Earth Surf. Dynam. Discuss., 3, C683–C687, 2016
www.earth-surf-dynam-discuss.net/3/C683/2016/

ESURFD_Log

Interactive comment on "Detection of seasonal erosion processes at the scale of an elementary black marl gully from time series of Hi-Resolution DEMs" *by* J. Bechet et al.

Anonymous Referee #2

Received and published: 6 March 2016

Review of ESD-Disc 1555-2015

Detection of seasonal erosion processes at the sacle of an elementary blac marl gully from time series of Hires DEMs

Bechet et al

I was saddened when reading in the acknowledgements that the first author had deceased in an avalanche accident. I wish the team of co-authors much strength in dealing with this loss. It is to be commended that they decided to finish this work and dedicate it to Dr. Bechet.

The ms deals with a multi-temporal dataset of highly accurate DEMs, which are subtracted from each-other to yield Dems of Difference (although this term is not mentioned). The objective is to create seasonal maps of erosion (confusingly called ablation) and sedimentation, and to extract a conceptual model from this. The data presented are interesting and worth my time. The main conclusions about seasonality appear to be warranted, although they should be defended rather than posited, and some extra calculations are required to put them further into context. I am not well placed to comment on the quality of embedding the discussion in the context of (international) gully erosion research, but this appears to be going well. Figures are well made up (but see comments) and support the storyline. My main points for improvement of the ms follow here - a detailed list of suggestions is given below.

First, I find that the seasonality of processes is the most interesting point of the document. It deserves a clear presentation - first as a hypothesis, which has led to your data gathering scheme (i.e. multiple times per year). Then the data should be examined, and you can conclude (a bit later in the ms than you do now) that there are strong seasonal differences in what you observe. From that, the conceptual model can follow.

Second, one main possible uncertainty that you have not been able to resolve is the effect of weathering on bulk density and hence on slope swelling. I think that you should get at some preliminary estimates of this effect, and that this can strengthen your interpretation. I make suggestions below.

Third, there is a long list of small language issues in the ms. I make detailed suggestions for improvement below. The main point would be that in my perception ' erosion' is a more common term for what you call 'ablation'.

Most of my comments will be easily considered and if needed, corrected. However, because some restructuring of the arguments is needed along with new calculations that could lead to some changes in the argumentation, I recommended major revisions to the editor. I expect however that these will not take up too much of your time.

Abstract l 22 temporal : temporary? 1558 l 20 : It is unclear to me what SOERE RBV is. Is it a reference? Then it lacks a year. 1559 l 15 - move the explanation of SOERE BV to earlier in the ms 1559 l19 what is IRSTEA? 1560 l23 A limestone ridge overlies the marls - this is confusing to me. A ridge is a landform, 'the marls' is a sedimentary formation. Please clarify. 1561 l17 it would be useful here to present the mean annual air temp and the average temperature in the three winter months instead of daily average. 1561l25 But... this sentence is not understandable (use 'but' only once, for instance). 1562 l 11 A popcorn structure? This requires a photograph and/or some extra explanation. I have no idea what this means. 1562 l 13 erosion rates of the b. m. is 8 mm yr-1 (no 'of"). 1562 l14 8 mm / yr , calculated over which period? Same for next sentences l17 upper part of the slopes 1563 l 8 Yes, indeed, give wavelength. l10 from May 2007 to November 2010 (no 'the') l18 are less than (no of) l19 ranges from 0.3 to 3 pts cm-2 1564 l8 As an example : this sentence is too long, has at least one error and is not clear to me. Please check and cut up into two new sentences. l21 to l24 this is not understandable to me. What are you doing in addition to simply taking the difference between each HRDEM and the subsequent HRDEM? Are you matching a HRDEM with one from the same season a year back? Why? If that is true, change in l17 : "from AN earlier HRDEM". l26 "these maps ....including the interpretation ... of .. process"? How can a map include an interpretation of a process - it shoudl be a result of your work that can not be contested - not an interpretation that we can have different opinions about. 1565 l5 subtracted from l10 why do these volumes need to be corrected? Do you mean convert? And what does this have to do with vegetated areas? l12 and if the density changes throughout the year, then why always use 1500 kg m-3 ? l16 results were compared l23 that were quantified l25 due to atmospheric conditions in the last section of the methods, you talk a lot about what CAN be done to quantify the errors. Has this also been done in your case? 4 results l22 ablation should be erosion, also in captions and elsewhere. It is not an international term, I believe. 1567 Two main comments about the 5 'seasons'. I believe that your recognition of possible seasonality is a main attraction of this work. I think you should therefore not

