Temporal Fluctuations and Coherencies of Broadband Signals Observed during SW06

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Outline

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- Internal Wave Field Potential Energy
- Temporal Coherence
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- Data and Models
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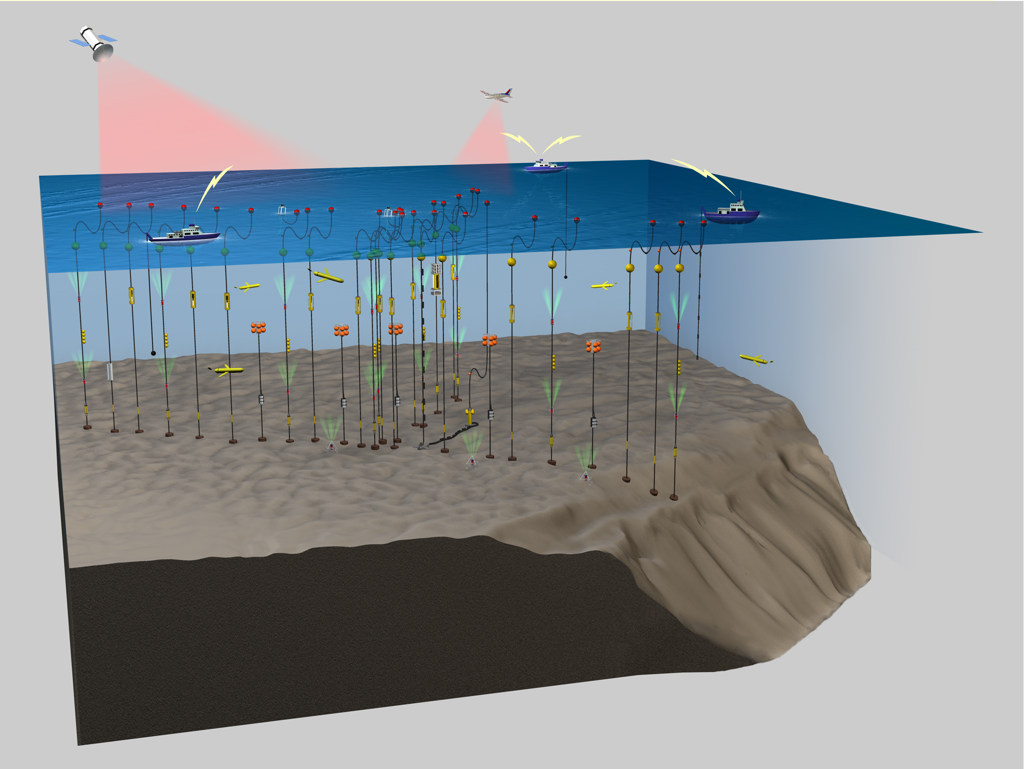
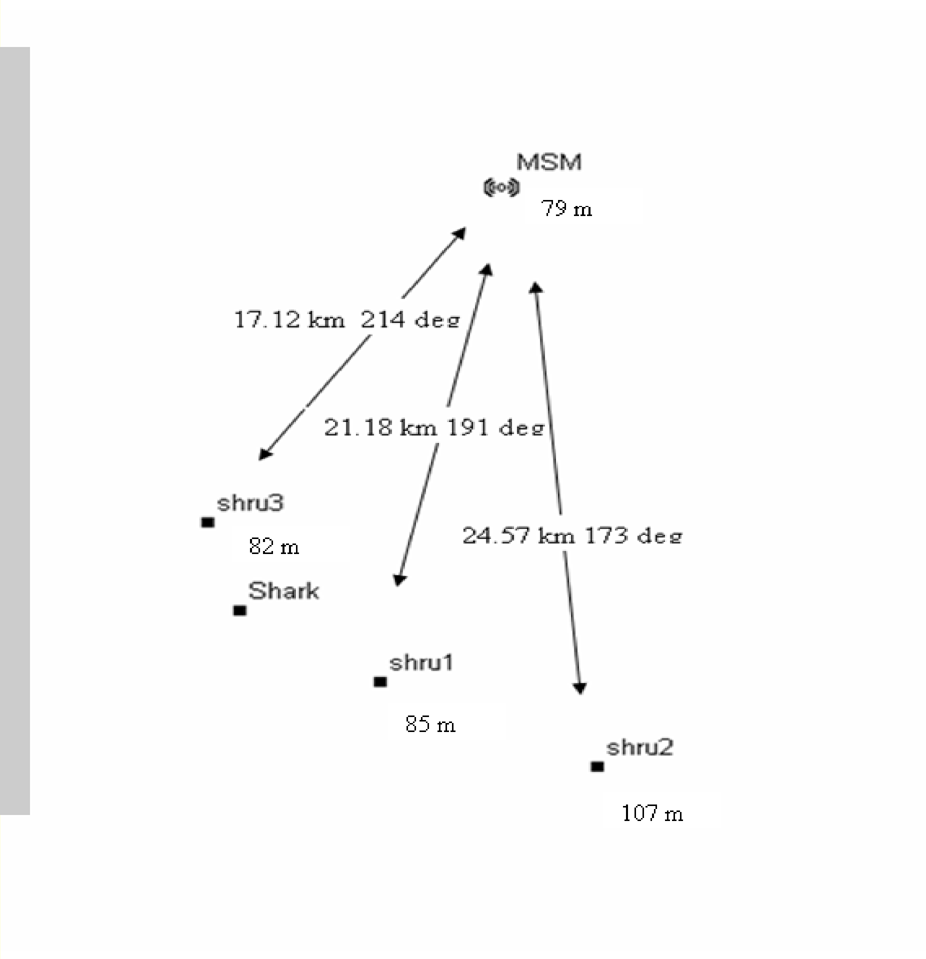
  - -200 Hz, 800 Hz, 1600 Hz
  - -Determination of Modes
- Summary

Experimental Setup





Internal Wave Field Potential Energy

The potential energy of the internal wave field can be estimated by (Gill, 1982):

