III. Model documentation and write-up

Information included in this section may be shared publicly with challenge results. You can respond to these questions in an e-mail or as an attached file. Please number your responses.

1. Who are you (mini-bio) and what do you do professionally? If you are on a team, please complete this block for each member of the team.
   My name is Azin Al Kajbaf. I am a postdoctoral research fellow at Johns Hopkins University and the National Institute of Standards and Technology (NIST). As a postdoctoral fellow, I am leveraging data science techniques and geospatial analysis to collaborate in projects to support community resilience planning through the development of methods and tools that evaluate the economic impacts of disruptive events.

   My name is Kaveh Faraji. I am a Ph.D. candidate at the University of Maryland, and I work in the area of Disaster Resilience. My main research is focused on risk assessment of natural hazards such as flood, sea level rise and hurricanes. I am employing geospatial analysis and machine learning approaches in my research.

2. What motivated you to compete in this challenge?
   We implement machine learning and deep learning methods in our research projects. We are interested to learn more about these approaches and their real-world application. Competing in these challenges allows us to gain experience with different machine learning and deep learning techniques that we can potentially employ in our research projects as well.

3. High level summary of your approach: what did you do and why?
   This solution contains two main steps. First, we used a 1-D CNN to perform pixel-by-pixel regression. In this network, we read each image and used a custom training loop for training the network. We reshaped satellite imagery (with the size of [15 * 12 * 256 * 256]) to a matrix with the shape of [channel_size(C) = 15 batch_size(B) = (256*256) temporal_size(T) = 12]. We predicted labels for each image in training and testing datasets. Second, we used a 3-D U-Net model and provided it with inputs with the shape of [16*12*256*256]. The 16th channel in the input of the U-Net network, is the labels generated in step 1.

4. Do you have any useful charts, graphs, or visualizations from the process?
   No.

5. Copy and paste the 3 most impactful parts of your code and explain what each does and how it helped your model.
   The first step which was creating a 1-D CNN improved the score.

```
%% Buidling a 1-D CNN
filterSize = 3;
numFilters = 64;
numClasses=10;
layers = [ ...
```

```
    sequenceInputLayer(15, MinLength=12)
    convolution1dLayer(filterSize,numFilters,Padding="causal")
    reluLayer
    layerNormalizationLayer
    maxPooling1dLayer(2)
    convolution1dLayer(filterSize,2*numFilters,Padding="causal")
    reluLayer
    layerNormalizationLayer
    globalMaxPooling1dLayer
    fullyConnectedLayer(512)
    reluLayer
    fullyConnectedLayer(128)
    reluLayer
    fullyConnectedLayer(1)
    reluLayer];
% analyzeNetwork(layers);
lgraph = layerGraph(layers);
net = dlnetwork(lgraph);
```

6. Please provide the machine specs and time you used to run your model.
   - CPU (model): AMD Ryzen9 7950X Processor
   - GPU (model or N/A): RTX 4090
   - Memory (GB): 64 GB
   - OS: Linux
   - Train duration: ~ 45 hours
   - Inference duration: ~ 2 hours

7. Anything we should watch out for or be aware of in using your model (e.g. code quirks, memory requirements, numerical stability issues, etc.)?
   No.

8. Did you use any tools for data preparation or exploratory data analysis that aren't listed in your code submission?
   We explored the data images and found the minimum, maximum, and average of channels of satellite images.

9. How did you evaluate performance of the model other than the provided metric, if at all?
   We tested conventional performance metrics for regression tasks (e.g., MAE, RMSE, MSE)

10. What are some other things you tried that didn't necessarily make it into the final workflow (quick overview)?
    We experimented using LSTM network instead of 1-D CNN, but it did not improve the score.

11. If you were to continue working on this problem for the next year, what methods or techniques might you try in order to build on your work so far? Are there other fields or features you felt would have been very helpful to have?

If we were to continue working on this problem, we would have tried image augmentation and we would have worked with ensemble of several different networks.