

REVIEW, “THE APPLICATIONS OF UFS-COASTAL ...”

SUN, TURUNCOGLU, JISAN, YU, ZHANG, LEMMEN, ABDOLALI, WORTHEN, TSAY, HADDAD, VELISSARIOU, CASSALHO, MANI, DANESHVAR, BANIHASHEMI, SALIMI-TARAZOUJ, SMITH, MYERS, MOGHIMI

In their manuscript “The applications of UFS-Coastal v1.0.0b01: wave-current coupling of SCHISM and WAVEWATCH III,” the authors Sun *et al.* describe the extension of a coupled modeling framework to include coastal ocean models. It is shown that one component model SCHISM and the wave model WW3 can reproduce the waves and water levels during an offshore hurricane.

It is our recommendation that this manuscript requires **major revisions**.

(It is noted that this review was completed by an invited reviewer and a team of graduate students, as a learning exercise in how to review an academic journal manuscript. Our review is longer and more-detailed than normal because it includes input from the team.)

UFS-Coastal is a significant achievement; it will ease the use of coastal ocean models for research and operations. However, this manuscript does not describe sufficiently its novel capabilities. In the methods sections, there is too much description of the individual components and too little description of the coupling mechanics, especially details about what quantities are passed and how. In the results section, the experiments demonstrate the coupling for only one of the four coastal ocean models, and the findings are similar to previous studies. The manuscript will be improved with a major revision to focus on and demonstrate the coupling framework.

The following major comments can be considered for a revised manuscript:

- Can the authors clarify the reasoning behind the ordering of the models when they are listed or presented? The ordering is inconsistent across instances in the manuscript (with examples below), and it is never justified. A clarification will be helpful, especially if it can align with how the models are used within NOAA. Then suggest to be consistent across all instances:
 - Lines 58–66: Presumably SCHISM is first because it is a focus of the demonstration in this study, but what is the reasoning behind the ordering of the other models?
 - Line 99, lines 104–105, lines 300 and 302, and line 340: Almost alphabetical?
 - Section 2.2: Almost alphabetical?
 - Line 482: SCHISM returns to the front?
 - Figure 1: New ordering?

- Section 2 should describe the details of the UFS-Coastal component models and their coupling. This section is challenging to write, because (a) if it is too detailed with technical information, then the manuscript should rather be a white paper or technical report, and (b) if it is too high-level with conceptual descriptions, then it is not useful to readers to understand the mechanics of the system. To this reviewer, this section misses the mark to the latter direction. Too much of this section is spent on describing the components and referencing to existing studies, and too little is spent on describing the details of their coupling within UFS-Coastal. The authors should be encouraged to revise – the manuscript has the potential to be a significant contribution if this section is written well. The following comments are specific but not comprehensive:
 - What information is passed between models? A detailed summary for all models is needed. Presumably the passed information is different, depending on whether the models are 2D or 3D? For coupling from a 3D circulation model to the wave model, what currents are passed – surface, depth-averaged, or something else? It is likely that all of the coastal ocean models can accept surface pressures and wind stresses from the atmospheric models, but which can also accept heat fluxes and precipitation? Which models can accept the radiation stresses, and which can accept the vortex forces? This passing of information is maybe the most essential part of the coupling, but it is not described sufficiently in the present manuscript.
 - How is information passed between models? Lines 140–145 claim that information can be transferred with “a range of temporal and spatial interpolation methods”, but no other details are provided. What spatial interpolation techniques are used? Do they differ for various models or information? Is there an attempt to interpolate in a ‘conservative’ way – for example, if the waves are computed on a finer mesh and the wave forces are focused in a specific region, then is their peak retained when interpolating to the circulation model, or is it smoothed over the coarser mesh? In time, how often is information passed between models, and does the coupling interval differ for various models or information? These details are also essential, but they are lacking in the present manuscript.
 - How are the coupled models implemented in an HPC environment? This reviewer would guess that different models are assigned to different sets of CPUs, and then the coupler manages the passing of information between the component models. If this is correct, then how many CPUs are needed for each model? Does it differ between models, i.e. presumably the 3D models are more expensive than the 2D models? How many CPUs are assigned for the atmospheric, wave, and ice models? What is the overhead of the coupling, i.e. how much time is spent in interpolating between components? These details are also essential, but they are also lacking.
 - Section 2.1: These subsections contain background on CDEPS/CMEPS, WW3, and CICE. This background is nice, but much of it is duplicated from other studies. Can these subsections be shortened and focused on how they support the specific development of UFS-Coastal in the present study? For example, in Section 2.1.2, the first