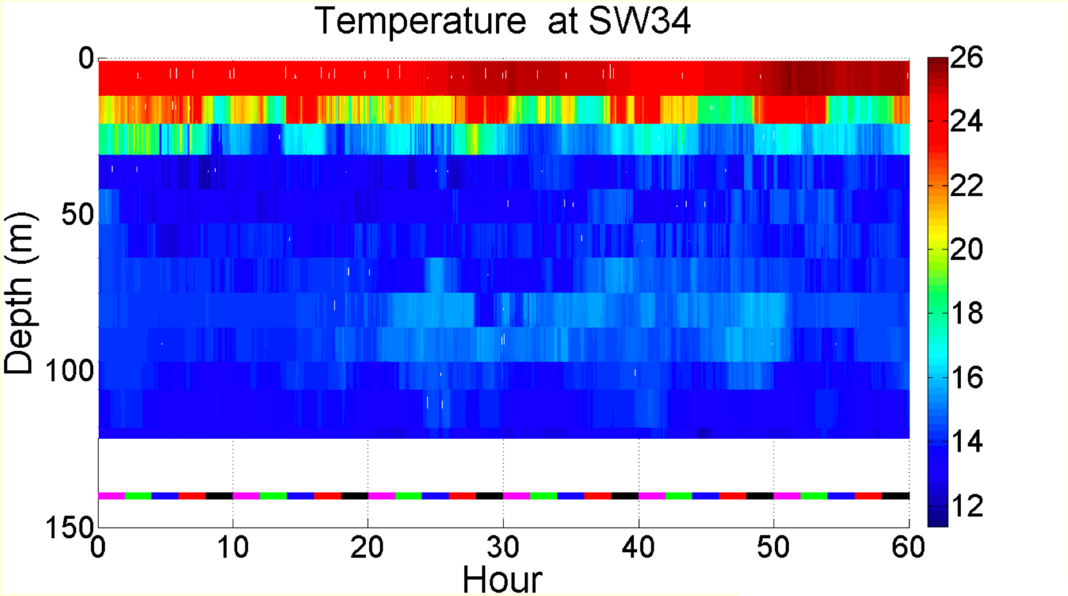
$$PE = (r\ /2)h^{2}N^{2}$$

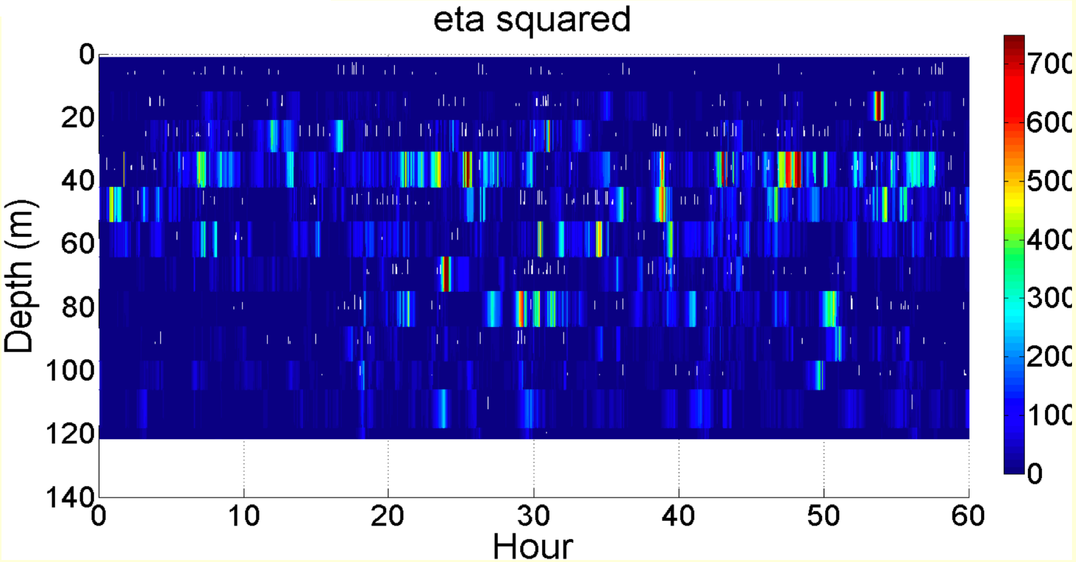
with:

$$\eta = T^{'}/dT/dz$$

On the NJ shelf the Buoyancy Frequency is relatively stable, so the potential energy can be estimated from η 2

Internal Wave Field Potential Energy





Temporal Coherence

Temporal coherence is the statistical measure of the change of a waveform in time

$$COH(t,\tau) = \frac{\left\langle \left(\; p(t) * p(t+\tau) \; \right)^2 \right\rangle_{\Delta\tau,\Delta T}}{\left\langle p(t)^2 \right\rangle_{\Delta\tau,\Delta T} \left\langle p(t+\tau)^2 \right\rangle_{\Delta\tau,\Delta T}}$$

Types of Coherence:

•Deterministic: slow changes in coherence, typically recoverable with phase tracking

•Multipath: Deterministic but typically unrecoverable

•Stochastic: Randomized by internal waves, bottom scattering, or a combination of both

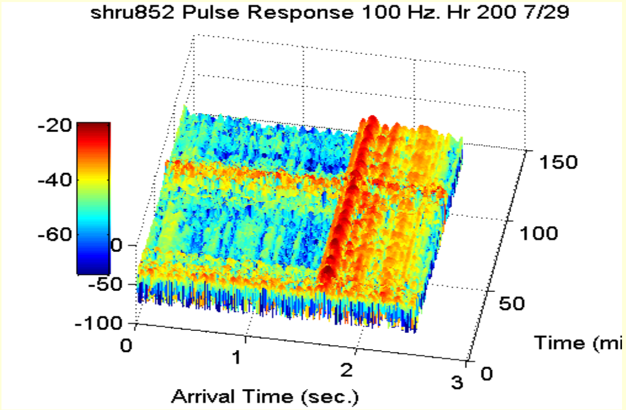
•Single Mode vs. Multimode

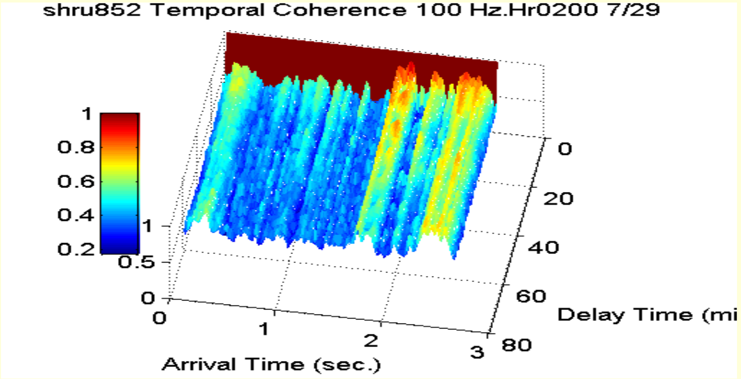
  -Broadband coherence: coherence of the entire pulse response

