Review of "A 20-year satellite-reanalysis-based climatology of extreme precipitation characteristics over the Sinai Peninsula" by Soltani et al. (Submitted to ESD). Summary and Recommendation: This study invoked IMERG precipitation and NCEP/NCAR reanalysis dataset for atmospheric variables to first identify extreme rainfall characteristics followed by understanding synoptic properties responsible for wet and dry periods observed over Sinai Peninsula. The authors use a range of tools in CDO toolbox to perform statistical analysis over the region. The study has merit in terms of identifying mechanisms responsible for extreme rainfall events but it needs more statistical basis so as to establish "meaningful" relationship between atmospheric state and precipitation events. I highly recommend not using strong sentences such as "remarkable correlation" and "meaningful results" without performing some kind of statistical significance tests on their results. I also found out many spelling and grammatical mistakes with incoherency in their sentences throughout the manuscript and it was impossible for me to pin point each of the error and thus I highly recommend going through the manuscript carefully to fix those errors before submitting the revised version of this manuscript. Therefore, I recommend "Major Revision" before I can recommend accepting this manuscript.
We appreciate your time and consideration. The respected reviewer's comments/recommendations are clarified and addressed below.

My primary suggestions are as follows:
1) I suggest adding the lat-lon bounds of the entire study region Sinai Peninsula corresponding to their Figure 1 Description.
Response: It is done in the revised manuscript.

2) Multiple spelling and grammatical errors are present throughout the manuscript and thus I cannot pin point each of them, so please correct those throughout the manuscript.
Response: It is done in the revised manuscript.

3) Lines 137-139: I am not sure if I agree with this statement. I have observed cyclonic and anticyclonic patterns in coarser and finer resolution with almost similar accuracy and it was even better captured in finer resolution. I do not mind authors using coarser resolution product for their analysis but this statement is not necessarily true and I suggest removing this from their manuscript.
Response: The reviewer has a point; however, a coarser resolution data to diagnose/explore large-scale pressure-fields (cyclones/anticyclones) is indeed wise to be used in regions with a complex atmospheric PBL such as the eastern Mediterranean basin. This is particularly true for the low-level features (e.g. sea level pressure SLP, relative vorticity RV, potential vorticity PV) due to the strong interactions between the orography and PBL dynamics.

However, following the suggestion, we now modified the sentence as follows in the revised manuscript: *''… NCEP/NCAR data was used to study the pressure fields due to its coarser resolution, as it is believed that large-scale pressure systems such as cyclonic -and anticyclonic patterns could be better represented in a coarse resolution especially at lower levels of the atmosphere over complex regions''.*

4) Line 170: How did authors come up with the threshold of 10 mm/day for this region? Are there previous studies available backing this claim or did authors perform any statistical analysis to come up with this threshold? Currently this looks like an arbitrary threshold and I don't think I can accept this as it is.
Response: We experimentally (but not arbitrary) used a threshold of ≥10mm precipitation, after testing other thresholds like ≥5mm and ≥20mm, to define the overall wet-period and dry-period on a monthly basis in the Sinai Desert. For this, Figure 3 was our major reference determining the wet-months and dry-months, which is estimated based on the *frequency occurrence* of the precipitation events (but not precipitation amount only) with a threshold of ≥10mm/day for the period of 2001-2020 (7305 days).

Indeed, we are particularly interested in to determine months with the lowest frequencies of precipitation in the Sinai. This is because, the current study is an initiative to the follow-up major Sinai's research, which is to examine the regreening impacts on the local/regional hydrometeorological process (such as precipitation recycling) in the Sinai that is currently a desert. Due to the poor Sinai's literature, this study aims at, among others, determining the months/periods with minimum -or no rainfall amount/frequency throughout the year in the Sinai in order to select the driest months to address the above-mentioned goal; particularly, estimating the rate of enhanced precipitation recycling under a vegetated-surface scenario during a naturally-dry-period of the year over the Sinai's water-limited environment.

In addition to the threshold of ≥10mm precipitation (Fig. 3b, see below) determined in this study, we now did estimate the precipitation frequencies with thresholds of ≥9mm/day and ≥11mm/day (Figure 001), as test cases; this figure is attached below -- *but will not be added to the manuscript/supplement*. It is clear, their results (≥9, ≥10, ≥11 mm/day) are almost identical; so, it is not much about thresholds with ±1mm/day with respect to frequencies to be defined as dry -or wet at a monthly basis. However, it will be different for much higher thresholds like ≥5mm -or ≥20mm in the Sinai, as shown in the supplement. Therefore, a threshold of ≥10 mm/day looks logical to define the wet -and dry periods in the case of Sinai Desert.

However, following the other respected reviewer to use percentile-based approach (and your suggestion to use standard deviation to better understand rainfall variations), in addition to the frequency-analysis with a threshold of ≥10 mm/day, we now did estimate the monthly 90th percentile and standard deviation of the precipitation as well. So, in the revised manuscript, we now developed a multi-statistical-approach using three statistical measures based on percentile, frequency and standard deviation to determine/split wet -and dry months in the Sinai region -- as the results obtained from these statistical methods are in very good agreement in time and space (see Fig. 3 below).

So, in the revised manuscript, we now added a new subsection at the beginning to explicitly explain our approach developed in this study as follows:

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2.3 Data analysis approach

2.3.1 Determining the Sinai's wet and dry periods

In this research, we are particularly aimed at, among others, determining months with the lowest (-or no rainfall) and the highest amounts/frequencies of the precipitation events throughout the year in the Sinai Peninsula. This is mainly because, it is planned as the follow-up Sinai's research, to assess regreening impacts on the local/regional hydrometeorological process such as precipitation recycling in the Sinai Desert under a vegetated-surface scenario during a naturally dry period of the year. Thus, herein we developed a multi-statistical-approach to split the wet -and dry months of the year in the Sinai's water-limited environment for the period of 2001-2020. This is achieved via a combination of the results obtained from three statistical measures: i) monthly 90th percentile of the daily precipitation (Fig. 3a), ii) an experimentally-based precipitation frequency occurrence with a threshold of ≥10 mm/day (Fig. 3b) – after examining other thresholds such as ≥5 mm/day and ≥20 mm/day (see Figs. S1 and S2), and iii) monthly rainfall standard deviation SD estimates (Fig. 3c). These methods were calculated using a set of statistical functions, described in the follow-up subsection (see Table 1). Therefore, using the above-mentioned approach developed in this study, the Sinai's wet months are determined from October to March, defined as wet-period, and its dry months from April to September, defined as dry period.

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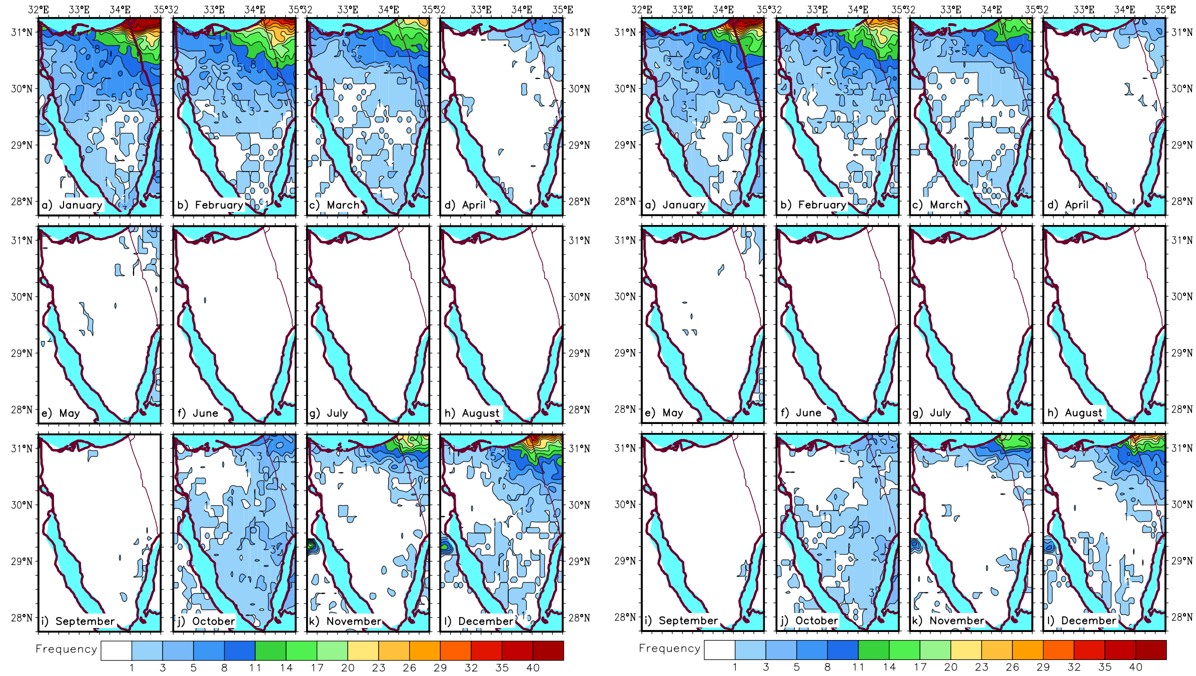


Figure 001. Frequency occurrence of the monthly precipitation events for the climatology period of 2001-2020 (7305 days) over the Sinai Peninsula: **left)** with a threshold of ≥*9 mm/day*, **right)** with a threshold of ≥*11 mm/day***.** Units are frequency in days.

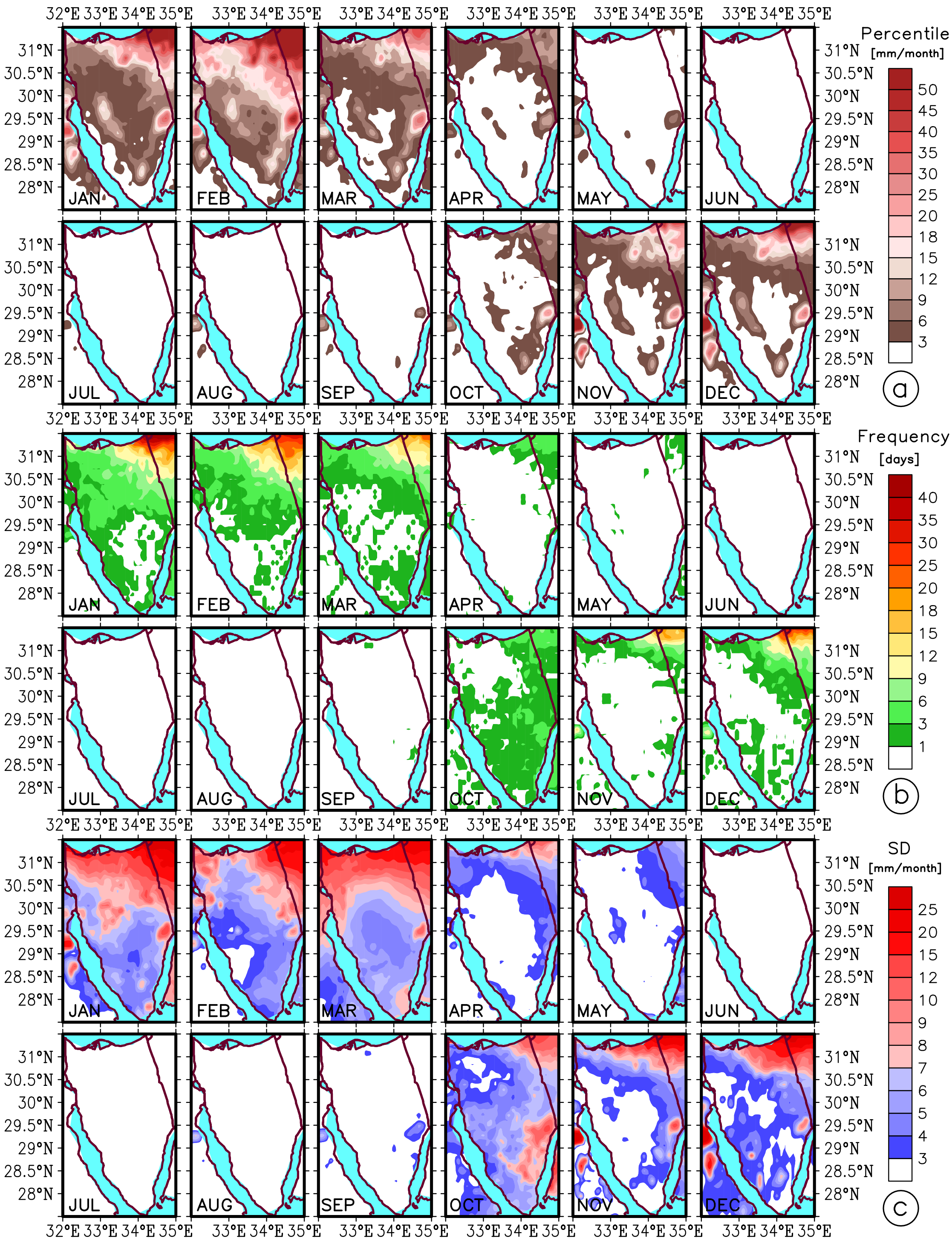


Figure 3. A multi-statistical analysis of the precipitation in a monthly basis: a) the 90th percentile of rainfall climatology, b) frequency occurrence of the rainfall events with a threshold of ≥10 mm/day, and c) grid-based standard deviation SD estimates of the rainfall for the period of 2001-2020 (240 months) over the Sinai Peninsula.

5) Lines 198-204: Are these numbers in trends and slopes statistically significant at a certain level of significance (say 95% or 99%)? Did authors perform any test to identify some kind of statistical significance like bootstrapping? If not, I suggest performing such tests to better aid the readers about the significance of these numbers.

Response: The statistical tests for significance of the regression model/trends are typically performed for the time-series dataset (between two variables), which can be determined by e.g. r^2-values along with the p-values (or t-test). As such, if r^2 is typically >0.6 with $p <0.05$ in regressions, then the trend is regarded as statistically significance and meaningful. However, our trend of slope (Fig.2: now Fig. S8 in the revised supplement) is estimated using an *anomaly-based approach* (not timeseries in a regression model). Here, we detected the precipitation anomalies (annual/seasonal) with a *Mean* function, meaning that the long-term mean (average) of each rainfall data was calculated; then it was subtracted from each year/season precipitation values to estimate the anomalies (i.e. anomaly equals individual values of each year/season minus long-term mean value), and finally the trend of slopes of those anomalies was drawn using the common least-squares fitting process. Therefore, our trend of slope represents the rate at which change occurs over time. If the slope has a positive value, the rainfall rate is increasing (-or the wetter condition). If it is negative, the rainfall rate is decreasing (-or the drier condition). In that figure, we interpreted the trend of slope to mean that, on average, the rainfall rate is changed by the slope value each year/season over the past two decades (2001-2020). Therefore, we deliberately avoided to use the terms such as ‘’significant trend’’ -or ‘’statistically significance’’, related to that figure.

Indeed, for the anomaly-based approach and its trend of slopes it is not feasible to perform any kind of statistical significances like Bootstrapping; however, we did perform *Bootstrapping Confidence Interval* for the original datasets of seasonal and annual precipitation climatology (20-years) on the selected sites across the Sinai. The results are given in Table S1 in the revised supplement data – also attached below.

However, since we now applied the EOF-based analysis (Fig. 4 in the revised manuscript, also shown below) suggested by the other respected reviewer, we decided to move the temporal site-scale anomaly-based analysis/figure into the supplement data (Fig. S8). It is good mentioning that, the results of the site-scale anomaly-based analysis are in good agreement with those of the grid-scale EOF-based spatiotemporal analysis in the Sinai Desert.

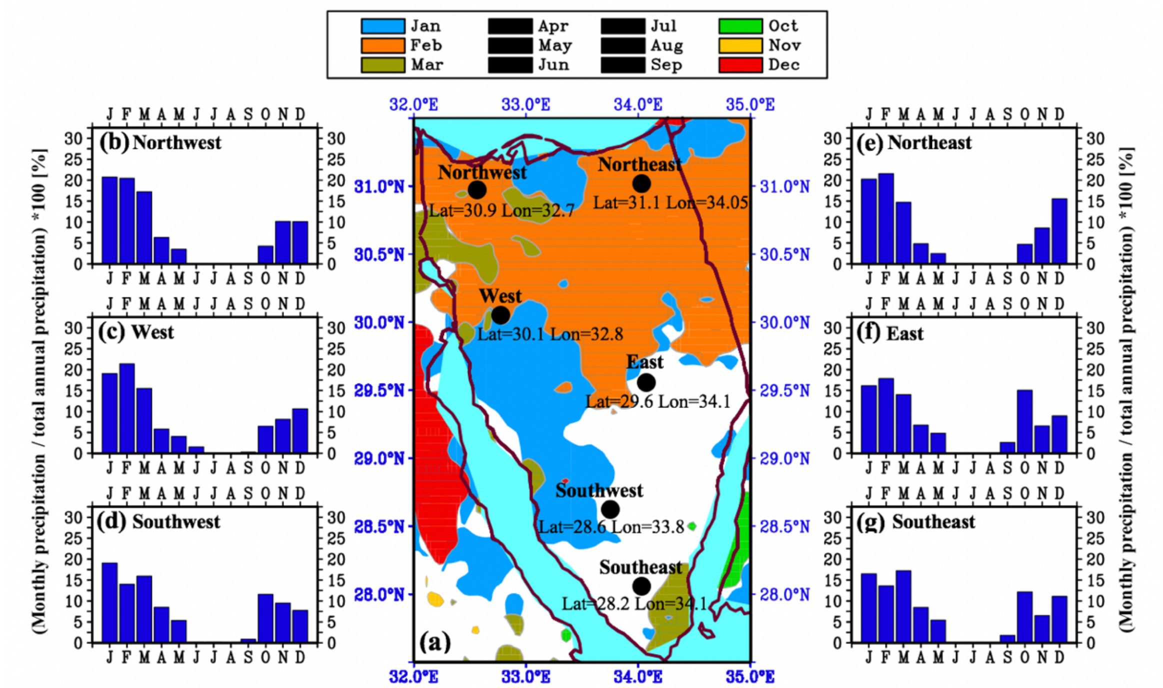
Table S1. The 95% and 99% bootstrapped confidence interval (CI) for the Mean and Median values of the original dataset (mean seasonal and annual for 20-years: 2001-2020) for the selected sites across the Sinai (anomaly-based analysis in Fig. S8), see Fig. 1 for the locations. For this analysis, 300 bootstrapped samples were generated each with a sample size of n=10.

	North-site			Middle-site			South-site		
	Winter	Autumn	Annual	Winter	Autumn	Annual	Winter	Autumn	Annual
Average precipitation (mm)	***68.6***	***18.5***	***28.4***	***22***	***6.1***	***9.3***	***9.1***	***4.8***	***5.1***
95% bootstrapped CI for **Mean** value of original dataset	79.8	24	31.9	30.8	9.1	11.2	14.3	9.4	6.9
99% bootstrapped CI for **Mean** value of original dataset	85.5	26	33.4	35.4	10.3	12	16.2	10.8	7.3
95% bootstrapped CI for **Median** value of original dataset	88.3	26.1	31.4	23.9	7.5	10.5	11.7	5.3	7.5
99% bootstrapped CI for **Median** value of original dataset	90.4	29.1	36.1	29.1	9.7	12	17.5	8.2	8.3

6) Figure 3 and its analysis: What is the standard deviation of each month? While performing analysis of extreme events, knowledge of standard deviation is very important for each bar shown in these plots. Right now, I am not sure if I see any major differences between different months shown here.

Response: Figure 3 (now Fig. 5 in the revised manuscript) represents the monthly *ratios* of precipitation across the Sinai region in %; and it doesn't provide standard deviation SD for each month. Following your suggestion, we now added the SD values in a monthly basis for each site. Further, we also did estimate the grid-based monthly SD values for the entire Sinai region; the results are shown in Fig. 3c, see above -- SD method together with percentile -and frequency was used to develop our ''multi-statistical-approach'' to determine/split the wet -and dry months in the Sinai Desert.

It is noted that, it might be not that surprising if not major differences among different months of the sites are observed. Unlike the complex/large mountain areas like alpine/pre-alpine regions in which the climatic variables in particular precipitation may significantly vary in a short distance horizontally -or vertically, this however is not much the case for an (hyper)arid/homogeneous region like the Sinai Desert as a pretty uniform and small area from a regional/global climate perspective. Therefore, figure 5 shows that, among others, *temporally* the Sinai receives the highest monthly-precipitation-ratios in the winter months for the entire region; though *spatially* the northern parts receive a higher magnitude compared to the southern Sinai.



(h)

Sites	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Northwest	11.6	7.09	12.4	3.83	2.11	0.18	0.00	0.00	0.12	2.55	6.06	4.46
West	4.79	4.15	10.5	2.23	1.72	0.26	0.00	0.00	0.22	3.73	1.74	2.71
Southwest	4.72	4.19	6.37	2.61	1.30	0.02	0.00	0.00	0.11	5.20	2.73	2.90
Northeast	15.4	14.4	17.0	6.58	3.68	0.24	0.09	0.00	0.92	9.01	15.6	15.7
East	4.63	4.45	4.83	2.41	1.97	0.10	0.10	0.02	1.50	6.36	2.91	3.38
Southeast	4.67	4.36	6.53	2.37	1.52	0.03	0.00	0.00	1.61	5.46	2.38	4.40

Figure 5. Monthly precipitation regime: (*a*) ratio of monthly sum precipitation to the annual total precipitation (%), where only ratios >20% are plotted for each month; panels (*b*-*g*) indicate the monthly ratios (January to December) for the selected sites; and panel (*h*) represents the standard deviation estimates (mm/month) in a monthly basis for each site shown in panel (*a*) across the Sinai Peninsula for the climatology period of 2001-2020. It is also noted that in the panel *a*, monthly ratios from April to September (colored in black in the legend) are below 20%, thus not plotted here, but full ratios (%) are illustrated in Fig. S9 in a monthly basis. In addition to the panel (*h*), full grid-based standard deviation estimate for the entire Sinai in a monthly basis is also represented in Fig. 3c.

7) Lines 225-226: When you say that "chosen sites do vary in terms of magnitude and trends", I recommend mentioning that how much do they vary actually quantitatively? Its very important to quantify these differences rather than just performing a qualitative analysis.
Response: Thank you for the suggestion. We now added quantitative values to highlight the differences among the sites across the study area in the revised manuscript.

8) Figure 4: Are these points statistically significant throughout the map? I am not sure if I can totally rely on these numbers without knowing the spatial statistical significance. Therefore, I recommend performing a significance test to identify which points on the map are statistically significant.
Response: Figure 4 (now Fig. 2a-c in the revised manuscript) displays the spatial patterns/distribution of the satellite precipitation events Sinai-wide in different time-scales: *a*) annual mean climatology, and *b, c*) records of the wettest month -and day, respectively. Ideally, tests for the statistical significance are typically used to find out what is the probability that a (meaningful) relationship -or correlation exists between two variables especially for the model observations. In that map there is only one variable of precipitation.
As you know, statistically significance tests like Bootstrapping could be performed for a singly variable; but, basically that method is applied to construct confidence interval for a statistic when the sample size is very small (e.g. from a lab work), and its underlying distribution is pretty unknown (e.g. form a model output). However, this is not really the case for remote-sensing satellite-based precipitation data, shown in Figure 2a-c (RS-data are nowadays used as *reference* e.g. to evaluate the model performance).

However, the statistical methods like the grid-based standard deviations estimated in this study (see Fig. 3c) could further help to understand the variations in the Sinai's precipitation spatial patterns. In Figure 2, the GPM-data and extreme indexes had been displayed both as shading and contours; however, we now removed the contours. Please also note that Figure 6 (climate extreme indices) is now attached to Figure 2d-f, due to the new subsection (3.1.1 *The precipitation spatial patterns and extreme indices*) added in the revised manuscript, see Figure 2 below.

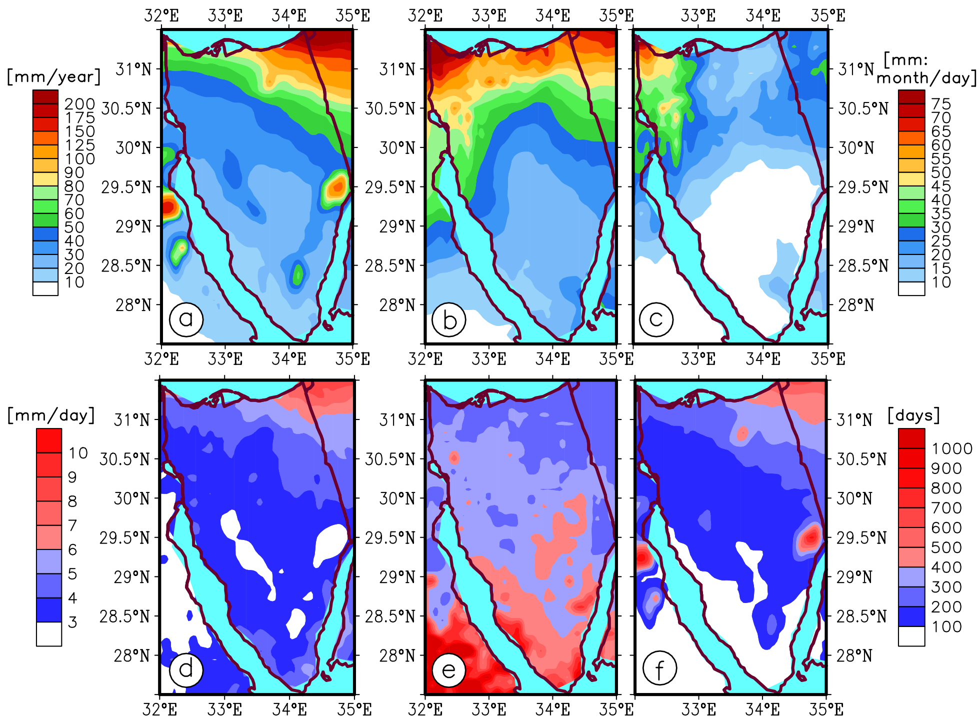


Figure 2. The precipitation spatial patterns and extreme indices: a) climatology map of mean annual precipitation (2001-2020); b) the wettest month i.e. March 2020 (out of 240 months), c) the wettest day i.e. March 12, 2020 (out of 7305 days); as well as extreme daily precipitation indices with a threshold of ≥1mm/day: d) simple daily intensity index (SDII), e) consecutive dry days (CDD) and f) wet days index (RR1) for the period of 2001-2020 over the Sinai Peninsula.

9) Section 3.2.2: I suggest not using strong words such as "a strong association is realized" as correlation is not causation. So be careful in using such sentences in your manuscript.
Response: It is done in the revised manuscript.

10) Section 4, Discussion: I do agree with authors' interpretation and schematic in Figure 12 depicting the primary mechanisms responsible for extreme rainfall events. However, as the authors mentioned that they observed low correlation values with atmospheric state variables which could be due to a number of factors of course. I am reiterating that correlation is not always causation and thus if the authors really wish to establish causality between atmospheric state and rainfall, I suggest using causual discovery methods such as PC and LINGAM methods. I suggest following this book if they are interested in causal discovery methods: https://matheusfacure.github.io/python-causality-handbook/landing-page.html
Response: Thank you for the suggestion; but this is out of the scope of our research. It can be considered in future studies though. However, it seems that the suggested methods are mostly applied in humanities, but not much in the physical science; this is what we found by their examples (e.g. tablets for students…) made to conclude '*'association is not causation''*.

However, we believe that the spatial-correlation approach presented in this study was reasonably capable of capturing the complex dynamical relationships/correlations (but not necessarily causations) between the rainfall and atmospheric variables over the eastern Mediterranean region. Indeed, the condensation process and precipitation event are truly complicated processes to make. Basically, it doesn't have a single driver, but driven by several variables combined; and yet it varies from one region to another. Thus, it might be not that surprising to get a bit lower correlation amongst them for the Sinai's case over the eastern Mediterranean region; nevertheless, possible reasons for that are discussed in the manuscript. Therefore, our method presented in this study (which, could be one of the first-analyses in atmospheric science) can be also examined in other regions with a different regional climate from a synoptic/dynamic perspective.

11) Line 574: I am not sure if I understand what the authors mean by "spatially dependency". I suggest explaining it in a bit more detail.
Response: The ''spatially dependency'' simply means, the spatial distribution of the precipitation varies across the Sinai region; and thus, it shows a spatial dependency. However, to avoid misunderstanding, we removed that term in the revised manuscript.