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# ArcGIS Model Builder

Short introduction



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# ModelBuilder

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- A tool to automatizise process chains (models) with graphic user interface:

”ModelBuilder is an application you use to create, edit, and manage models. Models are workflows that string together sequences of geoprocessing tools, feeding the output of one tool into another tool as input. ModelBuilder can also be thought of as a visual programming language for building workflows. ”





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Canvas

Variable

Tool

Variable



Connector



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# Canvas

Parameter

Tool

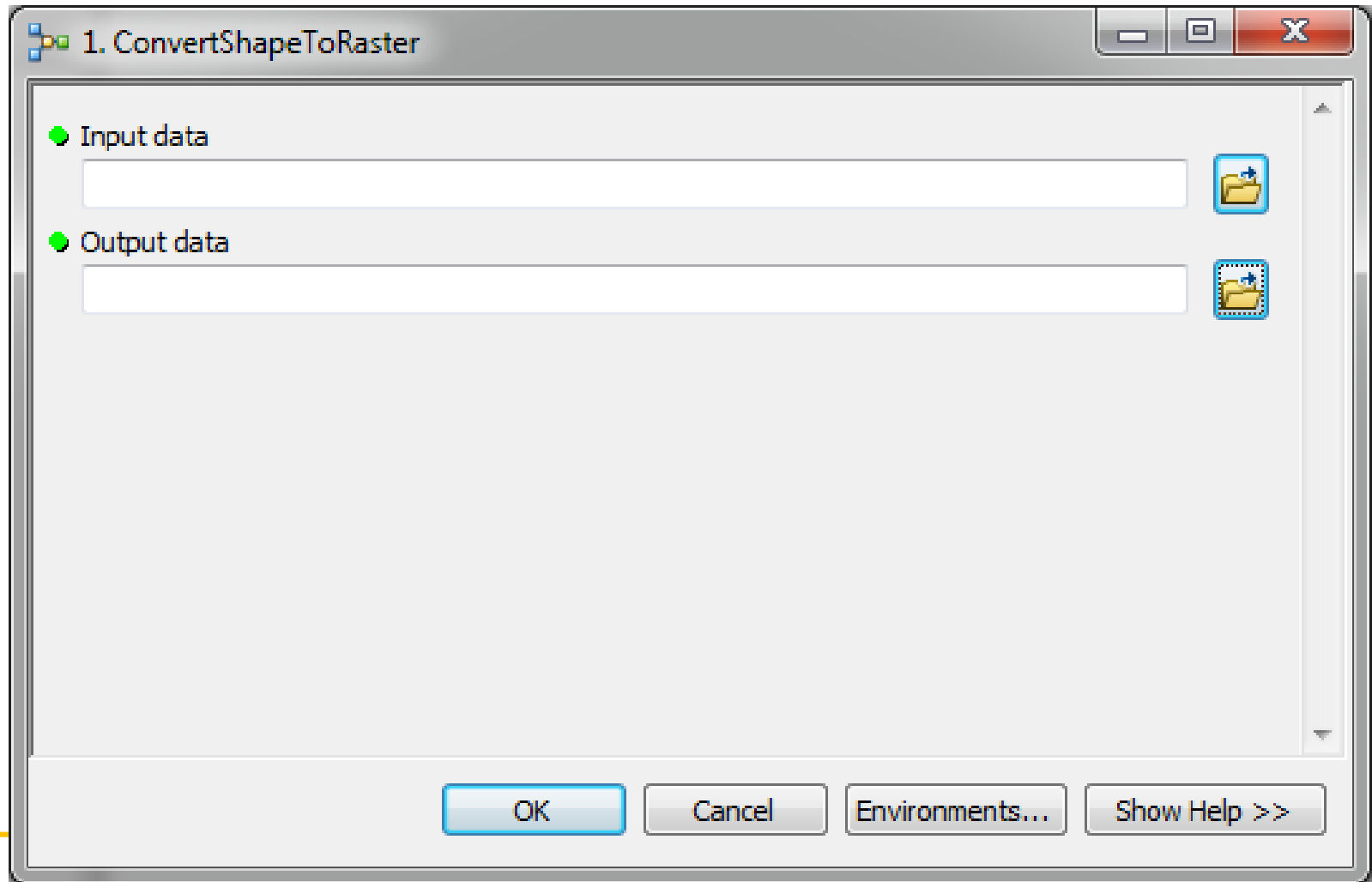
Parameter



Connector



# Parameters given via dialog boxes



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# ModelBuilder vocabulary

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- Model canvas
  - Empty model (i.e. white space)
- Model elements
  - Tools: Geoprocessing functionalities, i.e. ArcGIS tools
  - Variables:
    - Data (files)
    - Constant values (numbers, strings, spatial references, extents etc.)
  - Connectors: connect data and values to the tools
  - Parameters: Values that are given by the user, outside the model
  - Iterators: an object that enables to go through a list (of files, values etc)



# Finding Tools

The diagram illustrates three primary methods for finding GIS tools within a software environment:

- Catalog:** A window showing a hierarchical tree of folders and toolboxes. The location is set to "Home - Presentations\UC2012". The tree includes "Toolboxes" (My Toolboxes, System Toolboxes) and "Database Servers".
- ArcToolbox:** A window displaying a list of tool categories, each with a red toolbox icon. The categories include 3D Analyst Tools, Analysis Tools, Cartography Tools, Conversion Tools, Data Interoperability Tools, Data Management Tools, Editing Tools, Geocoding Tools, Geostatistical Analyst Tools, Linear Referencing Tools, Multidimension Tools, Network Analyst Tools, Parcel Fabric Tools, Schematics Tools, Server Tools, Spatial Analyst Tools, Spatial Statistics Tools, and Tracking Analyst Tools.
- Search:** A window with a search bar containing the text "buffer". Below the search bar, it shows "Search returned 7 items" and a list of results, including "Analysis (Toolbox)", "Buffer (Analysis) (Tool)", "Multiple Ring Buffer (Analysis) (Tool)", "Buffer (Coverage) (Tool)", "Buffer 3D (3D Analyst) (Tool)", and "Make Service Area Layer (Network Analyst...)".
- Geoprocessing Menu:** A menu listing various geoprocessing tools and options, including Buffer, Clip, Intersect, Union, Merge, Dissolve, Search For Tools, ArcToolbox, Environments..., Results, ModelBuilder, Python, and Geoprocessing Options...





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Let's go in practice



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# Excercises with Model Builder

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- Creating a tool box
- Creating a model to convert polygons to raster
- Creating a model that makes iterations based on attribute values
- Creating a model that makes iterations for all files in a folder



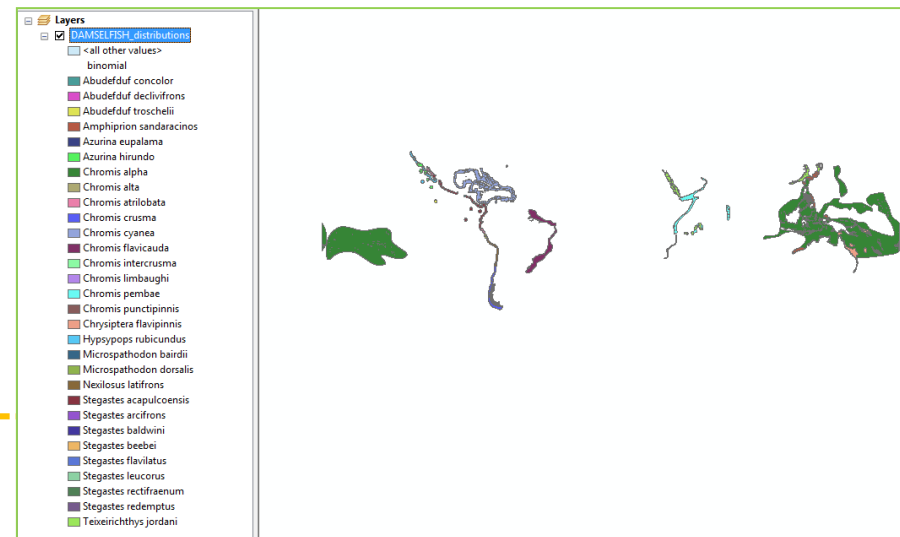
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# 0. Explore your data



# Explore your data

- Open the DAMSELFISH data
- See the attribute data structure
  - which column has species names
  - is there a field for presence?
- Visualise a bit the data



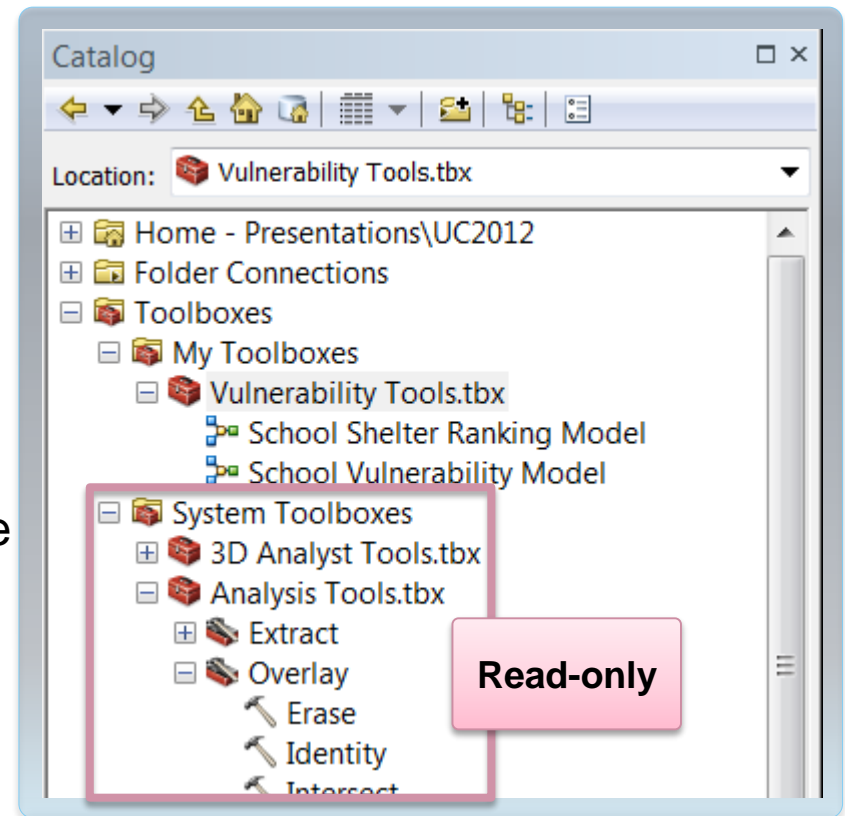
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# 1. Create a tool box



