



Phase picking, Blackboard Variables & Macros

SEISMIC ANALYSIS CODE (SAC)



Event Analysis Module:

This module is used to pick seismic phases.

An automatic phase picking algorithm can be applied using APK.





Event Analysis Module:

You can also use PPK to pick phases using the graphics cursor.

(PPK is described in the section on Graphics Capabilities).



Event Analysis Module:

Picks can be saved in HYPO format using the OHPF (open HYPO pick file) and CHPF (close HYPO pick file) commands; WHPF writes auxiliary cards into the HYPO pick file.

These picks can also be saved in a more general Alphanumeric format using the OAPF (open alphanumeric pick file) and CAPF (close alphanumeric pick file) commands.

The picks are also saved in the headers.

opens an X window with all data loaded in
memory.

open 6 files at a time.

sac> ppk

sac> ppk perplot 6

cheat sheet:

click on window to make it active

zoom in: type "x" to define left side time window, followed by
a left click of mouse to define the right side time window

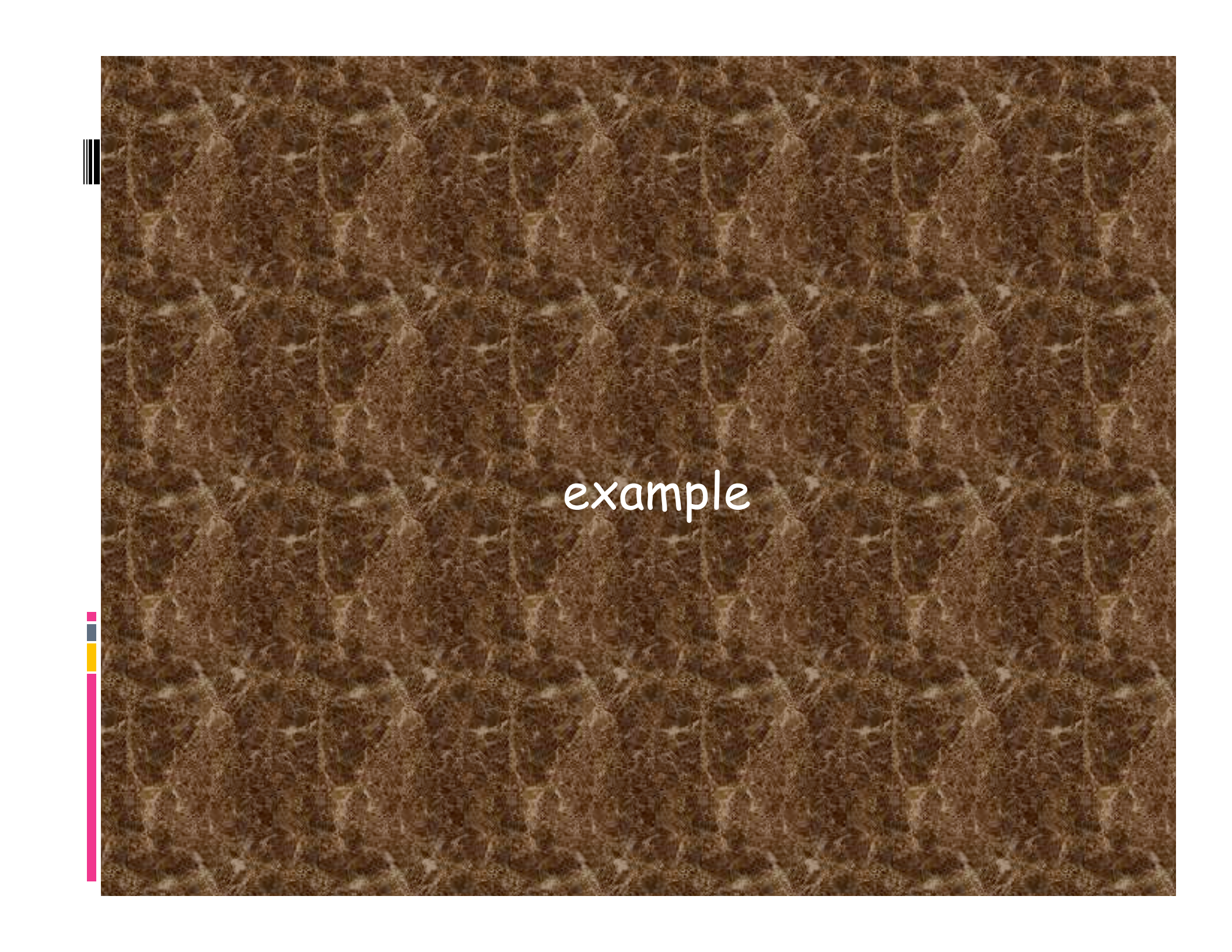
zoom out: type "o"

p arrival: type "a", or "p" at the time where you think the p
wave arrival in.

s arrival: type "t0", or "s" at the time where you think the s
wave arrival in.

other phases: type "tX" to place that time in your preferred
header

quit: type "q"

The image features a brown, textured background with a repeating diamond or quilted pattern. On the left side, there is a vertical bar with several colored segments: black, white, grey, yellow, and pink. The word "example" is centered in the middle of the image in a white, lowercase, sans-serif font.

example

What is a SAC macro?

A SAC macro is a file that contains a set of SAC commands to be executed together.

As well as regular commands and inline functions, a SAC macro file can contain references to SAC header variables and blackboard variables that are evaluated and substituted into the command before it is executed.



SAC macros can also have arguments that are evaluated as the macro is executed.

Control flow features such as "if tests" and "do loops" are also available.



These features let you control and alter the order of execution of commands within a macro.

example: macro for creating a plot

```
%vim plot1.macro  
r BJT.BHZ* BJT.BHN* BJT.BHE*  
xvport 0.1 0.6  
qdp off  
xlim t1 -5 50  
title on "Sumatra Event 2/13/2005 1:22:09 at BJT"  
xlabel on "Time, sec"  
ylabel on "Digital Counts"  
bd sgf  
P1  
ed sgf  
sgftops f001.sgf plot1.ps 1 y
```

