

# Using IFT-Consume for Landscape Smoke Management Planning

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## 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](#)
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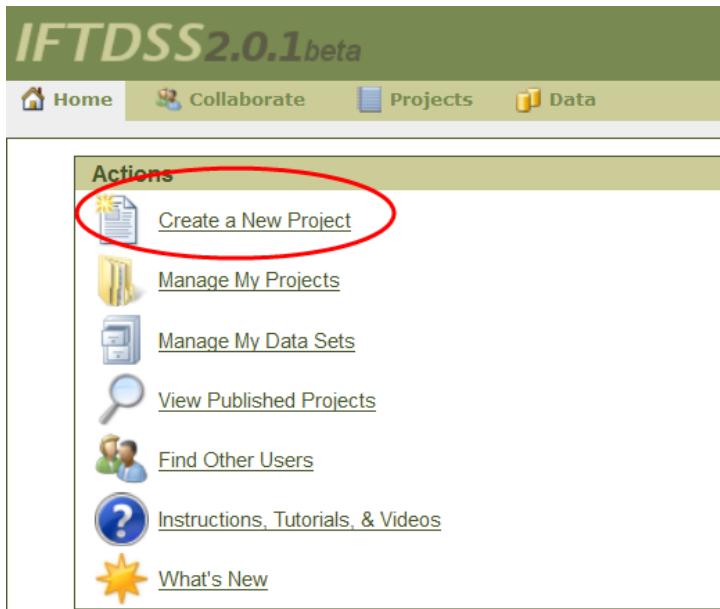
- 
- [Exporting data as raster layers to ArcMap for analysis](#)
  - [Evaluating results \(in ArcMap\)](#)
  - [Review and wrap-up](#)

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## Setting up the project

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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**.

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**Create New Project**

Project Name

**Optional Information:**

Organization Name

Project Start Date

Project End Date

Project Size

Treatment Type

Project Status  
Planned ▾

Description

**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**

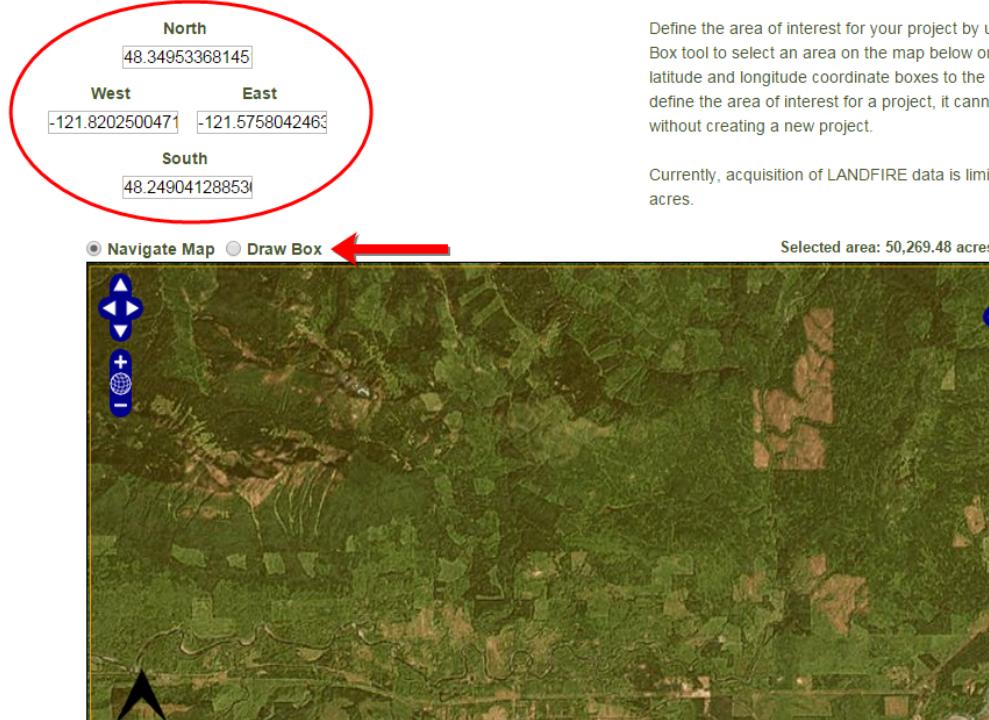
**West: -121.8202500471653**

**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.

**Set Up Project Area of Interest**



**Note**

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

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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) fuel-bed data needed to run Consume.

# Acquiring FCCS fuelbed data to run IFT-Consume

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

**Mt. Baker Snoqualmie Smoke**

**Project Summary**

**Information**

Organization Name:  
Project Start Date:  
Project End Date:  
Project Size:  
Treatment Type:  
Project Status: Planned  
Description:  
Date Modified: 06/09/2015  
Date Created: 06/09/2015

**Area of Interest**

Northeast corner:  
Latitude: 48.3496738°  
Longitude: -121.5752114°  
  
Southwest corner:  
Latitude: 48.2490413°  
Longitude: -121.8202500°  
  
Total Area:  
50,269.48 Acres  
203,434,200 m<sup>2</sup>

Resolution: 30.0m x 30.0m

[Import Landscape data from LANDFIRE](#)

[Import Fuelbeds from LANDFIRE](#) (circled in red)

[Upload Landscape Data Set](#)

**Runs**

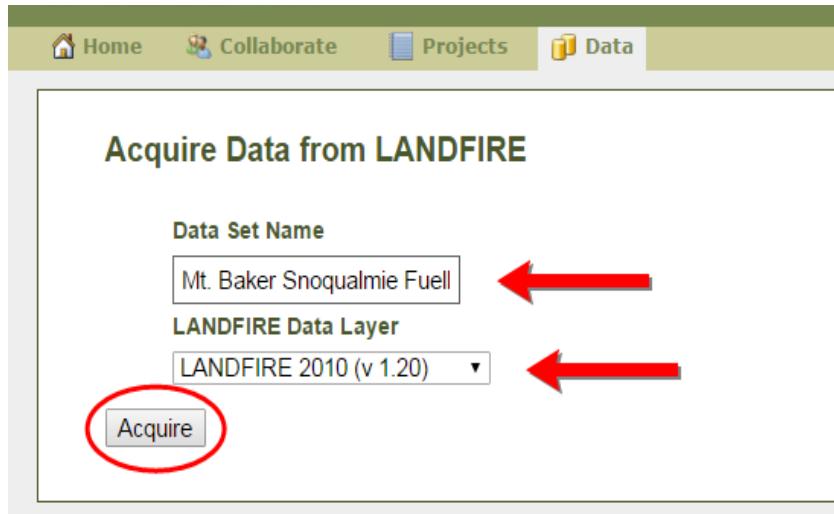
Run Name	Pathway	Date Modified	Date Created	Actions
No data available in table				

## Note

You may also import LANDFIRE Fuelbeds, or upload a fuelbed data-set 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**.