three paragraphs are a description of WW3 and its recent advancements, which are impressive but documented in other studies (with references here) – can this subsection be shortened and focused on how WW3 interacts with the other models inside the coupling of UFS-Coastal? Similar comments for Section 2.1.1 about CDEPS/CMEPS and Section 2.1.3 about CICE.

- Section 2.2: Suggest to introduce these four models with subsections of equal length and referencing. As it is, the subsections are less detailed for ADCIRC (8 lines), FVCOM (6 lines), and ROMS (7 lines), and more detailed for SCHISM (13 lines), even though the content is similar about model capabilities and typical applications. Suggest to either lengthen the other three subsections or shorten the SCHISM subsection.
- Section 2.2: The SCHISM subsection includes one reference within the past 10 years, but the other model subsections have only references that are more than 10 years old. All of these models have received continuous development and application during that timeframe. Can the authors include more-recent references for each model?
- Section 2.3: This is a nice background of the radiation-stress and vortex-force methods for momentum transfer from the wave model to the circulation model. But this background could be shortened and referenced to previous studies. Also, SCHISM is the only model mentioned under the vortex-force method, but wasn’t that method introduced first for ROMS?
- Section 2.4: This subsection seems to be closest to providing details about the coupling. But it is not clear to this reviewer which parts are existing technologies, and which parts were developed for UFS-Coastal and this study. Can this be clarified? Also, can Subsection 2.4.2 be expanded to describe the workflow with more description of Figure 1 or something similar?
- The demonstration of the UFS-Coastal capabilities does not show the performance of all model components, and its findings are repetitive of studies outside of this coupled framework. The authors should be encouraged to redesign the numerical experiments to demonstrate a novel capability of UFS-Coastal and teach the reader about its mechanics.
 - Lines 392–400: Why is there only a demonstration of SCHISM in this study? Why not show results for the other three models for this same test case? There needs to be a justification for showing only SCHISM. Why do the authors expect SCHISM to be representative of the overall performance of UFS-Coastal?
- Section 3.2.1: It is not clear to this reviewer that these test cases (ATM+WW3) are a demonstration of a novel capability in this study. Was WW3 already part of UFS? If so, then these test cases are demonstrating an existing capability, and not anything novel to this study. If not (i.e. if WW3 was not already part of UFS), then the earlier sections of this manuscript need to be revised to emphasize that WW3 was also added in this development of UFS-Coastal. For example, lines 58–59 describe only the extension to include the coastal ocean models.

- Sections 3.2.1 and 3.2.3: How does WW3 handle the boundaries of the model domain? Are waves from another source (observation, another wave model) applied as boundary conditions? In Figure 4, the comparison is excellent at the 26m sensor near the open boundary, which suggests that wave information is specified as boundary conditions, but this reviewer cannot find where this is discussed in the manuscript.
- Lines 434–435: “The rationale for comparing these two coupling approaches was to explicitly investigate the advantages of resolving vertical momentum exchanges and wave-induced turbulence” Lines 489–490: “A key contribution of this study was the explicit evaluation and comparison of two distinct wave-current interaction methodologies” This comparison has been done already, including in references cited in Section 2.3. The results are as expected, with the vortex-force method able to transfer momentum in a realistic way through the water column. Even if this finding was novel, it would not be a specific demonstration of the benefits of the model coupling within UFS-Coastal. Can the authors develop an experimental plan that demonstrates the novel capabilities of this new technology?
- Section 3.3: This section is a qualitative discussion of the results. It is claimed (lines 452–454) that the vortex coupling has better predictions, but the quantitative comparisons are relegated to Table 2. Can the quantitative
- This reviewer was expecting a discussion of the computational requirements for UFS-Coastal. How much time is required for each model component? How much time is spent in passing information between models? How much time is saved via the coupling in UFS-Coastal, relative to other coupling frameworks?

