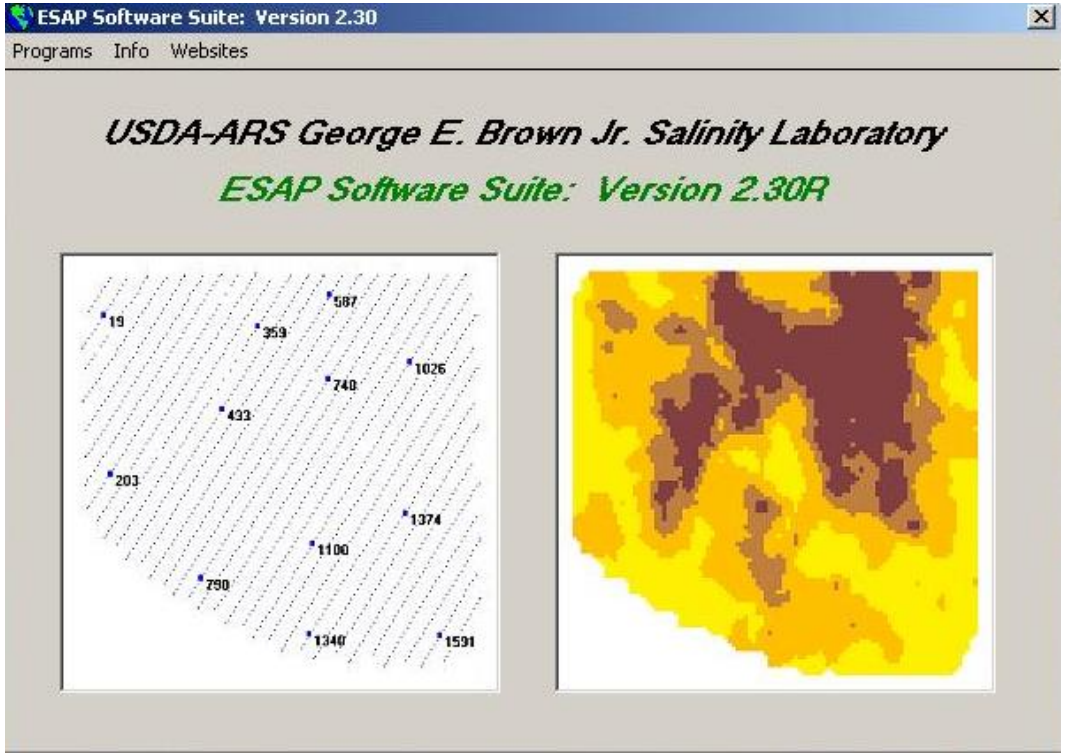


ELECTROMAGNETIC SAMPLING ANALYSIS AND PREDICTION (ESAP V. 2.35)

FOR SIGNAL PROCESSING DATA COLLECTED WITH EMI INSTRUMENTATION

OVERVIEW

How to import and edit survey data generated from and EM38 survey into ESAP for analysis

How to use ESAP to generate sampling designs from field measurements

How to create a map of various soil characteristics

WHAT IS ESAP?

ECe (or Salinity) Sampling, Assessment, and Prediction

A statistical software package for estimating field-scale, spatial soil property patterns from EMI signal data.

Developed at the USDA-ARS US Salinity Laboratory in Riverside, CA and specifically designed to facilitate cost-effective, technically sound, soil salinity assessment and data interpretation techniques.

Available for download free of charge online at: https://www.ars.usda.gov/pacific-west-area/riverside-ca/us-salinity-laboratory/docs/esap-model/

CORE MODULES OF ESAP

ESAP-RSSD (Response Surface Sampling Design)

Examine, analyze, & summarize EC_a survey data
Generates optimal soil sampling designs from sensor data

ESAP-Calibrate

Converts survey data into predicted soil salinity (a/o other soil properties)
Diagnose & identify primary soil properties influencing survey data
Generates multiple field summary statistics
Generates prediction data (used for making spatial maps)

ESAP-SaltMapper

1-D transect plots and 2-D raster maps
Tile line maps, calculate tile line locations, diagnose potential tile line problems

SUPPORT MODULES OF ESAP

ESAP-SigDPA (Signal Data Pre-processing Algorithm)

Tool to pre-process signal data into format used and recognized by core Modules.

Perform signal data QA/QC and validity checks, scale conversion, and row (transect) identification & assignment.

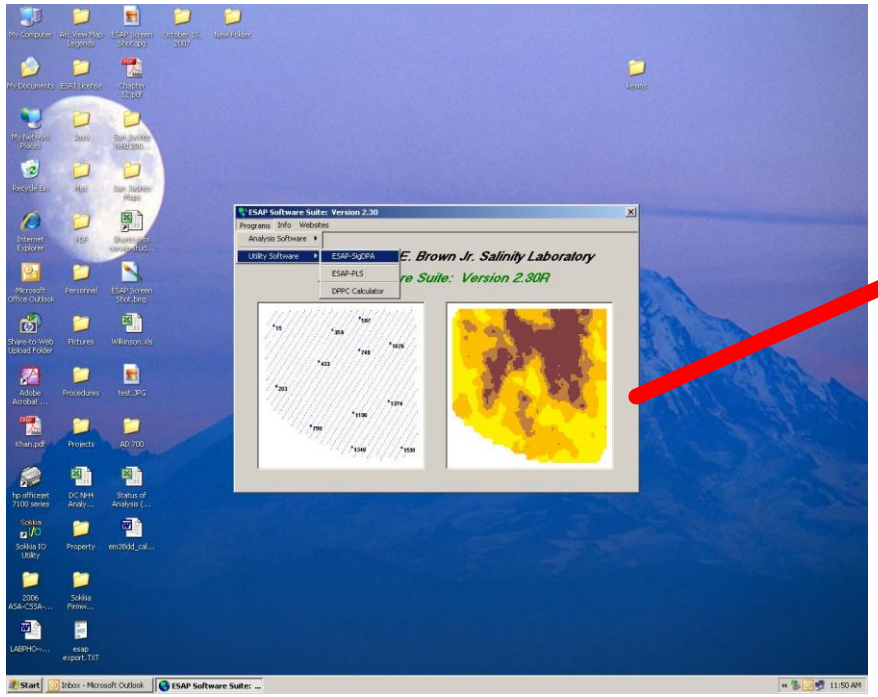
ESAP-DPPC (Dual Parallel Pathway Conductance) Calculator

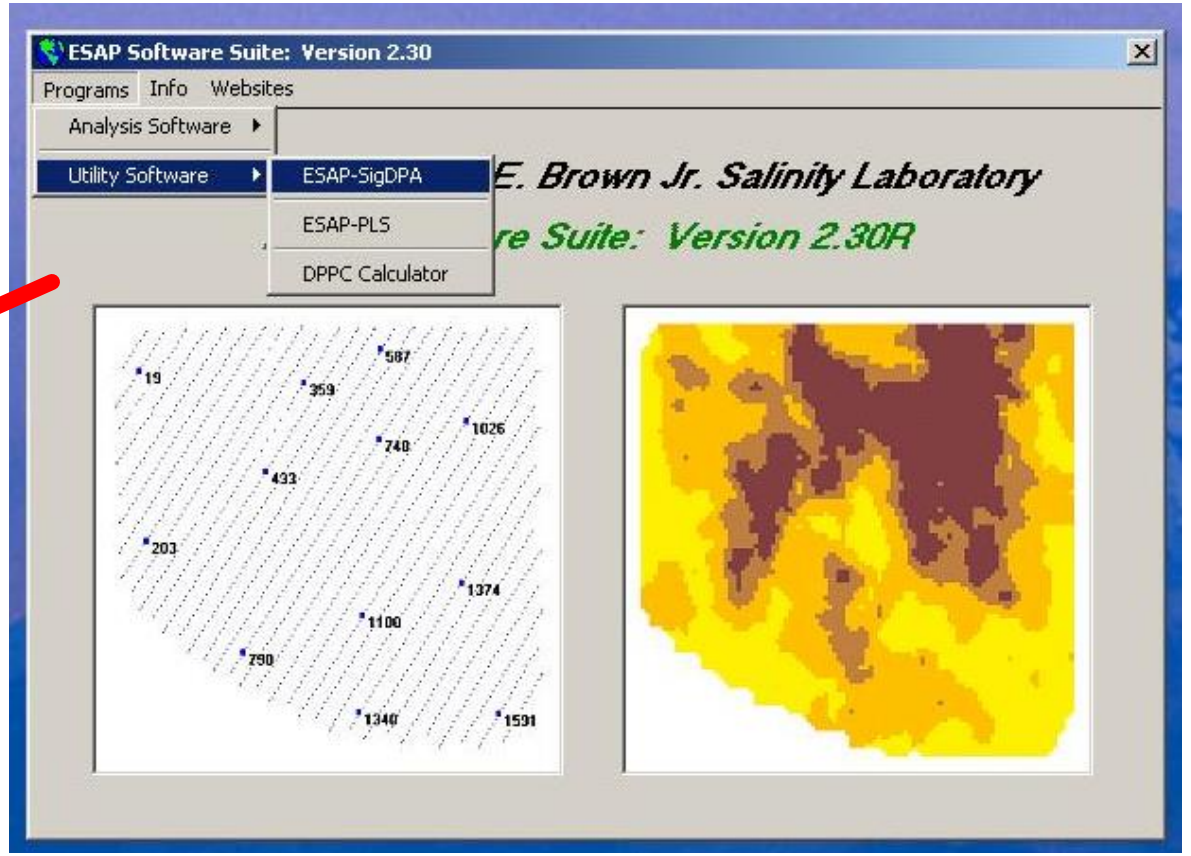
Convenient to use calculator version of the 1989 Rhoades DPPC model

Used for direct prediction of salinity from spot 4-probe or EM survey data given soil temperature, texture, and moisture measurements (or estimates)