Data and Models

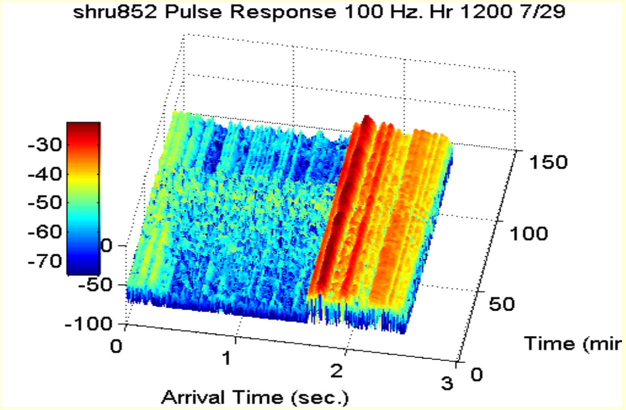
100 Hz Summary

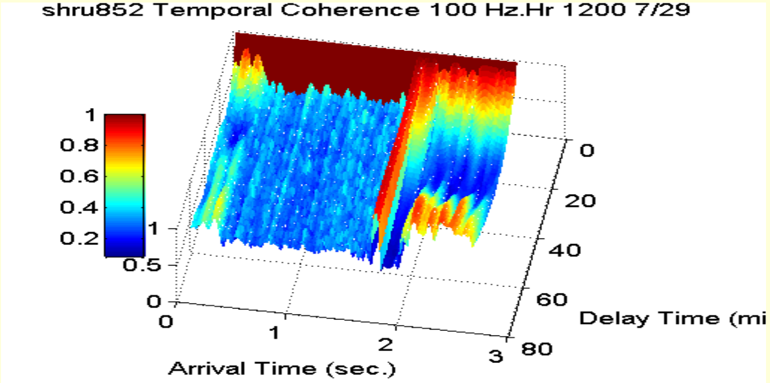
High IW Activity





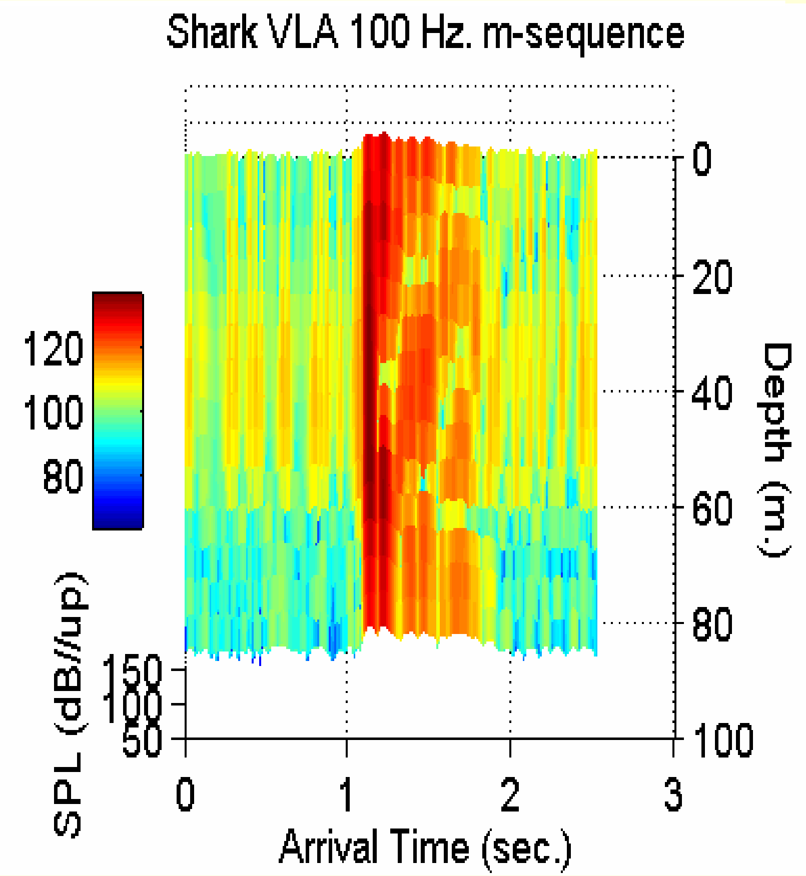
Low IW Activity

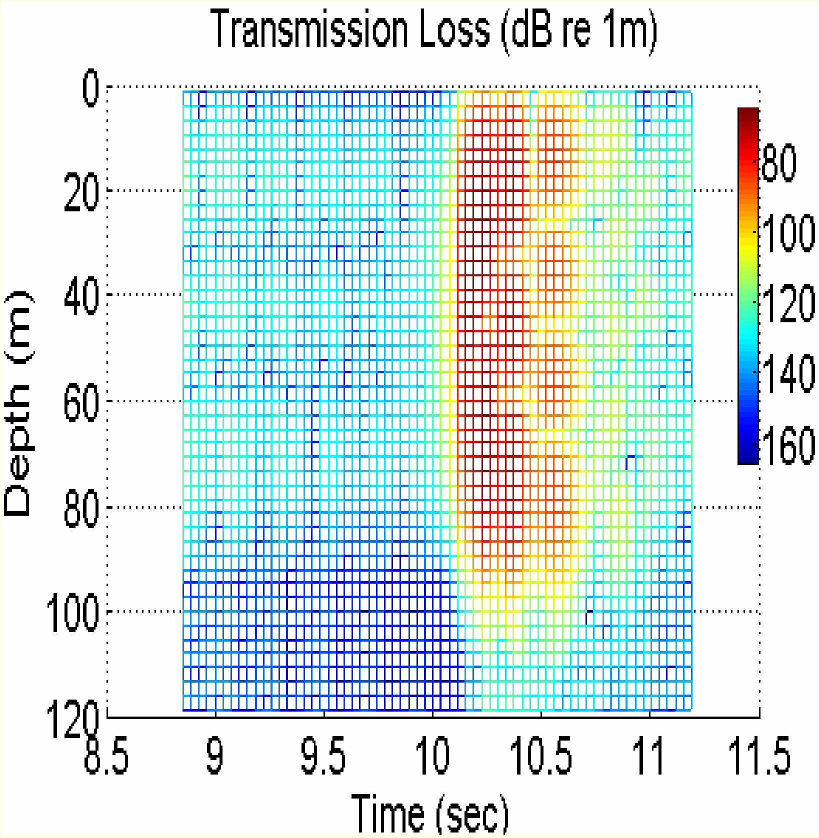




- 100 Hz coherency is effected by Internal Wave activity
- Bottom scattering negligible, behaves as if there was a smooth bototm

