Anatomy of a Flash Flood in a Hyperarid Environment: From Atmospheric Masses to Sediment Dispersal in the Sea

Kalman et al.

Author's response to the reviews

We thank the reviewers for their valuable and constructive feedback, which has helped us improve our manuscript. Below we provide our detailed responses to each comment. For Reviewer 1, we thank the reviewer's recognition of the major strengths of the paper. And similarly, we sincerely appreciate the reviewer's thoughtful comments and suggestions, which we believe helped us improve the manuscript. Furthermore, we sincerely thank Reviewer 2 for the thoughtful and encouraging feedback. We greatly appreciate the recognition of our work as both interesting and important, and we are pleased that the study was found to offer a detailed and holistic analysis of the flood. The reviewer's positive assessment and constructive comments have been very helpful. We detail all the changes that we have made in response to those remarks, following the responses to the remarks of Reviewer 1.

Reviewer 1

1. Meteorological Analysis Issues

R1C1 (Reviewer 1, Comment 1): **Overinterpretation of Atmospheric Processes (Lines 338–357):** The synoptic-scale discussion is overly detailed but does not provide sufficient context on how this event compares to other regional flash floods. A return period analysis or percentile ranking of rainfall intensity is missing.

Author Response (R1C1): This part of the manuscript was intended to lack interpretation whatsoever, and instead describe the atmospheric conditions that corresponded with different stages of the sequence, similarly as described in Dayan et al., (2001). Therefore, we have reviewed the section (previously 338-357) and made corrections to be certain that this is the case.

Regarding the second comment related to this section, because it was reporting rather than interpretation or discussion, we did not include comparative examples. However, we agree that it should contain more quantitative language which also allows for comparative values. Also, the aim of the study was to follow the full sequence of any flashflood, and therefore the scale of the flood was not emphasized.

The corrected version reads as follows, see also R2C11:

“The initial northward propagation of the Sudan Monsoon Low over the Red Sea (also known as the ‘Red Sea Trough’, RST) towards the Eastern Mediterranean was first detected 37 days before heavy precipitation event that ultimately led to a relatively large flash flood in Eilat. Rather than representing a continuous synoptic feature, this period comprised a series of RST-related disturbances with a through axis retaining in the region and intermittently re-intensifying. Particularly, the RST strengthened on the 24th (3mb over 9mb), three days prior to the massive rainfall in Eilat (**Supplementary fig. 2**).

R1C2: **Lack of Anomaly Computation (Lines 338–349):** No clear anomaly maps or statistical comparisons are provided to illustrate deviations from climatology.

Response: That is correct, we did not perform computations for modelling, instead, we used the widely accepted and applied NCEP/NCAR Reanalysis II, which uses a combination of observation data and fixed numerical weather model to create gridded dataset that represents the state of atmosphere over time.

Within the section in question (Lines 338-349), Supplementary Figure 1 shows the presence of the RST prior (1a) and on the flooding day (1b). For a proper comparison and deviation of the pressure values at sea level relative to flood producing conditions, we replaced Supplementary Figure 1a to a case, where RST was absent. Also, because of an added supplementary figure, now it is Supplementary figure 2.

R1C3: **Choice of Data Sources (Lines 247–273):** The study relies on NCEP/NCAR reanalysis, which has a coarse resolution (2.5° x 2.5°). A higher-resolution dataset such as ERA5 (0.25° x 0.25°) should have been used instead. Moreover, the temporal resolution used is not disclosed. You used daily information, whereas flooding in hyper-arid regions often requires data at sub-daily scales.

Response: Thank you for pointing out this issue, which can be confusing, and we agree that such a course resolution would not be appropriate for analyzing the watershed area. Upon reviewing the dataset, we realized that we used the PERSIANN dataset, which has a resolution of 0.25° x 0.25° and provides half-hourly temporal resolution, rather than the NCEP/NCAR reanalysis. This dataset was applied at a regional scale only, which is more suitable for the analysis, and we have now corrected this in lines 248-245. When we considered the conditions in the watershed area of the Kinnet (in local scale), we used GPM-Imerg with (0.1° X 0.1°) resolution. To clarify this in the manuscript, we have added and changed the first paragraph in Section 2.1 ()Meteorological data) as follows (lines 248-255:):

