California Clean Beaches Initiative

San Diego Coastal Ocean Observing System

WWW.SDCOOS.ORG

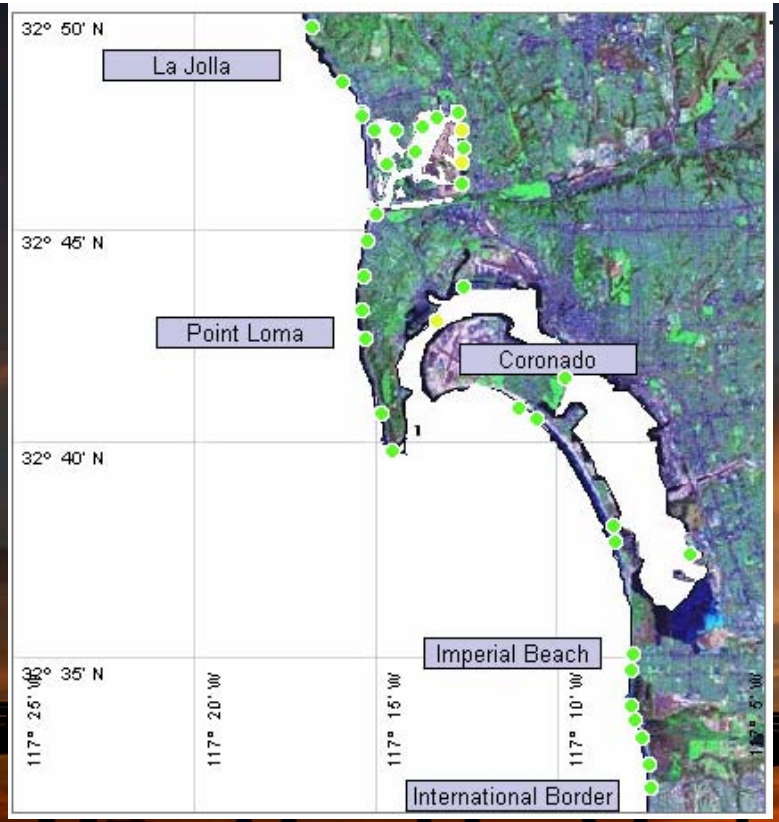
Presentation to Imperial Beach City Council

August 3, 2005

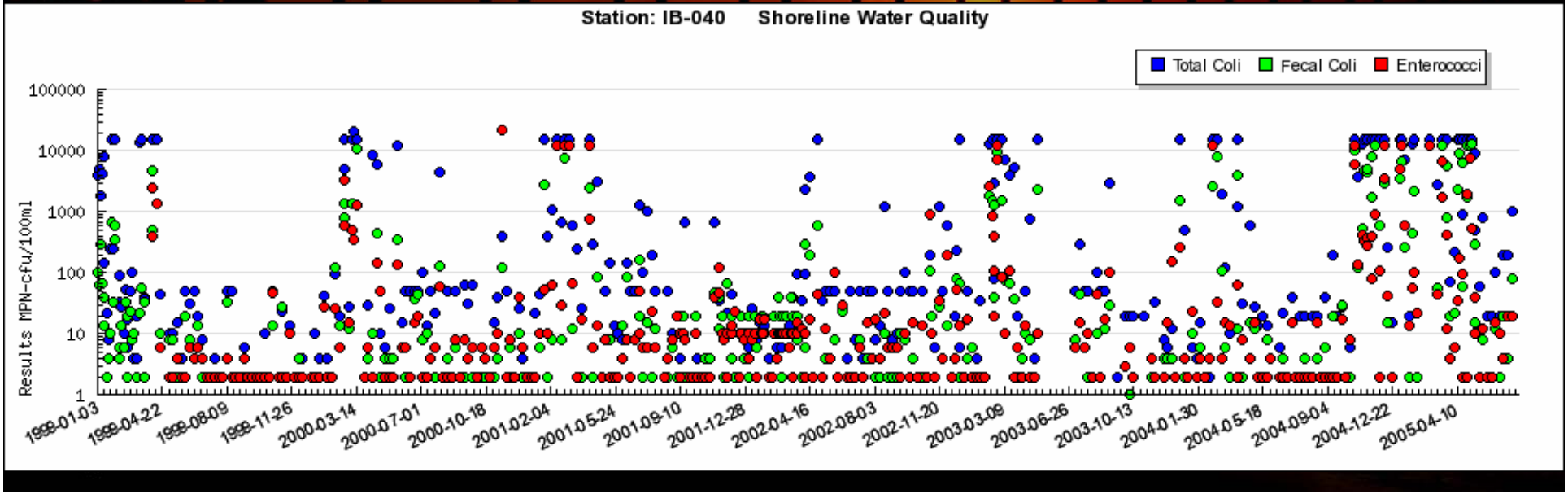
Eric J. Terrill, Ph.D.

Scripps Institution of Oceanography

- *Funded for two years, beginning in July 2002*
- *Prop 13 resources – partnership with the City of Imperial Beach and matching funds from County of San Diego*
- *Existing operations leverage scientific programs sponsored by National Science Foundation, Office of Naval Research, NOAA, and State of California. No present day operational support.*

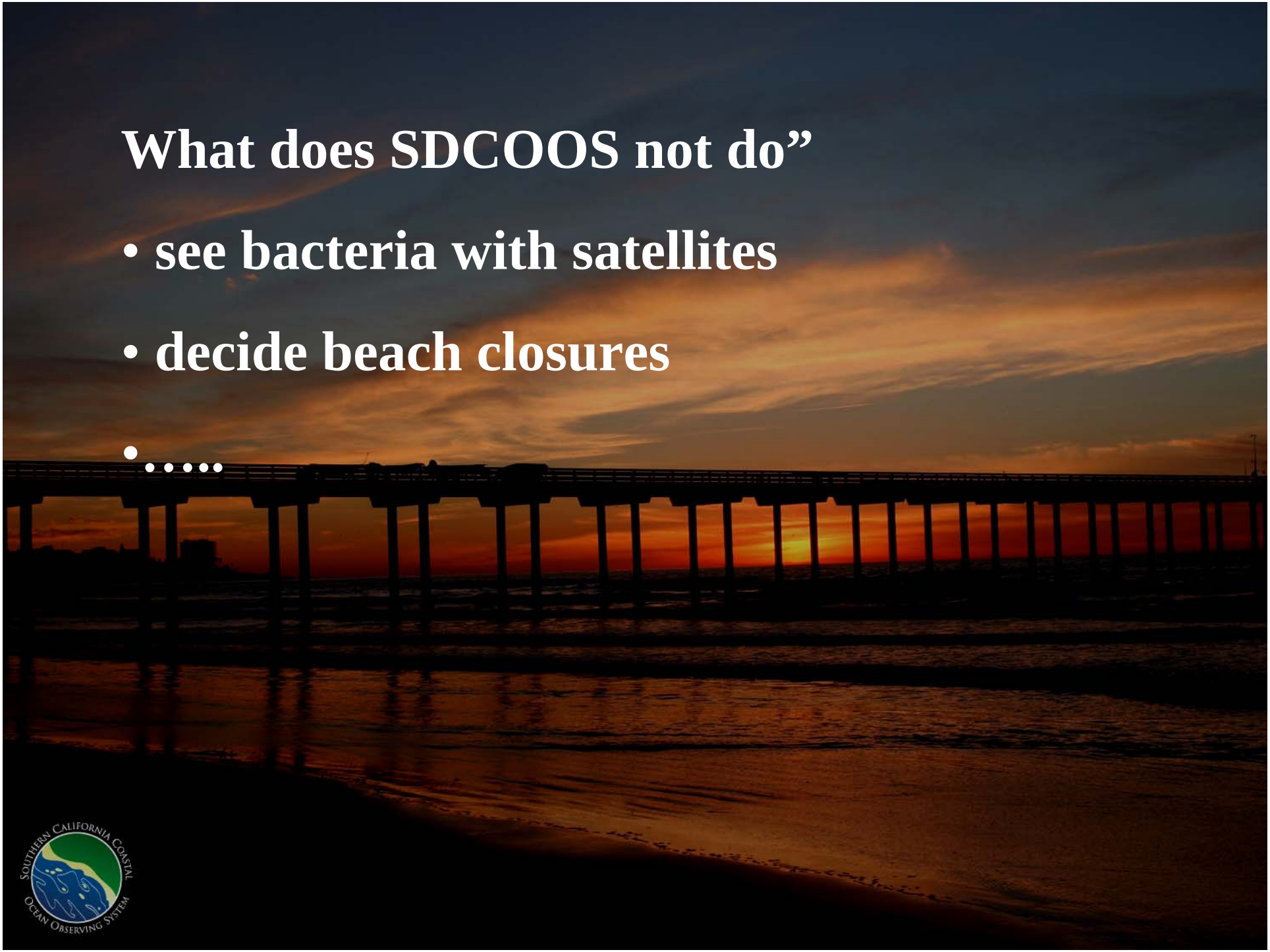


Significant variability exists in the water quality of the region. SDCOOS goals to explain how the environment impacts this variability.



What does SDCOOS do for Imperial Beach?

- "monitor the ocean at appropriate time and spaces scales to improve the understanding of changes in water quality"
- "provide real-time data to users in San Diego: marine safety, county DEH, local citizens, planners, USCG, USN, resource managers"
- "provide access to historical data to understand trends, changes, and efficacy of management decisions"



What does SDCOOS not do”

- **see bacteria with satellites**
- **decide beach closures**
- **…..**

Observing System needs to an objective source of Data.

STORY BELOW

...ne data shows conclusively that plume from Punta los Buenos is, under certain wind and tidal conditions, getting up to us."

David Schlesinger
Director of the San Diego Metropolitan Wastewater Department

San Diego

THE SAN DIEGO UNION-TRIBUNE • SATURDAY, MAY 6, 2000

...LANE BELL

...aught in comedy ...errors

...mply wasn't a good day for ...o aspiring burglars in Al... ...ne. First, the best time to at... ...a residential break-in is not ...on a Saturday morning when ...people are at home. The two ...were spotted removing prop... ...from a home on Bay Mead ...Drive.

...hen sheriff's deputies pulled ... ...er being summoned by the ...owner, the intruders took ...a run. A short distance later ...split up and one jumped over ...ce into a back yard. It turned ...to be the home of an off-duty ...Officer — who took the flee... ...suspect into custody. The ...man ducked into the garage ...other home and dived under ... Apparently, he didn't notice ...the car he hid under was ...red black and white and ...ed with lights. It also be... ...ed to a California Highway ...ol officer, who works outlying ...s of the county.

...ere's more

...o make matters worse, report... ...sheriff's investigator Dan ...ree, the two men had been us... ...a truck reported stolen a few ...s earlier. And in the truck, he ...was lost from two other re... ...burglaries in which the men ...now suspects.

...m the grapevine

... George W. Bush made ...shaking rounds at the huge ...o de Mayo celebration at the ...n & Country Hotel yesterday, ...planted a congratulatory kiss ...one lady in the audience — Na... ... Crooks. Yesterday was her ...birthday. She's Congressman ...e Cunningham's grandmoth... ...-law. Cunningham was in ...shington but his wife, Nancy, ...on hand to greet the Texas ...ernor. ... The charitable S.D. ...ndation postponed its 25th an... ...sary celebration from May ...until June 23 when word came ...ician NBC anchorman

Plume of pollution sent by Mexico, images show

Satellite shots depict sewage flowing north from treatment plant

By Leslie Wolf Branscomb
STAFF WRITER

New scientific research using satellite images indicates that sewage drifting up the coast from a Mexican sewage treatment plant may be a significant source of pollution on the county's southernmost beaches.

The color-enhanced images show a red plume drifting up the coast from the Mexican plant 5.6 miles south of the border that is in addition to the known discharge of untreated sewage from the mouth of the Tijuana River in Imperial Beach.

The federal government has spent more than $250 million on a sewage treatment plant north of the border in an effort to contain at least some of the sewage flowing into the United States via the Tijuana River. Yet, bacteria levels in the water off the coast at times remain mystifyingly high.

Late last year, the U.S. Environmental Protection Agency funded a small study in which satellite pictures, radar and thermal imaging were used to try to obtain an accurate picture of where the pollution originates.

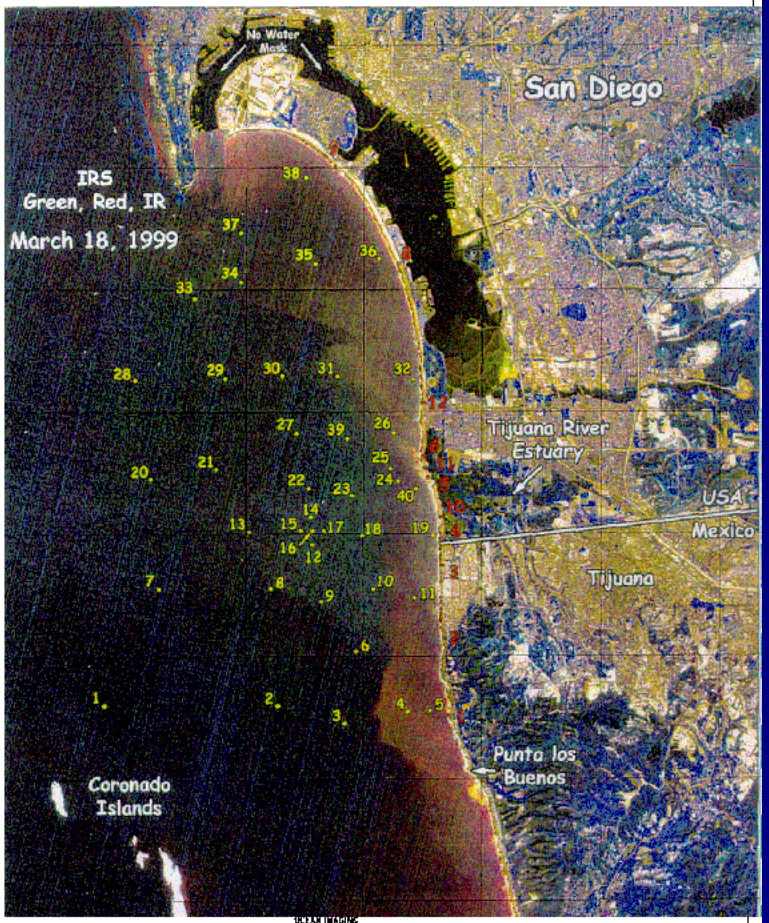
The report, prepared by Ocean Imaging of Solana Beach, was commissioned by the San Diego Metropolitan Wastewater Department using $9,877 from the EPA.

Selected satellite photos from 1999 show what appears to be a large flow entering the ocean at Punta los Buenos, near Mexico's San Antonio de los Buenos sewage treatment plant, and moving northward along the coast.

"The data shows conclusively that the plume from Punta los Buenos is, under certain wind and tidal conditions, getting up to us," said David Schlesinger, director of the San Diego Metropolitan Wastewater Department.

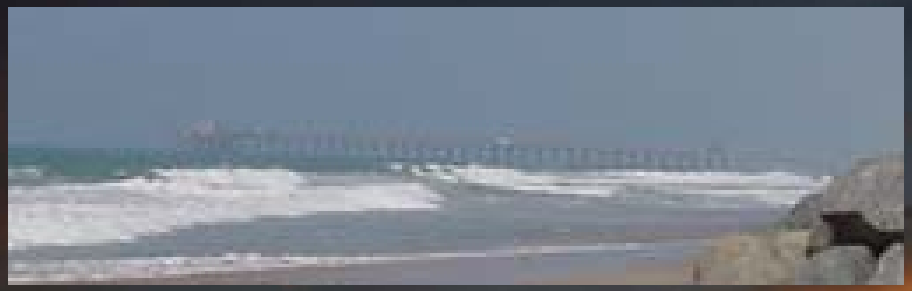
Department representatives plan to brief Mexican officials on the report at a meeting Friday.

The debate over how best to deal with sewage generated in Tijuana has been going on for decades. Tijuana currently gener-

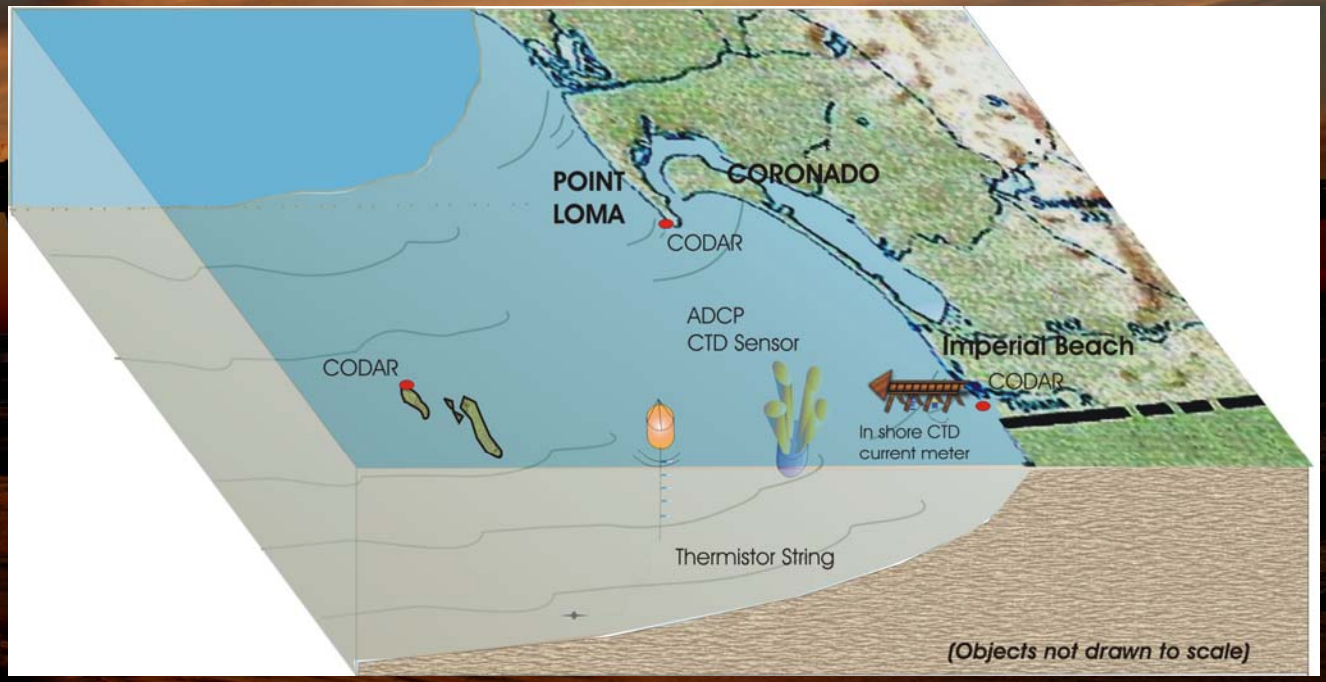


Imperial Beach Region

Apply real-time sensors to build a system to continuously monitor the coastal ocean



- moorings
- instrument city piers
- bottom mounted sensors
- HF radar
- satellite remote sensing



Couple data to existing monitoring efforts - provides framework for interpretation/understanding

