Morphodynamics of Tidal Flat Coastlines

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LONG-TERM GOALS

The long-term goal of this project is to advance the coastal community’s general understanding of predictable hydrodynamic and morphological feedback along tidal flat coastlines.

OBJECTIVES

The main objectives of the first year of this project are (i) to participate with other ONR investigators in planning the overall DRI field and modeling effort and (ii) to provide a peer-reviewed journal article that summarizes the scientifically established relationships among tidal flat and channel morphology, hydrodynamics (including riverine forcing, tides, and waves), sediment supply, human impacts, and geological/geotechnical setting along morphologically dynamic tidal flat coastlines.

APPROACH

Our approach in helping design the DRI effort was to attend DRI planning meetings, participate actively in plenary and breakout discussions and co-author resulting summary documents, before, during and after the planning meetings. The second major component of our efforts so far has been to begin a review paper tentatively titled “Morphodynamics of Tidal Flat Coastlines”. The organization and length of this paper will be similar to the lead PI’s recent summary article, “Tidal Salt Marsh Morphodynamics: A Synthesis” (Friedrichs & Perry 2001).

WORK COMPLETED

During FY2007, we attended Tidal Flats DRI workshops in Honolulu, Hawaii, in March and in Incheon, Korea in June. At the Honolulu meeting, we presented a poster entitled “Tidal Flat Morphodynamics” (Friedrichs & Wells, 2007), both PIs participated actively in the discussion, and Friedrichs was the rapporteur for the sediment transport and morphodynamics breakout sessions. Soon after the Honolulu meeting, both Friedrichs and Wells joined the small team of ONR investigators who led authorship of a Draft White Paper assembled in preparation for the planning workshop to be held in Incheon. We played a lead role in authoring the introduction and morphology sections of the first complete version of the Draft White Paper, we were the lead editors who produced the first condensed
version of the Draft White Paper, and we took responsibility for delivering both of these complete drafts to ONR.

At the Incheon meeting, both PIs participated actively in the discussions and field trips. Friedrichs and Wells both gave presentations summarizing components of the Draft White Paper contents, and Friedrichs was the rapporteur for the large scale breakout session. After the meeting in Korea, we continued to solicit comments from the workshop attendees regarding the content of the Draft White Paper and passed these comments on to ONR. We also began our literature survey in preparation for our review article and submitted an abstract on the topic to the Estuarine Research Federation Conference to be held in Providence, RI, in November 2007 (Friedrichs et al., 2007).

RESULTS

The introduction to the Draft White Paper authored by Wells summarizes the geological setting of the macrotidal flats found along the west coast of the Korean peninsula. These flats are of broad scientific interest because of their large extent despite a lack of a large local sediment source. In addition, they serve as large reservoirs of predominantly fine-grained sediments that undergo exchange with adjacent waters over a wide range of time and space scales. Because they lack a protective barrier at their seaward margins, the Korean tidal flats are considered to be an excellent model for the thick successions of tide-dominated deposits that occur throughout the stratigraphic record.

The section of the Draft White Paper on tidal flat morphology co-authored by Friedrichs presents research questions organized by temporal and spatial scale and by external forcing type. Key temporal scales include tidal, annual, episodic and decadal. Key spatial scales include small-scale vertical variability (cm), small to meso-scale horizontal variability (up to 100s of meters), large-scale along- and cross-shore variability (≥ km), and the influence of regional and geological settings. Dominant external forcings include tides, waves, fluvial processes, regional sediment supply and transport (including human impacts), and patterns and controls on sediment erodibility.

An experimental approach for investigating morphologic processes was proposed which includes small-scale intense study sites, an intermediate-scale spatial grid, large-scale surveys, and temporal sampling over individual tidal cycles, spring-neap cycles, seasons, and more than one year. Modeling should include small-scales (e.g., local cycles of erosion and deposition), application of community models, idealized and statistical approaches, and physical models in laboratory settings.

IMPACT/APPLICATIONS

We delivered the Draft White Paper (long and short versions) to ONR in June 2007. The Draft White Paper has since been used to help guide ONR and the coastal community in further planning of the Tidal Flats DRI. The review paper on tidal flat morphodynamics that we are preparing will further help ONR investigators execute their contributions to the DRI and better interpret their results by providing a broad scientific context for the investigations. We also anticipate that our review paper will be a valuable resource for advancing the larger coastal community’s general understanding of predictable hydrodynamic and morphological feedback along tidal flat coastlines.

RELATED PROJECTS

The following recent projects involving Friedrichs also focus on coastal sediment transport:


3. Reformulation of mine scour equations using observations from the MBP field sites. Office of Naval Research.

REFERENCES


Friedrichs, C.T., and J.T. Wells, Morphodynamics of tidal flat coastlines. Office of Naval Research, Coastal Geosciences Program, Tidal Flats DRI Planning Meeting, Honolulu, HI, 26-30 March.