Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., author comment AC1
https://doi.org/10.5194/gmd-2021-283-AC1, 2022

Reply on RC1

Guoding Chen et al.

Author comment on "iHydroSlide3D v1.0: an advanced hydrological–geotechnical model for hydrological simulation and three-dimensional landslide prediction" by Guoding Chen et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-283-AC1, 2022

We highly appreciated the comments from this review. Below are our detailed responses to your comments.

- "**Introduction:** The scientific and technical contribution of the paper and model is clear, but it would be good for the authors to mention the real-world applications of combined hydrological-geotechnical models for land planning and disaster risk management. Although briefly mentioned at the end (P29 L655-656), discussing the importance of this type of model to policy-makers and decision-makers would further underscore its utility."

Response:

We have mentioned the real-world applications of combined hydrological-geotechnical models for land planning and disaster risk management in the text. However, thank you for your suggestion. We will provide more information and discussion regarding the importance of this type of model to policy-makers and decision-makers in the revised manuscript.

- "**Model framework:** Section 2.8: this section needs some revision to present what inputs are needed in a more organized manner. The first sentence gives a high-level overview of what inputs datasets are needed, but the section doesn't give a good idea of what other parameters are needed in association with these datasets. P13 L337-338 then says that hydrological parameters are needed, but with only one example. Later in Section 3 (P14 L370), it says that information about the impervious surface area was calculated from the land cover map. This section would be more useful if it put the required underlying data and parameters up front. The following table is just a suggestion as a starting point."

Response:

Thank you for this comment. We will provide a new table (see Table 1) to give an overview of inputs datasets needed in iHydroSlide3D v1.0. The model inputs can be summarized into four types: meteorological forcing data, land surface feature data, simulation parameters, and calibration/verification data. More details on the description, value/resolution, and source of the input data will be provided in Section 3.

- **"Results and discussion:** Like the introduction section, it will be good to have more discussion about how the model framework can contribute to land management and disaster risk management.

P29 L655-656 says: 'The produced zones of risk and landslide geometric properties are valuable for disaster prevention and risk management.'

Can you give some examples of how you see the model framework and code being used in these situations? Would they be used for climate change scenarios? Would they be used for real-time modelling? Would the risk zones be used as guidelines for no-build areas?"

Response:

We thank the reviewer for the useful comment. We will add a new paragraph to discuss this point. The comprehensive assessments (in both flood and landslide) possibly contribute to land management and disaster risk management with professional analysis. The landslide susceptibility and hazard zoning are able to manage landslide hazard in urban/rural areas by excluding development in higher hazard areas, and requiring hydro-geotechnical assessment in the planning stage (Fell et al., 2008). The conception has been introduced across some countries such as France (Fell et al., 2008) and Switzerland (Leroi et al., 2005). A recent work corroborated existing hypotheses that urbanization increases landslide hazards (Johnston et al., 2021). Our model could be used as a tool to study the importance of considering interactions with urbanization when predicting landslide hazards under climate change scenarios. The current modular framework and flexibility of the modelling setup also make it feasible to link with other numerical weather prediction models and real-time forcings. We would like to stress that these complicated applications generally require extraordinary computing resources to support. Regarding your above questions, we will provide more explanation and discussion in the revised text.

- **For all typos and minor comments pointed out by the reviewer**

Response:

Many thanks for pointing them out. We will corrected them in the revised manuscript and do a futher grammar checking.

- "P10 L276: Why is the minimum value of and assigned to the cell?"

Response:

For regional modelling, our 3D landslide model randomly generates a large number of ellipsoidal potential landslides. As a result, every single grid cell will participate in the stability analysis of different landslides multiple times and thus brings a contradiction to the value of (see Fig. 4). The model did not provide the minimum but defined it by counting values (see Fig. 4 and Eq. 28). We acknowledge that the model outcomes the minimum value of (in the manuscript, and corresponds to the worst-case situation). However, we also compute the value to enhance the analysis. This point has been noted in the original manuscript (P12 L305) and will be further clarified in the revised version to avoid confusion.

