**Hydrology and
Earth System
Sciences
Discussions**

# *Interactive comment on* "Terrain surfaces and 3-D landcover classification from small footprint full-waveform lidar data: application to badlands" *by* F. Bretar et al.

**Anonymous Referee #1**

Received and published: 17 February 2009

Contribution overview:

In this contribution small footprint full-waveform laser data is used to classify a badland landscape for hydrological and erosion criteria.

Various features are extracted from the full-waveform laser data, namely range, intensity and pulse width. By considering the sensor orientation and position (trajectory) a 3D point is calculated for each single range value. Further a DTM of the landscape is determined based on the 3D points. The reached accuracy is within a decimeter range.

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

Restructured features derived by the laser data are used to feed a Support Vector Machine Classifier. The results of the classification are the four classes ROAD, ROCK, VEGETATION and LAND. Further for comparison purposes two RGB orthoimage data sets, captured with different cameras, are classified by a Support Vector Machine Classifier. Both classification methodologies consider the DTM generated from the laser data. Apart from this different features depending on the data sets are investigated. As final conclusion the classification based on the feature intensity and width derived from the laser data is promising but slightly better results are reached by the use of image based radiometric features. The best result is achieved by a combination of all features gained from the laser along with the image data sets.

General comments:

In general the paper is written well, interesting to read and a wide scientific area is covered. The topic falls, in my opinion, within the scope of HESS. Some aspects have been published before but never, as I know, within such a combination for hydrological aspects. Most aspects are presented clear. The "accuracy study of the DTM" (Section 5) could be reduced or should be considered in the title. The introduction could be better organized and clarified by structure it for technical and application criterias, right now it is mixed up. The authors give proper credit to other works and the number and quality of references is appropriate.

Specific comments:

Title: Could be improved it is very general

153-11: the only visible layer from passive sensors -> depending on the density of the observed vegetation

152-24: Remote sensing is an effective set of techniques ?

154-1: Please state "friction coefficients"?

154-8: same technology -> I disagree, the digitalization and recording of the waveform

has to be done

154-9: They -> The reflected pulse not the lidar system

155-29: Please add further references for this scientific field with direct citation, e.g. Reitberger et al. (2008), Jutzi & Stilla (2006), Wagner et al. (2006).

Reitberger J, Krzystek P, Stilla U (2008) Analysis of full waveform LIDAR data for the classification of deciduous and coniferous trees. International Journal of Remote Sensing, 29(5): 1407-1431

Jutzi B, Stilla U (2006) Range determination with waveform recording laser systems using a Wiener Filter. ISPRS Journal of Photogrammetry & Remote Sensing 61 (2): 95-107

Wagner W, Ullrich A, Ducic V, Melzer T, Studnicka N (2006) Gaussian Decomposition and Calibration of a Novel Small-Footprint Full-Waveform Digitising Airborne Laser Scanner. ISPRS Journal of Photogrammetry & Remote Sensing 60 (2): 100-112

157-9: Please add an additional sentence about the trajectory (navigation)

157-12: Which main influences?

158-21: literature -> can you please provide references

159-second paragraph: Does you method consider the shortest possible pulse length (FWHM of the emitted pulse)?

160-second paragraph: Was a boresight and leverarm correction done?

162-9: Was a fine registration done, eg by ICP? The accuracy might suffer from randomly measured vegetation points

162-18: For monostatic laser systems Theta_i=Theta_s can be assumed.

Please revise the expressions in general Source <-> sensor Distance <-> range I think it would be better to stay with one of these expressions. They are mixed up and

might confuse the reader.

163-11: variations -> This is interesting because it is depending on the used laser (scanning system). You use a Riegl LMS-Q560, as I know, it should be stable.

167-12: D8 ? Please provide references

169-11: Where is it "showed" I couldn't find, please improve.

172-11: Please separate 6.2 Results and 6.3 Discussion (174-16)

7 Conclusion: Please separate first paragraph in two paragraphs for accuracy an classification

Figure 3: Which criterias are used to separate the classes VEGETATION POINTS, OFF-GROUND POINTS, OUTLIERS ? Aren't VEGETATION POINTS and OUTLIERS a sub-class of the OFF-GROUND POINTS? Please clarify. How do you estimate the outliers?

Technical corrections:

152-13: Wa -> We

152-21: Introduction?

153-7: of -> with

153-8: reflection -> reflected

153-19: meshes?

153-20: Please clarify this sentence

156-15: Please proof grammar

157-14: The "selected" PRF

157-21: are -> have a small

157-25: Please revise this sentence.

158-3: FWHM -> width at FWHM

158-3: geometry ? Position, viewing angle?

158-4: neighborhood

159-3: please delete "a paper written by"

159-20: The sentence "The standard..." is not clear please improve

160-4: a -> one

160-10: Please delete this sentence it is not relevant at this point

161-23: comma

162-7: Please extend "distance source-target" this expression. Do you mean "distance between source and target"

162-10: Please revise this sentence it is hard to understand.

162-22: receptor, I suggest to use receiver optic instead

163-9: "emitted laser direction" makes no sense -> direction of the emitted laser pulse

163-20 The width at FWHM

166-5: w.r.t.?

168-3: bracket

168-27: form -> from

169-9 & 169-26: DTMs derived by full-waveform LiDAR

169-10: catchment -> area

169-24: bracket

170-7: mentioned

170-17: reference is missing

171-4: Mallet et al. (2008)

172-10: bracket

172-20: RGB_RAW is missing

175-4: I suggest to use "General conclusion"

Table 1 & 2: Please change order of appearance.

Figure 1: Please improve: Emitted laser pulse -> signal of the emitted (laser) pulse Backscattered signal -> signal of the backscattered (laser) pulse

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 151, 2009.