Using IFT-Consume for Landscape Smoke Management Planning

Overview & Background

Modeling the consumption of fuels and subsequent emissions is an important step in planning for smoke management. Running fuel consumption and emission production in IFTDSS can provide insight into potential emissions generated when a given area burns, as well as gauging the emissions impacts of fuels treatments by modeling consumption using pre and post treatment fuels data. IFTDSS workflows are laid out to either calculate fire effects at the stand level (Fire Effects>Calculate consumption or emissions), or at the landscape level (Fire Effects>Fire effects across the landscape). To calculate fire effects at the landscape level, you will run IFT-Consume.

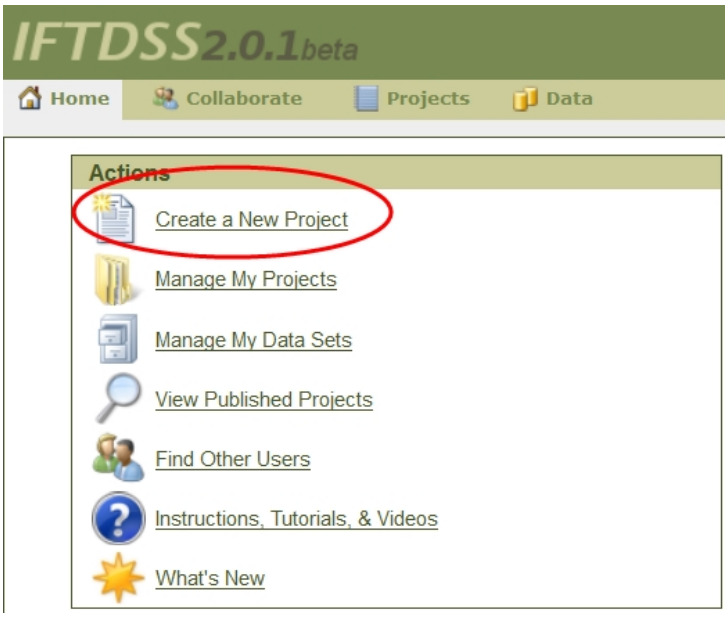
IFT-Consume is a decision-making tool designed to assist planning for prescribed burns and wildfires using fuels data. IFT-Consume predicts fuel consumption, pollutant emissions, and heat release based on input fuel characteristics, lighting patterns, fuel moistures and other environmental variables. IFT-Consume includes separate equations for calculating consumption of activity and natural fuels. IFT-Consume may be used to generate consumption and emissions data across the landscape, while Consume for Activity Fuels or Natural fuels may be used to generate information on the stand-level.

This tutorial will focus on predicting consumption and emissions using Consume. It will provide information and step by step instructions on the following:

- Setting up a project
- Acquiring FCCS fuelbed data to run IFT-Consume
- Selecting -IFT Consume from the IFTDSS workflows
- Populating and running the IFT-Consume model
- Viewing output data
- Exporting data as raster layers to ArcMap for analysis
- Evaluating results (in ArcMap)
- Review and wrap-up

Setting up the project

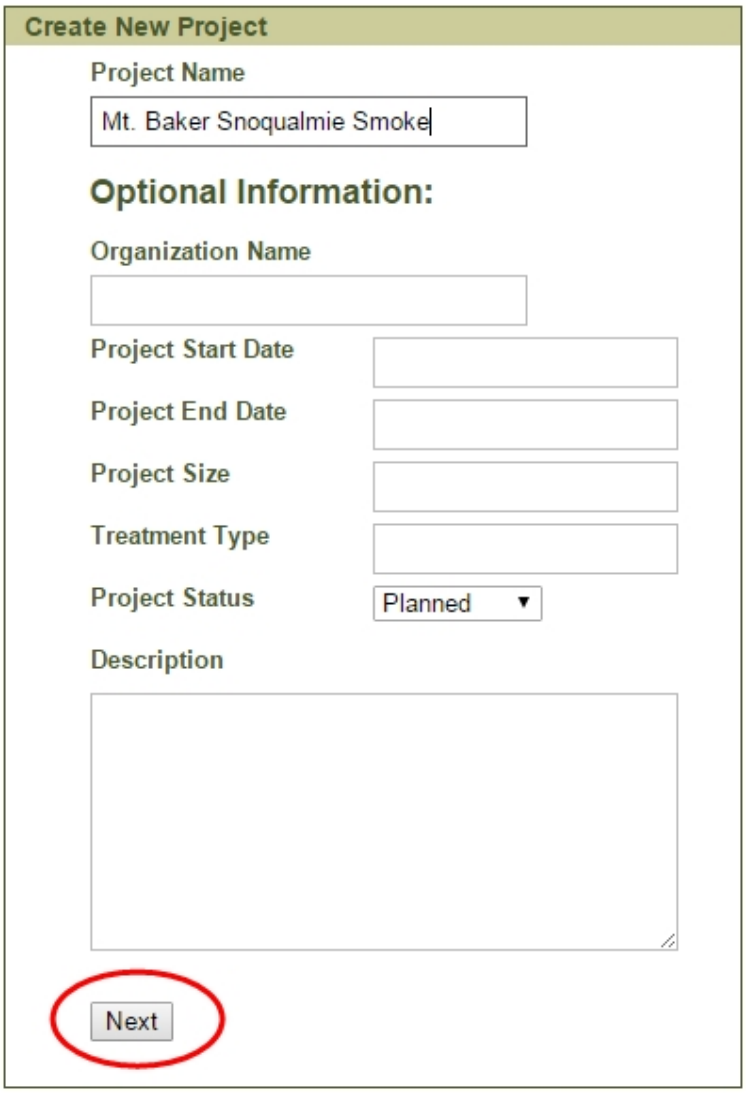
To begin, click **Create a New Project** from the actions menu.



Choose a descriptive project name.

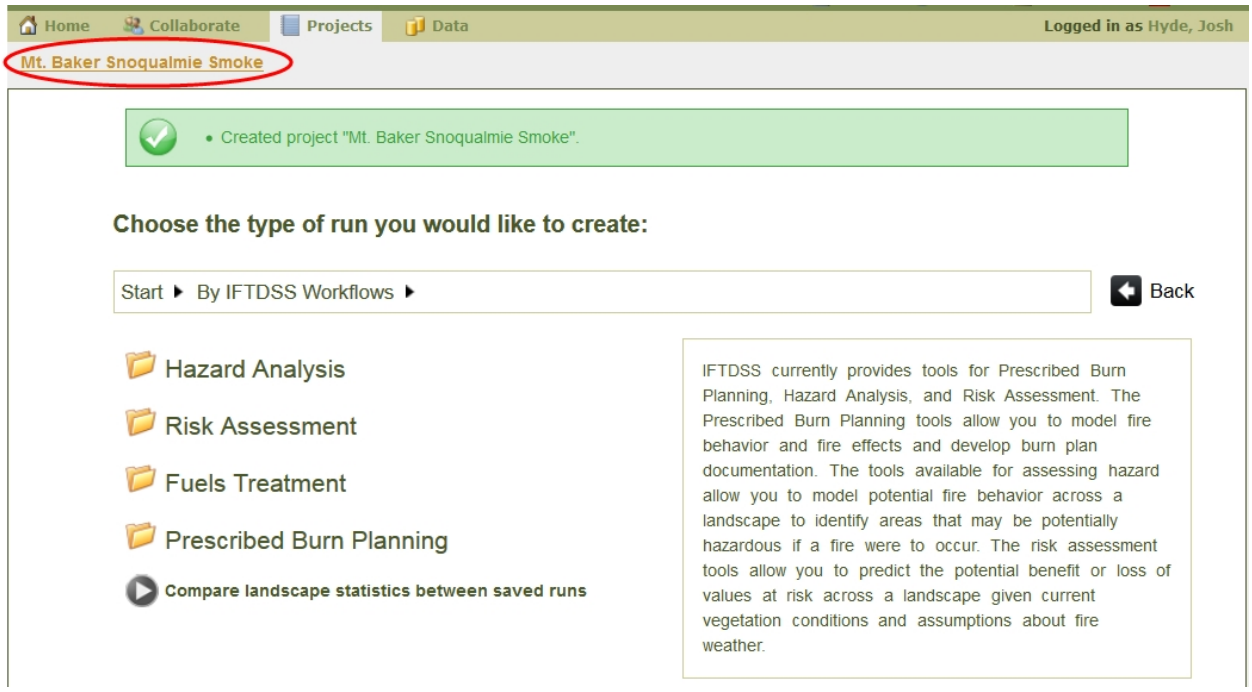
If desired, fill in the optional information.

Choose **Next**.

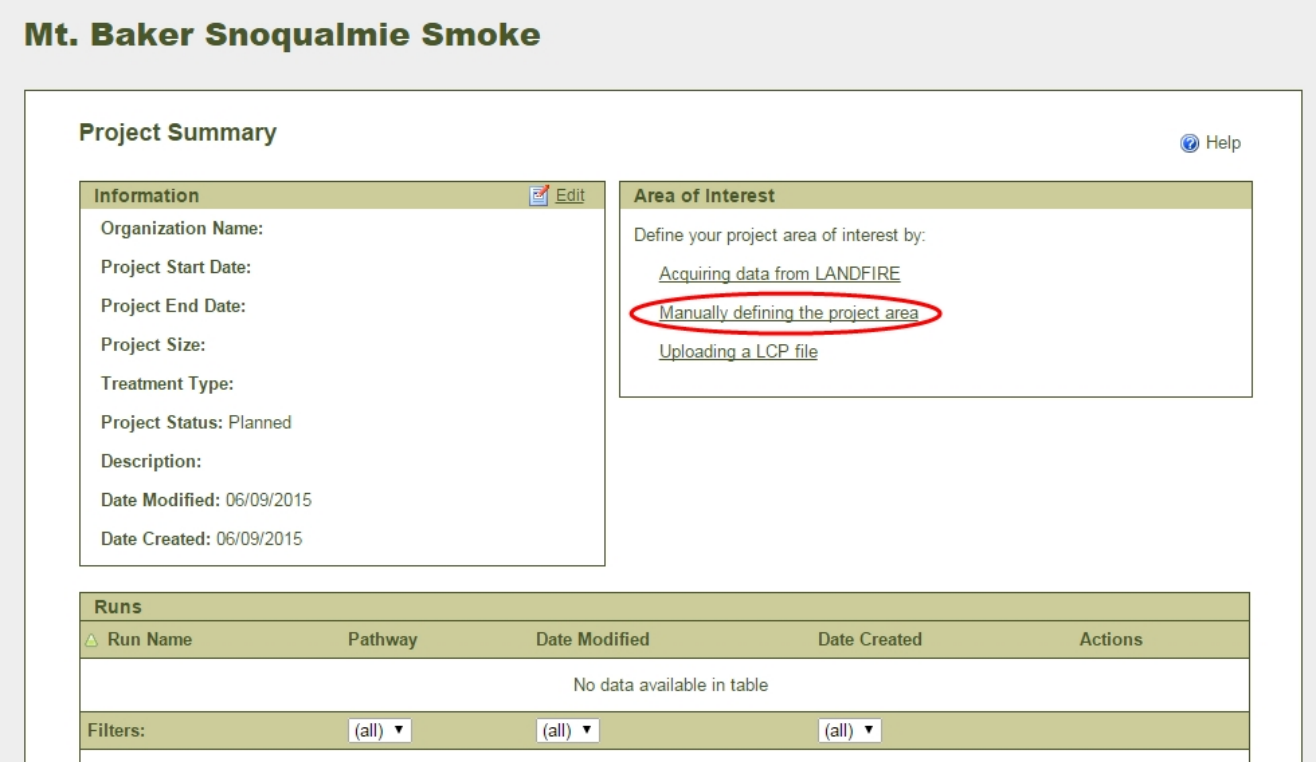


After creating a new project, you will see the page for **creating a new run**.

