

Interactive comment on “Observed and modeled diurnal variations around Lake Malawi” by Shunya Koseki and Priscilla A. Mooney

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The manuscript by Koseki and Mooney presents an interesting study on the diurnal variations and patterns of precipitation around Lake Malawi during summer. The authors investigate this cycle and the influence the lake itself has on this cycle, using satellite products and WRF simulations (with and without the lake). To identify and extract the diurnal variations and patterns, and the main contributors to these variations, the authors use harmonic analysis and empirical orthogonal function (EOF) analysis. It was found that the lake has a substantial effect on the diurnal cycle of precipitation due to enhancement of the lake-land breeze circulation. The overall analysis performed in this study is clear, straightforward and concise, and the results give a good overview of the processes responsible for the diurnal variations of precipitation found and the

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influence of Lake Malawi. I think this makes the study potentially interesting as it can contribute to our knowledge on the influence of lakes on meteorological variables and consequently on water resources in their direct surroundings. However, I have a few questions and remarks that can improve the clarity and focus of the manuscript before publishing. Therefore, my suggestion is that the manuscript needs in between minor and major revisions, which mainly focus on the structure of the discussion section and on textual improvements.

General comments

The first thing that I noticed when opening the manuscript is that the title of the manuscript does not reflect clearly that the focus of the authors is to study the diurnal variations of precipitation. I think it is important to change this and make it more specific to avoid misinterpretation by the readers.

According to the setup of the experiment and the aim stated in the introduction, the focus of this study is quantifying the effect of Lake Malawi on the diurnal cycle of precipitation in the area. However, in the discussion section the focus lies almost completely on the attempt to explain the remaining pattern of precipitation present in case when Lake Malawi is synthetically removed in the model simulation (WRF-NOLM). I would be more interested to first know what the authors learned about the influence of a lake on the regional precipitation patterns based on the analysis they did, and whether the authors think that the same principles apply to other lakes, rather than starting to focus on explaining the remaining pattern (lines 399-403), which lies outside the scope of the aim the authors stated in the introduction (lines 88-91). This means that the discussion section should be revised focussing on the main points that the authors want to state, starting with (1) explaining/quantifying the influence of Lake Malawi on the diurnal variation of precipitation (this can include section 4.1

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which indeed focusses on the effect of the presence of the lake), (2) whether this is generally applicable to other lakes, and then (3) as final remark the authors can write a paragraph on giving examples of factors that may influence the remaining observed patterns in precipitation and local breeze circulations. However, if the authors want to focus on explaining the remaining patterns, which then also should be clearly stated in the aim and introduction, then I would suggest to additionally quantify the topographical impact around Lake Malawi (section 4.2) on the local breeze circulation. This can be done by synthetically removing the strong topographical gradients around the lake.

What causes the peak to come slightly earlier in the case without the lake compared to the situation with the lake (lines 280/281)? Can this be expected at other lakes as well? This can be included in the discussion section.

Differences were found between precipitation over the northern part, the central part and the southern part of Lake Malawi. However, the authors do not give an explanation for this. It would be interesting and important to elaborate on this. Is this caused by the characteristics of the lake itself (e.g. bathymetry, mixing), or surrounding topography or land use?

Another general comment that I would like to make is that the English writing is poor in large parts of the current manuscript. This needs to be polished and edited before publishing.

Specific comments

At some of the figures the axis labels are missing, i.e. Fig. 5h,i,j, 10. Please be precise in this; describing it in the caption of the figure is not sufficient.

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Please include a DEM from the area as background information to the area. This will give the reader a better understanding of the regional landscape.

This comment concerns the use of cumulus parameterization. The authors state that the cumulus parameterization is switched off in the inner domain (lines 139/140). Later they state that in 'this' region the convective scheme Betts-Miller-Janjic is used (lines 141-144). It does not become clear from this explanation what the authors have used where. Please write this more clearly.

Line 408/409; this argumentation is not precise. The increased humidity of the air through enhanced latent heat fluxes can indeed be a source of precipitation. But depending on wind conditions and other (topographical) characteristics, it not necessarily falls within the studied region.

Line 416; technically it is not the heat capacity of the water surface only, but of the whole water body.

Lines 487-488 493-494; in the first 2 lines I refer to the authors write that the precipitation in the surroundings are enhanced in the situation without the lake. In the latter 2 lines I refer to this seems to be contradicted 'the enhanced and weakened precipitation over the lake and surrounding area'. If this sentence is missing a 'respectively', then it is not consistent with the above 2 lines. Without the word 'respectively' the sentence is not correct as precipitation cannot be enhanced and weakened at the same time.

Technical corrections

L. 33; southeasten -> southeastern

L. 40, 72, 174; quite is not specific enough, now the meaning can be interpreted in

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different ways.

- L. 44; Reorder the sentence; starting a paragraph with 'In addition' is not common.
- L. 49; creates -> create
- L. 67; brackets around Kumambala and Ervine, 2010
- L. 72; are -> is
- L. 73, 298, 422; On the other hand, this suggests that in the previous sentences on the one hand has been used, which is not the case here.
- L. 74; for -> in
- L. 80; huge is informal language -> large
- L. 84; remove comma
- L. 89; in the regional precipitation -> of regional precipitation
- L. 90; with -> using
- L. 91; and a numerical regional model
- L. 91; Using a satellite product with a relatively coarse spatial resolution,
- L. 99; observations
- L. 103; results simulation? -> of the simulation results
- L. 111, 115; superior -> high (and specify the temporal coverage (in case of line 111)).
- L. 116; The temporal resolution of the original Level-3 data is 30 minutes
- L. 144; Over the land and lake grids that/which are based on...
- L. 148; in -> at
- L. 160; grids is set to
- L. 165; of the outer domain are exactly the same
- L. 167; output of 5 months from November 2014 to March 2015; that is
- L. 175; in previous studies (remove the)
- L. 176; The use of harmonic analysis
- L. 181; phase of the diurnal
- L. 183; utilized -> used
- L. 184; remove the between following and previous
- L. 196; where A is a variable and t is time

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- L. 209; intense widely? What is meant here?
- L. 218; are -> is
- L. 218; finer resolution satellite product
- L. 221; 'quite modest'; be more specific
- L. 221; around Lake Malawi, (add comma)
- L. 222, 223; add part of before Lake Malawi
- L. 225/226; to which precipitation is the first referred to?
- L. 231; December should be November?
- L. 246; remove in and place Fig. 4b between brackets
- L. 277; down -> a decrease
- L. 294; obvious -> distinct
- L. 304; of -> is
- L. 331; now is says 2x south; the first should be north I think
- L. 333/334; what are the outgoing/incoming words referring to? Referring to daytime/night-time? Then respectively should be added.
- L. 337; : -> ;
- L. 351; specify 'almost identical'
- L. 352; over the lake as shown
- L. 353; 'some clue' is informal language
- L. 354/355; Rewrite last sentence; grammar is not correct
- L. 359; the diurnal cycle of precipitation
- L. 369; 'more dominant'; does it refer to daytime vs. night-time, or WRF-CTL vs. WRF-NOLM?
- L. 385; remove 'everywhere' -> in the surrounding region
- L. 409; it -> this
- L. 413; more -> higher
- L. 414; less -> lower
- L. 416; surface -> body
- L. 444; during night-time and daytime respectively

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- L. 463/464; comma should be directly after the equation
- L. 480; add term C in between brackets, as you are referring to that.
- L. 488; is 'relatively' referring to both noisy and weak? Correct order of words accordingly
- L. 504; the diurnal variation of precipitation
- L. 526/527; The magnitude of the lake-land breeze reduces over the lake.
- L. 530; 'weakened intensively' – another word for intensively works better I think
- L. 536; a main contributor -> the main contributor
- L. 547; could be -> is
- L. 552/553; the diurnal variations of precipitation can influence rainfall? Seems redundant to mention this as an example.
- L. 556-560; Very long last sentence. Better to break it up and keep it short and strong.

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