Manuscript title: Hazard Potential of Compound Flooding from Rainfall, Storm Surge, and Groundwater in Coastal New York and Connecticut

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General comments

The manuscript analyzes compound flooding from precipitation, storm surge, and shallow groundwater across coastal New York and Connecticut using multi-decadal observations (1970–2021). A copula-based biconditional framework is applied to estimate joint AND return periods and return period adjustments, and groundwater depth is incorporated through a hazard scoring approach to produce a spatial compound hazard map.

The study is regionally relevant and methodologically careful, particularly in its triad-based design and systematic copula selection procedure. The spatial integration of dependence and groundwater shallowness provides useful insights for coastal hazard assessment.

However, the contribution is primarily integrative rather than methodological. Groundwater is incorporated heuristically rather than probabilistically, and the assumptions regarding stationarity and threshold selection require stronger sensitivity analysis. Clearer conceptual framing and more explicit treatment of uncertainty would strengthen the manuscript.

Overall, the study is scientifically sound but requires substantial revision before publication in a high-impact journal.

Major comments

1. **Groundwater Is Not Fully Integrated in a Multivariate Framework**
   Although described as a compound analysis of three drivers, only precipitation and surge are modeled probabilistically via copulas. Groundwater is incorporated post hoc through ordinal scoring based on shallow depth thresholds. This creates a "pseudo-trivariate" hazard metric rather than a fully joint probability framework. The manuscript should either:
   a)- Reframe the study explicitly as a bivariate extreme analysis with groundwater preconditioning, or
   b)-Provide stronger justification for the scoring-based integration and clarify its limitations.

2. **Stationarity Assumption Requires Stronger Justification**

   The assumption of stationarity is based on limited comparisons of Kendall's tau and empirical upper tail dependence between two time periods. Given documented sea-level rise and changes in precipitation extremes in the region, a more formal test of non-stationarity (e.g., time-varying copula parameters or trend analysis in marginal extremes) would strengthen confidence in the results. At minimum, the manuscript should include a sensitivity discussion quantifying how moderate changes in dependence would affect return period shifts.

3. **Threshold Selection May Influence Dependence Estimates**

   Thresholds were selected partly to maximize Kendall's tau while maintaining 3–6 events per year. This approach may introduce bias toward stronger dependence. A sensitivity analysis using alternative thresholds (e.g., fixed 95th percentile across stations) would help demonstrate robustness.

4. **Imputation Uncertainty Is Not Propagated**

   Large portions of early NTR and groundwater data are imputed. While imputation performance metrics are provided, uncertainty from imputation is not carried into copula modeling or return period estimation. This may influence tail dependence estimates. The authors should clarify the potential magnitude of this impact and discuss whether extreme values are systematically dampened by regression-based imputation.

5. **Interpretation of Return Period Adjustments Needs Care**

   Statements such as compound events being "eight times more likely" should be clarified as referring to the ratio of joint AND return periods under dependence versus independence, not to changes in physical frequency due to climate forcing. The language should avoid implying causal climate change effects unless formally demonstrated.

6. **Hazard Versus Risk Terminology**

The manuscript evaluates hazard potential, not risk (no exposure or vulnerability metrics are included). The discussion and conclusions should consistently use “hazard” rather than “risk” to avoid conceptual ambiguity.

Minor comments

- Clarify explicitly in the methods that the joint return periods are AND-type (simultaneous exceedance) to avoid confusion with OR definitions.
- Provide a brief quantitative summary in the results of how many triads exhibit upper tail dependence and how many are independent under each conditioning approach.
- Include a brief sensitivity note on copula family selection—particularly the implications of using only symmetric copulas.
- Improve clarity of the weighting scheme used to aggregate return period adjustments (inverse CI width); a short formula or schematic would help.
- Ensure consistent units throughout (meters vs feet for groundwater depth).
- In spatial figures, consider including uncertainty ranges or classification uncertainty to prevent overinterpretation of sharp boundaries.
- Add a concise conceptual diagram summarizing the triad-based workflow (precipitation–surge sampling, copula fitting, RP shift, groundwater scoring, spatial interpolation).

Slightly streamline portions of the discussion that restate known regional climatology unless directly linked to quantitative findings.

Final Recommendation

The manuscript is promising and regionally important, but stronger treatment of stationarity, threshold sensitivity, uncertainty propagation, and conceptual framing would significantly enhance its robustness and impact.

I recommend **Major Revision** before acceptance for publication.