example: macro for creating a plot

There are two ways to run the sac macro,
from within sac

```
%sac
```

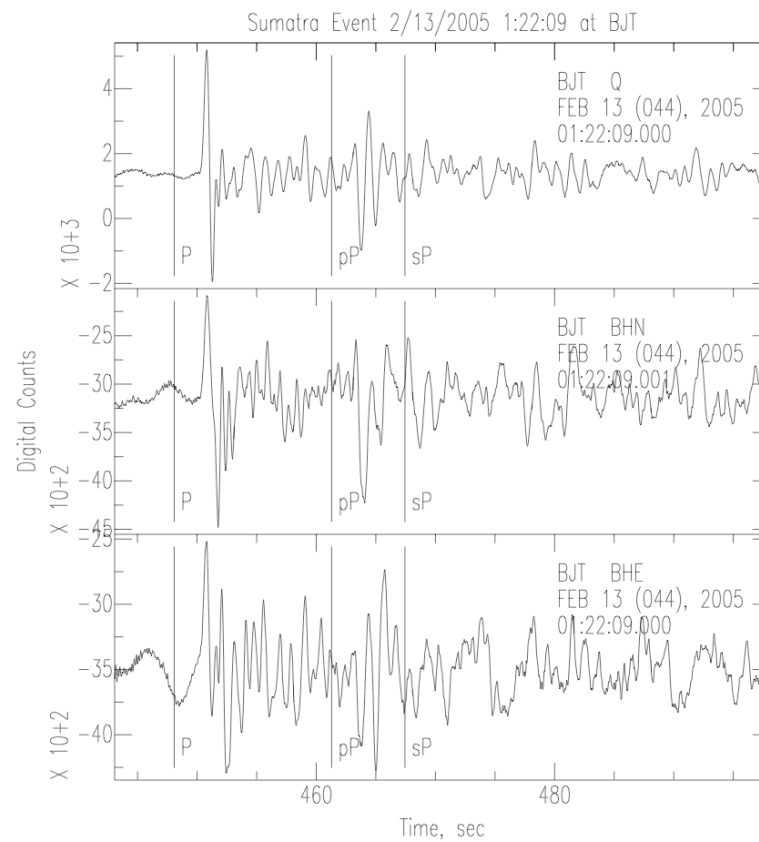
```
sac>macro plot1.macro
```

or from the command line

```
%sac plot1.macro (may not work)
```

```
%sac < plot1.macro
```

Postscript file made by macro.



Order dependent arguments

```
alpaca.ceri.memphis.edu656:> vi prt.macro
```

```
r $1 $2 $3
```

```
xvport 0.1 0.6
```

```
qdp off
```

```
xlim t1 -5 50
```

```
title on "demo"
```

```
xlabel on "Time"
```

```
ylabel on "Digital Counts"
```

```
bd sgf
```

```
P1
```

```
ed sgf
```

```
sgftops f001.sgf plot1.ps 1 y
```

SGFTOPS

SUMMARY Converts an SGF file to a POSTSCRIPT formatted file.

SYNTAX

```
SGFTOPS sgf-file ps-file {width} {YES|NO} {scale} INPUT sgf-  
file
```



sgs-file: name of a SAC Graphics File.

ps-file : The desired name for the
POSTSCRIPT file.



width : A number specifying the width or
thickness of lines in the output file. This is
an integer in the range 1 to 8. Default is 1.



YES|NO : Flag to apply additional scaling.

A value of YES turns scaling on, NO ignores the additional scale parameter.



scale : An additional scale factor. Can be used for making large or full-size maps.

```
alpaca.ceri.memphis.edu649:> sac
```

```
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```

```
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```

```
SAC> macro prt.macro AREN.BHZ AREN.167 AREN.257
```

```
SAC> quit
```

```
alpaca.ceri.memphis.edu650:> ls *.ps
```

```
plot1.ps
```

```
alpaca.ceri.memphis.edu651:>
```

Note: we are within SAC, not at the SHELL command line.

keyword driven arguments

```
%vim plot3.macro
```

```
$keys files plot
```

```
r $files
```

```
xvport 0.1 0.6
```

```
qdp off
```

```
xlim t1 -5 50
```

```
title on "Sumatra Event 2/13/2005 1:22:09 at BJT"
```

```
xlabel on "Time, sec"
```

```
ylabel on "Digital Counts"
```

```
bd sgf
```

```
P1
```

```
ed sgf
```

```
sgftops $plot plot3.ps 1 y
```

```
sac>macro plot3.macro files BJT.BHZ.SAC BJT.BHN.SAC  
BJT.BHE.SAC plot f001.sgf
```

Default keyword arguments

```
%vim plot3.macro
$keys files plot
$default plot f001.sgf
r $files
xvport 0.1 0.6
qdp off
xlim t1 -5 50
title on "Sumatra Event 2/13/2005 1:22:09 at BJT"
xlabel on "Time, sec"
ylabel on "Digital Counts"
bd sgf
P1
ed sgf
sgftops $plot plot3.ps 1 y

sac>macro plot3.macro files BJT.BHZ.SAC      BJT.BHN_SAC
      BJT.BHE.SAC
```

Missing Keyword arguments

Argument query

If you fail to enter a value for an argument on the SAC macro execute line and it has no default value, SAC will ask you to enter a value from the terminal.

```
SAC> macro plot3.macro   
files? BJT.BHZ.SAC BJT.BHN.SAC BJT.BHE.SAC
```



Blackboard variables.

The blackboard feature can be used to temporarily store and retrieve information.

A blackboard entry consists of a name and a value.



They are used extensively in macros

Blackboard entries are created using the SETBB and EVALUATE commands.

You can also substitute the value of a blackboard variable directly in other commands by preceding its name with a percent sign ("%").

Default is to print to terminal.

```
sac> setbb c1 2.45
sac> setbb c2 4.94
sac> bp butter co %c1 %c2
sac> evaluate to c2 %c1 * 2
sac> evaluate %c1 * 2
4.9000001e+00
```

The value of a blackboard variable can be obtained using the *GETBB* command.

```
sac> getbb c1 c2
```

```
c1 = 2.45
```

```
c2 = 4.90000001e+00
```



Blackboard variables can also be saved in a disk file using the WRITEBBF command and later restored into SAC2000 using the READBBF command.



There is also a function called UNSETBBV which deletes a variable from the blackboard.

Header variables.

SAC header variables can also be evaluated and substituted directly in commands much like blackboard variables.

You must specify which file (by name or number) and which variable to be evaluated.

You must precede this specification with an ampersand ("&") and you must separate the file and variable names with a comma.

Header variables.

The first example is referenced by file name, the second by file number.

```
sac> read ABC
sac> evaluate to temp1 &ABC,a + 10
sac> evaluate to temp2 &1,depmax * 2
sac> chnhdr t5 %temp1
sac> chnhdr user0 %temp2
```

Concatenation

To prepend simply concatenate the text string with the argument or variable.

```
sac> setbb temp BJT.BHZ.SAC
```

```
sac> w XYZ.%temp
```

```
XYZ.BJT.BHZ.SAC
```

Concatenation

To append you must repeat the delimiter (\$, %, or &) after the argument or variable (surround the string you are appending with the delimiter) and before the text string.

```
sac> setbb temp BJT.BHZ.SAC
```

```
sac> w %temp%.XYZ
```

```
BJT.BHZ.SAC.XYZ
```



Using various programs to write SAC
macros.

