COMMENTS BY PROF. HEINI WERNLI:

GENERAL COMMENT

Dear Annalisa Di Bernardino and colleagues
I had a look at your recent submission to WCD and while I find the topic and approach promising, I would like to suggest some important improvements related to (i) the representativity of the results, (ii) the definition of extremes, and (iii) the consideration of recent relevant publications on the topic.
With best regards,
Heini Wernli

We sincerely thank Prof. Heini Wernli for taking the time to review our manuscript and for your encouraging feedback on the promise of our topic and approach. We have carefully considered all your constructive comments and thoroughly revised the manuscript to address each of your key points.

Please find below a point-by-point reply to the Reviewer's comments. The complete, original Reviewer's comments are given in black, and our responses are listed in blue. The revised text is shown in italics and the Line number refers to the revised version of the manuscript.

In the revised version of the manuscript, modifications are marked in red. Please note that, in the revised manuscript, the original figures (Figure 1, Figure 2, Figure 3, Figure 5, Figure 6, Figure 7) have been updated and replaced with expanded figures in direct response to the Reviewer's requests.

MAJOR COMMENTS

Q1: The title is potentially misleading (not many would call a situation an "an extreme warm event" when the temperature anomaly is only in the upper troposphere); also since you only consider a single location (Rome) the title appears too general (the eastern or southern Mediterranean might behave differently).

A1: We thank the Reviewer for this insightful observation regarding the title. We agree that the title should more explicitly reflect both the geographical scope of the analysis and the specific definition of EWEs adopted in this study. Regarding the geographic coverage, we have modified the title to explicitly state that the analysis focuses on the Central Mediterranean (Rome), preventing any overgeneralization to other sectors of the Mediterranean basin. Regarding the terminology, we acknowledge the Reviewer's concern that an upper-tropospheric warm anomaly alone would not conventionally be interpreted as an extreme warm event at the surface. In this study, however, the term EWE is intentionally used as a broader, column-based diagnostic category encompassing episodes of anomalously high temperature occurring at any level of the tropospheric column, including vertically confined upper-tropospheric anomalies. This definition allows us to identify and investigate warm atmospheric structures that would not be detected by conventional surface-based heatwave metrics. The EWE definition is therefore used as an operational framework for characterizing the vertical thermal structure of warm extremes, rather than as a synonym for a surface heatwave.

To make this scope clearer and avoid potential ambiguity, we have revised the title as follows:

"Vertical structure and dynamical regimes of extreme warm events in the Central Mediterranean: a three-dimensional analysis over Rome (Italy)"

Q2: It is not clear from the abstract how you identified extremes (absolute threshold, percentile criterion?); it would also be good if you explained already here how you defined "duration" and "thermal intensity".

A2: Following the Reviewer's suggestion, we have revised the Abstract to clarify that EWEs are identified using the 90th percentile of the daily mean temperature distribution calculated over the 1991-2020 reference period with a 21-day moving window, requiring exceedance at least at one of the three reference pressure levels (1000, 500, or 300 hPa) for four consecutive days. We have also clarified that event duration is defined as the number of consecutive days satisfying the persistence criterion, while mean thermal intensity corresponds to the event-averaged temperature anomaly relative to the reference climatology. The Abstract has been modified as follows:

LL. 16-20: *"EWEs were identified using daily mean temperature anomalies exceeding the 90th percentile of the 1991-2020 climatological distribution, calculated with a 21-day moving window, at least at one of three pressure levels (1000, 500, or 300 hPa) for four consecutive days. Event duration was defined as the number of consecutive days satisfying the persistence criterion, while mean thermal intensity was quantified as the event-averaged temperature anomaly relative to the reference climatology. Then, EWEs were classified using a K-means clustering approach."*

Q3: You did not discuss your results in the context of recent studies about the vertical structure of heat extremes and processes leading to heat extremes, for instance:

– Hotz et al. 2024. https://wcd.copernicus.org/articles/5/323/2024/
– Hotz et al. 2026. https://egusphere.copernicus.org/preprints/2026/egusphere-2026-1522/
– Röthlisberger, M., and L. Papritz, 2023. Quantifying the physical processes leading to atmospheric hot extremes at a global scale. Nature Geosci., 16, 210–216.
– Fix et al. 2026a. https://wcd.copernicus.org/articles/7/17/2026/
– Fix et al. 2026b. https://egusphere.copernicus.org/preprints/2026/egusphere-2026-2350/