posit that seasons make a difference, but you should formulate it such that we see how you came to believe this, and to what extent you are sure about it. One weakness that you could highlight in this respect is that the winter season is characterized by only one observation / pattern. Second, does your method account for the fact that in some cases there may be a difference in altitude (or distance to the scanner) that is caused by expansion of the slope as it undergoes weathering but not erosion? You did discuss the large differences in bluk density between bedrock and regolith/soil, so this effect may be significant. This may be particularly important in the winter season. Please comment. 1568 l7 . This is probably etc. : please save interpretation for the discussion section. l8 This sentence is superfluous: for gullies with any flowaccumulation, if there is not enough rainfall or rain intensity, there will be no transport. l19 very often: often l21 characterized by relative drought 1569 l 8 The difference is in an - this is a new sentence l12 I would prefer the dimnsions of 8m3 to be changed into volume per time. This is going to be important because not all your seasons are equally long. 14 rainfall was 1570 At l6 you conclude that you are underestimating - and then you give the reasons, before hypothesizing that you are underestimating, Better turn this around: first hypothesize, then give your reasons for it, and then conclude that you have a lot of confidence in your hypothesis. l16 I am glad to see your attention for the swelling due to weathering. But before you discount this, why don't you provide a back-of-the-envelope calculation of the difference this would make? Roughly speaking, most of the year's weathering happens in winter, right? So, assuming equilibrium between weathering and erosion (which you implied before when you said that slopes do not change shape), why not take the annual volume of material captured in your sediment trap, divide that over the slope area (perpendicular to the slope, not aerial area). That should give you a first order estimate of the swelling? In imaginary numbers: if you have 10 kg leaving your catchment in a year, and you have 1000 m2 of slope area, then on average you have 0.01 kg/m2 slope area that has been eroded, and hence been weathered first. Weathering 0.01 kg/m2 from a bulk density of bedrock (2500 kg/m3) into a bulk density of sediment (1350 kg/m3) , would correspond to a swelling

of the slope by (0.01/1350)-(0.01/2500) m / m2. My numbers are surely wrong, but perhaps the approach is valuable. Alternatively and more locally, you have the local erosion for your pixels over a whole year - assuming again that this is of an order with the local weathering, you could maybe do local erosion [m] * local slope gradient [m/m] * (density regolith / density bedrock) [-] . 1571: 11 rainfall event l12 from a transport-limited pattern (at ....spring) to a supply-limited one (in summer). l22 sentence may be wrong 1572 l19 inter-rill erosion ,23 moving a few m through solifluction in one winter? That is very surprising to me. I am not aware of so rapid solifluction. Please illustrate this statement with literature or process knowledge. Are you thinking about mudflows?

Figures F1 - no comment F2 - I love this figure. Very crucial to the paper, and it illustrates the richness of your data. However, individual maps are rather small. Could you please rearrange the titles of each so that you can zoom in a bit more to the maps? They deserve as much space as you can give them. F3 ablation=erosion. In legend: deposit - deposition. Also here, I think you can blow up the maps a bit larger. F4 - do not show the zero values for cumulative [recipitation or intensity. You have used a threshold so this is not fair. In the caption, are you talking intensities per minute over a 1 minute period? Or five? or ten? F5 perfect.

Interactive comment on Earth Surf. Dynam. Discuss., 3, 1555, 2015.