Supplemental Coastal Observations and Monitoring in South Bay San Diego

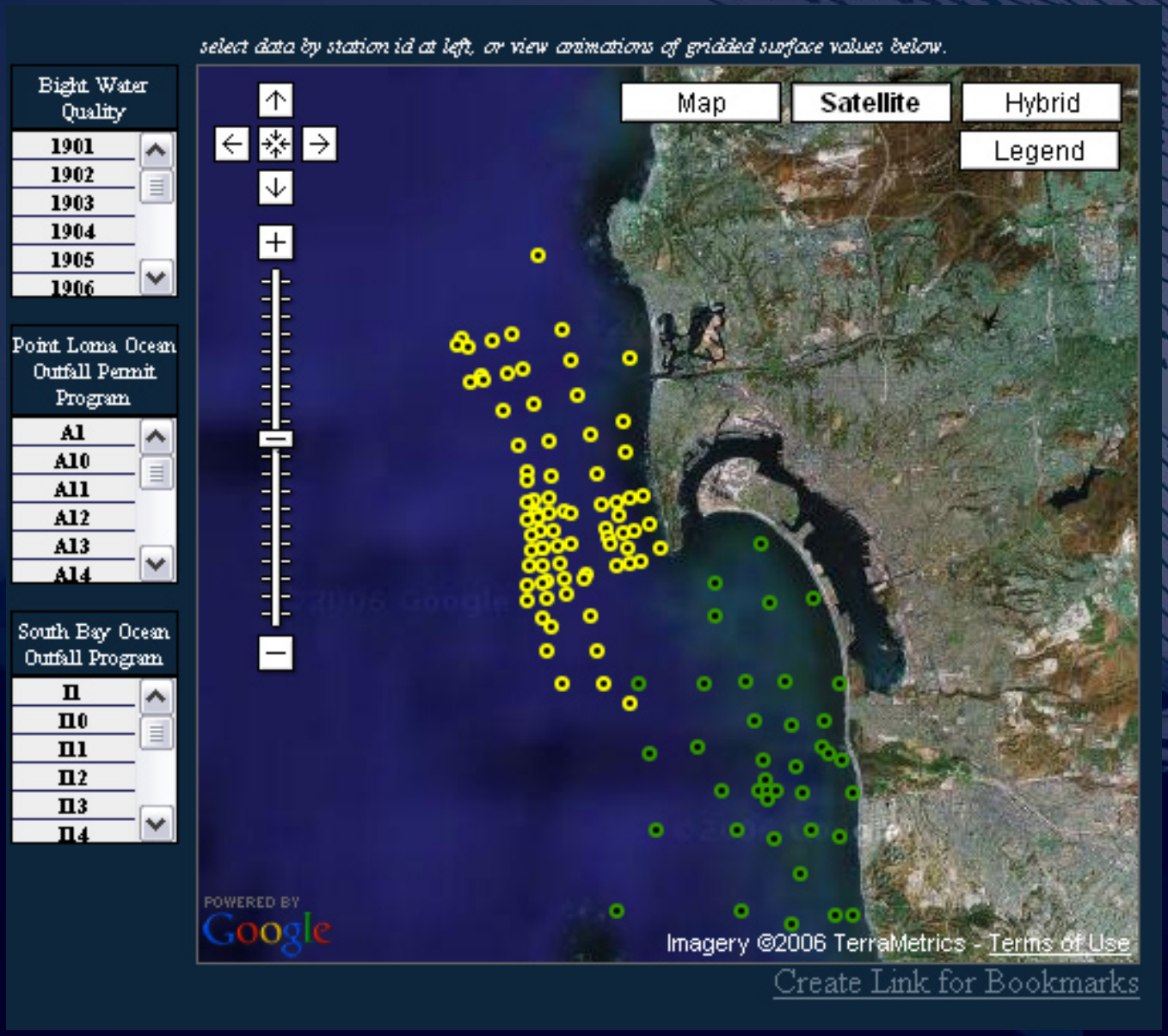
IBWC / Surfrider Consent Decree

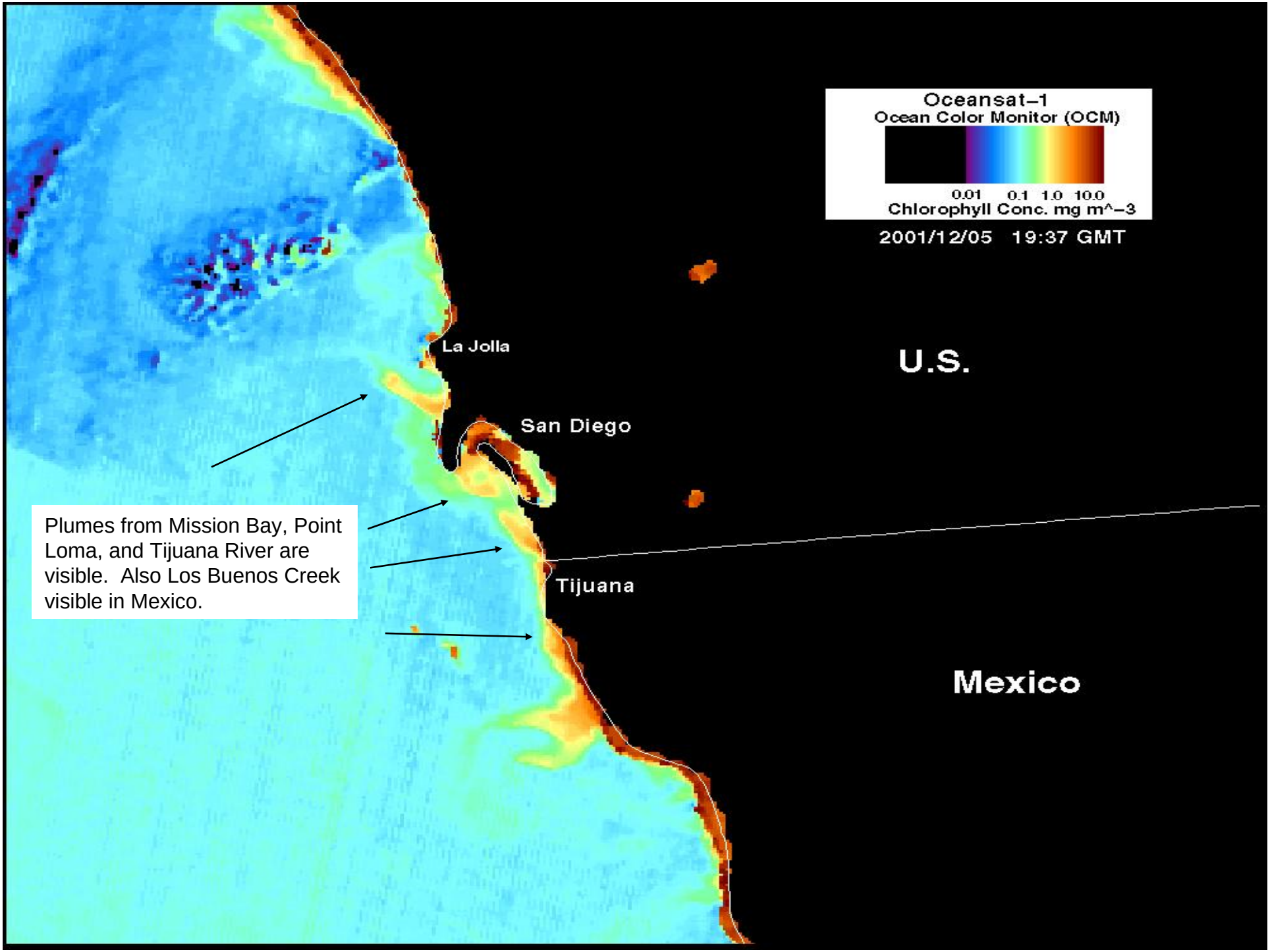
Eric Terrill, Scripps Institution of Oceanography

Burton Jones, University of Southern California

Richard Pyle, CH2MHILL

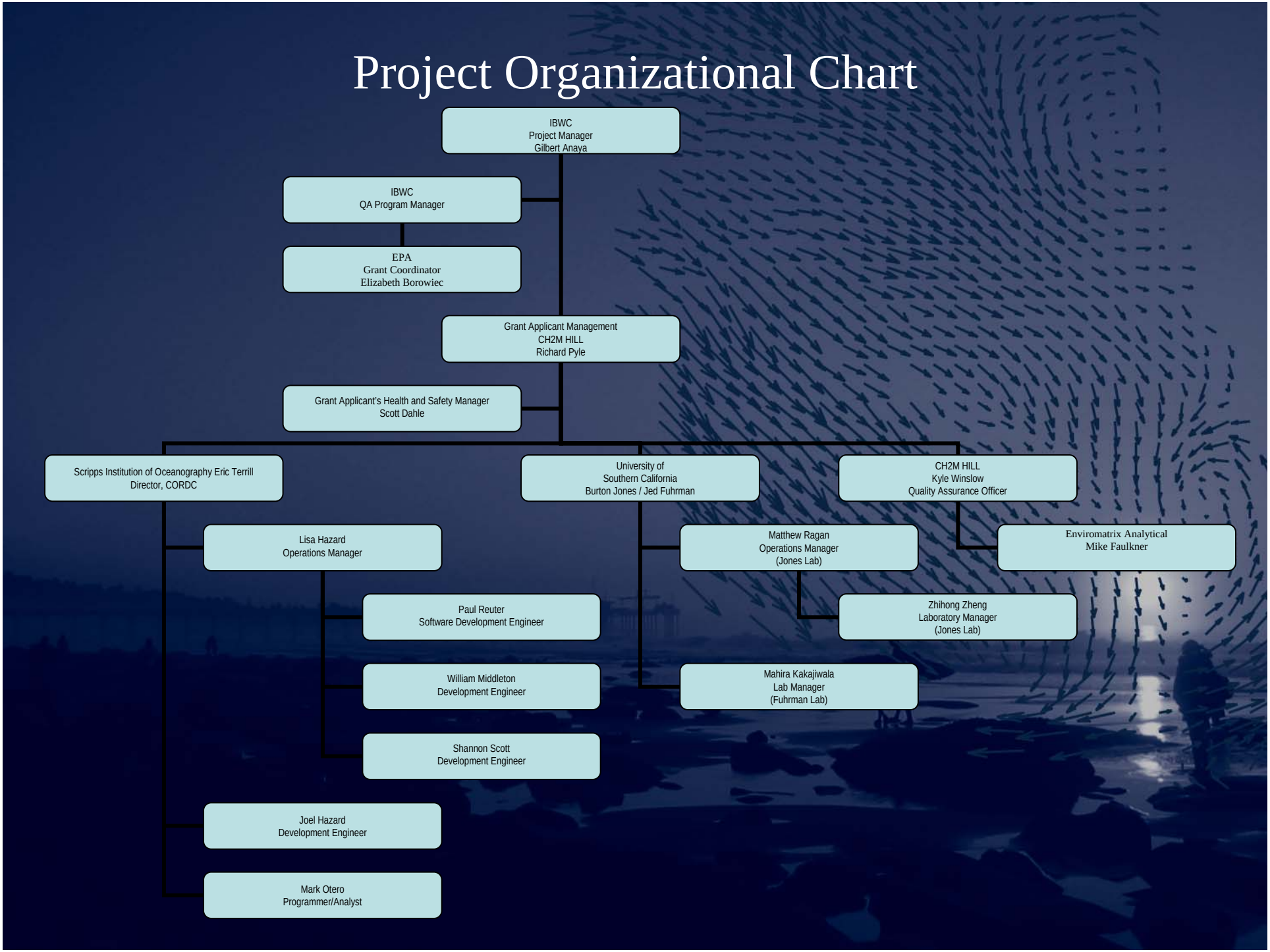
Existing Sampling Stations for both SBOO and PLOO




Oceansat–1
Ocean Color Monitor (OCM)
0.01 0.1 1.0 10.0
Chlorophyll Conc. mg m^–3
2001/12/05 19:37 GMT
La Jolla
San Diego
U.S.
Tijuana
Mexico
Plumes from Mission Bay, Point Loma, and Tijuana River are visible. Also Los Buenos Creek visible in Mexico.

Imperial Beach Region

Project Organizational Chart

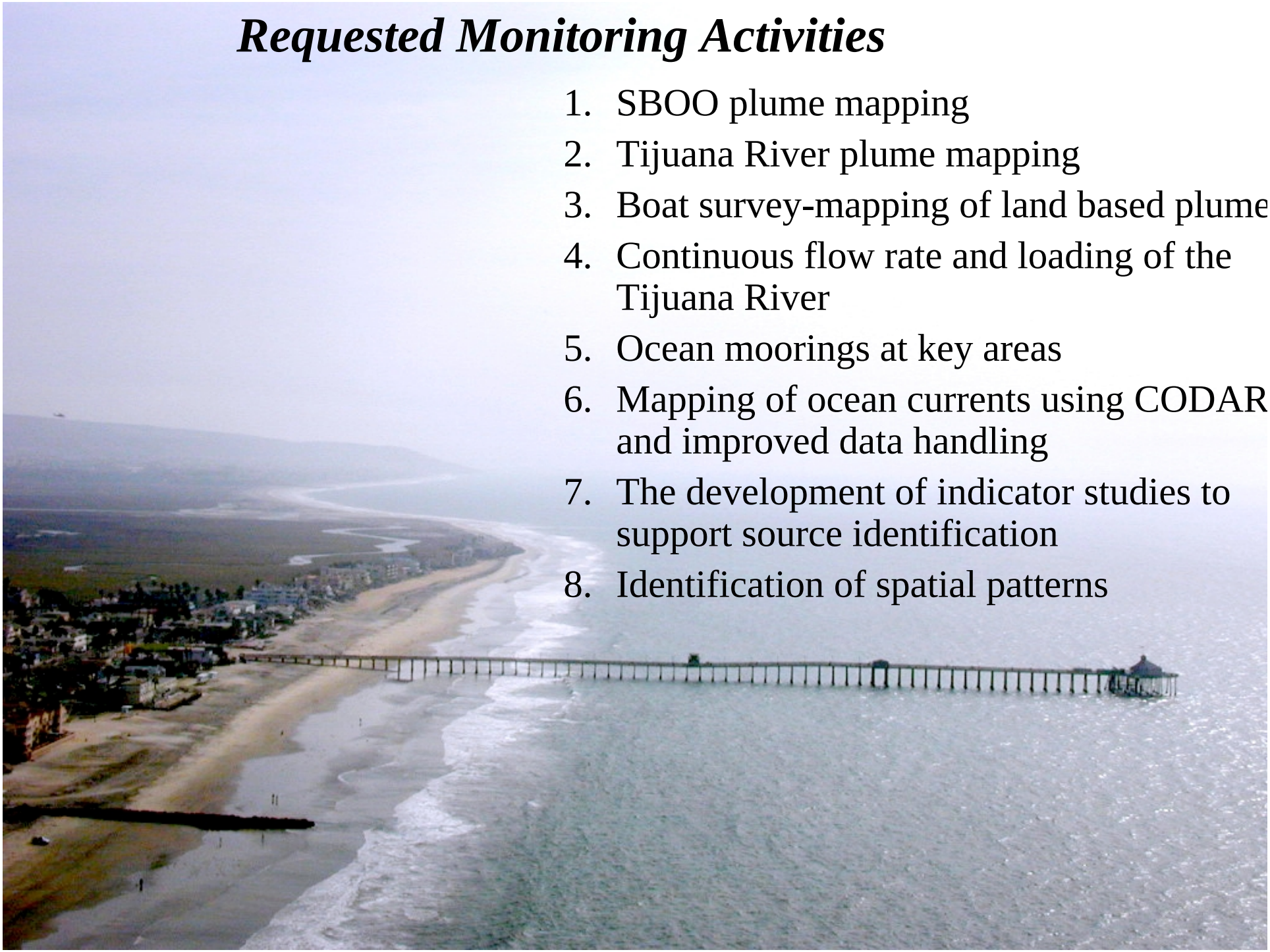


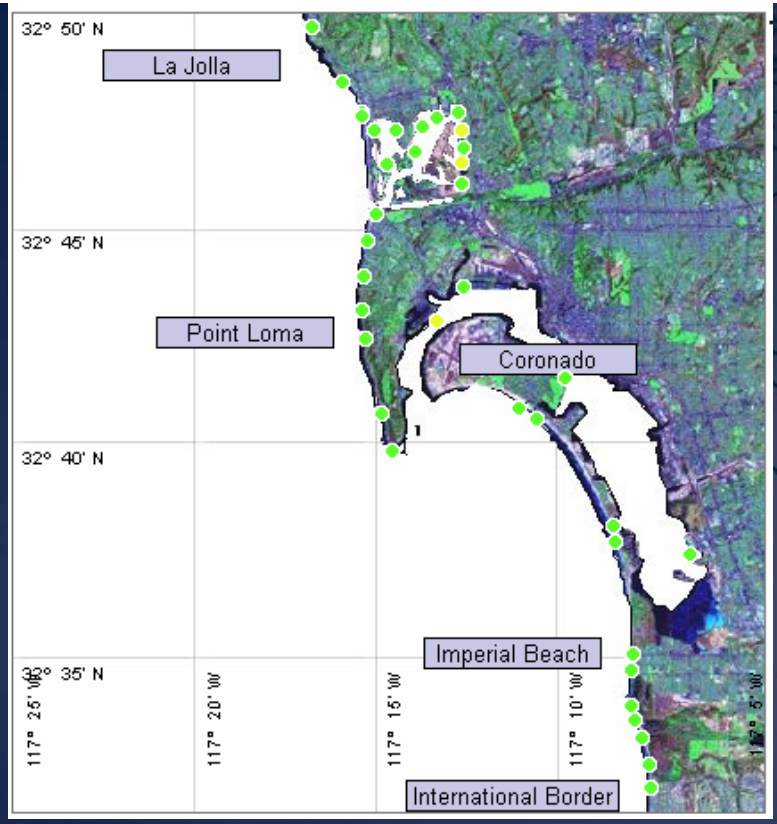
Coastal Observations and Monitoring in South Bay San Diego GOALS