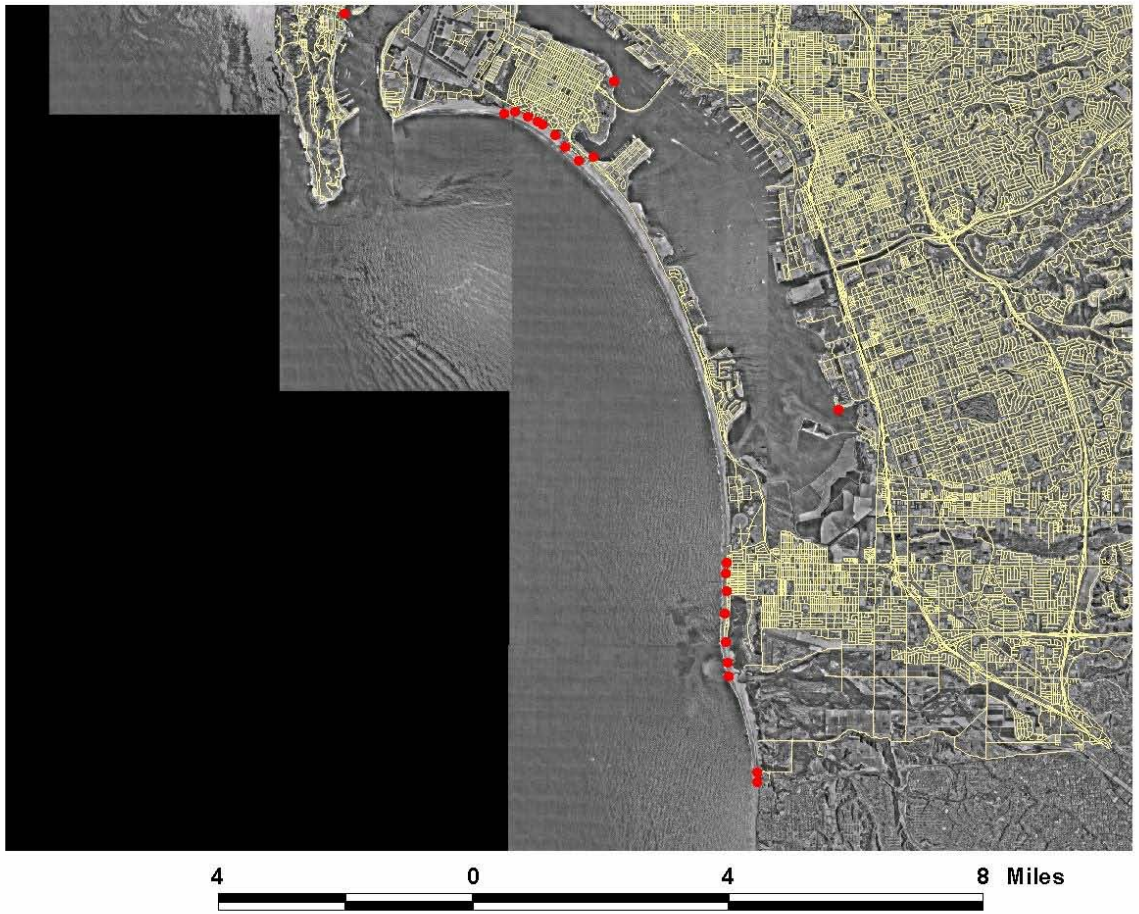
Use of city piers to support observing system infrastructure

Bacteria measurement stations maintained by San Diego County Department of Environmental Health

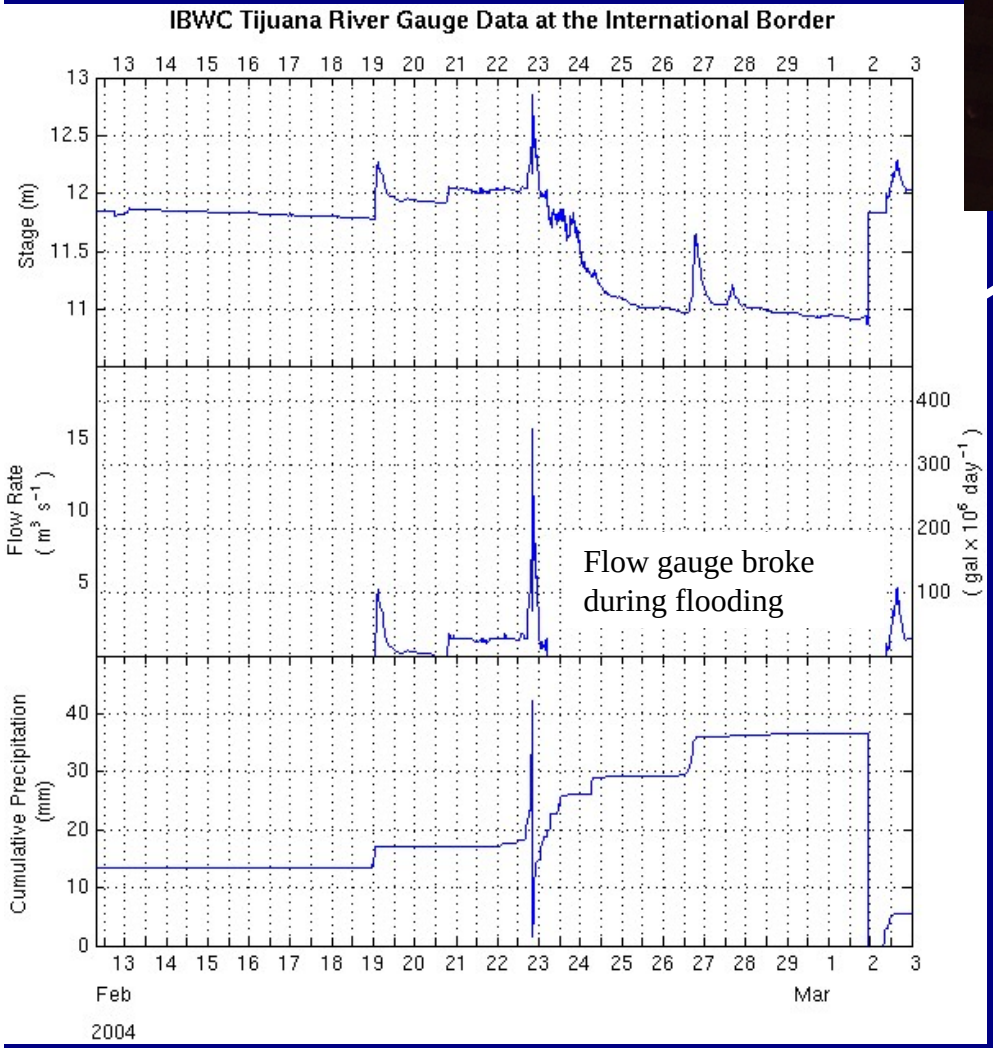
3 indicator species

- *total coliform*
- *e coli*
- *enterrococus*

South County Monitoring Locations

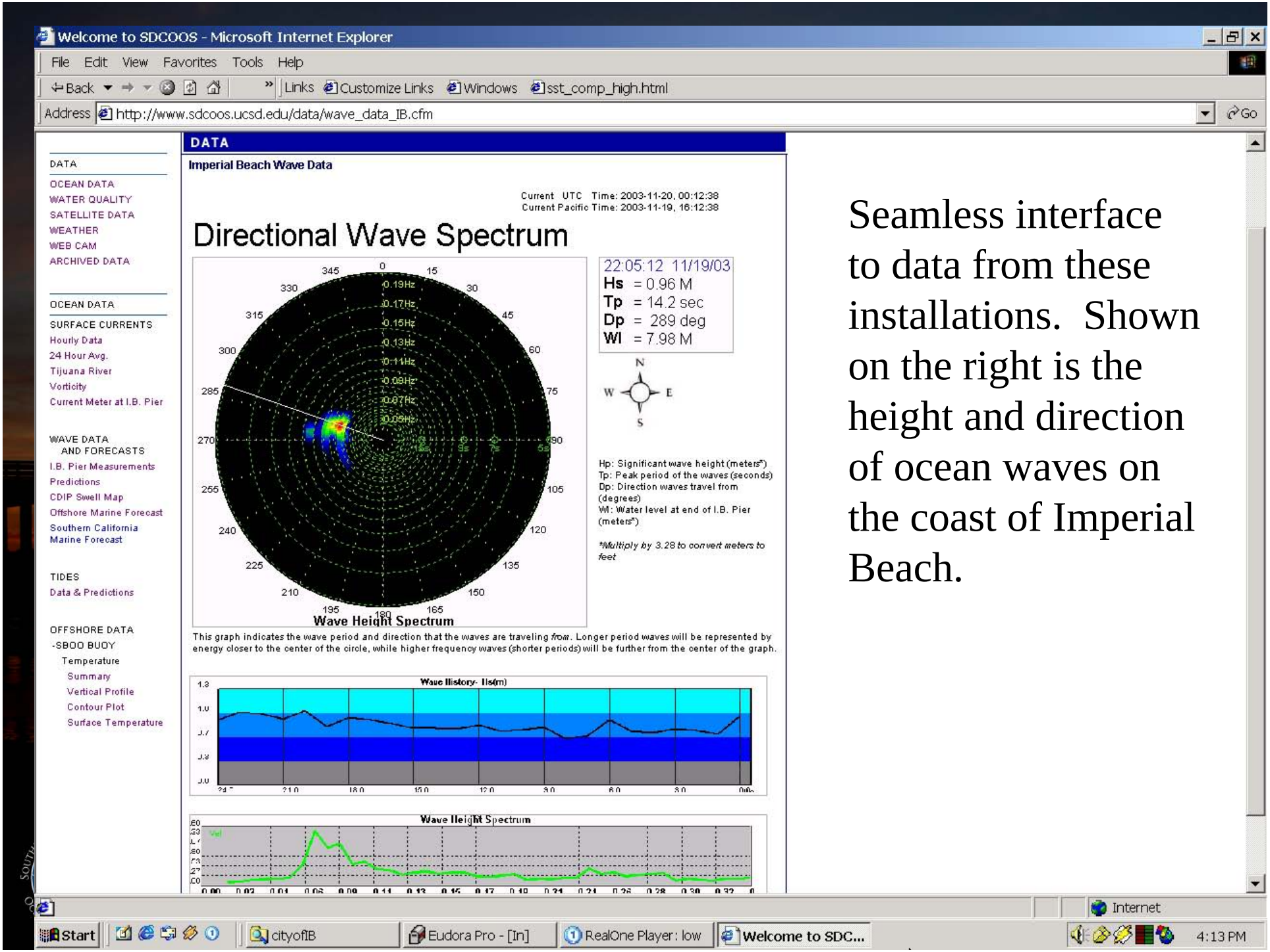


Multiple ‘pulses’ of rain into the TJ river watershed



SDCOOS accesses and locally archives the TJ river flow gauge owned by IBWC.

SDCOOS staff installed environmental monitoring equipment to the Imperial Beach Pier.

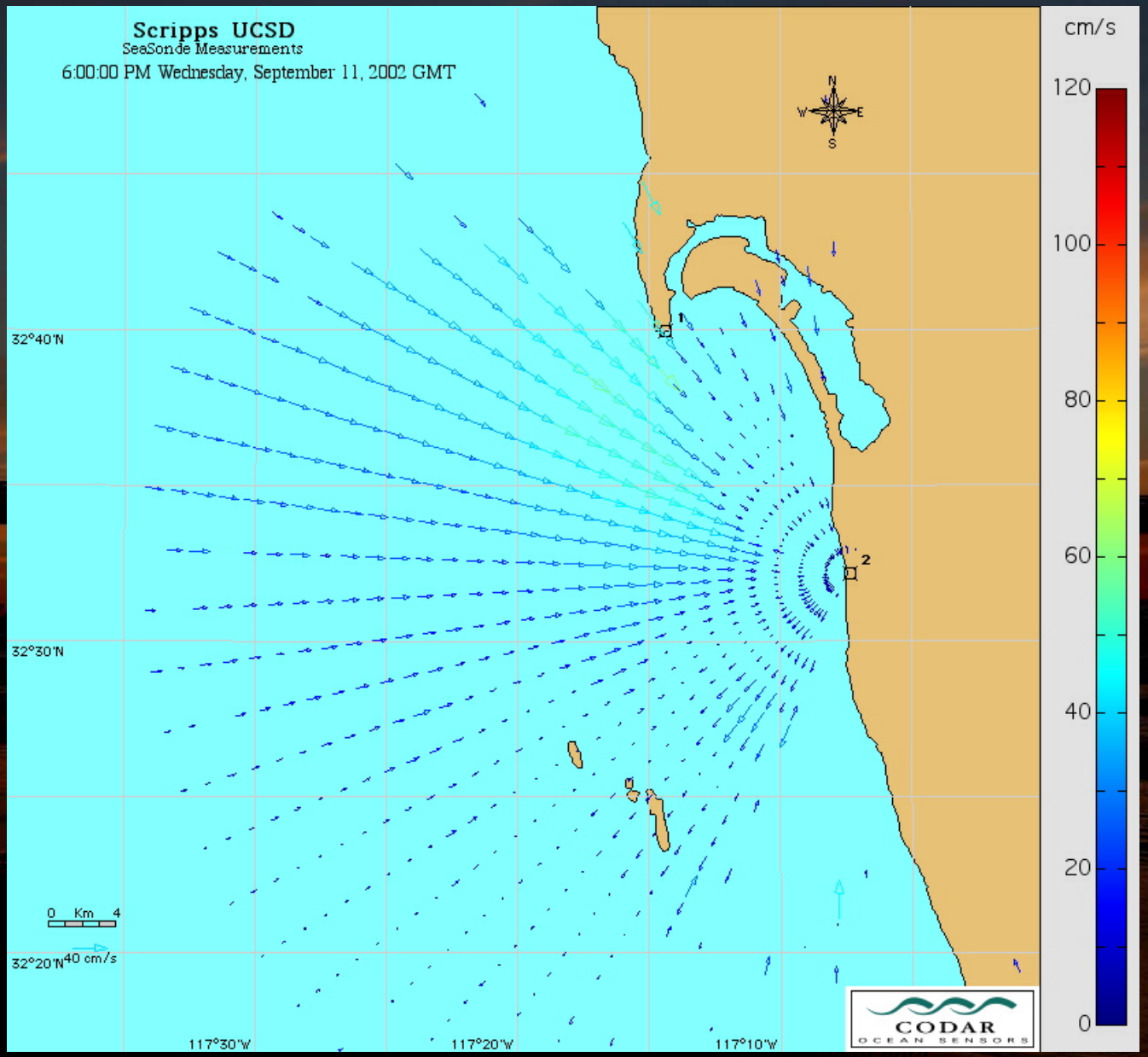


Seamless interface to data from these installations. Shown on the right is the height and direction of ocean waves on the coast of Imperial Beach.

Point Loma HF Radar site

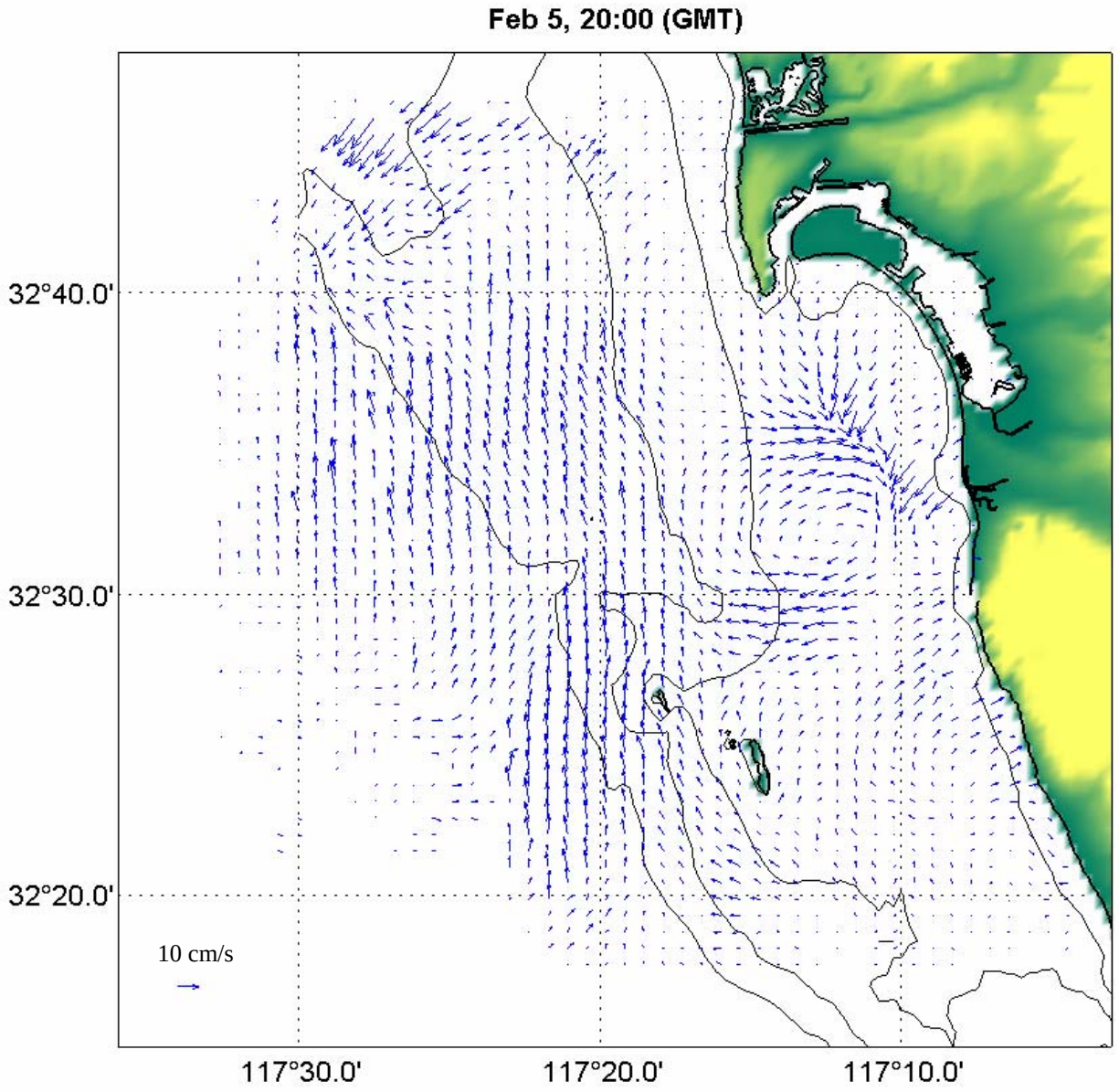
For mapping ocean currents

Example of radial velocities measured by a single radar site.



SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM

Binational observing system - working with colleagues at CICESE and UABC provides for expanded region of observations. Scripps facilitates the operation and communication to a Mexican owned radar site located at the PEMEX plant in Rosarito Beach.



24 hour average of data

Los Coronados Islands, MX

Installation of alternative power system for autonomous operation of the scientific instruments

SOUTH CORONADO ISLAND 5-17-55

Los Coronados Island station

Alternative power system for
scientific instruments

wireless I.P. connection to CICESE/UABC CODAR station at PEMEX facility, Rosarito Beach MX

SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM

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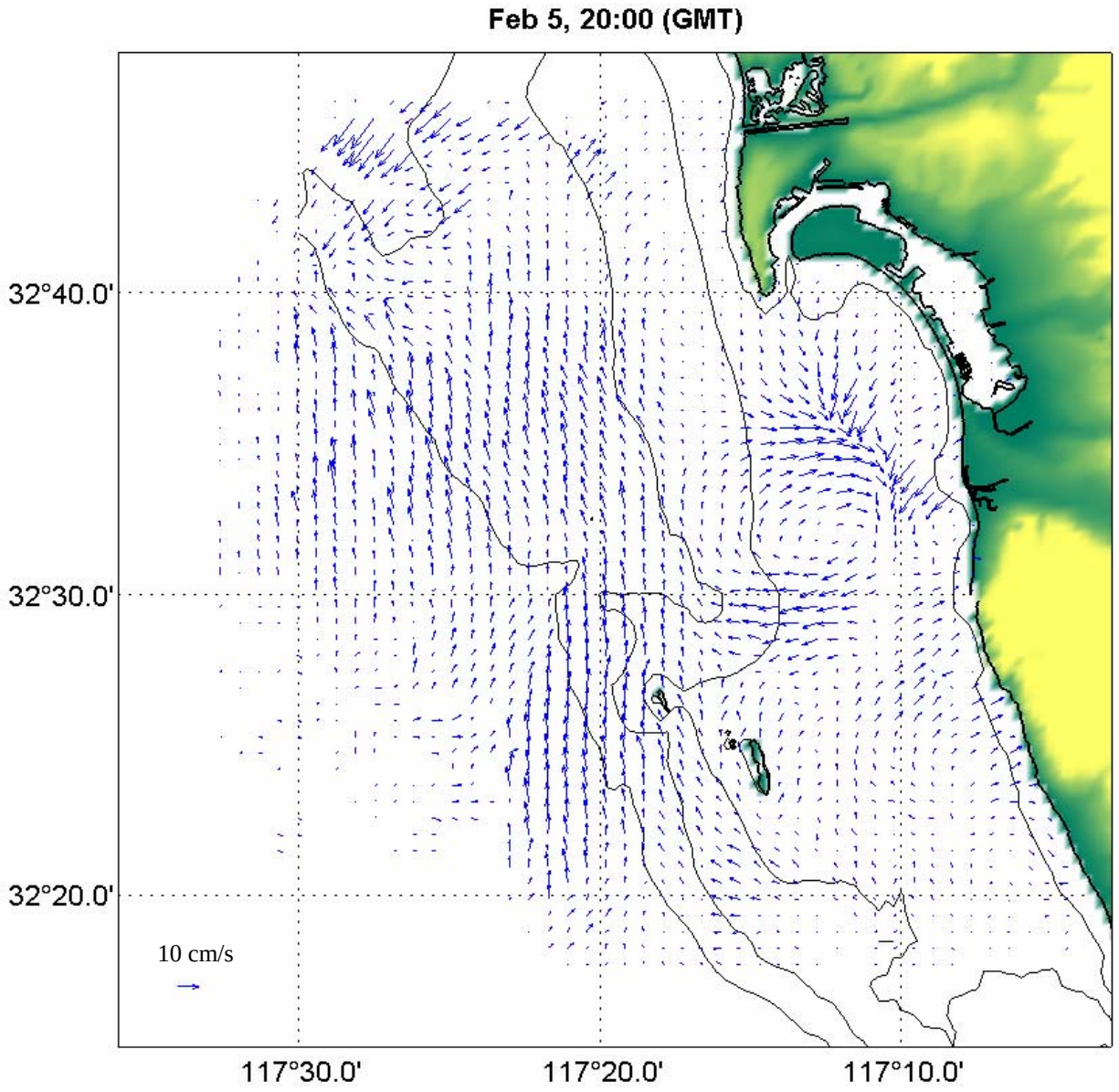
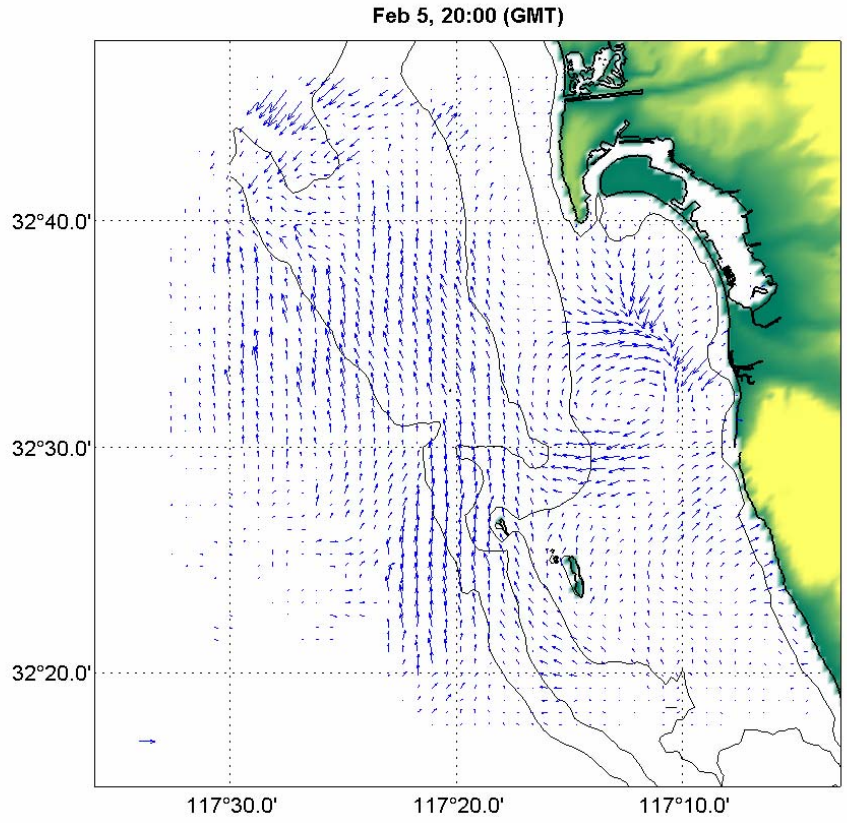


24 hour average of data

Current animation

trajectories



particle trajectory tracking research

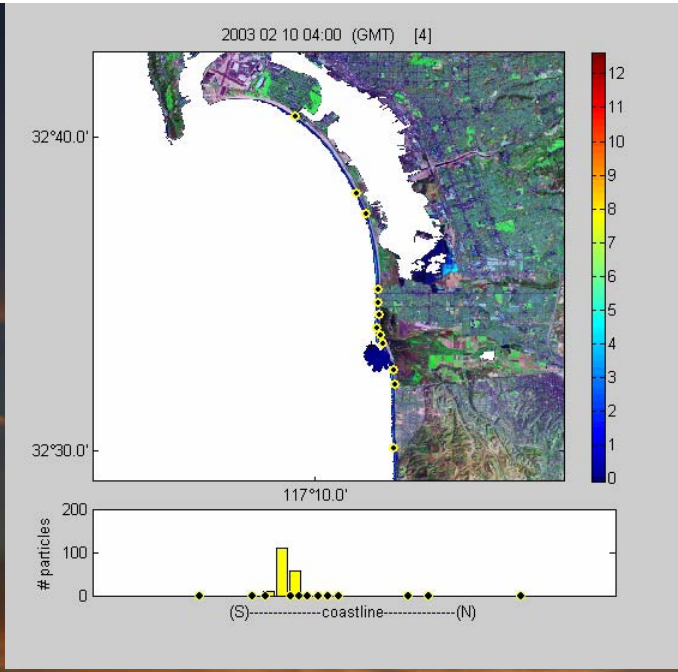
$$\begin{aligned} \mathbf{u}(\mathbf{x},t) &= \mathbf{u}(\mathbf{x},t) + u\cos\theta \\ \mathbf{v}(\mathbf{x},t) &= \mathbf{v}(\mathbf{x},t) + u\sin\theta \end{aligned}$$

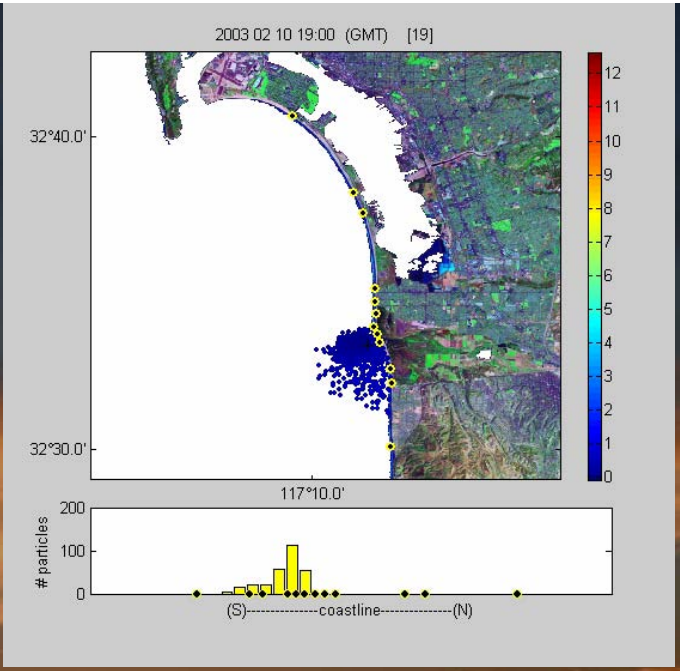
u : perturbation velocity$(= 5cm/s)$
θ : random angle.

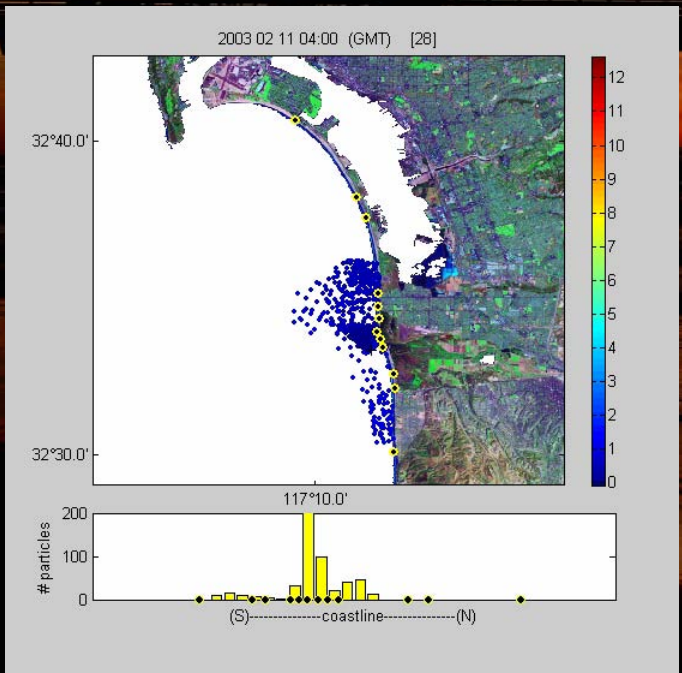
- Tijuana River Release
- offshore release

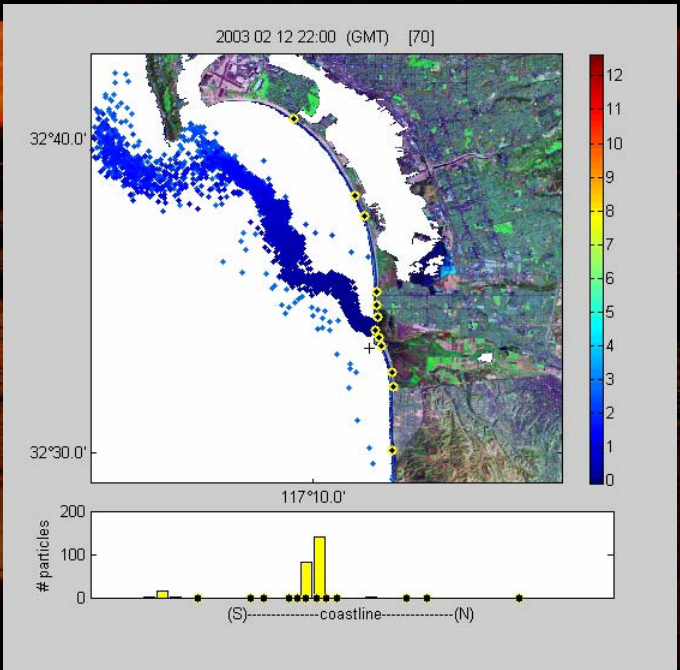
RESEARCH PROJECT:

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

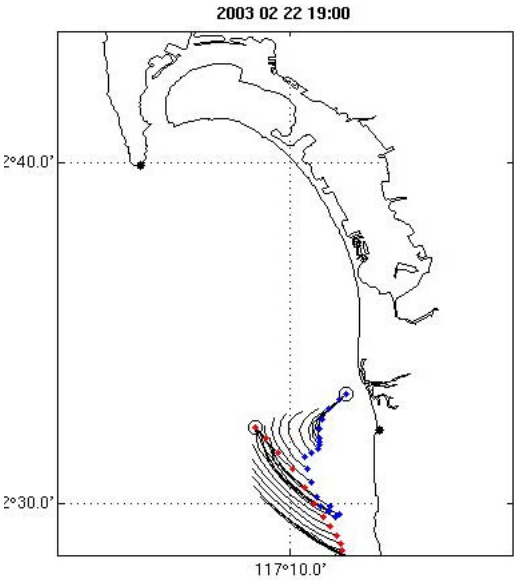


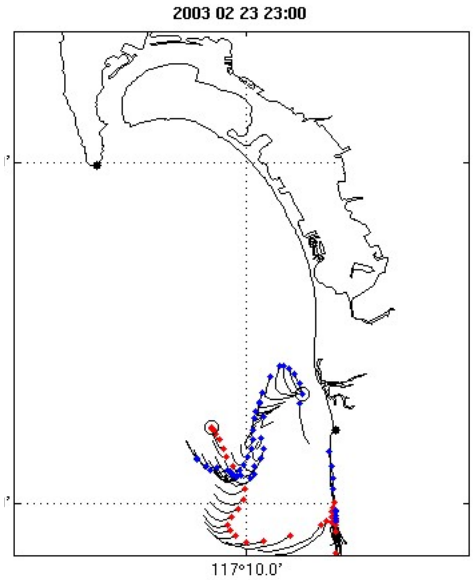


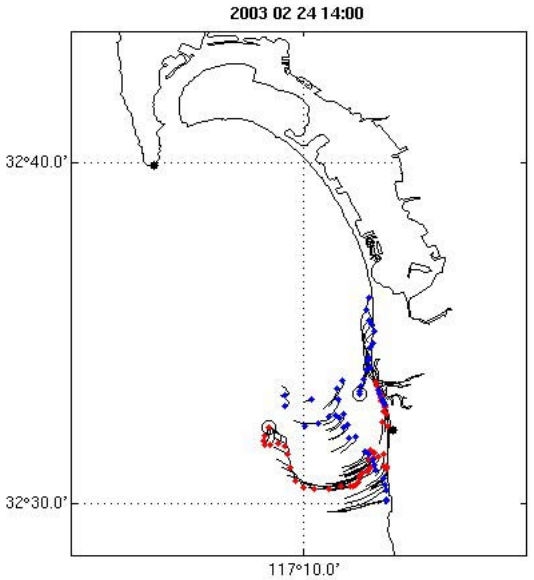


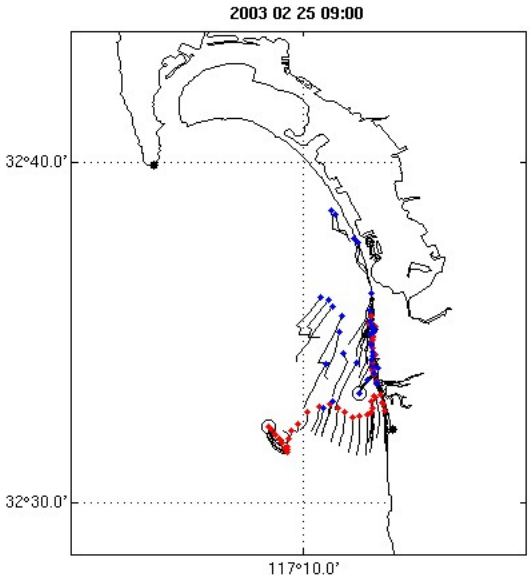


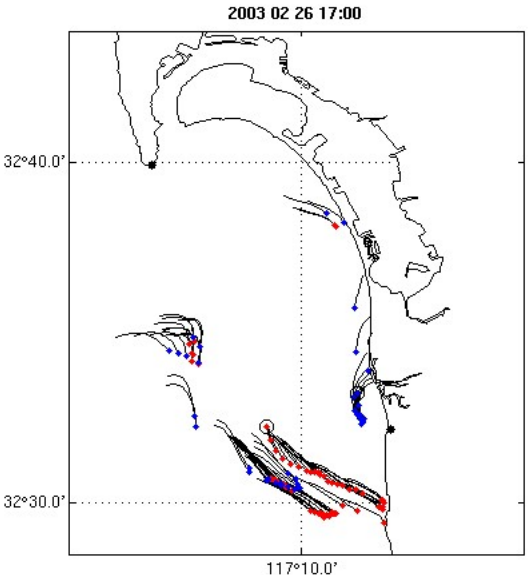
Research with trajectory analyses from HF radar used to understand fate and transport







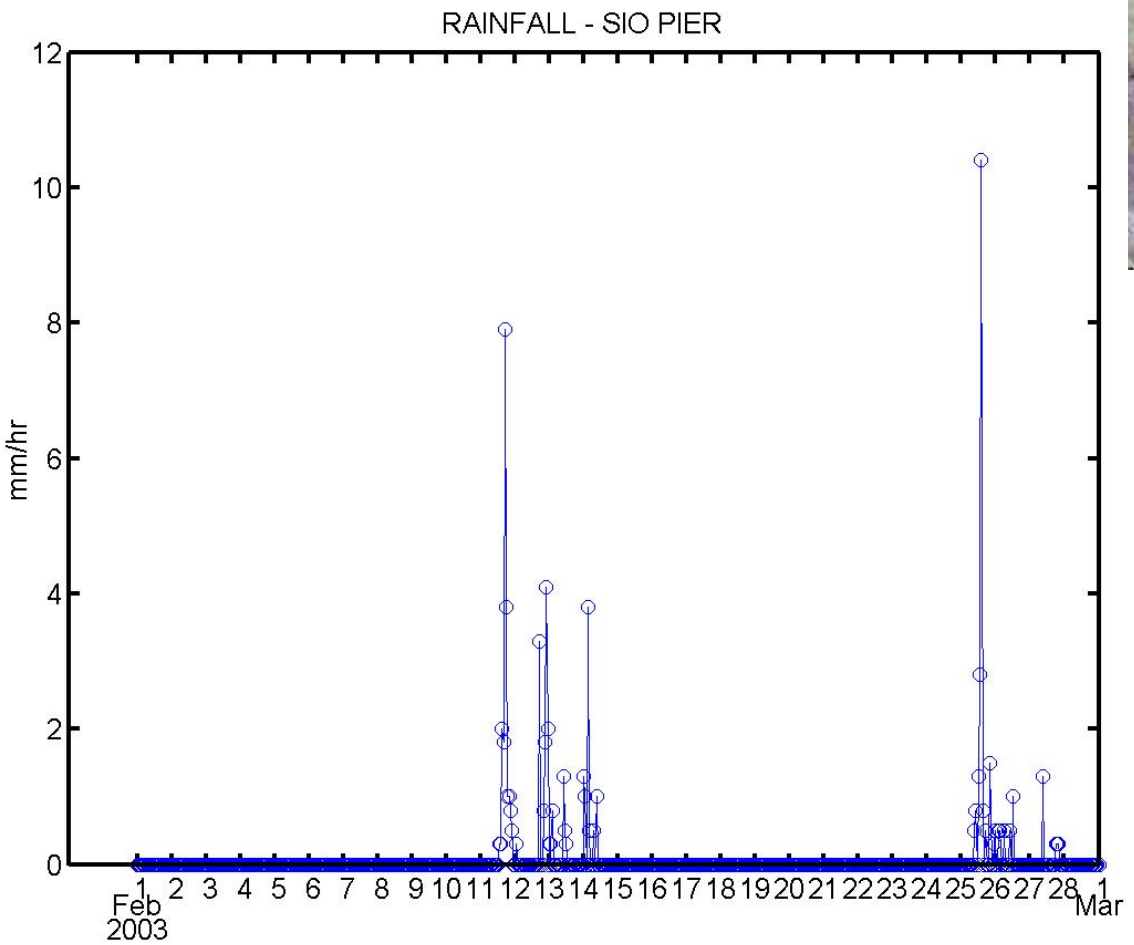




SOUTHERN CALIFORNIA COASTAL OCEAN OBSERVING SYSTEM

Making the connection to end-users:

Run-off, transport, and their influence on water quality.



TJ River Watershed

Linking the transport to the WQ stations sampled by the County DEH
February 18, 2003

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- OVERVIEW
- OCEAN DATA
- WEATHER
- WEB CAM
- SATELLITE IMAGES
- WATER QUALITY

DATA

Water Quality

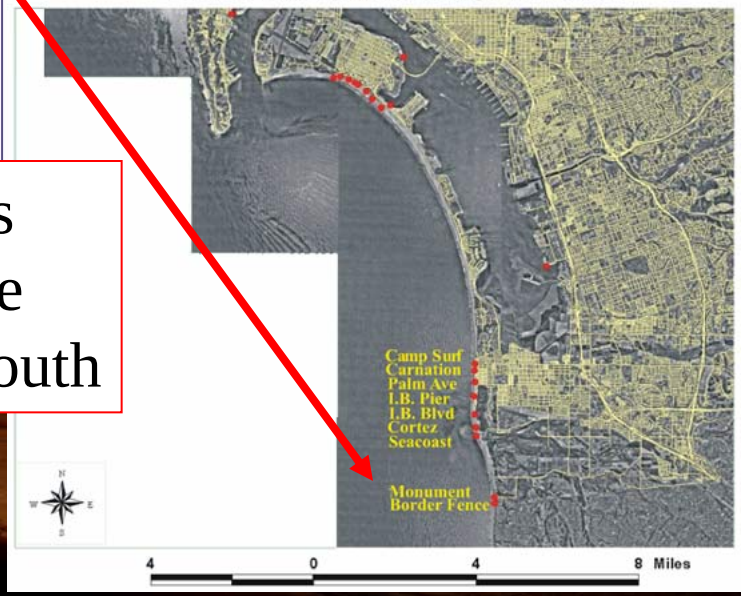
Site Location	Date	Total Coli	Fecal Coli	Enterococci
"Border Fence, N side"	02-18-2003	> 16000 CFU/100ml	e 400 CFU/100ml	e 800 CFU/100ml
Monument Rd.	02-18-2003	> 16000 CFU/100ml	= 1000 CFU/100ml	e 300 CFU/100ml
Tijuana Rivermouth	02-21-2003	= 1100 MPN/100ml	= 130 MPN/100ml	= 42 MPN/100ml
End of Seacoast Dr	02-21-2003	< 20 MPN/100ml	< 20 MPN/100ml	= 20 MPN/100ml
Carnation Ave.	02-22-2003	= 20 MPN/100ml	= 20 MPN/100ml	= 42 MPN/100ml
Avd. del Sol	02-20-2003	= 80 MPN/100ml	= 80 MPN/100ml	= 31 MPN/100ml
Palm Ave	02-22-2003	< 20 MPN/100ml	< 20 MPN/100ml	< 10 MPN/100ml

Single Sample standards

Total Coliforms - 10,000 organisms per 100 ml. sample
Fecal Coliforms - 400 organisms per 100 ml. sample
Enterococci - 104 organisms per 100 ml. sample
Fecal:Total ratio -if total coliforms >1,000 & ratio > 0.1

High levels south of the TJ river mouth

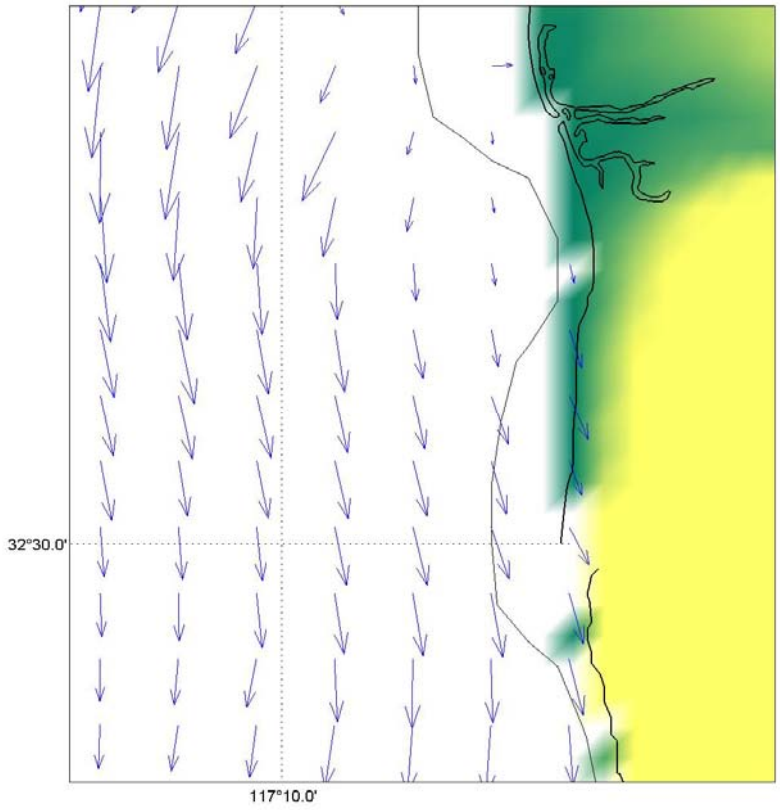
South County Monitoring Locations



Southern California Coastal Ocean Observing System

Southward currents dominant during the 2/18/03 time period.

