Abstract

During September 2002, Monterey Bay, California, experienced significant hydrographic and biological changes. In mid-September, there was a period of wind relaxation that was followed by the intrusion of a sub-surface salinity minimum layer. The change in water mass also brought about a different phytoplankton assemblage. In this study, the Laser In Situ Scattering Transmissometer (LISST) was implemented and will be discussed for its potential in identifying phytoplankton in situ. Future physical-biological studies in this area would benefit greatly from the addition of the LISST in identifying and quantifying key Harmful Algal Bloom (HAB) species and tracking their fate.

Introduction

Physical-biological coupling is a topic of growing interest in the field of oceanography. As the understanding of marine ecology increases through technological advances and integrated studies, the importance of physical processes in phytoplankton growth and productivity is becoming more apparent.

Phytoplankton are currently receiving an influx of increased attention due to their ability to uptake atmospheric carbon dioxide and, therefore, play a role in influencing global climate (Mann and Lazier 11). A select group of phytoplankton species that are receiving a less favorable wave of interest are those responsible for Harmful Algal Blooms (HABs).

The term "phytoplankton" refers to lifestyle rather than a specific organism. They are free-floating microscopic organisms that have the ability to carry out photosynthesis. In the pelagic environment, nutrients are often the limiting factor in the photosynthetic pathway. When organisms die, they sink to the seafloor and the nutrients that become liberated are located deep in the ocean, far away from euphotic zone. Therefore, it is necessary that these nutrients be brought back into the surface waters, where they can be used by the phytoplankton to grow and reproduce.

Upwelling is the process that is often responsible for bringing nutrients from the seafloor to the surface. Coastal upwelling occurs when winds are blowing parallel to the shoreline. Due to the rotation of the Earth, the Coriolis Force moves the water offshore, a process known as Ekman Transport. Deep, often nutrient-rich waters, then rise to the surface to replace the displaced water mass.

Located on the West Coast of California, Monterey Bay serves as a unique site for the study of physical processes, oceanographic fluctuations, coastal upwelling, and the subsequent impact these have on phytoplankton production. The circulation of Monterey Bay is highly influenced by the adjacent sea due to its close proximity to the California Current. The Bay is also unique in that it also serves as home to the Monterey Submarine Canyon, whose dimensions are roughly equivalent to those of the Grand Canyon. All of these factors contribute to the frequent upwelling seen in the Bay, which results in the high productivity seen in the region.

Historically, the Monterey Bay region has been divided into three, not necessarily consecutive seasons. The 'upwelling period' takes place from mid-February to mid-

November. The ‘oceanic period’ occurs from mid-August to mid-October. And the winter months of December through mid-February constitute the “Davidson Current Period.”

Figure 1

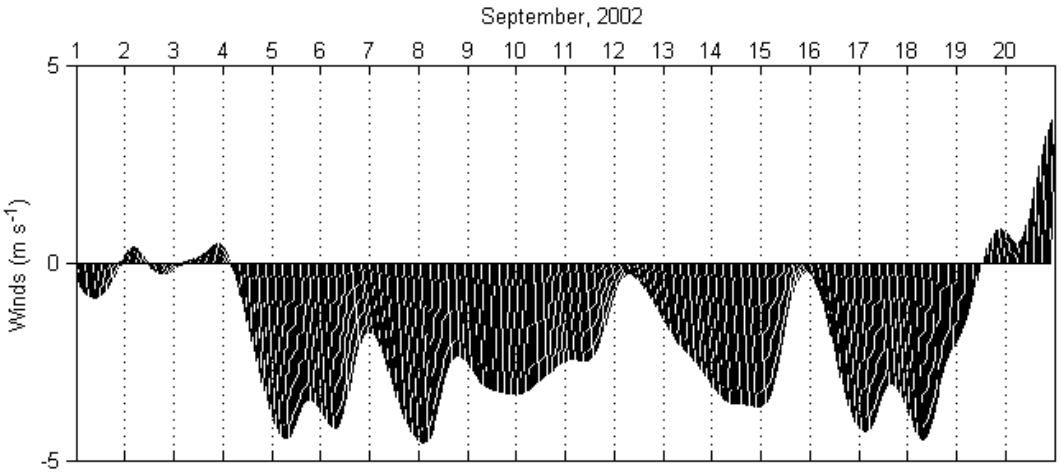

September, 2002
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
5
0
-5
Winds (m s-1)

