Extracting Flood Depths from Imagery

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Problem Statement

1. Client Prompt:

   "Floods cause damage to infrastructure and homes. The depth of flood waters is a good indicator of the severity of damage. Floods are incredibly difficult to model, and while model outputs are useful to emergency managers, it is crucial to know the actual depth. Social media and news outlets often present pictures of floods. **How can this imagery be used to estimate the depth of water in a given area?"**

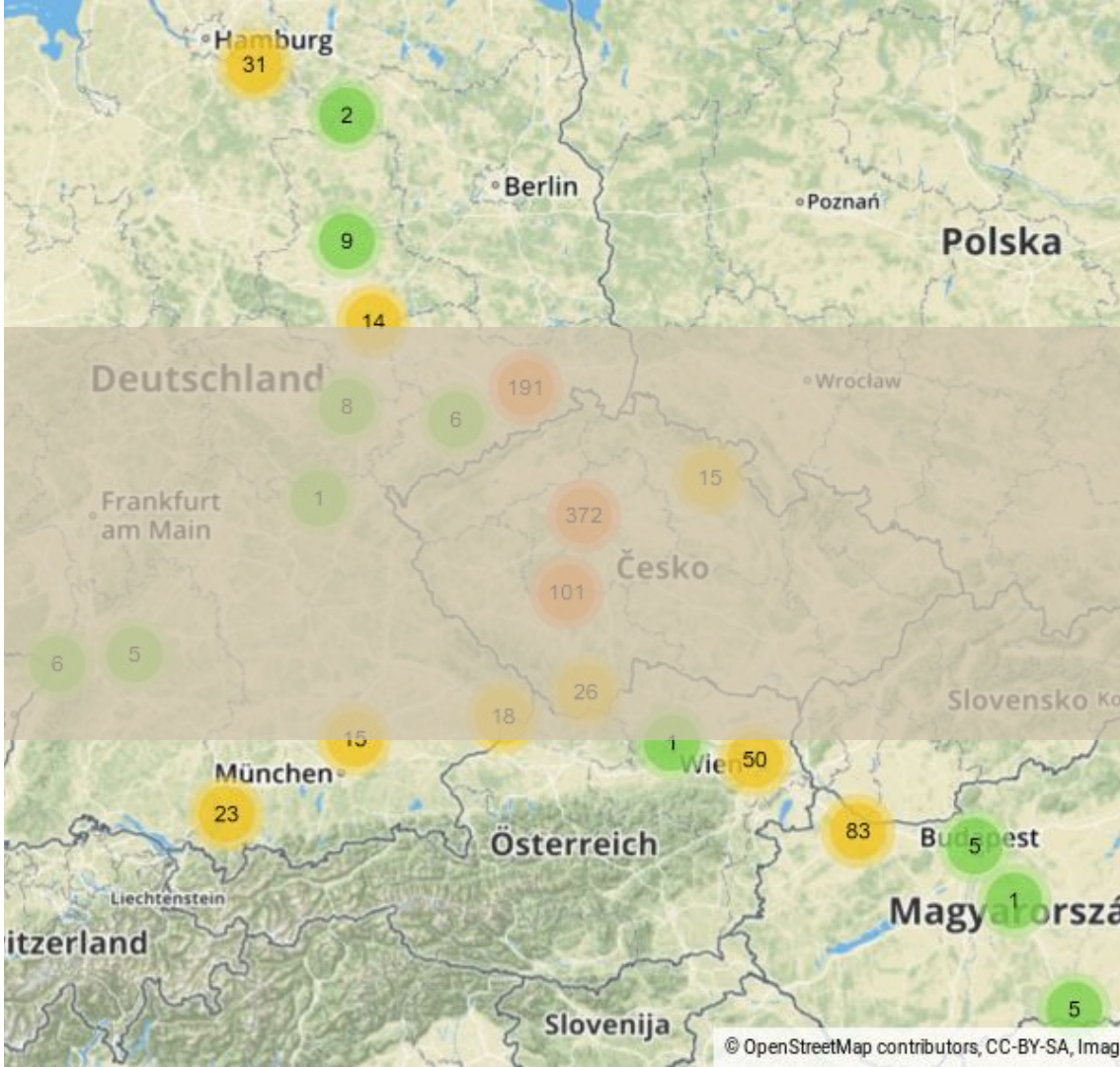
2. Adjusted Statement:

   "Given a ground-based image of a flooded area, estimate the depth of flooding present in that image."