For the next steps, setting up an area of interest and acquiring LANDFIRE data, we are going to navigate to the project summary page by clicking on our project name (circled in red).



In the Area of Interest window of the Project summary page, choose to define your project area of interest by **Manually defining the project**.



Navigate to your desired location using one of these methods:

- Use the navigation tools located in the top left portion of the map.
- Use the mouse. Click and drag to move; double-click to zoom in.
- **Enter coordinates**.

For this example, we will select the following coordinates

North: 48.34953368145102

South: 48.24904128853667

West: -121.8202500471653

East: -121.57580424635472

> **Note**
> To navigate to your desired location and select a project area using your mouse instead of typing coordinates, do the following: first click and drag, then double click to zoom into the approximate area of the map. Next, select the **Draw Box** radio button on the top left of the map, mouse to the edge of your intended project area, hold down the left mouse button, and drag over your area of interest, then let go of the mouse button.

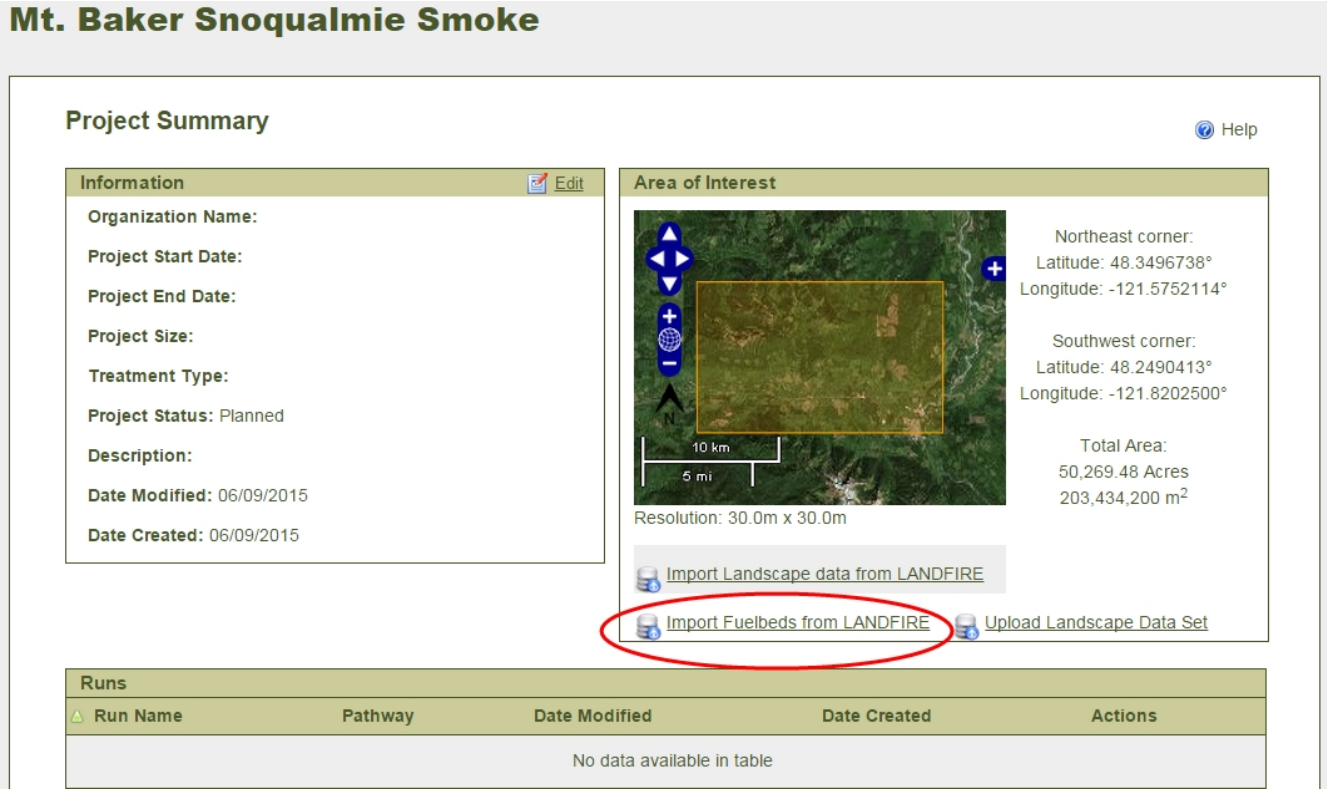
Note
Once you select your dataset, the project area **cannot** be changed. To change a project area, you must create a new project.

When finished, click **Next** at the bottom of the page, this will return you to the project summary page.

Next we will acquire the Fuels Characteristic Classification System (FCCS) fuelbed data needed to run Consume.

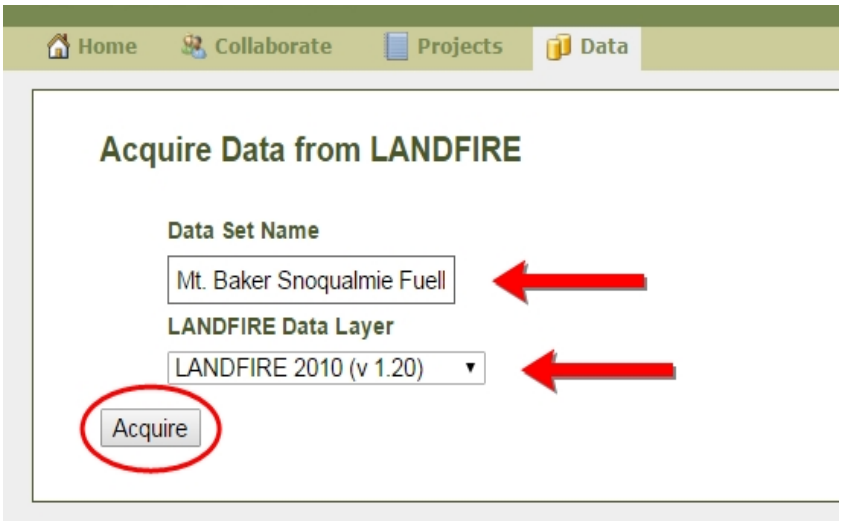
Acquiring FCCS fuelbed data to run IFT-Consume

From the Project Summary page, select **Import Fuelbeds from LANDFIRE**.



Note
You may also import LANDFIRE Fuelbeds, or upload a fuelbed dataset by clicking the **Data** tab and selecting **Fuelbed data** tab.

On the '**Acquire Data from LANDFIRE**' page, choose a name for your dataset, and the version of LANDFIRE you want to use. For this example we are downloading LANDFIRE 2010 version 1.20. When finished, click **Acquire**.



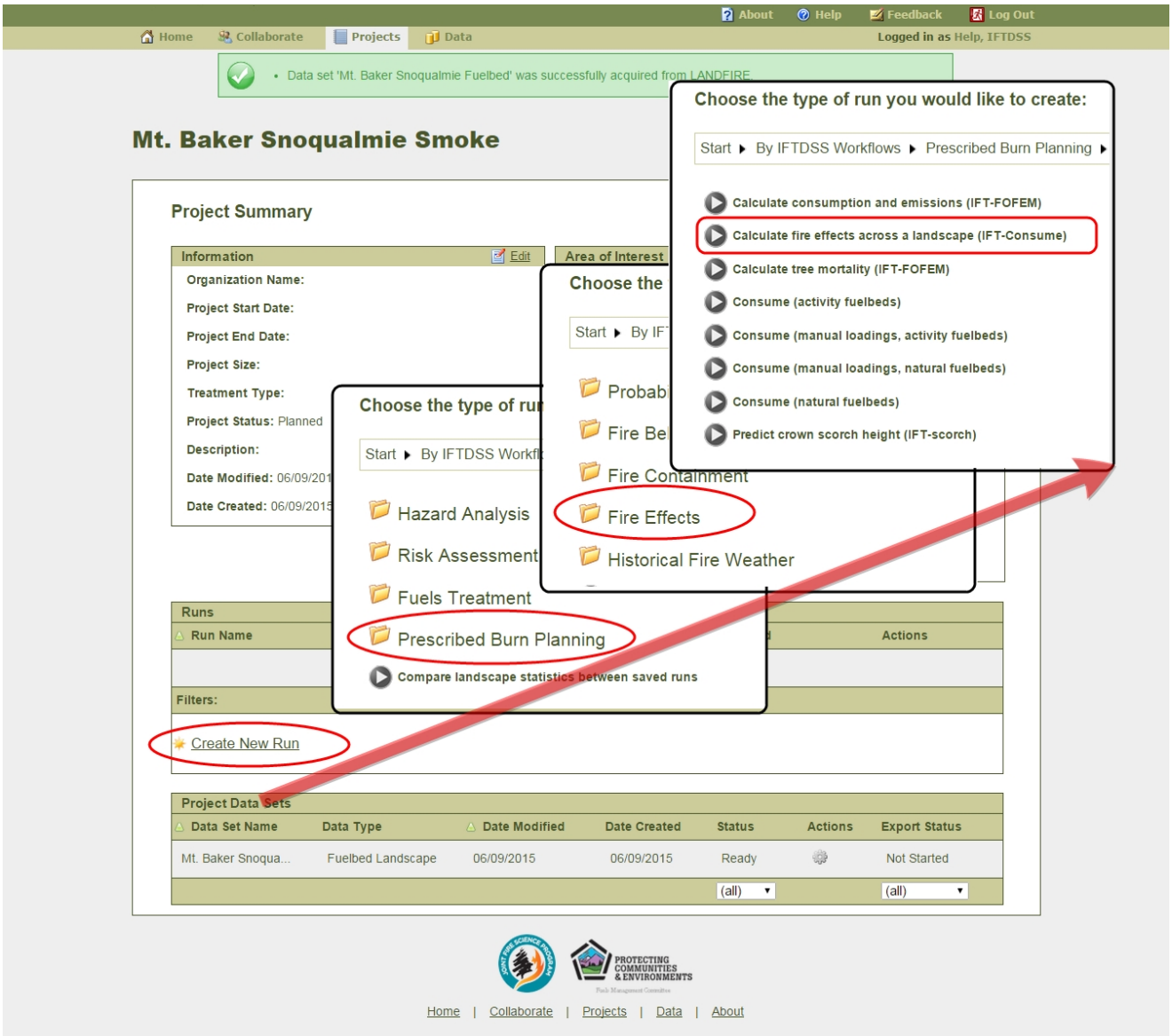
Once the data have downloaded you will be returned to the project summary page.

