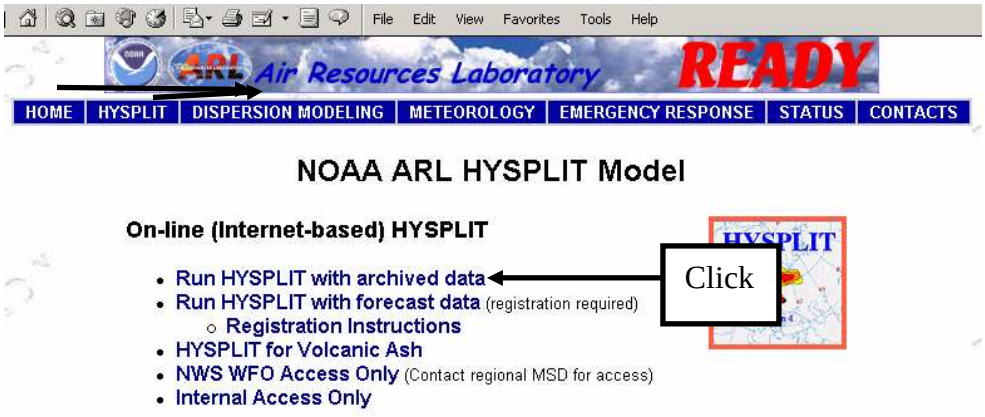
Basic Backward Trajectory to GIS Instructions

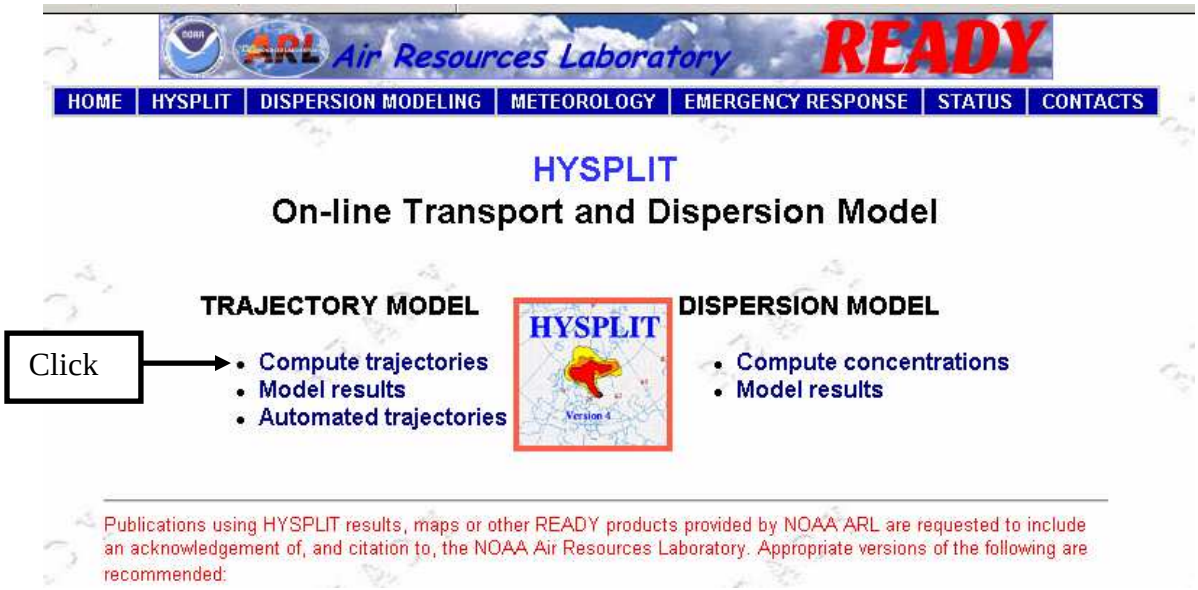
Introduction

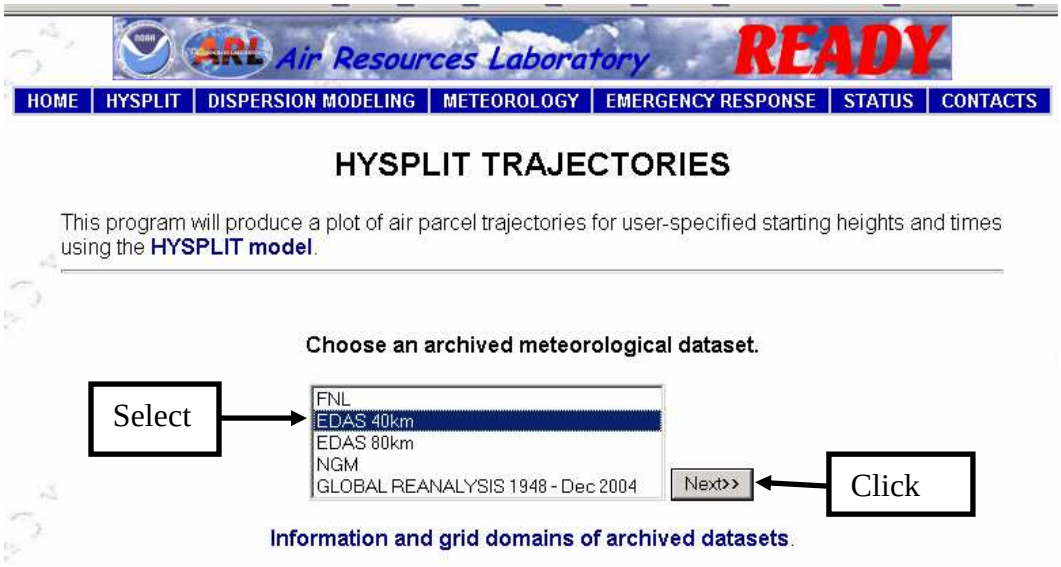
NOAA's Hysplit Modeling software is available for use on the Internet. The software can be used to create forward plumes from a source, as well as backward trajectories from a monitor. One use for this software is to track the path a particle of air took when you have high concentrations during ambient air monitoring. If you have sources on GIS, and the air passed near that source before it got to your monitor, that source may be suspected of having contributed to the high concentration. Of course, this intuitive analysis is subject to a variety of interpretations and caveats. Still, it is a valuable tool that can be used to help understand air quality issues in an area. This paper describes one method of obtaining a basic backward trajectory and integrating the trajectory into GIS software. Other software could be used. The software used in this document was selected because it is available to many tribal environmental employees.

Go to:

http://www.arl.noaa.gov/ready/hysplit4.html




Air Resources Laboratory
READY
HOME
HYSPLIT
DISPERSION MODELING
METEOROLOGY
EMERGENCY RESPONSE
STATUS
CONTACTS
HYSPLIT
On-line Transport and Dispersion Model
TRAJECTORY MODEL
Click
Compute trajectories
Model results
Automated trajectories
HYSPLIT
Version 4
DISPERSION MODEL
Compute concentrations
Model results
Publications using HYSPLIT results, maps or other READY products provided by NOAA ARL are requested to include an acknowledgement of, and citation to, the NOAA Air Resources Laboratory. Appropriate versions of the following are recommended:


Air Resources Laboratory
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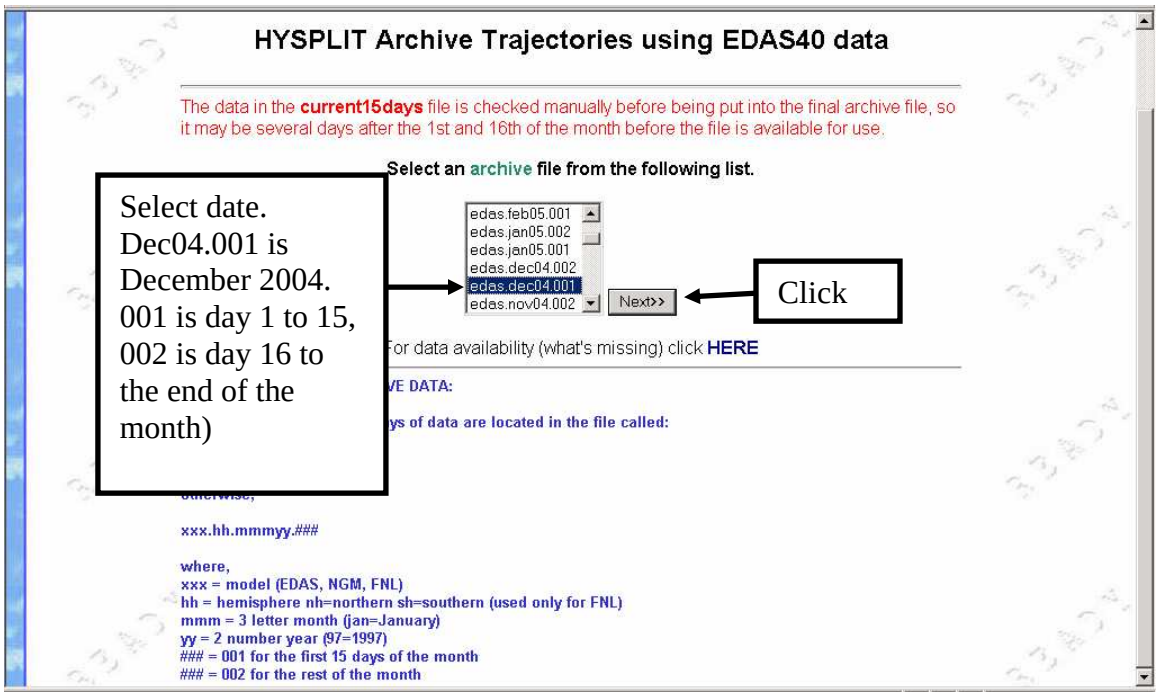
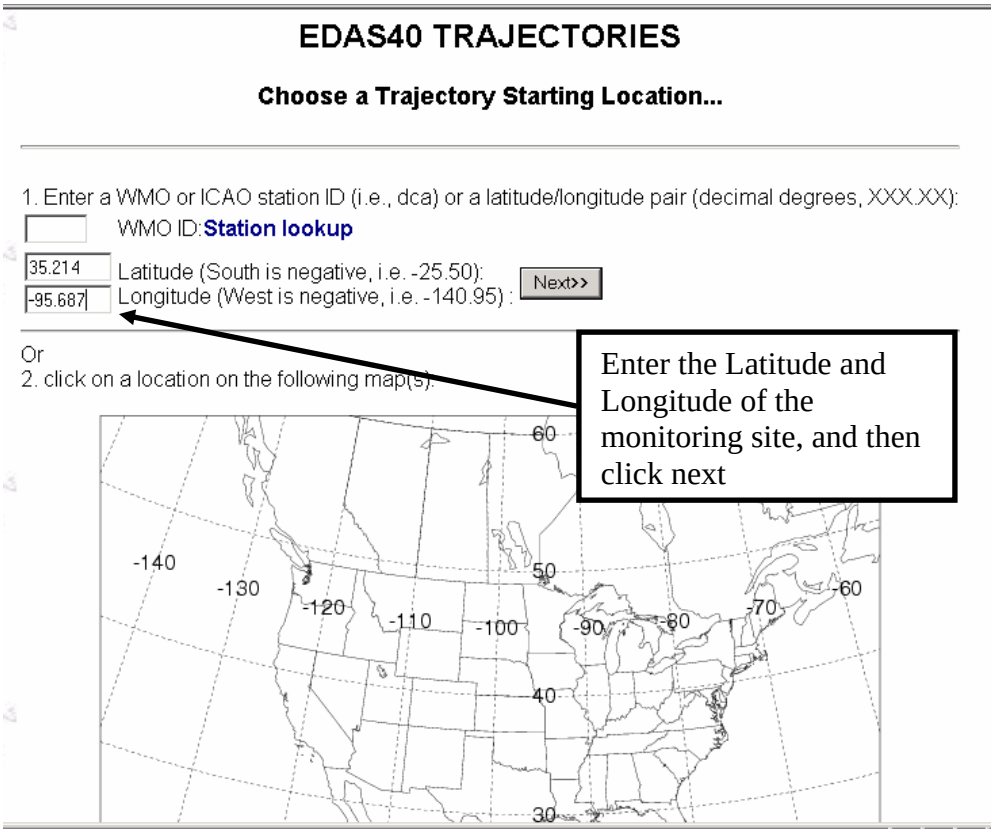
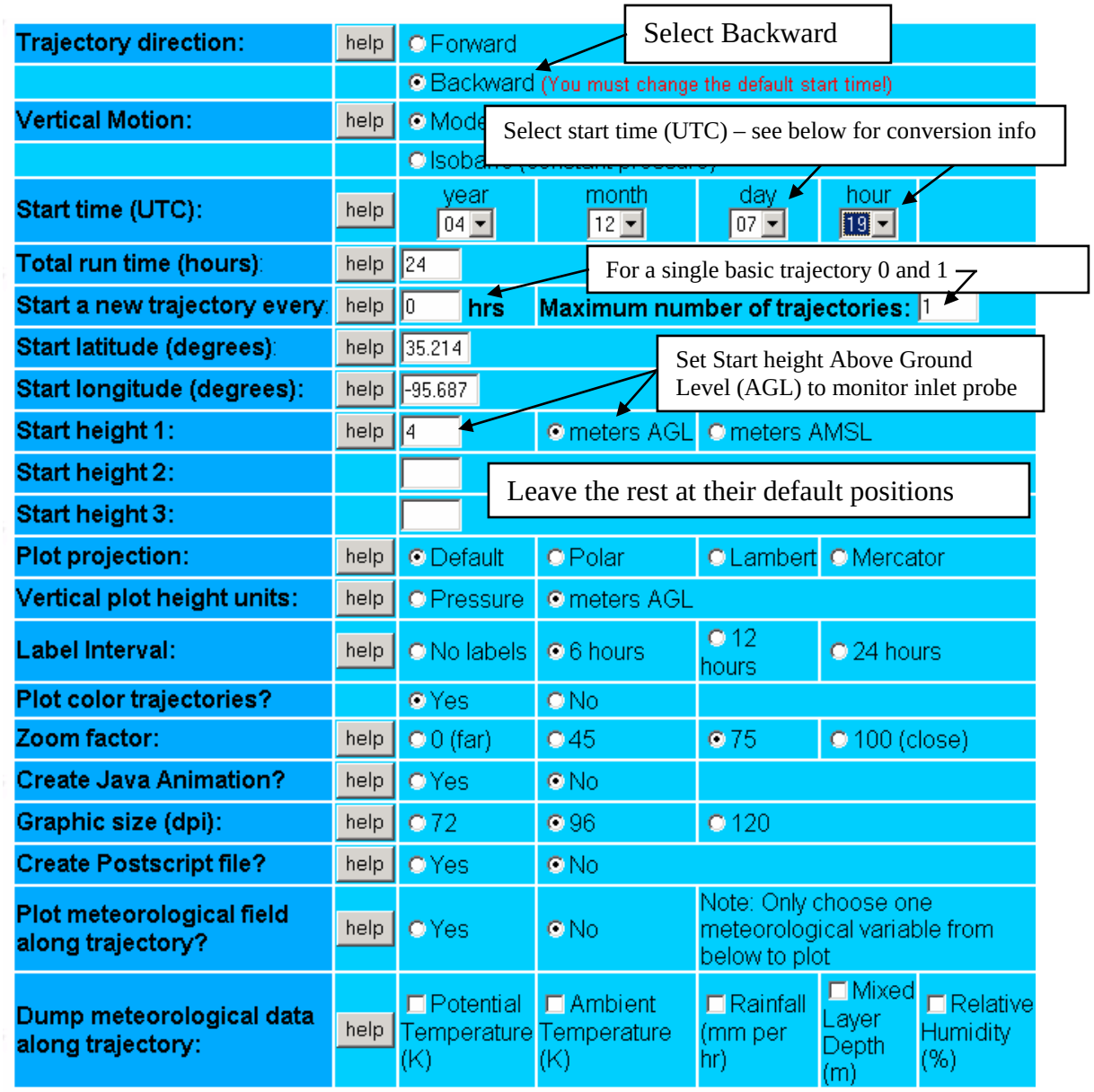
HYSPLIT TRAJECTORIES
This program will produce a plot of air parcel trajectories for user-specified starting heights and times using the HYSPLIT model.
Choose an archived meteorological dataset.
Select
FNL
EDAS 40km
EDAS 80km
NGM
GLOBAL REANALYSIS 1948 - Dec 2004
Next>>
Click
Information and grid domains of archived datasets.