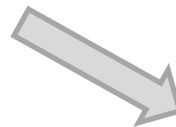
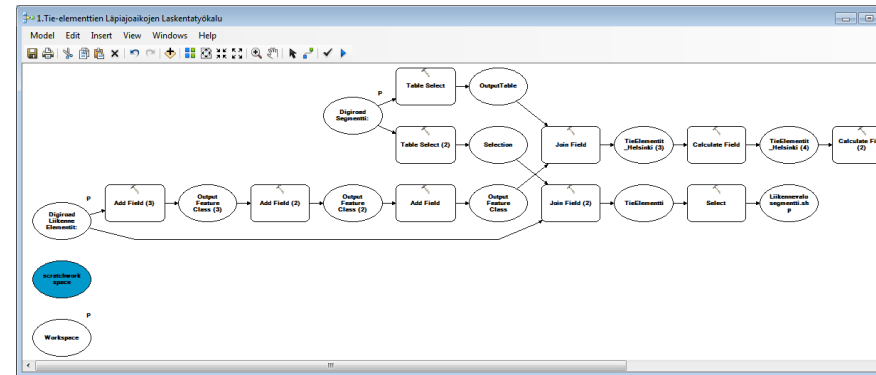
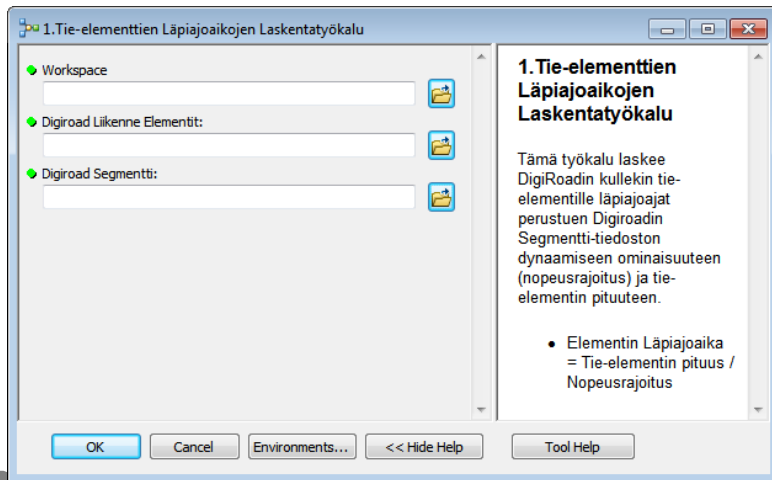
# Types of Toolboxes

- System toolboxes
  - Installed with ArcGIS
  - *Read-only*
- Custom toolboxes
  - User created
  - Stored in a folder (.tbx file type) or a geodatabase
- Python toolboxes



# ArcGIS Toolbox (.tbx)

- A Toolbox is a Graphical User Interface for using specific tools in ArcGIS
  - Setting input/output files
  - Setting parameters
- It is also possible (and recommendable) to create your own toolboxes for ModelBuilder models and Python scripts that you have created



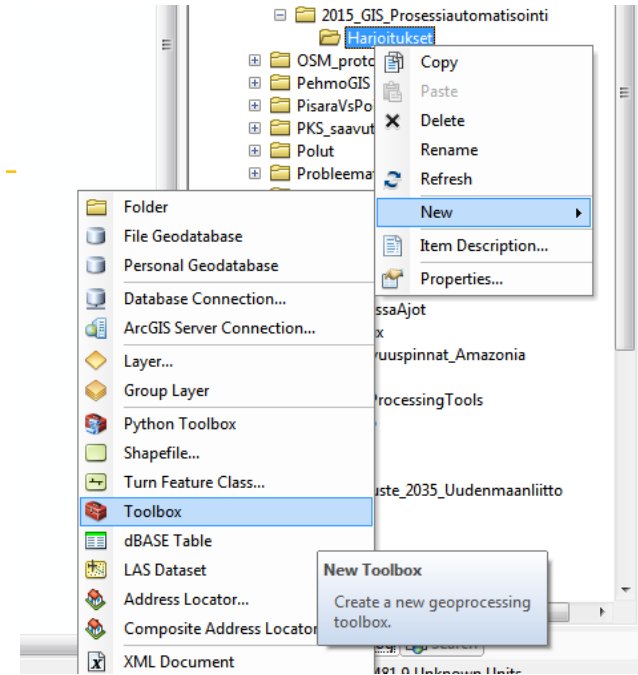
```
*Python 2.7.8: Vaihe1_LäpiajoaikojenLaskenta.py - C:\...
File Edit Format Run Options Windows Help

import arcpy, sys, time, os
from arcpy import env

# Tarvittavat Tiedostot:
Workspace = arcpy.GetParameterAsText(0)
LiikenneElementti = arcpy.GetParameterAsText(1)
Segmentti = arcpy.GetParameterAsText(2)
```

# 1. Create a toolbox

- Create a new toolbox called *MyDataManagement.tbx*
  - Browse to *C:\...\Harjoitukset\* → right click → New...Toolbox
  - Add ProcessChains.tbx to ArcGIS → ArcToolbox → right click in white space → Add Toolbox



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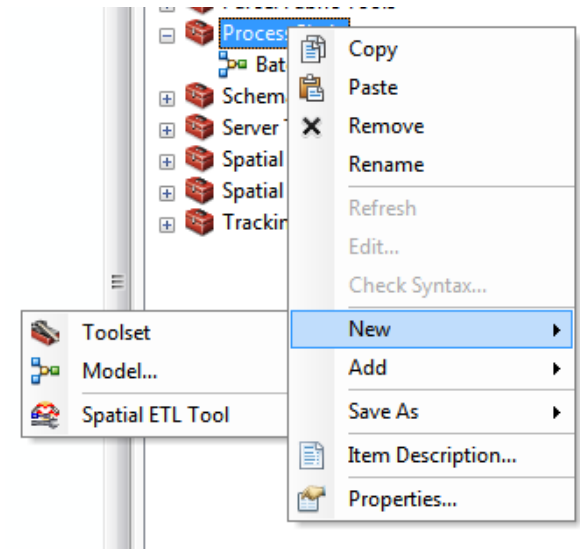
## 2. Create a super simple model

Add field to a table,  
update value, rasterize



# Create a model (in toolbox)

- Right-click your new tool box and select:  
*New → Model*
- Close the model and rename it:  
*1. SimplePoly2Raster*
- Open the model for editing:  
*Right-click → Edit*

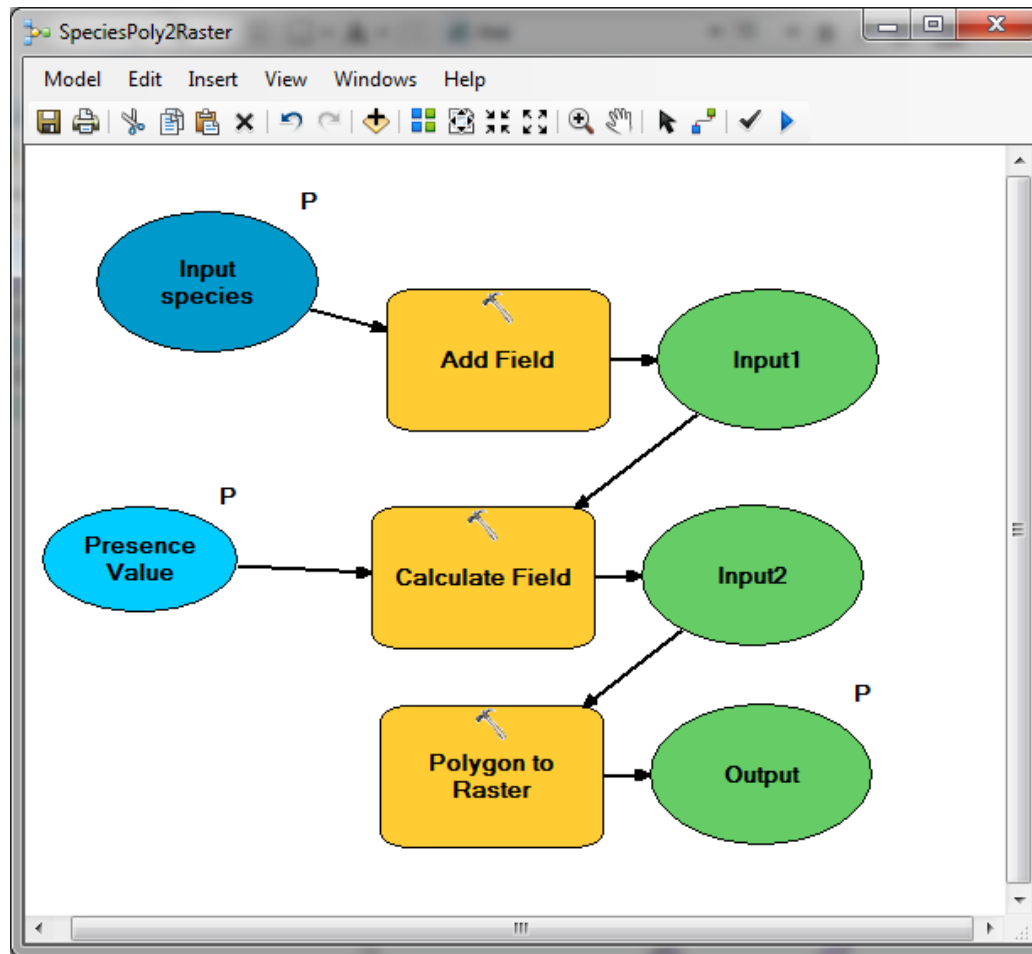


*\*Double click 1. SimplePoly2Raster:*

*Now you have a working ArcGIS tool but it does not do anything yet...*



# Our aim:



# Insert Add field tool:

**Add Field**

Input Table  
DAMSELFISH\_distributions

Field Name  
Presence

Field Type  
SHORT

Field Precision (optional)

Field Scale (optional)

Field Length (optional)

Field Alias (optional)

☒ Field IsNullable (optional)

☐ Field IsRequired (optional)

Field Domain (optional)

**Field Type**

The field type used in the creation of the new field.