A3: We thank the Reviewer for pointing out these highly relevant and recent studies: incorporating these works has significantly enriched the Introduction and the physical interpretation of our results in the Discussion. We have integrated these studies as follows:

- Introduction: we updated the state-of-the-art analysis to reflect recent progress on the physical drivers of tropospheric heat extremes. Specifically, we now frame our vertical analysis around the distinction between adiabatic subsidence warming, diabatic surface heating, and horizontal advection (*Röthlisberger & Papritz, 2023; Hotz et al., 2024*), while also noting the dynamical processes that govern how these anomalies evolve vertically (*Fix-Hewitt et al., 2026a, b; Hotz et al., 2026*).
- Discussion: we discussed our site-specific results over Rome against these broader Lagrangian frameworks. We explicitly highlight how the "top-down" and "bottom-up" behaviors observed in our dataset match the subsidence- and diabatic-driven pathways identified by Röthlisberger and Papritz (2023) and Hotz et al. (2024). Furthermore, we draw direct parallels between our EWR vertical coupling profiles and the mid-tropospheric warming signatures linked to Rossby wave breaking and large-scale atmospheric blocking described in Fix-Hewitt et al. (2026a, b) and Hotz et al. (2026).

Specifically, the manuscript has been modified as follows:

LL. 65-89: *"Traditionally, research has focused on HWs occurring during the boreal summer, as this coincides with the annual peaks in air and sea surface temperatures. However, it is now evident that* *global warming is triggering an increase in warm anomalies across all seasons, with profound implications for ecosystems, biodiversity, and phenology (Perkins-Kirkpatrick and Lewis, 2020; Rousi et al., 2022; Mahecha et al., 2024). Furthermore, most studies have approached HWs primarily as surface-level phenomena, largely to assess their impacts on human health and socio-economic sectors (Margolis, 2020; Lin and Li, 2026). While valuable, this two-dimensional approach overlooks the complex atmospheric processes governing the intensity and persistence of Mediterranean heat extremes, highlighting the need for a three-dimensional perspective (Lhotka and Kyselý, 2024). Recent global and regional studies demonstrate that tropospheric heat extremes are dictated by a delicate balance between adiabatic warming driven by synoptic-scale subsidence and diabatic processes such as surface sensible heat fluxes and radiative heating (Röthlisberger and Papritz, 2023; Hotz et al., 2024). Depending on the altitude-dependent dominance of these physical mechanisms, persistent warm anomalies can develop as vertically decoupled atmospheric structures, where significant warming remains confined to the middle or upper troposphere without exhibiting an immediate surface signature (Lhotka and Kyselý, 2024; Fix-Hewitt et al., 2026a). While upper-tropospheric thermal extremes do not directly exert thermal stress at the surface, identifying these elevated structures is crucial for understanding the dynamic precursors, upper-level ridge dynamics, and vertical energy transport that precede or sustain deep-column heat extremes (Fix-Hewitt et al., 2026b; Hotz et al., 2026).”*

LL. 773-798: *“Combining clustering, precursor analysis, and case studies, the five EWRs can be grouped into two main dynamical classes:*

- *Coupled events (Extreme Deep and Standard Deep EWRs): both regimes evolve toward a vertically coherent warm column, but through partly different physical pathways. As the ridge deepens, intense synoptic-scale subsidence and adiabatic compression force the warm anomaly downward until full vertical alignment is achieved at the EWE onset, overriding local mitigating factors (Lhotka et al., 2018; Sousa et al., 2018; Zschenderlein et al., 2019). The Extreme Deep precursor is characterized by the progressive downward extension of a mid-tropospheric warm anomaly, consistent with persistent blocking, sustained subsidence, and adiabatic warming, as documented in recent process-based Lagrangian frameworks (Röthlisberger and Papritz, 2023; Hotz et al., 2024). In contrast, the Standard Deep regime develops within a subtropical ridge and is accompanied by low-level warm-air advection from North Africa, favouring rapid warming of the lower troposphere and the establishment of a vertically coupled atmospheric structure. Despite these differences, both regimes ultimately evolve toward a fully coupled tropospheric column dominated by large-scale forcing and mid-tropospheric warming signatures often associated with Rossby wave breaking (Fix-Hewitt et al., 2026a; Hotz et al., 2026).*
- *Decoupled events (Mid Troposphere, Low Troposphere, and High Troposphere EWRs): unlike the Deep EWRs, these events never develop a vertically coupled warm column. Instead, the thermal anomaly remains confined to a limited portion of the troposphere, indicating that the large-scale forcing is either insufficient or unable to establish effective vertical coupling. In the Mid Troposphere case, the anomaly is confined to the free troposphere throughout the event, indicating limited penetration toward the PBL. The Low Troposphere EWR shows the opposite behaviour, with warming restricted to the PBL and weak anomalies aloft, mainly attributable to surface-driven processes, such as enhanced sensible heat fluxes, shallow warm advection, and local land-atmosphere feedback (Seneviratne et al., 2010; Stéfanon et al., 2014; Hirsch and King, 2020; Röthlisberger and Papritz, 2023). The High Troposphere EWR remains isolated in the upper troposphere, likely associated with transient upper-level dynamical disturbances or elevated wave-breaking events that do not project onto the surface (Fix-Hewitt et al., 2026b; Hotz et al., 2026). Together, these cases mirror the spectrum of three-dimensional thermal configurations recently identified in regional reanalyses (Fix-*