- A) Identify and track plumes from the South Bay Ocean Outfall (SBOO)
- B) Characterize land based sources with focus on the Tijuana River
- C) Identify the regional oceanographic conditions which lead to high fecal indicator bacteria (FIB) on the South Bay Beaches:

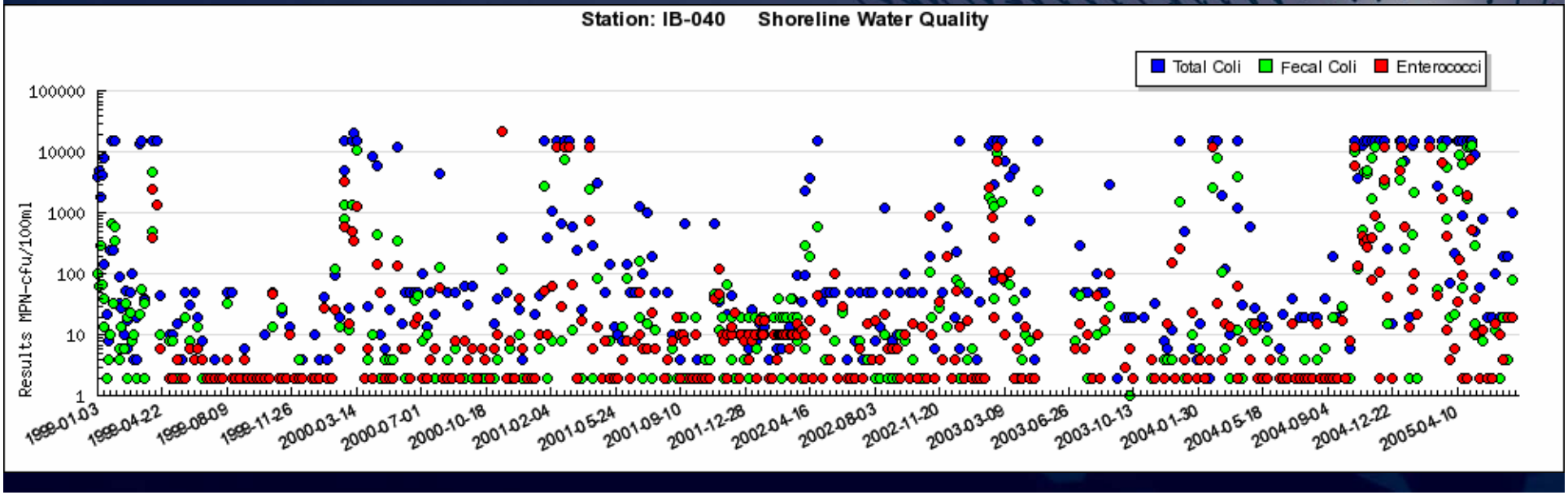
Requested Monitoring Activities

1. SBOO plume mapping
2. Tijuana River plume mapping
3. Boat survey-mapping of land based plume
4. Continuous flow rate and loading of the Tijuana River
5. Ocean moorings at key areas
6. Mapping of ocean currents using CODAR and improved data handling
7. The development of indicator studies to support source identification
8. Identification of spatial patterns

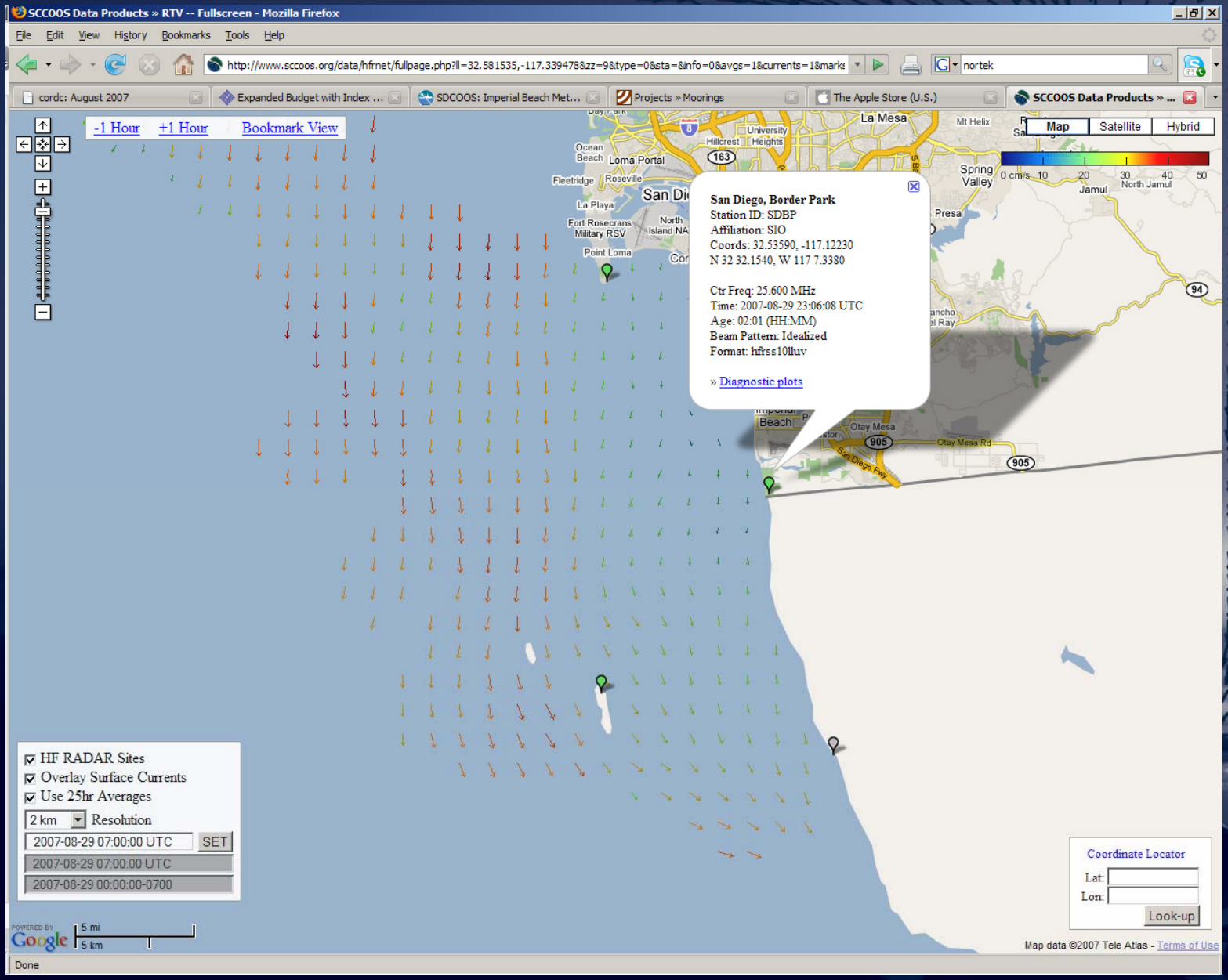




Significant variability exists in the water quality of the region. SDCOOS goals to explain how the environment impacts this variability.



Surface Current Mapping System Data Display



BORDER FIELD STATE PARK
Surface Current Mapping System

CORONADO ISLAND
Surface Current Mapping System

Solar and wind powered system

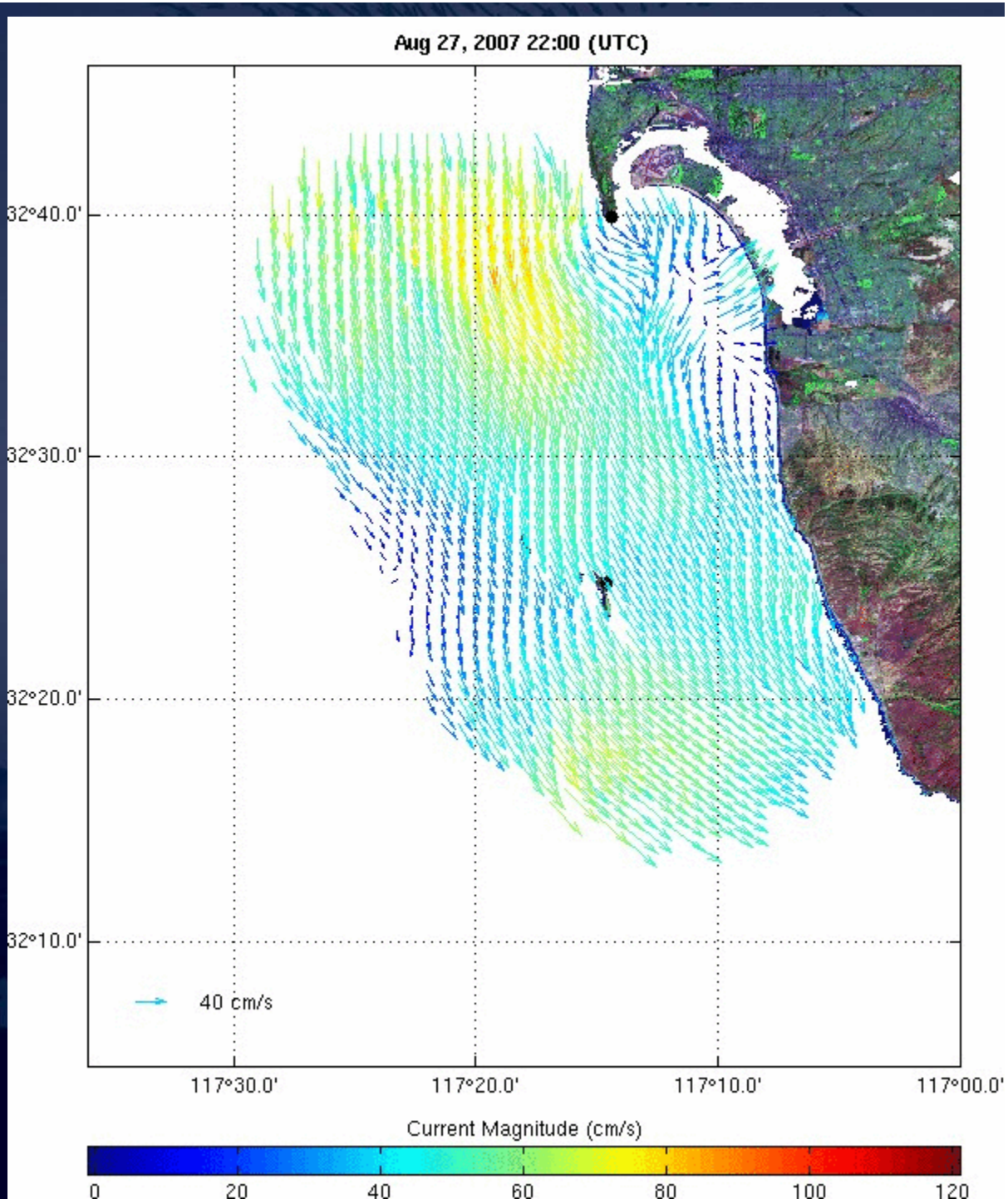
Meteorological Station

Wireless communications

Wind generator

Surface Current Mapping System Data Display

today ~ noon



particle trajectory tracking

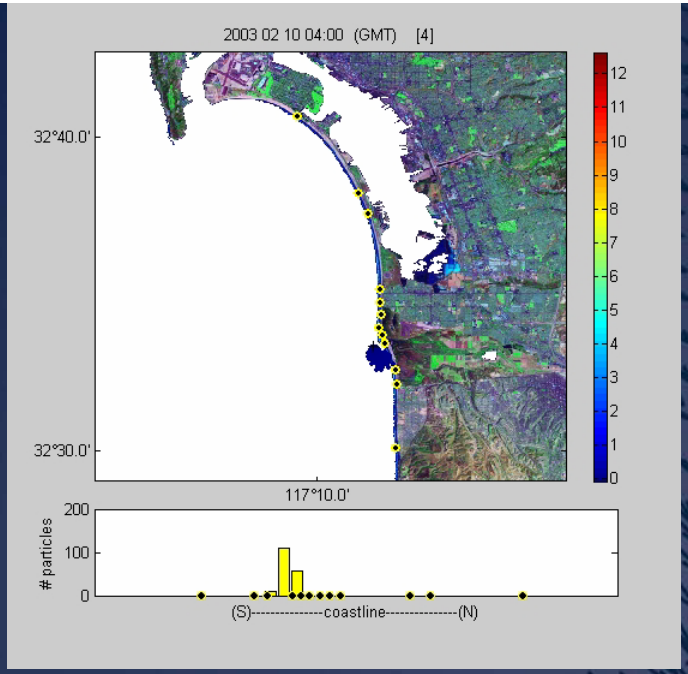
$$\begin{aligned} \mathbf{u}(\mathbf{x},t) &= \mathbf{u}(\mathbf{x},t) + u\cos\theta \\ \mathbf{v}(\mathbf{x},t) &= \mathbf{v}(\mathbf{x},t) + u\sin\theta \end{aligned}$$

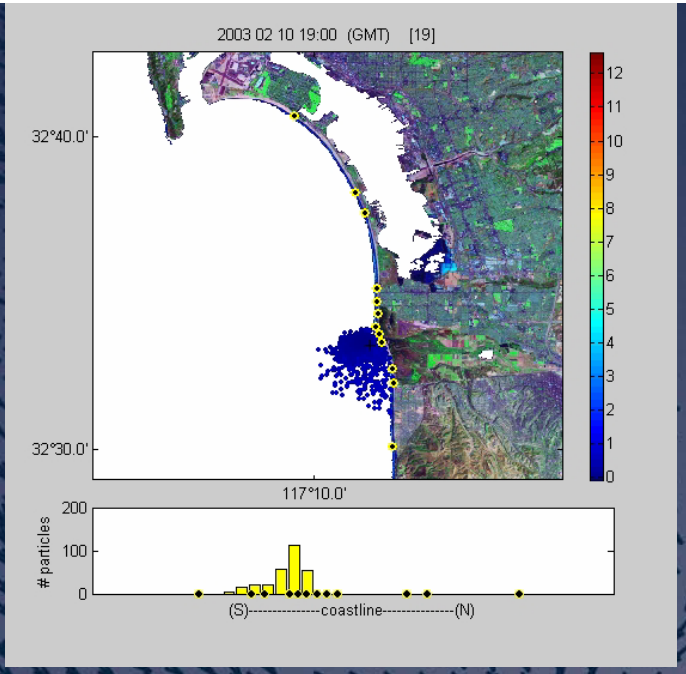
u : perturbation velocity$(= 5cm/s)$
θ : random angle.

