MEMORANDUM

Date: 6/10/2020

To: Ellen Rathje, PI

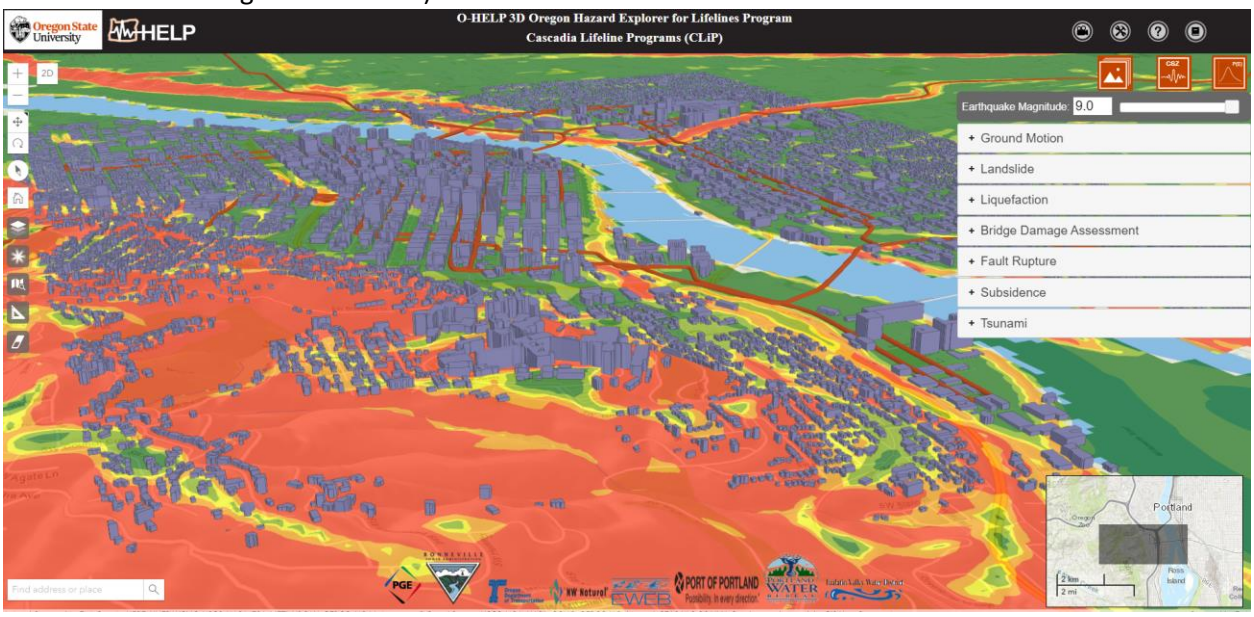
From: Michael Olsen, Troy Tanner, Joseph Wartman, & Jeffery Berman (NHERI RAPID FACILITY)

Subject: Proposed Enhancements to DesignSafe-ci to support RAPID reconnaissance

Below are some proposed ideas and thoughts of new features that could be developed in designsafe-ci to support RAPID reconnaissance that the RAPID Facility has identified. The key idea is to advance the capabilities of and integration of HazMapper with Potree so that loading and analyzing datasets is more seamless for the user and it also helps connect a variety of people in the natural hazards community and help them more readily share information. Below are preliminary ideas and examples for purposes of starting the conversation.

