A Tutorial for

L_SU,
a graphical user interface
for Seismic Unix (CSM),
under Linux

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1 General Information

1.1 Acknowledgements

This project is possible only because of the selfless work of others. I have shamelessly copied and modified notes extensively from the Colorado School of Mines website (Stockwell) for S*nix. Over the years, many students have also contributed to these notes: Class of 2008: Erin Walden, Kody Kramer, Erin Elliott, Andrew Harrison, Andrew Sampson, Ana Felix, JohnD'Aquin, Russell Crouch, Michael Massengale, and David Smolkin; Chang Liu (2013), Nevra Bulut (2019).

I will greatly appreciate any and all questions you have regarding installation and running of any of the programs to help us continue developing L_SU. Please send your questions to ***gllore@lsu.edu***. Please indicate what your operating system is and whether you have administrative priviliges (preferred).

Thanks,

Juan Lorenzo, BatonRouge, Dec. 5, 2019

1.2 What is L_SU?

L_SU, a graphical user interface (GUI), serves to select and build sequences of Perl modules and their parameters. L_SU generates two versions of these instructions in text files. These text files contain a shell and a Perl script version that can be modified and also executed independently of this GUI and from the command line.

Seismic Unix (Stockwell, 1999) is a widely distributed free software package for processing seismic reflection and signal processing. In Seismic Unix, a sequence of independent programs receive modify and generate data files of streams of data that are displayed on the screen. The data file is read in and the generated output data are handled internally by stdin, stdout functions in C while the data exchanges between programs and the linux operating system are managed from the command line via pipes "|" and redirections "> or <" respectively. Traditionally, the instructions on the command line can be assembled and saved as re-usable bash scripts. L_SU assembles these same scripts for the operating system to run with the help of modules written in Perl. L_SU generates these scripts within the directory of the user and thes scripts can be run independently of L_SU running.

L_SU is written using Perl/Tk which is mature, well-documented Perl module that allows its users to construct graphical user interfaces.

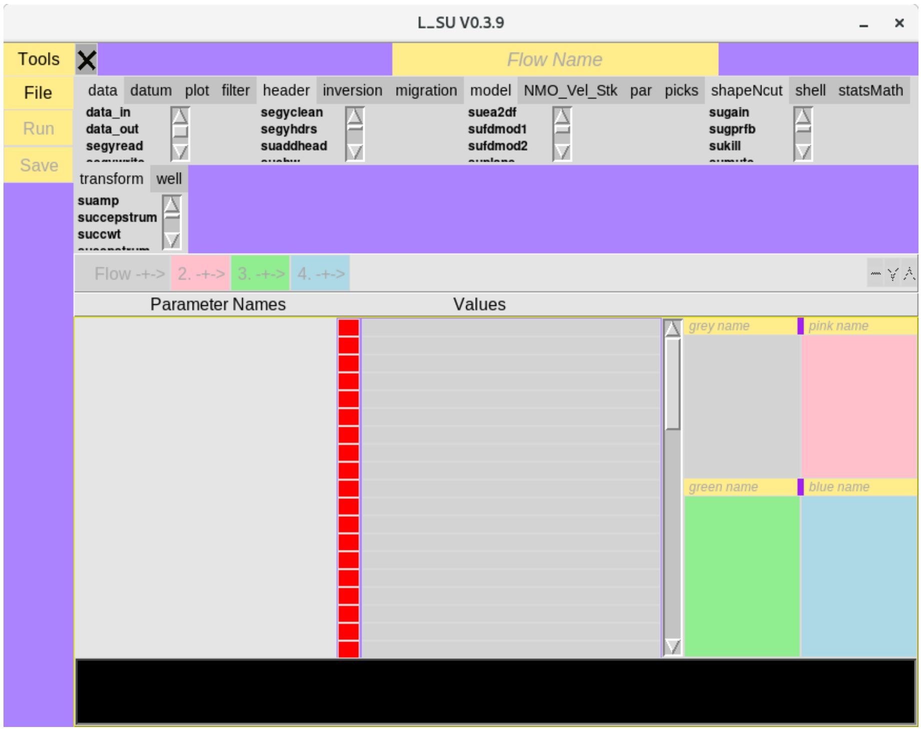
In a classroom environment, shell scripting of SU modules engages students and helps focus on the theoretical limitations and strengths of signal processing. However, complex interactive processing stages, e.g., selection of optimal stacking velocities, killing bad data traces, or spectral analysis requires advanced flows beyond the scope of introductory classes. In a research setting, special functionality from other free seismic processing software such as SioSeis (UCSD-NSF) can be incorporated readily via an object-oriented style to programming.

An object-oriented approach is a first step toward efficient extensible programming of multi-step processes, and a simple GUI simplifies parameter selection and decision making. Currently, in L_SU, Perl 5 packages wrap 65 of the most common SU modules that are used in teaching undergraduate and first-year graduate student classes (e.g., filtering, display, velocity analysis and stacking). Perl packages (classes) can advantageously add new functionality around each module and clarify parameter names for easier usage. For example, through the use of methods, packages can isolate the user from repetitive control structures, as well as replace the names of abbreviated parameters with self-describing names. Moose, an extension of the Perl 5 object system, greatly facilitates an object-oriented style. Perl wrappers are self-documenting via Perl programming document markup language.

An automatic directory structure is created for the user in which data and programs are distributed according to a pre-defined hierarchy. All the directories and minimal files needed by L_SU are created whenever a new 'Project' is created within the 'Project Selector' tool. The user can also create new projects within main GUI of L_SU as well as selecting different projects. At all times the user can use linux commands to navigate freely through the directories. Sometimes the user may find it convenient to create new subdirectories within the existing file structure. L_SU will not be able to detect these folders and their contents.

1.3 GUI Sections

1.3.1 Overview



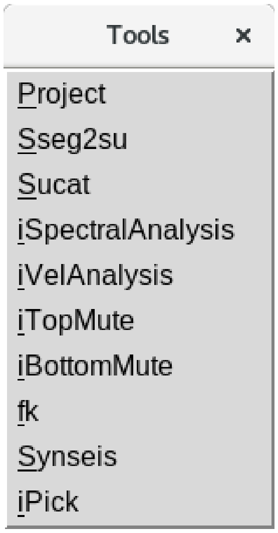
The main GUI is divided into 4 areas: Top Menu, Left Side Menu, Parameter Names and their Values, Four flow boxes, and a Message area. The large cross (**X**) in the top-left corner is used to kill many unwanted graphical process running in the background.

1.3.2 Top Menu

There are more than 400 independent programs are available from Seismic Unix. Currently L_SU implements over 65 of these.

1.3.3 Side Menu

1.3.3.1 Tools



Project: Defines the directory structure for data sets and programs in many languages, e.g. matlab, R, Perl etc.

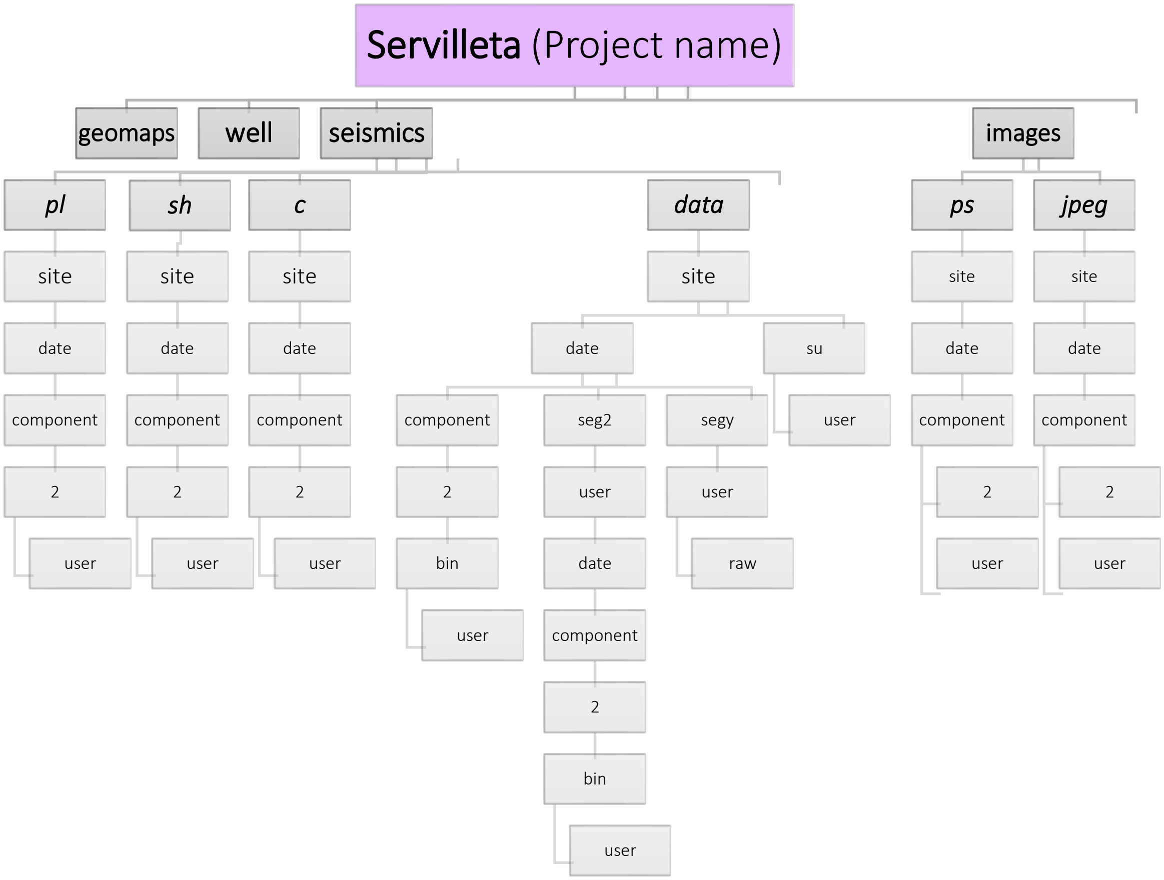
Sseg2su: Converts SEG-2 formatted data into the su format which is a simplified SEG-Y format.

% Sseg2su

Sucat: Concatenates multiple files of any format into a single file. These files can have names related by a continuous sequence of integers, e.g., Seismic Unix data files: 1000.su, 1001.su, 1002.su. If not, a list of names can be specified. Output files from interactive muting or velocity analysis and that have specific “par” formats can be handled.