Figure 2

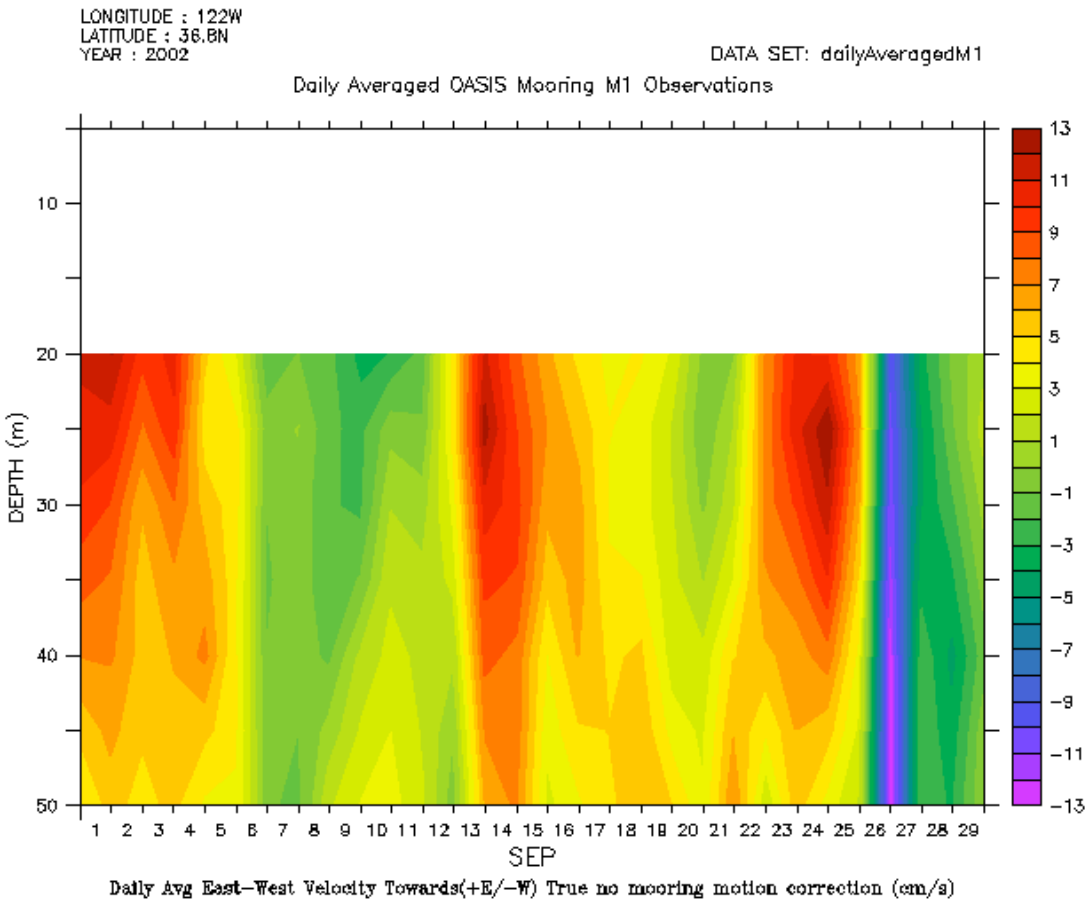
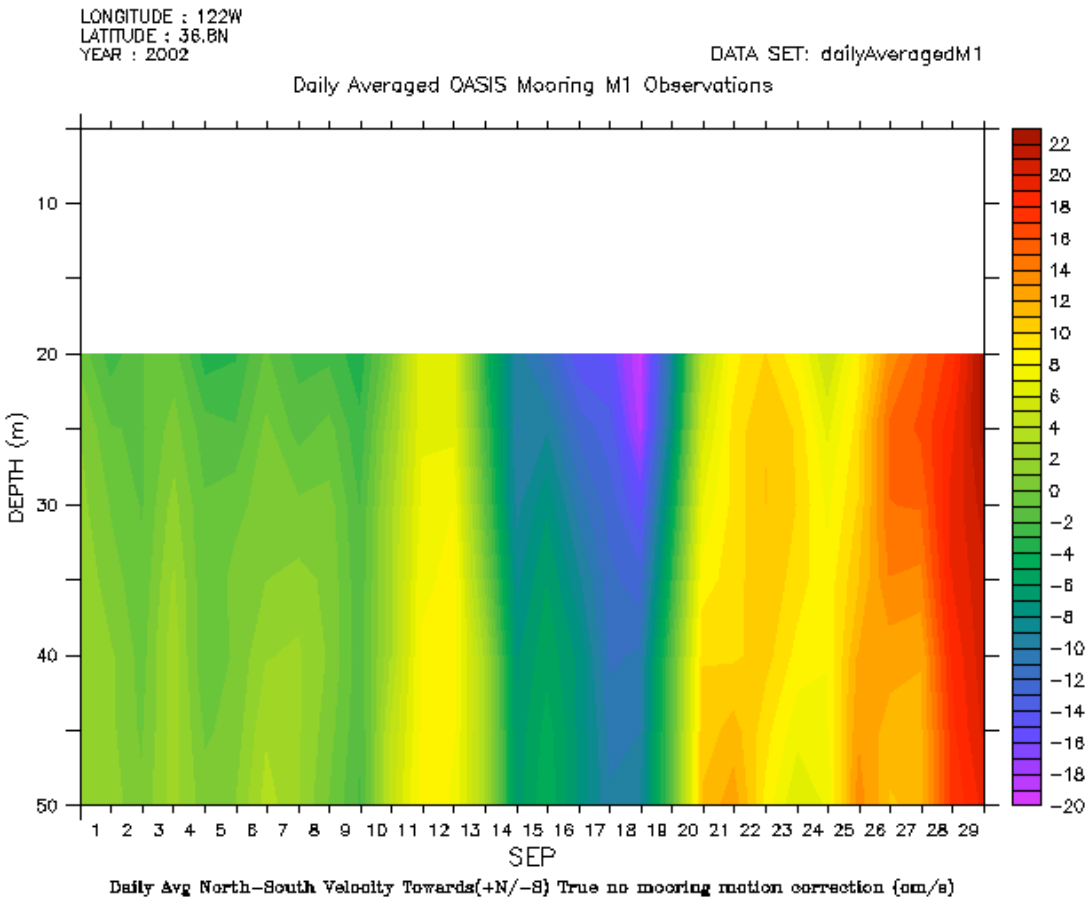

