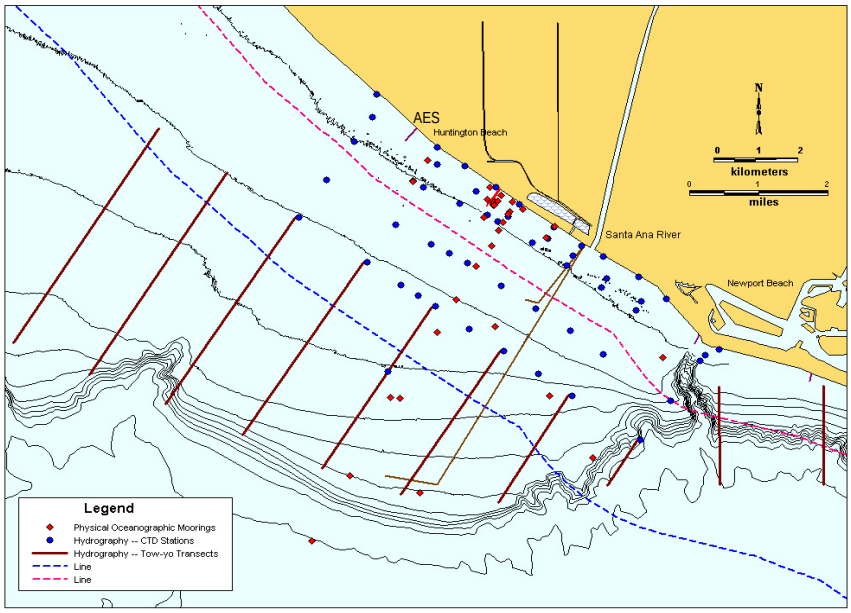
Noble et al



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

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?

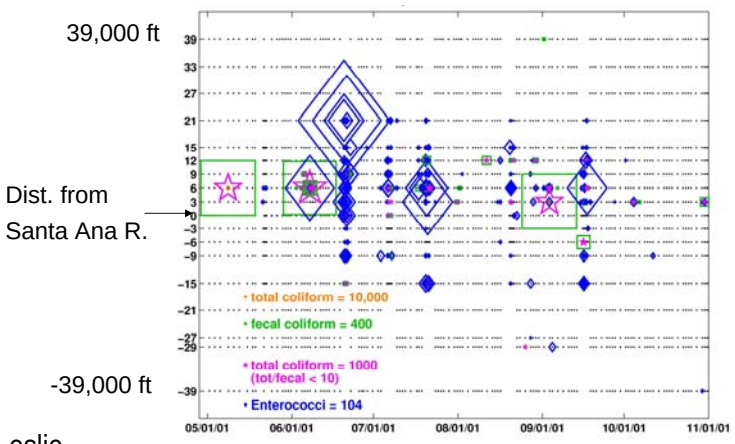
AB-411 Standards: Bacteria

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)

www.healthebay.org

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

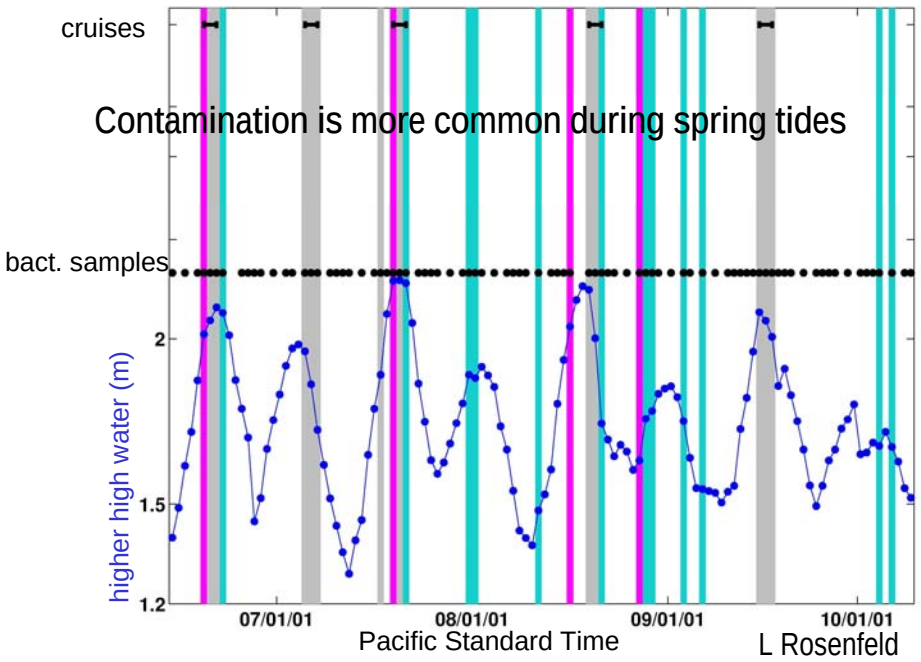
Leslie Rosenfeld

Enterococcus and Coliform
appear to come from different sources

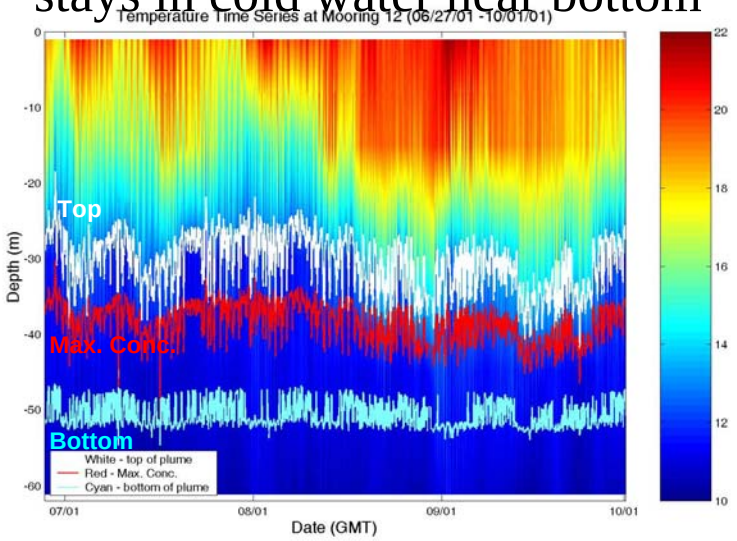
- Entero on wide swaths of beach, Coliform at single location
- Contamination events not at the same time
- Entero on beach higher concentration than plume
- Coliform on beach lower concentration than plume

? Is it likely that enterococcus comes from plume?

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

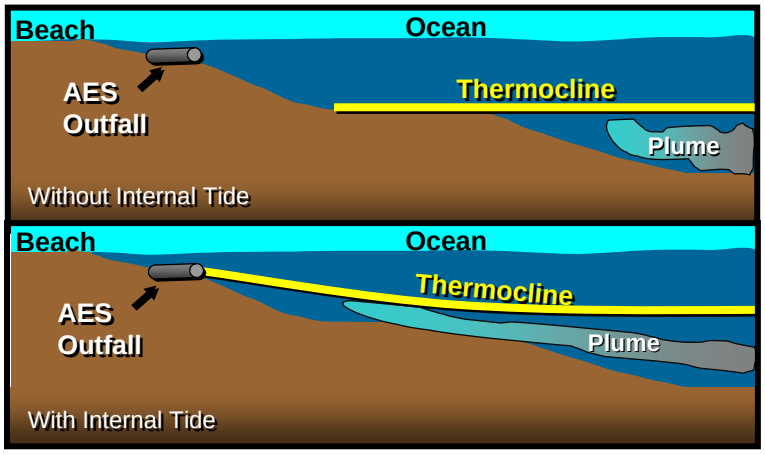


Modeled Plume
stays in cold water near bottom

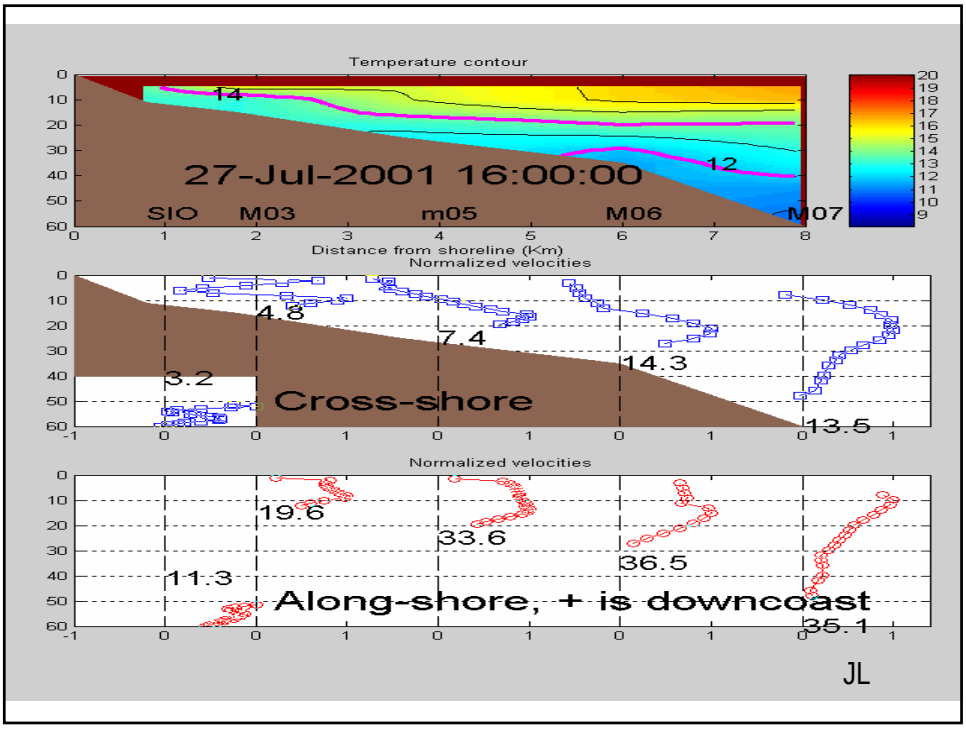


Internal Tides

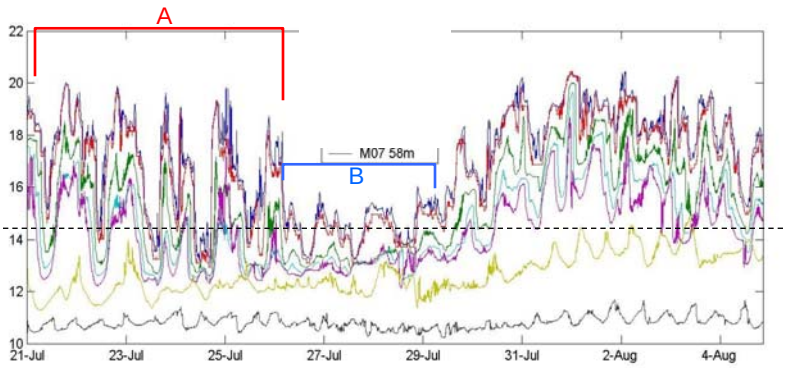
- Onshore and alongshore currents.
- Can occur every 12 or 24 hours.



John Largier



Cooling Events

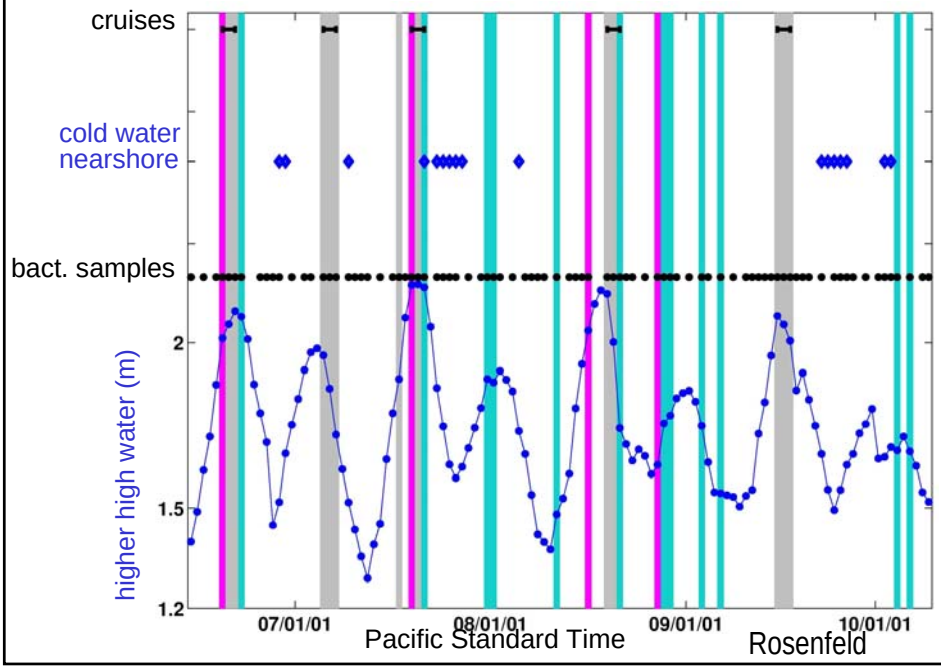


A – Cooling due to tidal surges

B – Longer term cooling events

JL

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



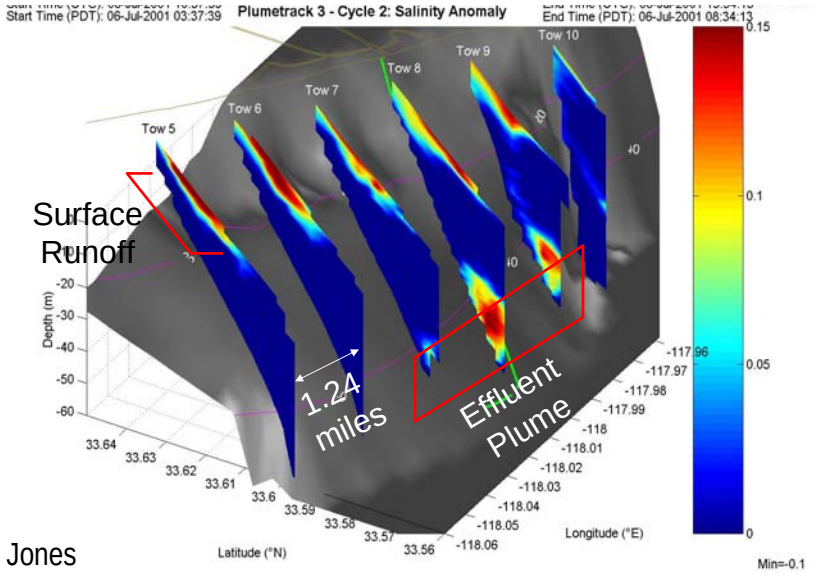
Rosenfeld

Conclusion for Cold Events

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

Noble et al

Where is the Bacterial Plume?



Burt Jones

Regulatory Issues

1999, state AB411 standards
- determines whether it's safe to swim at beach
- numbers of bacteria
- AB411 events probably not due to OCSD plume

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 AB411??

Levels of Sewage Treatment

The Clean Water Act [1972] requires publicly owned treatment facilities to upgrade to full secondary treatment before discharging into the ocean.

Primary Treatment –
Physical filters; removes 40% of solids

Secondary Treatment –
Biological treatment + more filters; removes 85% of solids

Tertiary Treatment –
May remove nutrients, toxic chemicals, metals, bacteria
Can use outflow to water food crops

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

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

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

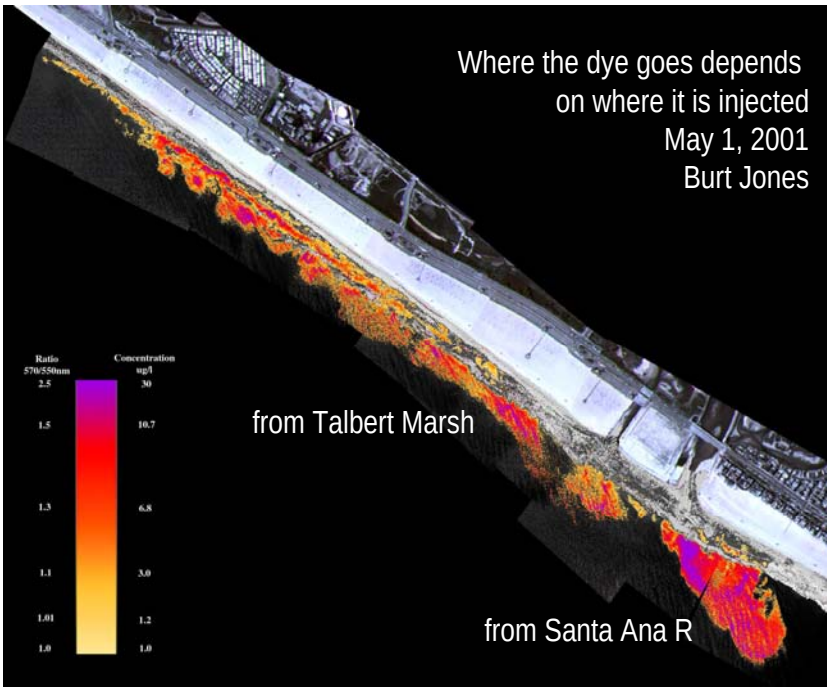
but ... what kills bacteria?

Review Questions

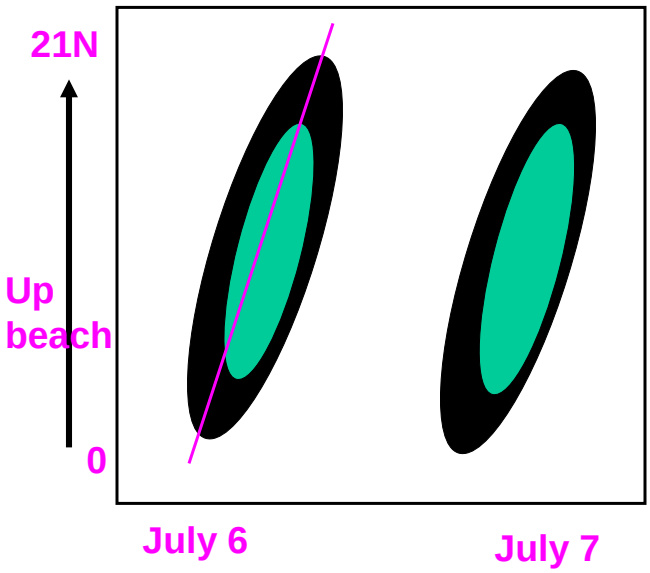
General
- what is governed by CA state AB411 standards?
- what are indicator bacteria?
- how are bacteria identified?

Huntington Beach enterococcus and coliform bacteria
- describe spatial and temporal patterns
- beach more or less concentrated than outfall?
- do they appear to come from the same source?
- do contaminations occur during spring or neap tides?

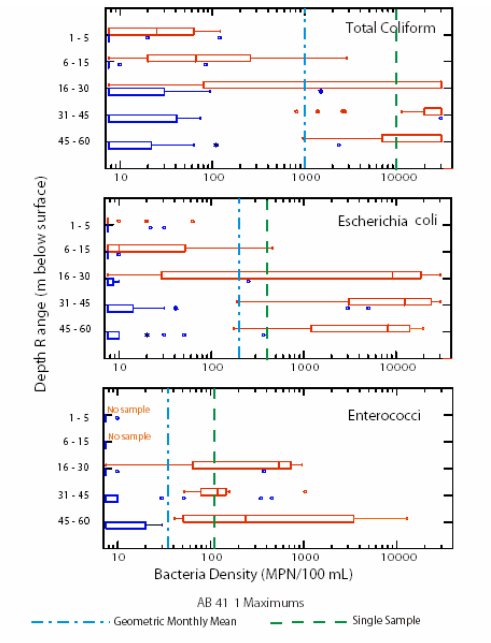
Internal Tides
- what is an internal tide?
- how could an internal tide affect transport of sewage?
- do internal tides appear to cause beach contamination?



Total Coliform Only



Moves
Up beach
0.3 m/s



plume bacteria reduced by disinfection

old: above AB411 standards
new: below AB411

it's safe to swim in the plume

... but ...

is the beach any cleaner?

Noble et al, 2004

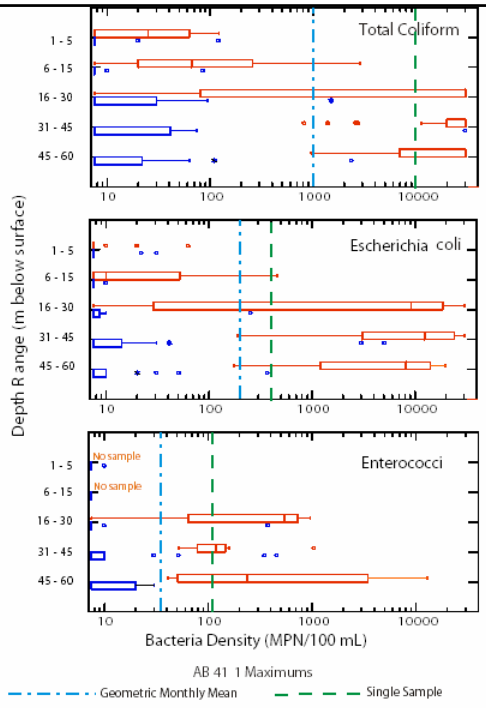
Effect of chlorination on Huntington Beach

- Chlorox kills bacteria, also nasty for other animals
- controversial; de-chlorination is tricky!
- will it affect beach bacteria?

RESULT

- bacteria in outfall reduced by 99.99 %
- outfall plume never exceeds AB411 standards
- outfall plume 100x cleaner than beach
- beach contaminations still occur

What does this imply about source of contamination?



plume bacteria

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... but ...

is the beach any cleaner?

Noble et al, 2004

Patterns in beach contamination are essentially unaffected by chlorination

Annual cycle:
lots of bacteria in winter due to local runoff in storms

Fortnightly cycle:
lots of bacteria during spring tides

Why:
- seawater gets into Talbert Marsh and Santa Ana River
- accumulated junk gets washed into ocean