HYSPLIT Archive Trajectories using EDAS40 data
The data in the current15days file is checked manually before being put into the final archive file, so it may be several days after the 1st and 16th of the month before the file is available for use.
Select an archive file from the following list.
edas.feb05.001
edas.jan05.002
edas.jan05.001
edas.dec04.002
edas.dec04.001
edas.nov04.002
Next>>
Click
Select date. Dec04.001 is December 2004. 001 is day 1 to 15, 002 is day 16 to the end of the month)
For data availability (what's missing) click HERE
xxx.hh.mmmyy.###
where,
xxx = model (EDAS, NGM, FNL)
hh = hemisphere nh=northern sh=southern (used only for FNL)
mmm = 3 letter month (jan=January)
yy = 2 number year (97=1997)
= 001 for the first 15 days of the month
= 002 for the rest of the month


EDAS40 TRAJECTORIES
Choose a Trajectory Starting Location...
1. Enter a WMO or ICAO station ID (i.e., dca) or a latitude/longitude pair (decimal degrees, XXX.XX):
WMO ID: Station lookup
35.214
Latitude (South is negative, i.e. -25.50):
-95.687
Longitude (West is negative, i.e. -140.95) :
Next>>
Or
2. click on a location on the following map(s):
Enter the Latitude and Longitude of the monitoring site, and then click next
60
50
40
30
-140
-130
-120
-110
-100
-90
-80
-70
-60



A backward trajectory traces the path a particle of air took from the time entered backward. The start time must be entered to HYSPLIT in UTC (Universal Time). Use the following table to convert Local Standard Time (not Daylight Savings) to UTC.

To convert Eastern Standard to UTC:	Add 5 Hours to local time
To convert Central Standard to UTC:	Add 6 Hours to local time
To convert Mountain Standard to UTC:	Add 7 Hours to local time
To convert Pacific Standard to UTC:	Add 8 Hours to local time

Example 1: A trajectory starting at 14:00 (2 pm) Central Standard Time (CST) is entered as 20 UTC the same day (14 + 6 = 20)
Example 2: A trajectory starting at 19:00 (7 pm) CST is entered as 1 UTC the next day (19 + 6 = 25 or 1 the next day – consider the day when converting start times)

Plot meteorological field along trajectory?	help	○ Yes	◉ No	Note: Only choose one meteorological variable from below to plot		
Dump meteorological data along trajectory:	help	☐ Potential Temperature (K)	☐ Ambient Temperature (K)	☐ Rainfall (mm per hr)	☐ Mixed Layer Depth (m)	☐ Relative Humidity (%)

IMPORTANT...You may submit only one trajectory job at a time to the server. When the calculation is finished you will be permitted to submit another one.

Request trajectory | Default values

Click

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HYSPLIT Model Run Submitted.

You will need the following job number to access your results at a later time from the HYSPLIT Main Menu:

31113

NOTE: All graphics files will be removed after 6 hours.

HYSPLIT RUN RESULTS

Click

HYSPLIT MODEL RESULTS FOR JOB NUMBER 311113

```
Complete Trajplot
Started Trajectory Drawing (Version: Feb 2005)
Complete Hysplit
Percent complete: 100.0
Percent complete:  95.8
Percent complete:  91.7
Percent complete:  87.5
Percent complete:  83.3
```

Your plot(s) are now available, but will be deleted in 6 hours:

Non-Javascript users click here for alternate links.

- Your Trajectory plot

Click

- How to read the trajectory maps.
- Rescale the trajectory plot without rerunning the model.

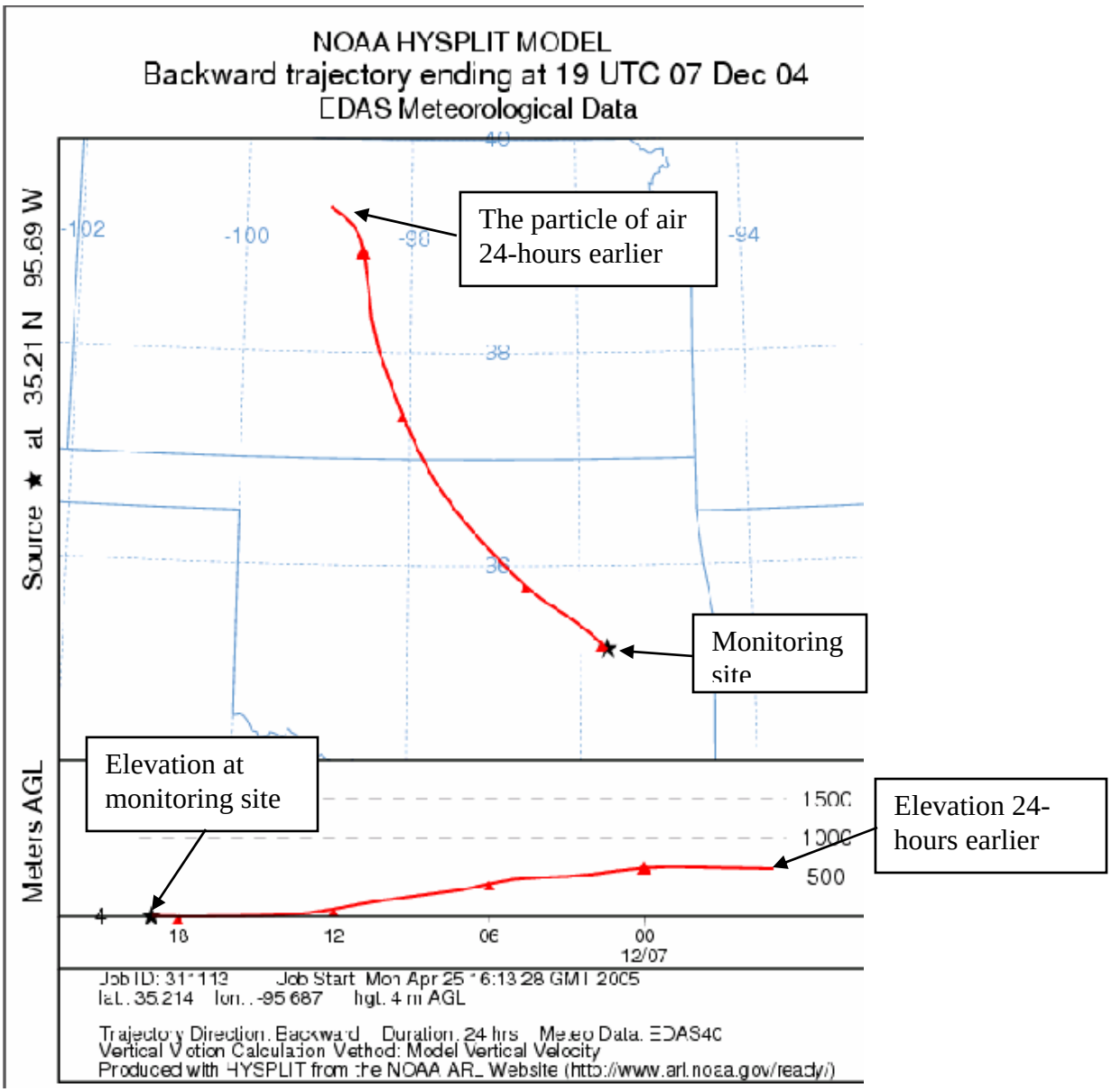
- Plot meteorological time-height-section along trajectory(ie
- Modify trajectory number 1.
- Modify trajectory number 2 (if available).
- Modify trajectory number 3 (if available)

- Trajectory endpoints file.
- Trajectory endpoints format help.