LONGITUDE : 122W
LATITUDE : 36.8N
YEAR : 2002
DATA SET: dailyAveragedM1
Daily Averaged OASIS Mooring M1 Observations
DEPTH (m)
10
20
30
40
50
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
SEP
13
11
9
7
5
3
1
−1
−3
−5
−7
−9
−11
−13
Daily Avg East−West Velocity Towards(+E/−W) True no mooring motion correction (cm/s)

Figure 3


LONGITUDE : 122W
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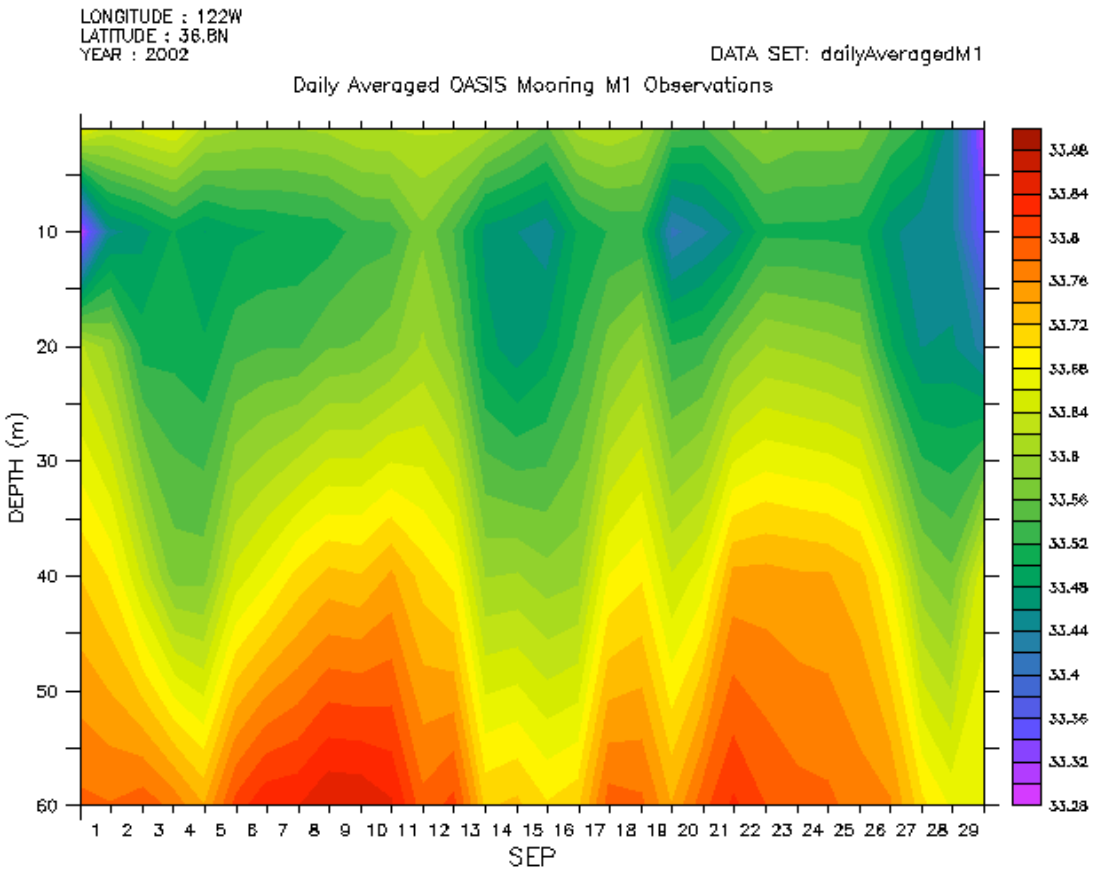
DATA SET: dailyAveragedM1
Daily Averaged OASIS Mooring M1 Observations
DEPTH (m)
10
20
30
40
50
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29
SEP
22
20
18
16
14
12
10
8
6
4
2
0
−2
−4
−6
−8
−10
−12
−14
−16
−18
−20
Daily Avg North−South Velocity Towards(+N/−S) True no mooring motion correction (cm/s)

