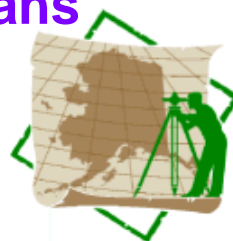




*40th Alaska Surveying  
and Mapping Conference  
GIS Jam*

# Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans



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## Overview

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- ◆ Transforming datums in Alaska
- ◆ Geoprocessing
- ◆ Changes at 9.2
- ◆ Tools, models, and scripts
- ◆ Sorting out data that doesn't line up

## NAD83 and NAD83 (CORS)

- ◆ Original NAD83 realization was 1986
- ◆ Statewide readjustments in 1990-2003
  - ◆ Alaska partially updated in 1992 and later
  - ◆ Adjusted control points will say “NAD83 (1992)” or “NAD83 (CORS)”
- ◆ Sometimes known as NAD83 HARN or HPGN
- ◆ No transforms between 1986 and later adjustments
- ◆ We'll focus on NAD27 to NAD83
  - ◆ NAD\_1927\_To\_NAD\_1983\_Alaska

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Besides NAD27 there are several datums/geographic coordinate systems in use in Alaska. The original realization of NAD83 was in 1986. There are still control points whose coordinate values are in the 1986 frame. Practically the minute the original NAD83 datum was released, GPS came along and everyone realized that they could make an even better-fitting datum. They could improve the control point coordinates. The National Geodetic Survey (NGS) in connection with individual states would re-survey the control network and then publish new coordinates and usually realize the transformation to convert between the 1986 and the re-adjustment which was originally called HPGN, and is now called HARN. The re-adjustments were published in a particular year, so you'll see control points that say NAD83 (1992). So a partial re-adjustment was done in Alaska in 1992. However, no transformation was published, so there's not a way to automate converting from 1986 to the HARN. There are more recently adjustment control points too, labeled NAD83 (CORS).

So I am going to focus on what we can automate and that getting data from NAD27 to NAD83 using the best available transformation: NAD27 to NAD83 Alaska. It uses the NADCON method, which in turns uses two files on disk to calculate the latitude and longitude shifts between the two datums.

## WGS84 transformations

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- ◆ Don't use them!
- ◆ NAD27/WGS84 transformations are much less accurate
- ◆ 3 parameters—good enough for military use
- ◆ NAS\_D/V/W
- ◆ NAD\_1927\_To\_WGS\_1984\_7 (21/22)

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**Don't use them. Don't use them in connection with one of the NAD83 to WGS84 transformations either. They are much less accurate than using NADCON. The NAD27/WGS84 transformations are all 3 parameters, known as Molodensky or Geocentric Translations. Originally published by the US military—they're good enough to hit the broad side of a barn. Or, probably worse than that.**

## On the fly and data

---

- ◆ ArcMap projects in memory
- ◆ Tools and commands create new datasets
- ◆ Original data is unaffected
- ◆ Disk space is cheap
- ◆ Keep the original data
- ◆ Don't be afraid to experiment

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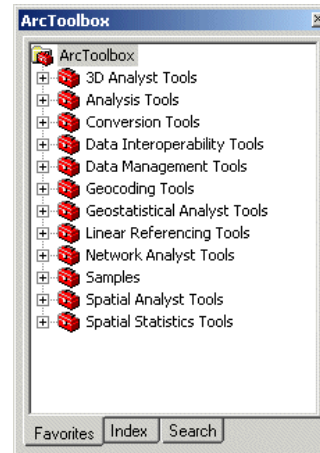
Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 5

**When you project data in ArcMap, it's all done in memory. The original data isn't affected. The methodology for projecting on-the-fly is the same as when you use the Project tools. Remember that tools and commands create new datasets. The original data is still there—don't delete it! Disk space is cheap. But along with that, don't be afraid to experiment. Run the tools and scripts as many times as you need or want to. While you update the geographic coordinate system, it's a perfect opportunity to combine other changes, like converting coverages to shapefiles or geodatabase feature classes, or converting rasters between different types.**

**However, really be careful on the quality control. I'm the last person that will claim that software is bug-free. I've seen some mighty strange problems over the years.**

## Geoprocessing in ArcGIS

- ◆ Hundreds of tools available
  - ◆ Organized by toolbox
  - ◆ Many options for performing analysis
- ◆ Several ways to access geoprocessing tools



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Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 6

### Geoprocessing in ArcGIS

ArcGIS contains many tools that allow you to efficiently accomplish geoprocessing-related tasks. With ArcInfo Desktop, many of the commands used in ArcInfo Workstation are in the geoprocessing framework. More important, these tools operate on all data types.

You will find that the geoprocessing functionality can be accessed in a variety of ways. It is up to the user how to execute the geoprocessing tool needed. Geoprocessing is the real power behind GIS, as you can help compile data and answer spatial questions about your data, rather than just use it as a mapmaking software. There are hundreds of tools available, depending on which license you have (ArcView, ArcEditor, or ArcInfo), for both processing and performing analysis on your data. In this class, we will examine tools from the Analysis Tools toolbox (Lesson 4), Spatial Analyst Tools toolbox (Lesson 7), and the Spatial Statistics Tools toolbox (Lesson 8).

# Geoprocessing framework

## ◆ Multiple environments

The diagram illustrates the Geoprocessing framework in ArcGIS, showing the Select tool being executed in four different environments:

- ArcToolbox:** The Select tool is highlighted in the ArcToolbox window.
- Command Line:** The Select tool is executed via the command line, showing the command and output.
- Models:** The Select tool is executed as part of a model, showing the flow from Runways to New Runways.
- Scripts:** The Select tool is executed via a script, showing the code used to execute the tool.

