Natural Hazards and Earth System Sciences Discussions

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC2
https://doi.org/10.5194/nhess-2022-79-RC2, 2022

Comment on nhess-2022-79

Anonymous Referee #2

Referee comment on "Insights into the vulnerability of vegetation to tephra fallouts from interpretable machine learning and big Earth observation data" by Sébastien Biass et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-79-RC2, 2022

The approach to studying effects of tephra deposition on vegetation using earth observation data available in digital archives is interesting. It offers new opportunities for complementing in situ observations and experimental studies of tephra effects. There are numerous caveats involved in such an approach, and the authors have listed most of these. However, among the issues that limit the interpretability of multispectral images to estimate tephra impacts, the following aspects should be given more attention:

- Vegetation structure: the three-dimensional structure of the above-ground parts of vegetation, the physical rigidity of the above-ground parts and the ability to resprout if buried under tephra are aspects which are likely to be relevant for estimating resilience of natural vegetation as well as agricultural crops. Given the low thematic resolution of the currently available data products such as those based on MODIS images, considerable uncertainty has to be expected, and reducing this will be a key challenge for integrative approaches that bring together remote sensing, field studies and experiments.

A relevant reference in this context is:

Zobel, D. B., and J. A. Antos. 1997. A decade of recovery of understory vegetation buried by volcanic tephra from Mount St. Helens. Ecological Monographs 67:317-344.

- Variability of physical and chemical characteristics of eruptive events: the relative importance of physical and chemical components in the impact of volcanic eruptions on vegetation and farming systems has been discussed for some time (see references listed below), but with the limited evidence available, no consensus has been reached. Gaining a better understanding of these aspects will be a prerequisite for utilizing remote sensing approaches in the development generalizable models of volcanic impacts.

Dodgshon, R. A., D. D. Gilbertson, and J. P. Grattan. 2000. Endemic stress, farming communities and the influence of Icelandic volcanic eruptions in the Scottish Highlands. Pages 267-280 in D. R. G. W.J. McGuire, P.L. Hancock and I.S. Stewart, editor. The archaeology of geological catastrophes. Geological Society, London.

Edwards, K. J., A. J. Dugmore, and J. J. Blackford. 2004. Vegetational response to tephra deposition and land-use change in Iceland: a modern analogue and multiple working hypothesis approach to tephropalynology. Polar Record 40:113-120.

Grattan, J. 2005. Pollution and paradigms: lessons from Icelandic volcanism for continental flood basalt studies. Lithos 79:343-353.

- The role of timing of eruptions in relation to phenological stages of natural vegetation and agricultural crops: there is some evidence for the relevance of the timing of tephra impacts on vegetation responses, e.g. from observations after volcanic events and from experiments.

Fruchter, J. S., D. E. Robertson, J. C. Evans, K. B. Olsen, E. A. Lepel, J. C. Laul, K. H. Abel, R. W. Sanders, P. O. Jackson, N. S. Wogman, R. W. Perkins, H. H. van Tuyl, R. H. Beauchamp, J. W. Shade, J. L. Daniel, R. L. Erikson, G. A. Sehmel, R. N. Lee, A. V. Robinson, O. R. Moss, J. K. Briant, and W. C. Cannon. 1980. Mount St. Helens Ash from the 18 May 1980 Eruption: Chemical, Physical, Mineralogical and Biological Properties. Science 209:1116-1124.

Mack, R. N. 1987. Effects of Mount St. Helens ashfall in steppe communities of Eastern Washington: one year later. Pages 262-281 in D. E. Bilderback, editor. Mount St Helens 1980 - Botanical consequences of the explosive eruptions. University of California Press, Berkeley.

Hotes, S., P. Poschlod, H. Takahashi, A. P. Grootjans, and E. Adema. 2004. Effects of tephra deposition on mire vegetation: a field experiment in Hokkaido, Japan. Journal of Ecology 92:624-634.

In this context, the statement in line 159 ' tephra on crops perturbate plant phenology ' is not ideal; tephra deposition can affect plants differently according to the phenological stage, and the magnitude of the impact determines whether subsequent phases in the phenological development are significantly disrupted or not.

The use of indicators to quantify and communicate tephra effects on vegetation should be considered carefully. The Cumulative Difference Index depicted conceptually in Figure 3 is not intuitive in the sense that it keeps decreasing even if the state of the vegetation under consideration is stable, a stable, negative value indicates recovery of the state prior to disturbance, whereas a return to the value prior to the disturbance event requires the underlying vegetation index to exceed the values during the baseline period. Although it is useful for determining the minV and minT values used in the modelling exercise of this study, for communicating the actual processes observed in the vegetation, using vegetation indices would be more accessible to a wider audience.

The text is generally well-written and the figures are largely clear, but some copy-editing is necessary.

Line 32 datasets open -> datasets and open

Line 125 Figure 1 It would be helpful to link the legends to the respective parts of the figure. Are all the listed climate types represented on the map? It seems that the legend could be simplified somewhat. Mean annual precipitation is by definition cumulative; this should also be corrected in the figure caption.

Line 145 of entire region -> 'an entire region' or 'entire regions'

Line 175 three different ecosystems: At this level of spatial classification, 'biogeographical region' seems more fitting than 'ecosystem', which is usually described based on more detailed biological, chemical and physical criteria.

Line 190 'precipitation' is uncountable; please check and correct throughout the manuscript

Line 267 identified from literature -> identified from the literature

Line 269 Here are presented the final set of variables -> Here we present the final set of variables

Line 270 Please quantify what you mean by 'a minimum degree of relations'

Line 271 an iteration -> iterations

Line 310 Beck et al., (2018)'s updated 1-km version of the Köppen-Geiger climate classification -> the updated 1-km version of the Köppen-Geiger climate classification by Beck et al. (2018)

Line 800 facet of risk -> facet of risk assessment and management