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Applied Systems Analysis
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science for global insight

Picture Pile: A citizen-powered tool for rapid post-disaster damage assessments

Olha Danylo, Tobias Sturn, Cristiano Giovando, Inian Moorthy, Steffen Fritz, Linda See, Ravi Kapur, Blake Girardot, Andrea Ajmar, Fabio Giulio Tonolo, Tobias Reinicke, Pierre Philippe Mathieu, Martina Duerauer



Disasters globally

- ▶ Disasters can be a country's worst nightmare — death and destruction devastate economies and citizens alike. Between 2005 and 2014 disasters were recorded around the world, causing damages of more than US\$1.4 trillion and killing more than 0.7 million people, 1.7 billion people were effected.



Once disaster happened...

Quick assessment of damage

- ▶ ... to map all those who need help!

But how fast the evaluation can be done?

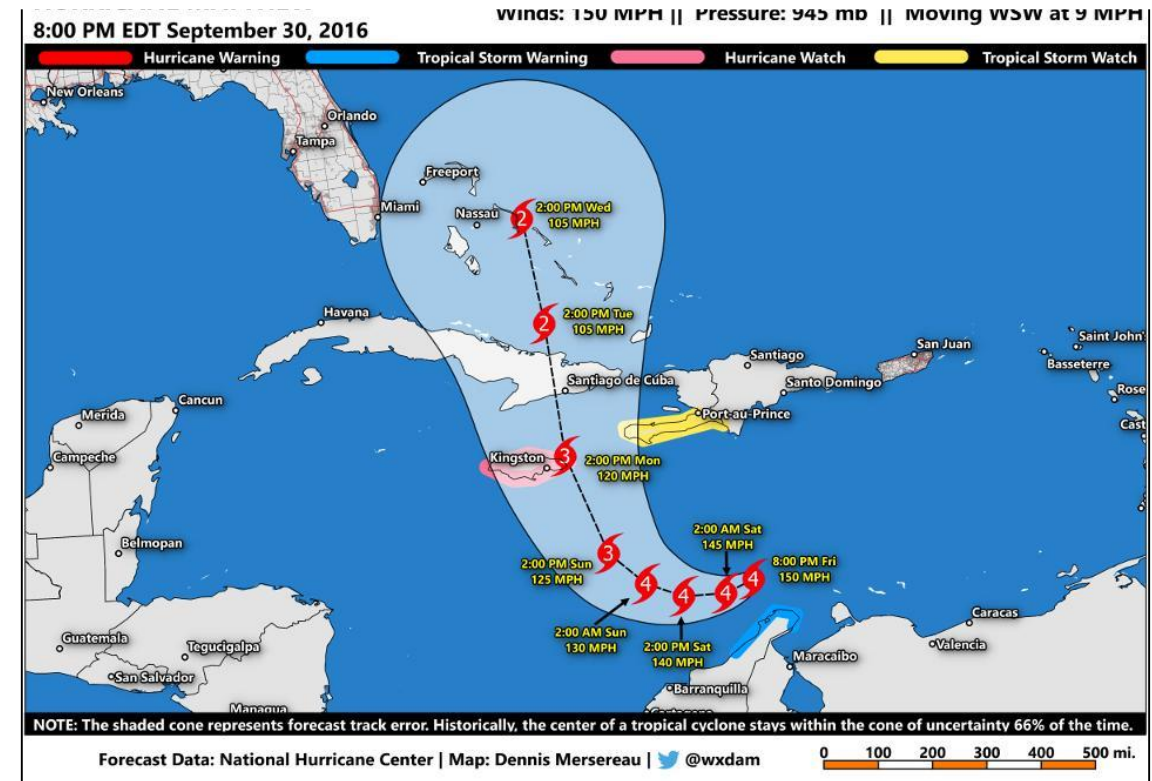
It depends on:

- ▶ how big the **area** of damage is
- ▶ what **type** of damage happened
- ▶ what **tools** are used for assessments

And it can be **very slow**...