OUR DATASET

European Flood 2013 Dataset from Jena University:
Flood images from

- Germany
- Czech Republic
- Austria
- Hungry



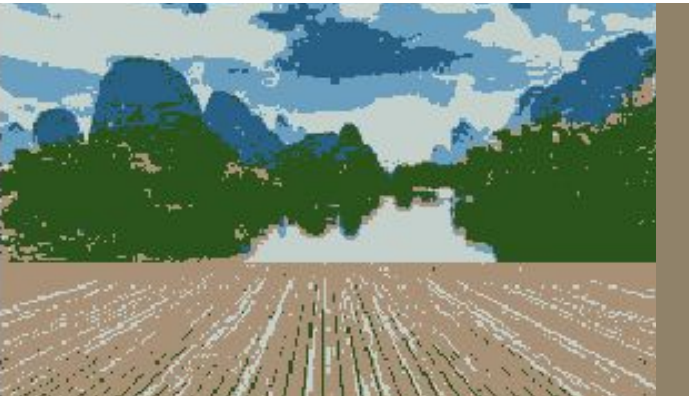
REFERENCE OBJECTS

Finding reference objects:

- Traffic signs
- Cars
- Houses
- Humans
- Things with known standard or average height.

CNN

- Convolutional Neural Networks are commonly used for image data.
- It would be trained on these reference objects and their height in order and compare the submerged portion from the known height.
- One can also use pretrained models from google or other sites to reduce computation.



WATER SEGMENTATION

Measuring the portion of reference objects obscured by floodwater requires identifying the region of the image occupied by floodwater

EDGE DETECTION AND SEGMENTATION METHODS

- Edge detection can identify boundaries in an image
- Segmentation divides an image into regions
- Thresholding methods segment an image based on whether pixels are above or below a certain value
- Clustering methods, such as K-Means (shown at left) group similar pixels into regions

PROBLEMS

HEAVILY SUBMERGED OBJECTS

NATURAL OBJECTS, HARD TO QUANTIFY

PROBLEMS

DIFFUSE REFLECTIONS

SPECULAR REFLECTIONS

PROBLEMS

FLOODED VS NON-FLOODED

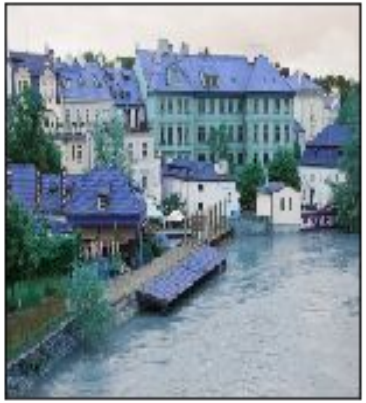
NATURAL BODIES OF WATER

MITIGATING REFLECTION

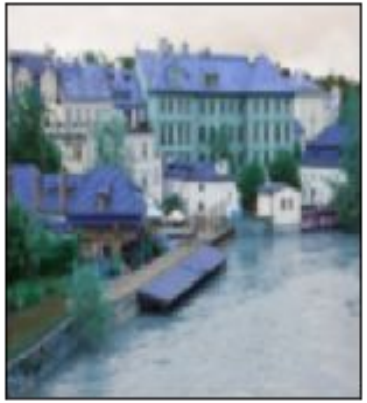
Edge detection methods and standard image segmentation methods generally failed due to reflections - preprocessing managed to control the interference from diffuse reflection but could not control for specular reflection

SEGMENTATION

Original



Blured



Here is another segmentation technique using Gaussian blur to reduce noise. Additional blurring and morphology methods were applied in order to separate the background from the foreground. The morphologyEx in the CNN segmentes the image into block color.

Additional note: Best performing cnn object detection model on traffic signs had:

- accuracy 93%

Segmented

Segmented Background

RESOURCES

VECTORS

- https://towardsdatascience.com/image-pre-processing-c1aec0be3edf
- https://towardsdatascience.com/traffic-sign-detection-using-convolutional-neural-network-660fb32fe90e
- https://www.arxiv-vanity.com/papers/1407.5736/
- https://www.analyticsvidhya.com/blog/2019/07/computer-vision-implementing-mask-r-cnn-image-segmentation/
- http://cvlab.cse.msu.edu/project-coupler-detection-GM.html
- https://www.pyimagesearch.com/2019/11/04/traffic-sign-classification-with-keras-and-deep-learning/

CREDITS

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