% Sucat

1.4 What is an example directory structure for a Project?



1.4.1 Copying data into the project directory structure from elsewhere in the system

If you want to copy seismic data already in su (seismic unix) format copy it with the following instruction, but first move yourself into the directory that receives the data.

Example 1:

```
% cd  PROJECT_HOME/seismics/data/site/component/line/username
```

Example 2:

```
% cd  /home/gllore/seismics/data/Servilleta_demos/H/1/gllore
```

Example 2:

```
% cp data /home/refseis18/Aug27_lab1/*.su   .
```

1.4.2 Where are my flows kept?

```
% cd  PROJECT_HOME/seismics/pl/site/component/line/username
```

1.5 Text conventions in this tutorial and their meaning

Left Mouse click is abbreviated to <MB1> Instruction

Right Mouse click is abbreviated to <MB3> Instruction

Variable names are shown in a large bold-style font.

```
% Command-line instructions are shown with pink background
```

1.6 Glossary

Term	Explanation and Example	Brief
HOME	Full linux directory path to the user's home directory, e.g. /home/xavier45	home directory path
PROJECT_HOME	Located inside **HOME** directory -- can be a soft link	project directory path
Projectname	e.g., Servilleta -- a National Wildlife Refuge in New Mexico, U.S.A.	name of the project
spare_dir	can be left empty	a bonus directory
date	053018	Of field work
component	Z stands for vertical and and H can be horizontal but any name is possible	Geophone particle displacement component
line	1	used to identify a profile
user	e.g., xavier45	login name

subUser	must be set to the user’s login name, e.g.,also xavier45	Allows groups to share Project space
flow	Data_in, sugain, suximage	Sequence of programs to execute
geomaps	Directories will be created when working with-maps	Directories for third-party software (if installed and accessible)
sqlite	Databases	Directories for third-party software (if installed and accessible)
gmt	GMT	Directories for third-party software (if installed and accessible)
grass	GRASS GIS	Directories for third-party software (if installed and accessible)

Table 1: Definitions of terms used when creating working projects

2 Demonstration Projects

When either creating a new project or accessing a pre-existing project instances, always start by running the following instruction:

```
% L_SU
```

2.1 A Quick start to preparing a demonstrations

2.1.1 Where are my data sets stored?

Before starting a new project you should understand the file structure in which programs and data sets are stored. The main directories are shown above for the example of Servilleta_demos in Section 1.4.

2.1.2 Install example flows and data sets

Several example projects that contain data and examples flows can help you become acquainted with the Seismic Unix Tools. For example:

- ***Servilleta_demos contains files from the 2018 IRIS internship orientation program***
- ***LSBB contains files from Pau University in France, courtesy of Dominique Dominique Rousset and Guy Sénéchal, both extensive contributors to the improvement of Seismic Unix.***
- ***Demos contains general demonstrations of tools not included in the previous tutorials***

The following is explained the L_SU Installation manual (Section 1.3.6) but is repeated here for convenience of the user. Once you completely instal L_SU on your system, you can move or copy any of the accompanying demonstration folders to the home directory of the user, where /home/user is the complete path to the location of the user (=”gllore”).

```
% cp -R $installation_directory_for_L_SU/L_SU/demo_projects/Servilleta_demos
        /home/gllore/

% cp -R $installation_directory_for_L_SU/L_SU/ demo_projects/LSBB      /home/gllore/

% cp -R $installation_directory_for_L_SU/L_SU/ demo_projects/demos     /home/gllore/
```

2.1.3 Create a new project, e.g., Servilleta_demos (IRIS demonstration data set)

The following instruction starts the program:

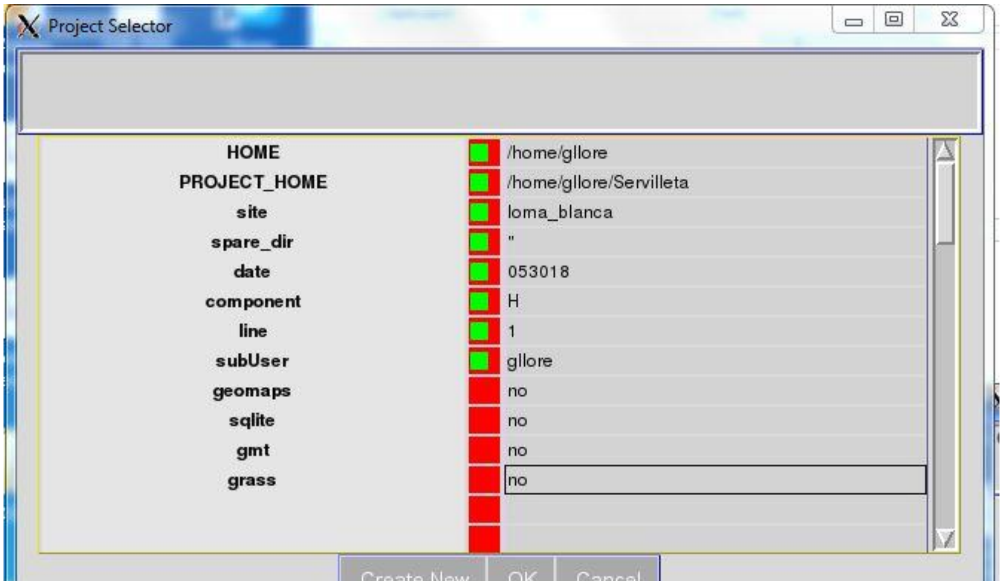
```
% L_SU
```

If you do not have any projects created previously, then:

<MB1> Create New

Otherwise, go to next section 2.1.5: Open a pre-exisitng project

After clicking on Create New, a default set of parameter names (e.g., **HOME**) and their values (e.g. **/home/gllore**) appears:



HOME	🟩	/home/gllore
PROJECT_HOME	🟩	/home/gllore/Servilleta
site	🟩	loma_blanca
spare_dir	🟩	''
date	🟩	053018
component	🟩	H
line	🟩	1
subUser	🟩	gllore
geomaps	🟥	no
sqlite	🟥	no
gmt	🟥	no
grass	🟥	no
	🟥	
	🟥	

Figure 1: Screen capture of Project Selector Pane with parameters and their values

The Project Selector pane displays several default options that work with the test data set that is included for this tutorial. The old variables are defaulted from prior projects and serve as an example to guide your input. The home directory of the user is required to follow the standard linux file structure naming system.

These options should be <u>updated</u> with an actual <u>user</u> name, for example:

Parameter name	Default values	User's new values
HOME	/home/**gllore**	home/user

PROJECT_HOME	/home/gllore/Servilleta_demos	/home/**user**/Servilleta_demos
Site	Servilleta	loma-blanca
spare_dir	“”	
date	053018	053018
component	Z	H
line	2	1
subUser	**gllore**	user
geomaps	no	no
sqlite*	no	no
gmt*	no	no
grass*	no	no

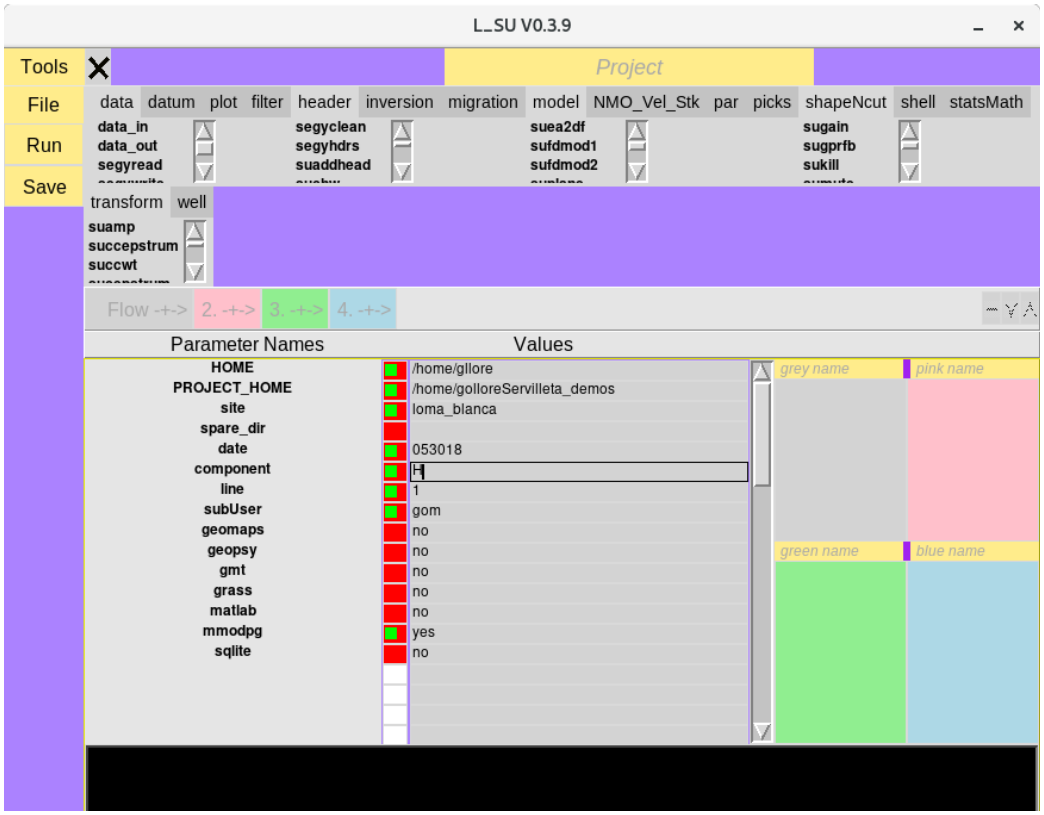
Table 1: Suggested changes to parameter vlaues

*** if set to ‘yes’ only the directories will come to be created although the accompanying programs are not yet available in this version (Nov. 2019)**