Other options?

- ▶ **Satellite images and crowdsourcing**



Satellite images and crowdsourcing

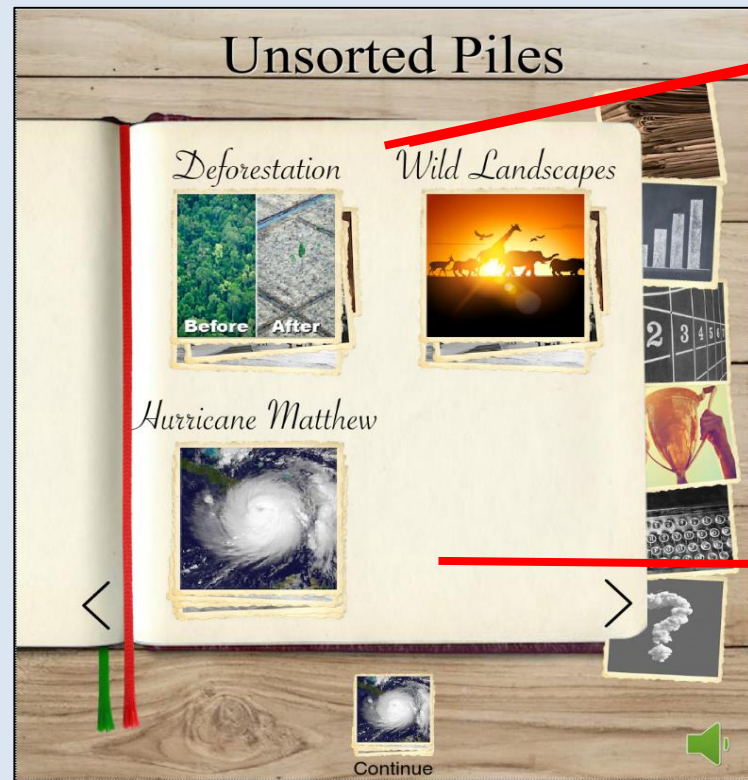
- ▶ Disaster can be seen from space
 - ▶ Satellite images: high resolution imagery for before and after event time
- ▶ Post-disaster assessment:
 - ▶ Crowdsourcing - with each volunteer spending even just a few minutes on it makes a significant contribution to the overall effort



Picture Pile app

("indoors")

Answer simple yes-no question
to help science tackle big problems!



1255+
Players



5+ million
classifications



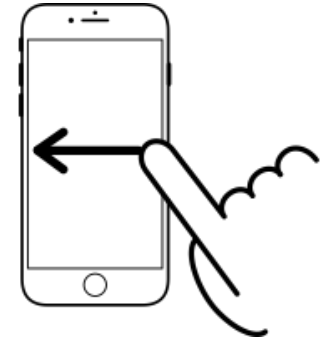
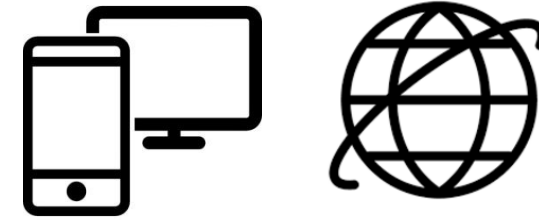
300,000+
Unique images



< 5
seconds

Key features of Picture Pile

- ▶ Who can contribute via Picture Pile?
 - ▶ Anyone with the phone or computer
 - ▶ Everywhere where the internet is available
- ▶ How?
 - ▶ **Microtasking through fast pattern recognition** doing only **tap or swipe**:
 - ▶ answering simple yes-no question
 - ▶ people can recognize what it would take time to teach algorithm to recognize
 - ▶ Furthermore, since the microtask is quick to do, with each volunteer spending even just a few minutes on it makes a significant contribution to the overall effort.



