



ModelBuilder – Tools and Iterators

Models in the ArcGIS environment are used to automate geoprocessing workflows, and are often used to perform repetitive tasks. Models can be saved to a toolbox for reuse, and can be executed as needed. This guide provides a generic example of using ModelBuilder to create feature classes to assist beginners with navigating the ModelBuilder window. This example also includes the use of an iterator and inline variables to demonstrate the concepts of model-only tools and variable substitution.

Note: *The text files used in this example can be found as Appendix 1 and 2 of this document. If you wish to follow along using the example files, simply copy/paste each file to Notepad or a similar text editor and save the text files to a folder on your local machine, ensuring that there are no spaces in the path and file names.*

Step 1 Set up your work environment

1. Open ArcMap to a new document and launch ArcCatalog from the main menu . ArcMap has a property called the *default geodatabase*, which marks the location where outputs from tools and models are to be stored. The default geodatabase (*Default.gdb*) is created automatically when a user installs ArcGIS software, and is usually located in the *My Documents > ArcGIS* folder on Windows machines. This property can be changed to any drive or directory you wish to use.

It is recommended that you set up a default geodatabase for your model. This is especially useful when running an iterative model with many outputs. The default geodatabase will keep your outputs organized, and having this default path set in advance will save time and ensure that you know exactly where your results are stored.

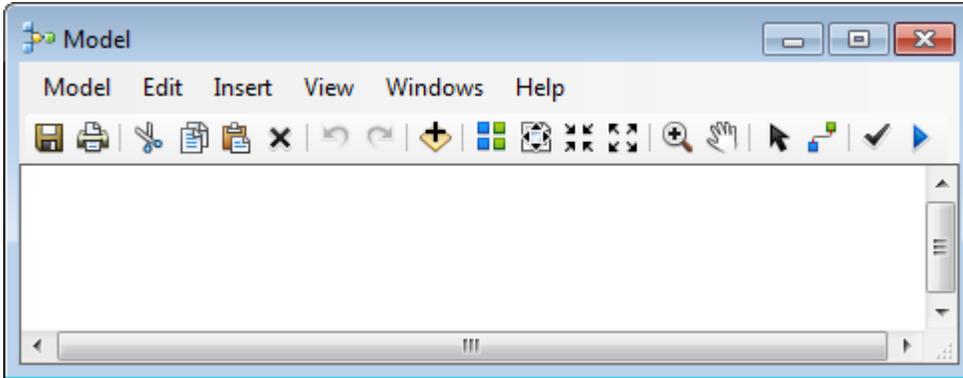
2. In the ArcCatalog window, browse to the workspace where you wish to save your data. If you are unable to see the drive or folder in the Catalog tree, use the *Connect to Folder* button to establish a connection with your workspace. Right-click the workspace and select *New > File Geodatabase*. Enter a descriptive name and click OK to create the database. Then, right-click the new geodatabase and select *Make Default Geodatabase*.

Note: *You must have full permissions (read, write, etc.) on the folder where you create your file geodatabase. If you do not have write access to this folder then the geoprocessing tools will not be able to save the outputs to this location, and the tools will fail.*

3. Save the map document.

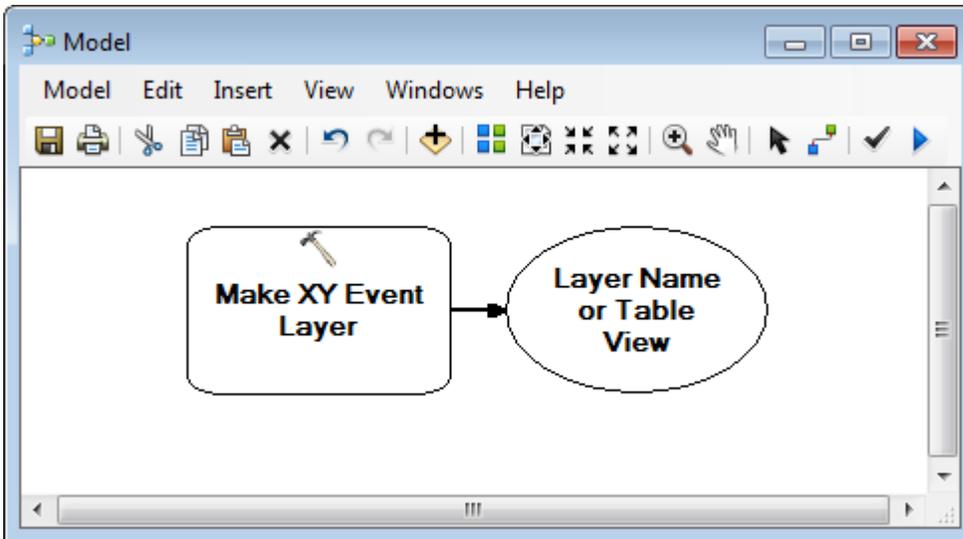
Step 2 Add tools and parameters to ModelBuilder

Launch ArcToolbox  and ModelBuilder  from the main menu in ArcMap. The model window will open to a new, blank model.