Finally, select: <MB1> OK

2.1.4 For the IRIS Data set, confirm you are working Project called “Servilleta_demos”

In the top left menu, select <MB1> Tools->Project

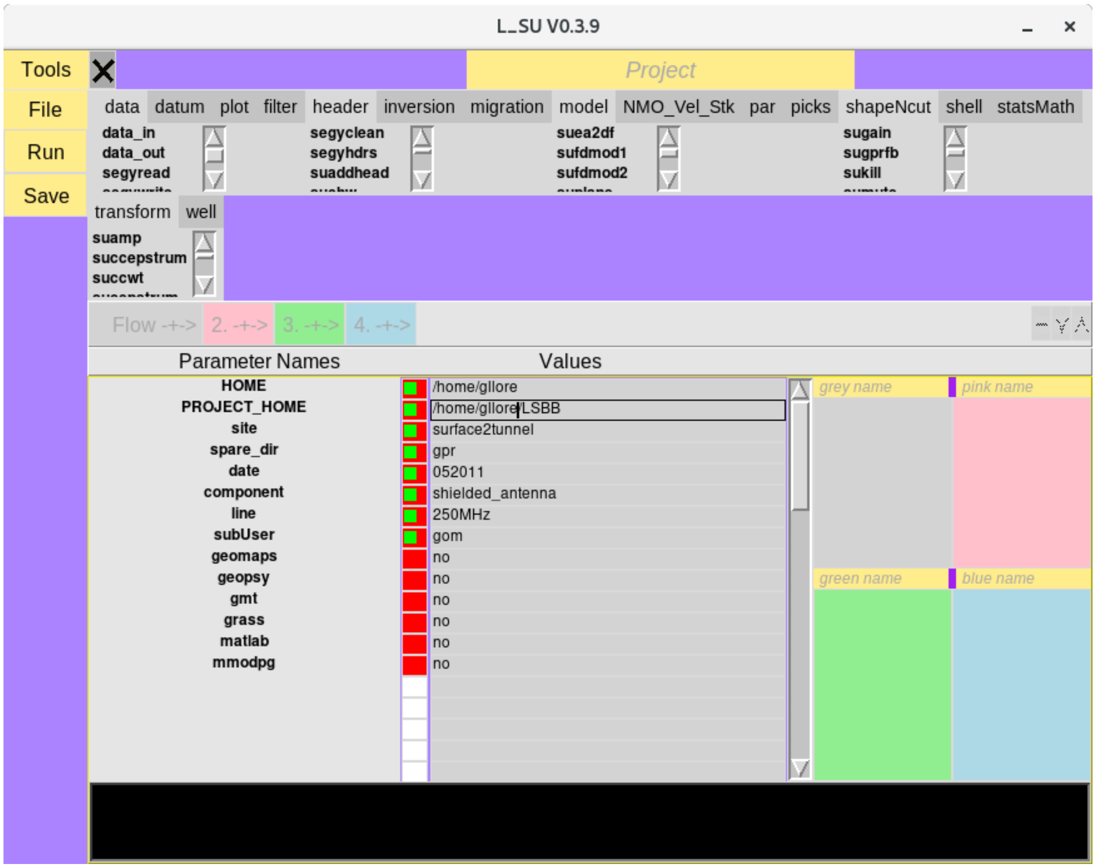


Parameter Names		Values
HOME	🟩	/home/gllore
PROJECT_HOME	🟩	/home/golloreServilleta_demos
site	🟩	loma_blanca
spare_dir	🟥	
date	🟩	053018
component	🟩	H
line	🟩	1
subUser	🟩	gom
geomaps	🟥	no
geopsy	🟥	no
gmt	🟥	no
grass	🟥	no
matlab	🟥	no
mmodpg	🟩	yes
sqlite	🟥	no

In the main window of the L_SU GUI you should see the previous changes you made to the same parameter values. It they are incorrect (the figure above show an inconsistent use of the user name) you can modify them again and, whthout exiting this window you can then select:

In the top left menu: <MB1> Save->Run

2.1.5 For the GPR data sets (from LSBB), confirm you are working Project called “LSBB”



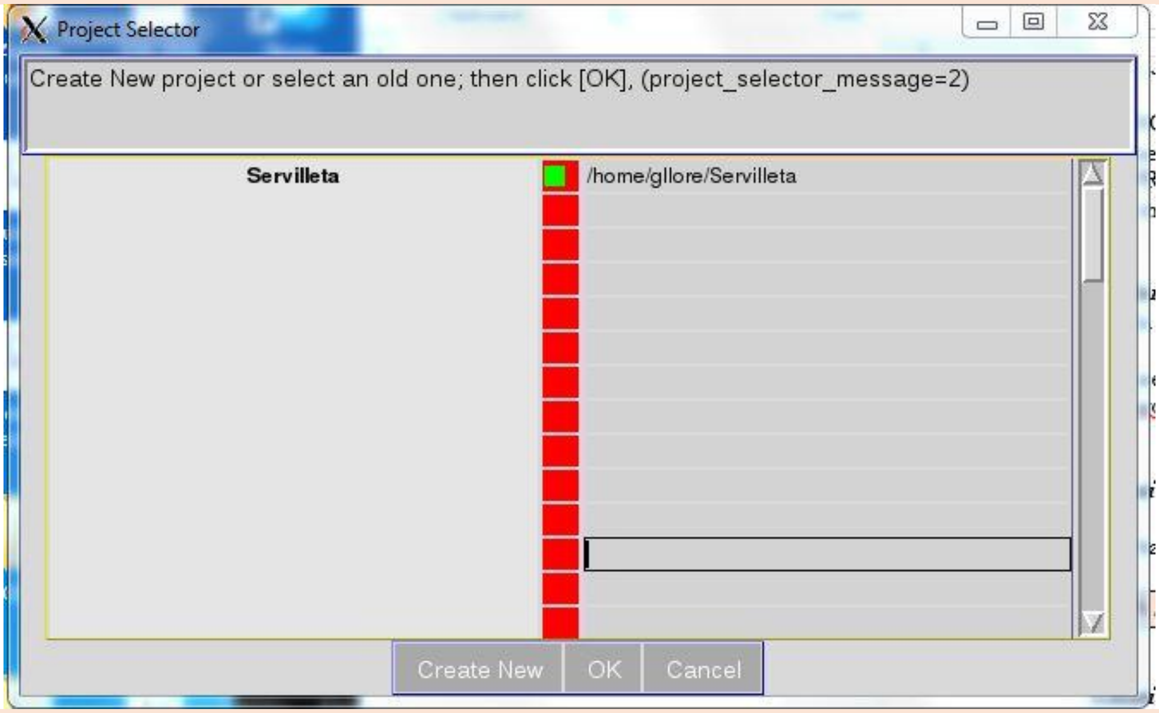
Parameter Names		Values
HOME	🟩	/home/gllore
PROJECT_HOME	🟩	/home/gllore/LSBB
site	🟩	surface2tunnel
spare_dir	🟩	gpr
date	🟩	052011
component	🟩	shielded_antenna
line	🟩	250MHz
subUser	🟩	gom
geomaps	🟥	no
geopsy	🟥	no
gmt	🟥	no
grass	🟥	no
matlab	🟥	no
mmodpg	🟥	no

2.1.6 For the remaining Demo Project confirm you are working Project called “demos”

2.2 Open a pre-existing project

2.2.1 The following instruction starts the program, and open the pane of the Project Selector window:

```
% L_SU
```



Create New project or select an old one; then click [OK], (project_selector_message=2)

If the project of interest (in this case Servilleta_demos) is selected (button is green) :

Select: <MB1> on OK

2.3 Running your first flows

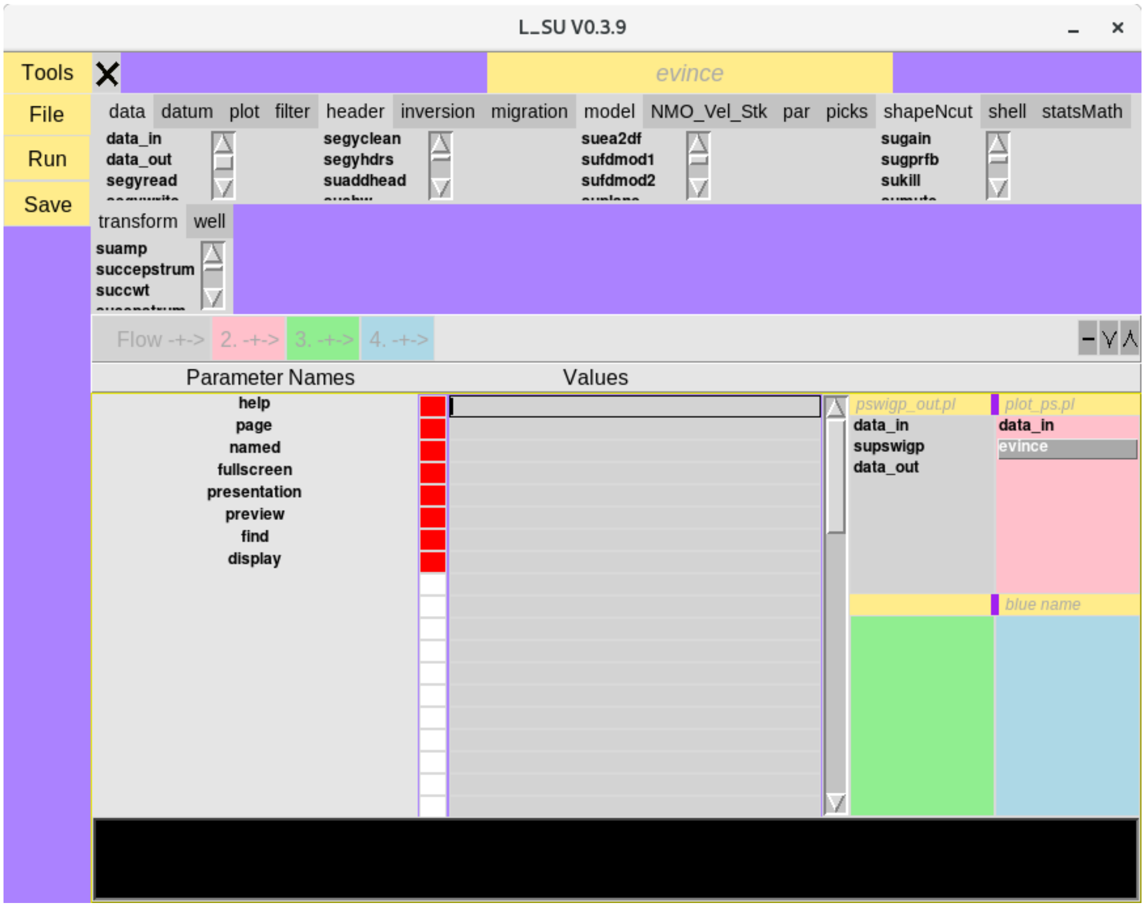
Assemble a sequence of modules to carry out a processing procedure. Choose one of four differently colored flow windows (grey, pink, green and blue) in which to place your sequence. The colored window appear on the right-hand side of the main window.

A module, with a specific functionality, is selected by clicking on its name from within the list on the left-hand side of the main window.