“The synoptic analysis in this study, used to track precipitation centers, was based on two data sources. One of these in a regional scale was the Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) dataset (Nguyen et al., 2019), obtained via CHRS Data portal, with a 0.5° × 0.5° resolution. Additionally, in a local scale, NASA's Global Precipitation Measurement (GPM) Integrated Multi-Satellite Retrievals (IMERG), with a 0.1° × 0.1° resolution, were utilized to compensate for the lack of a dense meteorological network in the trans-national Kinnet watershed, located at the northernmost tip of the Gulf of Aqaba-Eilat. Given the region's hyperarid conditions and limited gauging systems, satellite-derived precipitation data were essential for accurately estimating precipitated water."

R1C4: **Precipitation Data Validation (Lines 247–273):** GPM-IMERG is used, but it is not compared with ground-based rain gauge data or CHIRPS, which might be more reliable in the region you are analyzing.

Response: We fully acknowledge that CHIRPS is a valuable dataset; however, its reliance on ground-based rain gauge data (see lines 253–255) is problematic in this region due to the limited availability of stations and the patchy nature of rain events at the northernmost tip of Gulf of Aqaba-Eilat. While CHIRPS offers a fine spatial resolution (0.05° × 0.05°), its daily temporal resolution is less suited for capturing short-lived convective storms and flash floods, which are characteristic of hyperarid environments. We selected GPM-IMERG because its half-hourly data allow for better tracking of these rapid and intense precipitation events.

R1C5: **Overly Complex Synoptic Discussion (Lines 338–410):** The meteorological discussion does not add novel insights into Red Sea Trough (RST) events. The findings mostly reiterate known mechanisms of RST dynamics. If so, and I am not missing something, I would remove the meteorological analysis and instead focus on the hydrological and limnological analysis. Indeed, all the meteorological figures were placed in the supplementary information, which hints at its importance or the new insights this analysis provides.

Response: Te purpose of that description is not ro provide novel insights, but rather report on the conditions that were present at the time of this specific sequence. We agree that this is not adding novelty in terms of 'new' results, but we think for many readers less familiar with RST, especially in the field of sedimentology and flood dynamics research, including this may improve their comprehension of the study. We are comfortable removing or shortening upon your recommendation. According to the first comment (R1C1), it was suggested that we show some comparison of how RST conditions differ from non-RST conditions. Perhaps with this change this criticism may have already been addressed (see R1C1 response above).

R1C6: **Misinterpretation of meteorological analysis (Line 349 this is probably meant to be 339?):** Do you mean that something that had happened 37 days before contributed to the event's development?

Response: Reading your comment does make sense that 37 days seems somewhat arbitrary. Because we worked 'backwards' from the flood event to the past, each day was reviewed to determine whether the shape of the RST was present; and the first expression of the RST occurred 37 days prior to the flood. We will clarify this and also hope that the addition of the comparative non-RST case will make that clear. In the discussion we will also be certain to clarify that the presence of this subtle development of RST 37 days prior to the flood does not necessarily lead to full RST expression. In this case it did and we are reporting this observation. Please see the revised version (R1C1).

2. Flood Event Characterization Issues

R1C7: **Flood Return Period Not Established:** The study does not quantify how rare this event was in a historical context.

Response: We agree that this is not explained clearly enough. Modern flood records are available only from 1994, and records of most of these floods are limited to reports rather than precise measurements. Known historical events, mentioned in the introduction and discussion, only include extreme cases that had tragic outcomes, so it is difficult to place this flood comparatively. Where we could, we did compare these results to past recent events (example: Lines 631-641: sediment dispersal comparing flood of 2006, 2013, and this flood). We have also added more detail regarding what is known about the impact of this flood as well as others from the recent records (Discussion—first paragraph):

"This study followed the sequence of a storm that occurred on 28 October 2016 in Eilat from its initial phase to and through a flash flood that started depositing alluvium in the northern Red Sea a day later. The flood was the 13th flood recorded since records began in 1994 (Katz et al., 2015; Kalman et al. 2020). From 1994 to 2012, there was a drought period wherein flood occurrence was below one per year (0.17), followed by increased occurrence of 1.7 floods per year (2012-2020). With regard to the hazard level of the 28 October 2016 flood event, no deaths occurred nor was property damage reported; and transportation infrastructure (roads and airport) were not affected."