In this example we will build a workflow to create point feature classes from coordinate values stored in text files. We will create an *iterative* process, meaning that we will structure the model to repeat the workflow for each file stored in the associated directory. In other words, the model will iterate through the files in a folder and execute the geoprocessing tasks for each one in the order that they are encountered.

In ArcToolbox, browse to the *Data Management Tools > Layers and Table Views* toolbox. Select the *Make XY Event Layer* tool, hold down the mouse button and drag the tool into the Model window. The tool will appear as a white rectangle connected to its output.



Note: You can resize the Model window using the bottom right corner of the dialog.

Double-click the *Make XY Event Layer* tool in the Model window and fill in the associated parameter as follows.

1. Set the *XY Table* to the file or table containing the coordinate data.
2. Set the *X Field* to the column that contains longitude values (*Field8* in the example files).
3. Set the *Y Field* to the column that contains latitude values (*Field 7* in the example files).
4. Set the *Z Field* to the column that contains elevation values, if applicable.
5. Set the *Spatial Reference* to the coordinate system used to collect the coordinate values, if known.

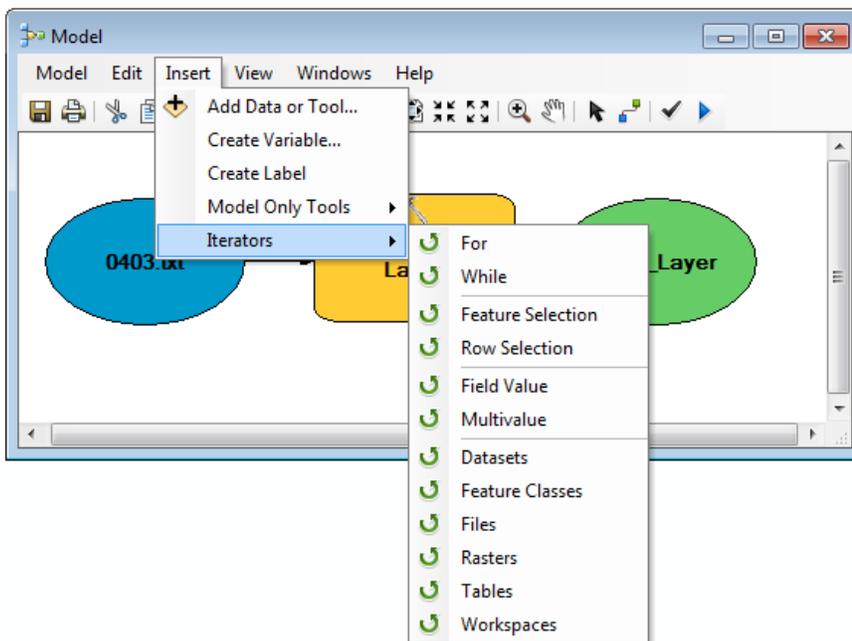
Click *OK* to close the tool dialog and return to the Model window.

Note: ModelBuilder uses colours to indicate the status of tools and variables. A white shape indicates that the tool still requires information from the user before it can be executed. Note that the *Make XY Event Layer* tool is now coloured after filling in the tool parameters, which means that the tool can be launched at any time. Blue represents inputs, yellow represents tools, and green represents outputs.



