Candidate Recommendation

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ORIGINAL BIG IDEA

Cross-shore Exchange Mechanisms: Implications for Larvae, Contaminants, Water Quality and Public Health

Relevance: The coastal region often controls material exchange which has important consequences for tracer transport, water quality, contaminant and larvae movement. This research focus is even more important with increasing coastal population, stormwater and wastewater runoff, and imminent sea-level rise.

Science Question: Physical processes (along with associated biological behavior of tracer) like wave-breaking, internal waves and winds control this exchange mechanism, and are poorly understood. Also time and spatial scales for spawning, followed by larvae recruitment is also unknown.

Needs: Concomitant data collection of physical, biological and tracer parameters for time scales extending to days, and for spatial scales for few kilometers. Develop and apply models which can simulate this behavior. Work with social scientists to figure out how does community respond to water quality degradation.

Suggestion: Suggest, research hub creates interface for physical, biological and social scientist to work on this topic. Implications for coastal region economy as well as stakeholders including coastal and beach managers.

What is your specific* recommendation?

(* Don't be abstract, general, or try to do too much in your recommendations. Try to be specific, actionable, stand alone)

Overarching Theme: Combination of basic and applied research topic to create a nexus of physicists, biologists and social scientists focused on identifying the implication of cross-shore coastal exchange on contaminant/larvae transport, water quality issues, beach usage, and public health. Related to NSF 10 Big Ideas on **Growing Convergence Research**.

- Design a research focus group within a hub to investigate how material movement is manifested in coastal regions. This broad group will investigate processes occurring over the entire coastal US or limited to certain coastal regions (proposal driven).

- Identify the relative importance of physical (surface waves, tides and winds) and biological processes (swimming ability, age, recruitment habitat) in controlling tracer exchange (e.g., early and late-stage larvae) between the shoreline and the coastal ocean.

- Determine bulk metrics which quantify the rate at which material movement occurs. Further, quantify the region specific dominance of one physical/biological process over others.

- Evaluate why are some regions different than others (coastal morphology, presence of riverine discharge, strong directionally spread waves, existing recruitment habitat for larvae). Furthermore, relate findings to population connectivity.

- Relate exchange dynamics to manifestation for water quality along the shoreline, and how would knowledge of water dilution for different regions help ecologists/beach managers to determine when is it safe to return to the beach. Immediate impact on length of beach closure warnings.

- Work with social scientists to determine the behavior/mindset of beach users and implications for local economy as water quality information is disseminated to general public.

- Quantify how does exchange mechanism and dynamics changes during extreme events like stormwater discharge during an atmospheric river event, or during hurricanes along the east, which would foster collaboration with other hubs (e.g., focused on storm test beds and extreme events).

Why is it valuable?

Who does it impact? How? How will the world be better? Who are the stakeholders and who will you partner with to make it stronger?

Overarching Theme: Anthropogenic impact and extreme events lead to urban, agricultural, and wastewater discharge making our coastlines unsafe for the general public.

- More than 60% of world population lives along the coast, a region vulnerable to anthropogenic activities and biophysical processes which controls material exchange. Land-based runoff, stormwater discharge, agricultural runoff all contribute to nutrient, microbial and chemical pollution.

- Degraded water quality is a primary cause for infectious and gastrointestinal diseases, often leading to beach closures, and loss of economy.

- The focus group suggested for a research hub will address basic research question on transport of biological (often active tracers) and passive tracers (like pollutants), and then relate to applied work on water quality, and how communities along the coastal US respond to water quality management.

Stakeholder Involvement:

- This research focus group will create an interface between physicists, biologists and social scientists to collect data together (region specific) and address implications for contaminant and larvae transport, further related to human interaction with a coastal area with degraded water quality.

- Coastal and Beach Managers, Local Sea Grant managers, Lifeguard Organizations, Coast Guard and local tribal organizations will be ideal stakeholders. They can inform how the regional data collected should be categorized/disseminated such that general public can

appreciate the role of biophysical processes.

- The findings for beach and water quality can be disseminated through agencies like NOAA, which already do something similar to a rip current forecast for beaches throughout the US.

- Lack of local morphology (or bathymetry) measurements is a caveat for this research focus, which is often key to understanding the physical dynamics in this region. This is where, stakeholders like lifeguard organizations can strongly tie in by identifying how local bathymetry evolves during their daily visual surveys.

What's the reasoning or supporting evidence behind it?

Evidence based, fact based, Takes into context current research (hasn't already been tried and failed). How will you validate success? How is it grounded in existing scholarship? Why do this now, above all the other things we could do?

Overarching Theme: Combination of beach closures, dead zones and health hazards strongly necessitates involvement of NSF through CoPe in investigating fundamental research question on transport mechanisms.

- Beach closures, dead zones (Gulf of Mexico) and health issues due to swimming in contaminated waters are commonplace in the coastal US. Traditionally, the research question of tracer transport and water quality has been focused on in isolation by physicists, biologists, ecologists and social scientists.

- The Coastlines and People program, through the research hub will foster connections between these isolated groups to target this multi-dimensional problem. Some examples of already funded NSF collaborative projects which have started focusing on this area are:
  https://www.nsf.gov/awardsearch/showAward?AWD_ID=1357327&HistoricalAwards=false
  https://www.nsf.gov/awardsearch/showAward?AWD_ID=1357290&HistoricalAwards=false

- Success metrics will be applied at all stages of project evolution.
  - Proposal selection would require an interdisciplinary team and strongly involved stakeholder. This can be designed almost similarly to Sea Grant funding pre-proposal, where the proposal is developed with the help of stakeholders.
  - Data collection (if specified) would require concomitant measurement of geophysical and biological parameters, along with statistics of beach usage.
  - Model development or application would have to involve biophysical interactions, and also require working with social structure and/or economic modeling.
  - Findings from the study would inform stakeholders about local water quality, and how is it changing. This information can be disseminated through either the research hub (i.e., if NSF intends to get involved) or through other agencies like NOAA/USGS.
  - Water quality indicator could be provided at lifeguard stations, and updated regularly.
  - Other metrics like involvement of STEM graduate students or K12 can be

added as well.

- Even though the question being pursued is broad, the primary focus is still on basic sciences (cross-shore exchange) as is often encouraged by NSF. The CoPe wrapper interface will facilitate the nexus between scientists involved and help provide a scaffolding for interdisciplinary research.

- Coastal land use is increasing and coastal communities are becoming more vulnerable to physical changes (like sea-level rise) and pollutants on to the ocean from variety of sources. A combination of basic and applied research focus maintained by a NSF supported research hub will help us make advance in becoming more resilient to these coastal threats.