# UNCERTAINTIES AND INTERDISCIPLINARY TRANSFERS THROUGH THE END-TO-END SYSTEM (UNITES)

## THE UNITES TEAM YEAR 2 OVERVIEW

Presented at ONR Uncertainty DRI Review and Planning Meeting

Providence Marriott, Providence, RI

June 18, 2003

# Environmental Uncertainty and Its Effect on Sonar Performance - UNITES Team Year 2
# Agenda

845-915 -- ASIAEX/ECS TL azimuthal variations and PRIMER vertical array beamformer fluctuations in signals and noise: *Abbot*

915-935 -- Possible correlations in PRIMER signals and noise due to oceanographic scattering processes: *Lynch*

935-945 – Coffee Break

945-1005 -- TL uncertainty characterization and reduction: *Chiu*

1005-1020 -- Environmentally associated LF BB active sonar signal-to-interference variability: *Cable*

1020-1035 -- Processes and products - two examples: *Gawarkiewicz*

1035-1100 -- Physical-acoustical data assimilation via ESSE for improved BB TL predictions and numerical simulations of the PRIMER ocean physics: *Lermusiaux*

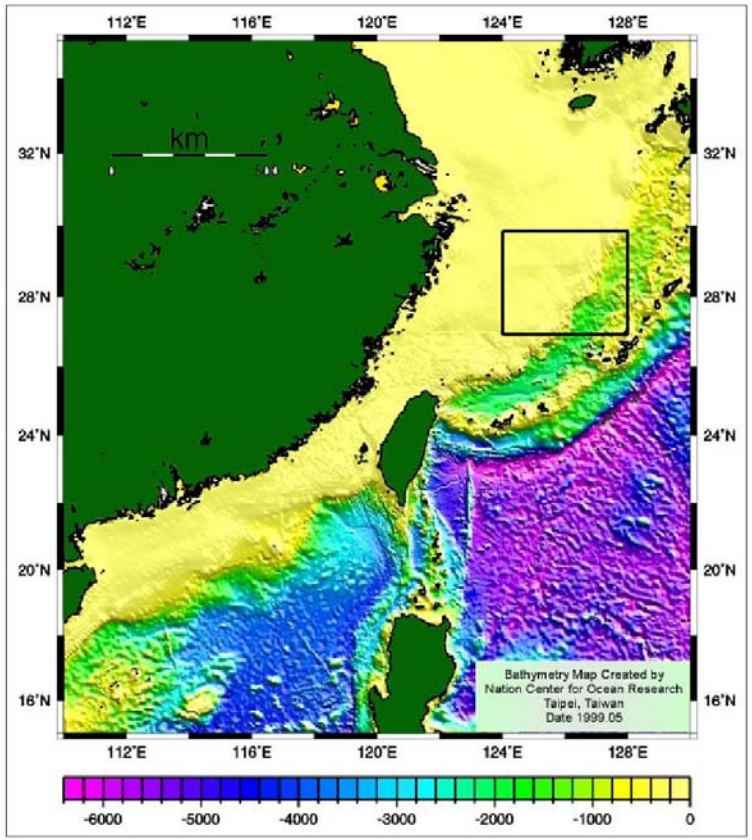
(Uncertainty Scientific Workshop Overview -- End of Day: *Robinson*)

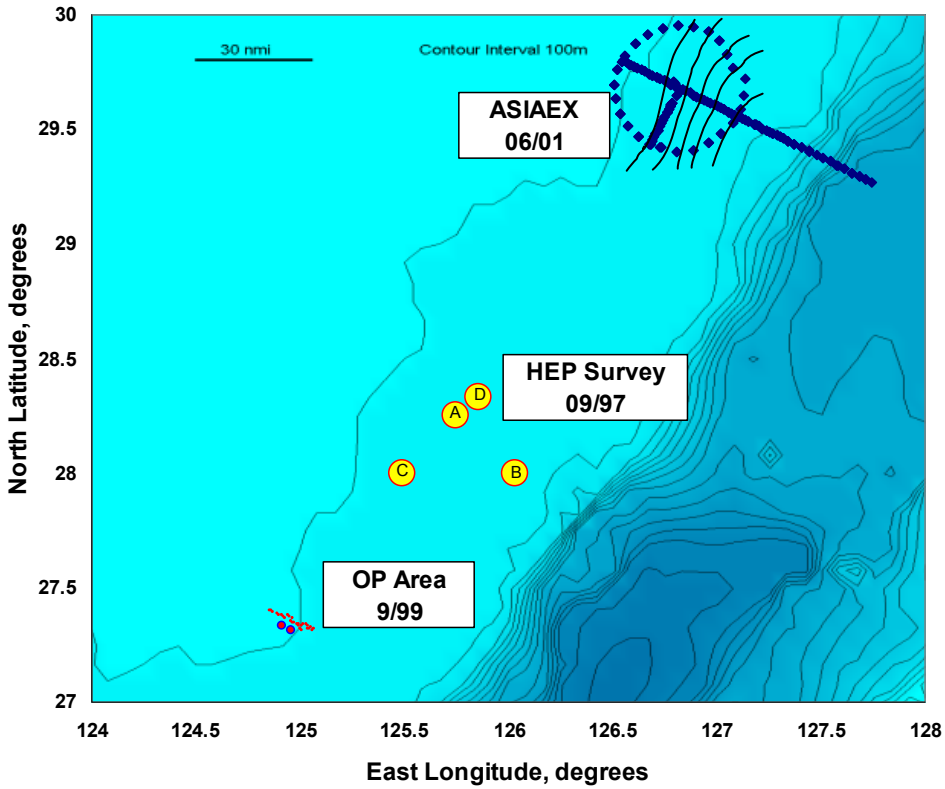
# OASIS* Accomplishments

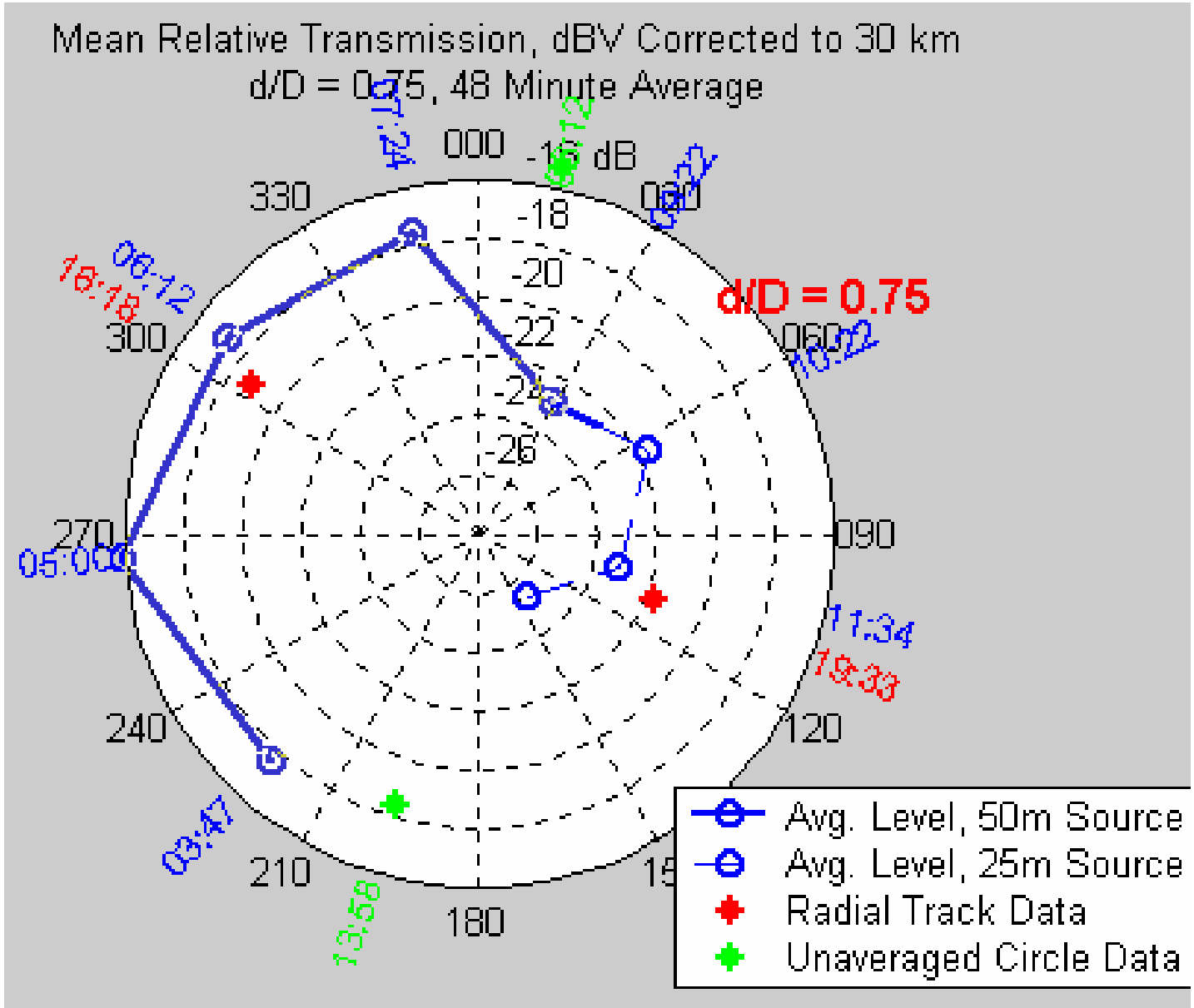
- Probabilistic performance prediction method presently being evaluated by Navy (SOWG)
  - ECS Passive Sonar End-to-End System (Uncertainty Scientific Workshop)
  - Narrowband Sonar End-to-End System About to Start
- ECS TL azimuthal variability (ASIAEX)
- Uncertainty Province Characterization from TL spatial variability at 3 separate locations in ECS
- PRIMER vertical array beamforming fluctuations, signal and noise

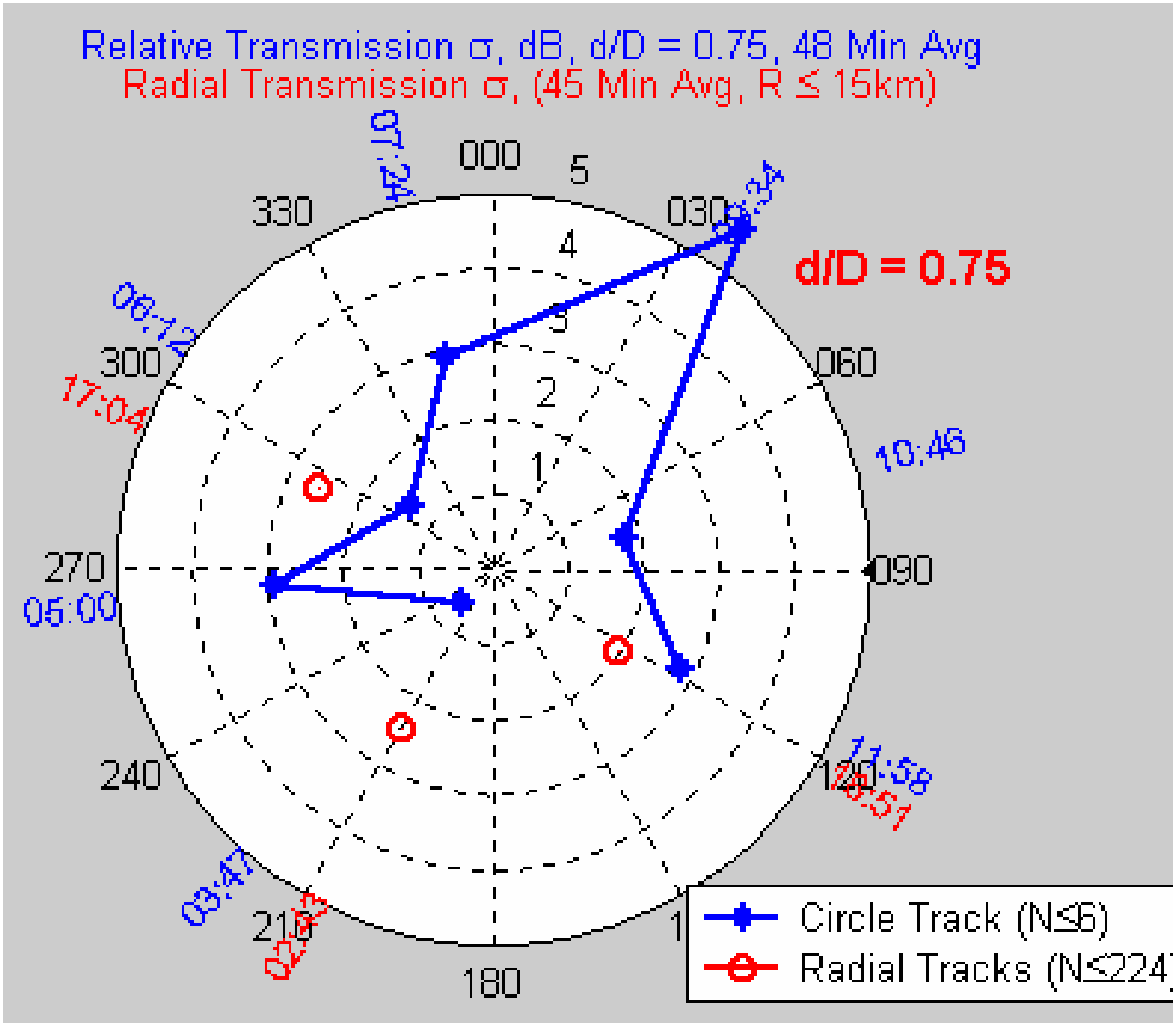
* OASIS Group Includes: Abbot, Dyer, Gedney, Emerson, Shanahan

