Advanced Workshop on Earthquake Fault Mechanics: Theory, Simulation and Observations
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Practise: MUSIC teleseismic Back-Projection

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Multiple Signal Classification (MUSIC)

- MUSICBP is a MATLAB implementation of the teleseismic MUSIC back-projections.
- Open wrapper General_BP.m
- Initialization (creating project folder, etc)
- Read seismograms in SAC format
- Align Seismograms by initial P arrival
- Run either MUSIC or beamforming solver
- The code produces movies, summary plot and distance vs time plot.

Cd

Cp –r /home/seismology_lecture/lmeng/musicbp-master ./

Cd ~/musicbp-master/MUSICBP

Matlab &

Open General_BP.m

General_BP.m

```
%% *** Set here the processing steps to perform (positive=1, negtive=0)****
Initial_flag=0;      % Initializing a new project
readBP_flag=0;       % Reading seismogram from .SAC files
alignBP_flag=0;      % Hypocenter alignment
runBPbmfm_flag=0;    % Beamforming Back-projection
runBPmusic_flag=1;   % MUSIC Back-Projection
```

Initialization

```
%% *** Set here the parameters to initialize the project and read the SAC files***
project = 'Palu_2018';% name of the project, e.g. Tohoku_2011
lon0=119.840;        % hypocenter longitude
lat0=-0.178;         % hypocenter latitude
dep=10.0;            % hypocenter depth
Mw=7.5;              % magnitude
sr=10;               % sampling rate in Hz (the frequency that seismograms are down-sampled to)
ori=60;              % length of seismograms before P-arrival time in seconds
displayLength=360;   % length of waveforms (in seconds) to be displayed
plotScale=1.5;       % amplitude scaling factor of seismograms for display purpose
```