Figure 4



Daily Avg Salinity

Figure 5

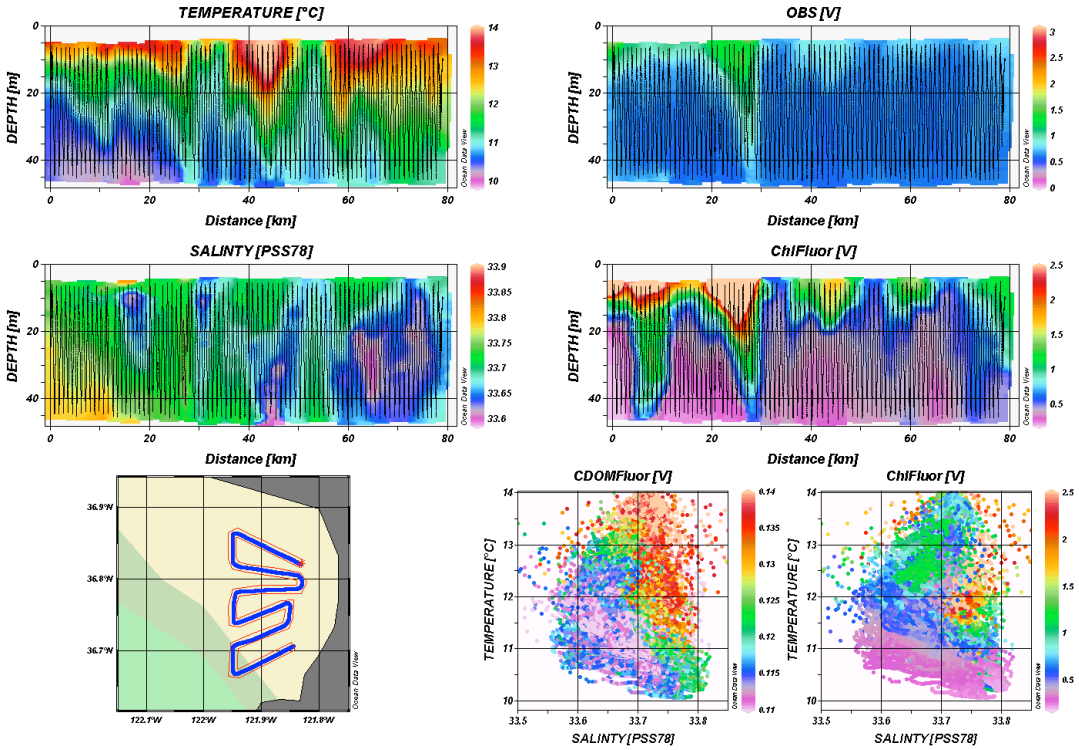

TEMPERATURE [°C]
OBS [V]
SALINTY [PSS78]
ChlFluor [V]
DEPTH [m]
Distance [km]
CDOMFluor [V]
TEMPERATURE [°C]
SALINTY [PSS78]
36.9°N
36.8°N
36.7°N
122.1°W
122°W
121.9°W
121.8°W
Ocean Data View

