Mach Wave analysis

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Open “refine_2017_55_C1.ipynb” and set the mainshock time, aftershock time, and mainshock hypocenter:

```
# Hypocenter infomation
origin_time_main = UTCDateTime("2017-07-17T23:34:56")          # get origin time of mainshock
origin_time_af   = UTCDateTime("2017-07-28T02:39:19")          # get origin time: AFTS-2 M6.1
lat0= 54.100
lon0= 169.800
dep0 = 20.1
```

Set the stations you want to analyze:

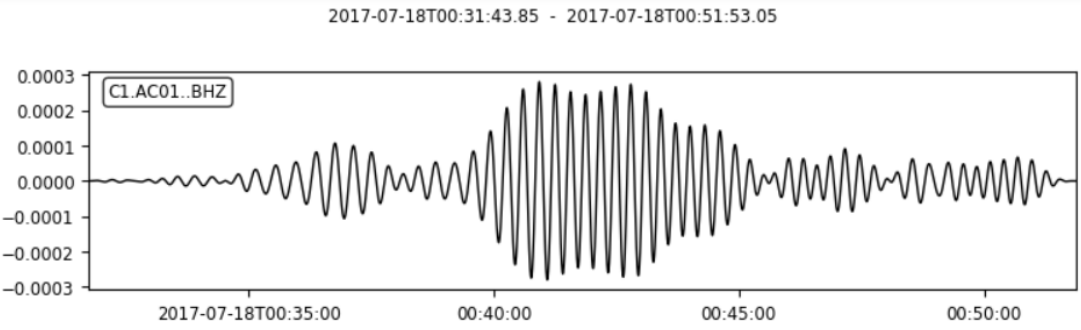
```
networklist="C1"
stationlist="AC01,AC04,AC05,AC06,AF01,AP01,AP02,AY02,AY03,BI02,BI04,BI05,BO01,BO02,BO03,BO04,CO01,\
CO02,CO03,CO04,CO05,CO06,LC01,LC09,LL01,LL02,LL03,LL04,LL05,LL06,LR03,LR04,LR05,MG01,MG02,MG03,\
MG04,MG05,ML02,MT01,MT02,MT03,MT04,MT05,MT07,MT08,MT09,MT10,MT12,MT13,TA01,TA02,VA02,VA03,VA04,\
VA05,VA06"
```

The waveforms are requested according to the lower time limit and the upper time limit, which are calculated by the minimum Rayleigh wave group velocity and maximum Rayleigh wave group velocity:

```
#travel time
Rayleith_arr = rdis*111.795 / 4.2  # assuming group velocity max is 4.5 km/s
Rayleith_end = rdis*111.795 / 3.1  # assuming group velocity max is 2.0 km/s

Rayleith_arr_main = origin_time_main + Rayleith_arr
Rayleith_end_main = origin_time_main + Rayleith_end
Rayleith_arr_af = origin_time_af + Rayleith_arr
Rayleith_end_af = origin_time_af + Rayleith_end
```

Filter the Rayleigh waves to the frequency band you want:

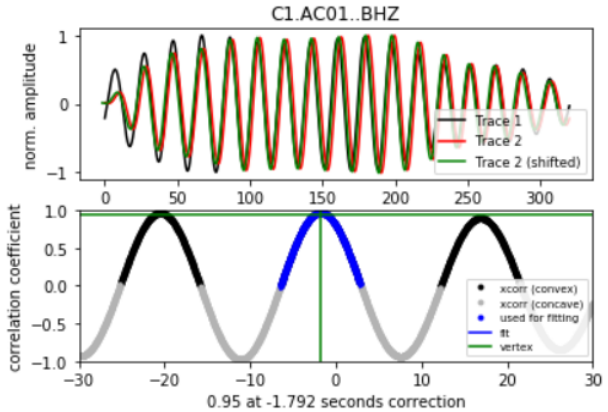
In [5]:
```
#This is used to filter
import numpy as np
import matplotlib.pyplot as plt
# Filtering with a bandpass on a copy of the original Trace
st_main_filt = st_main.copy()
st_af_filt = st_af.copy()

freq_min=1/25
freq_max=1/15
st_main_filt.filter('bandpass', freqmin=freq_min, freqmax=freq_max, zerophase=True)
st_af_filt.filter('bandpass', freqmin=freq_min, freqmax=freq_max, zerophase=True)

for i in range(0,len(st_main)):
    st_main_filt[i].plot()
    st_af_filt[i].plot()
```



Adjust the time window you want to calculate the cross-correlation coefficient:

```
dt, coeff = xcorr_pick_correction(main_starttime+500, tr1,
                                  af_starttime+520,   tr2,
                                  0.05, 290, 30, plot=True)
```

The results:




```
     Station      : C1.AC01..BHZ
Rayleith_length = : 1209.232702176388
Hypocenter dist = : 128.02824798910805
     Azimuth    = : 82.4340868211258
   corr-coeff   = : 0.948601109241
station number = : 0
```