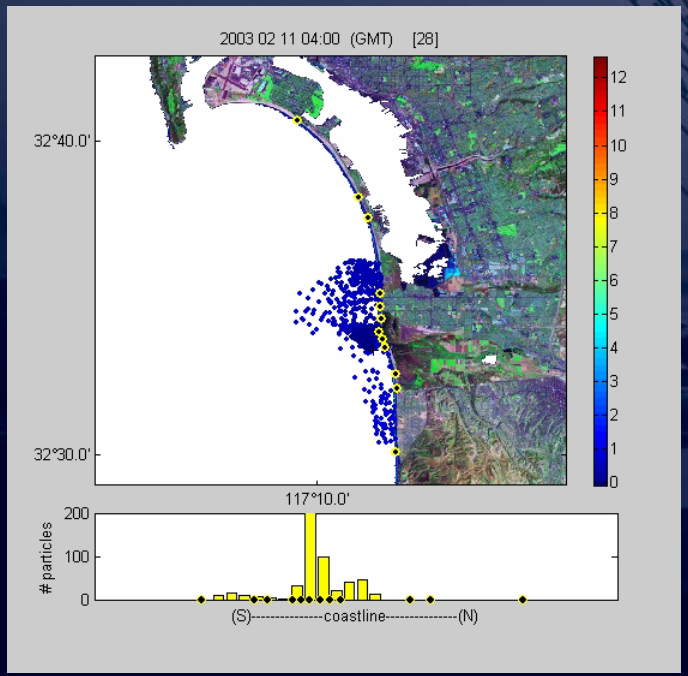
- Tijuana River Release
- SBOO surface release

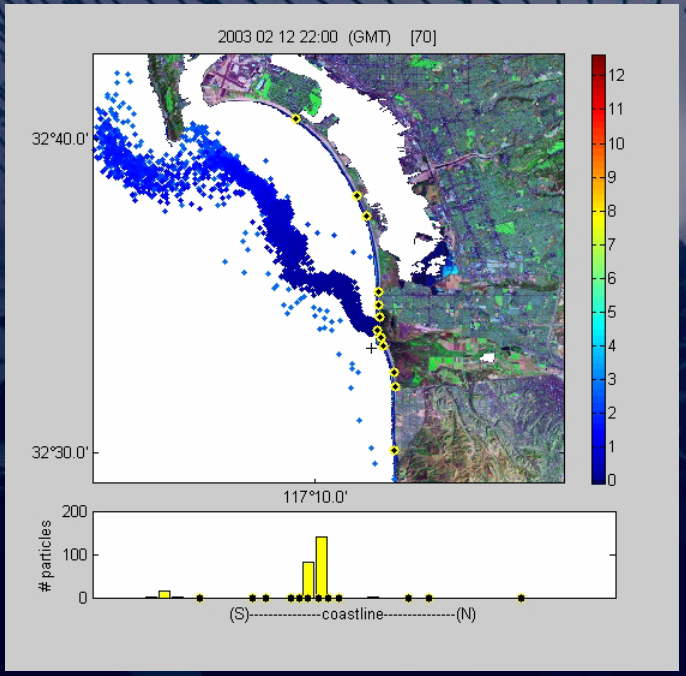
Graduate student Sung Yong Kim

Random walk Models using Objectively Mapped HF radar Data fields – data used to understand beach closures



