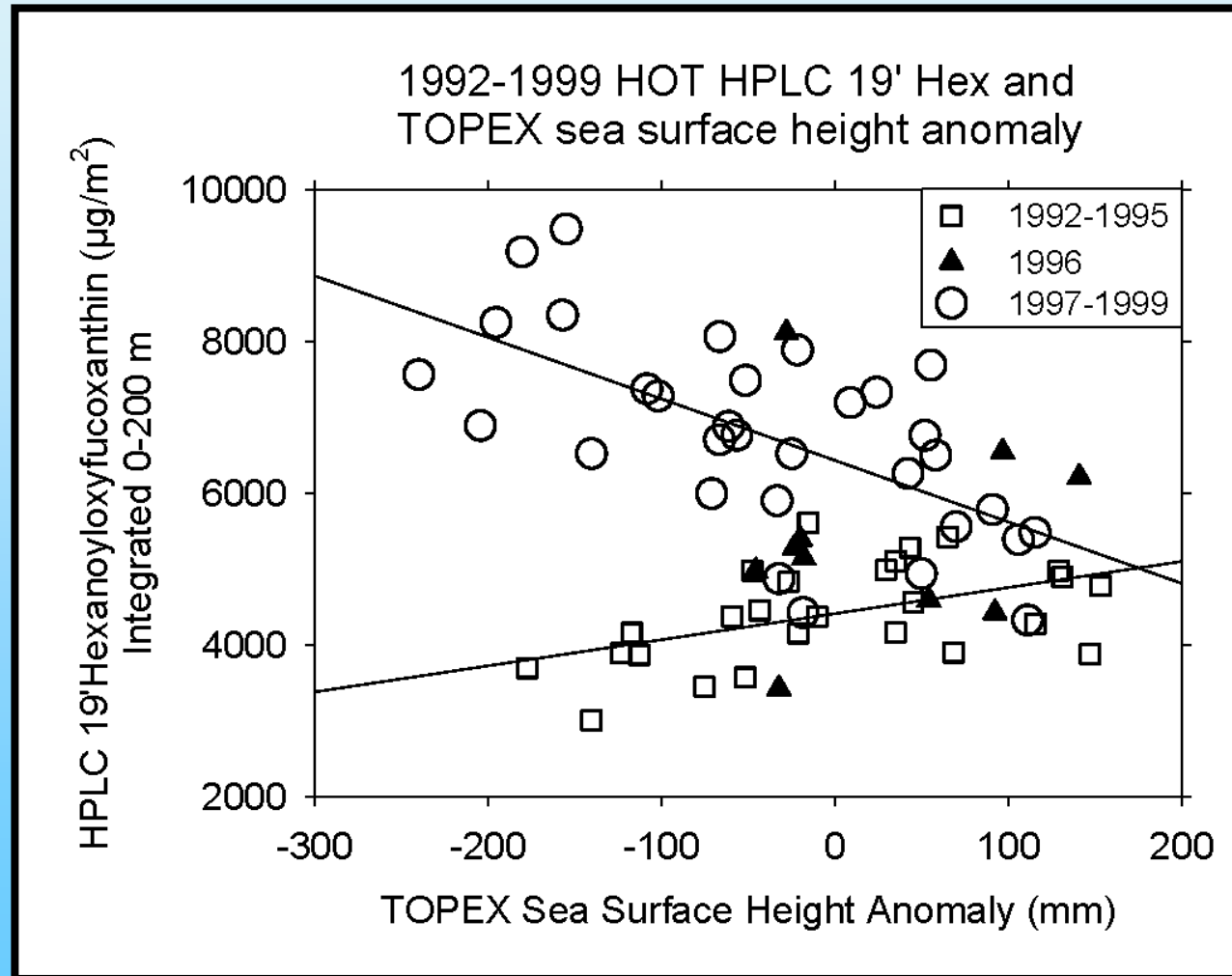


# Summary

- Plankton biomass and biogeochemical fluxes are not in steady-state at Station ALOHA
- High (intra-annual: *eddies and Rossby waves*) and low (decadal: *ENSO/PDO*) frequency variability in phytoplankton community structure (*possible feedback interactions*)
- The carrying capacity of the North Pacific Subtropical Ocean has increased during 1997-2002 (↑ *nutrient entrainment?*)
- Need for high-frequency measurements coupled with high-resolution 3-D circulation/food web models



# Hex-Fuco vs. SLA (1992-1999)



(Sakamoto *et al.*, 2004)