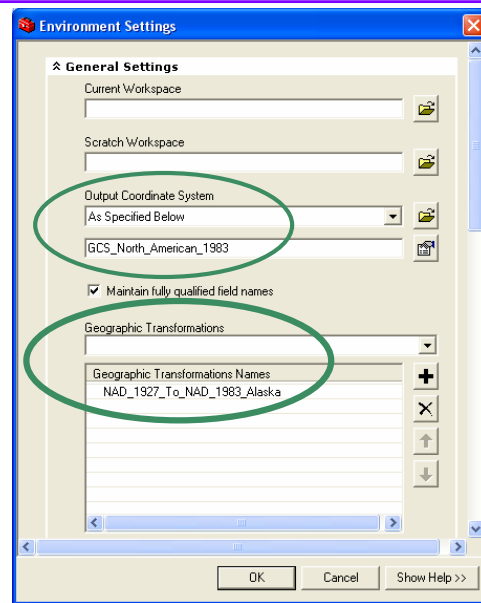
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## Geoprocessing in ArcGIS

The geoprocessing framework includes a series of tools that can run from numerous locations. For example, the Select tool in the ArcToolbox window can be executed directly from ArcToolbox as a dialog, the command line, a model, or a script. The ability to run these tools from multiple locations is what makes the geoprocessing environment so powerful.

## Changes for ArcGIS 9.2

- ◆ Tools didn't support geographic/datum transformations
- ◆ Use ArcToolbox environment to set up output coordinate system and geographic transformation
- ◆ Models now support iterations



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A major change to geoprocessing at 9.2 is a change to the environment settings. It's not widely enough known, but most of the data conversion tools, or any tool that allows you to set the output coordinate system/spatial reference, generally do not support datum transformations. You might use the Feature Class to Feature Class wizard, set the output coordinate system \*here\* in the general settings portion of the Geoprocessing environment, this is all you could set, and assume that a datum transformation from NAD27 to NAD83 would occur. That's not the case before 9.2, and if you don't set a geographic/datum transformation here, it still would not occur correctly.

You can only set a single coordinate system, and a single geographic transformation. This is particularly important because the system does have a 'default' transformation between NAD27 and NAD83. Unfortunately, it's the one for the lower 48, so Alaska and Hawai'i have to do some extra work.

## Choosing an environment

	Tool Dialog	Command Line	Model Builder	Script
Simple tasks	✓	✓		
Efficient		✓	✓	✓
Reusability		✓	✓	✓
Combine processes		✓	✓	✓
Batch operations	✓		✓	✓
Use logic			✓	✓
Schedule run				✓

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9

### Geoprocessing environments

There are five environments that compose the geoprocessing framework: tool dialogs, command line, ModelBuilder, scripts, and ArcObjects (ArcObjects is beyond the scope of this class and will not be discussed). Users must determine which environment best suits their geoprocessing needs. For users who are unfamiliar with a tool, the tool dialogs are a good way to learn how a tool works and what parameters are needed for the tool to execute. Both tool dialogs and the command line are effective environments for executing simple tasks such as a clip or a buffer. More experienced GIS users may choose to use the command line to type in commands versus clicking their way through a dialog to achieve the results they need. The command line, ModelBuilder, and scripting environments offer the ability to reuse commands and combine processes together, making these environments more efficient than the tool dialogs for completing geoprocessing tasks. Aside from a few tools, scripting is the only environment that provides the ability to perform batch operations, that is, process more than one input at a time. Scripting also has the ability to incorporate logic to allow for branching in a script, that is, if the user inputs a point, buffer it; if the user inputs a line, clip it as opposed to precondition statements in models that ensure that particular operations are completed before other operations execute. Another advantage to using a scripting environment to execute geoprocessing tasks is that it is possible to schedule runtimes using either the Windows Scheduler or Windows At command. This allows you to take full advantage of processing resources by scheduling or automating the runtime of your geoprocessing tasks to execute when you are out of the office.