High counts south of TJ River.



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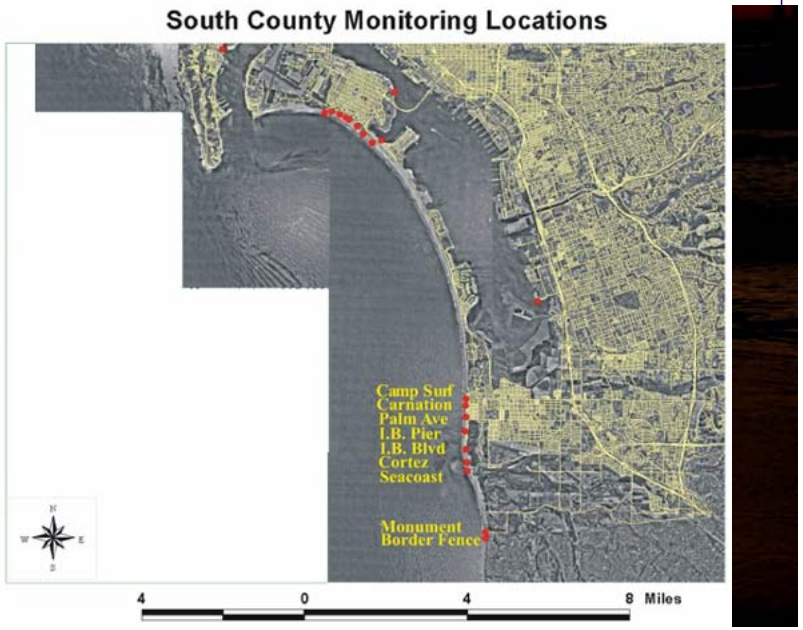
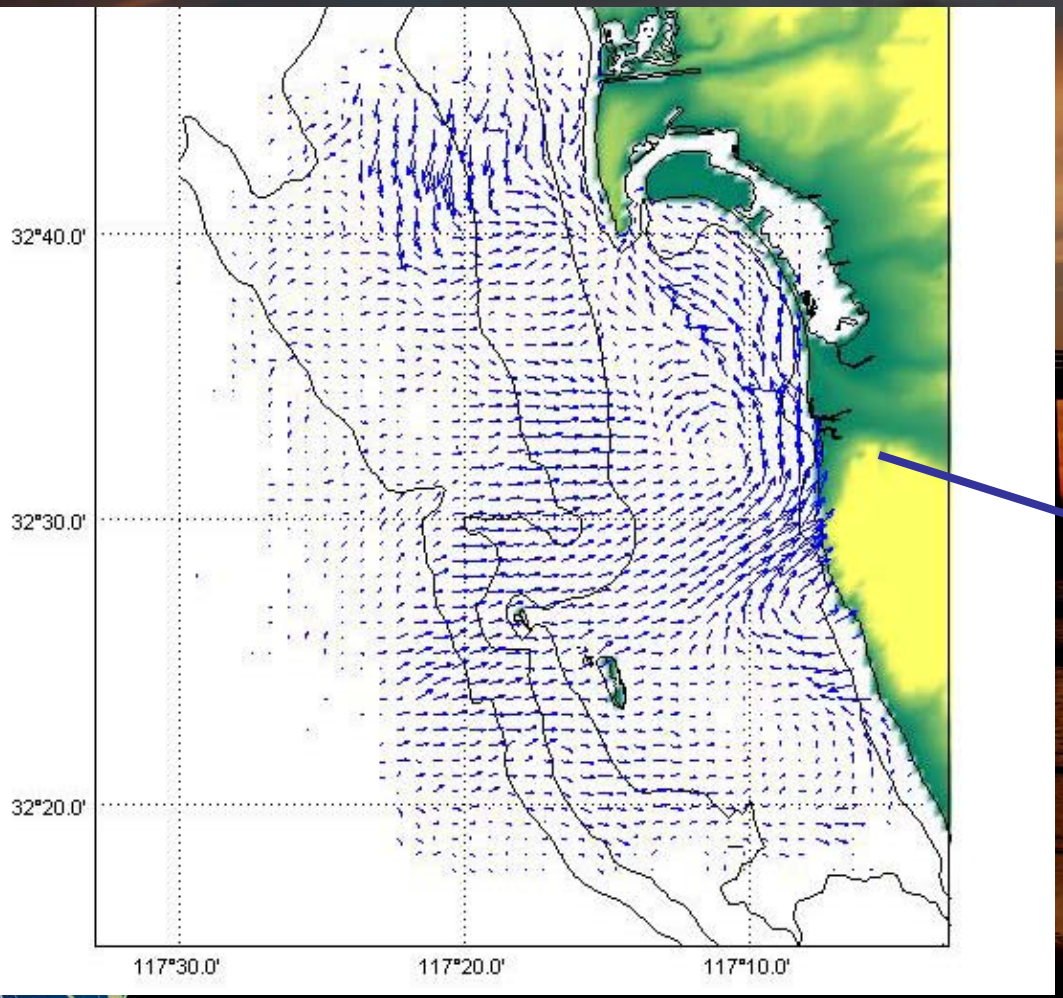
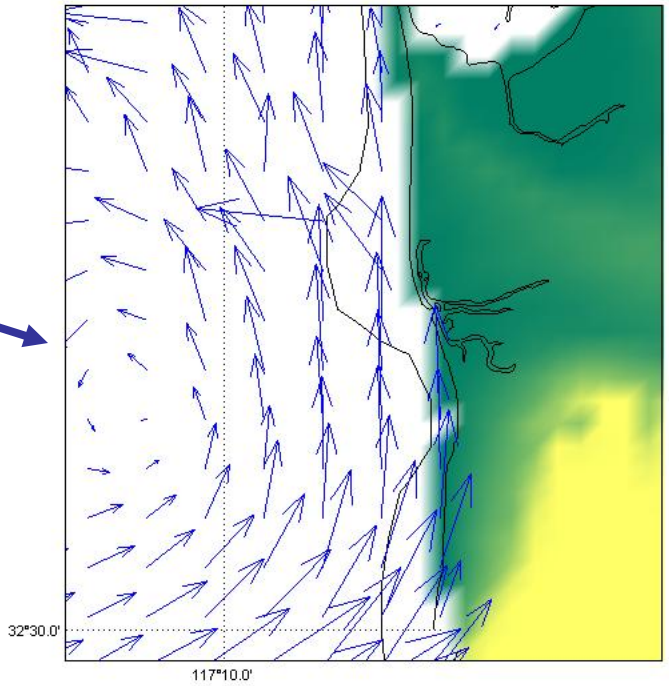
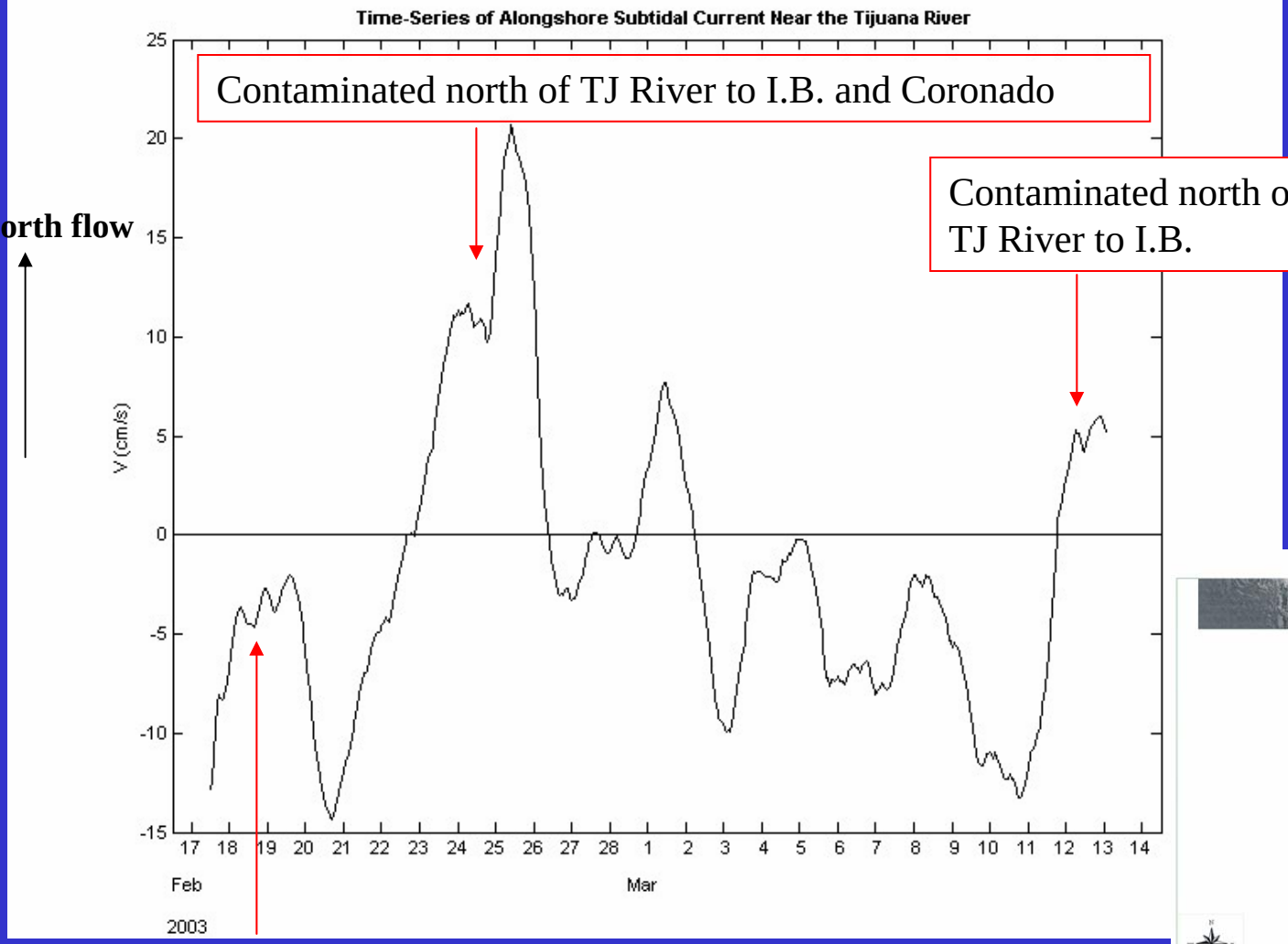


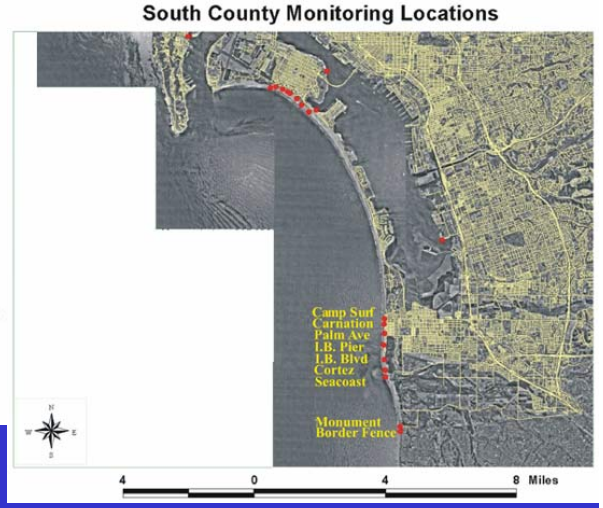
24hr averaged ocean currents, 2/25/03

Northward flow present during the time period of high counts in Imperial Beach, City of Coronado.

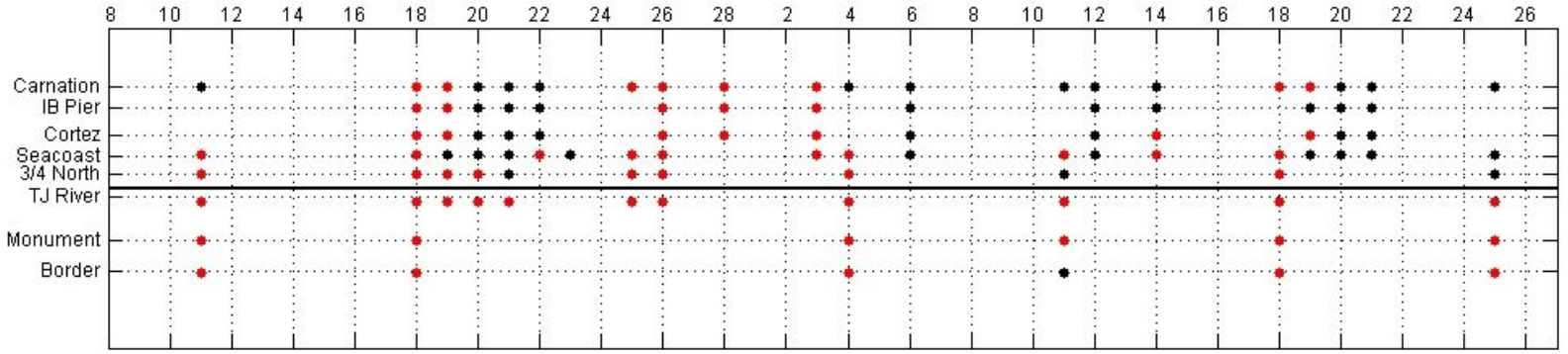




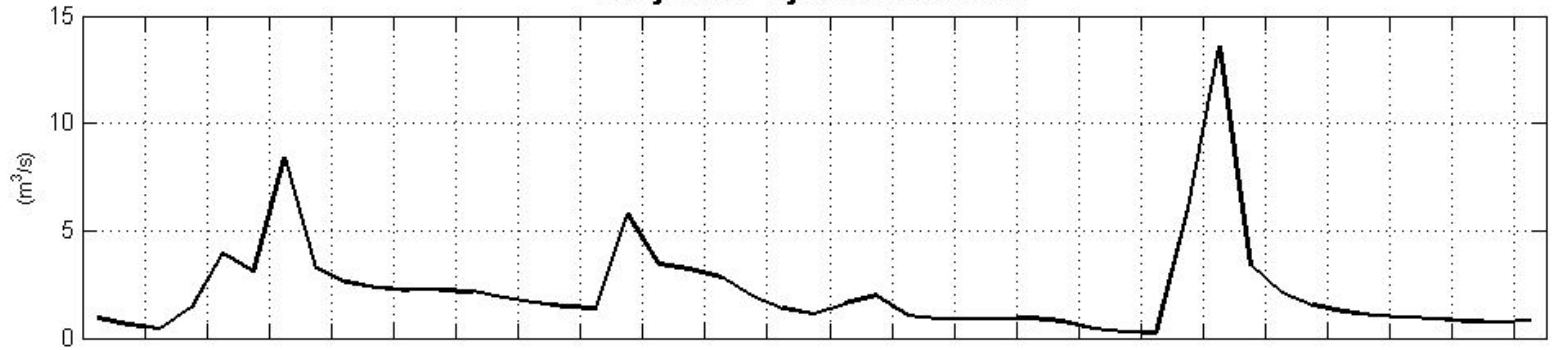

Time-Series of Alongshore Subtidal Current Near the Tijuana River
Contaminated north of TJ River to I.B. and Coronado
Contaminated north of TJ River to I.B.
north flow
V (cm/s)
25
20
15
10
5
0
-5
-10
-15
17 18 19 20 21 22 23 24 25 26 27 28 1 2 3 4 5 6 7 8 9 10 11 12 13 14
Feb
Mar
2003
Contaminated south of the TJ River, clean to the north


South County Monitoring Locations
Camp Surf
Carnation
Palm Ave
I.B. Pier
I.B. Blvd
Cortez
Seacoast
Monument
Border Fence
4 0 4 8 Miles

