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The Cryosphere Discussions

Interactive comment on "Quantifying the impact of synoptic weather types and patterns on energy fluxes of a marginal snowpack" *by* Andrew Jonathan Schwartz et al.

Anonymous Referee #2

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General comments

This paper begins to address a significant gap in Australian snow literature by identifying the local energy balance and synoptic scale conditions under which snow melt occurs. While only one site has been analysed in this work, making boarder inferences of the region difficult, the identification of typical synoptic scale patterns associated with energy fluxes contributing to snow melt is of interest to the community. In addition, observational data such as those presented here may be useful for future modelling studies of Australian snow pack.

My major comment is with respect to the temporal resolution of the study, which will be

discussed below. I am in agreement with the other reviewer, that these results should not be overstated as they are from only one site, but considered as an important first step. Further minor comments are listed below.

Major comment:

The use of the daily scale of analysis, while a practical measure, may be hiding some interesting diurnal cycle features. The authors have shown that short and long wave radiation play an important role in the energy fluxes calculated, both of which by nature, have strong diurnal cycles. Some sub-daily analysis, exploring the diurnal cycles of energy fluxes for the different synoptic types may be of interest to see how different fluxes, which over the sum of the day may (or may not) balance each other out, play different roles in snowpack characteristics. In addition, sub-daily knowledge of energy fluxes would be important for evaluation of any high-resolution modelling study attempting to study snowpack in the future.

In this vein, the authors have defined a day as the period '00Z-23.59Z'. Would not have converting the UTCZ time into a 24hour period more closely aligned with the local diurnal cycle have been better? For example, when considering local meteorological effects associated with the diurnal cycle, such as anabatic or katabatic winds, which may have an important influence on local energy fluxes?

Minor comments:

Introduction in general: Some of the snowfall and weather/climate literature presented in the introduction is somewhat out of date. For example, on line 64, the Hennessy et al (2008) study has been cited, when more recent work is available in Di Luca et al. (2018).

Similarly, the studies relating to SAM and the sub-tropical ridge are quite old, with much more literature available relating climate drivers and synoptic types to southeast Australian precipitation, including discussions on how these are changing. Of note,

the authors spend some time discussing the SAM, but then go on to state that SAM accounts for relatively small variability. So perhaps the climate/weather discussion needs to be rephrased to be more specific to the local area (see Pepler et al. 2015, or Fiddes et al. 2015). In addition, I think that you should make clearer how weather types that you have identified here, eg the passage of fronts, or high pressure systems, are changing/expected to change (see Pepler et al. 2019 and Catto et al. 2014). This will give the last sentence of your abstract a bit more context and to make the importance of this study clearer in your discussion.

Line 115: I think the BoM 2018b reference is missing

Lines 119-123: I think this section about the types of vegetation would fit better under Line 112.

Lines 182:188: I'm unsure if selecting just one timestep is a good representation of cloud cover for the day. I know you mention wishing to avoid short-lived clouds, but surely even short-lived clouds have some impact on the energy balance? The himawari data should allow you to get a daily average of cloud fraction. Alternatively, providing a sub-daily analysis would resolve this too.

Line 308:314: In the discussion of T6, you state that the passage of a trough has developed into a weak lee side cyclone. Have you considered or checked that it could also be a cyclone with east coast low characteristics? I.e not associated with westerly flow? Fiddes et al. 2015 found these types of synoptic systems had some influence on extreme precip in the region.

Lines 359-365: I think this paragraph needs a bit of context. I was quite confused as to its relevance to the paper before I got nearer to the end.

Line 475-476: Re: the ground energy fluxes. Would it be possible to look at these with a seasonal perspective, to see if they play a greater role early or late in the season? This could tie in nicely with the previous findings of shorter duration of snowpack.

Figure 5 and Figure 6: Please describe figures in full in the caption. Also, it would be beneficial to use the same colour scheme for each synoptic type throughout and also avoid the rainbow colour scheme at all costs (for our colour blind colleagues!).

Catto, J. L., Nicholls, N., Jakob, C., & Shelton, K. L. (2014). Atmospheric fronts in current and future climates. Geophysical Research Letters, 41(21), 7642–7650. https://doi.org/10.1002/2014GL06194

Di Luca, A., Jason, L., & Fei, P. E. (2018). Australian snowpack in the NARCliM ensembleâĂŕ: evaluation , bias correction and future projections. Climate Dynamics, 51(1), 639–666. https://doi.org/10.1007/s00382-017-3946-9

Fiddes, S. L., Pezza, A. B., & Barras, V. (2015). Synoptic climatology of extreme precipitation in alpine Australia. International Journal of Climatology, 35(2), 172–188. https://doi.org/10.1002/joc.3970

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Pepler, A., Hope, P., & Dowdy, A. (2019). Long-term changes in southern Australian anticyclones and their impacts. Climate Dynamics, 53(7–8), 4701–4714. https://doi.org/10.1007/s00382-019-04819-9

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