- TEXT—Names or other textual qualities.
- FLOAT—Numeric values with fractional values within a specific range.
- DOUBLE—Numeric values with fractional values within a specific range.
- SHORT—Numeric values without fractional values within a specific range; coded values.
- LONG—Numeric values without fractional values

OK Cancel Apply << Hide Help Tool Help

# Insert Calculate Field

**Calculate Field**

Input Table  
DAMSELFISH\_distributions (2)

Field Name  
Presence

Expression  
1

Expression Type (optional)  
VB

Code Block (optional)

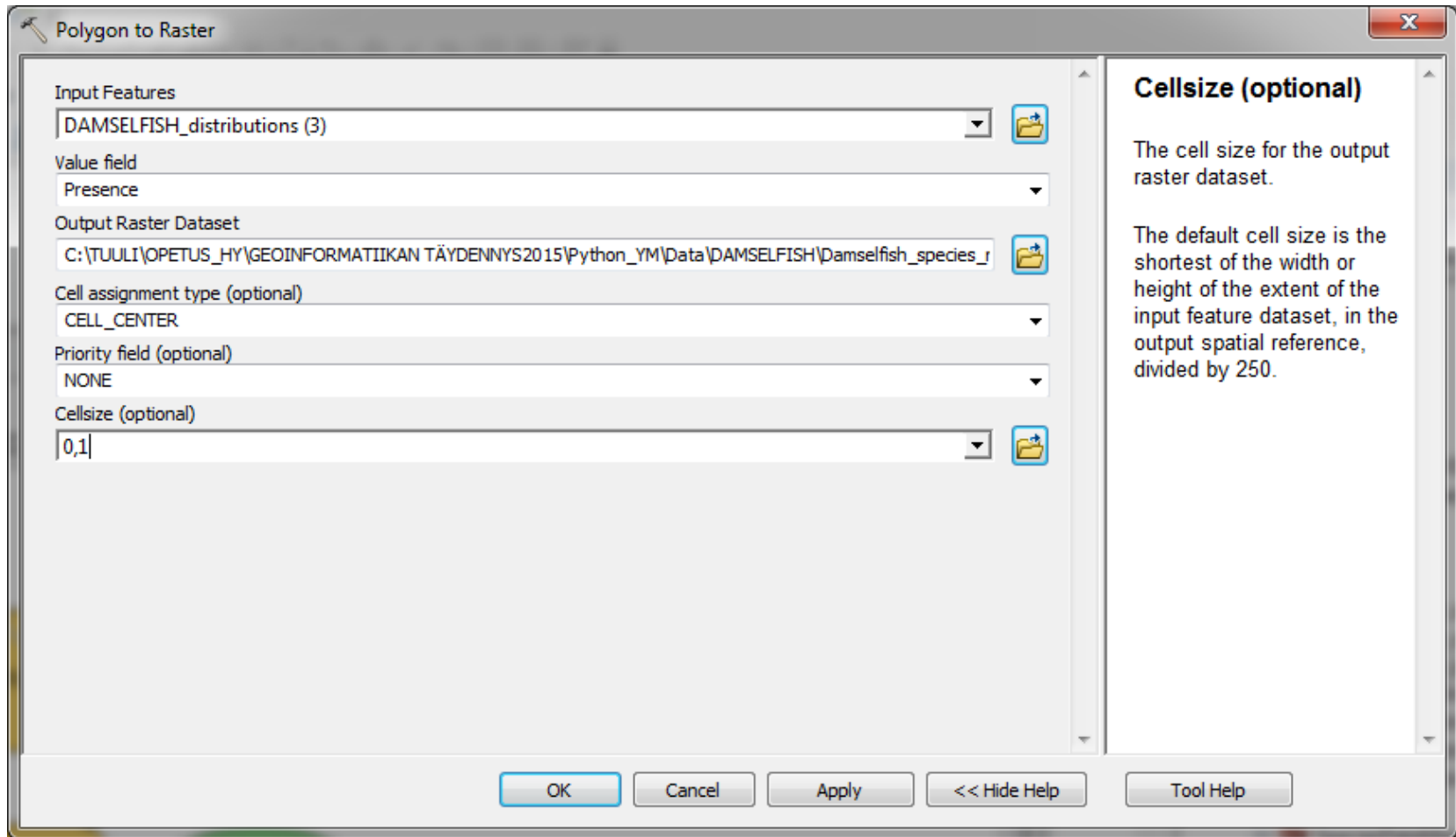
**Calculate Field**

Calculates the values of a field for a feature class, feature layer, or raster catalog.

OK Cancel Apply << Hide Help Tool Help



# Insert Polygon to Raster



**Polygon to Raster**

Input Features  
DAMSELFISH\_distributions (3)

Value field  
Presence

Output Raster Dataset  
C:\TUULI\OPETUS\_HY\GEOINFORMATIIKAN TÄYDENNYS2015\Python\_YM\Data\DAMSELFISH\Damselfish\_species\_

Cell assignment type (optional)  
CELL\_CENTER

Priority field (optional)  
NONE

Cellsize (optional)  
0,1

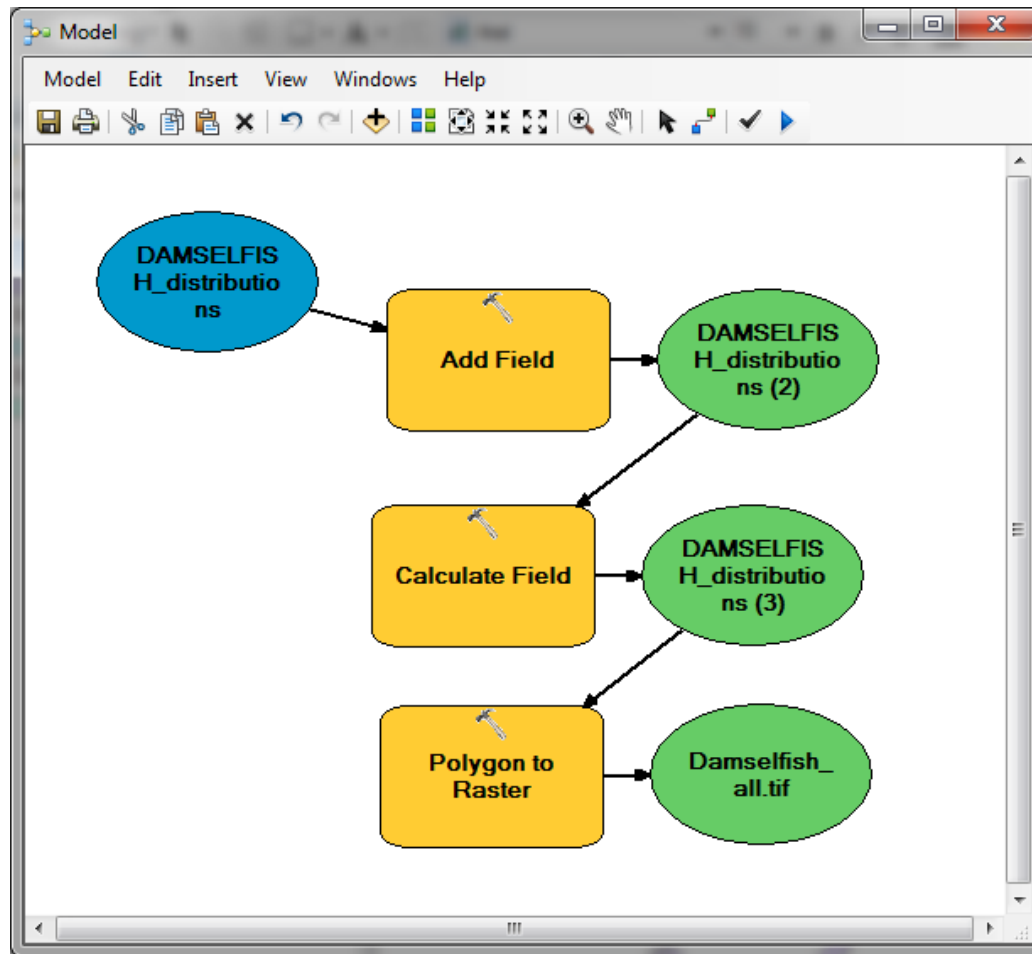
**Cellsize (optional)**

The cell size for the output raster dataset.

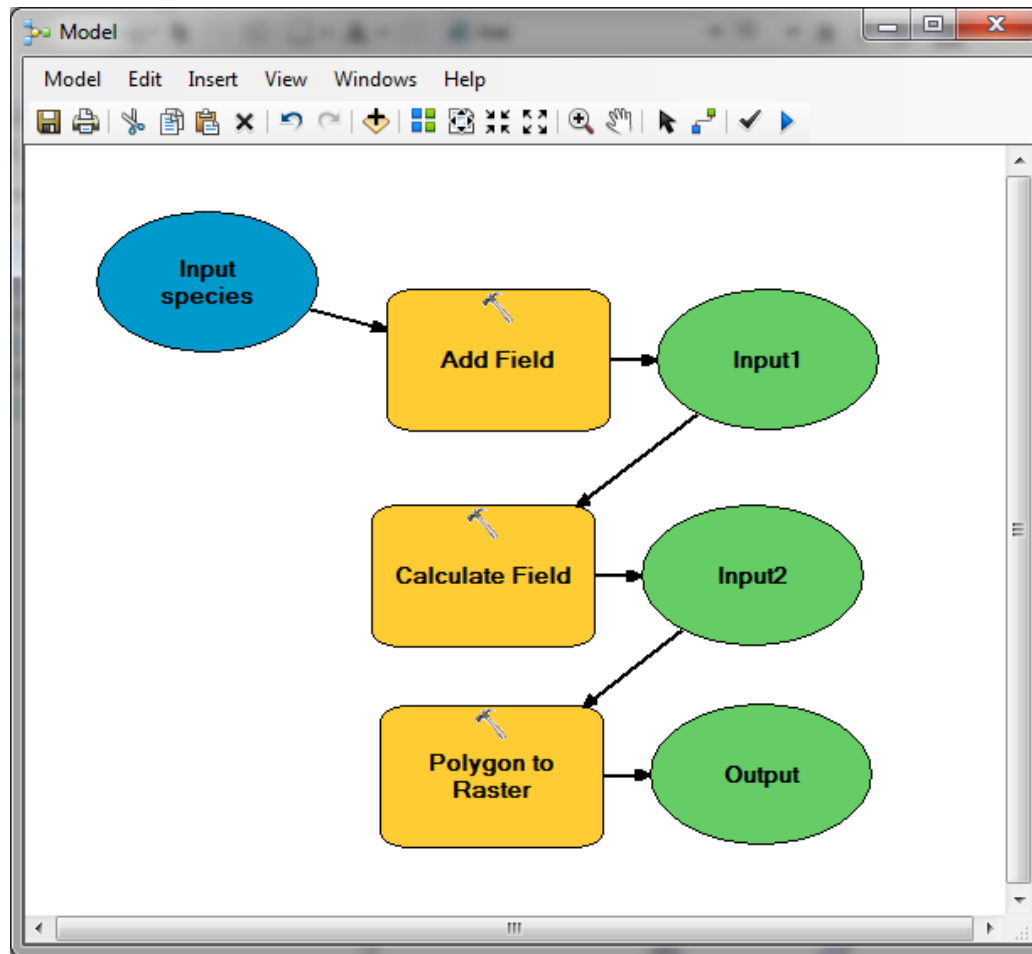
The default cell size is the shortest of the width or height of the extent of the input feature dataset, in the output spatial reference, divided by 250.