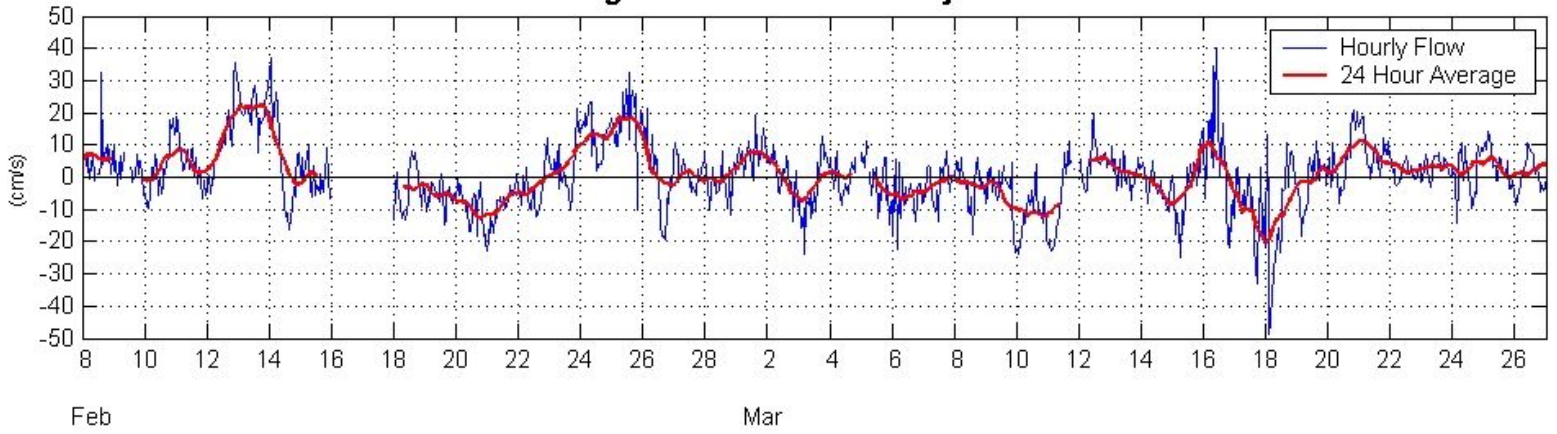
AB411 Exceedences

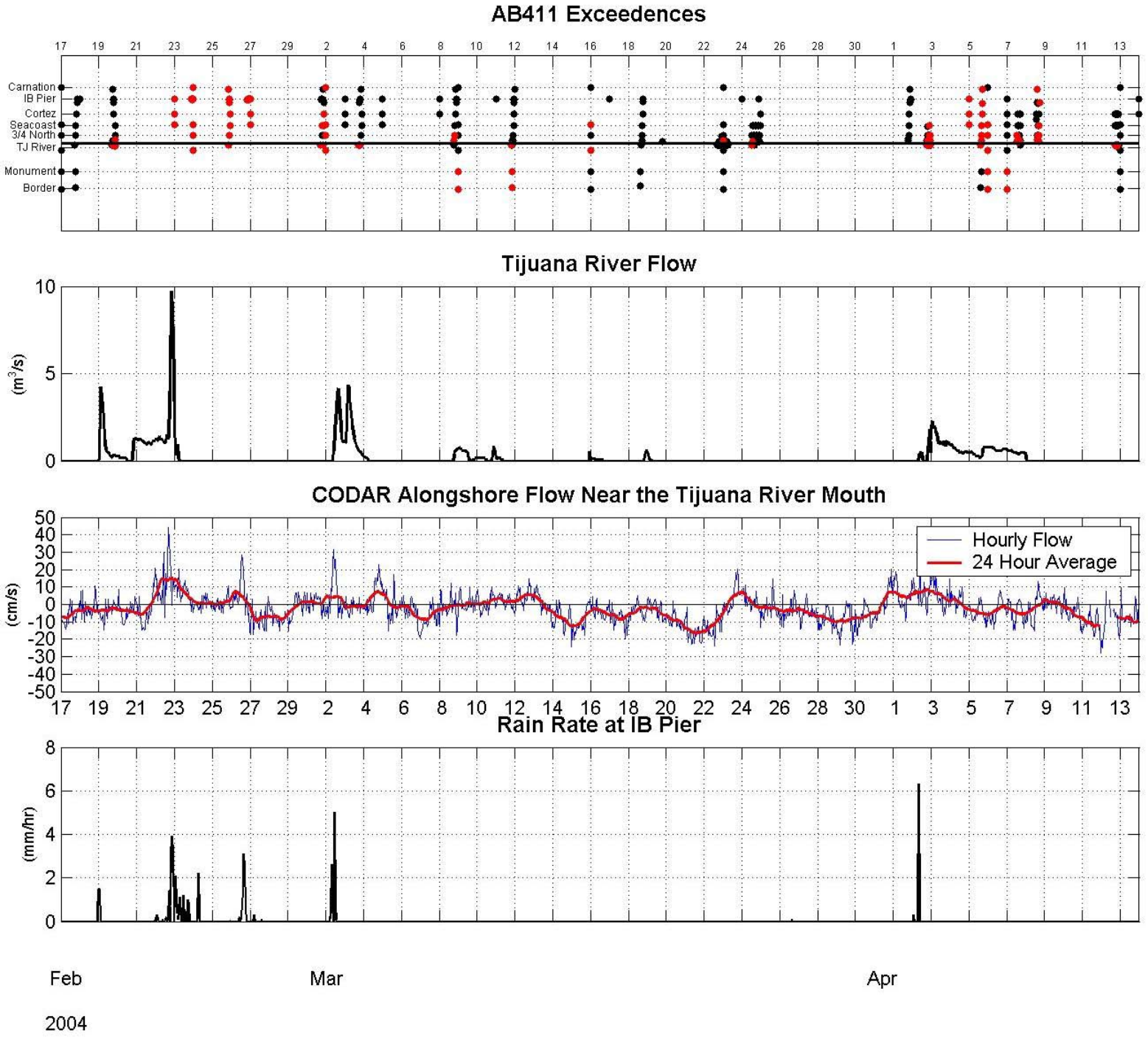


Daily Mean Tijuana River Flow



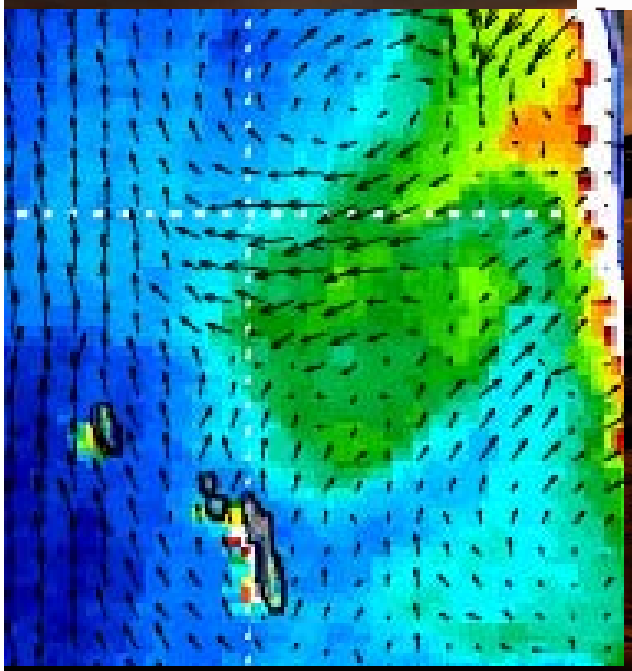
CODAR Alongshore Flow Near the Tijuana River Mouth

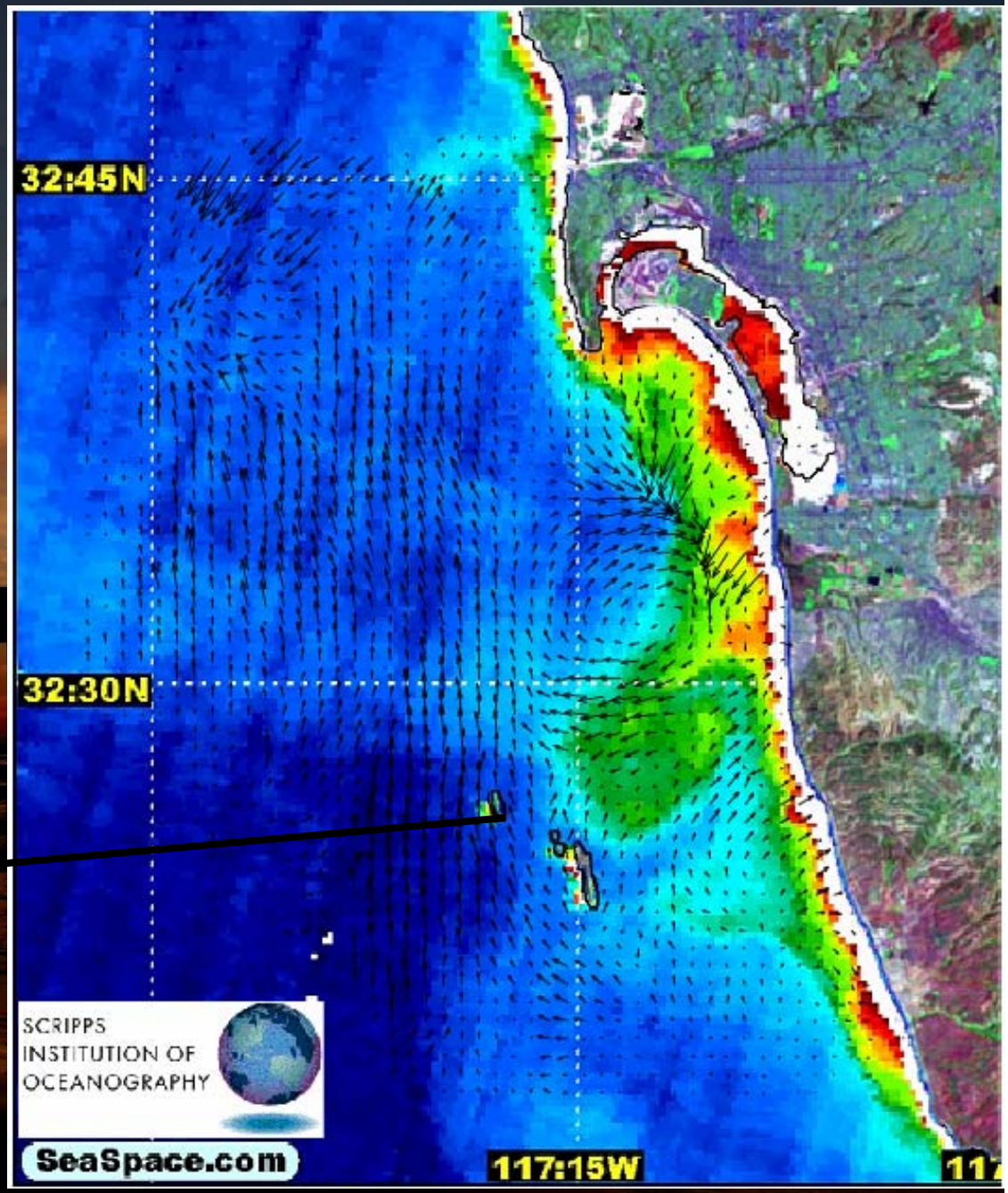


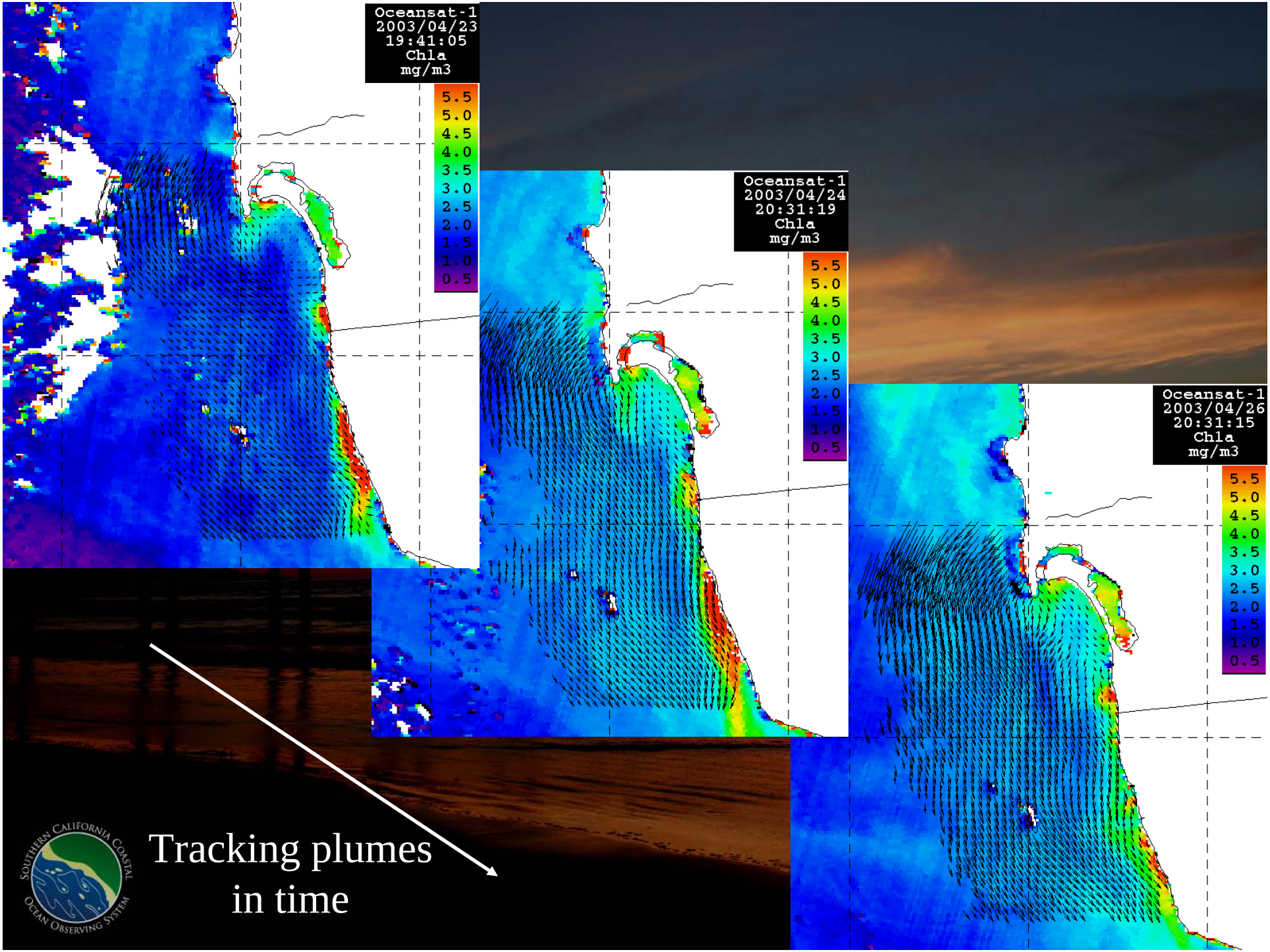

AB411 Exceedences
Carnation
IB Pier
Cortez
Seacoast
3/4 North
TJ River
Monument
Border
Tijuana River Flow
(m3/s)
CODAR Alongshore Flow Near the Tijuana River Mouth
(cm/s)
Hourly Flow
24 Hour Average
Rain Rate at IB Pier
(mm/hr)
Feb
Mar
Apr
2004

Combination of HF RADAR CURRENTS with OCEAN COLOR satellite data

2/5/03



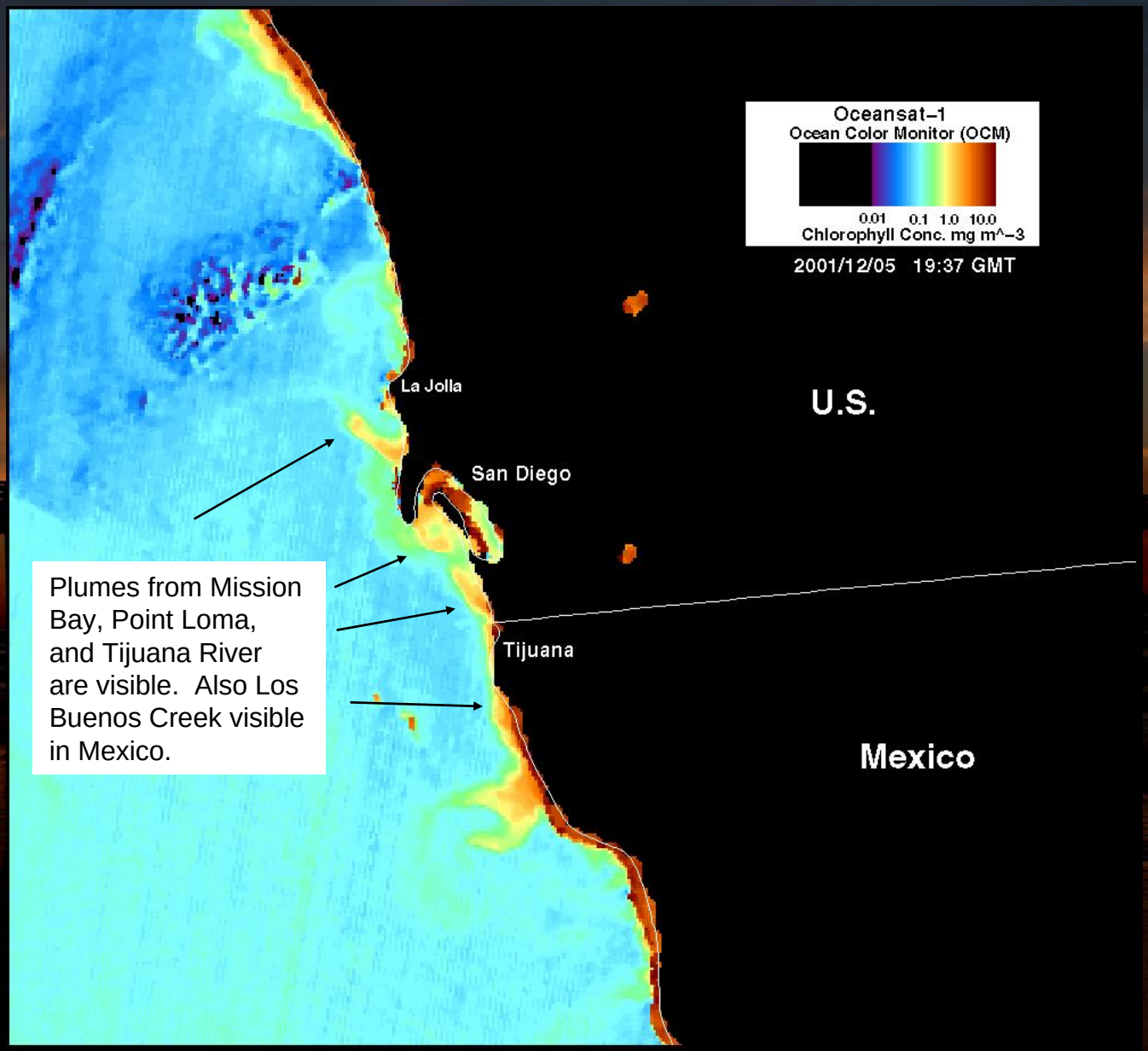


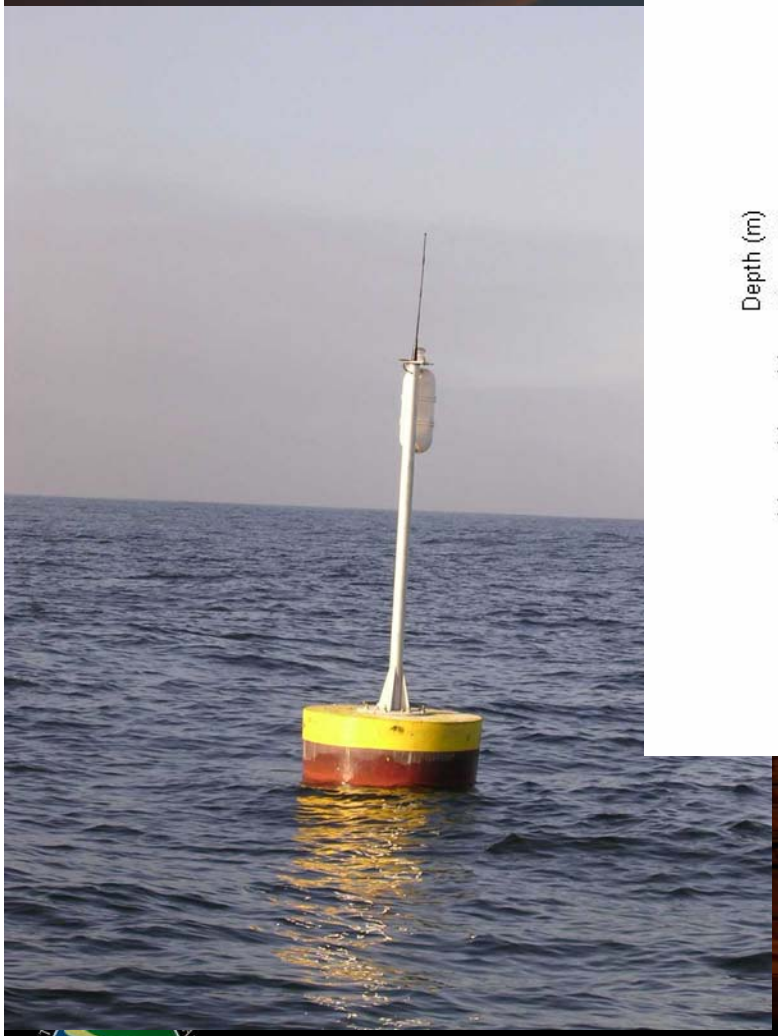

Oceansat-1
2003/04/23
19:41:05
Chla
mg/m3
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Oceansat-1
2003/04/24
20:31:19
Chla
mg/m3
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Oceansat-1
2003/04/26
20:31:15
Chla
mg/m3
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
Tracking plumes
in time
Southern California Coastal Ocean Observing System