Next you will scroll down to the **Runs** section of the project summary page.

Selecting IFT-Consume from the IFTDSS workflows

Select **Create New Run**

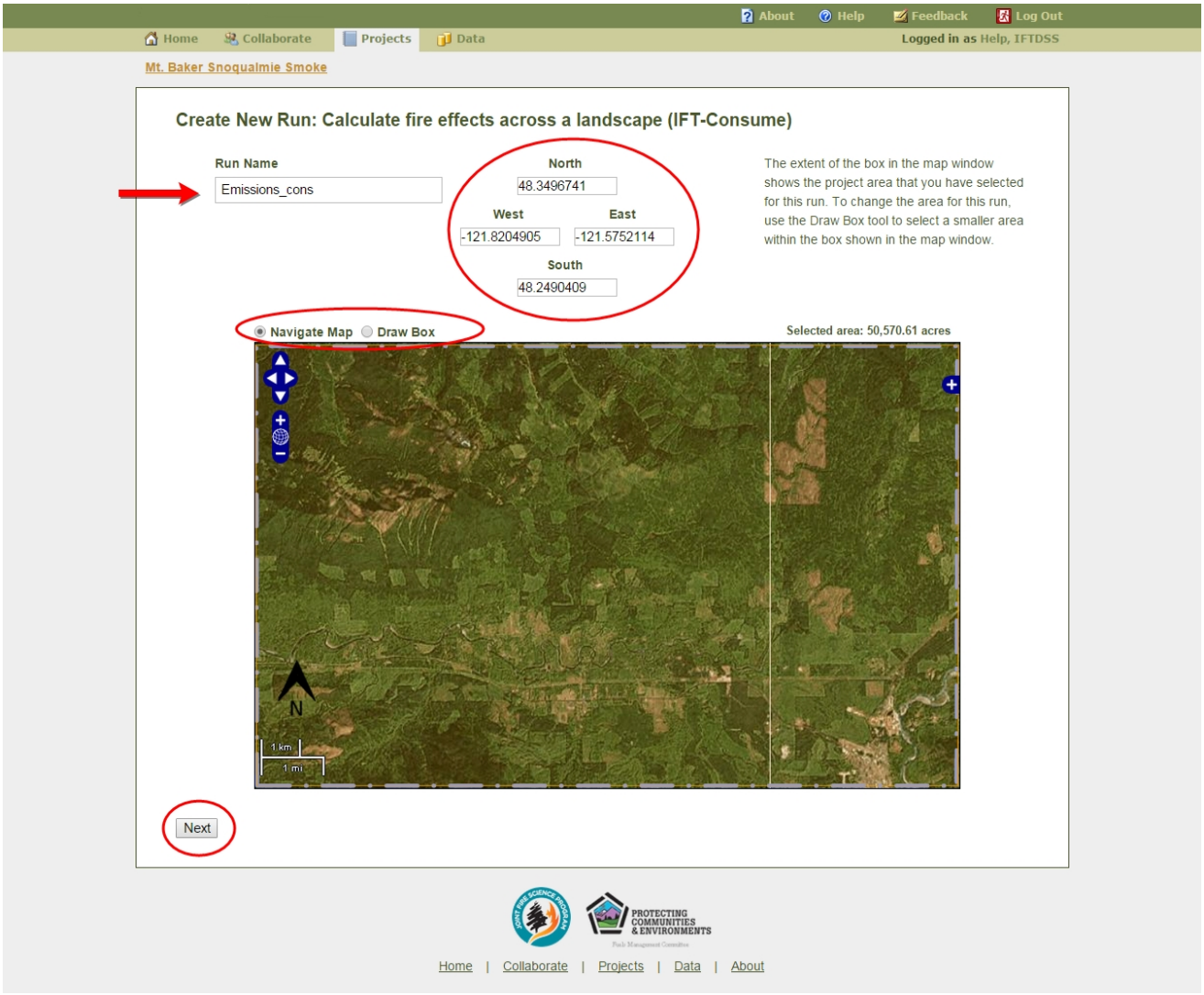
From the **Create New Run** menu, Select **Prescribed Burn Planning, Fire Effects, Calculate fire effects across a landscape (IFT-Consume)**.



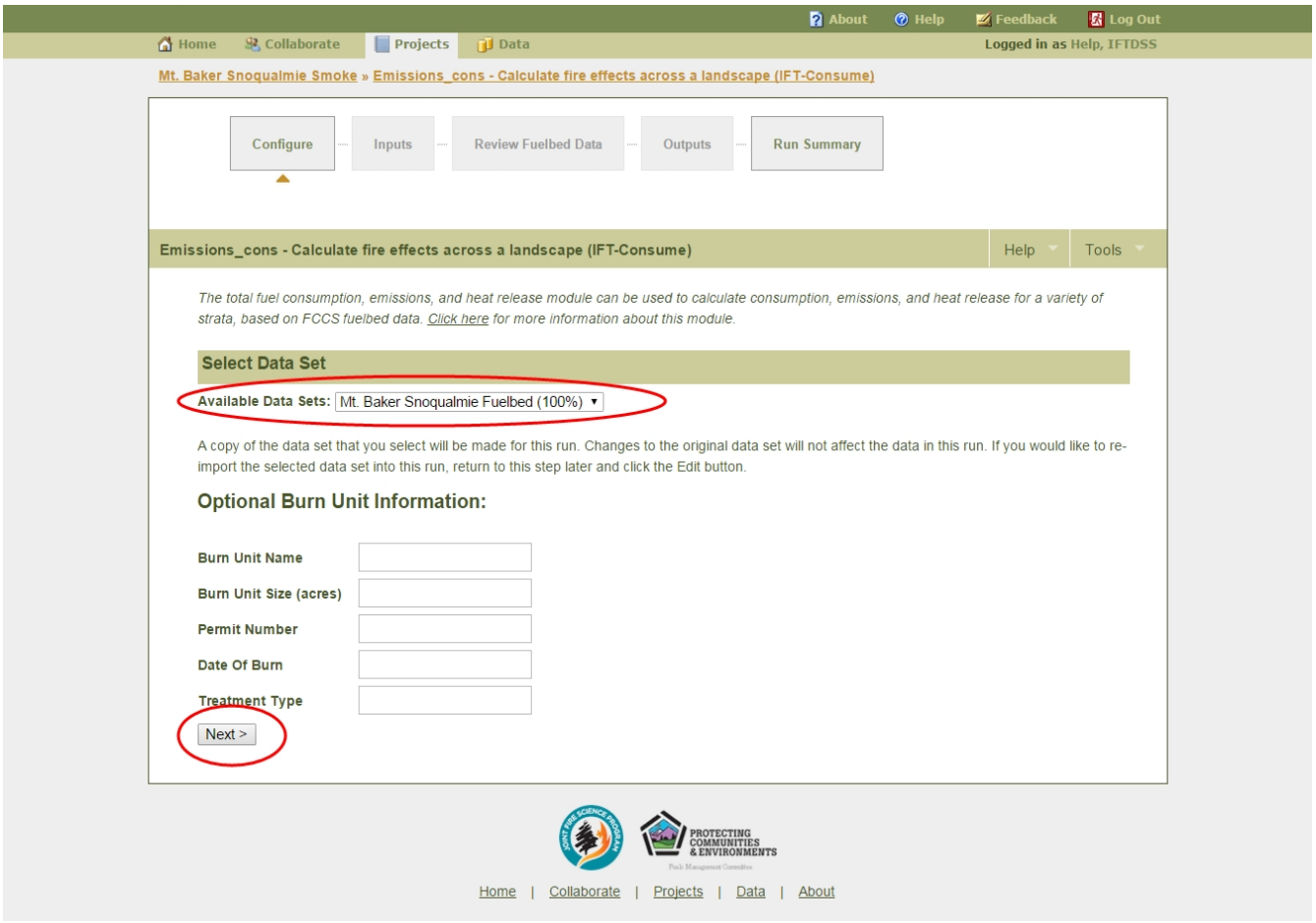
Note

Within the **Prescribed Burn** workflow under **fire effects**, there are several run options using the Consume fire effects model, depending on the inputs, outputs, and output format desired. These are detailed elsewhere in IFTDSS help.

Name your Run, ensure the coordinates are corrects, and click **Next.**



Confirm that the fuelbed data set selected by default is the one which you created for this project. You are given the option of populating additional information such as burn unit name, size, etc. For this example we will leave these blank. Click **Next**.


About
Help
Feedback
Log Out
Home
Collaborate
Projects
Data
Logged in as Help, IFTDSS
Mt. Baker Snoqualmie Smoke » Emissions_cons - Calculate fire effects across a landscape (IFT-Consume)
Configure
Inputs
Review Fuelbed Data
Outputs
Run Summary
Emissions_cons - Calculate fire effects across a landscape (IFT-Consume)
Help
Tools
The total fuel consumption, emissions, and heat release module can be used to calculate consumption, emissions, and heat release for a variety of strata, based on FCCS fuelbed data. Click here for more information about this module.
Select Data Set
Available Data Sets: Mt. Baker Snoqualmie Fuelbed (100%)
A copy of the data set that you select will be made for this run. Changes to the original data set will not affect the data in this run. If you would like to re-import the selected data set into this run, return to this step later and click the Edit button.
Optional Burn Unit Information:
Burn Unit Name
Burn Unit Size (acres)
Permit Number
Date Of Burn
Treatment Type
Next >
PROTECTING COMMUNITIES & ENVIRONMENTS
Home | Collaborate | Projects | Data | About

