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Natural Hazards and Earth System Sciences
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Discussions

Interactive comment on "Atmospheric Conditions Leading to an Exceptional Fatal Flash Flood in the Negev Desert, Israel" *by* Uri Dayan et al.

Uri Dayan et al.

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General

The paper presents a case study of an exceptional storm that not only had fatal impact, but was also a climatological outlier in the sense of its timing in the rain season, the distribution of precipitation relative to the regional orography, and the cyclone characteristics. The analysis involves a good combination of local observations and reanalysis data to infer the local instability conditions and the weather systems supporting the intense precipitation on the large-scale. Overall, the topic is important and the methodological approach is well designed. However, I have several reservations with regards to the data, diagnostics and interpretation, as detailed below, requiring major revision

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of the manuscript before it can be considered for publication. The text is in many places too thin and not accurate enough, or backed by sufficient evidence, as I elaborate in the specific comments. Enhancing the introduction is necessary to place this case in a climatological context and provide more solid background about spring season rainfall in the region and Mediterranean cutoff lows. We wish to thank the reviewer for his/her constructive comments and considerable contribution, which we believe will improve the paper.

Major comments

1. Introduction: this section is too thin to support the understanding of the unique aspects of this storm. In my view, more substantial background and recent literature should be included before the specific research aims are outlined. For example, I strongly recommend to include information on the following missing aspects: weather systems conductive for precipitation in the region in the transition seasons; what is the typical precipitation distribution in spring storms versus Cyprus lows; sharav cyclones; tropical systems affecting precipitation in the region; what are the typical precipitation intensities and how common is severe convection in such storms in this season; how common are cut-off lows?

Response: Following your comment, we plan to insert the following paragraphs in the introduction: The majority of the annual precipitation in Israel is associated with Mediterranean cyclones, while reaching its eastern part (i.e., Cyprus Lows, HMSO 1962; Saaroni et al. 2010; Zappa et al. 2015). Two-thirds of the rainfall occur during December through February (Alpert et al. 2004; Ziv et al. 2006). The focus on the Negev desert and Judean desert (Fig. 1), hereafter referred to as the 'study region'. The climatic regimes of the study region span from semiarid in the north to an arid in the center and the south (south of 31.25N, Ziv et al 2014). During the late spring (Apr-May), the rainfall over the northern and central parts of the Negev desert constitutes 4 - 9% of the annual average (5 - 10 mm). In spite of these negligible rain amounts, the number of flash flood events cannot be ignored. The flood regime in the study region was analyzed by Kahana (1999), based on 37 hydrometric stations operated by the Israeli Hydrological Service. He identified 59 “major floods”. A “major floods” is a flood in which the recorded peak discharge reached the magnitude of a 5-year recurrence interval for the period 1947- 1994 at least in one watershed. Eight (14%) of these major floods occurred during the late spring. The main synoptic circulation system associated with major floods in the late spring over the study region is the “Active Red Sea Trough” (ARST, Kahana et al., 2002). The ARST is most frequent during fall and spring (Sharon, 1978; Sharon and Kutiel, 1986; Dayan et al., 2001). This is a lower-level trough extending into the eastern and southern Israel from equatorial eastern Africa along the Red Sea and is accompanied by a pronounced quasi-stationary upper-level trough that develops over Egypt. At times, it initiates severe convective storms. The secondary source of major floods is generated mainly by a derivative of the Cyprus Lows âĂŤ the Syrian Lows. These Lows are Mediterranean midlatitude cyclones that approach Syria and differ substantially from normal conditions, in which Mediterranean cyclones tend to decay before reaching Syria (Kahana et al, 2002). Under such atmospheric conditions, the surface north-westerly ïňĆow over the eastern Mediterranean is enriched with moisture and crosses the northern Negev perpendicular to the terrain upslope toward the Dead Sea. This enhances the generation of orographic convective rain over the southern Dead Sea basin and the Judean Desert. As for the Sharav cyclone, the only rain that induced major flood in the study area resulting from this synoptic system was documented by Kahana et al. (2002), in April 1971. Considering the relation between rain intensities and the dominating synoptic systems or the timing along the rain season, such a database does not exist yet. Kahana et al. (2002) distinguished between the major flood intensity associated with ARSTs and Syrian lows and found these associated with the ARST as being more intense. This suggests that the rain associated with the ARST is more intense. This notion will be included in the introduction and discussed against the extreme rain intensities observed in the present storm, in spite of its being associated with a Syrian low. Concerning cutoff lows, we intend to include the following paragraph in the introduction of the revised manuscript:

"The storm was associated with a Syrian low, accompanied by an upper-level closed cyclone, resembling the features of a 'cutoff low'. A cutoff low is defined as a closed cyclone in the upper levels, overlapping with a PV maximum (e.g., Hoskins et al. 1985). Cutoff lows are considered as favorable for severe weather over the Mediterranean Basin (Porcu et al, 2007). For instance, it was found as a major source for heavy rainfall on a daily basis in south Portugal (Fragoso and Tildes Gomes, 2008). Porcu et al. (2007) found a total of 273 cutoff lows during the period 1992–2001 over the entire Mediterranean Basin. Over the 30-35N, 30-35E domain, representing the Levant, they found 6 cases (average of 0.6 y-1) during the months April-September. Since the Levant is free of upper-level significant cyclonic system (and also of rain) during the summer months June-September (Kushnir et al. 2017). This result reflects, actually, the events of April – May." The question "how common are cut-off lows?" is addressed by a comparative analysis of 11 rainstorms that caused floods in the late spring over the study region (including the present one). We found that in 10 of them a cutoff low was involved. We plan to include the findings in a separate subsection in section 3 (results).

2. The paragraph describing the aim of the study (L46-48) should be clarified. It is currently not clear what the authors mean by "one of the latest spring severe events. . ." does "latest" refer to the most recent one? Or to severe precipitation occurring very late in the rain season? Especially when the introduction is sufficiently expanded, it should be more clearly outlined what is unique about this storm/flood. For example, how well was it forecasted? What is unusual about the distribution of precipitation? What is unusual about this cut-off low? What else is unusual beyond its fatal impact? What do the authors mean by "its unique features" (L47)? The authors should avoid using such general terms and be more specific.

Response: In the revised text we will refrain from giving superlatives to the storm. Its features in the climatological perspective will be given in the introduction. The part of the original text, at L46: "The aim of this study .... of the Mediterranean" will be changed to: "This storm was severe in several aspects. One is the number of fatalities, 13, which is record breaking for Israel. Second, a part of the Zin basin (draining the center of the Negev desert) experienced precipitation intensities reaching 75-100-year return period, resulting in discharge magnitudes of 10-50-year return period (Rinat et al. 2020). The third aspect is the rainfall totals for the storm, which reached 40-50 mm over wide parts of the study region, i.e., 10 times the monthly long-term mean (retrieved from https://ims.gov.il/en/node/46). The aim of this study was not to evaluate the rainfall forecast's ability to predict this event (covered by Rinat et al. 2020) but rather to assess the severity of this storm in the seasonal perspective and to analyze the atmospheric conditions that explain its severity ". As for the role of cutoff lows in the climate of the Mediterranean, we plan to add a paragraph, quoted in our response to comment 22.

Reference: Rinat, Y., Marra, F., Armon, M., Metzger, A., Levi, Y., Khain, P., Vadislavsky, E., Rosensaft, M. and Morin E. Hydrometeorological analysis and forecasting of a 3-day flash-flood triggering desert rainstorm, NHESS doi.org/10.5194/nhess-2020-189, 2020.

3. The construction of the reference list of cases is not outlined with sufficient details. Are there objective quantitative criteria? Lines 58-59 and L 66-67 are still too general. Which streams are considered? What is the threshold for discharge? In how many stations? What is the reference region? Is the list restricted to cut-off lows? It will be good to reference Table 1 at this stage and provide information on the precipitation in those reference storms, to then contrast the current storm in focus that produces a very different precipitation distribution.

Response: The present paper has no hydrological orientation. This subject is covered in depth by Rinat et al. (2020). The storms referred to in line 58 are the same as these mentioned in line 66. To avoid ambiguity, the phrase "to other 11 storms, spread over 28 days, in which discharge was observed over the study area, during April and May for the years 1986 – 2018, entitled hereafter the 'reference period'" will be changed to: "to a set of 11 storms (including the one studied here), spread over 30 days, in which discharge was observed over at least one of the 37 hydrometric stations of the Israeli Hydrological Service that has been operative during 1986 – 2018 over the study area. These storms, which occurred during April and May, are hereafter entitled as the 'reference storms'". These storms were further analyzed and the findings will be included in a subsection in the "results" section.

4. There is a somewhat inconsistent usage of reanalysis datasets, with some fields taken from NCEP/NCAR, but PV and omega taken from ERA5. Why not analyse all fields from ERA5?

Response: The reason for using different data sources is availability. Unfortunately, we have no access to ECMWF data of 2.5×2.5 deg resolution on the one hand, and there is no fine resolution NCEP data, in the order of 0.25×0.25 deg, on the other. However, a comparison of several parallel maps from the two data bases used shows a satisfying fit (see Fig. 1 below - example of SLP). We will note this in the revised manuscript.

5. The motivation for examining and comparing the MCV values is not clearly revealed. Why not consider the shear vorticity as well and take the commonly used relative vorticity as a measure for the intensity? Please justify this, especially given the fact that relative vorticity is anyway shown in Fig. 3. This clarification is again needed with regard to the list of reference cases. What do we learn from the high MCV? How do you interpret these differences?

Response: The 'measure of the curvature vorticity' (MCV) is a proxy for average curvature vorticity over the upper-level cyclone, so it evaluates its overall intensity. Since this cyclone moved along the latitudes of Israel, while the Subtropical jet shifted >7 deg southward, the jet's associated wind shear vorticity was regarded as marginal, so that the MCV can be considered as an estimate for the full vorticity (See Fig. 2 below). We will add this notion in the "methodology" section before introducing the MCV.

Minor comments

1. L13: “one of the latest. . .3 decades” this is not clear and appears again throughout the manuscript. Please rephrase and clarify if you refer to the late timing in the season or to longer time scales.

Response: The phrase "The timing of the storm is also unique, at the end of the rainy season, when rain is relatively rare and spotty. The study analyses the dynamic and thermodynamic conditions that made this rainstorm one of the latest spring severe events in the region during the last 3 decades" will be changed to: "The timing of the storm, at the end of the rainy season, when rain is relatively rare and spotty, raises the question what made this rainstorm so intense." The subject will be further treated in the revised introduction, see our response to major comment #2.

2. L25: delete the mention of the temperature anomaly which is not shown, or add a section with this evidence to the results.

Response: We opt for the second alternative, and therefore will leave the notion in the abstract as is and add to the revised manuscript the following: "In the case studied here, the instability can be attributed to a negative temperature anomaly in the upper levels (in the order of -5 K in 500 hPa, not shown) that covered the southern Levant, as a part of the cutoff low".

3. L43: what does “them” refer to?

Response: We will replace the word "them" by “the resulting rains”.

4. L53: I suggest to replace “Material” by “Data and Methods”

Response: Will be replaced.

5. L57: delete “to”

Response: Will be done.

6. L58: what is meant by “maximum intensity”? it should be more accurate and clarify if it refers to precipitation/discharge/a vorticity measure/cyclone characteristic etc.

Response: After further consultation, we came to the conclusion that from the meteorological point of view, no distinct difference can be noted in the intensity of the rain between the 25 and the 26 of April. The relevant notions will be removed from the entire manuscript. We will replace "when it reached its maximum intensity" in L58 by "when the Tzafit flood took place" as well.

7. Fig. 1 caption: indicate the times in UTC for the date range; add “the red start marks the location of . . .”

Response: Will be done.

8. Equations: replace the cross sign with a dot, to not confuse with vector notation.

Response: Will be done.

9. L83: how is the depth of the cyclone estimated? Please provide the accurate measure.

Response: The cyclones’ depth was derived from the 500 hPa GPH. In the text, before "The tangential. . ." we will insert "The cyclone depth (in meters) is the difference between the central height and that of the outer most isohypse (which are depicted in 15 m intervals)."

10. L92: add “temperature” after “mean”.

Response: Will be done.

11. L94: remove one S from SSI.

Response: Will be done.

12. L89-103: for each index, mention which values indicate severe convection or thunderstorms.

Response: In Fig.3 and in its caption, the terms "High", "Elevated" and "Low" were used to describe values highlighted in red, yellow and green, respectively. The grades are based on values corresponding to severe convection for the pertinent region. For CAPE – 1000 j/Kg (Dayan et al. 2001), SI - -4ïĆřC (Dayan and Sharon, 1980), LI – negative (Galway 1956). These values and references will be added to the figure caption. Ref: Dayan U., B. Ziv, A. Margalit, E. Morin, D. Sharon, 2001: A severe autumn storm over the middle-east: synoptic and meso-scale convection analysis, Theor. App. Clim., 69, 1/2, 103-122.

13. Eq 4: What is meant by RH850,700? why a modification of the K-index is needed for the eastern Mediterranean? Ziv, B., Harats, N., Morin, E. et al. Can severe rain events over the Mediterranean region be detected through simple numerical indices? Nat Hazards 83, 1197–1212 (2016). https://doi.org/10.1007/s11069-016-2385-y.

Response: RH850,700 is the average relative humidity of the 850- and 700-hPa levels. The MKI was proposed and examined by Harats et al. (2010), to reduce false thunderstorm alarms in the Mediterranean region. The MKI differs from the KI in that the 1st term, the temperature difference between 850 and 500 hPa, is multiplied by the average relative humidity over the 850 and 700 levels, so that when the lower- or med-levels are dry the MKI is reduced compared to the KI. The MKI was further elaborated and tested by Ziv et al. (2016). See below Fig. 3 demonstrate high KI values compared to MKI over arid regions for selected times of the storm (07 and 09 UTC).

14. L104: replace "also used" by "analysed". Add "as" before "if". Is PW based on ERA5?

Response: The PW was calculated from the soundings of Beit Dagan. We will state it in the revised manuscript.

15. L116: "which activated convection" – this statement is not backed by evidence at this stage and should be deleted.

Response: We agree and will omit this phrase.

16. L118-119: the term "precipitative elements" is not a clear.

Response: We meant “major rain cells”. The text will be corrected accordingly along the entire text.

17. L121-122: the statement is again not backed by evidence at this stage, and it is not clear how this conclusion is reached, especially since it appears in the beginning of the results section. Furthermore, here and in L184-188 and throughout the text, the relationship between dynamical factors / orographic effects / convection / thermodynamic factors should be more clearly defined and distinguished from one another. For example, omega in ERA5 incorporates mass fluxes from convection, so its attribution as a clear dynamical diagnostic is not accurate. Please readdress these definitions, and outline them with regard to the analysis you carry out in this work.

Response: The sentence in L121-L122 is indeed a discussion statement, so it will be removed from the results (#3) section. Following your comments, we decided to refrain from using the Omega maps as a basis for explaining the formation of the major rain cells (hence, we omitted the Omega maps from Fig. 7). We propose a modified version in 2 aspects: 1) only two times (09 and 12 UTC) will be considered, corresponding to the two major rain cells analyzed. 2) the Omega maps are replaced by relative vorticity maps and satellite IR images, see Fig. 4 below. We are also reformulating the inter-relations among the various factors that controlled the convective activity in this rainstorm. This will be reflected in the discussion section.

18. L130-131: the transport of the dry air over the Levant is not consistent with the evolution of enhanced clouds at this stage.

Response: We do not agree on this point. As stated in the manuscript, prior to the initiation of the storm, on April 24, 2018, 12 UTC the Red Sea Trough (RST) at the lower-levels (Fig. 2a) created south-easterly flow across the lower and mid-levels, transporting dry air from the Arabian Desert toward the EM. This is evidenced by the Beit-Dagan radiosonde for that time indicating 30-45% relative humidity between 500-3,000 m ASL and below 10% between 3,000 and 5,000 m, and is consistent with the absence of cloudiness in figure 2a. 12 hours later, on April 25, 2018 00 UTC, the relative humidity from the surface up to 5,000 m exceeded 50%, and in several layers even 70%. The resulting cloudiness in April 25, 12 UTC is seen in the satellite imagery (Fig. 2b).

19. Fig. 2: switch the locations of panels c and d; add “blue contours” after “m”, and “black contours” after “hPa”.

Response: Will be done.

20. Fig. 3: replace “Course” by “Track”; add initials to the caption, e.g. “precipitable water (PW), CAPE (CA)”. . . ; replace here and throughout the manuscript (e.g., L200) “Km” with “km”; the blue text over the Med Sea is not visible; arrows in the late stages of the track are not visible;

Response: Following your suggestion, the term “course” will be replaced by “track” in the caption of Fig. 3, and initials will be added for the precipitable water and the 3 stability indices. Arrows were not marked in the late stages of the track due to the lack of space and for the sake of clarity. “Km” will be corrected to “km” here and along the entire text. The intended corrected caption is: "Figure 3: Track of the upper-level cyclone (500 hPa GPH) during 24–27 April 2018, in 12 hours increments. The instantaneous speed (ms-1) and distance (km) spanned during each increment are denoted by s and d, respectively. For each 24 hours increment, the radius of the upper-level low (km), the maximum relative vorticity (s-1), the precipitable water (PW, in mm) and 3 thermodynamic indices (LI, SI, CA) as calculated from the sounding of Beit Dagan are specified. "High", "Elevated" and "Low" values of the indices are highlighted in red, yellow and green, respectively."

21. Fig. 4 and accompanying text: it is unclear if this is PV or its anomaly (and how the anomaly is defined). I also recommend to switch the units to PVU and enlarge the domain. Response: The term "anomaly" refers to its spatial aspect (following Hoskins et al. 1985). This will be clarified in the text (see in #22). The units in this figure (see

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Fig. 5 below) have been changed to PV-units and the domain enlarged.

22. L141-142: please add a reference to a climatology of such cutoff lows to demonstrate it is exceptional.

Response: We modified the relevant phrasing and prepared for the introduction the following background and climatological aspects of Cutoff lows: "A cutoff low is defined as a closed cyclone in the upper-levels, overlapping with a PV maximum (e.g., Hoskins et al. 1985). Cutoff lows are considered as favorable for severe weather over the Mediterranean Basin (Porcu et al, 2007). For instance, it was found as a major source for heavy rainfall on a daily basis in south Portugal (Fragoso and Tildes Gomes, 2008). Porcu et al. (2007) found a total of 273 cutoff lows during the period 1992–2001 over the entire Mediterranean Basin. Over the 30-35N, 30-35E domain, representing the Levant, they found 6 cases (average of 0.6 y-1) during the months April-September. Since the Levant is free of upper-level significant cyclonic system (and also of rain) during the summer months June-September (Kushnir et al. 2017). This result reflects, actually, the events of April – May." Unfortunately, there are no previous studies on the role of cutoff lows in the EM during the spring season.

Refs: Fragoso M, Tildes Gomes P. 2008. Classification of daily abundant rainfall patterns and associated largeâĂŘscale atmospheric circulation types in Southern Portugal. Int. J. Climatol. 28(4): 537–544, doi: 10.1002/joc.1564. Kushnir, Y., U. Dayan, B. Ziv, E. Morin, and Y. Enzel, 2017. "Climate of the Levant: phenomena and mechanisms" in "Quaternary of the Levant: Environments, Climate Change, and Humans", Y. Enzel and O. Bar-Yosef Editors. Cambridge University Press, London (pp 31-44). Porcu et al. (2007): A study on cutoff low vertical structure and precipitation in the Mediterranean region, Meteorol Atmos Phys 96, 121–140 (2007) DOI 10.1007/s00703-006-0224-5.

23. L165-166: This sentence is not clear. Can simplify by rewording to ". . . is expressed by enhanced easterly flow between the two vortices."

Response: We will adopt the rewording as suggested.

24. Fig. 5: In my view, the figure belongs more naturally in the discussion, and clearly after Fig. 6. In the figure, the term “blocking L” is confusing and should be reworded to “cut-off L”.

Response: We replaced figures 5 and 6 by one figure (see below) and moved it to the discussion. We agree that the term "cutoff low" is more appropriate for the closed cyclone than "blocking Low". The figure and the text will be modified accordingly (See Fig. 6 below).

PV distribution on 300 hPa, starting from April 25 2018, 12 UTC, in 6 hour intervals, covering Europe and the Mediterranean Basin, on which a conceptual diagram of a dipole type block (following Yamazaki and Itoh, 2013) is superposed. A cutoff low is seen over the south-eastern Mediterranean and a blocking high over Eastern Europe, forming a dipole. The arrows show the induced flow of each of the two vortices.

25. In Fig. 6: the arrows in (c) are not visible.

Response: We intend to remove this figure (see our response to the previous comment #24).

26. Fig. 7 caption: add in the end “, of 26 April 2018”; add units of MKI.

Response: The units are deg C. The text will be modified accordingly.

27. L 189: “cloud systems rotated cyclonically” – is there evidence for this advection as opposed to locally-produced clouds?

Response: Following your reservation considering our proposed cyclonic rotation of the cloud system, we went through hourly radar and satellite images, and came to the conclusion that in spite of the cyclonic trajectory of the air that entered Tzafit in the height of 1,400 m (Fig. 9), there is no robust evidence for such a cloud cyclonic rotation. Hence, this hypothesis will be omitted. The only relevant reference for that is moisture that originated from sources east of Israel that have contributed to the intensity of the rain in Tzafit, as reflected by the above mentioned air back-trajectory.

28. L187, 194: replace “ascendance” by “ascent”.

Response: To be done.

29. L201: change 3c to 2c.

Response: To be done.

30. L202: add “reference” before “days”

Response: To be done.

31. Table 1: unclear how the depth is defined.

Response: The cyclones’ depth was derived from the 500 hPa GPH and are, therefore, expressed in m. In the text, before "The tangential. . ." we will insert "The cyclone depth (in meters) is the difference between the central height and that of the outer most isohypse."

32. Section 3.3 and elsewhere: change “Kg” with “kg”

Response: To be done.

33. L226-227 “where it interacted with deep moist convection” this is a vague statement. Please clarify what you mean here.

Response: The sentence: ". . . moisture strip that extended from tropical latitudes to Saudi Arabia, . . . in the morning of April 26 (Fig. 7e)." will be changed to: "The major feature is a moisture strip that extended from Saudi Arabia, curved cyclonically through Iraq, and entered north Israel from the east in the morning of April 26 (Fig. 8). This moisture transport can be inferred from the trajectory analysis (see Fig, 9)."

34. L233: what is the evidence for “One is of tropical. . . at upper levels”?

Response: After elaborating the possibility of moisture contribution from tropical sources, we decided to omit this hypothesis. The text will be modified accordingly.

35. L247: replace “one of the latest spring severe events” with “a severe storm occurring latest into spring”.

Response: To be done.

36. L257-258: cutoff lows are not typical midlatitude cyclones, but rather a particular case in which the high-PV air is separated horizontally from the stratospheric reservoir in the upper troposphere.

Response: We omitted the notion of mid-latitudes in this sentence.

37. L268-269: Please comment on the timing. This is occurring one day before the flood.

Response: We will change the phrase " The instability indices reached values indicating potential for thunderstorms (CAPE = 909 J Kg-1, LI = - 4.9 K, SI = - 2.7 K and MKI = 30 K). At the same time, the precipitable water over the study area increased from 17 to 30 mm" to: "During 25-26 April, the instability and moisture indices reached values that reflect potential for thunderstorms, and varied between these two days as follows: CAPE= 778 to 909 J Kg-1, LI = -4.9 to -3.6 K, SI = -2.7 to +1.7 K and the precipitable water (PW) 29 to 26 mm".

38. L299: “-5 K temperature anomaly”. Please add more details on where is this anomaly located, at what vertical level, and add “not shown”.

Response: We will modify the phrase "a -5 K temperature anomaly over the region" to "a -4 K temperature anomaly in the 500 hPa level over the Levant (not shown)". See Fig. 7 below a map showing the temperature anomaly at 26 April 2018, 09 UTC.

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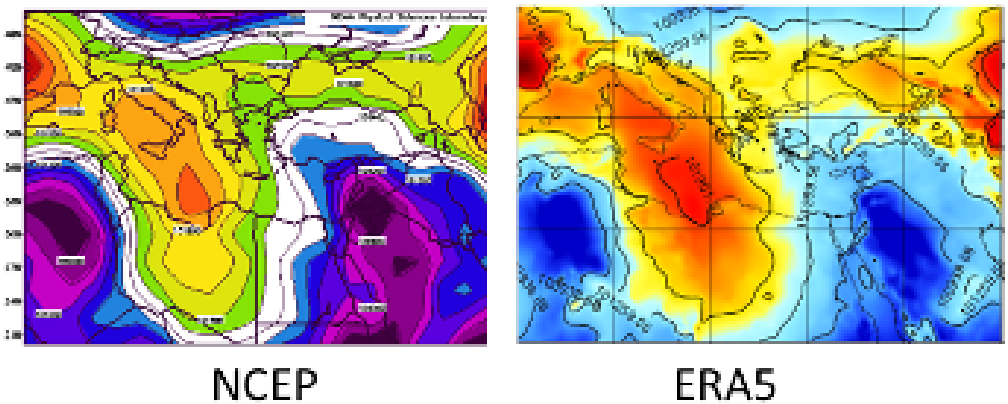

Fig. 1. example of SLP: NCEP vs. ECMWF.

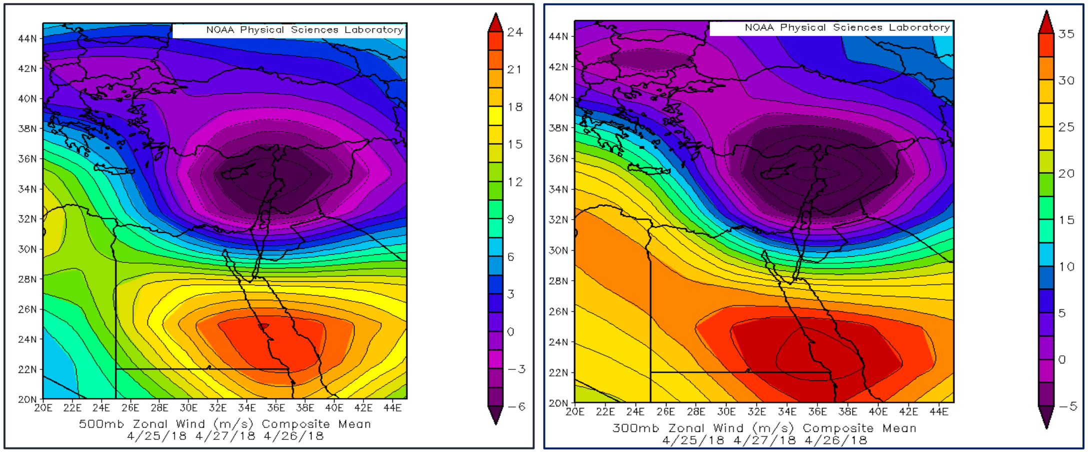

Fig. 2. The zonal component of the wind averaged over 25-27 April 2018 in 500 (left) and 300 (right) hPa

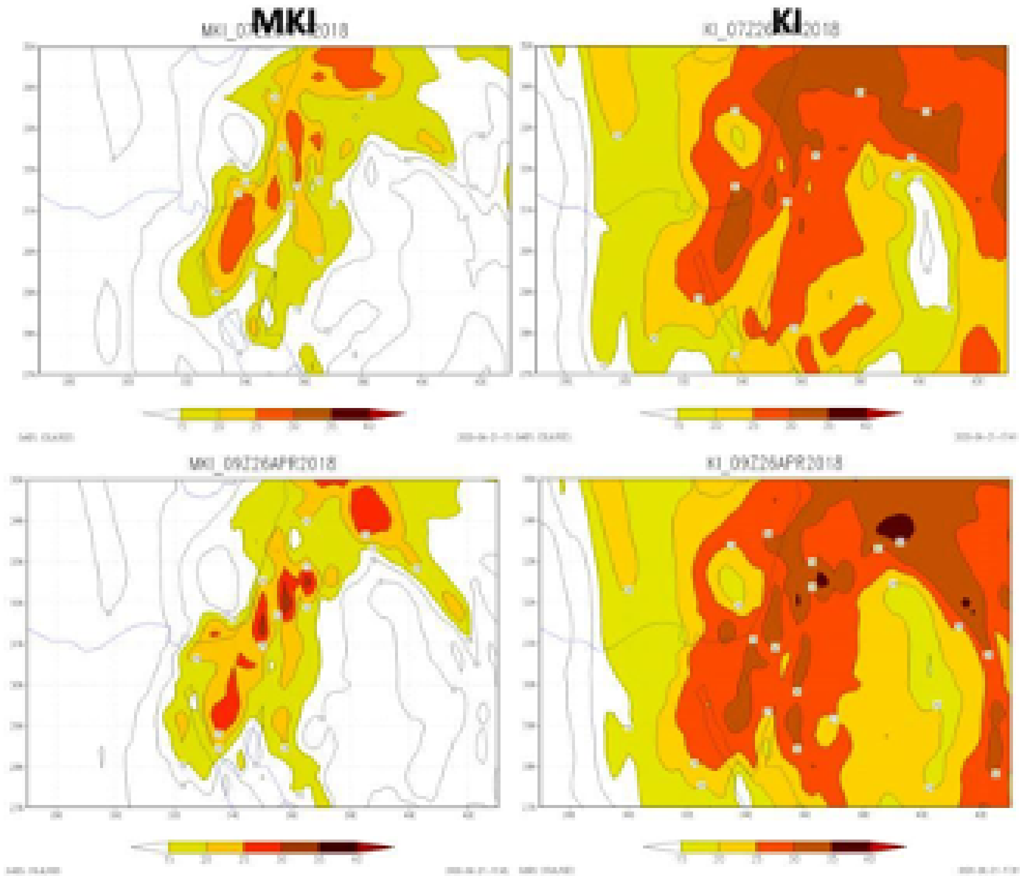

Fig. 3. MKI vs. KI

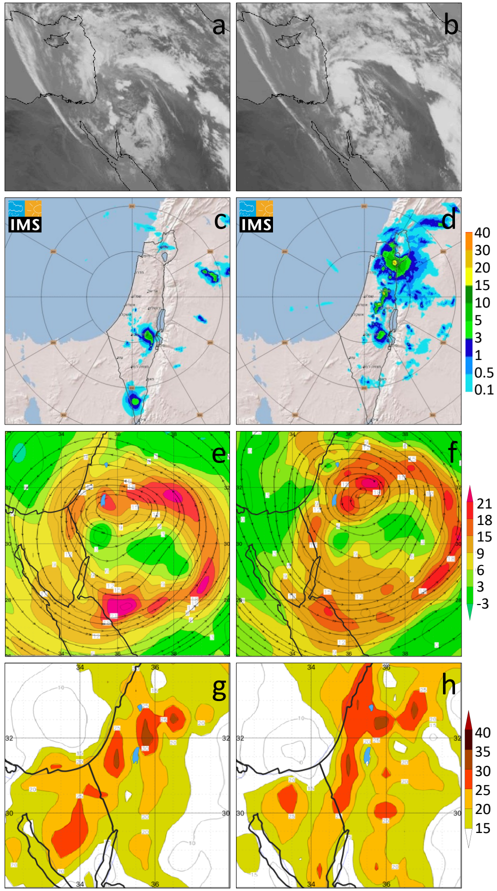

Fig. 4. Set of maps for April 26 2018, 09 and 12 UTC: Satellite image of MSG ch9 (10.8 um) (a,b); Radar imagery of one hour integrated rain depth (mm), (c,d); Relative vorticity and wind (e,f) and MKI (g,h).

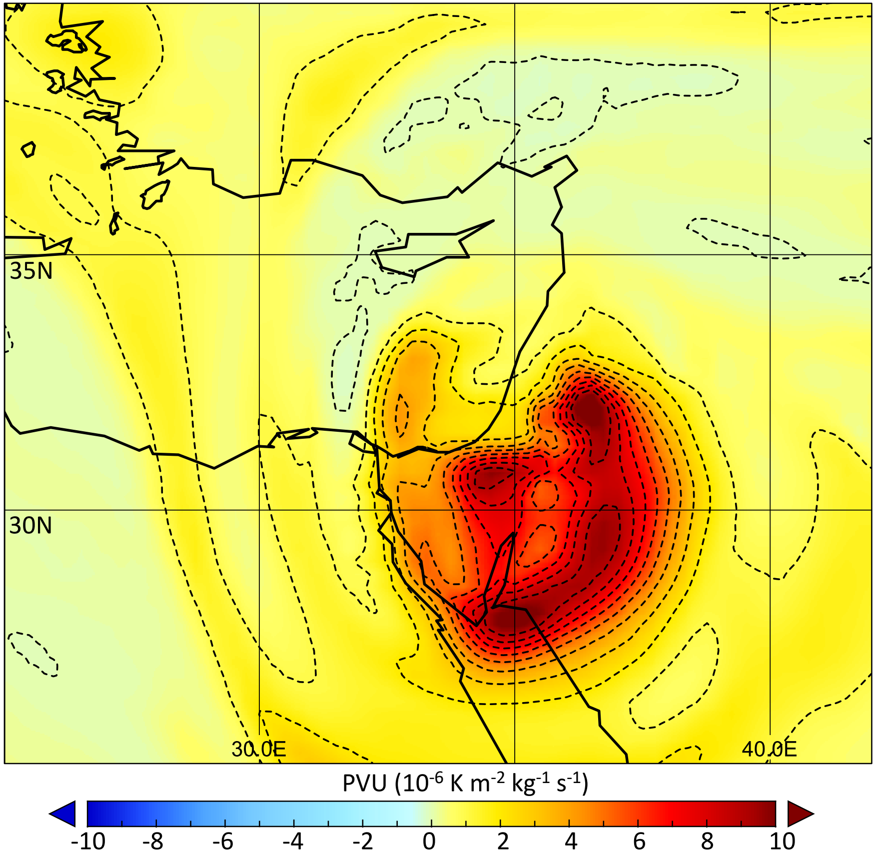

Fig. 5. PVU and enlarged domain of org Fig. 4.

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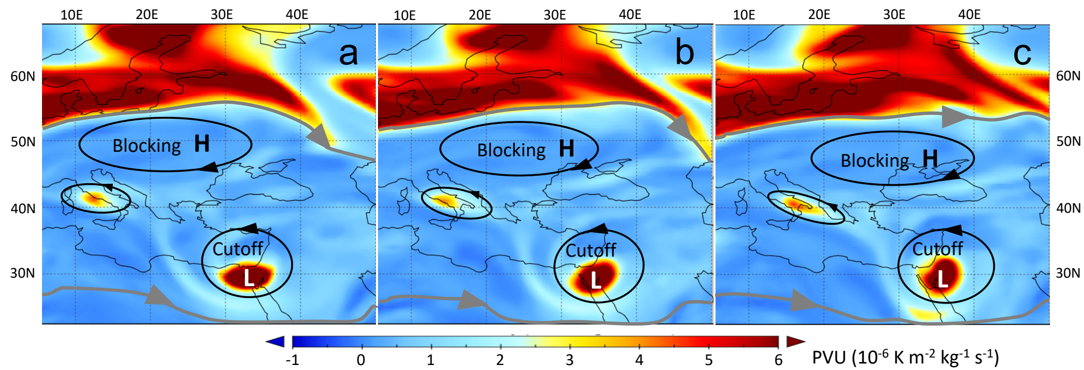

Fig. 6. PV distribution and conceptual diagram of a dipole type block

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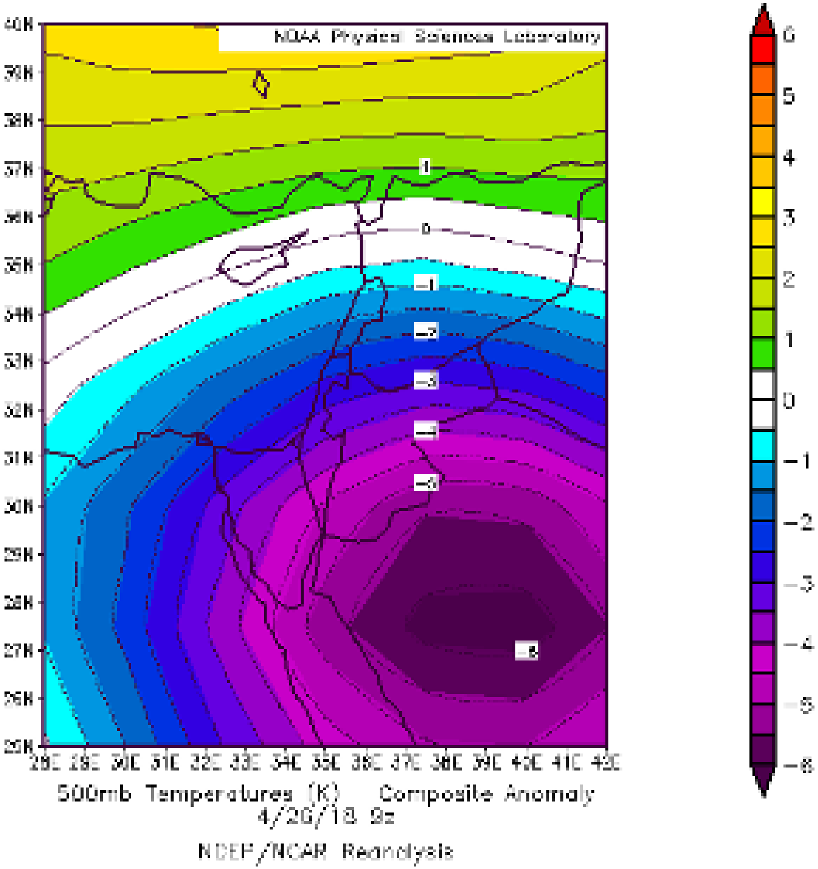

Fig. 7. temperature anomaly at 26 April 2018, 09 UTC.

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