OK Cancel Apply << Hide Help Tool Help

# Ready model

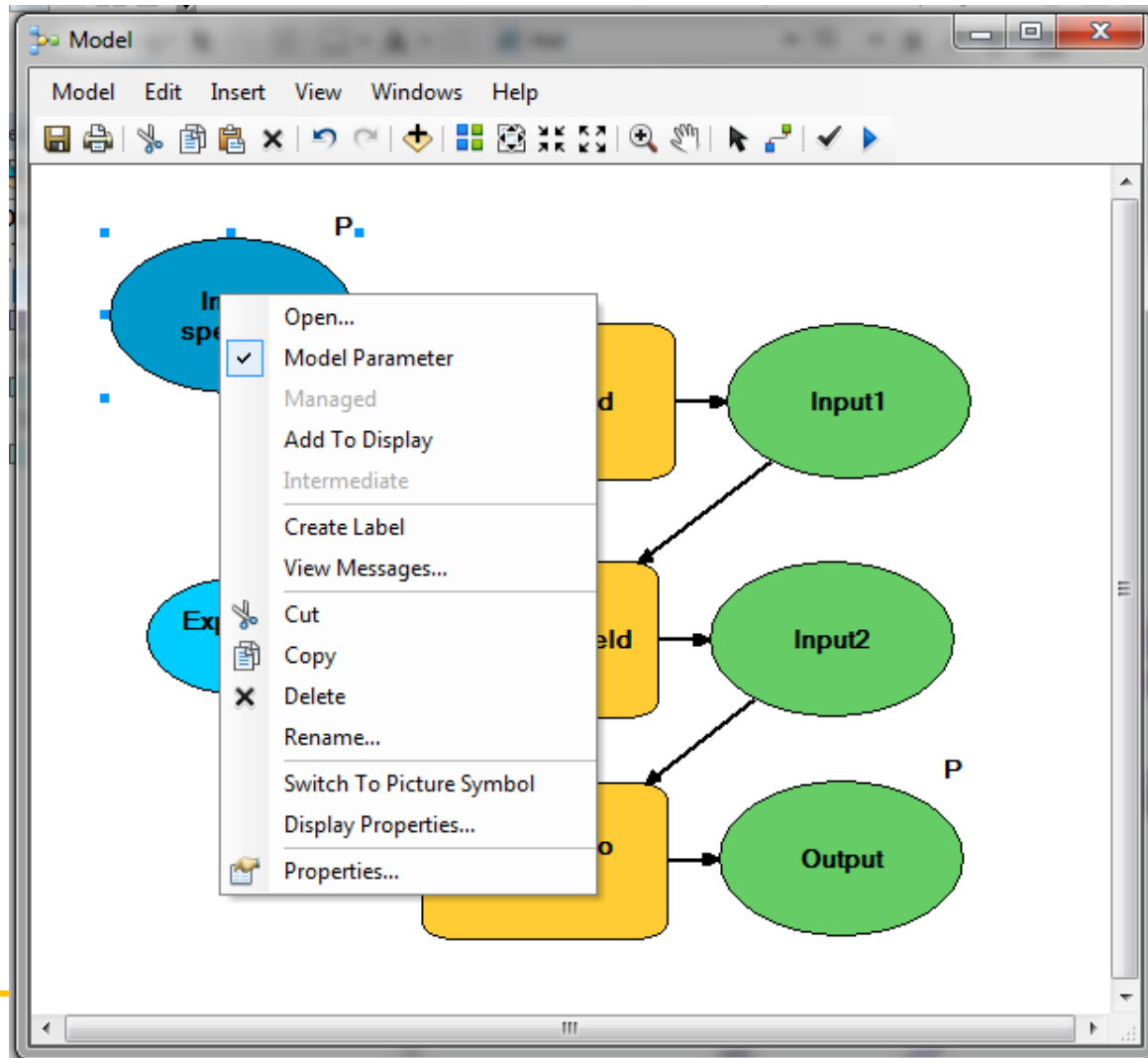


# Clean the names (right click!)

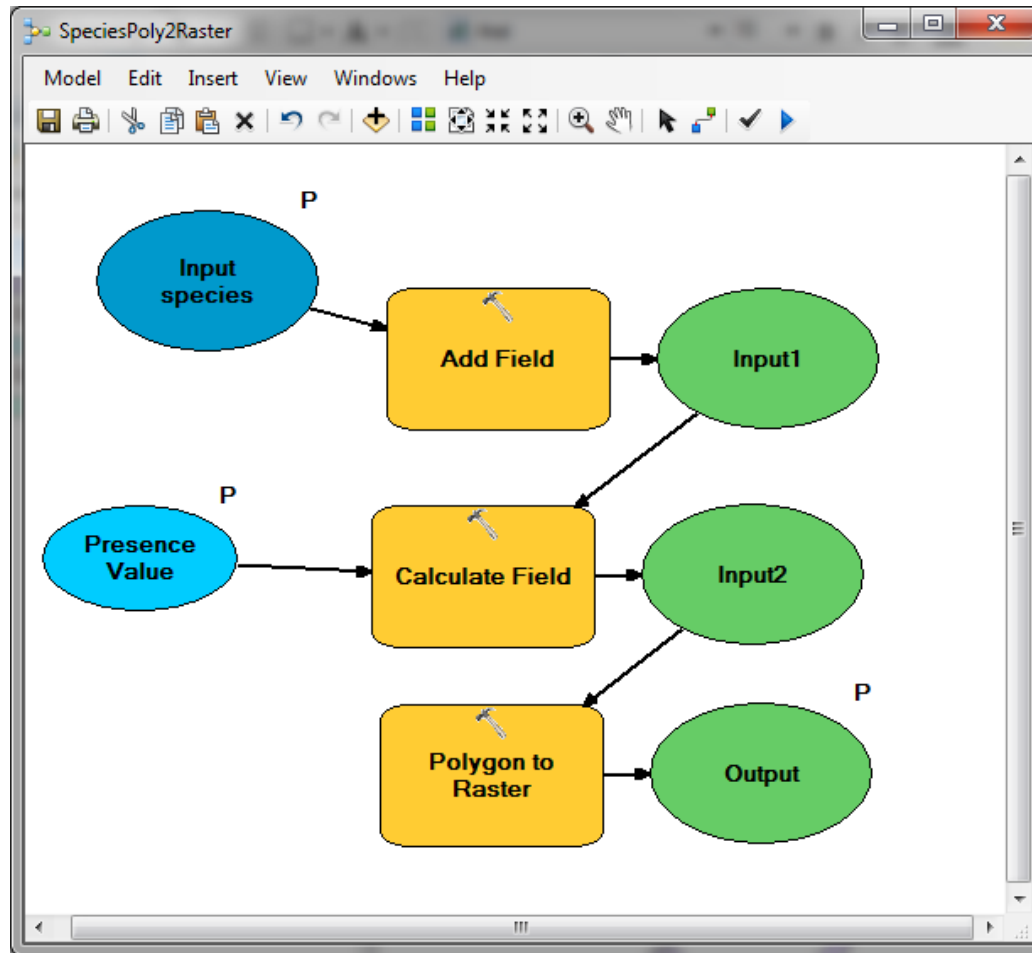




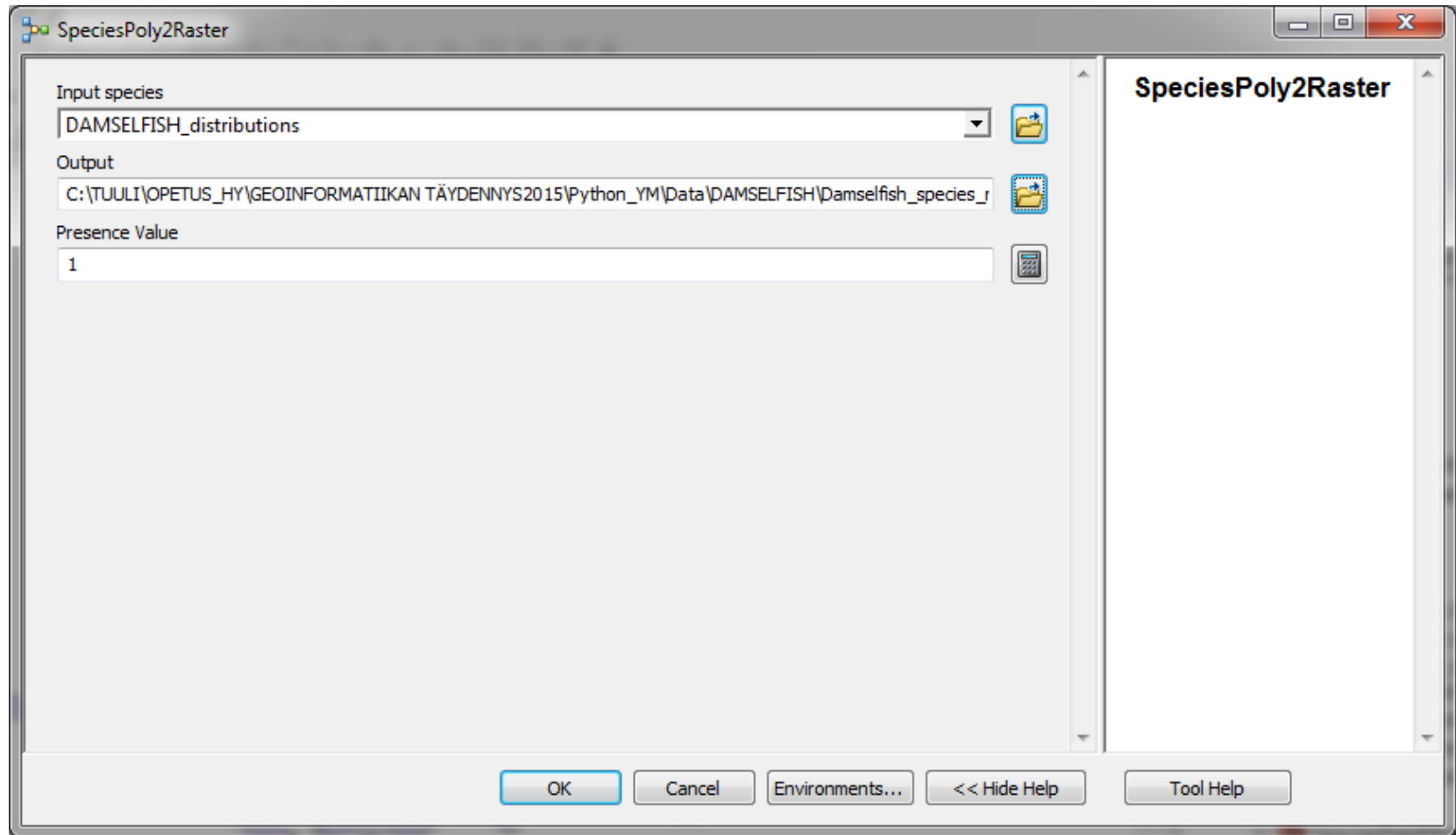
# Parametrizise Input, output and field value