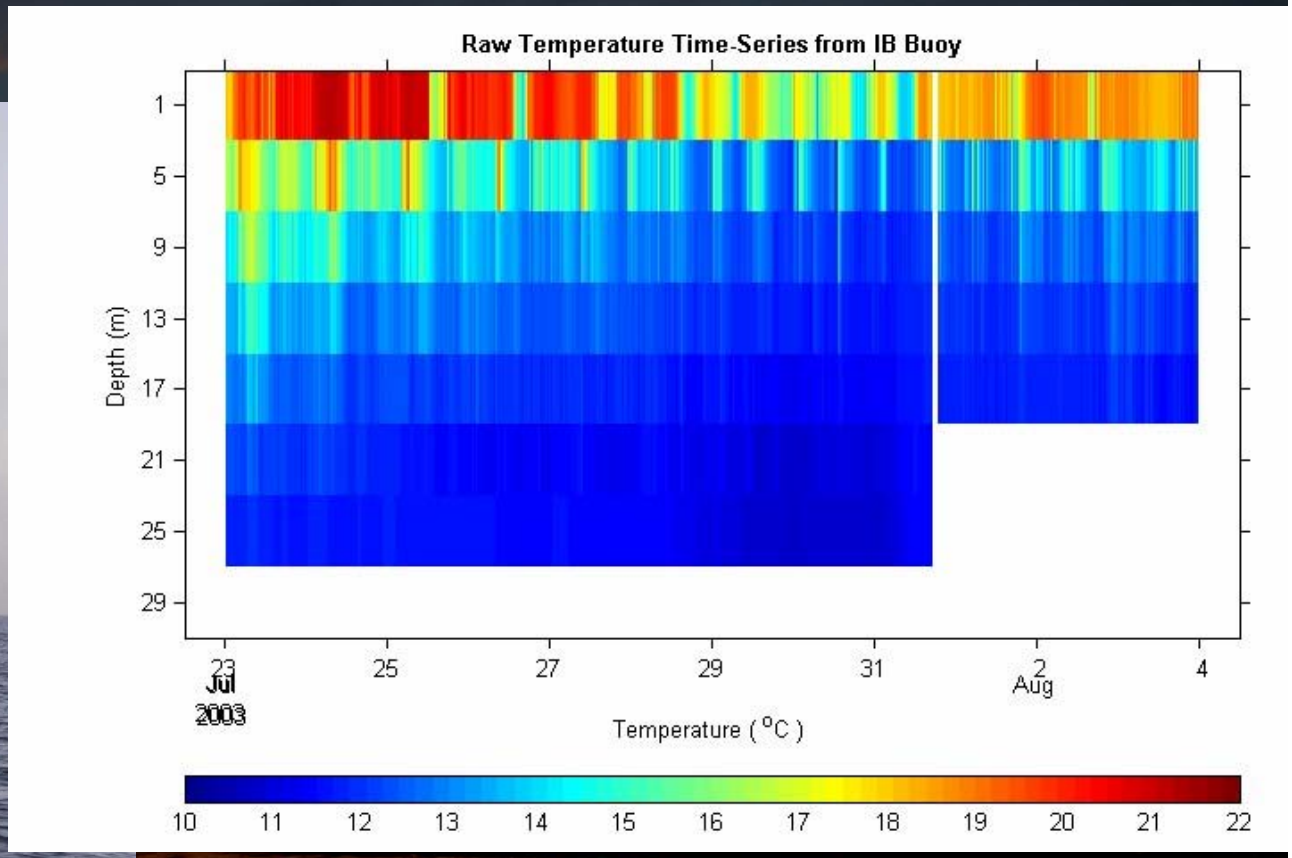
Integrate satellite remote sensing

OCM SENSOR

- *300m resolution*
- *available daily*
- *SEAWIFS bands*



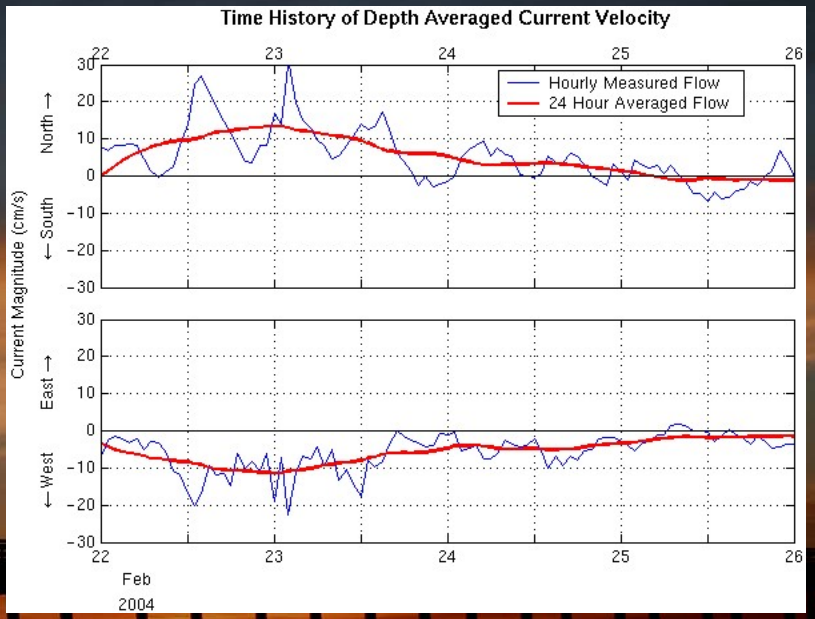


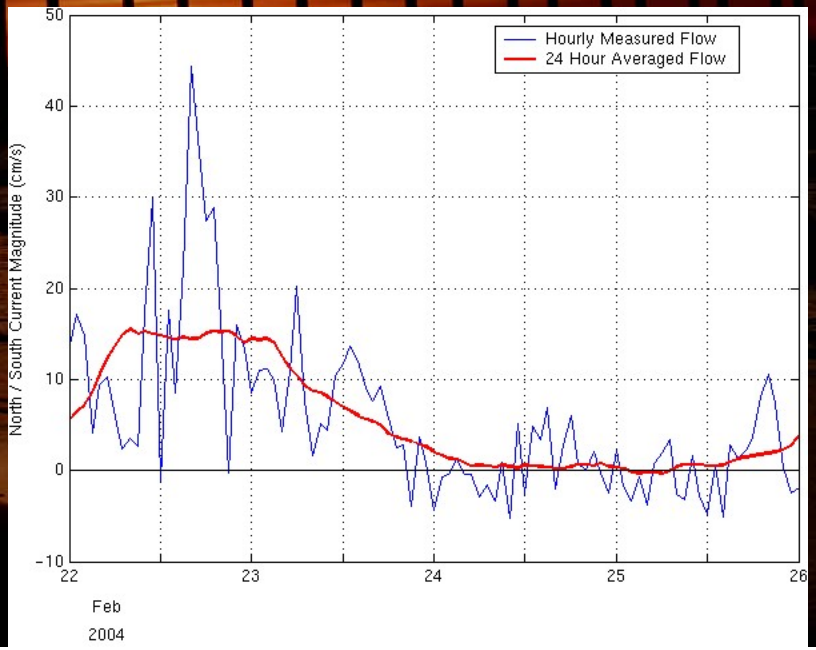

Raw Temperature Time-Series from IB Buoy
Depth (m)
1
5
9
13
17
21
25
29
23
Jul
2003
25
27
29
31
2
Aug
4
Temperature (°C)
10
11
12
13
14
15
16
17
18
19
20
21
22

Nearshore currents - northward flow during and after the rainfall event (heavy rains on the 22nd)

top: acoustic current meter data from City of Imperial Beach Pier

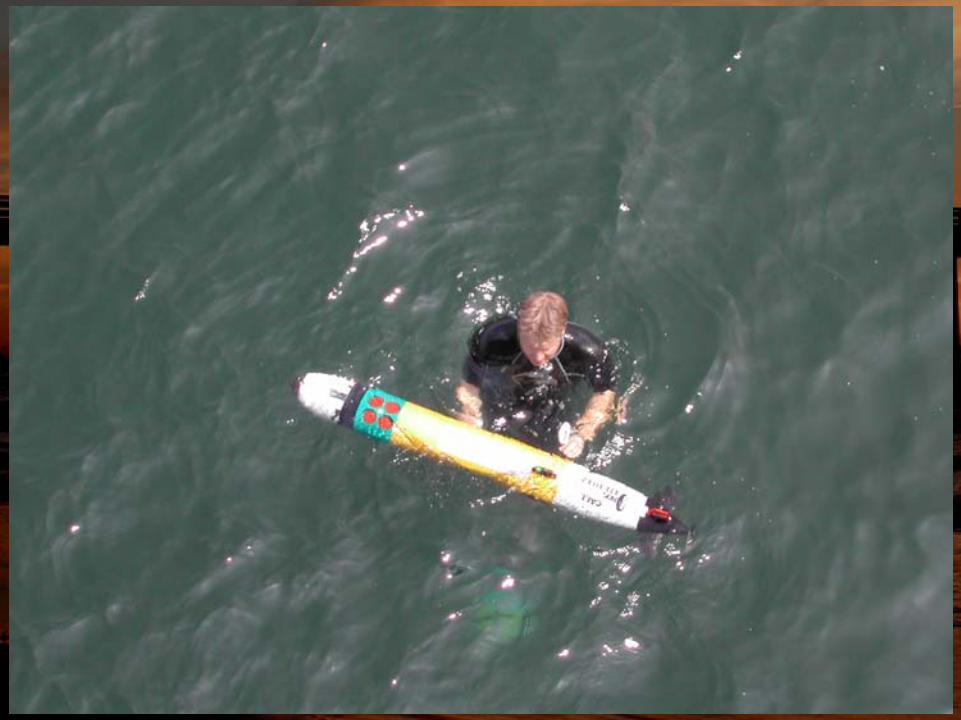
bottom: HF radar derived currents at mouth of TJ river





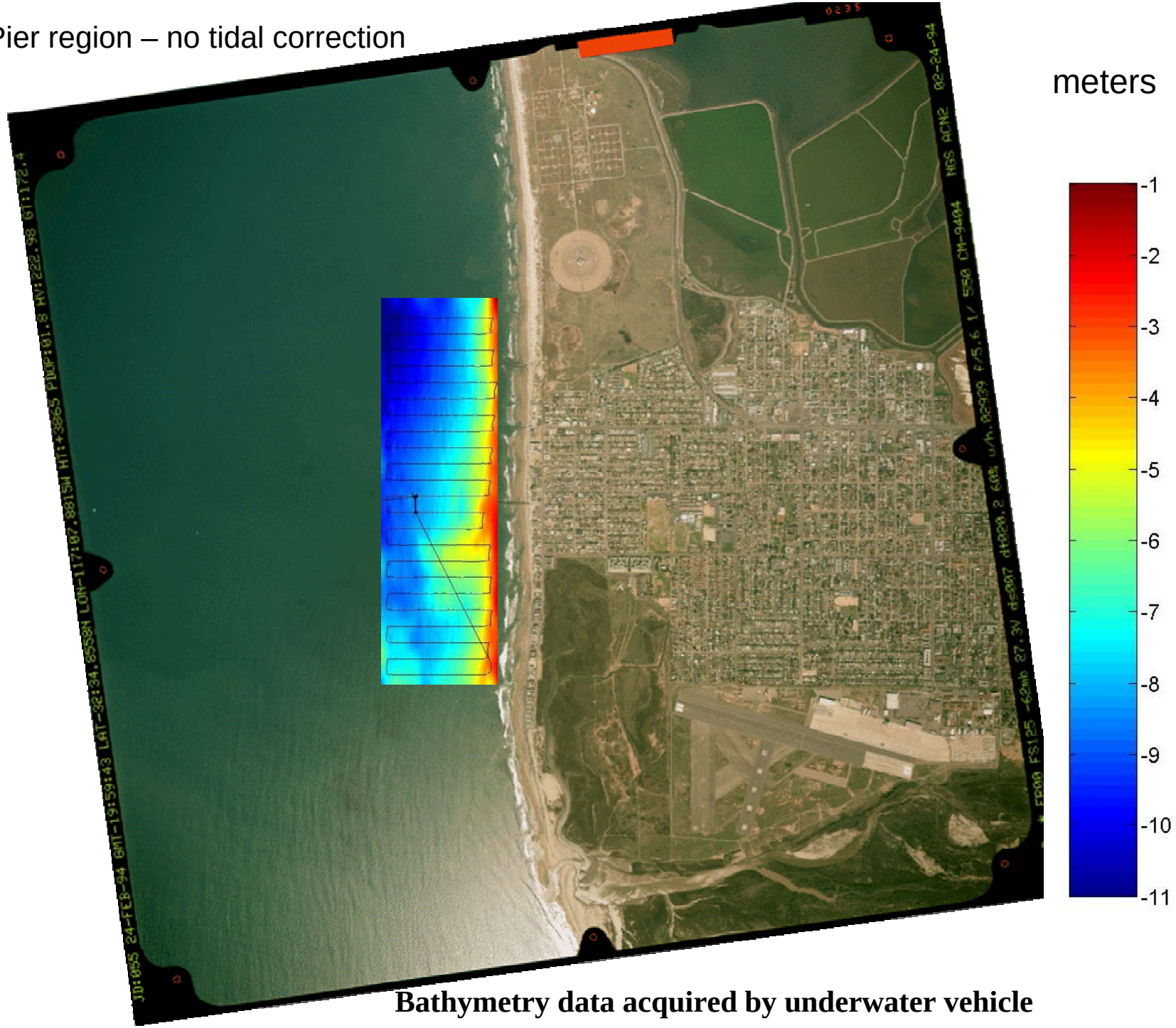
Continued usage of Imperial Beach region as an area for science and technology development.

Example: underwater swimming robot.

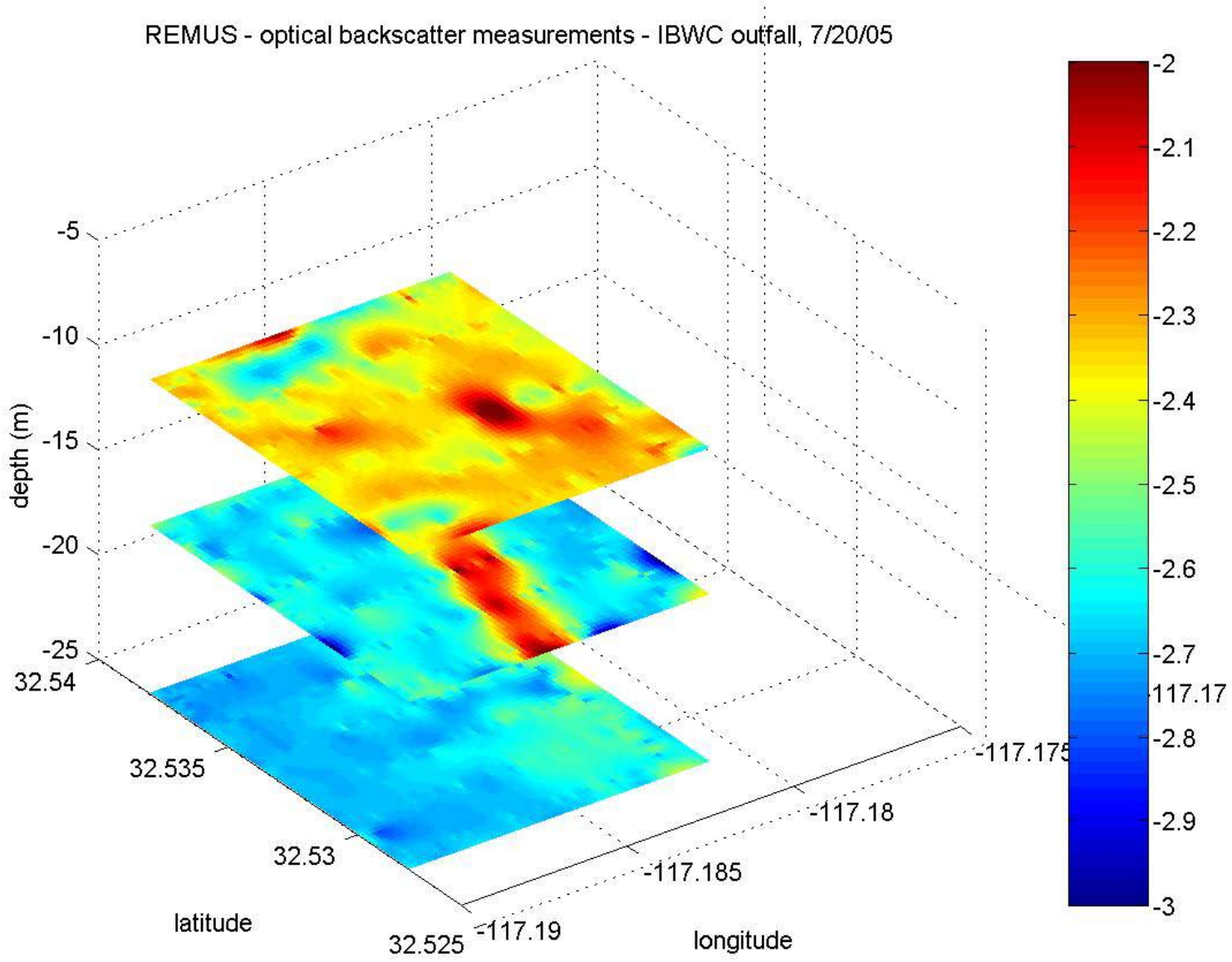


System deployed by Dr. Mark Moline, Cal Poly San Luis Obisbo.

IB Pier region – no tidal correction



Bathymetry data acquired by underwater vehicle



Robot can be used to map plume field of local outfall.

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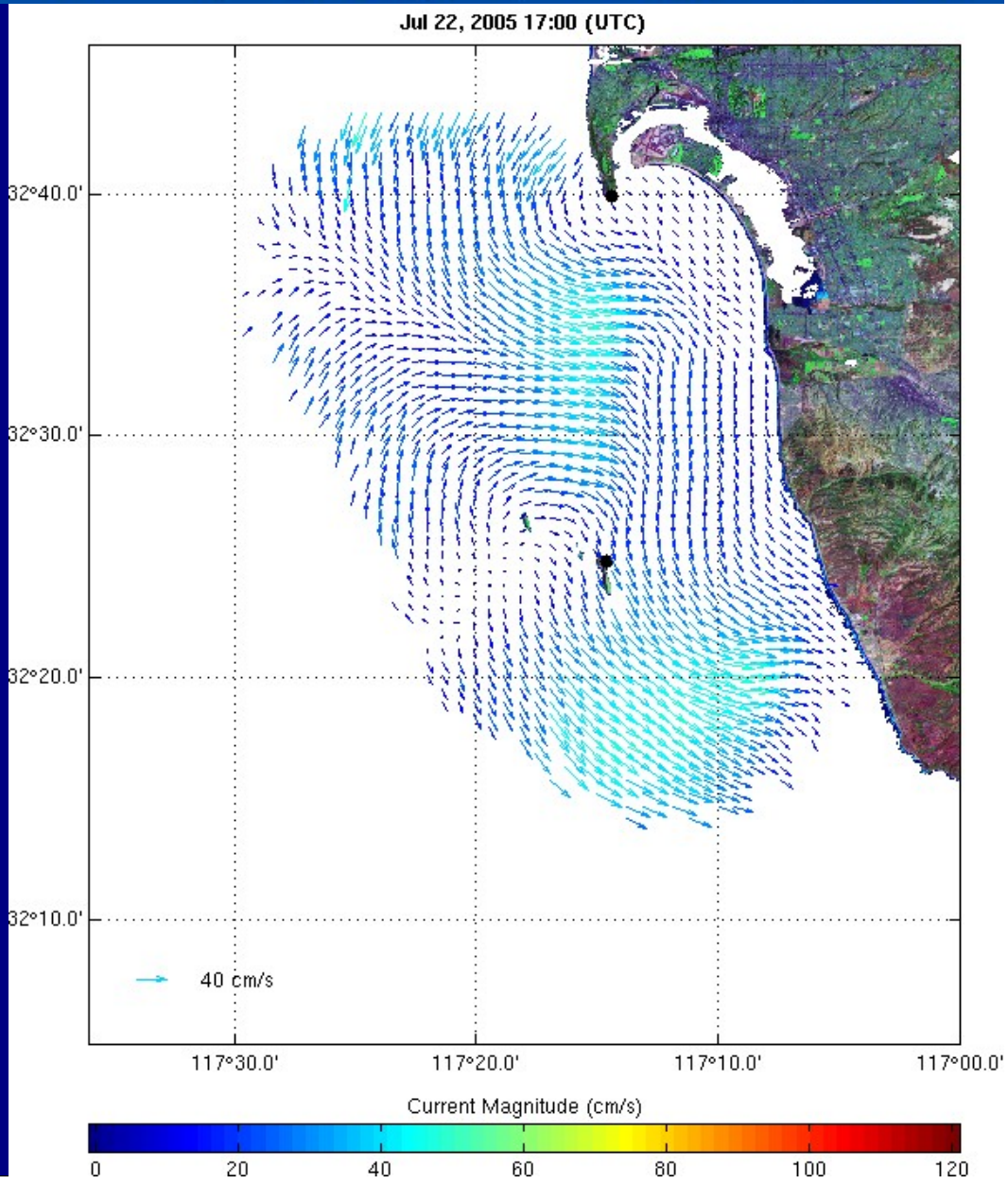
Website designed to distribute data to users.

