In the summer of 1999, bacterial contamination on Huntington Beach caused two months of beach closures.

This led to ….

The Great Huntington Beach Sewage Outfall Secondary Treatment Waiver Battle

www.bay13.de

Spring Break

studentwebs.coloradocollege.edu/~m_foley

www.stanford.edu/~ghoe/


Brown Pelican

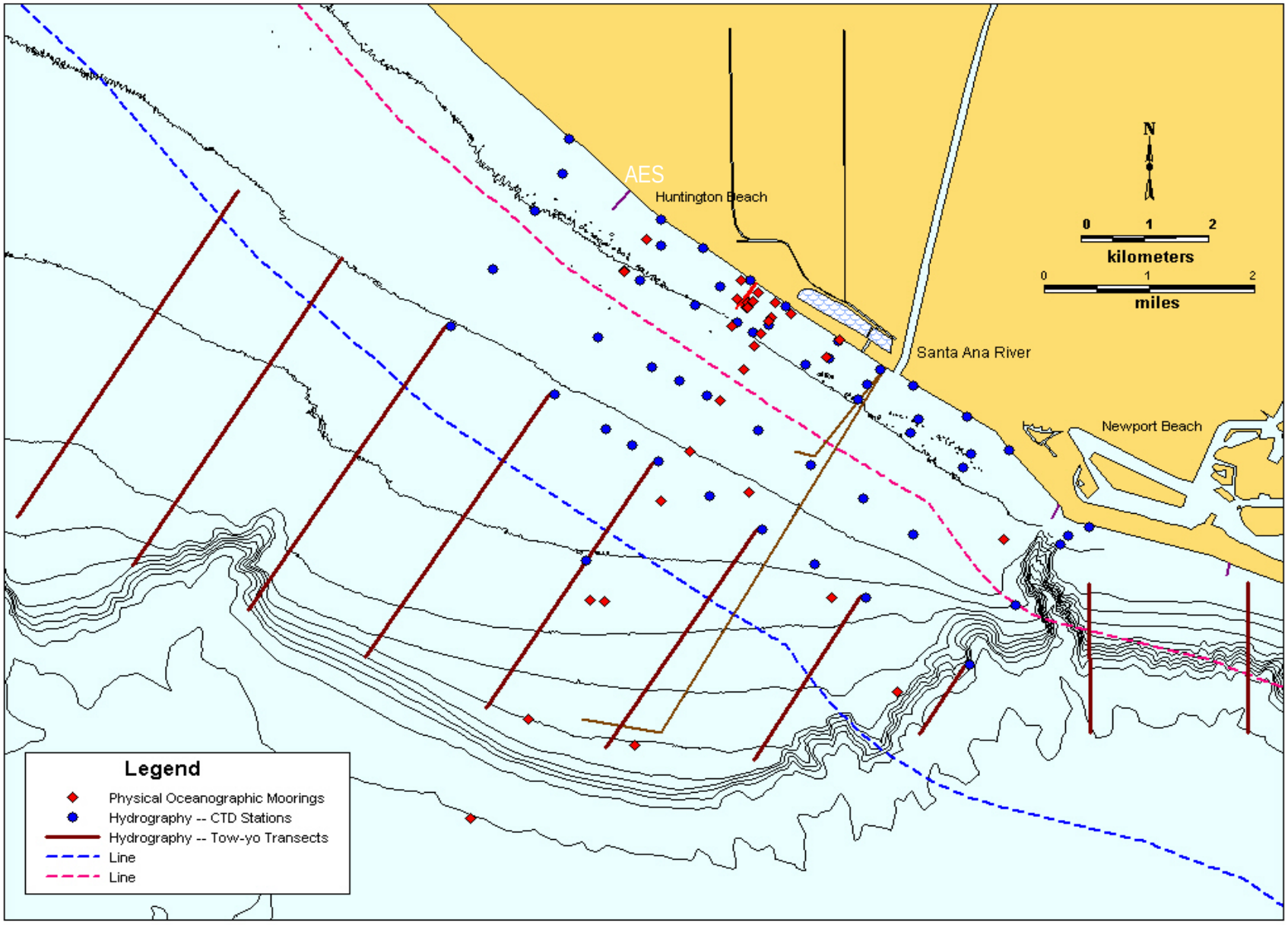
Harbor Seal

California Sea Lion

NOAA Marine Mammal Lab

www.hbonline.com

Noble et al



Does the sewage outfall contaminate the beach?

Timeline

1954: OCSD starts dumping treated sewage 2.1 km offshore
1958: OCSD starts measuring bacteria at H Beach
1965: new diffuser installed on outfall
=> bacterial concentration increased dramatically
1969: some raw sewage in Santa Ana River
=> worst beach contamination ever
1972: federal Clean Water Act defines dumping standards
1972: new outfall built 7.5 km offshore with federal $
=> improved water quality
1985: OCSD has secondary treatment waiver
1999: state AB411 standards for beach contamination
=> H Beach closed for 2 months
2000: OCSD starts treating runoff from river and marsh
=> reduced beach contamination
2002: secondary treatment waiver up for renewal
=> big public controversy

Battle at the Orange County Sanitation district
Things got all mixed up

Ways of thinking

- politics
- science
- emotions
- money

Issues

- beach contamination
- secondary sewage treatment

Topics regarding beach contamination:

- *Regulation:* State AB411 standards define bacterial contamination
- *Science:* identifying bacteria
- *Science:* transport between sewage outfall and beach
- *Regulation:* Federal Clean Water Act sets sewage treatment requirements
- *Technology:* how sewage is treated
- *Policy:* arguments and decisions --- what would you do?

- *Science:* sources of beach contamination
- *Science:* effects of chlorination
- *Regulation:* what are the laws in North Carolina?

How do you know if it's safe to swim at the beach?

- bacterial contamination causes health risks
- California State AB-411 Standards,1999
- count indicator bacteria to estimate risks
- sampling is expensive and time-consuming

What makes a good indicator?

- easy to detect
- only in polluted waters
- concentrations ⇔ contamination.
- lives as long as pathogens
- EPA says: enterococci

Source: JD Potts, NCDENER

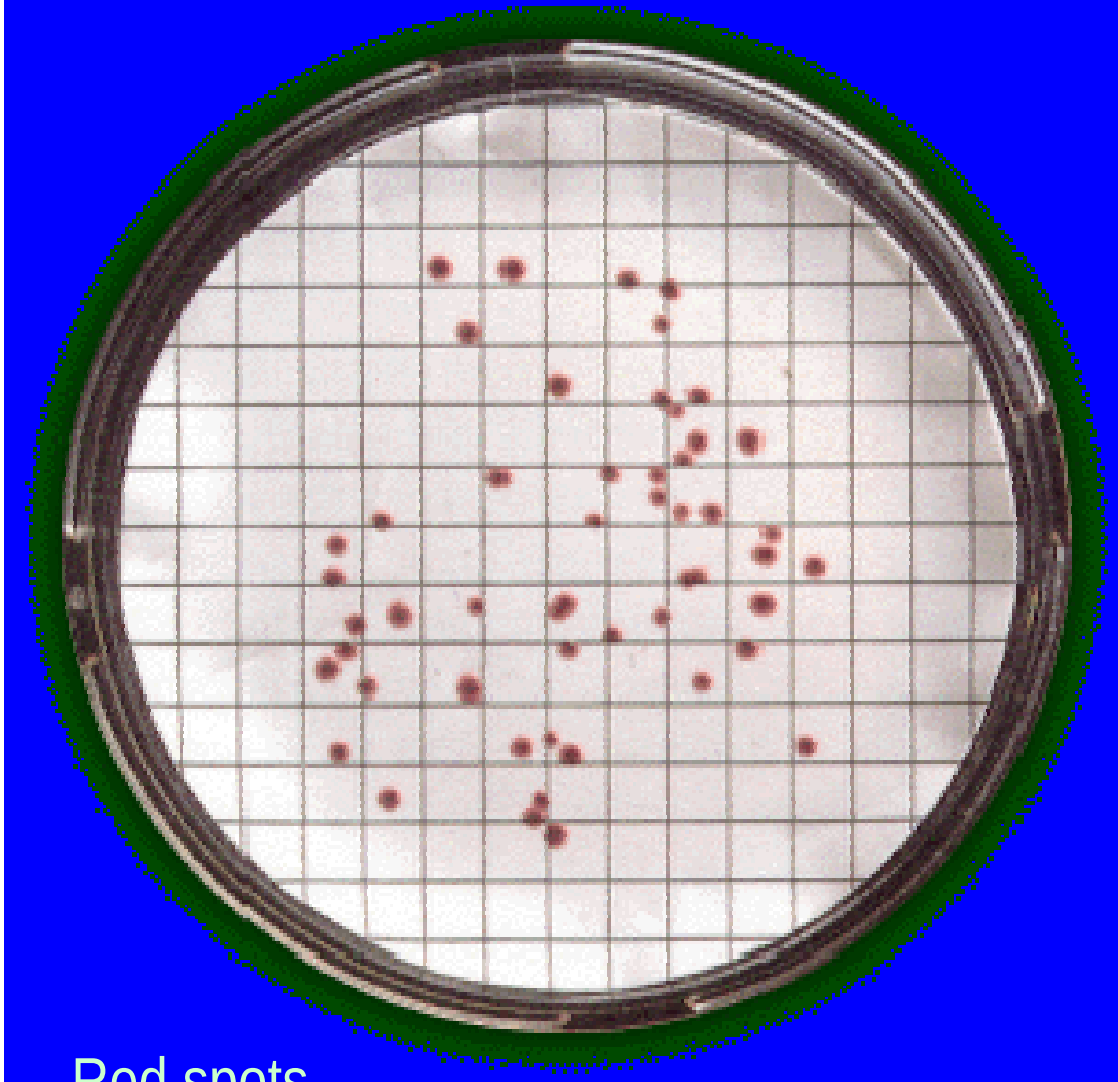
California AB-411 Standards:
Close the beach if bacterial concentrations exceed:

Kind of Bacteria	Number Allowed	Chance of Sickness
Total Coliform	10,000 / 100 ml	1 in 60 (skin rash)
Fecal Coliform	400 / 100 ml	
Fecal/Total ratio (for comparison:	1/10 1/2	1 in 85 (any illness) 1 in 20)
Enterococus	104 / 100 ml	1 in 77 (stomach flu)

- Are these standards strict enough?
- If you take 100 friends to the beach, can you risk one getting sick?

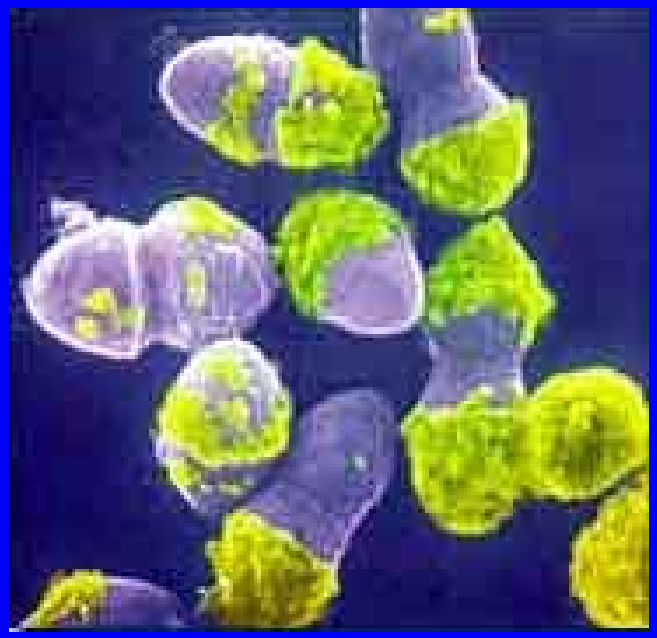

Sampling for Bacteria in Surf Zone
G. Robertson et al

Enterococcus Colonies



Red spots
with esculin

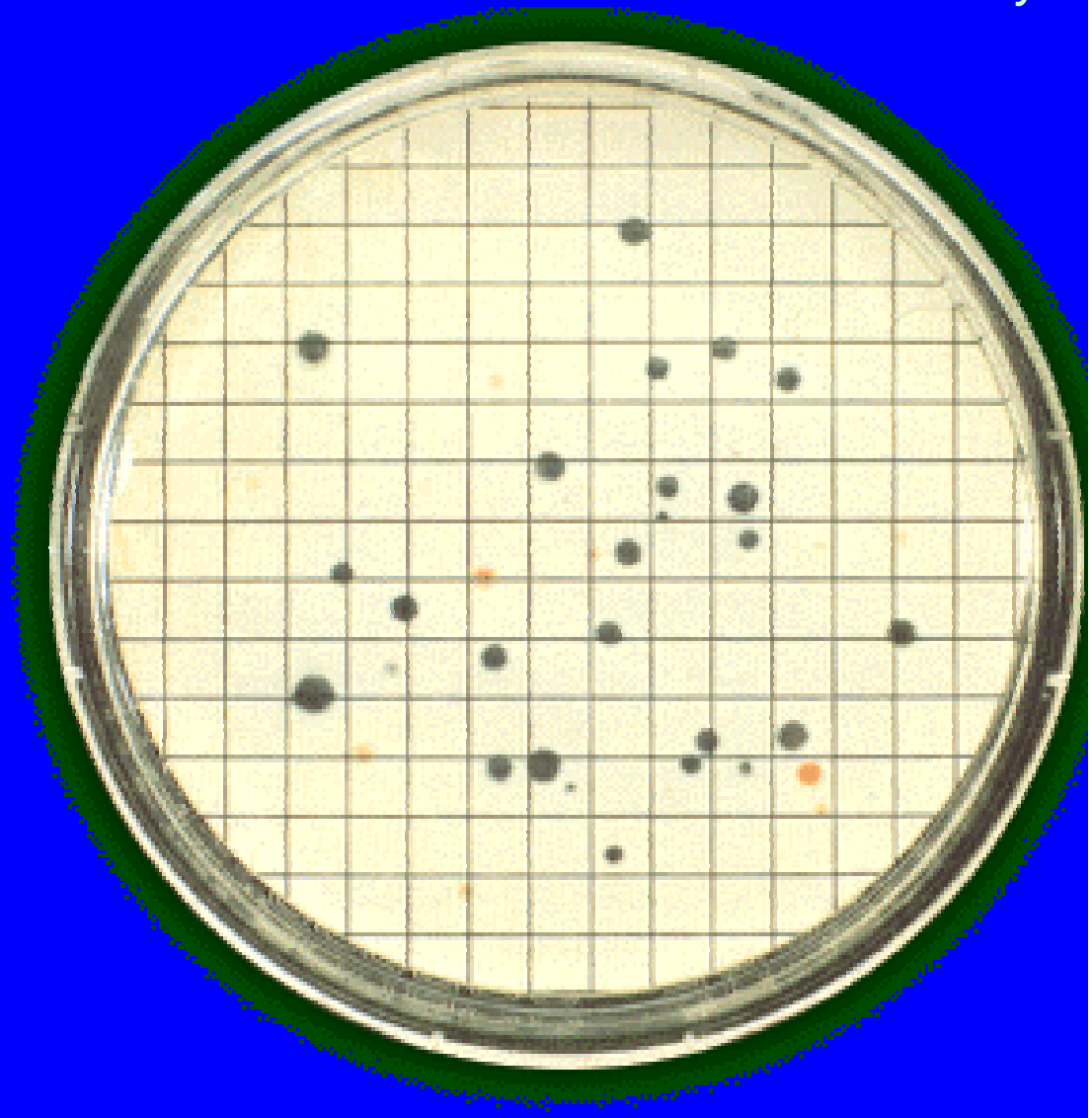
Enterococcus Faecium



http://www.lbl.gov/Science-Articles/Archive/enterococcus-sequencing.html

Colonies

Blue spots
with analine dye

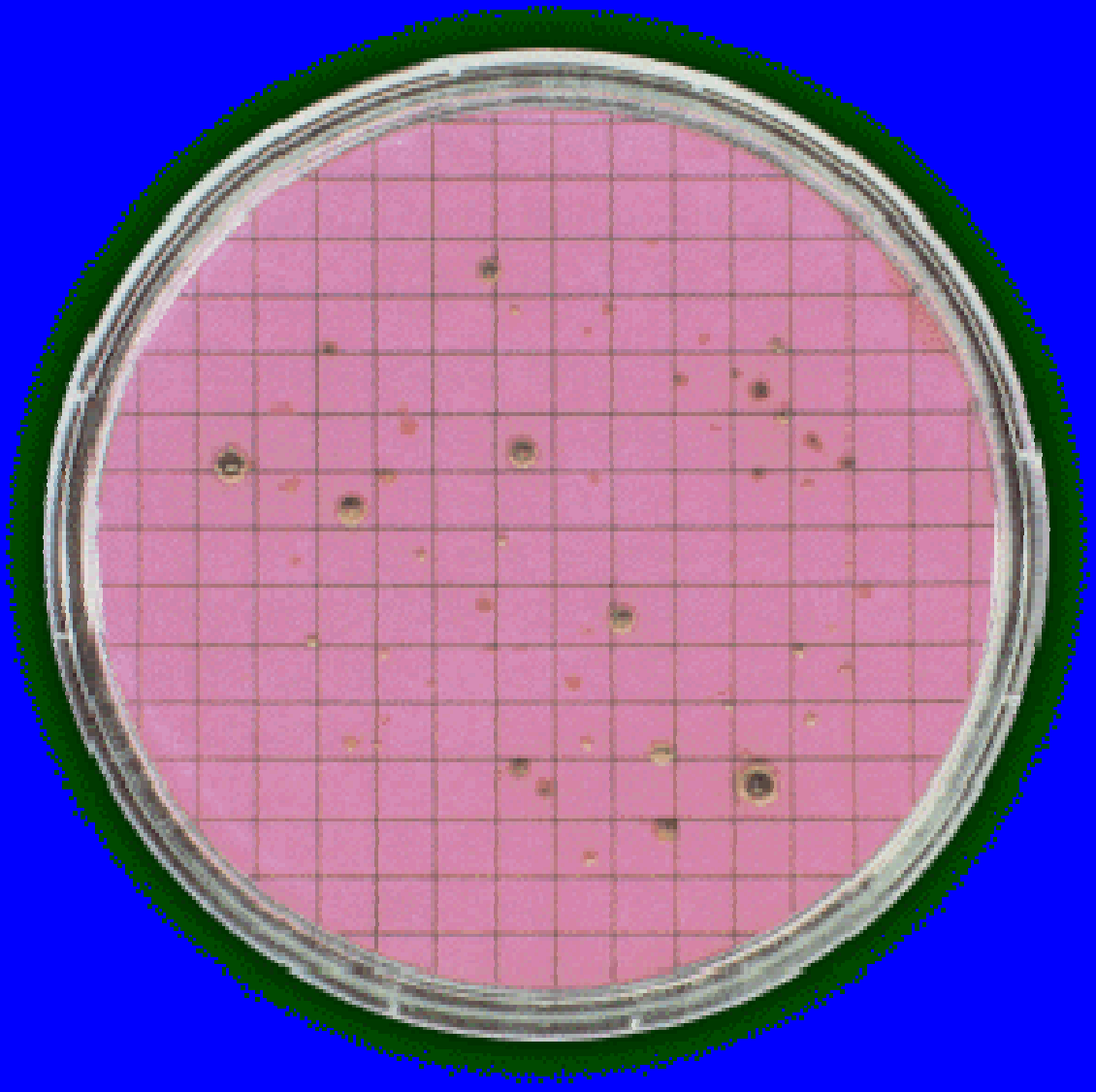


Fecal Coliform

http://www.great-lakes.net/beachcast/bw_waterborne.html

Total Coliform Colonies

"golden-green sheen"
with Schiffs Reagent



Take home points:

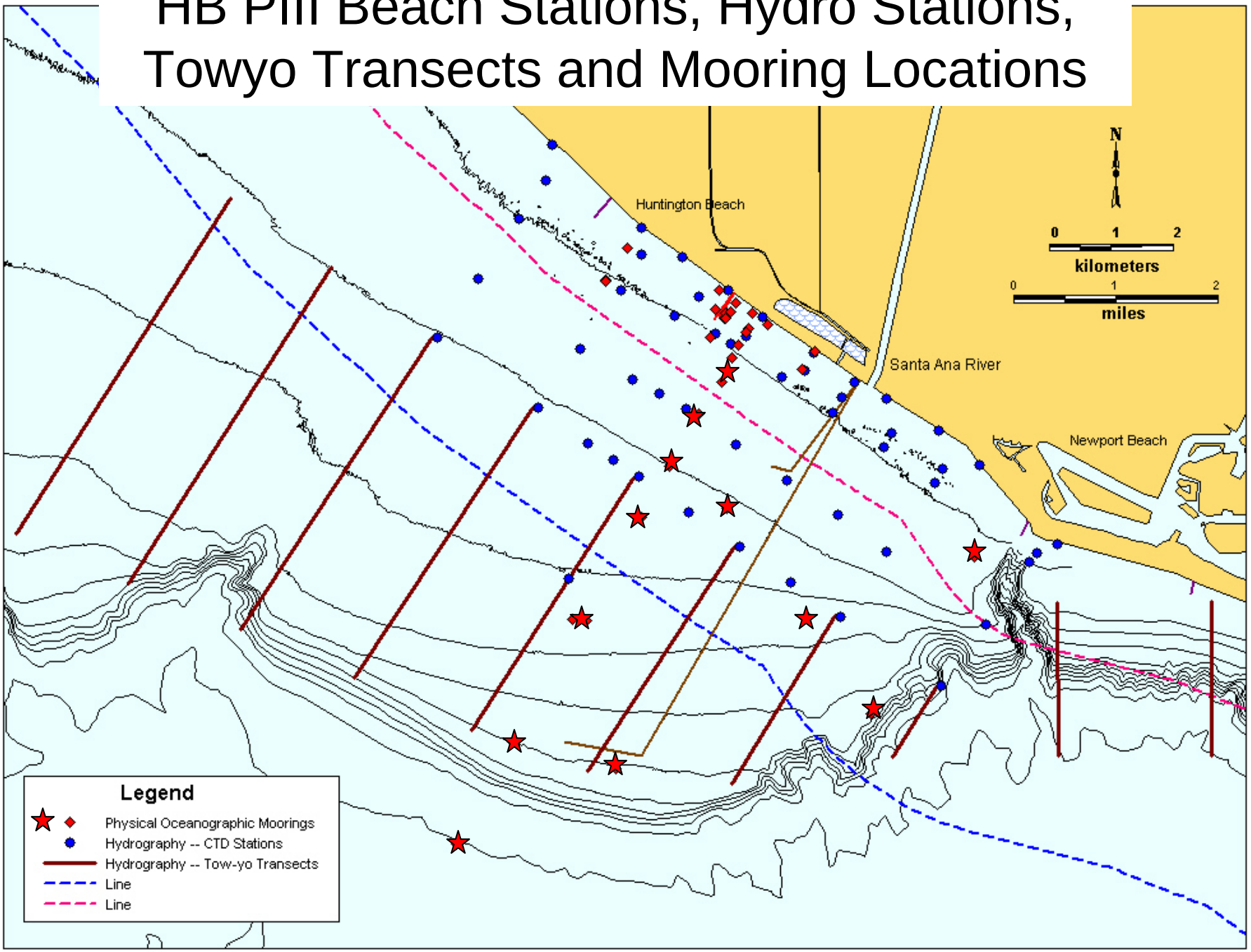
- state determines safe level of bacterial contamination
- each kind bacteria is tested in a different growth medium
- count bacteria by growing for a few days
- difficult and time-consuming

... questions so far?

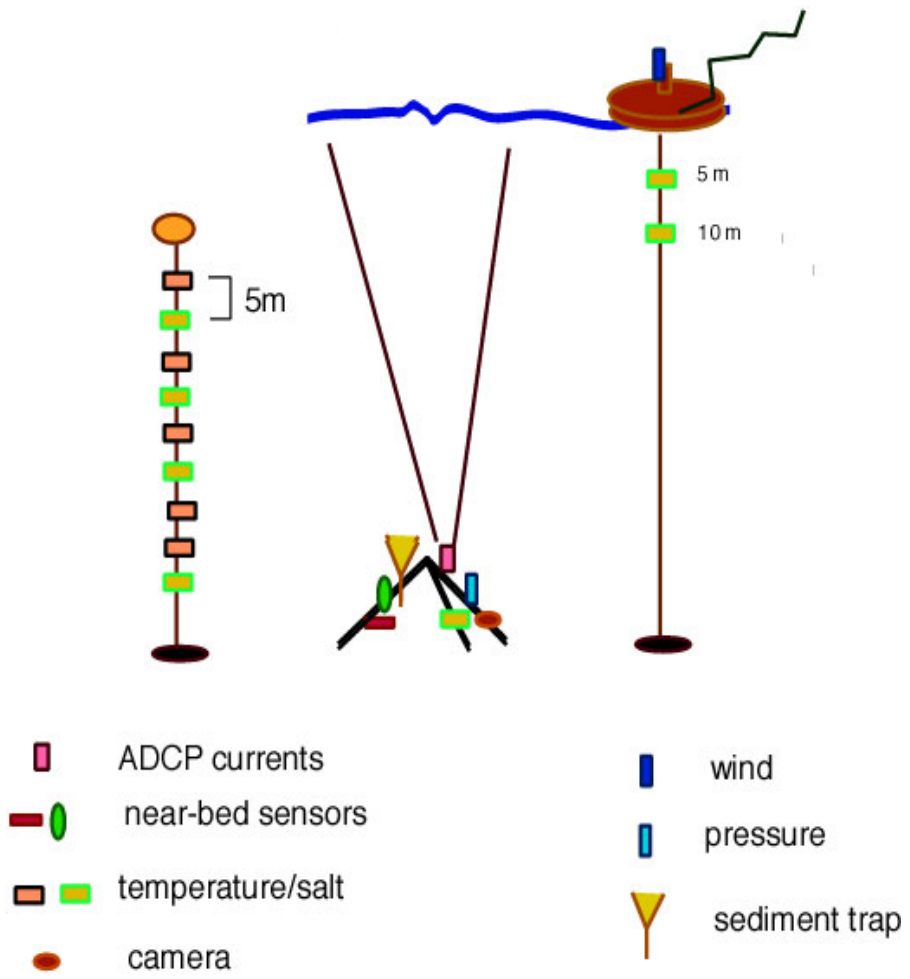
Can bacteria from the OCSD outfall hit the beach?

- count beach bacteria; compare with AB411 standards
- measure the outfall plume
- measure currents, temperature and salinity
- look for transport processes
- look for spatial connections

HB PIII Beach Stations, Hydro Stations, Towyo Transects and Mooring Locations

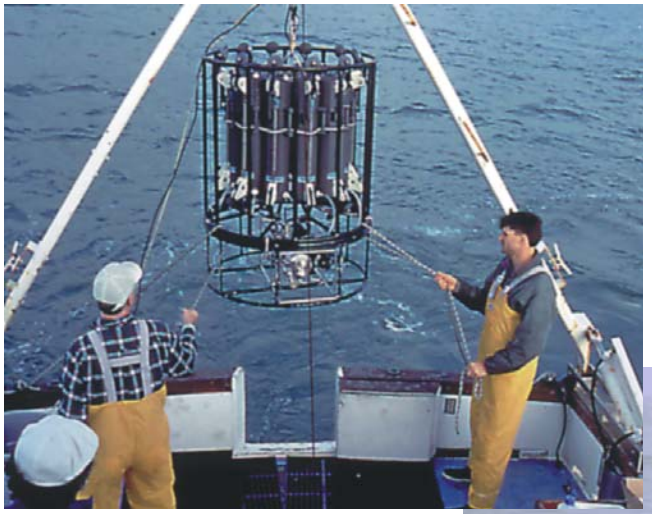


Example Mooring Array



Noble et al

Offshore and Surf zone Sampling



CTD

Surf zone

Towyo

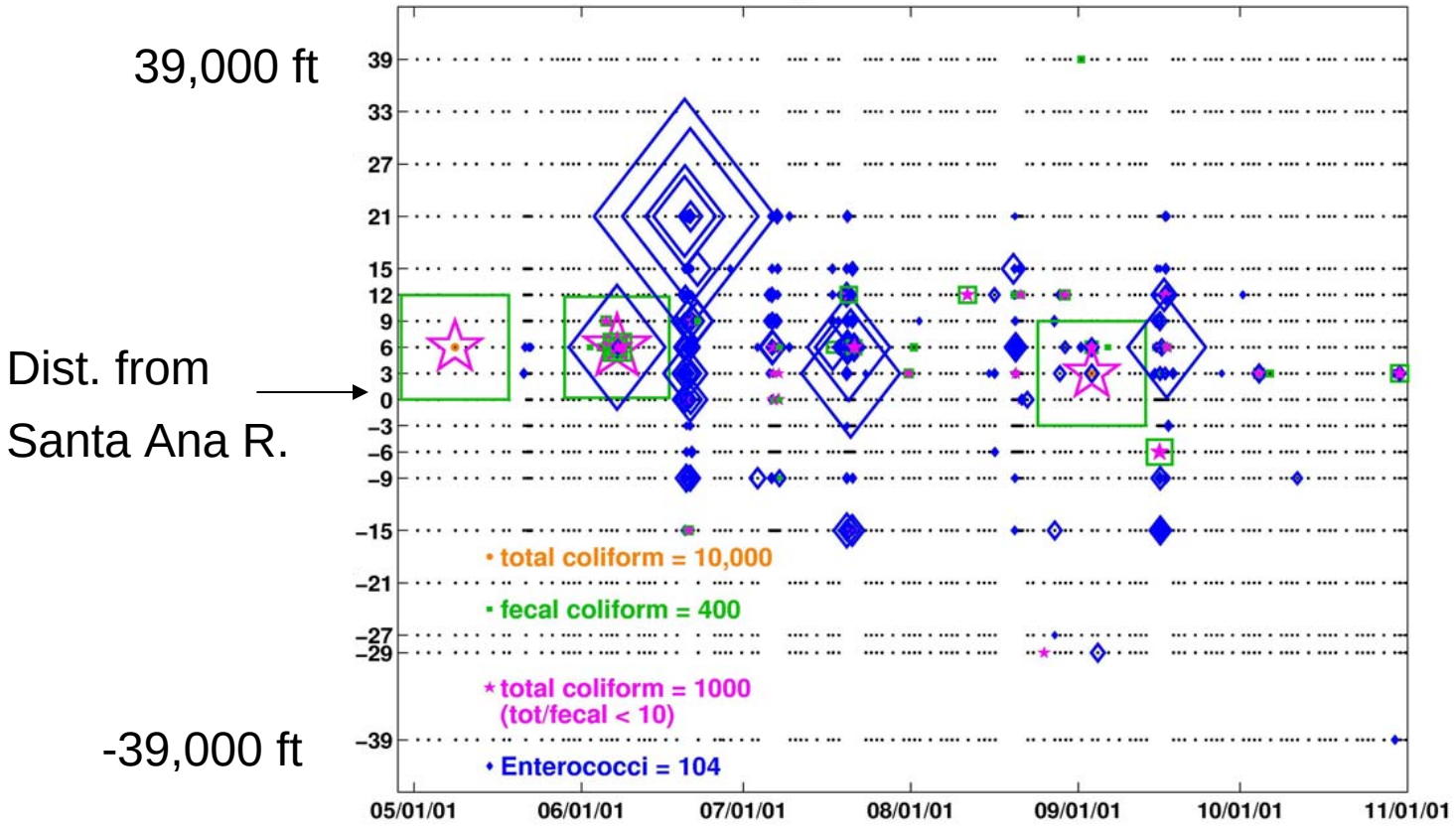
The next figure has an awful lot of information, but don't panic. Please try to make sense of it using think/pair/share.

- **what are the axes?**
- **what does a diamond on the plot indicate?**
- **what do stars and squares indicate?**
- **what does the size of the mark indicate?**
- **what patterns can you see?**
- **what do the shapes on the right indicate?**

Can you tell whether different types of bacteria come from the same place?

Surfzone Bacteria Patterns

- Type 1 Localized total and fecal coliform events ☆ □
- Type 2 Large-scale Enterococci events ◊



Tot. col. = 500,000

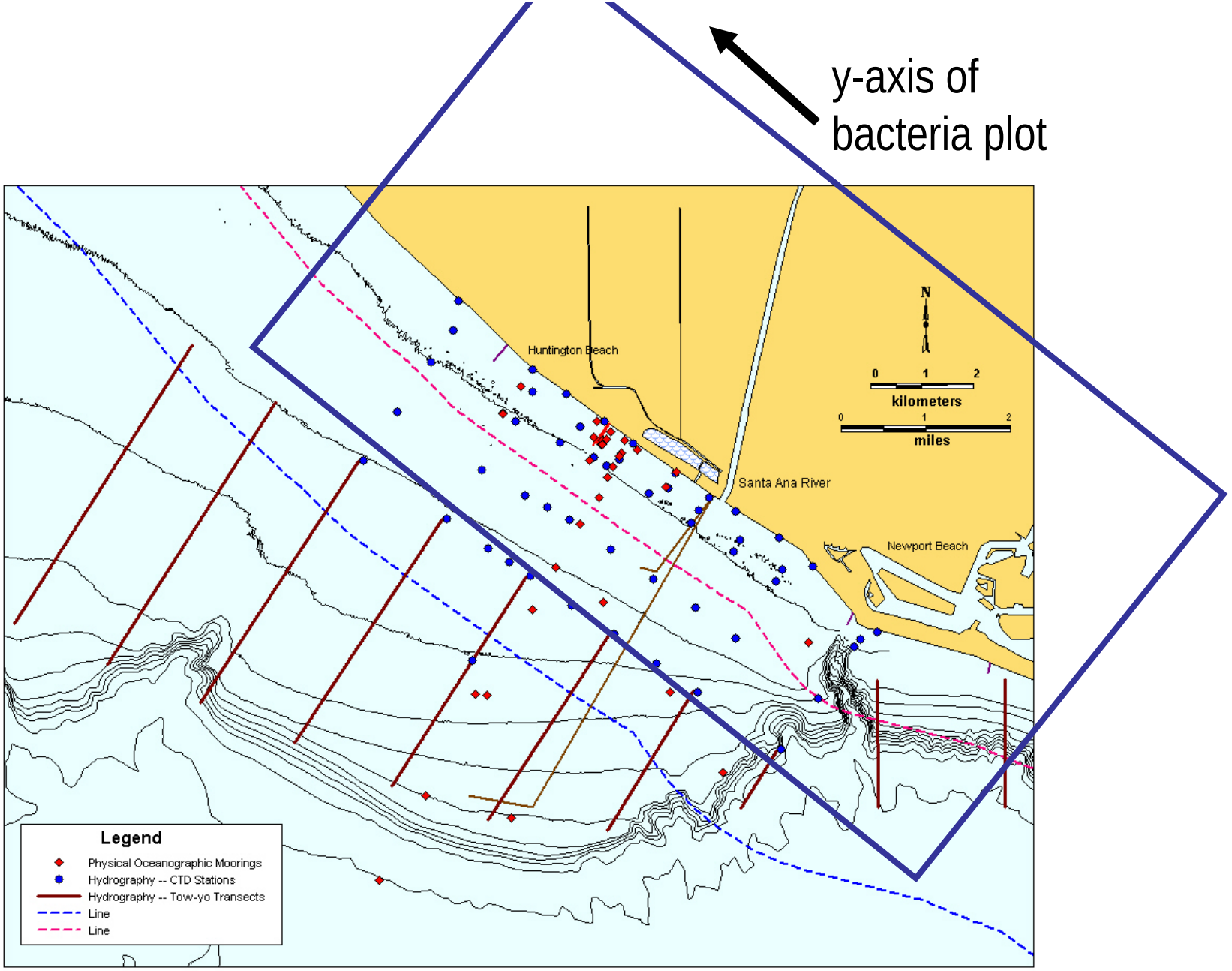
Fec.col. = 50,000

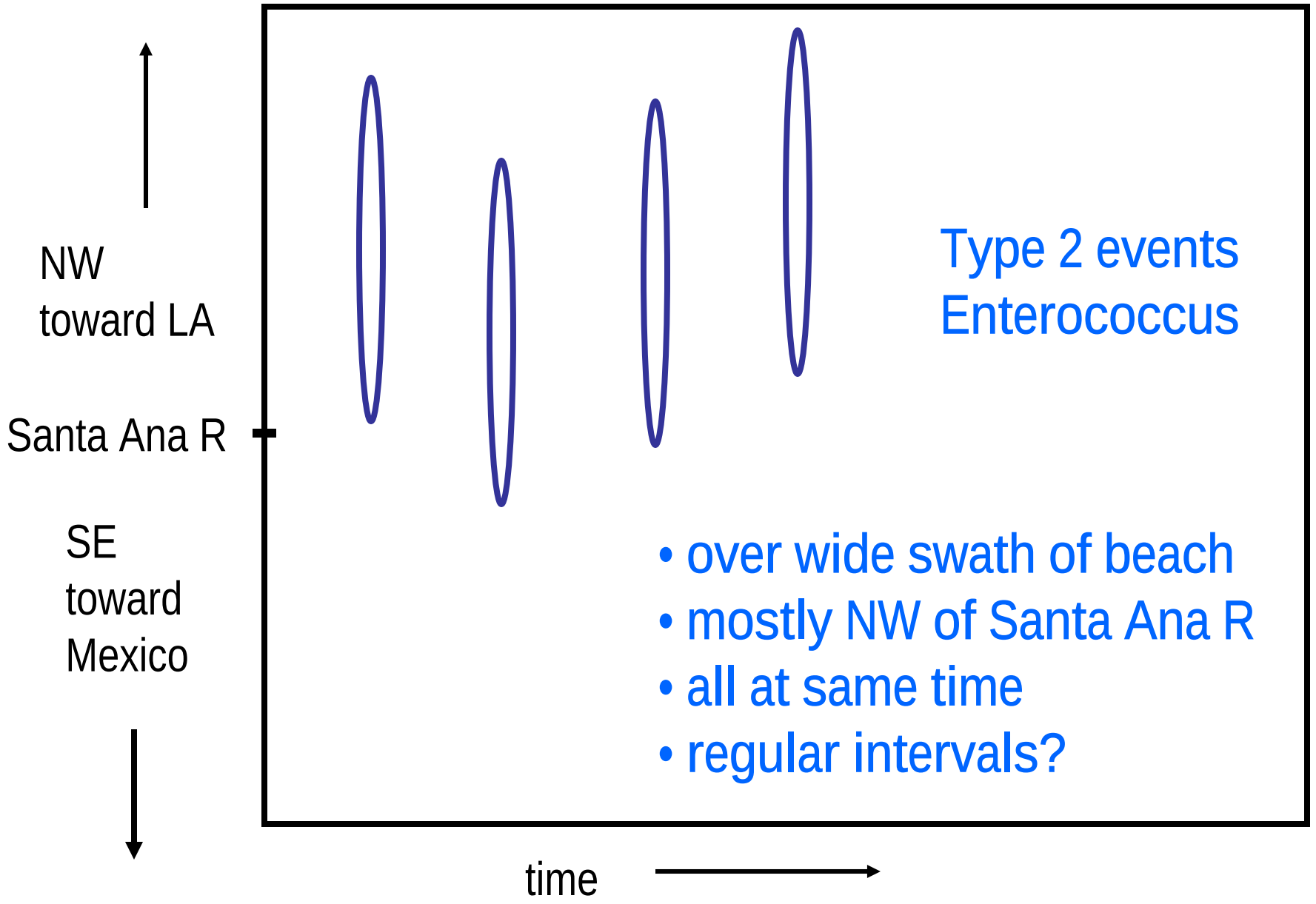
Ent. = 500

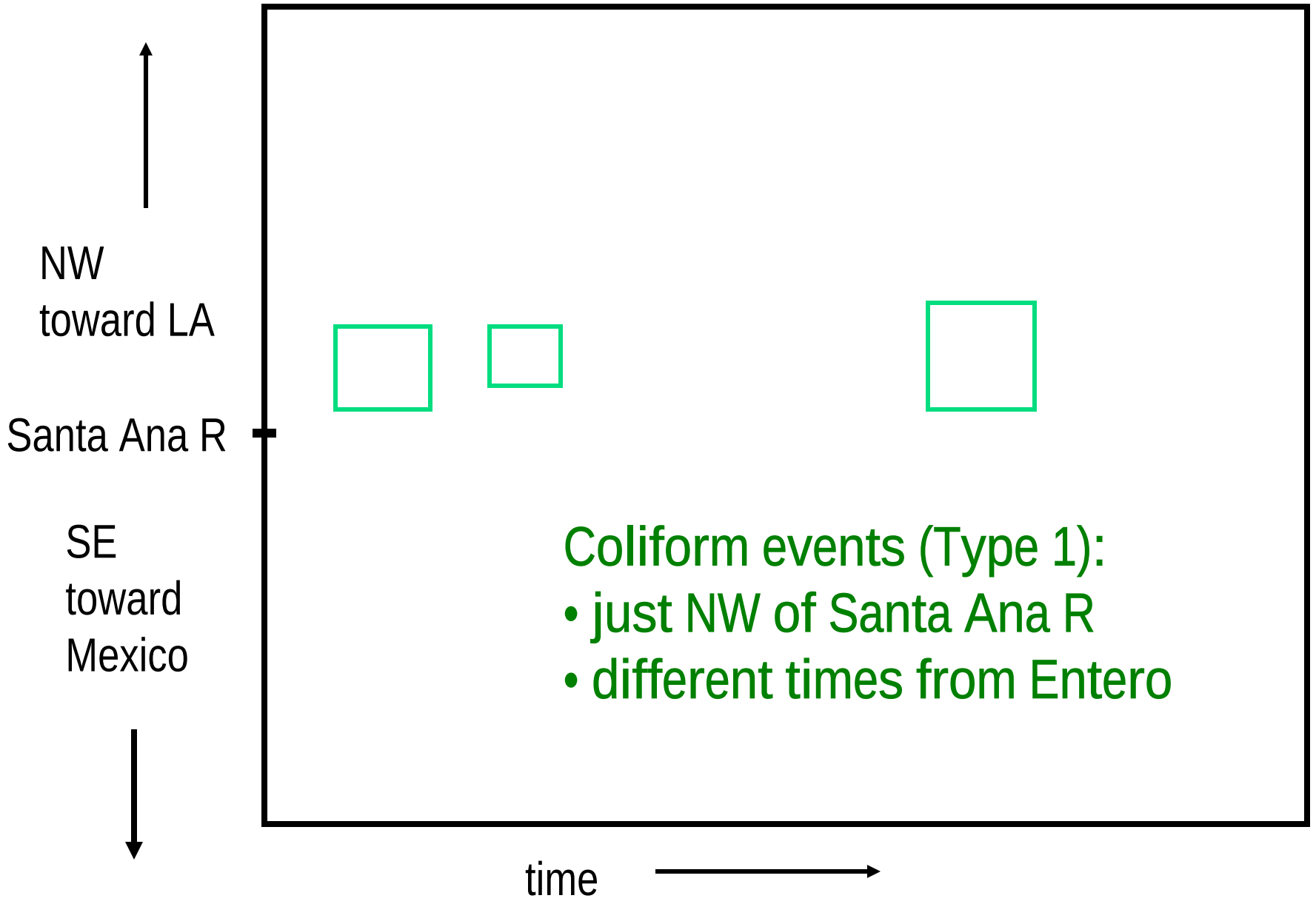
◊

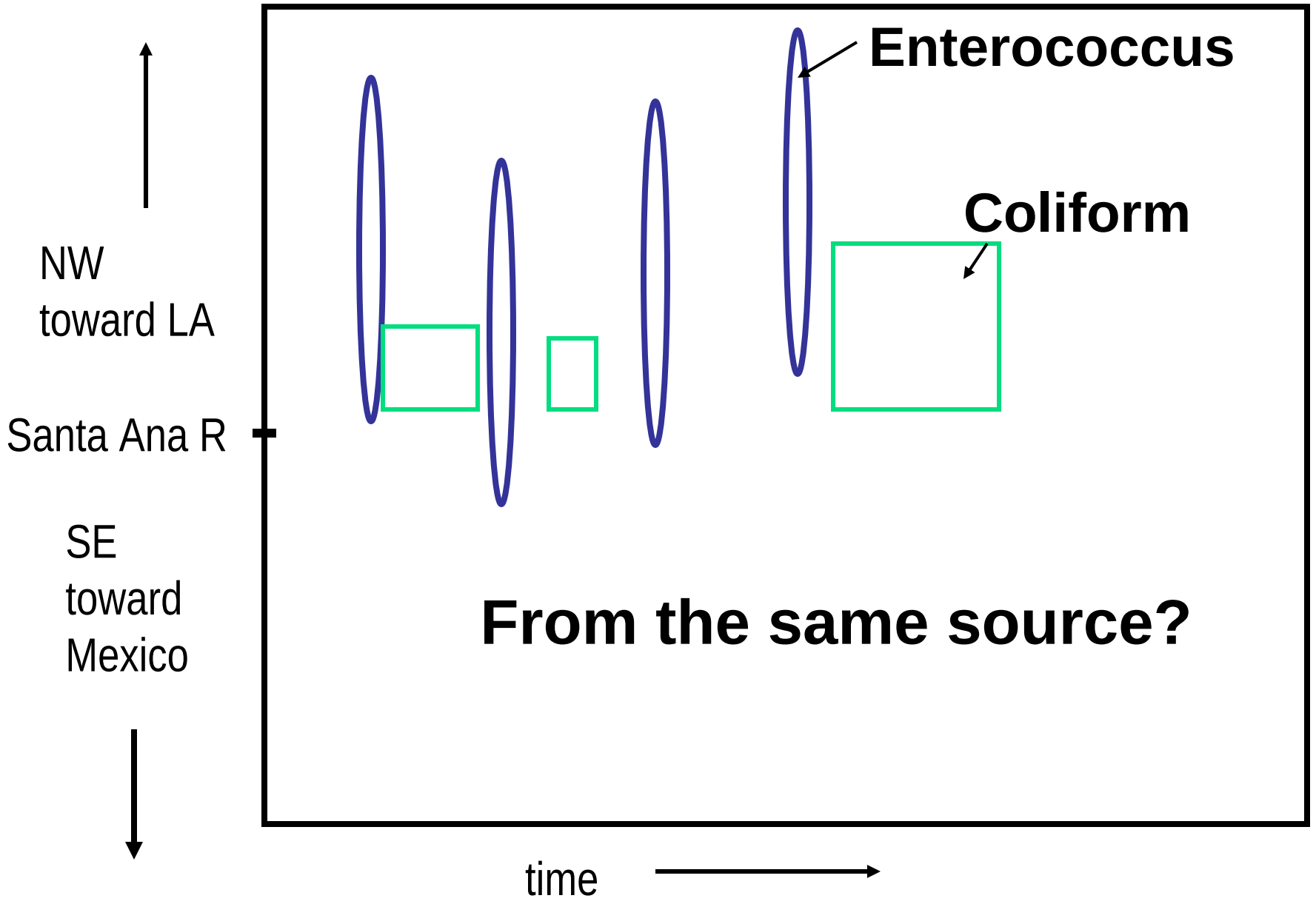
Concentrations in outfall plume

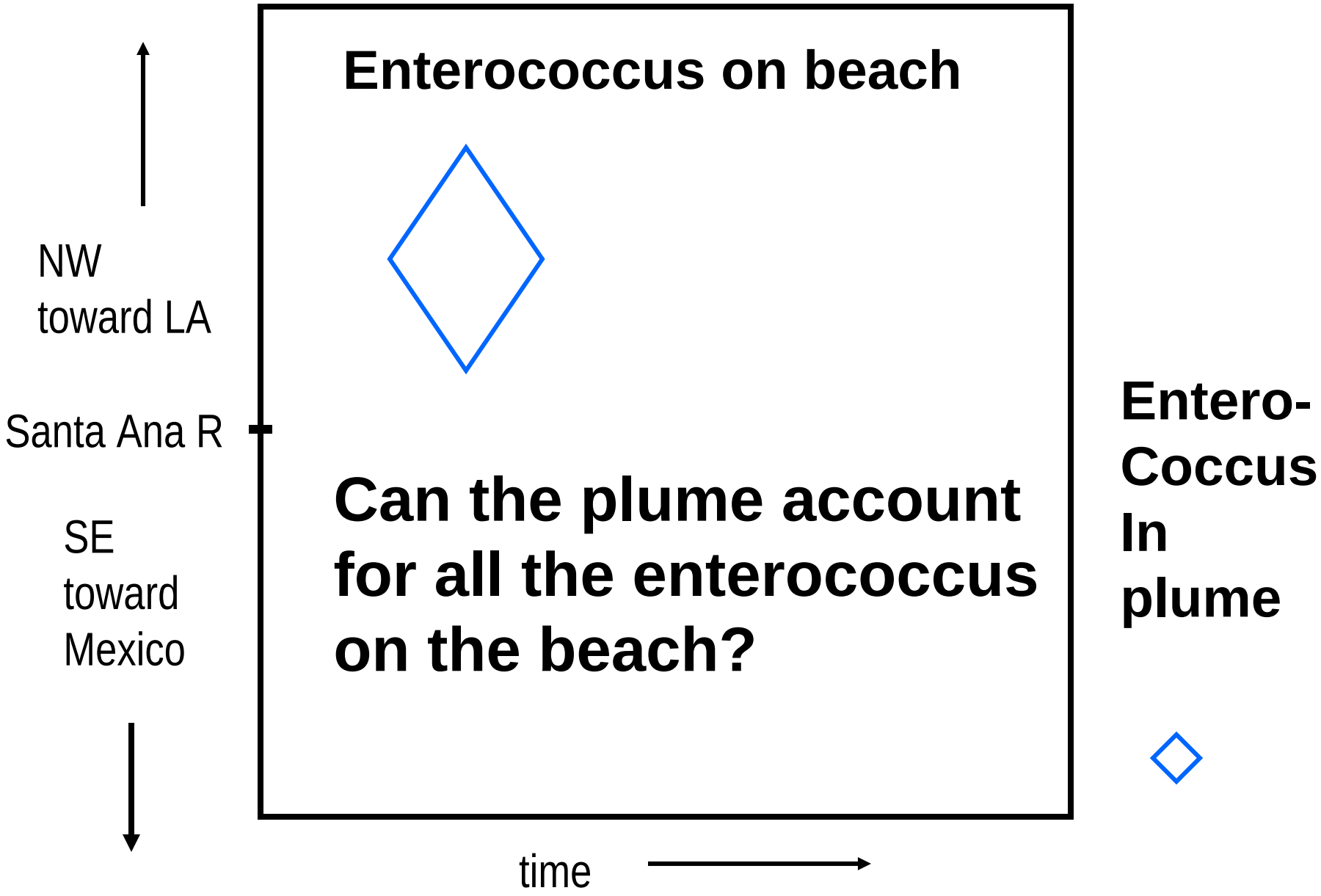
Rosenfeld et al, 2006

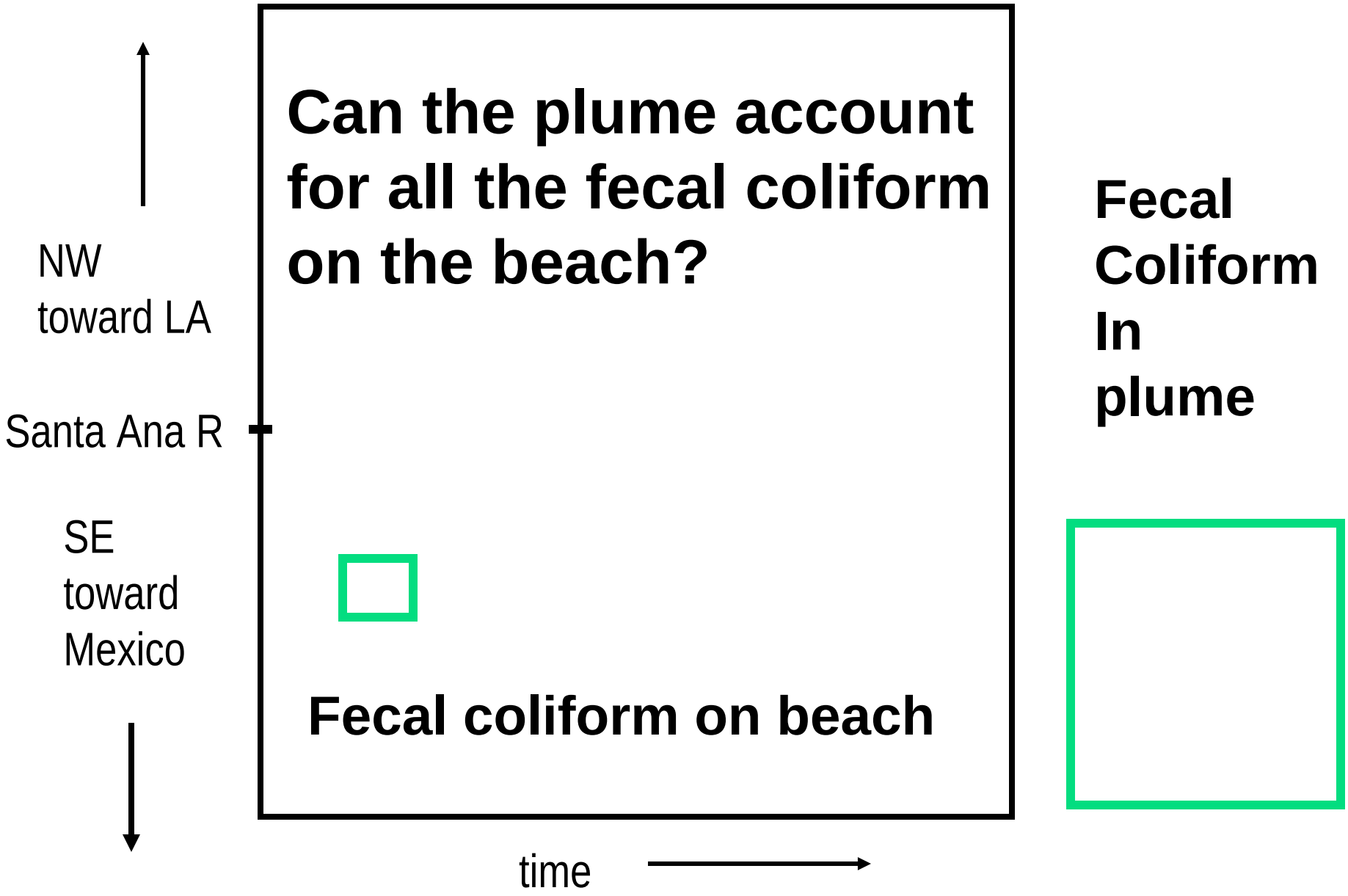

y-axis of
bacteria plot
Huntington Beach
Santa Ana River
Newport Beach
N
0 1 2
kilometers
0 1 2
miles
Legend
Physical Oceanographic Moorings
Hydrography -- CTD Stations
Hydrography -- Tow-yo Transects
Line
Line


NW
toward LA
Santa Ana R
SE
toward
Mexico
time
Type 2 events
Enterococcus
• over wide swath of beach
• mostly NW of Santa Ana R
• all at same time
• regular intervals?


NW
toward LA
Santa Ana R
SE
toward
Mexico
Coliform events (Type 1):
• just NW of Santa Ana R
• different times from Entero
time

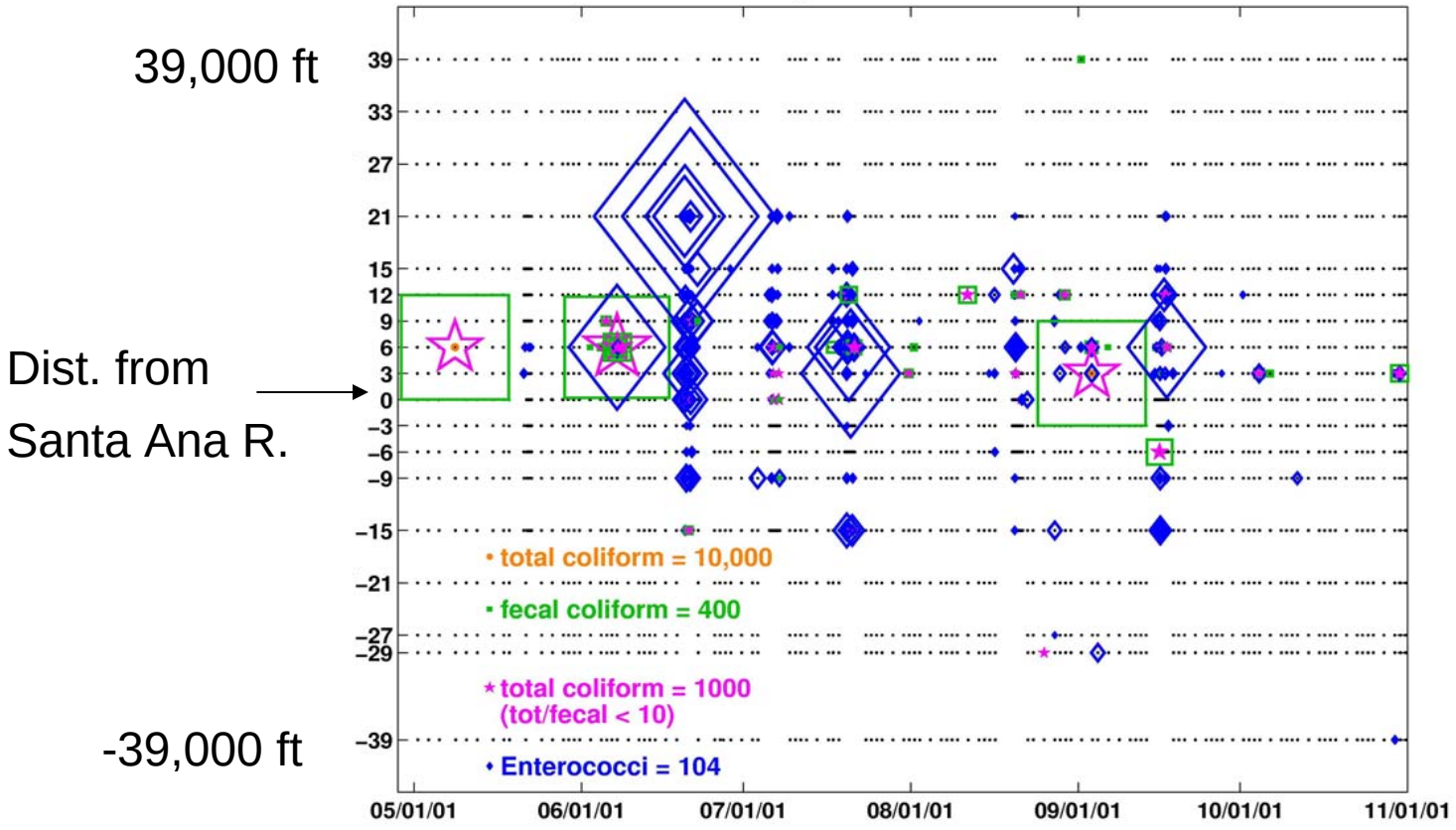

Enterococcus
Coliform
NW
toward LA
Santa Ana R
SE
toward
Mexico
From the same source?
time


Enterococcus on beach
NW
toward LA
Santa Ana R
SE
toward
Mexico
Can the plume account for all the enterococcus on the beach?
time
Entero-
Coccus
In
plume


Can the plume account for all the fecal coliform on the beach?
NW toward LA
Santa Ana R
SE toward Mexico
Fecal coliform on beach
time
Fecal Coliform In plume

Surfzone Bacteria Patterns

- Type 1 Localized total and fecal coliform events ☆ □
- Type 2 Large-scale Enterococci events ◊



Tot. col. = 500,000

Fec.col. = 50,000

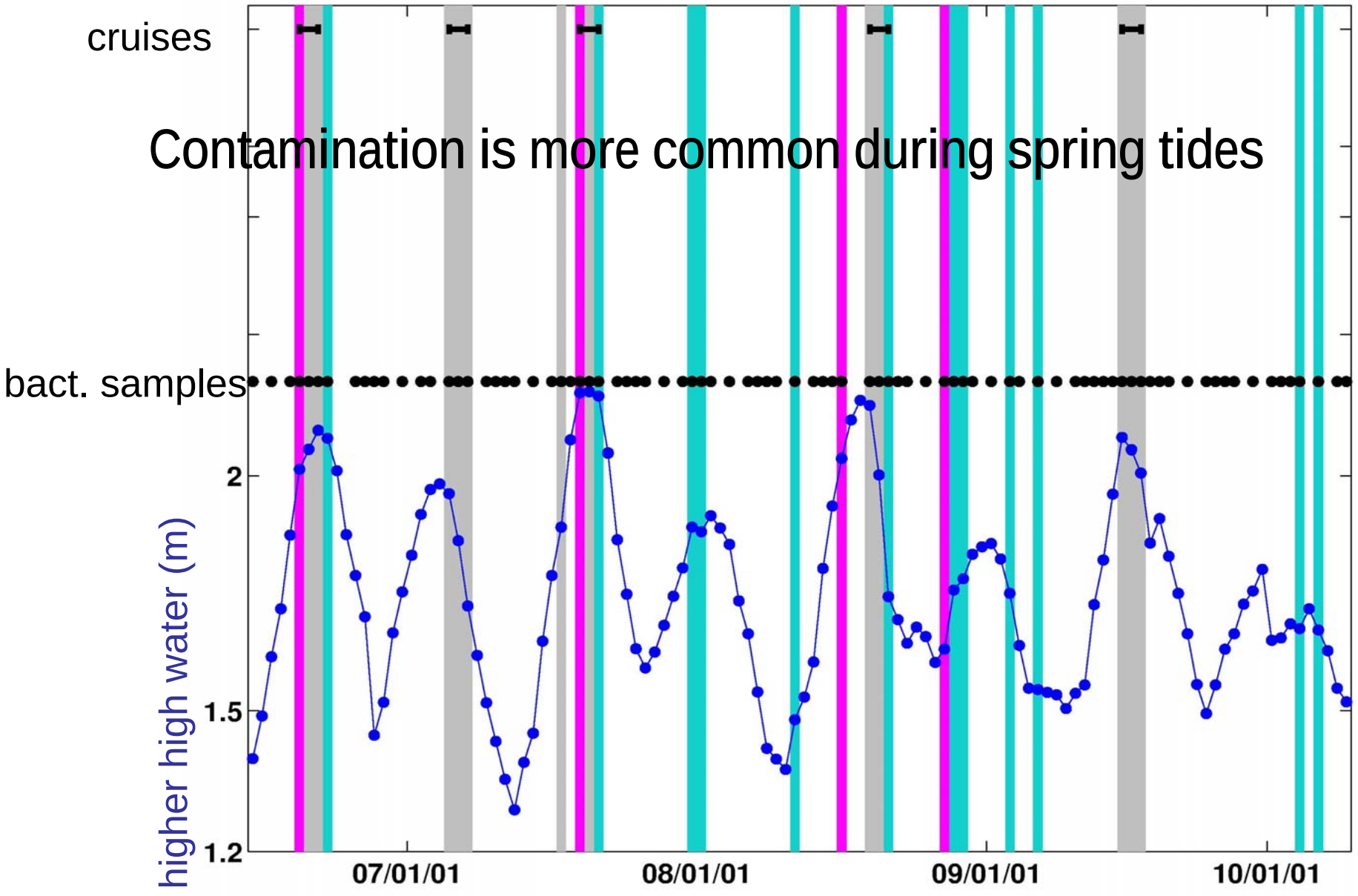
Ent. = 500

◊

Concentrations in outfall plume

Rosenfeld et al, 2006

Beach bacterial events denoted by vertical bars: type 1, type 2, both



Rosenfeld et al, 2006

Pacific Standard Time

Questions About Possible Transport Processes

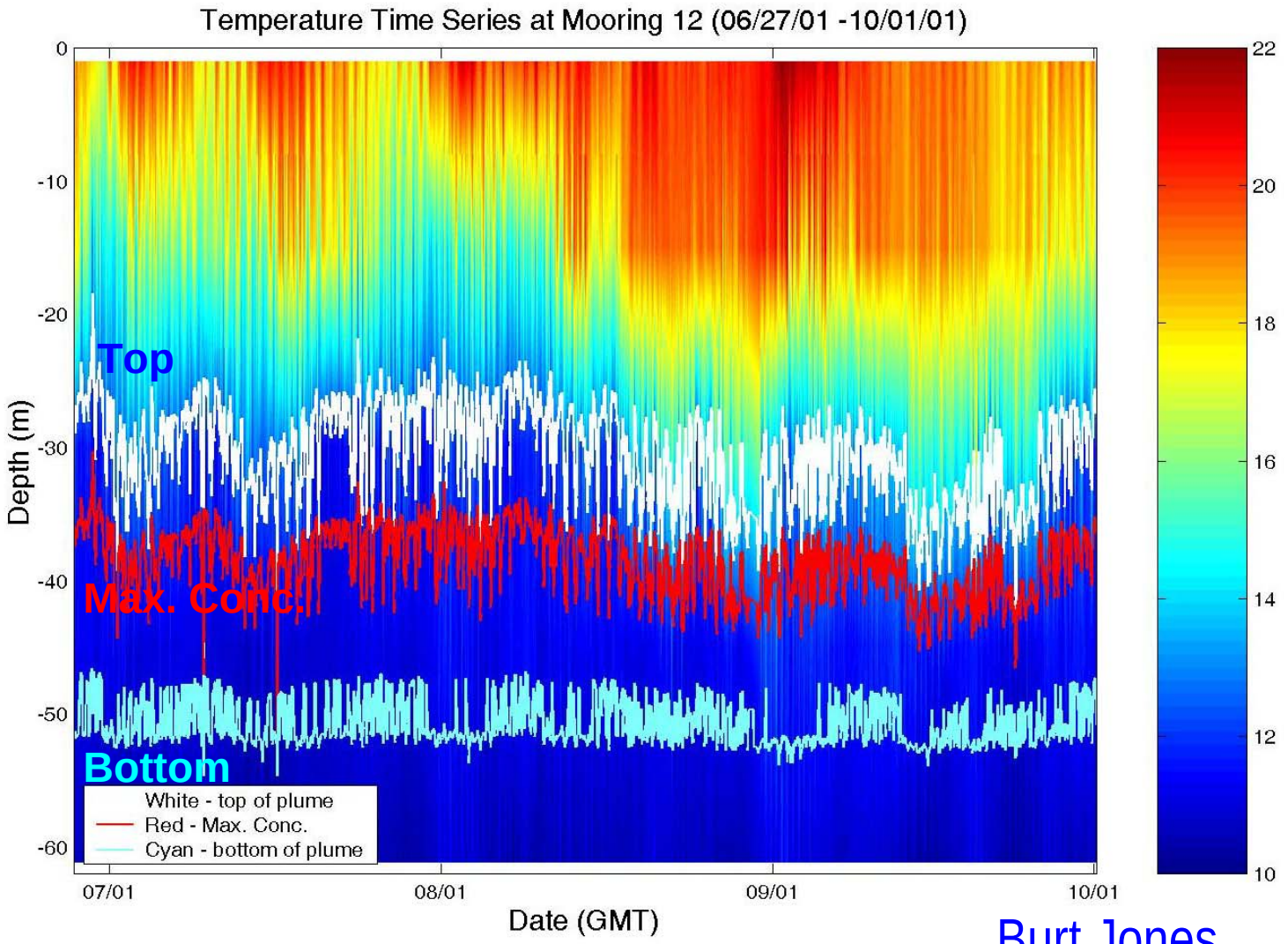
- Did we observe the process?
- Could the process transport plume water to the surf zone?
- Did we observe an association between the process and contamination events onshore?

Noble et al

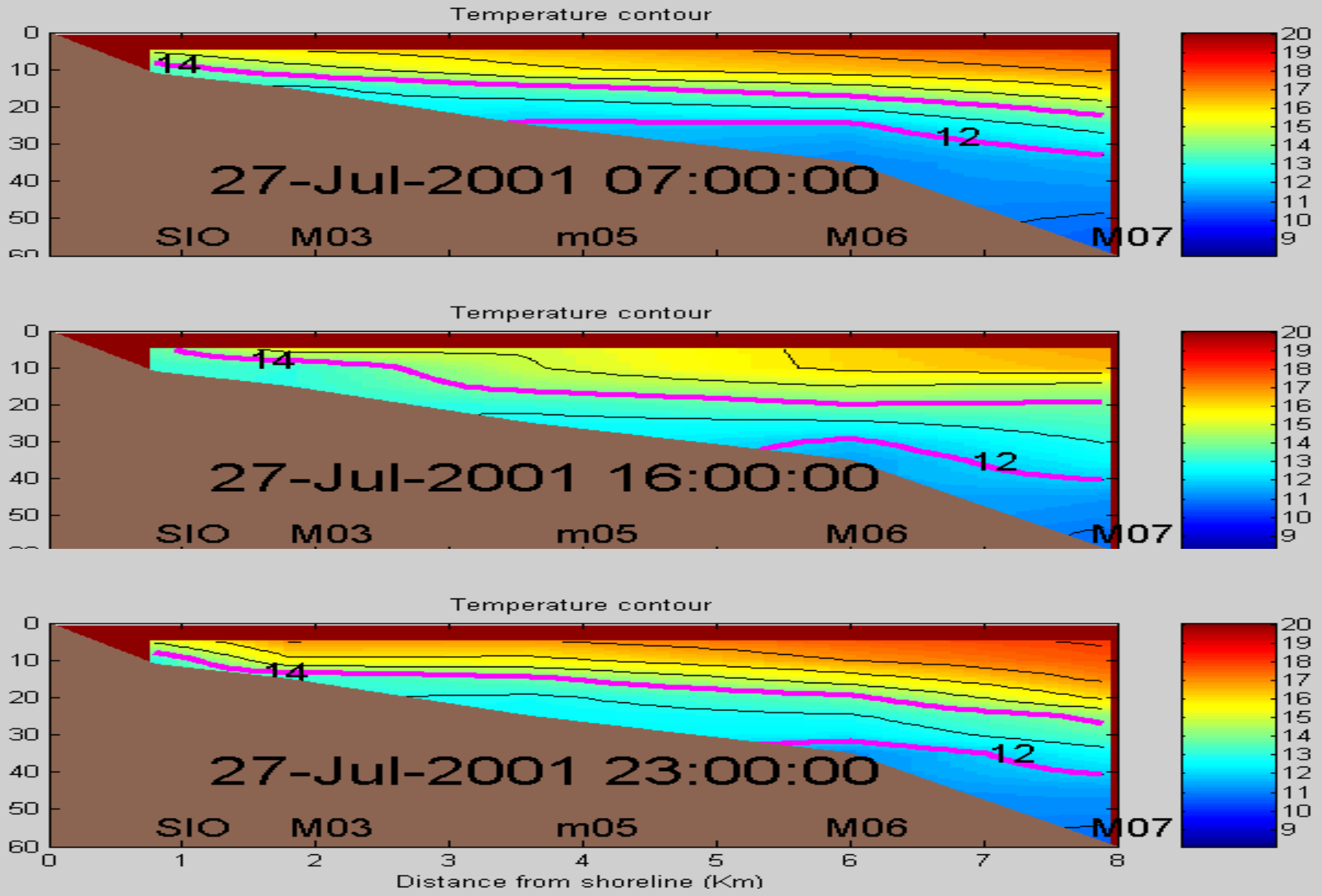
One possible transport process: Internal Tides

- where is the sewage plume?
- what is an internal tide?
- could internal tides bring sewage to the beach?
- do they actually do so?

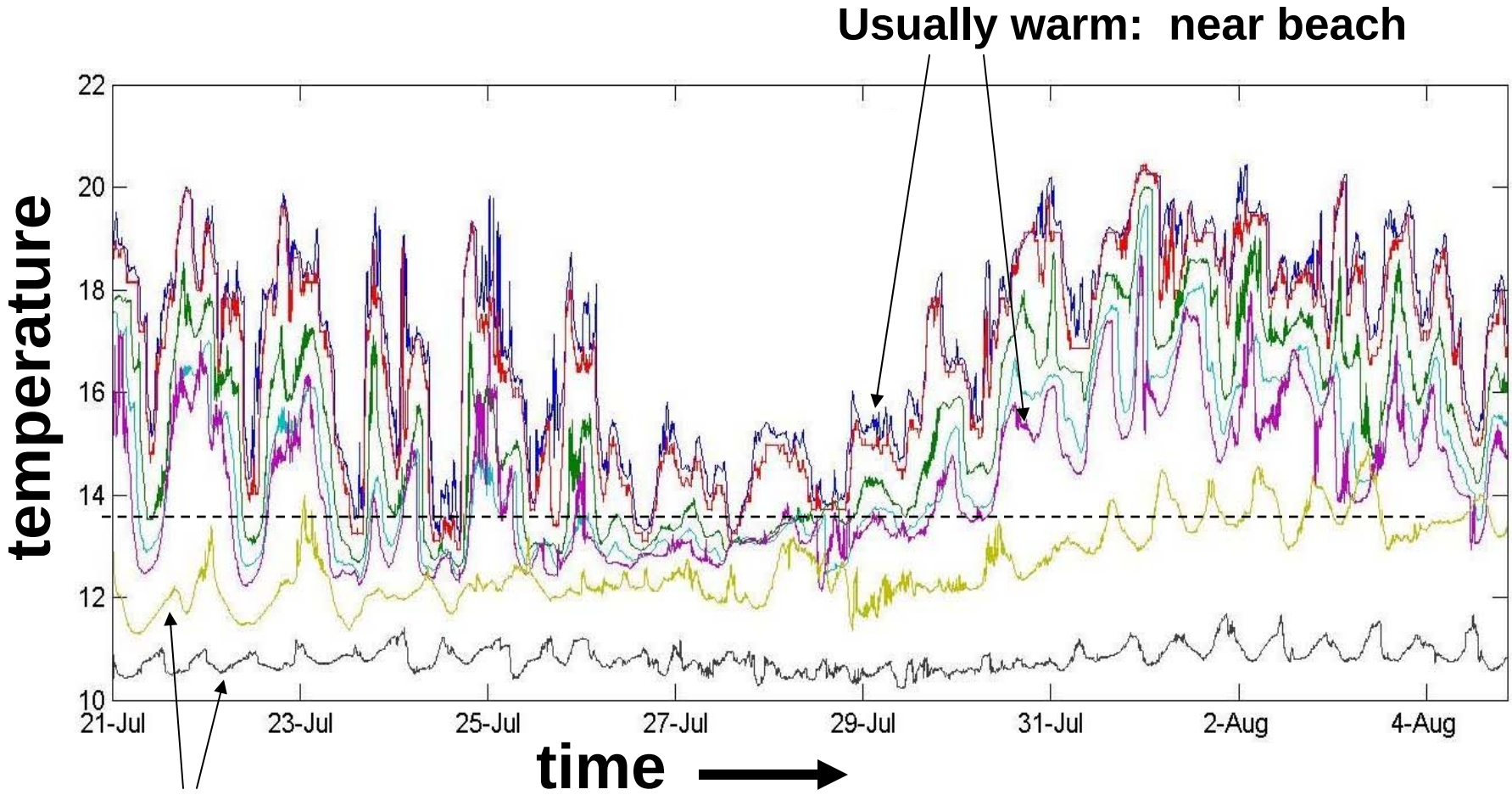
Modeled Plume stays in cold water near bottom



Burt Jones

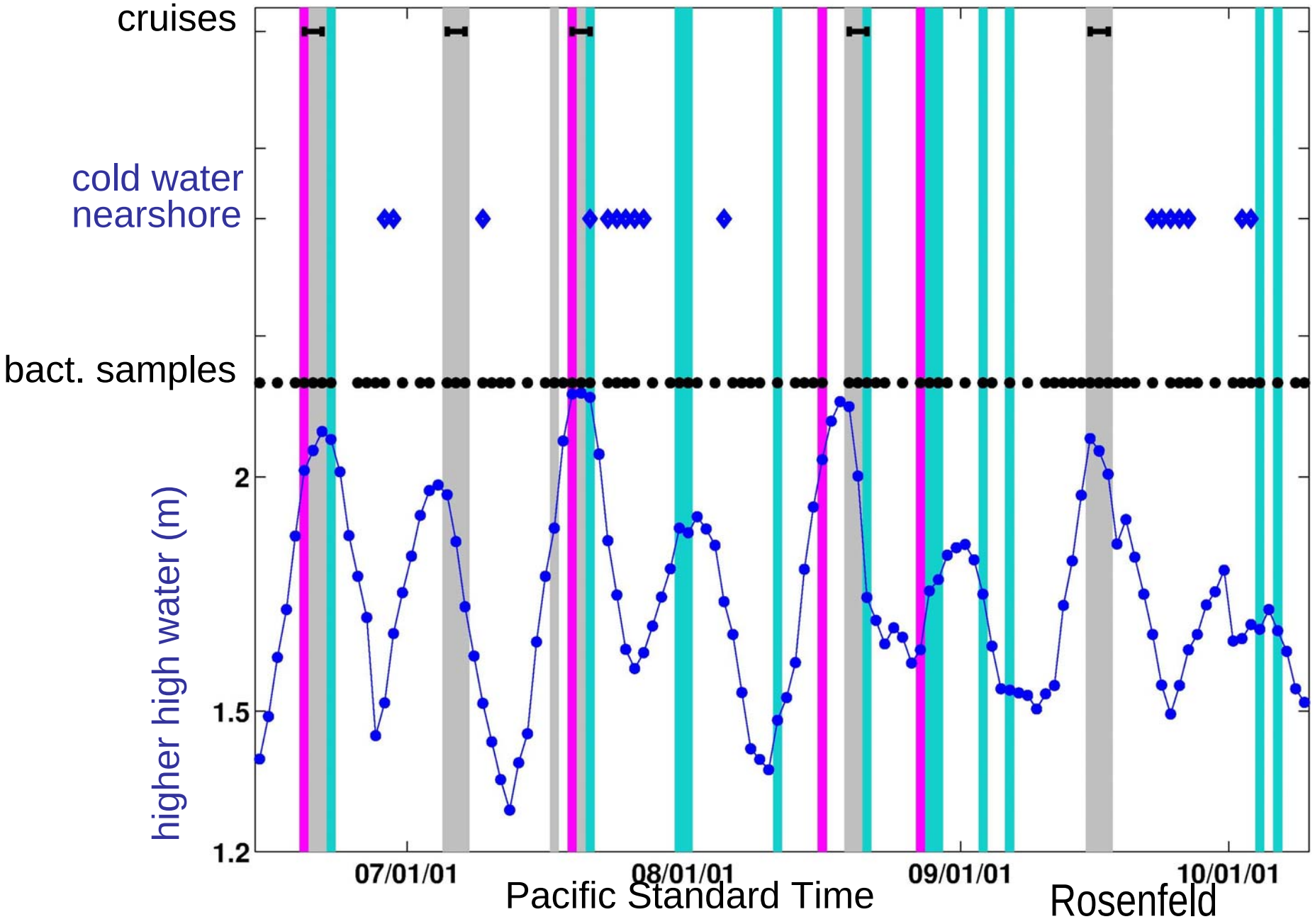

Temperature contour
14
12
27-Jul-2001 07:00:00
SIO
M03
m05
M06
M07
Temperature contour
14
12
27-Jul-2001 16:00:00
SIO
M03
m05
M06
M07
Temperature contour
14
12
27-Jul-2001 23:00:00
SIO
M03
m05
M06
M07
Distance from shoreline (Km)

When is the water near the beach as cool as the outfall plume?