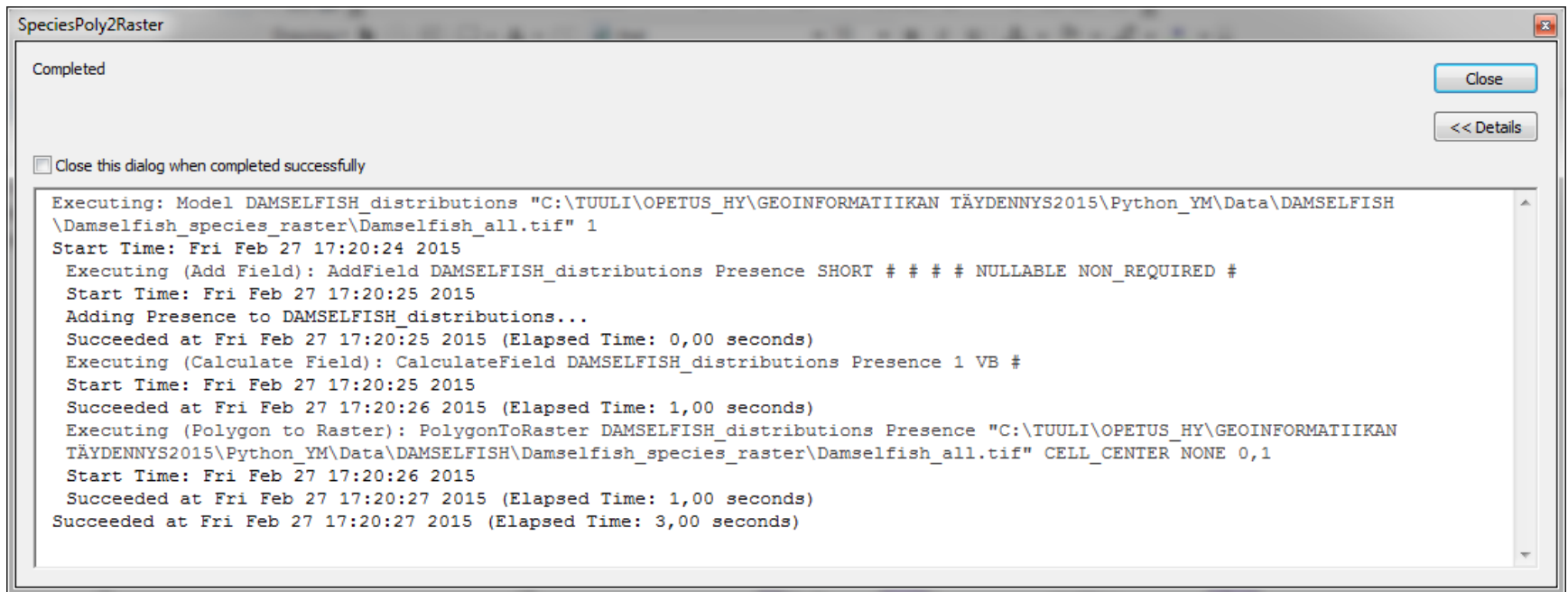
# Ready model should look like this



# Open the model (double click)



# The model runs!



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### 3. Create an iterative model: Iterate by field values

The aim: Select one species at a time, save to a separate shape file, add field, update value, rasterize

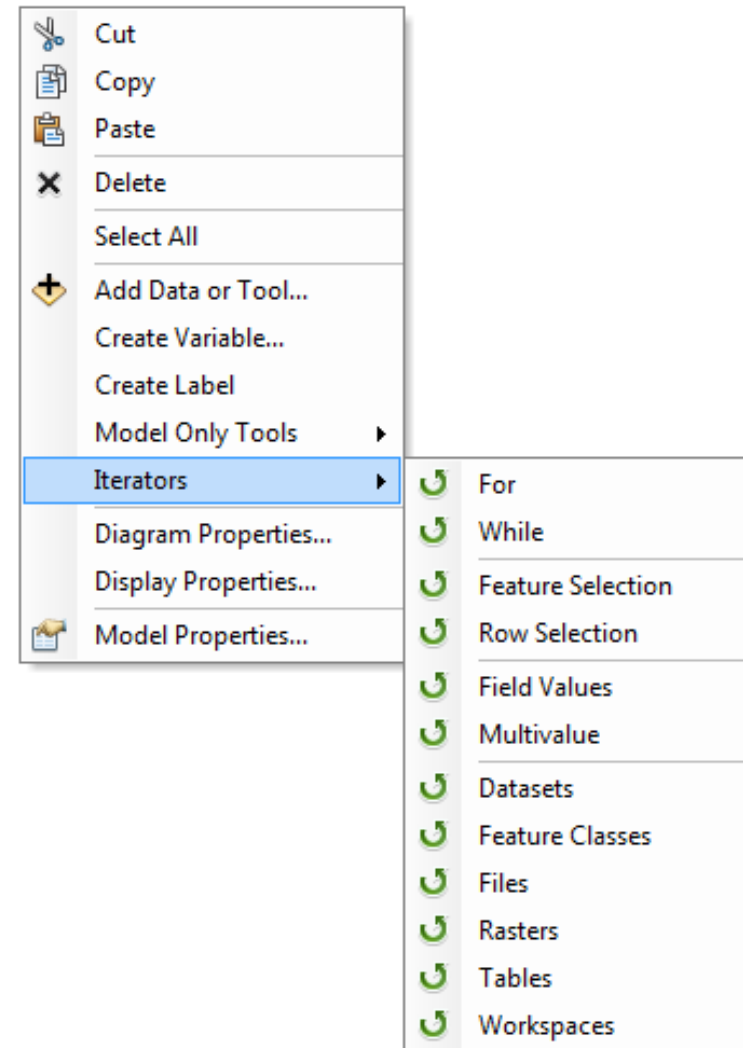


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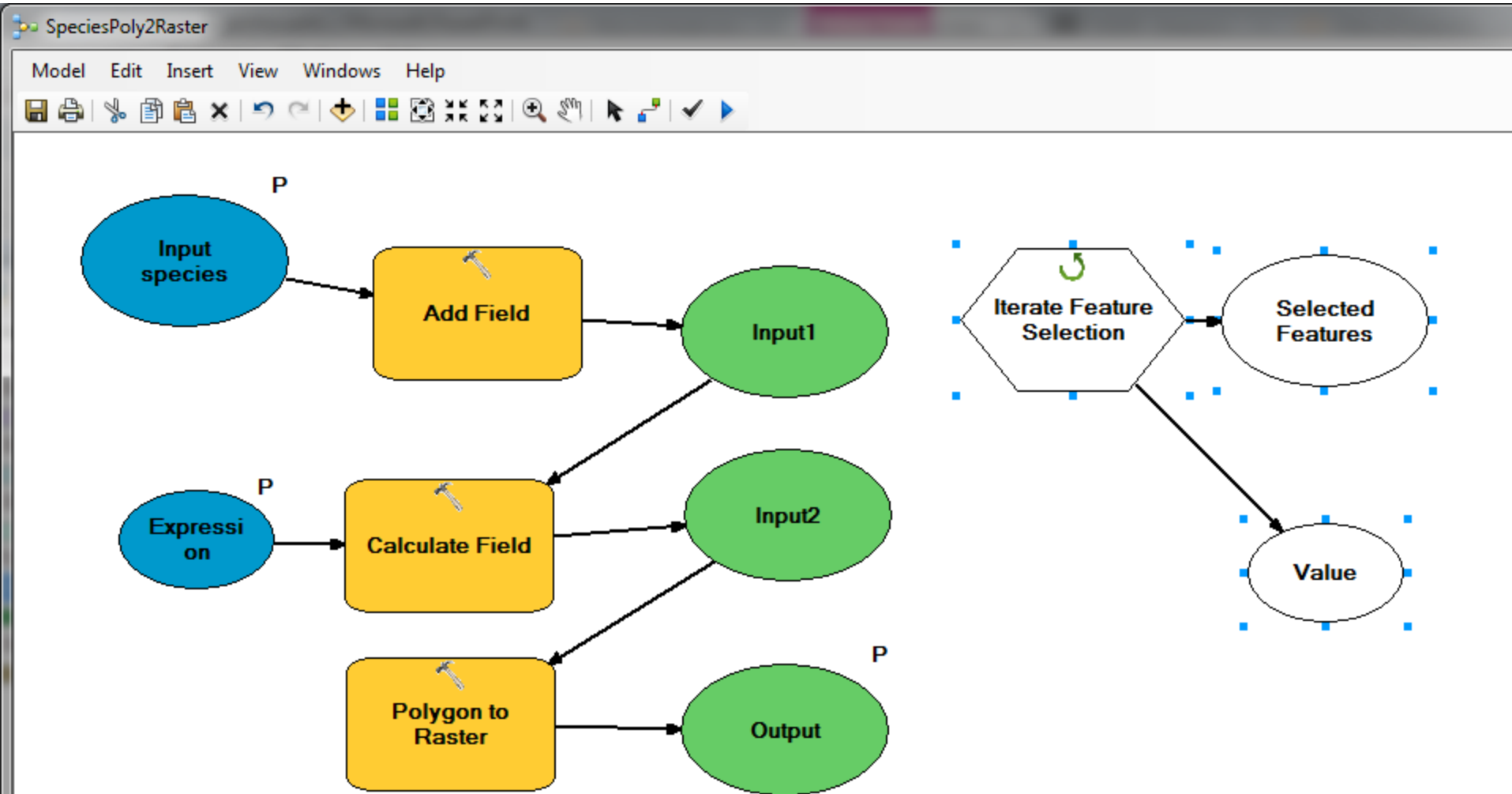
First,  
save the previous model with a  
new name and start editing it