Input data

Image "Before"

Image "After"



Filtering images

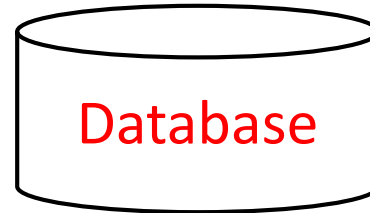


Preprocessing

Tile Map Service to image format for ingestion into Picture Pile (in parallel)

Initial training set

Sample scenarios for yes, no, non usable



Final set

Before
After

Campaign starts



Complete set

Before
After



Volunteers



Output

Experts – expert mode



Expert validations

Before
After

Preprocessing of images: filtering, before-after

- ▶ Ideally, “Before” and “After” images are high-resolution satellite images obtained from a space agency or commercial provider (e.g. WorldView-, Pleiades).
- ▶ “Filtering images” refers to two types of filtering:
 - ▶ **Water bodies.** The satellite image may cover a significant water area in coastal regions, therefore we filter those areas out to reduce the number of locations we need to process.
 - ▶ **Stratification of sample for expert validations.** We mark areas that may contain buildings (according to Global Urban Footprint (GUF) or road networks) in order to set up higher priority for those locations during the campaign.
- ▶ The areal extent of a single image “tile” in Picture Pile depends on the resolution of available imagery and the type of task requested.
- ▶ For the case of assessing damage of Hurricane Matthew in Haiti, the footprint of each tile on the ground is 77m x 134 m.

Volunteers training

- ▶ A subset of images is then annotated by experts to create an initial training set right before the campaign starts
- ▶ Training set is then used to explain the task to volunteers using a number of examples
- ▶ Part of labeled data will be used to check volunteers' performance

Score: 46671 **Expert mode** Sorted: 23.87%

Rank: 6 Place arrows on the important features by clicking on the map. Rank 5.
You can delete arrows by clicking on them again.
Write an explanation which is shown to the users here:

These buildings have been destroyed. The correct answer is 'Yes'. 455 Points to Rank 5.

Do you see damaged buildings?

Continue

Picture id: 850685

Before

After

es

Menu

Menu

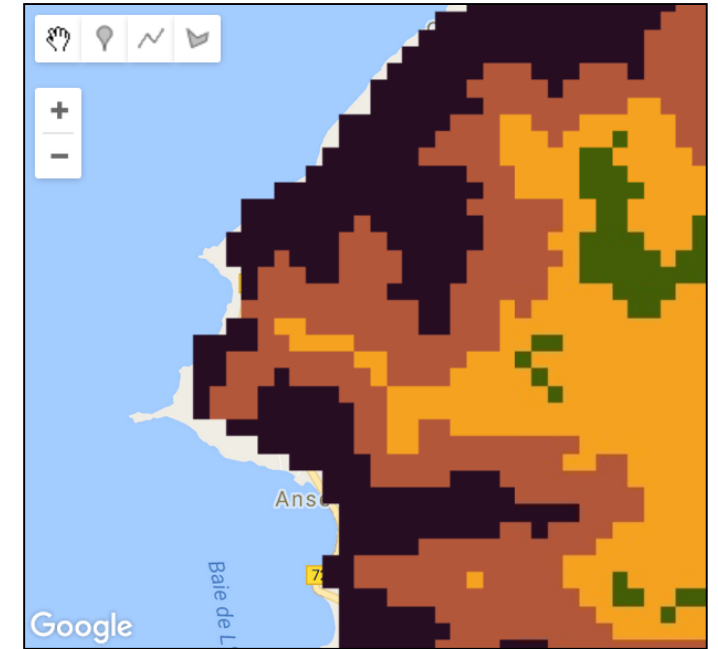
Week 74 ends in 6 days, 12 hours, 29 minutes.

When campaign starts... Quality control

- ▶ When a campaign starts, both volunteers and experts are involved in validations.
- ▶ All images validated by experts become part of a set for quality checks of volunteers' validations.
- ▶ On average, we check validation quality every 10 images, by showing an image already validated by an expert. If the participant fails to validate this image correctly, their quality performance score decreases.
- ▶ The campaign is finished when different users have validated each location at least 3 times. Absolute maximum – 8-10 validations per location.