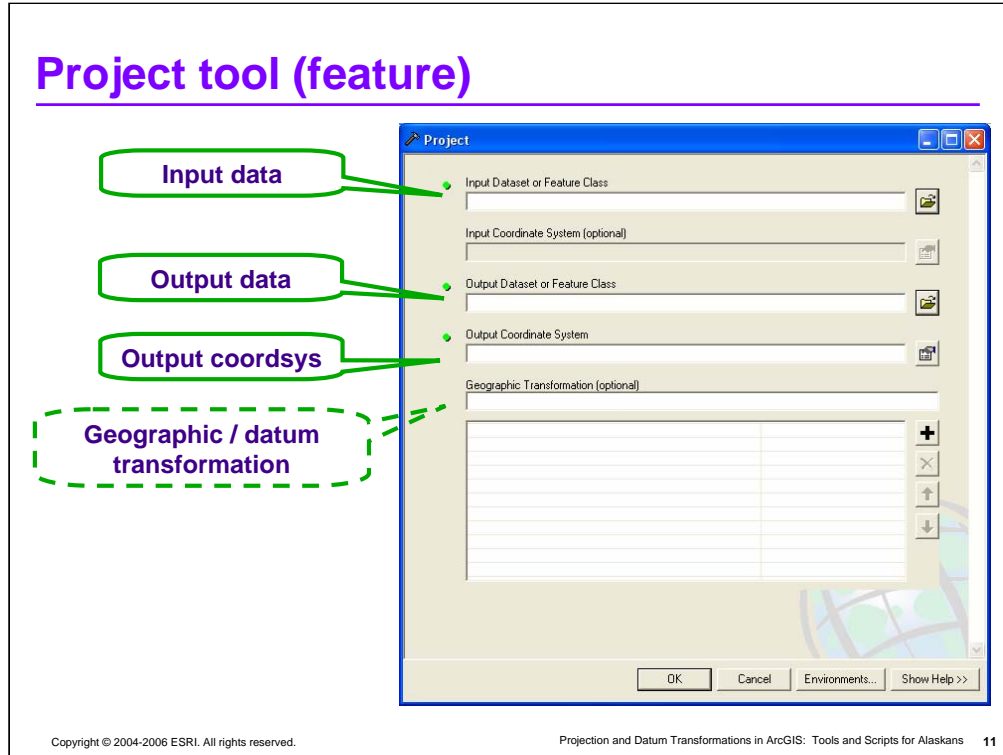
## Tool dialogs

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- ◆ All tools support batch processing at 9.2
- ◆ More flexible, as the tool is run for each input data
- ◆ Right click the tool to access the batch option

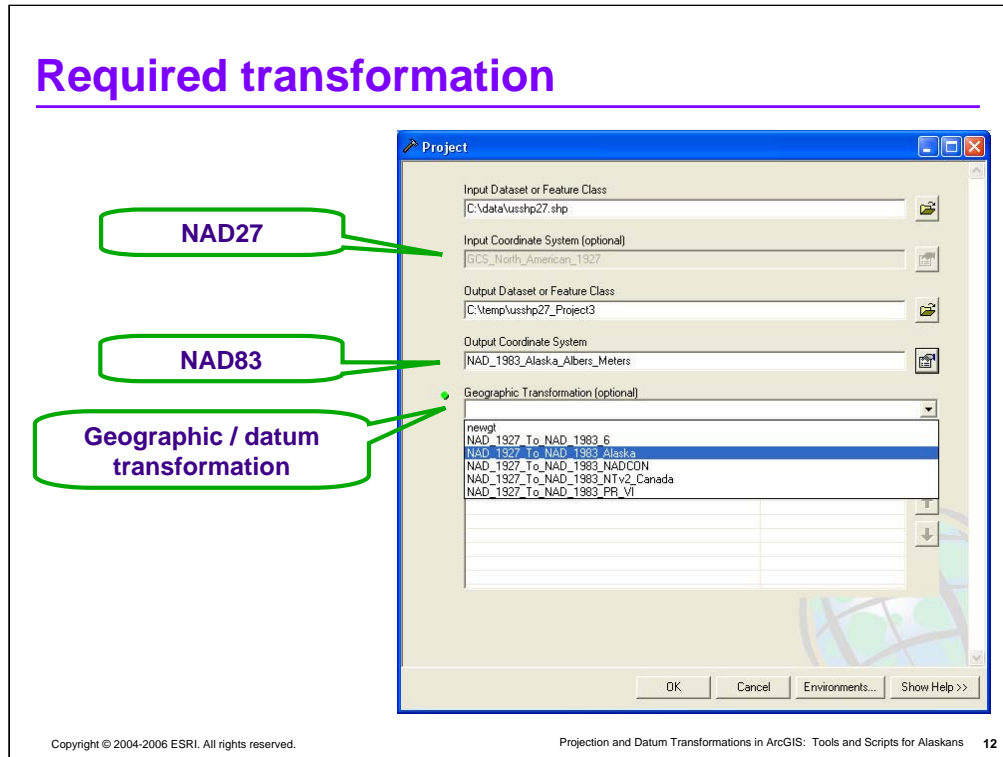
**All tool dialogs now support batch processing. There's a new control that places all the parameters for a tool into a table, and you just fill out the table. This is more flexible than some of the existing batch tools, like the Batch Project Tool. That tool created a list of feature classes as a single string which was a parameter to a special batch project command. There's a limit on how long that string could be. The batch table control, runs the tool as many times as it needs to, so you don't have that type of limitation. Right click a tool (open its context menu) to access the batch option.**