The following minor comments can also be considered:

- Line 33 (“successfully”), line 43 (“accurately”), line 46 (“specifically”), line 53 (“originally”), line 53 (“explicitly”), line 57 (“specifically”), line 60 (“particularly”), line 65 (“extensively”), line 67 (“dynamically”), line 97 (“closely”), line 98 (“originally”), line 111 (“specifically”), line 132 (“presently”), line 145 (“dynamically”), line 149 (“computationally”), line 150 (“seamlessly”), line 151 (“dynamically”), line 152 (“consistently”), line 153 (“flexibly”), line 153 (“globally”), line 154 (“fully”), line 160 (“efficiently”), line 161 (“locally”), line 163 (“explicitly”), line 165 (“notably”), line 166 (“directly”), line 172 (“strictly”), line 212 (“particularly”), line 213 (“extensively”), line 213 (“particularly”), line 220 (“commonly”), line 226 (“efficiently”), line 231 (“faithfully”), line 235 (“particularly”), line 240 (“commonly”), line 246 (“externally”), line 248 (“consistently”), line 256 (“fundamentally”), line 261 (“directly”), line 263 (“Consequently”), line 265 (“specifically”), line 266 (“accurately”), line 267 (“consistently”), line 269 (“predominantly”), line 272 (“explicitly”), line 274 (“solely”), line 280 (“internally”), line 286 (“particularly”), line 288 (“vertically”), line 296 (“regularly”), line 309 (“quickly”), line 326 (“systematically”), line 328 (“specifically”), line 328 (“nightly”), line 372 (“comprehensively”), line 373 (“Specifically”), line 379 (“sharply”), line 380 (“approximately”), line 383 (“specifically”), line 387 (“smoothly”), line 402 (“approximately”), line 403 (“roughly”), line 403

(“Observationally”), line 404 (“uniformly”), line 408 (“comprehensively”), line 409 (“incrementally”), and elsewhere (because this reviewer gave up after line 400): Suggest to remove adverbs in all instances. Adverbs are imprecise and thus not suitable for technical writing. Each of these adverbs can be removed without any change to the meaning of their sentences, and with a substantial streamlining of the writing. Suggest to do a careful scrub of all adverbs (by using a global search for words ending in -ly) in the manuscript.

- Abstract: Several acronyms are used but not defined (e.g. the four coastal models).
- Lines 24 and 25: The phrase “to address this need” is repeated. Also, the word ‘need’ is not used in the first sentence. Suggest to change to ‘address this requirement’ and use the phrase only once.
- Lines 25–26: “by disentangle extending” is awkward.
- The manuscript suffers from errors in typography and spelling.
 - *Spacing*: There are instances where spacing is wrong, often near references:
 - Line 27: “byintegrating” needs a space between words.
 - Line 64: “modeling(Luettich” needs a space.
 - Line 96: “configurations(Moghimi” needs a space.
 - Line 125: “(1)Atmospheric” needs a space.
 - Line 143: “CMEPS allows” has too many spaces?
 - Line 254: “formalism(Uchiyama” needs a space.
 - Line 261: “density(Moghimi” needs a space.
 - Line 386: “profiles(Fig” needs a space.
 - Line 402: “WW3(Fig” needs a space.
 - *Spelling*: There are instances of mis-spelled words:
 - Line 26: “CaostalApp” is mis-spelled.
 - Line 119: “compoents” is mis-spelled.
 - Line 143: “synchroning” is mis-spelled.
 - *Punctuation*: There are instances of missing periods:
 - Lines 109 and 112: Need periods to end these sentences.
 - Line 406: Need period at end of sentence.
- Line 27: “four different” can just be ‘four’.