%Set Initial_Flag=1

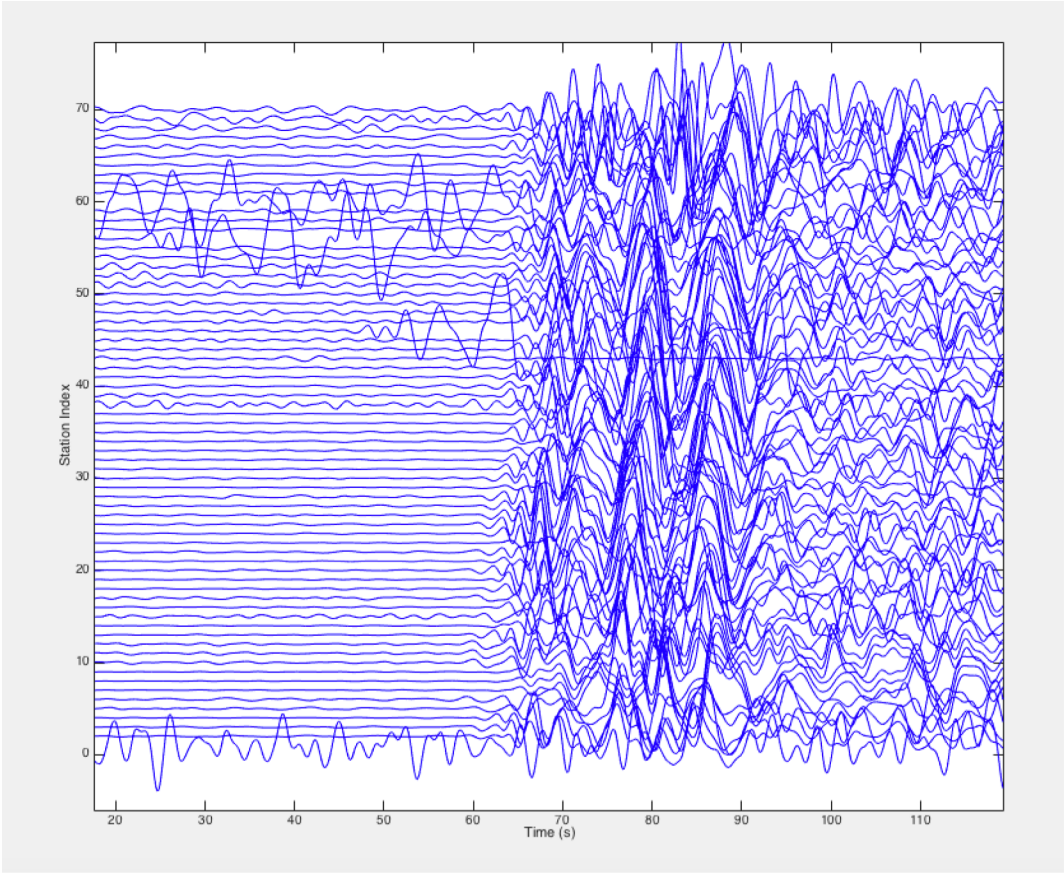
%run General_BP.m

Reading Seismograms

Cp ./PaluAUdata/*SAC ./Palu2018/Data/

%Set ReadBP_Flag=1

%run General_BP.m



Aligning Seismograms

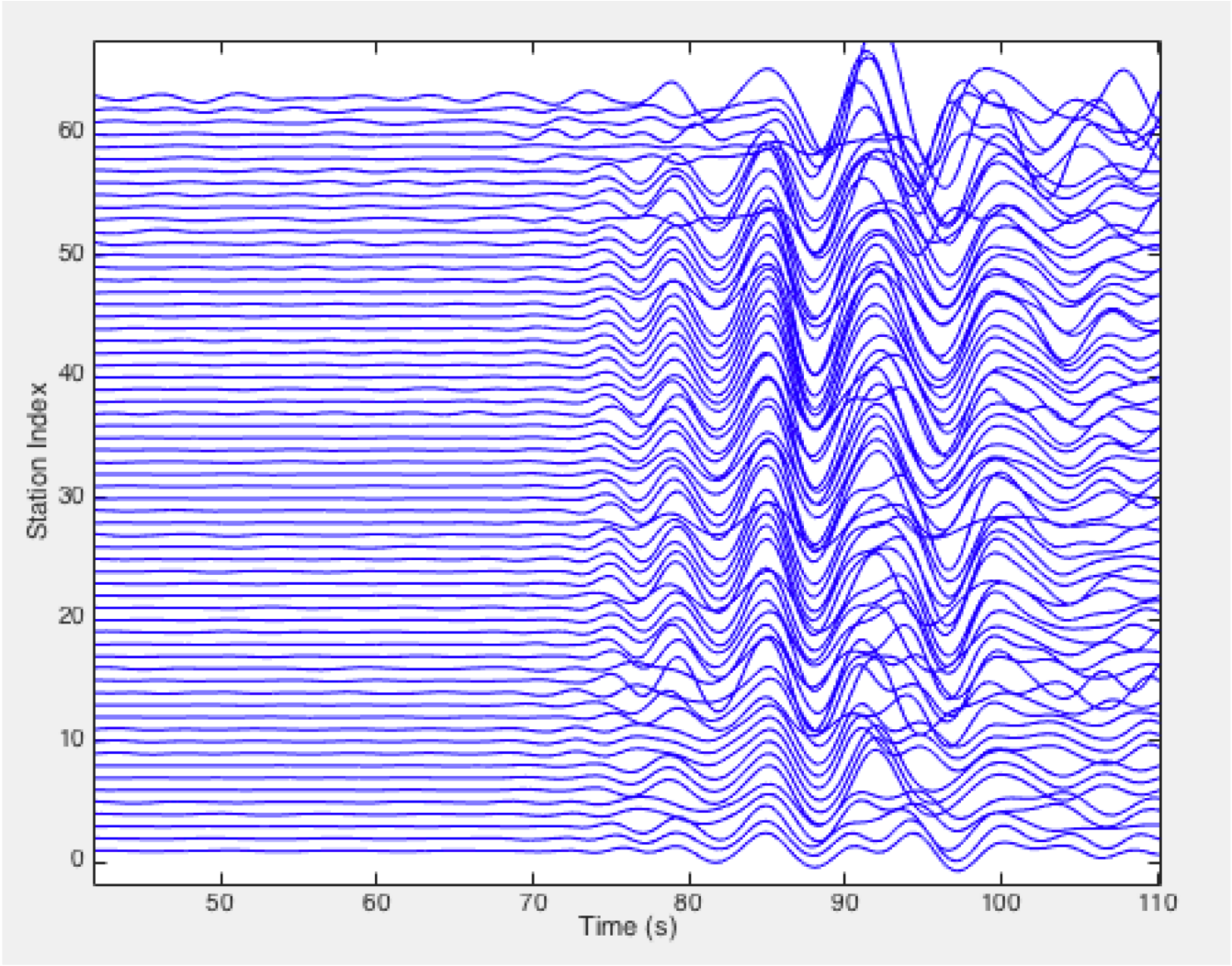
%Set AlignBP_Flag=1

% Set bandChoice from 1 to 4

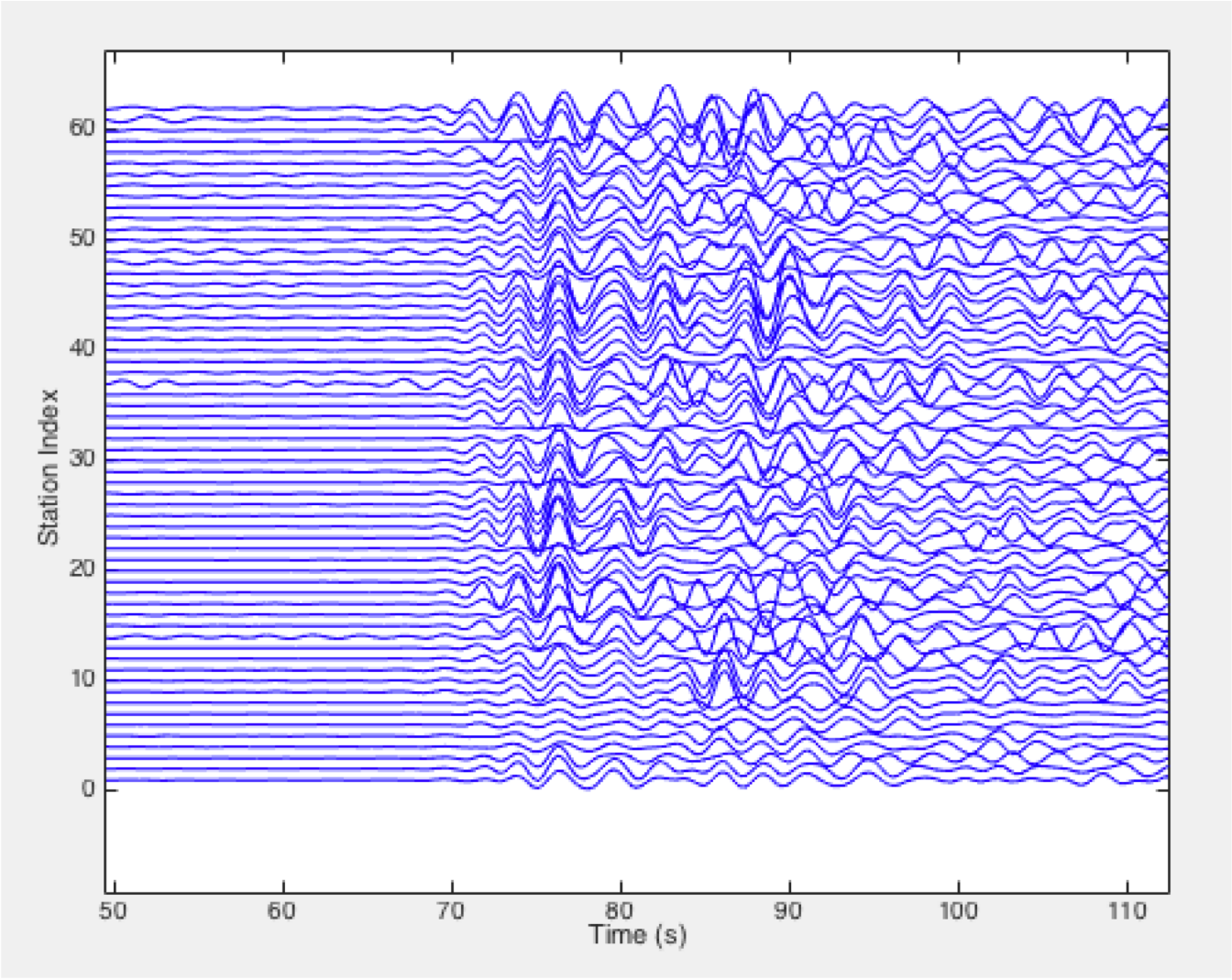
%run General_BP.m 4 times. The code progressively aligns the sesimograms at increasing frequencies.

```
%% *** Set here the Parameters for Hypocenter alignment ***
bandChoice=4;       % Choice of the alignment frequency band.
align(1,:)=[54,40,0.7]; % 1st align: freq band=[0.1, 0.25](Hz) windowLength=30(sec) maxShift=5(sec)
align(2,:)=[61,40,0.6]; % 2nd align: freq band=[0.25,0.5]  windowLength=15 maxShift=0.6
align(3,:)=[64,40,0.6]; % 3rd align: freq band=[0.5, 1.0]  windowLength=8  maxShift=0.1
align(4,:)=[64,0, 0.6]; % 4th align: freq band=[0.5, 1.0]  windowLength=8  maxShift=0.1
ts  = align(bandChoice,1); % start of the alignment window
refSta = align(bandChoice,2); % No. of the reference seismogram, set to zero for the stacked seismogram
cutoff= align(bandChoice,3); % cutoff threshold of the cross-correlation coefficient
```