## Project tool (feature)



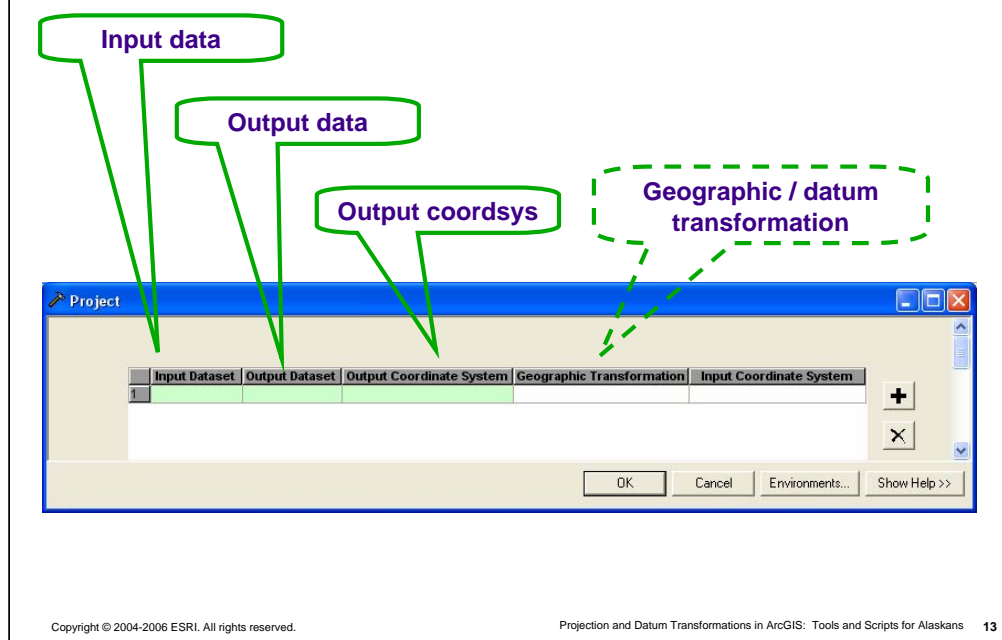
To give us a starting point, here is the project tool for features. The green dots denote required parameters. For this tool, you have to fill out the input data including path, output path and data name, and the output coordinate system. I haven't labeled it, but greyed out is the input coordinate system. It will be populated automatically, once you enter the input data. The last parameter is the geographic (datum) transformation. It's marked optional, which is really confusing. The geoprocessing tool dialogs are really a GUI or user friendly interface to a scripting/command line world. So the parameters here reflect how you would use the tool on the command line. So, if the input and output geographic coordinate systems are the same, no transformation is needed—thus, optional. If the input/output geographic coordsys are different, then it's a required parameter.

## Required transformation



Now I've filled out the input feature class, which is georeferenced to NAD27. The output coordinate system is NAD83. Because they're different, the 'optional' transformation parameter is now required—it has a green dot, and you can use the pull-down to see the possible transformations.

## Project tool (feature) – batch option



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Here is the batch option of the Project tool for features. Right-click on the tool to open the batch version. And what you end up with is a table, with all the parameters of the tool. Just like the tool, anything colored green is a required field—input data, output data, output coordinate system. A white field is either truly optional, or like the geographic transformation may become required as you fill in the other fields. Use the plus button to add more rows, and you can copy and paste values between the rows.

Select a field, and you can type directly into it, double click, and it will open a tool dialog with just that value, or right click to also open the dialog, fill the fields above or below with the current value, and so on.

## Project tool (raster)

- ◆ Three optional parameters
- ◆ Resampling technique
  - ◆ Nearest, bilinear, cubic
- ◆ Output cell size
- ◆ Registration point (x,y)

The Project tool for rasters is very similar to the feature one. There are three optional parameters. The first is the resampling technique which defaults to nearest. If the raster cell values represent continuous data, you probably should use bilinear or cubic instead. Cubic will cause the most smoothing. The tool will determine the cell size for you, but if you plan to mosaic rasters later, or just display them together, you may want to set the output cell size—particularly in this case, where all you may be doing to the coordinate system is changing the geographic part of a projected coordinate system. And for similar reasons as the cell size, you may want to choose a registration point. This point doesn't have to be in the raster. The point could be 0,0. What is means is that the lower left corner will be some cell size multiple of the registration point. So if the registration point is 0,0 and the cell size is 10, the lower corner of the raster might start at 100,100, and not 99.9998 and 100.003.

## ModelBuilder

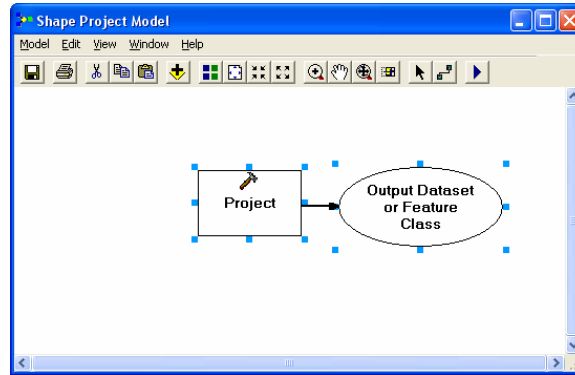
---

- ◆ Create a new toolbox
- ◆ Add a new model
- ◆ Drag tools onto the model
- ◆ Excellent way to test procedures

**The first step to creating a model is to open the ArcToolbox window and right click ArcToolbox. Create a new toolbox to contain your models. Now right click the toolbox to add a new model. The model window will open, and you can drag tools onto it. It's really an excellent way to test procedures. You can use it to set up the general flow, export it to python or another scripting language and then modify the script, with the guts already done.**

## Creating an iterative project model

- ◆ Drag the Project tool into the model
- ◆ White means the model needs parameters set



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Once the model window is open, drag the Project tool into it. This is what you'll see. The tool itself, plus the output dataset/feature class parameter will be added automatically. Everything is white, which means there are parameters that need to be set, so the model isn't ready to run.

## Defining the model

---

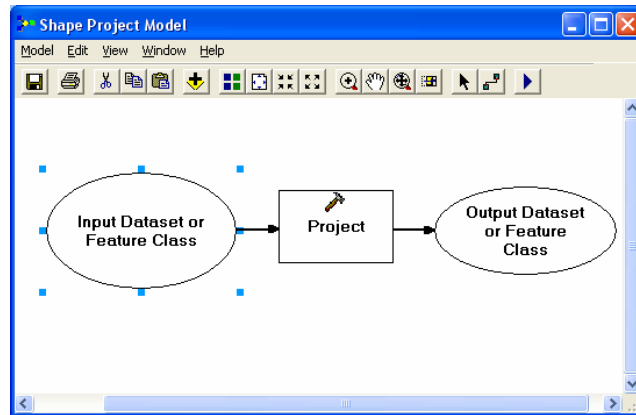
- ◆ Double click the Project box
- ◆ Set the output coordinate system
- ◆ Set the geographic transformation
  - ◆ NAD\_1927\_To\_NAD\_1983\_Alaska
- ◆ Model is still white
  - ◆ Input/output feature classes aren't defined