Step 3 Iteration

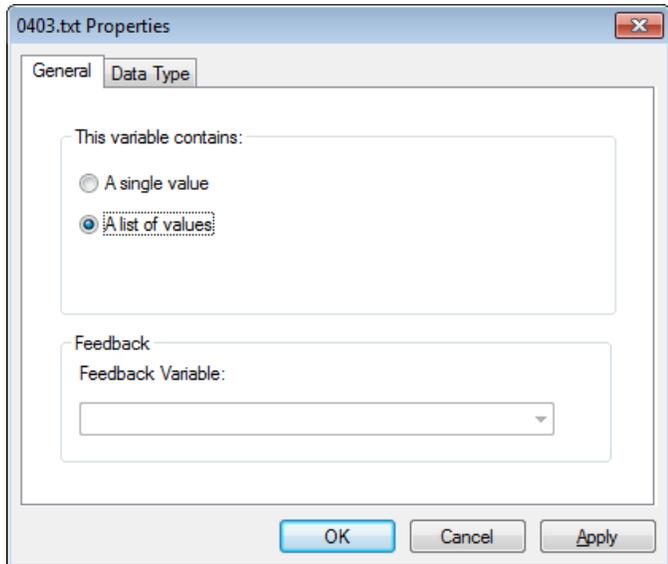
As mentioned, this model will be an **iterative** workflow. There are several iteration methods available within ModelBuilder, all of which can be accessed via the *Insert* menu in the Model window. Descriptions and help documentation for each iterator are available [here](#).



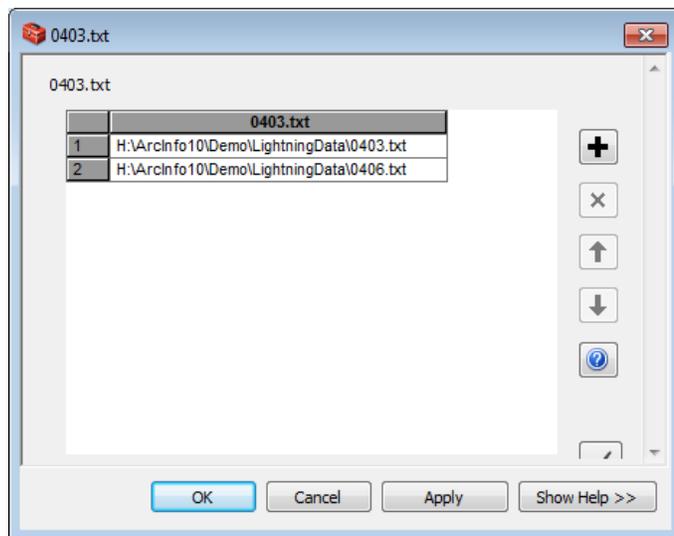
There is often more than one method to accomplish a task in ArcGIS. In this example our data is stored as text files in a folder and holds coordinate value information that we wish to convert to a spatial layer. There are two separate methods that will allow us to achieve our results; using the *Iterate Tables* iterator, or using the built-in *Python list logic*. Both of these processes are explained thoroughly in the remainder of this guide.

3a. Python List Logic

First, set the tool's input as a list – this tells the software that there will be multiple inputs to the tool. Right-click the blue input oval and select *Properties* from the hidden menu. Under *General*, ensure that the option 'A list of values' is checked and then click *OK*. The input and output will now display as multiple stacked shapes.



Double-click the blue input to open the **batch processing grid**. This grid displays an entry for each list item that you wish to process. Initially, you will see only the first input. Double-click the row number to view its properties.

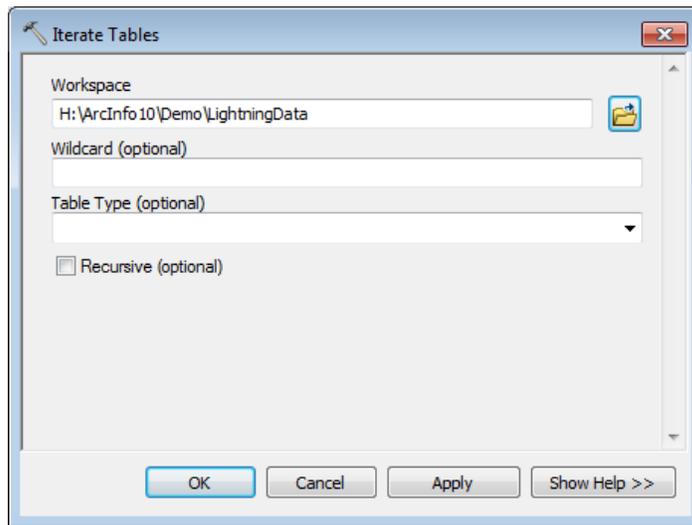


Click the + sign to add another item to the list and browse to the directory where your files are stored. Select the second file in the list to enter it to the grid. Repeat this step for each table you wish to process. In our example, we will be using only two files, which makes the batch processing grid a quick and easy method for iteration. However, if you are attempting to run the model on a relatively large number of files then this method can quickly become time-consuming. In this case, it may be a better option to use one of the built-in iterators.