- Lines 39–42: This sentence has multiple claims about multiple physical processes. It would be better to support these claims with multiple references.
- Line 40: Need a hyphen between “wave current”.
- Line 49: Should “earth” be capitalized?
- Line 49: Should “scale” be pluralized?
- Line 68 and elsewhere: The registered trademark symbol (®) seems out of place in an academic manuscript. Presumably all of these models are released with licenses that include copyrights, so why not include a copyright symbol (©) next to every model name and instance? Or better yet, suggest to omit these symbols.
- Lines 170–171: WW3 was not the first wave model to use unstructured grids and a domain decomposition. Suggest to remove the term “major paradigm shift”.
- Line 198: What is meant by the phrase “adding caps”? Is this short for capabilities?
- Line 200: There is a reference to “[t]hese atmospheric fields”, but the previous sentences are about “caps” for the ocean models? This phrasing is awkward.
- Line 204: Should “radiation stress” be expanded to also include vortex forces?
- Line 214: Can a reference be added for HSOFS?
- Line 242: “ROMS’ ” should rather be ‘ROMS’s’, because ROMS is an acronym and thus not plural already.
- Lines 294 (“UFS-Coastal”) and 338 (“the UFS-Coastal”): The use of the article “the” is inconsistent.
- Line 295: Should “System” be plural?
- Line 315: This URL is different than the URL provided in line 91. What is the difference?
- Line 330: Should “either” be deleted?
- Lines 418–419 and 459: What is the difference between a case (e.g. Case 1, line 419) and an experiment (e.g. Experiment #3, line 459)?
- Line 444: “Fig. 4 demonstrated” is awkward, because it anthropomorphizes a figure. It is also dry, in that the text is only a description of what is shown in the figures. The authors should be encouraged to narrate the story told by the results and including supporting references to the figures as necessary.
- Line 455: Should “was” be ‘were’ to agree with “comparisons”?
- Line 479: “systematic validation” is not accurate, as only one coastal model was used in the validation.

- Figure 1: It seems awkward to not show the four coastal ocean models on the same horizontal level in this figure. Why is ADCIRC placed above and to the side? Also, the ordering from left to right (SCHISM, ROMS, FVCOM, ADCIRC) does not match the ordering in other instances in the manuscript.
- Figure 1: The CDEPS box is not connected to anything else in this workflow. Can the figure be revised to show how CDEPS interacts with the other components?
- Figure 1: This is a high-level description of the coupling, but it does not provide details about the mechanics of the coupling. These details are also sometimes missing in the main text. For example, two-way green arrows are used to show the communication between model components, but it is not clear what is communicated. What quantities are sent to SCHISM, and what quantities does it send back to the other components? Are the same quantities sent back and forth to ROMS? Or FVCOM or ADCIRC? If not, then can the differences be indicated in this workflow figure? Somewhere, either in this figure or in the main text, it will be good to include a summary of what quantities can be passed between each model component.
- Figure 2: What are the units for the bathymetry scale?
- Figure 3: It would be helpful to include the locations where these quantities were observed, either as a label in each sub-figure or in the figure caption. For example, are these the water levels from the FRF8m sensor?
- Figure 6: It would be helpful to include the sign convention for the alongshore and cross-shore velocities. For the alongshore velocities, does a positive value indicate the velocity is directed into the page? For the cross-shore velocities, does a positive value indicate the velocity is directed to the right on the page?
- Figure 6: What are the units of the axes? Where is this slice in the overall domain, e.g. where in Figure 1?
- Table 1: The caption mentions six experiments, but only five are described in the table and main text.