**First, double click the Project tool and set the output coordinate system. Also set the geographic transformation. Because the input dataset (and coordinate system isn't set), we don't get the pulldown, but you can type in the name of the transformation. OK the dialog. The model will still be white because the input feature classes aren't defined.**

## Adding iteration

### ◆ Right click Project

- ◆ Make Variable > From Parameter > Input Dataset or feature class



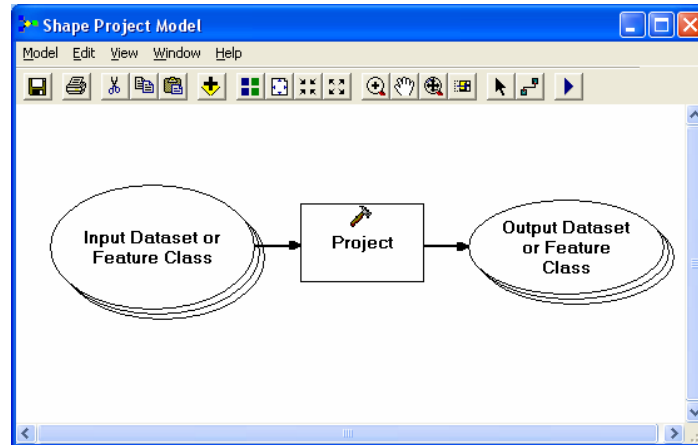
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**We want to make the input feature class a variable. Right click the project tool, select Make Variable, From Parameter, and choose the Input Dataset/Feature class. Now, you'll see we have a new parameter in the model.**

## Adding iteration (2)

- ◆ Right click Input Dataset or Feature Class
  - ◆ Select Properties, Set to List of Values



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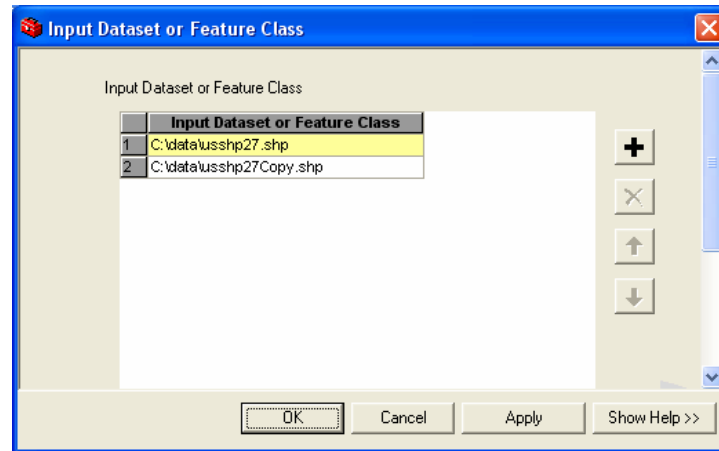
Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 19

**Right click the new variable and select the properties. Set it to List of Values and OK the properties. Now you can see that both the input and output dataset/feature class variable are 3D, basically. That means there will be multiple input and output feature classes. The model is still white because we haven't set anything.**

## Adding iteration (3)

### ◆ Double click Input Dataset or Feature Class

#### ◆ Add input data



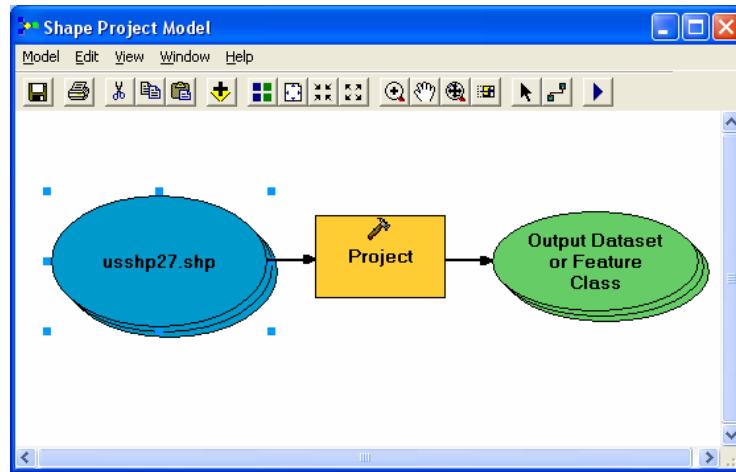
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**Double click the input dataset or feature class variable and you'll see a batch list where you can add multiple feature classes. OK this dialog and you will see...**

## Adding iteration (4)

### ◆ Model is ready to run (almost)



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**That the model is no longer white. Because we've set some values to the input feature class variable, the output variable has automatically assigned unique names for the output. Now the model is almost ready to run.**

## Adding iteration (5)

- ◆ **Output data is marked “Intermediate”**
  - ◆ Right click to turn off the setting
- ◆ **Open the model properties**
- ◆ **On the Iteration tab, set the value to the number of input datasets**
  - ◆ By default, this is set to 1
- ◆ **Save the model**