Figure 6

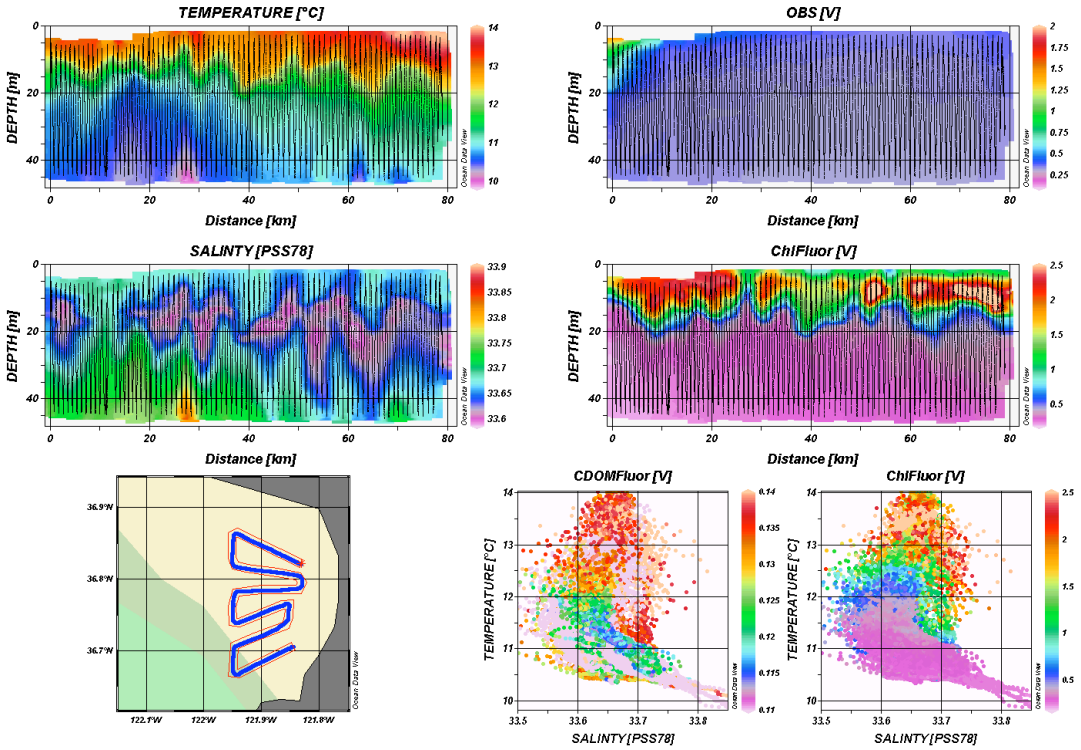

TEMPERATURE [°C]
OBS [V]
SALINITY [PSS78]
ChlFluor [V]
DEPTH [m]
Distance [km]
CDOMFluor [V]
TEMPERATURE [°C]
SALINITY [PSS78]
Ocean Data View

