

Example of shear-wave splitting applied to an icequake from Rutford Ice Stream, Antarctica

```
In [1]: %load_ext autoreload
        %autoreload 2
```

```
In [2]: import swspy
import obspy
from obspy import UTCDateTime
import numpy as np
%matplotlib notebook
import matplotlib.pyplot as plt
```

1. Load data for event:

```
In [3]: # Load data:
archive_path = "data/mseed"
archive_vs_file = "archive"
nonlinloc_event_path = "data/loc.Tom__RunNLLoc000.20090121.042009.grid0.loc.h

starttime = UTCDateTime("20090121T042009.18523") - 0.5
endtime = UTCDateTime("20090121T042009.18523") + 2.5
load_wfs_obj = swspy.io.load_waveforms(archive_path, starttime=starttime, end
load_wfs_obj.filter = True
load_wfs_obj.filter_freq_min_max = [1.0, 80.0]
st = load_wfs_obj.read_waveform_data()
```

```
In [4]: # # Add noise to data (for testing...) :
# for i in range(len(st)):
#     st[i].data = st[i].data + 0.3*np.roll(st[i].data, int(np.random.uniform
```

2. Calculate splitting:

```
In [5]: # Calculate splitting:
splitting_event = swspy.splitting.create_splitting_object(st, nonlinloc_event
splitting_event.overall_win_start_pre_fast_S_pick = 0.3 #0.1
splitting_event.win_S_pick_tolerance = 0.1
splitting_event.overall_win_start_post_fast_S_pick = 0.2 #0.2
splitting_event.rotate_step_deg = 1.0 #2.5
splitting_event.max_t_shift_s = 0.12
splitting_event.n_win = 10 #5 #10
# splitting_event.perform_sp
splitting_event.perform_sws_analysis(coord_system="ZNE", sws_method="EV_and_X
```

```
No S phase pick for station: ST06 therefore skipping this station.
No S phase pick for station: ST07 therefore skipping this station.
No S phase pick for station: ST08 therefore skipping this station.