SAC macros are essentially just a set of
SAC commands and therefore
you can create SAC macros using other
programs
(shell scripts, fortran, c, matlab, etc.).



This shell script is in a file called sta.csh.

The shell script runs sac for each file matching the name (*\${sta}*z) and appends the output of the sac listhdr command to the sta.log file.

```
alpaca.ceri.memphis.edu668:> vi sta.csh
```

```
#!/usr/bin/csh
```

```
# Script to report b, e and t1 sac header values for a given station
```

```
# usage: sta.csh [NAME]
```

```
\rm sta.log
```

```
set sta=$1
```

```
foreach file ( *${sta}*BH* )
```

```
sac <<EOF >> sta.log
```

```
r $file
```

```
lh b e t1
```

```
q
```

```
EOF
```

```
end
```

```
alpaca.ceri.memphis.edu666:> sta.csh AREN
```

```
sta.log: No such file or directory
```

```
alpaca.ceri.memphis.edu667:> more sta.log
```

```
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```

```
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```

```
FILE: AREN.BHE - 1
```

```
-----
```

```
    b = 7.400000e+04
```

```
    e = 7.600000e+04
```

```
SEISMIC ANALYSIS CODE [09/04/2008 (Version 101.2)]
```

```
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```

```
FILE: AREN.BHN - 1
```

```
-----
```

```
    b = 7.400000e+04
```

```
    e = 7.600000e+04
```

```
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```

```
Copyright 1995 Regents of the University of California
```

```
FILE: AREN.BHZ - 1
```

```
-----
```

```
    b = 7.400000e+04
```

```
    e = 7.600000e+04
```

```
alpaca.ceri.memphis.edu668:> vi stainfo.csh
```

What is this awk line testing if I apply it to the output of sta.csh?

```
awk '{if (/FILE/) f=$2; if ($1=="b") b=$3; if ($1=="e") e=$3;  
if (/t1/ && $3>b && $3<e) \ print "r more",f}' sta.log
```

Using shell scripts to run SAC

```
#!/usr/bin/csh
foreach file ( *.SAC )
echo $file

sac << EOF >>! log
setbb eqname Sum_2002_EGF
setbb evlat 2.84
setbb evlon 95.38
setbb chg 6.002

r $file
setbb old &1,o
evaluate to new %old + %chg
ch o %new
ch evlo %evlon

ch evla %evlat
ch kevnm %eqname
wh

cut o 0 8000
r $file
setbb chg2 &1,o
ch allt -%chg2
w over
q
EOF
end
```

carpincho:sacex smalley\$ cp /Volumes/carpincho_TB/charge/data/2001.174*SAC .

carpincho:sacex smalley\$ ls

2001.174.00.00.00.0010.YC.PENA.01.BHE.D.SAC	2001.174.00.00.00.00070.YC.CONS.01.BH2.D.SAC	2001.174.00.00.00.0140.YC.AMER.01.BH2.D.SAC
2001.174.00.00.00.0010.YC.PENA.01.BHN.D.SAC	2001.174.00.00.00.00070.YC.CONS.01.BH3.D.SAC	2001.174.00.00.00.0140.YC.AMER.01.BH3.D.SAC
2001.174.00.00.00.0010.YC.PENA.01.BHZ.D.SAC	2001.174.00.00.00.00070.YC.CONS.01.BHZ.D.SAC	2001.174.00.00.00.0140.YC.AMER.01.BHZ.D.SAC
2001.174.00.00.00.0030.YC.HURT.01.BHE.D.SAC	2001.174.00.00.00.00070.YC.RAFA.01.BHE.D.SAC	2001.174.00.00.00.0190.YC.ELBO.01.BHE.D.SAC
2001.174.00.00.00.0030.YC.HURT.01.BHN.D.SAC	2001.174.00.00.00.00070.YC.RAFA.01.BHN.D.SAC	2001.174.00.00.00.0190.YC.ELBO.01.BHN.D.SAC
2001.174.00.00.00.0030.YC.HURT.01.BHZ.D.SAC	2001.174.00.00.00.00070.YC.RAFA.01.BHZ.D.SAC	2001.174.00.00.00.0190.YC.ELBO.01.BHZ.D.SAC
2001.174.00.00.00.0030.YC.MAUL.01.BHE.D.SAC	2001.174.00.00.00.0100.YC.HEDI.01.BHE.D.SAC	2001.174.00.00.00.0240.YC.HUER.01.BHE.D.SAC
2001.174.00.00.00.0030.YC.MAUL.01.BHN.D.SAC	2001.174.00.00.00.0100.YC.HEDI.01.BHN.D.SAC	2001.174.00.00.00.0240.YC.HUER.01.BHN.D.SAC
2001.174.00.00.00.0030.YC.MAUL.01.BHZ.D.SAC	2001.174.00.00.00.0100.YC.HEDI.01.BHZ.D.SAC	2001.174.00.00.00.0240.YC.HUER.01.BHZ.D.SAC
2001.174.00.00.00.0040.YC.RINC.01.BHE.D.SAC	2001.174.00.00.00.0100.YC.JUAN.01.BHE.D.SAC	2001.174.00.00.00.0240.YC.LLAN.01.BHE.D.SAC
2001.174.00.00.00.0040.YC.RINC.01.BHN.D.SAC	2001.174.00.00.00.0100.YC.JUAN.01.BHN.D.SAC	2001.174.00.00.00.0240.YC.LLAN.01.BHN.D.SAC
2001.174.00.00.00.0040.YC.RINC.01.BHZ.D.SAC	2001.174.00.00.00.0100.YC.JUAN.01.BHZ.D.SAC	2001.174.00.00.00.0240.YC.LLAN.01.BHZ.D.SAC
2001.174.00.00.00.0050.YC.LITI.01.BHE.D.SAC	2001.174.00.00.00.0110.YC.PACH.01.BHE.D.SAC	2001.174.00.00.00.0240.YC.SJAV.01.BH2.D.SAC
2001.174.00.00.00.0050.YC.LITI.01.BHN.D.SAC	2001.174.00.00.00.0110.YC.PACH.01.BHN.D.SAC	2001.174.00.00.00.0240.YC.SJAV.01.BH3.D.SAC
2001.174.00.00.00.0050.YC.LITI.01.BHZ.D.SAC	2001.174.00.00.00.0110.YC.PACH.01.BHZ.D.SAC	2001.174.00.00.00.0240.YC.SJAV.01.BHZ.D.SAC
2001.174.00.00.00.0060.YC.AREN.01.BHE.D.SAC	2001.174.00.00.00.0120.YC.BARD.01.BHE.D.SAC	2001.174.17.25.50.2830.YC.ELBO.01.BHE.D.SAC
2001.174.00.00.00.0060.YC.AREN.01.BHN.D.SAC	2001.174.00.00.00.0120.YC.BARD.01.BHN.D.SAC	2001.174.17.25.50.2830.YC.ELBO.01.BHN.D.SAC
2001.174.00.00.00.0060.YC.AREN.01.BHZ.D.SAC	2001.174.00.00.00.0120.YC.BARD.01.BHZ.D.SAC	2001.174.17.25.50.2830.YC.ELBO.01.BHZ.D.SAC
2001.174.00.00.00.0060.YC.NIEB.01.BHE.D.SAC	2001.174.00.00.00.0130.YC.NEGR.01.BHE.D.SAC	2001.174.17.29.16.2900.YC.ELBO.01.BHE.D.SAC
2001.174.00.00.00.0060.YC.NIEB.01.BHN.D.SAC	2001.174.00.00.00.0130.YC.NEGR.01.BHN.D.SAC	2001.174.17.29.16.2900.YC.ELBO.01.BHN.D.SAC
2001.174.00.00.00.0060.YC.NIEB.01.BHZ.D.SAC	2001.174.00.00.00.0130.YC.NEGR.01.BHZ.D.SAC	2001.174.17.29.16.2900.YC.ELBO.01.BHZ.D.SAC