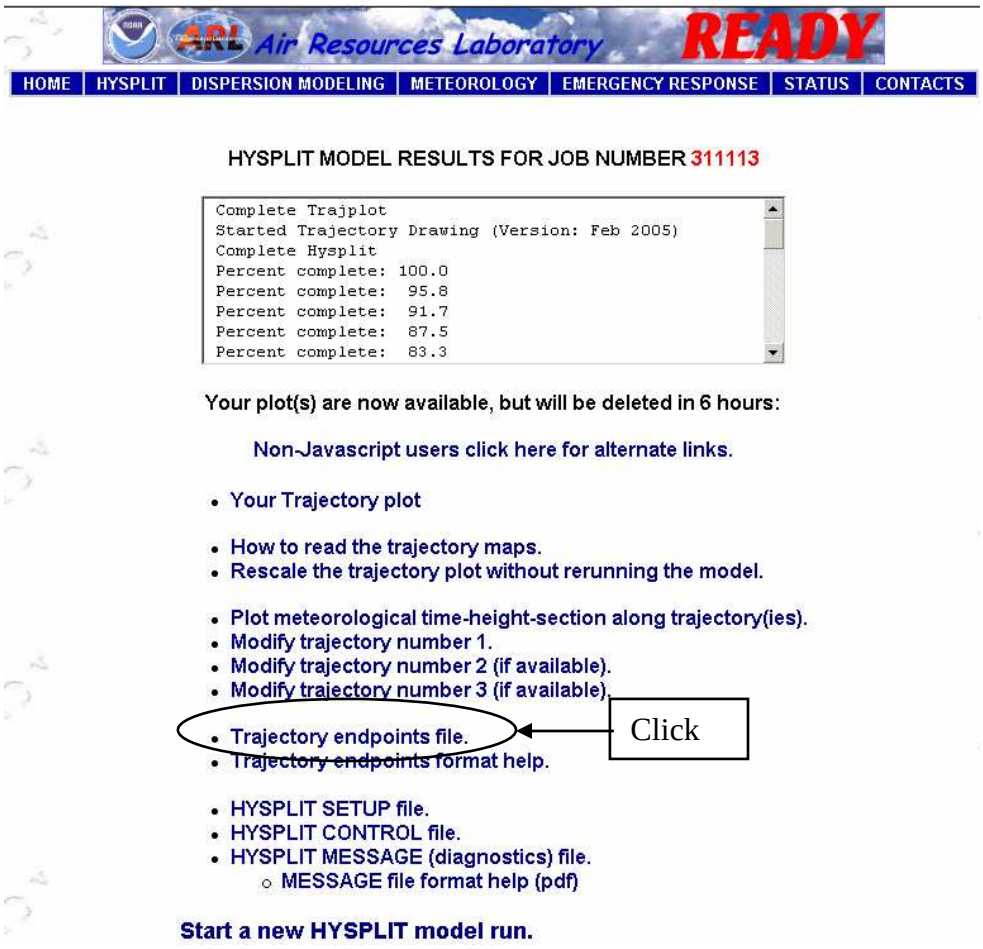
Notice – This will be used later to get a text file that can be used in GIS

- HYSPLIT SETUP file.
- HYSPLIT CONTROL file.
- HYSPLIT MESSAGE (diagnostics) file.
    - MESSAGE file format help (pdf)

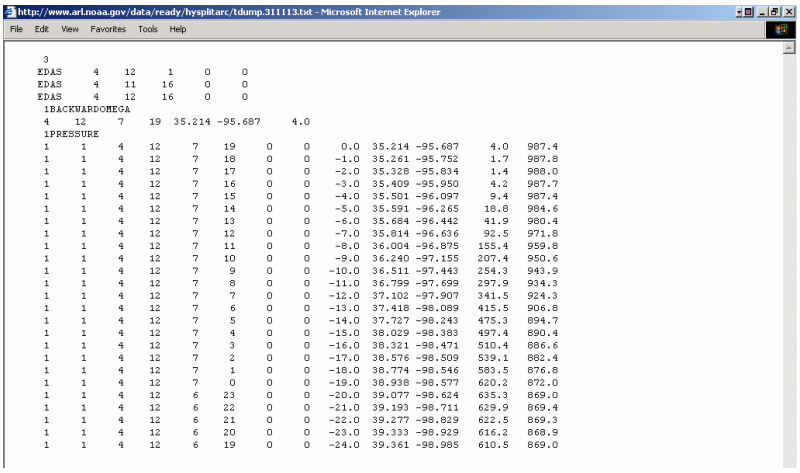
Start a new HYSPLIT model run.

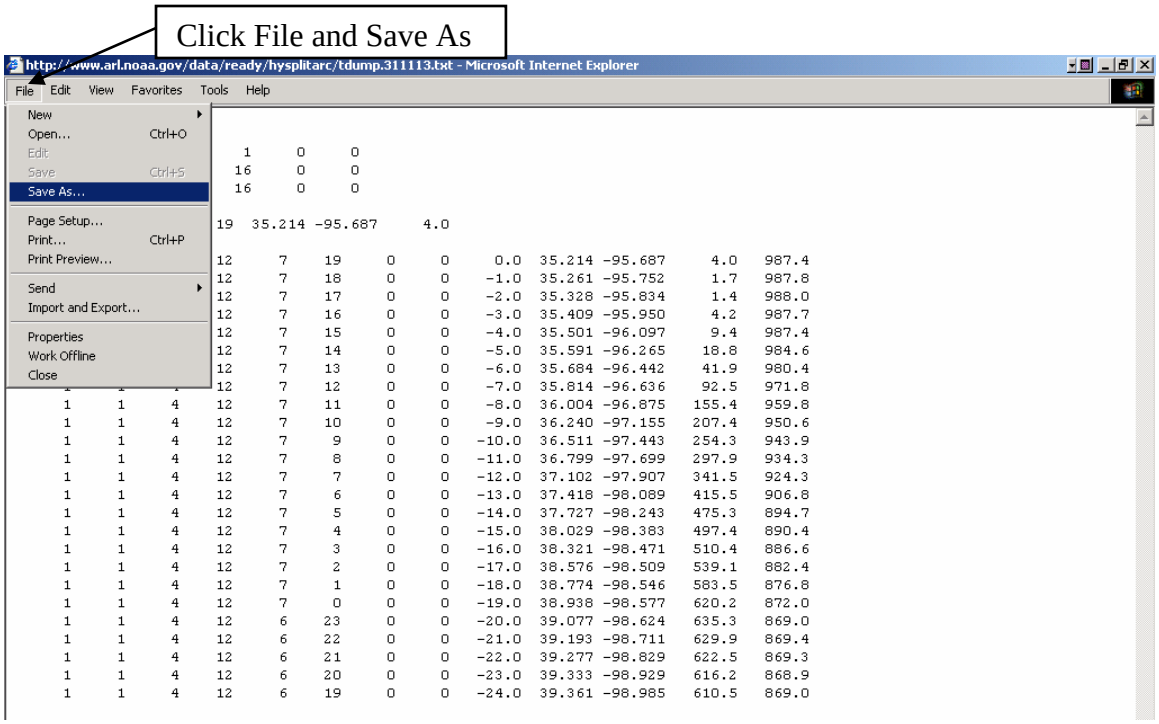


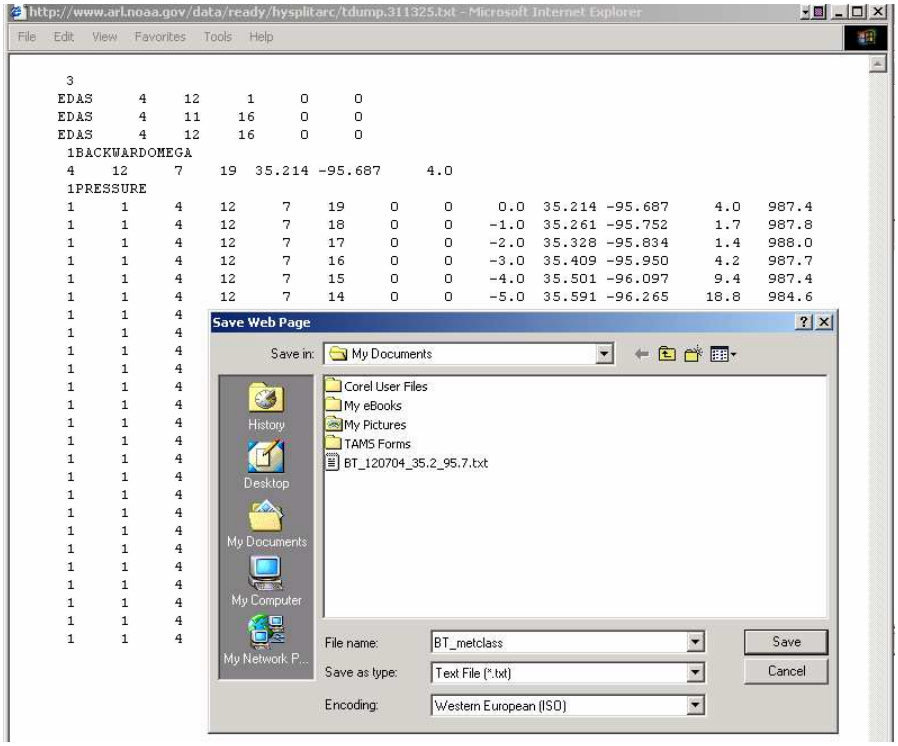
Return to the Internet Browser



The popup file you just looked at now has text. Save the text.