USING SIGDPA TO EDIT EM DATA FOR SAMPLE DESIGN

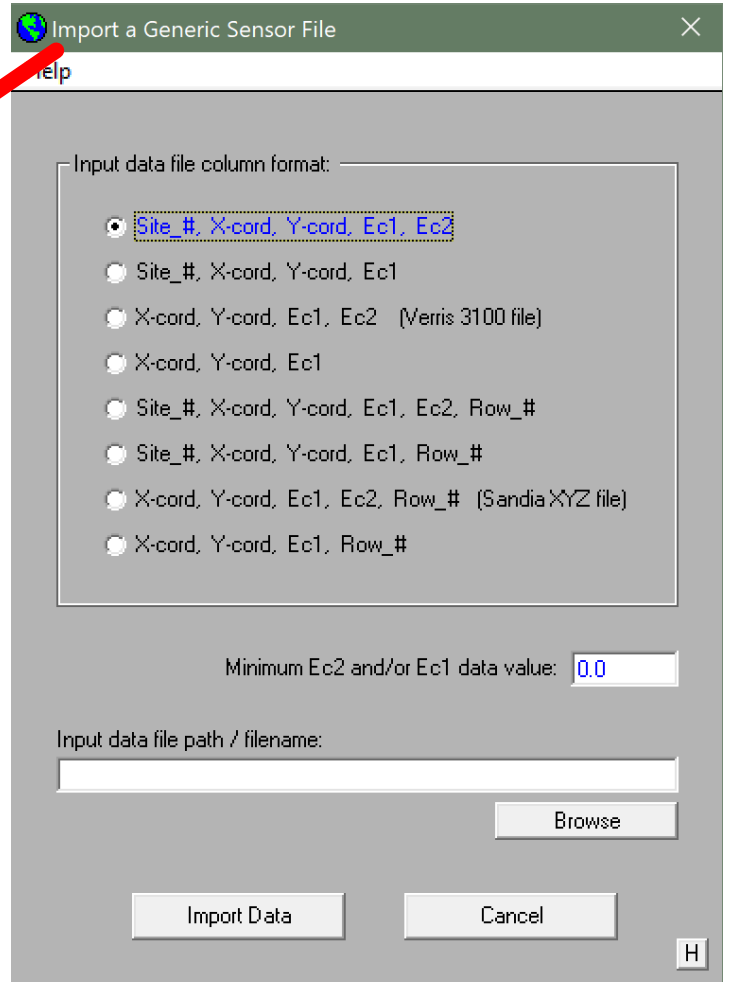
- Open ESAP and under "Programs" select "Utility Software" and then select "ESAP Sig-DPA"





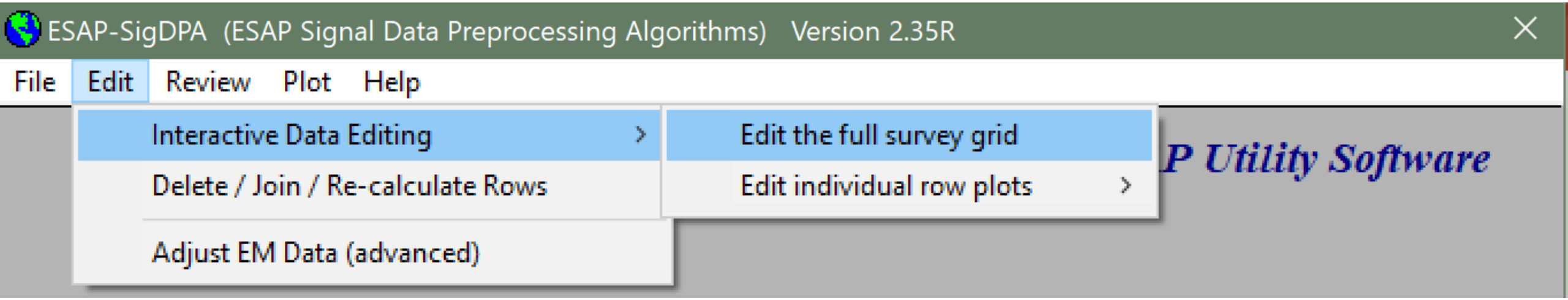
IMPORTING DATA INTO SIGDPA

- Under "File" select to Import a generic Sensor file
- Select the appropriate file format
  - Usually Site #, X, Y, Ec 1, Ec 2
- Browse for the EM38 .csv generated from DAT38MK2 but MAKE SURE TO DELETE the column headers



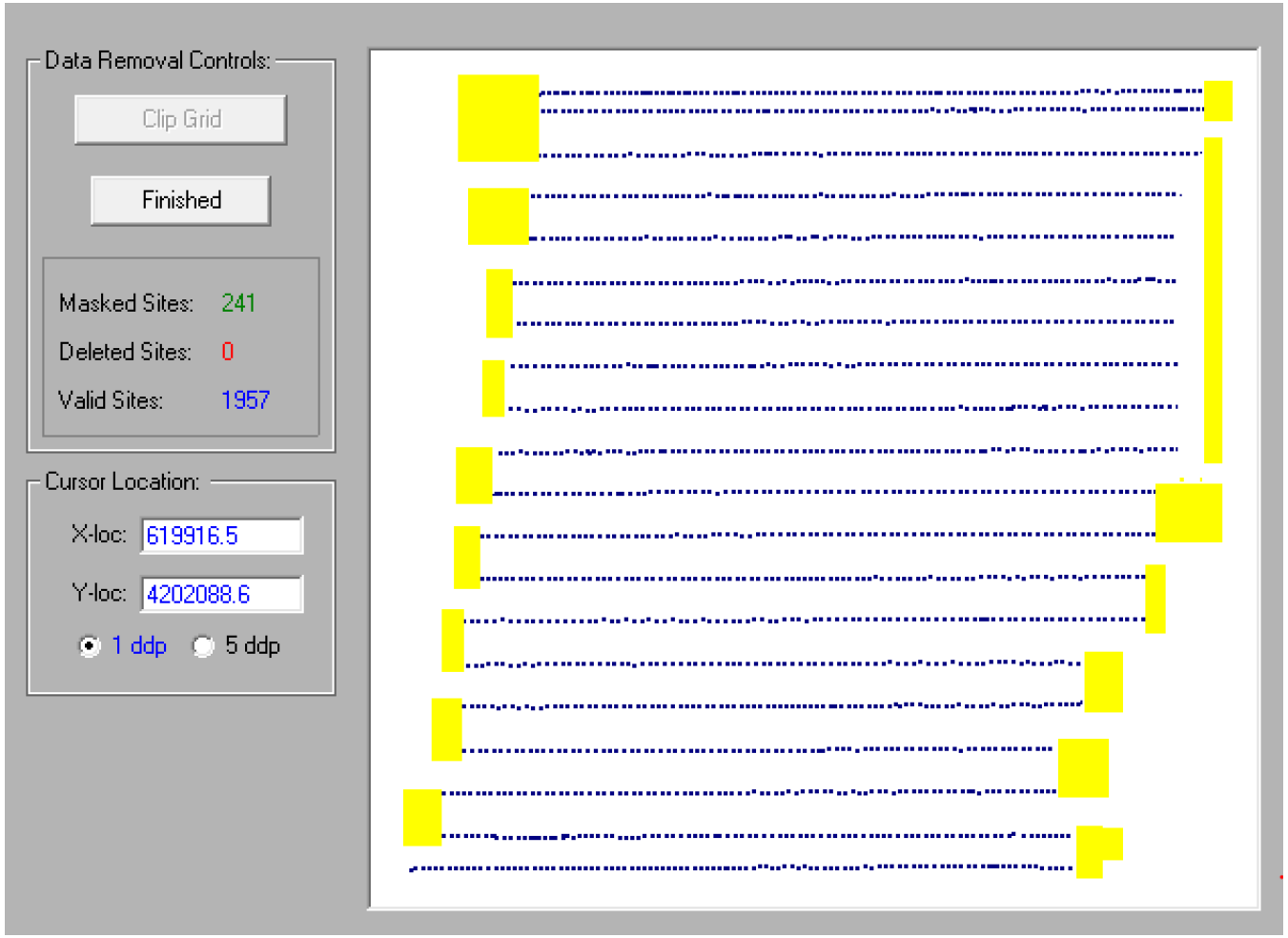
REMOVING EDGES TO GENERATE TRANSECT DATA

- Under "Edit" Select "Interactive Data Editing" and then "Edit the full survey grid"

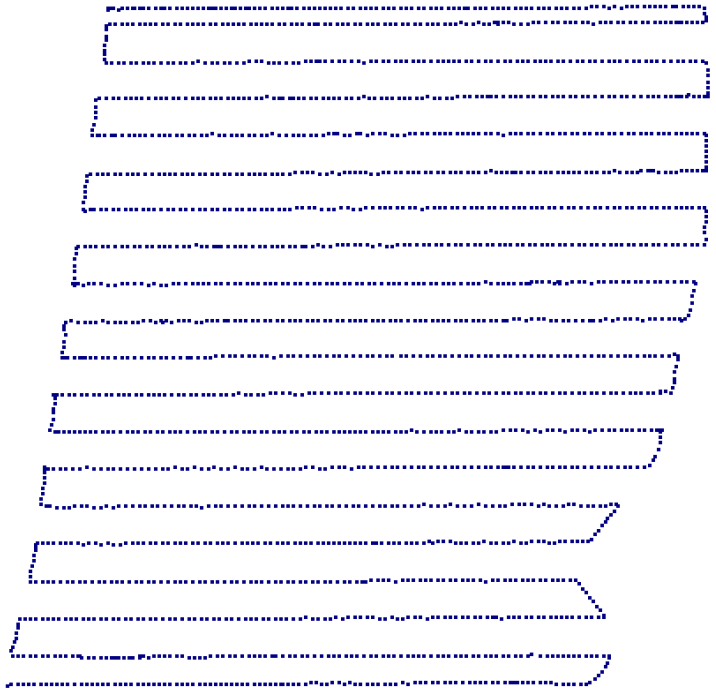


REMOVING EDGES TO GENERATE TRANSECT DATA

- Under "View" select "Display full map (max resolution)"
- Click the "Clip Grid" Button and highlight the areas of the map you want clipped
  - The areas you remove will be highlighted in yellow
- Click "Finished" and then mask and delete the clipped portion with the button that appears at the bottom of the screen