100 Hz
Shark VLA Data and Model

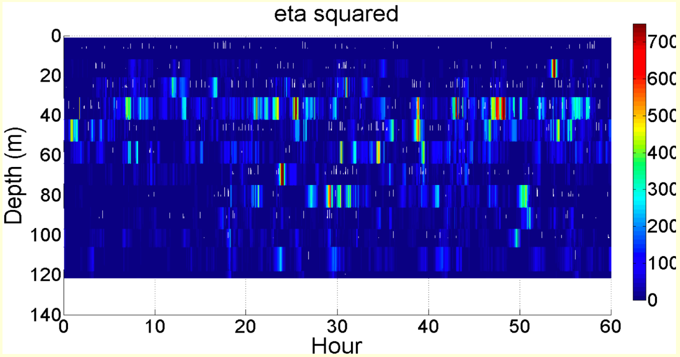


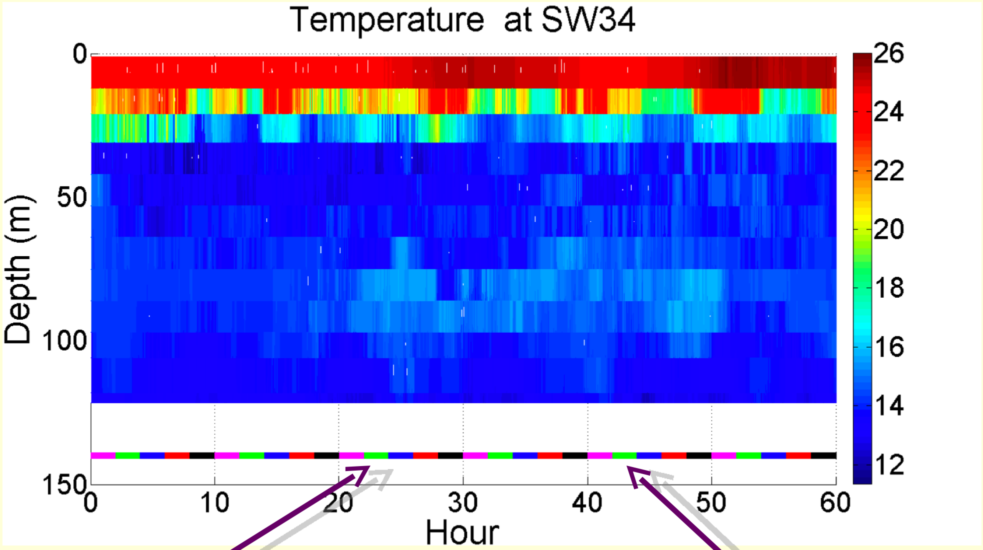


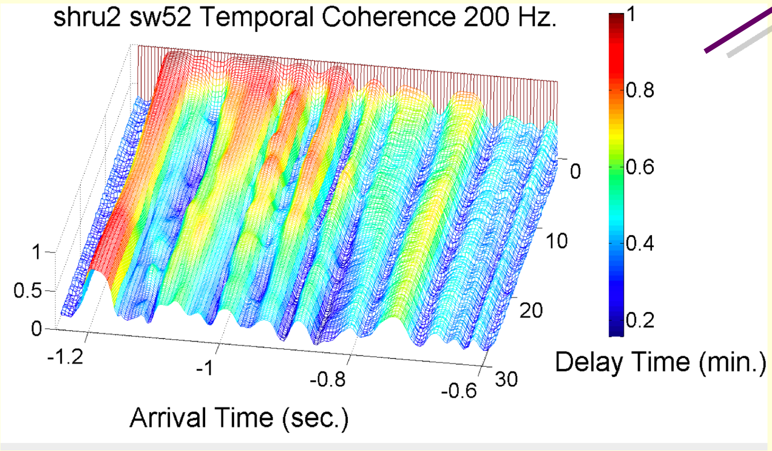
C_b=1595 m/s

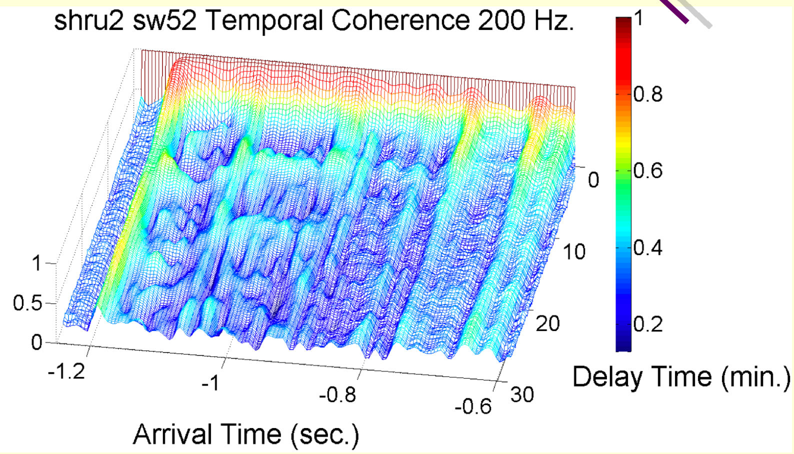
One to One mode correspondance

200 Hz

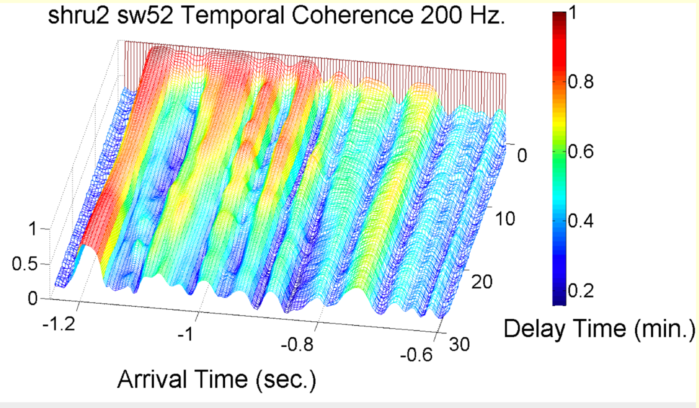

eta squared
Depth (m)
Hour
0
20
40
60
80
100
120
140
10
30
50
700
600
500
400
300
200
100

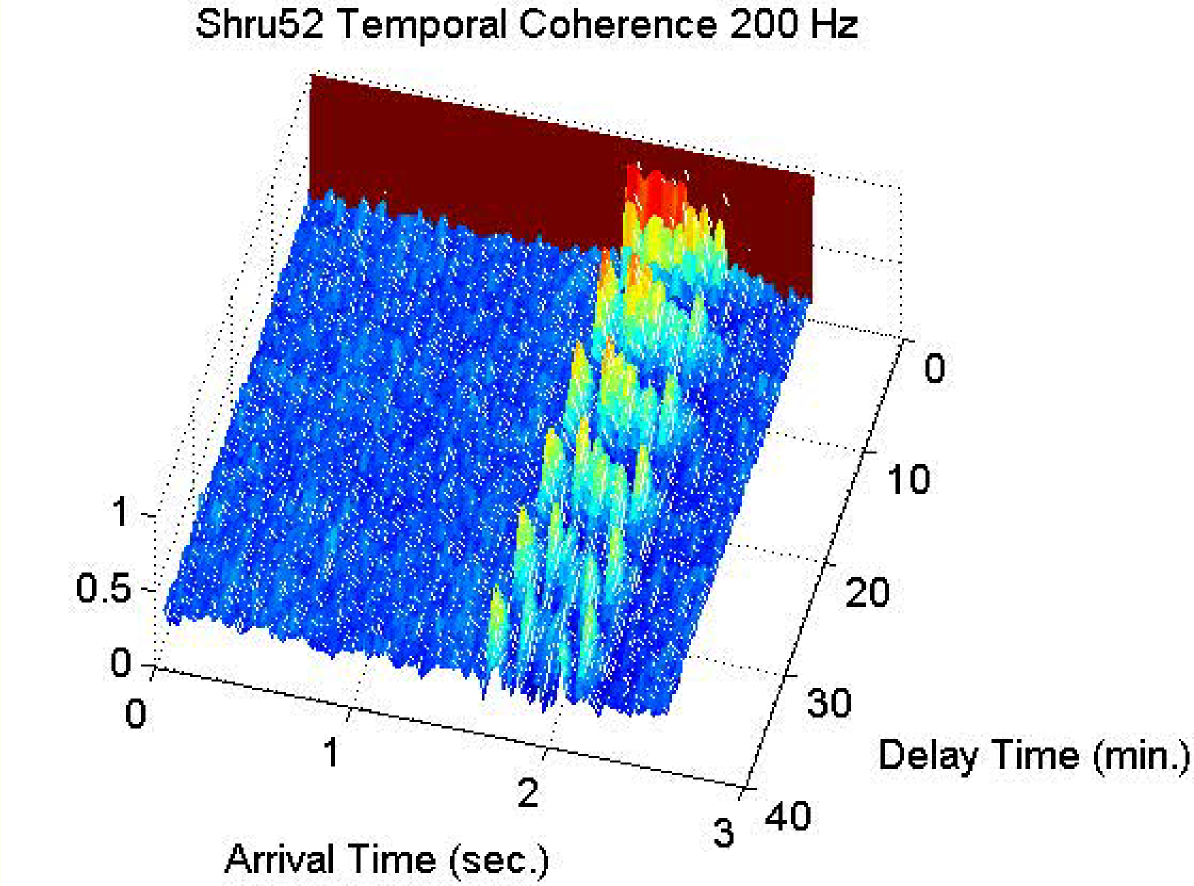

Temperature at SW34
Depth (m)
Hour
0
50
100
150
10
20
30
40
50
60
26
24
22
20
18
16
14
12