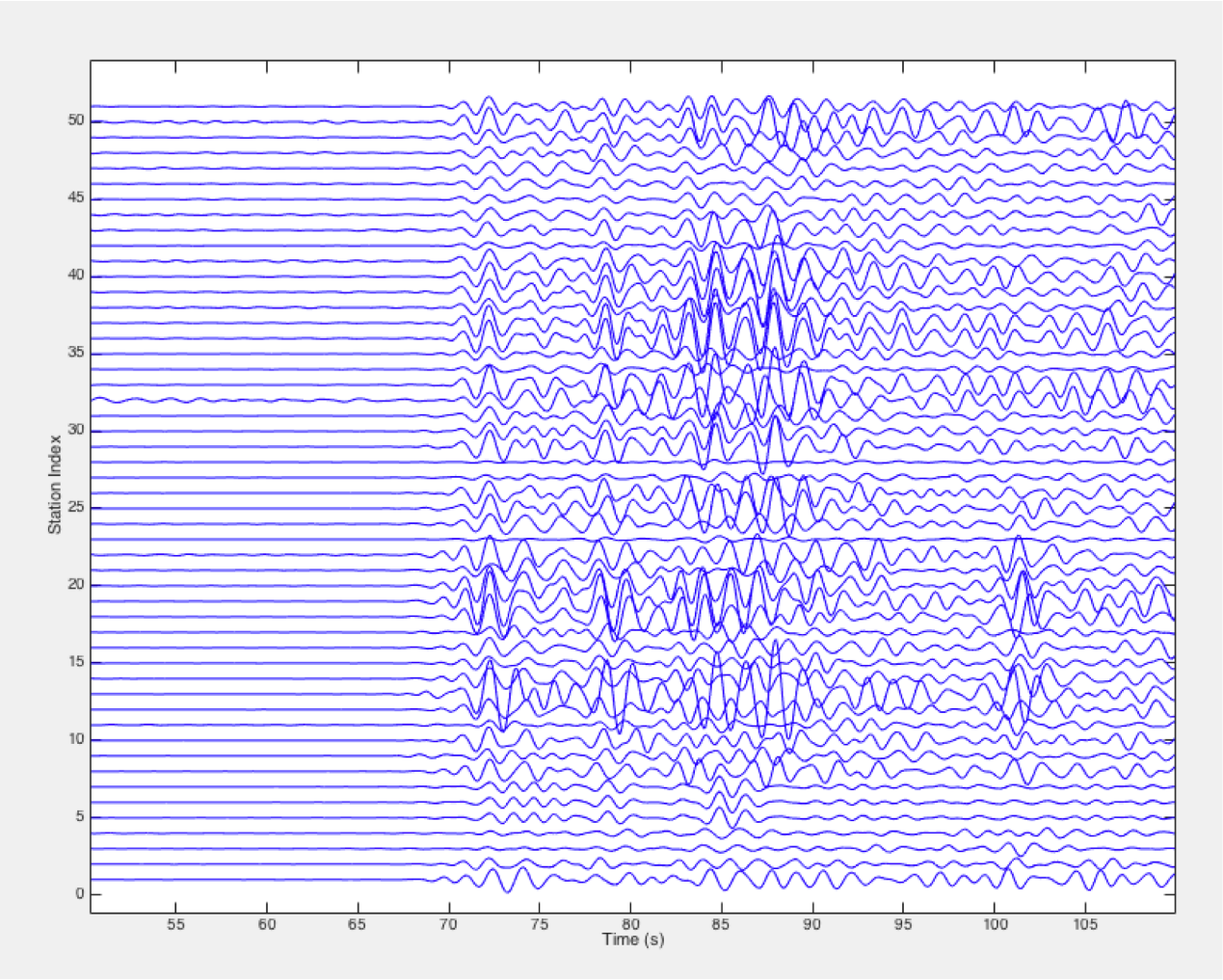
First Alignment



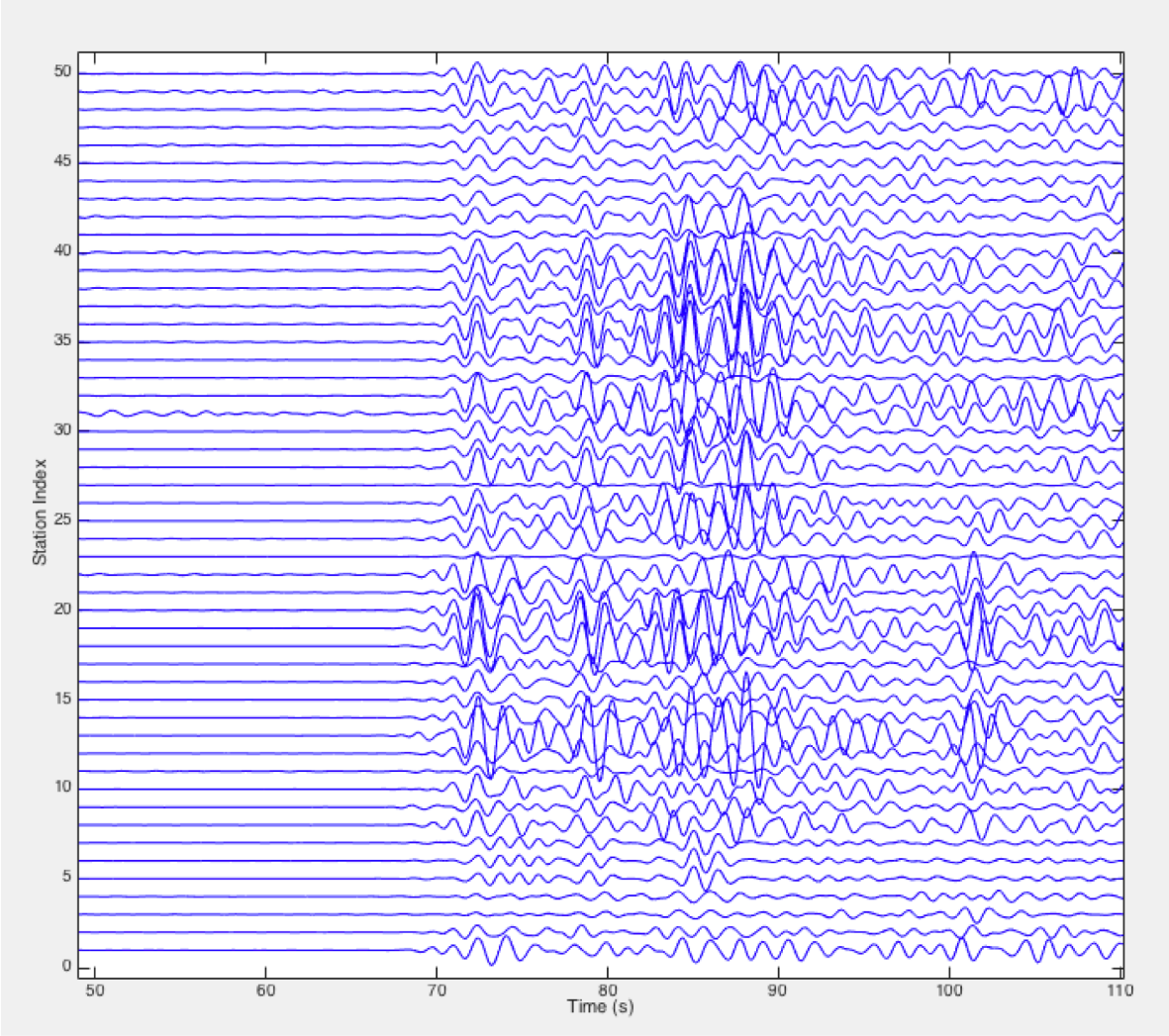
Second Alignment



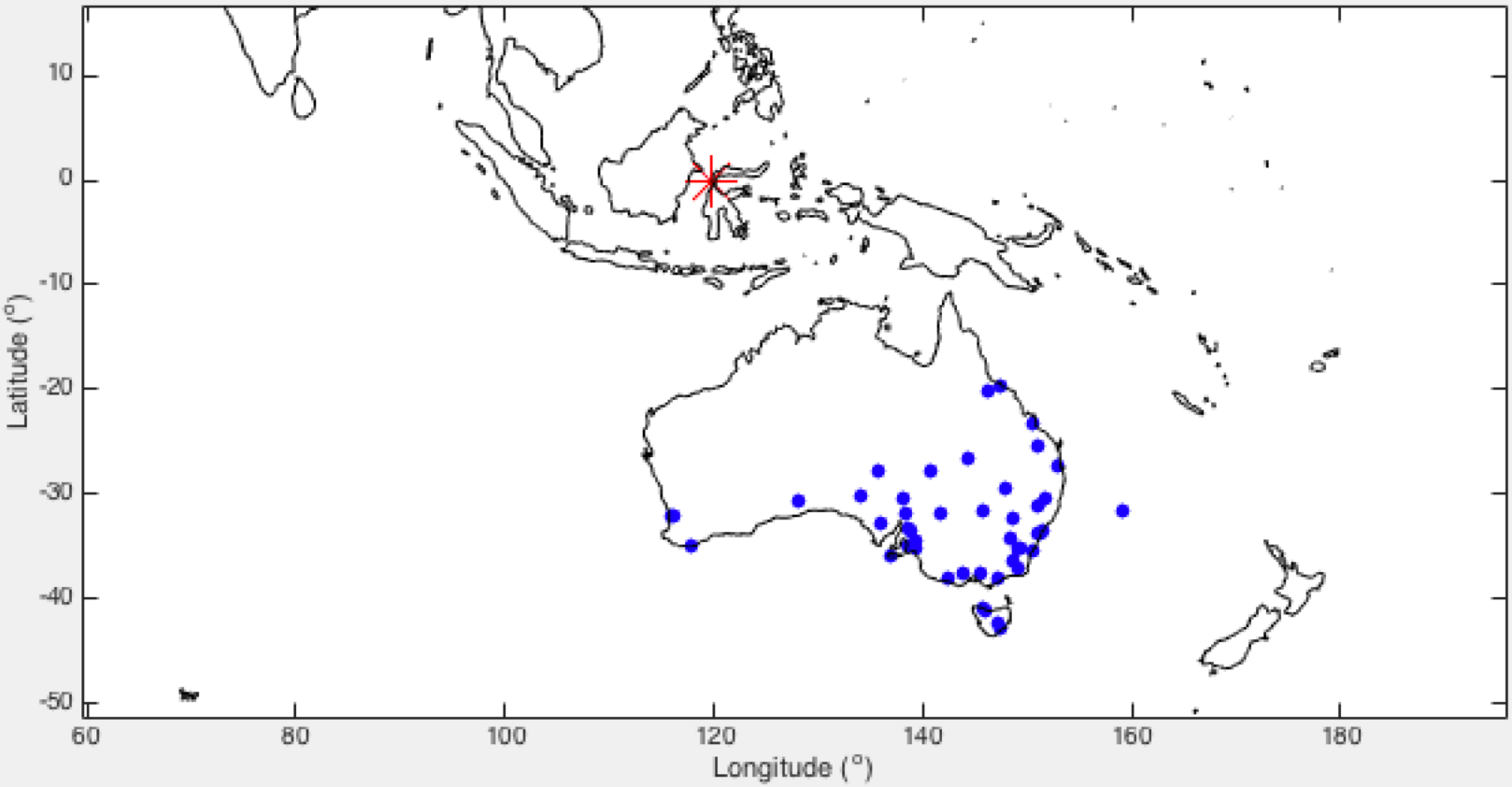
Third Alignment



