

Investigating an unusual noise phenomenon with HLA & VLA data

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THINK BIG

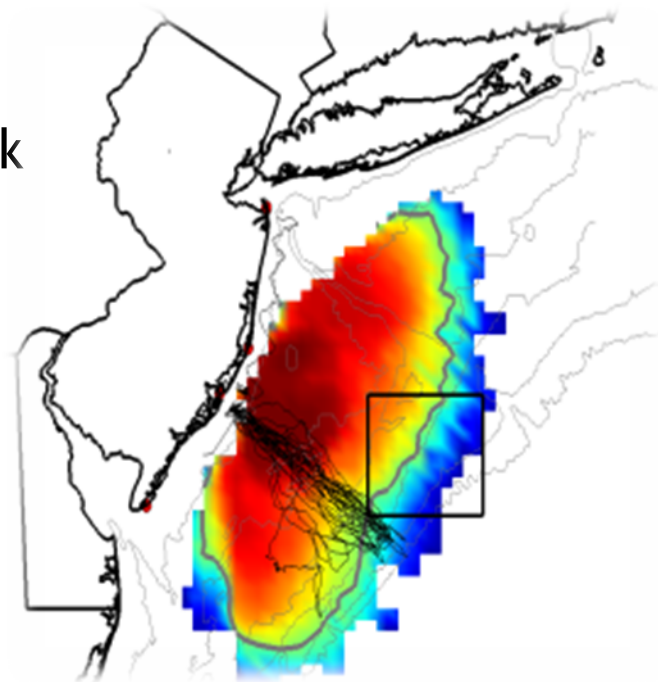
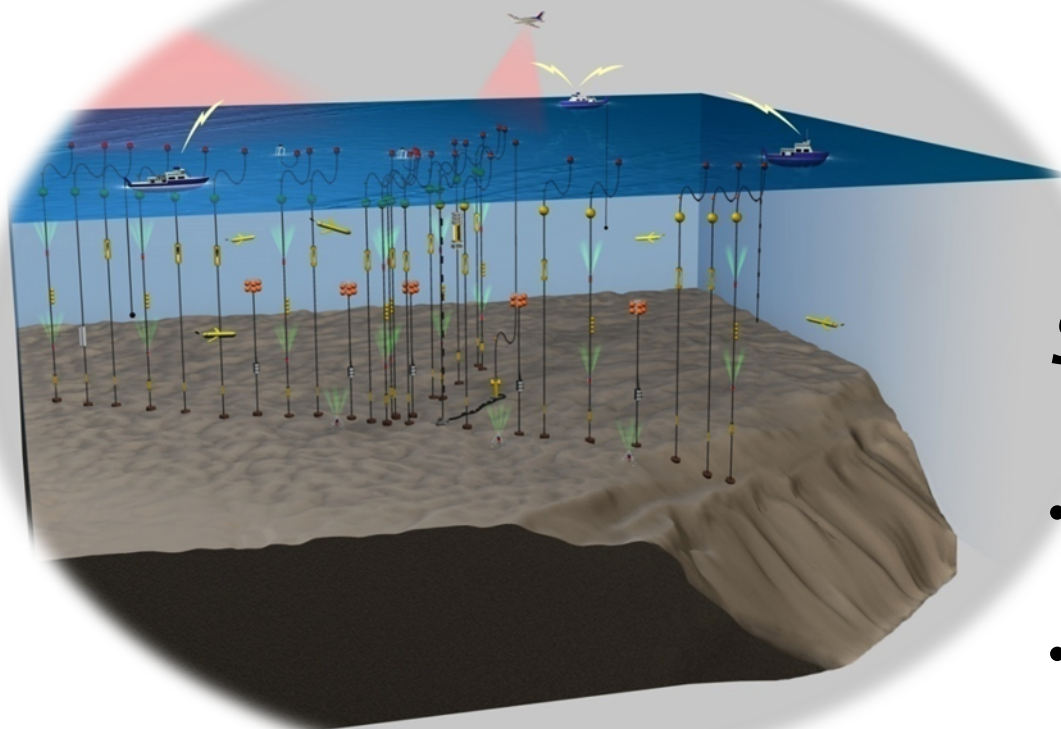


WE DOSM



Shallow Water 2006:

- Funded by Office of Naval Research
- July-August 2006 on the New Jersey shelfbreak
- Multiple teams of scientists and engineers
- 5+ ships and many institutions represented
- Largest field experiment in WHOI's History



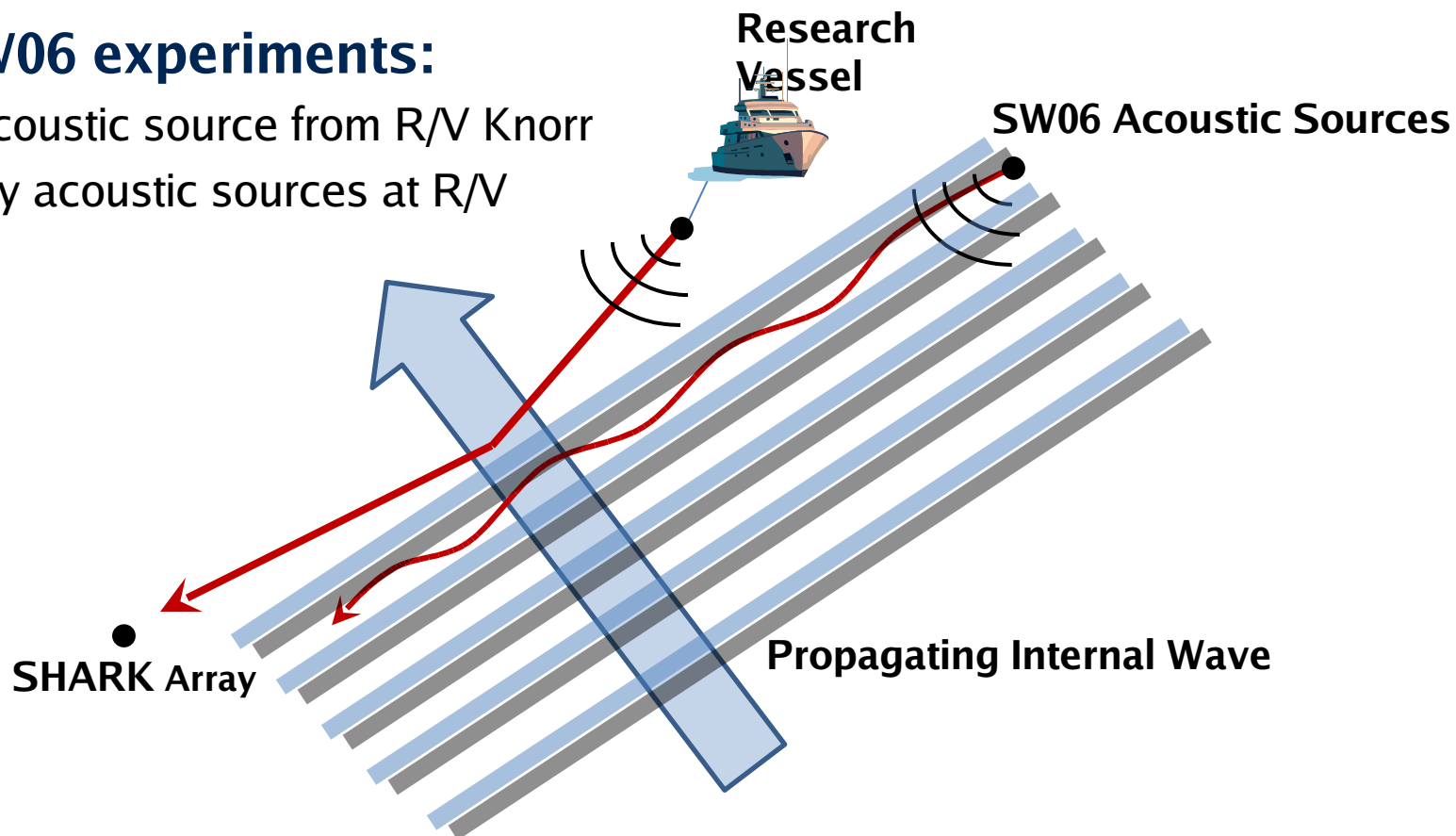
Specific interests include:

- Effects of ducting in presence of *internal wave*
- Effects of refraction in presence of *internal wave* and/or *bathymetry* of

What's going on?

Two SW06 experiments:

- Towed acoustic source from R/V Knorr
- Stationary acoustic sources at R/V Sharp



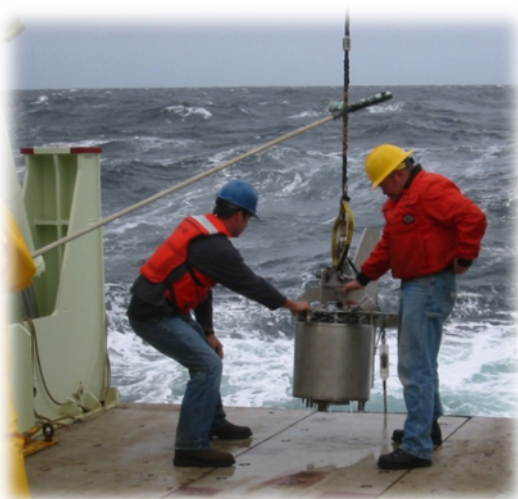
Where is the wave located in regard to the acoustic sources and receivers?

Use environmental data to help solve this

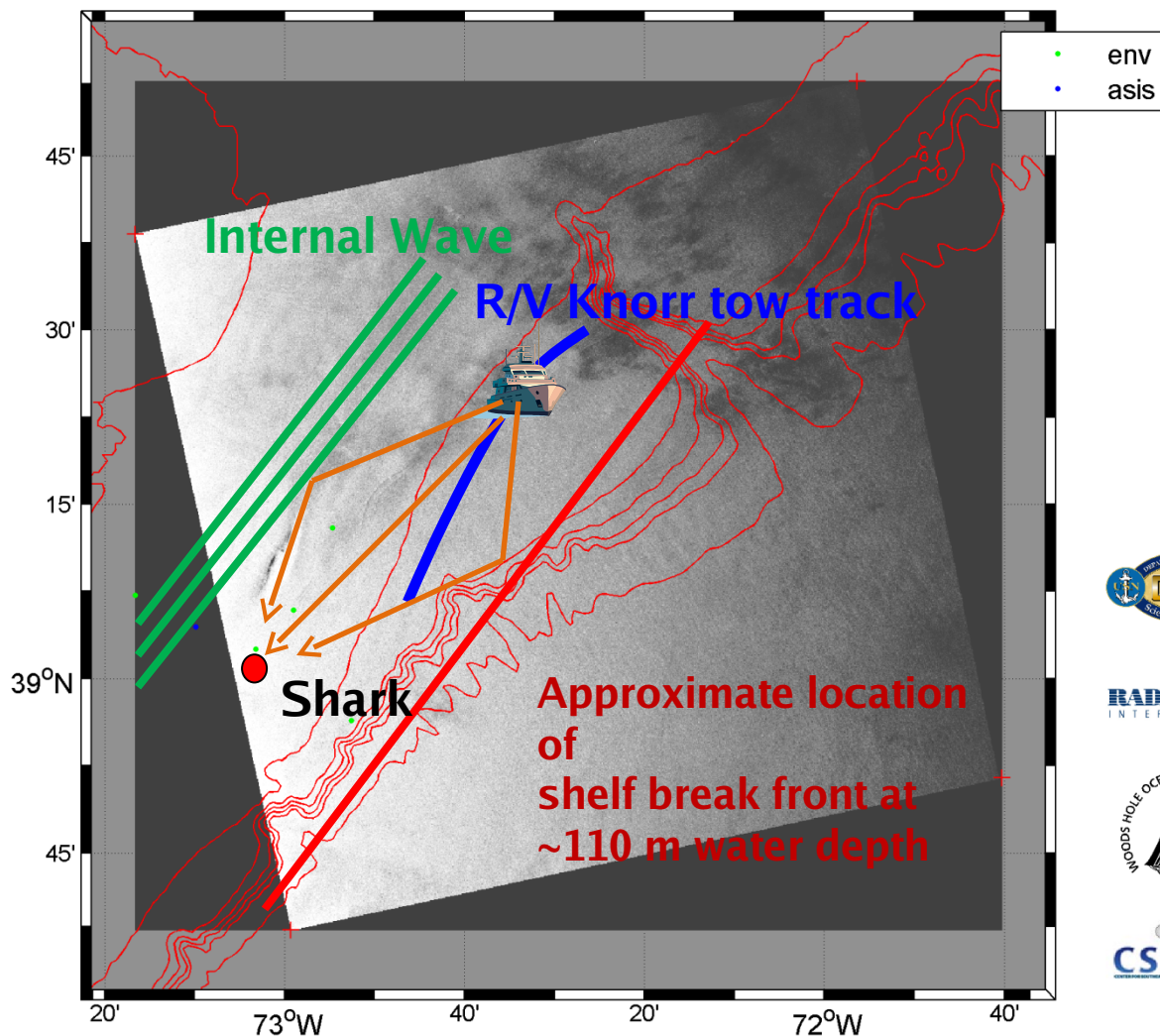
Is there any ducting or refraction of the acoustic signal?