The module name must be transferred to the list on the right by clicking one of the four different colored flow arrows, just to the right of the word “Flow”.

A final assembled flow must first be saved to a file before it is executed (**File->SaveAs**). Thereafter all executions require that the flow be first saved before running.

In a simple sequence of modules, data are usually read in first, the data is modified and the result is placed into another file or displayed using an imaging module (e.g., suximage, suxwigb)



1. Select the following named modules: ***data_in, supswig, and data_out***. Click on each names inside list on the left side of the window. When you do that, the words in the row immediately above will become activated. You will then be able to click on the words inside the grey box:

Flow-+->

You should be able to see the name of the program that you just selected move over to a colored box on the right-hand side of the window.

Select each of the three program names: ***data_in, supswigp***, and ***data_out***

2. You are required to select a **Value** for **base_file_name** (= "file name").

To do so, move your cursor into the corresponding row to the right of **base_file_name**.

A click of the right-mouse-button will automatically open a second window from which you can select a file, e.g. **“103.su”**.

Before you can run the program you have built, it must be saved:

For L_SU GUI

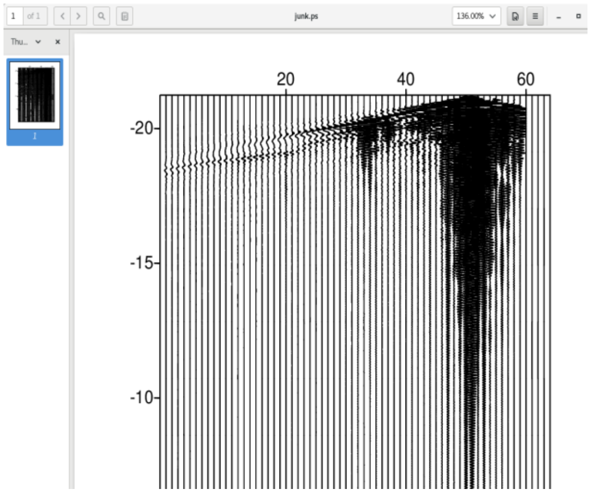
<MB 1> File/SaveAs

Save the resultant perl script file as, e.g.,

“pswigp_out.pl”

Then, click on

Tool: <MB 1> Run



Postscript plot viewed using the GUI

Tool: <MB1> Run

2.3.1 Perl and Shell script flows generated by L_SU

GUI-generated perl script: plot_ps.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl plot_ps.pl
```

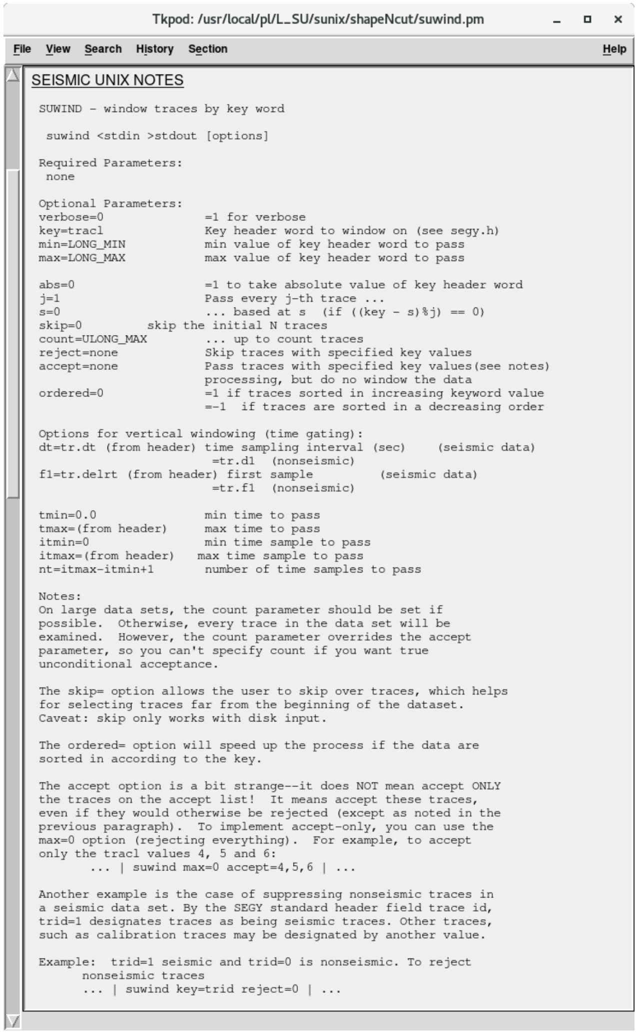
To run the bash script from the command line that is generated by **plot_ps.pl**:

```
% evince /home/gllore/Servilleta_demos/seismics/images/ps/loma_blanca//053018/H/1/gllore/junk.ps &
```

(Note that **pswigp_out.pl** is run first and and **plot_ps.pl** second.

2.3.2 Access to Documentation

Select **<MB3>** over the name of the program:



```
SEISMIC UNIX NOTES

 SUWIND - window traces by key word

  suwind <stdin >stdout [options]

 Required Parameters:
  none

 Optional Parameters:
 verbose=0               =1 for verbose
 key=tracl               Key header word to window on (see segy.h)
 min=LONG_MIN            min value of key header word to pass
 max=LONG_MAX            max value of key header word to pass

 abs=0                   =1 to take absolute value of key header word
 j=1                     Pass every j-th trace ...
 s=0                     ... based at s  (if ((key - s)%j) == 0)
 skip=0         skip the initial N traces
 count=ULONG_MAX         ... up to count traces
 reject=none             Skip traces with specified key values
 accept=none             Pass traces with specified key values(see notes)
                         processing, but do no window the data
 ordered=0               =1 if traces sorted in increasing keyword value
                         =-1  if traces are sorted in a decreasing order

 Options for vertical windowing (time gating):
 dt=tr.dt (from header) time sampling interval (sec)    (seismic data)
                          =tr.d1  (nonseismic)
 f1=tr.delrt (from header) first sample         (seismic data)
                          =tr.f1  (nonseismic)

 tmin=0.0                min time to pass
 tmax=(from header)      max time to pass
 itmin=0                 min time sample to pass
 itmax=(from header)    max time sample to pass
 nt=itmax-itmin+1        number of time samples to pass

 Notes:
 On large data sets, the count parameter should be set if
 possible.  Otherwise, every trace in the data set will be
 examined.  However, the count parameter overrides the accept
 parameter, so you can't specify count if you want true
 unconditional acceptance.

 The skip= option allows the user to skip over traces, which helps
 for selecting traces far from the beginning of the dataset.
 Caveat: skip only works with disk input.

 The ordered= option will speed up the process if the data are
 sorted in according to the key.

 The accept option is a bit strange--it does NOT mean accept ONLY
 the traces on the accept list!  It means accept these traces,
 even if they would otherwise be rejected (except as noted in the
 previous paragraph).  To implement accept-only, you can use the
 max=0 option (rejecting everything).  For example, to accept
 only the tracl values 4, 5 and 6:
        ... | suwind max=0 accept=4,5,6 | ...

 Another example is the case of suppressing nonseismic traces in
 a seismic data set. By the SEGY standard header field trace id,
 trid=1 designates traces as being seismic traces. Other traces,
 such as calibration traces may be designated by another value.

 Example:  trid=1 seismic and trid=0 is nonseismic. To reject
       nonseismic traces
       ... | suwind key=trid reject=0 | ...
```

Conventional Seismic Unix documentation for the modul: suwind

3 Simple Processing Flow: IRIS Data Set, Socorro New Mexico

Each year Incorporated Research Institutions for Seismology (IRIS) hold an orientation week for undergraduate research interns in the town of Socorro, New Mexico. As part of a week of training, the on May 30 of 2018, the students collected an active-source seismic data set, which we process using Seismic Unix.

3.1 Processing steps

The following outline is taken from a called notes.pl. This files exists in the perl flow directory (1.4.3) of the Servilelta_demos project. To get there change to the following directory:

```
% cd  /home/user/seismics/pl/site/component/line/user
```

To see the marked-up contenst of the perl file:

```
%perldoc notes.pl
```

```
LOMA BLANCA

  IRIS 2018 survey May 30 2018
  on S bank of Rio Salado
  along same line as pseudo-walkaway taken on 032618
  shoot-through

Acquisition paramters

Date                053018
SI                  1000 S/s
delrt                -11 ms
rec. length                  2 s
num tracr             64
Live channels           1-64
Channel 1             closest to recorder-- toward SE
Channel 64             farthest from recorder-- toward NW
geophones: Geospace            28 Hz L-4 3 component
geophone spacing:      1 m
line orientation:          NW-SE later shots more toward NW
Number of Geophones            60
Shotpoint Spacing      1 m
GPS is available (etrex garmin  10 m)

                    (sx-m)    NOMINAL offset-m        ACTUAL (m)
Raw SP 1                 0                    1-60              0.5 - 59.5
Raw SP 2                 1                    0-59             -0.5 - 58.5
Raw SP 3                 2                    -1-58            -1.5 - 57.5
Raw SP 4                 3                    -2-57             -2.5 - 56.5
Raw SP 60                59                   -58-1            -58.5 - 0.5
Striker plate    I-beam
Hammer                   10 lb sledge
No. blows            3 per side