Hewitt et al., 2026a), confirming that strong warming aloft does not necessarily translate into near-surface extremes."

References:

- *Hotz, B., Papritz, L., and Röthlisberger, M.: Understanding the vertical temperature structure of recent record-shattering heatwaves. Weather and Climate Dynamics, 5(1), 323-343, https://doi.org/10.5194/wcd-5-323-2024, 2024.*
- *Hotz, B., Wernli, H., Röthlisberger, M., and Noyelle, R.: Global characterisation of the vertical temperature anomaly structure of heat extremes over land in ERA5, EGUsphere [preprint], https://doi.org/10.5194/egusphere-2026-1522, 2026.*
- *Röthlisberger, M., and Papritz, L.: Quantifying the physical processes leading to atmospheric hot extremes at a global scale. Nature Geoscience, 16(3), 210-216, https://doi.org/10.1038/s41561-023-01126-1, 2023.*
- *Fix-Hewitt, F., Zeileis, A., Stucke, I., Stauffer, R., and Mayr, G. J.: Properties and characteristics of atmospheric deserts over Europe: a first statistical analysis. Weather and Climate Dynamics, 7(1), 17-35, https://doi.org/10.5194/wcd-7-17-2026, 2026a.*
- *Fix-Hewitt, F., Zeileis, A., Stucke, I., Stauffer, R., & Mayr, G. J.: Atmospheric deserts and extreme weather events: co-occurrence with positive temperature anomalies, thunderstorms, and dust. EGUsphere, 2026, 1-28, https://doi.org/10.5194/egusphere-2026-2350, 2026b.*

Q4: L26: not clear how your results can contribute to better predictions. This aspect is not considered in the paper and therefore should not appear in the abstract.

A4: We agree that the potential contribution of the proposed framework to improved prediction/forecasting is not directly evaluated in the present study. We have therefore removed the reference to this topic from the Abstract and revised the corresponding statement to focus on the aspects directly supported by our analysis, namely the classification and physical interpretation of the different vertical thermal regimes. Also, the final statement of the Abstract has been modified accordingly as follows:

LL. 834-837: *"Distinguishing between vertically coupled and decoupled regimes offers a physically based framework for interpreting the processes leading to the development of EWEs and for assessing their potential implications for climate-related impacts."*

Q5: L45: the text implies that Arctic amplification leads to more blocking over Europe; I don't think that this is supported by the literature.

A5: We agree with the Reviewer that the connection between Arctic Amplification and European blocking frequency and persistence remains a topic of ongoing scientific debate, with conflicting evidence across observational and modelling studies. Therefore, we have revised the text to avoid any implication of a direct causal link. The manuscript now explicitly frames Arctic Amplification as a hypothesized factor within a broader, complex atmospheric framework and highlights the current scientific debate surrounding its influence on European blocking patterns. We have also added key literature references representing both review perspectives and empirical modelling evaluations.

LL. 52-57: *"In this context, the marked warming in the Arctic region (Arctic Amplification) has been proposed as a mechanism that could potentially alter mid-latitude atmospheric circulation by weakening the equator-to-pole temperature gradient (Francis et al., 2017; Coumou et al., 2018; C3S/ECMWF and WMO, 2026). However, its exact influence on the frequency, intensity, and persistence of European blocking events remains a subject of debate in the scientific community, as* *observational trends and climate model simulations often yield divergent results (Cohen et al., 2020; Previdi et al., 2021).”*

References:

- *Cohen, J., Zhang, X., Francis, J., Jung, T., Kwok, R., Overland, J., Ballinger, T. J., Bhatt, U. S., Chen, H. W., Coumou, D., Feldstein, S., Gu, H., Handorf, D., Henderson, G., Ionita, M., Kretschmer, M., Laliberte, F., Lee, S., Linderholm, H. W., Maslowski, W., Peings, Y., Pfeiffer, K., Rigor, I., Semmler, T., Stroeve, J., Taylor, P. C., Vavrus, S., Vihma, T., Wang, S., Wendisch, M., Wu, Y., and Yoon, J.: Divergent consensuses on Arctic amplification influence on midlatitude severe winter weather. Nature Climate Change, 10(1), 20–29. https://doi.org/10.1038/s41558-019-0662-y, 2020.*
- *Coumou, D., Di Capua, G., Vavrus, S., Wang, L., and Wang, S.: The influence of Arctic amplification on mid-latitude summer circulation. Nature communications, 9(1), 2959. https://doi.org/10.1038/s41467-018-05256-8, 2018.*
- *Francis, J. A., Vavrus, S. J., and Cohen, J.: Amplified Arctic warming and mid-latitude weather: New perspectives on emerging connections. Wiley Interdisciplinary Reviews: Climate Change, 8(5), e474, https://doi.org/10.1002/wcc.474, 2017.*
- *Previdi, M., Smith, K. L., and Polvani, L. M.: Arctic amplification of climate change: a review of underlying mechanisms. Environmental Research Letters, 16(9), 093003, https://doi.org/10.1088/1748-9326/ac1c29, 2021.*

Q6: L60: I fully agree that such events exist (shallow warm layers in the upper troposphere are very common), but I am lacking the motivation why they should be discussed together with temperature extremes at the surface (that might have a complex vertical structure). They do not affect societies and ecosystem, so they clearly play a different role compared to surface extremes.

A6: We completely agree that elevated-only thermal anomalies do not directly exert thermal stress on human societies or ecosystems at the surface. However, their inclusion in our three-dimensional analysis is driven by two physical and dynamical reasons: (i) upper-tropospheric warm anomalies are frequently linked to large-scale circulation features, such as anticyclonic ridge build-up, Rossby wave breaking, and subsidence warming. Understanding their frequency, intensity, and vertical development provides insight into atmospheric coupling mechanisms and the conditions under which an elevated extreme fails/succeeds in propagating toward the surface, and (ii) by analyzing thermal extremes across all pressure levels using a consistent statistical baseline, we can differentiate between deep-column, fully coupled heatwaves (which strongly impact the surface) and shallow or elevated-only anomalies.

We have modified the Introduction to explicitly provide this physical motivation as follows:

LL. 80-89: *“While upper-tropospheric thermal extremes do not directly impact terrestrial ecosystems or human health at the surface, their diagnostic value lies in their role as dynamical indicators of large-scale atmospheric patterns (Pfahl et al., 2015; Zschenderlein et al., 2019). In fact, analysing high-level events that do not reach the surface allows us to isolate the near surface and lower-tropospheric mechanisms (such as cold-air advection, marine boundary layer stratification, or sea-breeze regime) that decouple the near surface atmospheric layer from intense mid-tropospheric ridging. In addition, high-tropospheric anomalies frequently act as dynamic precursors to synoptic-scale blockings, offering a diagnostic window into the vertical evolution and downward propagation of thermodynamic anomalies prior to full-column coupling (Sousa et al., 2018). Analysing the entire vertical column allows for a comprehensive classification of warm events, distinguishing deep,* *surface-impacting HWs from dynamically isolated upper-tropospheric thermal features (Lhotka and Kyselý, 2024; Hassoun et al., 2025).”*

References:

- *Pfahl, S., Schwierz, C., Croci-Maspoli, M., Grams, C. M., and Wernli, H.: Importance of latent heat release in ascending air streams for atmospheric blocking. Nature Geoscience, 8(8), 610-614, https://doi.org/10.1038/ngeo2487, 2015.*

Q7: L69: I don't understand the distinction between EWE and EWR.