Figure 8

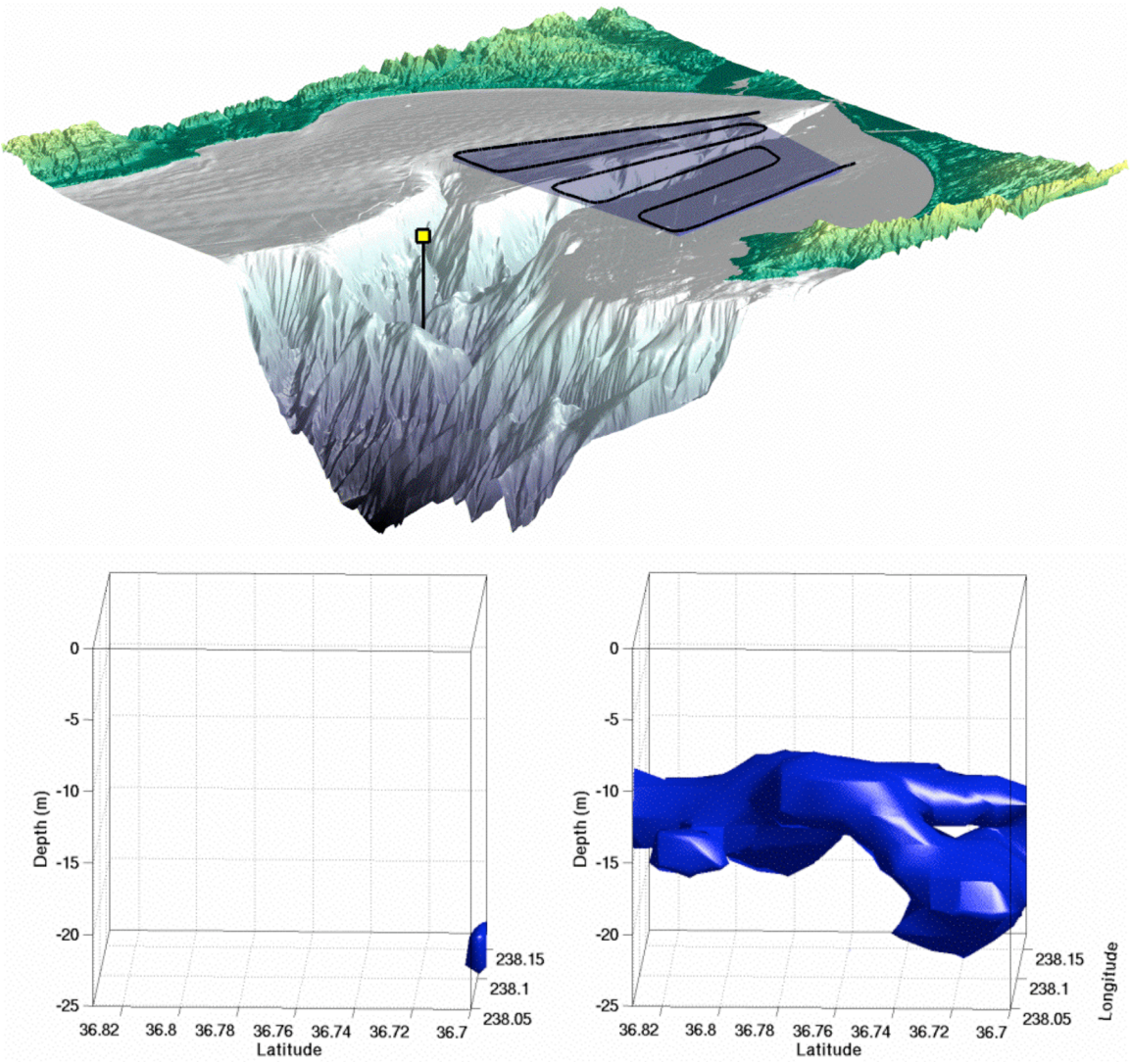

0
-5
-10
-15
-20
-25
Depth (m)
36.82
36.8
36.78
36.76
36.74
36.72
36.7
Latitude
238.15
238.1
238.05
Longitude

Figure 9

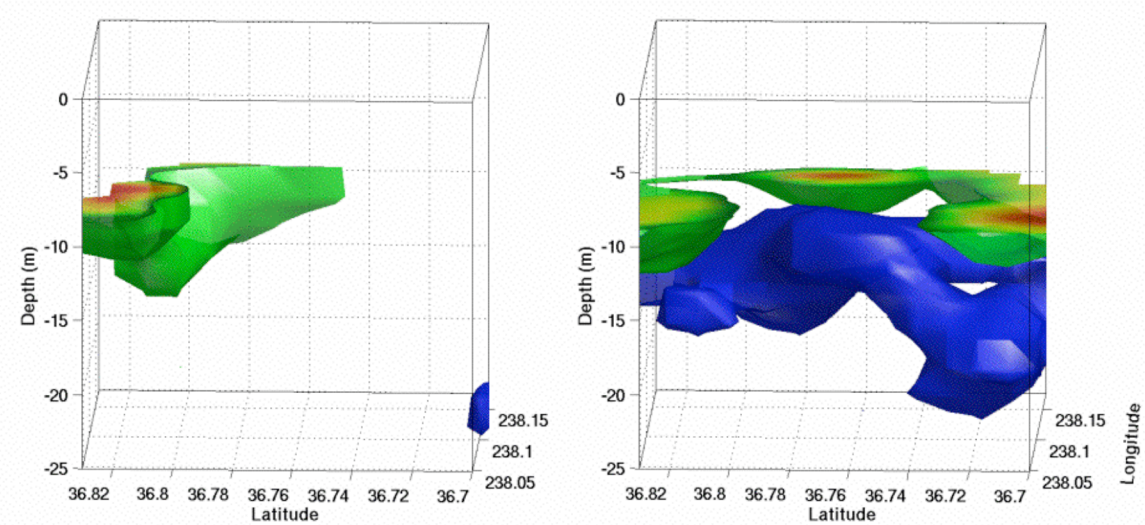

0
-5
-10
-15
-20
-25
Depth (m)
36.82
36.8
36.78
36.76
36.74
36.72
36.7
Latitude
238.15
238.1
238.05
Longitude

