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Discussions

Interactive comment on "iCRESTRIGRS: A coupled modeling system for cascading flood-landslide disaster forecasting" *by* K. Zhang et al.

Anonymous Referee #2

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Dear Editor, dear Authors,

I read with interest this research paper which describes a coupled system for prediction of landslide occurrences triggered by intense precipitation. The system is based on the use, in a cascade manner, of the models CREST and TRIGRS. Finally, the authors describe the results of a interesting case study. In the Introduction, the issues of flood and landslide disasters are well described in the context of natural hazarda which characterize the study area.

The general objects of the work are clear and well stated, the proposed methodology is of good scientific interest, and also the presentation quality is satisfactory. However, I have some doubts on the efficiency of the created system and I argue the use of the

terms 'early warning system' and 'flood'.

Please, read in the following my GENERAL COMMENTS

FLOOD and EARLY WARNING

1. I am not sure if using the term 'flood' is here appropriate. If I understood correctly, CREST model predict the discharge at outlet and the spatially distributed surface runoff. I did not see here any flood disaster forecasting analysis (as claimed by the authors), which normally expects identification of floodplains, critical discharges, etc.. Does the model include a propagation module? Also, note that in flash flood events, the evapotraspiration is almost negligible, whereas the spatially distributed component of CREST model mainly derives, if I understood correctly, from the use of LAI and vegetation cover, from which evapotraspiration and interception processes are estimated.
2. Similarly, an early warning system is a more complex system which includes the definition of a 'chain of different communication systems working together and aimed at the detection, analysis and mitigation of potentially hazardous events'. For example, they normally includes a monitoring network for real-time analysis and the definition of thresholds for launching alert/waning signals. I would simply say that the developed system could be potentially used within an early warning system'(P1L23)

LITERATURE REVIEW 3. Authors state that 'studies on dynamically coupling hydrological processes predicted by distributed hydrological models with soil physics and mechanics determining slope stability are still in a very early stage' (see discussion at P3L16-25). Actually I do not agree with authors analysis. Literature provides many examples of spatial distributed and coupled hydrological-stability models which have been successfully utilized. Besides the ones cited by the authors (Simoni et al., 2008 and Lanni et al., 2012), authors can refer, for example, to Burton and Bathurts (1998), Claessens et al. (2007), Arnone et al. (2011), Lepore et al. (2013), Tao and Barros (2014) (these last two are also cited and described by Bogard and Greco (2014) as 'good examples' of coupled physically based hydrological and slope stability modeling at catchment scale). Also, you may more deeply discuss the sentence 'due to lack of knowledge of interactions between these processes and differences in the spatiotemporal scales of the flood and landslide events'. CREST MODEL 4. If I understood correctly, CREST model does use only precipitation, LAI and vegetation cover as distributed in input variables (as said above). Other model parameters I guess are homogenous across the watershed. How about the soil parameters that influence the infiltration processes, and slope stability, such as porosity, hydraulic conductivity, retention curve parameters,? Please specify whether these are distributed or homogeneous.

TRIGRS MODEL 5. There is no mention on how FS is computing and which are the parameters affecting stability. I would like to see the FS equation, explain whether is based on classical Mohr-Coulomb or Bishop failure criterion (for unsaturated conditions) and if it is computed ad a fixed soil thickness of different soil depths. Indeed, FS varies significantly with depths, at given parameters (see other comments below).

INTEGRATED SYSTEM 6. The integration between the two models is not very clear to me. TRIGRS model has its own infiltration module which is based on an analytical solution of the Richards equation for vertical infiltration. As input, it requires rainfall intensity; based on the hydraulic properties, which vary in space, it computes the infiltration rate and thus the pore-pressure (or soil moisture), which are used to compute the FS. My question is, how this framework interfaces with CREST model? My impression is that the two models are simply used in 'cascade' and therefore they are run separately, to evaluate first the runoff, and then the FS, which use a different infiltration scheme. This is not a really 'coupled model' , as compared to others existing (same references as before, i.e., Burton and Bathurst, 1998, Claessens et al. 2007, Simoni et al., 2008, Arnone et al., 2011, Lepore et al., 2013, Tao and Barros, 2014). The 'initial condition' (P5L9) are updated at each time? These means that, in TRIGS, each time step is 'independent' from the previous. Honestly, I don't see the efficiency of such a system when many other models exists that do the same in a continuous way. Actually, I would directly substitute the TRIGRS infiltration model within CREST an then imple-

ment the FS equation as a function of the moisture and water table. (they are both written in fortran language); it is more complex but more efficient and functional. 7. Are all the input data listed in fig.1 fed to both the models?

RESOLUTION AND LANDSLIDE SIZE 8. Working spatial resolution is 90m (P7L18). How this size is compared to the landslide average size? Since you build up a confusion matrix, you need to convert the inventory map into raster structure. Some studies (e.g. Claessens et al., 2005 and Tarolli and Tarboton, 2006) have demonstrated the model performances also depend on the comparison of the landslide size and resolution cell (the impact on model results is mainly caused by the effects of landform parameters, i.e. slope, aspect, curvature). I believe that a description of landslide types and characteristics (size, depths) should be given in Section 2.2.1. Also, It should be reminded somewhere that such models fit well for shallow landslide.

I will lay out my SPECIFICS CONCERNS below, referring to page and line numbers.

1. P6L30. This sentence is misleading. It's true that the 'minimum forcing data' are precipitation and evapotraspiration, but it requires various parameters and input maps. Note that, other models, needs only the precipitation forcing.

2. P7L34. It is not clear to me whether the soil properties are spatialized in CREST. How the soil texture classes are involved in the model?

3. P8L14. USDA textural soil classification does not provide the mechanical properties (i.e. friction angle and cohesion). How did you estimated these? FS is obviously extremely sensitive to these parameters . . .

4. P9L27 – Are you able to explain the shift between modeled and observed peak discharges?

5. P9L29 – Which is the depth of failure? Please specify. This is crucial.

6. P9L30 – In both Fig.5a and 5b, the second basin from the left (Tuckasegee River basin?) is the one in which landslide are overpredicted . . . I guess because it's the

basin with most the steepest areas... Moreover, I would like to see the corresponding pore-pressure map (TRIGRS and iCRESTRIGRS)

7. P9L35 – radius 500 m means ∼78.5 ha that means ∼96 computation grid cells. This means that 'your model success' when 1 over 96 cells success ... Again, in such analyses the landslide size should be taken into account.

8. P10L15 – Please, report the corresponding AUC values in the figure.

9. P12L2 – you could also work on FS equation and mechanical properties (a better soil characterization?). Also, as said before, model performances are very sensitive to the landslide size and characteristics, which here are not taken into account in no way.

MINOR P7L30 – it should be Fig.2a. P7L33 – please specify Fig.2c (map of soil) and Fig.2d (land cover map)

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