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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Long-range transport of terrain-induced turbulence from high-resolution numerical simulations" *by* M. Katurji et al.

M. Katurji et al.

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Author response to reviewer comment RC 6310 on the paper:

Thank you for taking part in making this research a better science.

Katurji, M., Zhong, S., & Zawar-Reza, P. (2011). Long-range transport of terrain-induced turbulence from high-resolution numerical simulations. Atmospheric Chemistry and Physics Discussions, 11(3), 9797-9829. doi: 10.5194/acpd-11-9797-2011.

All typo errors were attended to in the updated version of the paper.

Reviewer: "While the authors state that "The simulations carried out in this work are 2-D turbulence resolving simulations. 2-D and 3-D turbulence resolving simulations are

very different in nature (physically and numerically)".

Author: This issue is already stated clearly in the last paragraph of the introduction section. Please refer to the paper. But it is worth reiterating it here again for the sake of more clarity.

2D and 3D turbulence simulations are very different in nature (physically and numerically). Practically, there might be no 2D turbulence in the physical world, and might only exist when geometric length scales permit the dominance of one dimension over the other. It is very theoretical, relatively simple and quicker to solve and is a purely numerical approach. One fundamental difference between 3D and 2D turbulence is the vortex stretching in the 3rd dimension, which is not present in 2D. The second fundamental difference is that 3D turbulence is characterized by downward energy cascade into smaller scale, while in 2D there exists an inverse cascade from smaller to larger energetic scales

Reviewer: "The explanation given for choosing one-minute averages does not make sense. In order to obtain statistically good estimate of the average the averaging period should be several eddy turnover times. The authors state that spectral analysis indicated that eddy turnover time is between 7 and 11 minutes (which is reasonable) then averaging time should be at least 30 minutes. For example, in Figures 4, 5, 6, 7. 8, 9, and 12 30-min averages are presented, so it is not clear why the authors did not compute use these averages to compute TKE".

Author: Calculating the perturbation velocity from a mean quantity (model output) can be basically done on any time average interval that represents the simulated phenomena and can be carried out without noise. Since the frequency analysis of the velocity signal suggests a periodic power enhancement on the wave period between 7 to 11 minutes, then this means the largest eddies take around this time to complete their travel cycle over a sampling point. In periods less than the 7 minute interval eddies, of various sizes are also present, in fact there exists overlapping periods of new coming and lagging eddies leaving various turbulent footprints in the signal. The 1-minute period was chosen as the average interval out of which the perturbation velocity was calculated so not to smooth out heavily the effect of these smaller eddies and large eddy footprints. The 30-minute average interval for the TKE diagrams is only a mean representation of the turbulent flow field and not the average interval out of which the turbulent quantities were calculated from.

Reviewer: "The estimate of subgrid TKE is given for the whole domain and as such could be considered meaningless. Subgrid TKE is dominant near the surface or near any strong gradients (eg. inversion) and subgrid TKE should be always included in the TKE estimate."

Author: Subgrid TKE was not estimated from the whole domain. Sorry for the confusion but this was missing information that should've been added before. Thanks for bringing it up to our attention. The subgrid TKE was actually estimated from near surface, 15 m above ground level. This clarification is now added in the text.

Reviewer: The authors present most of the results in terms of comparing base simulations to an ensemble of simulations, however, no explanation is given about the meaning of an ensemble over different slopes. In my opinion the analysis should be focused on the effect of the slope - variation and scaling of the results with the steepness of the slope. Ensemble averaging prevents such analysis.

Author: The ensemble, as defined in the paper, represents the average of the results over a range of slopes. This method of analysis was not chosen to highlight the effect of various terrain slopes (which is not the scope of this research), but rather was presented to ensure repeatability and a mean representation of the flow over such terrains. The second set of experiments was designed to deal with a different aspect of terrain, the height.

Reviewer: The sentence "It is worth noting that the formation of the above mentioned rotors do not represent a steady and periodic one." is not clear, it is not clear what is

"steady and periodic one".

Author: The new sentence now reads as: "it is worth noting that the formation of the above mentioned rotors represent a time snapshot in the simulation, and not a spatial or temporal average".

Reviewer: "Figure 3c - It is not clear what is the square in the figure representing".

Author: Clarification is now added in the figure caption, and the square region is already discussed in section 3.1 paragraph 4.

Please also note the supplement to this comment:
http://www.atmos-chem-phys-discuss.net/11/C7861/2011/acpd-11-C7861-2011-supplement.pdf

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