

General Comments: Major Revision

The manuscript describes thoroughly the framework of the Unified Forecast System Coastal Model (UFS-Coastal), including its model components (WW3 for ocean surface waves, CICE for ice modelling, and four hydrodynamic models, namely SCHISM, ADCIRC, FVCOM and ROMS), regression testing system for code development, and two strategies used for wave-current coupling, namely the radiation stress method and the vortex forces method. Through one case, Hurricane Sandy (2012), the good performance of the coupled WW3-SCHISM system is demonstrated.

It is a challenging work to develop a reliable, working coupling wave-ocean model. The efforts documented in this paper (development of the coupled WW3-SCHISM model) are very well welcome and will be highly useful for future cross-scale coastal simulations and predictions. I greatly appreciate the value of this work and therefore suggest to accept this work.

Reply: We thank the reviewer for the careful reading of the manuscript and for the positive assessment of the UFS-Coastal development. We appreciate the reviewer's recognition of the value of the coupled coastal modeling framework and the WW3-SCHISM implementation. The comments regarding the manuscript scope, organization, model setup, and interpretation of the numerical results were very helpful.

In response, we have substantially revised the manuscript. Most importantly, we changed the title to **“UFS-Coastal v1.0: description of a flexible coupled modeling framework for coastal ocean, wave, and sea-ice applications”** to better reflect the broader framework-oriented scope of the paper. We have clarified the distinction between the general UFS-Coastal framework and the specific SCHISM-WW3 demonstration, expanded the description of the coupling mechanics and boundary conditions, added more quantitative discussion of the Duck, NC results, and removed unsupported claims regarding the superiority of the 3-D vortex formulation. We are also adding a large-domain Bering Sea demonstration to broaden the application examples beyond the Duck, NC case.

But I indeed have a few concerns about the writing, presentation and organization of the paper, as summarized below.

1) The title of this paper reads “The applications of UFS-Coastal v1.0.0b01: wave-current coupling of SCHISM and WAVEWATCH III”, from which I would expect more technical details about the SCHISM-WW3 coupling in the paper. Nonetheless, a large (perhaps disproportionately large, in my opinion) part of the manuscript is devoted to the description of the UFS-WM, UFS-Coastal framework (e.g., section 2.1.3, 2.2.1, 2.2.2 and 2.2.4 which provide the overview of CICE, ADCIRC, FVCOM and ROMS, respectively). Instead, the very important details of the two methods for wave-current interactions are given in the online supplement only. If the current title is left unchanged in the revision, I would suggest to move Section S1 and S2 to the main text (Table S1 and S2 can still be in supplement), and then shorten the descriptive part about UFS-WM and UFS-Coastal infrastructure significantly.

Reply: We agree that the original title placed too much emphasis on SCHISM-WW3 wave-current coupling relative to the broader content of the manuscript. To better reflect the actual scope of the work, we have changed the title to **“UFS-Coastal v1.0: description of a flexible coupled modeling framework for coastal ocean, wave, and sea-ice applications.”**

Under this revised framework-oriented scope, we have retained the descriptions of CDEPS/CMEPS, WW3, CICE, ADCIRC, FVCOM, SCHISM, and ROMS because these components define the structure

and capabilities of UFS-Coastal. However, we have revised these sections to focus more clearly on the role of each component within UFS-Coastal rather than providing general model background.

We have also expanded the main-text description of the wave-current coupling implementation. The revised Section 2.3 distinguishes the previously established Longuet-Higgins radiation-stress and 3-D vortex-force formulations from their implementation within UFS-Coastal and describes the fields exchanged between SCHISM and WW3. The detailed field tables remain in the Supplement, while the information required to understand the coupling mechanics is now provided in the main text.

2) In Section 4, the authors mentioned that “the study has presented a comprehensive description, systematic validation, and detailed evaluation of the UFS-Coastal modeling framework”. However, I was a bit surprised to see that only one case study with three key figures (Figs. 4, 5, 6) were given in Section 3. Besides, “section 3.3 Results” is just ~1 page long.

Reply: We agree that the original wording overstated the extent of the numerical evaluation. The Duck, NC experiments do not constitute a systematic validation of the complete UFS-Coastal framework, and we have removed statements describing them as such.

In the revised manuscript, the Duck application is presented as a detailed demonstration of one supported SCHISM-WW3 configuration rather than as a comprehensive validation of all UFS-Coastal components. Section 3.3 has also been expanded substantially to include quantitative interpretation of the wave, water-level, and current results rather than relying primarily on qualitative statements.

To broaden the framework demonstration, we are also adding a large-domain application along the Alaska coast of the Bering Sea. This new section presents SCHISM-WW3 and SCHISM-CICE configurations to illustrate coastal ocean-wave and coastal ocean-sea-ice coupling within UFS-Coastal. A simultaneous SCHISM-WW3-CICE configuration remains under active testing and is therefore identified as ongoing development rather than presented as a fully evaluated capability.