What are the results?

- ▶ **Map of damaged areas**
(with different levels of confidence)
- ▶ Table with damage assessment results
- ▶ Several validations per locations



More than that...

The proposed approach will not only help to increase **citizen awareness** of natural disasters, but also provide them with **a unique opportunity to contribute** directly to relief, recovery and rebuilding efforts.



Do you want to join? Campaign starts **TODAY!**

- ▶ Help us to test collect data and be prepared for next disaster



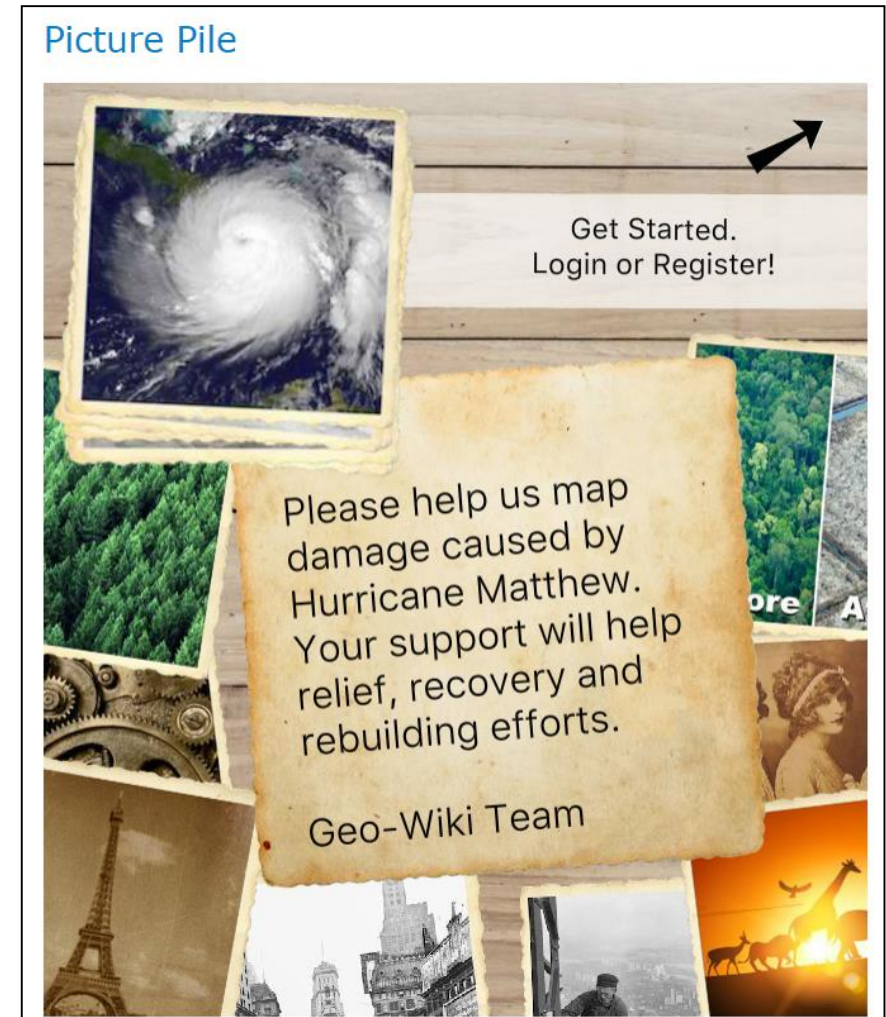
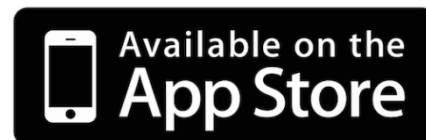
Picture Pile

www.geo-wiki.org/games/picturepile



@PicturePile

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Thank you!

Olha Danylo
Earth Observation Systems
International Institute for Applied Systems Analysis

danylo@iiasa.ac.at

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