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Geoscientific Model Development Discussions

Interactive comment on "A spatial evaluation of high-resolution wind fields from empirical and dynamical modeling in hilly and mountainous terrain" *by* Christoph Schlager et al.

Anonymous Referee #2

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Review of: A spatial evaluation of high-resolution wind fields from empirical and dynamical modeling in hilly and mountainous terrain

Summary

This paper describes an analysis of surface winds (not sure at what height though??) in 2 Austrian mountain regions, one with relatively simple topography and another with more complex detailed topography. The analysis compares a re-gridded product from in-situ observations of wind (and other) observations to provide a regularly gridded fields, an empirical analysis type product and a regional climate model. The analysis employs a number of statistical measures to determine the performance of the empir-

ical analysis and climate model in two objectively determined wind regimes 'thermal' events and 'strong wind' events. In general, performance with either model is poorer over the more complex terrain and for thermal events.

In general, this is a reasonable descriptive paper of standard measures of performance for wind speed simulations. However, I do feel like there is insufficient detail on 2 particular fronts of the paper. Firstly, it feels that the modeling approaches and the CALMET regridding are just presented as is, with no critical discussions of the pros and cons of the methodologies and how they could affect the analysis here. The COSMO model in particular is somewhat of a mystery and there is no speculation as to what the model may be doing wrong to have poorer performance, beyond just saying it is not high enough resolution (even though 1 to 3 km is not that big of a jump). Given the different behavior of the two regimes, the question that sparks most for me is that maybe COSMO is poorer at simulating the wind profiles of 'thermal events' versus 'strong wind events'. This is particularly pertinent to the study since the conclusions are that we need more observations and no evidence is shown that we may need better models. Thermal events are potentially complex interplays between differential heating and turbulence, which ultimately lead to the wind profile and yet none of the thermodynamic (or even wind) structures are examined from the model to understand this. So, in general an elaboration of the models' shortcomings is needed and more interpretation beyond just a description of the comparison, as this will inform model improvements which I presume is the end goal here.

Minor comments Abstract 1,14: 'skill scores' 1,16-18: I found the ordering of this confusing. 1,24: Even if the thermal events are 'strong events'? 2,3: What do you mean by decent? Acceptable?

1. Introduction 2,7: What's the definition of surface wind here – 10m? 2,9: This is potentially possible it just won't be high resolution. And how does it hamper interpolation? 2,28: Are the WegenerNet fields used as part of the INCA analysis and to also validate INCA? 3,7: Given you are referring to COLSMO-CLM as a climate model, I am unsure

how to think of actual synoptically overlapping periods with WNet? 3.12: 'and provide'

2. Study Areas and Model Data 3.26: Sensitive in that it has already experience change? 3.30: Could elaborate a bit her. Katabatic winds, turbulent PBL,... 4.10: Are not both regions subject to synoptic weather conditions given their close proximity? 4.22: Are there dangers in interpolating both relative humidity and temperature separately since one is a non-linear function of the other, due to saturation temperature being a non-linear function of T? 4.28: What are the meteorological fields used? Does this actually include explicit wind observations and what vertical levels are used? 5.25-29: This is a little confusing here. Do you mean the COSMO model is driven continuously by ECMWF on the domain boundaries for 2008-2010, and you are describing the time stepping numerics? Also, what are setting 'based on shallow convection'?

3. Evaluation Events and Methods

6.11: 'autochthounous' I had to look this up! But I am still not sure what is being referred to. 6.10-15: Is there any presumption of diurnal variations here? 6.20: 'daily global radiation'? surface solar? 6.30: These 'thermal wind events' have not really been defined yet. 6.31-34: Is this the only criteria for the 'strong wind events'. Given it is large scale synoptic would it be more meaningful to have an area coherence footprint or temporal longevity criteria. 7.7: Is this to reduce penalty in both space and time? Fig 2: This is very confusing indeed. Are these just snapshots of a particular day, even a specific hour, given the time stamp at the top of each plot? 7.33-35: I do not understand this at all. 'Ensemble of events'?? 8.21: You're implying here that Alpine pumping is a local phenomenon that arises due to local forcings topography. However, wouldn't you expect a model to do well at this if it is simply forced by the analyzed wind at its boundaries? 8.34: But wasn't this the less challenging terrain compared to the other region? 9.1-10: Although the wind roses do give a good summary of the biases in wind direction, the key thing to understanding the differences of course is the synoptic distribution over the domain. This shows that INCA is not southerly enough mostly in the southern part of the domain. Is this explainable from this perspective? 9.11-12:

This is really surprising given that COSMO is all yellow/orange whereas the other fields are seeing weaker speed values in the greens. 9.16: 1th?? 9.24-29: This needs more interpretation here. What aspect of the dynamical model is failing? Is it the solution itself or is it the synoptic setup? Why does 8/1/2012 mostly succeed but this day fail? 10.6: Won't this always be true of COSMO in these synoptic circumstances? However, the scale of the features for the high wind regions here are actually above the coarser grid scales of COSMO, so this lack of resolution reasoning is not correct is it? 10.21: Unable instead of able?? 10.25: Again, though isn't this the simpler terrain region? Fig 4: It is very surprising that the COSMO model has a widespread systematic bias over the simpler FBR region, but a much reduced systematic bias in general over the much more complex terrain of the JBT region.

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