www.sdcoos.org



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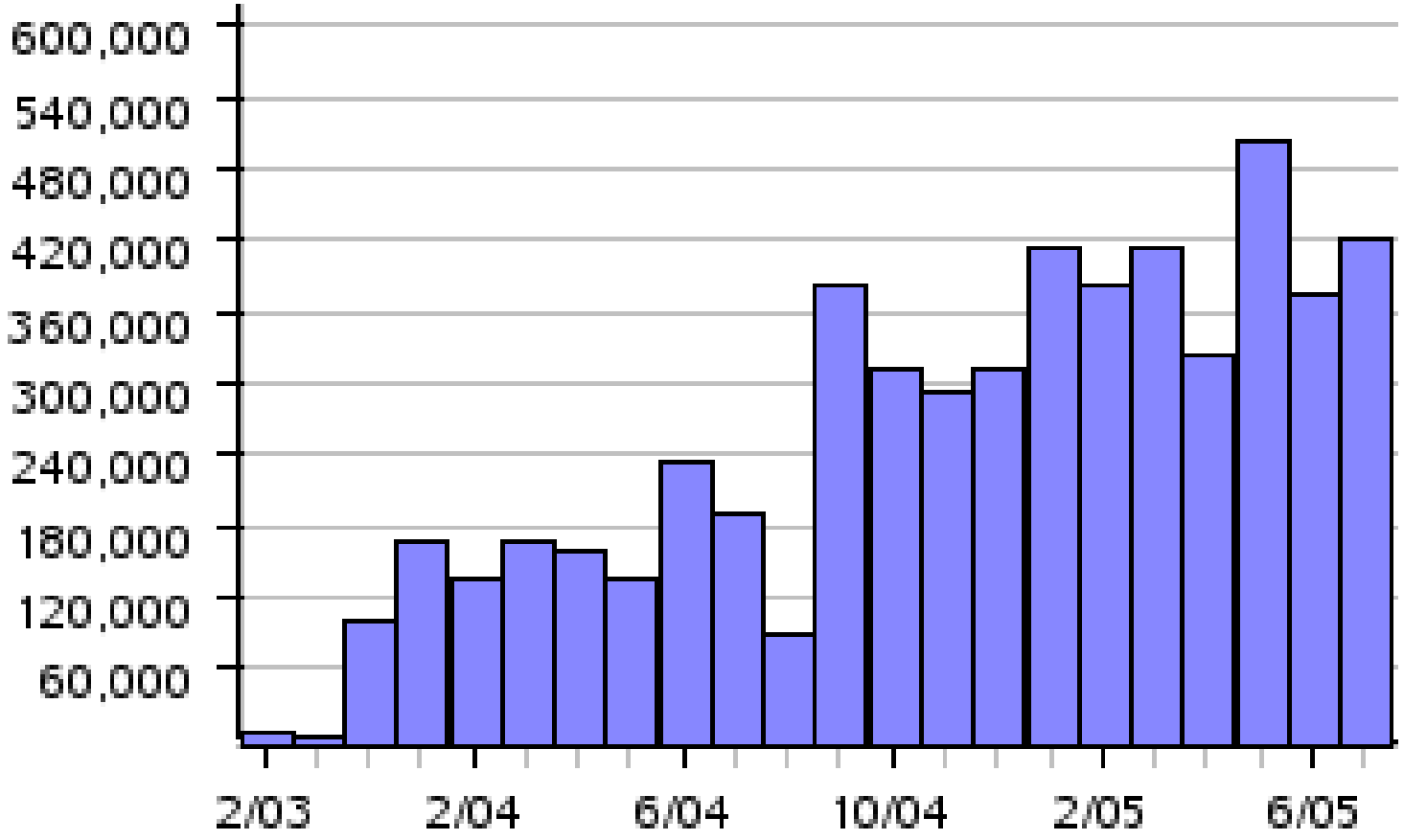
www.sdcoos.ucsd.edu usage statistics



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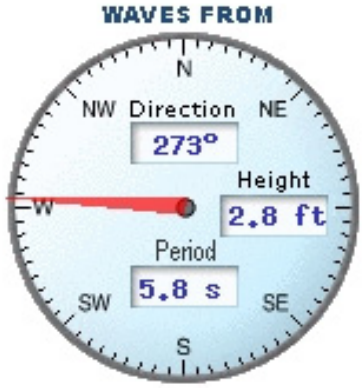
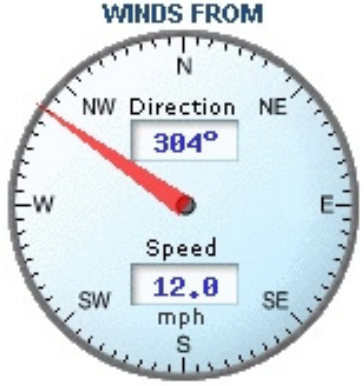
SAN DIEGO COASTAL OCEAN OBSERVING SYSTEM

Meteorological Data

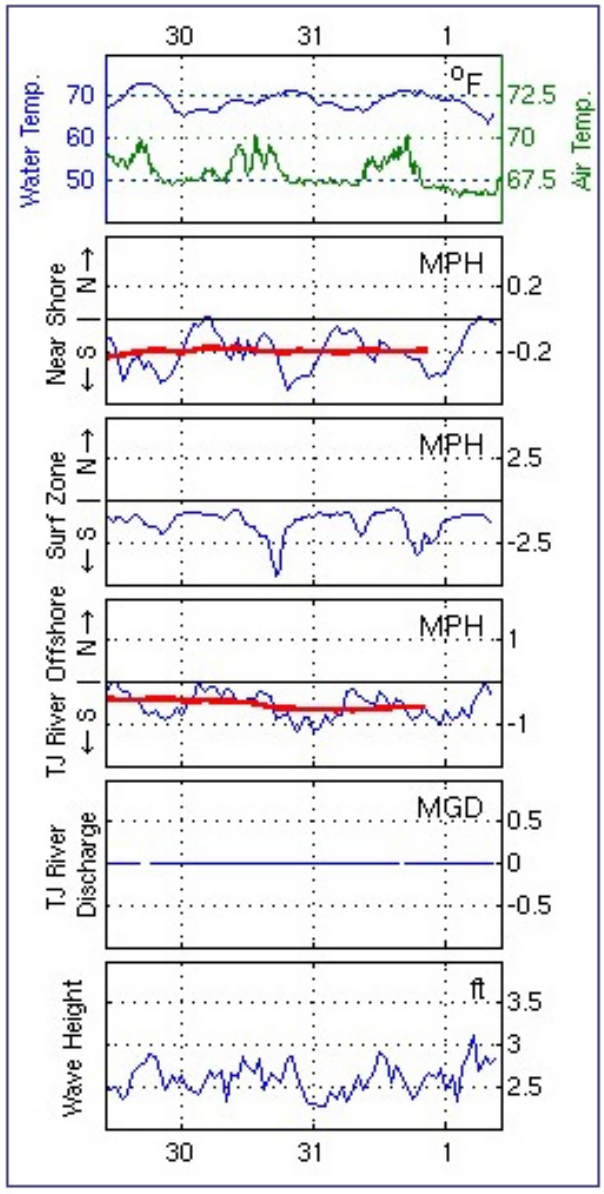


Water Temp	65.6 °F
Air Temp	68.3 °F
Air Pressure	1015.0 hPa
UV Index	5.5
Humidity	84.4 %
Rain Rate	0.0 in/hr

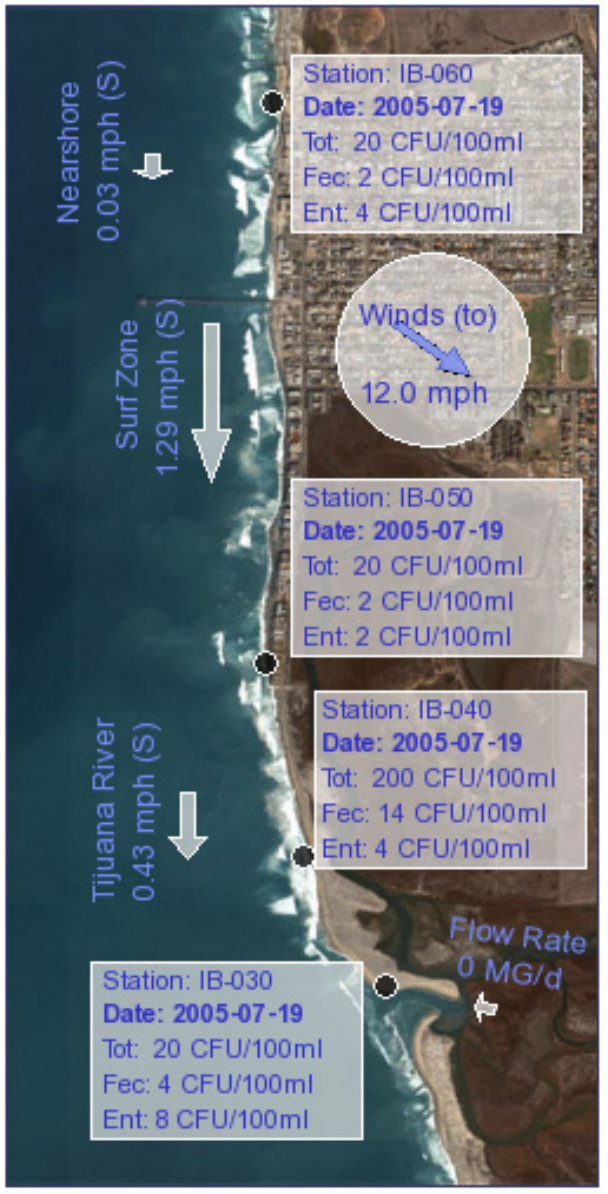


UTC Time: 2005-08-01, 17:27:50
Pacific Time: 2005-08-01, 10:27:50

Recent Time-Series Data



Imperial Beach Shoreline Conditions



DATA

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OCEAN DATA

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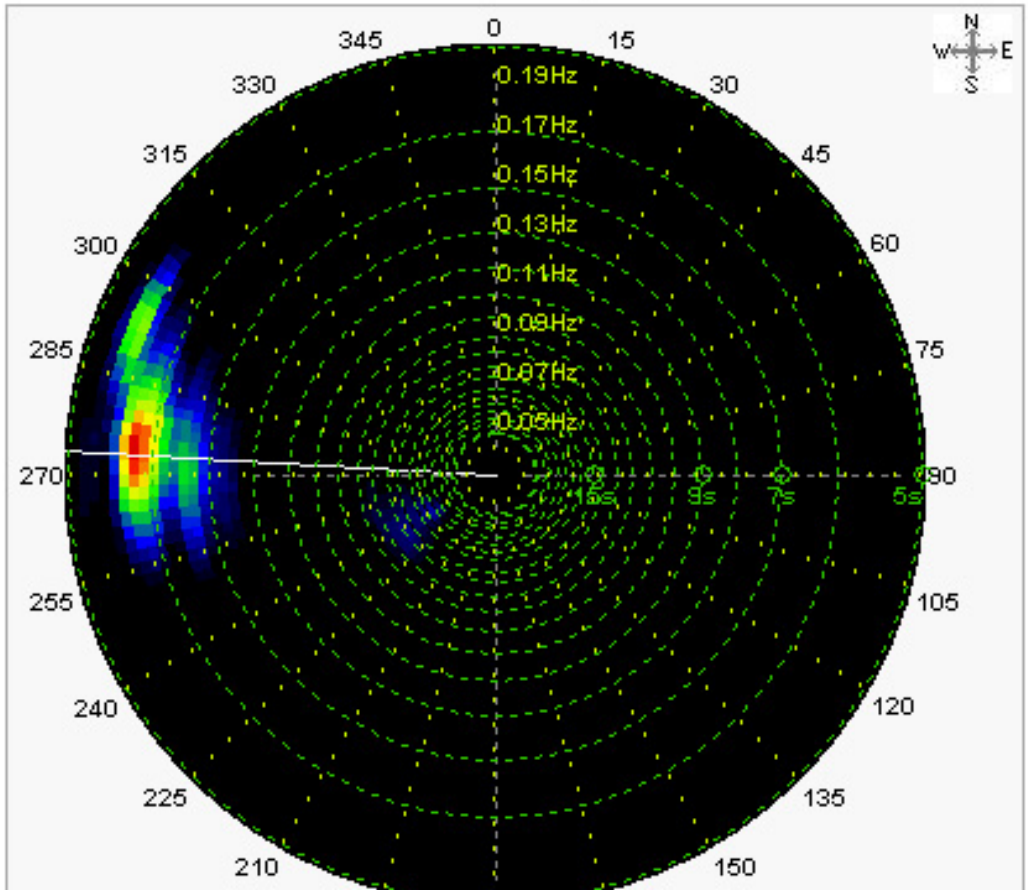
Current Profile
Wave Data
Meteorological Station
Temperature, Salinity & Density
Alongshore Current
Chlorophyll & Turbidity
SCRIPPS PIER
TIJUANA RIVER
WAVE DATA AND FORECASTS

DATA

Imperial Beach Wave Data

Current UTC Time: 2005-08-01, 17:09:18
Current Pacific Time: 2005-08-01, 10:09:18

Directional Wave Spectrum



15:59:48 08/01/05
Hs = 0.86 m
Tp = 5.80 sec
Dp = 273 deg
WL = 8.00 m

Hs: Significant wave height (meters*)
Tp: Peak period of the waves (seconds)
Dp: Direction waves travel from (degrees)
WL: Water level at end of I.B. Pier (meters*)

**Multiply by 3.28 to convert meters to feet*

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SCRIPPS PIER
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WAVE DATA AND FORECASTS

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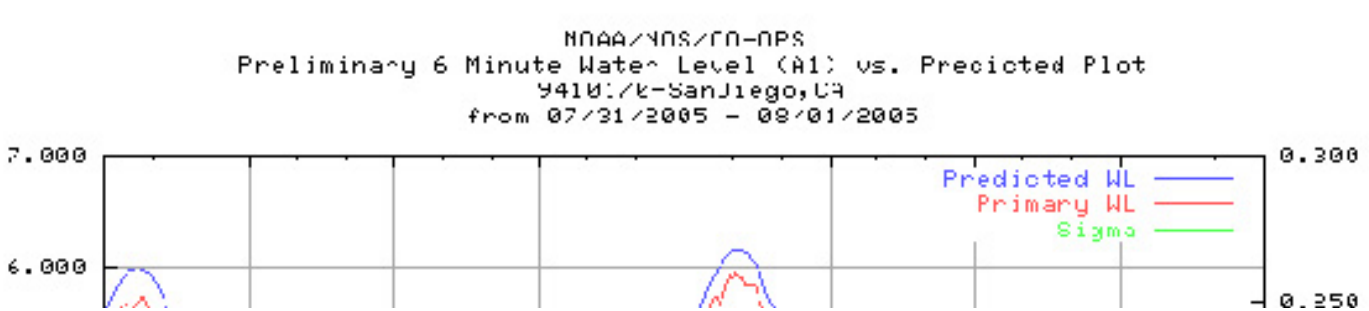
Meteorological Observations

Imperial Beach Pier
Image Captured: 10:10:00 AM (PDT)
Monday, August, 2005

2005-08-01 17:00:04 UTC	to English
Wind Speed	4.6 m/s
Wind Direction (from)	300.9 ° WNW
Air Temperature	20.0 ° C
Water Temperature	18.7 ° C
Relative Humidity	85.5 %
Barometric Pressure	1015.0 mb
Solar Radiation	469.8 Wm^{-2}
Rain Fall	0.0 mm/hr

Current UTC Time: 2005-08-01, 17:11:25
Current Pacific Time: 2005-08-01, 10:11:25



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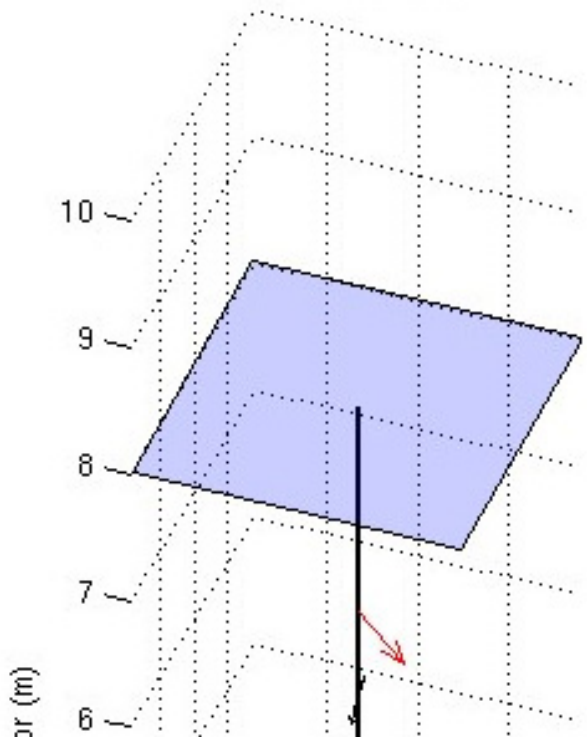
Imperial Beach Current Profile - End of Pier

Current UTC Time: 2005-08-01, 17:13:01
Current Pacific Time: 2005-08-01, 10:13:01

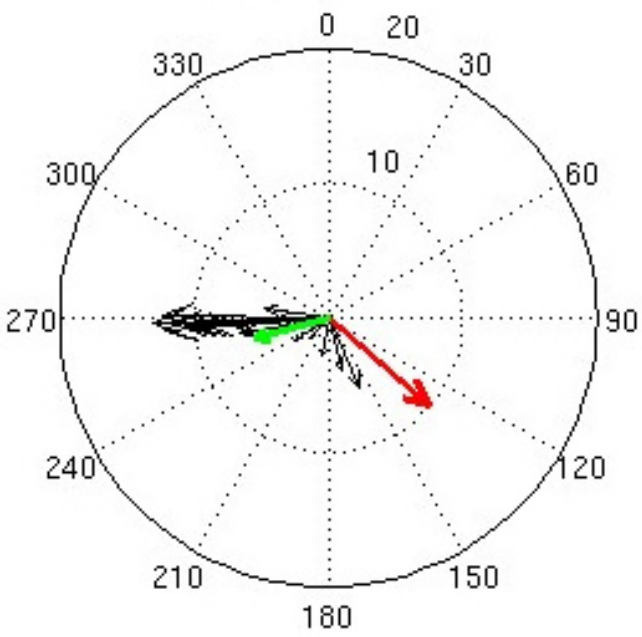
Aug 1, 2005 15:59 UTC

Water Depth = 8.002 m
Significant Wave Height = 0.86 m
Peak Wave Period = 5.8 s
Peak Wave Direction = 273 deg

Current Profile



Current Directions



Northern Speed **Eastern Speed**

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TIDES
SBOO STRATIFICATION

INTERACTIVE

24 Hour Averages

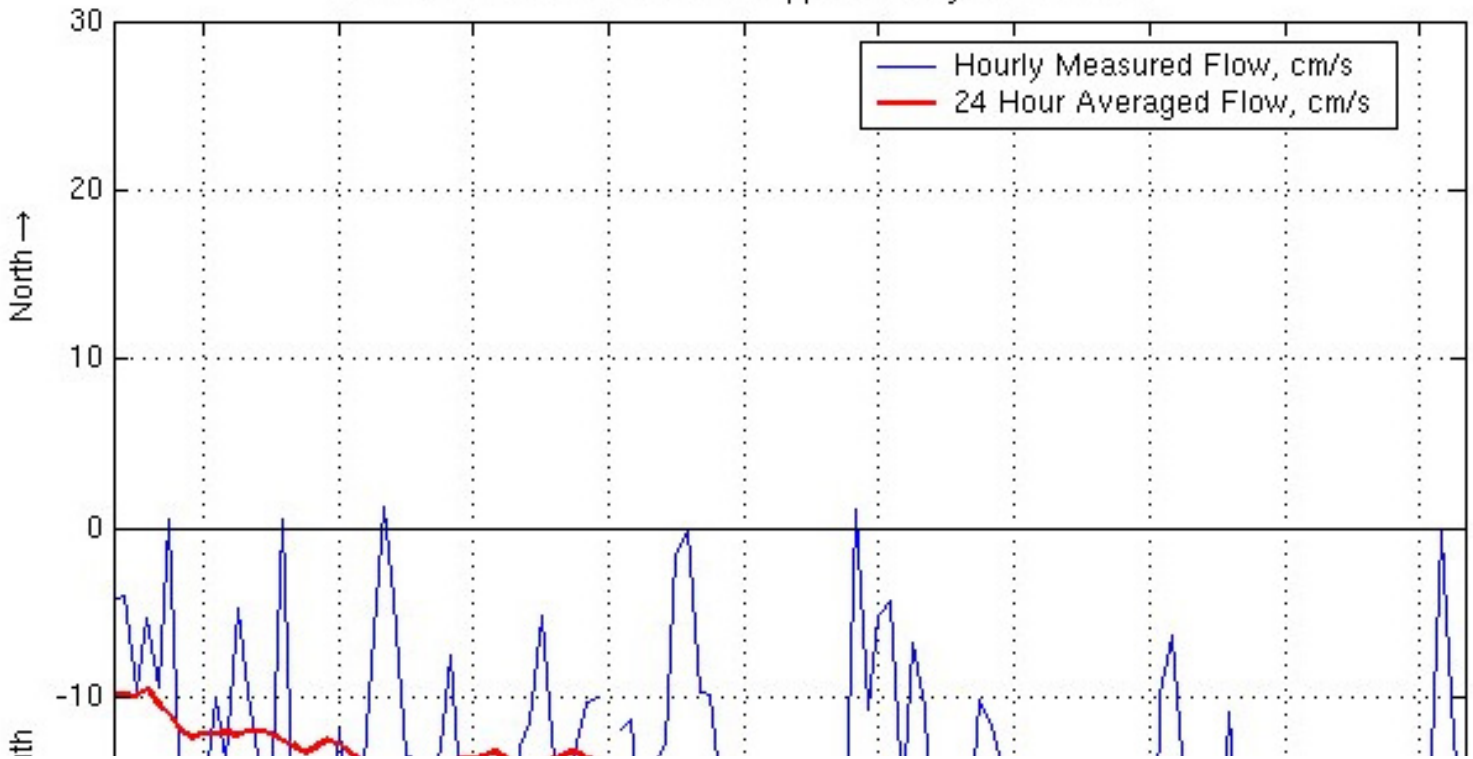
DATA

Near Shore Current Flow (Tijuana River)

Current UTC Time: 2005-08-01, 17:16:45
Current Pacific Time: 2005-08-01, 10:16:45

Time history of CODAR derived ocean currents at the Tijuana River Estuary entrance.