Use environmental and acoustic data to help solve this

R/V Knorr source tow



Radarsat September 5, 2006 22:33 GMT



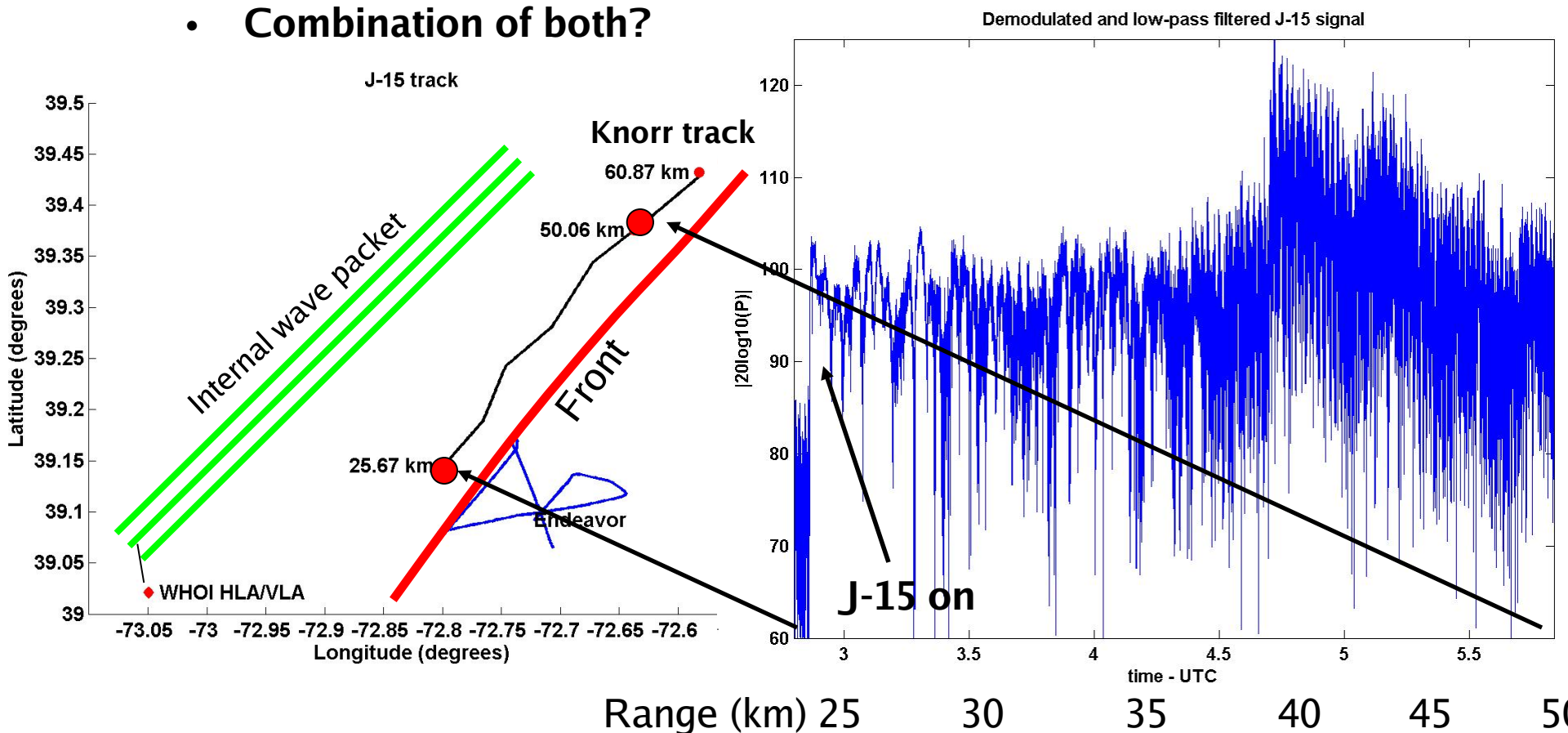
J-15 source tow - R/V Knorr

- Sep 05, 2006
- Parallel to shelf break front
- J-15 at 50 m depth
- Signal: 93 Hz tone
- Source Level: 165 -168 dB
- Collaborators: Knobles (ARL-UT); Lynch, Newhall (WHOI)

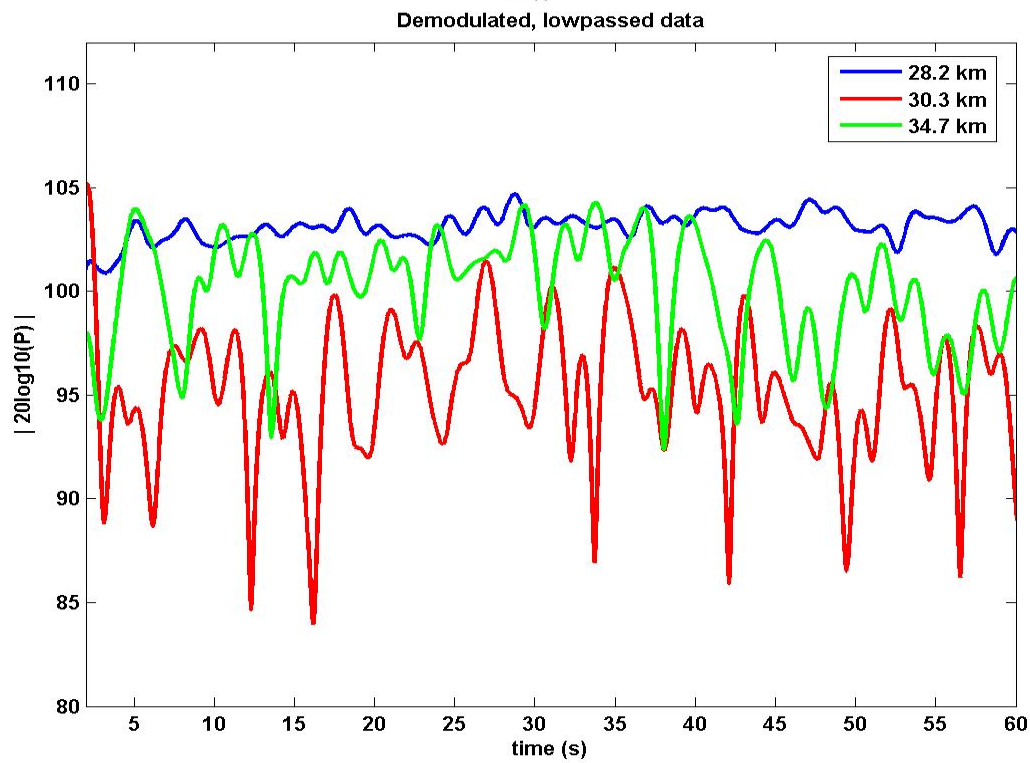
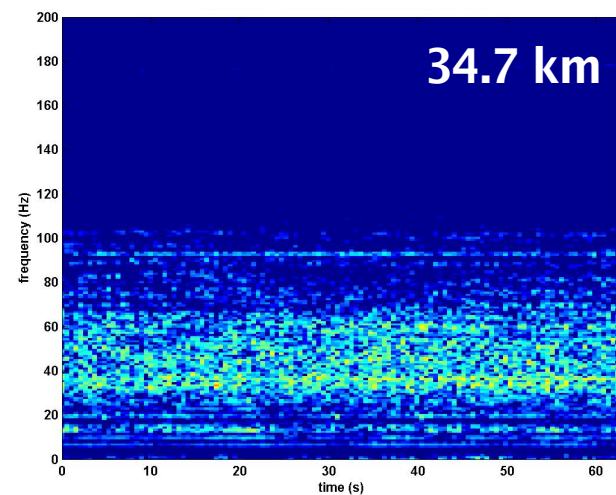
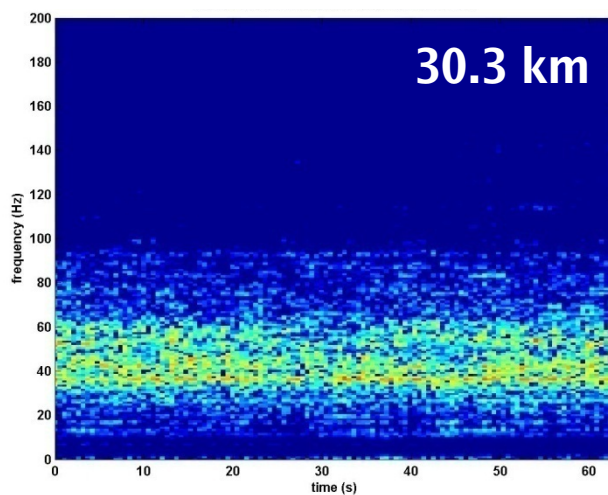
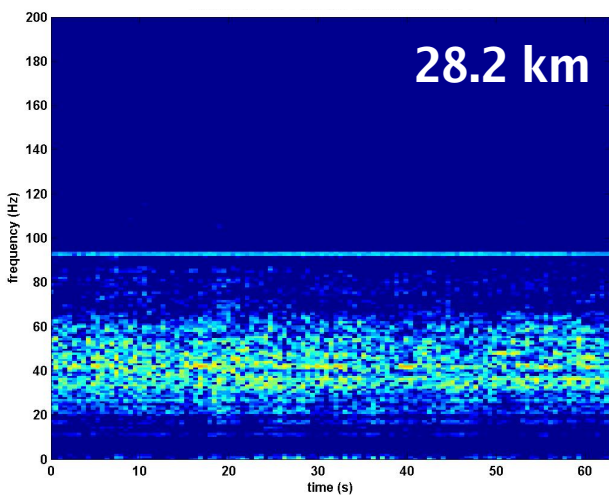


R/V Knorr source tow

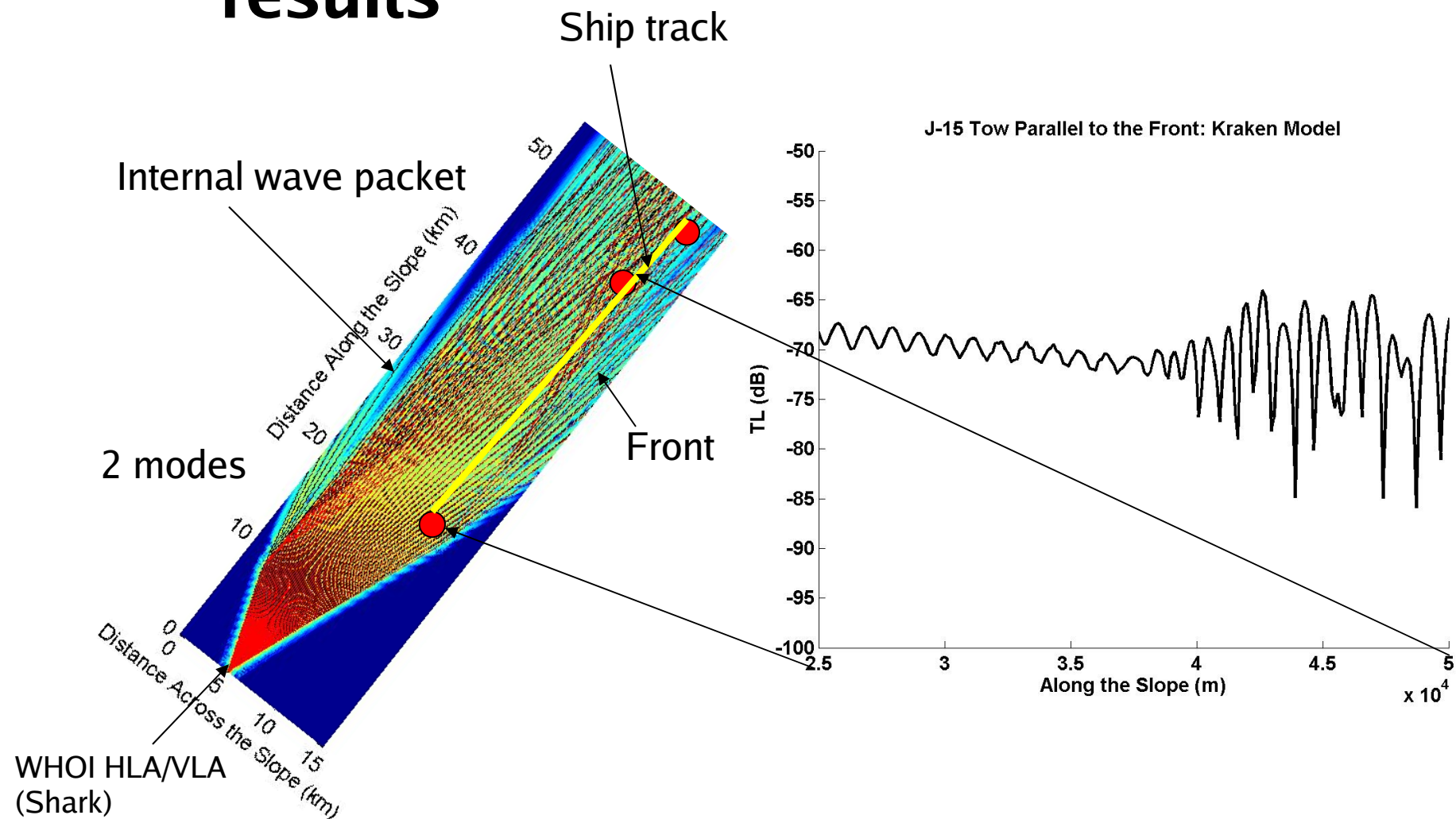
- Increase in sound level 30-40 km as predicted
- 20 dB increase in signal result of unexplained noise phenomena...
 - Boat Noise?
 - Passing Internal Wave?
 - Combination of both?



R/V Knorr source tow

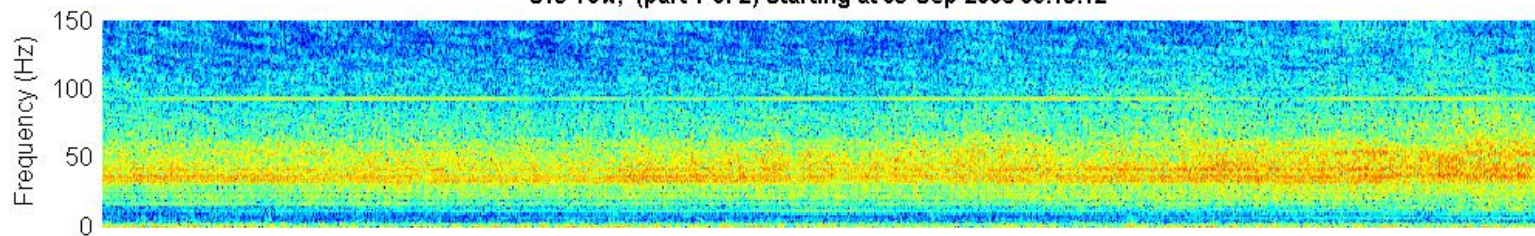


Modeling results

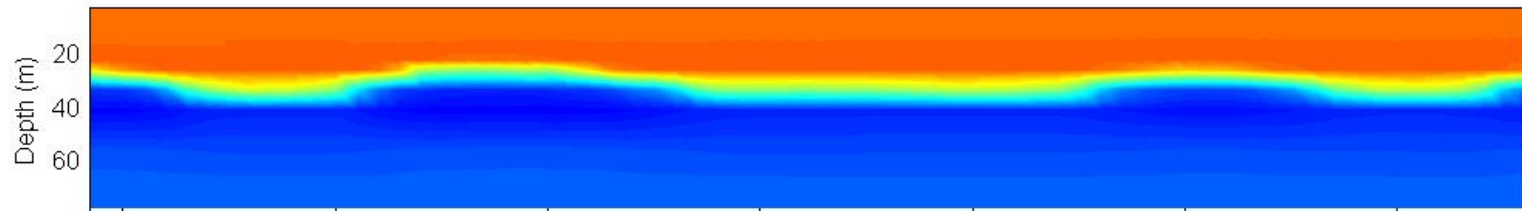


R/V Knorr source tow

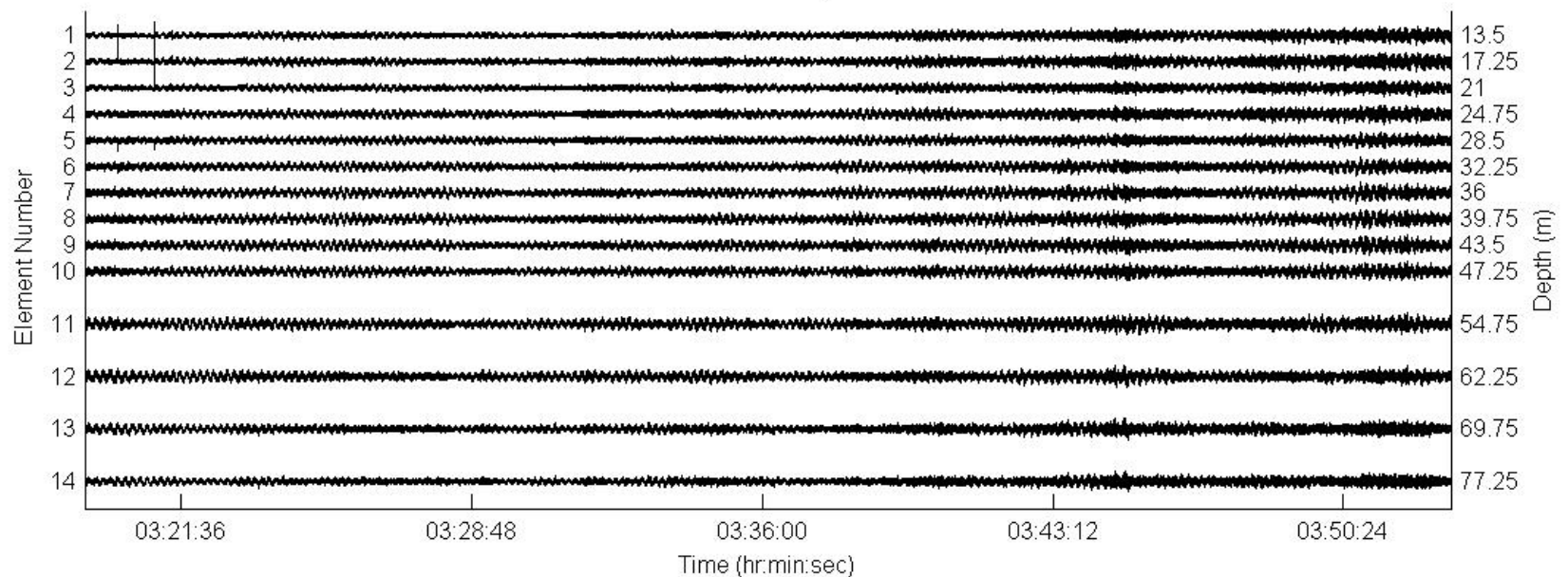
J15 Tow, (part 1 of 2) Starting at 05-Sep-2006 03:19:12