Updates to HazMapper

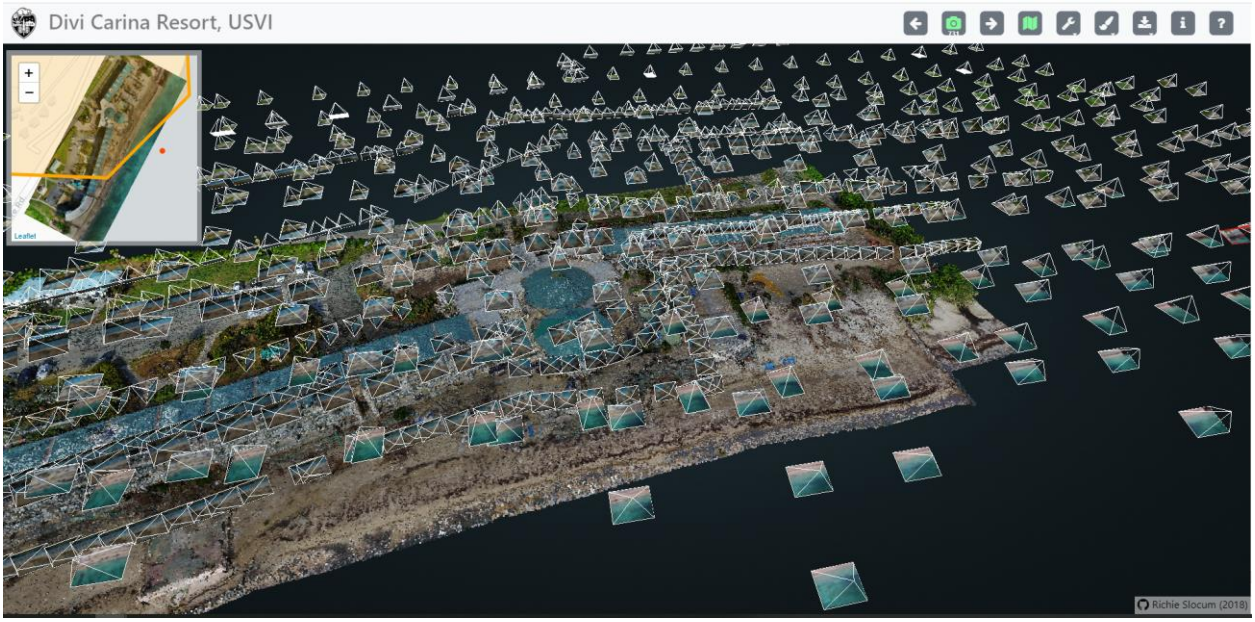
- Add 3D capabilities to the HazMapper in designsafe-ci. Below is an example of http://ohelp.oregonstate.edu (Mahyar helped develop the original implementation of the site). Not necessarily adding point clouds to here but ability to have 3D datasets (e.g., this example of the Portland buildings and rail lines)



- Improve ability to search and add datasets to HazMapper. Should have a layer that shows locations of projects & intuitive fields to query and filter data.
- Ability to access data layers published already on ArcGIS online as map services (e.g., the buildings and rails are a map service on arcgis online). For example, the building layer would be very helpful for those doing wind analyses. https://www.arcgis.com/home/group.html?id=1d1f24e8556642f49448f1c88b5a571b#overview
- Integrate potree with HazMapper. Have a layer that shows all potree datasets created in design safe that the user can simply click the dot (or polygon) and the potree viewer will load.

Advancements to potree

- Rather than an expendable temporary session, potree needs to be permanent. In addition, users should be able to bring in other sources of information, including measurement layers, photographs, other shapefiles, reports, etc.
- Integration of streetview/UAS imagery with the point clouds in potree. Please see this website template that Richie Slocum (an OSU geomatics PHD graduate working with Chris Parrish) has put together for some recon SFM data they collected in the USVI last fall. See: http://research.engr.oregonstate.edu/lidar/pointcloud/divicarina/#
  There are a lot of cool features that he has implemented that i wanted to share with you. Most notably, I'd like to call your attention to the following:
  - He has integrated the photographs with the point cloud showing the locations where the images were taken. One can view the photographs in context of the scene to help one see details that may be lost in the point cloud.
  - Check out the help menu! He has a really nice tutorial interactively showing how the different tools work.
  - The "look at" tool is one of my favorites. In this, you can select a point and filter the images that contain that point. This could be very useful in narrowing down images.
  - You can do a simulated fly through by using the arrows to the left and right of the camera to follow the acquisition trajectory (assuming the photographs are in order).
  - He added the orthophoto to the map viewer.
  - He has greatly simplified the potree interface using bootstrap.
  - He has done a great job of documenting it as well: https://github.com/hokiespurs/potree-sfm
  - I should mention that Richie's code is setup for Photoscan, not Pix4D.



