USING WILDFIRE MODELS FROM ISU'S GIS TREC

This document describes the general process you can use to successfully develop a wildfire susceptibility, wildfire hazard, and/or wildfire risk model for your area of interest (AOI). First, understand that each of these types of models (susceptibility, hazard, and risk) build upon one another with the base or core model being the wildfire susceptibility model. You must first create a susceptibility model before trying to create a hazard model. The resulting hazard model is then used to create a risk model.

Second, understand the difference between each model and use the correct terminology[1] to communicate the results of your work.

Before jumping into the development of wildfire models for *your* AOI, spend some time getting to know the models we have developed. Each model contains an ArcGIS Pro Toolbox file (`*.atbx`) and two folders. For the Hazard model[2], one folder is the `HazardModelInputs` folder and the other is the `HazardModelOutput` folder. The model inputs folder contains the data layers necessary to re-create the wildfire hazard model for Bannock County, Idaho. Remember, you will also need the output from the wildfire susceptibility model as an input. This is not stored in the `HazardModelInputs` folder but is found in the `ModelOutput` folder (you can also download the wildfire susceptibility model from the ISU GIS TREC spatial library[3]). You will need similar input layers to create wildfire models for your AOI.

Let's take some time to get acquainted with the wildfire hazard model:

1. For simplicity, I suggest creating a new ArcGIS Pro project for your wildfire modeling efforts. Alternatively, you could integrate these models into an existing project.
    a. Copy the entire contents of our wildfire model into the project folder of your ArcGIS Pro project. This includes the model input folder and its data, the model output folder (which is currently empty), along with the model's toolbox file (`*.atbx`)
    b. From ArcGIS Pro, use the Catalog pane to verify these files exist. Your project folder should look similar to the figure below.

[1] Cf. https://giscenter.isu.edu/pdf/PDF_NASA_SPARC/WildFireTerminologyReview.pdf
[2] Download the hazard toolbox and example data from https://giscenter-sl.isu.edu/AOC/AOC_Research/SPARC/Toolboxes/02_WildfireHazardModel.zip
[3] Download the susceptibility toolbox and example data from https://giscenter-sl.isu.edu/AOC/AOC_Research/SPARC/Toolboxes/01_WildfireSusceptibilityModel.zip

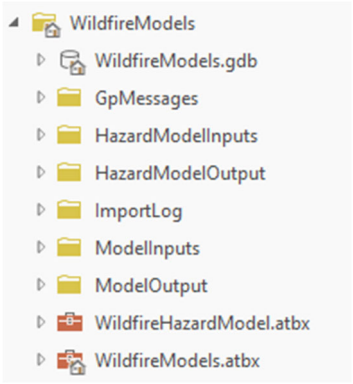
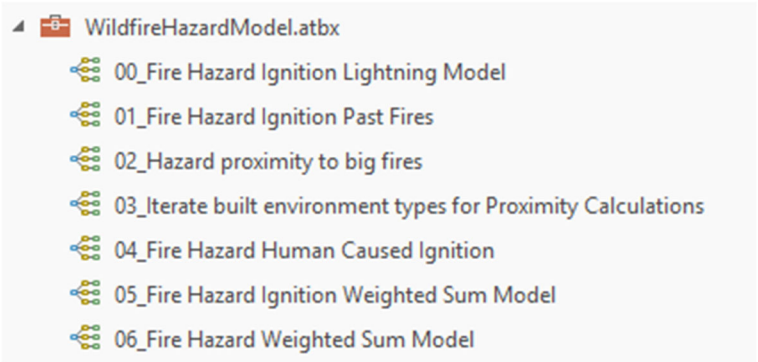


Figure 1. An ArcGIS Pro project was created and named WildfireModels. After copying the wildfire hazard model data into the project folder (WildfireModels), the project will contain two new sub-folders and a new toolbox.

2. From the Catalog pane, expand the hazard model inputs folder.
    a. Notice it contains two `EXAMPLE` shapefiles, one geodatabase, four EXAMPLE raster layers, and three raster layers that can be used to create a wildfire hazard model anywhere in Idaho (NOTE, after familiarizing yourself with this tutorial, you can delete all EXAMPLE files in the inputs folder).
    b. Expand the Hazards geodatabase.
    c. You will see three vector feature classes. Each is an `EXAMPLE` layer you can use to replicate the wildfire hazard model for Bannock County, Idaho. You can also use these layers as templates for the creation of similar layers for your AOI.
    d. The shapefile and geodatabase feature classes are essentially identical and you can choose to use either file format in your modeling work.

3. Add each of the example layers to the current map in ArcGIS Pro. Explore these layers to familiarize yourself with these data, their spatial resolution, spatial reference system, range in numeric values, and attributes.
4. Next, return to the Catalog pane and expand the model toolbox. It should look like the figure below.