Populating and running the IFT-Consume model

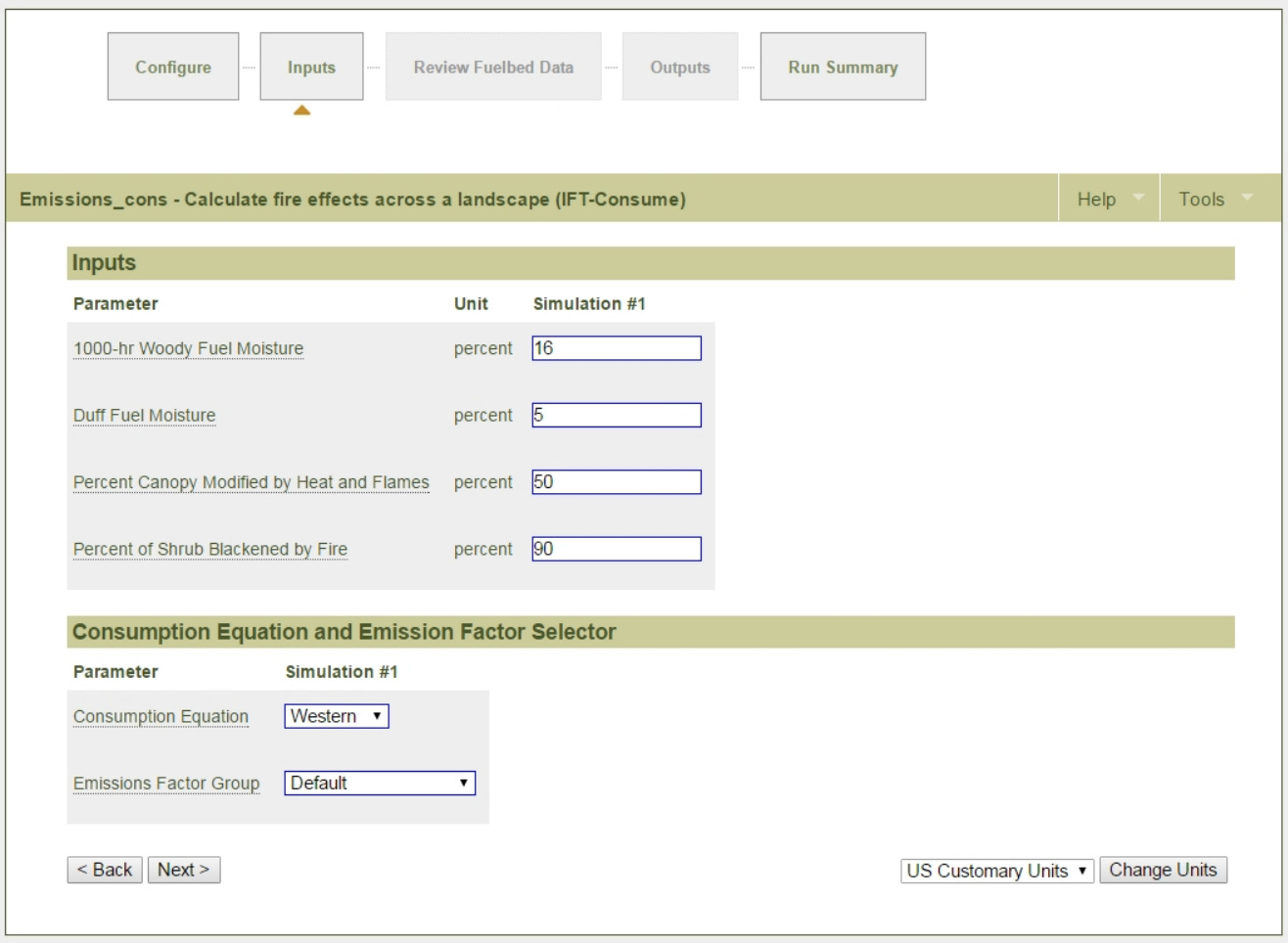
The parameters needed to run the IFT-Consume model for landscapes are listed in the table below:

Name	Units	Brief Description
Duff Moisture	Percentage	The moisture content of duff, expressed as a percentage of oven dry weight.
Eco Region	(A choice)	Fuelbeds are organized geographically into Bailey's ecoregion divisions, which are • Hot Continental • Marine • Mediterranean • Prairie • Rainforest • Savanna • Subarctic • Subtropical • Temperate Desert • Temperate Steppe • Tropical/Subtropical Desert • Tropical/Subtropical Steppe Desert • Tundra • Warm Continental
Moisture of 1000-hr Fuels	Percentage	The moisture content of sound, woody material 3 to 9 inches in diameter. Moisture content can be directly measured or estimated using the ADJ-Th or NFDRS-Th fuel moisture models.
Percent Canopy Loading Consumed	Percentage	Percentage of canopy loading consumed by the fire. If you do not know the value and choose not to enter this variable, Consume uses the following defaults: Prescribed burn = 0% Wildland fire use = 40% Wildfire = 60%.

Name	Units	Brief Description
Percent Shrub Blackened	Percentage	Percent of the shrub stratum that is blackened by the burn. This value is input (as a percentage) to the algorithm for calculating shrub consumption.

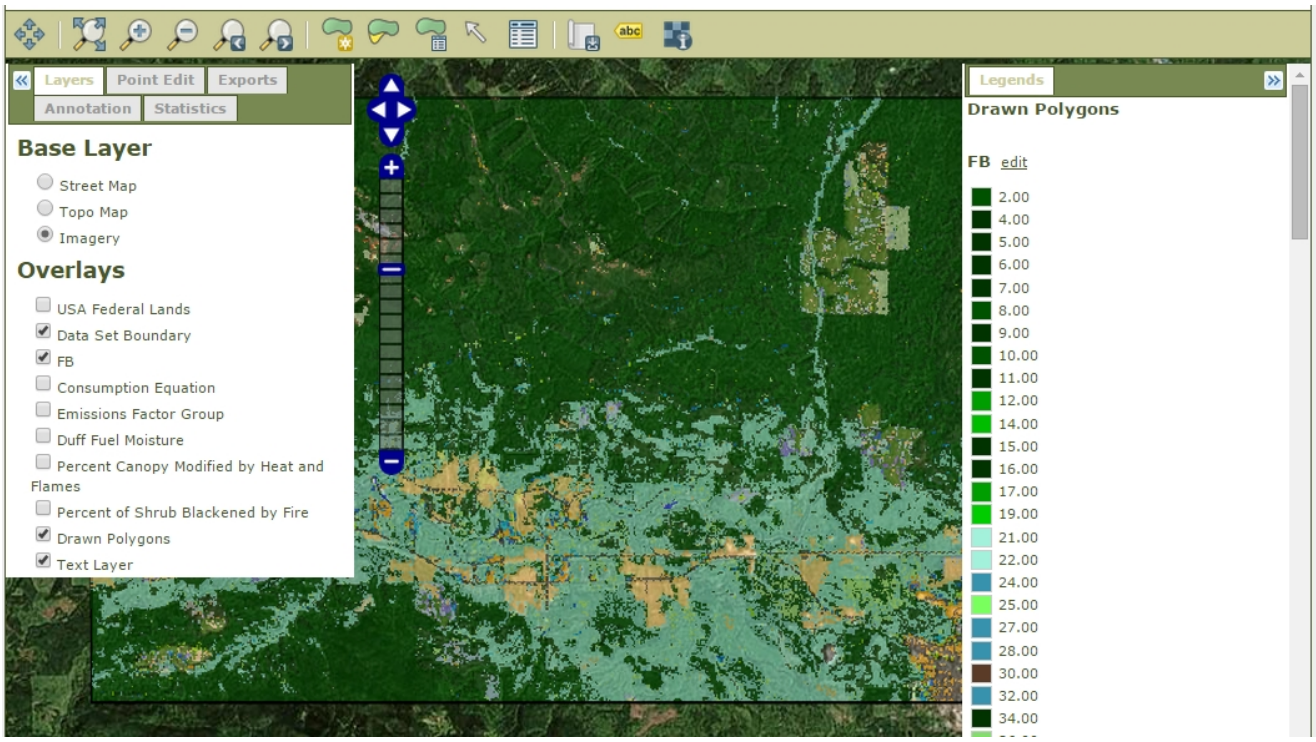
For this tutorial, we will use the inputs displayed below. We'll select dry conditions, including a **1000-hr woody fuel moisture** of **16**, and a **Duff fuel moisture** of **5**. We'll assume a scenario in which **50%** of the canopy is consumed, and **90%** of shrubs are blackened. For the **consumption equation** options (Boreal, Southern, or Western) we will choose **Western**, as it best represents the area of the burn. We will leave the **Emission Factor Group** set to its default setting.

Note
There are several Emission Factor Groups available. For more information on the Emission Factor groups, visit the **Emission Factor Groups by Cover Type** and the **Emission Factors by Emission Factor Groups**pages.



Once these inputs are done, click **Next**

Before the Consume model runs you will have a chance to review the fuel bed (FB) data



On this page you may use the data as is, or make edits to it using the mapping toolbar. In this example we will leave the data as-is, scroll to the bottom of the page, and click **next**.

If you choose to edit the data within the map interface during a run, the changes will take effect during the run. However, the original data file will remain unchanged. To make permanent changes to a dataset, use the **Data Studio** feature under the **Data** tab of IFTDSS.

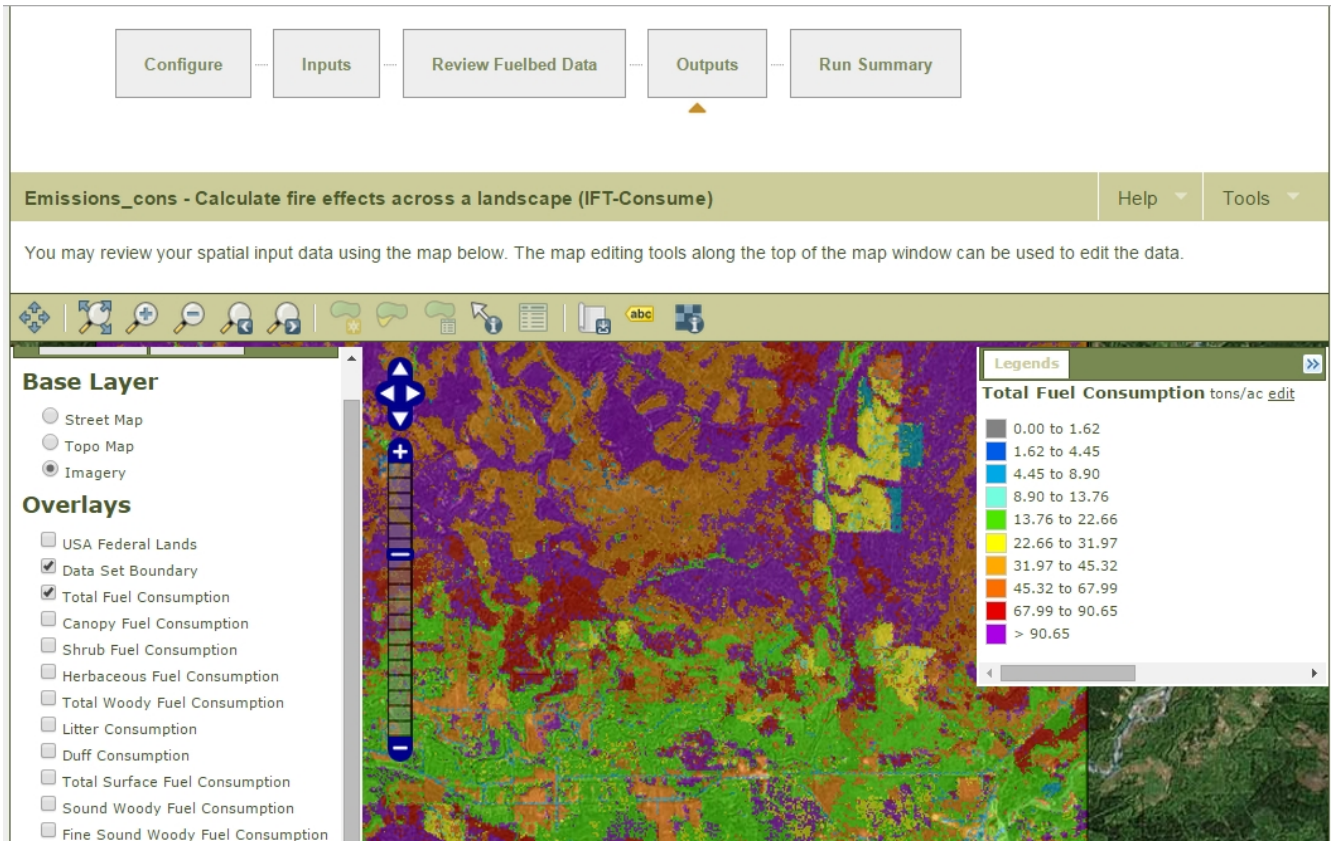
Note
Visit the **FCCS Fuelbed Overview** Page if you would like further information on fuelbeds.

