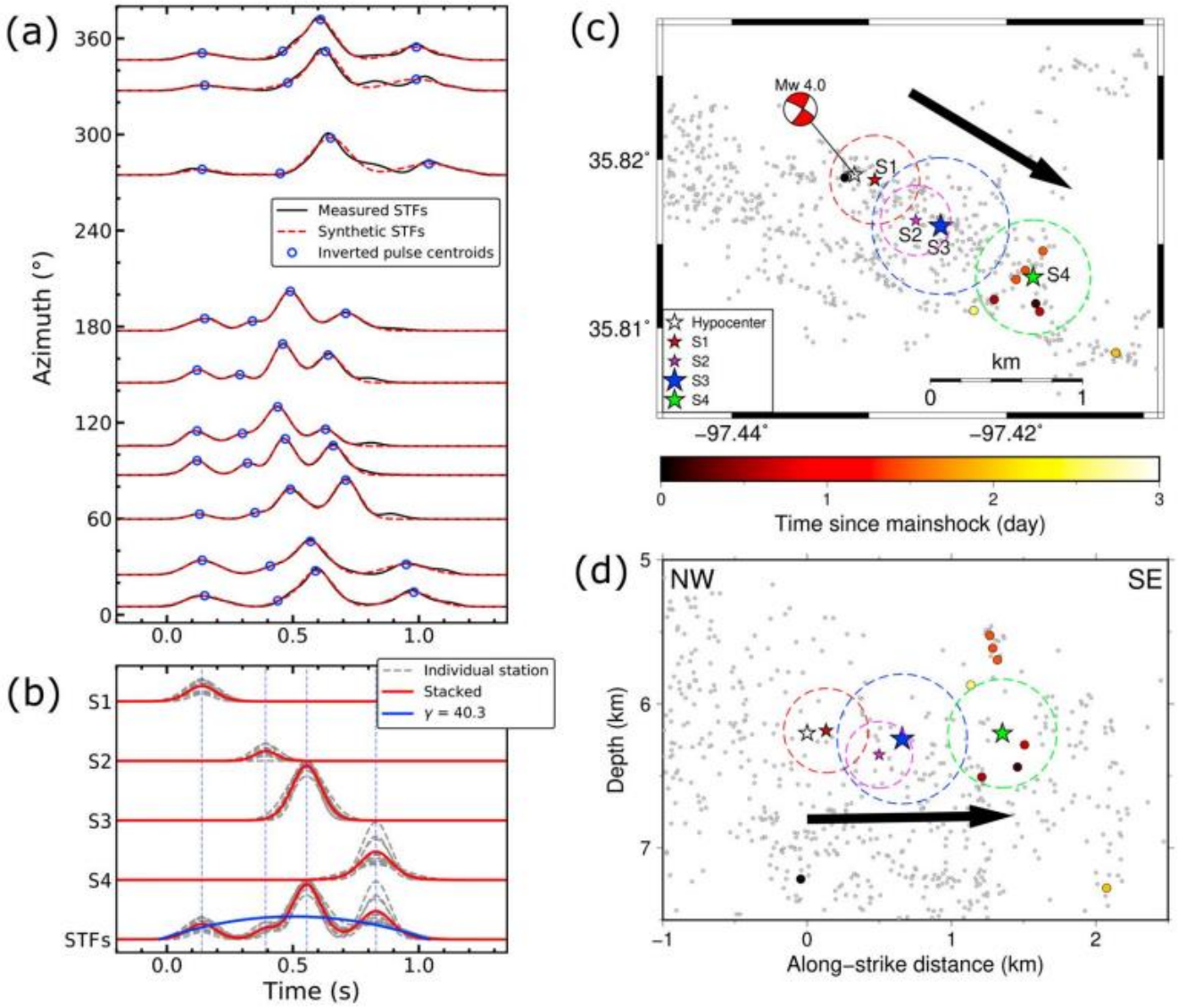
EGF Deconvolution

- Rupture directivity
- Rupture complexity (multiple subevents)
  - centroid locations