Soundspeed at SHARK

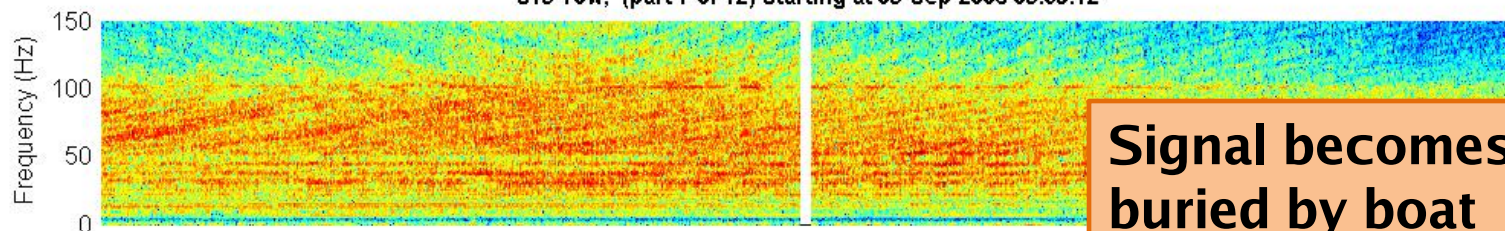


SHARK Vertical Line Array (Complex Envelope, $F_c = 93$ Hz, Low-Pass Filtered @ 10 Hz)



R/V Knorr source tow

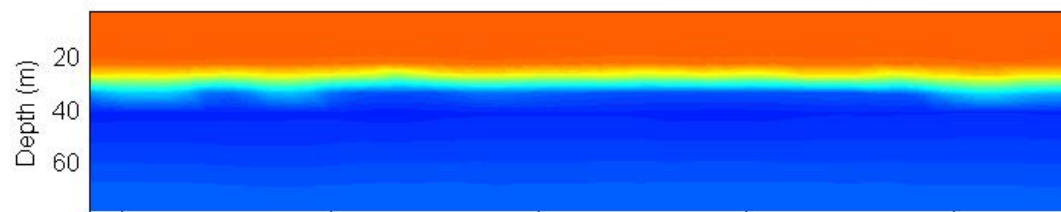
J15 Tow, (part 7 of 12) Starting at 05-Sep-2006 05:39:12



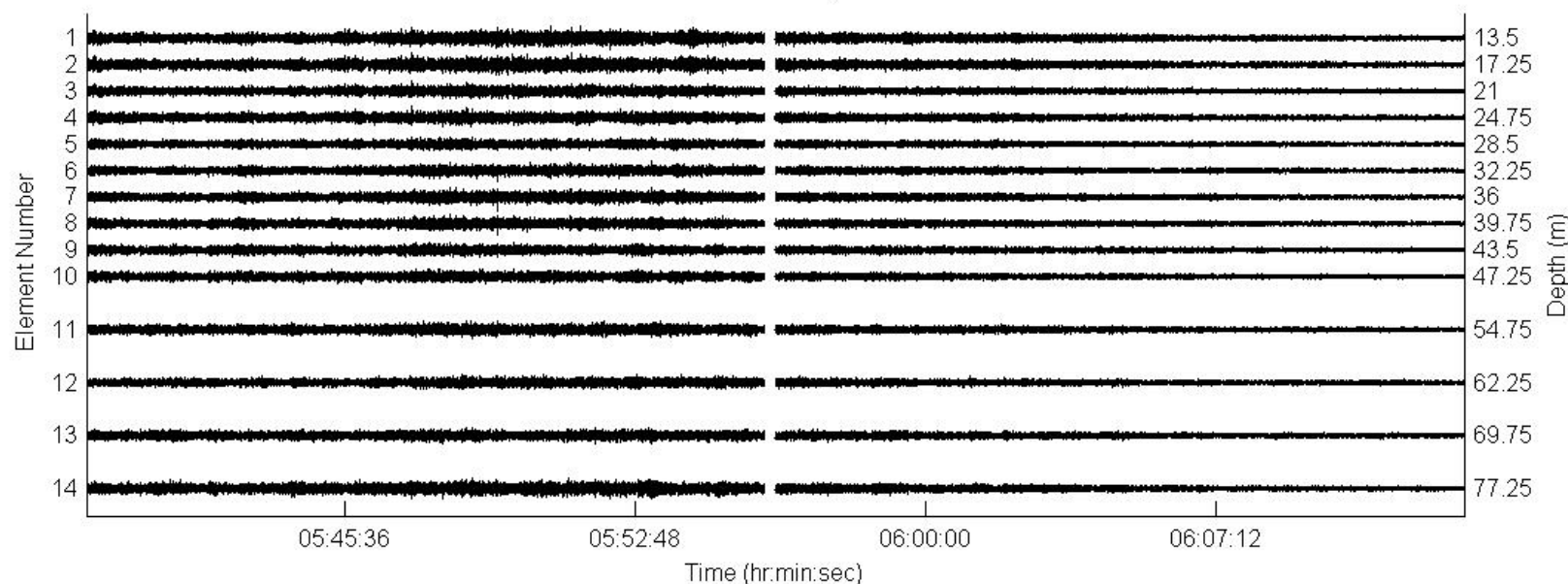
Signal becomes
buried by boat
noise...

Possible **that** boat noise
is being amplified by
passing internal wave
and/or shelf break front