carpincho:sacex smalley\$ rename.sh SAC 8 10

carpincho:sacex smalley\$ ls

AMER.BH2	BARD.BHZ	HEDI.BHN	JUAN.BHE	LLAN.BHZ	NIEB.BHN	RAFA.BHE	SJAV.BHZ
AMER.BH3	CONS.BH2	HEDI.BHZ	JUAN.BHN	MAUL.BHE	NIEB.BHZ	RAFA.BHN	
AMER.BH2	CONS.BH3	HUER.BHE	JUAN.BHZ	MAUL.BHN	PACH.BHE	RAFA.BHZ	
AREN.BHE	CONS.BHZ	HUER.BHN	LITI.BHE	MAUL.BHZ	PACH.BHN	RINC.BHE	
AREN.BHN	ELBO.BHE	HUER.BHZ	LITI.BHN	NEGR.BHE	PACH.BHZ	RINC.BHN	
AREN.BHZ	ELBO.BHN	HURT.BHE	LITI.BHZ	NEGR.BHN	PENA.BHE	RINC.BHZ	
BARD.BHE	ELBO.BHZ	HURT.BHN	LLAN.BHE	NEGR.BHZ	PENA.BHN	SJAV.BH2	
BARD.BHN	HEDI.BHE	HURT.BHZ	LLAN.BHN	NIEB.BHE	PENA.BHZ	SJAV.BH3	

carpincho:sacex smalley\$ sac

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SAC> cut 74000 76000

SAC> r *BHE* *BHN* *BHZ*

AREN.BHE BARD.BHE ELBO.BHE HEDI.BHE HUER.BHE HURT.BHE JUAN.BHE LITI.BHE LLAN.BHE MAUL.BHE NEGR.BHE NIEB.BHE PACH.BHE PENA.BHE RAFA.BHE RINC.BH
AREN.BHN BARD.BHN ELBO.BHN HEDI.BHN HUER.BHN HURT.BHN JUAN.BHN LITI.BHN LLAN.BHN MAUL.BHN NEGR.BHN NIEB.BHN PACH.BHN PENA.BHN RAFA.BHN RINC.BH
AMER.BHZ AREN.BHZ BARD.BHZ CONS.BHZ ELBO.BHZ HEDI.BHZ HUER.BHZ HURT.BHZ JUAN.BHZ LITI.BHZ LLAN.BHZ MAUL.BHZ NEGR.BHZ NIEB.BHZ PACH.BHZ PENA.BH
RAFA.BHZ RINC.BHZ SJAV.BHZ

WARNING: Start cut greater than file end for file ELBO.BHE

WARNING: Start cut greater than file end for file ELBO.BHN

WARNING: Start cut greater than file end for file ELBO.BHZ

WARNING: Unable to read some files reading the rest of the files.

SAC> w over

carpincho:sacex smalley\$ sac
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SAC> read *

AMER.BH2 AMER.BH3 AMER.BHZ AREN.BHE AREN.BHN AREN.BHZ BARD.BHE BARD.BHN BARD.BHZ CONS.BH2 CONS.BH3 CONS.BHZ ELBO.BHE ELBO.BHN ELBO.BHZ
HEDI.BHE HEDI.BHN HEDI.BHZ HUER.BHE HUER.BHN HUER.BHZ HURT.BHE HURT.BHN HURT.BHZ JUAN.BHE JUAN.BHN JUAN.BHZ LITI.BHE LITI.BHN LITI.BHZ
LLAN.BHE LLAN.BHN LLAN.BHZ MAUL.BHE MAUL.BHN MAUL.BHZ NEGR.BHE NEGR.BHN NEGR.BHZ NIEB.BHE NIEB.BHN NIEB.BHZ PACH.BHE PACH.BHN PACH.BHZ
PENA.BHE PENA.BHN PENA.BHZ RAFA.BHE RAFA.BHN RAFA.BHZ RINC.BHE RINC.BHN RINC.BHZ SJAV.BH2 SJAV.BH3 SJAV.BHZ

SAC> listhdr

FILE: AMER.BH2 - 1

NPTS = 3455983 B = 0.000000e+00
E = 8.639955e+04 IFTYPE = TIME SERIES FILE
LEVEN = TRUE DELTA = 2.500000e-02
IDEP = UNKNOWN DEPMIN = -2.000632e+06
DEPMAX = 2.115793e+06 DEPMEN = -6.740461e+02
KZDATE = JUN 23 (174), 2001 KZTIME = 00:00:00.014
KSTNM = AMER CMPAZ = 6.000000e+00
CMPINC = 9.000000e+01 STLA = -3.570000e+01
STLO = -7.110487e+01 STEL = 6.360000e+02
STDP = 0.000000e+00 KHOLE = 01
LOVRK = TRUE NVHDR = 6
SCALE = 1.048580e+09 NORID = 0
NEVID = 0 LPSPOL = FALSE
LCALDA = TRUE KCMPNM = BH2
KNETWK = YC