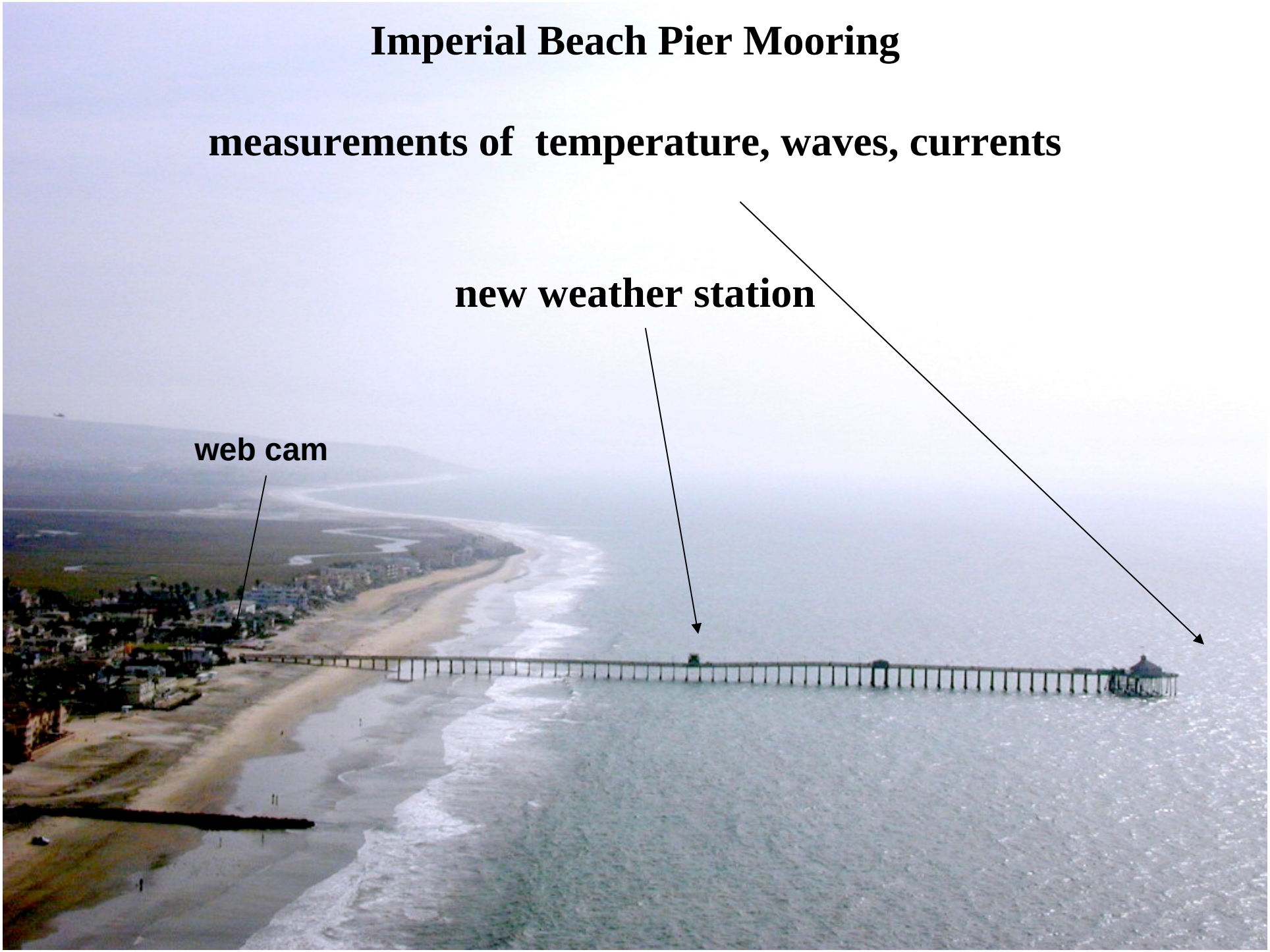






Imperial Beach Pier Mooring

measurements of temperature, waves, currents



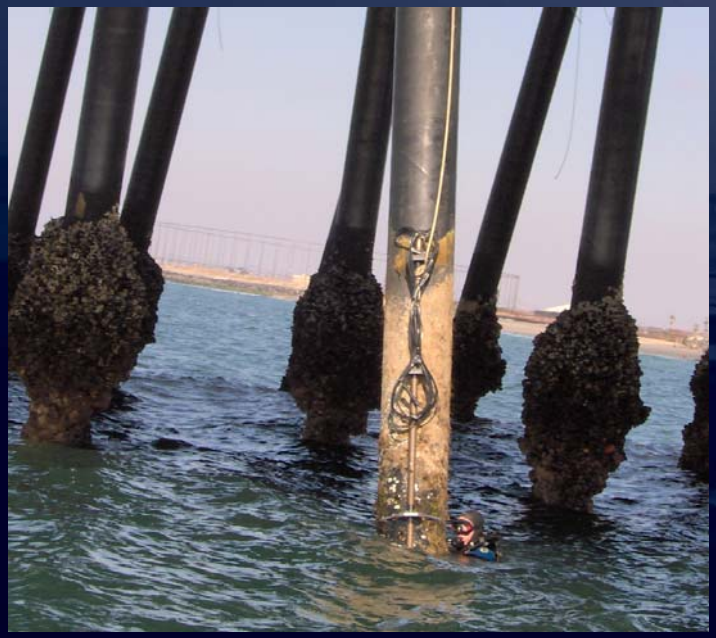
cable run 100 yards offshore


NG SERVICES

Imperial Beach Pier Mooring

Imperial Beach Pier

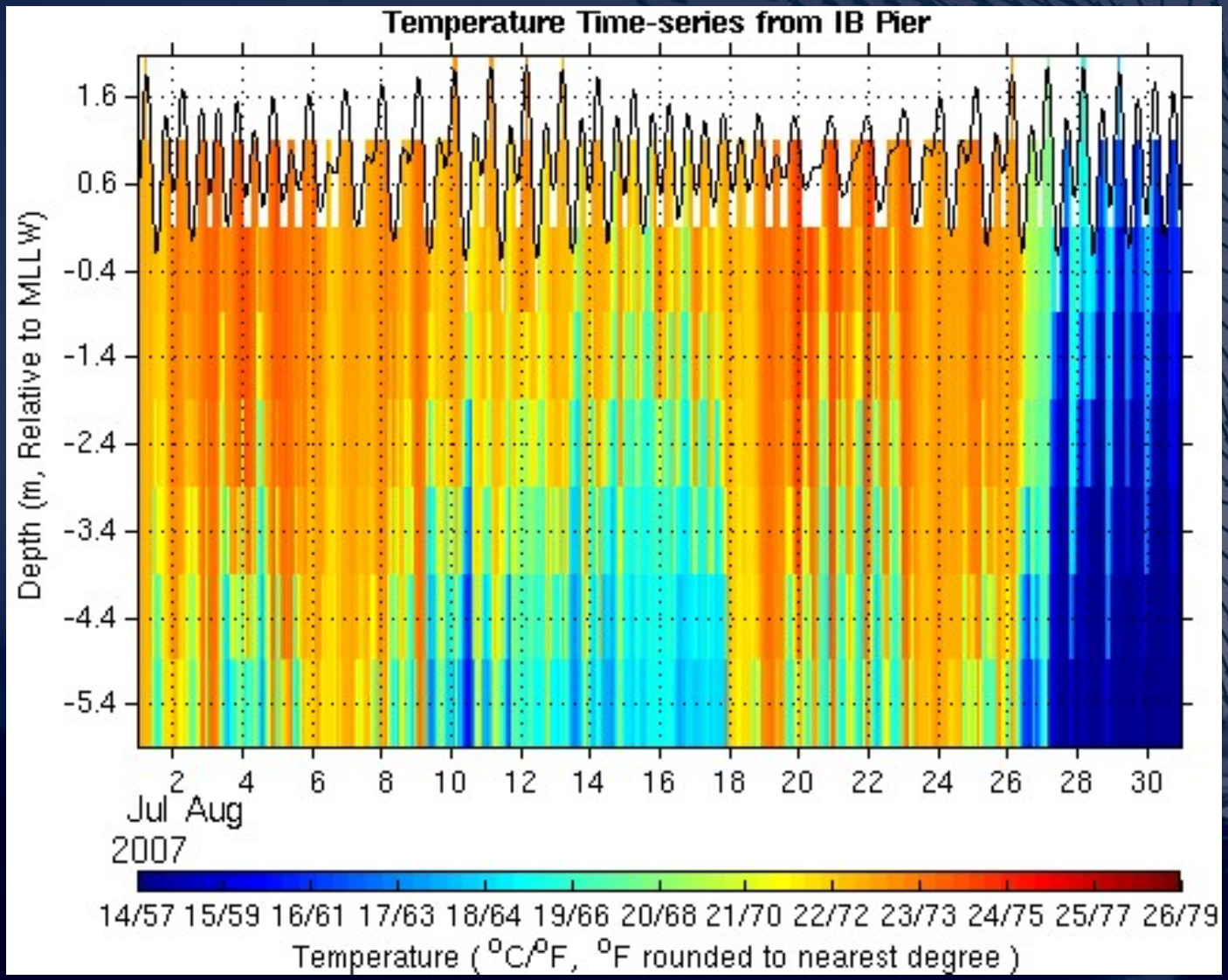
AWAC – Waves and Profiled Currents



Temperature Chain

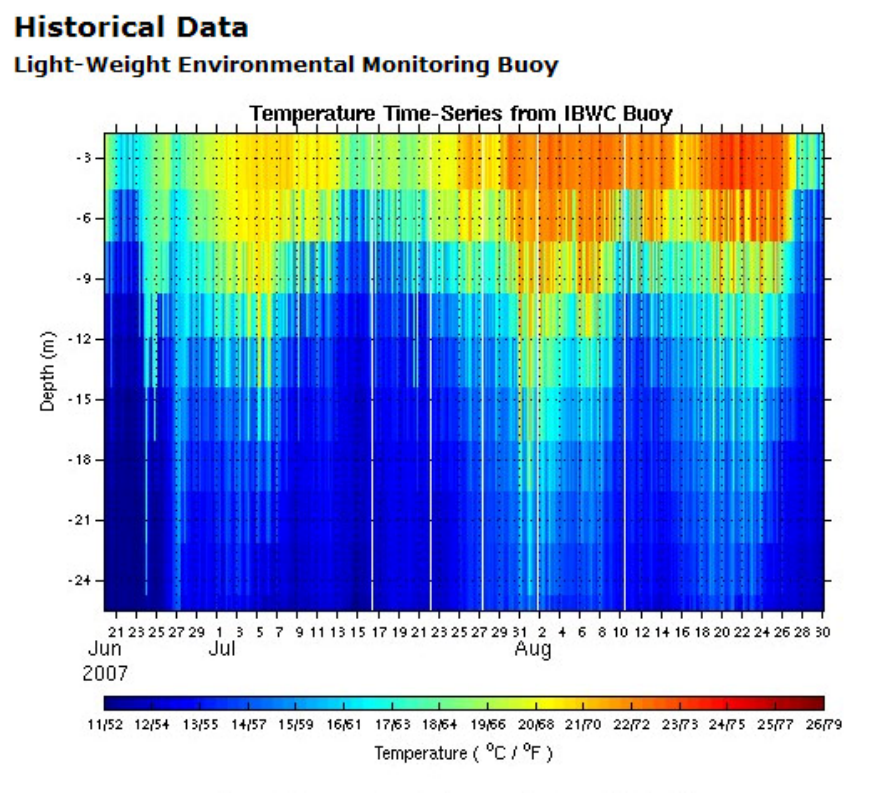
Data Acquisition System

Imperial Beach Pier Mooring

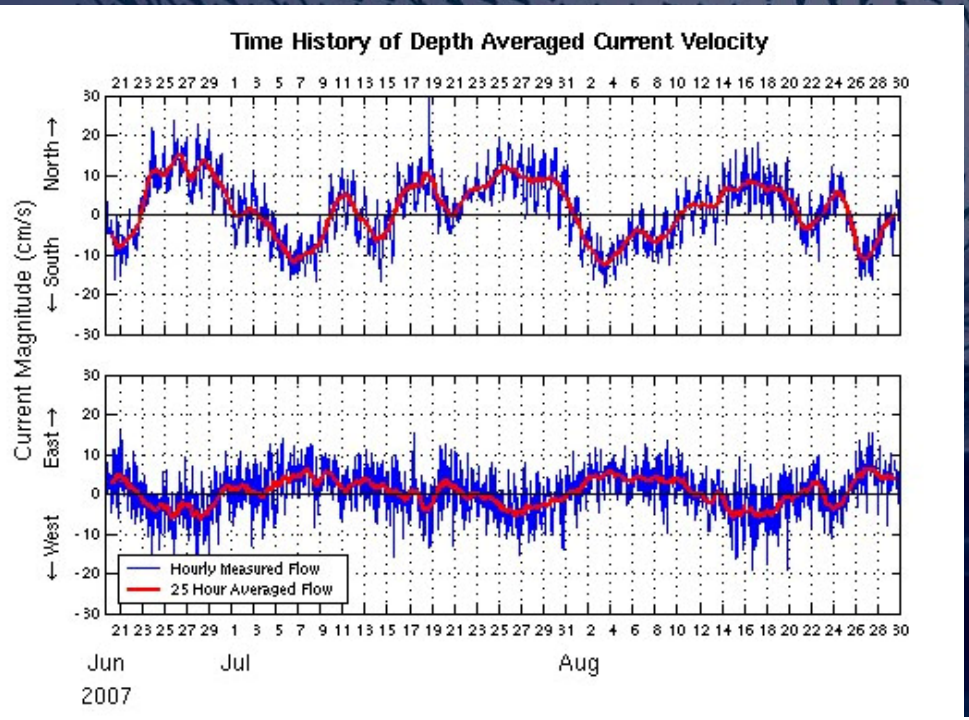


South Bay Ocean Outfall Mooring

SBOO Mooring Near Real-Time History of Data to Date



Time series of temperature chain data



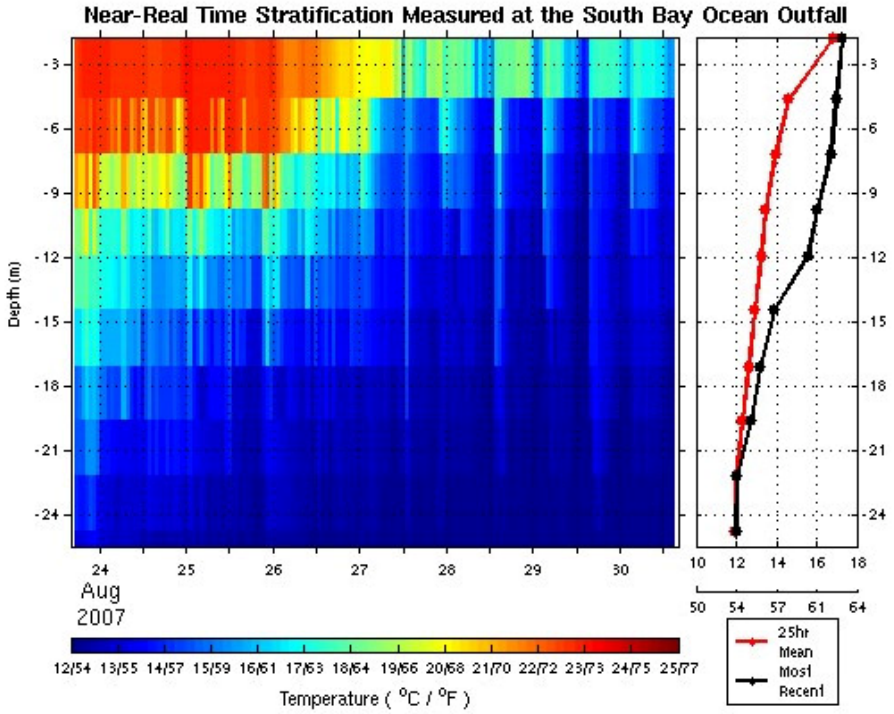
Time series of depth averaged current velocity

SBOO Mooring Near Real-Time Temperature Data

Real-time Buoy Data

Located at the South Bay Ocean Outfall

UTC Time: 2007-08-30 16:06:43
Local Time: 2007-08-30 09:06:43

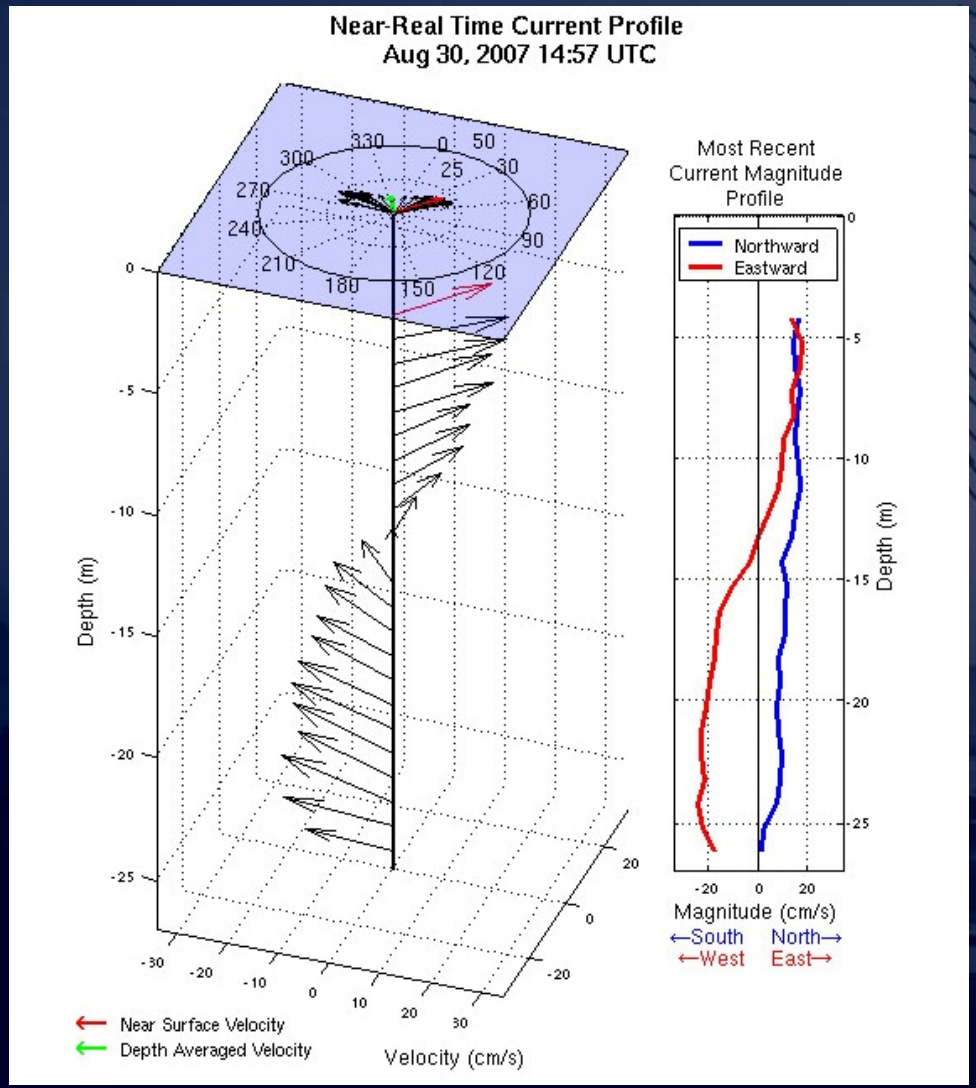


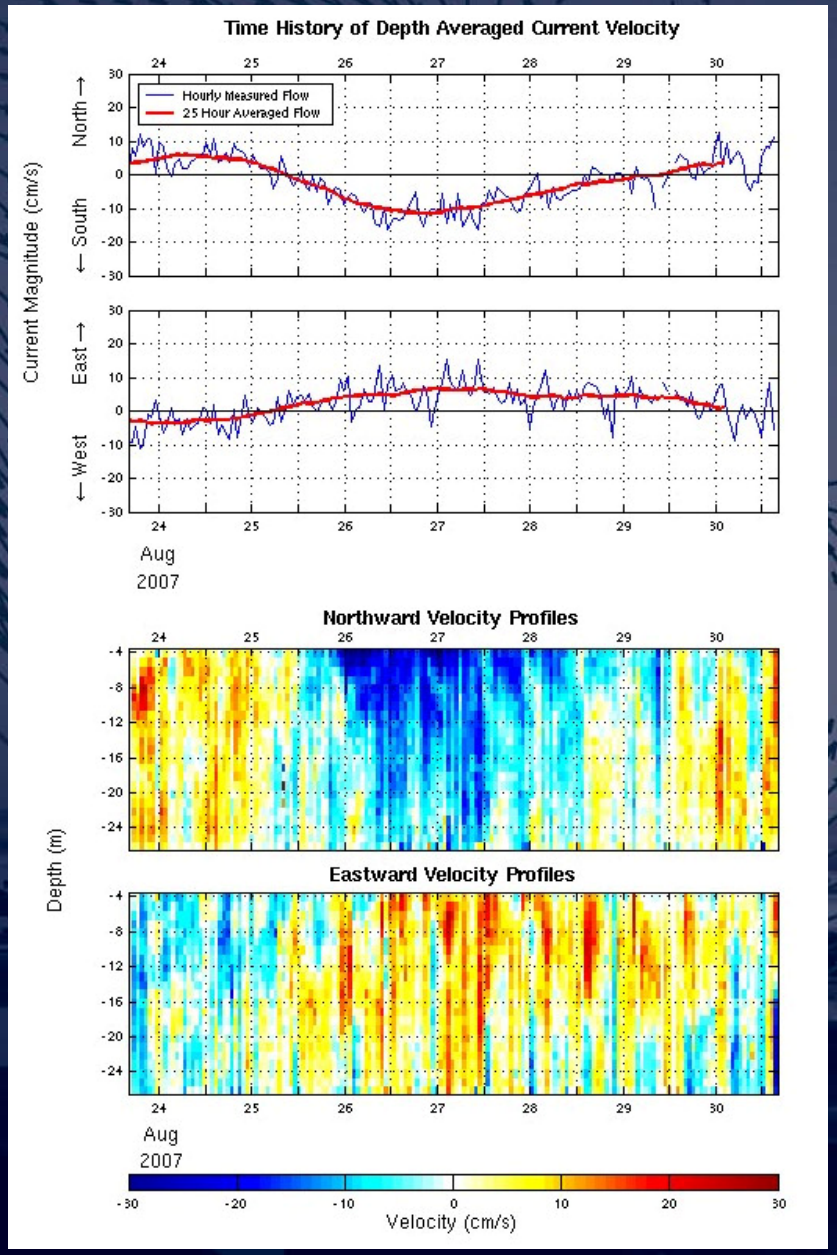
Last Sample Values

Depth	Temp. °C	Temp °F
1.7 m	17.25 °C	63.05 °F
4.6 m	16.95 °C	62.51 °F
7.2 m	16.70 °C	62.06 °F
9.8 m	16.04 °C	60.87 °F
11.9 m	15.54 °C	59.97 °F
14.4 m	13.88 °C	56.98 °F
17.1 m	13.17 °C	55.71 °F
19.6 m	12.73 °C	54.91 °F
22.2 m	12.04 °C	53.67 °F
24.8 m	11.96 °C	53.53 °F

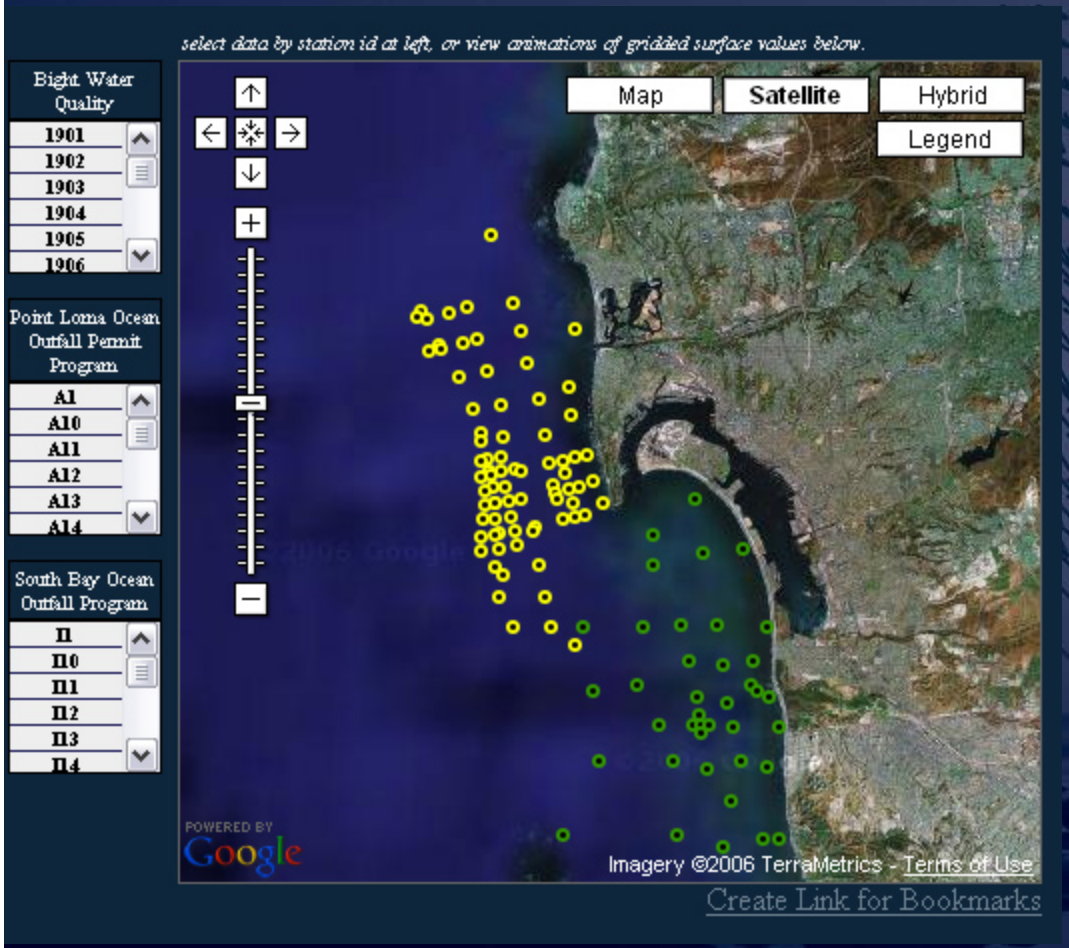
2007-08-30 14:59:27 GMT

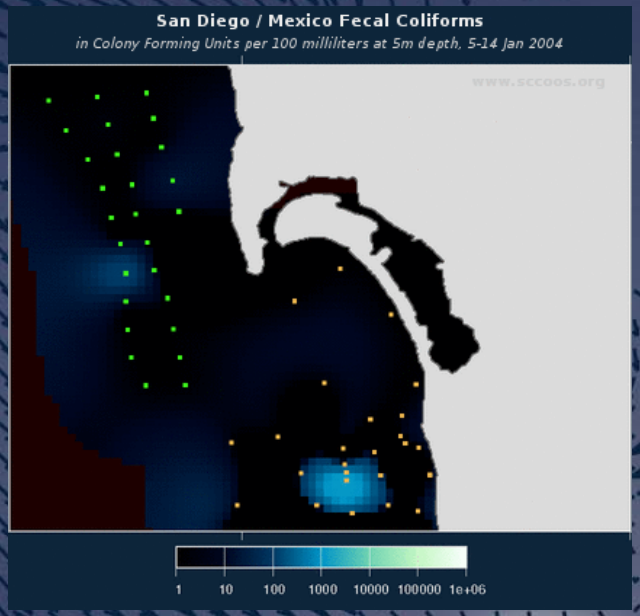
SBOO Mooring Near Real-Time Currents Data