shru2 sw52 Temporal Coherence 200 Hz.
Arrival Time (sec.)
Delay Time (min.)
-1.2
-1
-0.8
-0.6
0
10
20
30
0.5
1
0.2
0.4
0.6
0.8


shru2 sw52 Temporal Coherence 200 Hz.
Arrival Time (sec.)
Delay Time (min.)
-1.2
-1
-0.8
-0.6
0
10
20
30
0.5
1
0.2
0.4
0.6
0.8

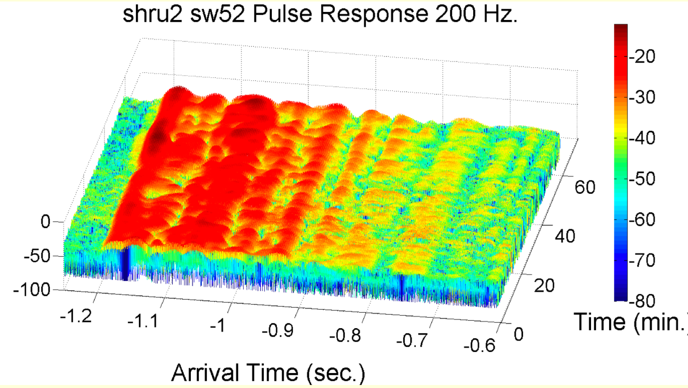
200Hz

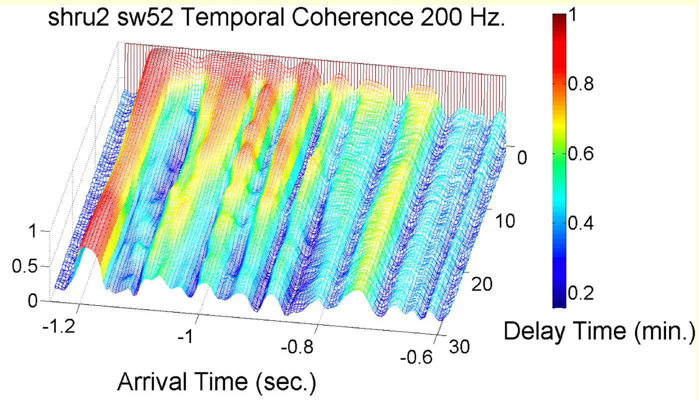

shru2 sw52 Temporal Coherence 200 Hz.
1
0.5
0
-1.2
-1
-0.8
-0.6
0
10
20
30
1
0.8
0.6
0.4
0.2
Arrival Time (sec.)
Delay Time (min.)

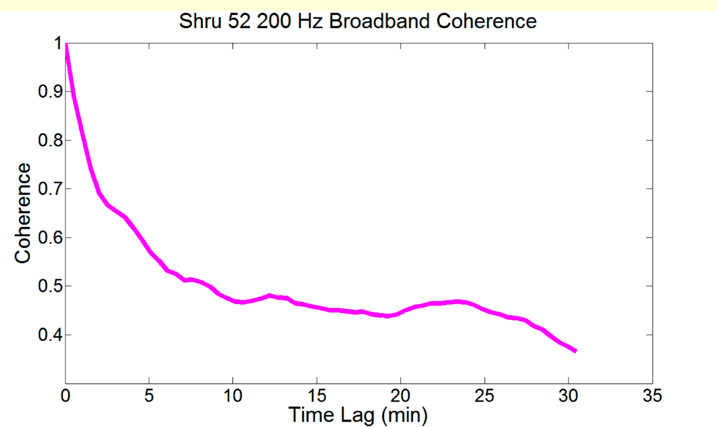

Shru52 Temporal Coherence 200 Hz
1
0.5
0
0
1
2
3
0
10
20
30
40
Arrival Time (sec.)
Delay Time (min.)