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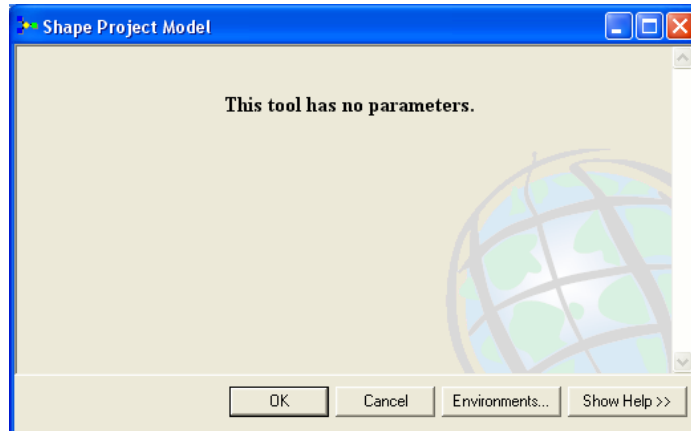
Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 22

**There are a few other options to change before this model is ready to use. Output data is marked as ‘intermediate’ by default. That means, in the modelbuilder environment, it won’t be written out, because you’re still working with the model. Right click the output parameter and turn off the intermediate check. Also, open the model properties and select the iteration tab. The model is set to iterate once. If you set up a model to iterate using a list, you need to change this value to match the number of input datasets. Finally, save the model.**

## Running the model

---

- ◆ This is correct, because all parameters are defined



## Geoprocessing scripting

---

```
# Import system modules
import sys, string, os, arcgisscripting

# Create the Geoprocessor object
gp = arcgisscripting.create()

# Load required toolboxes...
gp.AddToolbox("C:/arcgis/ArcToolbox/Toolboxes/Data
Management Tools.tbx")
```

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Once very useful thing about using a model is you can then export it to a scripting language. In this case, I've exported it to Python, but you can export it to other languages like Jscript or VBscript. Exporting the model means the framework, the weird programming stuff is already set up for you. Here's the beginning of the Python version of the model. Interestingly, the iteration was removed, but the result is still an excellent starting point for writing an automated script. The first lines are the weird programming stuff. You have to import some libraries so you can access the functionality. In this case we imported the system, string, operating system, and arcgisscripting libraries.

We then create the geoprocessor using arcgisscripting create method. And we need to load any toolboxes that contain existing tools that we want to use. In this case, the data management toolbox.

## Geoprocessing scripting (2)

---

```
# Local variables...
Output_Dataset_or_Feature_Class =
"c:\\temp\\usshp27_Project1.shp"
usshp27_shp = "C:\\data\\usshp27.shp"

# Process: Project...
gp.Project_management(usshp27_shp,
Output_Dataset_or_Feature_Class,
"PROJCS['NAD_1983_Alaska_Albers_Meters']",
"NAD_1927_To_NAD_1983_Alaska",
"GEOGCS['GCS_North_American_1927']")
```

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**The first input and output feature class information was exported as local variables. And the actual project command is here, with the variables, the output coordinate system (which I've shortened to just the name, for readability), the transformation, NAD 1927 to NAD 1983 Alaska, and the optional parameter, the input coordinate system. You can omit that. It's not used by the tool anyway.**

## Geoprocessing scripting with iteration

---

```
# Set the input and output workspace environment
gp.workspace = "c:\\data\\indata"
out_workspace = "c:\\data\\outdata"

#Loop through each featureclass in input workspace and
project
fcs = gp.listfeatureclasses()

fcs.reset()
fc = fcs.Next()
```

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**Here the input and output workspaces are set to variables. The back slash is a special character so we have to add a second one, so the path is interpreted correctly. You could also have these set as a parameter of the script. The next step is to retrieve a list of feature classes in the input workspace which is added to a variable called, fcs. I then reset the list to make sure I'm at the first entry, then I call the Next command. That actually retrieves the first feature class and sets it to a variable, fc.**

## Geoprocessing scripting with iteration (2)

```
while fc:
    # Set the output name to be the same as the input
    output = out_workspace + os.sep + fc

    # Process: Project...
    gp.Project_management(fc, output,
        "PROJCS['NAD_1983_Alaska_Albers_Meters']",
        "NAD_1927_To_NAD_1983_Alaska")
    fc = fcs.next()
```

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Now that we have a list of feature classes, we can create a loop to iterate through the list. In this case, we'll use a while loop. So while there is a valid feature class from the list, set the output feature class path and name to the output workspace and the input feature class name. The next step to run the project command. We have new variables for the input and output feature class parameters. I've again shortened the output coordinate system to just name—and you could have set this to a variable too. The last parameter is the transformation. Once the command runs, we need to retrieve the next entry in the list of feature classes and start the loop again.

## Sorting out data that doesn't line up

### Relatively small differences: < 200 meters (650 ft)

- ◆ Data accuracies or datums
- ◆ No transformation applied
- ◆ Wrong transformation used
- ◆ Wrong coordinate system definition
- ◆ Compounded with transformation

### Large differences: > 200 meters

- ◆ Completely wrong coordinate system definition
- ◆ Wrong units

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There may be legitimate reasons why two data layers don't line up—that is, a parcel extends into a street, a trail crosses into a lake, two boundaries overlap, etc. There are two general possibilities: relatively small differences from 1 to 200 meters or large differences, usually thousands or millions of meters off.

The two coordinate systems could have different accuracies. Data might have been acquired by digitizing or scanning hardcopy maps at different scales. By 'datums', I mean this loosely. The locations of water fountains in a city park have NAD83 (1986) coordinates. Now they've been re-surveyed relative to a NAD83 (CORS) control point.

No transformation was applied—this can happen a few places which I'll discuss in the next slide.

A transformation may be set, but it's not the correct one.

You're trying to make sure all existing data has a coordinate system, or you download some data for a website that doesn't have a defined coordinate system that ArcGIS can read. All your data is NAD27, so you define it as NAD27. If you use ArcCatalog or ArcToolbox's Define Projections Tools to change a coordinate system. Only the metadata is updated. The actual coordinate values are still in the previous coordinate system.

And then, sometimes, that data is then transformed with or without a projection on top of it so there's no history.

Large differences are often easier to figure out. A big clue is whether the reported lat/lon values make sense, if the data has a projected coordinate system. The spatial tab of the metadata has this information. If a dataset is 3x larger or smaller than the other data, usually the units are wrong. It's NAD27 Albers but in meters, not feet.

## No transformation applied

- ◆ ArcMap: project on-the-fly but doesn't set a transformation
- ◆ "NADCON/CONUS" transformation for lower 48
- ◆ Geoprocessing/ArcCatalog
- ◆ Many tools don't support datum transformations
  - ◆ Converters like feature class-to-feature class
  - ◆ Perform any transformations separately
  - ◆ At 9.2, use the GP env to set a transformation

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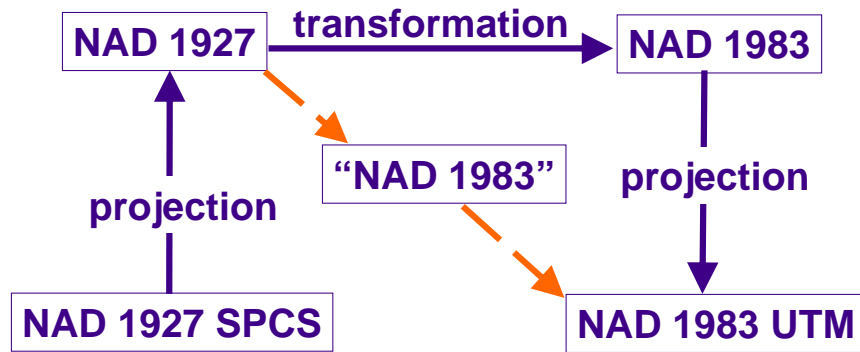
Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 29

Data was transformed without a geographic/datum transformation applied at all. This could happen in ArcMap—although you're warned if geographic coordinate systems differ, it's still possible to project on-the-fly without setting a geographic/datum transformation. There is a default transformation for NAD27/NAD83 that is always set, but it's for the lower 48 states. When you pick the Alaska transformation, it replaces the default CONUS transformation.

In geoprocessing, including the tools in ArcCatalog, if a tool doesn't let you explicitly set a transformation, even though you can set a different output coordinate system, no transformation is applied, whether one is needed or not. Here's the thing, if datum, the geographic coordinate system is the same, the tools will all work fine. It's only when you are changing the geographic coordinate system, that you need to be careful.

Remember, at version 9.2, you can set a transformation into the GP environment. The tools will pick it up if the data is going through a projection. You can set only one. So group your tasks.

## No transformation applied



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**So what really happens when no transformation is available to be applied. The most complex case is from a projected coordinate system to a different projected coordinate system that is based on a different geographic coordinate system. In that case, the data is first unprojected to the input geographic coordinate system, NAD27. If there was a transformation available, the data would be converted to NAD83 and then projected to UTM. Because there's not transformation, the data is internally redefined as NAD83 and projected to UTM.**

## Wrong transformation applied

- ◆ Transformation doesn't include the area
- ◆ Effectively no transformation occurs
  - ◆ NAD\_1927\_To\_NAD\_1983\_NADCON
- ◆ Area of use is incorrect
  - ◆ NAD\_1927\_To\_NAD\_1983\_NTv2\_Canada
- ◆ Use a WGS84-based one instead
  - ◆ NAD\_1927\_To\_WGS\_1984\_7 aka NAS\_D
  - ◆ Different method, less accurate

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Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 31

**In this case, a wrong, or at least, inappropriate transformation is applied.**

**For instance, NAD\_1927\_To\_NAD\_1983\_NADCON is chosen because you remember hearing that the NADCON method is the best...**

**That transformation is for the lower 48 states, so any Alaska data is completely out of the area, and effectively, no transformation occurs at all.**

## Wrong coordinate system

- ◆ Defined as NAD27, when it's NAD83
- ◆ Wrong GCS but the right 'projection' (UTM)
- ◆ If data is now transformed, increases the differences

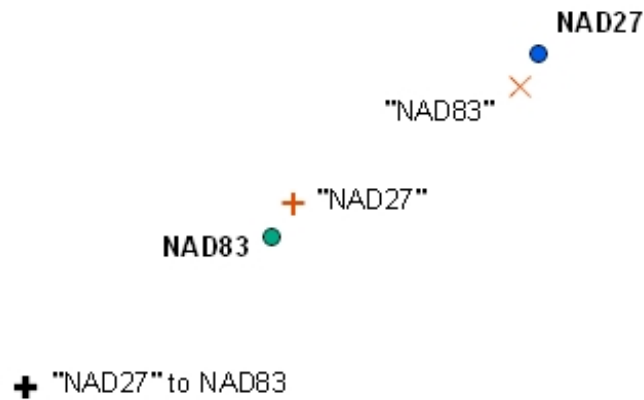
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Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 32

**A wrong coordinate system might be that it's lat/lon and someone chooses NAD83 when it should be NAD27 and so on. This can happen with projected coordinate systems too, like UTM or Albers. Less common with State Plane, because the false easting and northing values are different depending on the datum.**

**If someone then transforms the data—Data was actually NAD83, but defined as NAD27 and is now transformed to NAD83—it just increases to amount the data is off.**

## Relative positions in Albers



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Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 33

I wanted to give you some hard numbers by reproducing some of the problems that might occur. The bold NAD83 point, symbolized with a green circle is my original point. It's an NGS control point, using the original 1986 realization. I projected it to Albers and also to NAD27 Albers using the Alaska NADCON transformation. That point is symbolized by the blue circle.