R1C8: **Rainfall Distribution Analysis is Weak (Lines 425–450):** While the authors describe spatially uneven rainfall, they do not analyze how this variability influenced runoff and flood formation.

Response: This is not discussed here because we separated the interpretation from the results. Section 4.2 (From precipitation to flow into the sea) details the specific runoff and accumulation patterns related to the uneven rainfall leading to flood formation.

3. Structural and Presentation Issues

R1C9: **Redundant Sections (Lines 267-270):** Some sections repeat information unnecessarily.

Response: Thank you for the useful remark, it has been corrected, and we have made additional changes to the same section in response to **R2C9**.

"In the specific case of the Kinnet watershed, IMERG datasets are necessary, and used alone, because physical meteorological stations are sparce. The two stations (Eilat, Israel and Aqaba, Jordan) present in the watershed are only 10 kilometers from one another, and show nearly identical annual average precipitation values (*Jordan Meteorological Department, Israel Meteorological Service*, Katz et al. 2015). Therefore, they are not useful for measuring the overall contribution of rainfall for the entire watershed. This absence of adequate ground-based meteorological stations and gauging systems in this hyperarid region makes satellite-derived data the most reliable source for the accurate assessment of precipitation patterns. The integration of this high-resolution, satellite-based data with the NCEP/NCAR reanalysis imagery offers a comprehensive understanding of the hydrological dynamics within this trans-national watershed"

R1C10: **Terminology Confusion (Lines 410–413):** The study misuses the term "mesoscale" for features such as the Polar Jet and Subtropical Jet, which are large-scale systems, and the Red Sea Trough, which is a synoptic-scale system.

Response: Thank you for the correction, Figure 3 caption is corrected as follows:

"Composites on the heavy rainfall in Eilat (red dot) showing three mesoscale systems (Polar Jet, Subtropical Jet, upper-level trough) and a synoptic-scale system (Red Sea Trough) in which their fourfold contact zone narrowed down to ~200 km wide gap over the Eastern Mediterranean contributing to the formation of the historical flashflood."

R1C11: **Poorly Labeled Supplementary Figures (Lines 399–403):** The supplementary figures lack detailed captions, making it difficult to verify claims. Please provide a document that includes all supporting information figures with captions.

Response: Thank you for your feedback. We have compiled a merged PDF document containing all the supplementary figures and their corresponding detailed captions. This should provide a comprehensive overview and facilitate verification of the claims presented.

R1C12: **Missing references related to the Red Sea Trough:**

Response: Thank you for pointing these important sources out, it was certainly an oversight on our part, and some may have been removed erroneously in phases of editing. All have been incorporated into the manuscript (list specific sections)

Alpert, P., Osetinsky, I., Ziv, B. and Shafir, H. (2004), A new seasons definition based on classified daily synoptic systems: an example for the eastern Mediterranean. Int. J. Climatol., 24: 1013-1021. https://doi.org/10.1002/joc.1037

Lines 122-123: "At present, based on nearly 70 years of data reanalysis, the RST is 96% originated from Sudan (Almazroui et al., 2016), and is known to be the most active during the autumn and winter (Saaroni et al., 2020; Alpert et al., 2004)."

Awad, A.M. and Almazroui, M., 2016. Climatology of the winter Red Sea trough. Atmospheric Research, 182, pp.20-29.

Lines 122-123: "At present, based on nearly 70 years of data reanalysis, the RST is 96% originated from Sudan (Almazroui et al., 2016), and is known to be the most active during the autumn and winter (Saaroni et al., 2020; Alpert et al., 2004)."

El-Fandy, M.G., 1948. The effect of the sudan monsoon low on the development of thundery conditions in Egpyt, Palestine and Syria. Quarterly Journal of the Royal Meteorological Society, 74(319), pp.31-38.

Lines: 116-117: “For decades, there has long been an interest in the linkages between meteorological conditions and resulting floods (El-Fandy, 1948).”