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Home Collaborate Projects Data

### Acquire Data from LANDFIRE

Data Set Name  
Mt. Baker Snoqualmie Fuell

LANDFIRE Data Layer  
LANDFIRE 2010 (v 1.20)

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 work-flows

## Select Create New Run

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

The screenshot shows the IFTDSS application interface. At the top, there is a navigation bar with links for Home, Collaborate, Projects, and Data. On the right, it shows 'Logged in as Help, IFTDSS'. Below the navigation bar, a green success message box says 'Data set 'Mt. Baker Snoqualmie Fuelbed' was successfully acquired from LANDFIRE'. The main content area is titled 'Mt. Baker Snoqualmie Smoke'. It contains a 'Project Summary' section with fields for Organization Name, Project Start Date, Project End Date, Project Size, Treatment Type, Project Status, Description, Date Modified, and Date Created. Below this is a 'Runs' section with a 'Create New Run' button circled in red. To the right of the summary is a 'Choose the type of run you would like to create:' dropdown menu. This menu has several sections: 'Start ▶ By IFTDSS Workflows ▶ Prescribed Burn Planning ▶', 'Choose the', 'Choose the type of run', and 'Actions'. The 'Choose the type of run' section is expanded, showing options like 'Calculate consumption and emissions (IFT-FOFEM)', 'Calculate fire effects across a landscape (IFT-Consume)' (which is also circled in red), 'Calculate tree mortality (IFT-FOFEM)', 'Consume (activity fuelbeds)', 'Consume (manual loadings, activity fuelbeds)', 'Consume (manual loadings, natural fuelbeds)', 'Consume (natural fuelbeds)', and 'Predict crown scorch height (IFT-scorch)'. Below this is another expanded section 'Prescribed Burn Planning' containing 'Hazard Analysis', 'Risk Assessment', 'Fuels Treatment', 'Fire Effects' (circled in red), and 'Historical Fire Weather'. A large red arrow points from the 'Create New Run' button in the 'Runs' section towards the 'Fire Effects' option in the dropdown menu. At the bottom of the interface, there are logos for 'Protecting Fire Science & People' and 'Protecting COMMUNITIES & ENVIRONMENTS', along with links for Home, Collaborate, Projects, Data, and About.

### 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 correct, and click **Next**.

**Create New Run: Calculate fire effects across a landscape (IFT-Consume)**

Run Name:   

North	48.3496741
West	-121.8204905
East	-121.5752114
South	48.2490409

The extent of the box in the map window shows the project area that you have selected for this run. To change the area for this run, use the Draw Box tool to select a smaller area within the box shown in the map window.

Navigate Map  Draw Box

Selected area: 50,570.61 acres

Next

Pilot Management Committee

[Home](#) | [Collaborate](#) | [Projects](#) | [Data](#) | [About](#)

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**.

[Home](#) [Collaborate](#) [Projects](#) [Data](#)

[About](#) [Help](#) [Feedback](#) [Log Out](#)

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 >**

[Home](#) | [Collaborate](#) | [Projects](#) | [Data](#) | [About](#)

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## Populating and running the IFT-Consume model

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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 <ul style="list-style-type: none"><li>• Hot Continental</li><li>• Marine</li><li>• Mediterranean</li><li>• Prairie</li><li>• Rainforest</li><li>• Savanna</li><li>• Subarctic</li><li>• Subtropical</li><li>• Temperate Desert</li><li>• Temperate Steppe</li><li>• Tropical/Subtropical Desert</li><li>• Tropical/Subtropical Steppe Desert</li><li>• Tundra</li><li>• Warm Continental</li></ul>
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%.
Percent Shrub	Percentage	Percent of the shrub stratum that is blackened by the burn. This value is input (as a percentage) to the

Name	Units	Brief Description
Blackened		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.

Emissions\_cons - Calculate fire effects across a landscape (IFT-Consume)

Inputs

Parameter	Unit	Simulation #1
1000-hr Woody Fuel Moisture	percent	16
Duff Fuel Moisture	percent	5
Percent Canopy Modified by Heat and Flames	percent	50
Percent of Shrub Blackened by Fire	percent	90

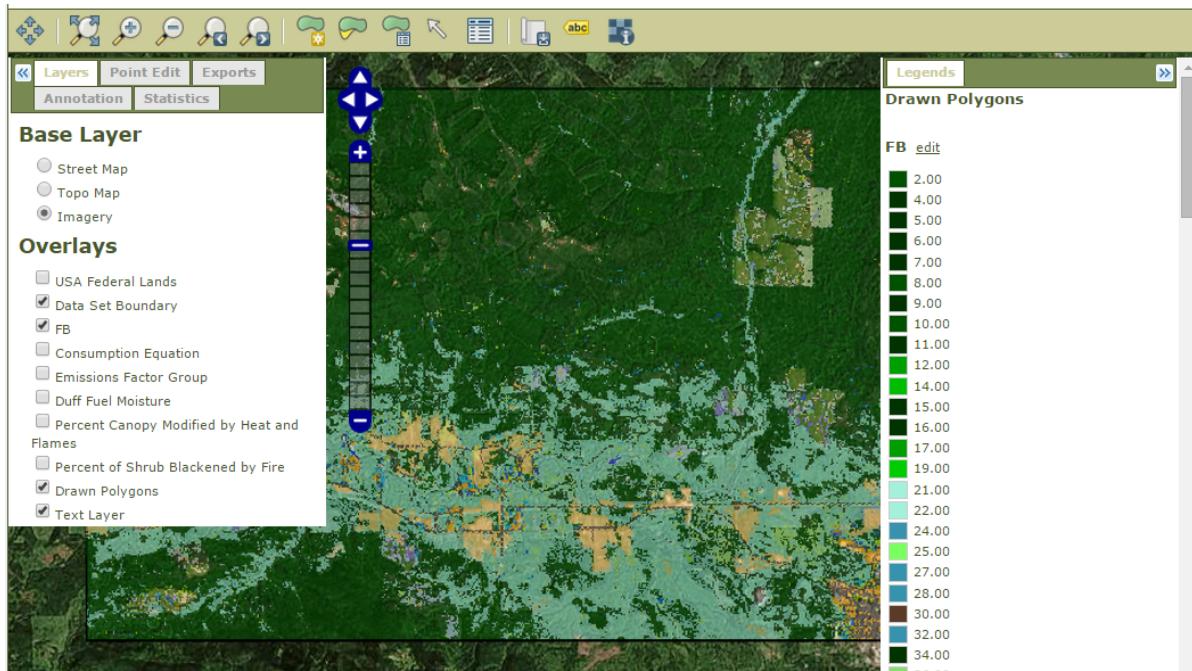
Consumption Equation and Emission Factor Selector

Parameter	Simulation #1
Consumption Equation	Western
Emissions Factor Group	Default

< Back | Next > | US Customary Units | Change Units

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.

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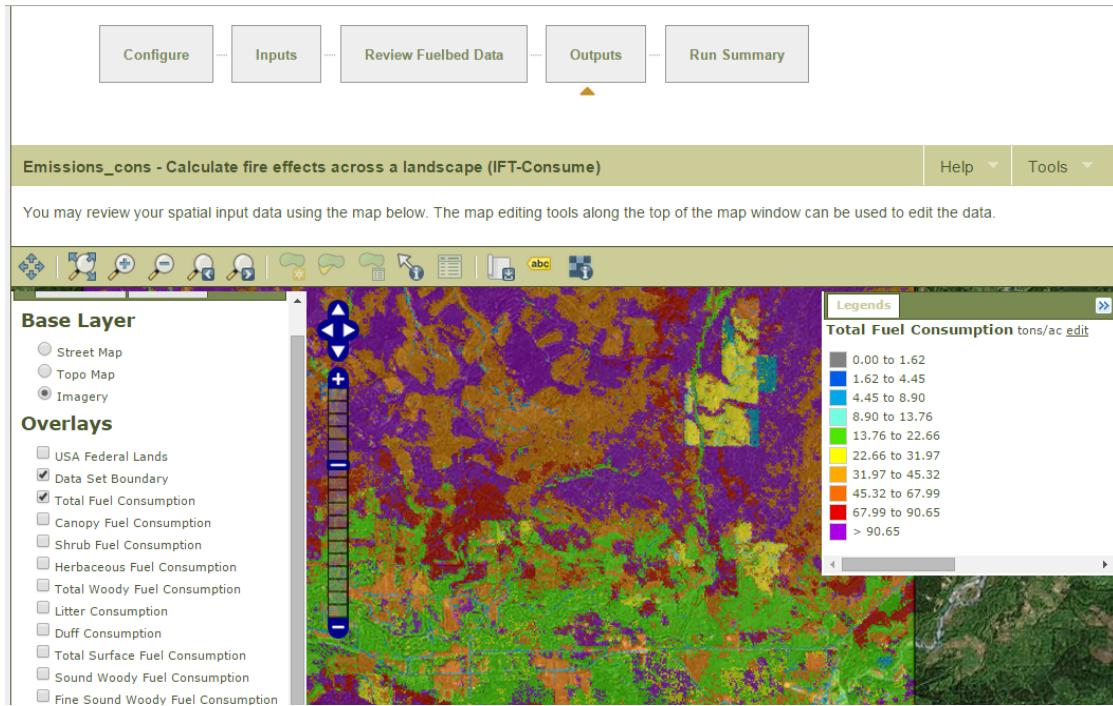
## Viewing output data

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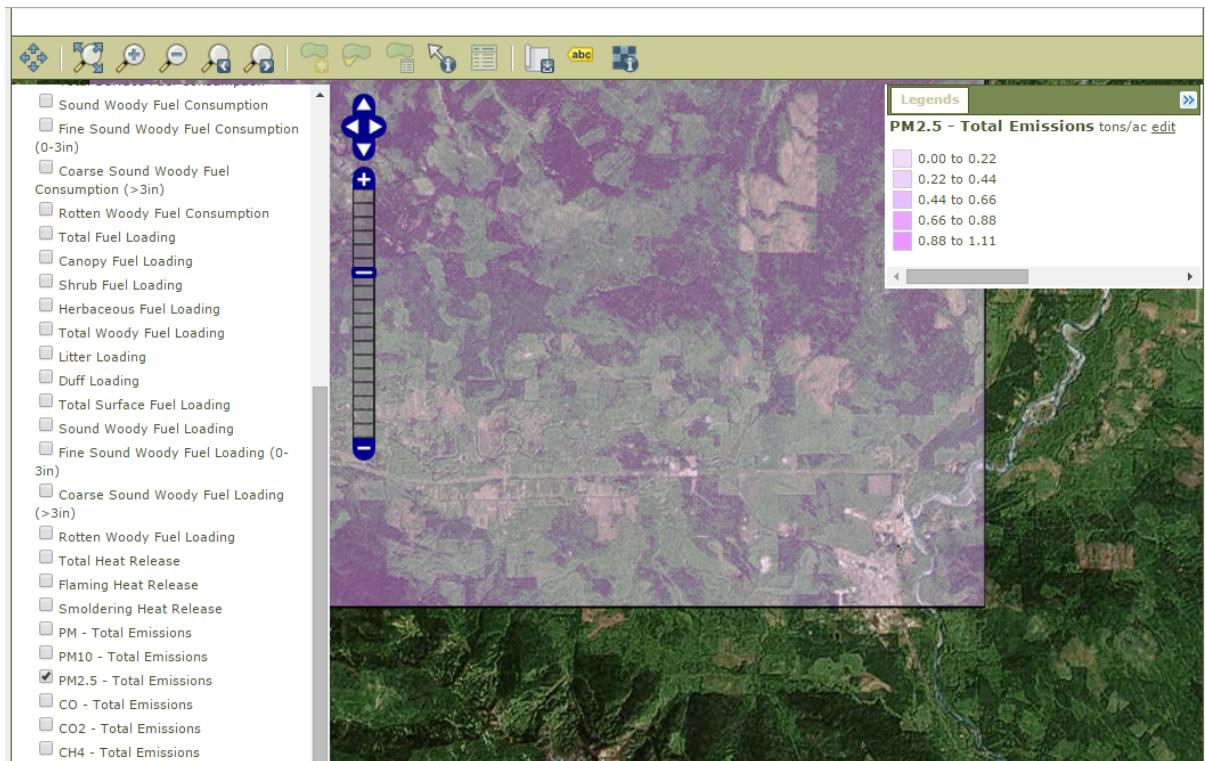
IFT-Consume will list several emissions:

Name	Units	Brief Description
Carbon monoxide (CO)	Tons per acre, kg per meter squared	Total carbon monoxide emitted.
Carbon dioxide (CO <sub>2</sub> )	Tons per acre, kg per meter squared	Total carbon dioxide emitted.
Methane (CH <sub>4</sub> )	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 <sub>2.5</sub> )	Tons per acre, kg per meter squared	Total particulate matter 2.5 emitted.
Particulate matter 10 (PM <sub>10</sub> )	Tons per acre, kg per meter squared	Total particulate matter 10 emitted.

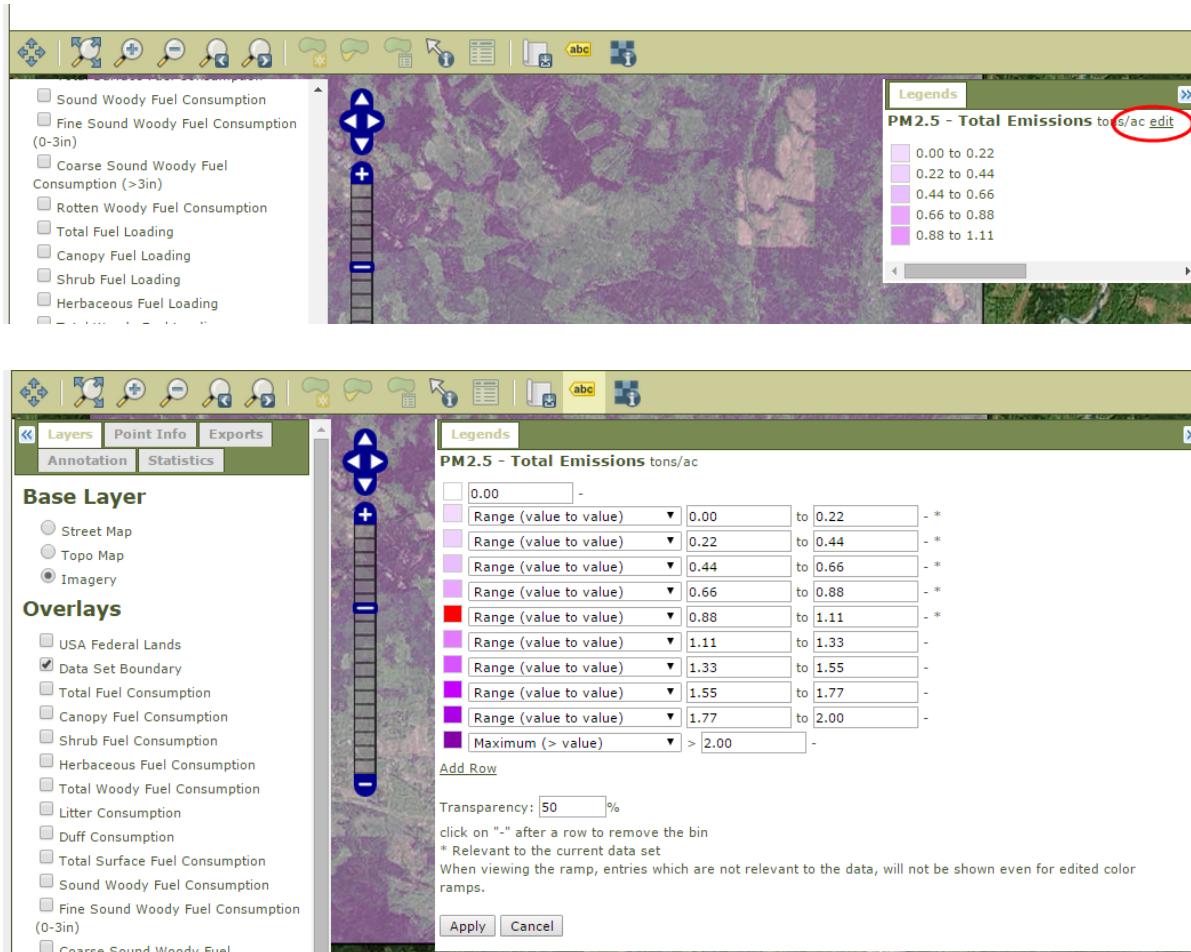
When the model is finished running, you can view the outputs spatially. We'll focus on the emissions outputs for most of this tutorial.



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 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 replaced by a **Download** icon. Click the download icon to download a zip-file.

The screenshot shows the 'Run Summary' page with the following sections:

- Data Sets:** A summary table with columns: Name, Status, Number of Grid Cells, Actions, and Export Status. It lists two items: 'Input' (Ready, 226038, Actions: Save As, Download, In progress... 26%) and 'Consume output' (Ready, 226038, Actions: Save As, Download, Select format...).
- Actions:** A modal window showing a list of actions for each dataset. Each row has 'Save As', 'Download' (with a progress bar), and another 'Download' button. Red boxes numbered 1, 2, and 3 highlight specific elements:
  - Box 1: The 'Download' button for the 'Consume output' row.
  - Box 2: The 'Select format...' dropdown for the 'Consume output' row.
  - Box 3: The 'Download' button for the second dataset in the list.
- Downloadable Files:** A table showing downloadable files. It has columns: Name, Type, and Actions. It displays 'No data available in table'.
- Buttons at the bottom:** Back to Project, Copy This Run, Capture screenshot.

# Evaluating results in ArcMap

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

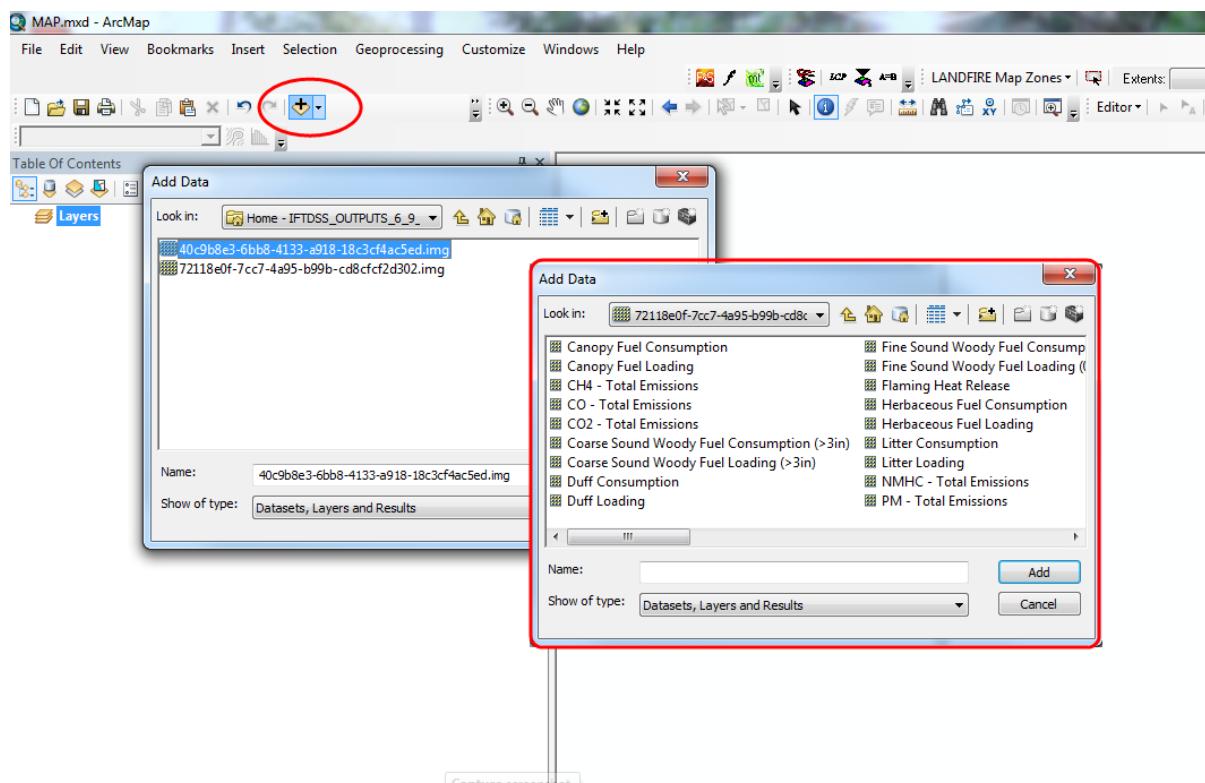
Place your saved input and output zip files in a folder of your choosing, and unzip the datasets

Open Arcmap

## Note

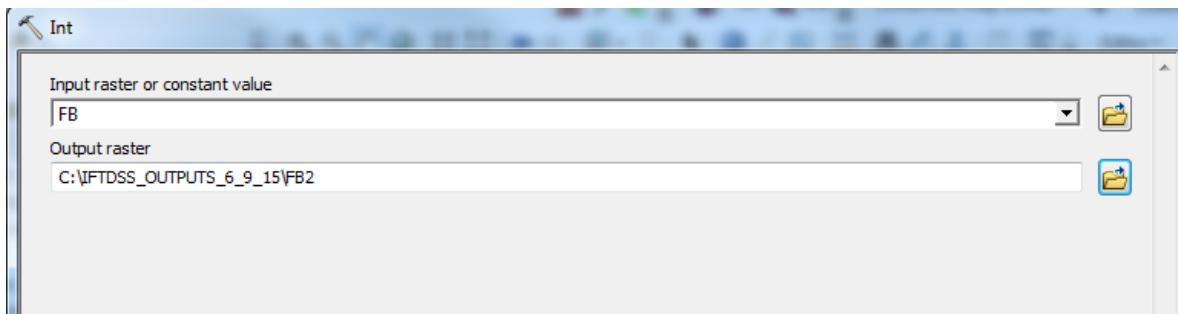
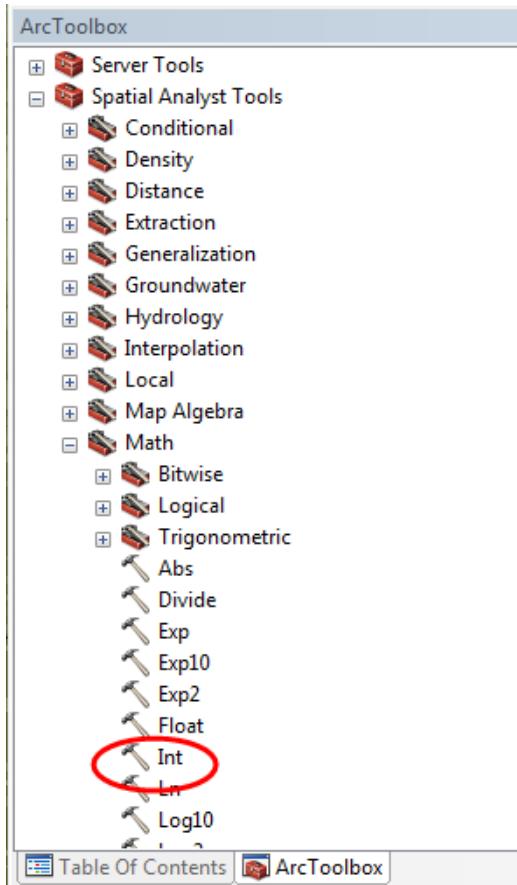
Your Arcmap menus may look different than those depicted in this tutorial, depending upon the version of Arcmap you are using.

