REPLY TO REVIEWER SHUANG-HUA YANG

Dear Dr. Shuang-Hua Yang,

We would like to thank you very much for your comments and suggestions. Your help is strongly appreciated, and we believe it will significantly contribute to the improvement of our manuscript.

We propose to address your comments after dividing them into two major points. For easing the reading of our rebuttal, original comments are reported in italics after the tag "***Reviewer:***", while our reply is flagged using the tag "**Authors**".

1. ***Reviewer:*** *The presentation of this manuscript is very clear. The authors provide six geomorphic descriptors to build decision tree model for classification and regression. By nature the DT is designed for calssification rather than regression. The authors need to give more details to describe how the DT can be used for regression.*

   Authors: we are very pleased to receive this overall positive evaluation of our manuscript, as well as to answer to this very important point. DTs are commonly used to address both classification and regression problems (see Hastie et al., 2009, https://doi.org/10.1007/978-0-387-84858-7), but indeed, their output always consists of a classification of the input data. This means that even if regression is performed, the continuous range of output values is binned into classes, and so the output of a regressor DT is a discrete estimation of the output variable. The number and distribution of the output classes for the predicted water depth depends on the tree structure (i.e., on the number of nodes and on the configuration), and it is automatically handled by the considered algorithm (i.e., function from software *scikit-learn*, see the manual on the official website https://scikit-learn.org/0.21/_downloads/scikit-learn-docs.pdf) once the tree parameters are decided by the user (maximum depth, minimum samples per leaf).
   In our case, the discretization of the output variable (i.e., water depth) is not a problem. In fact, as we use continuous flood hazard maps as target data and we have millions of observations (i.e., pixels), we can train very complex DTs, with many output classes for water depth. To give an idea of the grade of approximation, the regressor DT that produces the output map of figure 11 has about 10^4 output classes.
   We will address these comments and make our description clearer in our revised manuscript.

2. ***Reviewer:*** *Figure 4 illustrates the water depth has been classifed into different groups <0.5, 0.5-1.0, 1.0-1.5 ...,>7. The reviewer guesses the regression was based on these grouping categories. More information is required*

   Authors: Thank you for pointing out this issue, which can lead to a misunderstanding of our results. As we stated in our reply to the Reviewer's previous comment, the classification of our regressor DTs is based on thousands of classes. The legend in Figure 4 (which is the same of figures 11 and 14) explains a classification of the raster values that has been chosen for an effective representation of the maps. We will clarify this aspect in the revised manuscript.

We hope that our letter successfully replies to your comments, that we will address while revising our manuscript.

Thank you again for your appreciated help,

Kind regards

Andrea Magnini, Michele Lombardi, Simone Persiano, Antonio Tirri, Francesco Lo Conti, Attilio Castellarin