Current Measurement location is approximately 1 km offshore.



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Address http://www.sdcoos.ucsd.edu/data/aqua_qual/index.cfm Go

24 Hour Avg.
Tijuana River
Vorticity
Current Meter at I.B. Pier
Current Meter at SIO Pier

WAVE DATA AND FORECASTS
I.B. Pier Wave Data
SIO Pier Wave Data
Predictions
CDIP Swell Map
Offshore Marine Forecast
Southern California Marine Forecast

TIDES
Data & Predictions

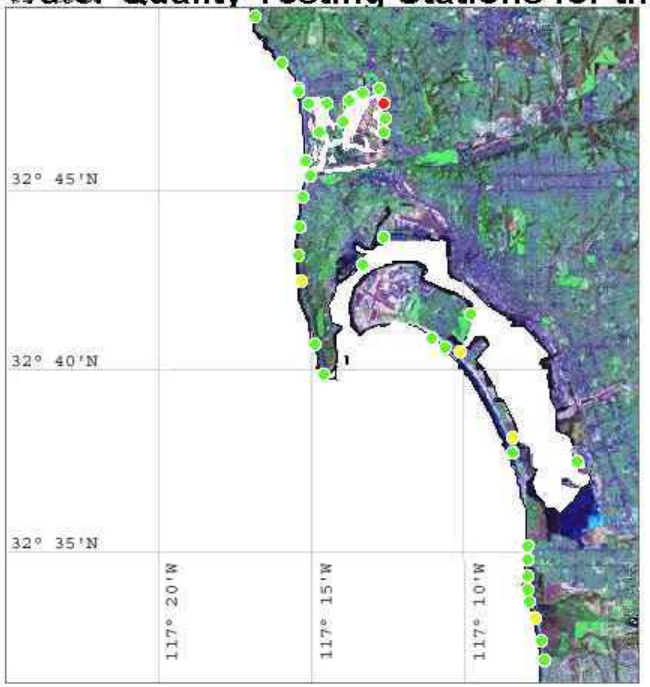
OFFSHORE DATA
-SBOO BUOY
Temperature
Summary
Vertical Profile
Contour Plot
Surface Temperature

Single Sample standards

Total Coliforms - 10,000 organisms per 100 ml. sample
Fecal Coliforms - 400 organisms per 100 ml. sample
Enterococci - 104 organisms per 100 ml. sample
Fecal:Total ratio -if total coliforms >1,000 & ratio > 0.1

For more information, please visit http://www.sdcounty.ca.gov/deh/.
Select "*Beach and Bay Report*" from their 'Key Issues' menu.

Water Quality Testing Stations for the San Diego



Click on a dot to view water quality details for that location.

Done

Local intranet

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Address http://www.sdcoos.ucsd.edu/data/aqua_details_plot.cfm?sid=IB-040

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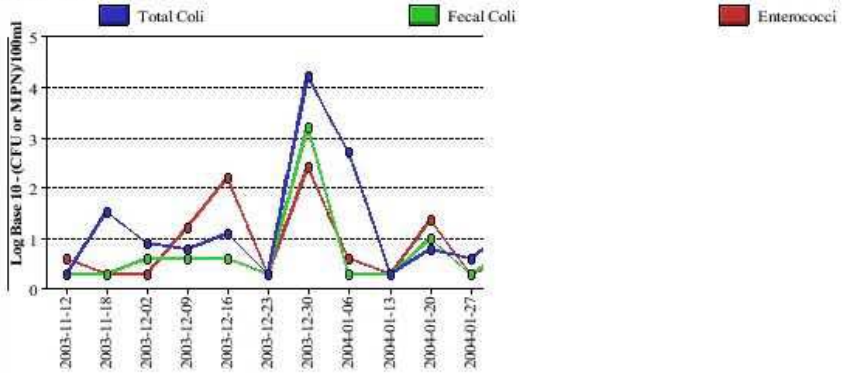
DATA

Data Archives

Site: IB-040
Description: 3/4 mi. N of TJ River
Lat: 32° 33' 39.60"N
Lon: -117° 7' 54.48"W

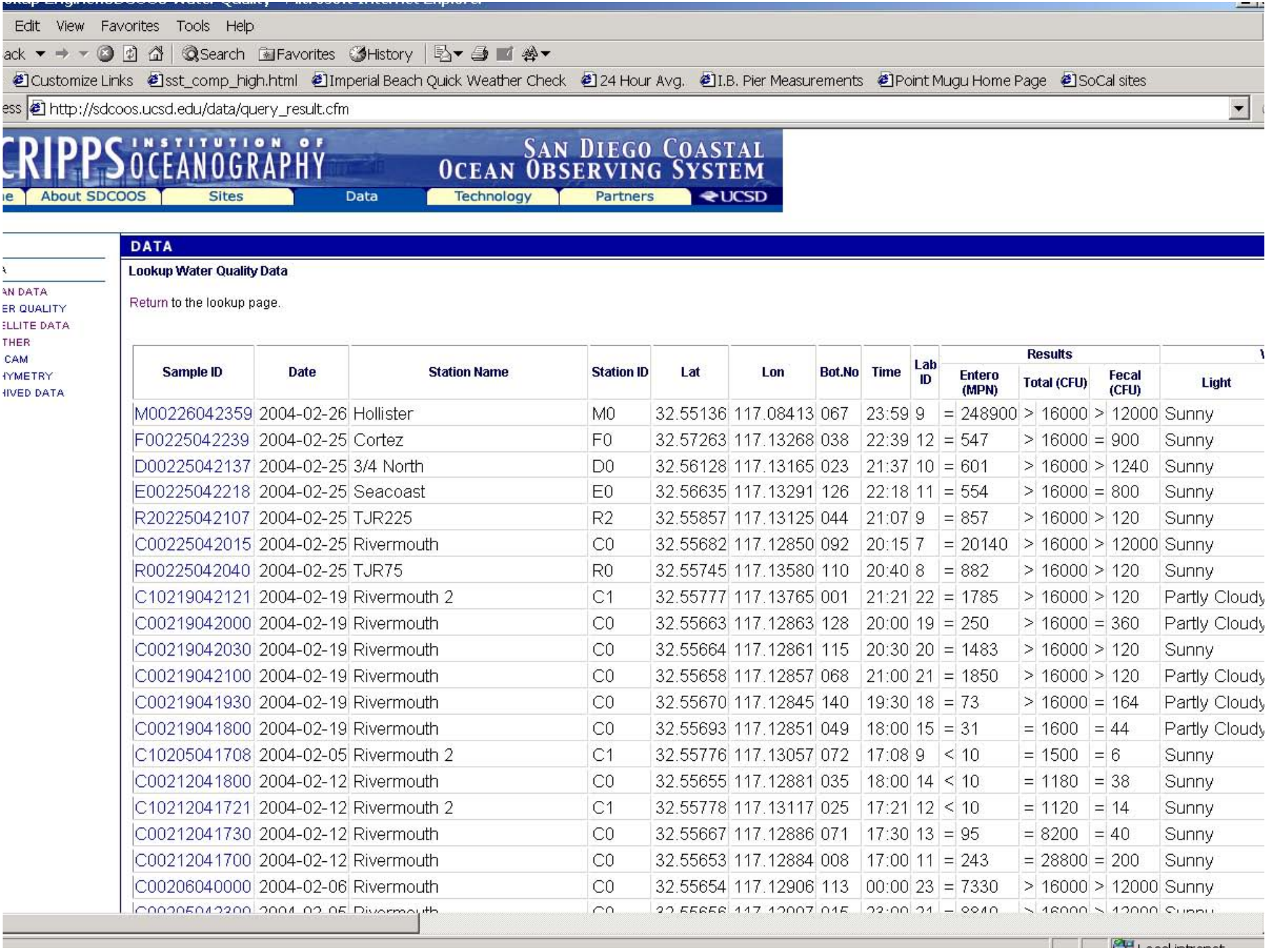


Not all available data was plotted. Click here to plot all data.

Exceedences in the last 180 days:
Total Coli: 266
Fecal Coli: 266
Enterococci: 63

Date	Total Coli	Fecal Coli	Enterococci
2004-01-06	= 520 CFU/100ml	= 2 CFU/100ml	= 4 CFU/100ml
2003-12-30	> 16000 CFU/100ml	= 1600 CFU/100ml	= 260 CFU/100ml
2003-12-23	= 2 CFU/100ml	< 2 CFU/100ml	< 2 CFU/100ml
2003-12-16	= 12 CFU/100ml	= 4 CFU/100ml	= 160 CFU/100ml
2003-12-09	= 6 CFU/100ml	= 4 CFU/100ml	= 16 CFU/100ml
2003-12-02	= 8 CFU/100ml	= 4 CFU/100ml	= 2 CFU/100ml
2003-11-18	= 34 CFU/100ml	< 2 CFU/100ml	< 2 CFU/100ml
2003-11-12	= 0 CFU/100ml	< 0 CFU/100ml	= 0 CFU/100ml
2003-11-04	= 0 CFU/100ml	= 0 CFU/100ml	= 0 CFU/100ml
2003-10-29	= 20 CFU/100ml	= 0 CFU/100ml	= 0 CFU/100ml

Local intranet



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http://sdcoos.ucsd.edu/data/query_result.cfm

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DATA

Lookup Water Quality Data

Return to the lookup page.

Sample ID	Date	Station Name	Station ID	Lat	Lon	Bot.No	Time	Lab ID	Results							
									Entero (MPN)		Total (CFU)		Fecal (CFU)	Light
M00226042359	2004-02-26	Hollister	M0	32.55136	117.08413	067	23:59	9	= 248900	>	16000	>	12000	Sunny
F00225042239	2004-02-25	Cortez	F0	32.57263	117.13268	038	22:39	12	= 547	>	16000	=	900	Sunny
D00225042137	2004-02-25	3/4 North	D0	32.56128	117.13165	023	21:37	10	= 601	>	16000	>	1240	Sunny
E00225042218	2004-02-25	Seacoast	E0	32.56635	117.13291	126	22:18	11	= 554	>	16000	=	800	Sunny
R20225042107	2004-02-25	TJR225	R2	32.55857	117.13125	044	21:07	9	= 857	>	16000	>	120	Sunny
C00225042015	2004-02-25	Rivermouth	C0	32.55682	117.12850	092	20:15	7	= 20140	>	16000	>	12000	Sunny
R00225042040	2004-02-25	TJR75	R0	32.55745	117.13580	110	20:40	8	= 882	>	16000	>	120	Sunny
C10219042121	2004-02-19	Rivermouth 2	C1	32.55777	117.13765	001	21:21	22	= 1785	>	16000	>	120	Partly Cloudy
C00219042000	2004-02-19	Rivermouth	C0	32.55663	117.12863	128	20:00	19	= 250	>	16000	=	360	Partly Cloudy
C00219042030	2004-02-19	Rivermouth	C0	32.55664	117.12861	115	20:30	20	= 1483	>	16000	>	120	Sunny
C00219042100	2004-02-19	Rivermouth	C0	32.55658	117.12857	068	21:00	21	= 1850	>	16000	>	120	Partly Cloudy
C00219041930	2004-02-19	Rivermouth	C0	32.55670	117.12845	140	19:30	18	= 73	>	16000	=	164	Partly Cloudy
C00219041800	2004-02-19	Rivermouth	C0	32.55693	117.12851	049	18:00	15	= 31	=	1600	=	44	Partly Cloudy
C10205041708	2004-02-05	Rivermouth 2	C1	32.55776	117.13057	072	17:08	9	< 10	=	1500	=	6	Sunny
C00212041800	2004-02-12	Rivermouth	C0	32.55655	117.12881	035	18:00	14	< 10	=	1180	=	38	Sunny
C10212041721	2004-02-12	Rivermouth 2	C1	32.55778	117.13117	025	17:21	12	< 10	=	1120	=	14	Sunny
C00212041730	2004-02-12	Rivermouth	C0	32.55667	117.12886	071	17:30	13	= 95	=	8200	=	40	Sunny
C00212041700	2004-02-12	Rivermouth	C0	32.55653	117.12884	008	17:00	11	= 243	=	28800	=	200	Sunny
C00206040000	2004-02-06	Rivermouth	C0	32.55654	117.12906	113	00:00	23	= 7330	>	16000	>	12000	Sunny

DATA

OCEAN DATA
WATER QUALITY
SATELLITE DATA
WEATHER
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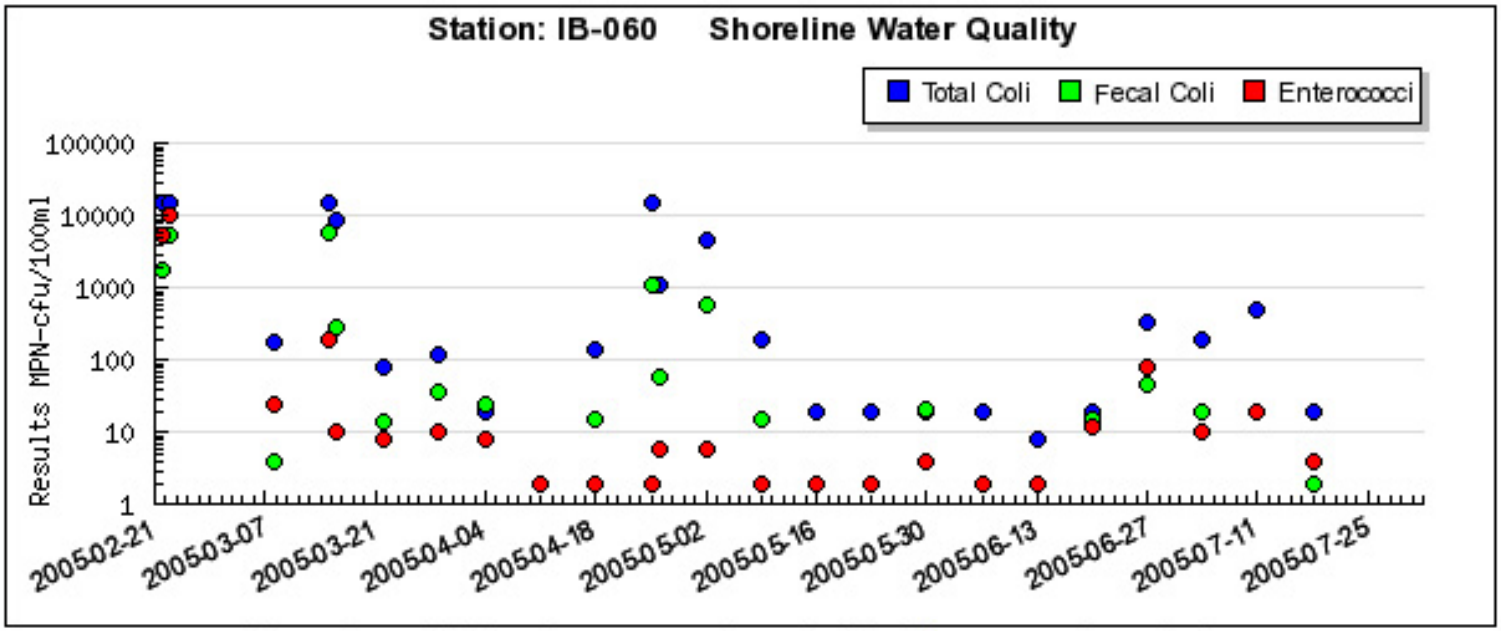
San Diego Habitat and Environmental Resource Mapping

DATA

Water Quality Time-series

Site: IB-060
Description: Carnation Ave.
Lat: 32° 35' 11.76"N
Lon: -117° 7' 57.72"W



Not all available data was plotted. Click here to plot all data.

DATA

OCEAN DATA
WATER QUALITY
SATELLITE DATA
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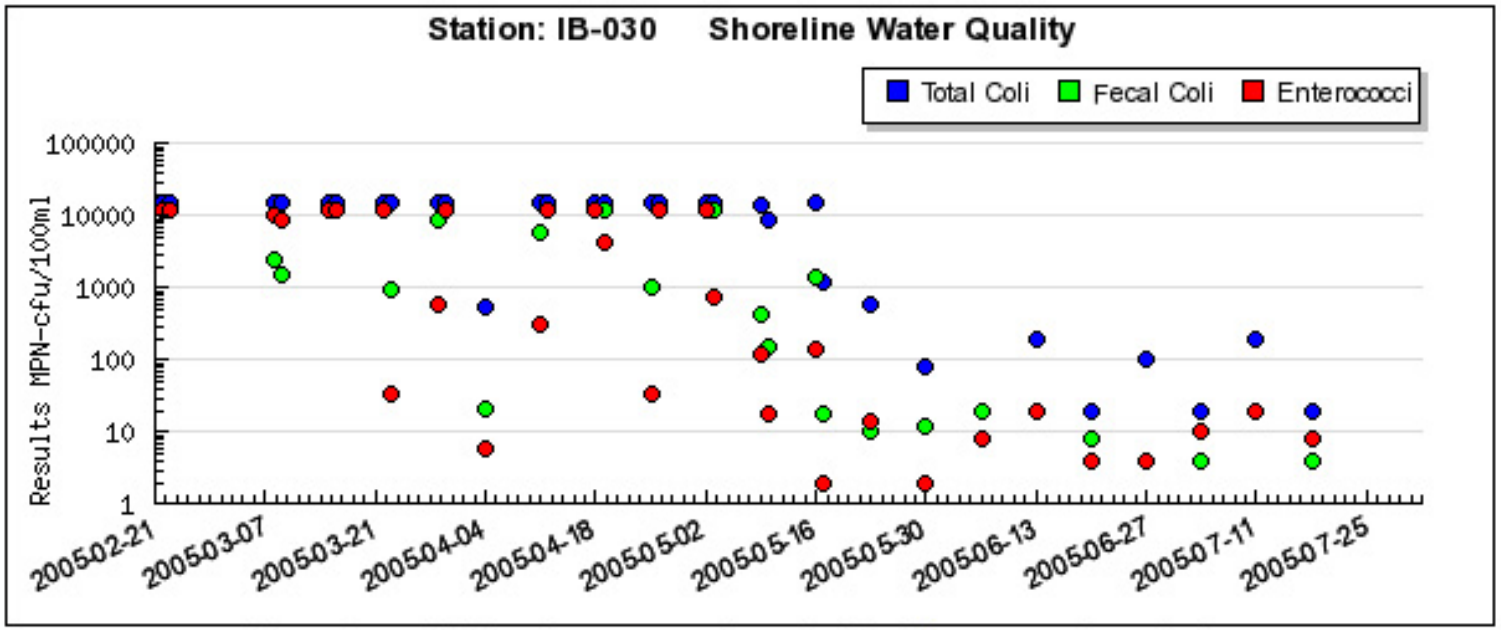
WEB CAM
BATHYMETRY
ARCHIVED DATA

San Diego Habitat and Environmental Resource Mapping

DATA

Water Quality Time-series

Site: IB-030
Description: Tijuana Rivermouth
Lat: 32° 33' 14.40"N
Lon: -117° 7' 42.96"W



Not all available data was plotted. Click here to plot all data.

Exceedances in the last 120 days: