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Earth System Dynamics
Discussions



# *Interactive comment on* "A New View of Heat Wave Dynamics and Predictability over the Eastern Mediterranean" *by* Assaf Hochman et al.

**Anonymous Referee #2**

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Review of: A New View of Heat Wave Dynamics and Predictability over the Eastern Mediterranean Author(s): Assaf Hochman et al. MS No.: esd-2020-37 MS Type: Research article

General comments:

The study titled "A New View of Heat Wave Dynamics and Predictability over the Eastern Mediterranean" by Hochman et al., presents a fresh viewpoint on the dynamics and predictability of heat waves in the Eastern Mediterranean by using both dynamical system theory and an ensemble of NWP models. This study continues the line of previous papers by the authors, dealing with the dynamics of cold spells, and weather regimes in the Eastern Mediterranean in general, which is an interesting viewpoint on a well-studied subject. This study stands out, by showing comparisons to ensemble



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of NWP results, which seems really promising and puts this viewpoint in perspective. The study presents the climatology of the heat waves from this viewpoint, along with a complementary analysis of back-trajectories, showing the origins of air parcels – which is interesting on its own. Furthermore, a specific heat-wave case-study is presented and analyzed, showing the evolution of this unique heat wave.

To my view, the study addresses relevant and current problems, and shows a novel concept to answering such problems. I think this paper is worth publishing in ESD, after addressing some points, as follows:

Sect. 2.3, and in general: I feel that there is not enough "intuition" in the description of the dynamical system metrics. For example, it is hard for me to understand what exactly is the meaning of ðİlJČ−1 ("quantifies the persistence of the system in the neighborhood of the state of interest, and tends to be very sensitive to small changes in the state of the system"). I do realize this notion was already mentioned in quite a few papers in recent years, however, I feel that me (and the other readers) of this paper can benefit from a more intuitive explanation of the metrics. Moreover, the possibility of other readers to repeat such an analysis is limited by the fact you refer to other studies on how to estimate the parameters. I believe the parameter estimation should be further detailed, at least in the supplementary material, including the report on the errors in estimating the parameters.

It could be worthy to expand much the discussion about the differences between the intrinsic and the practical predictability. Such a discussion could be exampled and explained using the presented case study, by showing how exactly can you elevate the dynamical system theory in predicting this heatwave better than using only the ensemble of NWP. Could this be performed and displayed in the paper?

Another point which I think you should address, is the portion of the back-trajectories which is terrestrial vs. the marine portion. It seems to me there could be much of a difference between the heat waves and the cold days. Am I correct?

Specific comments

L44: “(e.g., Goldreich et al., 2003)”. Consider citing (Kushnir et al., 2017).

L48-L52: some of this description seems appropriate to describe the generally mild temperatures and small inter-daily variability which was mentioned at the beginning of the paragraph. Please consider having some of this description moved to the beginning of the paragraph, and leave out only the part which is unique to low-temp days (possibly emphasize the role of the upper-level trough).

L58: “∼55,000 excess deaths”: where?

L62: “record-breaking”: in terms of duration? Extent? Temperatures? Please address this in the text.

L69: “A framework”: which framework? Is it yours or in general?

L133: The term “Etesian winds” was not introduced before. To me it seems like a good idea to present it in the paragraph describing the summer climatology of the Eastern Mediterranean.

Sect. 2.2: please elaborate on why the CSI is better at describing heat waves than, e.g., the temperature alone. This could be done by using examples or just a further explanation on other effects these heat waves consist of.

L174-179: Does this seasonal cycle related to the synoptic-scale circulation? If it is, I am not sure why is it reasonable to subtract it from the data.

L190: Could you write explicitly if this interpolation is done on the horizontal axis only or on the vertical axis as well?

L191: I did not understand what the reason was for choosing 69 hours as the lead time. Please elaborate.

L200: the bootstrapping and the statistical tests are already mentioned elsewhere,

and to my opinion should not be detailed twice. However, it will be good if you could explain what was the variable on which the bootstrapping was applied on, and how many repetitions were made.

L209-210: where do you start the trajectories from? Are they spread allover the domain? Is it only from the 5 stations?

L224: "upper level ridge" vs. trough: please write more precisely, that the center of the high is to the southeast of the study area, as it is hard to tell from this map weather the Eastern Mediterranean is affected by the ridge or the trough to the northwest (it actually seems in between them).

L224-226: please make sure the SLP intervals are the same in panels a and b, as it is hard to understand which of these situations is associated with a deeper/shallower longer/shorter Persian trough (might be worth mentioning this as well).

L227-242: I am not convinced that the median back-trajectory is a good representation of the paths of the air parcels. For example, the median track for the cool days is out of the highest density region (if I understand the plot correctly). This means, it could also be some compromise between trajectories passing over the Black Sea, and trajectories passing over the Mediterranean. Could you please explain why the median is a good representation? Could you convince me (and the readers) why should those maps not be read differently? For example, one can argue the main difference between the trajectories is that during heat waves more tracks are arriving after the passage over continental regions (Turkey), while during cold spells, tracks are arriving from the Black and Aegean seas.

L251: "Zero. . ." please add one of the following, or a similar description: x-axis / Time / abscissa.

L267-275: Could you please give an intuition about the numbers shown in Fig. 4? For example, what does zero on the y-axis means? What is the difference between an

increase of d and an increase of theta?

L277-283: It is not clear to me what can we learn from the abserr graphs. Is this the error computed relative to the stations?

L306: What do we learn from Fig. 8? Please enhance its description or cut it out of the main body (it could be transferred to the supplementary).

L390: Could you also provide a table showing the d and Theta for the analyzed times?

Figure 1: The colorscale of panels a and b is not the same (panel a uses green colors in the middle of the SLP range, while panel b uses only yellows). Please match the colorscales. Furthermore, please either write the interval of the SLP contours or add labels to some of them, so it could be easier to compare between the plots.

Figure 3: either the SLP and Z500 labels were swapped or their mentioning in the figure caption. Please also explain what is represented by each dot. Is it the 12 UTC d and theta from the NCEP for each of the analyzed days? If so, please write something in that spirit.

Figure 7a,b: Could you please make the blue colors somewhat transparent? It is harder to read the map in the opaque form of the trajectories densities.

Figure S1: Please add either topography or some measure of the summer-climate (average temp. / max temp.) to the map. In this way the readers could assess why does the 5 stations are representative of the climate.

Technical corrections

L46: “On the upper levels”: please consider adding the words “of the troposphere”.

L49: “Saaroni and Ziv,2000”: please add a space before the “2000”.

L89: Please consider deleting the word “thus”.

L141: “. . .nine out of eleven days”: please add “on average”.

References

Kushnir, Y., Dayan, U., Ziv, B., Morin, E. and Enzel, Y.: Climate of the Levant: phenomena and mechanisms, in Quaternary of the Levant: environments, climate change, and humans, edited by Y. Enzel and B.-Y. Ofer, pp. 31–44, Cambridge University Press, Cambridge, UK., 2017.

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