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.**



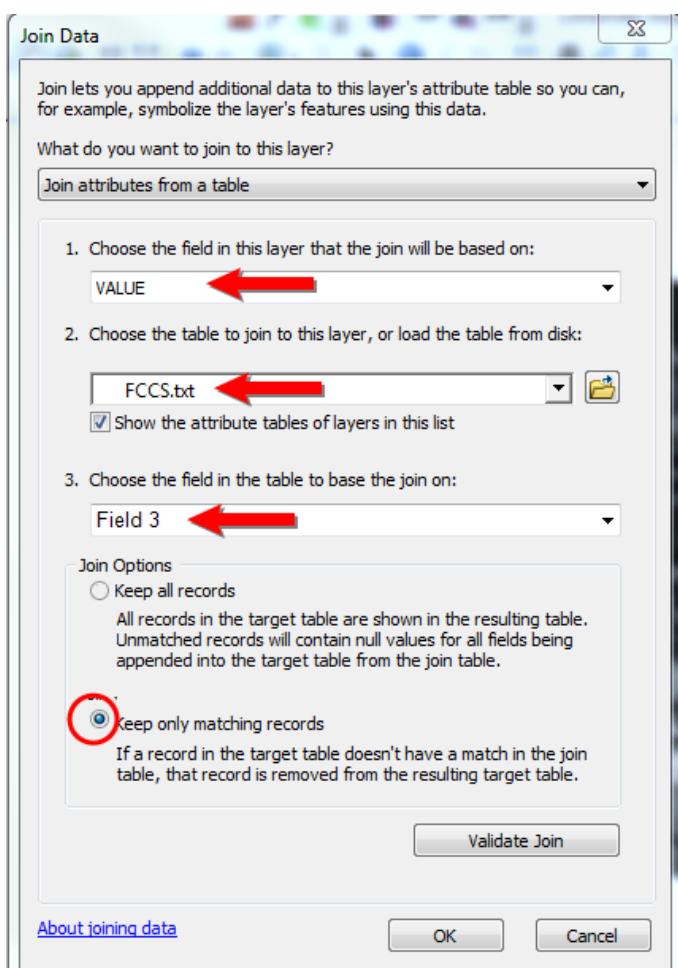
### Note

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.

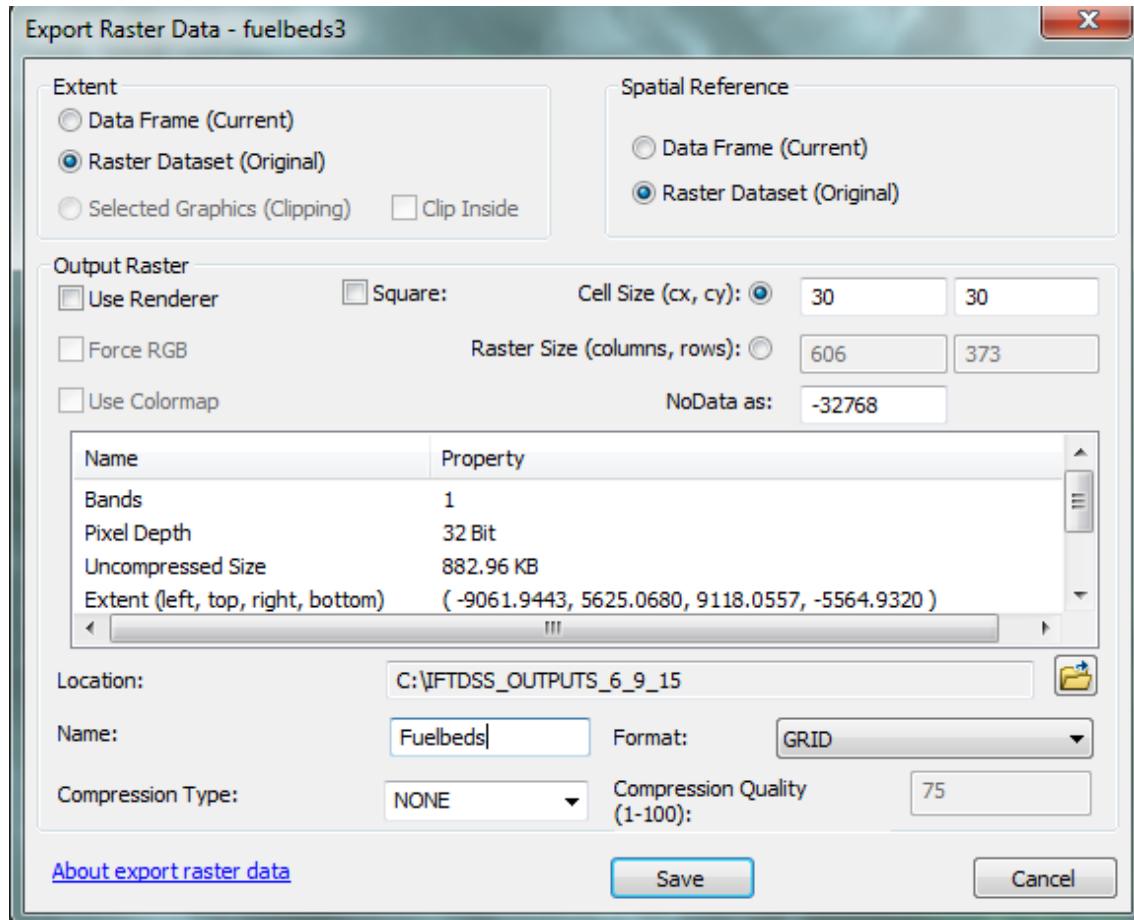
## Joining a database to layer

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**.



