

ESSD-2025-514: Reply to comments from Referee #1  
(Reviewer comments in bold, author responses in blue)

The reference list is a mess. The entire reference list must be revised. DOIs should be added everywhere if available.

We sincerely thank the reviewer for the feedback. We apologize for the disorganized state of the previous reference list. Per your instruction, we have completely revised the entire reference list to ensure consistency and accuracy. Furthermore, we have systematically added DOIs to all eligible references.

## References

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ESSD-2025-514: Reply to comments from Referee #2  
(Reviewer comments in bold, author responses in blue)

This is my third review of this manuscript. In this revision, the authors have addressed all of the concerns I raised in previous submissions—the manuscript has come a long way from the first submission—and I’m quite happy that they persisted in that I feel the work to be a valuable contribution. I did encounter a few grammatical issues but all are minor.

We sincerely thank the reviewer for taking the time to carefully review our manuscript for the third time. We are very pleased that the reviewer recognizes the improvements made since the first submission and considers our work a valuable contribution. We also appreciate the reviewer’s attention to minor grammatical issues, which we have carefully addressed throughout the manuscript.

### Questions about Procedures

1. Line 35: “population-based (Cayula” ==> “population-based (Cayula” (space after based)

We thank the reviewer for pointing this out. We have corrected the spacing to “population-based (Cayula et al., 1992)” for consistency.

2. Line 56: “with an mean Dice Similarity” ==> “with a mean Dice Similarity”

We appreciate the reviewer’s attention to this detail. The text has been corrected to “with a mean Dice Similarity Coefficient.”

3. Line 74: “encompassing the altimetry (1993“ ==> “encompassing altimeter data (1993”

We appreciate the reviewer’s careful reading and helpful suggestions. We have revised this to “encompassing altimeter data (1993–2023)” to correct the phrasing.

4. Equation 2: “ $T(i+1, j) - T(i, j-1)$ ” = > “ $T(i+1, j) - T(i-1, j)$ ”

We thank the reviewer for identifying this. The equation has been corrected to “ $T(i+1, j) - T(i-1, j)$ ” to properly represent the finite difference operator.

5. Lines 158 and 167 should not be indented

We thank the reviewer for the careful review. We have removed the unnecessary indentation from these lines to conform to the journal’s formatting guidelines.

6. There is a carriage return between line 176 and 176. There should not be.

We thank the reviewer. We have removed the unintended carriage return to ensure proper paragraph flow.

7. Lines 211-212: I found the definitions of TP, FP and FN to be confusing in “TP denotes the number of ocean fronts recognized by the model as ocean fronts, FP refers to the number of ocean fronts recognized by other objects, and FN refers to the number of ocean fronts recognized as other objects.” ==> “TP denotes predicted ocean-front instances that correctly match a ground-truth front, FP denotes predicted instances that do not correspond to any ground-truth front, and FN denotes ground-truth fronts that were not detected by the model.”

We thank the reviewer for pointing out the issue. The definitions have been revised as follows: “TP denotes predicted ocean-front instances that correctly match a ground-truth front, FP denotes predicted instances that do not correspond to any ground-truth front, and FN denotes ground-truth fronts that were not detected by the model.”

8. Line 244: “automatic detection and detection of” ==> “automatic detection of”, although you may have intended another word for one of the detections.

We thank the reviewer for the careful review. We have corrected this to “automatic detection of” to remove the duplicate wording.

9. Line 260: “insufficient training set hinder” ==> “insufficient training data hinder”

We appreciate the reviewer’s careful reading and helpful suggestions. We have corrected this to “insufficient training data hinder” for grammatical correctness.

10. “time-consuming manual labelling”
  - \* Inconsistent spelling throughout paper: both labelling and labeled are used.
  - \* Choose either British or American spelling consistently.

We thank the reviewer for the careful review. We have standardized the manuscript to consistently use American spelling throughout.

11. “The identification of ocean fronts can help us better understand the Earth’s climate and ecosystem”
  - \* “ecosystem” should probably be plural: “ecosystems.”