# Add iterator "Feature selection"

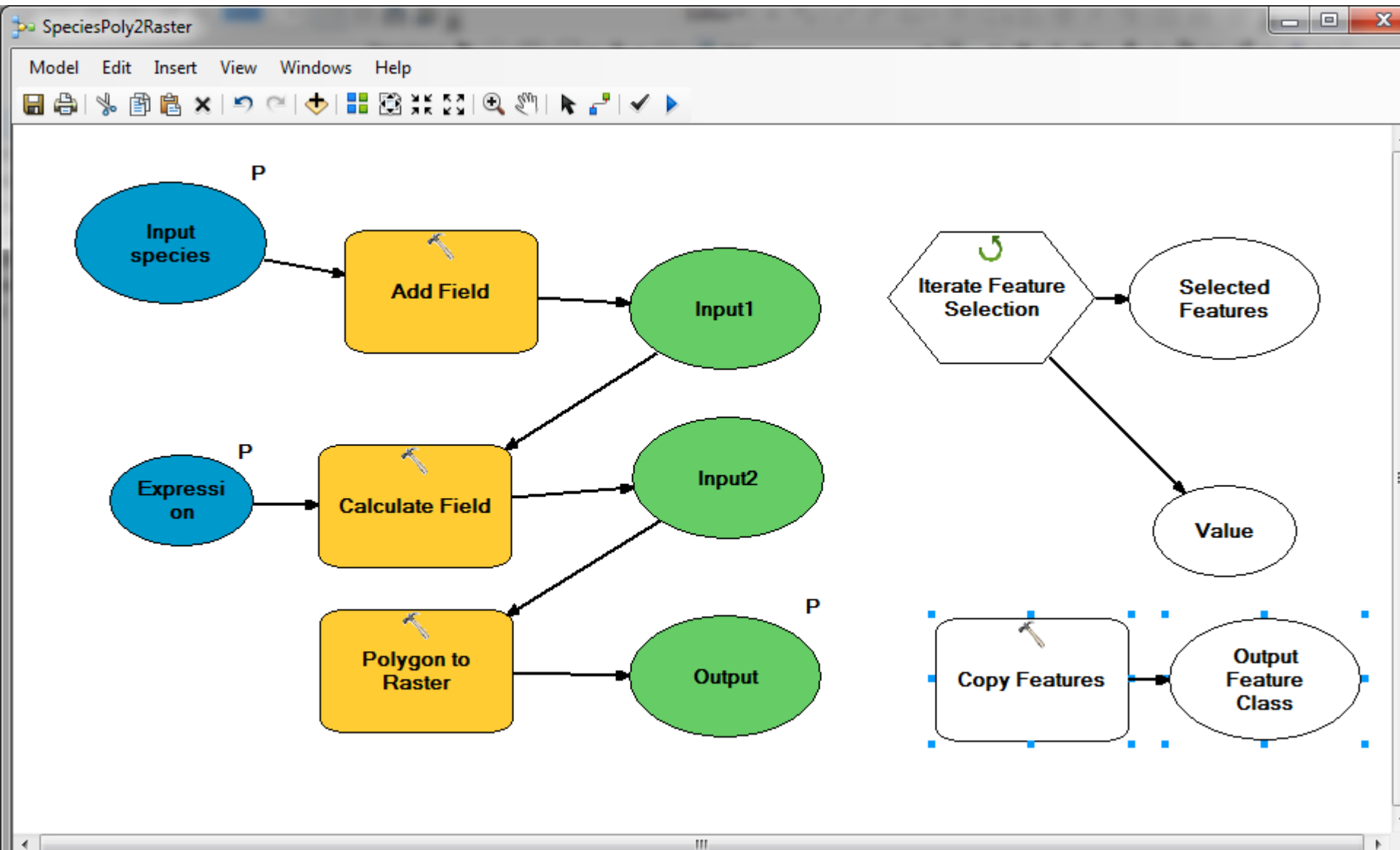


# Iterate feature selection



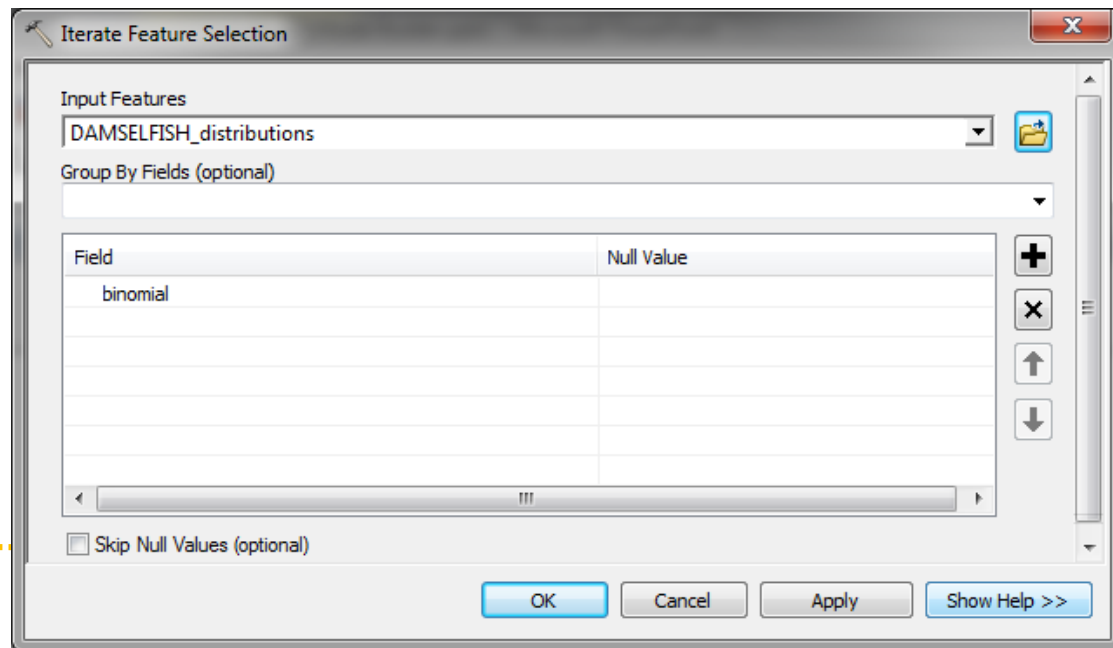


# Add Copy features-tool

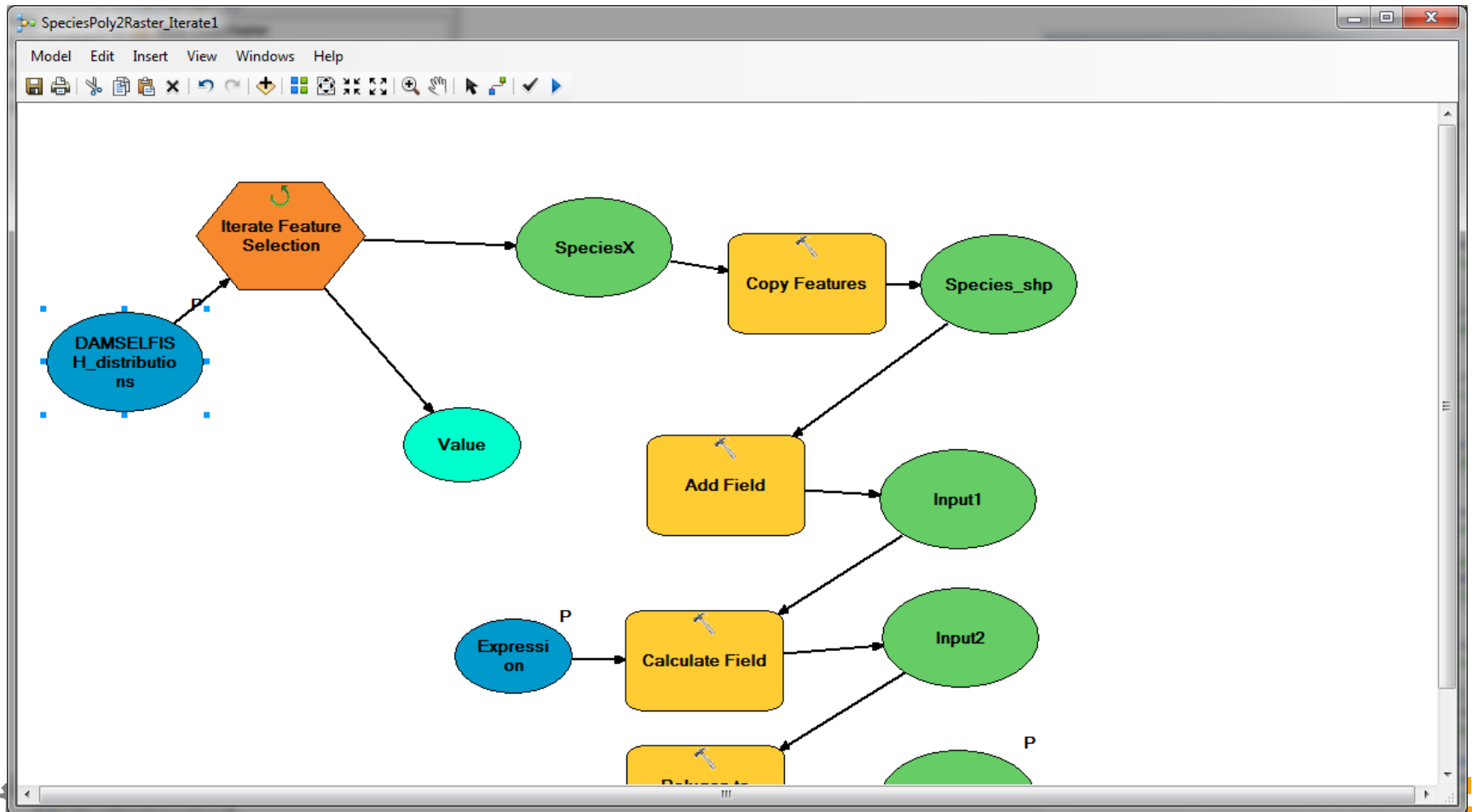


# Iterator settings

- Define that:
  - DAMSELFISH are the input
  - "Binomial" (the species name) will be used to group the features



# Reorganise



# Feature selection

Iterate Feature Selection

Input Features  
DAMSELFISH\_distributions

Group By Fields (optional)

Field	Null Value
binomial	

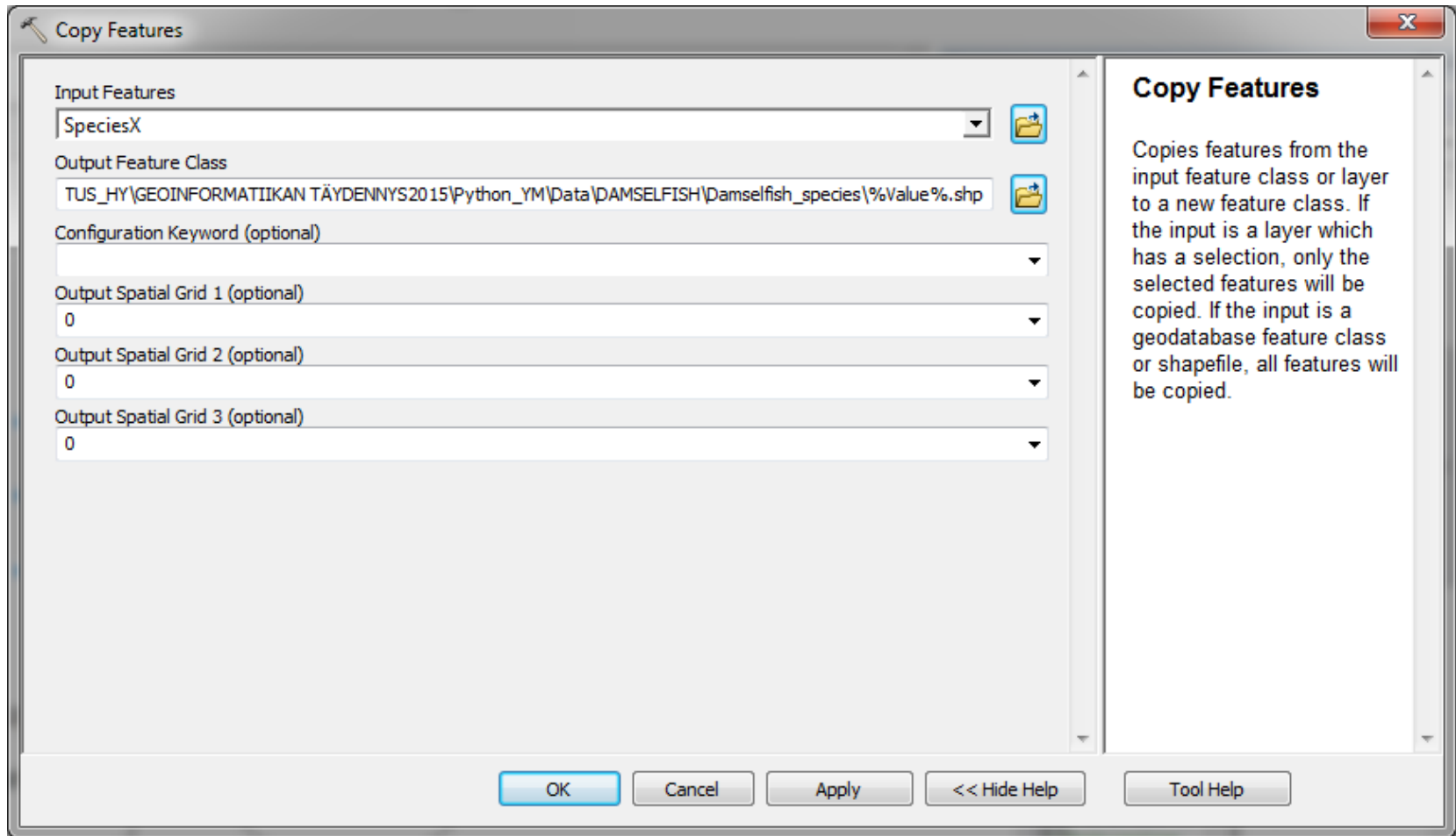
☐ Skip Null Values (optional)

Iterate Feature Selection

Iterates over features in a feature class.

