RESEARCH BRIEF

Photo courtesy of Meghan Shea

FEBRUARY 2021

Stanford WOODS INSTITUTE for the ENVIRONMENT

New Coastal Water Quality Model Enables Better Beach Management

A new modeling framework utilizing high-frequency, short-term sampling can help resource managers assess water quality, leading to better informed public health decisions at more beaches.

Background

To reduce the incidence of recreational waterborne illness, fecal indicator bacteria are measured to assess water quality and inform beach management. It is estimated that up to 90 million illnesses, costing between $2.2–$3.7 billion annually, can be attributed to poor water quality at beaches in the United States. Ensuring clean and safe beaches is not only critical for public well-being, but also allows for thriving ocean economies.

In the United States, routine monitoring of fecal indicator bacteria is conducted at nearly 4,000 beaches and when concentrations exceed regulatory guidelines, authorities post beaches as unfit for swimming or close them down. However, there are major limitations associated with using fecal bacterial observations for beach management. Routine monitoring at most locations is conducted weekly or less frequently and the culture-based methods used by many monitoring agencies to measure concentrations have up to a two day turnaround time. Beach managers also need significant historical bacterial and

POINTS FOR POLICY MAKERS

- **Water quality models based on high-frequency sampling can have comparable performance to standard models developed using years of data for at least an entire swimming season.** This sampling method provides a new means of developing such models without needing to wait years for data to accumulate. With the appropriate support government agencies, university research institutes, community scientist groups or NGOs such as Surfrider Foundation's Blue Water Task Force would be able to conduct the more intensive water quality data collection and create forecast models for their local beaches after a day or two of sampling effort.

- **Broad adoption of the new modeling framework would result in improved public notification in coastal locations lacking water quality monitoring programs.** The benefits of access to water quality predictions, especially at data-poor beaches where no water quality information previously existed, are quite significant. Ideally, predictive performance would be continually assessed and models retrained using new data collected during additional high-frequency sampling events or through establishing new routine monitoring programs at the beach.

- **The model can be used as a framework to guide data-driven modeling efforts of other contaminants of concerns such as harmful algae, metals and nutrients for data-poor coastal areas.** Although this research focuses on fecal indicator bacteria models, the findings can be applied to other contaminants harmful to public health and the code is publicly available. Measuring water quality can protect beachgoers around the world from adverse health effects such as gastrointestinal and respiratory illnesses and skin ailments that are associated with exposure to toxic substances and waterborne pathogens.

environmental variable data sets to develop models that can reliably predict water quality at a beach — a requirement that limits data-poor beaches from being included in water quality modeling systems.

Data-poor beaches — sites where bacterial monitoring programs haven't been established or where relevant ocean and weather data are not routinely monitored — exist in the United States as well as globally. While nearly 450 beaches in California require weekly monitoring by state law, there are many popular beaches not monitored as frequently and considered data-poor, such as Huntington Beach Pier and San Onofre State Beach. A 2018 United Nations report indicated that many beaches around the world are also data-poor with 73% of their 193 member states not monitoring or reporting water quality data.

A new study led by Stanford scholars provides evidence that conducting more frequent sampling over a shorter time-period when combined with their newly developed modeling framework, efficiently and accurately predicts water quality models for data-poor beaches. By collecting high-frequency samples from three California locations, the researchers found that this new technique could alleviate public health notification time-lag from traditional monitoring samples and provide communities adjacent to data-poor beaches with a tool to monitor and report water quality.

Photo courtesy of Meghan Shea


Photo courtesy of Ryan Searcy

Stanford WOODS INSTITUTE for the ENVIRONMENT

ABOUT THE AUTHORS

Alexandria Boehm

Alexandria Boehm is a professor of civil and environmental engineering at Stanford, senior fellow at the Woods Institute for the Environment and affiliate of the Program on Water, Health and Development.

Ryan Searcy

Ryan Searcy is a Ph.D. candidate in civil and environmental engineering at Stanford.

This brief is based on **A Day at the Beach: Enabling Coastal Water Quality Prediction with High-Frequency Sampling and Data-Driven Models** published in *Environmental Science & Technology*.


Photo courtesy of Meghan Shea

FOR MORE INFORMATION

Office of Policy & Engagement
Stanford Woods Institute for the Environment
woods-extaffairs@stanford.edu
woods.stanford.edu