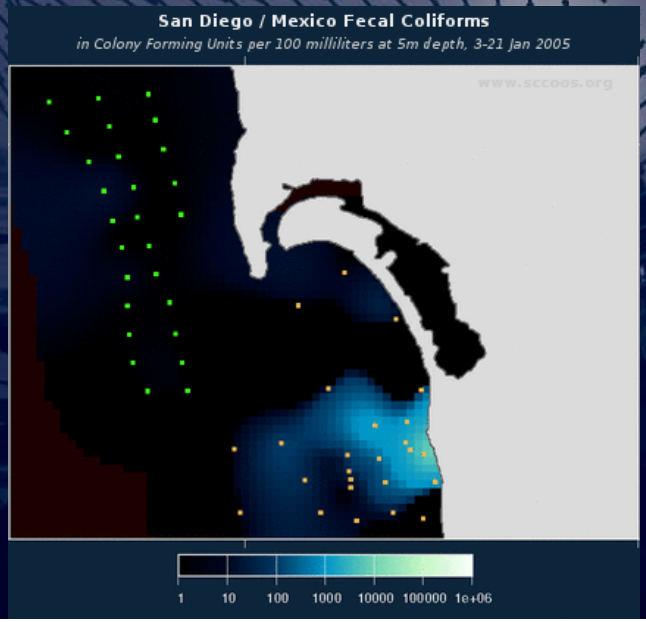




South Bay Existing Sampling Stations for both SBOO and PLOO

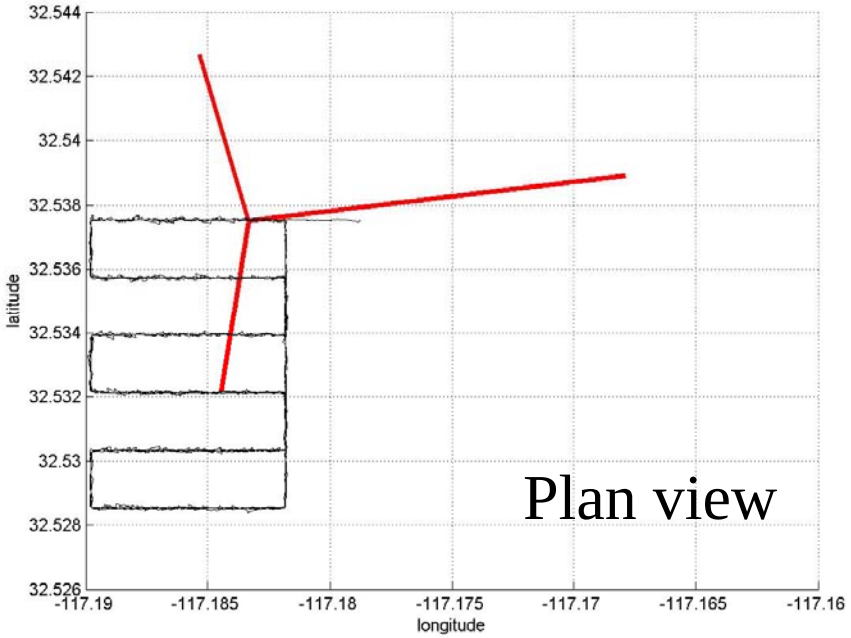




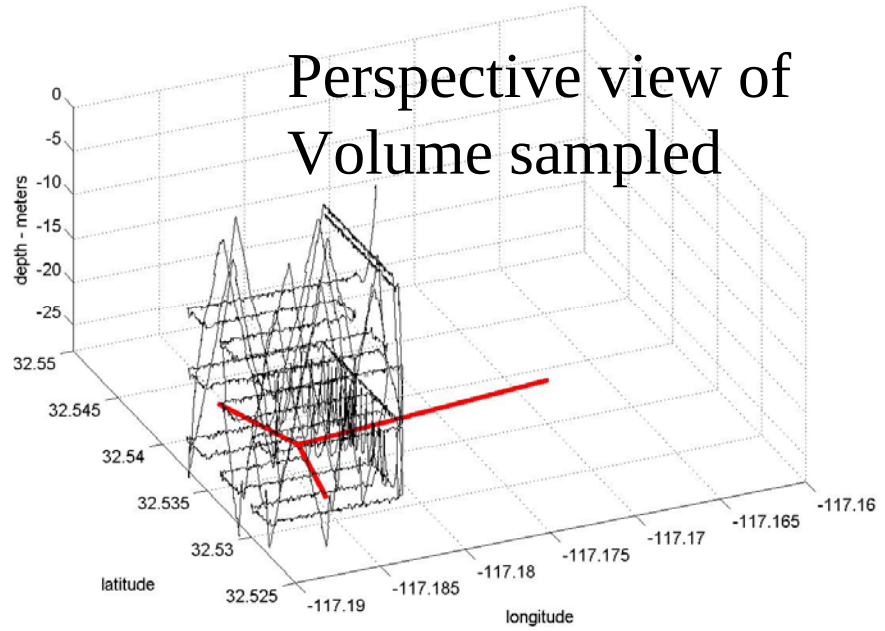


REMUS Autonomous Underwater Vehicle (AUV)

- Payload
  - 900 kHz sidescan sonar
  - 1200 kHz Acoustic Doppler Velocity Current Profiler (ADCP)
  - Conductivity, Temperature, Depth (CTD)
  - Optical Sensors for water clarity, chlorophyll, backscatter at 2 wavelengths
  - Compass
  - GPS
  - Iridium communications
  - Onboard navigation system

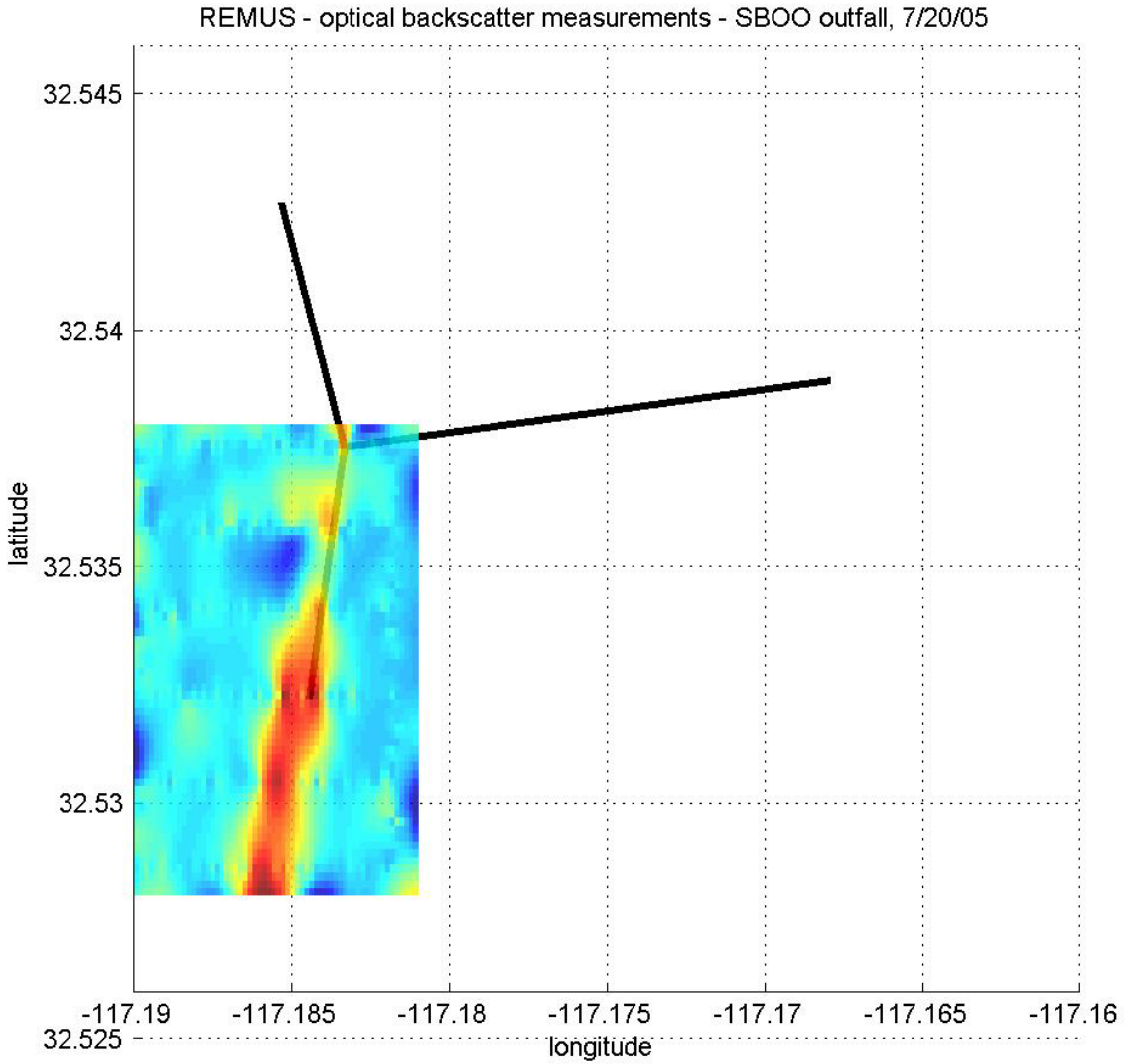


Plan view



Perspective view of Volume sampled

- **Vehicle operated to 'mow the lawn' at 3 depths: 25m, 17m, 10m in a box surrounding the SBOO.**
- **Focused on lower third of southern wye which are where the operating diffusers are located. Sampling mission took approximately 6 hours. Conducted from 22' Boston Whaler boat.**

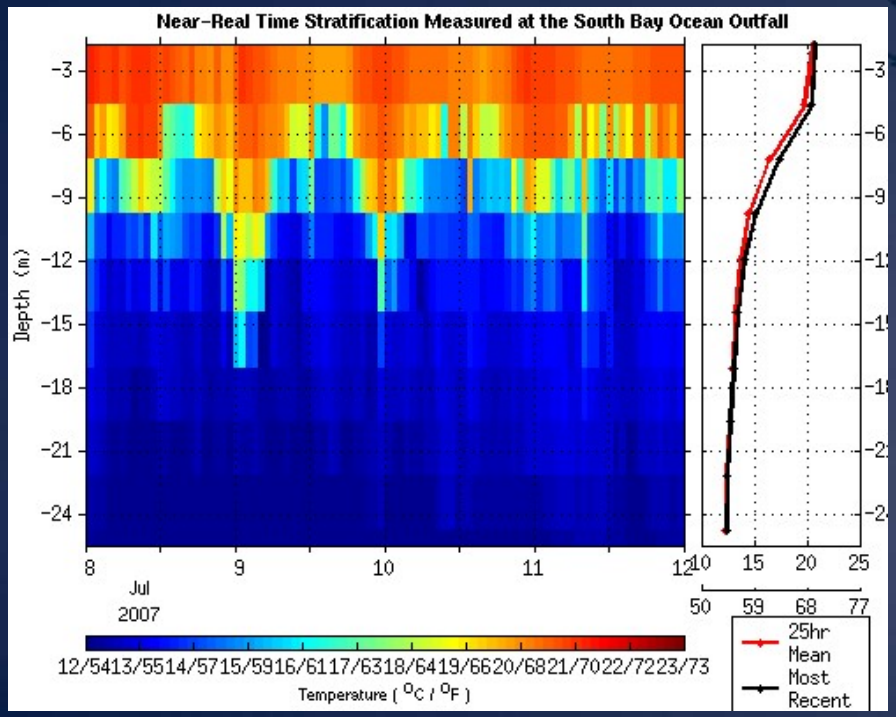


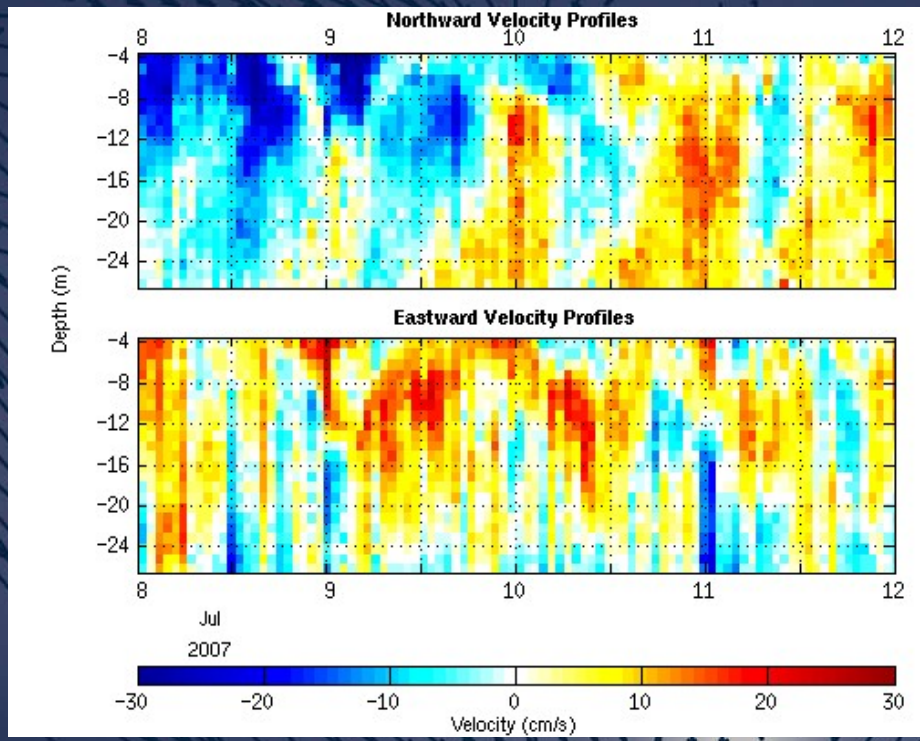
Plan view of 20m depth data – plume appears to be southward Flowing during this time period.

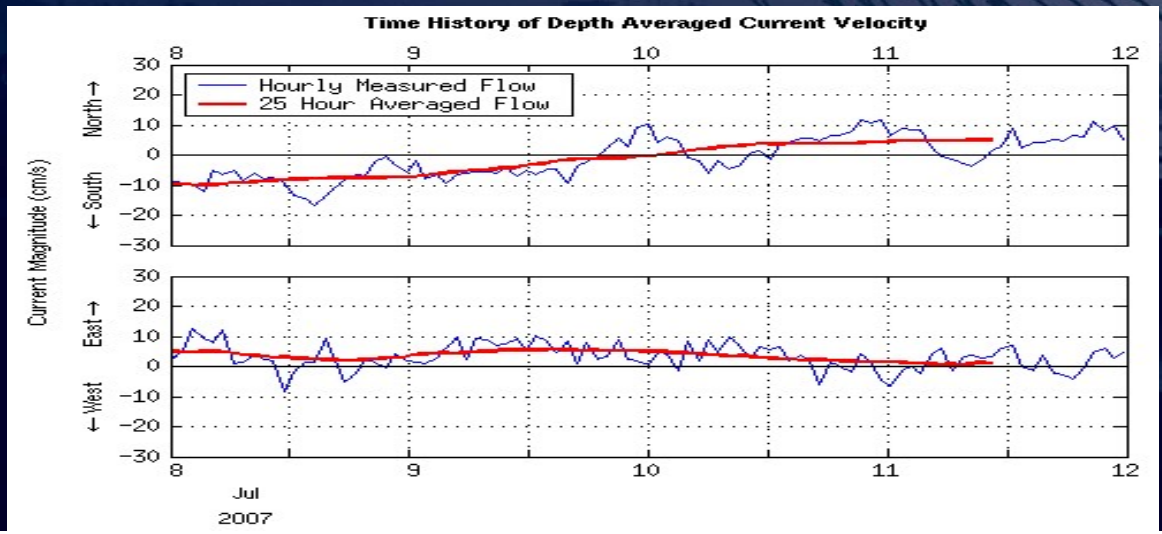
REMUS Missions at SBOO

REMUS Test Mission July 10, 2007

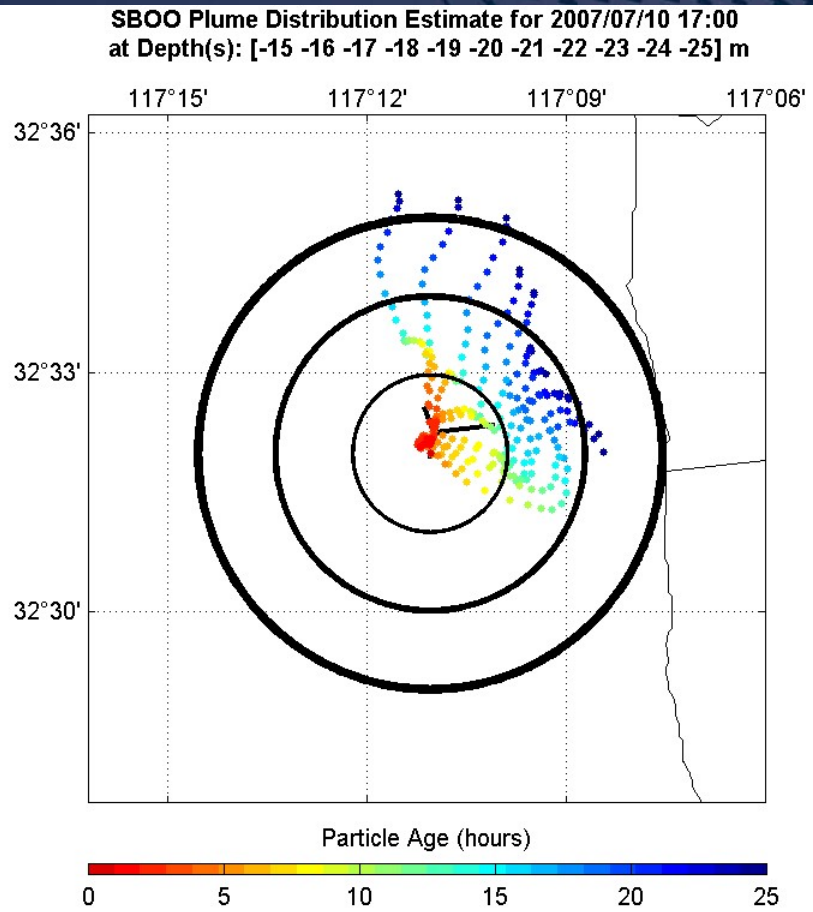
July 10, 2007 Temperature and Currents from Buoy



