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Earth System Dynamics Discussions

Interactive comment on "Sensitivity Experiments on the Response of Vb Cyclones to Ocean Temperature and Soil Moisture Changes" *by* Martina Messmer et al.

Anonymous Referee #2

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The study analyses the moisture sources of 5 selected Vb cyclones, which caused high precipitation over the Alpine region. To investigate the moisture sources, sensitivity studies are used, with altered SST of the Mediterranean Sea, the North Atlantic Ocean and soil moisture. They found that the analysed events were most sensitive to the Mediterranean SST changes, and although the SST increase resulted in a strong increase of precipitation over the region influenced by the Vb cyclones, it also resulted in a decrease of precipitation over the north-eastern flanks of the Alps. The study is well structured, and deals with a scientifically interesting subject.

General comments

The study aims to give a general view on the moisture sources of Vb events, but only

focuses on 5 selected events from summer, which were all connected to heavy precipitation. The extreme cases are indeed interesting, but the study should underline it more that these are not typical Vb evenents, since even their previous study (Messmer et al. 2015) concluded that only 23 % of all Vb events are associated with extreme precipitation. Also their conclusions are valid mainly for summer, due to the event selection. This should be mentioned, since previous studies have shown that moisture sources in the Alpine region is influenced by seasonality, and for example the North Atlantic region is a more pronounced source during winter (Sodemann and Zubler, 2010). Thus the low sensitivity to the changes of North Atlantic SST might not be valid for the whole year.

I found the 6 hour spin-up time rather short. I would expect that the water vapour fluxes do not have enough time to adjust to the altered boundary conditions. Also Winschall et al. (2014) found that for heavy precipitation events over a slightly different domain, the time of maximum moisture uptake varies between a few hours to more than a week before the precipitation event. So with 6 hours spin up time the moisture uptake is probably already occurred, and included in the initial and boundary conditions (SST and soil moisture). So the changed boundary values and thus moisture fluxes have less effect on the cyclonic precipitation. The authors already analysed the sensitivity for the spin-up time in case of the SST experiments, but I would like to ask for more details about those analysis, and also the a revision of the above mentioned moisture uptake "problem". Also I do not see if they have investigated the spin up effect during the soil moisture experiments. I would like to see some results regarding this, because the 6 hour spin-up time also seems to be rather short for the soil experiments.

Specific comments

Abstract: The soil moisture experiments are mentioned, but no results are included, also the North Atlantic experiments are not mentioned.

Page 2 Line 8: Besides the Elbe, it would be nice to mention, which other large rivers

are especially affected by the precipitation of the Vb cyclones.

Page 2 Line 30-32: Please reformulate this sentence so, that is not so strong, it should show that the variability of moisture sources are still high besides the seasonality.

Page 3 Line 8: Please write “extreme Vb events” instead of just “Vb events”.

Part 2.1: Can you include here some information about the SST field? If not the ERA Interim SST fields are used for the sensitivity experiments, then please write something about the details of the SST boundary fields at the model setup part.

Part 2.2: Please mention, which variables do you use from E-OBS. Also I found the terminology for precipitation rate a bit misleading. As I understood precipitation rate here means daily accumulated precipitation, and accumulated precipitation means multi-day sums of daily precipitation.

Part 2.3: It might be useful to shortly introduce the synoptic situations regarding the selected events, e.g. what was different and what was the same for the 5 cyclones.

Part 2.4: Can you include more information about, how the atmosphere interacts in the model with the SST boundary conditions and with the soil (e.g. frequency, fluxes).

Page 4 Line 21: Please explain in more detail, what does 2-way basis mean. Is it 2 way nesting?

Page 5 Line 9: Please state clearer that the spectral nudging is done for these extra spin-up sensitivity experiments, otherwise it is a bit confusing after stating that nudging techniques are avoided (Page 4 Line 30).

Page 6 Line 1: Mentioning eleven simulations is misleading, since the control is not considered as a Mediterranean SST sensitivity experiment. So please change to “10 sensitivity and one control” or “10 sensitivity simulations”.

Page 6 Line 7: Can you find a projection for SST instead of surface air?

Page 6 Line 23: Higher precipitation rates can also be due to the higher resolution of the simulated data.

Page 7 Line 20: Please denote somehow on the tracks in Fig. 3, which are the intensification and decaying phases of the cyclones.

Page 7 Line 30. The moisture uptake from land and ocean by the cyclones happened probably before the precipitation. I think time steps before the precipitation can also give information about the moisture exchange.

Page 8 Line 17: Why are the ocean-land winds slightly reduced?

Page 9 Line 8: Note that the North Atlantic is shown to be more important during winter precipitation events. So there is maybe a lack of sensitivity because these were summer events.

Page 10 Line 5-16: It would help the understanding if an extra domain, a costal domain, would be introduced, and the results would be visualised in a way similar to Fig. 4k.

Page 10 Line 20: 24% in which direction, and where?

Figure 4c. Moisture flux over ocean, is misleading, since almost all points are from the Mediterranean Sea. It might be clearer if the few North Atlantic Ocean points would be excluded, and the moisture flux would only refer to the Mediterranean Sea.

Figure 6. Please mention the resolution of the different data.

Reference

Sodemann, H., & Zubler, E. (2010). Seasonal and inter-annual variability of the moisture sources for alpine precipitation during 1995-2002. International Journal of Climatology, 30, 947–961. http://doi.org/10.1002/joc.1932

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