OK Cancel Apply << Hide Help Tool Help

# Copy Raster, output to %Value%.shp



The image shows a screenshot of the 'Copy Features' dialog box in a GIS application. The dialog has a title bar with a hammer icon and the text 'Copy Features'. It contains several input fields and a help panel on the right.

**Input Features**  
SpeciesX

**Output Feature Class**  
TUS\_HY\GEOINFORMATIIKAN TÄYDENNYS2015\Python\_YM\Data\DAMSELFISH\Damselfish\_species\%Value%.shp

**Configuration Keyword (optional)**  
[Empty field]

**Output Spatial Grid 1 (optional)**  
0

**Output Spatial Grid 2 (optional)**  
0

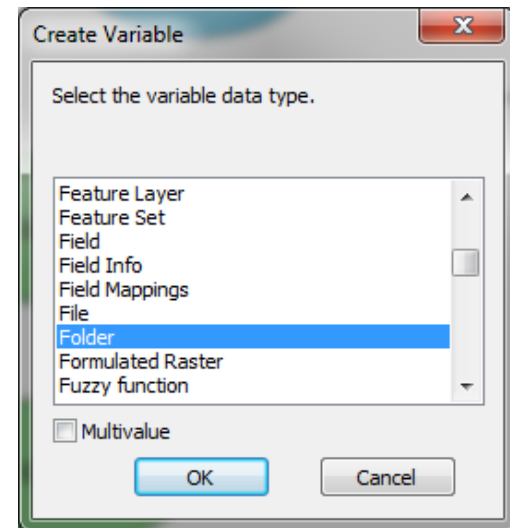
**Output Spatial Grid 3 (optional)**  
0

**Copy Features**  
Copies features from the input feature class or layer to a new feature class. If the input is a layer which has a selection, only the selected features will be copied. If the input is a geodatabase feature class or shapefile, all features will be copied.

**Buttons:** OK, Cancel, Apply, << Hide Help, Tool Help

# Fix output setting

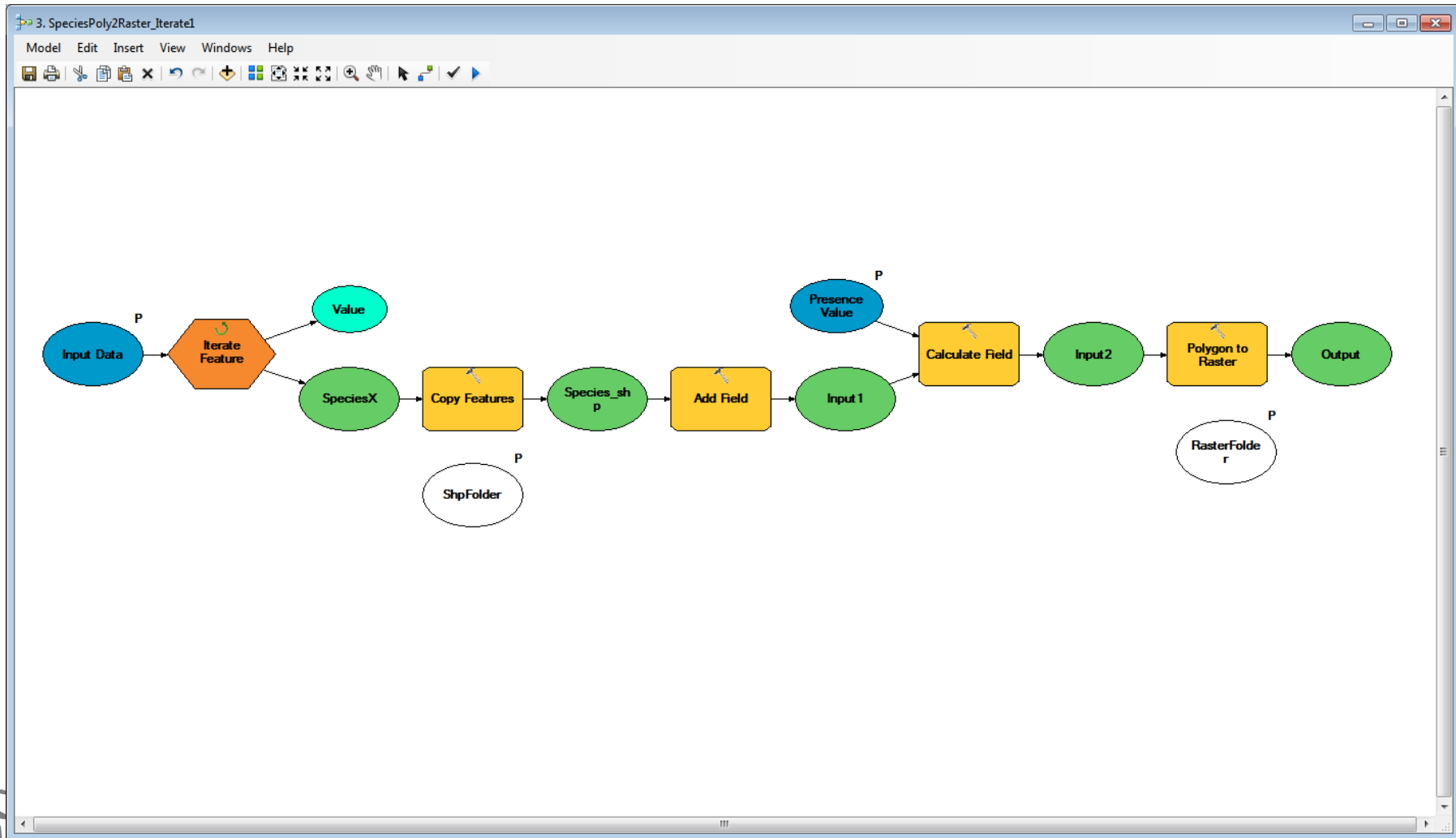
- Add Variables for output shp folder and output raster folder (Create Variable)
- Make folders model parameters
- In the output file, say:
  - %PolyFolder%/%%Value%.shp
  - %RasterFolder%/%%Value%.tif



What are the output names now?



# Ready to run!



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## 4. Create an iterative model: Iterate files

Aim: Go through all the rasters  
and aggregate them to a coarser  
resolution: c. 100 km





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## 4. Create an iterative model: Iterate files

Think yourself first!  
How could you do this?

The command to aggregate cells is  
**AGGREGATE**



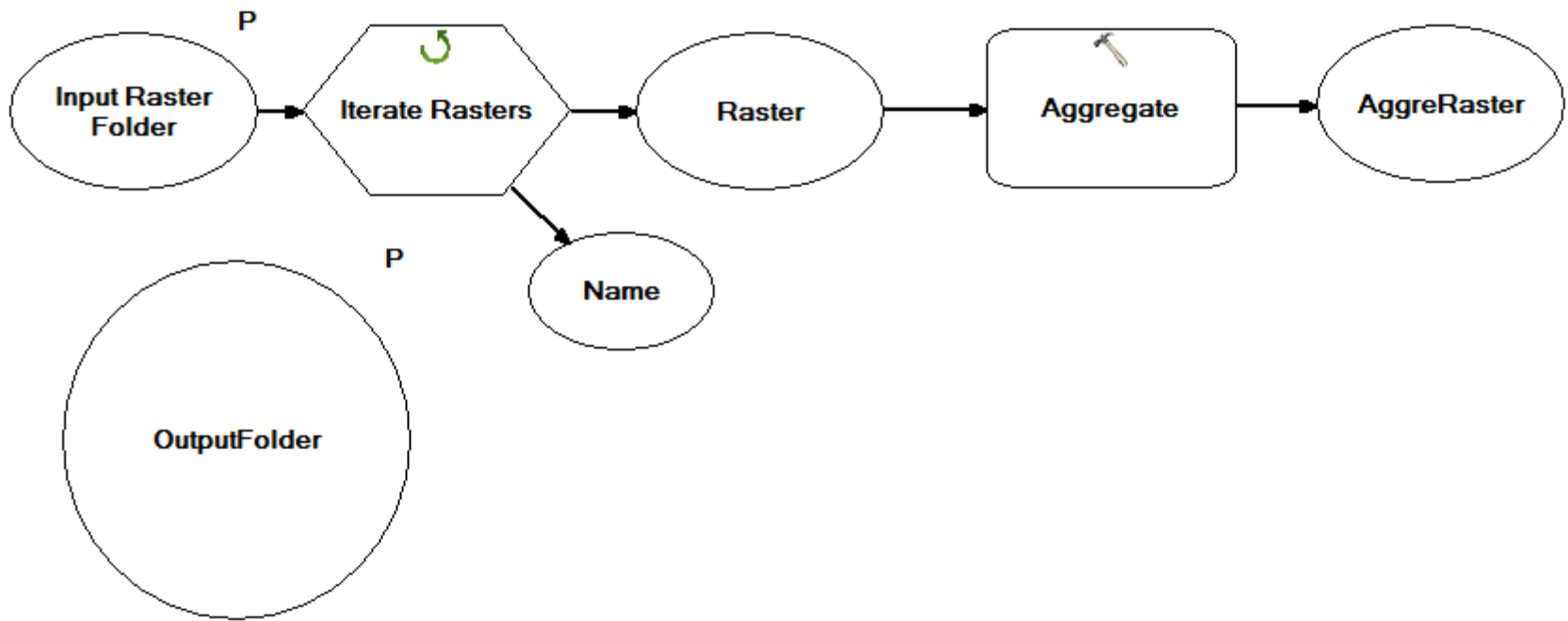
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# 4. Create an iterative model: Iterate files

