Earth Surf. Dynam. Discuss., 3, C429–C431, 2015
www.earth-surf-dynam-discuss.net/3/C429/2015/

Earth Surface Dynamics
Discussions
Open Access

Interactive comment on "Predicting the roughness length of turbulent flows over landscapes with multi-scale microtopography" *by* J. D. Pelletier and J. P. Field

Anonymous Referee #2

Received and published: 18 November 2015

The authors propose a phenomenological model of the roughness length for fully rough flows in terms of the amplitude and slope of each Fourier mode of the topography. The functional form of the roughness length is obtained from CFD simulations of turbulent flows on sinusoidal surfaces. At least one parameter of the model is then calibrated using measurements of wind velocity and topography in flat non-vegetated areas. It is finally shown that the model reproduces the data within a 50% error.

The problem of estimating the roughness length or friction factor from topography is an old, difficult and indeed important one. However, in my opinion the present manuscript has several fundamental problems and I cannot recommend publication in its present

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

form.

1- Multi-scale analysis: There is no evidence in the paper that the fact a topography has multiple scales affects the roughness length in any meaningful way. The CFD simulations are run with single scale sinusoidal surfaces, while there is no clear way to measure the contribution to the roughness length from the different scales within the topography. I suggest the authors to use the CFD code to test this hypothesis and run simulations with multi-scale synthetic data (with few sinusoidal modes to get a better picture). That way they could compare the simulations with predictions using either Eq. 3 with an effective amplitude and slope or Eq. 4. Without this basic information any discussion of the effect of multiples scales is merely speculative.

2- Comparison with field data and interpretation: it is very confusing to use Fourier analysis to make statements about multiple scales because for non-sinusoidal patterns there is no one-to-one relation between the scale of the pattern and a peak in the Fourier spectra. In fact, I don't think it is possible to discuss any 'potential' effects of multiples scales from Figs. 5 and 11, which renders Eq. 4 meaningless when applied to non-sinusoidal surfaces. I suggest using different techniques such as wavelet analysis for this.

2a- More than a signature of a multi-scale phenomena, the good correspondence between measured values and fitted ones using Eq. 4 in Fig. 12, could be just result of the underlying correlations of the roughness length with H_RMSE and S_av as shown in Fig. 8. The authors could check if Eq. 3 fits the field data with an effective amplitude and slope. Eq. 3 could then represent an improvement over existing formulas but without all the complexities of a multi-scale approach.

3- Validation of the CFD model: It is not clear to me that the CFD code is actually able to reproduce the real trends of the measured roughness length on different surfaces. Why not use the measured microtopography to run the model and compare? Even a qualitative comparison will strengthen the argument of the CFD model as a tool to

ESurfD

3, C429–C431, 2015

develop expressions for the roughness length.

Minor points:

- Figure 6: please plot wind velocity u vs elevation z in a semilog plot without rescaling the wind velocity. That way the interpretation is straightforward: slope is proportional to u* and the virtual crossing of the z-axis at u=0 by the prolongation of the log-profile is z_0.

- End of page 1121: The description of Fig. 6 is wrong, a steeper slope doesn't necessarily correspond to a smaller z_0. Please correct with the new version of Fig. 6 (see above).

- In Eq. 4, is the constant z_{0g} fitted to the field data?

- The definition of S_{av} is not clear, why not use the RMS of the gradient of the topography or an alternative definition that doesn't not involves defining any thresholds?

Interactive comment on Earth Surf. Dynam. Discuss., 3, 1107, 2015.

ESurfD

3, C429–C431, 2015

Interactive Comment