SAC> chnhdr EVLA -16.27

SAC> chnhdr EVLO -73.64

SAC> listhdr

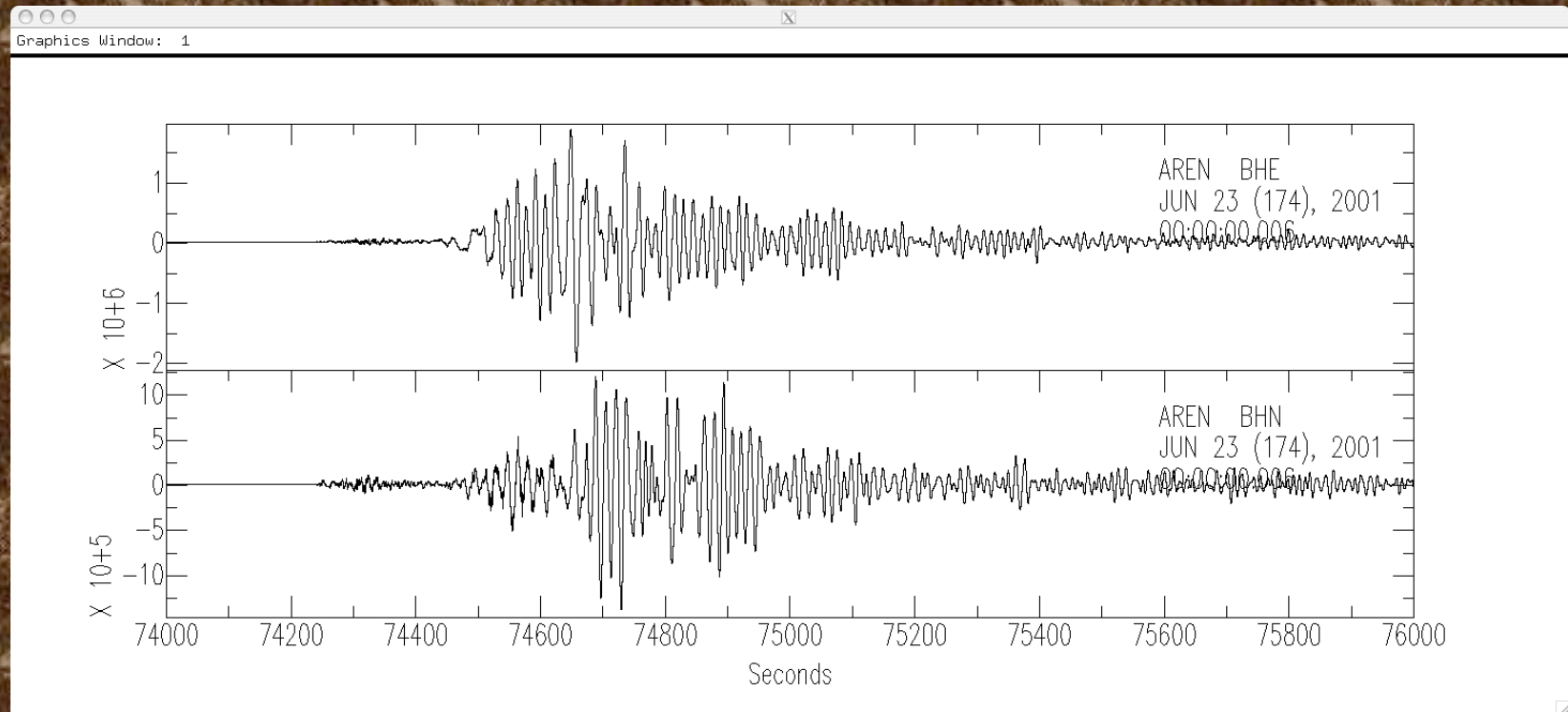
FILE: AMER.BH2 - 1

NPTS = 3455983 B = 0.000000e+00
E = 8.639955e+04 IFTYPE = TIME SERIES FILE
LEVEN = TRUE DELTA = 2.500000e-02
IDEP = UNKNOWN DEPMIN = -2.000632e+06
DEPMAX = 2.115793e+06 DEPMEN = -6.740461e+02
KZDATE = JUN 23 (174), 2001 KZTIME = 00:00:00.014
KSTNM = AMER CMPAZ = 6.000000e+00
CMPINC = 9.000000e+01 STLA = -3.570000e+01
STLO = -7.110487e+01 STEL = 6.360000e+02
STDP = 0.000000e+00 EVLA = -1.627000e+01
EVLO = -7.364000e+01 KHOLE = 01
DIST = 2.167411e+03 AZ = 1.738032e+02
BAZ = 3.526821e+02 GCARC = 1.948290e+01
LOVRK = TRUE NVHDR = 6
SCALE = 1.048580e+09 NORID = 0
NEVID = 0 LPSPOL = FALSE
LCALDA = TRUE KCMPNM = BH2
KNETWK = YC