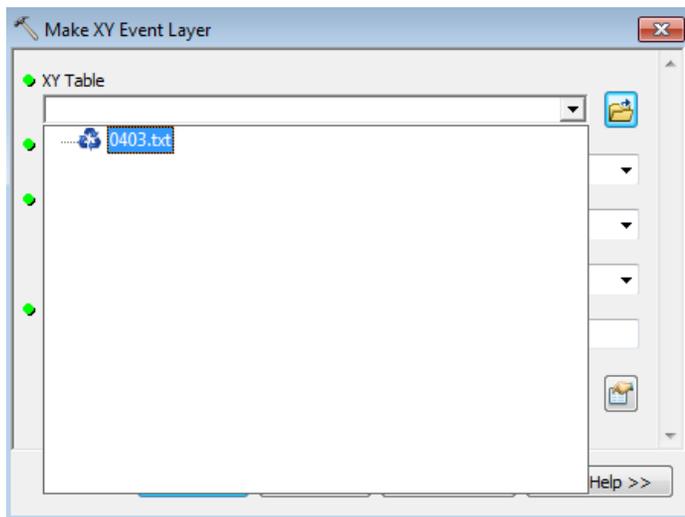
3b. Iterate Tables

Access the *Insert > Iterators* menu and select the *Iterate Tables* option to add the process to the Model window. Double-click the *Iterate Tables* process and enter the parameters as follows.

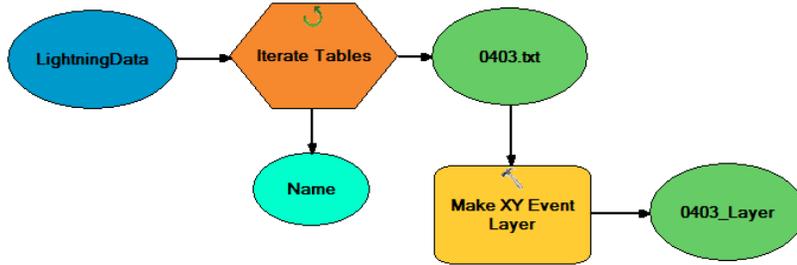
1. Set the *Workspace* to the directory where the files to be processed are stored.
2. Set the *Wildcard* parameter if you wish to restrict the model to iterate through files that have a specific word or character. If this is left blank then all of the files within the directory will be processed.
3. Set the *Table Type* parameter if you wish to restrict the model to iterate through specific file types. For example, entering DBF here will ensure that the model only processes DBF files. If this parameter is left blank then the tool will attempt to process all valid file types within the directory.



At this point, you can go ahead and delete the input to the *Make XY Event Layer* tool that we created in Step 2. Instead, double-click the *Make XY Event Layer* tool to open its parameters and click the drop down arrow beside the *XY Table* parameter and select the iterative list of tables  as your input.



The iterator and tool should now be connected, with the iterator's output file acting as the input for the *Make XY Event Layer* tool.

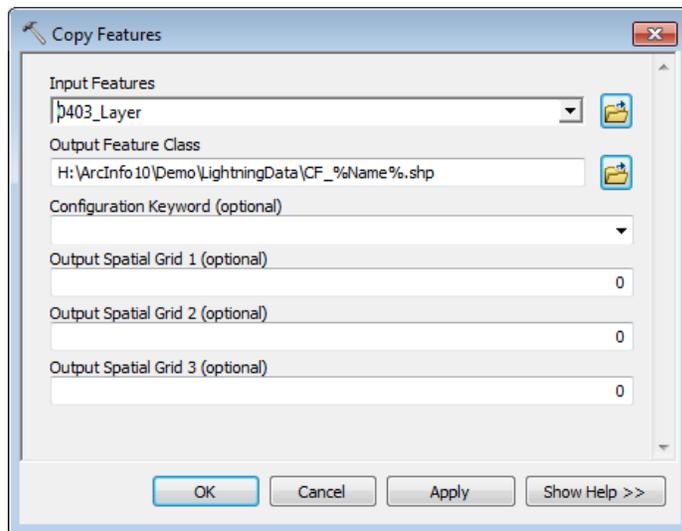


Step 4 Add Processes

The first iterative process in our model is now complete and ready to execute. However, our end goal with this model is to create feature classes from the coordinate information stored in our text files. The *Make XY Event Layer* tool creates a temporary event layer for our point data. To subsequently create a permanent feature class, we will use the *Copy Features* tool.