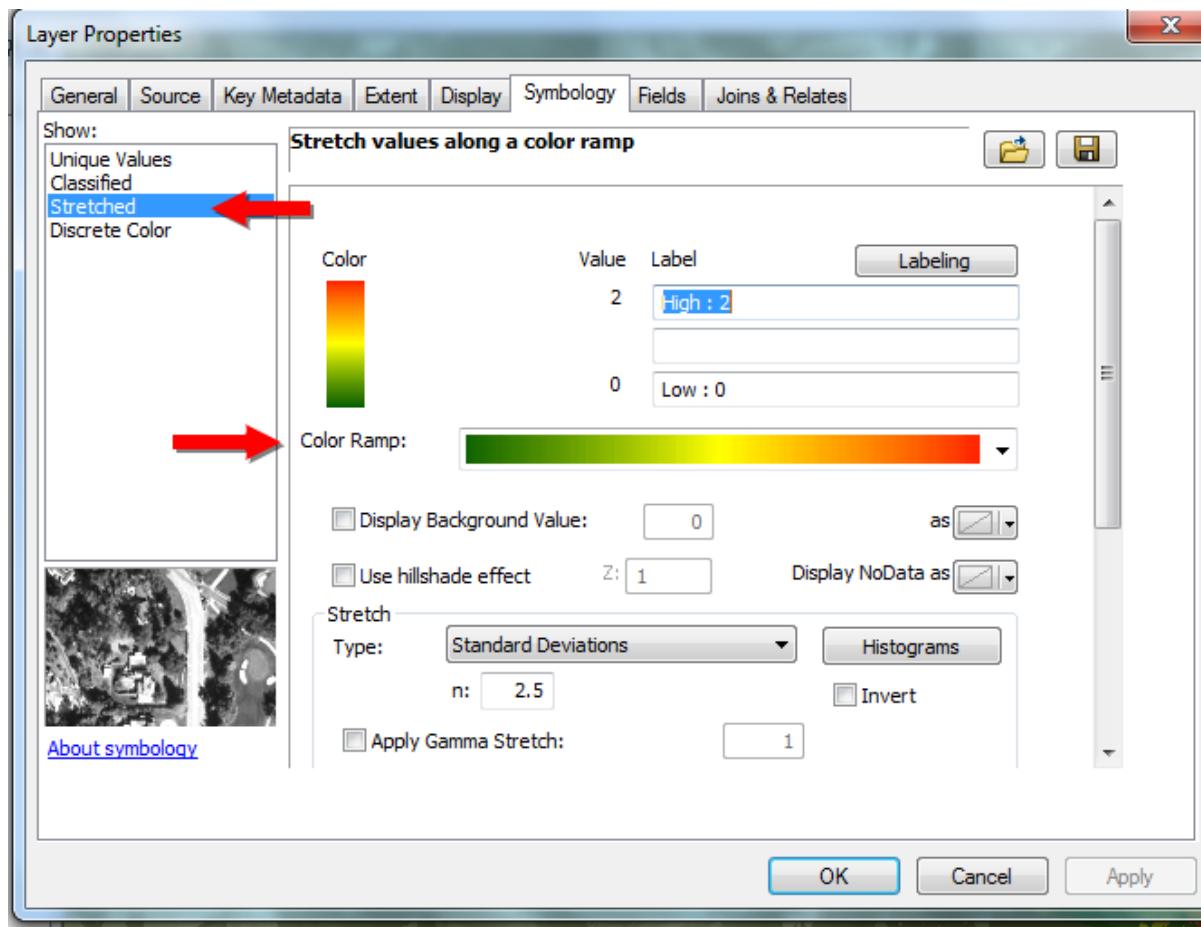
To make the join permanent, export the joined fuelbed layer by **right clicking**, select **data**, and **export data**. Ensure your extent and spatial references are set to use the original (**Raster Dataset (Original)**), and **Cell Size** is 30 by 30, and the format is set to **GRID**, as they are 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.