Figure 10

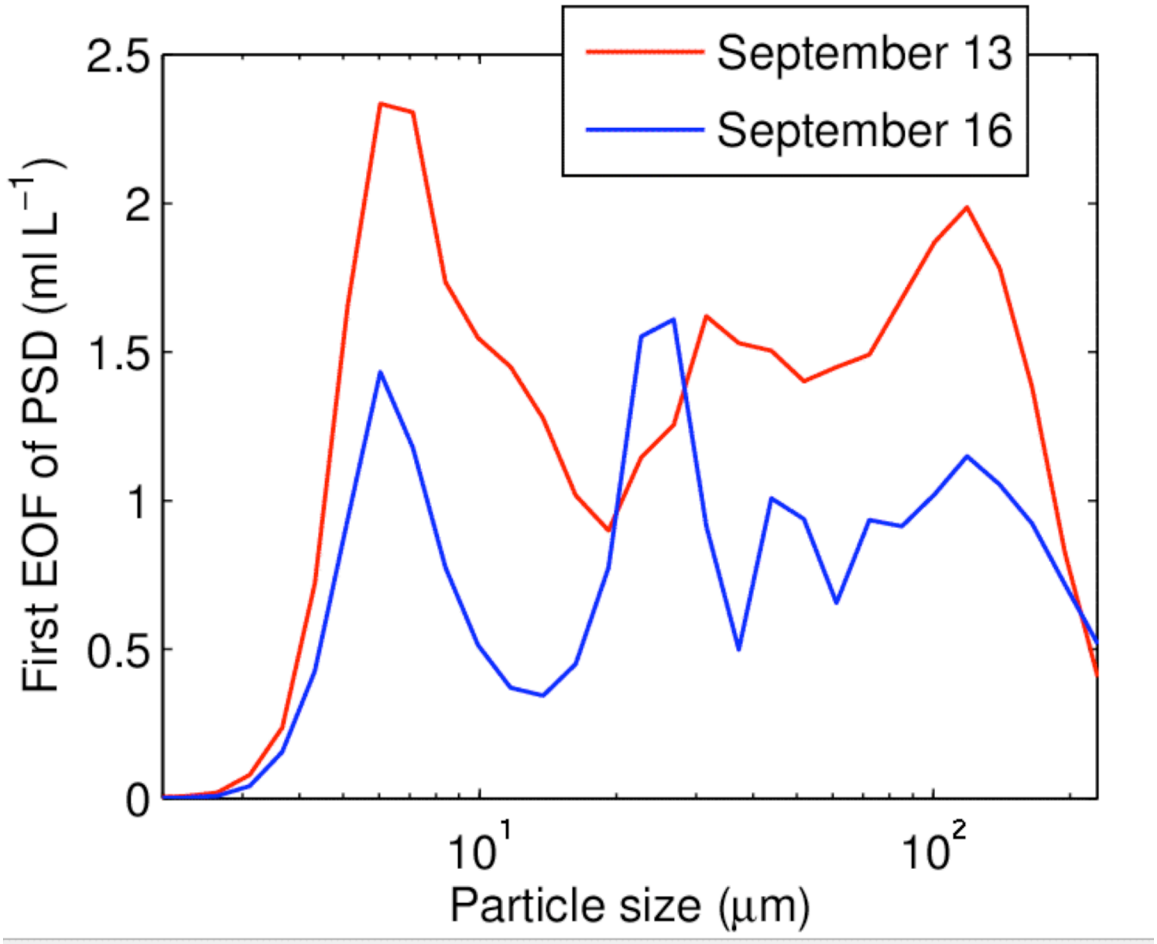

September 13
September 16
2.5
2
1.5
1
0.5
0
First EOF of PSD (ml L^{-1})
10^1
10^2
Particle size (μm)