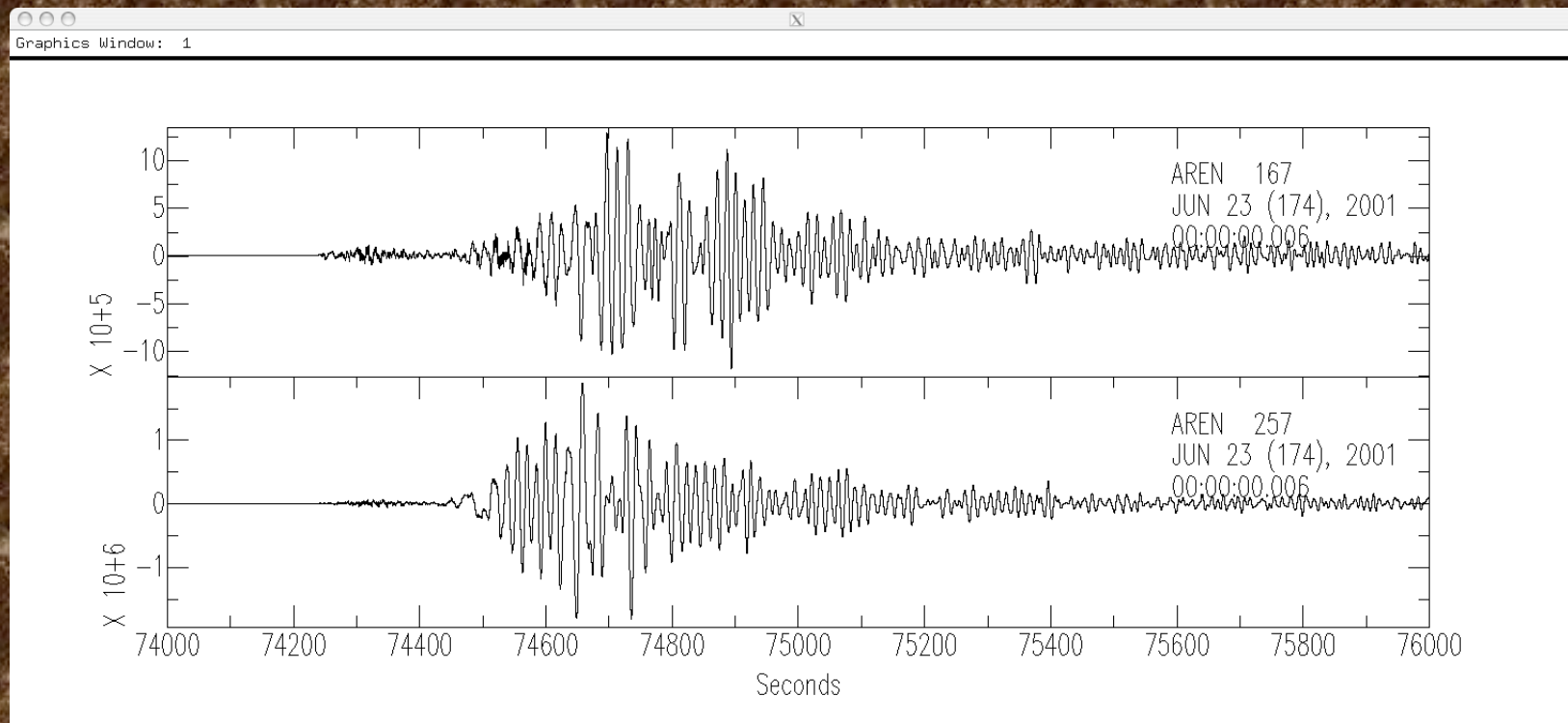
SAC> wh

```
carpincho:sacex smalley$ sac
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```

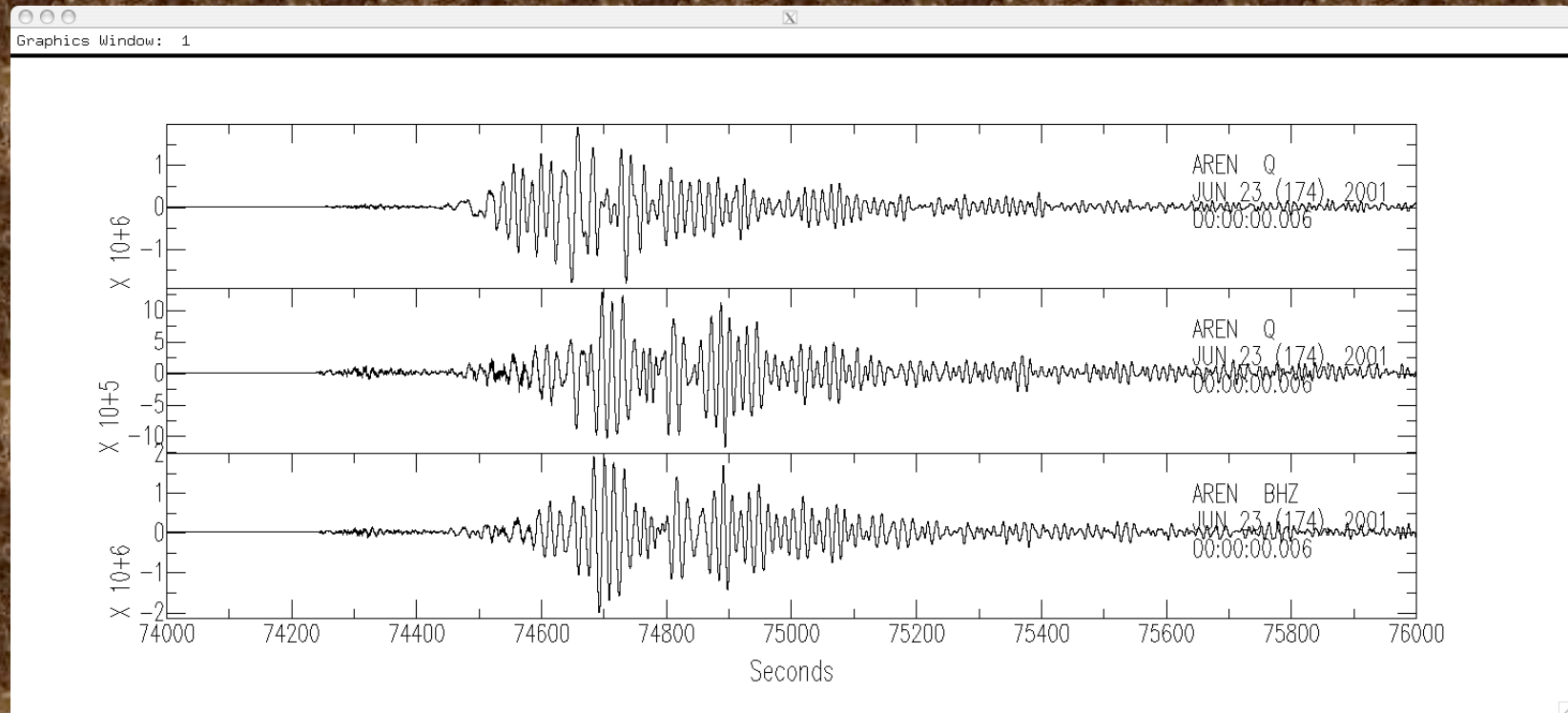
```
SAC> r AREN.BHE AREN.BHN
SAC> qdp off
SAC> p1
```



```
SAC> rotate to gca  
SAC> p1
```



```
SAC> read AREN.257 AREN.167 AREN.BHZ
SAC> pl
```



FILE: AREN.257 - 1

```
-----  
NPTS = 80001  
E = 7.600000e+04  
LEVEN = TRUE  
IDEP = UNKNOWN  
DEPMAX = 1.883052e+06  
KZDATE = JUN 23 (174), 2001  
KSTNM = AREN  
CMPINC = 9.000000e+01  
STLO = -6.951091e+01  
STDP = 0.000000e+00  
EVLO = -7.364000e+01  
DIST = 1.965666e+03  
BAZ = 3.468291e+02  
LOVROK = TRUE  
SCALE = 4.194300e+08  
NEVID = 0  
LPSPOL = TRUE  
KCMPPNM = Q  
B = 7.400000e+04  
IFTYPE = TIME SERIES FILE  
DELTA = 2.500000e-02  
DEPMIN = -1.824698e+06  
DEPMEN = -8.282498e+03  
KZTIME = 00:00:00.006  
CMPAZ = 2.568291e+02  
STLA = -3.361547e+01  
STEL = 2.786000e+03  
EVLA = -1.627000e+01  
KHOLE = 01  
AZ = 1.685817e+02  
GCARC = 1.766853e+01  
NVHDR = 6  
NORID = 0  
NWFID = 15  
LCALDA = TRUE  
KNETWK = YC
```

FILE: AREN.167 - 2

