

Second review of egosphere-2023-1961

‘Comparison between ground-based remote sensing observations and NWP model profiles in complex topography: the Meiringen campaign’

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Paper in review for Atmospheric Measurement Techniques

Summary

The manuscript presents a comparison of campaign observations from the Meiringen Campaign in a narrow Swiss Alpine valley with the high-resolution 1-km KENDA analysis. The comparison focuses on temperature and wind profiles measured by a microwave radiometer and Doppler wind lidar, respectively, for ten months during 2021/2022. It is shown that observed and modeled seasonal climatologies of temperature and wind profiles agree well, although for specific situations, such as for example temperature inversions or foehn events the differences are relatively large. The manuscript also links the complex topography to thermal wind systems and presents cross- and along valley flow systems observed during the campaign period.

The manuscript presents valuable observations from an Alpine site and provides new insights in the quality of the high-resolution analysis in complex terrain and shows examples of how specific terrain-induced flow features can influence the differences between observations and the analysis.

The manuscript has been substantially improved during the first revision phase and the authors have addressed major reviewers’ comments, i.e., the general structure was revised and the manuscript was streamlined. I support publication of this manuscript but I have several mostly minor comments that should be clarified and addressed prior to publication.

1 Comments

1. KENDA T bias

I still struggle to fully follow the discussion about KENDA temperature biases discussed in Section 3.1. 1. 213 ff states: ”The main observed pattern is a general low altitude (< 1500 m) T underestimation from KENDA-1/MEE.” This cold bias pertains to all hours of the day and all months (Fig. 2b; except June). Subsequently, Fig. 4 shows that ”KENDA-1 overestimates the T during nighttime (+1.5C) in both cells and underestimates it during the day (-2C in MEE and -1.5C in MER).” (1. 240 ff). I understand that different data and levels are compared in Fig. 4, however, at nighttime Fig. 4 suggests that KENDA is larger than MWR. The latter is not visible in Fig. 2b. I would ask the authors to elaborate on and clarify the KENDA warm or cold bias, respectively, and streamline this paragraph. If the main reason of the KENDA-SMN bias results from

differences in altitude between KENDA grid box and SMN observation and the frequent presence of inversions, Fig. 4 and the respective text may be misleading. From Fig. S5 I cannot induce if KENDA overall over- or underestimates temperature.

2. Altitude depiction in observation and KENDA data
I would appreciate if the authors could provide information directly in the text, figures, and/or figure captions about the altitude of the used data. It is difficult to remember the altitude of lowest model grid box at MEE/MER as well as of MRW and DWL. I think this would facilitate following the storyline of the manuscript.
3. I would ask the authors to again double-check the manuscript for typos, missing words, and grammar mistakes (e.g., l. 36 "Such inversions are favored in complex topography (Joly and Richard, 2018) and persist-s longer in deeper valleys, whereas inversion lifetimes converge to the one over a plain for wide valleys (Colette et al., 2003)."; l. 40 "The quality of predictions for", l. 392 "of a monthly median values"). Please also consistently adjust the date/time format.
4. l. 6: Please introduce the acronyms COSMO-1E and KENDA-1 as not everyone may be familiar with the terminology.
5. l. 19: "of a model": I would specify this and explicitly mention "KENDA-1".
6. l. 125: "Vertical levels with spacings from 20 m at the surface": What is the height of the lower-most level?
7. l. 176: "from 200 m to 12000 m above ground". Can the DWL measure successfully up to 12 km height?
8. l. 186: "Even if SNM/MER surface observations are assimilated by KENDA-1, the comparison of the modeled and observed data allows evaluating the impact of the assimilation at MER." Please clarify this sentence. From a comparison of the resulting KENDA analysis and the assimilated observations alone, the observation impact cannot be deduced directly, unless first-guess (as mention in l. 272 ll) is available.
9. l. 296: "direction at low altitudes (800-1000 m) is mainly from W-SW": I find this very difficult to see in Fig. 6, among others, as the 800-1000 m layer is very shallow and the colors are not distinct.
10. l. 296: "in the rest of the profile": Please specify.
11. l. 338: "The comparison of the first level of KENDA-1/MER (Fig. 7.c)": Fig. 7c suggests that KENDA-1/MER is shown at 775 m. Which altitude is shown?
12. l. 373: "Plots of radial winds perpendicular to the valley direction clearly present this circulation pattern both in presence of up and down valley winds around sunset (Fig. S9)." Please rephrase, e.g. Figure S9 shows ...
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13. l. 359 ff: "Finally, KENDA-1/MEE overestimates the influence of the synoptic winds leading to the absence of along valley wind in winter replaced by constant slow down valley winds below 1200 m and to higher up valley wind speed in spring and summer." (i) "along valley wind in winter replaced by constant slow down valley"; Do you mean "up valley wind" replaced by down valley wind (as "along valley" wind includes both, up and down valley wind)? I'm not sure if I understand the authors reasoning why the "influence of the synoptic winds" leads to down valley winds in winter and an overestimation of up valley wind in summer in KENDA? Could the authors please explain their reasoning.
14. l. 379 "intense north-facing slope winds": Please rephrase; it is easy to confuse this with "north-facing" "slope winds" (i.e., south to north wind direction).
15. l. 389 ff: Please indicate where this information is shown.
16. .. 391: Please correct "SM/MER".
17. l. 451: "Note that the KENDA-1/MER is in better agreement than KENDA-1/MEE with SMN/MER (not shown), which can indicate significant differences in the foehn influence at the two stations." (i) "not shown" Isn't this information shown in Fig. 11? (ii) Can the difference also be related to differences in locations (as argued for MWR/MEE above)?
18. l. 480 ff: I appreciate the summary paragraph. Out of curiosity, do the authors have any hypotheses about the reasons for KENDA wind speed overestimation and simultaneous temperature underestimation?
19. l. 490: "such wind speeds difference is subject to a discussion about a potential large overestimation of the winds at this location": Do you here refer to an overestimation specifically during foehn events or during all conditions?
20. l. 592 ff: Please replace "daily cycle" by "diurnal cycle".
21. l. 610: "the NWP": Please rephrase.
22. Figure 1: I appreciate the revised map. I would suggest to increase the size of Fig. 1b, and would find it more intuitive if the x-axis were reversed to match panels a and c. In addition, I would find it helpful if the caption would indicate colors for up valley and down valley wind, respectively (e.g. up valley wind (red), etc.). Similarly for slope winds.
23. Figure captions: I would appreciate if the authors could revise figure captions (e.g. Fig. 3, 4, 7) and make sure to include the altitude of data which is shown.
24. Figs. 8 and 9: Are the same sub-sets of dates/data points used in DWL and KENDA profiles (i.e., are KENDA data points removed from the analysis when no DWL observations are available)? It looks like KENDA includes more data points. In contrast, in Fig. 6 the NAN grid points appear to match.

25. Fig. 12: Please correct date and time in all panels.
26. Fig. 12b: Please correct the colorbar labeling.
27. Fig. S11b,c and Fig. S12: I would ask the authors to increase the label sizes.
28. Supplement: I think Figs. S7 and S10 are not referenced in the manuscript. If they are relevant, please include a reference in the manuscript.
29. Title: Generally, abbreviations such as "NWP" are avoided in the title. Moreover, did the authors consider adding "Switzerland" in the title, as Meiringen is rather unknown?