Hochman, A., Rostkier-Edelstein, D., Kunin, P. et al. Changes in the characteristics of ‘wet’ and ‘dry’ Red Sea Trough over the Eastern Mediterranean in CMIP5 climate projections. Theor Appl Climatol 143, 781–794 (2021).

Line: 514: “Hochman et al. (2021) used CMIP5 climate projections to categorize winter RSTs and analyzed their characteristics and impacts on the region. They found that rainfall associated with the wet Red Sea Trough (WRST) is projected to decline by 37% by the end of the 21st century due to shifts in atmospheric circulation patterns, increased temperatures, and a reduction in the frequency and intensity of WRST events.”

Hochman A, Plotnik T, Marra F, Shehter ER, Raveh-Rubin S, Magaritz-Ronen L. 2023. The sources of extreme precipitation predictability; the case of the ‘Wet’ Red Sea Trough. Weather and Climate Extremes 100564.

Continuing the paragraph from line: 514: “Hochman et al. (2021) used CMIP5 climate projections to categorize winter and dry Red Sea Troughs (RSTs) and analyze their characteristics and impact on the region. They found that rainfall associated with the wet Red Sea Trough (WRST) is projected to decline by 37% by the end of the 21st century due to shifts in atmospheric circulation patterns, increased temperatures, and a reduction in the frequency and intensity of WRST events. Additionally, they found that extreme precipitation events related to the WRST show distinct atmospheric pattern differences when compared to lighter precipitation events within the same system (Hochman et al., 2023).”

Reviewer 2

R2C1 (Reviewer 2, Comment 1): Line 47 ("128%"): Given the high variability in annual precipitation in Eilat, it would be helpful to report the annual mean rainfall along with its standard deviation to contextualize this percentage.

Response: Thank you, we agree that this is important. Changes suggested as follows:

"In Eilat), 128% (~34mm) of the mean annual rainfall average (27 mm±10mm) fell within hours, with the flood reaching the sea approximately 50 hours later and lasting for 27 hours.

R2C2: Line 52 ("hypopycnal and hyperpycnal flows"): For clarity, consider rephrasing as: "hypopycnal (surface) and hyperpycnal (bottom) flows."

Response: Thank you, yes, and it is now corrected as suggested.

"In turn, particle dispersal in the sea switched several times between hypopycnal (surface) and hyperpycnal (bottom) flows."

R2C3: Lines 90–96: Since rain intensity plays a critical role in flood generation (as acknowledged later in the paper), consider referencing this here as well.

Response: The section is now referenced with the following papers:

1. Cohen, H., Laronne, J.B., 2005. High rates of sediment transport by flashfloods in the Southern Judean Desert, Israel. Hydrol. Process. 19, 1687–1702. https://doi.org/10.1002/hyp.5630
2. Katz, T., Ginat, H., Eyal, G., Steiner, Z., Braun, Y., Shalev, S., Goodman-Tchernov, B.N., 2015. Desert flash floods form hyperpycnal flows in the coral-rich Gulf of Aqaba, Red Sea. Earth Planet. Sci. Lett. 417, 87–98. https://doi.org/10.1016/j.epsl.2015.02.025
3. Mathalon, A., Goodman-Tchernov, B., Hill, P., Kálmán, Á., Katz, T., 2019. Factors influencing flashflood deposit preservation in shallow marine sediments of a hyperarid environment. Mar. Geol. 411, 22–35. https://doi.org/10.1016/j.margeo.2019.01.010
4. Mulder, T., Syvitski, J.P.M., Migeon, S., Faugères, J.C., Savoye, B., 2003. Marine hyperpycnal flows: Initiation, behaviorand related deposits. A review. Mar. Pet. Geol. 20, 861–882. https://doi.org/10.1016/j.marpetgeo.2003.01.003
5. Reid, I., Frostick, L.E., 1987. Flow dynamics and suspended sediment properties in arid zone flash floods. Hydrol. Process. 1, 239–253. https://doi.org/https://doi.org/10.1002/hyp.3360010303

R2C4: Lines 98–102: Analyzing a single flood event may not significantly improve predictability due to the variability of flood-generating mechanisms. Consider motivating the study by suggesting a generalizable framework for flood analysis. Could this methodology be applied to other events, even with less detailed data?

