## Local modelling for DAS

### (a) Geometry for DAS cable locations

**sta-dasl:**
Uses DAS specific parameters and outputs the information of the position and azimuth associated with the ends of the gauge length for each channel location

*Sample input to sta-dasl.f:*

```
0.001                                   ! Depth of cable
0.01                                    ! Gauge length
0.0002                                  ! Offset of source from cable
90.0                                    ! Local cable azimuth
ewt-staz.das                            ! Station file (distance, azimuth)
ewt-gaz0.dls                            ! Output file
```

*Example station input: ewt-staz.das*

```
  12                                              #  of distances /distances
 -0.011      0.00
 -0.009      0.00
 -0.007      0.00
 -0.005      0.00
 -0.003      0.00
 -0.001      0.00
  0.001      0.00
  0.003      0.00
  0.005      0.00
  0.007      0.00
  0.009      0.00
  0.011      0.00
```

*Example output: ewt-gaz0.dls*

```
      xs     cable azim      xg1      az1          xg2       az2
         12
    -0.011     90.000      0.01550 179.26074     0.00650 178.23759
    -0.009     90.000      0.01350 179.15121     0.00450 177.45518
    -0.007     90.000      0.01150 179.00365     0.00251 175.42607
    -0.005     90.000      0.00950 178.79395     0.00054 158.19858
    -0.003     90.000      0.00750 178.47246     0.00151   7.59464
    -0.001     90.000      0.00550 177.91743     0.00351   3.27049
     0.001     90.000      0.00351 176.72949     0.00550   2.08257
     0.003     90.000      0.00151 172.40535     0.00750   1.52753
     0.005     90.000      0.00054  21.80140     0.00950   1.20605
     0.007     90.000      0.00251   4.57392     0.01150   0.99635
     0.009     90.000      0.00450   2.54480     0.01350   0.84876
     0.011     90.000      0.00650   1.76239     0.01550   0.73926
```

This style of file is used by the synthetics program when flag “DL” is used.

**(b) Modelling of DAS response by frequency-slowness integration**

**Erzslr--das:**
Calculates synthetic seismograms for DAS for a stratified wavespeed model and configuration file for cable geometry for a surface force or a moment tensor source. Option ”DL” - the effect of gauge length is included by differencing the ground velocity at the ends of the gauge interval. Takes range and azimuth file ***.dls** from step (a).

The surface conditions are:
HS – half space with free surface
H1 – half space (only single surface reflection)
WF – whole space (no free surface reflection- but free surface amplification effects)
WS – whole space (no free surface reflection)

Also includes options for seismometer response with and without free surface effects, with simple range, azimuth input.

*Sample DL input to erzslr-das:*

```
"ERZSLR-das   ewg 4  "                  # Title
"dlr-ewg4-4.txz"                        # File for T-X seismogram output
YE                                      # Adaptive slowness
"ewg4.mod"                              # Velocity model file
"DL"                                    # Response (GD,GV,GA,DL,DR,DV)
"HS"                                    # Surface Condition (HS,H1,WF,WS)
  2500                                  # Number of slownesses (<2500)
 -0.0010                                # Minimum slowness
  4.0000                                # Maximum slowness
100                                     # Slowness taper plo (n samples)
100                                     # Slowness taper phi (n samples)
"WA"                                    # Wavelet input or Ricker (WA/RI)
"ewd.wav"                               # Wavelet file
"YE"                                    # Exponential damping? (YE/NO)
  4096                                  # Number of time points
  0.0005                                # Time step
   0.125  0.25                          # Frequency taper (low)
   90.0   120.0                         # Frequency taper (high)
   60.0                                 # Dominant frequency [RI]
"SF"                                    # Moment tensor or Force (MT/SF)
   0.00     0.00     0.00     0.02      # Moment tensor & Force Components
   0.00     0.00     0.00     0.02
   0.00     0.00     1.00     1.00
   0.000                                # Depth of source
   0.001                                # Cable depth (assumed in layer 1)
"ewt-gaz0.dls"                          # Range and azimuth file
  0.0                                   # Reduction slowness
 -0.100                                 # Start time (reduced)
"NO"                                    # Debug/frequency-slowness (YE/NO)
"NO"                                    # Debug/waveform (YE/NO)
```

*Sample model file: ewg4.mod*

```
Nr    Vp       Vs       Rho      Thickness. Qp-1.    Qs-1
     [km/s]   [km/s]   [Mg/m3]    km
ewg4a
     6        0
3    0.580    0.280    2.35     0.008    0.01    0.02
3    0.750    0.375    2.48     0.012    0.01    0.02
3    0.800    0.400    2.50     0.050    0.01    0.02
3    1.000    0.550    2.60     0.100    0.01    0.02
3    1.500    0.833    2.65     0.500    0.01    0.02
3    2.000    1.100    2.70     5.000    0.01    0.02
```

*Sample wavelet file: ewd.wav*

```
   3                                  # of points in waveform /waveform
 1.0      -1.00      0.00
```

### (c) Travel time calculation

**Travel time calculation tkald** – includes effect of an offset source from line of stations. Uses the same wavespeed model file as for the synthetics

*Sample input: tkd-ewd.cm*

```
'ewg4.mod'                    # Vel model filename
 300                          # Number of ray parameters (<600)
 0.0   3.0                    # Pmin, Pmax
'ewg4e-p.tim'                 # Filename for travel time output - P
'ewg4e-s.tim'                 # Filename for travel time output - S
0.012                         # source offset [km]
```

### (d) Seismogram output and display

The seismograms are written out by **erzslr-das** in a simple ascii format in a loop over stations (index JX):
XD(JX), AZD(JX), CDC, DELT, NT, PR, TCAL, SMP, (FR(LK),LK=1,NT)

XD – distance along cable
AZD – azimuth
CDC – type identifier
DELT – time increment
NT – number of time points
PR – reduction slowness
TCAL – starting reduced time
SMP – maximum amplitude
FR – time series

*Example showing first few time points:*

```
-4.30000015E-02   90.0000000     DASL   5.00000024E-04       4096   0.00000000
-0.100000001      2.13151979      -3.98850441E-03  -3.68603622E-03  -3.41499783E-03
-3.22220637E-03  -3.14382929E-03  ....
```

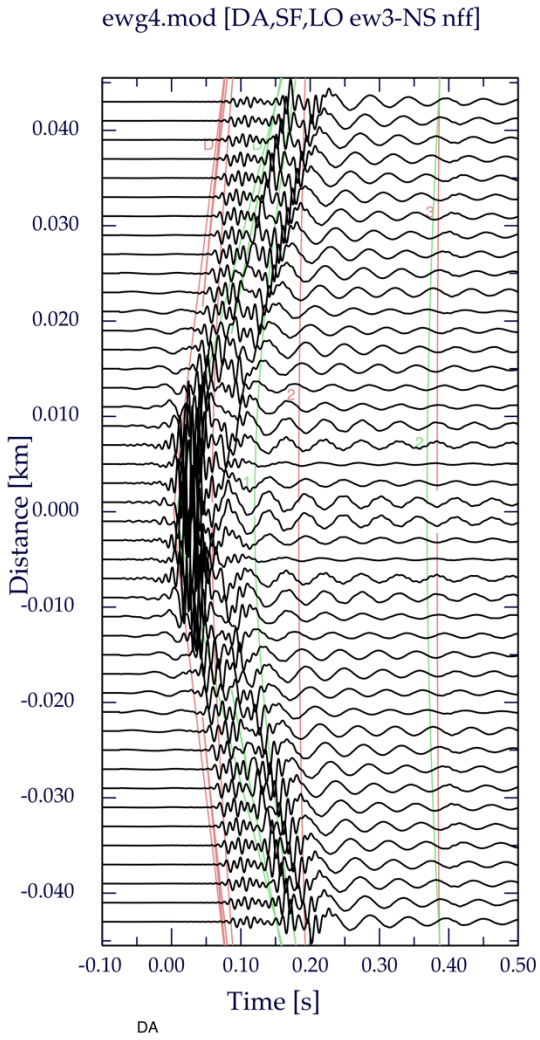
**Display zsyd**

The zsyd routine displays seismograms with the distance axis vertical and time horizontally, a style suitable for comparison with DAS records. Travel times are plotted with identification of the major branches.

A sample input file for a local event is:

```
YE                                Plot seismograms? (YE/NO)
DA                                 <se> Plot components (DA,ZC,RC,TC,3C)
1                                  <se> Number of files for seismograms(<5)
dlr-ewg4-4.txz                     <se> Name of file
44                                 <se> Number of distances to plot
0.0                                <se> Reduction slowness for plot
-0.1   0.025                       <se> Minimum red time for seismograms, time shift
0.00   5.0                         <se> Component offset, polarisation window
 1 10  4                           <se> Pen colours for seismic components (Z/D,R,T)
NO                                 <se> Trace normalisation? (YE/NO)
 -0.0003   1.0  0.0   0.01  0.0    <se> Amp,b1,b2,xr,eps | amp*(b1+b2/xr)**eps
YE                                Plot travel times? (YE/NO)
2                                  <tt> number of files for travel times (<5)
ewh4d-p.tim                        <tt> Name of file
LI                                 <tt> line or symbol mode (LI/SY)
11                                 <tt> Pen colour
ewh4d-s.tim                        <tt> Name of file
LI                                 <tt> line or symbol mode (LI/SY)
14                                 <tt> Pen colour
FR                                Frame: FR - full frame , NL - no labels
3                                  <fr> font choice
   -0.0455     0.0455              <fr> Rmin, Rmax
   25.00                           <fr> length of R-axis
   -0.10    0.50                   <fr> Trmin,Trmax
   12.00                           <fr> length of T-axis
    0.01    0.1                    <fr> Large Tic spacing R,T
    0.005   0.05                   <fr> Small Tic spacing R,T
    3       2                      <fr> # of dec. in label R,T
   0.5000   0.47500                <fr> character size text,title
Distance [km]                                                    X-txt
Time [s]                                                         Y-txt
ewg4.mod [DA,SF,LO ew3-NS nff]                                   Title
```

The product is a Postscript file **zsy.ps** in landscape format


ewg4.mod [DA,SF,LO ew3-NS nff]
0.040
0.030
0.020
0.010
0.000
-0.010
-0.020
-0.030
-0.040
Distance [km]
-0.10
0.00
0.10
0.20
0.30
0.40
0.50
Time [s]
DA