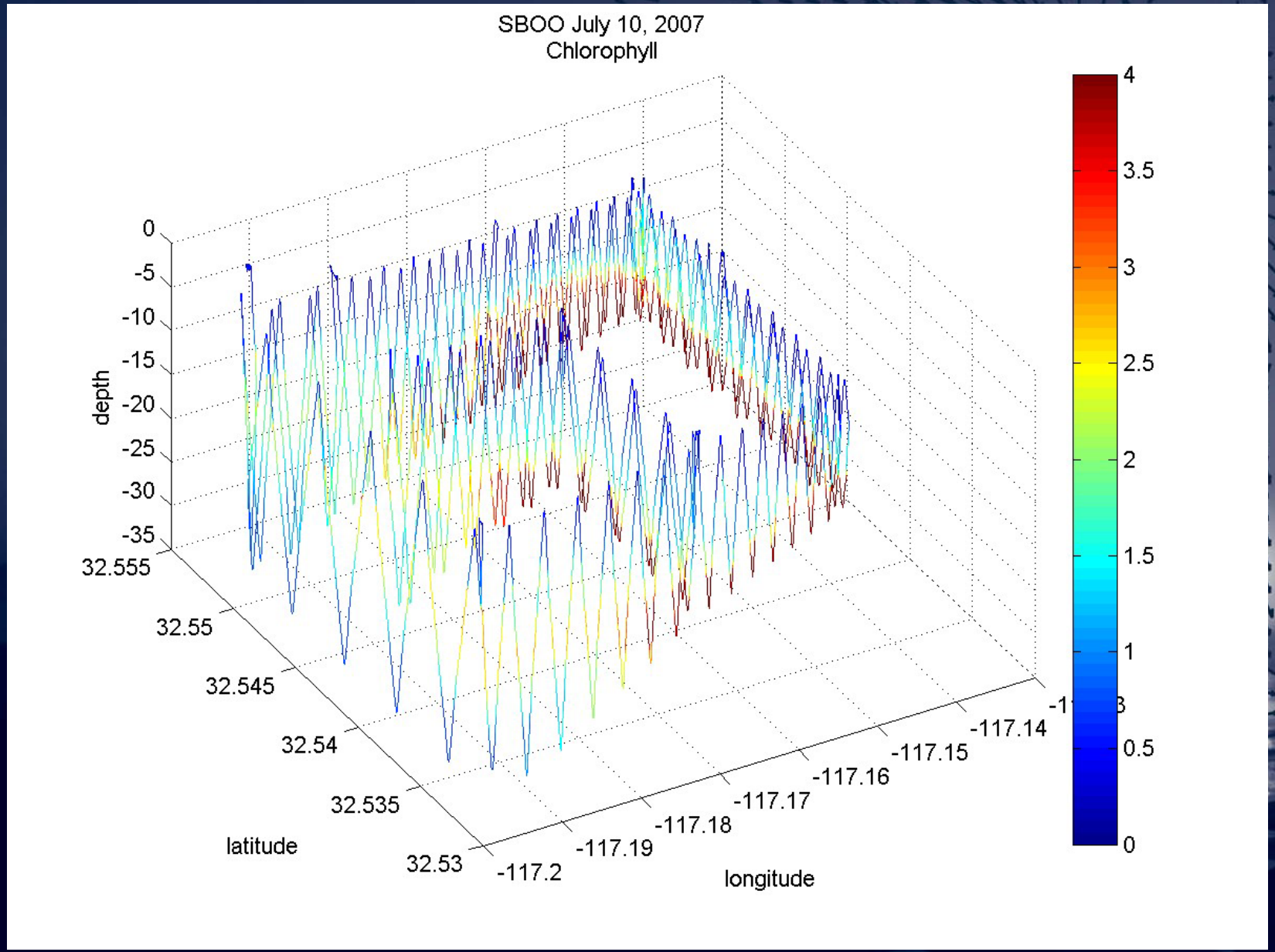




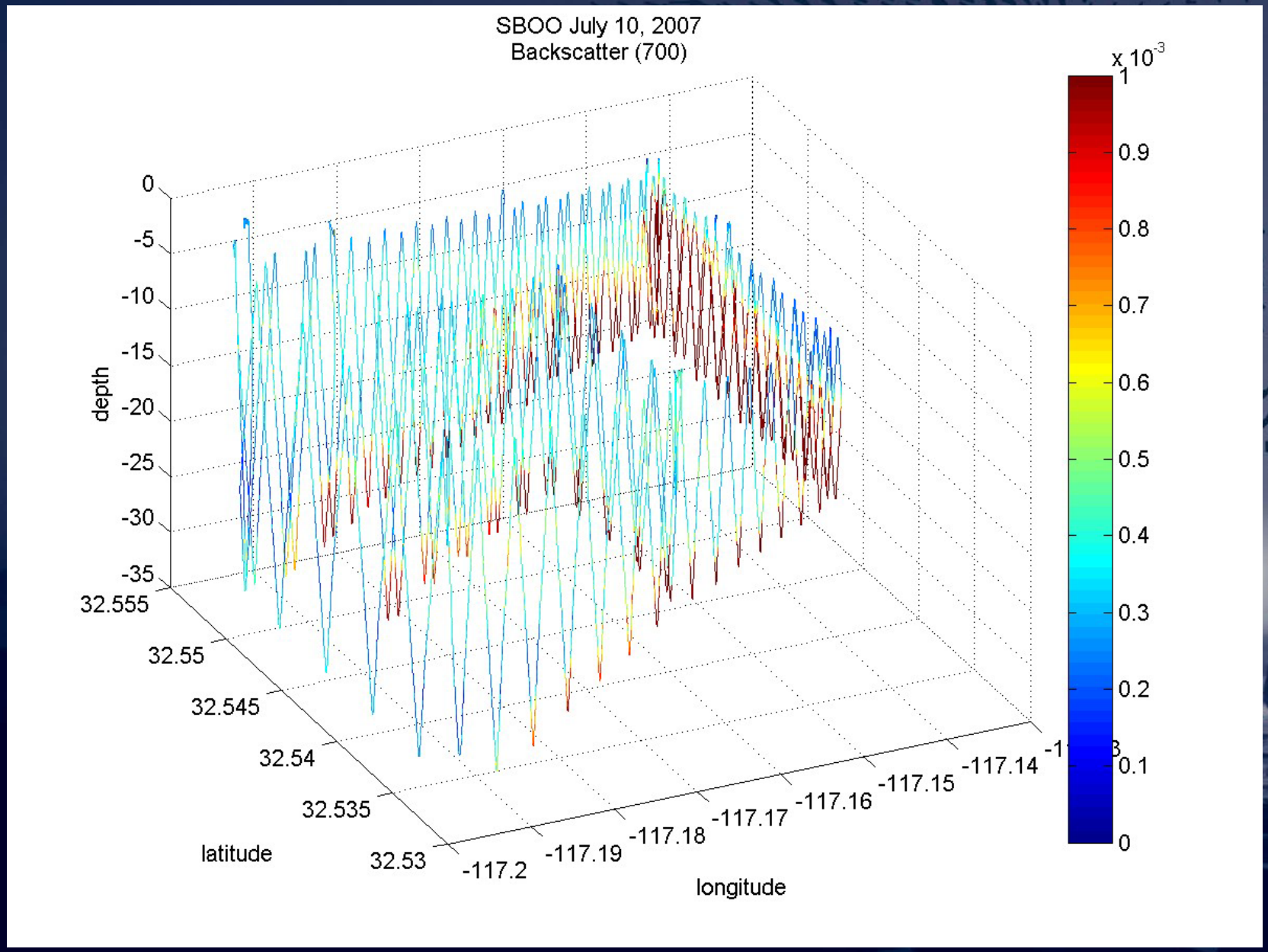
July 10, 2007 Potential Location of Plume estimated using SBOO buoy