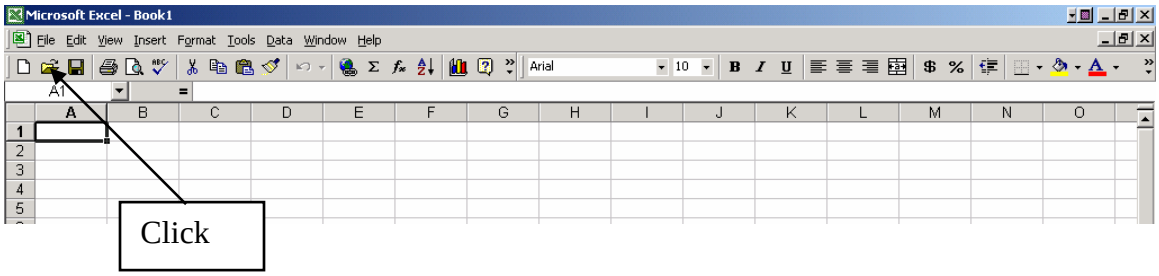


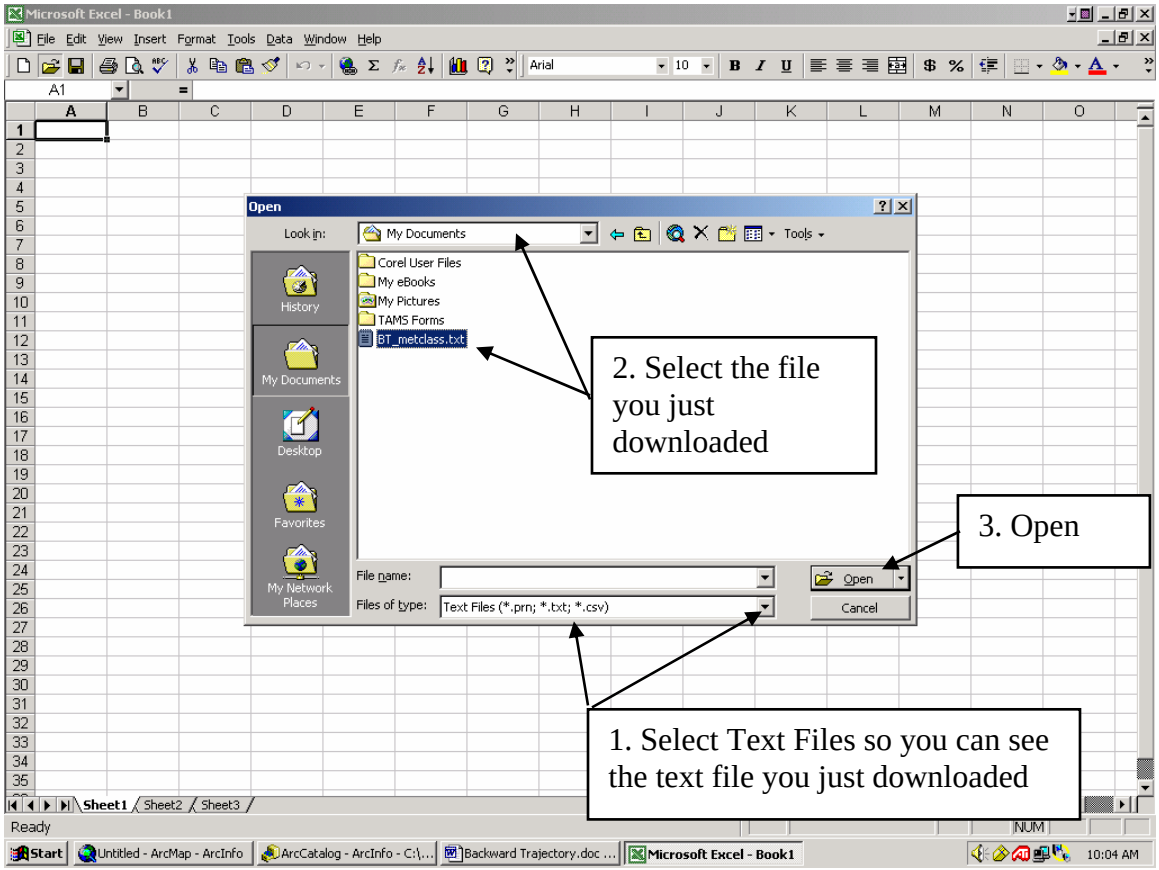


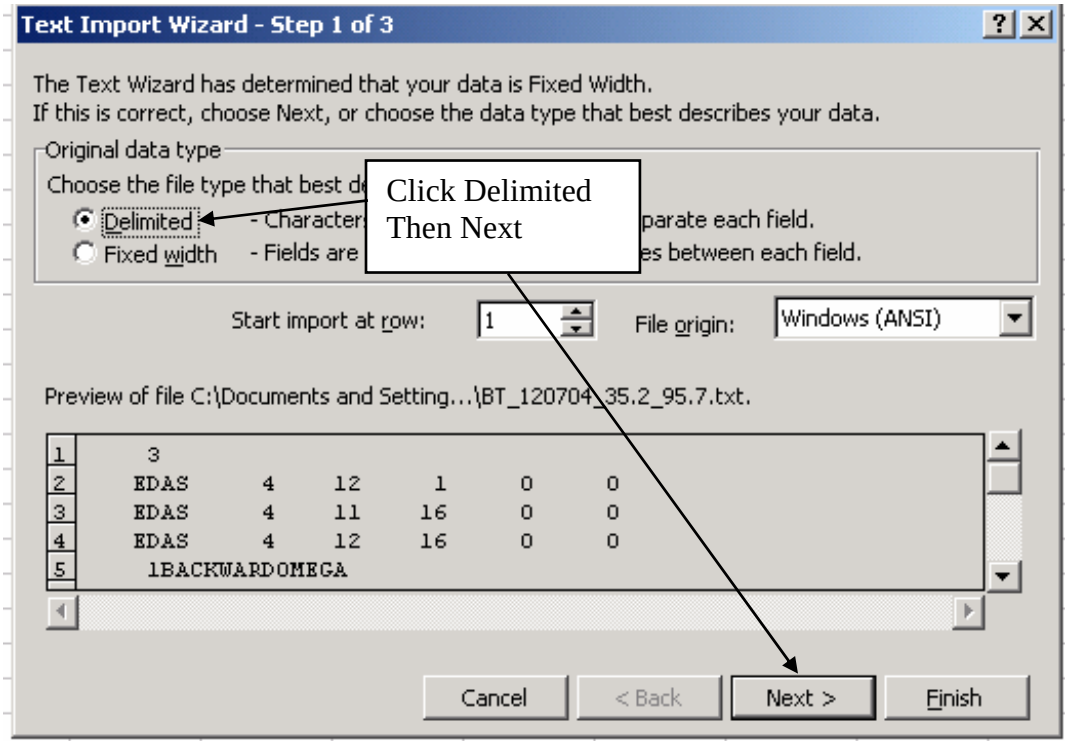


Name the file and select a location to save the file to. Then click save

Open Microsoft Excel and point it to the file you just downloaded






Text Import Wizard - Step 1 of 3
The Text Wizard has determined that your data is Fixed Width.
If this is correct, choose Next, or choose the data type that best describes your data.
Original data type
Choose the file type that best d
Delimited - Character
parate each field.
Fixed width - Fields are
es between each field.
Start import at row: 1
File origin: Windows (ANSI)
Preview of file C:\Documents and Setting...\BT_120704_35.2_95.7.txt.
3
EDAS 4 12 1 0 0
EDAS 4 11 16 0 0
EDAS 4 12 16 0 0
1BACKWARDOMEGA
Cancel
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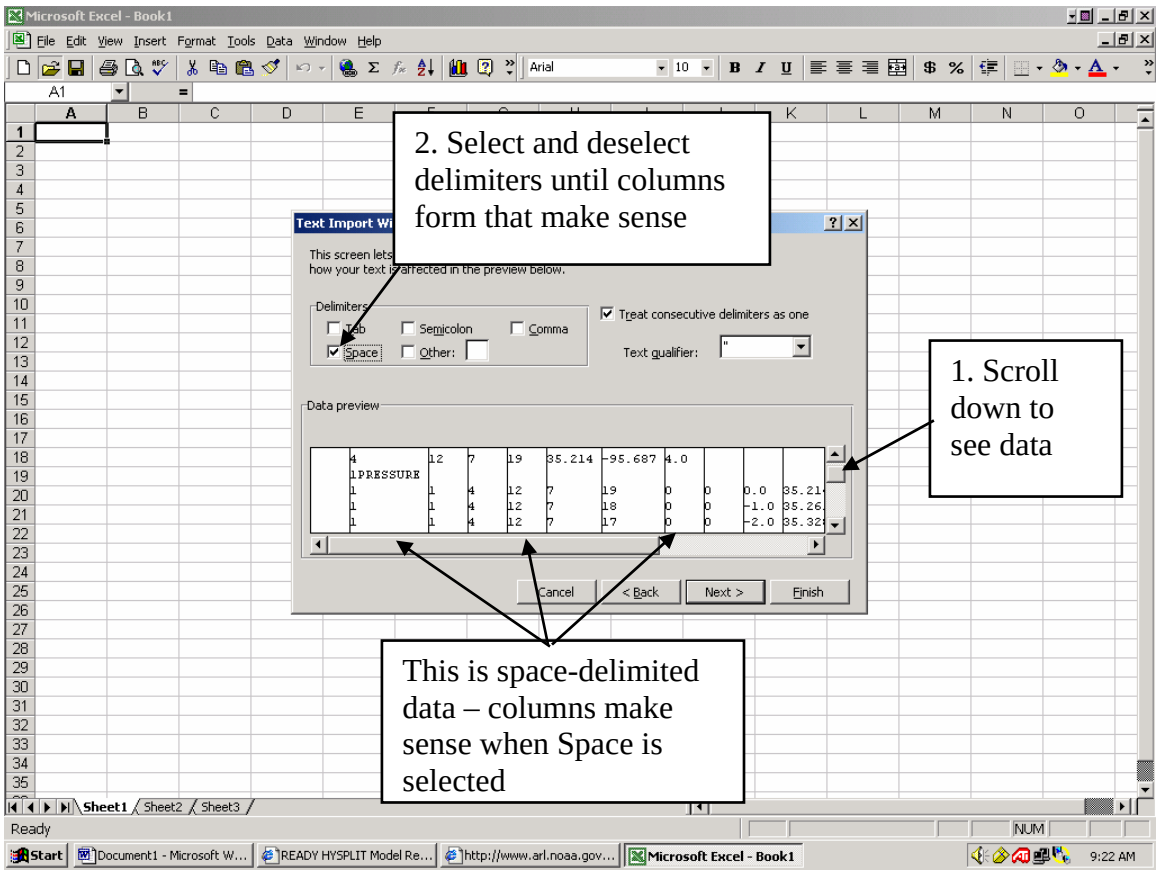
Next >
Finish
Click Delimited
Then Next


Microsoft Excel - Book1
2. Select and deselect delimiters until columns form that make sense
Delimiters
Tab
Semicolon
Comma
Space
Other:
Treat consecutive delimiters as one
Text qualifier:
Data preview
Cancel
< Back
Next >
Finish
1. Scroll down to see data
This is space-delimited data – columns make sense when Space is selected
Sheet1
Sheet2
Sheet3
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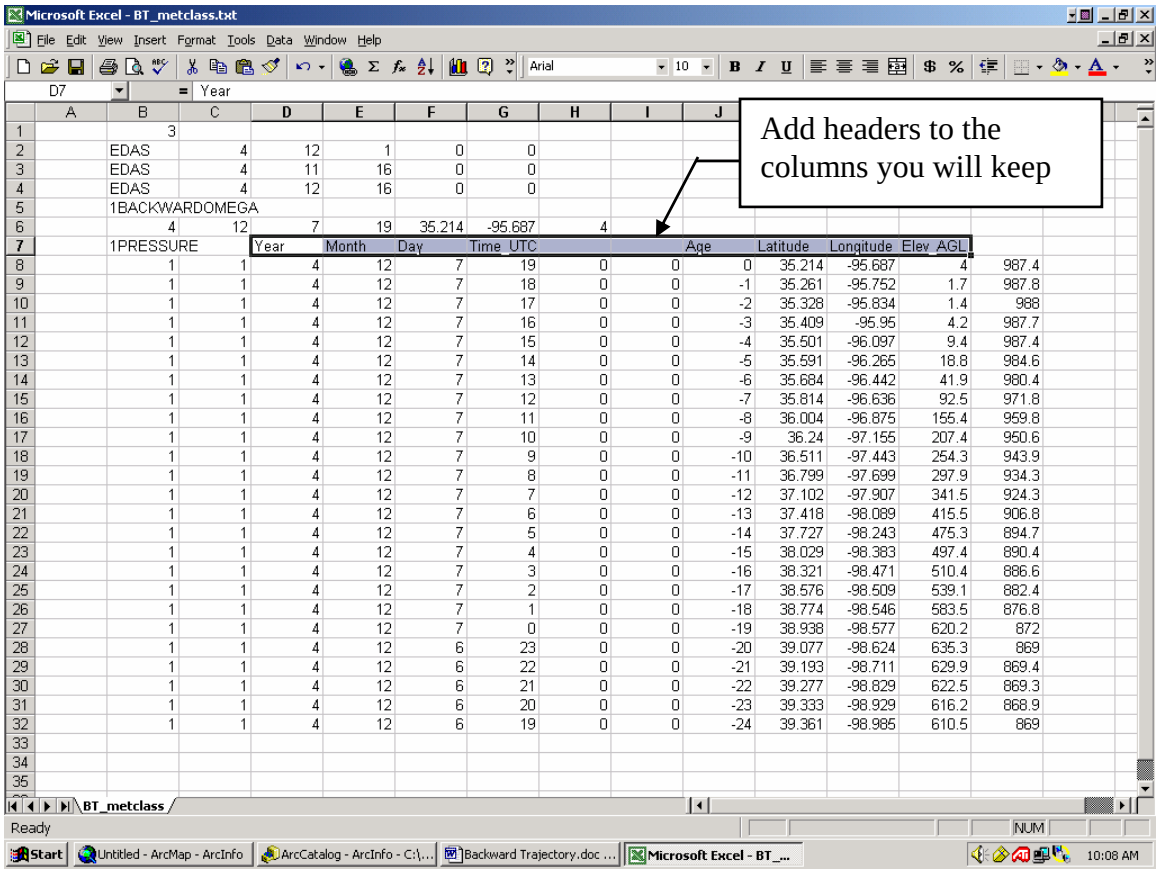
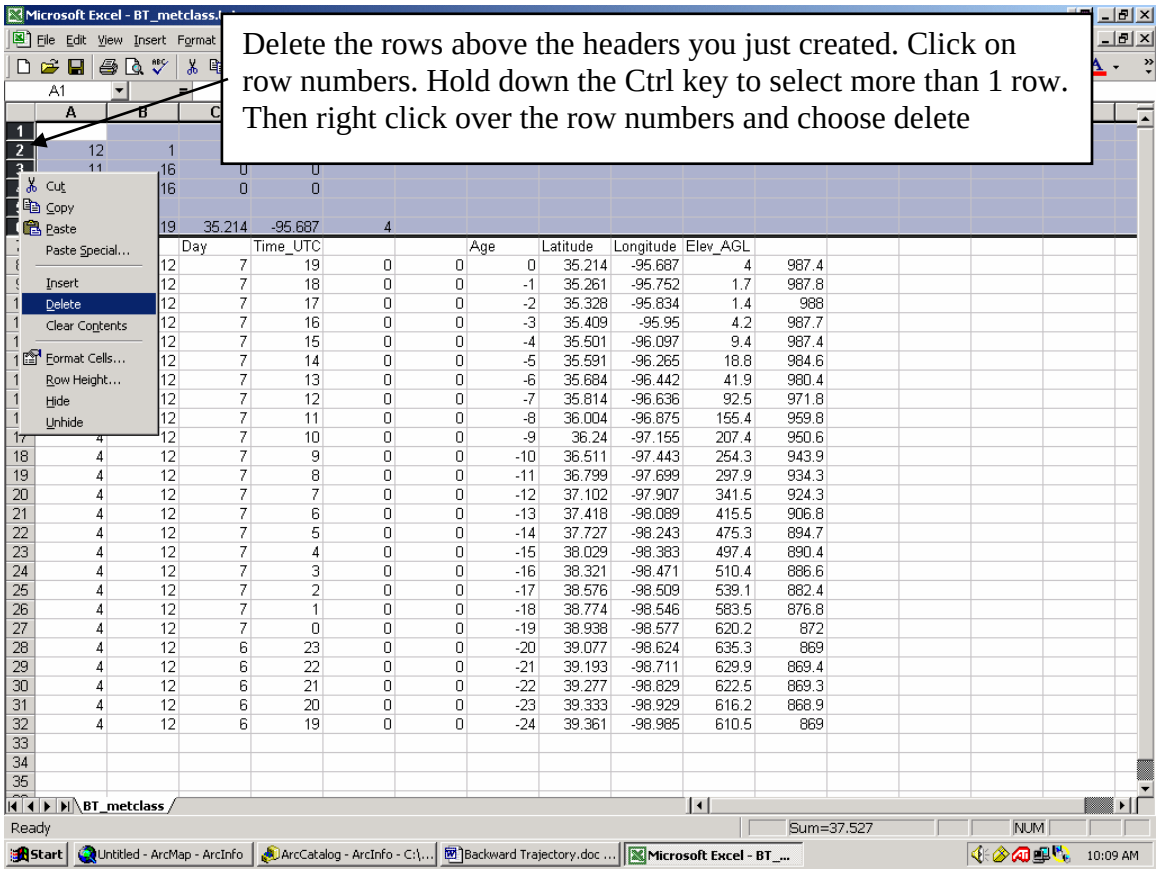
Document1 - Microsoft W...
READY HYSPLIT Model Re...
http://www.arl.noaa.gov...
Microsoft Excel - Book1
9:22 AM