A7: We thank the Reviewer for pointing out this lack of clarity. We have revised the text to explicitly define both concepts: an EWE represents a level-specific extreme occurrence, defined strictly at a single isobaric level when the daily mean air temperature exceeds the level-dependent threshold (90th percentile) over a period of time. An EWR represents the broader three-dimensional/vertical atmospheric structure obtained by analysing how level-specific EWEs co-occur, overlap, or interact across multiple pressure levels simultaneously.

To avoid ambiguity, the revised text has been modified as follows:

LL. 90-100: *“In this study, it is worth noticing that a clear distinction is provided among three related but conceptually distinct phenomena:*

- *“Heatwave” (HW): persistent periods of high near-surface air temperature exceeding a specific percentile threshold for a minimum multi-day period, consistent with standard surface climatological definitions (World Meteorological Organization and World Health Organization, 2015);*
- *“Extreme Warm Event” (EWE): episodes during which daily mean air temperature exceed the level-specific 90th percentile threshold at a given isobaric level (from the surface up to 300 hPa). This term encompasses both classical surface-based HWs and vertically limited warm anomalies that are not necessarily experienced also at the surface;*
- *“Extreme Warm Regime” (EWR): three-dimensional atmospheric configuration formed by the vertical co-occurrence of EWEs at multiple pressure levels. While an EWE identifies events at a given pressure level, an EWR characterizes the coherent vertical profile of the warming, distinguishing deep-column coupled extremes from surface-confined or upper-tropospheric isolated layers.”*

Q8: L75: this aspect is also discussed in Hotz et al. 2026.

A8: As suggested by the Reviewer, we have modified the sentence to explicity cite Hotz et al. (2026), as follows:

LL. 109-111: *“A critical yet under-explored aspect is the lead-lag relationship between these layers: distinguishing between “top-down” intensification, driven by synoptic-scale subsidence, and “bottom-up” thermodynamics, where surface processes may precede or amplify tropospheric warming, a structural dynamic also recently highlighted by Hotz et al. (2026).”*

Q9: L173/L304: it takes a long time until the reader understands how you defined EWEs. With the 90th percentile you use a very soft criterion and identify 1371 EWE days in 35 years, corresponding to on average about 40 EWEs per year! To me, this indicates that these are not really extreme events, as they occur about once a week. I suggest to avoid the term "extreme" when you investigate the 1371 events, or even better, you apply a much stronger percentile threshold to really focus on rare / extreme events.

A9: We thank the Reviewer for this comment, which allows us to clarify the methodological background and the physical rationale behind our threshold selection. We fully agree that applying a stricter threshold (e.g., 95th or 99th percentile) would isolate rarer and more extreme events. However, in our multi-level, three-dimensional diagnostic framework, adopting the 90th percentile serving as a baseline serves two strategic purposes:

1. The 90th percentile is the standard benchmark recommended by the Expert Team on Climate Change Detection and Indices (ETCCDI) (e.g. for the definition of indices *TX90p* and *TN90p*; Zhang et al., 2011), endorsed by the World Meteorological Organization (WMO), and widely adopted in IPCC Assessment Reports (Seneviratne et al., 2021) as well as broad-scale atmospheric and marine HW literature (Hobday et al., 2016, https://doi.org/10.1016/j.pocean.2015.12.014; Perkins-Kirkpatrick and Lewis, 2020, Perkins-Kirkpatrick and Lewis, 2020).
2. Multi-level clustering and precursor/trajectory analyses require a sufficiently large and statistically robust sample size. Using a stricter threshold would drastically reduce the number of identified cases, especially for decoupled or elevated regimes (such as High Troposphere EWR), making cluster stability, precursor composite signals, and trend evaluations statistically underpowered.

Furthermore, while 1371 EWE days are detected across the 35-year record (i.e., about 39 days per year), these days are predominantly grouped into multi-day persistent episodes (lasting 5 to 8 days on average). This corresponds to about 5-7 discrete events per year, which fully aligns with typical regional HW frequencies over Southern Europe rather than isolated weekly occurrences.
We have expanded the Data and Methods and the Discussion sections to highlight that while stricter thresholds isolate rarer extremes, our choice balances standard climatological definitions with the statistical sample size necessary for robust three-dimensional clustering and diagnostic analyses.