Response: Good point, thank you. Now modified as suggested below:

"…comprehensive studies tracing the entire sequence for a specific event are lacking. Developing a framework that traces the entire sequence of events during a single flood can serve as a model for understanding similar processes in other arid coastal systems, even when only partial or less detailed data are available. Such a methodology could enhance our broader understanding of sediment dynamics and support environmental management, ecological conservation, urban planning in coastal deserts, and natural hazard assessment."

R2C5: Lines 171–172: Please revise for clarity; the sentence is difficult to follow.

Response: Noted, thank you. Revised as follows:

"In this local hyperarid wadi, total suspended solids (TSS) during flooding were measured at 44 grams per liter, based on an average from three flash flood events (Lekach and Schick, 1982)."

R2C6: Line 178 ("50,000 people"): The current population of Eilat is closer to 58,000. Please update accordingly.

Response: thank you for pointing this out. We returned to the resources for population data, and the highest published value is 55000 (though it could easily be 58000). We've change it to greater than 55000.

"Eilat, a coastal city established in 1951 with an increasing population of greater than 55,000 people (population 50000 reported in 2005 by Azaryahu, 2005; and 55000 reported in www.worldpopulationreview.com, accessed in 2025) is located in the northernmost part of the GAE immediately west of the neighboring city of Aqaba, Jordan which is home to over 150,000 residents (Arieli, 2021)."

R2C7: Line 185 ("Kinnet outlet"): Consider adding an inset figure showing the Kinnet Canal. For example: https://www.researchgate.net/figure/Local-A-and-regional-B-diagrams-showing-the-location-of-the-study-site-designed-by_fig6_323028491

Response: Thank you for the great idea. Within the text, we referenced Figure 2 as follows:

Line 185: "Floods in the GAE can form within hours after rainfall effects the Kinnet watershed in the northern GAE (**Fig. 1**). The Kinnet Canal (**Fig. 2**) serves as a conduit for the Kinnet watershed…"

And additionally, we also added the cross-section survey (referenced within the method section) of the Kinnet outlet during the flood event to Supplementary Figure 1. Accordingly, we updated the supplementary figure document (attached) introduced in response to Reviewer 1 comment (**R1C11**). Also, because this is the first Supplementary figure, the rest of the supplementary figures were consistently relabeled to Supplementary Figure 2, 3, 4 and 5 throughout the entire MS.

Line 298: "Similarly, at regular intervals the flood level at the banks was recorded and after the flood had finished, the cross-section areas of the Kinnet Canal (m^2) for each 3-hour interval were calculated (**Supplementary fig. 1**)."

R2C8: Figure 1: Briefly explain the rationale behind the division of ephemeral rivers.

Response: If we understand the remark correctly, we assume the division refers to the five basins within Yutum drainage basin (e.g. Yutum E, CN).

Figure 1b caption corrected as follows:

"Local map illustrates the mooring's position in the study area. The dominate drainage systems Yutum and Arava are highlighted. Their boundaries were delineated previously (Shatanawia et al. 2024, Farahan and Anaba 2016; Kalman et al. 2020); and in this study the sub-basins were defined (Yutum 'N, E') along topographic (elevation) digital elevation models (GISHydrology). Although all runoff ultimately converges at a single outlet, the Kinnet Canal; dividing the watershed into sub-basins helps to identify distinct source areas and improves the estimation of flood arrival times at the river mouth (Eilat city center). Maps adapted from Kalman et al., 2020."

R2C9: Lines 267–273: Since the analysis focuses on a specific event, satellite precipitation estimates could be validated against data from Eilat and nearby meteorological stations (using, e.g., data from the Israel Meteorological Service).

Response: We appreciate the suggestion, and agree that ground-based validation would be ideal. The majority of the Kinnet Canal's watershed lies outside of Israel in Jordan and a small part of Saudi Arabia (Yutum drainage). There are 29 meteorological stations in Jordan; however, only one within our drainage area (Aqaba). This specific station is located at the Aqaba airport north of Eilat/Aqaba, at 50m elevation. It is geographically the closest to Eilat; and shares very similar annual averages as Eilat (example, 2024-2025 was 23.3mm REF website https://jmd.gov.jo/en/rainfall). Requests were made for higher resolution precipitation records for the time of the storm discussed in this manuscript, without success. Fortunately, a 2019 publication (Aladaileh et al. 2019) provides some insight of station data, but only on an annual scale resolution. In any case, 28 out of 29 of the stations are located outside of the watershed, so even high-resolution data would not contribute to the study. Due to these limitations, satellite-derived products were the most reliable and spatially comprehensive option for assessing the full precipitation event.

