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Interactive comment on "Modeling Slope Environmental Lapse Rate (SELR) of temperature in the monsoon glacio-hydrological regime of the Himalaya" *by* Renoj J. Thayyen and Ashok P. Dimri

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These are responses to the major specific comments by the Reviewer-1 for the purpose of ongoing interactive discussion. A detailed reply including other minor points will be provided during the final response phase.

Response#1: Temperature lapse rates studies are very few in the Himalayan region, especially covering the higher altitude region , which reflects in the paper as well. The information from farthest mountain systems becomes all the more important because of the same reason. Those references provide an understanding of the advances made in the other mountain systems as compared to the Himalayan region. We believe, we have not missed any related critical references from the region and the references

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Discussion paper

suggested by the reviewer will be consulted in the revised MS.

Response#2: Latest research have provided better understanding of the wintertime precipitation mechanism in the Himalayas. Indian winter monsoon (IWM: during Dec, Jan and Feb) does carry the moisture from the mid Atlantic Ocean and Caspian Sea during the passage of Western disturbances (Dimri et al. 2015) embedded within the large scale sub-tropical westerly jet (SWJ). But moisture incursion is not limited from these two sources; moisture incursion from the Arabian Sea and Bay of Bengal as well added to the winter precipitation occurring over the Indian Himalayan fronts and thus this mechanism is called as IWM. Apart from Dimri and co-authors' work (not referred here but referred in the manuscript) many other researchers have given distinct dynamical and physical mechanisms of IWM, viz., Bony et al. (2000), Krishnamurti et al. (1997), Laat et al. (2002) etc. May be addition of latest work of Dimri (2016) will provide improved understanding on IWM. There are other work from synoptic analysis to diagnostics and modeling to provide dynamical and physical explanations on IWM. A discussion on IWM is out of scope of the present paper. Hence, some relevant references are provided here.

References

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Krishnamurti T. N., B. Jha, P. J. Rasch and V. Ramanathan (1997). A high resolution global reanalysis highlighting winter monsoon. Part I, Reanalysis field, Meteorol. Atmos. Phys., 64, 123-150.

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Dimri et al. (2015). Western Disturbances : A review. Rev. Geophys., doi: 10.1002/2014RG000460.

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Response#3: At vertical pressure/altitude levels maximum/minimum temperature hardly will occur at the same time. Thus the notion of the maximum/minimum temperature lapse rate at the same time is a debatable question.

Say, in case of the dry adiabatic lapse rate [dT/dz=-g/Cp] and saturated adiabatic lapse rate [dT/dz= -g/Cp-{(L/Cp)X(dws/dz)}] in principal, in situ maximum/minimum temperature observations will not satisfy the equation, as Cp will change at differing time of occurrence of maximum/minimum temperature at different altitudes. Use of daily mean temperature resolve this problem as it is not time specific. Diurnal micro to meso scale processes due to valley – ridge slope, higher elevation snow, inversion etc. can only be captured in the daily mean SELR rather than maximum/minimum temperature lapse rate. Therefore in the present manuscript SELR is specifically proposed and discussed as it very well captures net effect of suggested valley scale processes.(Descriptions of these equations are provided in the manuscript). Moreover, mean daily temperature is also the fundamental temperature unit used in many of the glaciological, hydrological and ecological models and our aim is to provide a better solution for improving such modelling efforts.

Response#4: What is suggested earlier is the lower lapse rate during the monsoon period. We have made significant contribution to understand the processes further from our own work such as a) differing valley scale (section-1) and higher altitude region (section- 2) SELR, b) Differing SELR stability of both the sections, c) Relationship with lifting condensation level variations d) Higher SELR for pre-monsoon season, e) SELR equivalence to SALR during the monsoon regime f) regional similarity in SELR for

both valley scale and higher altitude sections and g) proposing a modelling solution for SELR of monsoon regime etc. Again, role of radiation and other fluxes in SELR is not within the scope of the present manuscript primarily due to lack of data in this region, especially from the high altitude region. We hope that the present paper and discussion will trigger more research in this direction and emerging questions and issues will be addressed subsequently.

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