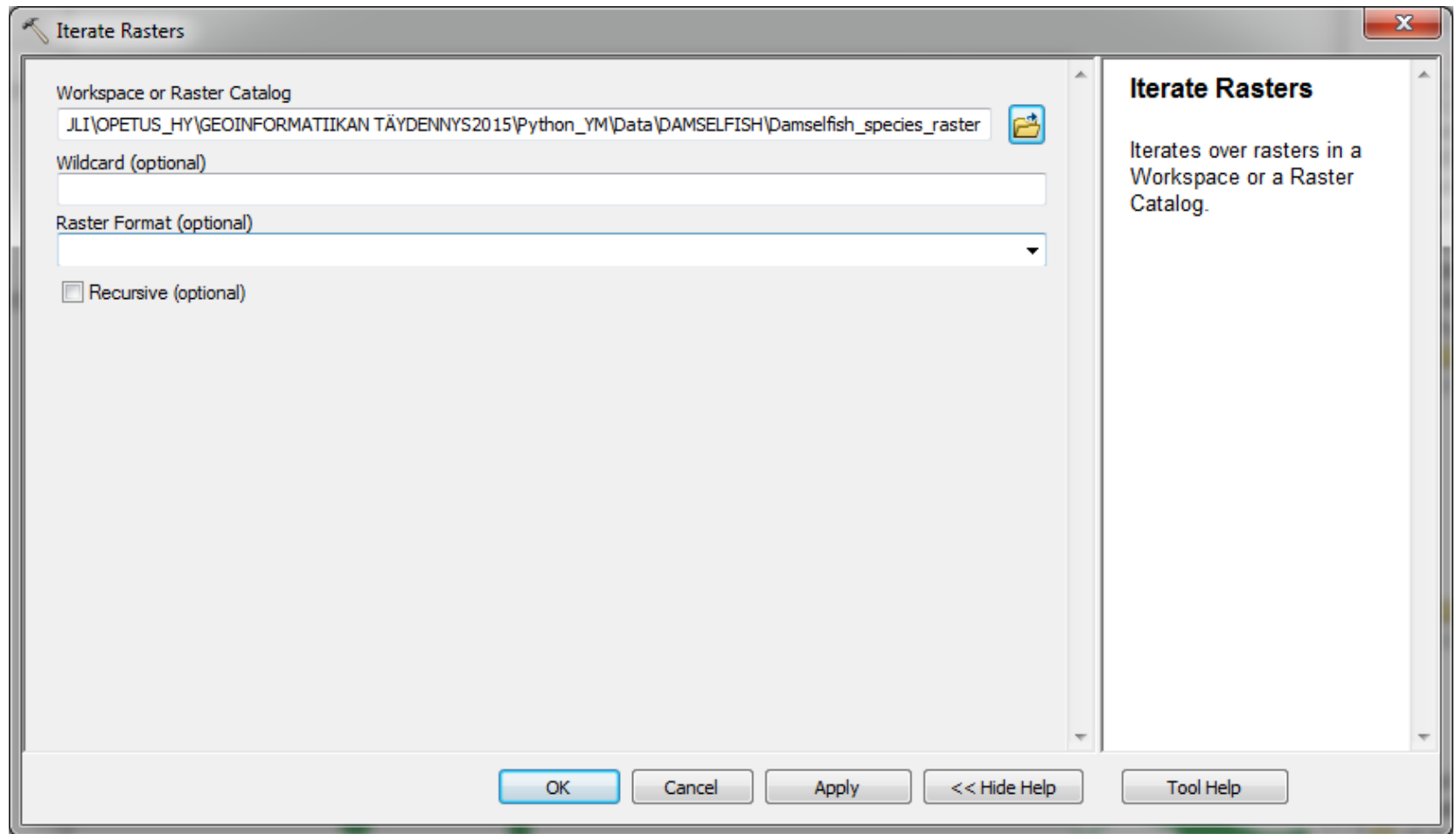
Hints on the next slides!



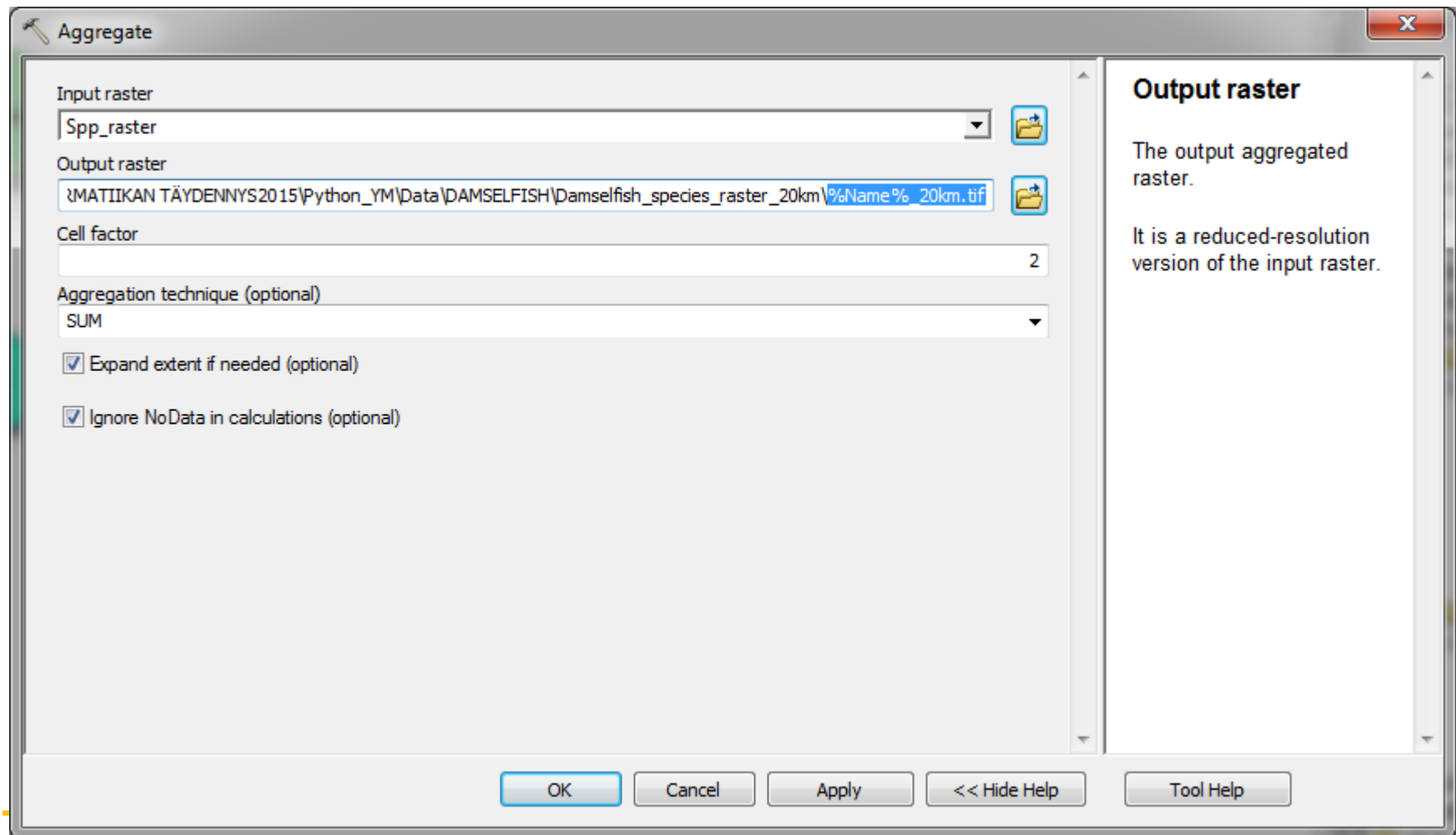
# Final workflow



# Iterator: Iterate Rasters



# Add Aggregate tool with cell factor 2



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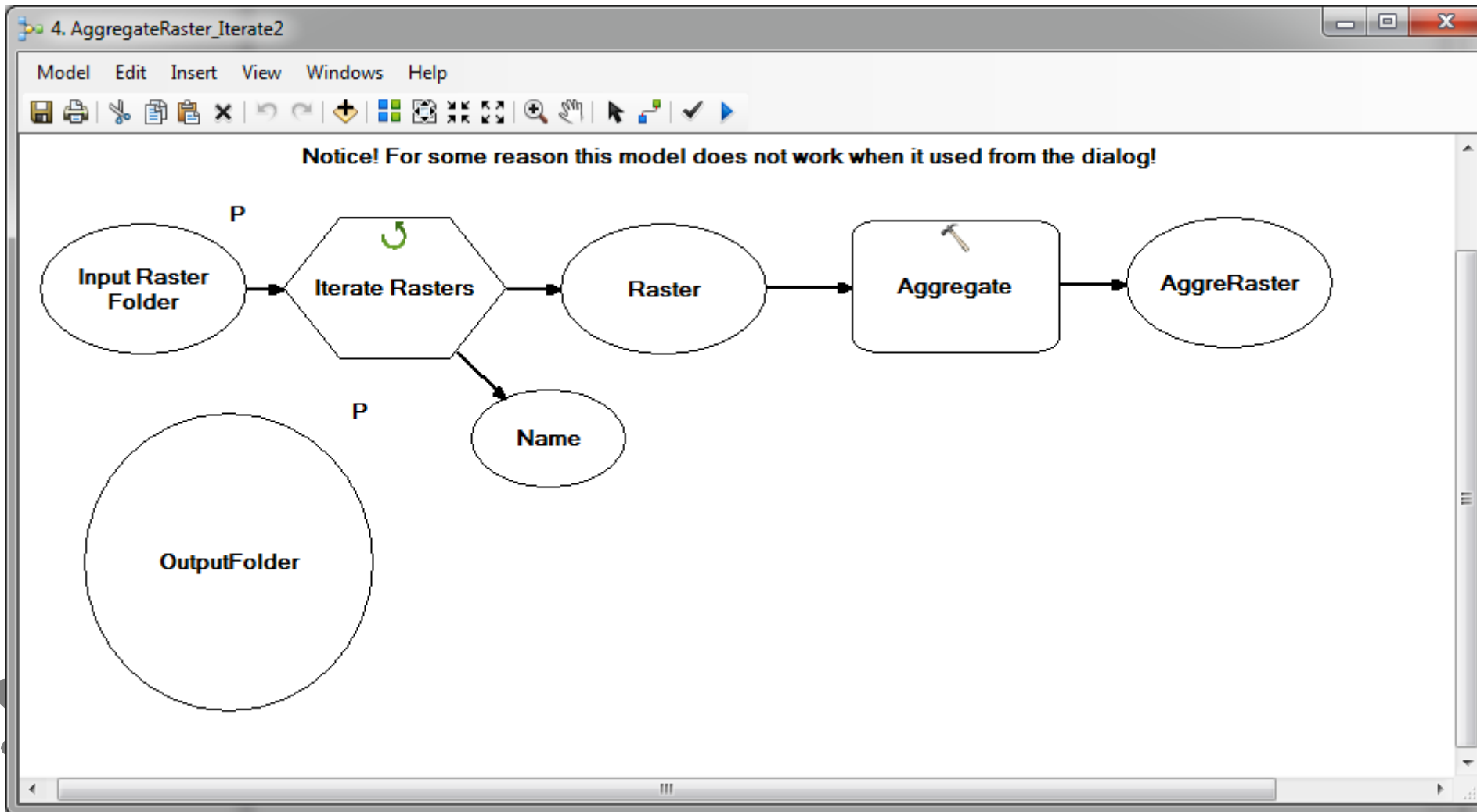
# You can modify the model:

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- Define standard extent for output with environmental settings
  - *Model properties* → *Environments* →  
*Processing extent* → *Values* → *Damselfish*



# Aggregate model



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# 5. You made it! 😊

Some thoughts on Model Builder





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# Experiences on Model Builder

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- Works quite well with simple tasks
- Becomes very unhandy with complex processing chains
- Can only have one iterator
- Can include submodels (with iterators)
- Sometimes strangely unreliable
- There's lots more to explore!