No S phase pick for station: ST09 therefore skipping this station.
No S phase pick for station: ST10 therefore skipping this station.
```

```
Out[5]:
```

	station	phi	phi_err	dt	dt_err	src_pol	src_pol_err	Q_w	ray_back_azi	ray_i
0	ST01	71.0	3.5	0.048	0.001	147.709834	24.782576	0.000000	108.74	15
0	ST02	89.0	2.5	0.042	0.001	9.462904	58.375066	0.000000	29.53	16
0	ST03	-66.0	4.0	0.020	0.001	41.413732	24.562153	0.000000	354.47	14
0	ST04	77.0	2.0	0.044	0.001	68.105109	76.455853	0.000000	282.07	16

```
splitting_event.clustering_info
```

[illegible]

[illegible]

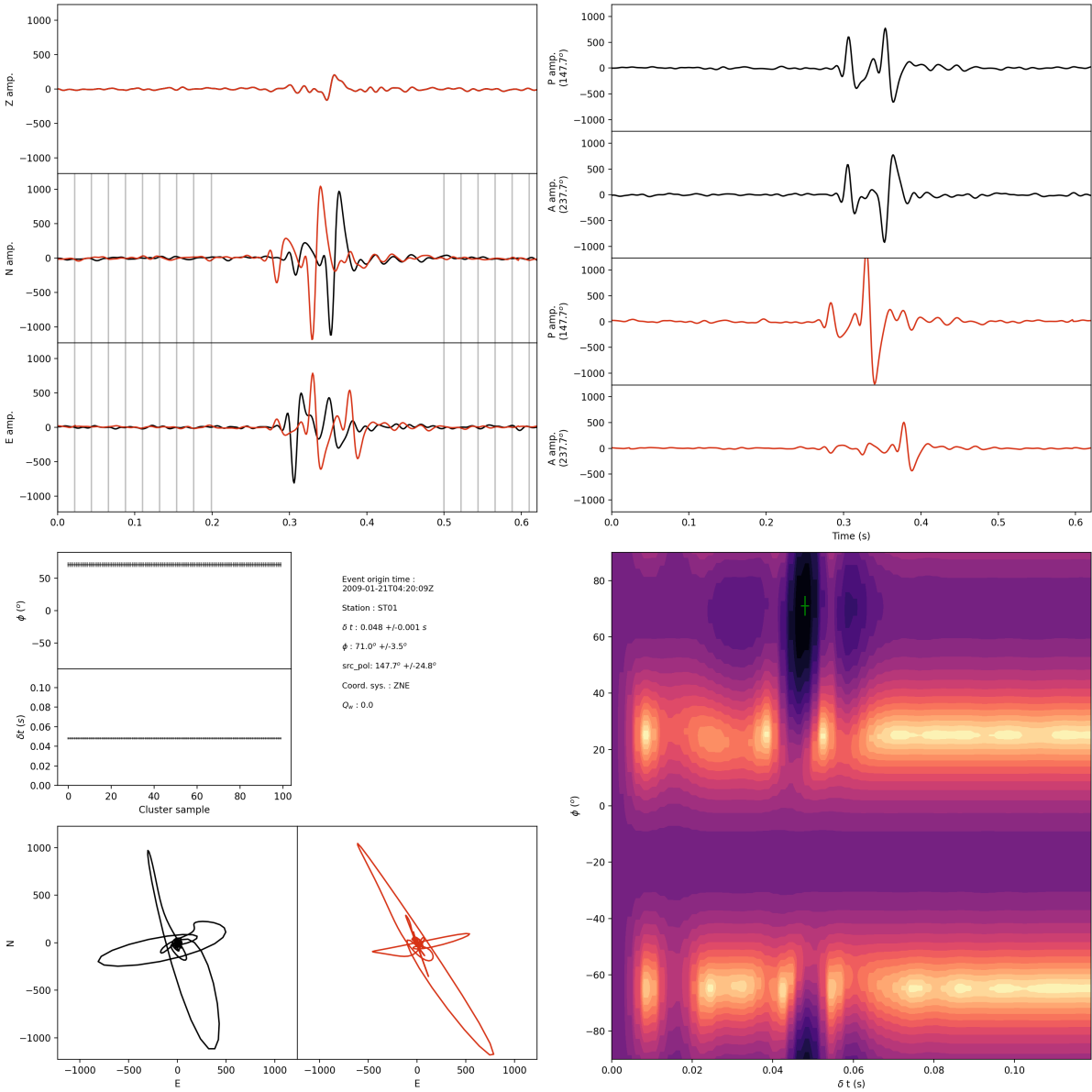
[illegible]

```
0.001]),
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76., 76., 76., 76., 76., 76., 76., 76.] ),
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2. , 2. ,
       2. , 2. , 2. , 2. , 2. , 2. , 2. , 2. , 2. , 2. ,
2. , 2. , 2. , 2. , 2. , 2. , 2. , 2. , 2. , 2. ,
2. , 2. , 2. , 2. , 2. , 2. ] )} } },
'ST05': {'min_var_idx': 0,
'clusters_dict': {'0': {'lags': array([ 0.004, 0.004, 0.004, 0.004, 0.00
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'lag_errs': array([ 0.01 , 0.01 , 0.01 , 0.01 , 0.011, 0.011, 0.011,
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0.011, 0.011, 0.011, 0.011, 0.003, 0.01 , 0.003, 0.01 ,
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0.011, 0.011, 0.011, 0.011, 0.003, 0.003, 0.003, 0.01 ,
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'phis': array([-84., -84., -84., -84., -84., -84., -84., -84., -84., -84.,
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13. , 13.5, 47.5, 48. , 48.5, 48.5, 48.5, 48.5, 12.5,
13. , 13. , 13.5, 13.5, 47.5, 47. , 47. , 47. , 47. ,
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48.
```

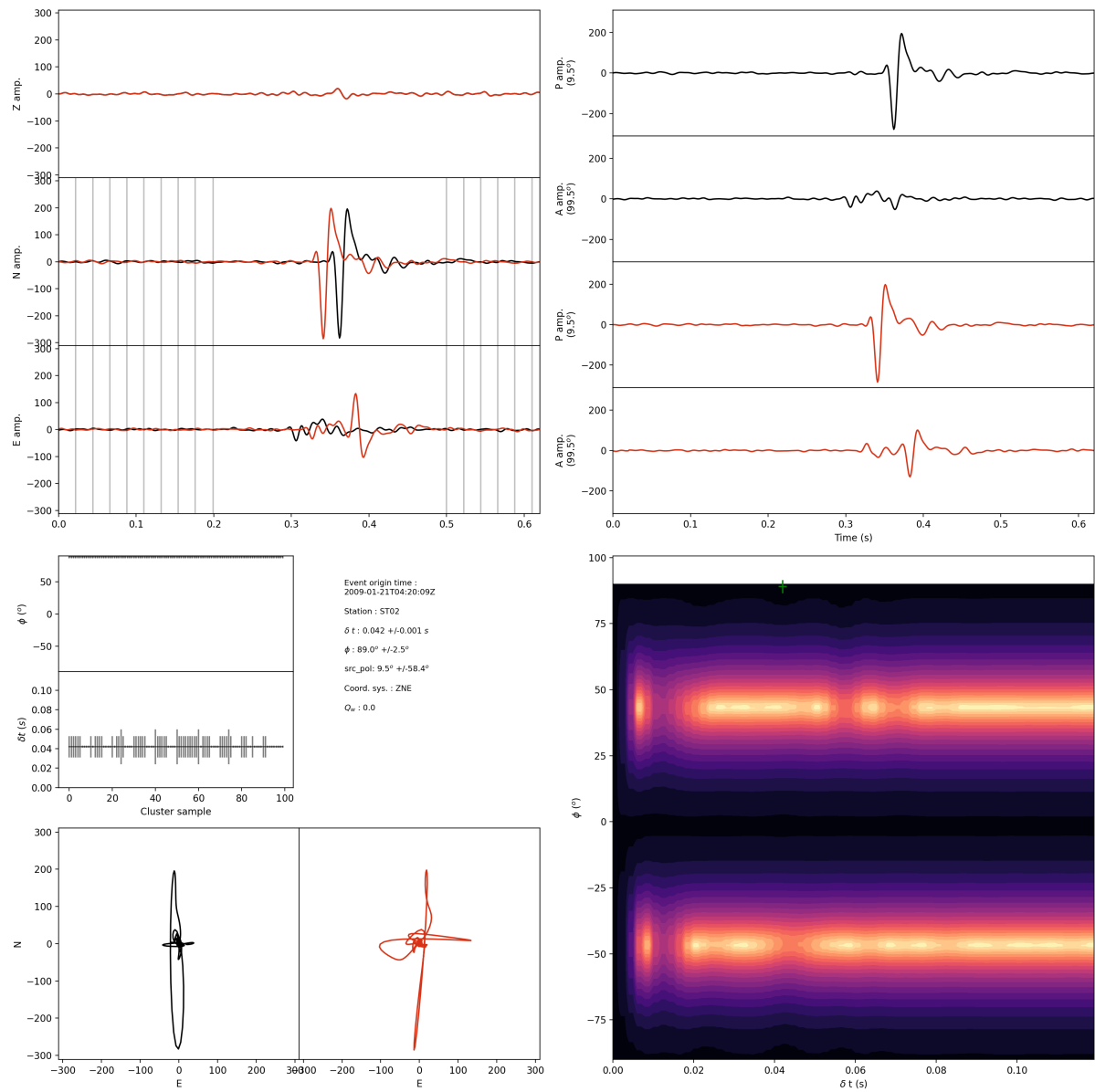
3. Plot result:

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In [7]: splitting event.plot()
```

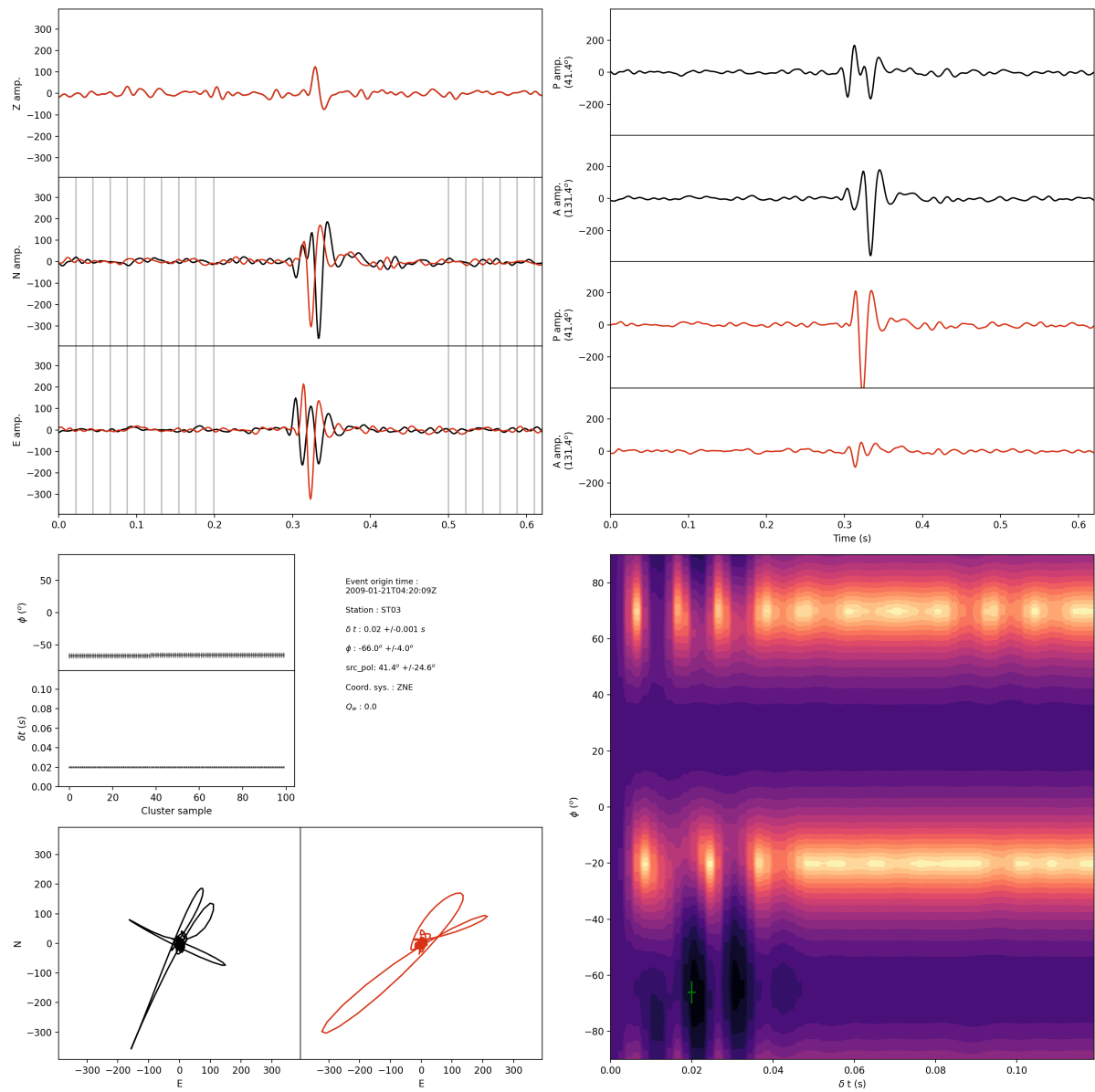
3 Trace(s) in Stream:
ZZ.ST01..EHE | 2009-01-21T04:20:10.080000Z - 2009-01-21T04:20:10.700000Z | 100
0.0 Hz, 621 samples
ZZ.ST01..EHN | 2009-01-21T04:20:10.080000Z - 2009-01-21T04:20:10.700000Z | 100
0.0 Hz, 621 samples
ZZ.ST01..EHZ | 2009-01-21T04:20:10.080000Z - 2009-01-21T04:20:10.700000Z | 100
0.0 Hz, 621 samples



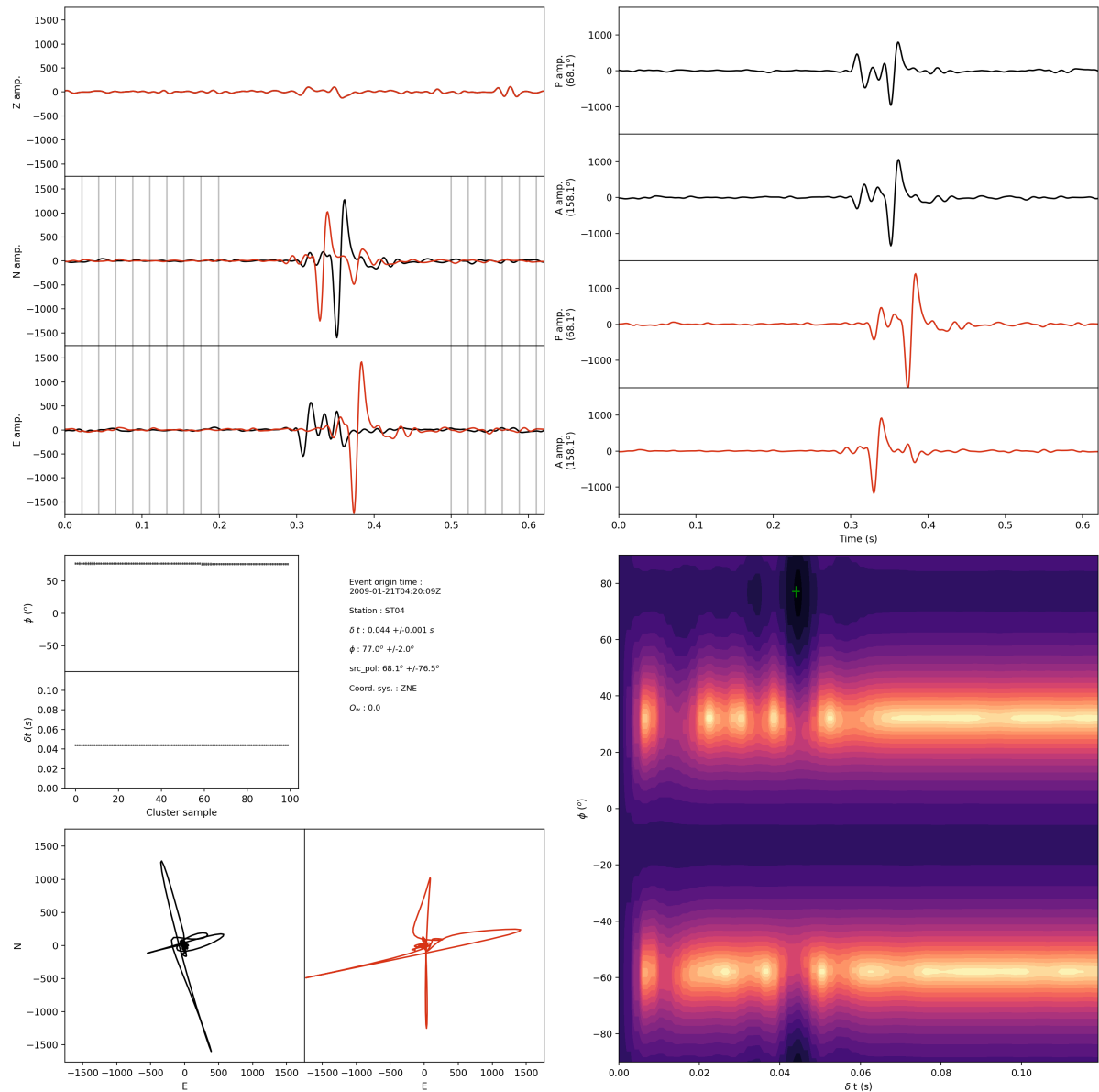
3 Trace(s) in Stream:
YG.ST02..EHE | 2009-01-21T04:20:10.040000Z - 2009-01-21T04:20:10.660000Z | 100
0.0 Hz, 621 samples
YG.ST02..EHN | 2009-01-21T04:20:10.040000Z - 2009-01-21T04:20:10.660000Z | 100
0.0 Hz, 621 samples
YG.ST02..EHZ | 2009-01-21T04:20:10.040000Z - 2009-01-21T04:20:10.660000Z | 100
0.0 Hz, 621 samples



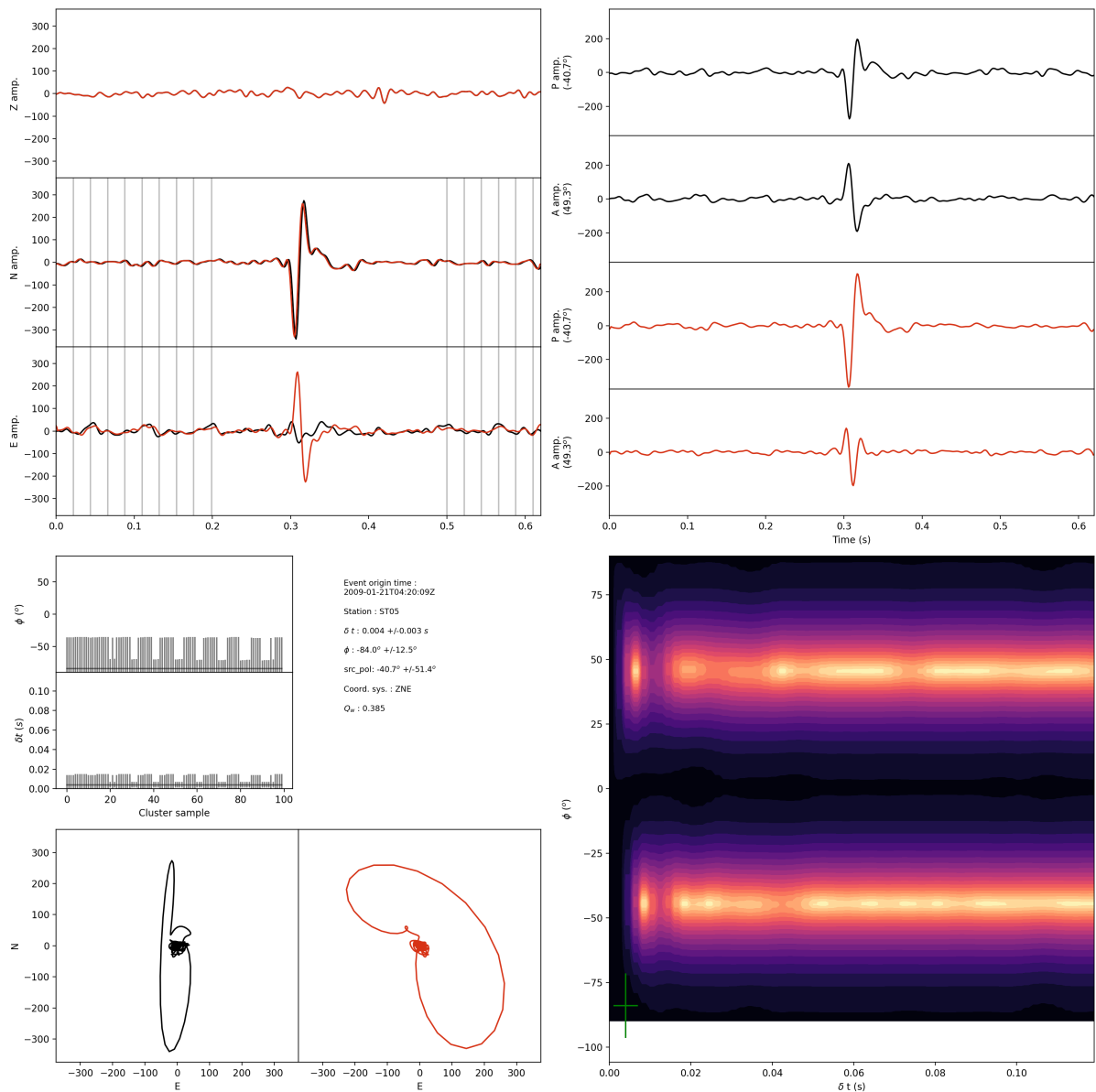
3 Trace(s) in Stream:
ZZ.ST03..EHE | 2009-01-21T04:20:10.230000Z - 2009-01-21T04:20:10.850000Z | 100
0.0 Hz, 621 samples
ZZ.ST03..EHN | 2009-01-21T04:20:10.230000Z - 2009-01-21T04:20:10.850000Z | 100
0.0 Hz, 621 samples
ZZ.ST03..EHZ | 2009-01-21T04:20:10.230000Z - 2009-01-21T04:20:10.850000Z | 100
0.0 Hz, 621 samples



3 Trace(s) in Stream:
ZZ.ST04..EHE | 2009-01-21T04:20:10.050000Z - 2009-01-21T04:20:10.670000Z | 100
0.0 Hz, 621 samples
ZZ.ST04..EHN | 2009-01-21T04:20:10.050000Z - 2009-01-21T04:20:10.670000Z | 100
0.0 Hz, 621 samples
ZZ.ST04..EHZ | 2009-01-21T04:20:10.050000Z - 2009-01-21T04:20:10.670000Z | 100
0.0 Hz, 621 samples



3 Trace(s) in Stream:
ZZ.ST05..EHE | 2009-01-21T04:20:10.310000Z - 2009-01-21T04:20:10.930000Z | 100
0.0 Hz, 621 samples
ZZ.ST05..EHN | 2009-01-21T04:20:10.310000Z - 2009-01-21T04:20:10.930000Z | 100
0.0 Hz, 621 samples
ZZ.ST05..EHZ | 2009-01-21T04:20:10.310000Z - 2009-01-21T04:20:10.930000Z | 100
0.0 Hz, 621 samples



No S phase pick for station: ST06 therefore skipping this station.
 Skipping waveform correction for station: ST06
 No S phase pick for station: ST07 therefore skipping this station.
 Skipping waveform correction for station: ST07
 No S phase pick for station: ST08 therefore skipping this station.
 Skipping waveform correction for station: ST08
 No S phase pick for station: ST09 therefore skipping this station.
 Skipping waveform correction for station: ST09
 No S phase pick for station: ST10 therefore skipping this station.
 Skipping waveform correction for station: ST10

4. Save result:

```
In [8]: # And save result to file:
        splitting_event.save_result()
```

Saved sws result to: /Users/eart0504/Documents/python/github_repositories/swspy/examples/icequake_example/20090121042009_sws_result.csv

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In [ ]:
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In [ ]:
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