We thank the reviewer for the careful review. We have changed “ecosystem” to “ecosystems” in the Abstract and Introduction.

12. “population-based(Cayula et al., 1992...”

- \* Missing space before citation:
- \* population-based (
- \* gradient-based (

We thank the reviewer. The missing spaces before citations in “population-based” and “gradient-based” have been added in the manuscript.

13. “The gradient algorithm is a commonly used ocean front detection method and includes...”

- \* Subject-verb mismatch/logic issue.
- \* Algorithms do not “include” operators; methods “use” operators.

We thank the reviewer for the careful review. We have revised the sentence to “The gradient algorithm is a commonly used ocean front detection method and uses...” to correct the logic and grammar.

14. “identify sea fronts manually”

- \* Probably should be “identify ocean fronts” for consistency.

We thank the reviewer for the careful review. We have revised all instances to “identify ocean fronts manually” for consistency.

15. “with an mean Dice Similarity Coefficient”

- \* Should be:
- \* “with a mean Dice Similarity Coefficient”

We thank the reviewer. The wording has been corrected to “with a mean Dice Similarity Coefficient” in the manuscript.

16. “the fusion of ocean front detection and deep learning can yield sufficient training data with high integration cost and scarce data” \* Grammatically broken / logically malformed sentence.

We thank the reviewer for pointing out the grammatical and logical issues. We have revised the sentence for clarity and accuracy. The corrected version now reads: “The integration of ocean front detection and deep learning requires significant computational and integration costs, while training data remain scarce, making dataset construction particularly difficult.”

17. “The worldwide ocean eddy-resolving...”

- \* Missing article:
- \* “The worldwide ocean eddy-resolving ... reanalysis encompassing altimetry...”

\* or “the altimetry.”

We thank the reviewer. The sentence has been corrected in the revised manuscript.

18. “assimilated along the track altimeter data” \* Should be:

\* “along-track altimeter data”

We thank the reviewer for the careful review. We have corrected this to “assimilated along-track altimeter data.”

19. “multiple satellite sources. The dataset”

\* Missing space after period.

We thank the reviewer for the careful review. We have added the space after the period.

20. Equation (2):  $D_y(i,j) = \frac{T(i+1,j) - T(i,1-j)}{2\Delta y}$

\* Almost certainly a typo.

\* Should presumably be:  $T(i-1,j) - T(i,1-j)$

\* This is a substantive mathematical error.

We thank the reviewer for pointing this out. Equation (2) has been corrected in the revised manuscript.

21. “grid indices..” \* Double period.

We thank the reviewer for the careful review. We have removed the extra period.

22. “quasilinear”

\* Usually hyphenated:

\* “quasi-linear”

We appreciate the reviewer’s careful reading and helpful suggestions. We have changed it to “quasi-linear” for correctness.

23. “area recommendations”

\* Incorrect terminology in Mask R-CNN discussion.

\* Should likely be “region proposals.”

We thank the reviewer for the careful review. We have corrected this to “region proposals.”

24. “Pretreatment:”

\* In ML/data processing literature, “preprocessing” is standard.

\* “pretreatment” is unusual in this context.

We thank the reviewer for the careful review. The term “Pretreatment” has been replaced with “Preprocessing” throughout the manuscript.

25. “using Formulas (1) – (3)”

\* Usually singular in English scientific writing:

\* “using Eqs. (1)–(3)” or “using equations (1)–(3)”

We thank the reviewer. The wording has been corrected to “using Eqs. (1)–(3)” in the manuscript.

26. Figure inconsistency

\* Text says:

\* “Fig. 5 shows the resulting field for January 2023”

\* Figure caption says:

\* “January 2020”

\* One is wrong.

We appreciate the reviewer’s careful reading and helpful suggestions. The inconsistency between the text and figure caption has been corrected.

27. “LabelMe” vs earlier “Labelme”

\* Inconsistent capitalization.

We thank the reviewer for highlighting this issue. The capitalization has been made consistent throughout the manuscript.

28. “Lin et al., 2014)..”