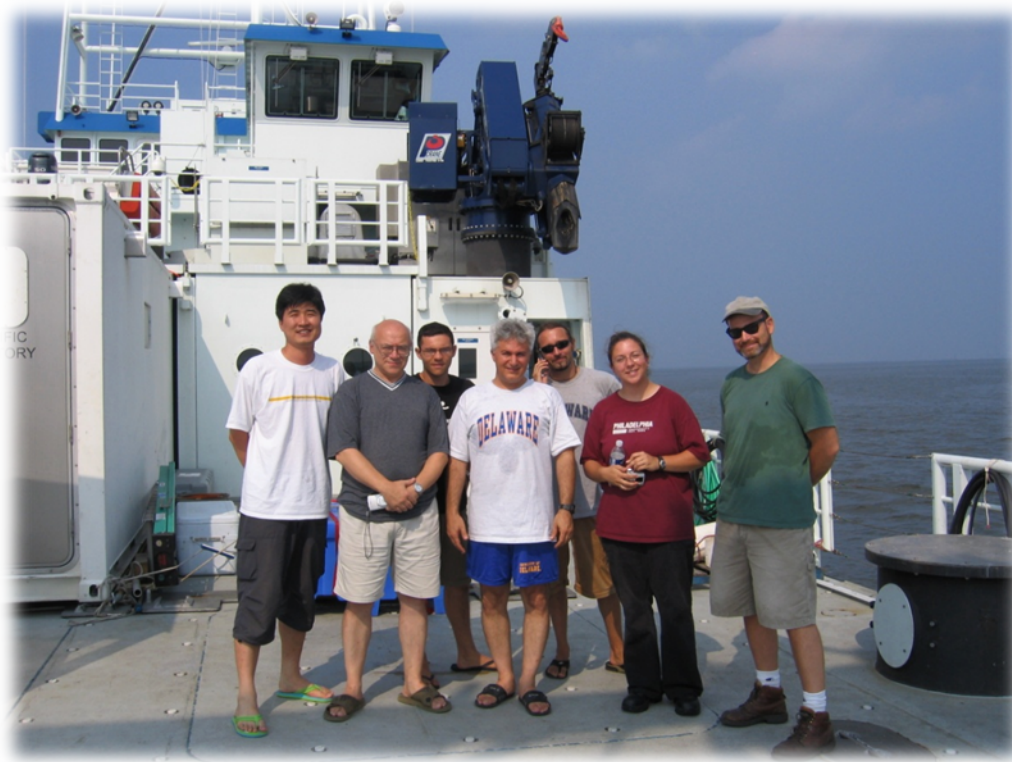
Soundspeed at SHARK



SHARK Vertical Line Array (Complex Envelope, $F_c = 93$ Hz, Low-Pass Filtered @ 10 Hz)



R/V Sharp datasets



**Can use similar methods to help
examine Internal Wave Events
experienced aboard the R/V
Sharp**

Lots of data to tackle...

The R/V Sharp experienced over 50 Internal Wave events during 3 weeks of ship time

- How do we prioritize the analysis of so much data?
- How do we ensure we do not 'miss' any data sets of opportunity?
- How do we catalog the analyzed data?
- How do we link different types of data together?

Develop a data analysis toolbox to survey and visualize the data

Develop a web-based cataloging structure

Share tools and data to facilitate future research

tentative webpage structure



Webpage is a tool developed for easy access to (viewing of) large amounts of data

- We will soon incorporate research from University of Delaware and Georgia Tech
- Easy to modify, add to, or change by using Excel as the web creation tool
- Any comments or suggestions are welcome

THE UNIVERSITY OF RHODE ISLAND

Reasons for this approach...

This method allows us to easily 'pick out' interesting phenomena

- Allows us to prioritize data analysis and modeling efforts
- Allows us to share and collaborate between colleagues
- Allows us to archive work already done

http://www.egr.uri.edu/~dossetg/research/index.php - Windows Internet Explorer

http://www.egr.uri.edu/~dossetg/research/index.php

http://www.egr.uri.edu/~dossetg/research/index.php

Radar-Captured Internal Wave Events aboard R/V Sharp, SW06

Notes:
- Keeping with the convention used on the Sharp Cruise, Events 6, 35, 46, and 52 were not recorded on radar
- Events 46 and 47 run together (47a and 47b)
- Yellow indicates potentially promising event data
- Color indicates wave structure indicated by ADCP or environmental data: Excellent Promising Data Good Little/None

