Seismicity Visualization:
Plot with individual Python, GMT, & MATLAB scripts

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Outline

- Tools
  - Python / Matplotlib
  - GMT
  - Matlab
- Dimensions of seismicity
  - location distribution
  - magnitude distribution
  - temporal distribution
- Other plots
  - quality control, waveform plots …

README.md

Seismicity-Visualization

Scripts for seismicity statistics and visualization. One script for one figure, with example outputs

1. Python

1.1 Location distribution

> *plot_loc-map.py* map view of location distribution
> *plot_loc-cross-sec.py* plot map view + cross-sections
> *plot_loc-compare.py* plot comparison of map + cross-section location
> *plot_dep-compare.py* plot comparison of depth distribution

1.2 Magnitude distribution

> *plot_mag-time.py* magnitude-time sequence & seismic rate
> *plot_fmd-compare.py* plot comparison of FMD
> *plot_b-map.py* plot b-value distribution in map view

1.3 Phase / Catalog quality control

> *plot_ts-tp-dist.py* S-P time and P&S travel time ~ hypocentral distance

1.4 Waveform plots

> *plot_wave-dist.py* plot waveform moveout, x-y for travel time and epicentral distance
> *plot_wave-tp.py* waveform alignment by P arrival

2. MATLAB

> *plot_seis3d.m* 3D seismic events distribution

3. GMT

> *plot_sta.sh* plot station distribution

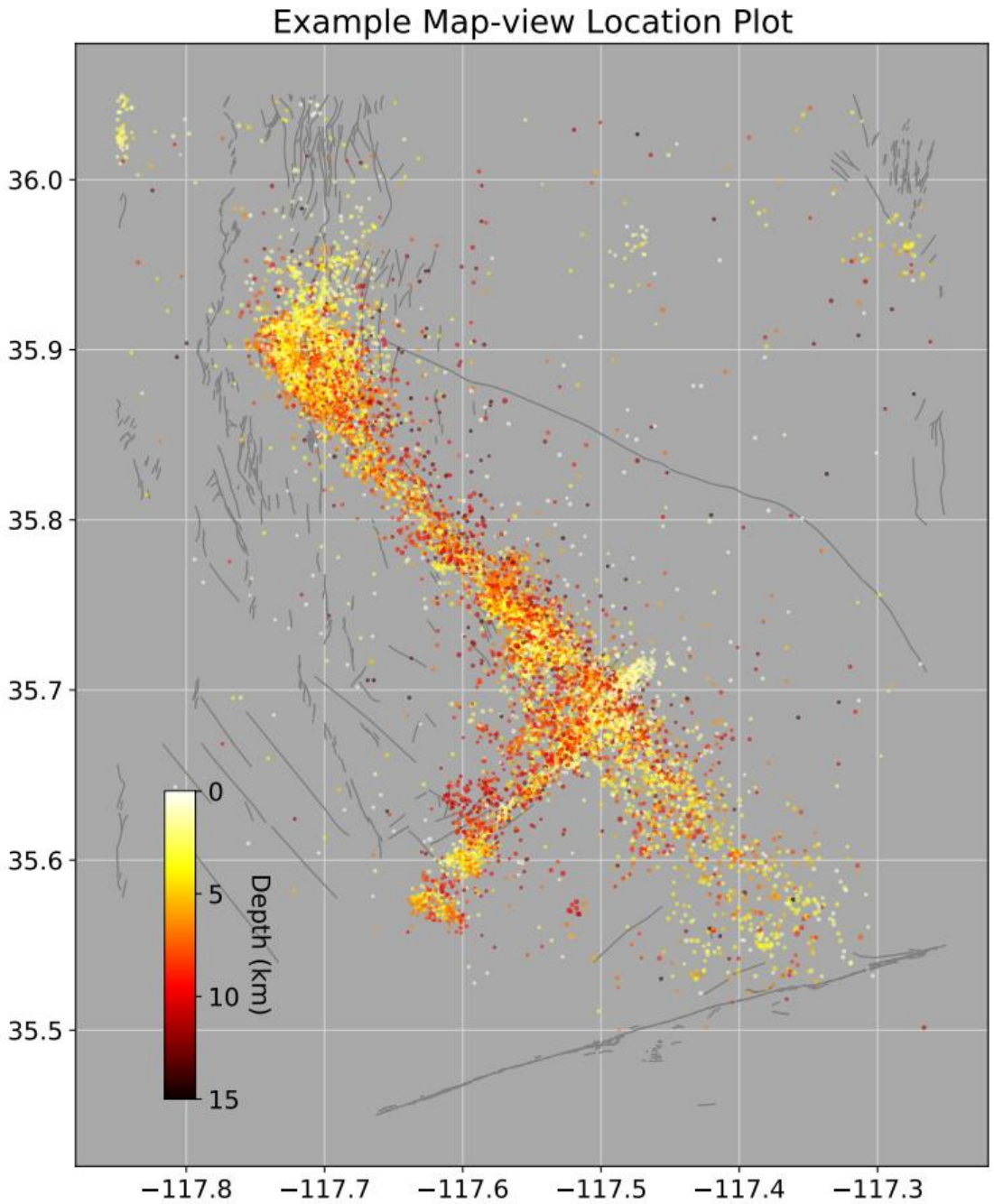
https://github.com/YijianZhou/Seismicity-Visualization

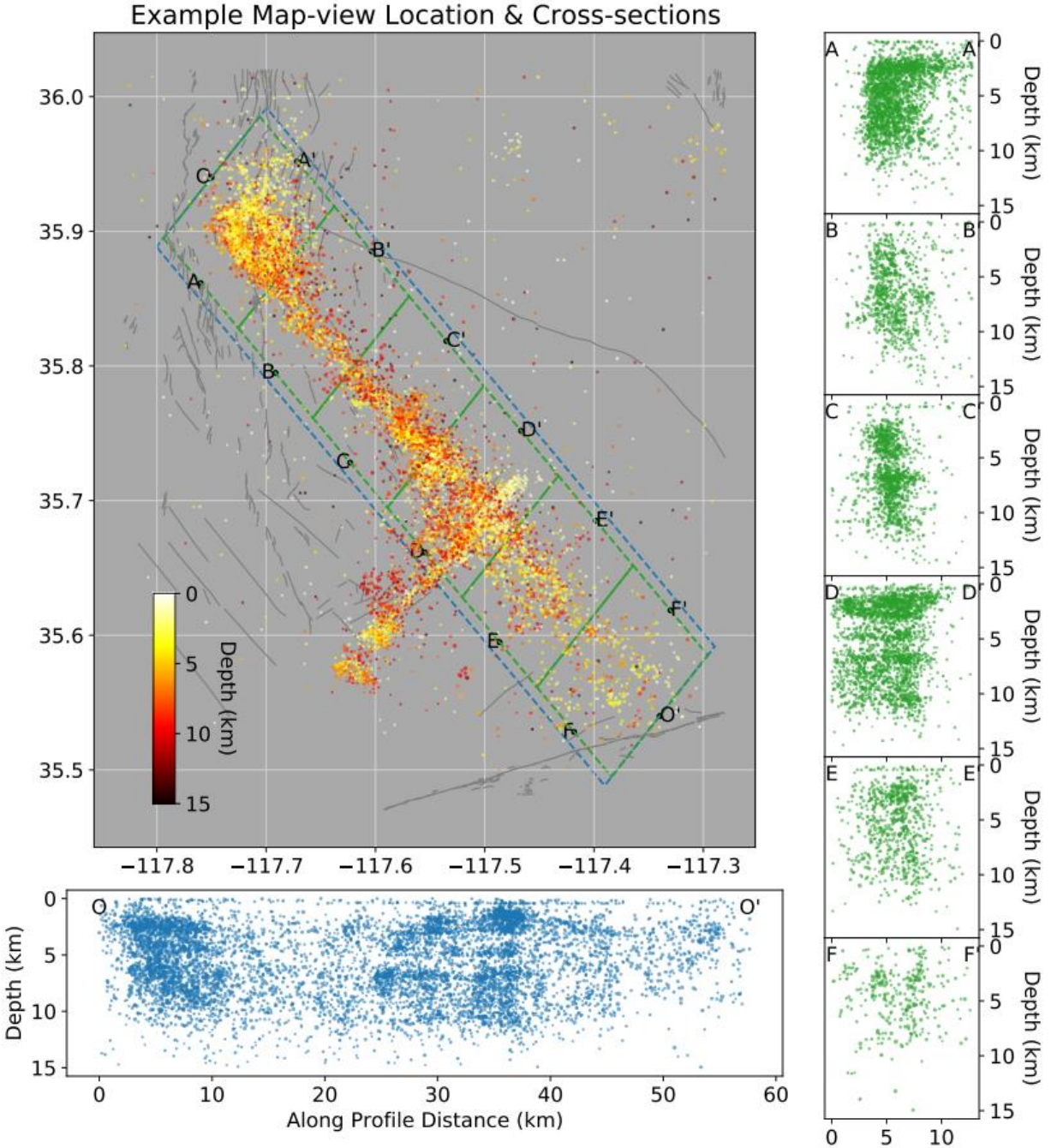
Input Format

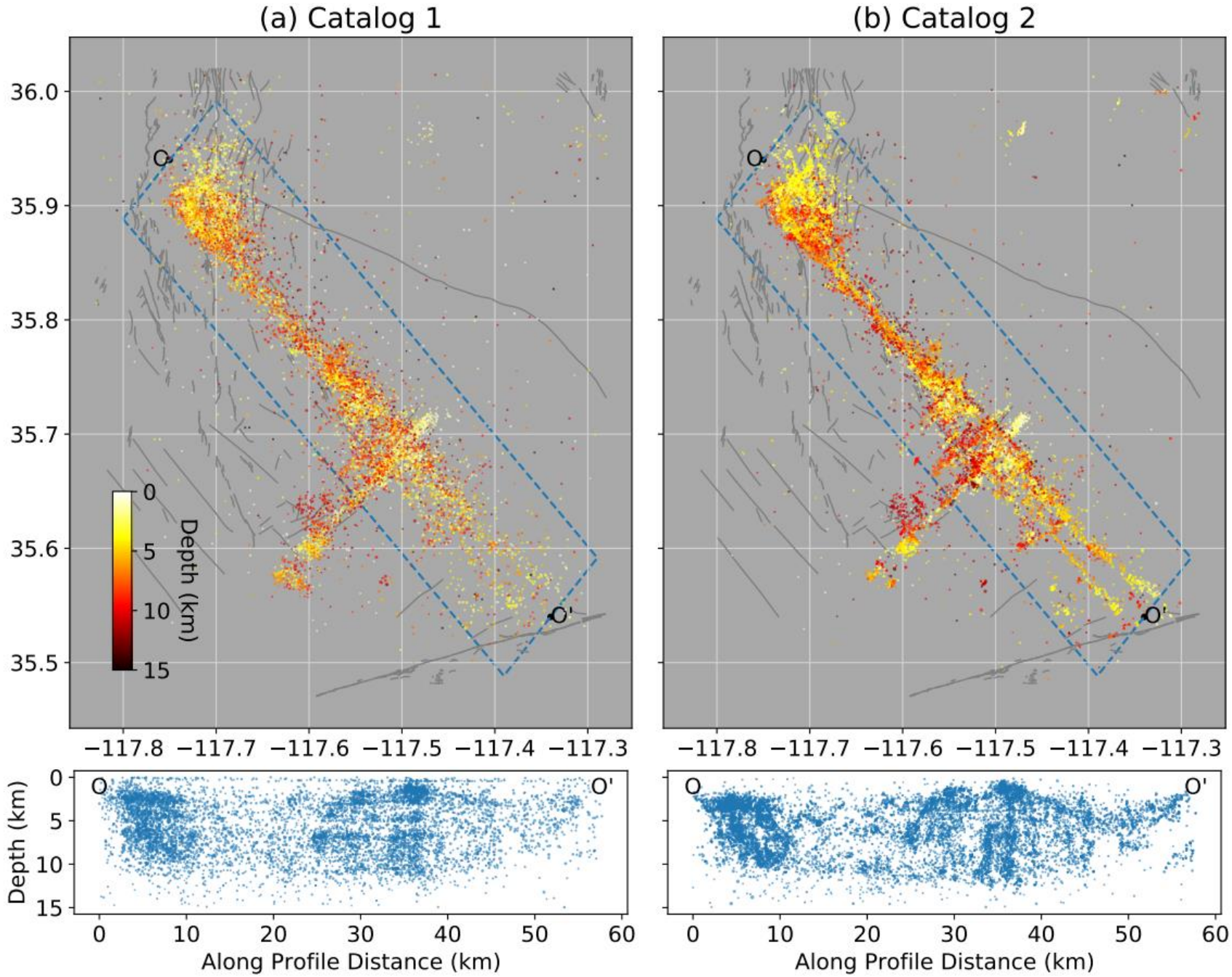
- fctlg: *input/fctlg_eg.csv*
  - event line: ot, lat, lon, dep, mag
- fpha: *input/fpha_eg.csv*
  - event line: ot, lat, lon, dep, mag
  - phase line: net_sta, tp, ts
- fsta: *input/fsta_eg.csv*
  - net_sta, lat, lon, ele
- ffault: *input/faults_eg.dat*
  - same as GMT fault data format
  - lines start with “>” marks a new fault; each location is *lon+*\t*+lat+*\n

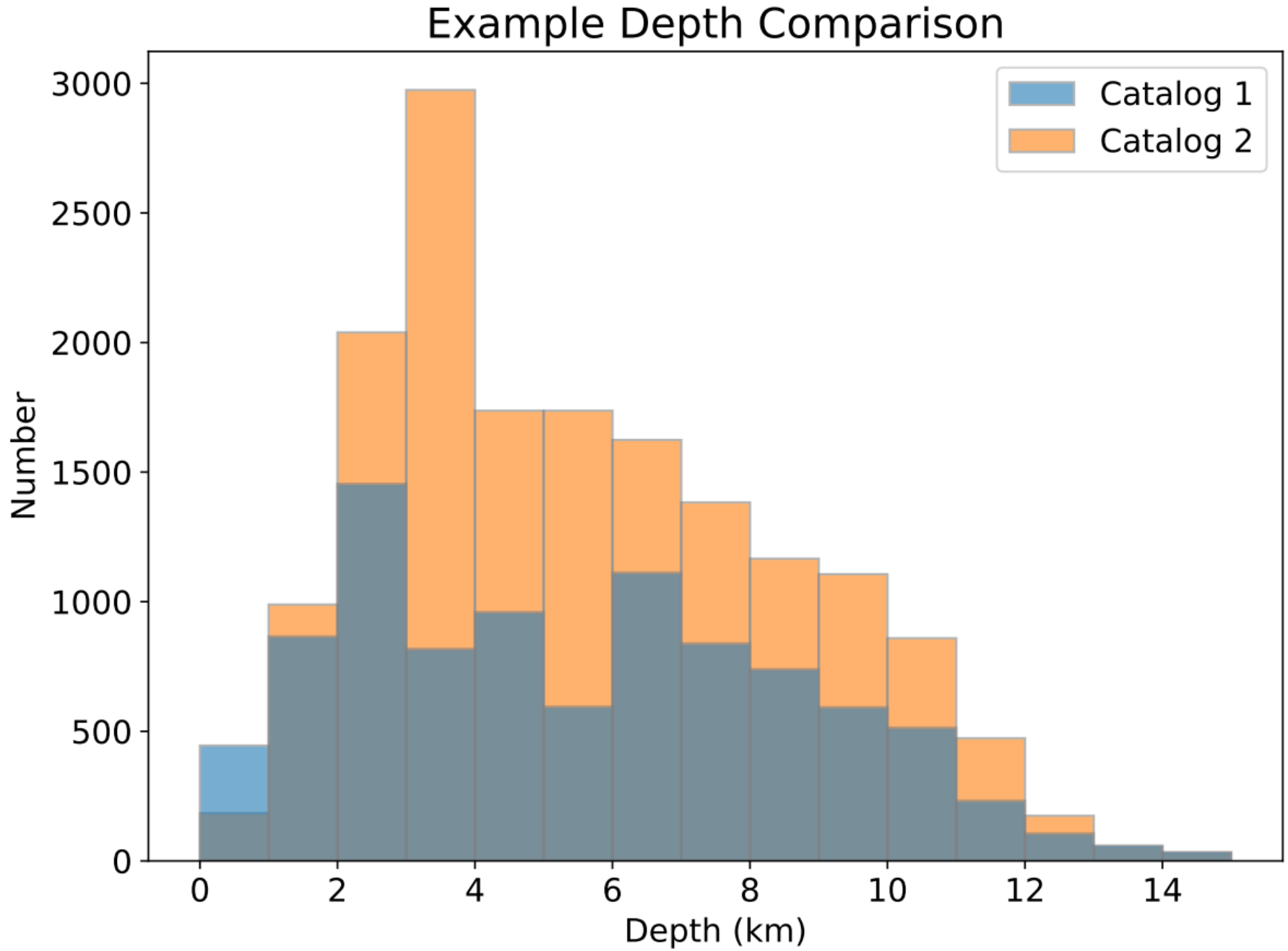
Gallery

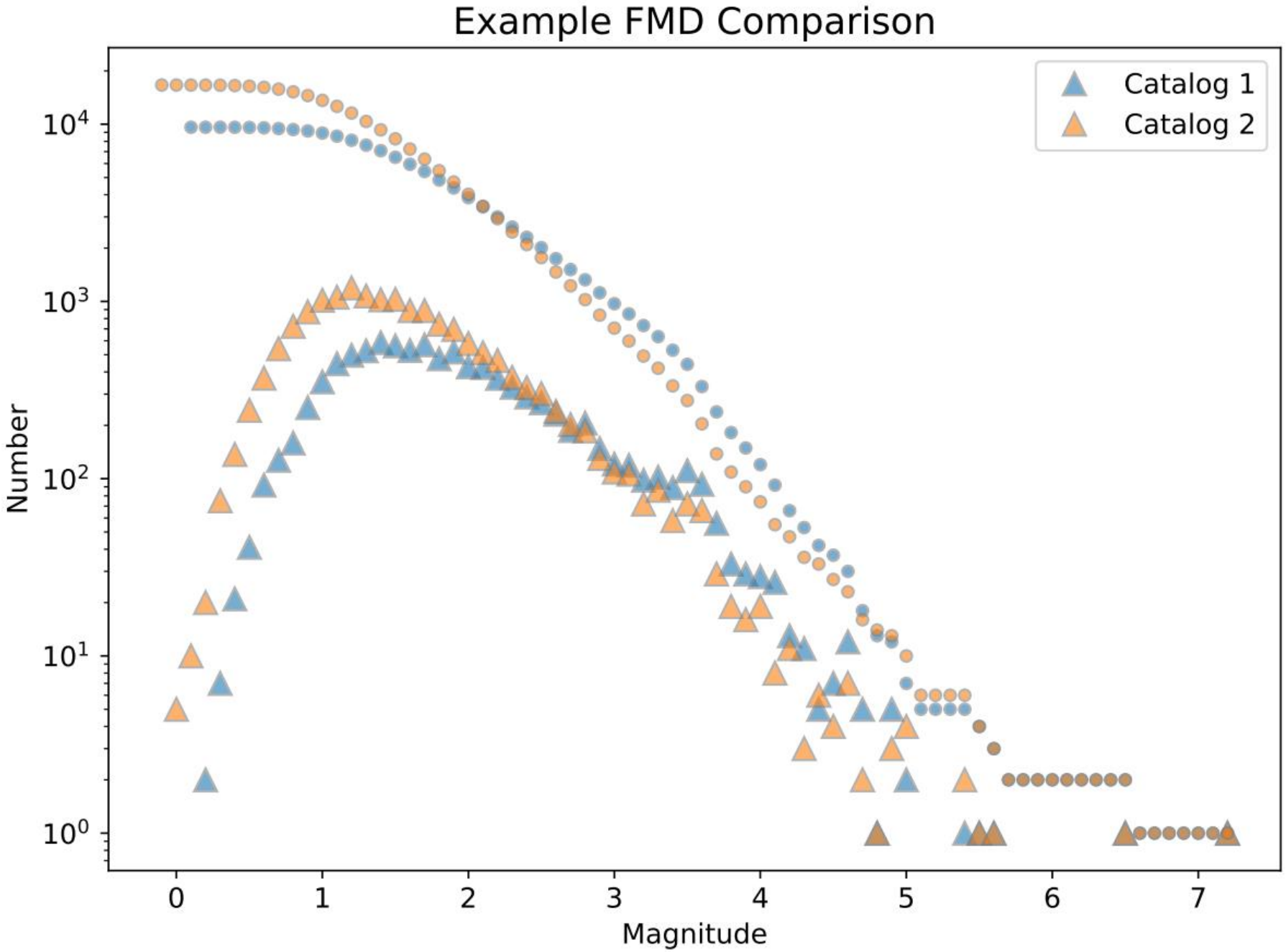
- Location distribution
  - *plot_loc-map.py* plot map view of location distribution
  - *plot_loc-cross-sec.py* plot map view + cross-sections
  - *plot_loc-compare.py* plot comparison of map + cross-section location
  - *plot_dep-compare.py* plot comparison of depth distribution
- Magnitude distribution
  - *plot_mag-time.py* plot magnitude-time sequence & seismic rate
  - *plot_fmd-compare.py* plot comparison of FMD
  - *plot_b-map.py* plot b-value distribution in map view

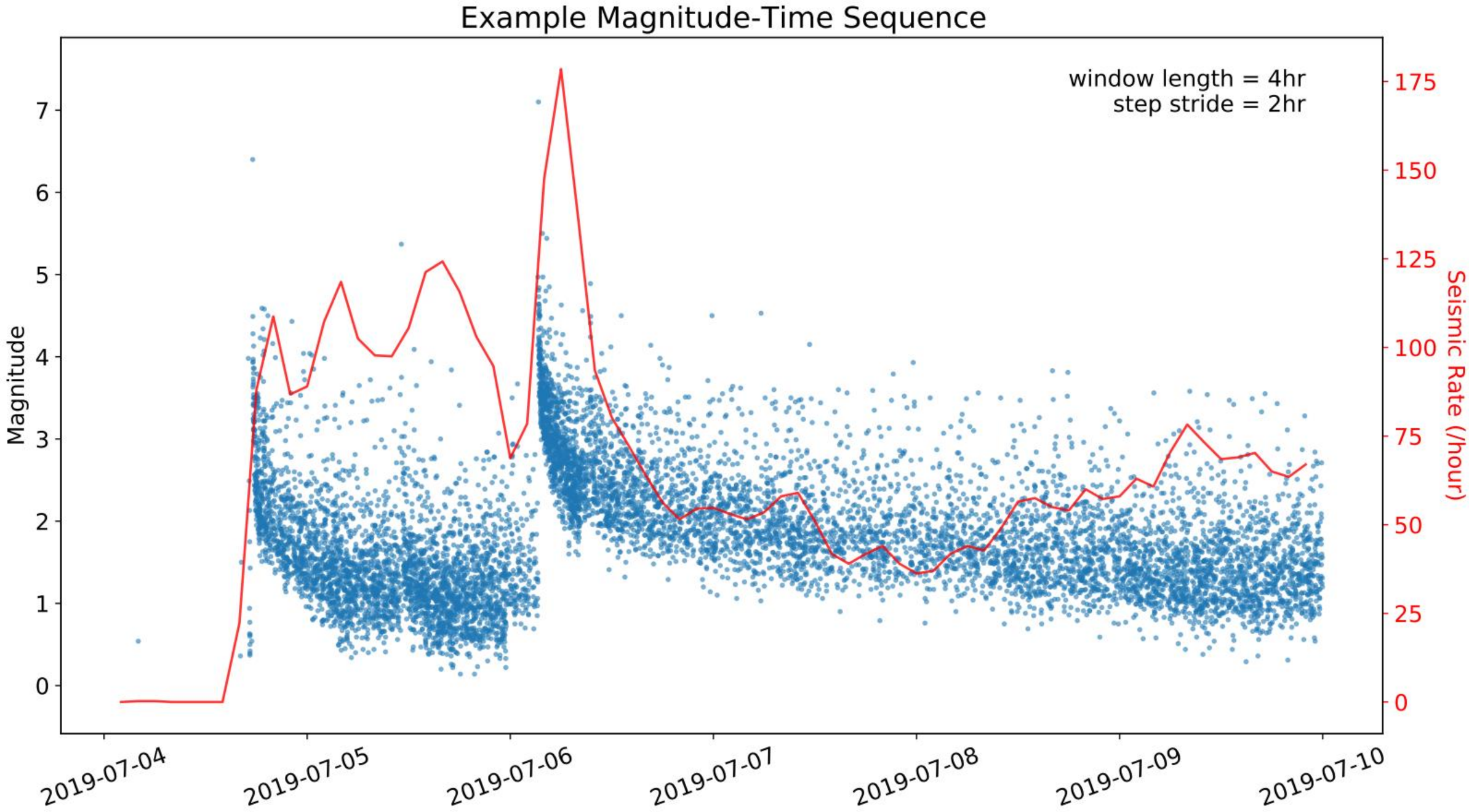

Example Map-view Location Plot
36.0
35.9
35.8
35.7
35.6
35.5
−117.8
−117.7
−117.6
−117.5
−117.4
−117.3
0
5
10
15
Depth (km)

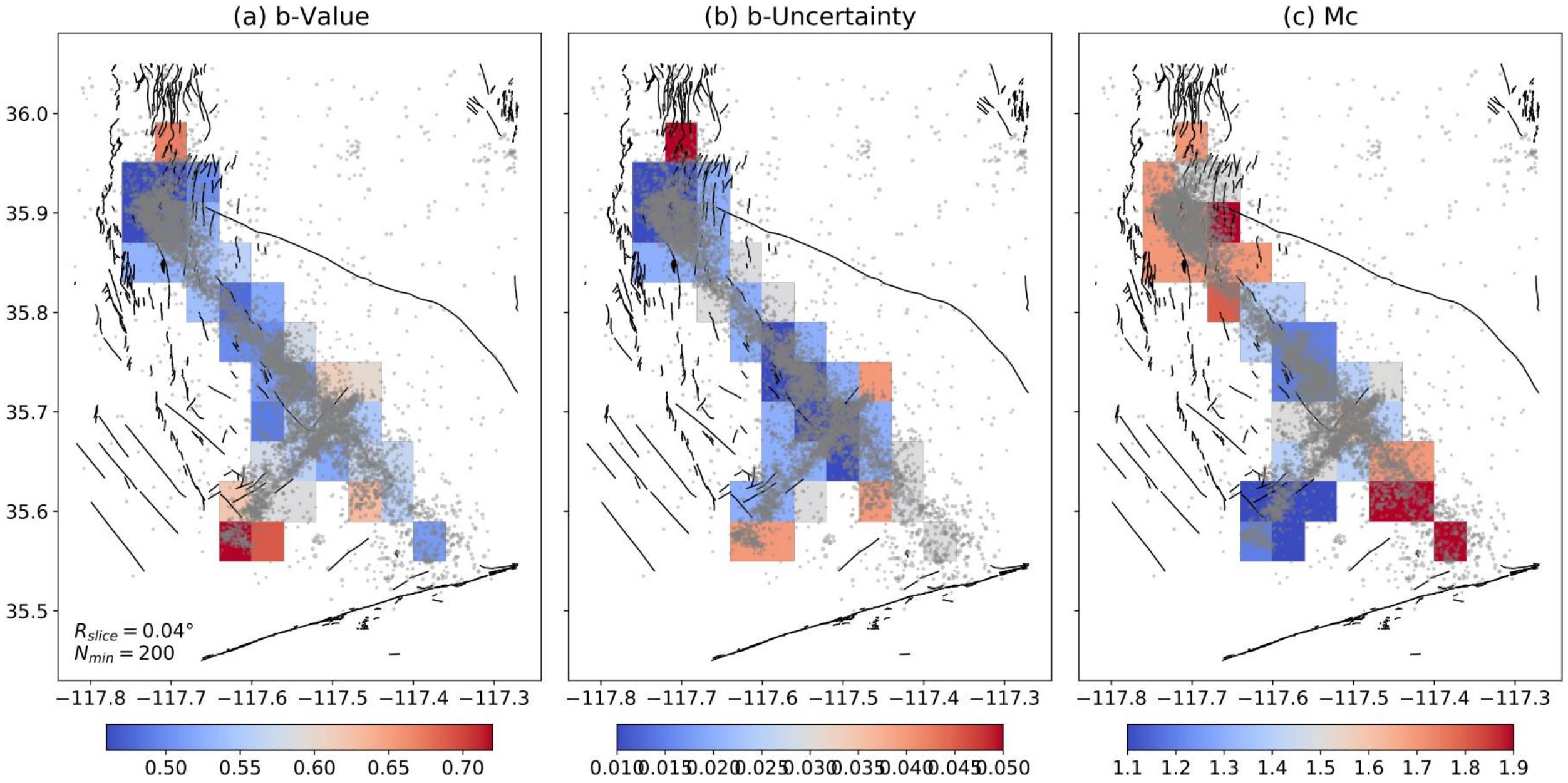

Example Map-view Location & Cross-sections
A
A'
B
B'
C
C'
D
D'
E
E'
F
F'
O
O'
Depth (km)
Along Profile Distance (km)


(a) Catalog 1
(b) Catalog 2
36.0
35.9
35.8
35.7
35.6
35.5
−117.8 −117.7 −117.6 −117.5 −117.4 −117.3
O
O'
Depth (km)
0
5
10
15
Depth (km)
Along Profile Distance (km)
0 10 20 30 40 50 60


Example Depth Comparison
Catalog 1
Catalog 2
Number
Depth (km)
0
500
1000
1500
2000
2500
3000
0
2
4
6
8
10
12
14

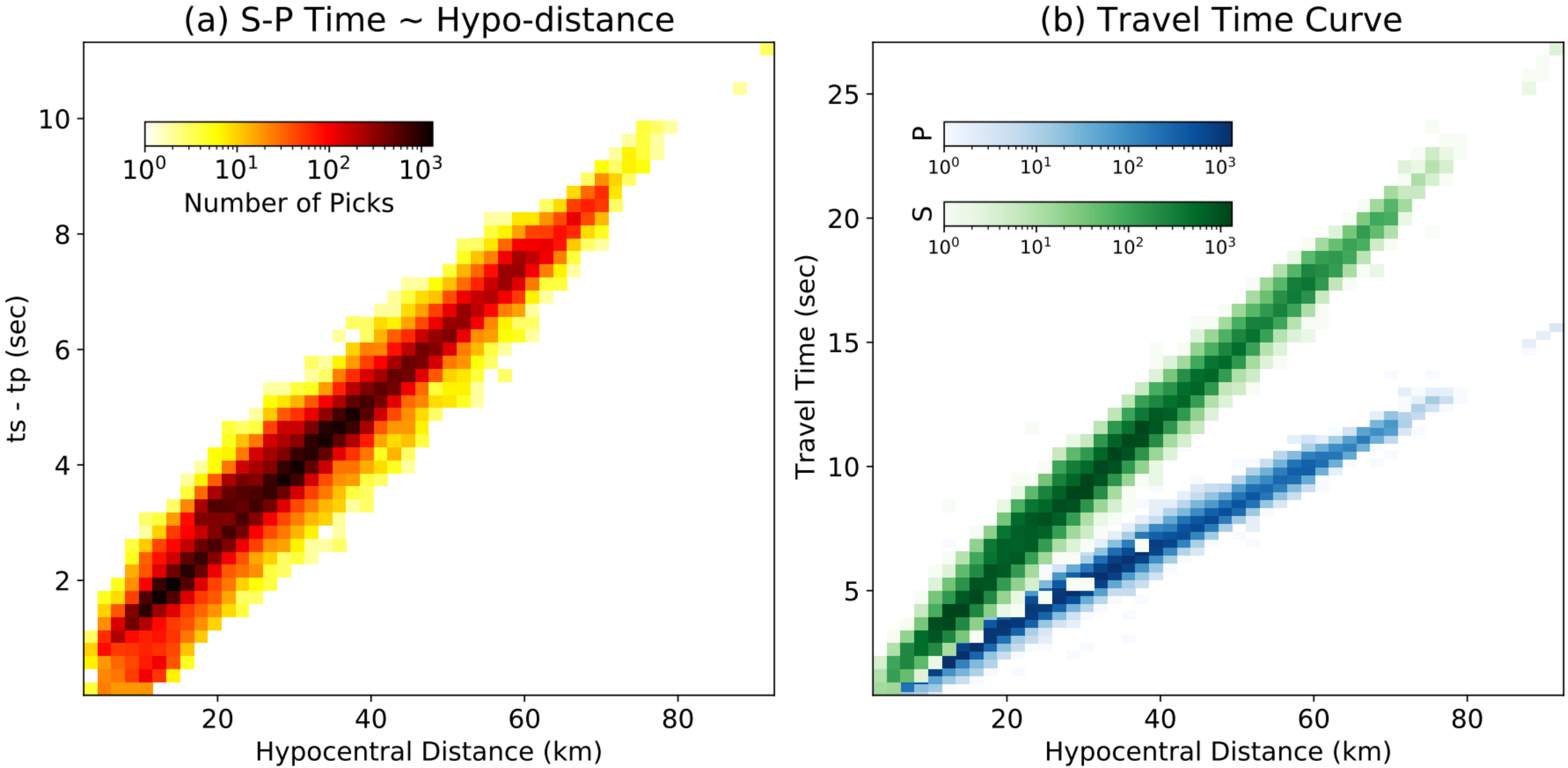

Example FMD Comparison
Catalog 1
Catalog 2
Number
10^4
10^3
10^2
10^1
10^0
0
1
2
3
4
5
6
7
Magnitude

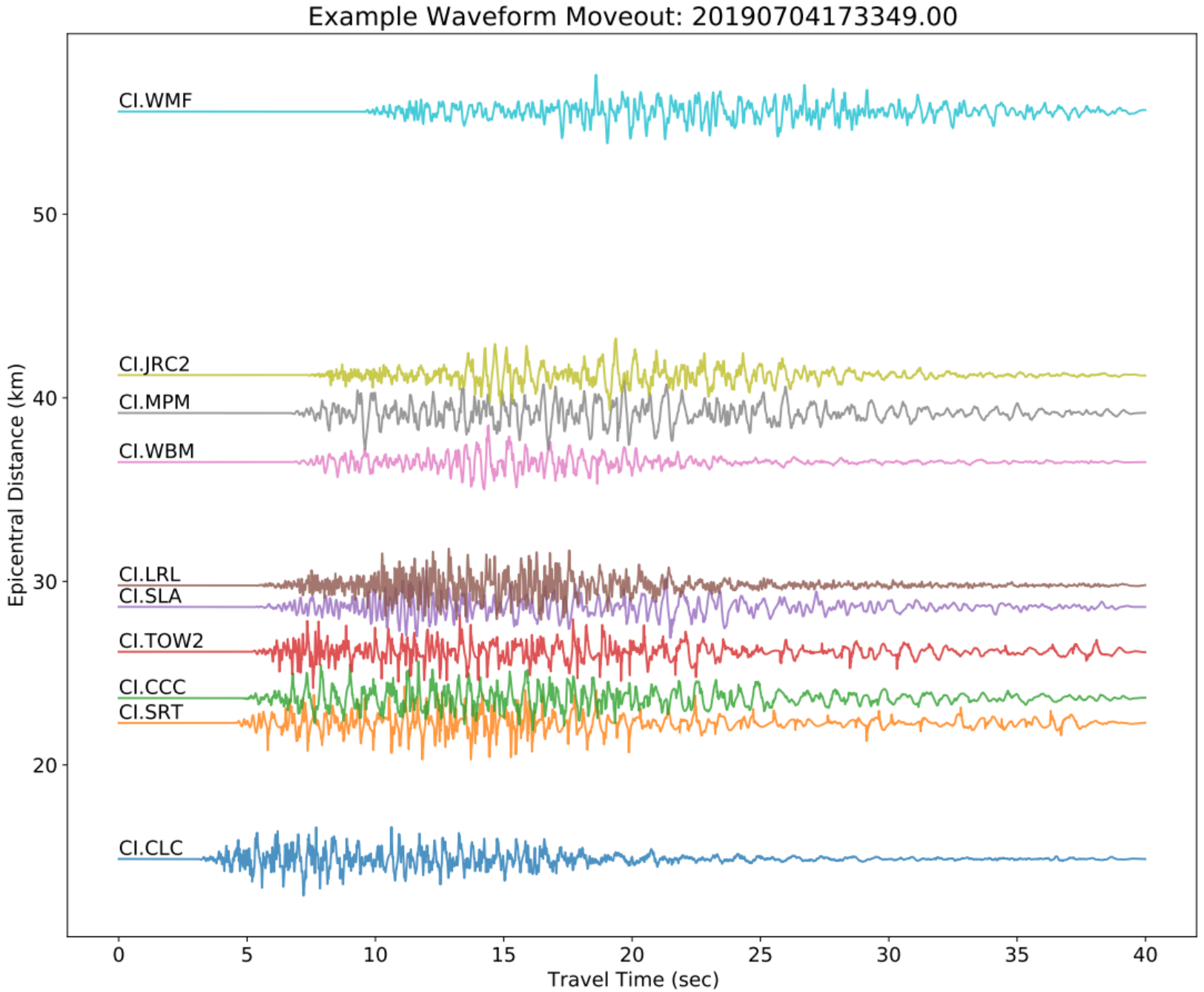

Example Magnitude-Time Sequence
window length = 4hr
step stride = 2hr
Magnitude
Seismic Rate (/hour)
0
1
2
3
4
5
6
7
0
25
50
75
100
125
150
175
2019-07-04
2019-07-05
2019-07-06
2019-07-07
2019-07-08
2019-07-09
2019-07-10