  Noise sources:        5 - 10 mph from SE
  I-25                       to  E
```

Acquisition parameters taken from the file notes.pl

3.2 STEP 1. File format conversion

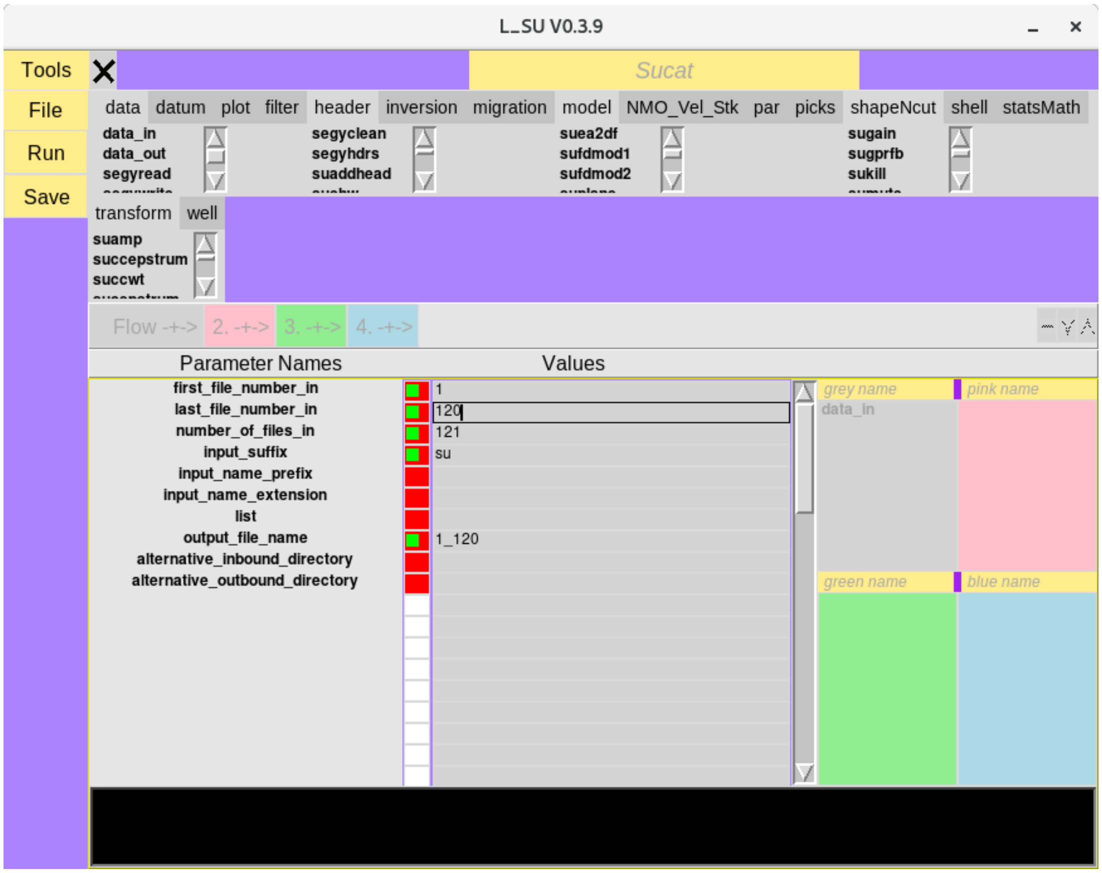
Tool: Seg2su (from GUI)

Purpose: Convert Seg2 to Seismic Unix format
Input: 1 to 120.dat
Output: 1 to 120.su

3.3 STEP 2. Concatenate files

Tool: **Sucat** (from GUI)
Purpose: cat all files
Input: 1.su to 120.su
Output: 1_120.su
Uses: /home/gllore/Servilleta_demos/seismics/pl/loma_blanca/053018/**Sucat.config**

L_SU Gui:



Parameter Names	Values
first_file_number_in	1
last_file_number_in	120
number_of_files_in	121
input_suffix	su
input_name_prefix	
input_name_extension	
list	
output_file_name	1_120
alternative_inbound_directory	
alternative_outbound_directory	

3.4 STEP 3. Clean headers

Flow name: **Suclean_geom.pl** (from GUI)

Purpose: Modify the geometry headers for shoot-through survey by wiping certain headers and populating new ones

Input: 1_120.su
Output: 1_120_clean.su

3.5 STEP 4. Window the shotpoint gathers

Flow name: **Suwind.pl** (from GUI)

Purpose: Only allow
traces 1-60 (exclude last 4 in each gather)

Input: 1_120_clean.su
Output: All.su

To view the data as an image: **view_All.pl** (from GUI)

3.6 STEP 5. Negative stack

Flow name: **suop2.pl**
Input: L28HzHit_fromNE.su and L28HzHit_fromSW.su
Output: L28Hz_Ibeam.su

Subtract 'from-NE_shotgathers' from 'from-SW-gathers'

To view the data: **view_L28Hz_Ibeam.pl** (from GUI)

3.7 STEP 6. Modify header files--gx,ep,sx

SuGeom2.pl (from GUI)
Purpose: populate headers with meaningful values;
header names are: gx, ep and sx

Input: L28Hz_Ibeam
Output: L28Hz_Ibeam_geom2

To verify new header parameters: **SuPlotHeader.pl** (from GUI)

To view new header parameter numerical values: **suxedit**
If you want to directly view the data change to the current data directory (2.4.1):

```
% cd /home/gllore/Servilleta_demos/seimics/data/loma_blanca//053018/H/1/su/user
```

And then when you are in the correct data directory:

```
% suxedit L28Hz_Ibeam_geom2
```

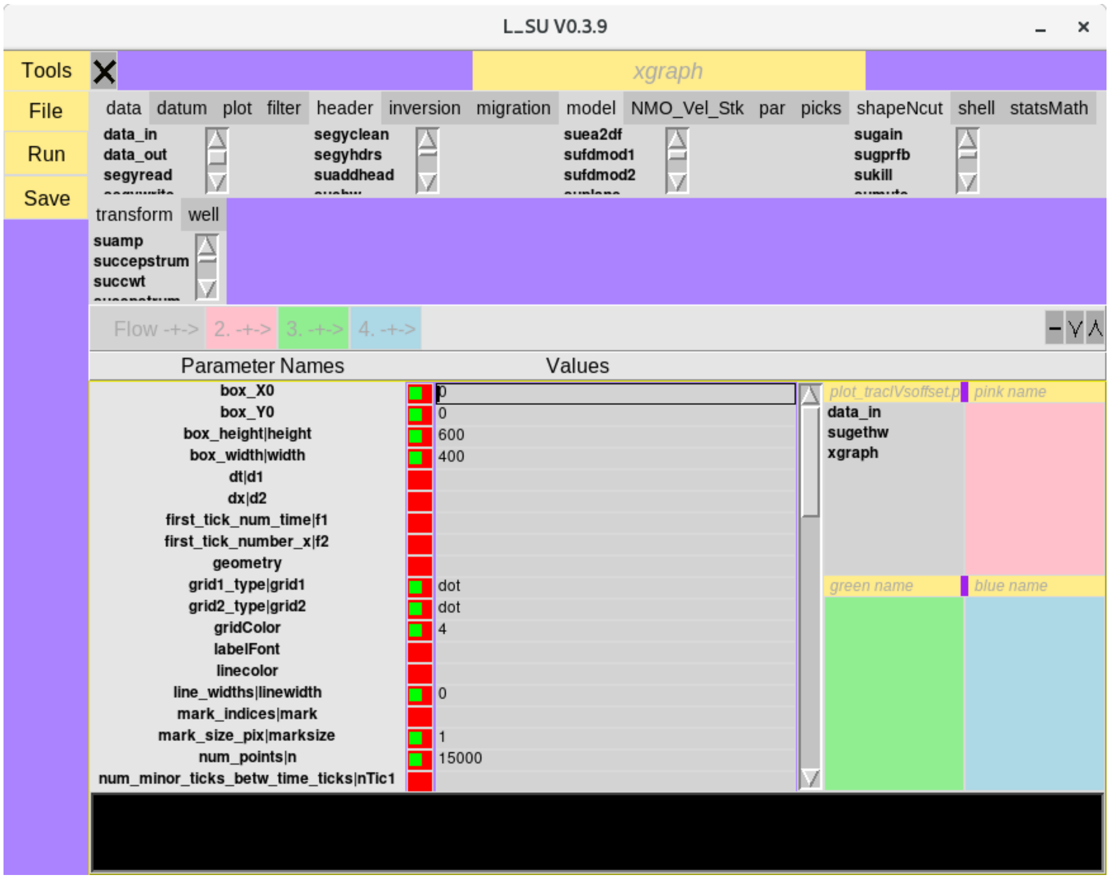
3.8 STEP 7. Modify Header files--offsets

SuGeom3.pl (from GUI)

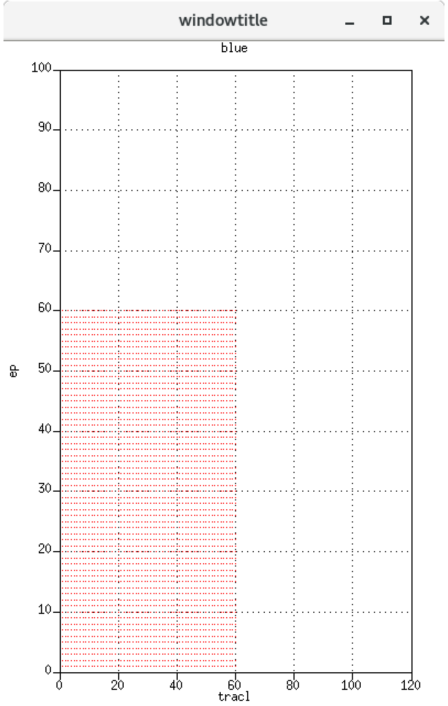
Purpose: Add offsets to headers

Input: L28Hz_Ibeam_geom2
Output: L28Hz_Ibeam_geom3

Graphically verify new header parameters using **view_traclVsoffset.pl**



Parameter Names		Values
box_X0	🟩	0
box_Y0	🟩	0
box_height|height	🟩	600
box_width|width	🟩	400
dt|d1	🟥	
dx|d2	🟥	
first_tick_num_time|f1	🟥	
first_tick_number_x|f2	🟥	
geometry	🟥	
grid1_type|grid1	🟩	dot
grid2_type|grid2	🟩	dot
gridColor	🟩	4
labelFont	🟥	
linecolor	🟥	
line_widths|linewidth	🟩	0
mark_indices|mark	🟥	
mark_size_pix|marksize	🟩	1
num_points|n	🟩	15000
num_minor_ticks_betw_time_ticks|nTic1	🟥	



Plotted header values of tracl versus offset display a regular geometric pattern that reflects the regular acquisition geometry of soruces and ssoureces used in the experiment.

Numerically verify new header parameters using **suxedit**

Convention: Positive offets are when geophones lie N of shot. Negative offsets are when shot lies N geophone

```
% cd /home/gllore/Servilleta_demos/seimics/data/loma_blanca//053018/H/1/su/user
```

And then when you are in the correct data directory:

```
% suxedit L28Hz_Ibeam_geom3
```

3.9 STEP 8. Modify Header files--Make CMP's

make_cmp.pl (from GUI)

Purpose: Put cdp values in the ”cdp” headers

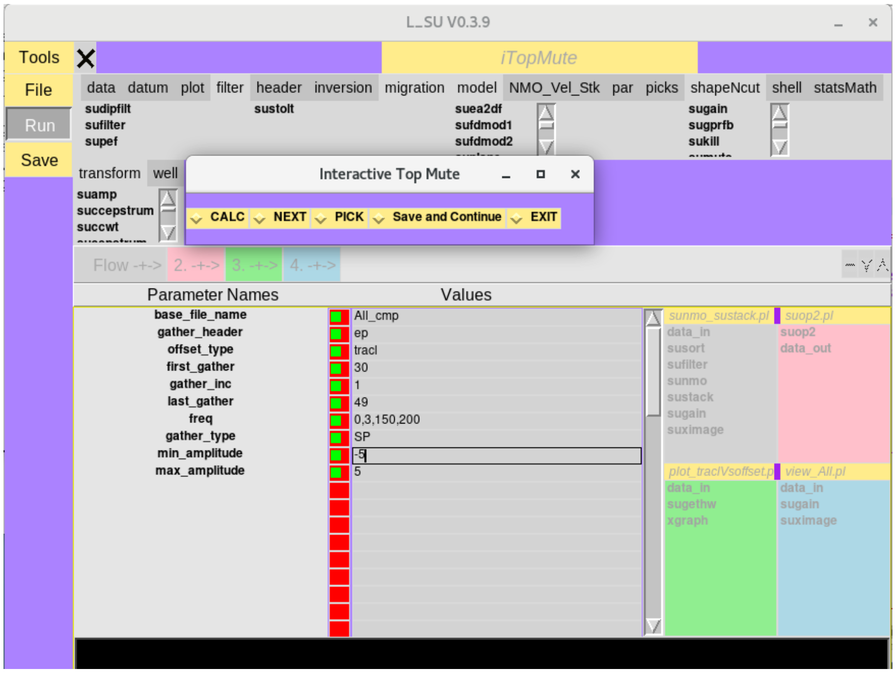
Input: L28Hz_Ibeam_geom3
Output: All_cmp(.su)

3.10 STEP 9. Dip filter

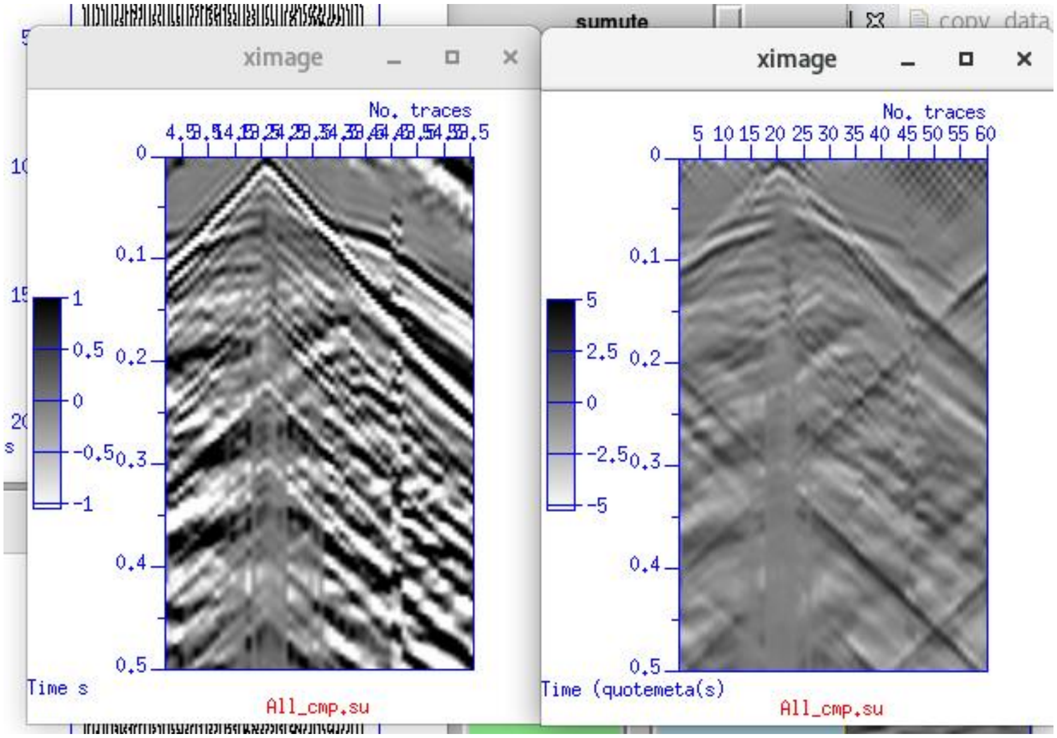
Tool: **ifk** (interactive velocity filtering)

Purpose: Useful for separation of reflections from surface waves
Uses: /home/gllore/Servilleta_demos/seismics/**pl**/loma_blanca/053018/Sucat.config

L_SU Gui



Parameter Names	Values
base_file_name	All_cmp
gather_header	ep
offset_type	tracl
first_gather	30
gather_inc	1
last_gather	49
freq	0,3,150,200
gather_type	SP
min_amplitude	-5
max_amplitude	5



Before (left) and after (right) f-k filtering

3.11 STEP 10. Test Muting of surface waves and refracted waves

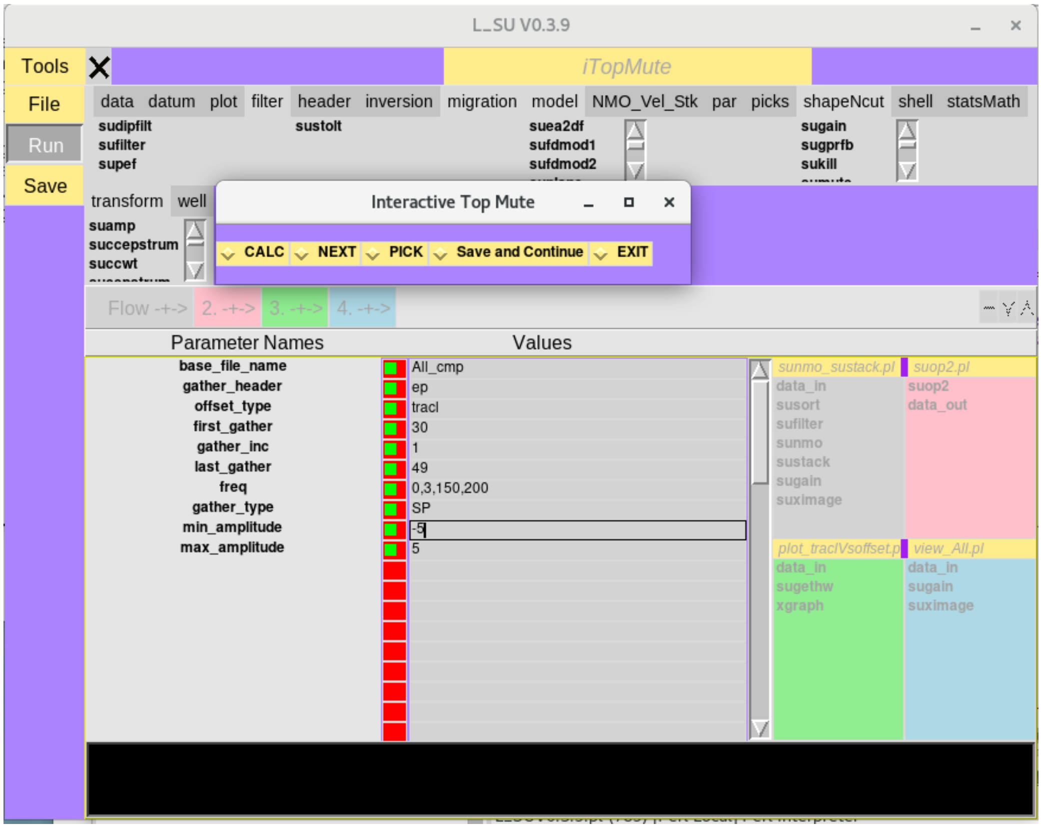
Tool: **iBottomMute** Interactive Top Bottom Mute,SP 1

Testing- not used in this flow

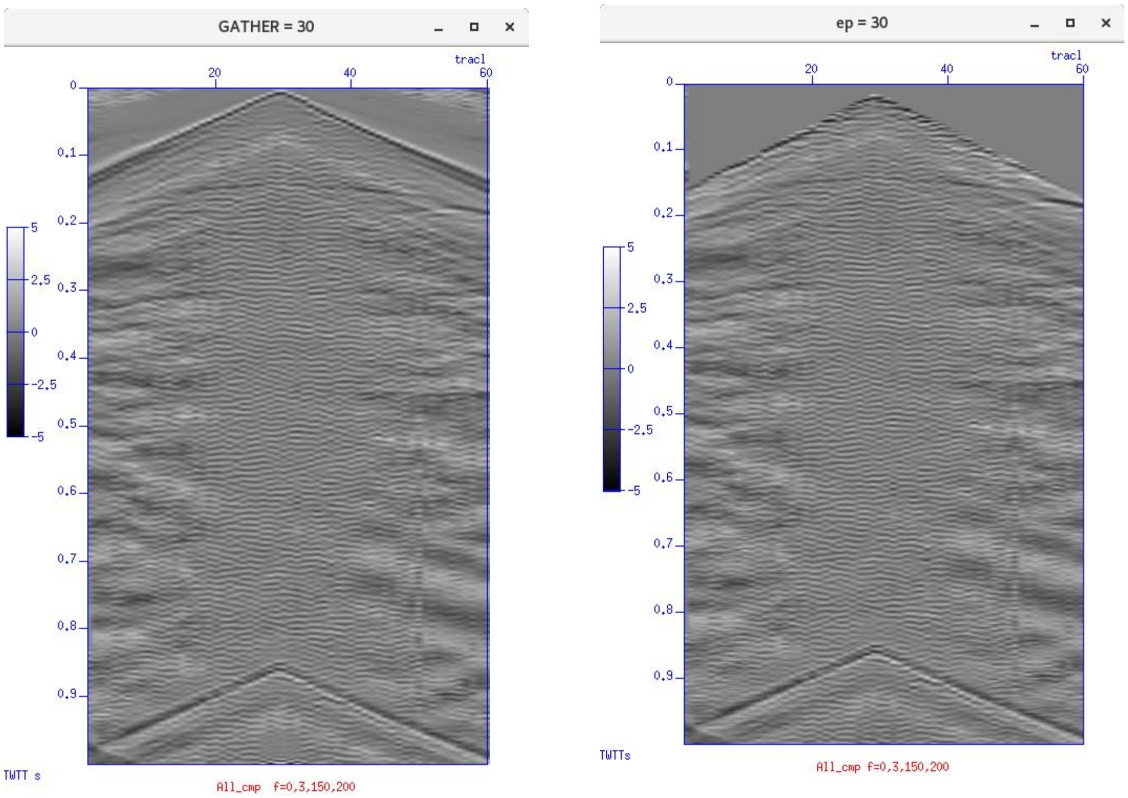
Input:

Output:

Uses: Uses: /home/gllore/Servilleta_demos/seismics/pl/loma_blanca/053018/Sucat.config



Parameter Names	Values
base_file_name	All_cmp
gather_header	ep
offset_type	tracl
first_gather	30
gather_inc	1
last_gather	49
freq	0,3,150,200
gather_type	SP
min_amplitude	-5
max_amplitude	5

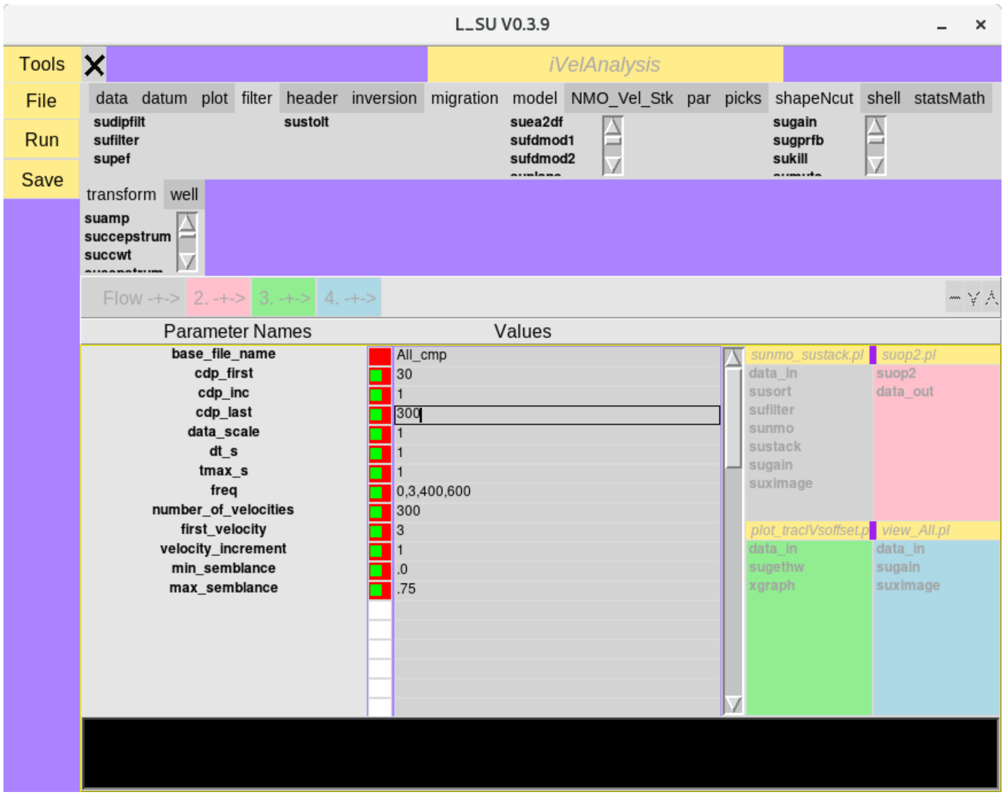


(Left) Before and after (Right) images of cdp=30 gather generated during application of interactive top-muting Tool.

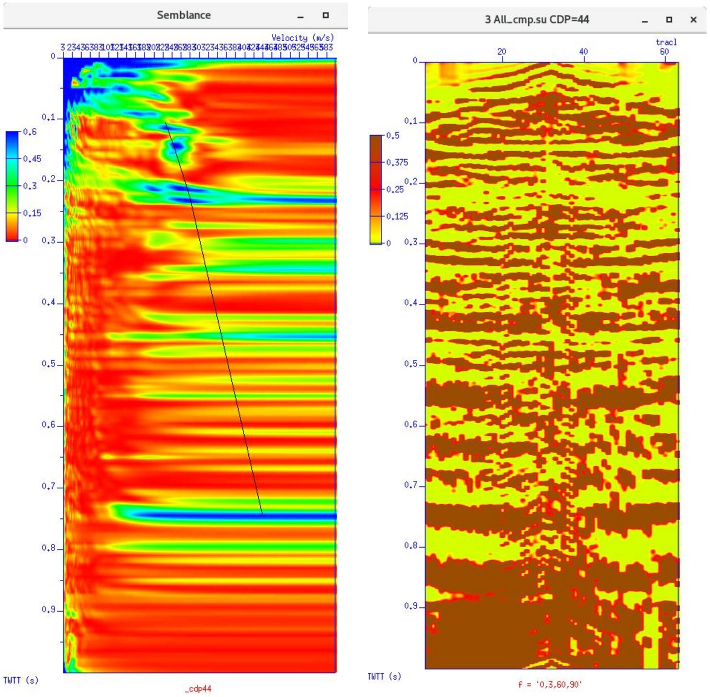
3.12 STEP 11. Test Semblance Analysis

Tool **iVA:** Interactive velocity analysis
Uses: Uses: /home/gllore/Servilleta_demos/seismics/pl/loma_blanca/053018/Sucat.config

