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Earth Surface Dynamics Discussions

Interactive comment on "Non-linear power law approach for spatial and temporal pattern analysis of salt marsh evolution" *by* A. Taramelli et al.

Anonymous Referee #1

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General Comments: In this paper titled "Non-linear power law approach for spatial and temporal pattern analysis of salt marsh evolution", Taramelli et al. analyze the spatial distribution of vegetation pattern sizes and show that the probability distribution of cluster size might not follow a power law relationship. In the tail of the distribution, in fact, data may show a non-linearity (in a log-lo plot) and lie outside of a power law. The Authors argue that changes in the main climatic and hydrodynamic variables are responsible for such a behavior.

Although the manuscript addresses a timely issue of interest to ESurfD, I do not find the key findings of this paper particularly capturing nor capable of bringing new insight into our current knowledge of salt-marsh geomorphological and ecological dynamics. Many parts of the paper seem to be poorly written and the paper is often cloudy and unclear.

Most of the paper focuses on methodology, whereas the causal effects between the distribution of vegetation patterns and environmental stressors, which could be the novel aspect of this paper, are overlooked. Overall, I do not feel that at this stage, this is a strong enough paper to merit publication in ESurfD.

Specific Comments: A crucial point is that the purported correlation between the distribution of vegetation patches, salinity, rainfall and water height completely lacks a physical explanation. The same observation holds for the link between the existence of a relationship between areas of different vegetation patches and sinuosity. The description and discussion of such relationships is very vague and suggests the authors mistake correlation with causation. Some of these issues have already been studied (a list of papers follows) through the attempt of finding a causal relationship between the interaction of physical and ecological processes and their effects on vegetation distribution.

As I said, most of the paper focuses on methodology, whereas the description of the salt-marsh environment and of the physical and ecological processes which control its evolution is lacking or addressed superficially. Moreover, the authors do not discuss existing results which their analyses could be building upon. While reading the manuscript one has the feeling that almost no work has been done in the fields of remote sensing methods in salt-marsh systems and of salt-marsh eco-geomorphology. While the consideration of related works is not adequate at all, it seems that the authors indulge too much on their own contributions referring also to submitted papers (this should be avoided, in my view). The spatial distribution of halophytic vegetation over salt marshes, characterized by the existence of typical vegetation patches (zonation) has been largely studied, and possible physical-ecological interactions leading to the development of these patterns have largely been addressed. This is completely overlooked in this paper. A short list of contributions on this issue follows:

- Adam P. (1990), Saltmarsh Ecology, Cambridge Univ Press, Cambridge;

- Chapman V.J (1964), Coastal Vegetation. Pergamon Press, Oxford the Macmillan Company, New York;

- Bertness M.D (1991), Interspecific interactions among high marsh perennials in a New England salt marsh, Ecology 72, 125–137;

- Bertness M.D. and A.M. Ellison (1987) Determinants of pattern in a New England salt marsh plant community, Ecol Monogr 57(2):129–147;

- Bertness M.D et al. (1992), Salt tolerances and the distribution of fugitive salt marsh plants. Ecology 73, 1842–1851;

- Bockelmann A.C., et al. (2002), The relation between vegetation zonation, elevation and inundation frequency in a Wadden Sea salt marsh, Aquatic Botany 73, 211–221;

- Marani M. et al. (2013), Vegetation engineers marsh morphology through multiple competing stable states, Proc. Natl. Acad. Sci. USA 110, 3259–3263;

- Moffett K.B. et al. (2012) Salt marsh ecohydrological zonation due to heterogeneous vegetation – groundwater – surface water interactions, Water Resources Research, 48, W02516;

- Pennings S.C., and R.M. Callaway (1992), Salt marsh plant zonation: the relative importance of competition and physical factors, Ecology 73, 681–690.

As to the effects of environmental forcing on salt-marsh vegetation patterns, I have included below a short list of references:

- Moffett K.B. et al. (2010) Relationship of salt marsh vegetation zonation to spatial patterns in soil moisture, salinity and topography, Ecosystems, 13: 1287-1302.

- Moffett K.B. et al. (2010) Salt marsh–atmosphere exchange of energy, water vapor, and carbon dioxide: effects of tidal flooding and biophysical controls, Water Resources Research, 46, W10525;

- Pennings S.C. et al. (2005) Plant zonation in low-latitudes salt marshes: Disentangling the roles of flooding, salinity and competition, J Ecol 93:159–167;

- Pezeshki S.R. (2001), Wetland plant responses to soil flooding, Environmental and Experimental Botany 46, 299–312;

- Sanchez J.M. (1996), Relationships between vegetation zonation and altitude in a salt-marsh system in northwest Spain, Journal of Vegetation Science 7, 695–702;

- Silvestri S. et al. (2005), Tidal regime, salinity and salt-marsh plant zonation, Estuarine, Coast. and Shelf Sci. 62, 119-130.

Salt-marsh vegetation patterns have already been studied through remote sensing analyses, as well as the probability distribution of cluster vegetation size (analogous to what is done here): - Belluco, E. et al. (2006), Mapping salt-marsh vegetation by multispectral and hyperspectral remote sensing, Remote Sensing of Environment, 105, 54–67;

- Eastwood, J. A. et al. (1997), The reliability of vegetation indices for monitoring salt-marsh vegetation cover. International Journal of Remote Sensing, 18(18), 3901−3907;

- Marani M. et al.(2006), Analysis, synthesis and modelling of highâĂŘresolution observations of saltâĂŘmarsh ecoâĂŘgeomorphological patterns in the Venice lagoon, Estuarine Coastal Shelf Sci., 69, 414–426;

- Marani M. et al.(2006) Spatial organization and ecohydrological interactions in oxygen-limited vegetation ecosystems, Water Resour. Res., 42, W06D06;

- Ramsey E. W. and S.C. Laine (1997), Comparison of landsat thematic mapper and high resolution photography to identify change in complex coastal wetlands, Journal of Coastal Research, 13(2), 281−292;

- Schmidt, K.S. et al. (2004). Mapping coastal vegetation using an expert system and hyperspectral imagery, Photogrammetric Engineering and Remote Sensing, 70(6),

703−715.