July 10, 2007 Chlorophyll

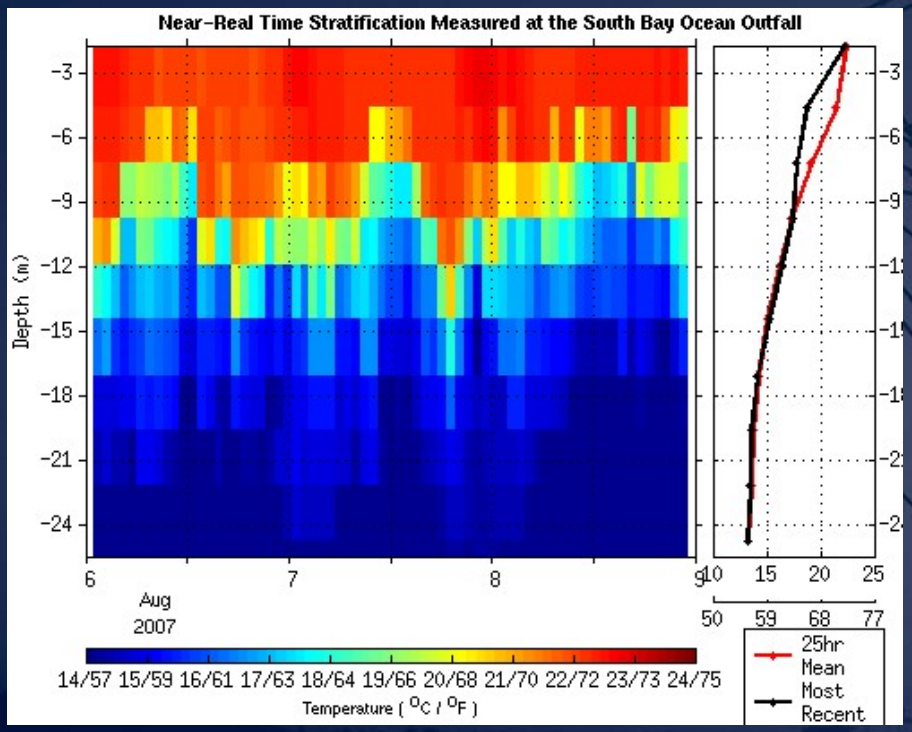


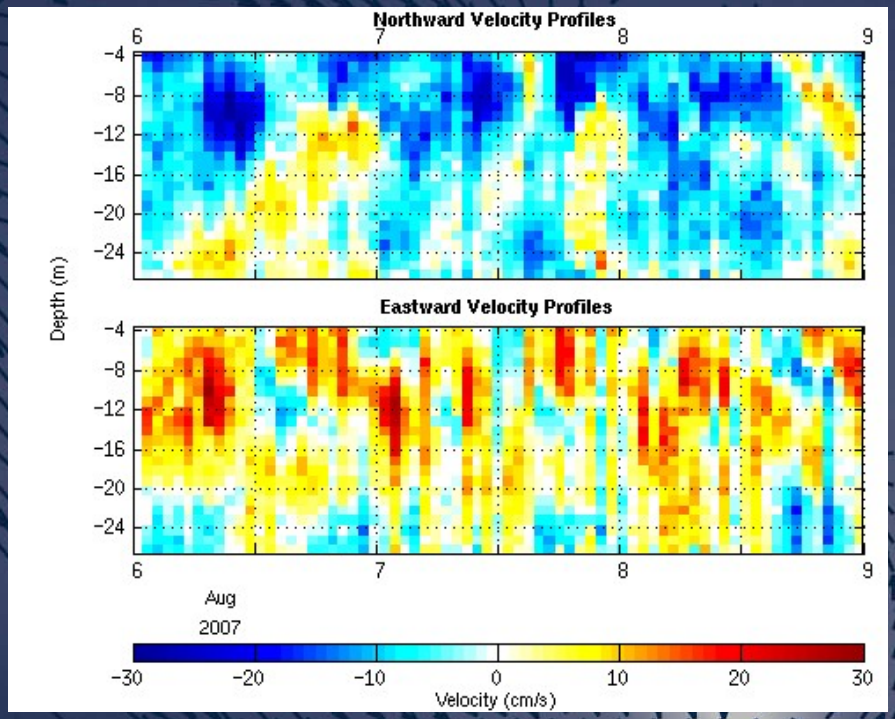
July 10, 2007 Backscatter

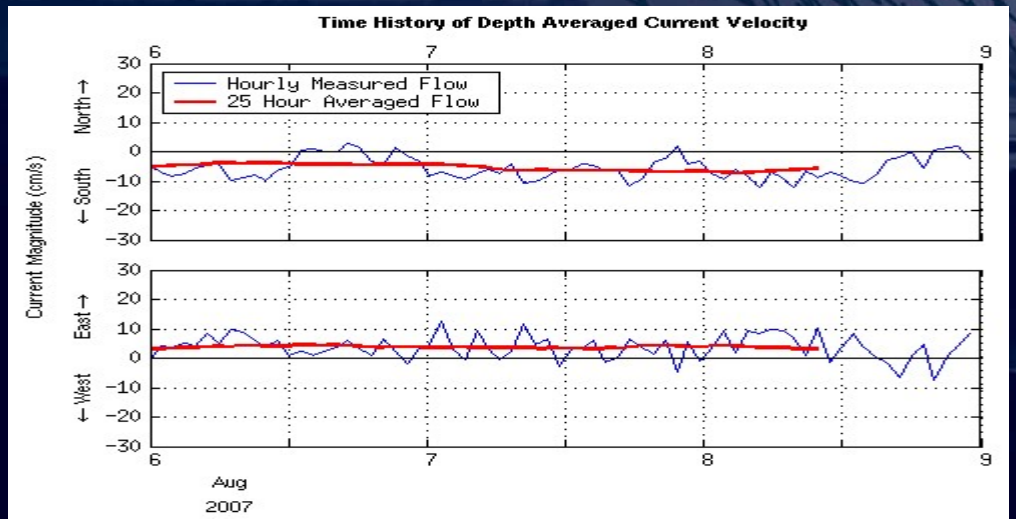


REMUS Mission at SBOO August 8, 2007

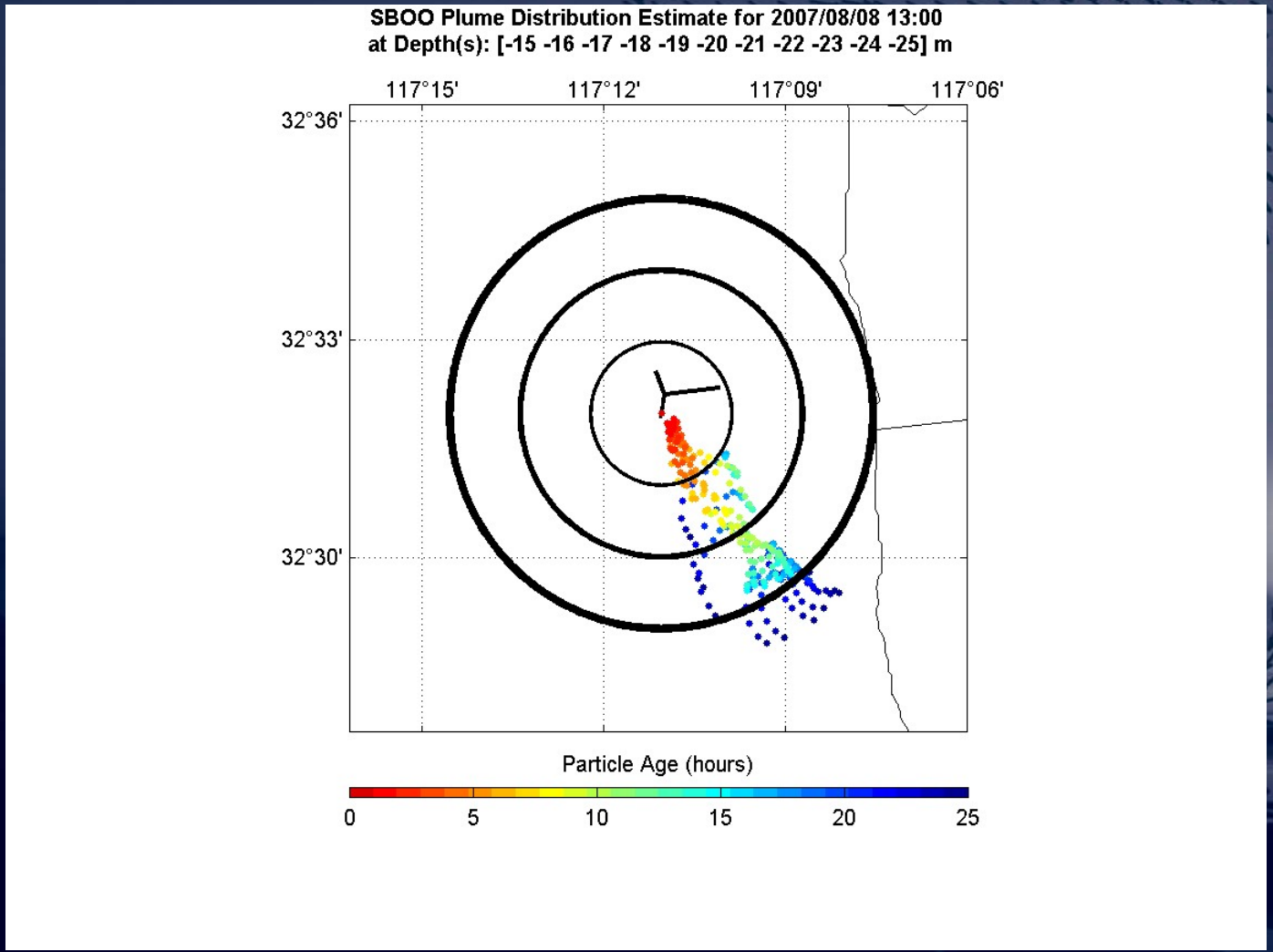
August 8, 2007 Temperature and Currents from Buoy



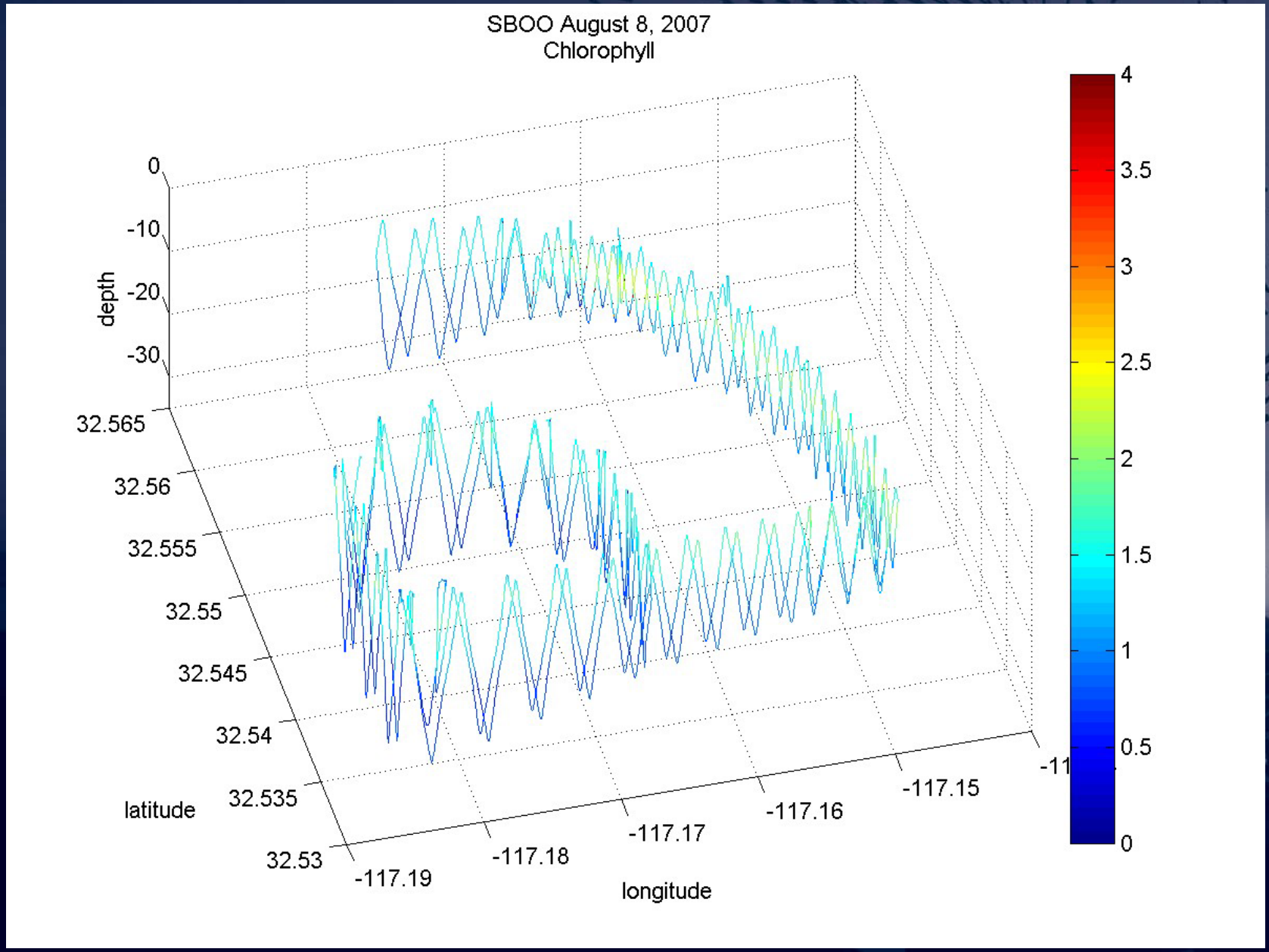




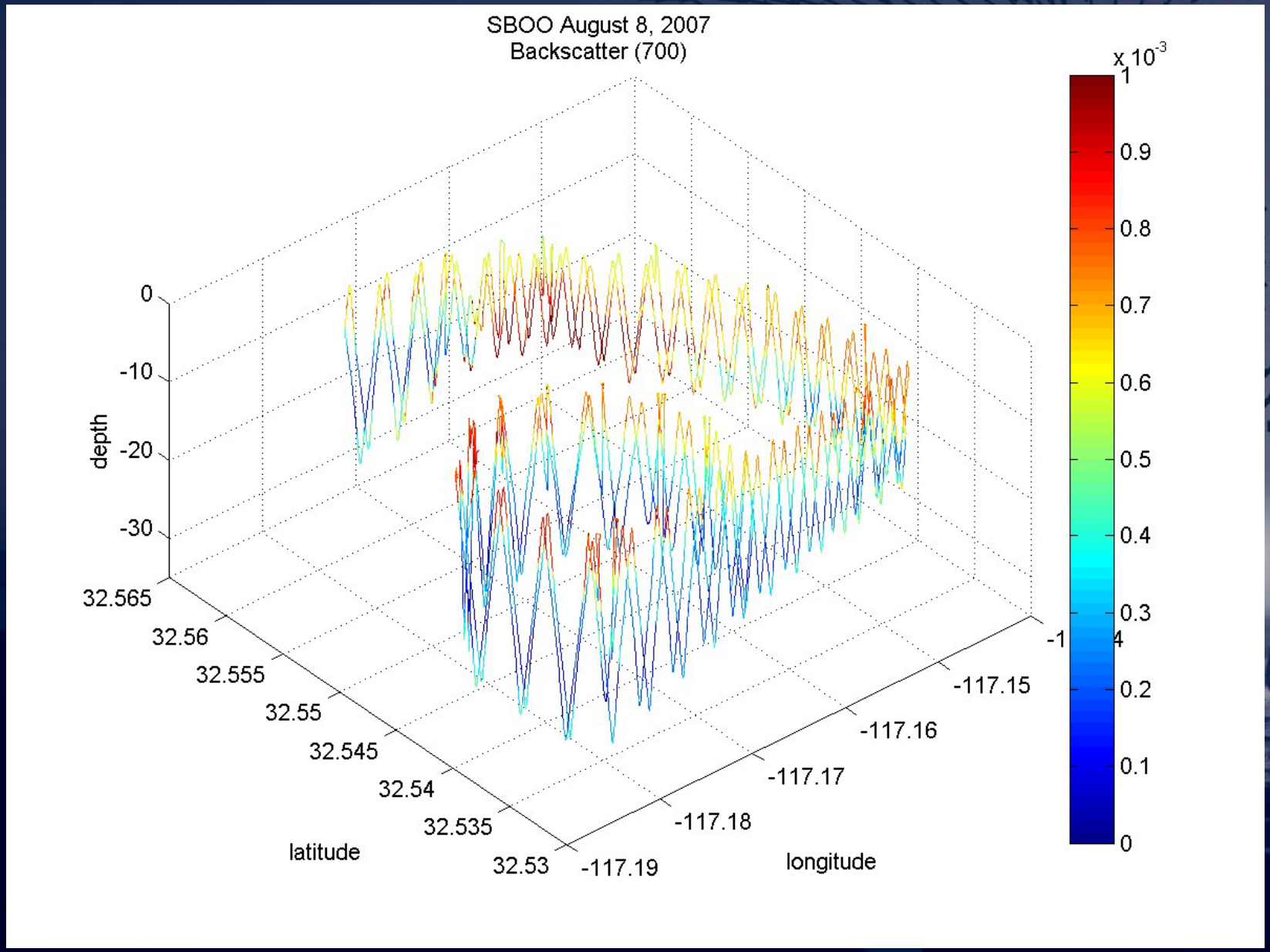
August 8, 2007 Potential Location of Plume estimated by SBOO buoy