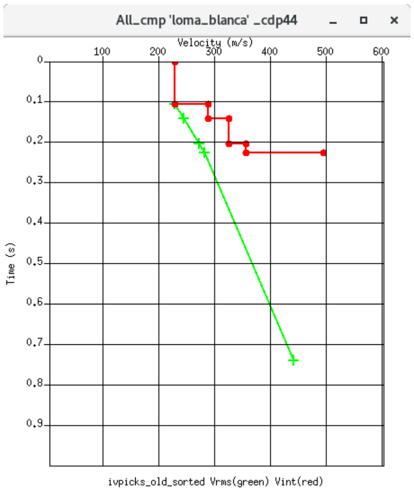
L_SU Gui



Parameter Names	Values
base_file_name	All_cmp
cdp_first	30
cdp_inc	1
cdp_last	300
data_scale	1
dt_s	1
tmax_s	1
freq	0,3,400,600
number_of_velocities	300
first_velocity	3
velocity_increment	1
min_semblance	.0
max_semblance	.75



(Left) Velocity verusus time and semblance image (left) and two selected points connected by a line. (Right) CDP/CMP gather analyzed in the adjoining semblance image. Data are NMO-corrected with the two velocity-time values selected in the semblance image.

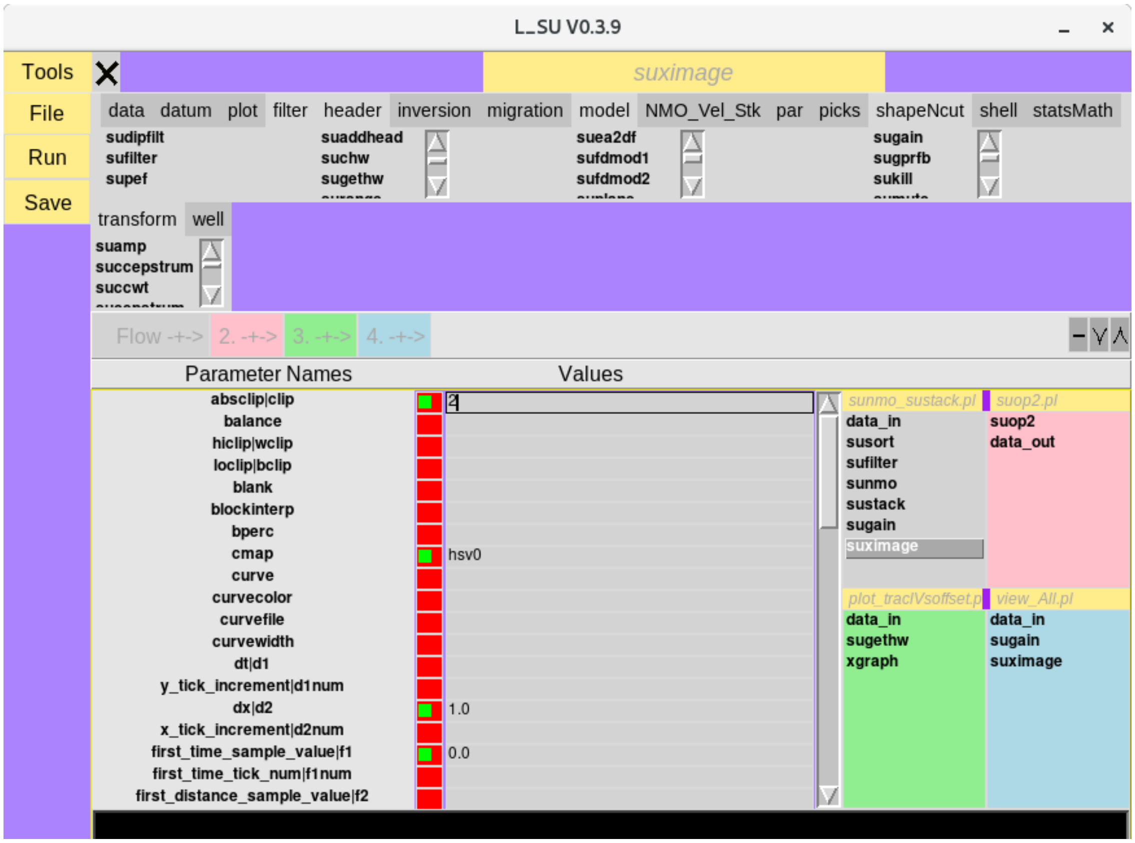


Velocity-time picks interpreted from the semblance plot (far left)

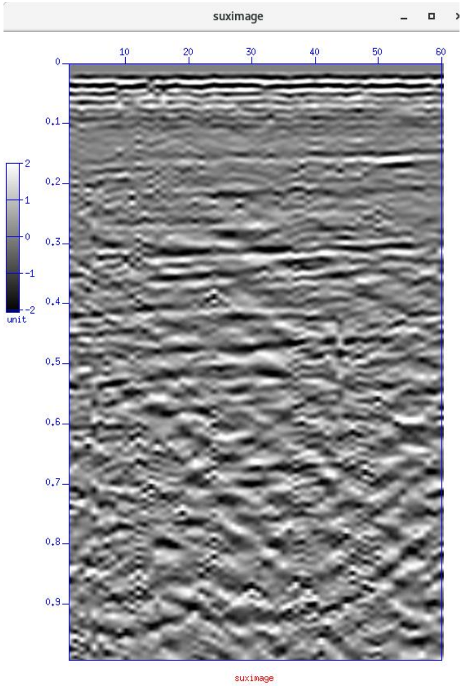
3.13 STEP 12. Normal Moveout and Stacking and Migration

Uses two velocity-time pairs from the iVA above.

STEP 12: L_SU Gui:



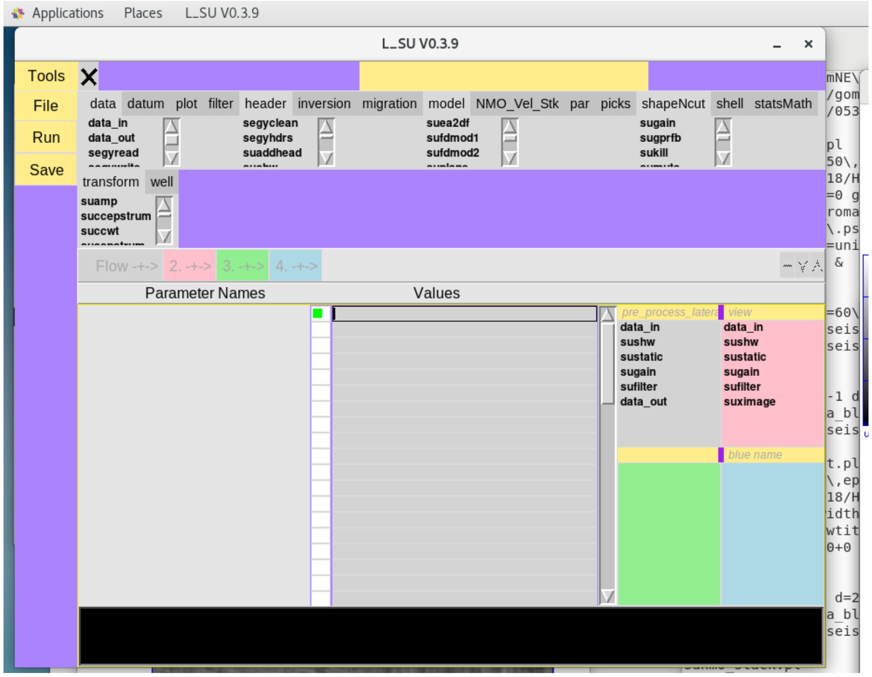
Parameter Names		Values
absclip|clip	🟩	2
balance	🟥	
hiclip|wclip	🟥	
loclip|bclip	🟥	
blank	🟥	
blockinterp	🟥	
bperc	🟥	
cmap	🟩	hsv0
curve	🟥	
curvecolor	🟥	
curvefile	🟥	
curvewidth	🟥	
dt|d1	🟥	
y_tick_increment|d1num	🟥	
dx|d2	🟩	1.0
x_tick_increment|d2num	🟥	
first_time_sample_value|f1	🟩	0.0
first_time_tick_num|f1num	🟥	
first_distance_sample_value|f2	🟥	

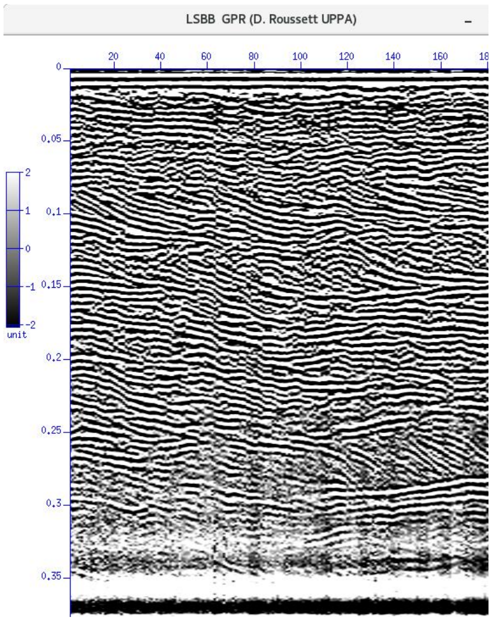


STEP 12: Output image of field data

4 Simple Processing Flow for GPR data

L_SU GUI:





Output image of GPR data

5 Perl and Shell script flows generated by L_SU

5.1 IRIS Data Set, Socorro, New Mexico

Project Name: Servilleta_demos

STEP 2: GUI Tool Name: Sucat

Uses: /home/gllore/Servilleta_demos/seismics/pl/loma_blanca/053018/Sucat.config

To run from the command line in the directory where the perl flows are kept (see 1.4.3)