JL

Beach bacterial events denoted by vertical bars: type 1, type 2, both

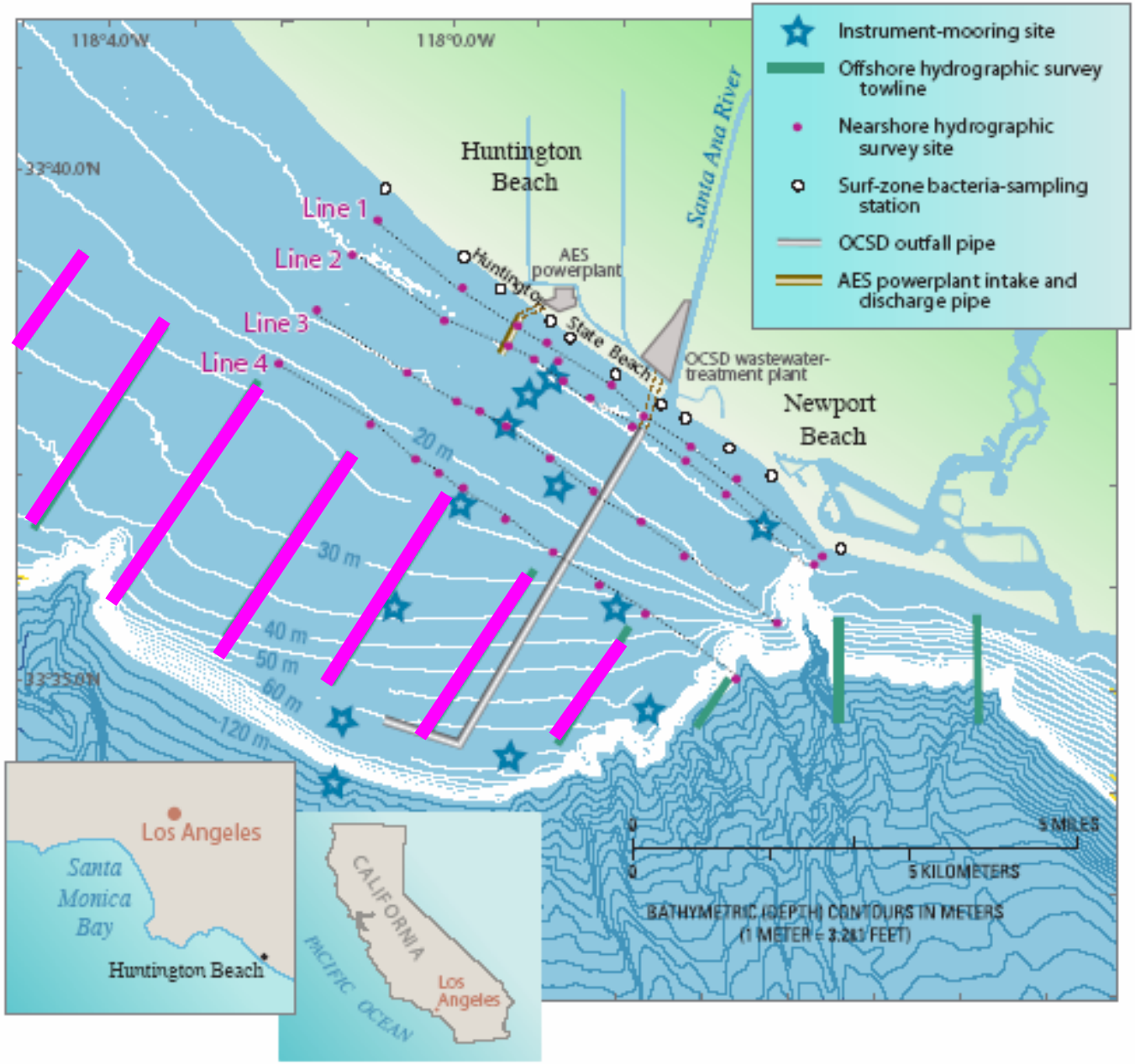


Conclusion for Cold Events

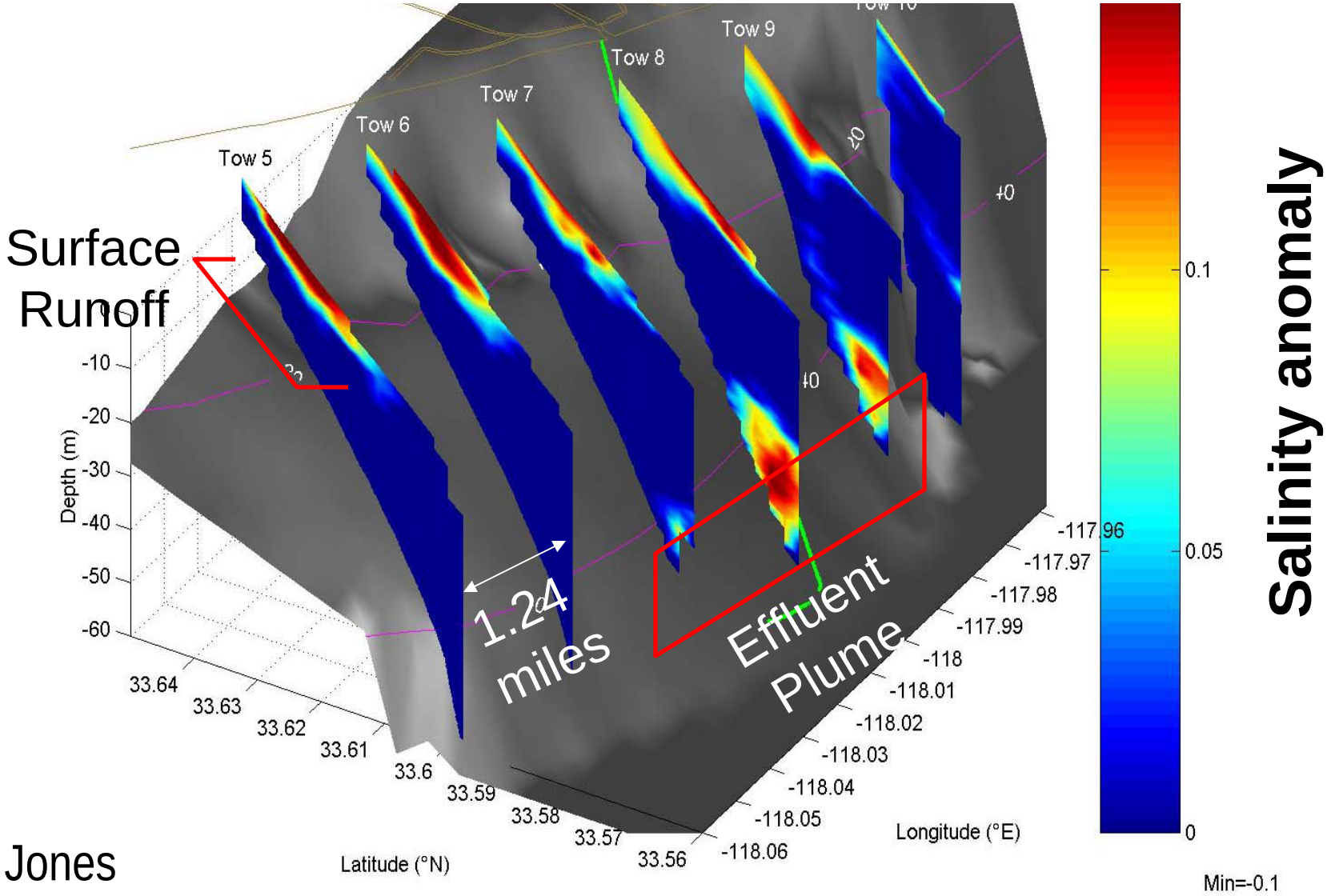
- Internal tides exist.
- Temporal disconnect between transport and contamination.

Noble et al

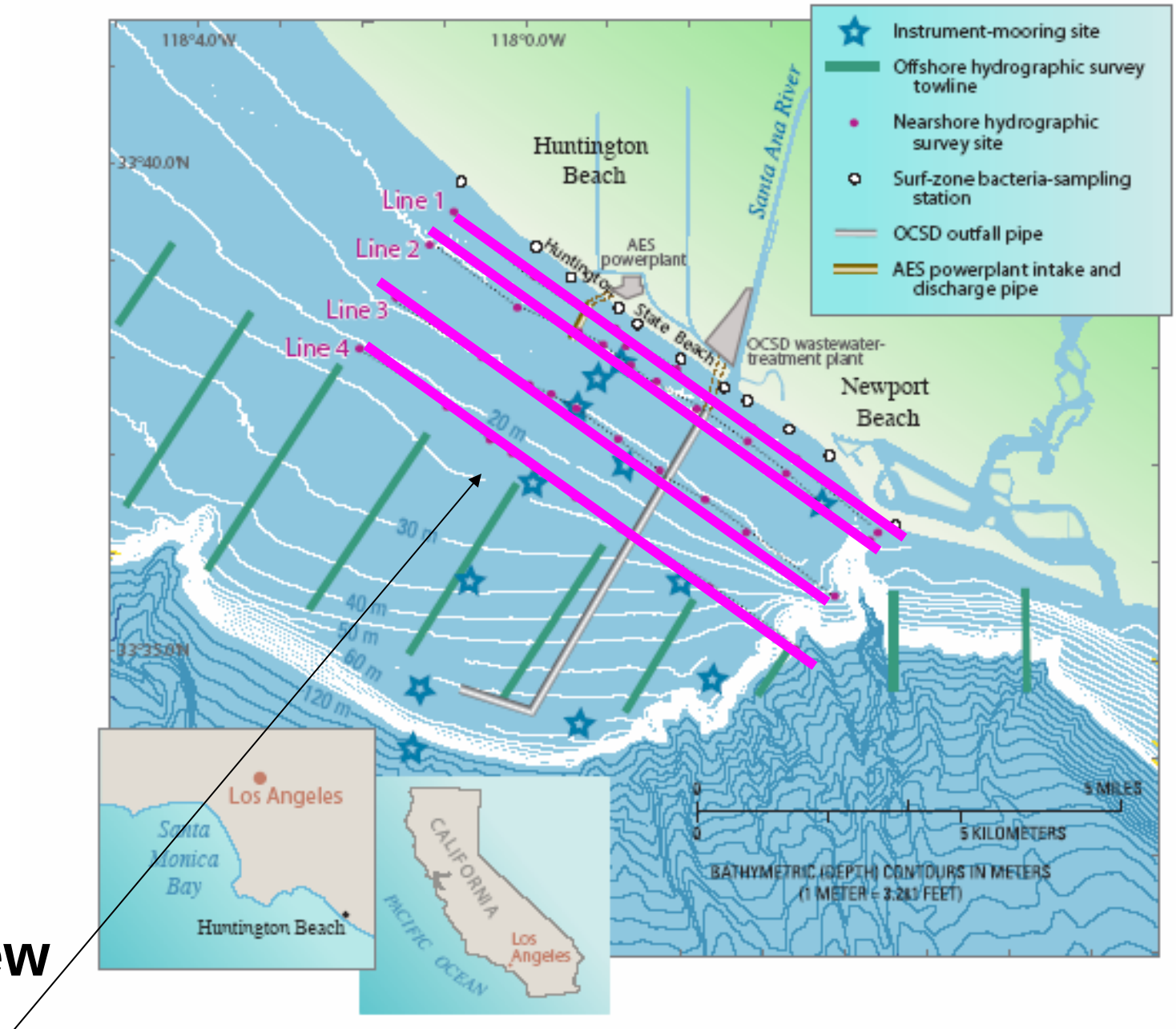
view


Instrument-mooring site
Offshore hydrographic survey towline
Nearshore hydrographic survey site
Surf-zone bacteria-sampling station
OCSD outfall pipe
AES powerplant intake and discharge pipe
118°4.0'W
118°0.0'W
33°40.0'N
33°35.0'N
Huntington Beach
Santa Ana River
AES powerplant
Huntington State Beach
OCSD wastewater-treatment plant
Newport Beach
Line 1
Line 2
Line 3
Line 4
20 m
30 m
40 m
50 m
60 m
120 m
0
5 MILES
0
5 KILOMETERS
BATHYMETRIC (DEPTH) CONTOURS IN METERS
(1 METER = 3.281 FEET)
Los Angeles
Santa Monica Bay
Huntington Beach
CALIFORNIA
PACIFIC OCEAN
Los Angeles

Cold Fresh Water at Outfall and Beach
Is there a connection?