\* Extra period.

We appreciate the reviewer’s careful reading and helpful suggestions. The extra period has been removed in the revised manuscript.

29. “automatic detection and detection of ocean fronts”

\* Duplicate word:

\* “detection and extraction”

\* or just “detection.”

We thank the reviewer. The wording has been revised in the manuscript.

30. “insufficient training set hinder”

\* Should be:

\* “an insufficient training set hinders”

\* or “insufficient training data hinder”

We appreciate the reviewer's careful reading and helpful suggestions. The wording has been corrected in the revised manuscript.

31. "the ocean front" used repeatedly as singular generic noun

\* Throughout the manuscript there are many instances where English would more naturally use plural:

\* "ocean fronts."

\* Not always wrong, but repeatedly awkward.

We have revised the manuscript according to the reviewer's suggestion.

32. "analysed"

\* British spelling appears alongside American spelling elsewhere ("labeled," "centerline").

\* Consistency issue.

We thank the reviewer. The spelling has been made consistent throughout the manuscript.

33. "ocean fronts recognized by other objects"

\* Incorrect wording.

\* Probably intended:

\* "non-front objects incorrectly recognized as ocean fronts."

We appreciate the reviewer's careful reading and helpful suggestions. This has been corrected in the revised manuscript.

34. "single ocean front width"

\* Capitalization inconsistent within Table 5:

\* "Single Ocean Front Intensity"

\* "single ocean front width"

We thank the reviewer for pointing this out. The capitalization in Table 5 has been made consistent, and "single ocean front width" has been corrected accordingly.

35. "temperature and salinity gradient"

\* Since there are two quantities:

\* "temperature and salinity gradients"

We thank the reviewer for the suggestion. The wording has been corrected to "temperature and salinity gradients" throughout the manuscript.

36. Equation (2) is wrong

This is the biggest technical issue I saw.

Current:  $T(i+1,j)-T(i,1-j)$

Should almost certainly be:  $T(i+1,j)-T(i-1,j)$

As written, the finite difference operator is mathematically incorrect.

We thank the reviewer for pointing this out. Equation (2) has been corrected in the revised manuscript.

37. Mask R-CNN architecture description appears factually incorrect/misleading This paragraph:

“The architecture takes a square  $224 \times 224$  pixel RGB image as input and produces a distribution over the ImageNet object classes...”

describes AlexNet/VGG-style image classification networks, not Mask R-CNN. Mask R-CNN is not fundamentally an ImageNet classifier architecture.

This section appears to mix generic CNN classification-network language with Mask R-CNN architecture.

We thank the reviewer for pointing out the inaccuracy in the description of the Mask R-CNN architecture. In the revised manuscript, the paragraph has been corrected to accurately describe Mask R-CNN as follows: “Mask R-CNN is an instance segmentation network that takes an input image of arbitrary size, predicts class labels, bounding boxes, and pixel-level masks for each detected object.”

38. TP / FP / FN definitions are technically incorrect

Current wording:

“FP refers to the number of ocean fronts recognized by other objects”

This is not the definition of false positives.

We thank the reviewer for pointing this out. The definitions of TP, FP, and FN have been corrected in the revised manuscript.

39. “30-year manually labelled ocean front dataset”

Potentially misleading.

Earlier text states:

\* only 5,000 samples were manually annotated.

But conclusion says:

“this study constructed a 30-year manually labelled ocean front dataset”

That sounds like the entire 30-year dataset was manually labelled, which does not appear to be true.

We thank the reviewer for the valuable comment. We have updated the wording in the Conclusion section.

40. “front width calculated as distance from centerline to boundary”

Then later:

“width ... calculated as twice the Euclidean distance transform...”

Those are different definitions:

\* distance to boundary = half-width

\* twice EDT = full width

The wording is internally inconsistent.

We thank the reviewer for pointing out the inconsistency in the definition of front width. In the revised manuscript, we have clarified that the front width is defined as twice the Euclidean distance from the centerline to the boundary, corresponding to the full width of the ocean front.