- Richie also has some other prototype tools such as an orthophoto preview for UAS:

https://hokiespurs.github.io/uasortho/ which would be cool to integrate into the UAS planning process.

- Ability to save measurements from a potree session. For example, if I'm developing a landslide displacement model, I can go into the potree dataset for a landslide and make measurements. Those can be saved as a json file and then loaded with the potree in the future as a layer so others can see where I took those measurements and what my points of reference were for those measurements. (They can also see if I made some blunders!)
- There are several example implementations of various features that would be very useful here: https://github.com/potree/potree/
- Some notable ones include
    - Loading a project with information previously saved: http://potree.org/potree/examples/load_project.html
    - Loading pre-saved measurements: http://potree.org/potree/examples/measurements.html
    - Annotations: http://potree.org/potree/examples/annotations.html
      note that when you click on an annotation, it takes you to a predefined view. This would make potree more like the ESRI Story Maps that help researchers tell their story and communicate aspects of interest.
      Also note that you can use the annotation to take you between potree worlds, reports, published design safe projects , etc via links.
    - Hierarchical annotations: http://potree.org/potree/examples/annotation_hierarchy.html
      (also includes showing a basemap in potree, which is pretty cool!)
    - Bringing shapefiles into a potree world: http://potree.org/potree/examples/shapefiles.html
- Here is a really crude demo of adding a photograph as part of an annotation within potree: http://research.engr.oregonstate.edu/lidar/pointcloud/PTtestout/PTtestruct.html
- For implementation, perhaps the process could be:
    - A user publishes a potree for their AOI. Design safe behind the scenes would customize the html files to add this functionality based on the examples below.
    - The potree is linked to the project that it came from and shows up in the master list in HazMapper. (can be queried by location or keywords in the metadata)
    - Or perhaps it is better to let each user customize their own version of the main interface with the information that is included. (Something we should discuss). Regardless, design safe could auto-write the html based on the features they want and the files they want to be part of it. (It should be fairly straightforward to automate writing the html file for potree with sections and capabilities you want). The user can check boxes of what features they want and then appropriate files to load.
    - That user or another can go into that potree and perform measurements. There is a save button that saves those measurements (with the user id) into a json file that is then loaded with the potree. A similar process would be in place for users to create annotations.
    - They can also run a design safe process to take image position orientation and location information and create a potree world that can be integrated with the original.

    - In other words, the potree world is not a static object, but dynamic that can be updated as people continue to add information.
- If you want to have a lot of fun, access the USGS 3DEP data (all of the lidar data across the US) and then connect that with internal links to the potree datasets that are created on designsafe. See https://www.usgs.gov/core-science-systems/ngp/3dep . Note they are using entwine as the data organization library for point clouds. https://entwine.io/ (We discussed this a long time ago when there wasn't much info but now a lot of information is starting to trickle out about entwine. It can be integrated directly with potree where entwine does the back end hosting and potree provides the interface.

In short, let's make it seamless for the user to go between hazmapper, potree and other information on design safe. In hazmapper, they should be able to see all possible potrees, click on them and then be in the potree world. In the potree world, they should be able to make annotations as well as access relevant photographs or annotations (e.g., links to a report or discussion about a particular feature of interest in the model someone else did before). We might need to rethink a bit on the publishing as some of these someone may not want to formally publish until it is finally developed, but could be a community project" that everyone can add to before it is formally published.

We look forward to discussing these ideas further with you and improving the capabilities of designsafe-ci to better support the Natural Hazards & Reconnaissance communities.