200 Hz

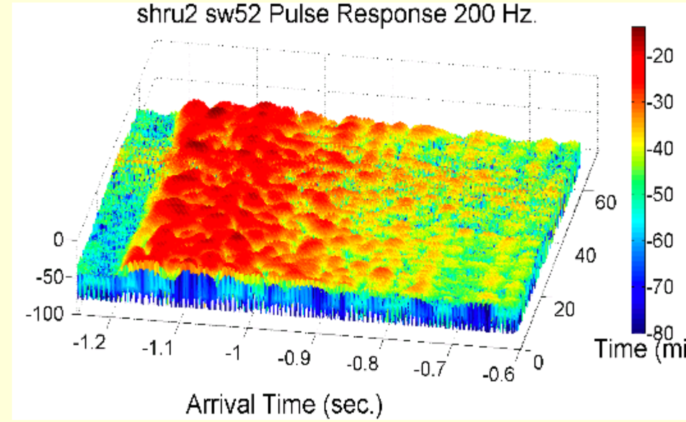
Low IW Activity

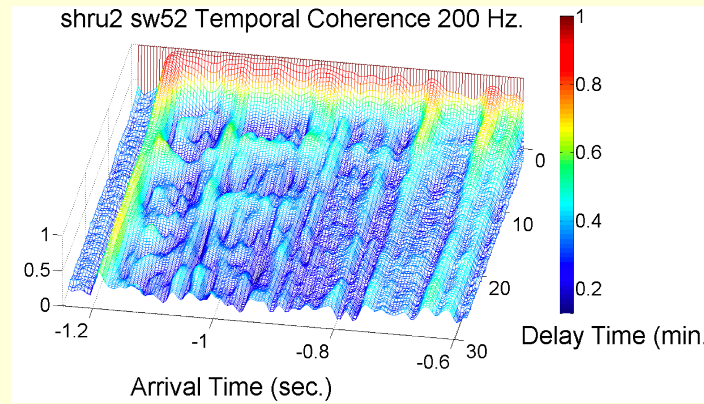


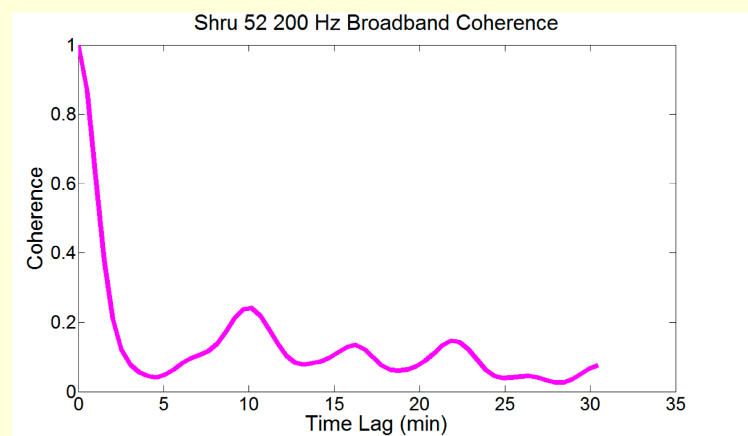




High IW Activity

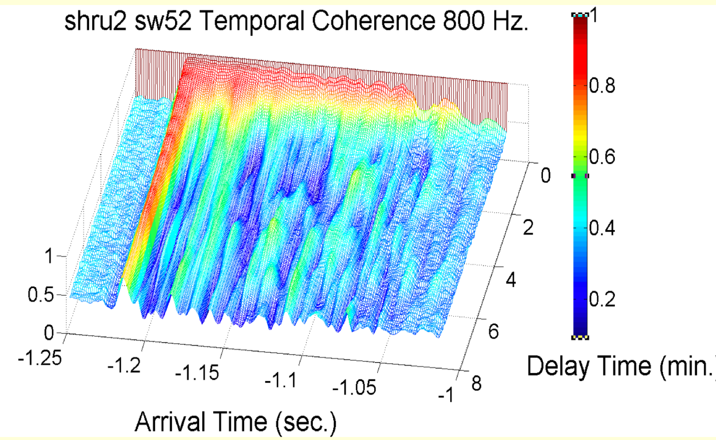


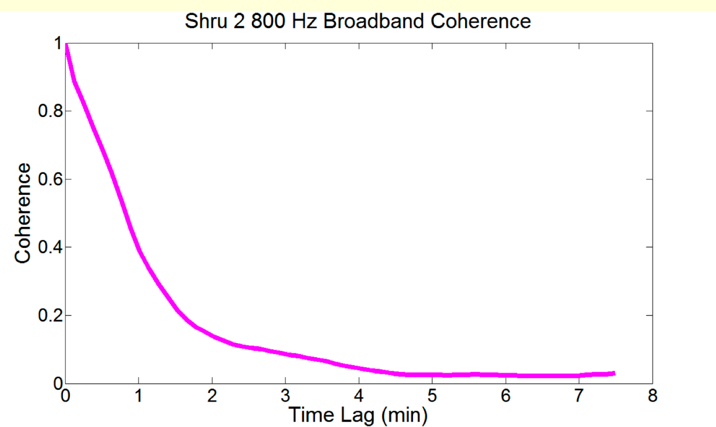




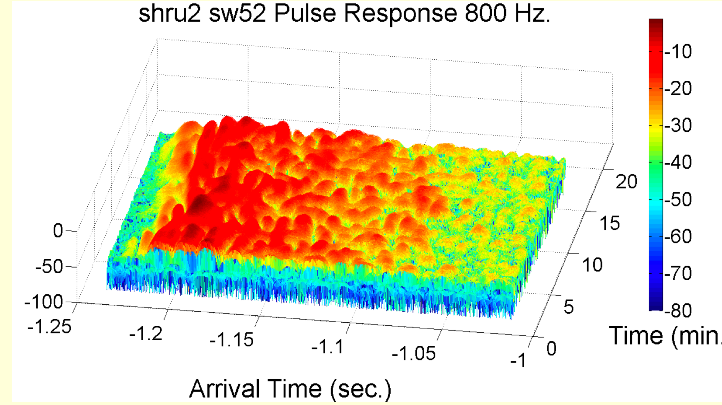
800 Hz

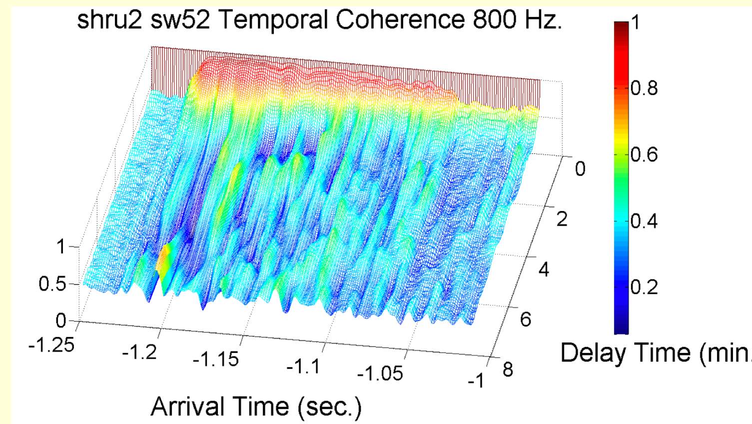
Low IW Activity

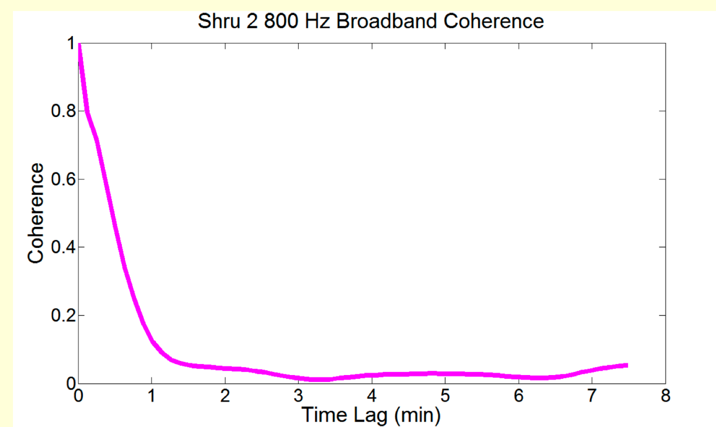




High IW Activity





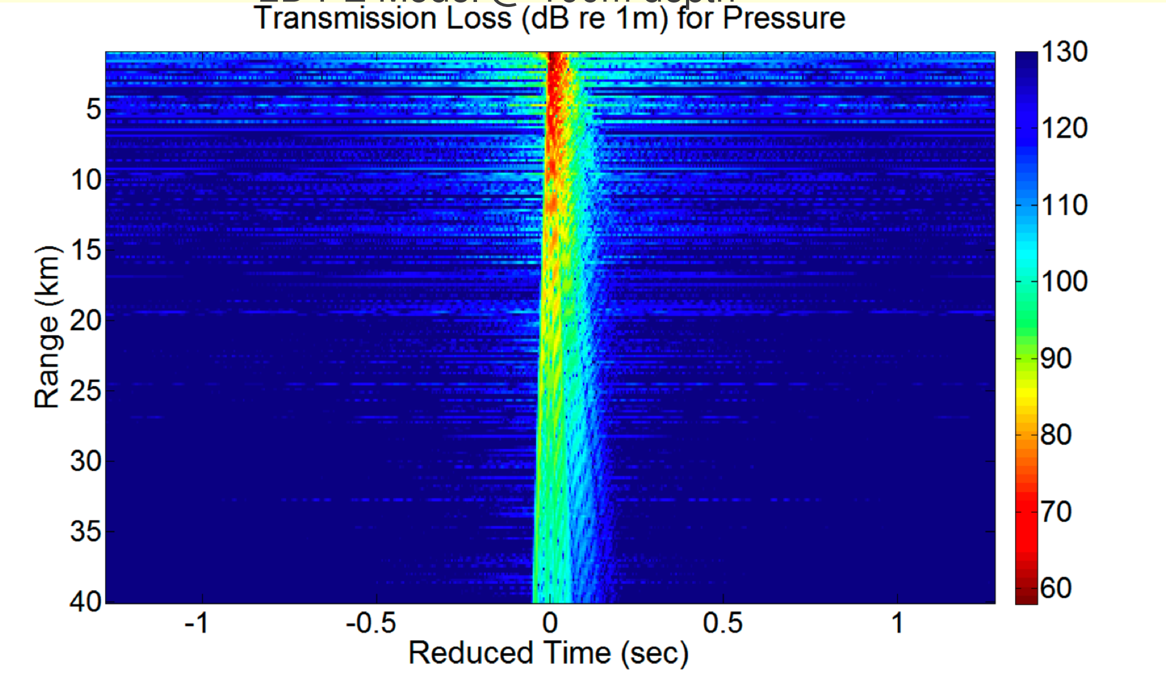


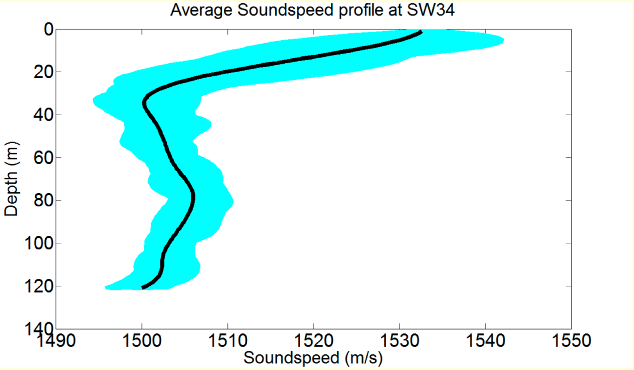
800 Hz

C_b=1605 m/s

1st mode – direct path

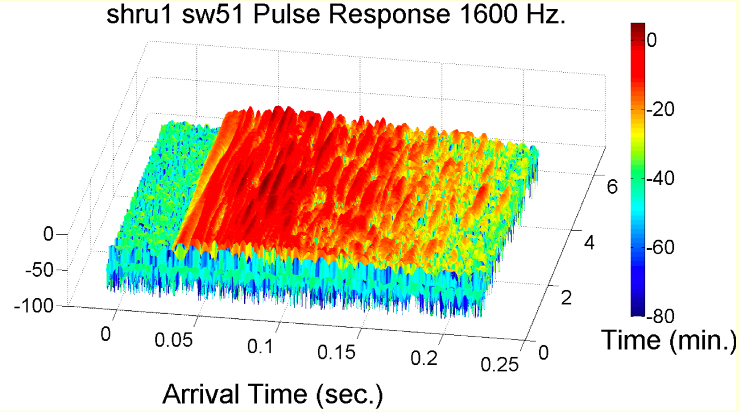