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1		3												
2		EDAS	4	12	1	0	0							
3		EDAS	4	11	16	0	0							
4		EDAS	4	12	16	0	0							
5		1BACKWARDOMEGA												
6		4	12	7	19	35.214	-95.687	4						
7		1PRESSURE		Year	Month	Day	Time_UTC			Age	Latitude	Longitude	Elev_AGL	
8		1	1	4	12	7	19	0	0	0	35.214	-95.687	4	987.4
9		1	1	4	12	7	18	0	0	-1	35.261	-95.752	1.7	987.8
10		1	1	4	12	7	17	0	0	-2	35.328	-95.834	1.4	988
11		1	1	4	12	7	16	0	0	-3	35.409	-95.95	4.2	987.7
12		1	1	4	12	7	15	0	0	-4	35.501	-96.097	9.4	987.4
13		1	1	4	12	7	14	0	0	-5	35.591	-96.265	18.8	984.6
14		1	1	4	12	7	13	0	0	-6	35.684	-96.442	41.9	980.4
15		1	1	4	12	7	12	0	0	-7	35.814	-96.636	92.5	971.8
16		1	1	4	12	7	11	0	0	-8	36.004	-96.875	155.4	959.8
17		1	1	4	12	7	10	0	0	-9	36.24	-97.155	207.4	950.6
18		1	1	4	12	7	9	0	0	-10	36.511	-97.443	254.3	943.9
19		1	1	4	12	7	8	0	0	-11	36.799	-97.699	297.9	934.3
20		1	1	4	12	7	7	0	0	-12	37.102	-97.907	341.5	924.3
21		1	1	4	12	7	6	0	0	-13	37.418	-98.089	415.5	906.8
22		1	1	4	12	7	5	0	0	-14	37.727	-98.243	475.3	894.7
23		1	1	4	12	7	4	0	0	-15	38.029	-98.383	497.4	890.4
24		1	1	4	12	7	3	0	0	-16	38.321	-98.471	510.4	886.6
25		1	1	4	12	7	2	0	0	-17	38.576	-98.509	539.1	882.4
26		1	1	4	12	7	1	0	0	-18	38.774	-98.546	583.5	876.8
27		1	1	4	12	7	0	0	0	-19	38.938	-98.577	620.2	872
28		1	1	4	12	6	23	0	0	-20	39.077	-98.624	635.3	869
29		1	1	4	12	6	22	0	0	-21	39.193	-98.711	629.9	869.4
30		1	1	4	12	6	21	0	0	-22	39.277	-98.829	622.5	869.3
31		1	1	4	12	6	20	0	0	-23	39.333	-98.929	616.2	868.9
32		1	1	4	12	6	19	0	0	-24	39.361	-98.985	610.5	869
33														
34														
35														


Delete the rows above the headers you just created. Click on row numbers. Hold down the Ctrl key to select more than 1 row. Then right click over the row numbers and choose delete
Cut
Copy
Paste
Paste Special...
Insert
Delete
Clear Contents
Format Cells...
Row Height...
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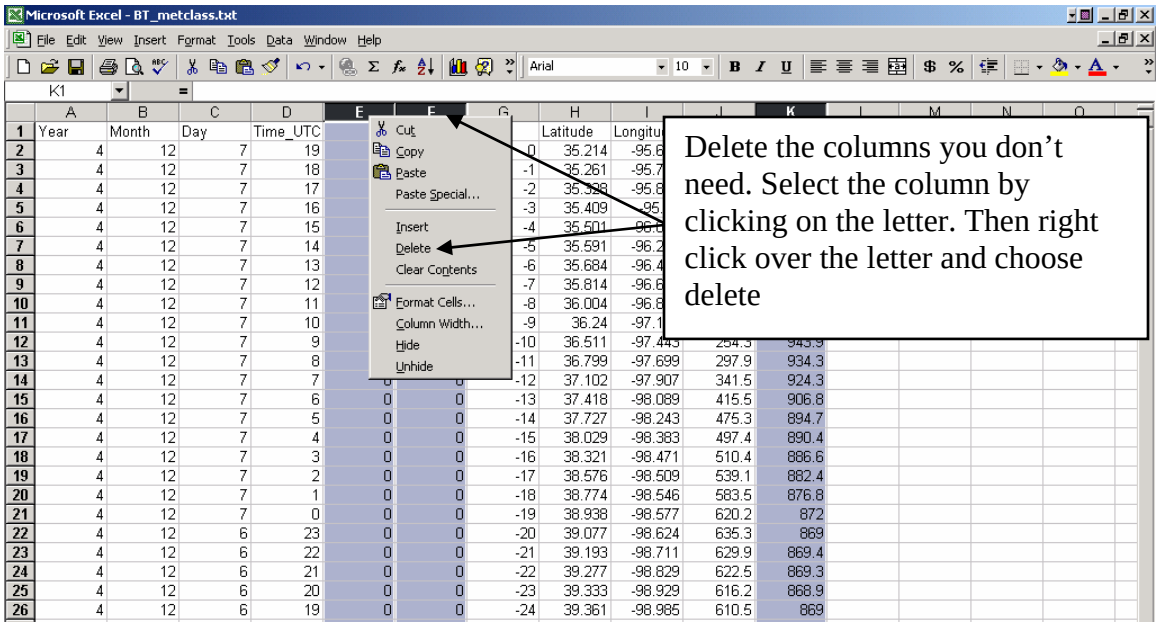
BT_metclass
Ready
Sum=37.527
NUM
Start
Untitled - ArcMap - ArcInfo
ArcCatalog - ArcInfo - C:\...
Backward Trajectory.doc ...
Microsoft Excel - BT_...
10:09 AM


Microsoft Excel - BT_metclass.txt
Delete the columns you don't need. Select the column by clicking on the letter. Then right click over the letter and choose delete
Cut
Copy
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Insert
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Format Cells...
Column Width...
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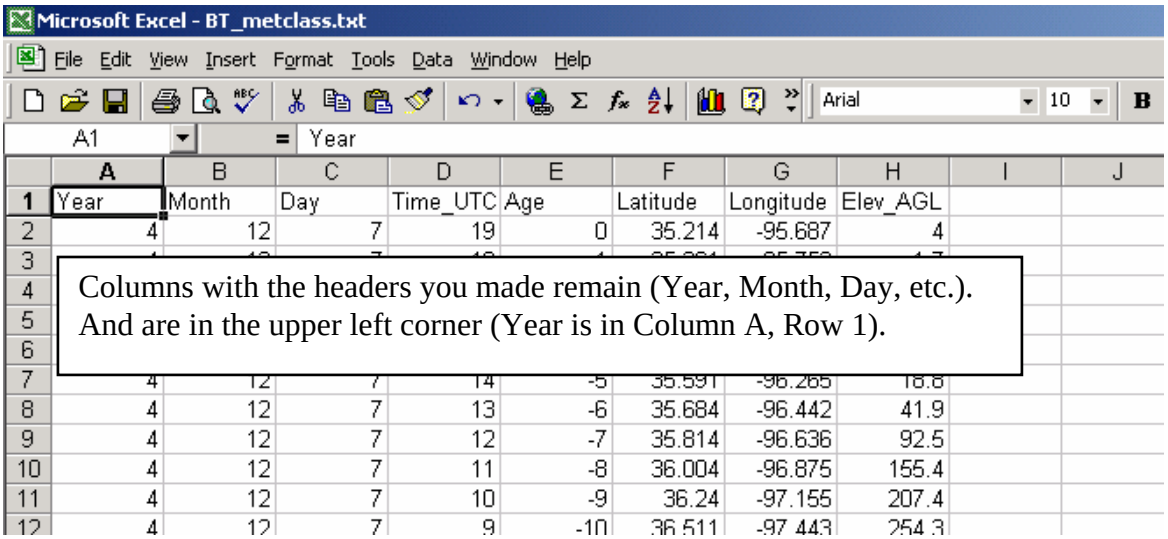
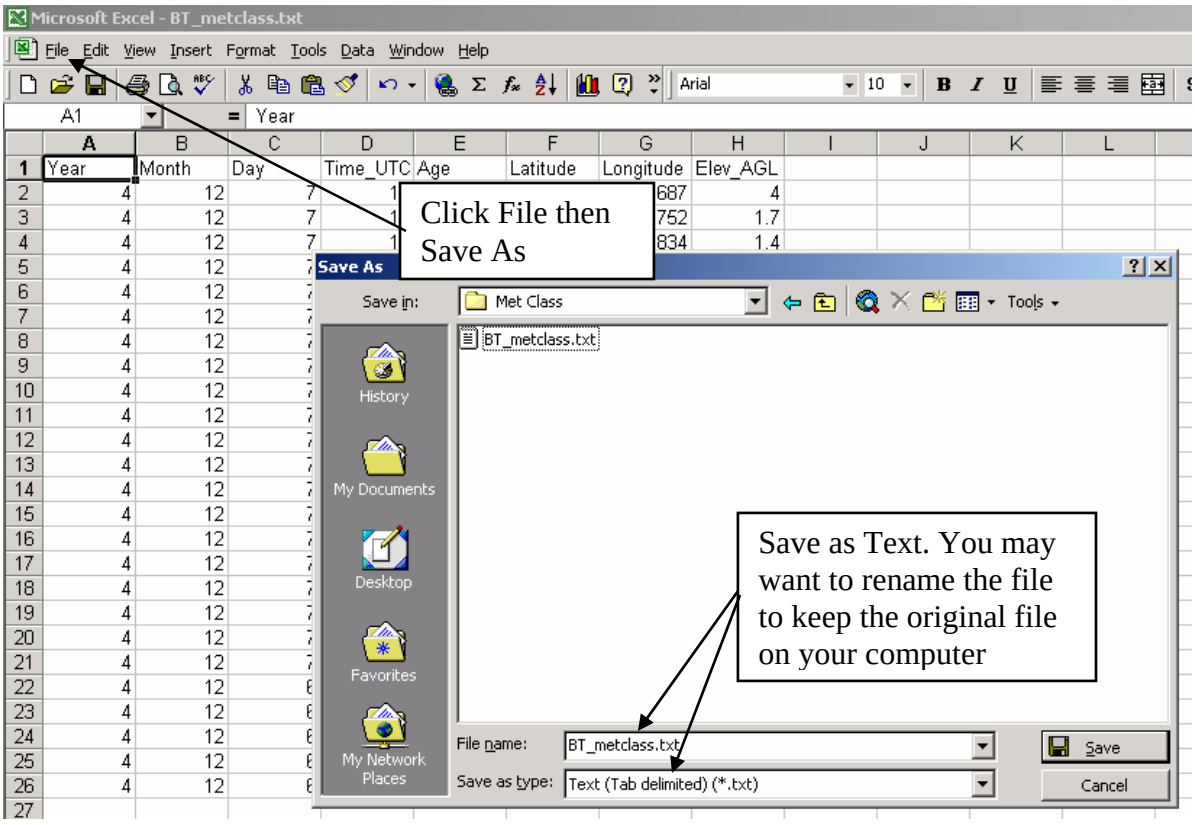
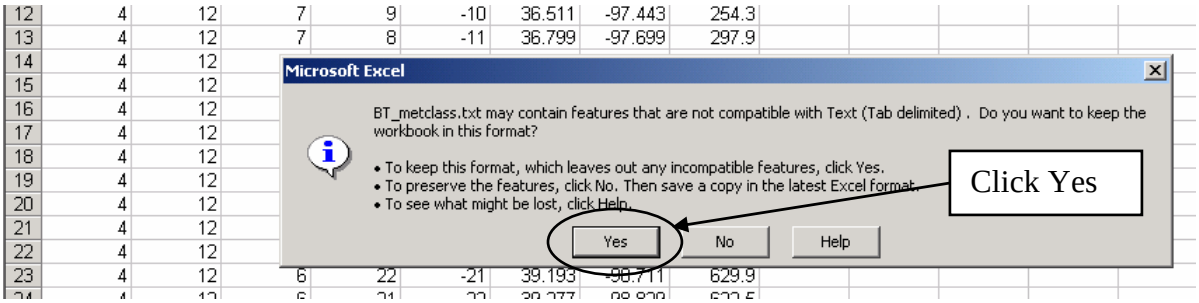
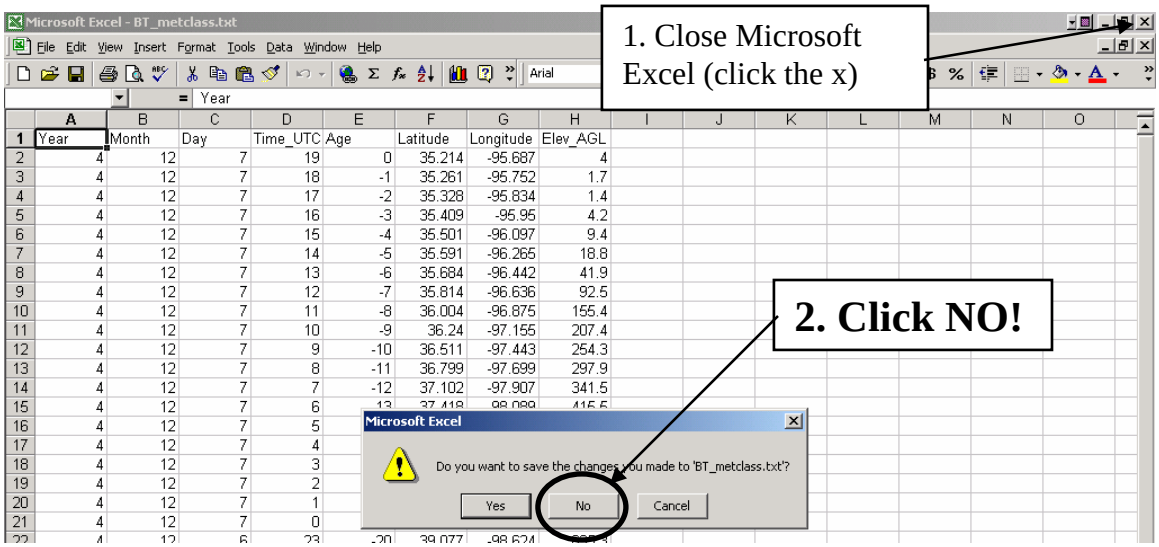
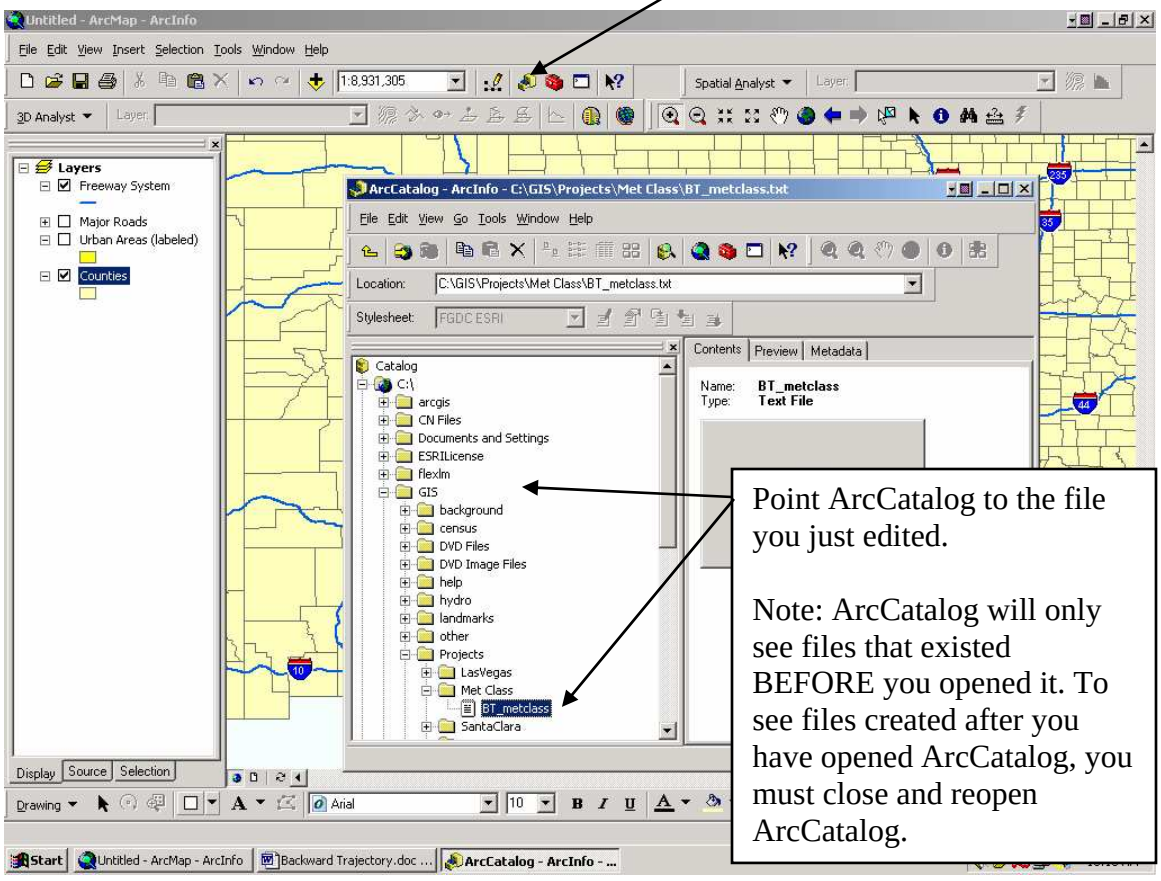