3) For the single case presented, there are also some important details that need to be discussed more thoroughly.

a) Fig. 4: wave height and period are not well simulated at AWAC 6 m and 8 m stations, and mean wave direction is poorly simulated at ADOP 2m station. Discussion about the possible reasons for these mismatches should be provided.

Reply: We agree that these mismatches required more discussion. Section 3.2.3 has been expanded to include quantitative bias and RMSE values from Table 3 and to discuss the station-dependent model performance.

The revised text now notes that significant wave height remains underestimated at the 6 m and 8 m stations and that mean wave period is also overestimated at these locations. At the 2 m station, the mean-direction bias remains approximately -19° in the standalone WW3 cases. We also discuss the semi-diurnal variation in significant wave height at the 2 m station, which is consistent with modulation of shallow-water wave transformation by changing water depth, although the present experiments do not isolate this mechanism from other nearshore processes.

We further note that the remaining model-observation differences may be influenced by the limited computational domain, spatially homogeneous atmospheric forcing, bathymetry, and the representation of nearshore wave-transformation processes. These factors were not evaluated separately in the present study.

b) Fig. 5: The standalone and coupled SCHISM simulations show very marginal differences. In this regard, the benefit of the coupling for the SCHISM simulations is not well demonstrated.

Reply: We agree. The differences among the standalone SCHISM simulation (Case 3) and the two coupled simulations (Cases 4 and 5) are small in Fig. 6, and the revised manuscript no longer interprets this figure as evidence that wave-current coupling improves storm-surge prediction for the Duck configuration.

The relatively small model domain and the prescribed observed water elevation along the seaward SCHISM open boundary strongly constrain the modeled water-level response. The northern and southern lateral boundaries are periodic rather than open boundaries. We have therefore revised the discussion to state that Fig. 6 is used primarily to compare the water-level responses of the standalone and coupled SCHISM configurations under the same forcing and boundary conditions. The results indicate that wave-current coupling produces only a limited change in water level for this particular domain and setup.

c) Fig 6: “Spatial distributions and vertical cross-sections of simulated current velocities provided clear evidence of enhanced realism and accuracy using the 3D vortex method compared to the depth-integrated approach”. Are there any observational data available to support this statement? Without doing so, it is difficult to judge which one (Run 4 or 5) is correct.

Reply: We agree that the original interpretation of Fig. 6 was too strong. Direct model-observation comparisons of the vertical current profiles are not presented in this study, and therefore the statement that the 3-D vortex simulation provided “enhanced realism and accuracy” was not supported by the presented evidence.

We have removed this statement and the related claims that the 3-D vortex configuration is more accurate than the Longuet-Higgins configuration. Figure 7 is now used only to demonstrate that the two coupling formulations produce different modeled vertical structures in the alongshore and cross-shore current components. Because direct current-profile comparisons are not presented, we do not use Fig. 7 to determine which formulation provides the more realistic nearshore circulation.

4) I am also curious about how the boundary conditions were specified for the wave and ocean simulations. These details are not clearly mentioned. In the blue box of Fig. 1, the block “NUOPC Cap/Data wave” is not included. I am wondering if any boundary conditions were used for the WW3 simulations.

Reply: We agree that the boundary conditions were not described sufficiently in the original manuscript. We have expanded the model-setup description to specify the boundary treatment for both SCHISM and WW3.

For both models, the only open boundary is the seaward offshore boundary, while the northern and southern lateral boundaries are periodic. For SCHISM, observed water elevation from the FRF 8 m station is prescribed along the seaward open boundary. For WW3, observed directional wave spectra from FRF_waverider-26m are prescribed as the offshore wave boundary forcing. The same WW3 boundary treatment is used in Cases 1, 2, 4, and 5.

We have also clarified the role of Fig. 1. The figure is intended as a high-level schematic of the UFS-Coastal component architecture and therefore does not depict all model-specific boundary-condition inputs. Data wave is a part of CDEPS for the prescribed field forcing, not the boundary. The WW3 wave-boundary forcing is now described explicitly in the model-setup section rather than being represented as a separate component in Fig. 1.

To sum up, the work presented in this manuscript is very interesting and will be very useful for future coastal applications. However, in my opinion, the paper should undergo a Major Revision to improve the readability and to make the study more convincing.

Reply: We thank the reviewer again for these constructive suggestions. The revisions have helped us better align the manuscript title and structure with its actual scope, distinguish framework development from case-specific demonstration, provide more complete model-setup information, and present a more quantitative and appropriately qualified interpretation of the numerical results.