In ArcToolbox, browse to *Data Management Tools > Features* and drag the *Copy Features* tool to the Model window. Double-click the *Copy Features* tool to open its dialog and set the parameters as follows.

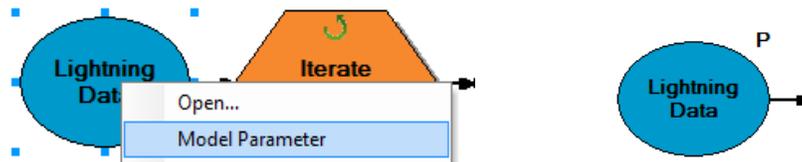
1. Set the *Input Features* to the output from the *Make XY Event Layer* process.
2. Set the *Output Feature Class* to the path where you wish to store your final outputs.



Note: This example uses *inline variable substitution* to provide a name for the output feature class. As seen in the model examples, the *Name* variable is created via the *Iterate Tables* tool. Each time the tool moves through an iteration, the variable is populated with the name of the file that is currently being processed. Use of inline variable substitution in this case insures that each file has a unique name that will allow us to identify the outputs later. In our example, the first time the model iterates through, the *Name* variable is populated with the filename 0403. Thus, our final output will be CF_0403. The second iteration processes a file called 0406.txt – so our next output will be CF_0406, etc. More information can be found [here](#).

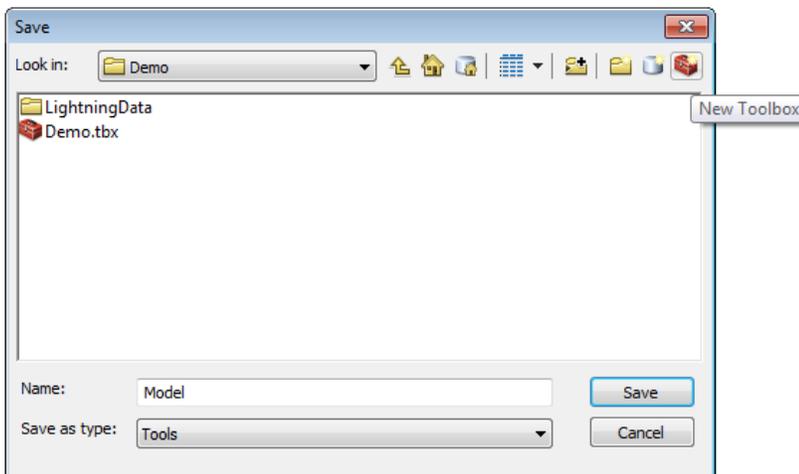
Step 5 Set Parameters

Model parameters are those that will be set by the user during runtime. That is, since models are designed for reuse, you will likely incorporate inputs that must be set by the user each time the model is run. For example, in our model we will ask the user to set the input workspace for the *Iterate Tables* tool. To set a model parameter, simply right-click the input/s that will be asked for from the user and select *Model Parameter* from the hidden menu. A 'P' will appear beside the selected input, indicating that it has been designated as a model parameter. The model will now prompt the user for this parameter before execution.



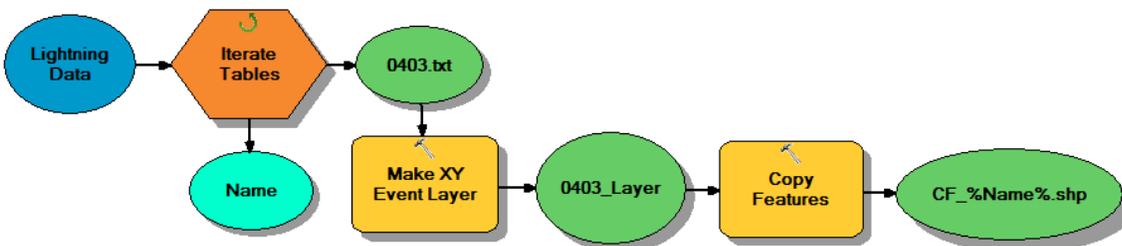
Step 6 Save and Run the Model

To save your model, click the *Save* button  in the Model window and either browse to an existing toolbox or use the tools provided in the Save dialog to create a new toolbox.

