Response to Reviewer

We sincerely thank the reviewer for the positive evaluation of our manuscript. We appreciate the constructive comments, which helped us improve the clarity, methodological justification, validation discussion, and presentation of the manuscript. Our point-by-point responses are provided below.

Comment 1

The manuscript would benefit from careful English editing, as there are many grammatical issues and repeated singular/plural mismatches such as “images is” and awkward phrasing throughout the text.

Response:

Thank you for pointing this out. We have carefully revised the language throughout the manuscript. In particular, we corrected grammatical errors, singular/plural mismatches, awkward expressions, and inconsistent sentence structures. We also improved the readability of the Abstract, Introduction, Methods, Results and Discussion, and Conclusions. Expressions such as “images is” have been corrected, and several long or unclear sentences have been rewritten for clarity.

Comment 2

The novelty relative to prior Sentinel-1 time-series flood mapping studies, especially Z-score or anomaly-based approaches, should be stated more explicitly in the Introduction and Discussion. At present, the distinction from earlier methods is somewhat diffuse.

Response:

Thank you for this important suggestion. We have strengthened the description of the novelty in the Introduction and Discussion. The revised manuscript now explicitly distinguishes our method from previous Sentinel-1 flood mapping studies by emphasizing three aspects: first, pixel-wise temporal standardization is used to reduce dependence on event-specific global thresholds; second, VV and VH anomalies are integrated in a rule-based classification tree to handle different flood responses in natural and built-up areas; third, the method remains operationally scalable because it only requires Sentinel-1 GRD time series, auxiliary water-occurrence data, and simple statistical operations. These points clarify how our method differs from conventional single-image thresholding, image differencing, and single-polarization anomaly detection. The revised Introduction now explicitly states these three contributions.

Revision made:

We added a paragraph in the Introduction to explicitly summarize the methodological contributions:

1. pixel-wise temporal Z-score standardization;
2. dual-polarization VV/VH classification-tree integration;
3. operational scalability for both large-area flood monitoring and urban inundation detection.

We also expanded the Discussion by comparing our method with VV-only Z-score, VH-only Z-score, simple image differencing, Otsu thresholding, and the Sentinel-1 Global Flood Monitoring product. The revised comparison shows that the proposed method has more balanced performance across both natural and urban environments.

Comment 3
The choice of thresholds for natural areas (-2, -2.5, -3) and urban areas (2, 2.5, 3) is statistically motivated, but the final recommended threshold should be justified more systematically, perhaps with a table summarizing OA, UA, PA, and CSI for all cases.

Response:
Thank you for this helpful suggestion. We have revised the threshold selection discussion to provide a clearer statistical and empirical justification. The revised manuscript explains that negative Z-score thresholds are used for natural areas because open-water flooding generally decreases SAR backscatter due to specular reflection, whereas positive Z-score thresholds are used for urban areas because inundation around buildings can enhance wall–water double-bounce scattering and increase backscatter intensity. We also clarified that VV and VH are standardized independently, so the same numerical Z-score threshold represents the same standardized anomaly magnitude within each polarization rather than the same absolute backscatter change in dB.

Revision made:
We added a clearer explanation of threshold interpretation in the Methods section and expanded the Results section to discuss why -2 was selected for natural areas and 2 for urban areas. In natural areas, lowering the threshold captures more flood pixels but introduces more speckled false alarms; at the 95% confidence level, the method achieved approximately 90% OA and CSI above 60%, supporting the use of -2. In urban areas, lower thresholds improved flood-region continuity and increased CSI, although UA slightly declined.

We also added a comparison table among different methods. The current Table 2 reports CSI/OA for the proposed method and baseline methods: the proposed dual-polarization Z-score tree achieved 60%/90% CSI/OA in natural areas and 62%/73% in building areas.

Comment 4
The validation strategy deserves clearer discussion, especially because the Sentinel-2 and Sentinel-1 acquisitions are not fully synchronous, and the paper itself notes that flood extent changed rapidly between dates. This temporal mismatch should be treated more explicitly as a source of uncertainty.

