Developing a parameterization for coastal erosion based on offshore and nearshore ocean typologies: North Slope of Alaska.

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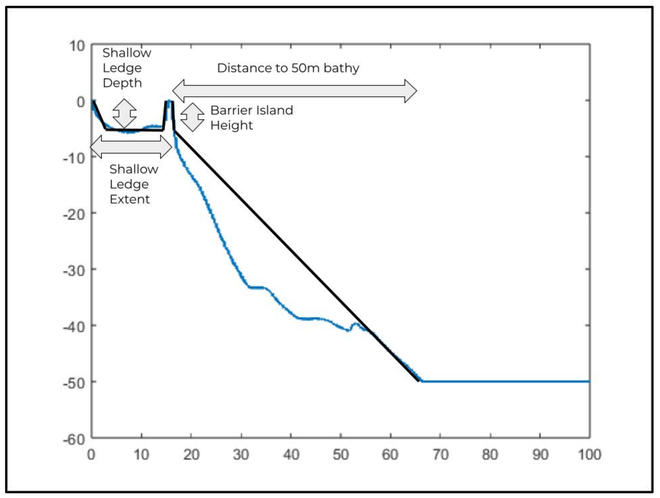
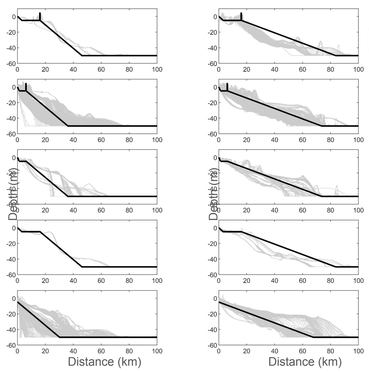
1. Development of Transect Informed Typologies

Focused on the North Slope of Alaska, this project is exploring the development of a fine-scale parameterization of offshore and nearshore ocean and coastal typologies for use in the Energy Exascale Earth System Model (E3SM). The early phases of this work involved the development of bathymetric typologies, derived from sub-parameters identified below (Figure a).



(a)

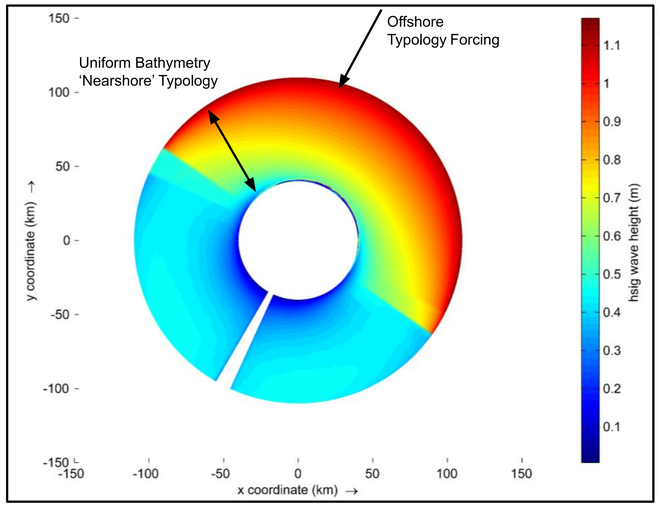
Based on a set of 10 identified typologies (to include short/long ledge, shallow/steep slope, presence / absence of barrier islands, etc.), representative typologies were identified and compared to real-world locations on the North Slope of Alaska, simulated using the Delft3D modeling suite.



(b)

Suggested typologies can be seen in Figure b.

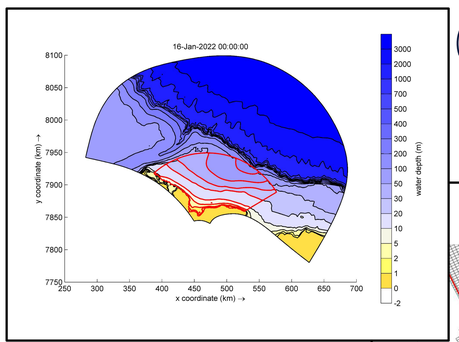
2. 'Directionally Operable Nearshore Uniform Typologies' Simulations Based on Uniform Equidistant Transects



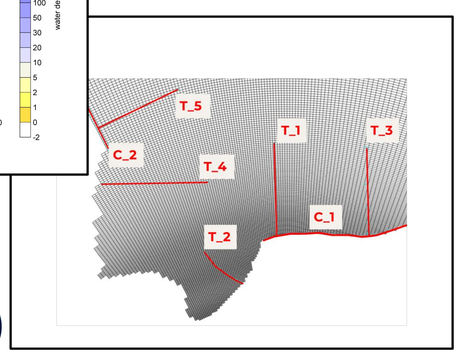
(c)

Development of nearshore transect DONUTs allows 'all-angles' analysis for identified typologies (see Figure c), reducing computational needs and supporting variable angle of incidence. This allows a lookup-table approach from completed simulations.

'Real-world' simulations were then completed for specific site locations (see Figures d and e).

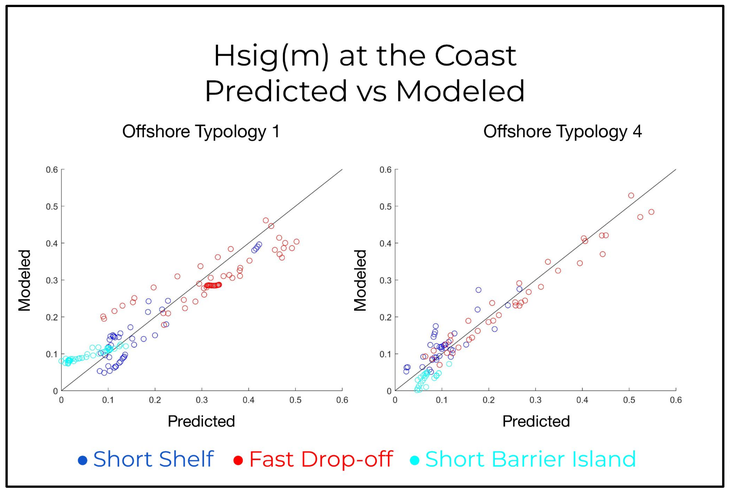


(d)



(e)

3. Simulation of Transect Informed Typologies



(f)

Each of the real-world transects (red lines in Figure d) were assigned to one of the identified typologies. Pre-calculated wave properties from idealized 'donut' runs were compared to representative real-world transects (see Figure f) The Delft3D model was used to simulate both categories. This resulted in the identification of a strong relationship between 3m depth wave activity and coast depth.

Our approach will be implemented in E3SM, and going forward, there is a need to reconcile the mismatch between resolutions of coastlines in this approach and that of E3SM.