Major revisions cover letter re: Operational ecoforecasting for coral reefs using artificial intelligence and integrated near real-time environmental data

From: BMS 2022-0012 Decision Letter

Should you decide to revise the manuscript for further consideration, your revision should address the specific points made by each reviewer. With the revision you will need to submit a detailed (i.e., point-by-point including original reviewer comments) cover letter that fully explains how you addressed the reviewers' comments. Should you disagree with a reviewer on any substantial point, please include the reason for your disagreement.

Dear Editor:

Please consider for resubmission our manuscript entitled, "Operational ecoforecasting for coral reefs using artificial intelligence and integrated near real-time environmental data". We would like to extend our thanks to the editor for the opportunity to resubmit our manuscript, as well as both reviewers for their helpful and insightful comments. We have addressed each comment individually in our responses below as well as in the updated text of our manuscript.

Signed,
Madison Soden, Lew Gramer, and James Hendee

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Comments from the Editors and Reviewers:

Reviewer #1: **This paper describes the effort of developing an operational ecoforecasting system for coral reefs bleaching in the Florida Keys. The major merit of this paper is the utilization of the long-history data collected by stations in the SEAKEYS network.**

The reviewer has the following comments, and hope these can help to improve the paper:

1. The proposed ecoforecasting system has many steps, and it would be great to provide a "flow-chart" or similar way to visualize the full processes.

> The Reviewer has pointed out a very useful addition to the methods as presented in the text. We have added a new Figure 1 showing a flowchart of the NEIS Procedural Data Flow. We hope this will help clarify the steps performed by the ecoforecasting system.
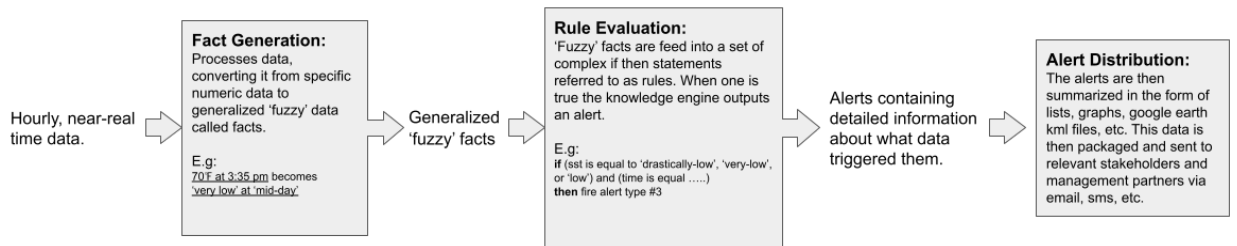
2. Fuzzy-logic is really a very old technique, and the authors may want to consider and compare it with more modern AI methods that can also process multiple environmental triggers.

> The reviewer rightly points out that expert systems are a very long-established AI methodology. We have added text to our Introduction as follows to address this concern: "Heuristic programming employs a practical method, not guaranteed to be optimal, but instead sufficient for reaching an immediate goal. Heuristics are strategies derived from previous experiences with similar problems - in this case, coral bleaching response to environmental stressors. Although heuristic programming based on fuzzy logic is a relatively old AI technique it is well suited to diagnosis; in this case the monitoring of environmental health. Heuristic programming in general is well-suited to problems with open and imprecise data representation and logical rules. It succeeds in making accurate, if broad, conclusions where other AI or ML techniques might stumble due to the low precision of validation data. This technique also prioritizes efficiency and utility at the cost of precision to create near real-time monitoring alerts that can help enable rapid management response to ecological threats."

3. In the ECOFORECAST SKILL SCORE section, why does NEIS have a high degree of accuracy than the satellite-derived products when both PSSs are 0.83?

> We thank the reviewer for pointing out the need for clarification here and have sought to make the text more clearly reflect how our results compare with other methods, as follows:
> "The overall PSS for the 13-year record of bleaching observations and S/RIs for 2005-2017 was calculated from the contingency table (Table 1) using Eq. 1. The PSS was found to be 7/8−1/22 = 0.83. This score compares with the published PSS for satellite-derived coral bleaching products (van Hooidonk and Huber 2009) of 0.83, indicating that NEIS had a degree of accuracy in identifying coral bleaching conditions on a yearly scale at sub-regional resolution during the validation period comparable with satellite methods, while also being able to incorporate other environmental triggers like in situ wind measurement comparable with satellite methods, while also being able to incorporate other environmental triggers like in situ wind measurement."

4. The paper mentioned the ocean and atmospheric models at the beginning, however, it was not discussed in the following text how to use the models. Please justify.

> We appreciate the reviewer pointing out that these hydrodynamic model outputs were not further discussed. We have sought to resolve this by adding the following text to the Introduction:
> "Regional operational ocean, atmospheric, and surface-wave models were also evaluated for this purpose, but issues of horizontal and temporal resolution as well as data availability for the earlier periods of the study (prior to 2005) made use of model data problematic."

Overall, this is a nice paper and it can be accepted after revision.