Viewing output data

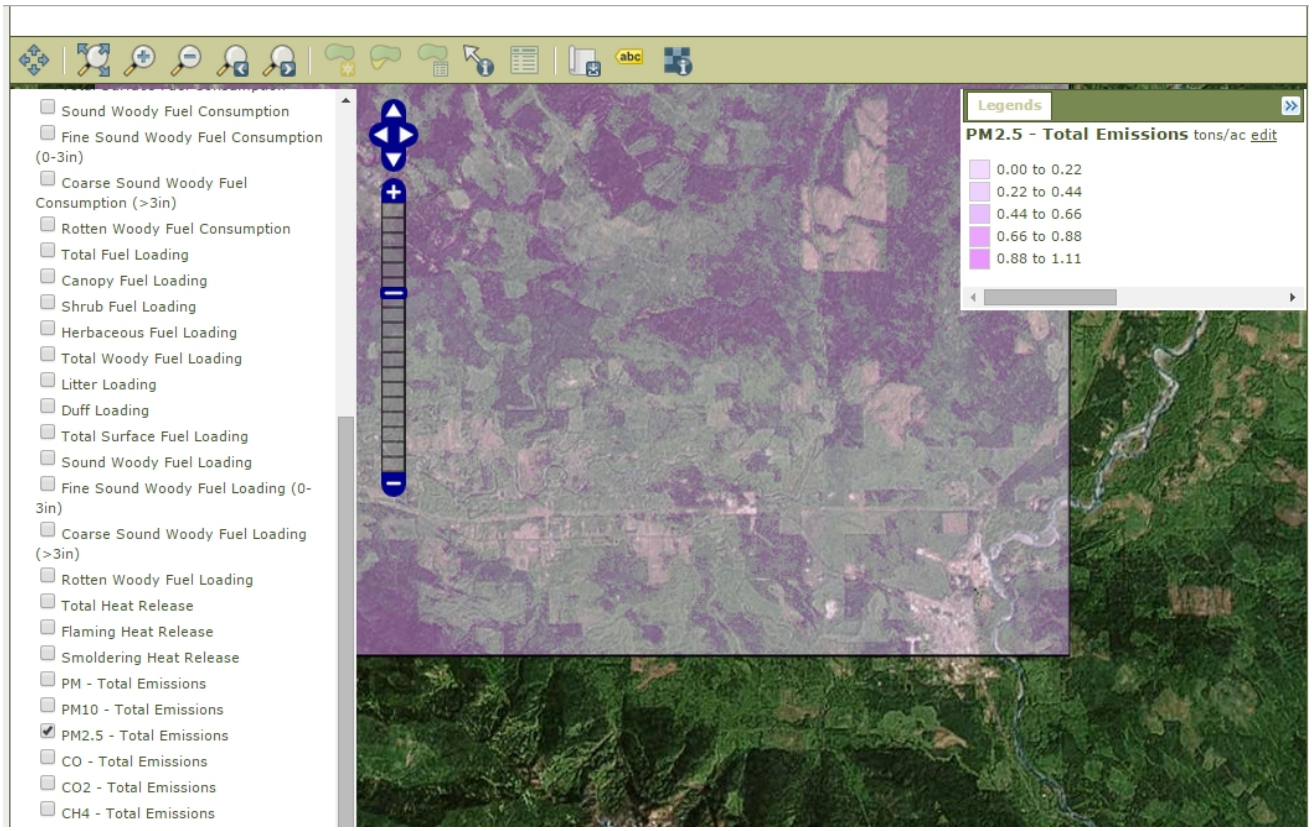
IFT-Consume will list several emissions:

Name	Units	Brief Description
Carbon monoxide (CO)	Tons per acre, kg per meter squared	Total carbon monoxide emitted.
Carbon dioxide (CO_2)	Tons per acre, kg per meter squared	Total carbon dioxide emitted.
Methane (CH_4)	Tons per acre, kg per meter squared	Total methane emitted.
Non-methane hydrocarbon (NMHC)	Tons per acre, kg per meter squared	Total non-methane hydrocarbons emitted.
Particulate matter (PM)	Tons per acre, kg per meter squared	Total particulate matter emitted.
Particulate matter 2.5 ($PM_{2.5}$)	Tons per acre, kg per meter squared	Total particulate matter 2.5 emitted.
Particulate matter 10 (PM_{10})	Tons per acre, kg per meter squared	Total particulate matter 10 emitted.

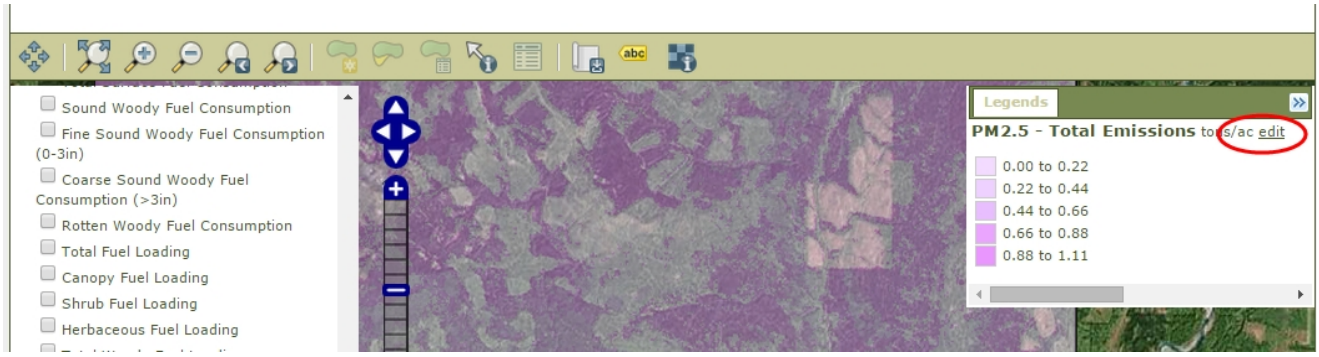
When the model is finished running, you can view the outputs spatially.

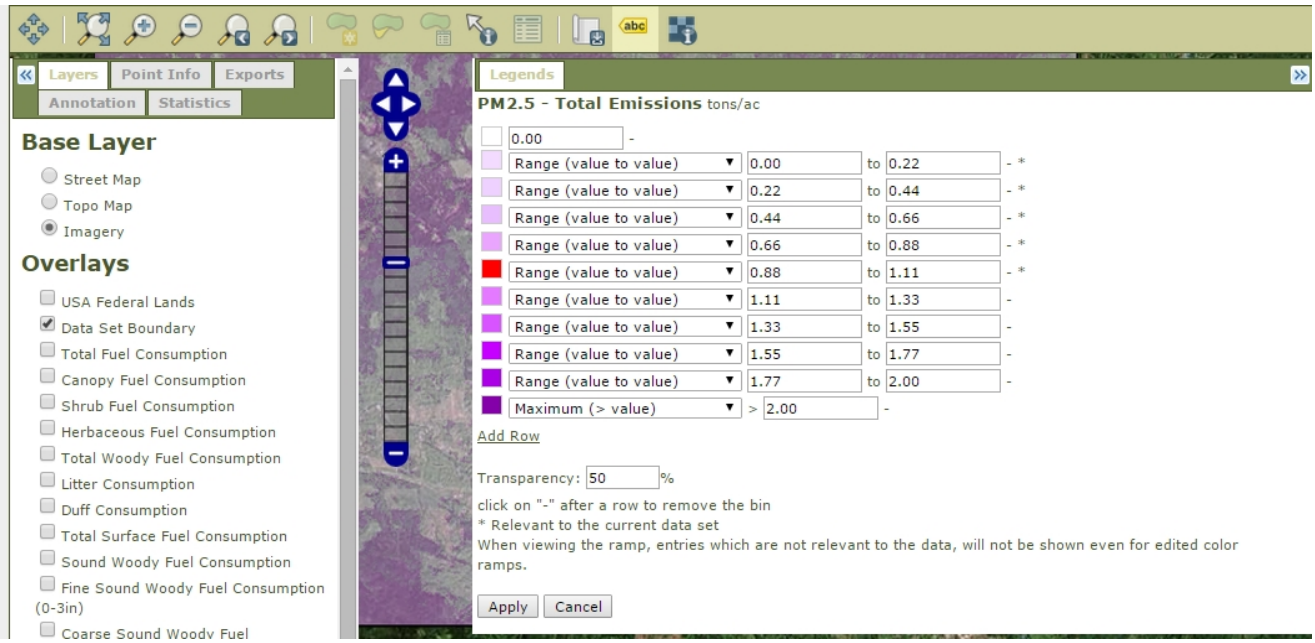


On the dropdown list to the left, we have the option of viewing total particulate matter, coarse particulates (PM_{10}), fine particulates ($PM_{2.5}$), carbon monoxide (CO), carbon dioxide (CO_2), methane (CH_4), and non-methane hydrocarbons (NMHC). PM 2.5 is displayed below.



To change the display color, or adjust the range of values displayed, select the **edit** option in the legend.





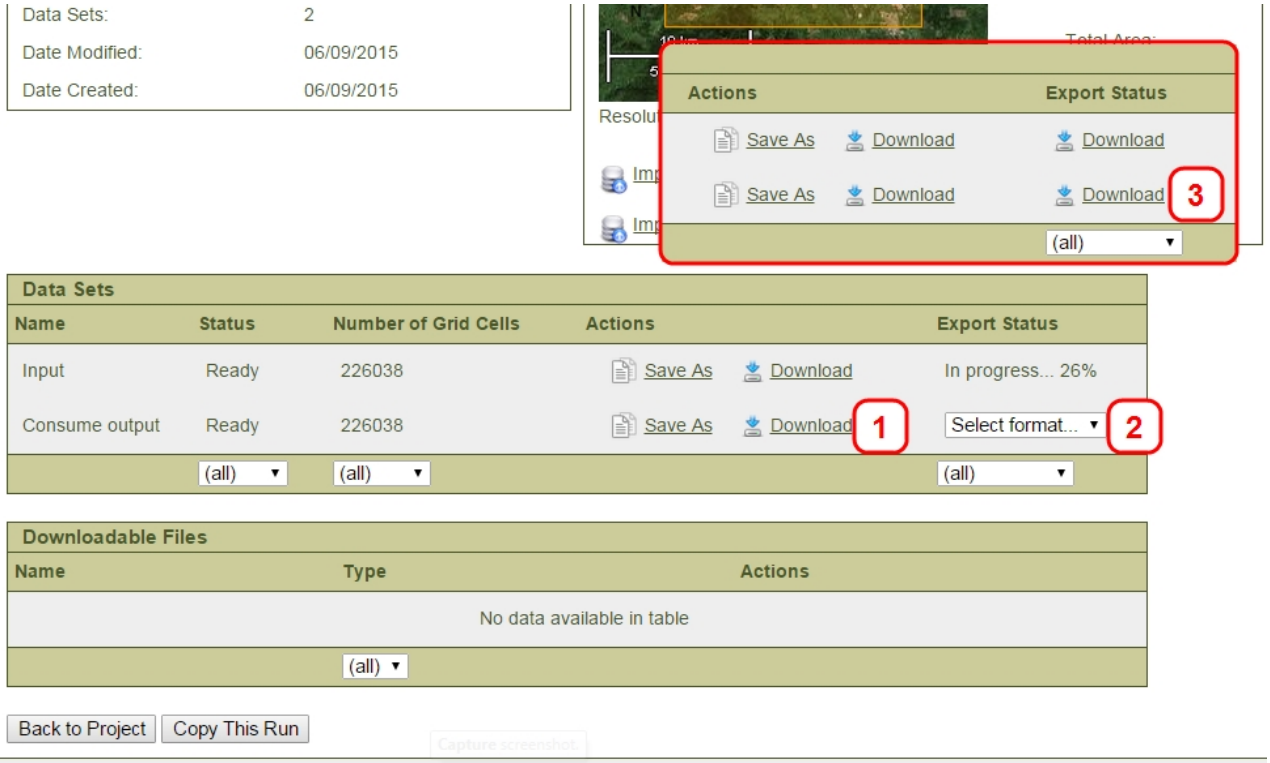
To prepare for the next step, click **Finish** at the bottom of the page, this will take you to the **Run Summary** page.

Exporting data as raster layers to ArcMap for analysis

To download shapefiles or raster versions of the consume inputs and outputs, scroll down to the **Data Sets** box of the **Run Summary** page

Download the raster datasets of the consume inputs and outputs:

1. Select **Download** under Actions
2. Select your desired format (**raster** for this example). You will see the export progress indicated as a percent
3. Once the export process has completed, the percent progress will be replace by a **Download** icon. Click the download icon to download a zipfile.



Evaluating results

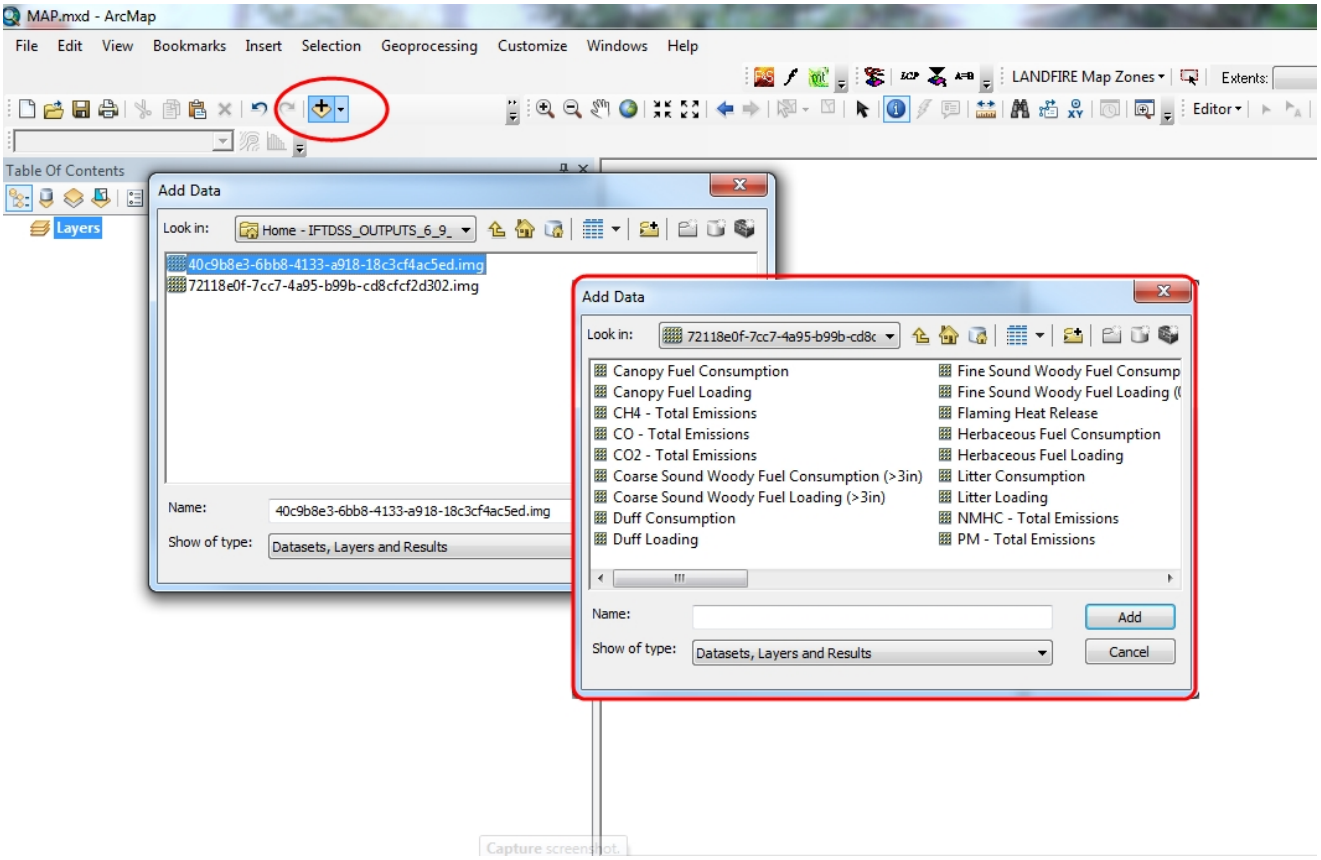
For this next section, we will evaluate results in ArcMap.

Place your saved input and output zip files in a folder of your choosing, and unzip the datasets

Open Arcmap

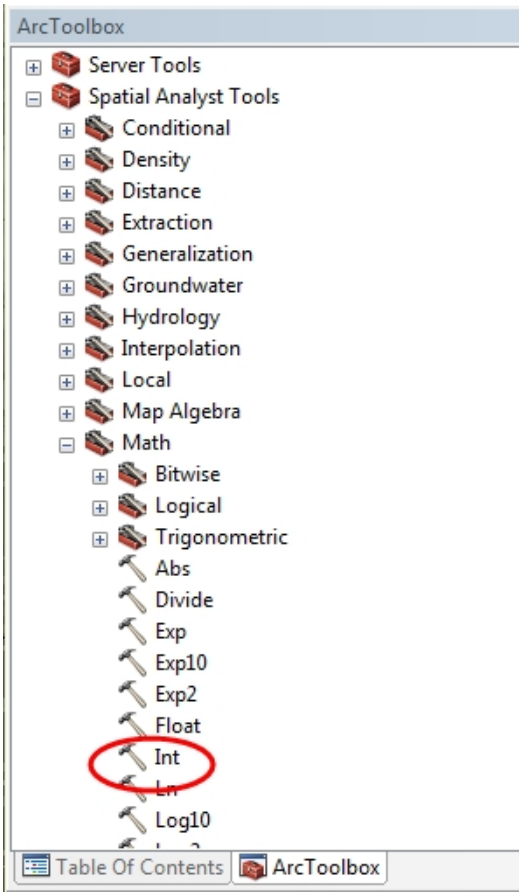
> **Note**
> Your Arcmap menus may look different than those depicted in this tutorial, depending upon the version of Arcmap you are using.

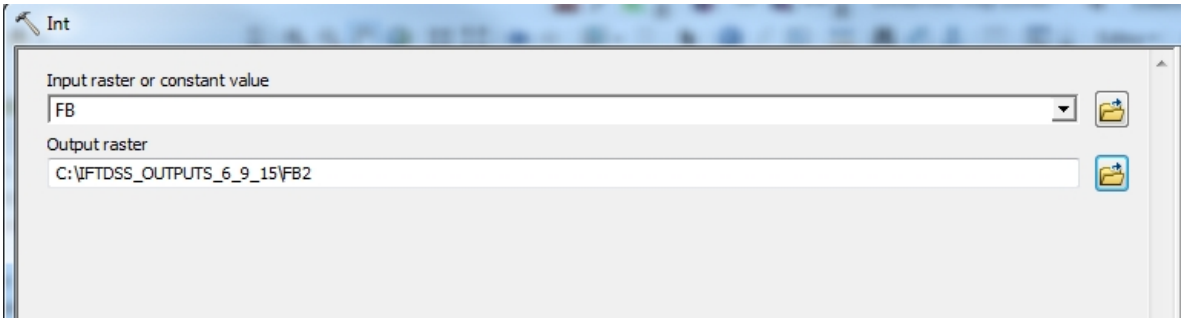
Use the **Add data** tool (circled in red) to find the folder with the exported Consume inputs and outputs. For this example we will download the **FB (Fuelbed) layer** from inputs. From outputs we'll download consumption layers for **duff, litter, woody fuel, sound woody fuel, rotten woody fuel, and canopy**, as well as the **total particulate matter** layer. This process is displayed in the images below:



Note

These layers are saved as IMAGINE files. To generate an attribute table, or perform quantitative analysis, you will have to convert them to integer format by opening **Geoprocessing>ArcToolbox >Spatial Analyst> Math>Int.**



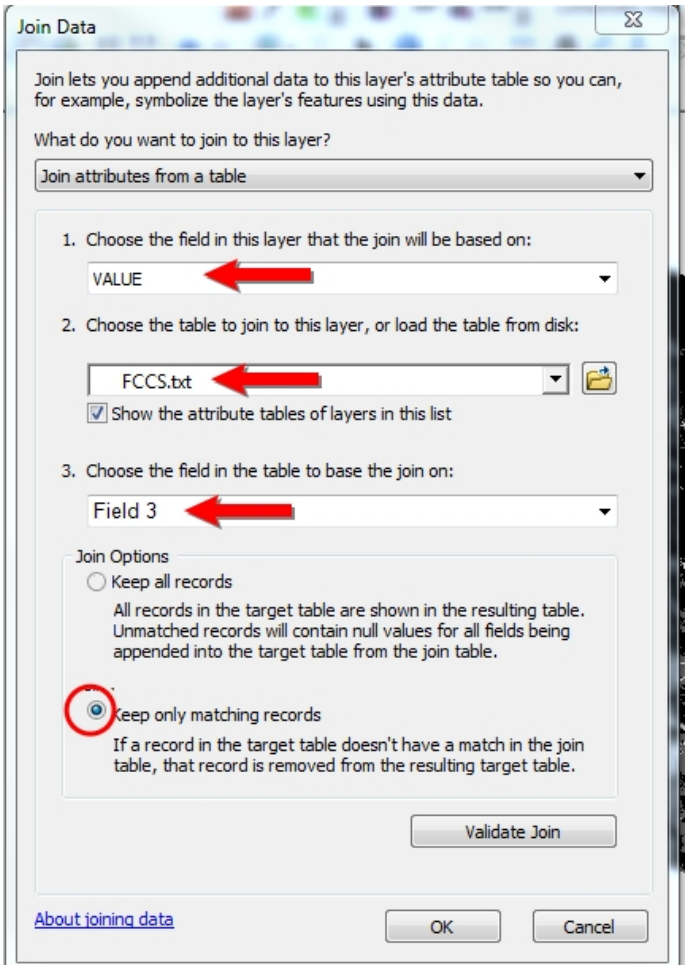


Note

The fuel bed layer, as imported from IFTDSS, will list fuelbeds by their FCCS number only. However, if you have a corresponding database file of FCCS fuelbeds in your area, their numbers, and names, it can be joined to the IFTDSS fuelbed layer and exported as new layer; this will allow you to identify fuelbeds by name across your landscape.

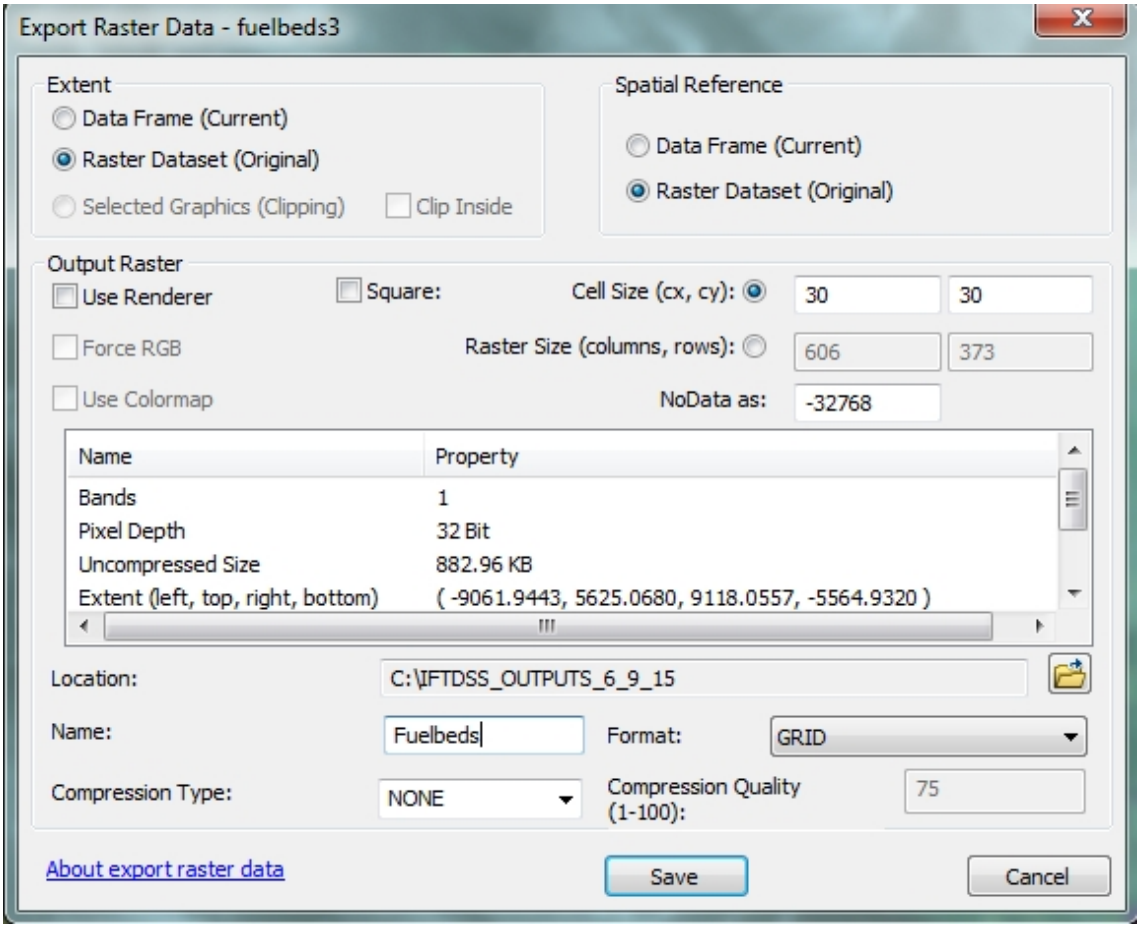
Right click on fuelbed layer and select **join**.

Specify which fields to join, in the example below the **VALUE** field of the imported IFTDSS fuelbed layer corresponds to the FCCS number (Field 3) of an FCCS text file that was available for the area in this example. If you are using a table that has more FCCS fuelbeds than your imported IFTDSS fuelbeds layer, make sure to select the join option **Keep only matching matching records** is selected. **Select OK**.



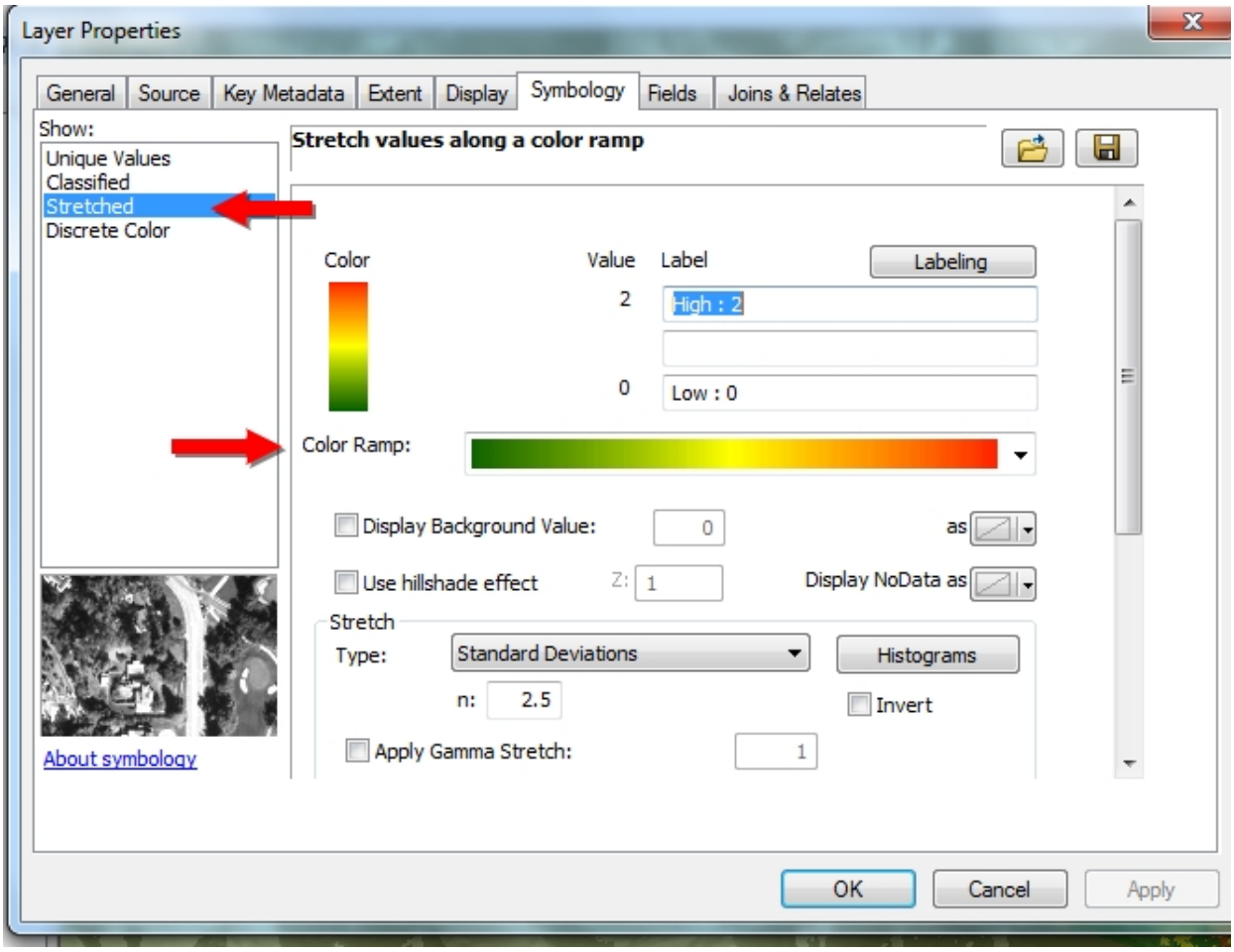
To make the join permanent, export the joined fuelbed layer by **right clicking**, select **data**, and **export data.** Ensure your extent and spatial references are set to use the ori-

ginal (**Raster Dataset (Original)**), and **Cell Size** is 30 by 30, and the format is set to GRID, as they are in the figure below. Select **Save**.

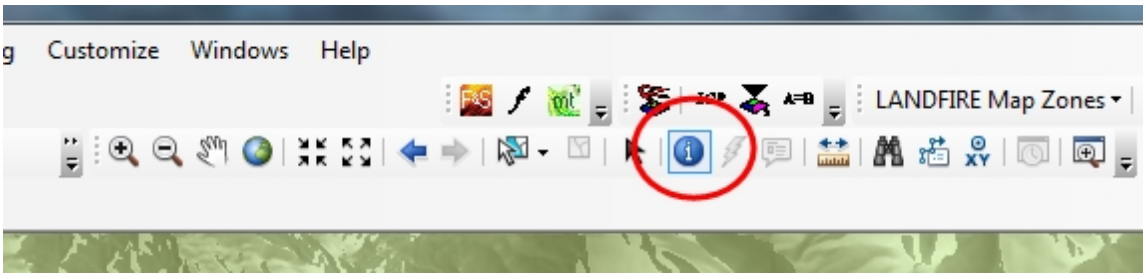


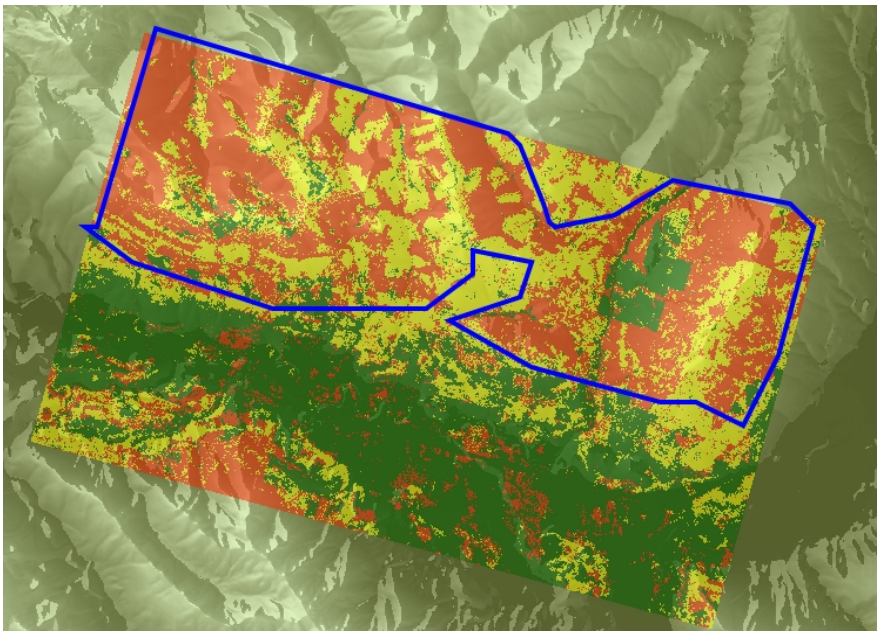
For this example, we have joined the fuelbed names to the FB data layer, and exported the result as new raster file so that fuelbed names are visible on the landscape.