- "P11 L280: What is meant by "sufficiently large number of ellipsoids" and how is that determined? P16 Table 3 talks about the parameter set based on landslide inventory, but how is that calculated?"

Response:

In this work, a dimensionless value "landslide density" is defined to reflect the number of ellipsoids. We carried out several convergence tests to find the reasonable value for landslide density (Fig. 7). The so-called "sufficiently large number" means that we have gotten a steady (or convergent) result. The detailed analysis has been shown in Sect. 4.2. We will also add more explanation in the revise manuscript.

The parameters set based on landslide inventory in Table 3 are the maximum and minimum of landslide dimensions (length and width). Our inventory did not record the dimensional information for all landslides, but a few of them. We extract the maximum and minimum of length/width from this limited dataset. The max/min values therefore comprised the constraints for landslide modelling. Considering the random interval equals the spatial resolution (12.5 m in this work), the constraint boundaries were rounded to the integer for simplification. We will add more explanation in Section 3.

- "P14 L375: Please give an idea of how much time was needed, either for each module (hydrological and geotechnical) or total runtime to get the user an idea of computational efficiency."

Response:

It's not easy to record the runtime for each module because the whole model was executed in a coupled manner. However, we will provide more informaiton on the total runtime.

- "**Code testing:** I tested the code available on Zenodo. The included manual is great to show a step-by-step of what needs to be done. It was relatively easy to get it up and running, but I ran into some errors in MATLAB because I had not installed some toolboxes (e.g. Mapping Toolbox, Parallel Computing Toolbox, Curve Fitting Toolbox). It would be good if the manual included the list of Toolbox dependencies in case the user has a limited installation of MATLAB.

Once the Toolboxes were installed, I was able to run the code without errors. I wasn't sure how to interpret the datasets in the Results section, and it would be good if the manual could give a brief rundown on what the results represent. The accompanying text files (Outlet_Results, Outpix_03501000_Results, Outpix_03501000_Results_Statistics) were also empty."

Response:

We thank the helpful feedback. The code does rely on some toolboxes of MATLAB. We have improved the **manual** by addressing this point. In addition to the most basic installation content, the software requires additional toolboxes: Curve Fitting Toolbox, Global Optimization Toolbox, Optimization Toolbox, Partial Differential Equation Toolbox, Statistics and Machine Learning Toolbox, Symbolic Math Toolbox, MATLAB in the Cloud, MATLAB Parallel Server, and Parallel Computing Toolbox. For users who have most of the toolbox installed by default, they can run the software easily. For users who have a limited installation of MATLAB, they are advised to check the availability of toolboxes in advance. Users can also directly run the code without concerns and install the toolboxes needed according to the error prompt.

We have added the explanation for all possible outputs in our updated **manual**. The empty text file is a small bug with csv file writing and we have fixed it in our updated version of **iHydroSlide3D v1.0**. The model provides results for the outlet location, which are written to csv format series file. The model will automatically calculate the output pixel and output the csv file named **"Outlet_Results"**. Users may also choose any specified output pixels so long as they are within the given watershed extent. For this purpose, users can define it in **"ControlFile"**. Our example chose the pixel location the same as basin outlet for example (named "Yuehe"). As a consequence, the result file for the output pixel location will be named **"Outpix_Yuehe_Results"**. If the observed streamflow is provided in OBS fold, three statistical metrics Nash–Sutcliffe coefficient of efficiency (NSCE), Pearson correlation coefficient (CC), and relative bias will be computed and stored in **"Outpix_Yuehe_Results_Statistics"**. Please note that abnormalities may exist in statistics if streamflow data are missing or all zeros, for which we would like to suggest a simulation including a complete flooding event. The above information is also detailedly described in the updated **manual**. We will also sync the code on GitHub to Zenodo this discussion is closed.