The following is the revised paragraph, clarifying the issue of meteorological station data.

"In the specific case of the Kinnet watershed, IMERG datasets are necessary, and used alone, because physical meteorological stations are sparce. The two stations (Eilat, Israel and Aqaba, Jordan) present in the watershed are only 10 kilometers from one another, and show nearly identical annual average precipitation values (*Jordan Meteorological Department, Israel Meteorological Service*, Katz et al. 2015). Therefore, they are not useful for measuring the overall contribution of rainfall for the entire watershed. This absence of adequate ground-based meteorological stations and gauging systems in this hyperarid region makes satellite-derived data the most reliable source for the accurate assessment of precipitation patterns. The integration of this high-resolution, satellite-based data with the NCEP/NCAR reanalysis imagery offers a comprehensive understanding of the hydrological dynamics within this trans-national watershed."

R2C10: Line 311 ("SRTM"): Confirm that this is the correct acronym. If referring to elevation data, clarify that this refers to a digital elevation model (DEM), and explain briefly.

Response: Thank you for this valuable note. It is now explained better as follows:

"Digital elevation models (DEMs) from the Shuttle Radar Topography Mission (SRTM) were downloaded (https://earthexplorer.usgs.gov/) and processed in a series of steps…"

R2C11: Line 339 ("37 days"): A 37-day duration seems unusually long for a Red Sea Trough system. Clarify whether this reflects a series of disturbances or a continuous synoptic feature.

Response: Thank you again for this valuable note. We've expanded on this and hope this explanation is improved:

"The initial northward propagation of the Sudan Monsoon Low over the Red Sea (also known as the 'Red Sea Trough', RST) towards the Eastern Mediterranean was first detected 37 days before heavy precipitation event that ultimately led to a relatively large flash flood in Eilat. Rather than representing a continuous synoptic feature, this period comprised a series of RST-related disturbances with a trough axis retaining in the region and intermittently intensified. Particularly, the RST strengthened on the 24^{th} (3 mb over 9 mb) three days prior to the massive rainfall (**Supplementary fig. 2**)."

R2C12: Supplementary Fig. 3: Add contour values to enhance readability.

Response: Now it is added and now Supplementary Figure 4.

R2C13: Lines 406–408: Consider adding a schematic diagram or cartoon to visually summarize the key processes.

Response: Thank you for the insightful suggestion regarding the additional graph. We have added the new figure as figure 9 and referenced it within the text as follows:

Line 731-734: It is expected that the combined analysis of climatology, hydrology and sedimentology of flash flood events will help to better understand the interlinkages between the otherwise separately discussed aspects of flood hazards in hyperarid regions (Figure 9).

R2C14: Figure 4: Suggest including a time series of observed precipitation from Eilat and other IMS stations, and comparing it with satellite estimates. This is especially relevant given the difficulty of measuring precipitation in arid regions.

Response: We appreciate this thoughtful suggestion and fully agree that comparisons would be the best to visualize even with numbers. However, as shown in Figure 1, only a small portion of the Eilat sub-basin lies within Israeli territory, and only two stations are within or near the relevant area. Including a single point (or two within the same area) observation to represent the entire watershed would be inaccurate, especially considering the localized nature of rainfall in arid environments. For this reason, we chose to rely on GPM satellite data, which offers consistent spatial coverage across the full extent of the basin and aligns better with the scale of our hydrological analysis. Please also see discussion of this in R2C9 and changes made to clarify this issue.

R2C15: Line 471: Please revise this sentence for clarity.

Response: Now it is revised as follows:

"…250 m offshore the canal outlet. These two parameters mirrored one another; as salinity dropped turbidity rose and vice versa.

R2C16: Line 475 ("values6"): Add a space.

Response: Thank you, corrected.

R2C17: Figure 6: Consider plotting ocean temperature along with salinity vs. TSS (after appropriate adjustments) and discuss the observed anti-correlation between salinity and TSS.

Response: We thank the reviewer for this valuable suggestion. Interestingly, ocean temperature remained unchanged during this October, 2016 flood event. We believe this is due to the ~50-hour delay between the rainfall and the arrival of floodwaters at the sea, allowing sufficient time for thermal equilibration with the surrounding environment. This is in contrast to a minor flash flood event on March 1, 2017 (see Line 617), which followed a hailstorm that directly impacted the Eilat Mountains. During that event, we observed a ~0.4°C temperature drop and increased turbidity at the top and the bottom of the water column, as measured by CTD+OBS sensor transects (data not shown).

Given the lack of temperature variation during the main event, we did not include temperature in the salinity–TSS plot, but we have now expanded to clarify this point in the figure caption:

"…The flooding event is clearly visible as a sudden decrease in salinity. No significant temperature change was registered during the event. Gaps in the data indicate…"

And also within the text as suggested:

"According to the sensors, water temperature did not change, but water salinity and turbidity started to fluctuate at 9:50 AM on the 28th of October, 2016, 250 m offshore the canal outlet.

R2C18: Line 570 ("subbasin (Figure."): Add the correct figure number and close the parentheses.

Response: Thank you, corrected.

"…significantly larger amounts precipitated in the vicinity of Wadi Arava and Yutum-CN subbasin (**Figure 1b**)."

R2C19: Line 585 ("0.1x0.1"): Clarify if this refers to a 10×10 km grid.

Response: Thank you, cleared for clarity as follows:

"It is important to note that its 0.1° x 0.1 ° spatial resolution (10x10 km grid) does not allow to analyze precipitation accumulated in wadis and lower ranked streams specifically…"

R2C20: Line 593: Could it be that water from more distant basins did not reach the GAE, and that closer basins contributed most of the flow? Please evaluate this.

Response: Yes, thank you for pointing it out, that is exactly the case, and we see and agree that it needs to be more elaborated.

"We calculate that approximately 133 million m^3 of precipitation fell across the entire watershed of the Kinnet Canal during this event, and that ~1 million m^3 (0.75%) ultimately reached the GAE through the canal. This limited yield reflects the fact that runoff from more distant parts of the watershed (particularly from the eastern sub-basins) faces greater losses due to longer travel distances, allowing for increased infiltration and evaporation. A portion might also remain in the watershed as isolated pools. The ~99% difference may reflect the combination of these factors. In arid regions where sequential gage measurements were conducted, transmission loss rates showed considerable variations. For example, 13.2 % in an Australian desert stream (Dunkerley and Brown, 1999) up to 98% in parts of Saudi Arabia (Walters, 1990); and in between 20% and 85%, located in Nahal Zin, Israel's Negev Desert (Greenbaum et al., 2001)."

R2C22: Line 598: Please revise this sentence for clarity.

Response: We agree and it is revised as follows:

"In arid regions where sequential gage measurements were conducted, transmission loss rates showed considerable variations. For example, 13.2 % in an Australian desert stream (Dunkerley and Brown, 1999) up to 98% in parts of Saudi Arabia (Walters, 1990); and in between 20% and 85%, located in Nahal Zin, Israel's Negev Desert (Greenbaum et al., 2001)."

R2C22: Figure 7B: Clarify if this refers to the ratio of days exceeding 14.5 mm to the total number of days. Also consider adding a map of the long-term annual mean precipitation.

Response: Thank you for the suggestion. We clarified that the ratio refers to the number of days exceeding 14.5 mm relative to the total number of days (please see below the correction of the figure caption). While we appreciate the idea of adding a long-term annual mean precipitation map, we believe the current figures sufficiently illustrate the precipitation patterns relevant to our analysis and the addition of another map might distract from the interpretation because annual values do not illustrate event conditions.

Fig 7 caption: "GPM-IMERG data visualized in the Kinnet watershed at the head of the Gulf of Aqaba–Eilat, Red Sea. (A) Sum of accumulated rain preceding a flashflood on 27 October 2016. (B) Likelihood of precipitation exceeding 14.5 mm. This threshold corresponds to a local flashflood event recorded on 1 March 2017, when 14.5 mm of rain fell in under 3 hours and temporarily flooded the streets of Eilat. This threshold was used to assess flashflood potential across the basin. Likelihood values represent the proportion of days with precipitation exceeding 14.5 mm relative to the total number of days during the analyzed period (2000–2021)."