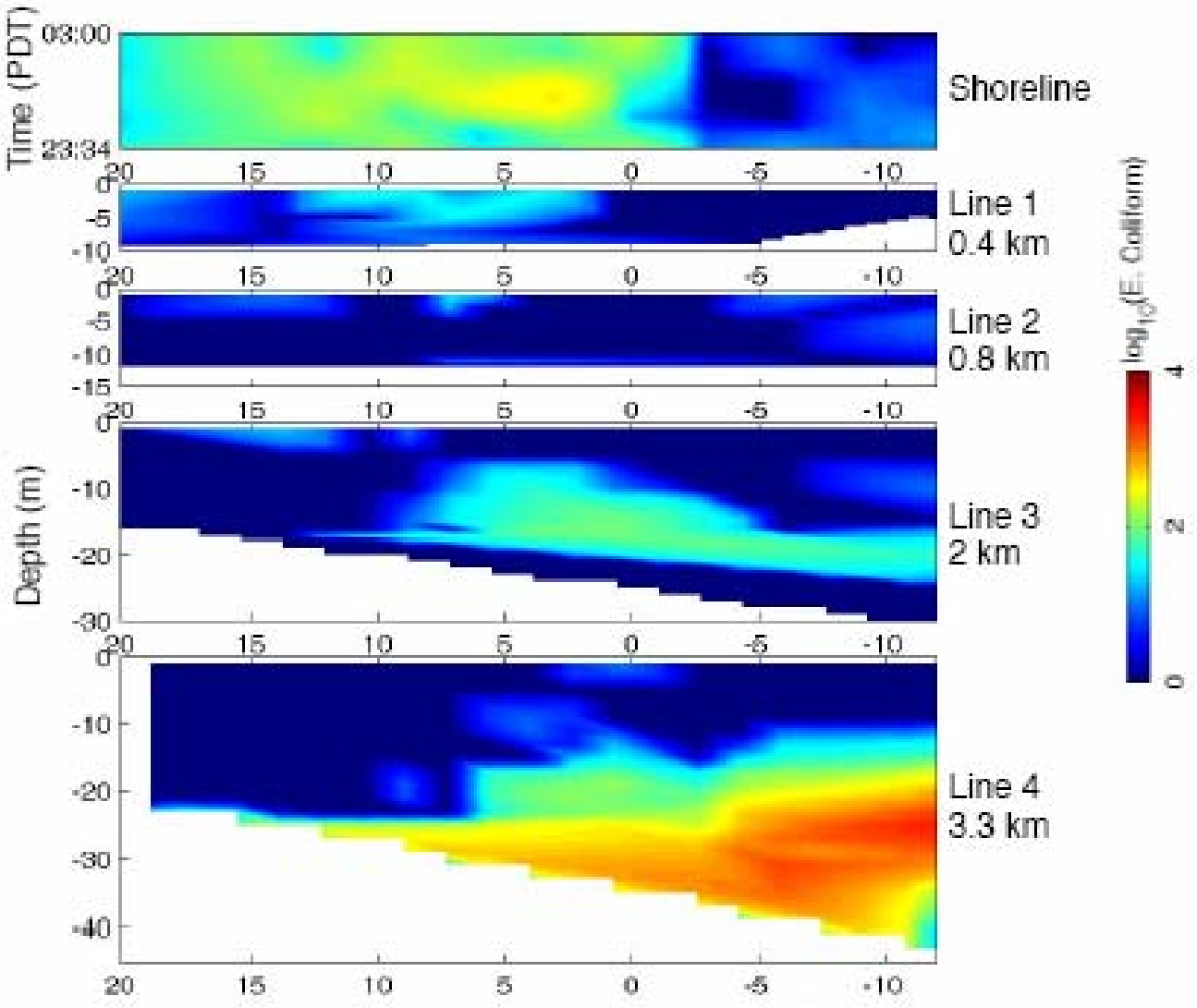


Burt Jones


Instrument-mooring site
Offshore hydrographic survey towline
Nearshore hydrographic survey site
Surf-zone bacteria-sampling station
OCSD outfall pipe
AES powerplant intake and discharge pipe
118°4.0'W
118°0.0'W
33°40.0'N
33°35.0'N
Huntington Beach
Santa Ana River
AES powerplant
Huntington State Beach
OCSD wastewater-treatment plant
Newport Beach
Line 1
Line 2
Line 3
Line 4
20 m
30 m
40 m
50 m
60 m
120 m
0
5 MILES
0
5 KILOMETERS
BATHYMETRIC (DEPTH) CONTOURS IN METERS
(1 METER = 3.281 FEET)
Los Angeles
Santa Monica Bay
Huntington Beach
CALIFORNIA
PACIFIC OCEAN
Los Angeles

view

High Bacterial Concentrations at outfall and shore



Lines parallel to shore, at different depths

Take home points on sewage transport

- temporal disconnect – internal tides / contamination
- spatial disconnect – beach / plume

What do you think?

- is the plume responsible for beach contamination?
- what more information do you need?

Scientist's Conclusions

"We have not yet found a connection between coastal ocean processes and bacterial contamination on the beaches."

"We do not think bacteria in the plume contributes substantially to the contamination events on the beach that exceed the AB411 standards."

Noble et al

.. but OCSD was still not obeying the federal law.

Regulatory Issues

1972, federal Clean Water Act

- controls what is dumped in the ocean
- requires secondary sewage treatment for ocean outfalls
- OCSD was not in compliance with CWA

? Does compliance with CWA ensure safety
by AB411 standards?? ... actually, no

Sources: www.wef.org, www.healthebay.org

Settlement Tank
Johnstown, PA
WWW.CTCnet.Net

Primary Treatment
40% of solids

1. **Filter**
2. **Settle**
   - **a) solids sink to bottom**
   - **b) oils float to surface**
   - **c) middle cleaner**

Secondary Treatment
85% of solids

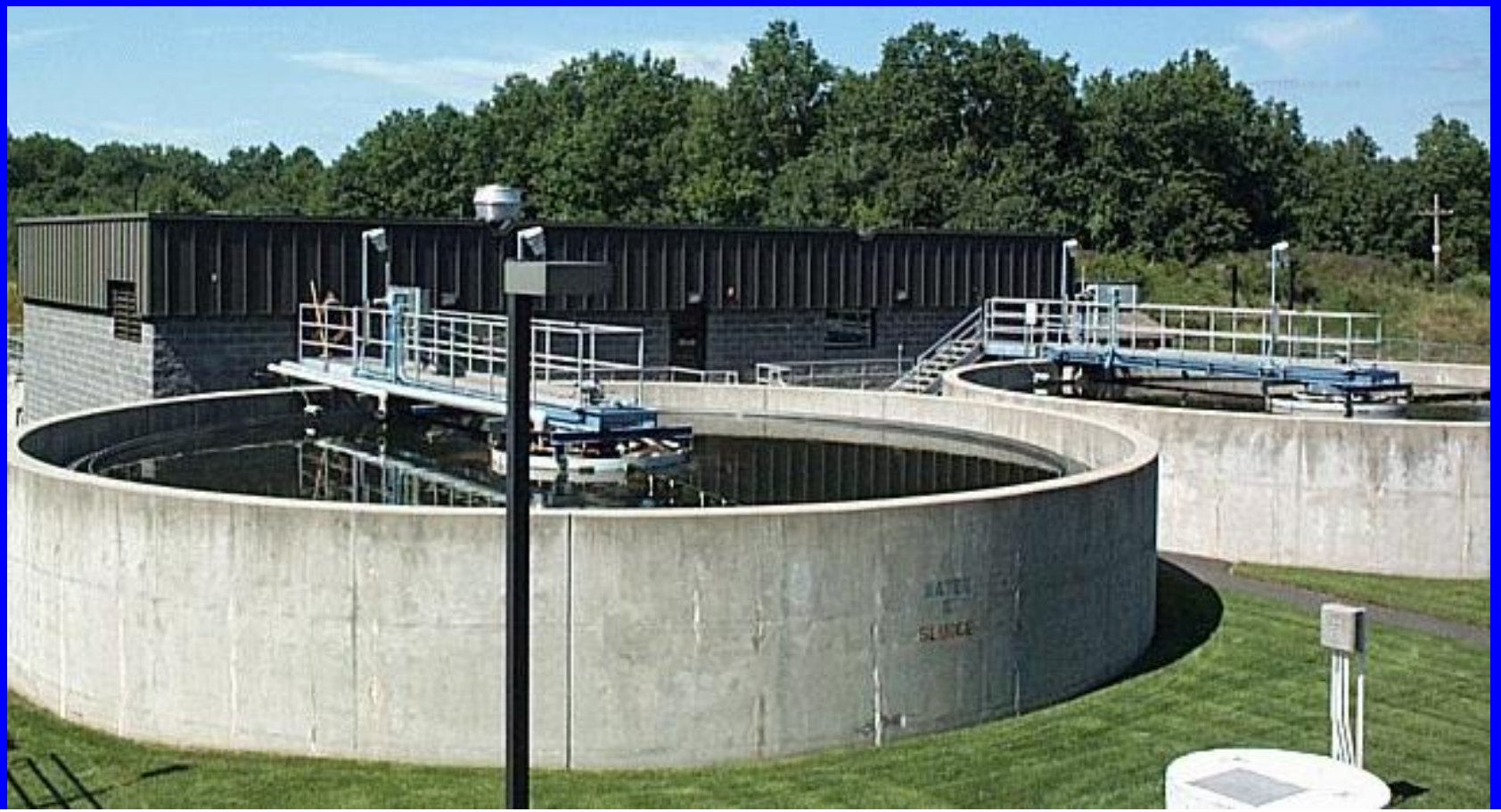
- biological treatment + more filters
- required by 1972 CWA
- does **not** kill bacteria
- upgrade $270 – $400 **million**

Oxidation ditch – encourages bacteria

Secondary Treatment: bacteria decompose organics

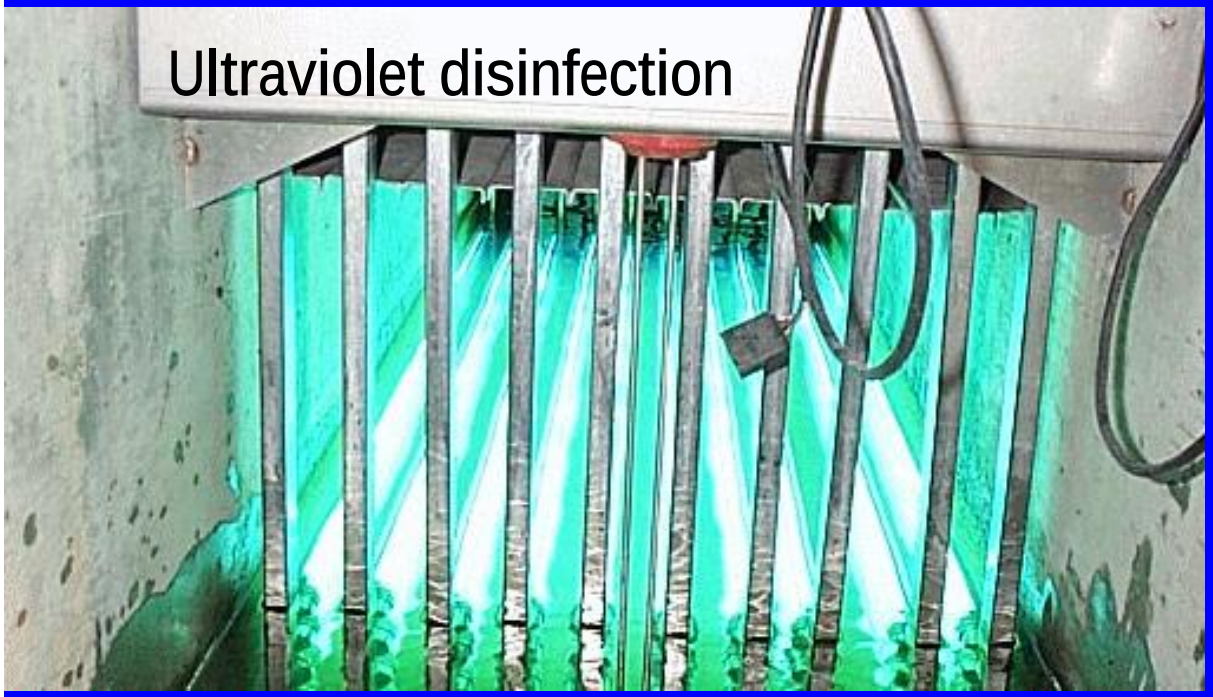
- activated sludge
- filter through rocks
- lagoons in sun

Final clarifier



Tertiary Treatment

- reverse osmosis
- micro-filtration
- activated charcoal
- water your crops!!



… OR …

kill bacteria

The Argument: (as of early July, 2002)

OCSD

- has a waiver allowing only 50% secondary treatment
- believes they are not harming environment
- wants to save money on treatment ($400 million)
- suggests chlorine to kill bacteria

Scientists

- believe beach contamination from other source than plume

The Argument:

Environmentalists

- want clean beaches and clean ocean
- believe bacterial contamination due to OCSD outfall
- demand an end to the secondary treatment waiver
- cite non-compliance with Clean Water Act
- object to chlorine disinfection

The Irony:

- secondary treatment does not kill bacteria
- disinfection kills bacteria

Issues for decisions on sewage treatment

Where do the bacteria on the beach come from?
Would secondary treatment make the beach cleaner?

... but ....

are these the only issues to be considered?

Whose needs should we consider?

How can we make this important decision?

Do you care about

bacteria counts on the beach

Or

any sewage anywhere in the ocean?

Should decision be based on

cost / benefits analysis

OR

zero tolerance for impact?

What other issues are important?

Should OCSD go to full secondary? VOTE!!

1. full secondary
2. chlorination
3. further study
4. other ideas?

The Result

July 17, 2002, OCSD Board of Directors voted 13/12 to go to full secondary treatment

- can't demonstrate no impact on beach bacteria
- possible water reclamation
- public opinion
- cost now somewhat lower ($270 million)

Also plan chlorine bleach disinfection + dechlorination, by August 12, 2002.

What if ....

- imagine you're a student at UCSB
- Goleta Beach is next to campus
- sewage outfall is at beach
- it was not full secondary in 2002
- cost of upgrade is $8/person/month
- beach is contaminated after rain

would you vote to pay for the upgrade?

santabarbara.com