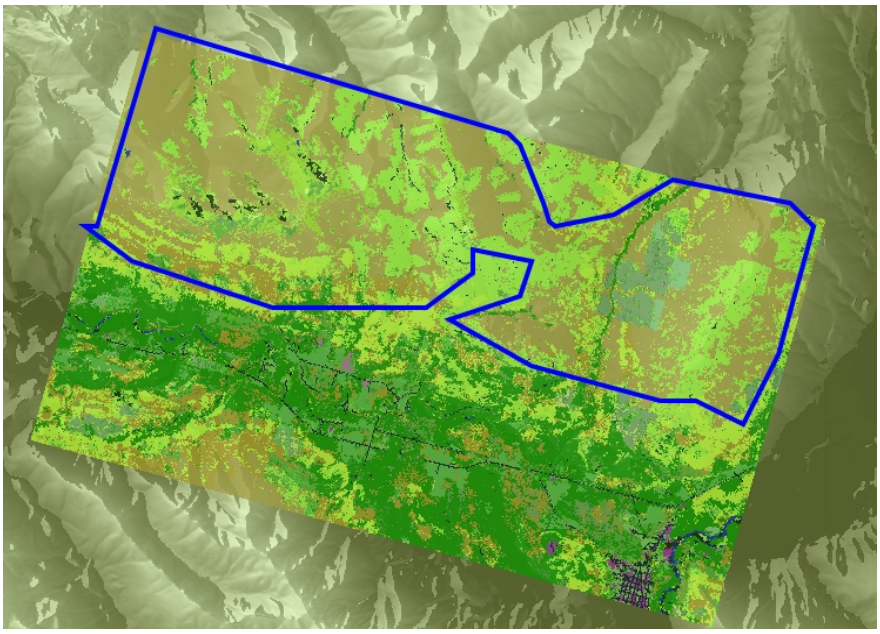
Right click on each layer, select **properties>symbology**, and adjust the color and display to your preference. In this example we selected the total particulate layer, and selected **stretched** and chose a color scheme ranging from green to red as the values increased. This will show where on the landscape the highest particulate matter concentrations would be produced.



By toggling back and forth between the fuelbed layer and the particulate matter layer, and using the **identify tool** (circled in red) we can see the fuels which are likely to produce the greatest quantities of particulate matter, that could potentially impact human health, or regulatory compliance.



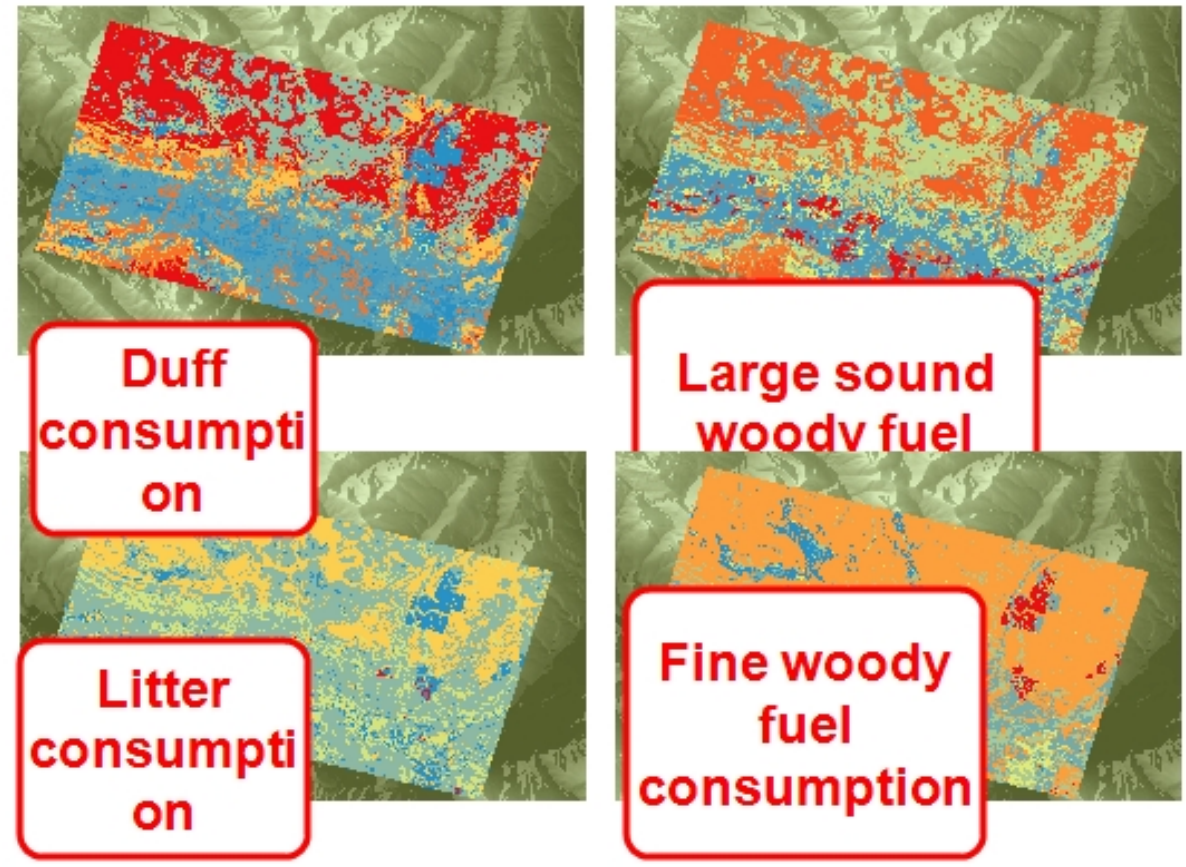




We can see in the mountains to the north of the valley, the fuelbeds and high particulate matter areas match well. Using the identify tool, we can see that the fuelbed predicted to generate these levels of particulate matter is Fuelbed 2, ‘Douglas fir-Western redcedar-Western Hemlock’.

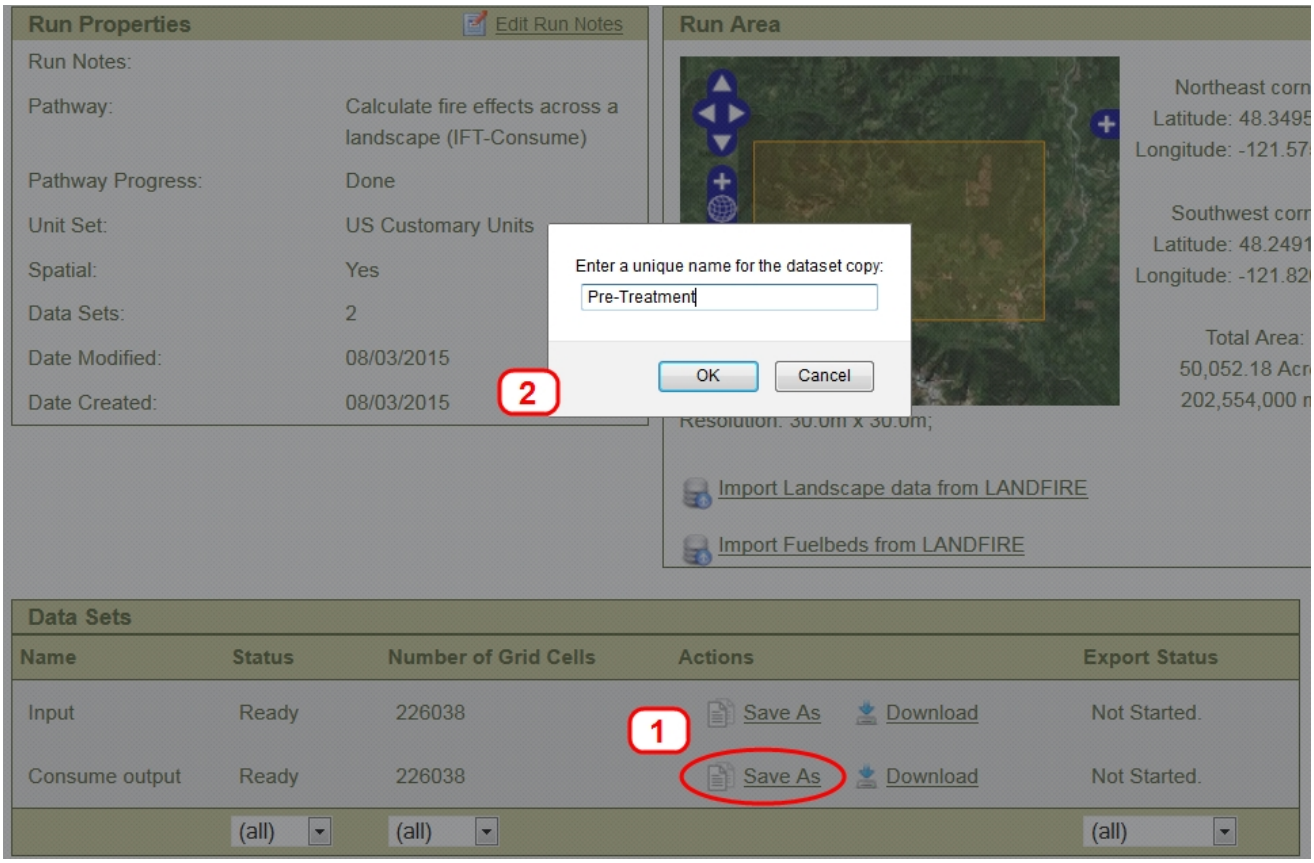
By using the same sliding color scale to see the relative highest amounts of various fuels, we see Fuelbed 2 also corresponds well to high quantities of litter, duff, and sound woody fuel consumed, but not necessarily fine woody fuel consumption. This provides

information on the specific fuels in these areas that would contribute to particulate emissions.



These choices are just examples, feel free to explore, using a similar approach for your own area of interest, evaluating different fuels, fuelbeds, and emissions. Doing so will allow you to identify areas of interest, and potential fuel characteristics.

To use this feature to compare emissions from pre and post-treatments, go through the process outlined in this tutorial using your pre-treatment data. When finished, save your outputs ..... Then create a new run using post-treatment data and compare the outputs.



This comparison can be useful in both identifying areas of the landscape that are likely to produce high levels of emissions, and the differences in emissions between treated and untreated areas.

Review

In this tutorial we walked through the steps needed to predict consumption and emissions using Consume. The tutorial provided information and step by step instructions on:

- Setting up a project
- Acquiring FCCS fuelbed data to run IFT-Consume
- Selecting -IFT Consume from the IFTDSS workflows
- Populating and running the IFT-Consume model
- Viewing output data
- Exporting data as raster layers to ArcMap for analysis
- Evaluating results (in ArcMap)

Additional Help

To navigate to additional tutorials in the IFTDSS online help content,

1. Click the **Help** button.
2. Then select **Getting Started (Tutorials and Videos)** from the side menu.

On that page, you'll find links to tutorials and videos on such topics as hazard analysis, prescribed burn planning, fuels treatment, spatial analysis across a landscape, and many more.