The NAD27 in double quotes, red cross, is the original point, redefined as NAD27 and projected to NAD27 Albers. No transformation. On the next slide I have the actual offsets. It's several meters. The NAD83 in double quotation marks, red X, is the 'good' NAD27 point, redefined as NAD83 and projected to NAD83 Albers. The point in the lower left, with the thick black cross, is the redefined as NAD27 data, transformed to NAD83 and projected.

## Differences in Albers

- ◆ Base data: NAD83 223612.9 m 1252538.6 m  
NAD27
- ◆ NAD27 (NADCON AK) 122.6 m 84.5 m NE
- ◆ Defined as “NAD27” or projected to NAD27 with  
no GT 8.9 m 5.5 m NE  
NAD83
- ◆ NAD27 defined as “NAD83”  
8.8 m 15.5 m SW
- ◆ Defined as “NAD27”, projected with GT to  
NAD83 113.8 m 68.0 m SW

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Projection and Datum Transformations in ArcGIS: Tools and Scripts for Alaskans 34

I started out with a point in NAD83 (1986) and projected it to Albers, using the same parameters. Here are the XY coordinates. The point correctly transformed to NAD27 is shifted to the northeast by 122 meters and 84.5 meters. The next two cases both involve data that was defined incorrectly but not transformed. The first case, NAD83 data was defined as NAD27 and projected to NAD27 Albers. The same offsets occur if you had data in NAD83, projected on-the-fly in ArcMap, but didn't set the transformation, and saved out the data. That's off under 10 meters. The second case is NAD27 data defined as NAD83. The shift is slightly larger, almost 9 and 15.5 meters.

The final case occurs when data mistakenly defined as NAD27 is then transformed to NAD83 and projected. We have 114 meters in X and 69 meters in Y, but southwest of the original NAD83 point.

## Differences in UTM

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◆ Base data: NAD83    348209.2 m    6787348.8 m

### NAD27

◆ NAD27 (NADCON AK)    114.8 m    147.3 m SE

◆ Versus Albers    122.6 m    84.5 m NE

**Remember that those shifts apply to Albers only. If you have data in UTM, you'll see different offsets. For instance, here's the same NAD83 point in UTM. If I correctly transform it to NAD27, the shifts are in a different direction and with different magnitudes.**

## Recovering from datum problems

- ◆ Use ArcMap's on-the-fly capabilities
  - ◆ Change the definition without affecting the data
  - ◆ Won't create multiple datasets
- ◆ Need reference data
- ◆ Look at the data
- ◆ Large offsets aren't datum problems

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**You can use ArcMap's project, and transform, on-the-fly capabilities to often figure out what the true coordinate system should be. These capabilities allow you to temporarily change the coordinate system of the data, without affecting the actual coordinates. You also won't have to delete multiple copies of the data when you're finished.**

**The hardest part of this is to find appropriate reference data. If you're lucky you can use NGS control points. Other federal data is excellent as well. If you working with two new datasets, you have to figure out which one is correct. Hopefully, one of them is good. Then you'll have to find a third dataset that has a known good coordinate system.**

**Look at the data—check the reported extents in ArcCatalog, metadata, spatial tab. If the coordinate system is defined, both the projected/local and geographic (lat/lon) extents are shown. There's a lot of people who don't seem to know the lat/lon extent that they're working in. You can also use ArcMap to look at a dataset relative to others. That's an excellent way to spot unit mix-ups—is one dataset 3x larger or smaller than the other one?**

**You can also clear the coordinate system of the data frame. Make it unknown, in essence, so you can see how two datasets relate, without a projection/transformation on-the-fly occurring.**

## Some procedures to follow

- ◆ If the data is projected—
  - ◆ Redefine the GCS (datum)
  - ◆ Unproject, then redefine the GCS
- ◆ Go back to the original GCS
  - ◆ Transform, then redefine

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**If the data is using a projected coordinate system, try redefining just the geographic coordinate system and see if it lines up. If that doesn't work, create a new dataset by unprojecting the data. Then try redefining the geographic coordinate system.**

**If that doesn't work, it's likely someone did something bad to the data in the past. Take the original "unprojected" data, and transform it. Redefine it.**

**Some other possibilities are to 1) redefine, 2) transform, 3) redefine, or use an inappropriate transformation, like NADCON, or NAD27 to WGS84 transformations. You have to make a decision on how much time you want to spend on trying possibilities like this, or do you bite the bullet and adjust the data.**

## Wrap up

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- ◆ Can automate NAD27 to NAD83 (1986)
- ◆ Several methods depending on
  - ◆ Scope
  - ◆ Time
  - ◆ Resources
- ◆ Data offsets due to datums/transformations
- ◆ Some solutions

**Now for the wrap up. We talked about automating the conversion from NAD27 to NAD83 (1986). We look at several methods which could be useful depending on the scope of your data or project, time available, and resources. We then looked at some possible data offsets depending on what might have been done to data by mistake, and some solutions to try.**

## Questions?

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