Answers to Reviewer1

"Overview towards improved understanding of the mechanisms leading to heavy precipitation in the Western Mediterranean: lessons learned from HyMeX" by Samira Khodayar et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-350-RC1, 2021

Dear reviewer1

Thank you for your effort in reviewing the present manuscript. We appreciate all your comments and suggestions. We have considered all of them. Please find below a detailed answer to all your suggestions.

With kind regards

Samira Khodayar on behalf of all co-authors

This paper presents an overview of the main mechanisms associated with heavy precipitation over the Mediterranean. In particular, it reviews the main outcomes from the HyMex international project and their field campaigns. After a general introduction and a description of the observational and modelling infrastructure, the paper encompasses many of the key mechanisms leading to heavy precipitation. In general, all mesoscale and microphysical aspects are very well covered with the correct highlight of the results coming from the HyMex observation campaign.

The only aspect which in my view could have been further expanded, given also the relevance in the genesis of heavy precipitation, is their relation with the large-scale dynamics (section 3.1). Amongst the important literature on this topic, like Massacand et al. 1998 and Martius et al. 2008, it is worth mentioning a few very recent papers like 1) De Vries 2020, 2) Mastrantonas et al. 2021, 3) Grazzini et al. Part II 2021, which are showing robust and quantitative relations and dynamical linkages with large-scale precursors. But I understand that the focus of the current review is more on the mesoscale and local interaction so take my suggestion as not compulsory but as a simple indication. You decide whether it is necessary to expand the section. Other than that I think the manuscript is ready for publication after very minor changes reported below.

References:

1) Vries, A. J. D., 2020: A global climatological perspective on the importance of Rossby wave breaking and intense moisture transport for extreme precipitation events. Weather and Climate Dynamics.

2) Mastrantonas, N, Herrera-Lormendez, P, Magnusson, L, Pappenberger, F, Matschullat, J. Extreme precipitation events in the Mediterranean: Spatiotemporal characteristics and connection to large-scale atmospheric flow patterns. Int J Climatol. 2021; 41: 2710– 2728. https://doi.org/10.1002/joc.6985

3) Grazzini, F, Fragkoulidis, G, Teubler, F, Wirth, V, Craig, GC. Extreme precipitation events over northern Italy. Part II: Dynamical precursors. Q J R Meteorol Soc. 2021; 147: 1237– 1257. https://doi.org/10.1002/qj.3969

Thank you for this comment. We agree that much more can be said about the relation with the large-scale dynamics, however, as the reviewer correctly points out the focus of the current review is on the mesoscale. Moreover, the paper is already lengthy. Nevertheless, to clarify this relevant point to the readers we have included a paragraph in the introduction, additionally referencing the papers suggested.

In the new document L112-121 ***"Nevertheless, in the last few years, relevant knowledge has been gained in the field. Vries (2020) presented for the first time a global and systematic climatological analysis of the Rossby Wave Breaking (RWB) and intense moisture transport, and their linkage to extreme precipitation events (EPEs) in several regions, with the findings of this study contributing to an improved understanding of the atmospheric processes that lead to EPEs. Mastrantonas et al (2021) demonstrated that a clustering combination of sea level pressure (SLP) and geopotential height at 500 hPa (Z500), increases by more than three the conditional probability of EPEs, which could result critical for extended-range forecasts. Grazzini et al. (2021) further investigated the relation between EPEs and Rossby Wave Packets (RWPs), showing the evolution and properties of precursor RWPs key for the categorization of EPEs."***

Minor changes

- On page 9, line 291, you mention "comma-shaped" cloud coverage. You did not explain the meaning but hinting some implication of that. The explanation comes later, on pages 10 lines 324-327. It would be preferable to introduce first the relevant concepts.

Thank you for this comment. We rephrased lines 290-293 of the original submission as follows:

"During the night from the 25th to the 26th of October, and in the following day, several MCSs formed under the influence of the cyclone and within its "comma-shaped" cloud coverage. Such cloud coverage is typically found in mid-latitude storms and owes its shape to warm conveyor belts (WCB; Eckhardt et al. 2004; Madonna et al. 2014), i.e., the airstreams that ascend slantwise over the cyclone warm front. All MCSs showed a quasi-stationary behavior, forming first over the sea, between the eastern Spanish coast and the Balearic Islands (Duffourg et al., 2016), and afterwards over the Gulf of Lion where they induced large amounts of precipitation over sea during morning hours."

Accordingly, we changed lines 322-328 as follows:

"Therefore, most intense Mediterranean cyclones are baroclinic systems with frontal structures and associated airstreams such as dry air intrusions and WCB (Ziv et al. 2009; Flaounas et al. 2015a). In particular WCBs are associated with stratiform, but also with convective rainfall due to embedded convection..."

Eckhardt, S., Stohl, A., Wernli, H., James, P., Forster, C., and Spichtinger, N.: A 15-Year Climatology of Warm Conveyor Belts, J. Climate, 17, 218–237, 2004

Madonna, E., Wernli, H., Joos, H., and Martius, O.: Warm conveyor belts in the ERA-Interim

dataset (1979–2010). Part I: Climatology and potential vorticity evolution, J. Climate, 27, 3–26, doi:10.1175/jcli-d-12-00720.1, 2014.

- For the benefit of readers non used to European geography, it would be helpful to show CI, NEI, CO regions (only defined in the text) delimited on a geographical map

Thank you for this comment, we have included following your suggestion boxes with the location of these subdomains in Figure 1 of the maunscript