```
-----  
NPTS = 80001  
E = 7.600000e+04  
LEVEN = TRUE  
IDEP = UNKNOWN  
DEPMAX = 1.274883e+06  
KZDATE = JUN 23 (174), 2001  
KSTNM = AREN  
CMPINC = 9.000000e+01  
STLO = -6.951091e+01  
STDP = 0.000000e+00  
EVLO = -7.364000e+01  
DIST = 1.965666e+03  
BAZ = 3.468291e+02  
LOVROK = TRUE  
SCALE = 4.194300e+08  
NEVID = 0  
LPSPOL = TRUE  
KCMPPNM = Q  
B = 7.400000e+04  
IFTYPE = TIME SERIES FILE  
DELTA = 2.500000e-02  
DEPMIN = -1.190844e+06  
DEPMEN = 3.710197e+02  
KZTIME = 00:00:00.006  
CMPAZ = 1.668291e+02  
STLA = -3.361547e+01  
STEL = 2.786000e+03  
EVLA = -1.627000e+01  
KHOLE = 01  
AZ = 1.685817e+02  
GCARC = 1.766853e+01  
NVHDR = 6  
NORID = 0  
NWFID = 31  
LCALDA = TRUE  
KNETWK = YC
```

SAC> READ BARD.BHE BARD.BHN

SAC> qdp off

SAC> p1

SAC> rotate to gcp

SAC> p1

SAC> write KSTCMP

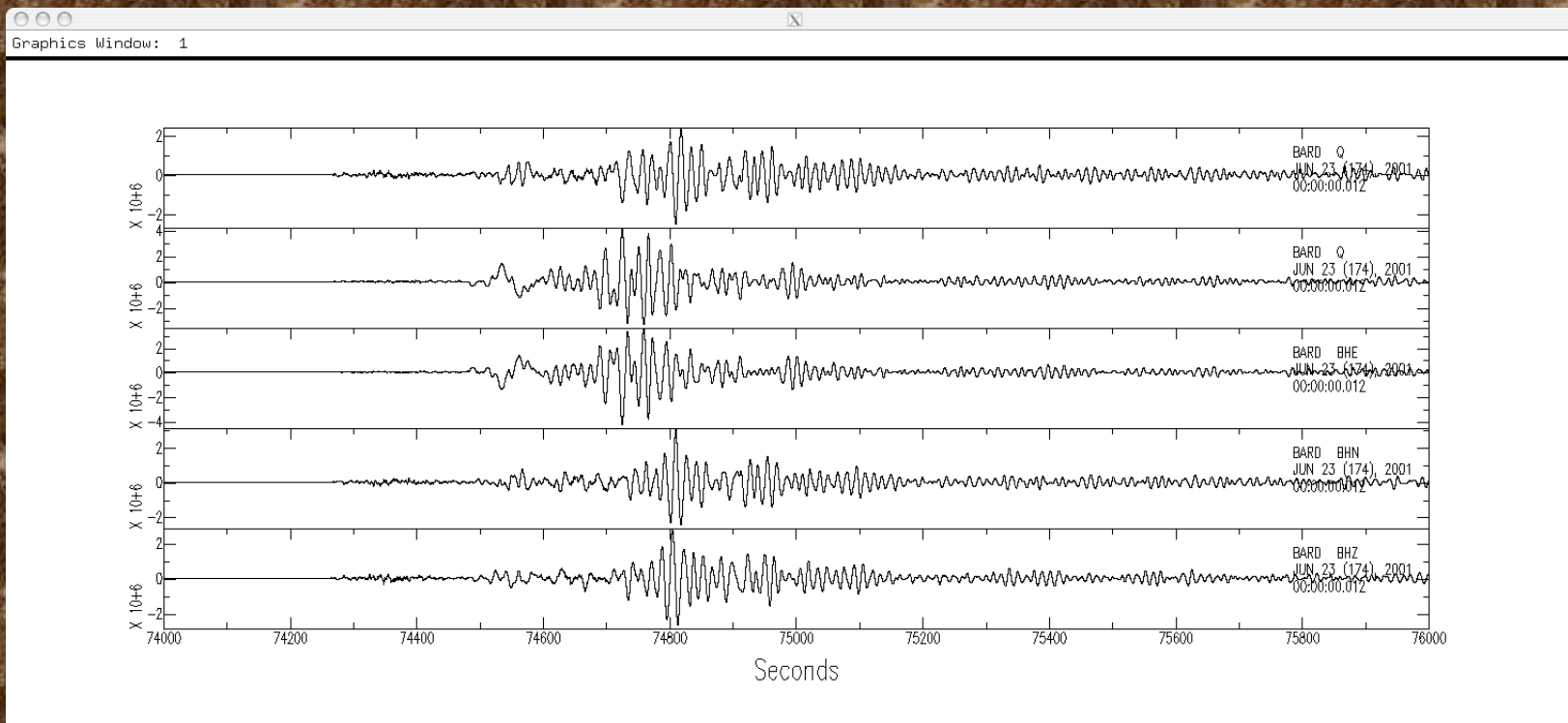
SAC> ls

AMER.BH2	AREN.BHZ	CONS.BH3	HEDI.BHZ	JUAN.BHE	LLAN.BHN	NEGR.BHZ	PENA.BHE	RINC.BHN
AMER.BH3	BARD.168	CONS.BHZ	HUER.BHE	JUAN.BHN	LLAN.BHZ	NIEB.BHE	PENA.BHN	RINC.BHZ
AMER.BHZ	BARD.258	ELBO.BHE	HUER.BHN	JUAN.BHZ	MAUL.BHE	NIEB.BHN	PENA.BHZ	SJAV.BH2
AREN.167	BARD.BHE	ELBO.BHN	HUER.BHZ	LITI.BHE	MAUL.BHN	NIEB.BHZ	RAFA.BHE	SJAV.BH3
AREN.257	BARD.BHN	ELBO.BHZ	HURT.BHE	LITI.BHN	MAUL.BHZ	PACH.BHE	RAFA.BHN	SJAV.BHZ
AREN.BHE	BARD.BHZ	HEDI.BHE	HURT.BHN	LITI.BHZ	NEGR.BHE	PACH.BHN	RAFA.BHZ	saveorig
AREN.BHN	CONS.BH2	HEDI.BHN	HURT.BHZ	LLAN.BHE	NEGR.BHN	PACH.BHZ	RINC.BHE	

SAC> read BARD*

BARD.168 BARD.258 BARD.BHE BARD.BHN BARD.BHZ

SAC> p1



