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Comment on egusphere-2022-336

Anonymous Referee #2

Referee comment on "Daytime along-valley winds in the Himalayas as simulated by the Weather Research and Forecasting (WRF) model" by Johannes Mikkola et al., EGUsphere, https://doi.org/10.5194/egusphere-2022-336-RC2, 2022

The manuscript titled "Daytime along-valley winds in the Himalayas as simulated by the WRF–model" is a good attempt to simulate winds particularly along the valleys in the complex terrain of Himalayan Mountains. In this work, four neighboring valleys are identified for the investigation on along-valley and cross-valley circulations in the Nepal Himalaya using the WRF model. Interestingly, point highlighted here is the interaction between local induced circulation and synoptic-scale flow, however, there are major concerns associated with methodology and persisting in the interpretation of the results as well.

Major comments

- The five days period is too small for investigating the influence of synoptic scale flows on valley circulations, hence required to be explored to a longer time scale as strong seasonality may be associated with synoptic flows. The synoptic-scale flow are found to show pronounced variations from northerlies to the westerly. This could be due to the trough region embedded in the upper-level westerlies and moving eastward. If the longer period is considered, the overall variation of the synoptic-scale flow may change, and at some point, it can be southerly or southwesterly, which can strongly support the along-valley flows. Diurnality will also have a profound influence on the topographic flows due to thermal gradients.
- It is suggested to select a longer time period of at least two contrasting seasons. The valley inversions dominate during winter, and that might be confined within the valley region. The selected period is of winter, where the solar insulation is comparatively low, and the inversion can persist for a longer time. This can also affect along-valley flow.
- There are some issues with the model configurations and simulation. The spin-up time is not seen to be considered. The Land-surface scheme is not specified here, while it strongly impacts the near-surface fluxes and meteorological fields.
- One of the major challenges to the models is to simulate the weak flow conditions. The local induced circulation is more prominent during the weak synoptic-scale flow (Solanki et al. 2019, BLM). It is strongly suggested here to investigate the model

performance for two different wind flow regimes; low and strong. That can be performed only if the longer time period for simulations is taken into account.

- A robust discussion was missing on how the selection of five days is made.
- The wind follows the logarithmic variation within the surface layer. So it is suggested to compare the simulated winds to the observations at similar elevations (5m).
- The brief description on the observational data is not added here. In order to have close agreement, the comparison of the model output, preferably, is required to be made with the closest available instantaneous observations, along with mean values.
- Why is the altitude adjustment discarded? The actual altitude and model altitude comparison could be added to the description.
- Discuss the model evaluations using other matrices such as correlations, RMSE, and Mean Bias Error. In the comparison table, the MAE is much higher than the addressed benchmark values in literature, e.g., Emery et al., (2001). In addition, it would be interesting if the diurnal variation of wind and other meteorological variables, is presented. The WRF shows limited performance in simulating the diurnal cycle of winds over the Himalayas region (Singh et al., 2021).
- Line 176, the decomposition of the vector **A**, into along- and cross-valley is carried out taking the three-points on either sides of valley center, to avoid the sharp gradients. However, the valley is narrowing towards the north, so the taking six points for the actual orientation of the valley, will change largely, and hence may not be a close representation. Here it is suggested to compare these two components, along-valley, and cross-valley, by choosing one-, two- and three points. If there is not large variability between one- and three-, the orientation of the valley may be considered to be represented correctly.

- The investigation of the cross-valley component is not discussed in detail. The cross-section of the valleys for 19-21 December showing the intrusion of the synoptic-scale flow into the valley region is to be presented/plotted.

Specific comment:

- In figure 2, there are some visible artifacts (locations of about 1000m high, as per the scale) on the topography data, along the costal lines extending from Arabian Sea to Bay of Bengal. Topography needs to be checked.
- Line 126-128: The local circulations change with the day-night contrast including two transitions during sunset and sunrise. Better to select the stable atmosphere during nighttime and convective daytime hours by discarding such transitions.
- Line 144-145: The observed wind speed is below 2 ms $^{-1,}$ while the corresponding MAE is 2.1 ms^{-1}. The model performance is not very convincing for the low wind conditions.
- Line 163-164: it would be interesting to see a close view of the individual valley, (possibly 3-d view to have a better understanding of the orientation and shapes) that will highlight the geometrical differences between the valleys.
- Line 166: How is this criterion selected?
- Line 226: Is it the pressure level corresponding to the ridge height? What is the criterion of this selection? Why not 500hPa, which is generally used in synoptic weather charts?
- Line 226-228: this discussion may change for the longer run of the model.
- Line 242: This is not a sufficient explanation for neglecting this period here. The

interaction between two flows should be investigated separately.

- Line 243: During 19-21 Dec, the flow is reported to be westerlies, while it can still impact the thermal winds in the valleys like northerly, depending upon the orientation of the valleys and magnitude of the westerlies. How can the interruption of the thermal winds by synoptic westerlies be neglected?
- Figure 2: Why the valley width is missing at some grid points?
- Line 246: Is it thermal-induced local circulation or synoptic flow? Moreover, it is unlikely characteristic of mountain meteorology, if it is happening so (evening time upslope winds), then meteorological processes operating at high altitudes are required to be investigated with specific observational experiments.
- Figure 4: Remove the extra contour lines related to the topography. Due to the jumbling contour lines, the wind field is not very clear.
- Line 265-266: How the diurnal cycle is explained by taking a single hour. If the northerlies prevailed during 17-18 Dec, it would remain unchanged irrespective of the hour.
- Line 275-276: Show the observation and model comparison for these calm wind conditions. It is very interesting if the model and observations are in agreement.
- Figure 5: The scale on y-axis is not correct. Many of the points are out of the scale and not visible.
- Line 333: But not all valleys are north-south oriented. These model levels can be well above the near valley inversions during the nighttime.
- Line 366-367: Suggested to add a figure on valley cross-section wind.