Figure 11

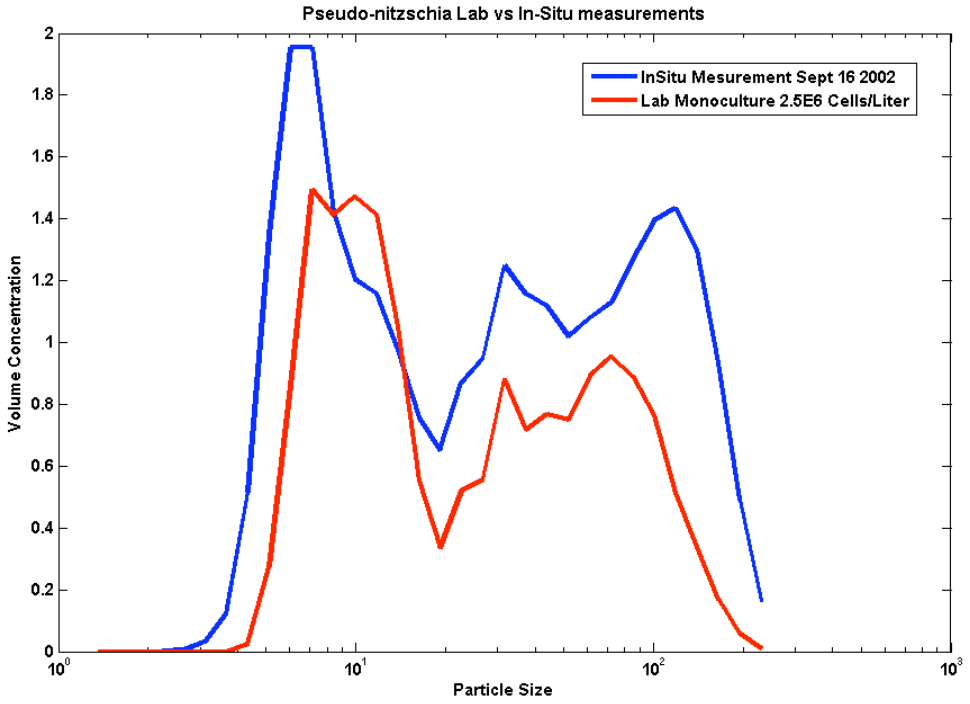
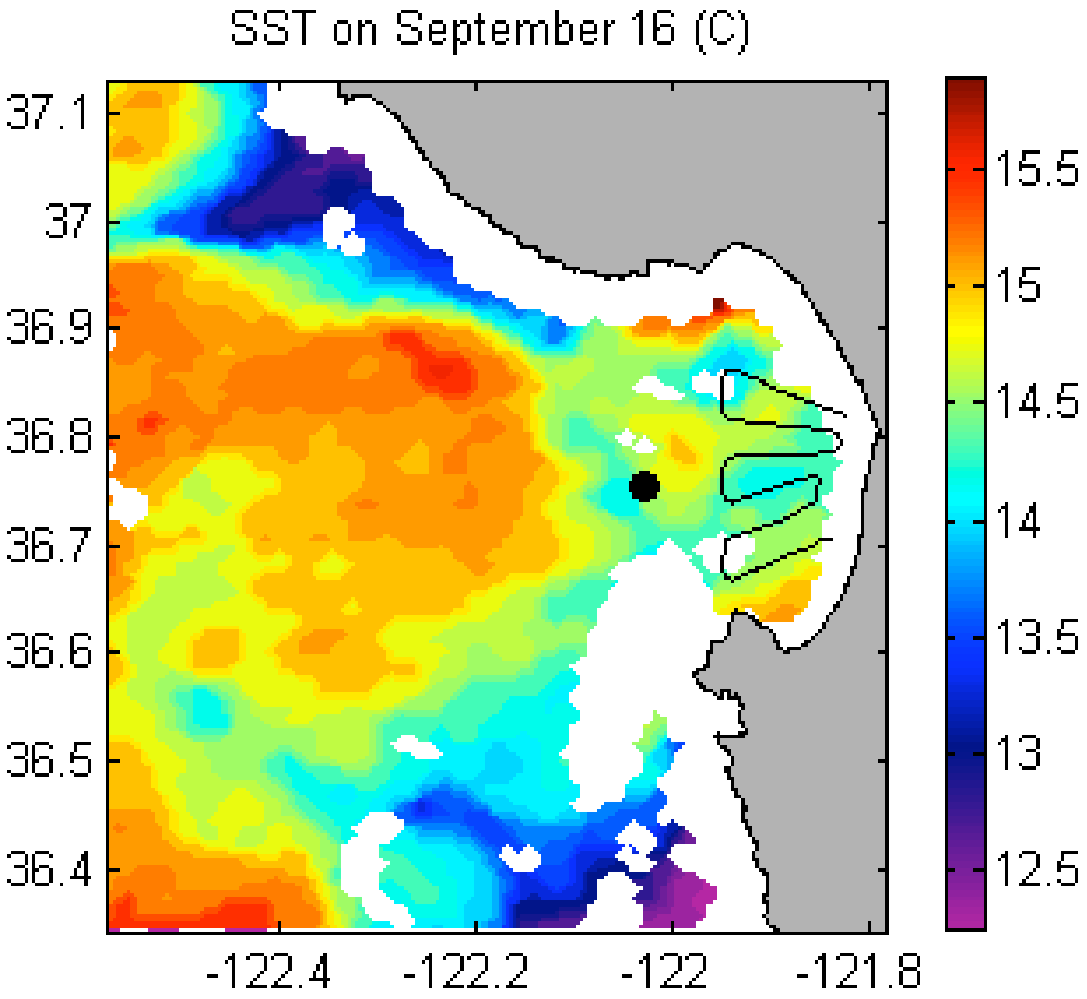

Pseudo-nitzschia Lab vs In-Situ measurements
InSitu Mesurement Sept 16 2002
Lab Monoculture 2.5E6 Cells/Liter
Volume Concentration
Particle Size
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
10^0
10^1
10^2
10^3

Figure 12


SST on September 16 (C)
37.1
37
36.9
36.8
36.7
36.6
36.5
36.4
-122.4
-122.2
-122
-121.8
15.5
15
14.5
14
13.5
13
12.5