```
% Sucat
```

STEP 5: GUI-generated perl script: suop2.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl suop2.pl
```

To run the bash script from the command line that is generated by suop2.pl:

```
% suop2 \/home\/gllore\/Servilleta_demos\/seismics\/data\/loma_blanca\/\/053018\/H\/1\/su\/gllore\/L28HzHit_fromNE\.su
```

```
\/home\/gllore\/Servilleta_demos\/seismics\/data\/loma_blanca\/\/053018\/H\/1\/su\/gllore\/L28HzHit_fromSW\.su op=diff > /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam.su &
```

STEP 5: GUI-generated perl script: view_L28Hz_Ibeam.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl view_L28Hz_Ibeam.pl
```

To run the bash script from the command line that is generated by view_L28Hz_Ibeam.pl:

```
% sufilter f=3\,6\,50\,80 verbose=0 < /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam.su | sugain agc=1 wagc=0\.1 | suximage clip=1 cmap=hsv0 d2=1 f1=0 gridcolor=blue labelcolor=blue labelfont=Erg14 legend=1 legendfont=times_roman10 lwidth=16 lx=3 mpicks=\/dev\/tty n1tic=1 n2tic=1 perc=100 plotfile=plotfile\.ps style=seismic title=suximage titlecolor=red titlefont=Rom22 tmpdir=\.\/ units=unit verbose=1 windowtitle=suximage wperc=100 xbox=500 ybox=500 wbox=550 hbox=550 &
```

STEP6: GUI-generated perl script: SuGeom2.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl SuGeom2.pl
```

To run the bash script from the command line that is generated by SuGeom2.pl:

```
% sushw a=0\,1\,1 j=60\,60\,60 key=sx\,gx\,ep b=0\,1\,0 c=1\,0\,1 < /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam.su > /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam_geom2.su &
```

STEP 7: GUI-generated perl script: SuGeom3.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl SuGeom3.pl
```

To run the bash script from the command line that is generated by SuGeom3.pl:

```
% suchw a=0 b=1 c=\-1 d=1 e=1 f=1 key1=offset key2=gx key3=sx < /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam_geom2.su > /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam_geom3.su &
```

STEP 7: GUI-generated perl script: plot_traclVsoffset.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl plot_traclVsoffset.pl
```

To run the bash script from the command line that is generated by plot_traclVsoffset.pl:

```
% sugethw key=tracl\,ep output=binary < /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam_geom3.su | xgraph grid1=dot grid2=dot gridColor=4 linewidth=0 marksize=1 n=15000 reverse=0 style=normal title=blue windowtitle=windowtitle x1beg=0 x1end=120 x2beg=0 x2end=100 label2=ep label1=tracl -geometry 400x600+0+0 &
```

STEP 8: GUI-generated perl script: make_cmp.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl make_cmp.pl
```

To run the bash script from the command line that is generated by plot_traclVsoffset.pl:

```
suchw a=0 b=1 c=1 d=2 e=1 f=1 key1=cdp key2=gx key3=sx < /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/L28Hz_Ibeam_geom3.su > /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/All_cmp.su &
```

STEP 12: GUI-generated perl script: sunmo_stack.pl

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl sunmo_stack.pl
```

To run the bash script from the command line that is generated by sunmo_stack.pl:

```
% cdp offset < /home/gllore/Servilleta_demos/seismics/data/loma_blanca//053018/H/1/su/gllore/All_cmp.su | sufilter f=10\,20\,70\,80 verbose=0 | sunmo invert=0 lmute=25 smute=1\.5 sscale=1 tnmo=0\,1 upward=0 vnmo=100\,600 | sustack key=cdp normpow=0 nrepeat=1 repeat=0 verbose=0 | sugain agc=1 wagc=0\.2 tmpdir=\/tmp | suximage clip=2 cmap=hsv0 d2=1 f1=0 gridcolor=blue labelcolor=blue labelfont=Erg14 legend=1 legendfont=times_roman10 lwidth=16 lx=3 mpicks=\/dev\/tty n1tic=1 n2tic=1 perc=100 plotfile=plotfile\.ps style=seismic title=suximage titlecolor=red titlefont=Rom22 tmpdir=\.\/ units=unit verbose=1 windowtitle=suximage wperc=100 xbox=500 ybox=500 wbox=550 hbox=550 &
```

5.2 GPR data

Collected in Low-Noise Underground Gallery (LSBB) in southern France forming by Dominique Rousset of the Université de Pau et des Pays de l'Adour (UPPA) Institut Pluridisciplianire de Recherche Appliqué

Project Name: LSBB

To run the bash script from the command line that is generated by view_LSBB-1.pl:

To run from the command line in the directory where the perl flows are kept (see 1.4.3):

```
% perl view_LSBB-1.pl
```

In the case immediately above, the location of the perl flow is in the following directory: /home/gllore/LSBB/seismics/data/surface2tunnel/gpr/052011/shielded_antenna/250MHz/su/gllore/. In this example “gllore” is the name of the user and should be changed in your particular case.

To run the bash script from the command line that is generated by .pl:

```
% sushw a=9\,1 key=tstat\,cdp b=0\,1 < /home/gllore/LSBB/seismics/data/surface2tunnel/gpr/052011/shielded_antenna/250MHz/su/gllore/LSBB1\-1.su | sustatic hdrs=1 | sugain mbal=1 tmpdir=\/tmp | sufilter f=0\,30\,400\,500 verbose=0 | suximage clip=2 cmap=hsv0 d2=1 f1=0 gridcolor=blue labelcolor=blue labelfont=Erg14 legend=1 legendfont=times_roman10 lwidth=16 lx=3 mpicks=\/dev\/tty n1tic=1 n2tic=1 perc=100 plotfile=plotfile\.ps style=seismic title=suximage titlecolor=red titlefont=Rom22 tmpdir=\.\/ units=unit verbose=1 windowtitle=LSBB\ \ GPR\ \(D\.\ Roussett\ UPPA\) wperc=100 xbox=500 ybox=500 wbox=550 hbox=550 &
```

5.3 General tools

5.3.1 How to mute a data set consisting of a range of multiple gathers

Data set: