Environmental Consequences of Coastal Engineering

A case for coupled biological-physical models for pathogen prediction

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Pathogenic vibrios a problem in coastal states with warm climates
Where and when is the risk greatest? Can we do anything about it?

**Star Bulletin**
Vol. 11, Issue 95 - Wednesday, April 5, 2006

Man dying after fall into polluted Ala Wai
34-year-old mortgage loan officer Oliver Johnson has flesh-eating disease

CDC Data 2003-2006
Why so poor?
Not time-resolved
No physical processes
Next steps: parameterization for biological model

\[ \sqrt{k_p} = b(T - T_{\text{min}}) \{ \exp [c(t - T_{\text{max}})] \} \sqrt{(a_w - a_{w,\text{min}}) \{ 1 - \exp [d(a_w - a_{w,\text{min}})] \} } \]

Coupling to a Physical Model

ROMS with data assimilation

nearshore sensor

Canal

Daily Average USGS Stream Gauge Data
Ala Wai as conduit for SWAC waste?


2009 Honolulu seawater air conditioning final environmental impact statement. Honolulu Seawater Air Conditioning, LLC, Prepared by TEC Inc., Honolulu, HI.

### Table

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
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<tr>
<td>P</td>
<td>0.89 (0.2-4.4)</td>
<td>2</td>
</tr>
<tr>
<td>N</td>
<td>24 (2-280)</td>
<td>34</td>
</tr>
<tr>
<td>Si</td>
<td>122 (28-486)</td>
<td>45</td>
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<td>DOC</td>
<td>215 (80-913)</td>
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<tr>
<td>Flowc</td>
<td>0.2 (0.05-20)</td>
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<tr>
<td>Temp</td>
<td>27.9 (25-34)</td>
<td>11-14</td>
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<tr>
<td>Sal</td>
<td>27 (2-36)</td>
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</table>

a Data from Nigro et al. (unpublished)
b Data from Hawaii Ocean Time Series data server (hahana.soest.hawaii.edu/hot-dogs/interface.html)
c Data from USGS stream gauge 16247100 (http://waterdata.usgs.gov/usa/nwis/uv?16247100)

\[
\sqrt{V_r} = b(T - T_{max}) \left[ \exp\left(\frac{e(T - T_{max})}{T_{max} - T_{min}}\right) \right] \sqrt{\left(\frac{e_{max} - e_{min}}{1 - \exp\left[\frac{e_{max} - e_{min}}{T_{min} - T_{max}}\right]}\right)}
\]
Conclusion

✦ Using the Ala Wai as a conduit for SWAC waste could be a win-win (or win-win-win-LOSE), but models needed to evaluate consequences

✦ The coupled biological-physical model described can be expanded to predicting transport and fate of sewage-derived pathogens, harmful algal blooms
Acknowledgments

• NSF (OCE04-32479, OCE05-54768)
• NIEHS (1P50EF012740-01)
• NOAA - HiOOS/PacIOOS (NA07NOS4730207 and NA08NOS4730299)
• Center for Microbial Oceanography-Research and Education
• La’Toya James, Brett Marchant, Gordon Walker (C•MORE Scholars Program)