Fourth Alignment

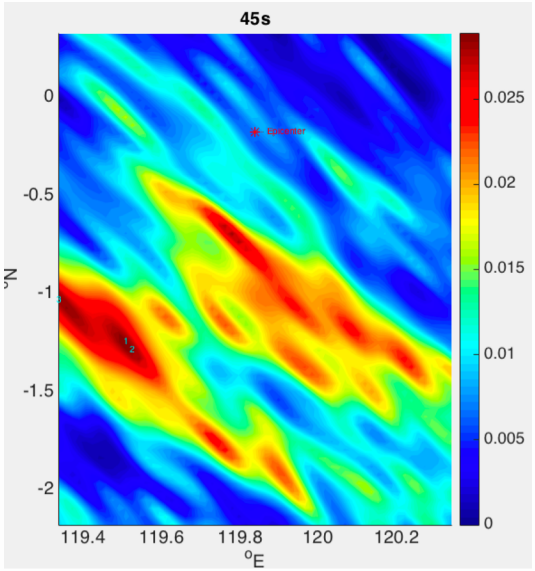


Final Station Map

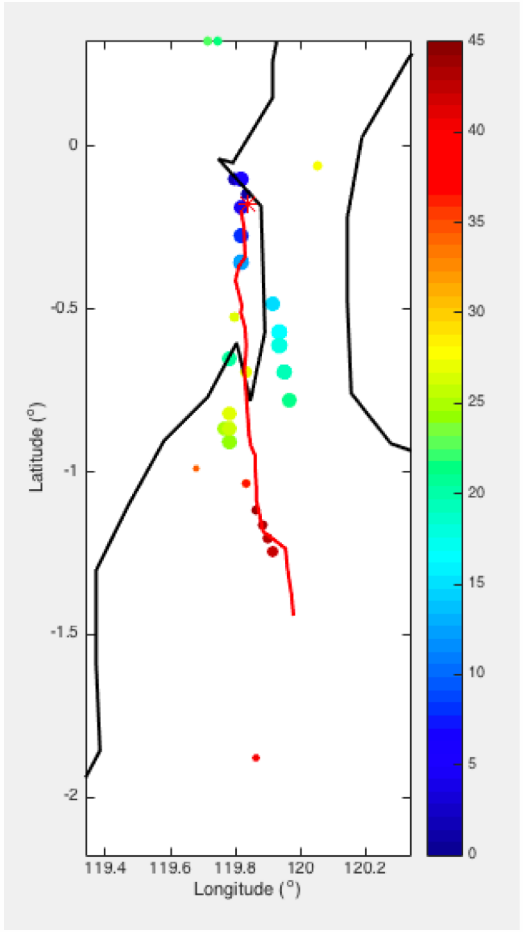


Running MUSIC back-projection

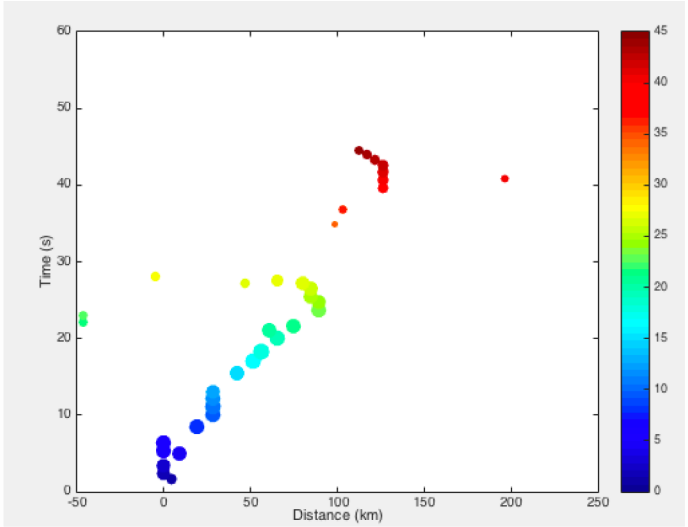
Movie/snapshot



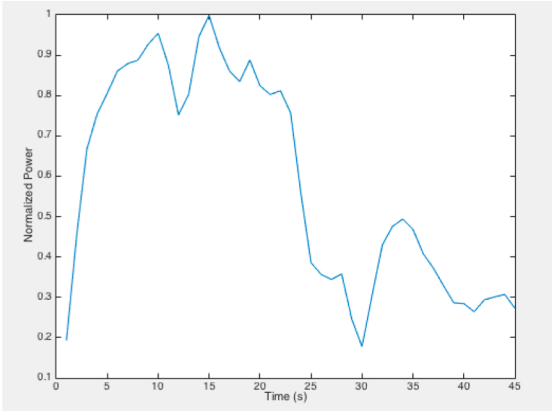
Summary Plot



Distance vs Time



Normalized Power



Things to try…

Use the beamforming solver and see if there's any difference.

Try your own alignment and station selections

If you messed up the parameters in General_BP.m,

check General_BP_Backup.m for the set of parameters I use.