Microsoft Excel - BT_metclass.txt
Columns with the headers you made remain (Year, Month, Day, etc.). And are in the upper left corner (Year is in Column A, Row 1).

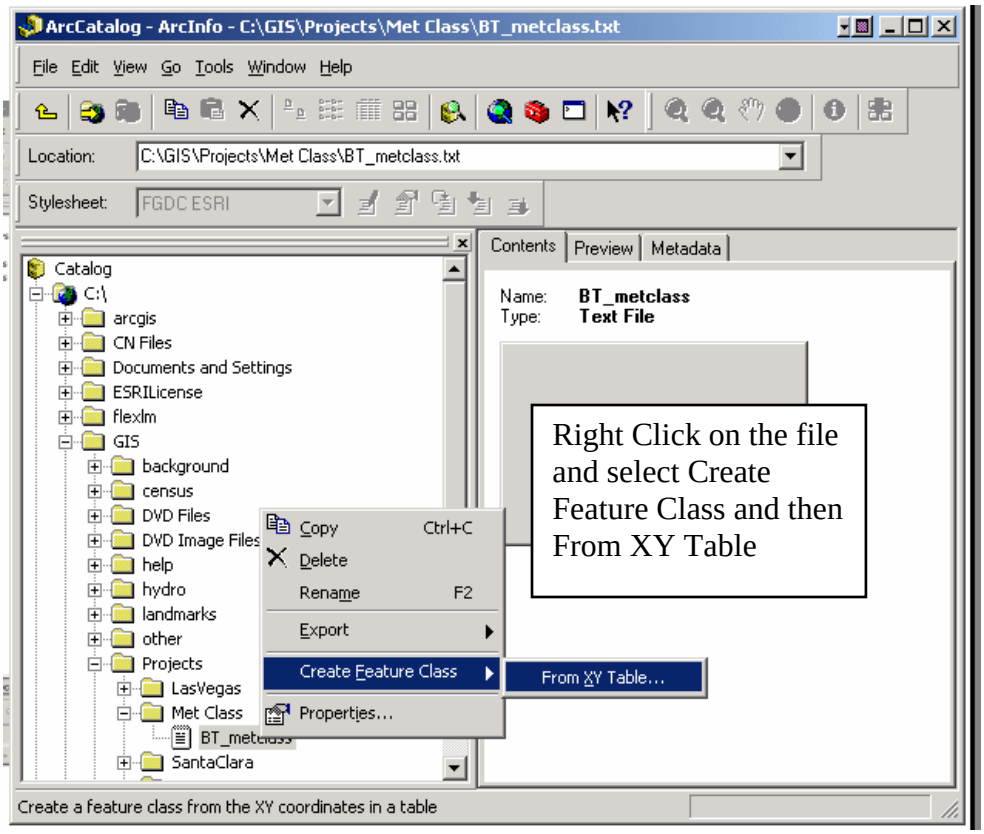

Click File then Save As
Save As
Save in:
Met Class
BT_metclass.txt
History
My Documents
Desktop
Favorites
My Network Places
Save as Text. You may want to rename the file to keep the original file on your computer
File name:
BT_metclass.txt
Save as type:
Text (Tab delimited) (*.txt)
Save
Cancel


Microsoft Excel
BT_metclass.txt may contain features that are not compatible with Text (Tab delimited) . Do you want to keep the workbook in this format?
• To keep this format, which leaves out any incompatible features, click Yes.
• To preserve the features, click No. Then save a copy in the latest Excel format.
• To see what might be lost, click Help.
Click Yes
Yes
No
Help

