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Interactive comment on "Estimating the effect of rainfall on the surface temperature of a tropical lake" *by* Gabriel Gerard Rooney et al.

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Response to Referee 2

We would like to thank the referee for their comments.

Section 3, ln 15: The authors point 4 processes in which rainfall can affect lake surface temperature. Since the authors mention the evaporative cooling, the solar radiation shading during daytime associated with clouds could be also mentioned as a process which should be, in principle properly represented by the atmospheric model.
We agree that modelling the cloud cover correctly is extremely important for the purposes of predicting LWST. Since this study is primarily concerned with the effects of

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rainfall, in the present context we would see cloud cover as a related atmospheric process. That is, significant rainfall requires the presence of clouds, but the presence of clouds does not guarantee rain. This is unlike the evaporative cooling referred to, which only occurs when rain is present.

We would therefore be happy to add this point about cloud cover, but would describe this as a related process rather than a direct influence of rainfall.

Figure 4: Power spectrum of wind: There are several peaks on the sub-daily frequencies. Could the authors provide the frequencies of these and comment on their source (breeze effects?)
The sub-daily wind fluctuations giving rise to these peaks are also evident on the wind-speed panels of figures 6 and 10. We assume these are due to local circulations caused by lake- or land-breezes, and the bi-modal distribution of the wind direction histograms (figure 7) would seem to also support this interpretation.

We can add information on the frequencies of the dominant sub-daily spectral peaks and their likely origin.

The authors filtered the effect of radiation by defining the DWET days as days with net radiation below 1.5x107 J m-2. The average different between DWET net radiation and VWET is about -2.3 W m-2. Visual inspection of T and LSWT mean diurnal cycles for VWET suggests a temperature difference between air and LSWT of about 22.5 (air) - 25 (LSWT) -2.5 (maximum difference), which would give an cooling heat flux of about -3 W m-2 (using the formula in section 3.1). Therefore, even on the mean, the radiation effect might still be relevant and comparable in this case with the direct heat flux.**
There may be some slight confusion here, so it may be worth beginning our response by repeating the relevant text from p.7:
"With a threshold total radiation of 1.5$\times 10^7$ J m^{-2}, the average total radiation of DWET days is approximately 1.03$\times 10^7$ J m^{-2}, compared to an average total radiation of

1.05$\times10^7$ J m^{-2} on VWET days."
That is, the threshold has been chosen with a deliberate slight element of caution, so that VWET days absorb 1–2% *more* net radiation on average than DWET days. In our judgement this makes the later LWST cooling of VWET days relative to DWET days *less* attributable to a simple difference in net radiation.

We can add a further sentence to the text quoted above to emphasise the point made in this response.

Furthermore, it is not shown the partition between SW and LW. While LW radiation affects only the surface water temperature, SW penetrates the water column. I believe it is important to further detail the potential radiation effects. Figure 10 could be extended with two extra panels including SWnet and LWnet complementing the information in figure 9 to clarify potential impact of radiation, in particular solar in the differences between DWET and VWET.
As suggested, we are happy to extend figure 10 with extra panels showing the net LW and SW.

The authors suggest that rainfall temperature and rain-induced turbulence could be implemented into lake models as a way to represent the effects of rainfall in LSWT. However, they do not show if a lake model (or several) are not able to represent the LSWT differences seen in the observations. Considering the high quality and length of the observations, simulations with a lake model in stand-alone model would prove fundamental to support the authors suggestions. For example: does the model when forced with the observations also gives lake surface temperature differences comparable with the observations? This would strong support the efforts to represent missing processes. Another conclusion could be that other errors in the model have a higher impact and role of rainfall on LSWT is of secondary. I understand that this would require an extra and significant amount of work, and leave this decision to the editor in case the authors do not have the time and/or capacity to perform those simulations in a reason-

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able time window. If this is the case, I would encourage the authors to at least extend a bit more the conclusions suggesting model protocols to access this problem,

Unfortunately, as the referee has anticipated, we do not have the available resource to perform a modelling study to go alongside this observational analysis. We would however be willing to discuss this in more detail as potential future work in the Discussion and Conclusion, which is the referee's alternative suggestion.

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