2D PE Model @ 100m depth

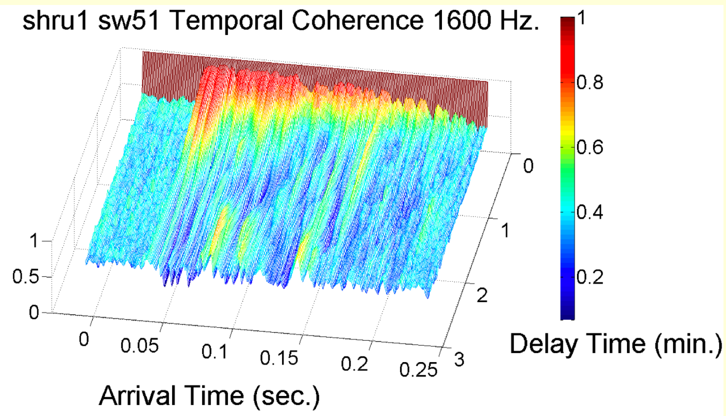


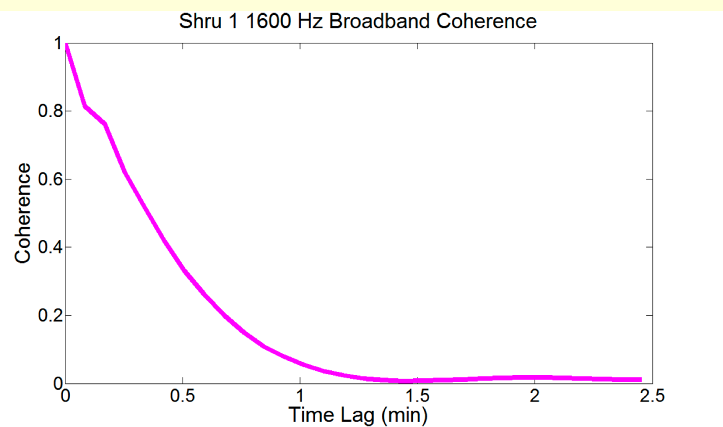


1600 Hz

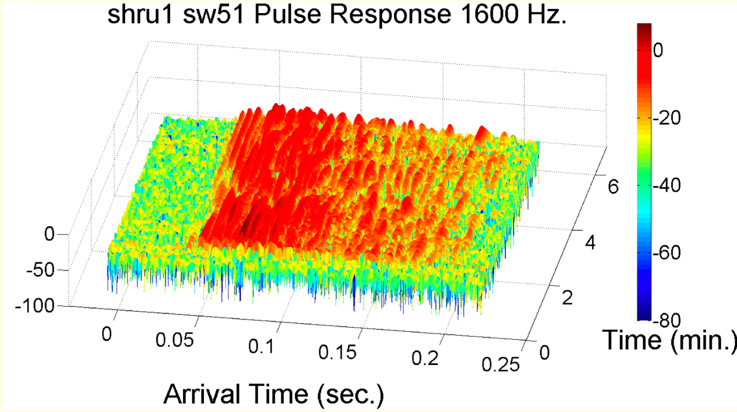
Low IW Activity

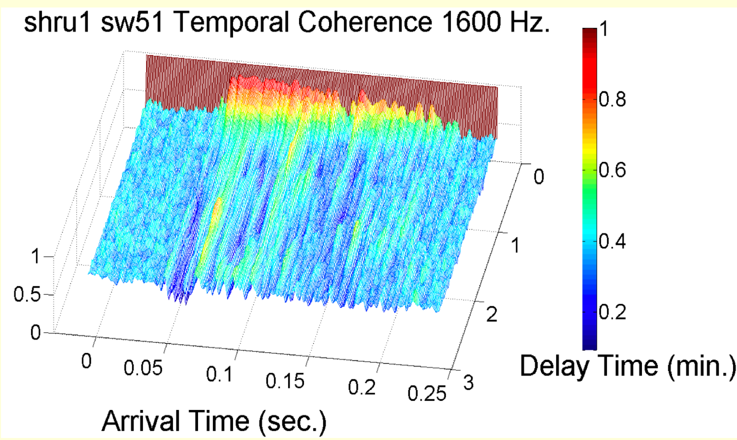


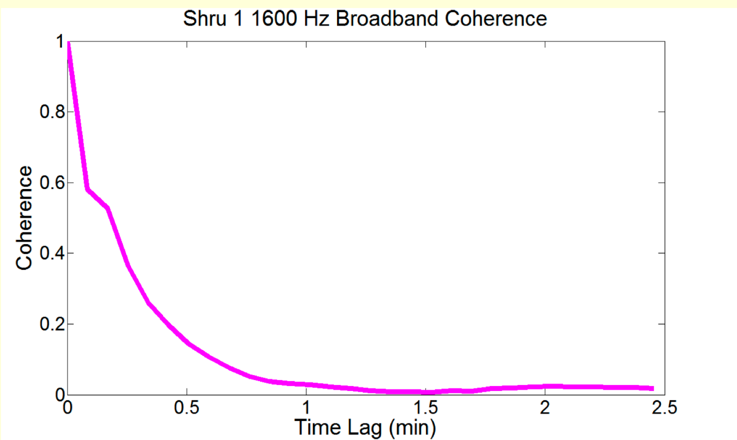




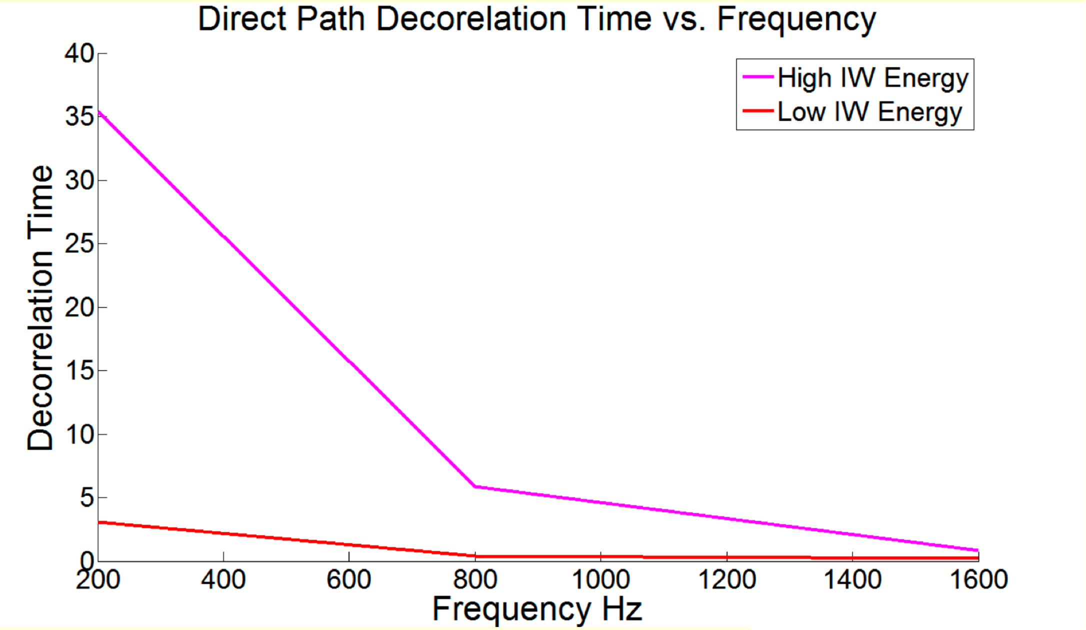
High IW Activity

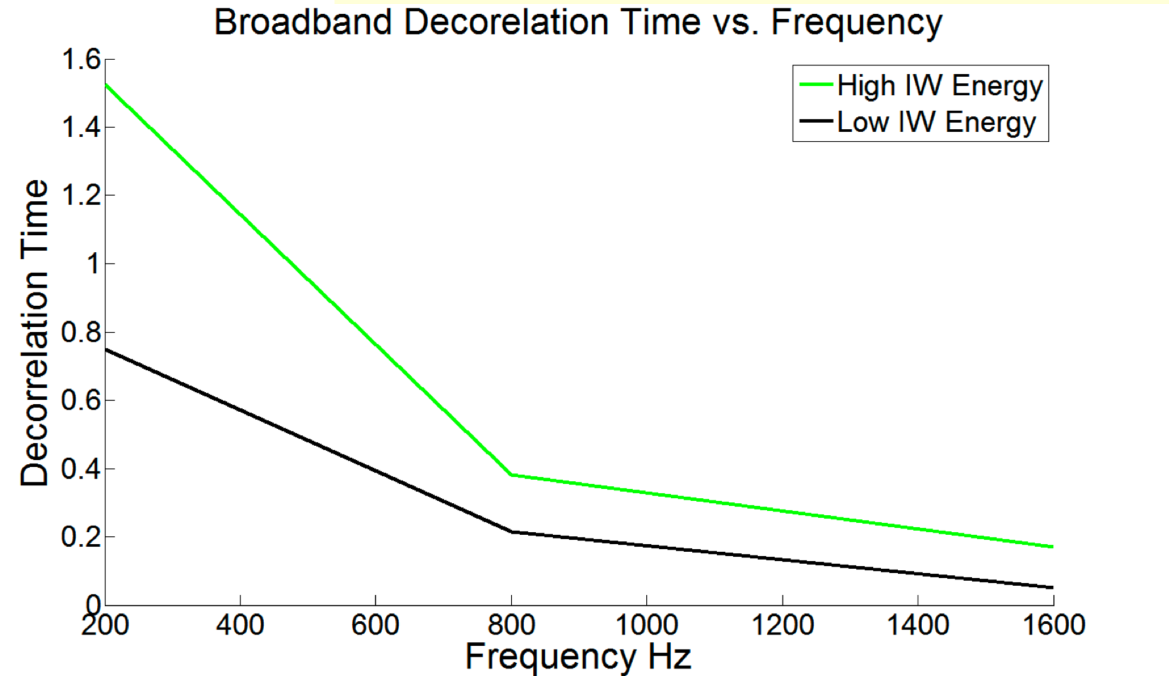






Summary


Direct Path Decorelation Time vs. Frequency
High IW Energy
Low IW Energy
Decorrelation Time
40
35
30
25
20
15
10
5
0
200
400
600
800
1000
1200
1400
1600
Frequency Hz


Broadband Decorelation Time vs. Frequency
High IW Energy
Low IW Energy
Decorrelation Time
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
200
400
600
800
1000
1200
1400
1600
Frequency Hz

Summary

•100 Hz

-Coherency affected by internal wave activity

-Bottom scattering negligible, behaves like smooth bottom

•200 Hz & 800 Hz

-Bottom scattering becomes important

-Direct path still affected by internal wave activity

-Higher modes affected greater by bottom scattering

•1600 Hz

- Bottom Scattering plays the dominate role

References

Gill, A. E., 1982: Atmosphere-Ocean Dynamics. Academic Press, London, United Kingdom, 661 pp

Oceanus, Vol. 45, NO. 3, July 2007