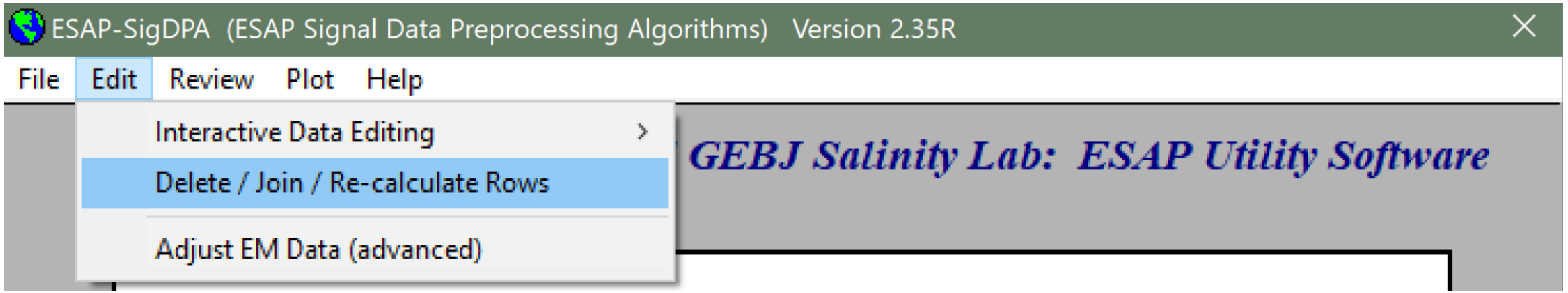


BEFORE AND AFTER CLIPPING



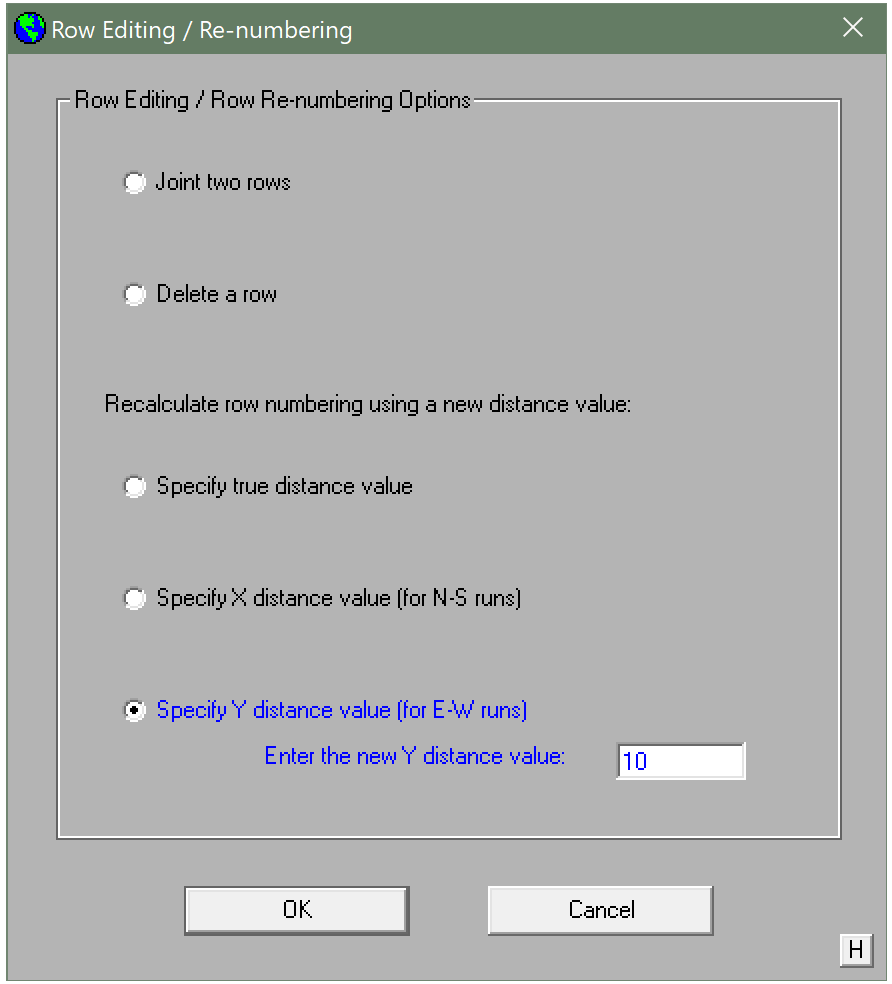
NUMBERING ROWS FOR TRANSECT DATA

- Under "Edit" Select "Delete/Join/Re-Calculate Rows

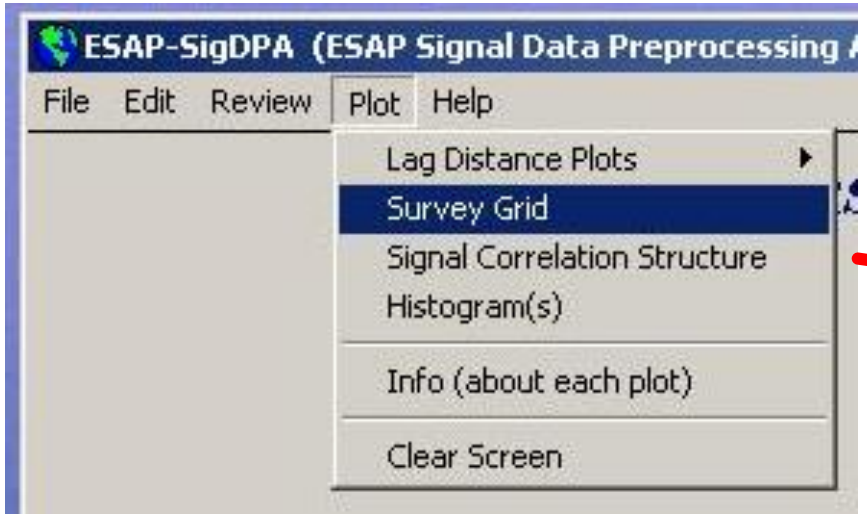


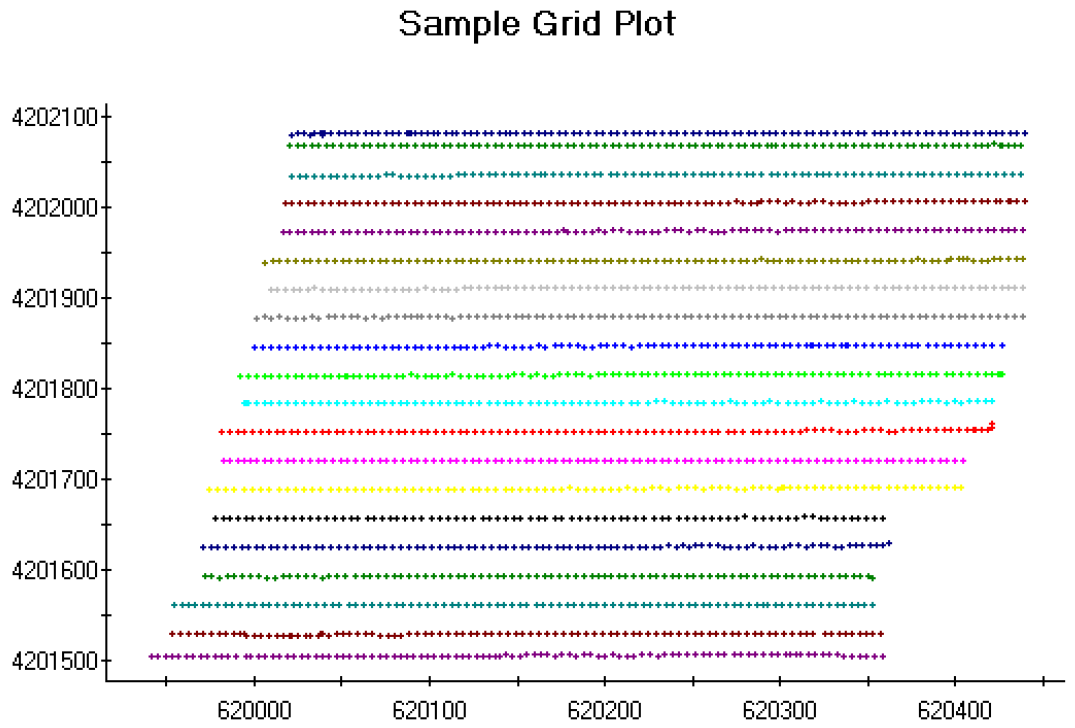
ADDING NUMBERS TO ROWS

- Check the "Specify Y distance value" (or X distance value if the transects run north and south)
  - Input the distance between transect passes (note: it is better to underestimate than overestimate here)
- Press "OK"



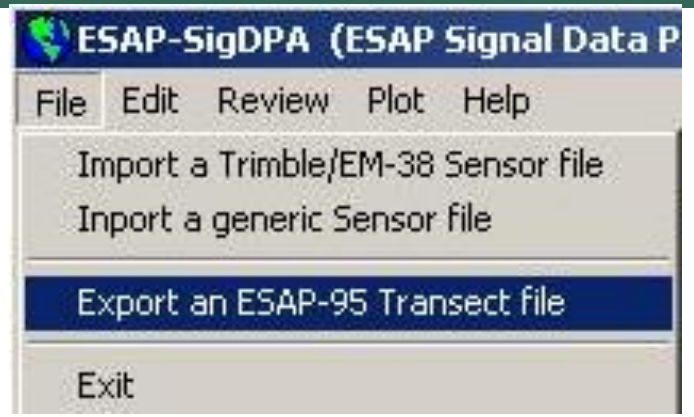
- Select "Survey Grid" under "Plot" to check that each transect has a distinct color in the correct location

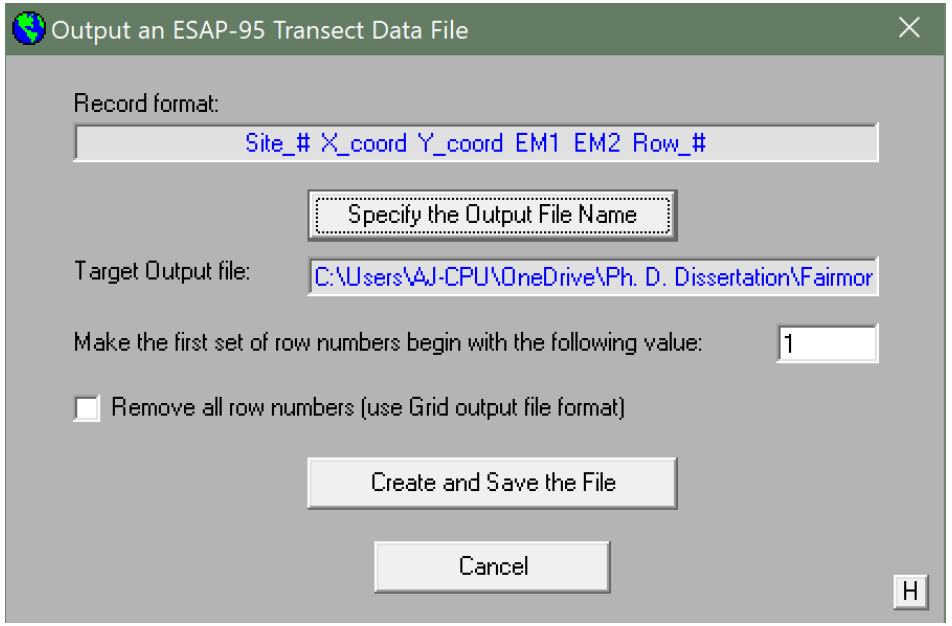




EXPORTING TRANSECT DATA TO USE IN ESAP-RSSD

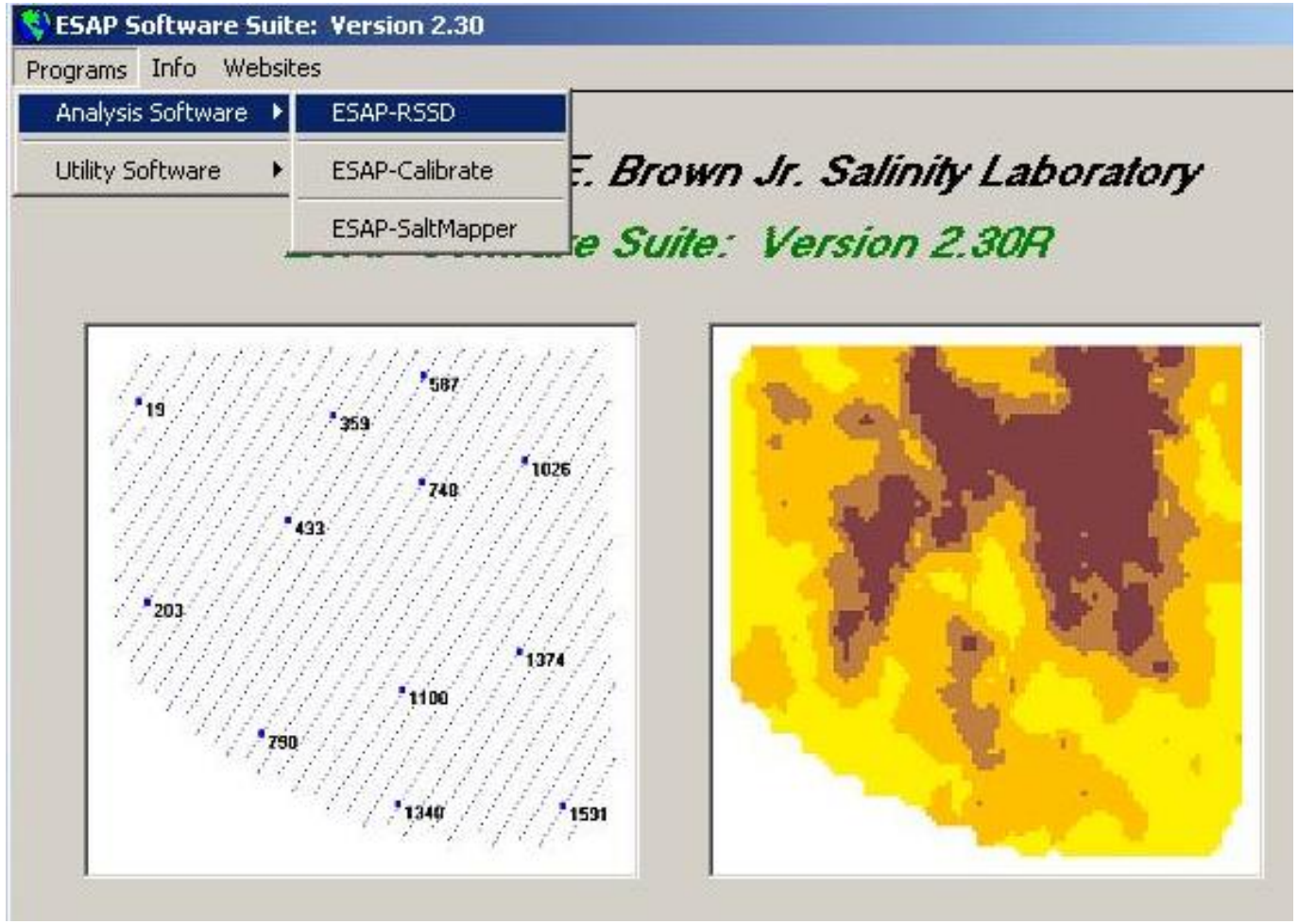
- Once the transects are labelled correctly:
  - Under "File" select "Export an ESAP-95 Transect file"
  - Specify the name and location of your output file
  - "Create and Save the File"
- You may now exit Sig-DPA





GENERATING A SAMPLING DESIGN

- ESAP-RSSD will take EM38 Transect data to statistically locate the best sampling locations for correlating soil characteristics to EM38 readings
- Open ESAP-RSSD from the ESAP main menu under "Programs" and "Analysis Software"

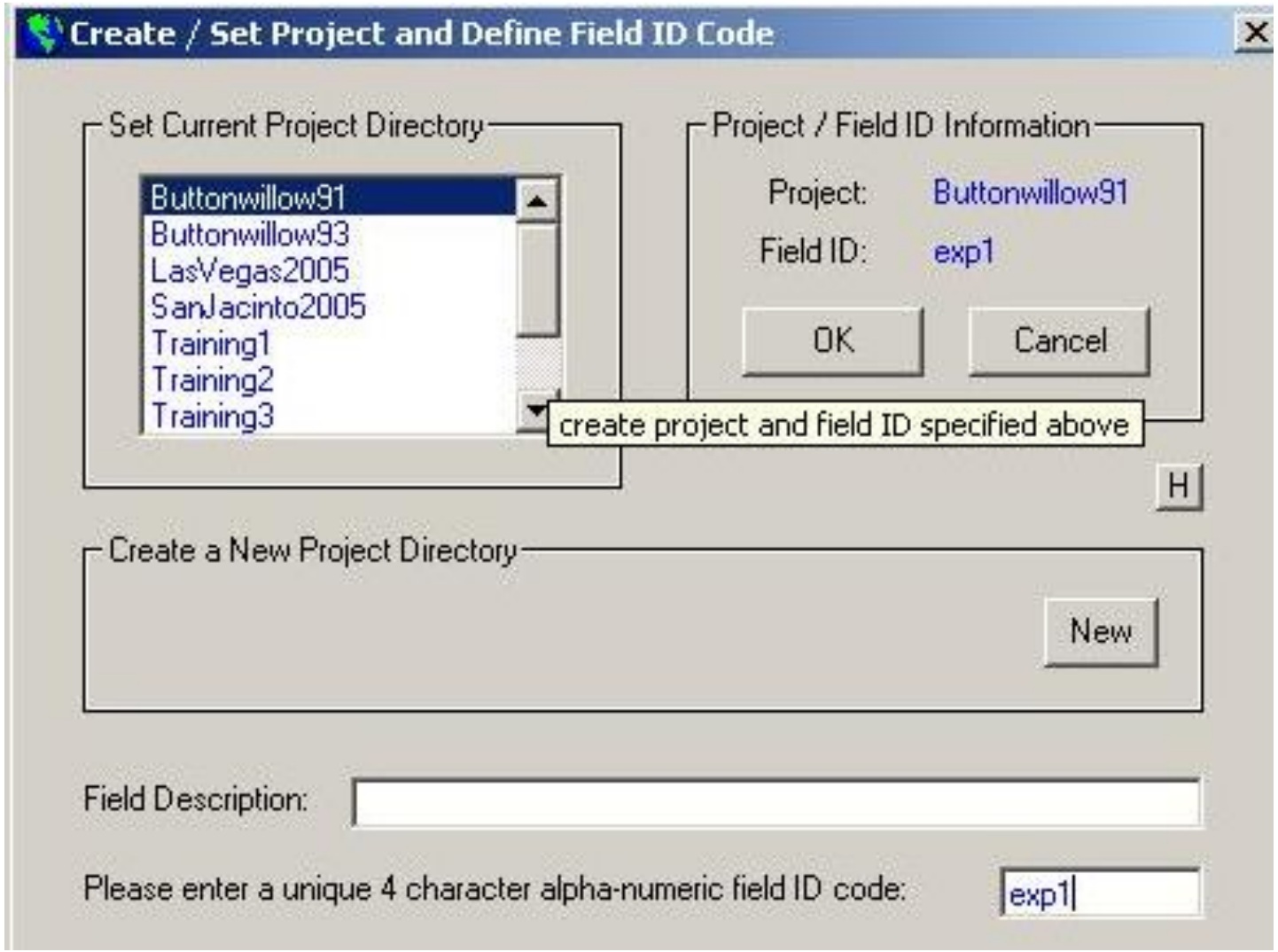


CREATING NEW PROJECTS

- Select Set/Create Project and Field ID under “File” menu.

CREATING NEW PROJECTS

- Create Project in "Create/Set Project" window.

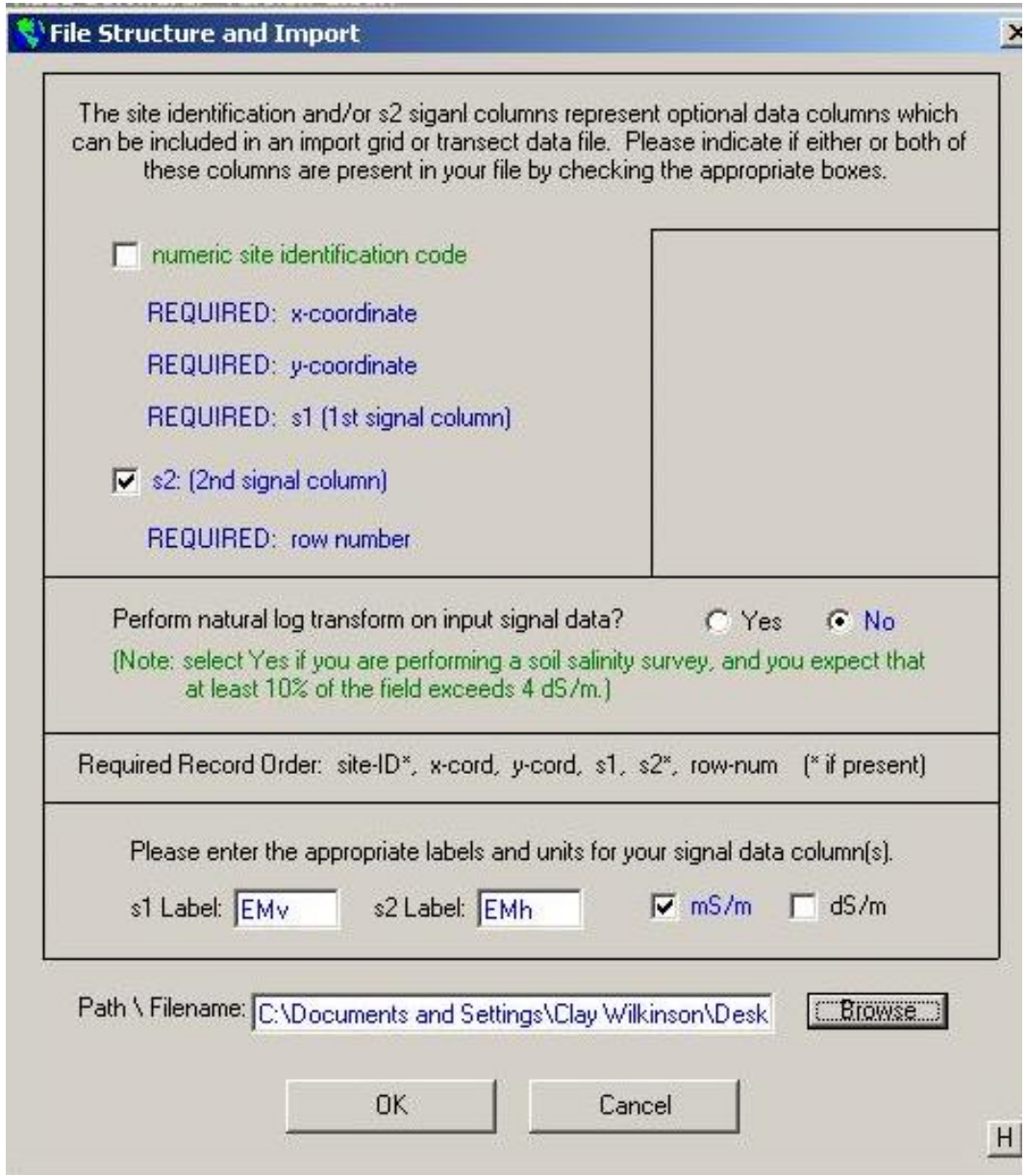


IMPORTING DATA

- Select Import a Transect Survey File under the "File" and "Import Survey Data File."

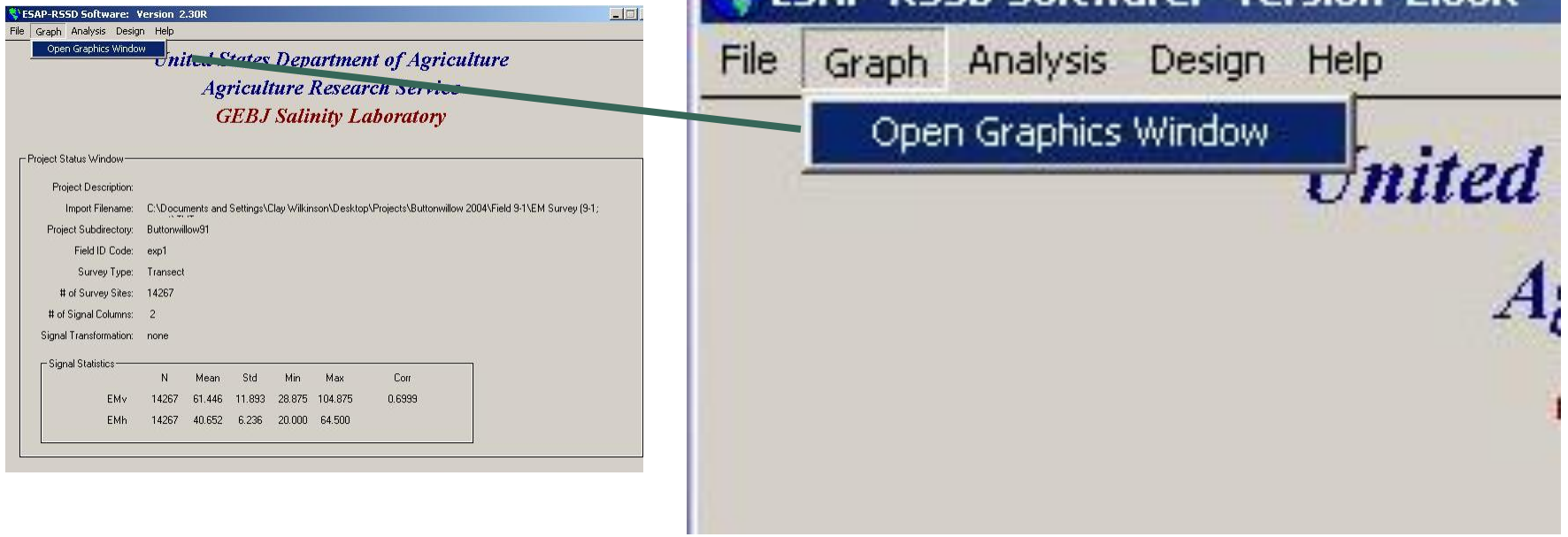
IMPORTING DATA

- Browse to locate file we created in Sig-DPA, click on it, then click "OK" in the "File Structure and Import" window.



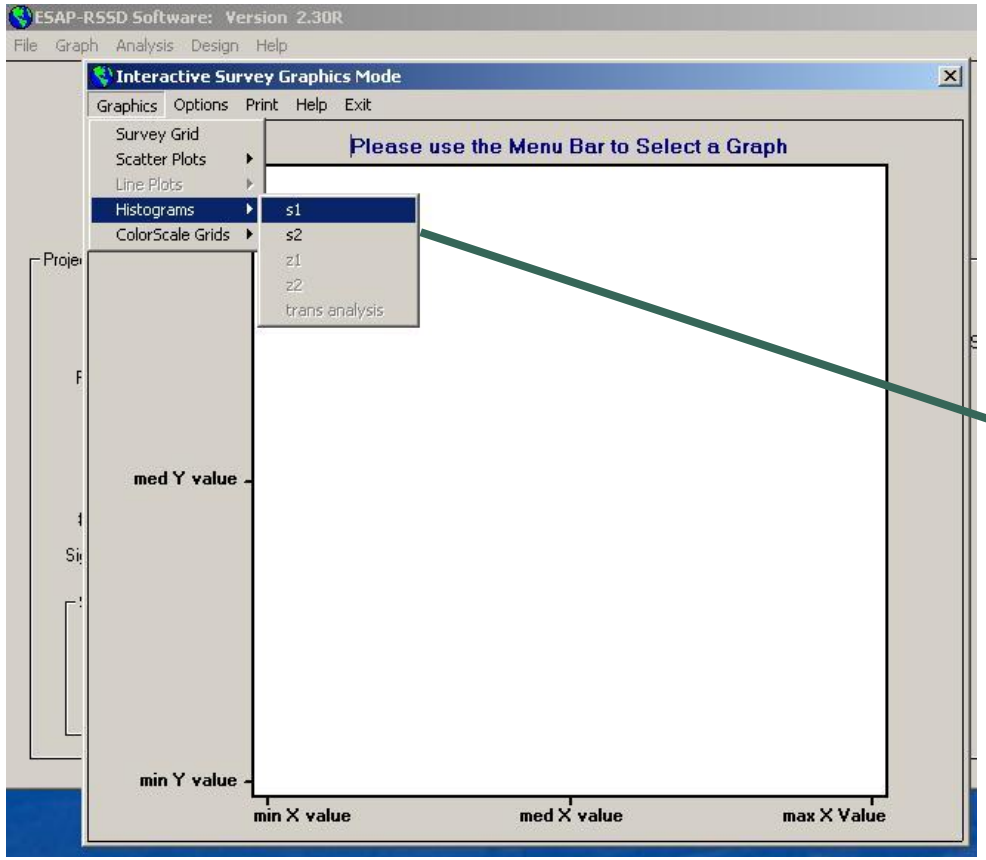
CHECKING ASSUMPTIONS

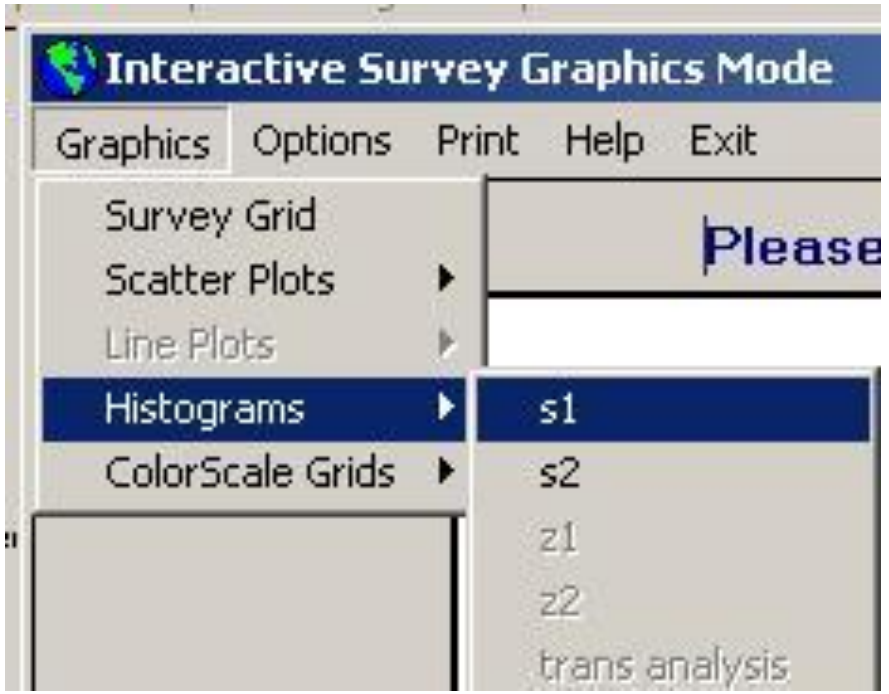
- Select Open Graphics Window under “Graph” menu.



CHECKING FOR NORMALITY

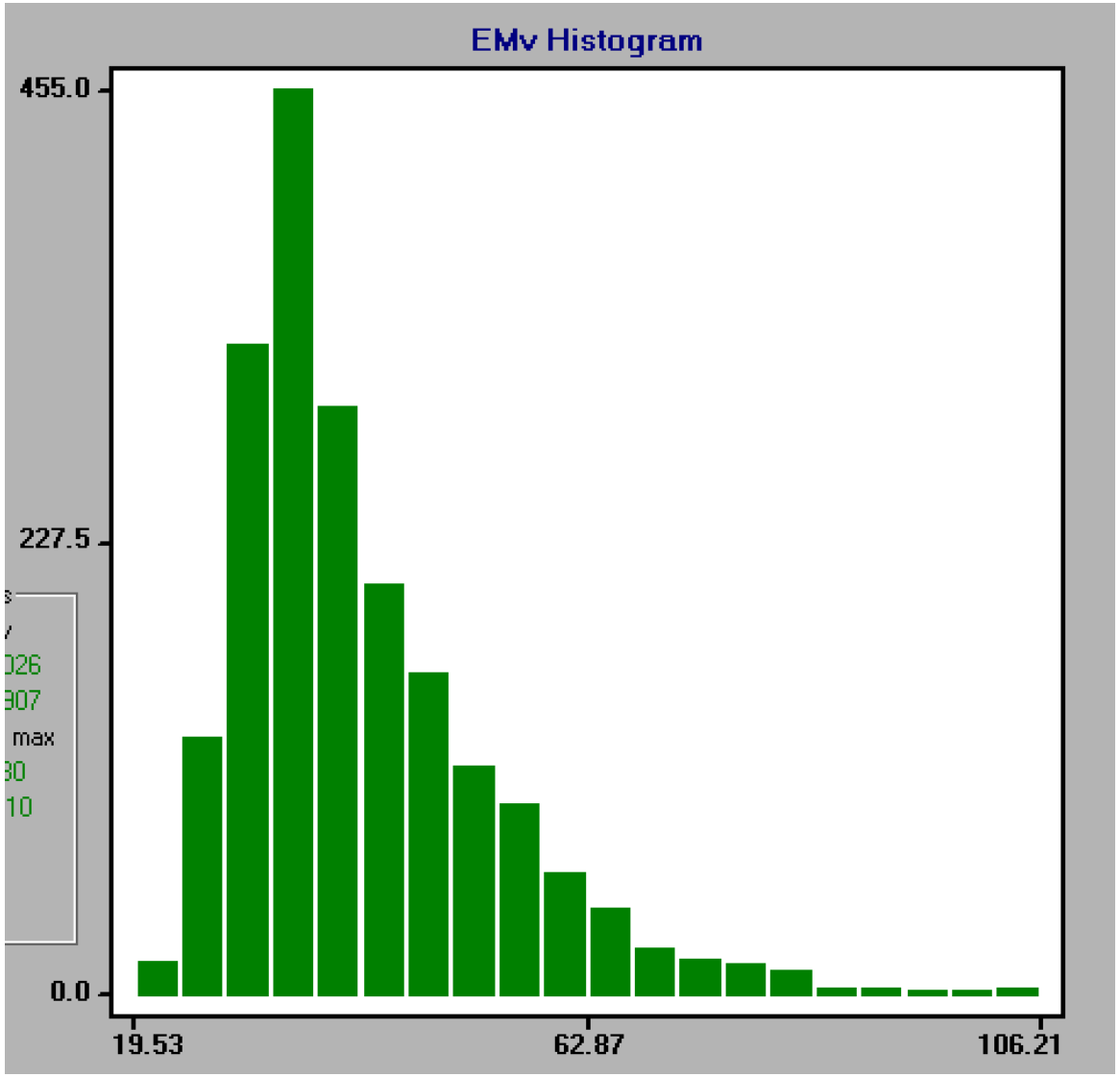
- RSSD sampling designs require that the EM values are normally distributed to satisfy statistical assumptions
- To check we must look at histograms of both EM signals (Graphics → Histograms → s1/s2





NON-NORMAL DATA AND LOG TRANSFORMATION

- Often EM data is non-normally distributed.
- This is because most fields only have small areas of lahig salinity, and not the entire field
- To correct for this, we must log-transform the data

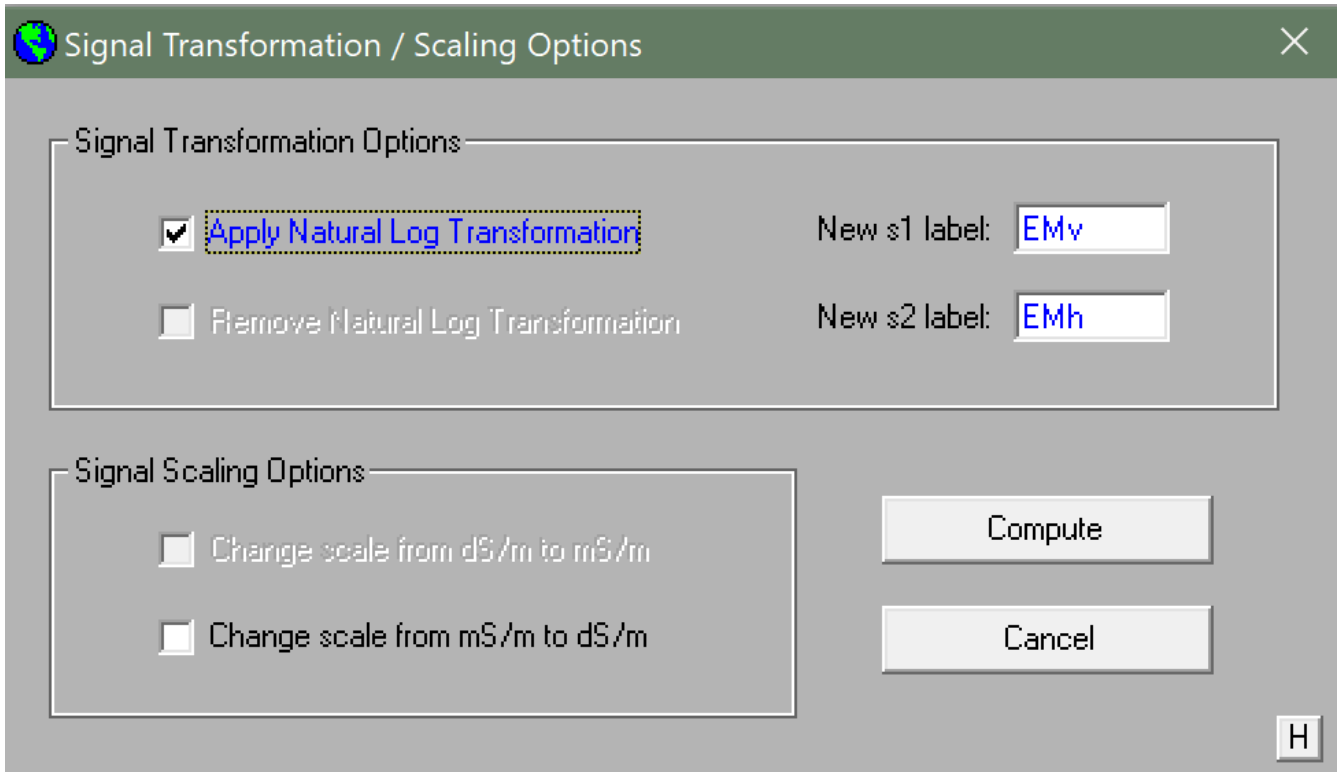


LOG TRANSFORMING DATA

- To log transform the data, under "Analysis" select "Basic Statistics"

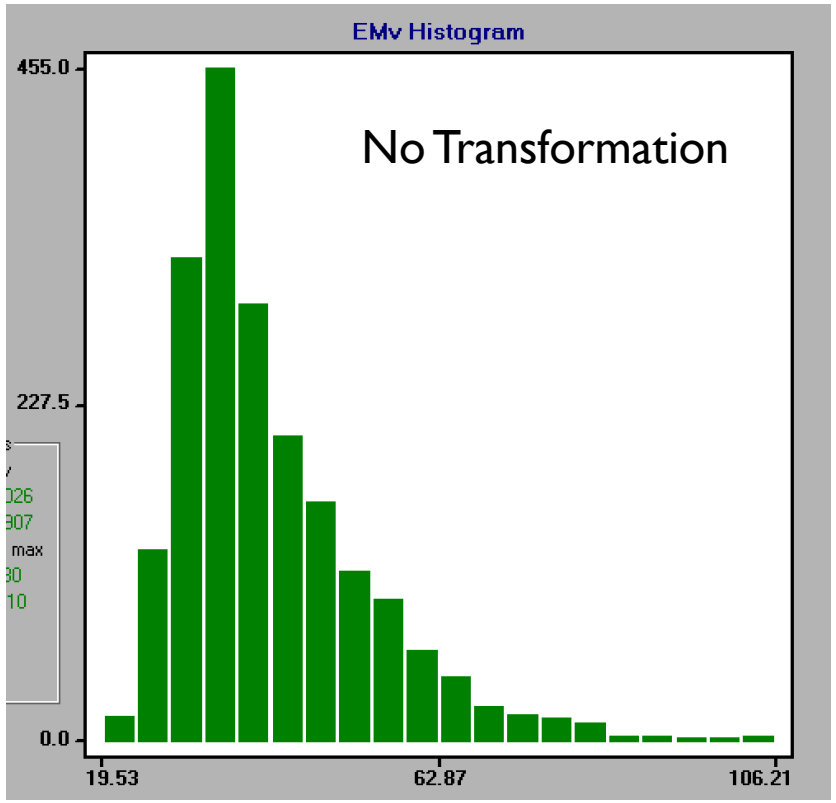
LOG TRANSFORMING DATA

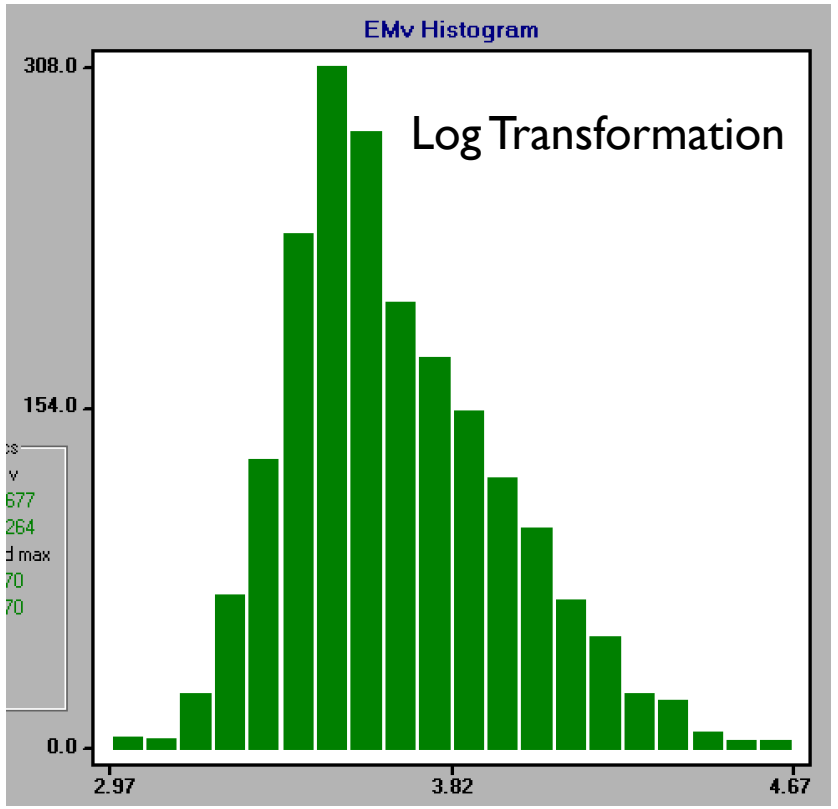
- Check "Apply Natural Log Transformation" and press "Compute"



CHECKING NEW DISTRIBUTION

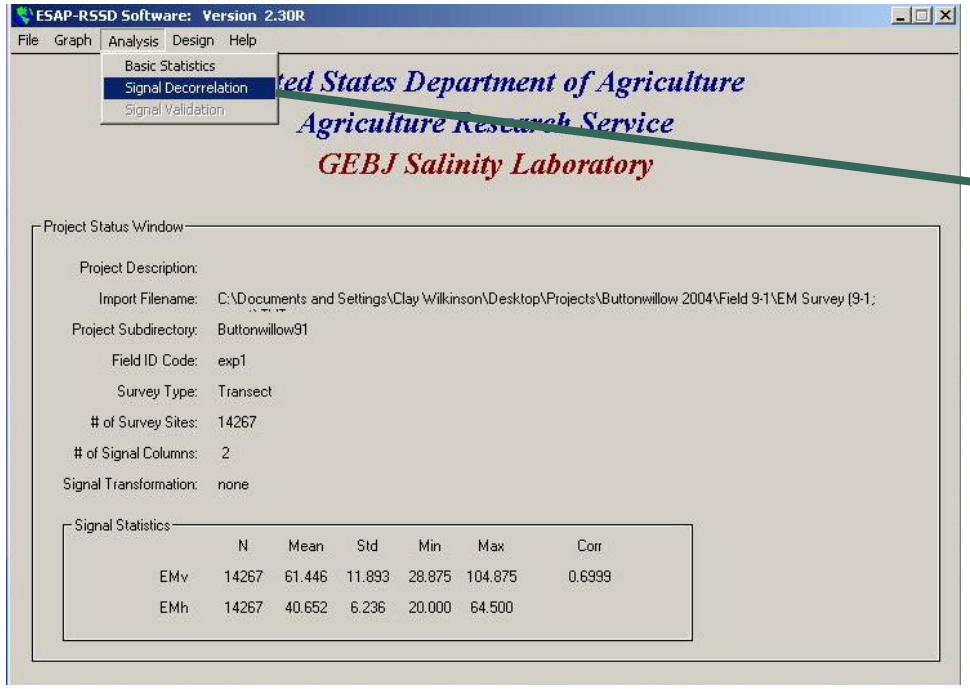
- Check to see that your log transformed data is more normally distributed in the graphics menu again.

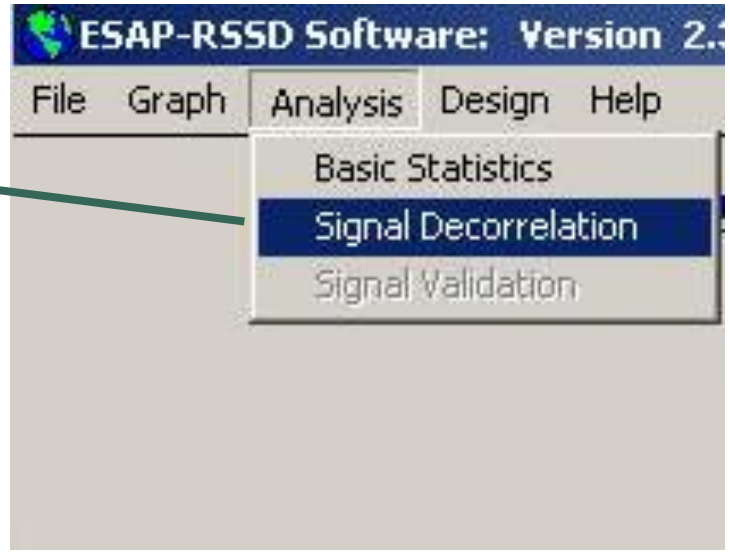




SIGNAL DECORRELATION

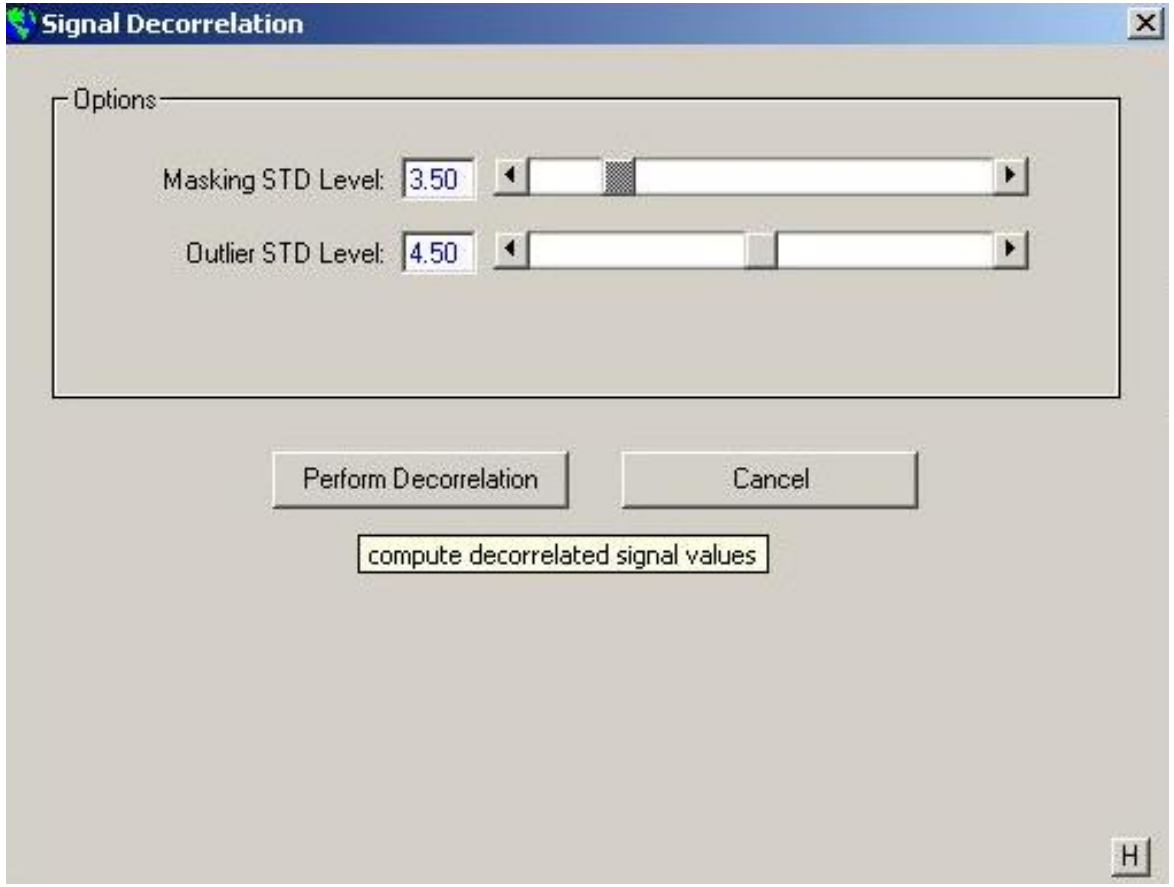
- Select Signal Decorrelation under the “Analysis” menu.





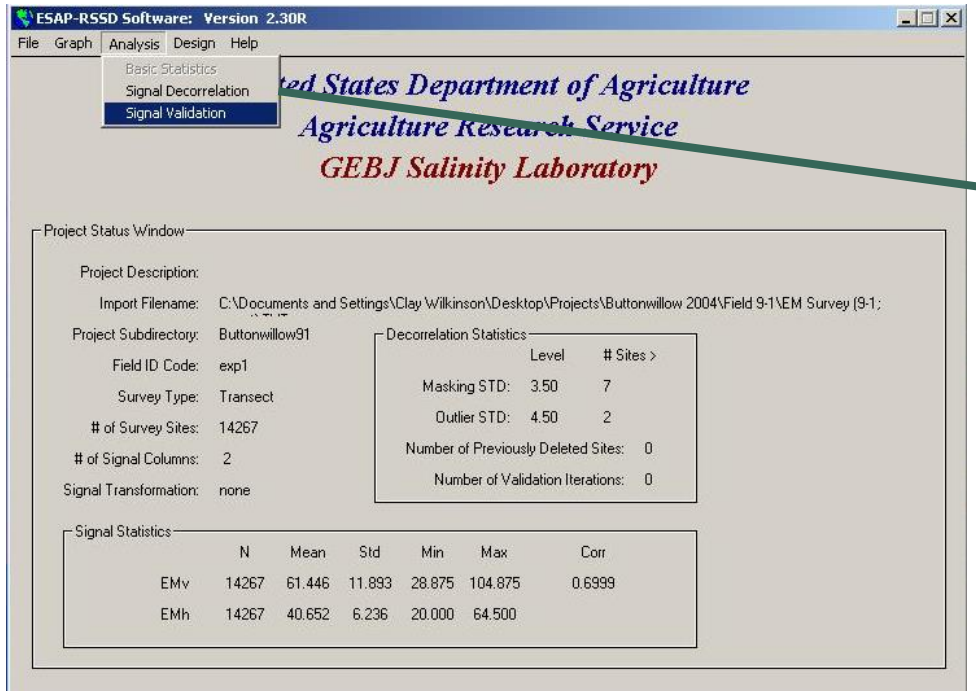
SIGNAL DECORRELATION

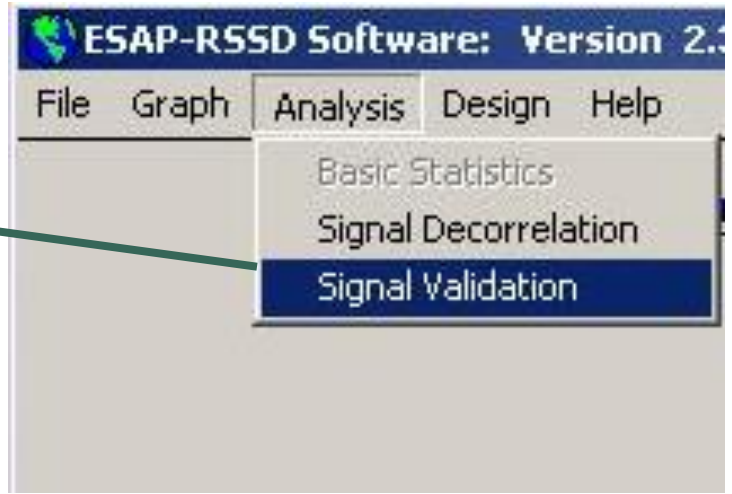
- Click “Perform Decorrelation” button.



SIGNAL VALIDATION

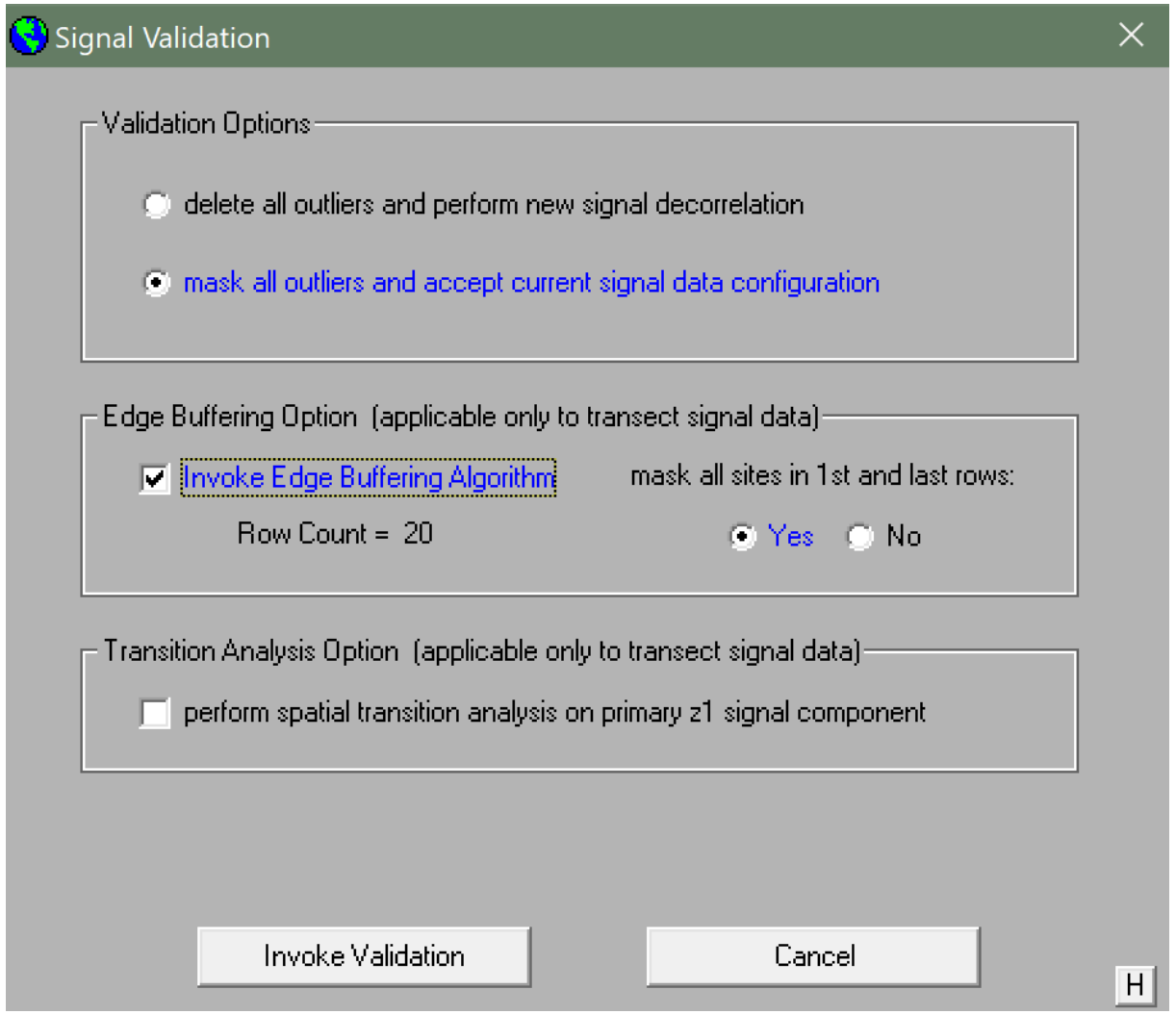
- Select Signal Validation from the "Analysis" tab





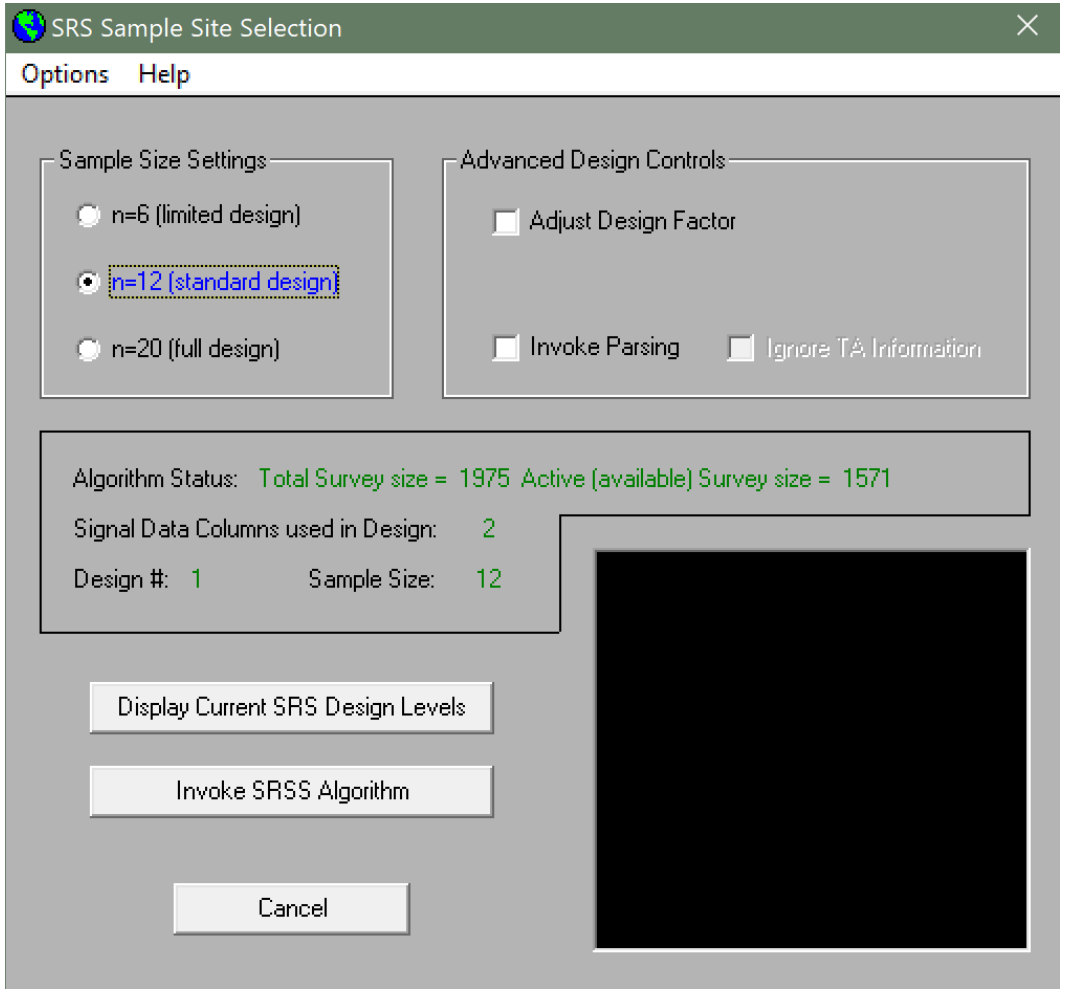
SIGNAL VALIDATION

- "Mask all outliers and accept current signal data configuration"
- Invoke edge buffering algorithm (optional)
- "Invoke Validation"



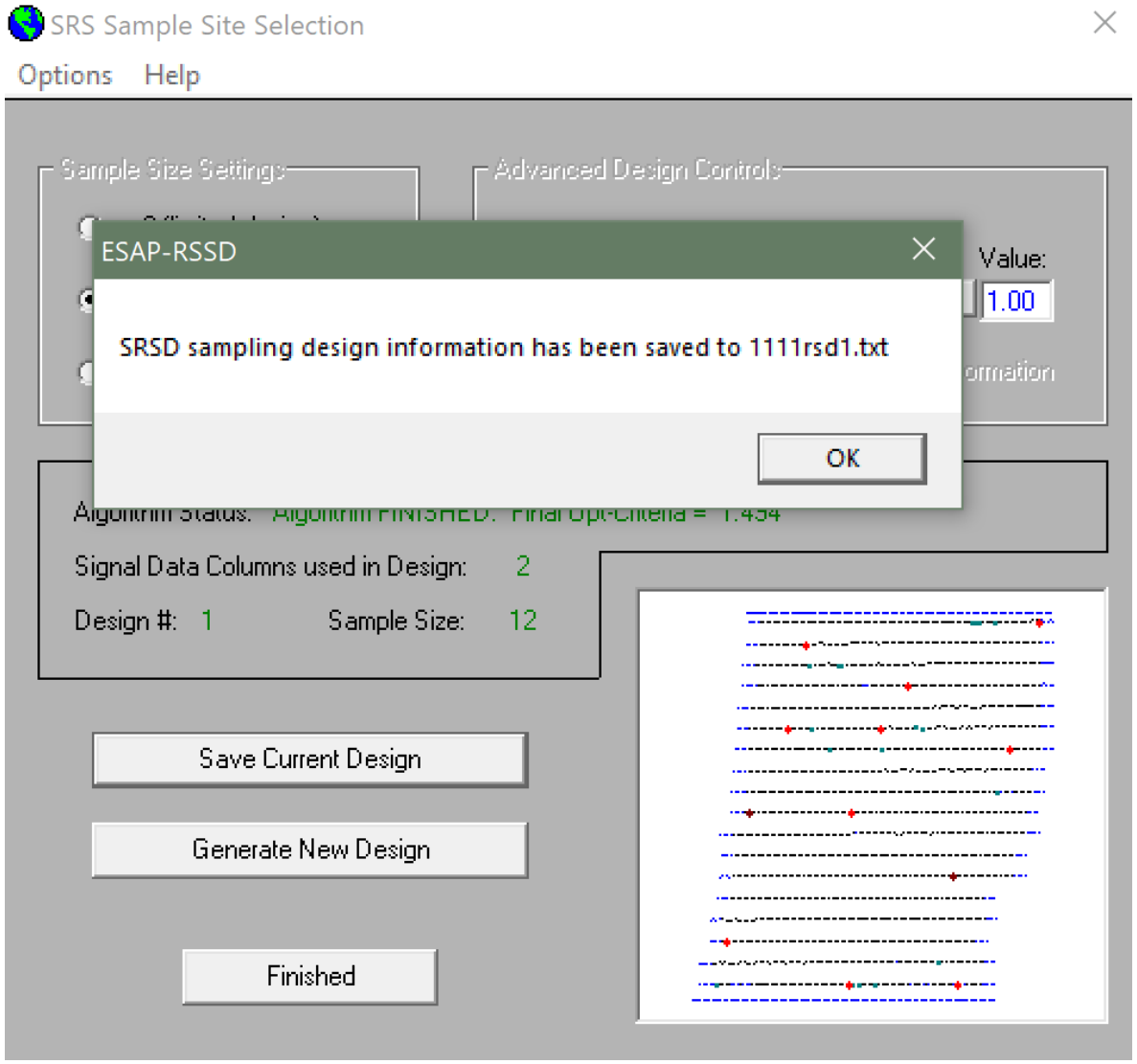
SAMPLE DESIGN

- Select Signal Validation from the "Analysis" tab
- "Invoke SRSS Algorithm"



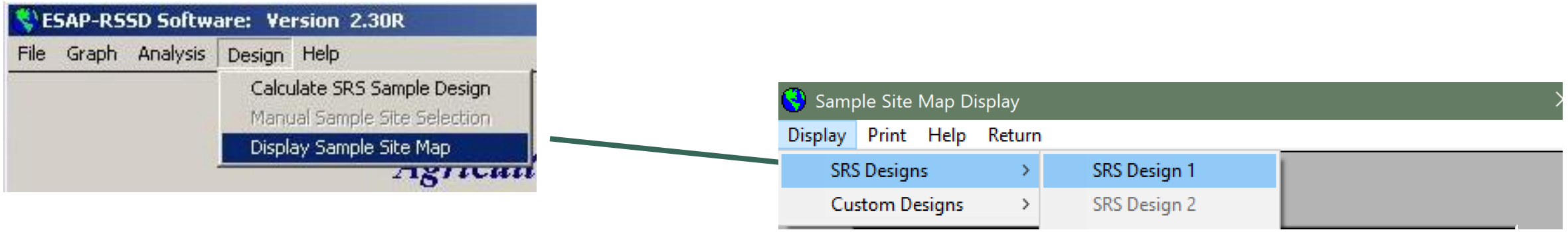
SAMPLE DESIGN

- "Save Current Design"
- Try to have Opt-Criteria 1.30 or less
  - Change design factor and/or invoke parsing to obtain best results
- Generate as many designs as needed to pick best result



SAMPLE DESIGN

- After clicking "Finished", from the main menu, open the sample site map



SAMPLE DESIGN

- You may now view and print your sample map
- To view gps coordinates and statistical results, open the project folder on the desktop and go to the "rsd1" and "gps1" files