R2C23: Line 635 ("24,000 tons"): Provide an uncertainty estimate for this sediment discharge value if possible.

Response: Very good point, unfortunately we can just hypothesize that our measurements captured the majority of the flood event as we missed the initial very low flow and possibly sediment transport, and similarly the waning stage of the flood. To provide this uncertainty, we improved the section as follows:

"Based on the flow and sediment concentrations in the Kinnet canal we calculated that during the October 2016 flashflood, approximately 24,000 tons of suspended sediment entered the sea. This value is probably an underestimate because it is based on the periodic measurements (3 hour intervals), which may have missed the peak flood maximums (Figure 6), which presumably exhibited higher total suspended sediment. Nevertheless, the estimate captures the main body of the event and is representative of the overall magnitude. The amount is similar to the previously reported 21,000 tons of suspended sediment…"

C2R24: Lines 654–656: Are aerial images available from the time of the flood? For example, see Fig. 7 in Gildor et al. (JPO, 2009).

Response: Unfortunately, we do not. The earlier images that you mentioned were from a professional aerial photography company; and during our event such photography was not done. It may also be because much of the more photogenic parts of the event occurred overnight in the dark. Sadly, we were not yet using drone photography as a regular part of our toolkit. Today we would undoubtedly have many photographs from above! Another note of interest is that the early flood image you mentioned (2006 flood) was such an attention-drawing event due to the long drought that it drew a lot more attention than floods that occur in the past few years when it has been a more regular phenomenon.

C2R25: Lines 673–675: It would be useful to report how many standard deviations the observed decrease represents.

Response: Very good point and very relevant information. Please see the addition below:

"At its peak, salinity at the moored station was reduced to 38.75 ‰ which is approximately 1.75 ‰ less than the measured salinity in the 7 months of measurements prior to the event. This drop is 19 times greater than the standard deviation of the salinity observed during that period."

C2R26: Lines 693–694: Add a closing bracket. Also, fix spacing in "Fig.8c".

Response: Thank you, corrected.

C2R27: Lines 707–710: Could concentrations have been higher closer to the outlet? Consider discussing this.

Response: Thank you for pointing it out. We improved the text of the section as follows:

"This would suggest that sometime around 2:00 am between the 3rd and 4th TSS measurements, sediment concentrations in the Kinnet may have reached the required minimum threshold (36-43 g/l) to generate a hyperpycnal plume upon entering the GAE. Sediment concentration measurements at the outlet during both the 3rd and 4th collections were around 15-fold higher relative to the marine station located 250m offshore. These values record the process of both dilution with seawater and sediment dispersal as the suspected plume traveled along the seafloor. It is therefore reasonable to assume, given the relatively low sediment concentration values recorded (2.18 g/l) at 250m offshore, that the proposed hyperpycnal plume dissipated before reaching the station's sensors. While a hyperpycnal plume may not have been present at that distance, sediment dispersal continued in the form of continued near-bottom transport, possibly enhanced by added sediment entrained in the turbulent flow. Salinity returned to near background levels by 5:45 AM Oct 29, and remained at ~ 40.3 PSU, ~0.2 PSU less than average until the retrieval of the mooring 9 days after the flood event."

C2R28: Lines 729–730: The use of machine learning seems unlikely here due to the small dataset. Consider revising this claim.

Response: Thank you for pointing out this important detail that we missed to discuss. Please see the more elaborated section below:

"…by recognizing changes in flood deposit signatures, it is possible to reconstruct past climatic variations on the seafloor downcore (Kalman et al., 2020, 2022; Katz et al., 2015). Just as atmospheric parameters are catalogued in synoptic analyses, the physical and chemical properties of flashflood sediments in their depositional settings can be compiled into the same database, linking atmospheric triggers with sedimentary responses. While the use of machine learning requires large datasets, we propose that in locations where distinct flood layers are consistently preserved (potentially hundreds of well-characterized sediment-climate pairs), such datasets could be developed and applied to train machine learning models. It is expected that the combined analysis of climatology…"