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14. ABSTRACT
To develop and validate three-dimensional, coastal optical prediction systems that leverage results from the Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS®1) and the Navy Coastal Ocean Model (NCOM). The modeling system will forecast the emergence and transport of near shore turbidity plumes and the eruption/propagation of turbidity in the benthic boundary layer. This forecasting capability will be validated and prepared for transition to the Naval Oceanographic Office to be used in support of Navy missions.

15. SUBJECT TERMS
turbidity plumes, COAMPS1), benthic boundary layer

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Research Objectives: To develop and validate three-dimensional, coastal optical prediction systems that leverage results from the Coupled Ocean Atmosphere Mesoscale Prediction System (COAMPS®[1]) and the Navy Coastal Ocean Model (NCOM). The modeling system will forecast the emergence and transport of near shore turbidity plumes and the eruption/propagation of turbidity in the benthic boundary layer. This forecasting capability will be validated and prepared for transition to the Naval Oceanographic Office to be used in support of Navy missions.

Methodology: Two core research projects that are focused upon the physical forcing of coastal optical dynamics utilized HPC resources under this HPC project in FY17. Both projects were specifically concerned with results from the Coupled Ocean-Atmosphere Prediction System (COAMPS) in air-sea and coupled surface gravity wave (air-sea-wave) mode. Inner nest spatial resolution was achieved at 250 meter horizontal grid spacing for domains in the northern Gulf of Mexico. Numerical experiments were performed by including/excluding coupling mechanisms in the COAMPS set up. The purpose of this experimental design was to ascertain the real-world impact of (1) current-wave interactions and (2) optical attenuation feedback effects on temperature and upper-ocean heating.

Results: As expected, using the default (and operational mode) optical attenuation coefficients in the COAMPS ocean model resulted in significant underestimation of observed sea surface temperatures, significant differences in simulated turbulent air-sea thermal energy fluxes, and where the simulated Mississippi River plume was present, significant salinity-compensated temperature inversions (not observed during field work). In another series of experiments, nested COAMPS was run with and without an integrated surface gravity wave model. The time period was during the far field passage of Tropical Storm Bill. As described in Jolliff et al. (2017), inclusion of the wave model resulted in increased thermal stratification (colder bottom waters) along the inner continental shelf (shoreward of 20 meters depth; Fig. 1). This counter-intuitive result was more consistent with observations made during a 2015 field observation campaign. These results verify and emphasize the importance of the bottom wave boundary layer as an important transport conduit for material properties over the continental shelf. This result has direct ramifications for our overall goal of modeling and forecasting coastal ocean optical signals—the wave coupling to the physical models is essential and cannot be ignored.

DoD Impact/Significance: The proposed research falls directly within the Naval S&T Strategic Plan Focus Area "Assure Access to the Maritime Battlespace" under the "Match Environmental Predictive Capabilities to Tactical Planning Requirements" objective. It was discovered and confirmed that optical attenuation and current-wave interactions can both, respectively, alter physical processes substantially in coastal COAMPS simulation results. These results are crucial since COAMPS air-sea is operational and COAMPS air-sea-wave is undergoing operational testing. The substantial differences in COAMPS with the integrated wave model justify the continuing work on integrating surface gravity wave models into the COAMPS, and further justify the computational expense of running larger surface wave models, such as WAVEWATCHCH III, as boundary conditions. As well, a 6.4 program has been initiated to properly direct satellite-based optical attenuation data into COAMPS domains so as to rectify obvious heating rate simulation errors.

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[1]COAMPS® is a registered trademark of the Naval Research Laboratory.

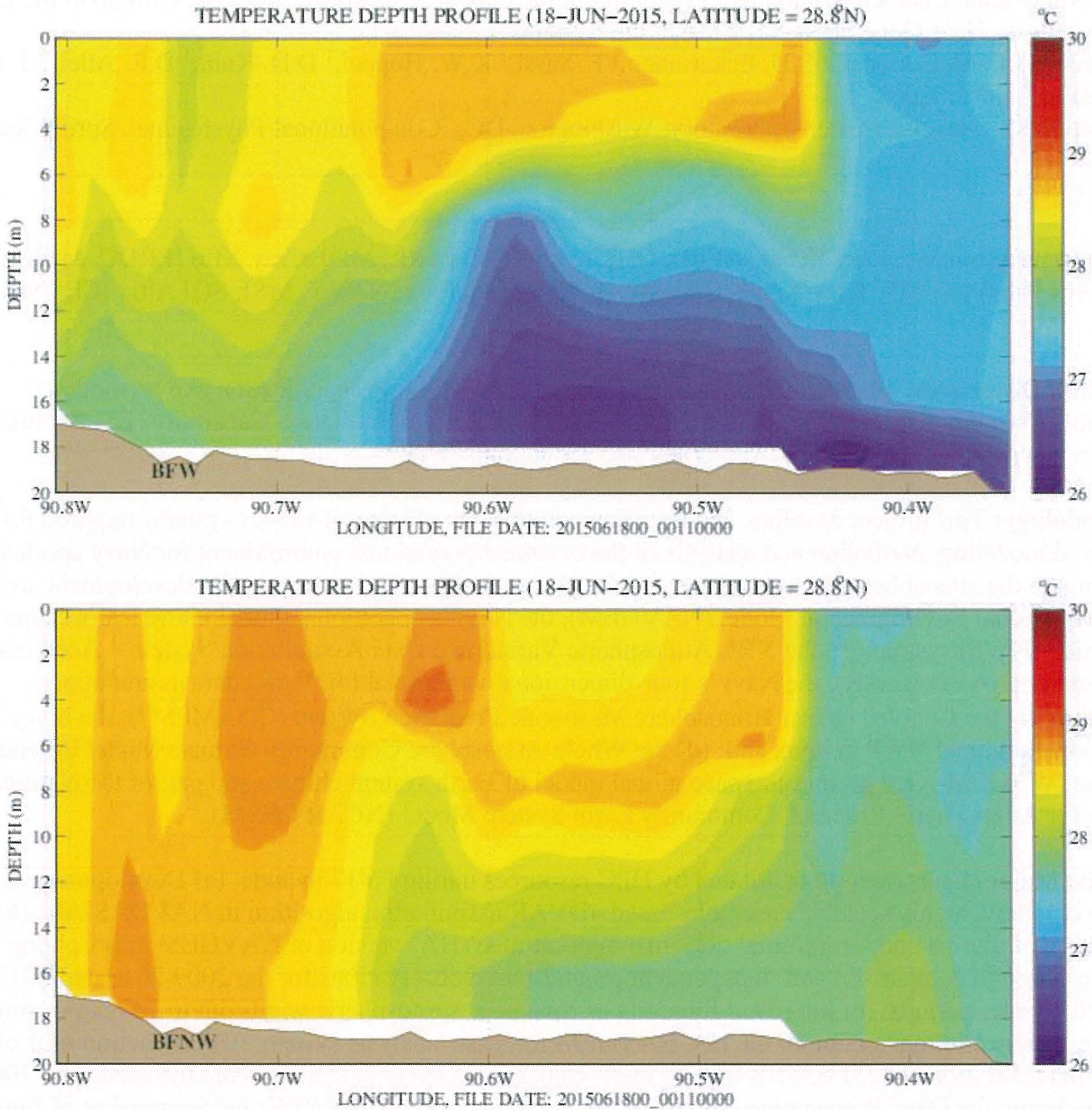

Figure 1. Top – Simulated temperature distribution for COAMPS A-O-W; Bottom COAMPS – no wave model.