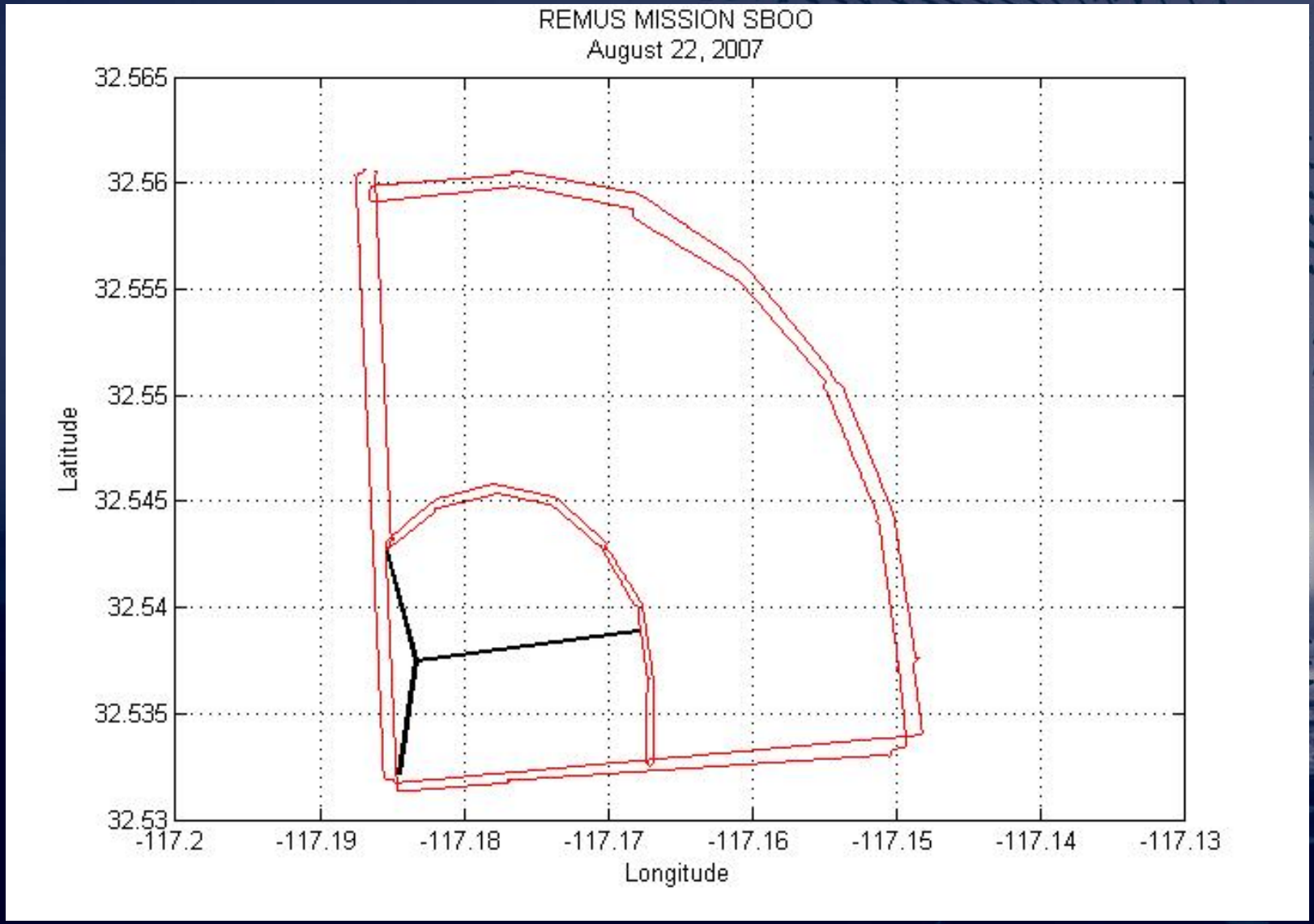
August 8, 2007 Chlorophyll



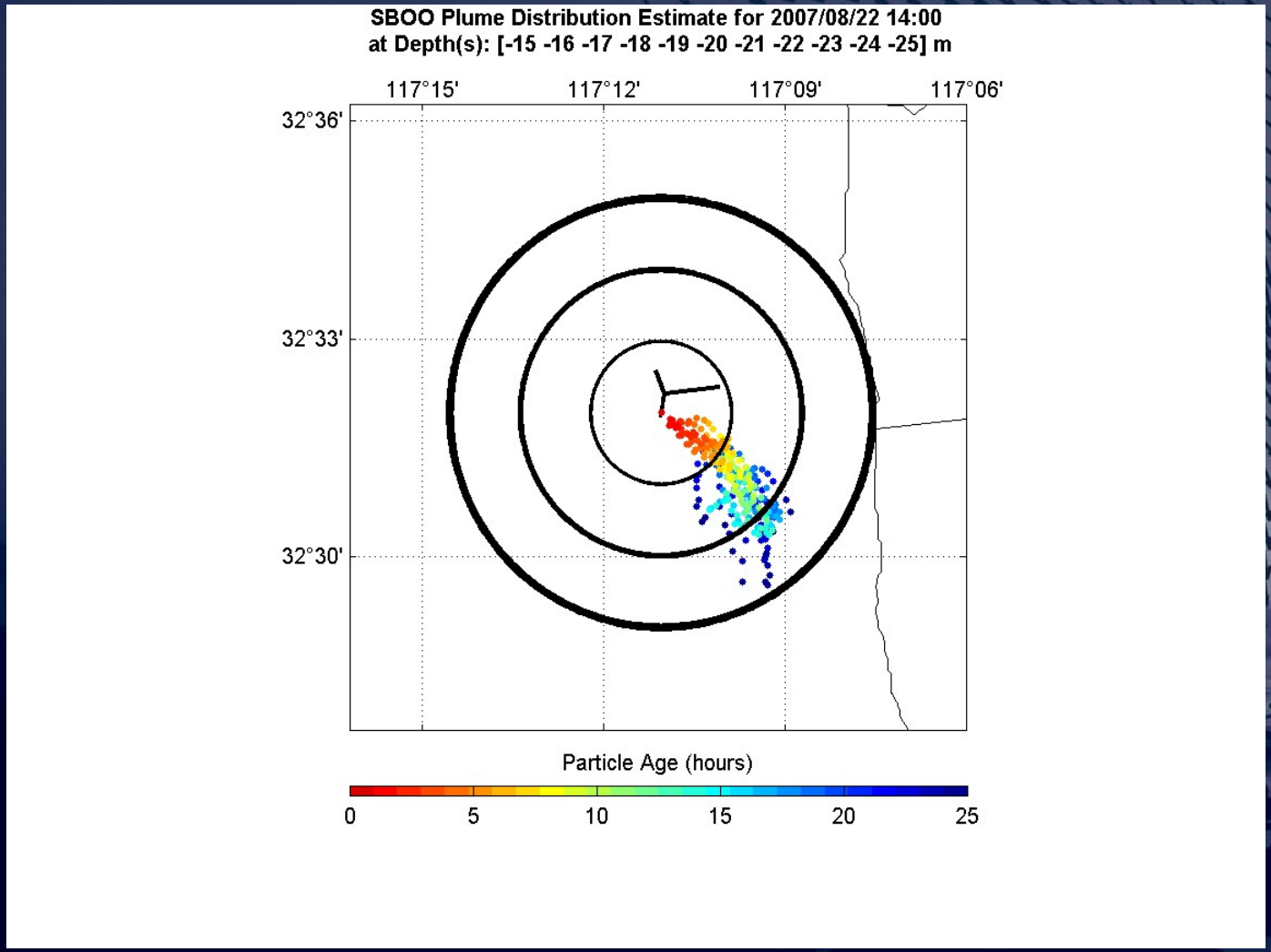
August 8, 2007 Backscatter



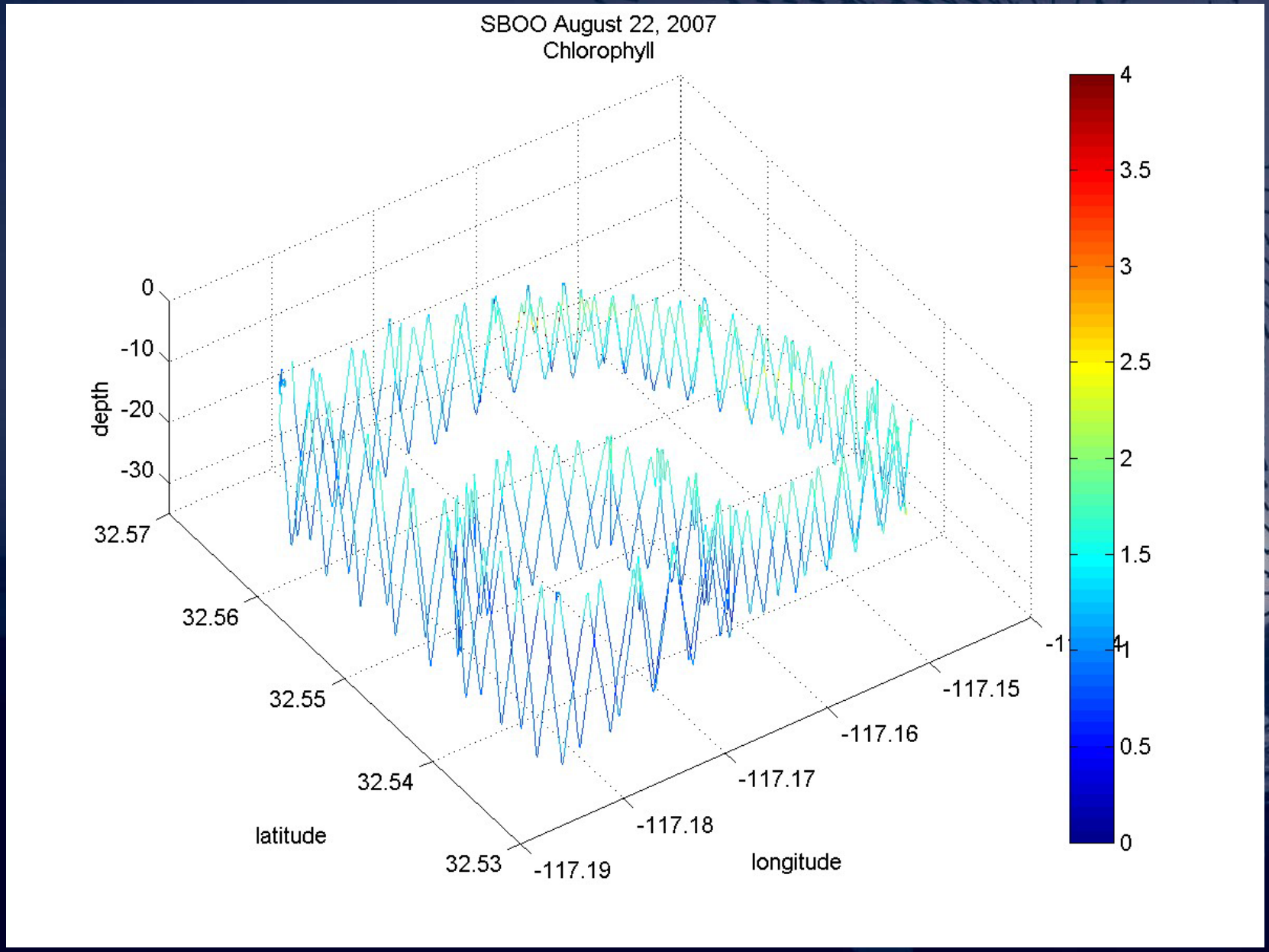
REMUS Mission at SBOO August 22, 2007



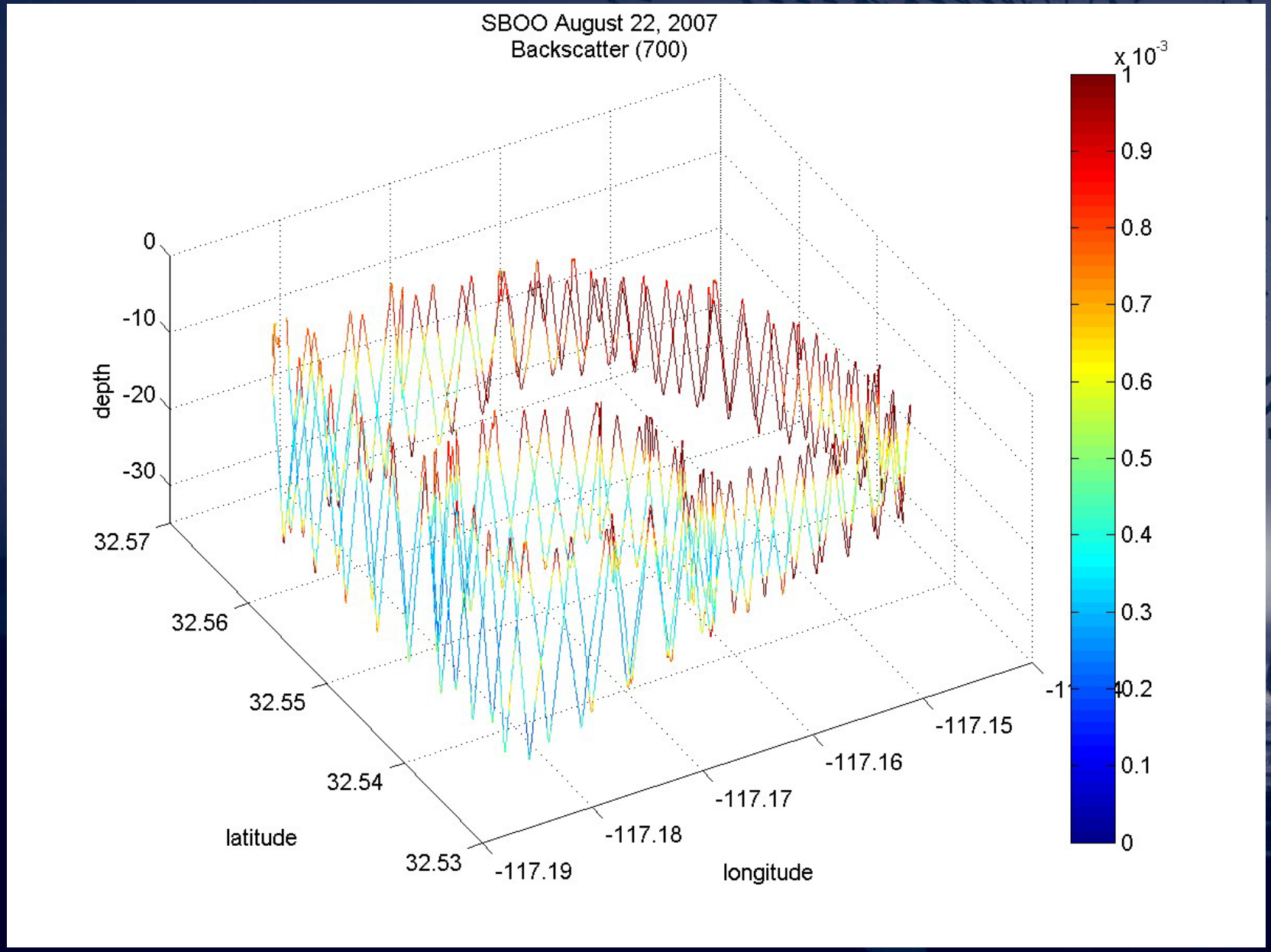
August 22, 2007 Potential Location of Plume



August 22, 2007 Chlorophyll

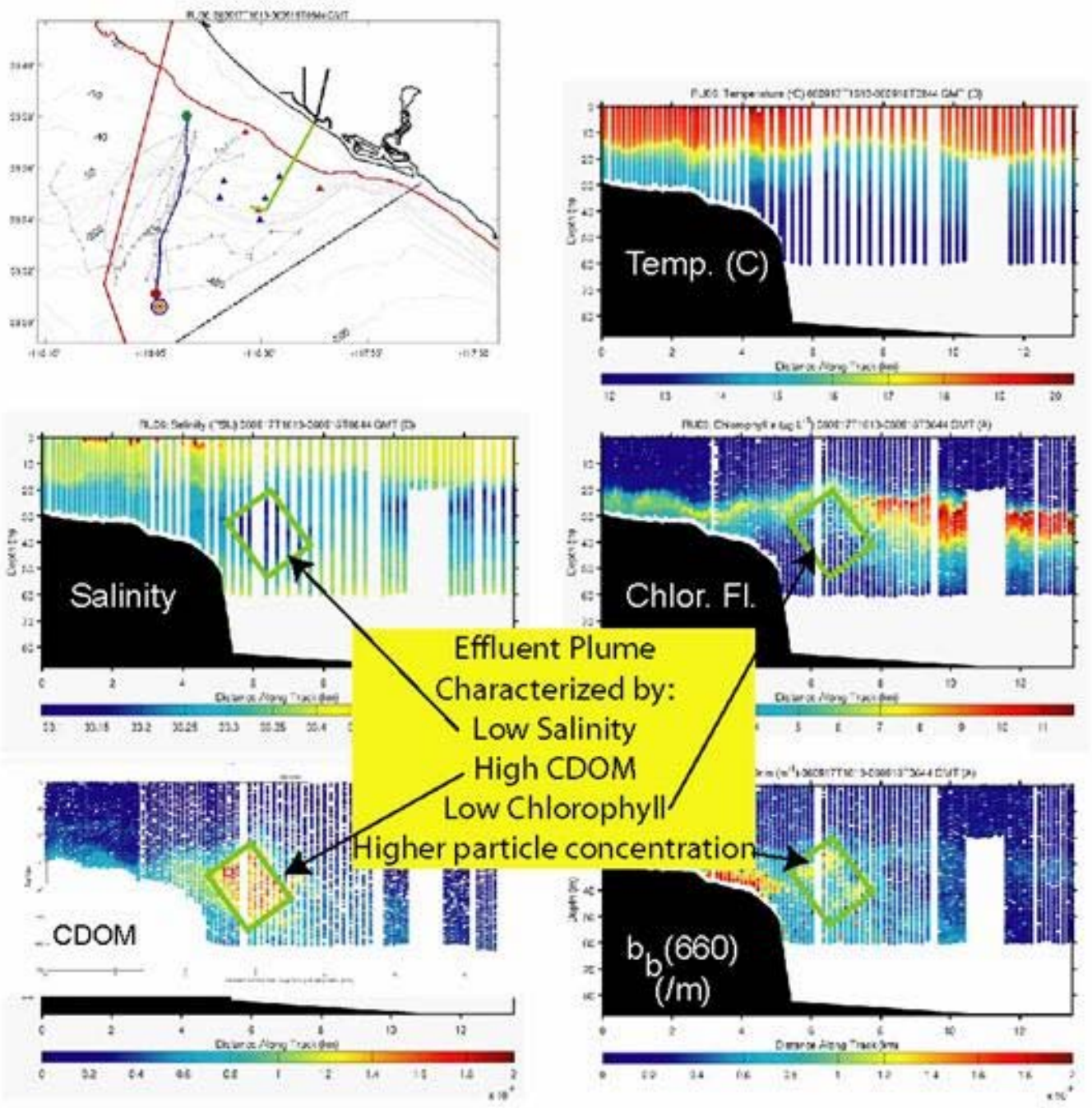


August 22, 2007 Backscatter



Plume sources can be differentiated based on a combination of physical and optical properties.

Example OCSD – Huntington Beach



Microbiological sampling

a. Utilizes human-specific pathogens

i. Prevotella/Bacteroides – bacteria found to be human specific

ii. Pathogenic viruses (specific to humans)

1. Enteroviruses

a. Different types can cause neurological or intestinal ailments, and respiratory problems

b. Vector: person to person through contact with nasal secretions, saliva, stool from an infected person Symptoms: common cold – runny nose, cough, etc.; neurological and GI problems

2. Norwalk-like viruses

a. Infects mostly GI tract

b. Vector: infected by swallowing stool-contaminated food or water

c. Symptoms: nausea, diarrhea, vomiting, stomach cramps

d. Humans are the only known hosts

3. Adenoviruses

a. Infects the membranes of the respiratory tract, eyes, intestines and urinary tract

b. Symptoms: variety including respiratory, GI

c. Infants and young children most sensitive to these infections

IBWC Project Timeline YR 2007

- January
  - Initiated efforts for purchase order of REMUS autonomous underwater vehicle (AUV)
- February
  - Finalized contract with CH2MHILL
  - Finalized purchase of AUV, equipment for SBOO and IB Pier moorings;
  - Conducted site and communication assessments at SBOO and IB Pier
- March
  - 1st: Submitted SIO Draft Monitoring and QAPP
  - Finalized “Tideland Use and Occupancy Permit” with San Diego Unified Port District for access to IB Pier (May 15, 2007 (5yrs))
  - 19th-23rd: SIO staff attended HYDROID AUV training

IBWC Project Timeline YR 2007

- April
  - Conducted test REMUS mission
  - Submitted Schedule update 1
  - Responded to IBWC comments from April 17th
- May
  - Finalized SBOO mooring fabrication and submitted location/description to USCG
  - 10th: CH2MHILL, USC, SIO conference call
  - Responded to IBWC comments from May 4th
- June
  - 4-5th: IB Pier piling cleaning and preparation
  - 19th: Deployed SBOO Mooring
  - 19th: Hosted IBWC, Gilbert Anaya and CH2MHILL, Richard Pyle lab tour and technology overview
  - 28th: Deployed IB Pier mooring and seafloor cable infrastructure

IBWC Project Timeline YR 2007

- July
  - 10th: Conducted test SBOO REMUS survey to aid in determining vehicle mission planning
  - 13th: EPA, IBWC, CH2MHILL, USC, and SIO conference call to discuss EPA QAPP comments from July 3rd
  - **23rd: Received conditional approval by EPA and IBWC to start monitoring**
  - Initiated programming for SBOO Mooring online display
  - Conducted HF Radar beam pattern calibrations at Point Loma and Border Field State Park
- August
  - 8th: Conducted SBOO REMUS survey
  - 22nd: Conducted SBOO REMUS survey
  - Initiated real-time data flow from IB mooring