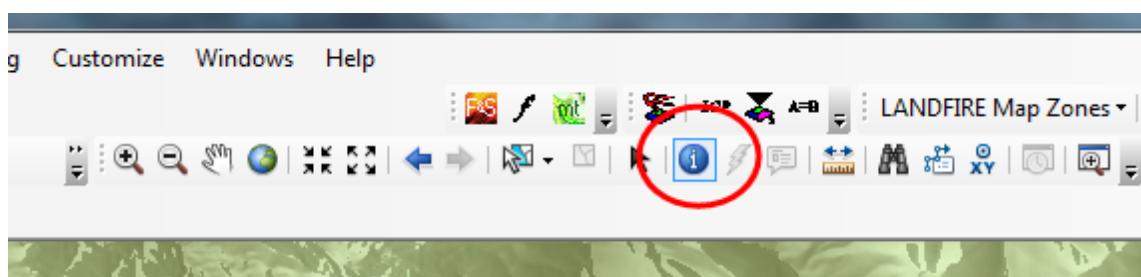
## Changing the appearance of a layer

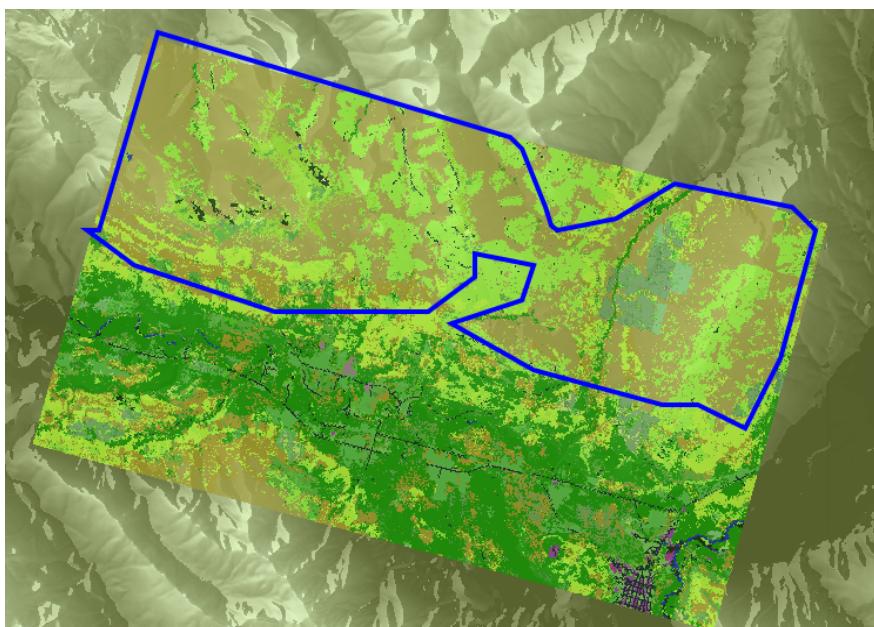
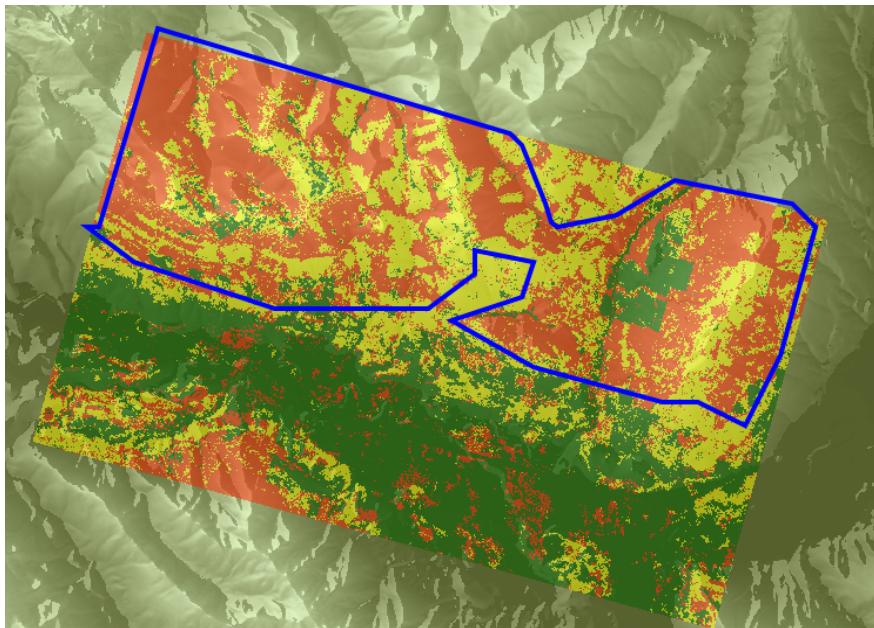
Right click on each layer, select **properties>symbology**, and adjust the color and display to your preference. In this example we selected the total particulate layer, and selected **stretched** and chose a color scheme ranging from green to red as the values increased. This will show where on the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



## Comparing layers

By toggling back and forth between the fuelbed layer and the particulate matter layer, and using the point info tool, 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.



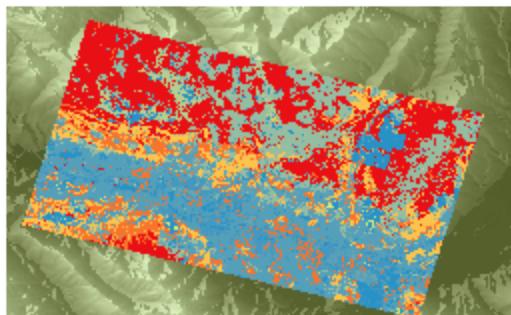


We can see in the mountains to the north of the valley, the fuelbeds and high particulate matter areas match well. Using the identify tool, we can see that the fuelbed predicted to generate these levels of particulate matter is Fuelbed 2, 'Douglas fir-Western redcedar-Western Hemlock'.

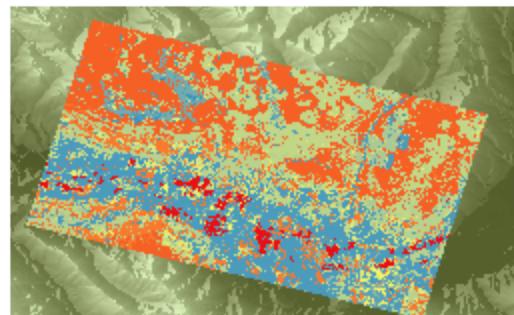
By using the same sliding color scale to see the relative highest amounts of various fuels, we see Fuelbed 2 also corresponds well to high quantities of litter, duff, and sound woody fuel consumed, but not necessarily fine woody fuel

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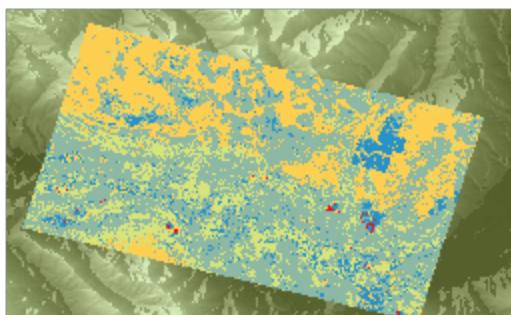
consumption. This provides information on the specific fuels in these areas that would contribute to particulate emissions, and may be candidates for treatments.



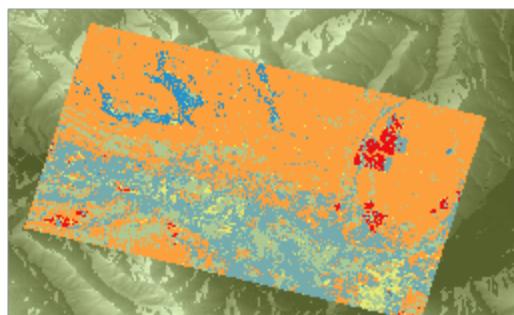
Duff Consumption



Large sound woody  
fuel consumption



Litter Consumption



Fine woody fuel  
consumption

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.

**Run Properties**

- Run Notes: Calculate fire effects across a landscape (IFT-Consume)
- Pathway: Done
- Unit Set: US Customary Units
- Spatial: Yes
- Data Sets: 2
- Date Modified: 08/03/2015
- Date Created: 08/03/2015

**Run Area**

Northeast corner  
Latitude: 48.3495  
Longitude: -121.57

Southwest corner  
Latitude: 48.2491  
Longitude: -121.82

Total Area:  
50,052.18 Acre  
202,554,000 m<sup>2</sup>

Resolution: 30.0m x 30.0m;

Enter a unique name for the dataset copy:  
**Pre-Treatment**

**OK**   **Cancel**

**Data Sets**

Name	Status	Number of Grid Cells	Actions	Export Status
Input	Ready	226038	<b>1</b> <a href="#">Save As</a> <a href="#">Download</a>	Not Started.
Consume output	Ready	226038	<a href="#">Save As</a> <a href="#">Download</a>	Not Started.

(all) (all) (all)

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.