Response:
Thank you for this important comment. We agree that temporal mismatch between Sentinel-1 and Sentinel-2 may introduce uncertainty, especially during rapidly changing flood events. We have revised the validation section to explicitly discuss this issue. The manuscript now states that the time difference between Sentinel-2 and Sentinel-1 was approximately 8–9 hours, while the UAV imagery used for urban validation had an approximately 2-hour time difference. We also clarified that the UAV validation should be regarded as local high-resolution validation rather than complete city-wide validation because of its limited spatial coverage.

Comment 5

Please define all abbreviations at first use and keep terminology consistent, for example “building areas,” “urban areas,” and “urban (building) areas,” which are currently used interchangeably.

Response:
Thank you for this comment. We have checked the manuscript and revised the abbreviation definitions and terminology. Abbreviations such as SAR, Sentinel-1 GRD, GPM, IMERG, GSW, DEM, UAV, MNDWI, OA, UA, PA, and CSI have been defined at first use. We also revised the wording related to urban inundation areas. To improve consistency, we now use “building areas” consistently when referring to built-up regions where urban inundation is detected through enhanced double-bounce scattering. We use “natural areas” for non-artificial surfaces such as water bodies, bare soil, cropland, and forests.

Comment 6
In the methods section, it would help to clarify how the “reference images” were selected, how many were used for each flood-date analysis, and whether seasonality was controlled equally for natural and urban surfaces.

Response:
Thank you for this suggestion. We agree that the reference-image selection procedure should be described more clearly. We have revised the Methods section to clarify that the Z-score calculation was based on same-orbit Sentinel-1 time series, so that differences caused by orbit direction, polarization, and imaging geometry were minimized. We also clarified that the baseline statistics were calculated separately for each polarization and orbit configuration.

Revision made:
We added text explaining that same-orbit reference images were used to calculate the temporal mean and standard deviation for each pixel, and that flood-period images were standardized relative to this reference distribution. For natural areas, seasonality is important because vegetation phenology can strongly affect backscatter stability; therefore, reference images were selected with attention to seasonal consistency. For urban/building areas, the manuscript now explains that building backscatter was comparatively stable during non-flood periods and was less affected by seasonal vegetation dynamics, so seasonal constraints are less strict than in cropland or other vegetation-covered natural areas. The manuscript also added normality diagnostics for different land-cover classes, showing that urban VH backscatter was relatively stable while cropland had stronger deviations due to crop phenology.

Comment 7
Figures are generally helpful, but some captions are too brief. The reader would benefit from more explicit legends, clearer color explanations, and a more direct connection between figure content and the interpretation in the main text, especially for Figs. 5–8.

Response:
Thank you for this helpful suggestion. We have revised the figure captions and improved the discussion associated with Figs. 5–8. We added clearer descriptions of what each color represents, the date of each

image, and how the figure supports the interpretation in the main text.

Revision made:
For Fig. 5 and Fig. 6, we clarified that the panels compare flood monitoring results from different dates and that differences among these panels reflect the rapid temporal evolution of flood extent. For Fig. 7, we clarified that grey indicates areas not affected by flood and red indicates areas affected by flood, and that the UAV imaging range is shown in Fig. 1. For Fig. 8, we clarified that the UAV oblique images represent severely inundated and moderately inundated urban regions, and we added an explanation of how low-rise building height and water depth can weaken or suppress wall–water double-bounce scattering. The revised text now directly links the UAV visual evidence to SAR missed-detection mechanisms.

Comment 8
I strongly recommend that the authors cite the recent paper *Spatiotemporal SWMM-LSTM surrogate modeling for efficient node-level water depth and inflow prediction in urban drainage networks* as it is highly relevant to the topic of urban flood prediction and would strengthen the manuscript's engagement with recent advances in the field.

Response:
Thank you for recommending this relevant recent study. We agree that this paper is closely related to urban flood prediction and data-driven urban drainage modeling. We have added it to the Introduction/Discussion to broaden the manuscript's engagement with recent advances in urban flood modeling. The paper is authored by Nima Zafarmomen, Vidya Samadi, and Edoardo Borgomeo, published in Cambridge Prisms: Water in 2026, with DOI 10.1017/wat.2026.10013.