  → rupture area

  → ΔCFS calculation
  - centroid times

  → guide multi-point-source inversion, which need preset time windows

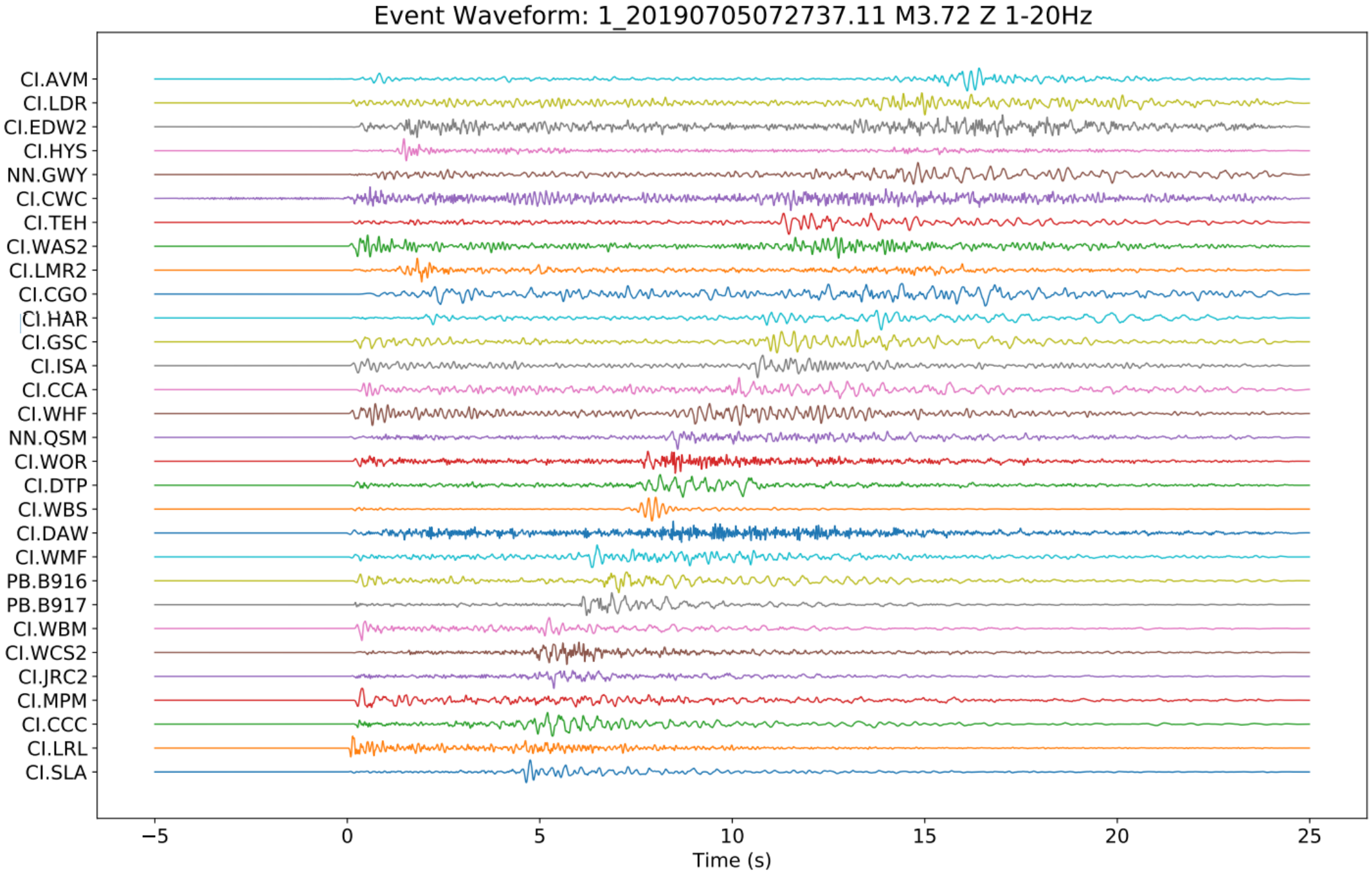


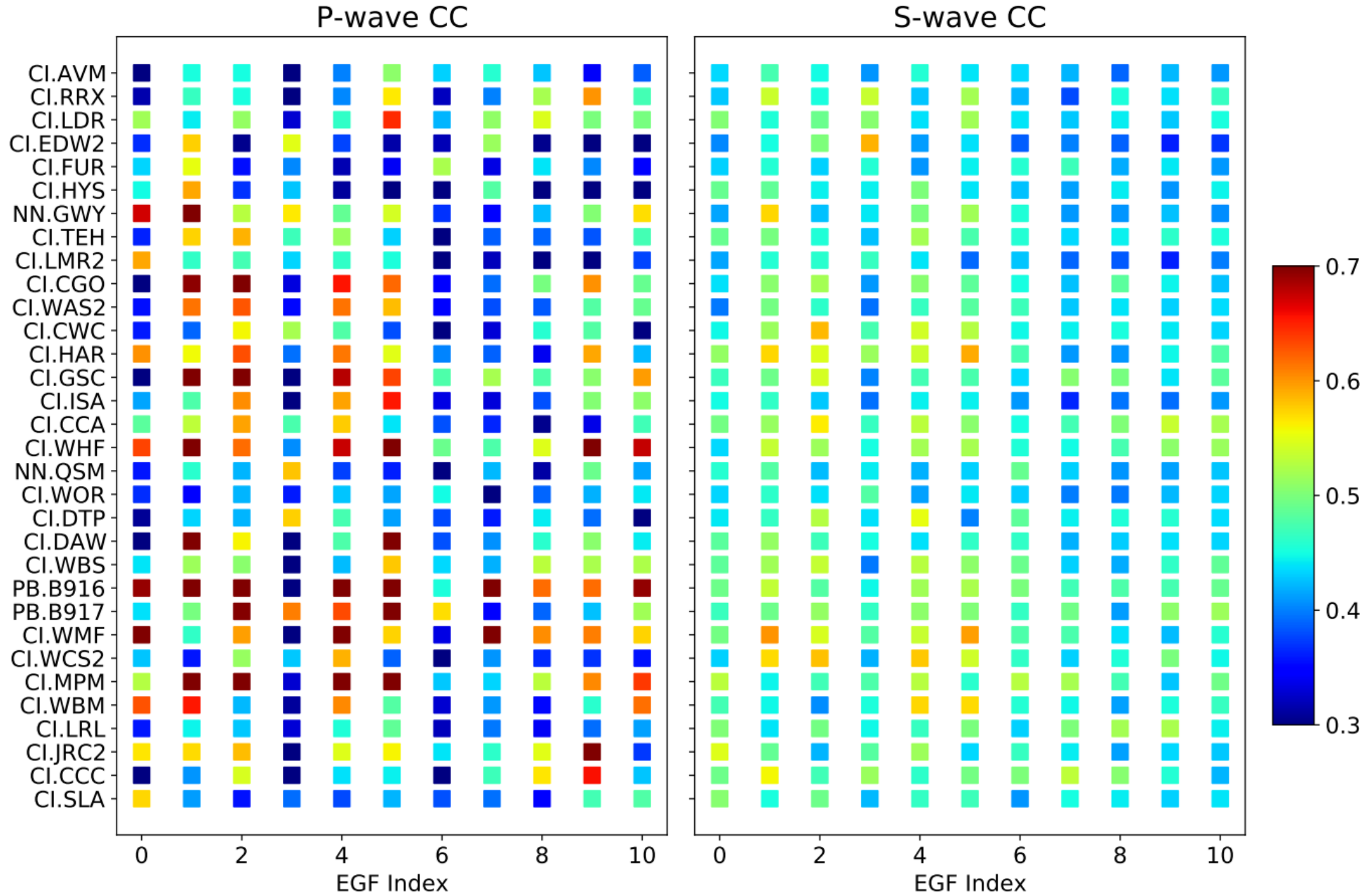
Wu, Chen, & Abercrombie, GRL 2019

EGF Deconvolution

- Inputs
  - fpha_tar: phases for the target events
  - fctlg_all: catalog that contain all available events
  - fsta (station_eg.csv): station file
- Outputs
  - spectrum of target & EGFs
  - STF on 1-station & 1-EGF
  - STF on 1-station & multi-EGF
  - STF alignment by azimuth

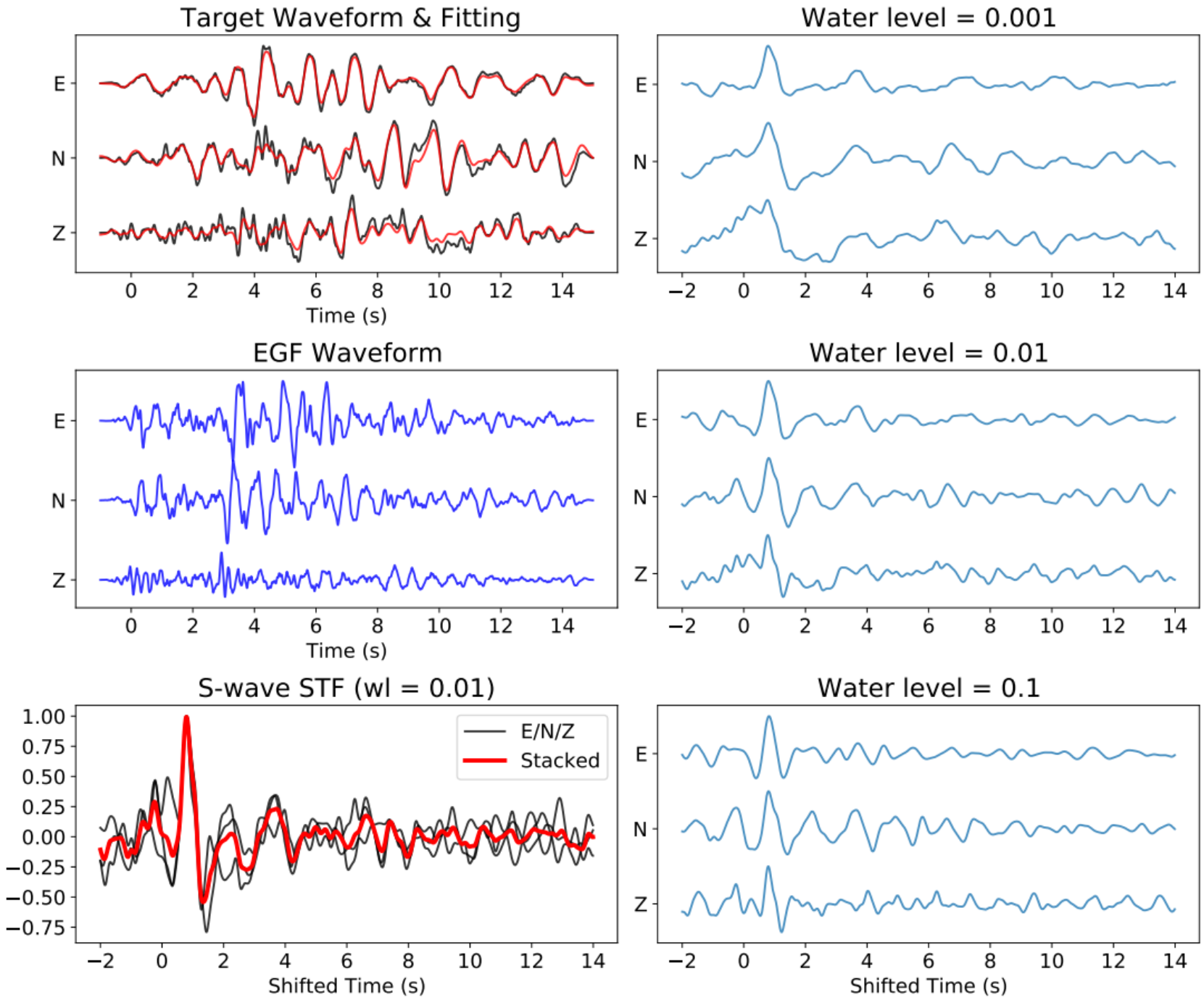
Input	**Operation**	**Output**	***Notes***
fctlg_all & fsta	*select_egf_loc.py*	fpha_egf_org	select EGF by time, location, & magnitude
fpha_tar & fpha_egf_org	*cut_events.py*	input/events_tar input/events_egf	cut raw data
fpha_egf_org & input/events_egf	*pick_events.py*	fpha_egf_org	refine original pick with STA/LTA
fpha_egf_org	*calc_egf-cc.py & plot_egf-cc.py*	eg_tar-egf.cc & eg_tar-egf-cc.pdf	
eg_tar-egf.cc	select_egf_cc.py	fpha_egf	select with CC (not strict criteria as well)
fpha_egf	*plot_waveform-events.py*	evid_name.pdf	inspect selected events

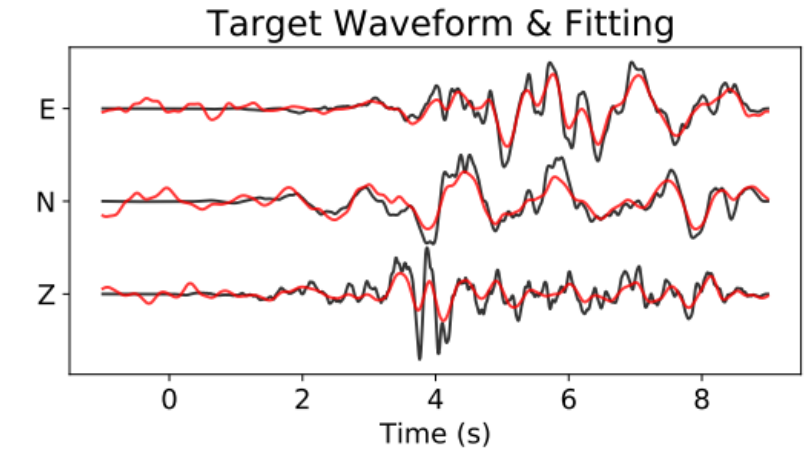

Event Waveform: 1_20190705072737.11 M3.72 Z 1-20Hz
CI.AVM
CI.LDR
CI.EDW2
CI.HYS
NN.GWY
CI.CWC
CI.TEH
CI.WAS2
CI.LMR2
CI.CGO
CI.HAR
CI.GSC
CI.ISA
CI.CCA
CI.WHF
NN.QSM
CI.WOR
CI.DTP
CI.WBS
CI.DAW
CI.WMF
PB.B916
PB.B917
CI.WBM
CI.WCS2
CI.JRC2
CI.MPM
CI.CCC
CI.LRL
CI.SLA
−5
0
5
10
15
20
25
Time (s)

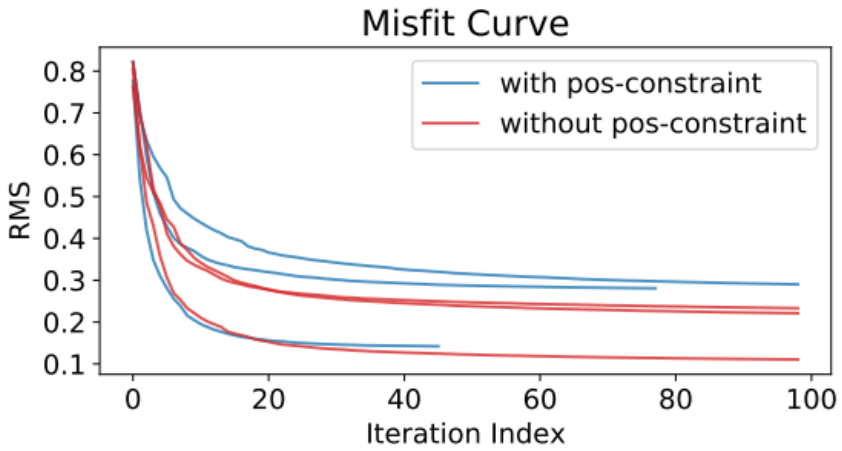

P-wave CC
S-wave CC
CI.AVM
CI.RRX
CI.LDR
CI.EDW2
CI.FUR
CI.HYS
NN.GWY
CI.TEH
CI.LMR2
CI.CGO
CI.WAS2
CI.CWC
CI.HAR
CI.GSC
CI.ISA
CI.CCA
CI.WHF
NN.QSM
CI.WOR
CI.DTP
CI.DAW
CI.WBS
PB.B916
PB.B917
CI.WMF
CI.WCS2
CI.MPM
CI.WBM
CI.LRL
CI.JRC2
CI.CCC
CI.SLA
0
2
4
6
8
10
EGF Index
0
2
4
6
8
10
EGF Index
0.7
0.6
0.5
0.4
0.3

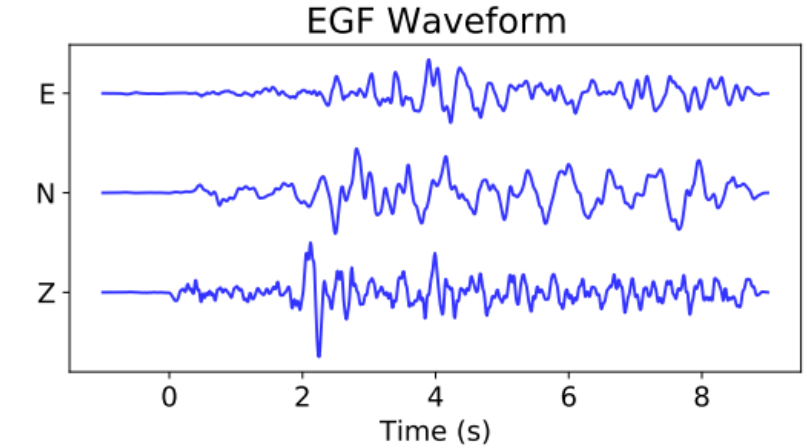
EGF Deconvolution

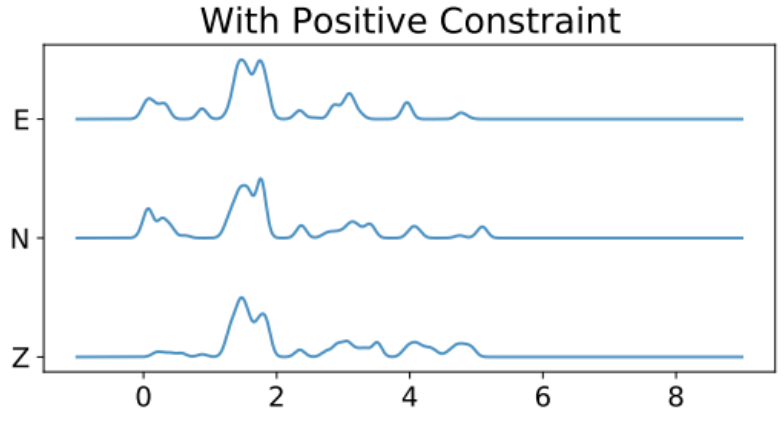
Input	Operation	Output	*Notes*
fpha_egf & fpha_tar	plot_spec-s.py	eg_spec-s_name.pdf	check the consistency between spectrum of EGFs
fpha_egf & fpha_tar	check_stf-sta_freq.py check_stf-sta_time.py	eg_stf-sta_freq-p/s.pdf eg_stf-sta_time-p/s.pdf	check deconvolution on 1-sta & 1-EGF
fpha_egf & fpha_tar	check_stf-egf_freq.py check_stf-egf_time.py	eg_stf-egf_freq-p/s.pdf eg_stf-egf_time-p/s.pdf	check deconvolution on 1-sta & multi-EGF
fpha_egf & fpha_tar	plot_stf-align.py	eg_stf-align.pdf	align STF by azimuth

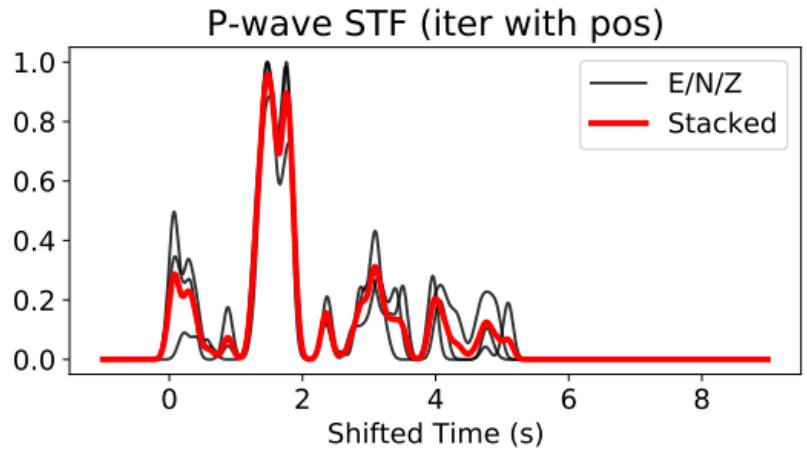

Target Waveform & Fitting
Water level = 0.001
EGF Waveform
Water level = 0.01
S-wave STF (wl = 0.01)
Water level = 0.1
E
N
Z
Time (s)
Shifted Time (s)
E/N/Z
Stacked

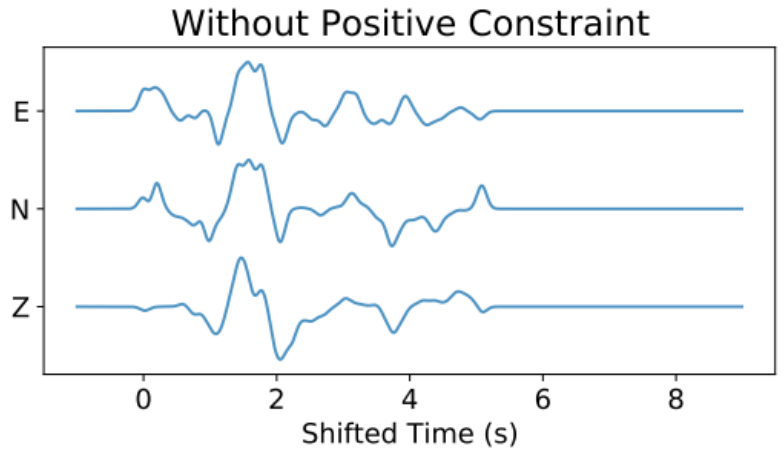

Target Waveform & Fitting
E
N
Z
0
2
4
6
8
Time (s)

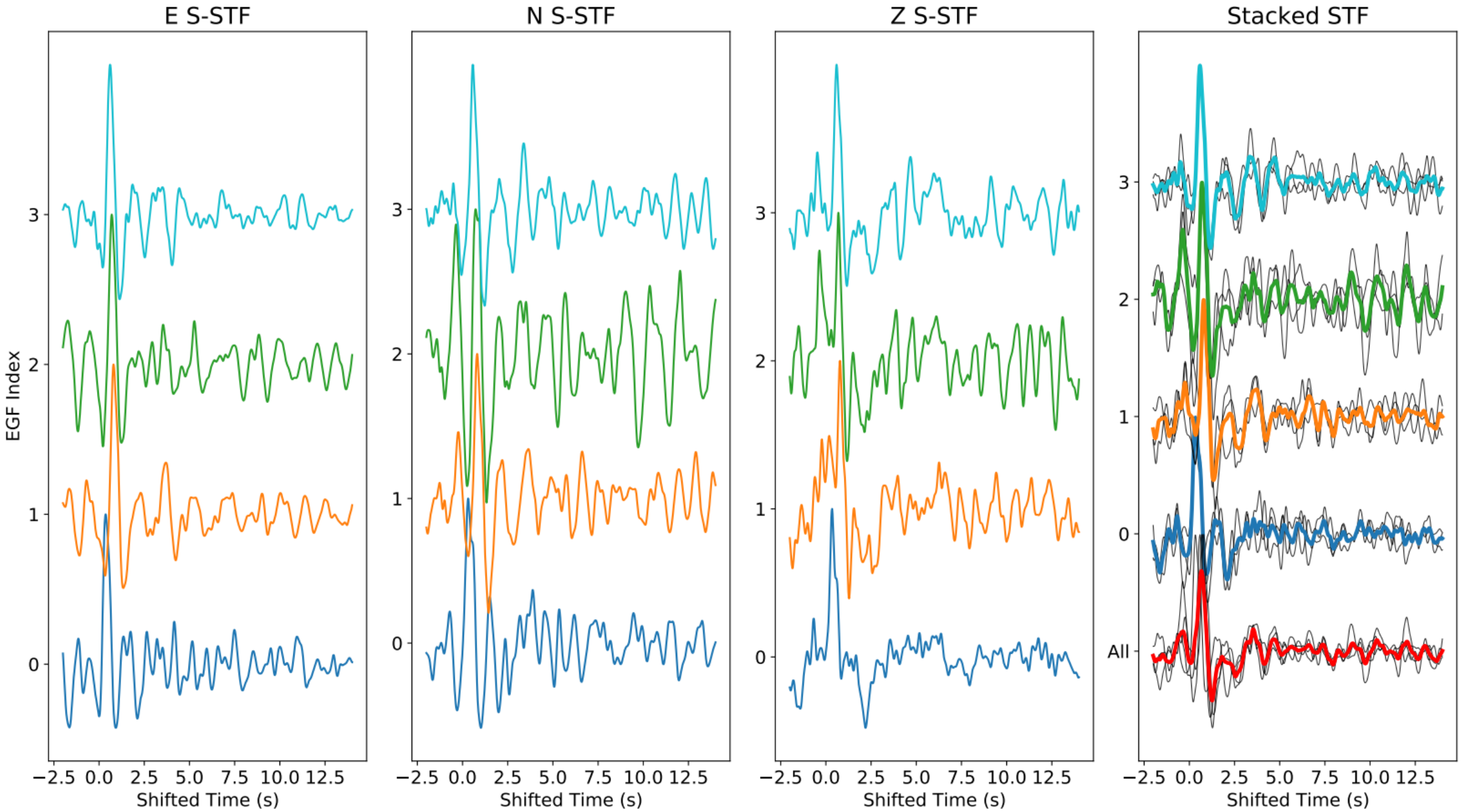

Misfit Curve
with pos-constraint
without pos-constraint
RMS
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
20
40
60
80
100
Iteration Index

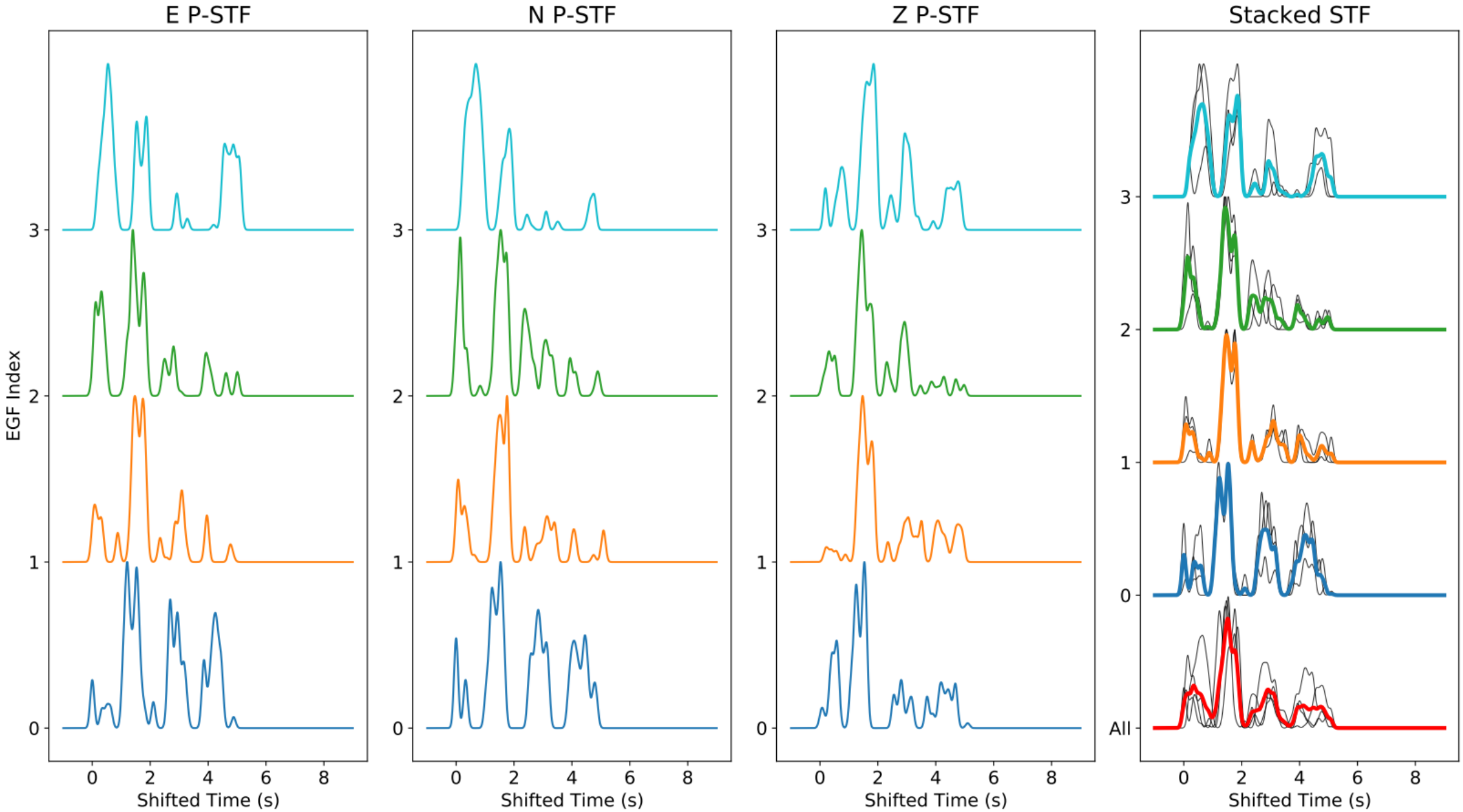

EGF Waveform
E
N
Z
0
2
4
6
8
Time (s)


With Positive Constraint
E
N
Z
0
2
4
6
8


P-wave STF (iter with pos)
E/N/Z
Stacked
1.0
0.8
0.6
0.4
0.2
0.0
0
2
4
6
8
Shifted Time (s)


Without Positive Constraint
E
N
Z
0
2
4
6
8
Shifted Time (s)


E S-STF
N S-STF
Z S-STF
Stacked STF
EGF Index
3
2
1
0
All
−2.5 0.0 2.5 5.0 7.5 10.0 12.5
Shifted Time (s)


E P-STF
N P-STF
Z P-STF
Stacked STF
EGF Index
3
2
1
0
All
0
2
4
6
8
Shifted Time (s)

References

- Abercrombie, R. E. (2015), Investigating uncertainties in empirical Green's function analysis of earthquake source parameters. *J. Geophys. Res. Solid Earth*, 120, 4263– 4277. doi: 10.1002/2015JB011984.
- López-Comino, J. A., Stich, D., Morales, J., and Ferreira, A. M. G. (2016), Resolution of rupture directivity in weak events: 1-D versus 2-D source parameterizations for the 2011, M_w 4.6 and 5.2 Lorca earthquakes, Spain, *J. Geophys. Res. Solid Earth*, 121, 6608– 6626, doi:10.1002/2016JB013227.
- Wu, Q., Chen, X., & Abercrombie, R. E. (2019). Source complexity of the 2015 Mw 4.0 Guthrie, Oklahoma earthquake. Geophysical Research Letters, 46, 4674–4684. https://doi.org/10.1029/2019GL082690
- Yoshida, K., Uchida, N., Kubo, H., Takagi, R., & Xu, S. (2022). Prevalence of updip rupture propagation in interplate earthquakes along the Japan trench. *Earth and Planetary Science Letters*, *578*, 117306. https://doi.org/10.1016/j.epsl.2021.117306