Event #	Sharp Location (Map)	SHARK Data		Radar Information				Other R/V Sharp Sensors & Activity									
		Environmental	Acoustic	Local	GMT	Local	GMT	Duration (Movie)	Wave Heading	Star-Mini Receive During Event	Source Transmit During Event G34 Signal	J35 Signal	Echo	ADCP Evidence	Wavelet	Thermistor String	CTD
1	A1	Not Yet Analyzed	Not Yet Analyzed	8/2/06 5:30 AM	8/2/06 9:30 AM	8/2/06 6:00 AM	8/2/06 10:50 AM	1:20	TBD	No	None	None	Yes	Yes	Yes	Yes	Every Hour
2	A1	Not Yet Analyzed	Not Yet Analyzed	8/2/06 12:10 PM	8/2/06 4:10 PM	8/2/06 1:30 PM	8/2/06 5:30 PM	1:20	TBD	No	None	None	Yes	Yes	Yes	Yes	Every Hour
3	A1	Not Yet Analyzed	Not Yet Analyzed	8/2/06 6:10 PM	8/2/06 10:10 PM	8/2/06 7:50 PM	8/2/06 11:30 PM	1:40	TBD	No	Yes	Yes	Yes	Yes	Yes	Yes	No
4	A1	Not Yet Analyzed	Not Yet Analyzed	8/3/06 2:40 AM	8/3/06 6:40 AM	8/3/06 4:10 AM	8/3/06 8:10 AM	1:30	TBD	Partial	Yes	None	Yes	Yes	Yes	Yes	Every Hour
5	B1a	Yes	Not Yet Analyzed	8/3/06 11:20 AM	8/3/06 3:20 PM	8/3/06 12:20 PM	8/3/06 4:20 PM	1:00	TBD	No	Yes	Yes	Yes	Yes	Yes	No	No
7	B1a	Yes	Not Yet Analyzed	8/3/06 6:30 PM	8/4/06 12:30 AM	8/3/06 9:30 PM	8/4/06 1:30 AM	1:00	TBD	No	Yes	Yes	Yes	Yes	Yes	Yes	Every Hour
8	B1a	Yes	Not Yet Analyzed	8/3/06 11:40 PM	8/4/06 3:40 AM	8/4/06 2:20 AM	8/4/06 6:20 AM	2:40	TBD	No	Yes	Yes	Yes	Yes	Yes	Yes	Every Hour
9	B1a	Not Yet Analyzed	Not Yet Analyzed	8/4/06 6:20 AM	8/4/06 12:20 PM	8/4/06 11:40 AM	8/4/06 3:40 PM	3:20	TBD	Yes	None	None	Yes	Yes	Yes	No	Every Hour
10	B1a	Not Yet Analyzed	Not Yet Analyzed	8/4/06 12:30 PM	8/4/06 4:30 PM	8/4/06 3:30 PM	8/4/06 7:30 PM	3:00	TBD	Partial	Yes	None	Yes	Yes	Yes	No	Continuous yoyoy
11	B1a or B1B7	Yes	Not Yet Analyzed	8/4/06 10:30 PM	8/5/06 2:30 AM	8/4/06 11:20 PM	8/5/06 3:20 AM	0:50	TBD	No	Yes	Yes	Yes	Yes	Yes	Yes	Every Hour
12	B1a or B1B7	Yes	Not Yet Analyzed	8/4/06 11:40 PM	8/5/06 3:40 AM	8/5/06 1:20 AM	8/5/06 5:20 AM	1:40	TBD	No	Yes	Yes	Yes	Yes	Yes	Yes	Continuous yoyoy
13	B1a or B1B7	Not Yet Analyzed	Not Yet Analyzed	8/5/06 7:30 AM	8/5/06 11:30 AM	8/5/06 9:20 AM	8/5/06 1:20 PM	1:50	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Continuous yoyoy
14	B1a or B1B7	Not Yet Analyzed	Not Yet Analyzed	8/5/06 1:30 PM	8/5/06 5:30 PM	8/5/06 2:20 PM	8/5/06 6:20 PM	0:50	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Every Hour
15	B1a or B1B7	Not Yet Analyzed	Not Yet Analyzed	8/5/06 3:00 PM	8/5/06 7:00 PM	8/5/06 5:10 PM	8/5/06 9:10 PM	2:10	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Continuous yoyoy
16	Stop during Transit	Not Yet Analyzed	Not Yet Analyzed	8/5/06 6:20 PM	8/5/06 10:20 PM	8/5/06 7:10 PM	8/5/06 11:10 PM	0:50	TBD	No	None	None	Yes	Yes	Yes	No	Continuous yoyoy
17	B1	Not Yet Analyzed	Not Yet Analyzed	8/6/06 12:40 PM	8/6/06 4:40 PM	8/6/06 3:30 PM	8/6/06 7:30 PM	2:20	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Continuous yoyoy
18	B1	Not Yet Analyzed	Not Yet Analyzed	8/6/06 4:00 PM	8/6/06 8:00 PM	8/6/06 6:00 PM	8/6/06 9:00 PM	1:00	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Continuous yoyoy
19	B1	Not Yet Analyzed	Not Yet Analyzed	8/6/06 5:50 PM	8/6/06 9:50 PM	8/6/06 9:20 PM	8/7/06 1:20 AM	3:30	TBD	No	Partial	Partial	Yes	Yes	Yes	No	Partial Continuous yoyoy
20	B1	Not Yet Analyzed	Not Yet Analyzed	8/6/06 11:30 PM	8/7/06 3:30 AM	8/7/06 3:10 AM	8/7/06 7:10 AM	3:40	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
21	B1	Not Yet Analyzed	Not Yet Analyzed	8/7/06 3:20 AM	8/7/06 7:20 AM	8/7/06 6:20 AM	8/7/06 10:20 AM	1:00	TBD	No	Partial	Partial	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
22	B1	Not Yet Analyzed	Not Yet Analyzed	8/7/06 6:40 AM	8/7/06 10:40 AM	8/7/06 7:50 AM	8/7/06 11:50 AM	1:10	TBD	Yes	None	Partial	Yes	Yes	Yes	Yes	No
23	B7	Yes	Not Yet Analyzed	8/7/06 2:00 PM	8/7/06 6:00 PM	8/7/06 2:40 PM	8/7/06 6:40 PM	0:40	TBD	No	None	Yes	Yes	Yes	Yes	Yes	Continuous yoyoy
24	B7	Not Yet Analyzed	Not Yet Analyzed	8/7/06 8:00 PM	8/8/06 12:00 AM	8/7/06 9:40 PM	8/8/06 1:40 AM	1:40	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Every Hour
25	B7	Not Yet Analyzed	Not Yet Analyzed	8/8/06 12:01 AM	8/8/06 4:01 AM	8/8/06 8:50 AM	8/8/06 9:50 AM	5:28	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Continuous yoyoy
26	BSA	Yes	Not Yet Analyzed	8/8/06 2:20 PM	8/8/06 6:20 PM	8/8/06 3:10 PM	8/8/06 7:10 PM	0:50	TBD	No	None	Yes	Yes	Yes	Yes	Yes	Continuous yoyoy
27	BSA	Not Yet Analyzed	Not Yet Analyzed	8/9/06 12:21 AM	8/9/06 4:01 AM	8/9/06 4:00 AM	8/9/06 8:00 AM	3:59	TBD	Yes	None	None	Yes	Yes	Yes	Yes	Every Hour
28	CSA	Not Yet Analyzed	Not Yet Analyzed	8/9/06 12:30 PM	8/9/06 4:30 PM	8/9/06 2:40 PM	8/9/06 6:40 PM	2:10	TBD	No	Yes	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
29	CSA	Yes	Not Yet Analyzed	8/9/06 4:00 PM	8/9/06 8:00 PM	8/9/06 6:30 PM	8/9/06 10:30 PM	3:30	TBD	No	None	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
30	CSA	Yes	Not Yet Analyzed	8/10/06 12:00 AM	8/10/06 4:00 AM	8/10/06 1:30 AM	8/10/06 5:30 AM	1:30	TBD	No	None	Yes	Yes	Yes	Yes	Yes	Every Hour
31	CSA	Not Yet Analyzed	Not Yet Analyzed	8/10/06 2:30 AM	8/10/06 6:30 AM	8/10/06 5:30 AM	8/10/06 9:30 AM	1:50	TBD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Continuous yoyoy
32	C3	Not Yet Analyzed	Not Yet Analyzed	8/10/06 11:00 PM	8/10/06 5:10 PM	8/10/06 2:30 PM	8/10/06 6:30 PM	1:20	TBD	Partial	Yes	None	Partial	Yes	Yes	Yes	Every Hour
33	C3	Yes	Not Yet Analyzed	8/10/06 6:50 PM	8/10/06 10:50 PM	8/10/06 9:20 PM	8/11/06 1:20 AM	2:30	TBD	Yes	None	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
34	C3	Yes	Not Yet Analyzed	8/10/06 11:10 PM	8/11/06 3:10 AM	8/10/06 11:59 PM	8/11/06 3:59 AM	0:48	TBD	Yes	None	Yes	Yes	Yes	Yes	Yes	No
36	C3 and Transit	Not Yet Analyzed	Not Yet Analyzed	8/11/06 8:00 AM	8/11/06 12:00 PM	8/11/06 11:20 AM	8/11/06 3:00 PM	3:20	TBD	At Start	None	Yes	Yes	Yes	Yes	Yes	At Start
37	Transit/Tow	Not Yet Analyzed	Not Yet Analyzed	8/12/06 7:40 AM	8/12/06 11:40 AM	8/12/06 8:30 AM	8/12/06 12:30 PM	0:50	TBD	No	None	None	Yes	Yes	Yes	No	No
38	C1A	Yes	Not Yet Analyzed	8/12/06 9:20 AM	8/12/06 1:20 PM	8/12/06 10:30 AM	8/12/06 2:30 PM	1:10	TBD	Yes	None	Yes	Yes	Yes	Yes	Yes	Every Hour
39	C1A	Not Yet Analyzed	Not Yet Analyzed	8/12/06 6:50 PM	8/12/06 10:50 PM	8/12/06 9:10 PM	8/12/06 1:10 AM	2:20	TBD	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
40	C1b	Yes	Not Yet Analyzed	8/13/06 1:10 AM	8/13/06 5:10 AM	8/13/06 6:00 AM	8/13/06 10:00 AM	5:50	<110	Yes	None	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
41	C1b	Yes	Not Yet Analyzed	8/13/06 3:00 PM	8/13/06 7:00 PM	8/13/06 5:20 PM	8/13/06 9:20 PM	2:20	<110	No Data	None	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
42	C1b	Yes	Not Yet Analyzed	8/13/06 6:10 PM	8/13/06 10:10 PM	8/13/06 7:50 PM	8/13/06 11:50 PM	1:40	<110	No Data	None	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
43	C1b	Yes	Not Yet Analyzed	8/13/06 9:00 PM	8/14/06 1:00 AM	8/13/06 10:40 PM	8/14/06 2:40 AM	1:40	<110	No Data	None	Yes	Yes	Yes	Yes	Yes	Every Hour
44	C1b	Yes	Not Yet Analyzed	8/13/06 11:40 PM	8/14/06 3:40 AM	8/14/06 6:20 AM	8/14/06 10:20 AM	6:50	<108	No Data	None	Yes	Yes	Yes	Yes	Yes	Continuous yoyoy
45	C1b	Yes	Not Yet Analyzed	8/14/06 12:40 PM	8/14/06 4:40 PM	8/14/06 6:50 PM	8/14/06 7:50 PM	3:10	<110	No Data	None	Yes	Yes	Yes	Yes	Yes	Partial Continuous yoyoy
46 (47a)	C1b	Not Yet Analyzed	Not Yet Analyzed	8/16/06 1:30 PM	8/16/06 5:30 PM	8/16/06 5:00 PM	8/16/06 9:00 PM	3:30	TBD	Yes	None	Yes	Yes	Yes	Yes	Yes	Continuous yoyoy

< 47 (47b)

WELCOME | Event Table | Highlights | Event#1 | Event#2 | Event#3 | Event#4 | Event#5 | Event#6

Internet 75%

Example Data – Event 44

Some analyzed and catalogued data types:

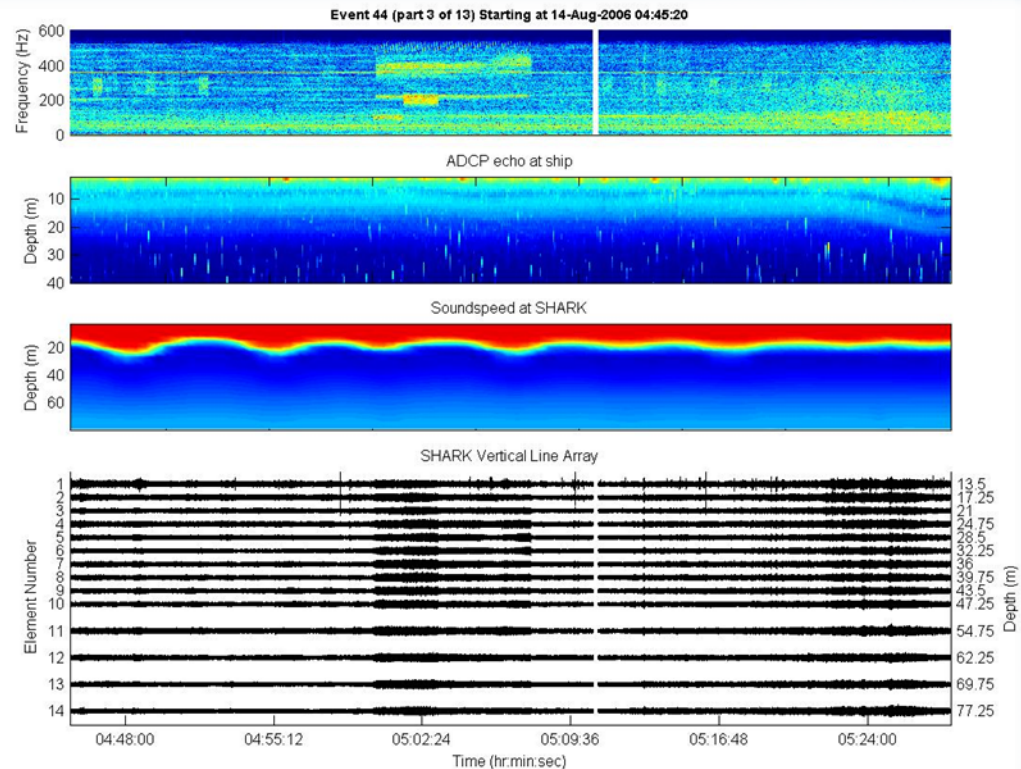
Location

Radar

ADCP

SHARK

Acoustic

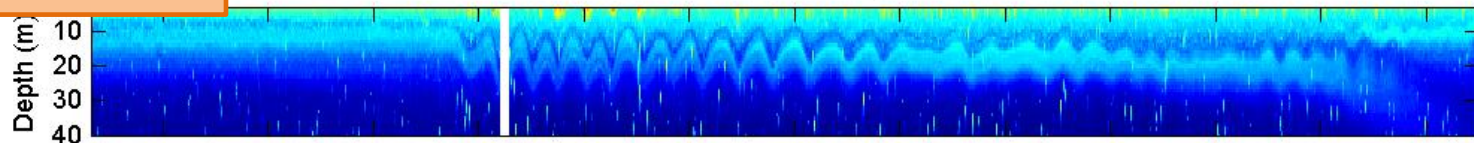
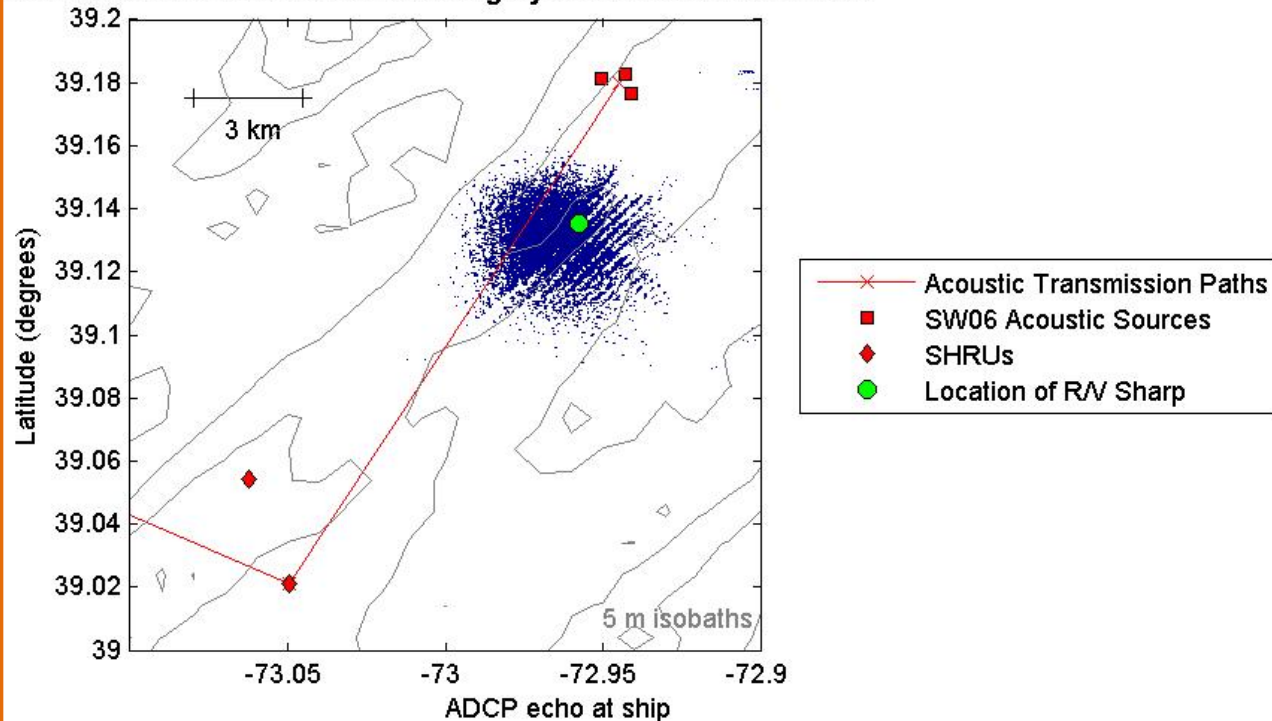


Over time – Event 44

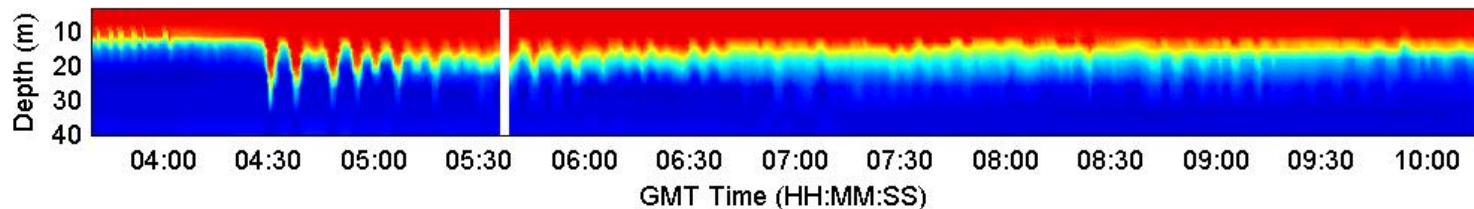
Compiled environmental data is useful for visualizing the event – and for acoustic modeling

- Radar data determines the orientation of the wave front
- R/V Sharp ADCP shows internal wave structure
- SHARK soundspeed shows internal wave front arrives at SHARK array one hour prior to location of R/V Sharp

SW06 Test Site - Extracted radar imagery for Event 44 - at 05:37:38



Soundspeed at SHARK



What's next?

Finish data analysis toolbox

- Include data from SHRUs and other PO sensors
- Include more robust acoustic analysis

Focus on Internal Wave events likely to cause 3D propagation effects

- Integrate existing models into propagation code to explore 3D effects
- Compare to measured mode and beam fluctuations in amplitude, travel time, and/or phase

Pose inverse problem for Internal Wave structure given acoustic signal characteristics

Thank you