- Silvestri S. et al. (2003), Hyperspectral remote sensing of salt marsh vegetation and morphology, Physics and Chemistry of the Earth, 28 (1-3), 15-25;

- Thomson A. G. et al. (1998), Ground and airborne radiometry over intertidal surfaces:Waveband selection for cover classification, International Journal of Remote Sensing, 19(6), 1189−1205;

- Thomson, A. G et al. (2003), The use of airborne remote sensing for extensive mapping of intertidal sediments and saltmarshes in eastern England, International Journal of Remote Sensing, 24(13), 2717−2737.

- Wang C et al. (2007), Mapping mixed vegetation communities in salt marshes using airborne spectral data, Remote Sensing of Environment, 107 (4), 559-570.

The Authors have some work to do in order to clarify the importance of their results and in particular to interpret their findings in view of the physical and ecological processes which control salt-marsh geomorphological and ecological features. In general, I suggest the Authors do a better job in identifying what may be new in what the propose to do (the non-linear relationship between the percentage of flooded salt-marsh area and tidal elevation is known since the 1955, to my knowledge).

Specific/Technical Comments Lines 17-18. This is called zonation and a wide literature exists describing zonation patterns in salt-marsh systems e.g., Adam (1990);

Lines 21-22. Please rephrase.

Lines 23-24. Why “the presence and typology of vegetation and channel sinuosity” should be “monitored simultaneously”?

Lines 28-29: Why “the deviation from power laws” should represent “stochastic conditions under climate drivers”?

Line 49. Change “permit” to “permits”.

Line 56. Please specify what equations you are referring to.

Line 57. “times” should be “time”.

Lines 60-63. This needs be rephrased. It is not clear to what power laws the authors are referring to. Do you mean that power law relationships describe the characteristics of estuarine systems?

Lines 64-66. Please rephrase. “element” should be “elements”; “small changes perturbation that. . .” does not make sense.

Lines 70-79. My feeling is that the Authors indulge too much on their own works, neglecting a large body of literature which has addressed analogous issues in tidal landscapes, e.g.:

- Eastwood et al. (1997) [International Journal of Remote Sensing, 18(18), 3901−3907]; - Ramsey et al. (1997) [Journal of Coastal Research, 13(2), 281−292]; - Thomson et al. (1998) [International Journal of Remote Sensing, 19(6), 1189−1205]; - Thomson et al. (2003) [International Journal of Remote Sensing, 24(13), 2717−2737]; - Silvestri et al. (2003) [Physics and Chemistry of the Earth, 28 (1-3), 15-25]; - Schmidt et al. (2004) [Photogrammetric Engineering and Remote Sensing, 70(6), 703−715]; - Belluco et al. (2006) [Remote Sensing of Environment, 105, 54–67]; - Marani et al. (2006) [Estuarine Coastal Shelf Sci., 69, 414–426]; - Wang et al. (2007) [Remote Sensing of Environment, 107 (4), 559-570].

Line 84. “on certain occasions” is very vague. Please clarify. Line 105. “represent” should be “represents”.

Lines 124-126. This sentence does not make sense. Please rewrite.

Line 127. What do you mean with “strong climate forcing”?

Lines 157-159. I wonder why the “starting and ending points” were chosen at channel bifurcations.

Line 163. I fairly do not think that you need to specify that you have used Pythagoras' theorem to compute the distance between two points.

Lines 164-166. I wonder why these network attributes were chosen. Is there a physical explanation? Does the number of bifurcation points or the total number of channels carry information on network structure and function?

Lines 170-171. Please clarify the reason for averaging tide levels over 14, 30 and 60 days before the acquisition.

Lines 176-177. I wonder if there is any evidence supporting the assumption that actual landscapes are not in "dynamic equilibrium".

Line 198. Please define \alpha.

Line 237. "aposteriori" should be "a posteriori".

Lines 290-293. I wonder why channel sinuosity should be related to patch size. What are the biogeomorphic processes and feedbacks responsible for the relationship between channel properties and patch size distribution?

Line 297. "distribution" should be "distributions". The sentence in lines 297-298 is unclear, please rewrite and clarify.

Lines 343-351. The non-linear relationship between inundated slat-marsh area and tidal height was observed by Ragotzkie and Bryson (1955) [Bull. Mar. Sci. Gulf Carib. 5, 297-314] and later used by e.g. Boon (1975) [Limnology and Oceanography 20, 71-80] and Pethick (1980) [Estuarine and Coastal Marine Science 11, 331-345] in their simplified models of tidal channel hydrodynamics. It is usually called hypsometric curve. The effects of an increase in the tidal level can be determined straightforward, with no need of "sophisticated" analyses. Moreover, I do not see any (non-trivial) linear relationship between the percentage of inundated area and the tidal level for elevations smaller than -50 cm NAP.

Lines 359-360. Where was this shown?

Lines 402-406. This speculation might be interesting, but need be supported by evidence in a scientific paper.

Interactive comment on Earth Surf. Dynam. Discuss., 1, 1061, 2013.