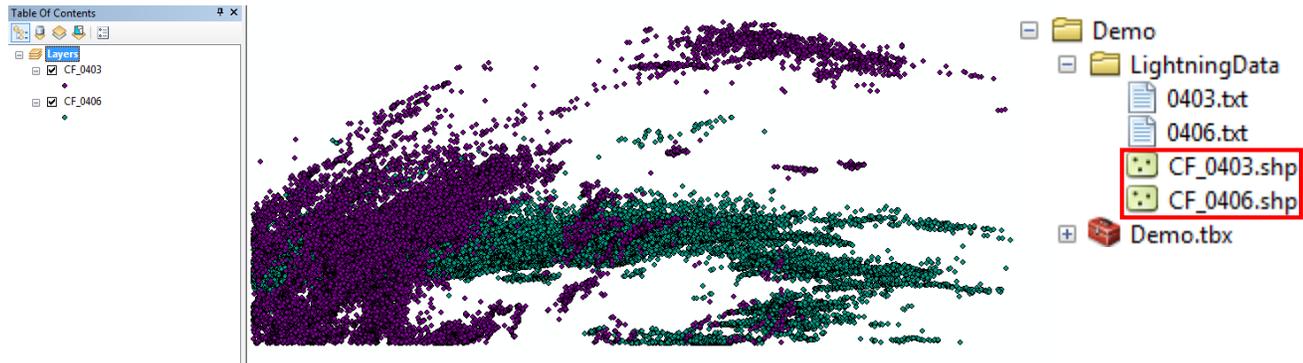


Note: Models must be saved to a toolbox. You can choose to save the model to an existing toolbox, or alternatively there is a default *My Toolboxes* workspace available in the Catalog tree. You may also choose to create a new toolbox in a workspace of your choice (right-click > *New > Toolbox*). You must have full permissions (specifically write access) to the directory where your toolboxes and models are saved.

To run the model, click the *Run* button  from the Model window. If you are attempting to edit or run the model after it has been closed, simply browse to the toolbox in ArcCatalog, right-click the model and select *Edit* or *Run*. A drop shadow will appear behind the tools and inputs/outputs that have completed successfully, as shown below.



Our example model iterates through two text files in the specified workspace and subsequently creates two feature classes within the directory we have chosen for our outputs. The inline variable substitution insures that each file is named uniquely according to the original tables, as shown below.



Although it is by no means an exhaustive manual, this guide attempts to illustrate some of the basic concepts employed when using ModelBuilder to create reusable, iterative workflows. Shortened versions of the example text files used to create and test this model have been provided as appendices to this document. Simply copy the text for each file into Notepad or a similar text editor and save the files to your local drive. Then, build the model as instructed and substitute the paths and variables for your local directory paths and filenames accordingly.

For further assistance with this guide or other topics related to geospatial and/or statistical data and software, please contact us at madgichelp@trentu.ca.

Appendix A: File 0403.txt

1999 04 03 01 04 33.912822700 +42.5060 -093.7287 -025.8 01 1
1999 04 03 01 15 40.107793500 +42.4444 -093.9771 -027.2 04 1
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1999 04 03 01 23 29.853438798 +42.4936 -093.9029 -017.3 01 1
1999 04 03 01 25 40.042725900 +42.4768 -093.8548 -013.6 01 1
1999 04 03 01 28 29.075882600 +42.5037 -093.8264 -018.5 01 1
1999 04 03 01 29 20.099120300 +42.5363 -093.8548 -012.9 02 1
1999 04 03 01 30 19.254680000 +42.5435 -093.8510 -010.7 04 1
1999 04 03 01 36 23.243391500 +42.5923 -093.7545 -008.9 03 1
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1999 04 03 02 12 01.212328400 +42.8166 -093.3647 -015.1 01 1
1999 04 03 02 12 01.801661332 +42.8271 -093.3958 -012.5 01 1
1999 04 03 02 15 10.277733900 +42.0418 -093.8809 +023.0 01 1
1999 04 03 02 16 00.149242800 +42.4864 -093.2807 +077.0 01 1
1999 04 03 02 17 18.027795400 +42.8497 -093.3059 -020.0 02 1
1999 04 03 02 17 49.778184500 +42.4526 -093.2206 -016.1 01 1
1999 04 03 02 18 07.512454200 +42.8612 -093.3100 -019.4 01 1
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1999 04 03 02 22 09.775696900 +42.8937 -093.2740 -017.1 01 1
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1999 04 03 02 27 01.755185600 +42.6499 -093.0230 -006.6 01 1

Appendix B: File 0406.txt

2010 04 06 00 00 02.411294097 +40.2549 -085.5296 -010.7 02 1
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2010 04 06 00 01 03.864217924 +42.3329 -090.4455 -011.9 02 1
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