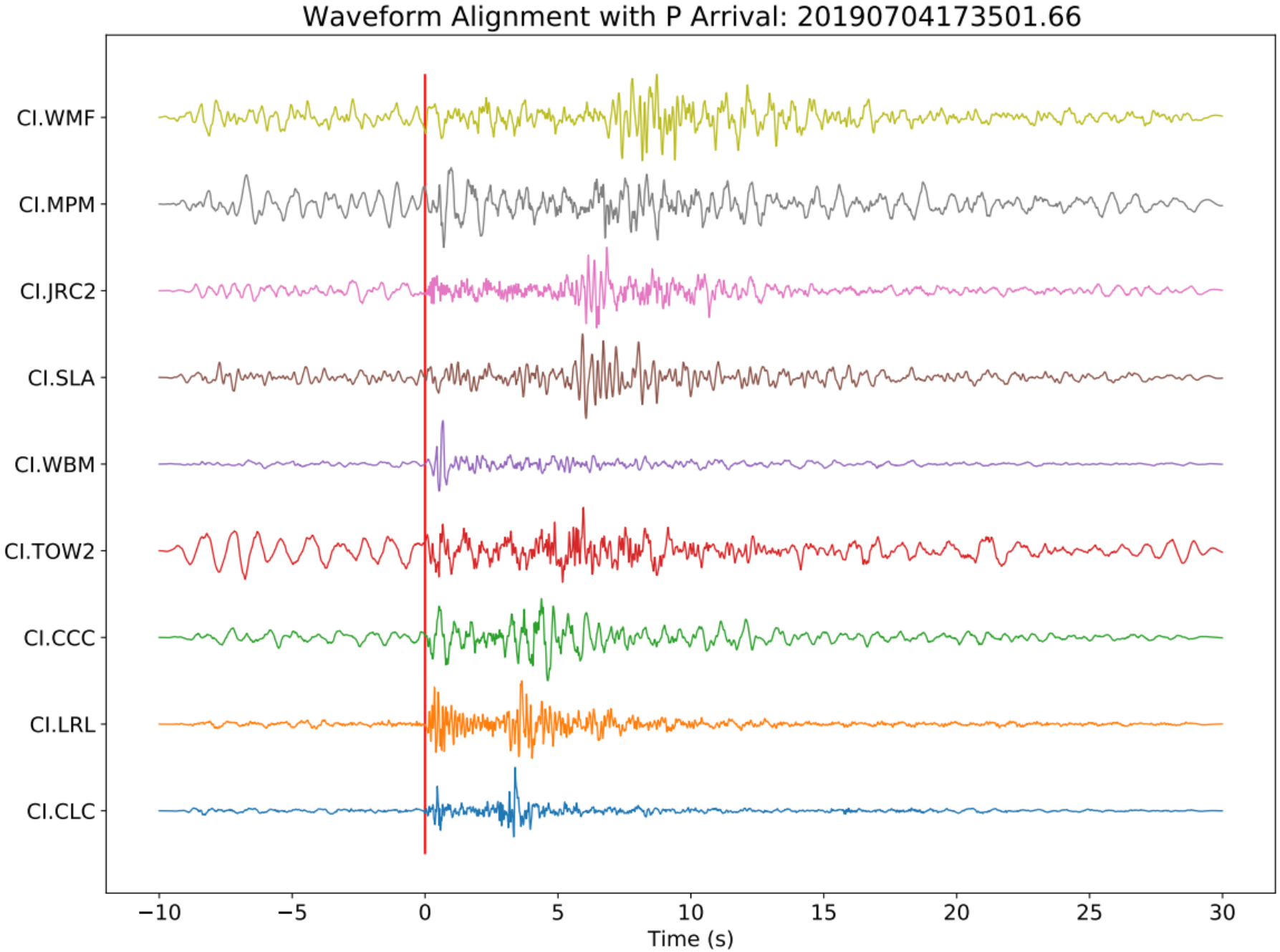

(a) b-Value
(b) b-Uncertainty
(c) Mc
36.0
35.9
35.8
35.7
35.6
35.5
$R_{slice} = 0.04°$
$N_{min} = 200$
−117.8 −117.7 −117.6 −117.5 −117.4 −117.3
0.50 0.55 0.60 0.65 0.70
0.010 0.015 0.020 0.025 0.030 0.035 0.040 0.045 0.050
1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9

Gallery

- Phase / Catalog quality control
  - *plot_ts-tp-dist.py* S-P time and P&S travel time ~ hypocentral distance
- Waveform plots
  - *plot_wave-dist.py* plot waveform moveout, x-y for travel time and epicentral distance
  - *plot_wave-tp.py* waveform alignment by P arrival


(a) S-P Time ~ Hypo-distance
Number of Picks
10^0 10^1 10^2 10^3
ts - tp (sec)
Hypocentral Distance (km)
(b) Travel Time Curve
P
S
Travel Time (sec)
Hypocentral Distance (km)


Example Waveform Moveout: 20190704173349.00
CI.WMF
CI.JRC2
CI.MPM
CI.WBM
CI.LRL
CI.SLA
CI.TOW2
CI.CCC
CI.SRT
CI.CLC
Epicentral Distance (km)
50
40
30
20
0
5
10
15
20
25
30
35
40
Travel Time (sec)


Waveform Alignment with P Arrival: 20190704173501.66
CI.WMF
CI.MPM
CI.JRC2
CI.SLA
CI.WBM
CI.TOW2
CI.CCC
CI.LRL
CI.CLC
−10
−5
0
5
10
15
20
25
30
Time (s)