```
carpincho:sacex smalley$ more elbo.macro
read ELBO.BHE ELBO.BHN
rotate to gca
w KSTCMP
quit

carpincho:sacex smalley$ sac < elbo.macro
SEISMIC ANALYSIS CODE [09/04/2008 (Version 101.2)]
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```

```
carpincho:sacex smalley$ ls
AREN.167      BARD.258      ELBO.BHE      HUER.BHE      JUAN.BHE      LLAN.BHE      NEGR.BHE      PACH.BHE      RAFA.BHE
               elbo.macro
AREN.257      BARD.BHE      ELBO.BHN      HUER.BHN      JUAN.BHN      LLAN.BHN      NEGR.BHN      PACH.BHN      RAFA.BHN
AREN.BHE      BARD.BHN      ELBO.BHZ      HUER.BHZ      JUAN.BHZ      LLAN.BHZ      NEGR.BHZ      PACH.BHZ      RAFA.BHZ
AREN.BHN      BARD.BHZ      HEDI.BHE      HURT.BHE      LITI.BHE      MAUL.BHE      NIEB.BHE      PENA.BHE      RINC.BHE
AREN.BHZ      ELBO.168      HEDI.BHN      HURT.BHN      LITI.BHN      MAUL.BHN      NIEB.BHN      PENA.BHN      RINC.BHN
BARD.168      ELBO.258      HEDI.BHZ      HURT.BHZ      LITI.BHZ      MAUL.BHZ      NIEB.BHZ      PENA.BHZ      RINC.BHZ
```

```
#!/bin/sh
OUT=all.macro
STNNAMES=`ls *.BHZ | nawk 'BEGIN {FS="."}{print $1}`
for stn in $STNNAMES
do
#echo process $stn
echo r $stn.BHE $stn.BHN >> $OUT
echo rotate to gcr >> $OUT
echo w KSTCMP >> $OUT
done
echo quit >> $OUT
sac < all.macro
```

carpincho:sacex smalley\$ ls

AREN.BHE	HEDI.BHZ	LITI.BHN	NIEB.BHE	RAFA.BHZ
AREN.BHN	HUER.BHE	LITI.BHZ	NIEB.BHN	RINC.BHE
AREN.BHZ	HUER.BHN	LLAN.BHE	NIEB.BHZ	RINC.BHN
BARD.BHE	HUER.BHZ	LLAN.BHN	PACH.BHE	RINC.BHZ
BARD.BHN	HURT.BHE	LLAN.BHZ	PACH.BHN	all.macro
BARD.BHZ	HURT.BHN	MAUL.BHE	PACH.BHZ	elbo.macro
ELBO.BHE	HURT.BHZ	MAUL.BHN	PENA.BHE	huer.log
ELBO.BHN	JUAN.BHE	MAUL.BHZ	PENA.BHN	huer.macro
ELBO.BHZ	JUAN.BHN	NEGR.BHE	PENA.BHZ	makerotatemacro.sh
HEDI.BHE	JUAN.BHZ	NEGR.BHN	RAFA.BHE	
HEDI.BHN	LITI.BHE	NEGR.BHZ	RAFA.BHN	

carpincho:sacex smalley\$ makerotatemacro.sh

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carpincho:sacex smalley\$ ls

AREN.167	HEDI.BHE	JUAN.BHZ	NEGR.255	PENA.BHN
AREN.257	HEDI.BHN	LITI.171	NEGR.BHE	PENA.BHZ
AREN.BHE	HEDI.BHZ	LITI.261	NEGR.BHN	RAFA.165
AREN.BHN	HUER.154	LITI.BHE	NEGR.BHZ	RAFA.255
AREN.BHZ	HUER.244	LITI.BHN	NIEB.167	RAFA.BHE
BARD.168	HUER.BHE	LITI.BHZ	NIEB.257	RAFA.BHN
BARD.258	HUER.BHN	LLAN.154	NIEB.BHE	RAFA.BHZ
BARD.BHE	HUER.BHZ	LLAN.244	NIEB.BHN	RINC.157
BARD.BHN	HURT.168	LLAN.BHE	NIEB.BHZ	RINC.247
BARD.BHZ	HURT.258	LLAN.BHN	PACH.161	RINC.BHE
ELBO.168	HURT.BHE	LLAN.BHZ	PACH.251	RINC.BHN
ELBO.258	HURT.BHN	MAUL.171	PACH.BHE	RINC.BHZ
ELBO.BHE	HURT.BHZ	MAUL.261	PACH.BHN	all.macro
ELBO.BHN	JUAN.161	MAUL.BHE	PACH.BHZ	elbo.macro
ELBO.BHZ	JUAN.251	MAUL.BHN	PENA.165	huer.log
HEDI.160	JUAN.BHE	MAUL.BHZ	PENA.255	huer.macro
HEDI.250	JUAN.BHN	NEGR.165	PENA.BHE	makerotatemacro.sh

carpincho:sacex smalley\$



```
carpincho:sacex smalley$ more all.macro
r AREN.BHE AREN.BHN
rotate to gcr
w KSTCMP
r BARD.BHE BARD.BHN
rotate to gcr
w KSTCMP
r ELBO.BHE ELBO.BHN
rotate to gcr
w KSTCMP
r HEDI.BHE HEDI.BHN
rotate to gcr
w KSTCMP
r HUER.BHE HUER.BHN
rotate to gcr
w KSTCMP
r HURT.BHE HURT.BHN
rotate to gcr
w KSTCMP
r JUAN.BHE JUAN.BHN
rotate to gcr
w KSTCMP
r LITI.BHE LITI.BHN
rotate to gcr
w KSTCMP
r LLAN.BHE LLAN.BHN
rotate to gcr
w KSTCMP
r MAUL.BHE MAUL.BHN
rotate to gcr
w KSTCMP
r NEGR.BHE NEGR.BHN
rotate to gcr
w KSTCMP
r NIEB.BHE NIEB.BHN
rotate to gcr
w KSTCMP
r PACH.BHE PACH.BHN
rotate to gcr
w KSTCMP
r PENA.BHE PENA.BHN
rotate to gcr
w KSTCMP
r RAFA.BHE RAFA.BHN
rotate to gcr
w KSTCMP
r RINC.BHE RINC.BHN
rotate to gcr
w KSTCMP
quit
```



Notice importance of

- Organization/structure
- Naming conventions

Take advantage of them to automate processing.





Try to automate as much as possible.

- Saves time if have to do it over and over.
 - Documents what you did - you can reproduce it exactly.
- 