LL. 238-245: *"The 90th percentile baseline follows standard climatological definitions established by the Expert Team on Climate Change Detection and Indices (ETCCDI; Zhang et al., 2011), endorsed by WMO, and widely applied in IPCC assessment frameworks (Seneviratne et al., 2021). While adopting a stricter percentile threshold (e.g., 95th or 99th) would isolate rarer and more extreme events, the 90th percentile threshold was deliberately selected to balance detection sensitivity with statistical robustness. In a multi-level diagnostic framework, this sample size is essential for ensuring robust cluster convergence, stable precursor composites, and reliable trend evaluations, particularly for vertically confined or transient regimes aloft."*

LL. 815-821: *"Second, the multi-level clustering framework is inherently sensitive to the choice of the specific pressure levels (1000, 500, and 300 hPa) and the threshold utilized for EWE identification. While adopting a stricter threshold would naturally isolate rarer and more severe events, the 90th percentile was selected to maintain climatological consistency with standard ETCCDI/WMO guidelines (Zhang et al., 2011; Seneviratne et al., 2021) and to ensure a statistically robust sample size. This sample size is critical for evaluating multi-level cluster stability, composite precursor dynamics, and trend significance, in particular for vertically decoupled or upper-tropospheric regimes that occur less frequently."*

References:

– *Zhang, X., Alexander, L., Hegerl, G. C., Jones, P., Tank, A. K., Peterson, T. C., Trewin, B., and Zwiers, F. W.: Indices for monitoring changes in extremes based on daily temperature and precipitation data. Wiley interdisciplinary reviews: climate change, 2(6), 851-870, https://doi.org/10.1002/wcc.147, 2011.*
– *Seneviratne, S. I., Zhang, X., Adnan, M., Badi, W., Dereczynski, C., Luca, A. D., Ghosh, S., Iskandar, I., Kossin, J., Lewis, S., Otto, F., Pinto, I., Satoh, M., Vicente-Serrano, S. M., Wehner, M., Zhou, B. and Allan, R.: Weather and climate extreme events in a changing climate. In: Masson-Delmotte, V. P., Zhai, A., Pirani, S. L. and Connors, C. (eds.) Climate Change 2021: The Physical Science Basis: Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, pp. 1513-1766, 10.1017/9781009157896.013, 2021.*

Q10: I think the paper would be much stronger if the analyses were extended to a few more locations across the Mediterranean. A single location always bears the risk of not being representative.

A10: We agree that expanding the analysis to additional sites across the Mediterranean represents a logical and valuable direction for future research. In this study, Rome was chosen as a strategic reference site for urbanized coastal environments in the Central Mediterranean, i.e., a region highly exposed to both large-scale synoptic forcing (e.g., subtropical ridges and atmospheric blocking) and local mesoscale dynamics (e.g., land-sea breezes and urban thermal effects). Focusing on a single site allowed us to systematically develop, test, and validate this multi-level diagnostic and clustering framework across the entire tropospheric column before scaling it spatially. To directly address the Reviewer's comment, we have expanded the discussion in the manuscript to highlight: (i) the representative character of Rome for Central Mediterranean coastal and urban environments, and (ii) the extension of this multi-level framework to other coastal and inland Mediterranean locations as a key perspective for future work, aiming to evaluate regional variability in vertical thermodynamic coupling. The Discussion has been modified as follows:

LL. 821-829: *"Third, while Rome provides a highly representative reference location for urbanized coastal environments in the Central Mediterranean, where large-scale synoptic drivers interact with mesoscale sea-breeze dynamics and urban microclimates (Di Bernardino et al., 2022), the present analysis focuses on a single geographical location. Establishing this diagnostic framework at a single site was instrumental for developing and rigorously testing the multi-level clustering methodology across 35 years of tropospheric data. However, regional variations in topography, coastal proximity, and synoptic exposure across the Mediterranean basin may influence vertical thermodynamic coupling. Extending this three-dimensional EWE diagnostic framework to a broader network of Mediterranean coastal and inland locations constitutes a natural perspective for future work, enabling a regional assessment of vertical extreme regimes and their evolution under climate change."*

Reference:

- *Di Bernardino, A., Mazzarella, V., Pecci, M., Casasanta, G., Cacciani, M., and Ferretti, R.: Interaction of the sea breeze with the urban area of Rome: WRF mesoscale and WRF large-eddy simulations compared to ground-based observations. Boundary-Layer Meteorology, 185(3), 333-363, https://doi.org/10.1007/s10546-022-00734-5, 2022.*