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 create a susceptibility model to create a hazard model, and 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 each model.

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. One is a `ModelInputs` folder and the other a `ModelOutput` folder. The model inputs folder will contain the data layers necessary to re-create the wildfire models for Bannock County, Idaho. You will need similar layers to create wildfire models for your AOI.

Let's take some time to get acquainted with these models:

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.

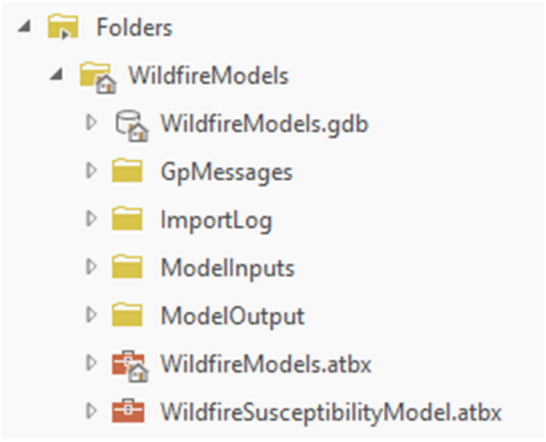


Figure 1. An ArcGIS Pro project was created and named WildfireModels. After copying the wildfire susceptibility model data into the project folder (WildfireModels), the project will contain two new sub-folders and a new toolbox.

2. Open the model inputs folder.
3. Notice it contains numerous `EXAMPLE` layers ($n = 6$) and 11 text files (these are used by the `Reclass by ASCII` tool and must not be deleted).

[1] Cf. https://giscenter.isu.edu/pdf/PDF_NASA_SPARC/WildFireTerminologyReview.pdf

NOTE: To create a wildfire susceptibility model for *your* AOI you will need a Bare Soil Index (BSI), Normalized Difference Moisture Index (NDMI), Normalized Difference Vegetation Index (NDVI), fuel load layer (in tons per acre), and a digital terrain bare earth elevation layer (i.e., surface layer). These are all raster image layers. In addition, you will also need a structure points layer. This is a vector point feature layer stored as either a shapefile or geodatabase feature class.

Each of the raster *index* files can be easily created from Landsat imagery as simple band ratios. I suggest creating these using Landsat imagery acquired during peak biomass production (e.g., June) covering the entire spatial extent of your AOI. Using the USGS Earth Explorer website (https://earthexplorer.usgs.gov/) to download the necessary Landsat imagery free of charge. Once you have acquired these data, you can create the various simple band ratio layers in ArcGIS Pro using the following equations to guide you:

BSI: (SWIR1+ RED) -(NIR+BLUE)/ (SWIR1+ RED) +(NIR+BLUE)
Using Landsat 8/9 band numbers: (6+4) -(5+2)/ (6+4) +(5+2)

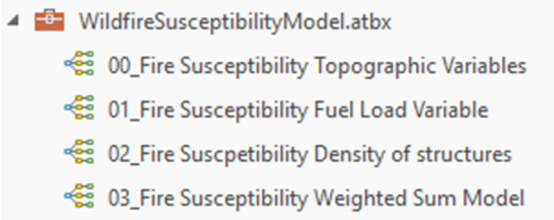
NDMI: (NIR-SWIR1)/ (NIR+SWIR1)
Using Landsat 8/9 band numbers: (5-6)/ (5+6)

NDVI: (NIR-RED)/ (NIR+RED)
Using Landsat 8/9 band numbers: (5-4)/ (5+4)

You can download fuel load data quite easily using the Rangeland Analysis Platform (RAP) (https://rangelands.app/products/#production). While no fuel load model is perfect, I have found RAP provides very good fuel load data across much of the western US. Your fuel load layer must be expressed using *tons per acre* and should account for all types of vegetation (annual forb and grass, perennial forb and grass, forests, etc.). The RAP Biomass README file (https://giscenter.isu.edu/pdf/PDF_NASA_SPARC/RAP_Biomass_Readme.pdf) may be of assistance to help you understand and prepare the necessary data.

The structure points layer can be derived in a number of ways. For this project, we used Artificial Intelligence Deep Learning tools in ArcGIS Pro to extract structure footprints (polygons) from current aerial imagery (e.g., National Agricultural Imagery Program (NAIP)) and then, after good clean up and verification, converted the polygons to point data using the `Feature to Point` geoprocessing tool. Be sure to retain the polygon structure data as it is used in subsequent models.

4. 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.
5. Next, return to the Catalog pane and expand the model toolbox. It should look like the figure below.



6. 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.

7. 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 the output from a previous model.
8. When the final model builder tool completes, you will have a wildfire susceptibility model for Bannock County, Idaho.

9. You can now, prepare data for your AOI and re-run each of the model tools to develop a wildfire model for your AOI.

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

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