5. Before running any of the models, take a few minutes to become acquainted with the model and its overall workflow. To do this, iteratively open each model by right-clicking the model and selecting `Edit` from the fly-out menu.

Do not make any changes to the model, just review it so you are familiar with how each model functions. When finished, close each model.

6. It is important to run the toolbox models in the order indicated by the model's name. In other words, run model 00 first, then model 01, etc. This is important as some models use output from a previous model.
7. The first model (00) characterizes lightning frequency. Additional lightning frequency datasets are available by visiting the GIS Center's spatial library at https://giscenter-sl.isu.edu/AOC/AOC_Research/SPARC/

When running subsequent models (02 through 06), the following details will help ensure you run the models correctly.

8. Model 02 describes wildfire hazards related to the AOI proximity to big fires that have burned in the past. While past megafire events are not a guarantee that future megafires will occur in the same area but they tend to be indicative of landscapes with the propensity to support large fire events. Furthermore, the effects of a large wildfire are not perfectly scalable with smaller wildfires and for these reasons this component model has been included in the wildfire hazards model.
    a. Running Model 02 is relatively straightforward save for the minimum and maximum score settings. Before running this tool, carefully consider these scale values. To do this:
    b. Open the **`Proximity_BigFires_WesternUS.tif`** layer in ArcGIS Pro
    c. Zoom into your AOI
    d. We need to know the minimum and maximum proximity values for your AOI. To do this, use the **`Clip Raster`** geoprocessing tool to clip out a portion of the proximity is raster for your AOI (alternatively, you can approximate these values by clicking around the raster layer and noting the minimum and maximum values displayed on the pop-up).
    e. Record the minimum and maximum pixel values in the space provided below
    MINIMUM PROXIMITY (**A**):
    MAXIMUM PROXIMITY (**B**):

    f. As shown in the Proximity to large fires tab of the **`Hazard calculation.xlsx`** file, we can apply a regression expression to calculate the correctly scaled minimum and maximum hazard scores. Following this approach will ensure the wildfire hazard model for your AOI is directly comparable to hazard models for other areas.

    g. To determine these scores, complete the following calculations:
    Maximum score = (-0.0063 x **A**) + 1000
    Minimum score = (-0.0063 x **B**) + 1000

h. For the Bannock County AOI, the minimum proximity to a large wildfire is 0 (meters)(**A**). As a result, the maximum score is 1000. Similarly, the maximum proximity to a large wildfire is 77037, resulting in a minimum score of 515.

9. Running model 03 is also relatively straightforward but an understanding of the necessary source data is critical. We encourage you to study the Human-Caused Wildfire Hazard document that describes the development of the necessary built environment dataset in detail. That document can be found at https://giscenter.isu.edu/pdf/PDF_NASA_SPARC/Human-Caused_WildfireHazardModeling.pdf
10. Previous model steps created the input necessary for Model 04. These raster layers are called `ProximityPriority_01.tif` through `04`. These layers are found in the `HazardModelInputs` folder.
11. Model 05 has no user input and completes all processing using data layers produced in previous steps of the overall model. Launch the model and click Run.

12. The same is true of the final step of the Wildfire Hazard Model. Simply launch model 06 and click Run.
13. When the final model builder tool completes, you will have a wildfire hazard model for Bannock County, Idaho. The final wildfire hazard model is named `WildfireHazard.tif` and can be found in the `HazardModelOutput` folder.

    NOTE: All other spatial data found in the `HazardModelOutput` folder can be safely deleted. Before deleting the files, you may be interested in the individual Hazard* and Ignition* layers to gain more insight into wildfire ecology, science, and management.

14. To better interpret wildfire hazard, we provide you with a *years since fire* layer. This layer is named `YearsSinceLastFire_2026Base1980.tif` and is located in the same download zip file as the overall hazard model. We suggest adding this layer to your ArcGIS Pro project using the associated layer file (`YearsSinceLastFire_2026Base1980.tif.lyrx`) as some more meaningful symbology has been applied to help you understand these data.

    The years since last fire raster layer was derived from the historic fires database (HFD)[4] and pixel values literally represent the number of years since the last documented wildfire. This layer was created in 2026 and calculates years back to 1980. This is encoded into the file name `2026Base1980`. Thus, the value of 1 means a fire burned in that area in 2025 (2026 – 2025 = 1). Updated years since fire data may be available by visiting the SPARC spatial library at https://giscenter-sl.isu.edu/AOC/AOC_Research/SPARC/

15. You can now, prepare data for *your* AOI and re-run each of the model tools to develop a wildfire model for *your* AOI (NOTE: when running these models with your data be sure NOT to use any of the default EXAMPLE data/layers).

[4] Cf. https://giscenter.isu.edu/research/Techpg/HFD/index.htm

16. If you encounter errors while running any of the models, please let us know by emailing giscenter@isu.edu

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