Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
https://doi.org/10.5194/gmd-2022-7-RC2, 2022

Comment on gmd-2022-7

Anonymous Referee #2

Referee comment on "The Regional Coupled Suite (RCS-IND1): application of a flexible regional coupled modelling framework to the Indian region at kilometre scale" by Juan Manuel Castillo et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-7-RC2, 2022

General comments

This paper presents a new regional coupled modelling framework focussed on the Indian region, termed RCS-IND1. The framework includes the Unified Model (UM) as atmospheric component, directly coupled to the JULES land surface model, on a grid with horizontal spacing of 4.4 km, enabling convection to be explicitly simulated. These models are coupled through the OASIS3-MCT coupler to the NEMO ocean circulation model and the WAVEWATCH III wave model configured on a grid with horizontal spacing of 2.2 km. The coupled system was tested in two tropical cyclone cases in the Indian region, namely Titli in October 2018 and Fani in April 2019, using five different coupling strategies. It is a very good work carefully written with very interesting findings supporting the research in air-sea coupled modeling systems and tropical cyclones. However, I can suggest it for publication after minor revisions.

Specific Comments

Line 63: “focussed” is used in the rest of manuscript

Lines 189-191: I am trying to understand this advantage. Please give an example and provide more details, because the air-sea momentum transfer is a very important factor in cyclones.

Line 210: Does the time step refer to the atmospheric model or to the land surface model? For a resolution of 4.4 km, an atmospheric time step of 120 s sounds large. Please clarify it.

Line 227: Improve -> Improvement of

Section 2.6: Please provide information about the bathymetry used in the wave model.

Line 315: How did you choose the upper limit of 0.32 for Charnock?

Lines 373-374: I suppose that with the term “frictional heating” you mean dissipative heating. It is usually considered as a term that added in sensible heat flux calculation in surface layer parameterizations of atmospheric models. How do you estimate it in your model? E.g., provide an equation.

486-487: MSLP differences of 30-36 hPa seem very large. I think that the SST cooling presented in this study may hardly result in such large pressure differences? Do they agree with MSLP differences reported by other studies using coupled systems for tropical cyclones?

Line 498: Why does AOW result in slightly earlier intensification? The increased wave-induced sea surface roughness in AOW is expected to delay the intensification due to the kinetic energy loss in the surface layer. Please explain your finding.

Line 510: is however -> are however

Line 535: “having increased MSLP”. Maybe, do you mean “decreased”?

Line 554-557: How is this inconsistency in MSLP and maximum wind speed explained?

Lines 555 & 557, Table 8 and Figures 7 & 8: m/s is preferable than knots to be consistent with Figures 5, 6 and 9.

Line 575: You mention that the impact of wave coupling on wind speeds is relatively

small. However, according to relative studies using coupled systems, wave coupling seems to have strong effects on momentum exchange and, subsequently, on wind speed because it changes the roughness length and the drag coefficient. I appreciate your discussion in L581-592 about sea surface drag and the decrease of drag coefficient in high intensities, but please further explain the finding presented in L575. Also, write in the text a range of wind speed differences between the simulations because the color palette does not help the readers to quantify the differences.

Lines 595-628: It is a little unclear for me which simulation has the best overall performance. Putting it another way, which coupled configuration would you choose to better predict rainfall during TCs in the India region? An approach using contingency table and respective statistics for discrete variables could support the evaluation.

Lines 672-674: Do you use a drag formulation including saturation in very high wind speeds? Such formulation could impact not only momentum exchange but also heat exchange through the change of Ck (bulk air-sea enthalpy transfer coefficient). Please provide more information about these important processes in the surface layer.

Table 9: Please check output/day values, they seem inconsistent. For example, AOW resulted to 109 Gb/day, but summing a, o and w gives 42 Gb/day.

Figures 12 & 13: Although the spatially accumulated precipitation expressed in mm can be used for the comparison of simulations results, it is dependent on horizontal spacing used and, thus, it does not have robust physical meaning. For example, if you used 2 times higher resolution you would have 4 times higher spatially accumulated precipitation values, given the same area. So, it would be better to express the spatially accumulated precipitation as kg (or tons) per total area instead of mm. Another approach would be the estimation of areal precipitation which is the average precipitation depth over the area.