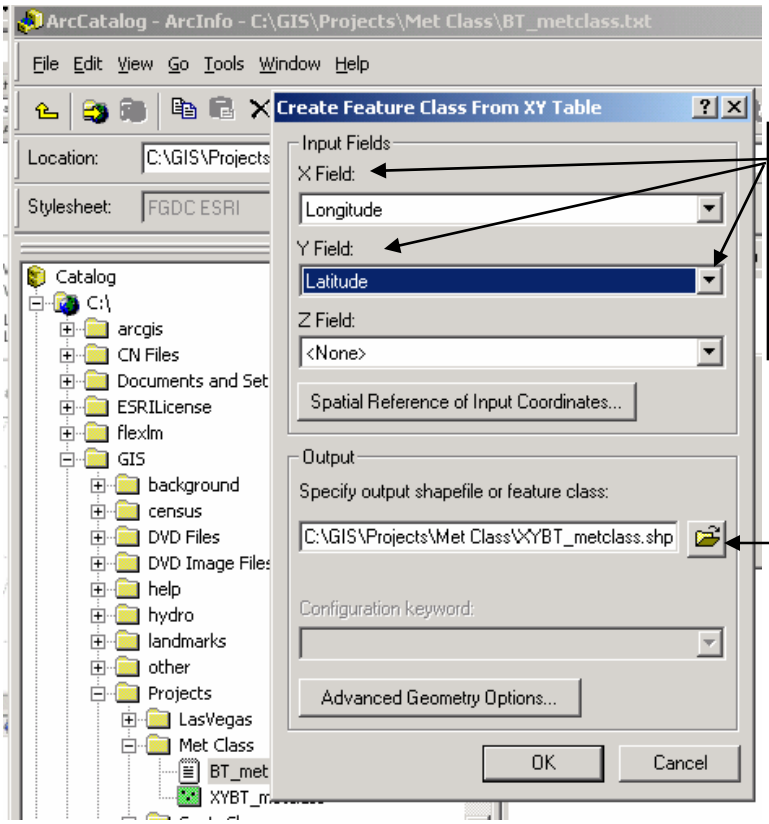


Open ArcMap and then ArcCatalog



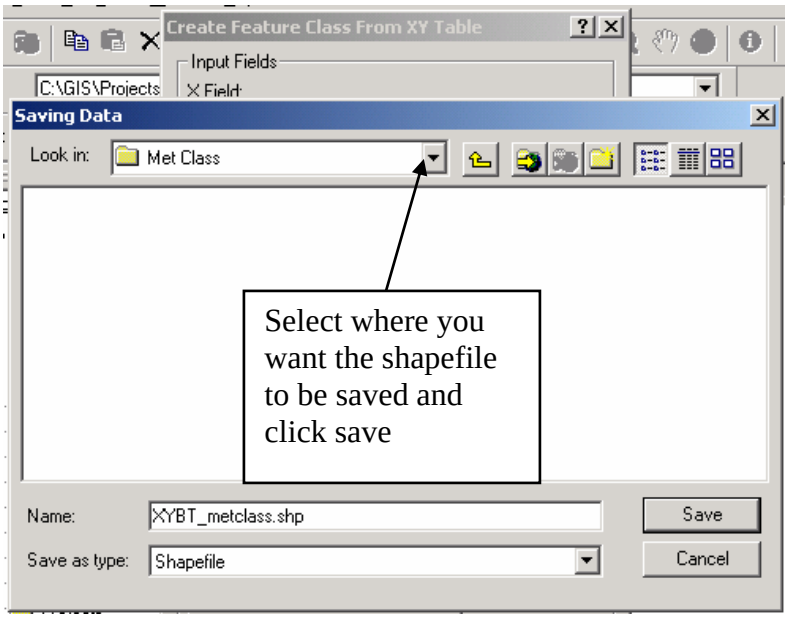


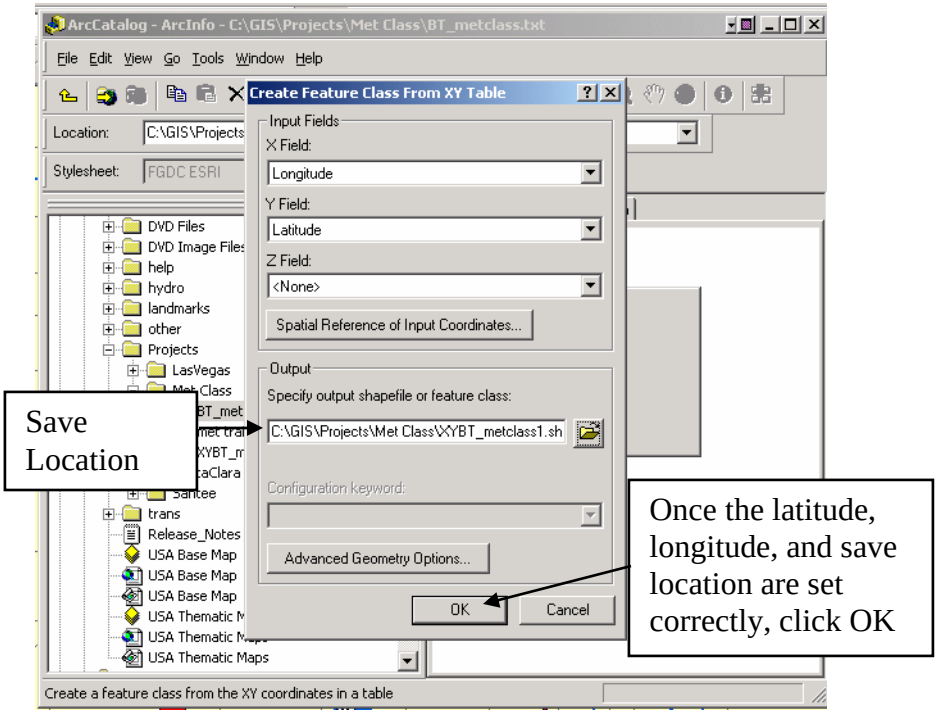
Right Click on the file and select Create Feature Class and then From XY Table



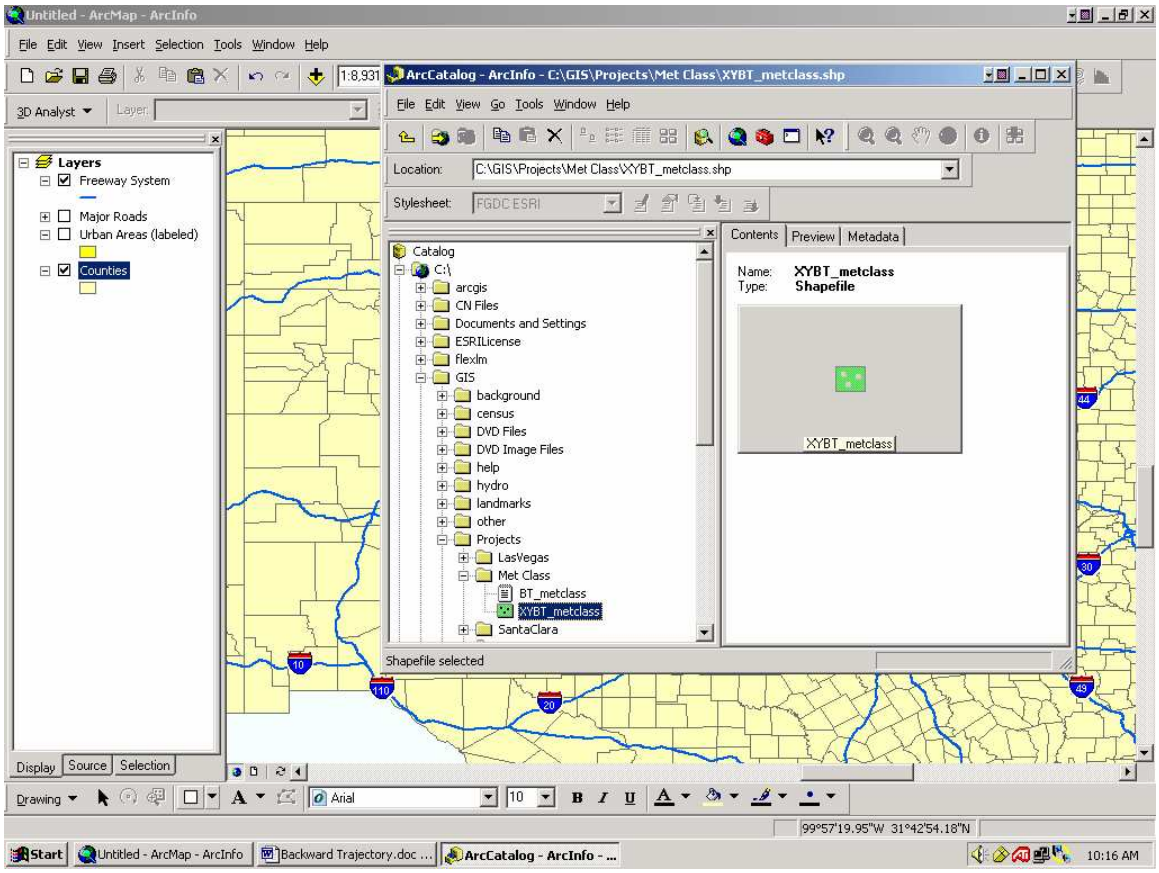
Be Sure that X Field is Longitude and Y Field is Latitude. If not, use the dropdown box and select the correct field

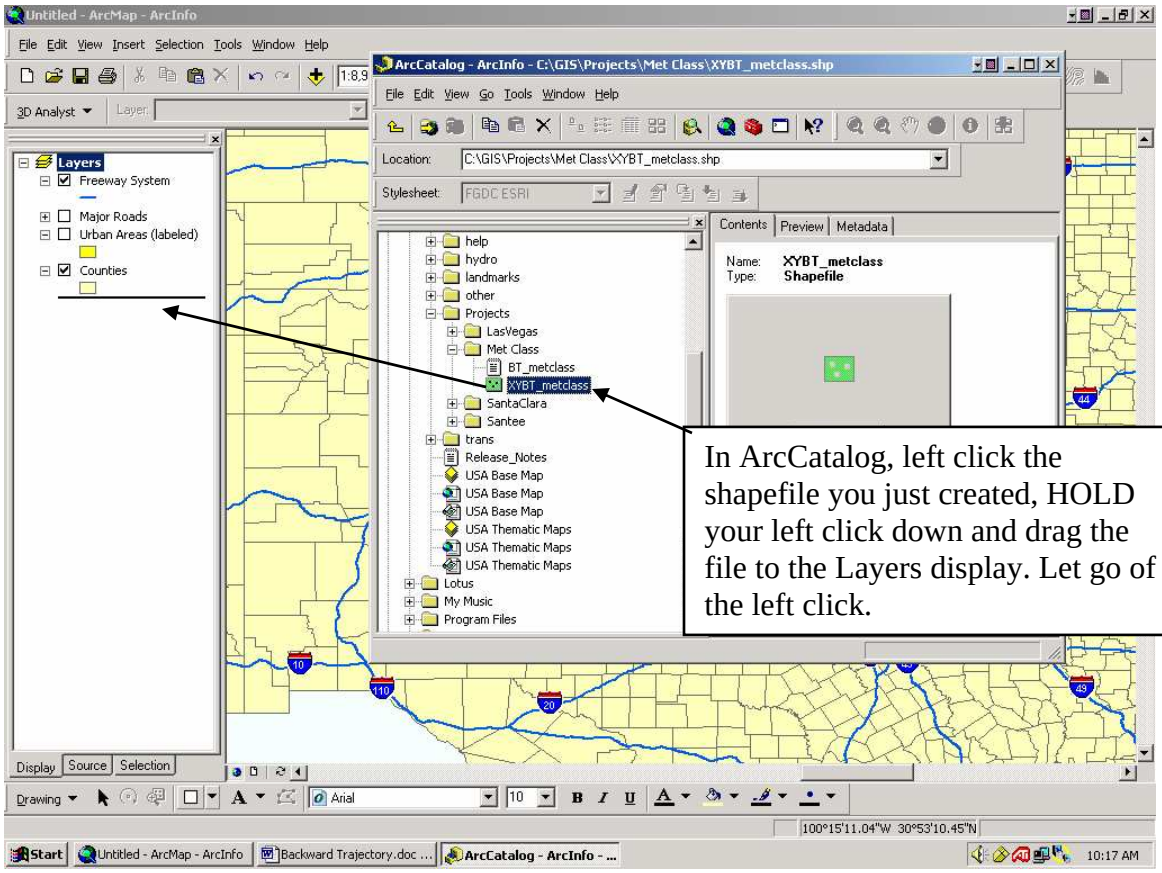
Click the open folder button and select where you want the shapefile to be saved (see next picture)

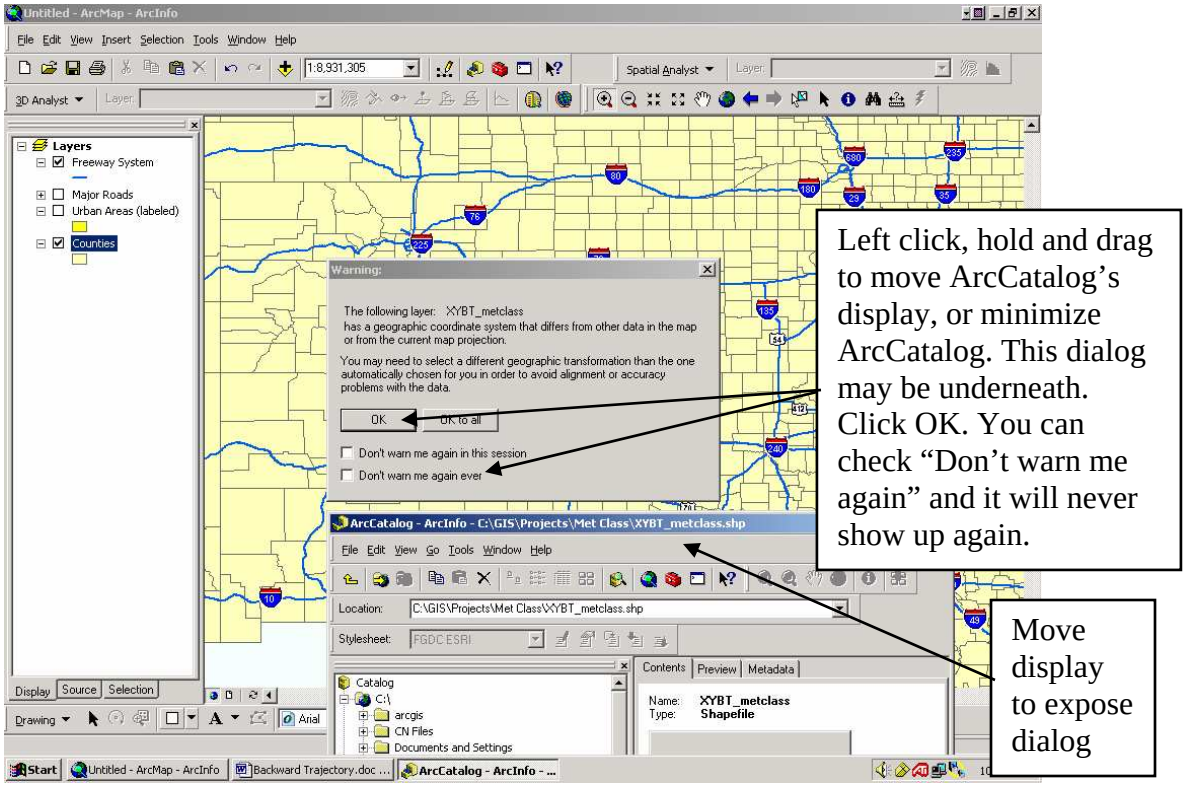


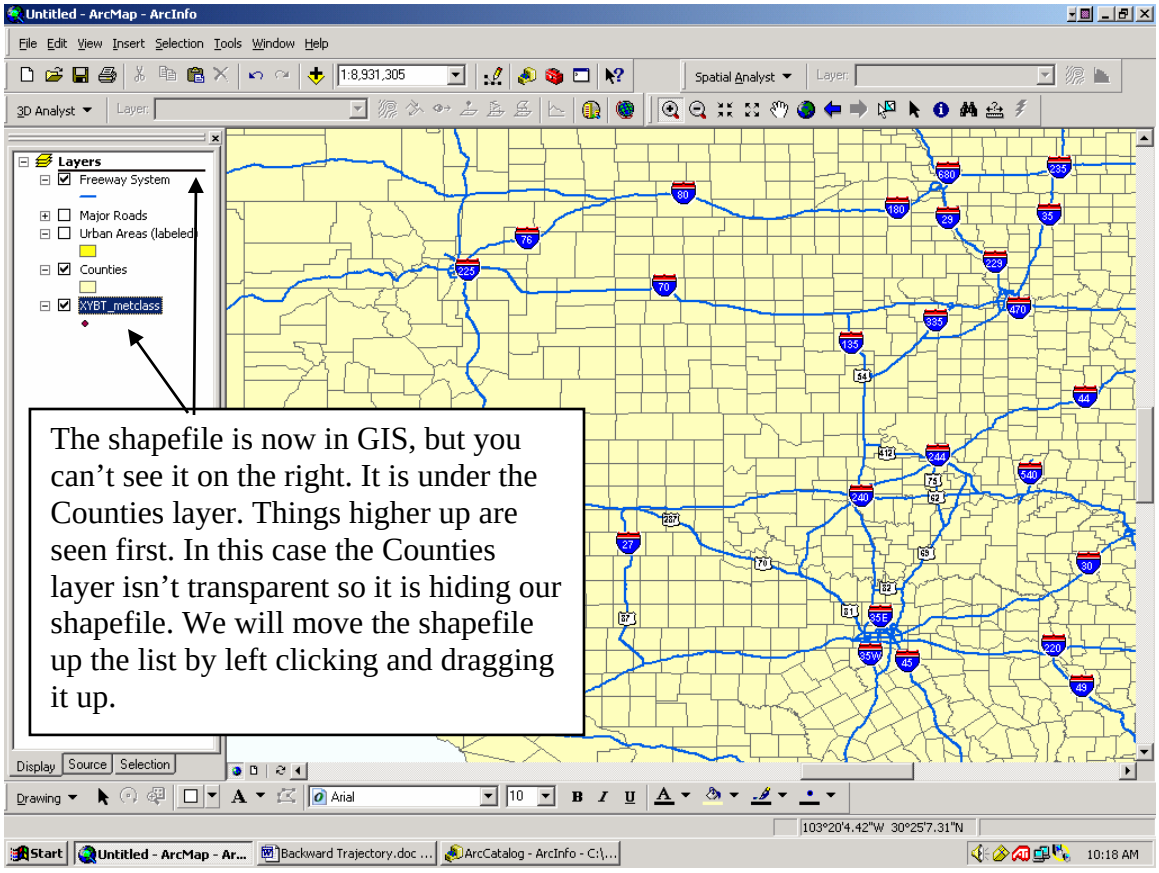


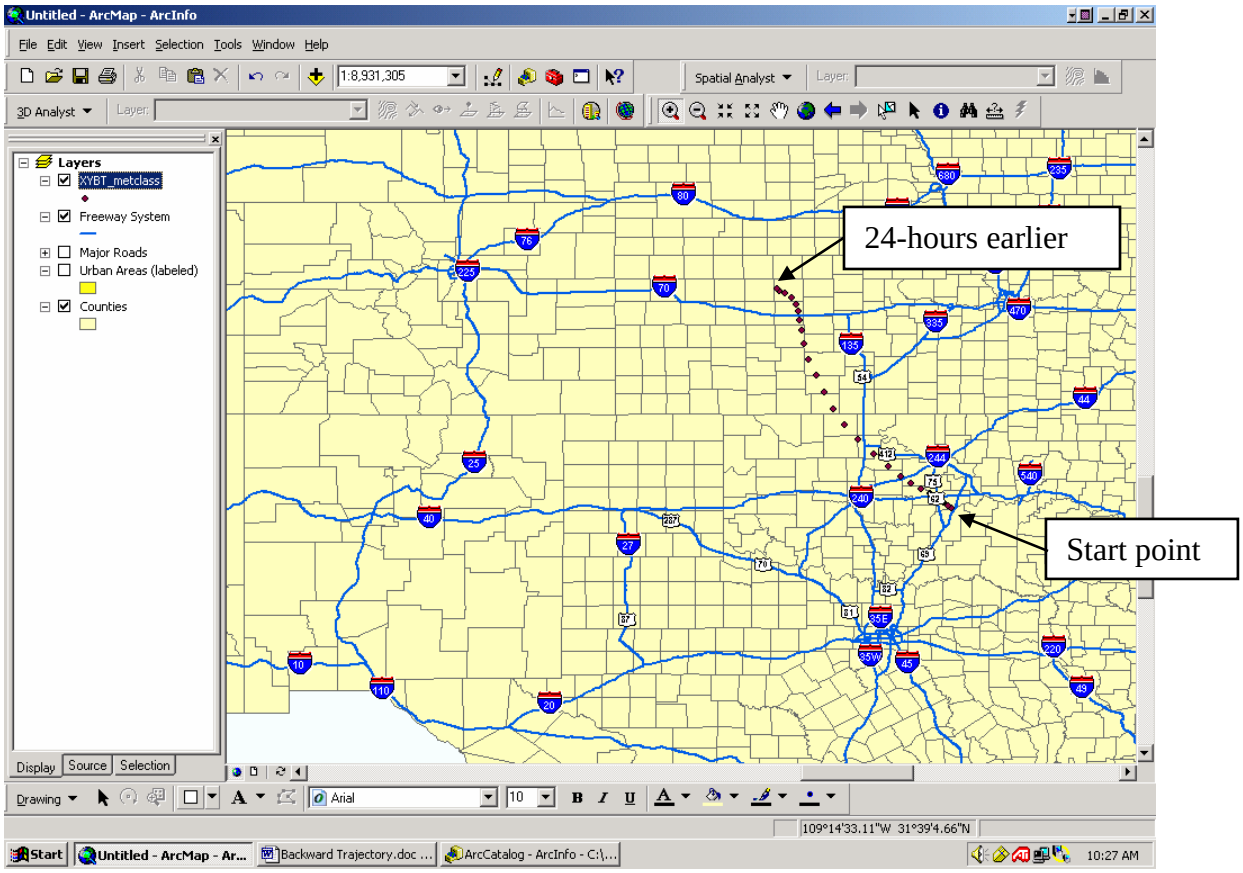
Close and reopen ArcCatalog (so you can see the shapefile just created)

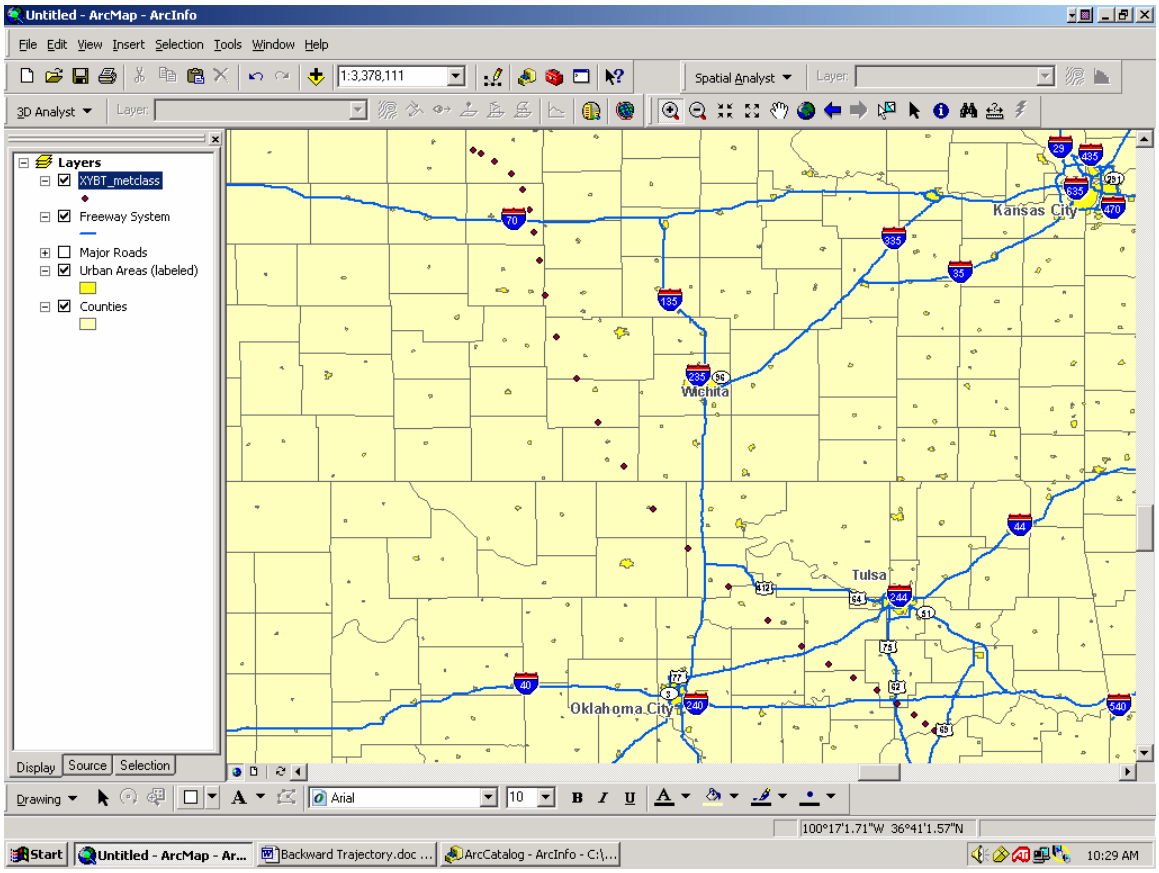

Untitled - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
ArcCatalog - ArcInfo - C:\GIS\Projects\Met Class\XYBT_metclass.shp
File Edit View Go Tools Window Help
Location: C:\GIS\Projects\Met Class\XYBT_metclass.shp
Stylesheet: FGDC ESRI
Contents Preview Metadata
Name: XYBT_metclass
Type: Shapefile
XYBT_metclass
Catalog
C:\
arcgis
CN Files
Documents and Settings
ESRILicense
flexlm
GIS
background
census
DVD Files
DVD Image Files
help
hydro
landmarks
other
Projects
LasVegas
Met Class
BT_metclass
XYBT_metclass
SantaClara
Shapefile selected
Layers
Freeway System
Major Roads
Urban Areas (labeled)
Counties
Display Source Selection
Drawing
Arial
99°57'19.95"W 31°42'54.18"N
Start
Untitled - ArcMap - ArcInfo
Backward Trajectory.doc ...
ArcCatalog - ArcInfo - ...
10:16 AM


In ArcCatalog, left click the shapefile you just created, HOLD your left click down and drag the file to the Layers display. Let go of the left click.


Left click, hold and drag to move ArcCatalog's display, or minimize ArcCatalog. This dialog may be underneath. Click OK. You can check "Don't warn me again" and it will never show up again.
Move display to expose dialog


Untitled - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:8,931,305
Spatial Analyst
3D Analyst
Layers
Freeway System
Major Roads
Urban Areas (labeled
Counties
XYBT_metclass
The shapefile is now in GIS, but you can't see it on the right. It is under the Counties layer. Things higher up are seen first. In this case the Counties layer isn't transparent so it is hiding our shapefile. We will move the shapefile up the list by left clicking and dragging it up.
Display
Source
Selection
Drawing
Arial
10
103°20'4.42"W 30°25'7.31"N
Start
Untitled - ArcMap - Ar...
Backward Trajectory.doc ...
ArcCatalog - ArcInfo - C:\...
10:18 AM


Untitled - ArcMap - ArcInfo
File Edit View Insert Selection Tools Window Help
1:8,931,305
Spatial Analyst
3D Analyst
Layers
XYBT_metclass
Freeway System
Major Roads
Urban Areas (labeled)
Counties
Display Source Selection
Drawing
Arial
10
24-hours earlier
Start point
109°14'33.11"W 31°39'4.66"N
Start
Untitled - ArcMap - Ar...
Backward Trajectory.doc ...
ArcCatalog - ArcInfo - C:\...
10:27 AM



The HYSPLIT backward trajectory text file provided latitude and longitude (and elevation) for the location of the particle of air at 1-hour intervals, backward in time from your selected start time and location. The GIS map shows the locations in a more easily understood image than the one at HYSPLIT. If you put sources on GIS it could point to sources suspected of contributing to air quality problems.