# ECS Sample Locations for TL and TL Azimuth Measurements

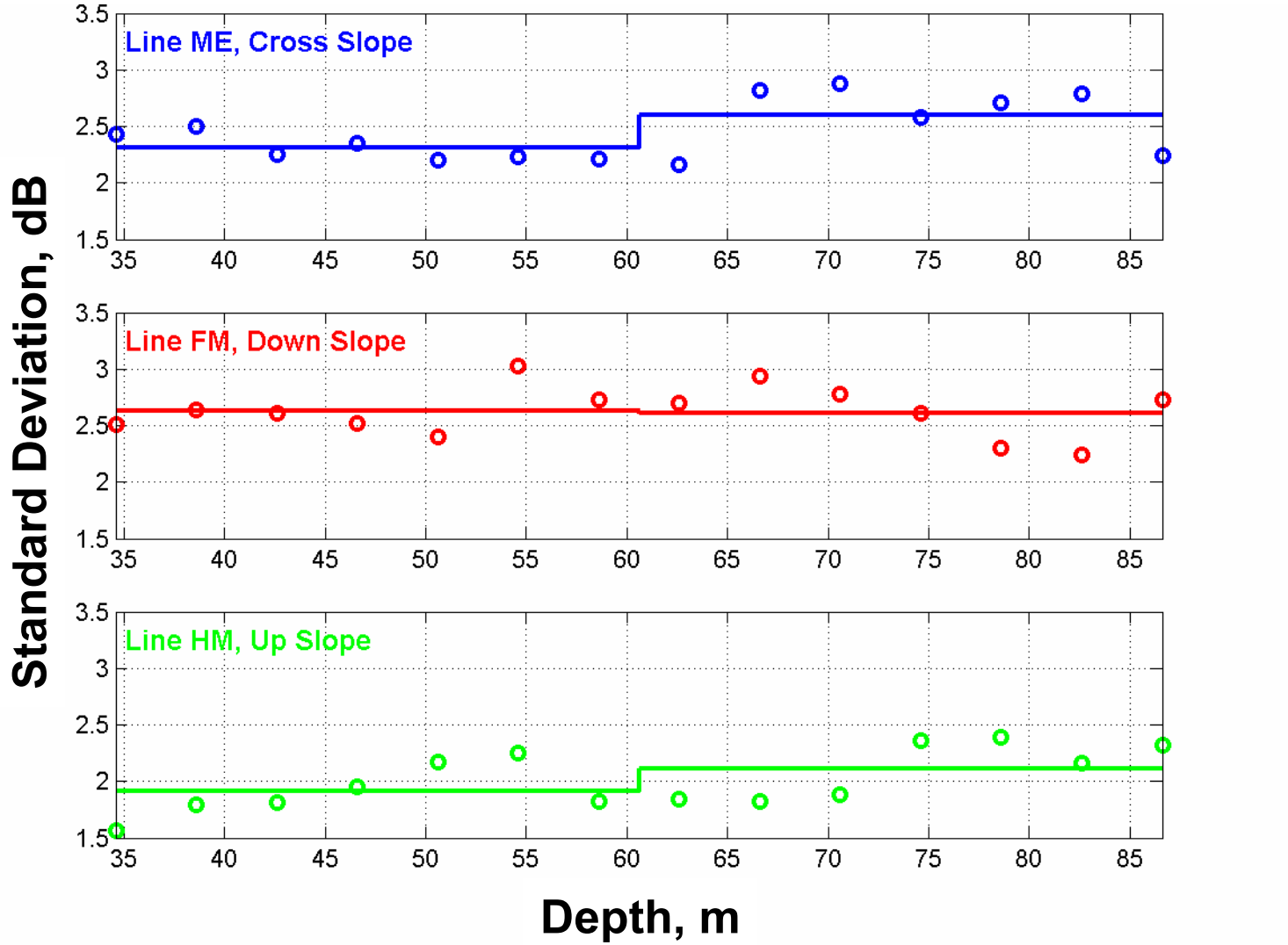


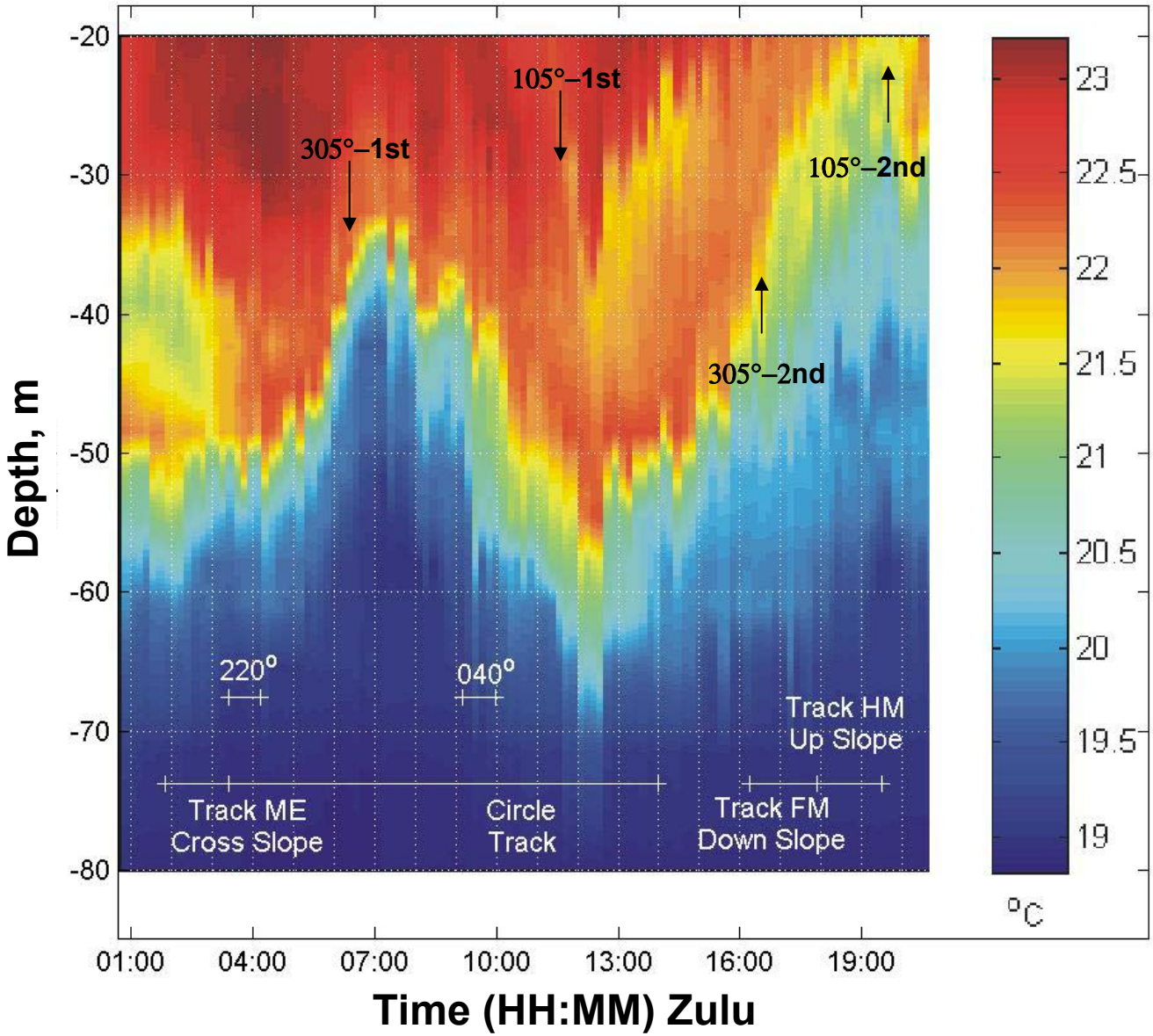

Mean Relative Transmission, dBV Corrected to 30 km
d/D = 0.75, 48 Minute Average
000
-16 dB
-18
-20
-22
-24
-26
d/D = 0.75
030
060
090
120
150
180
210
240
270
300
330
Avg. Level, 50m Source
Avg. Level, 25m Source
Radial Track Data
Unaveraged Circle Data


Relative Transmission σ, dB, d/D = 0.75, 48 Min Avg
Radial Transmission σ, (45 Min Avg, R ≤ 15km)
d/D = 0.75
000
030
060
090
120
150
180
210
240
270
300
330
5
4
3
2
1
07:24
08:12
17:04
10:46
05:00
03:47
Circle Track (N≤6)
Radial Tracks (N≤224

# Standard Deviation of Measured Data About TL Fit Line With Shallow and Deep Hydrophone Means (Solid Lines) R ≤ 15 km, 45-Min. Avg., TBW = 18

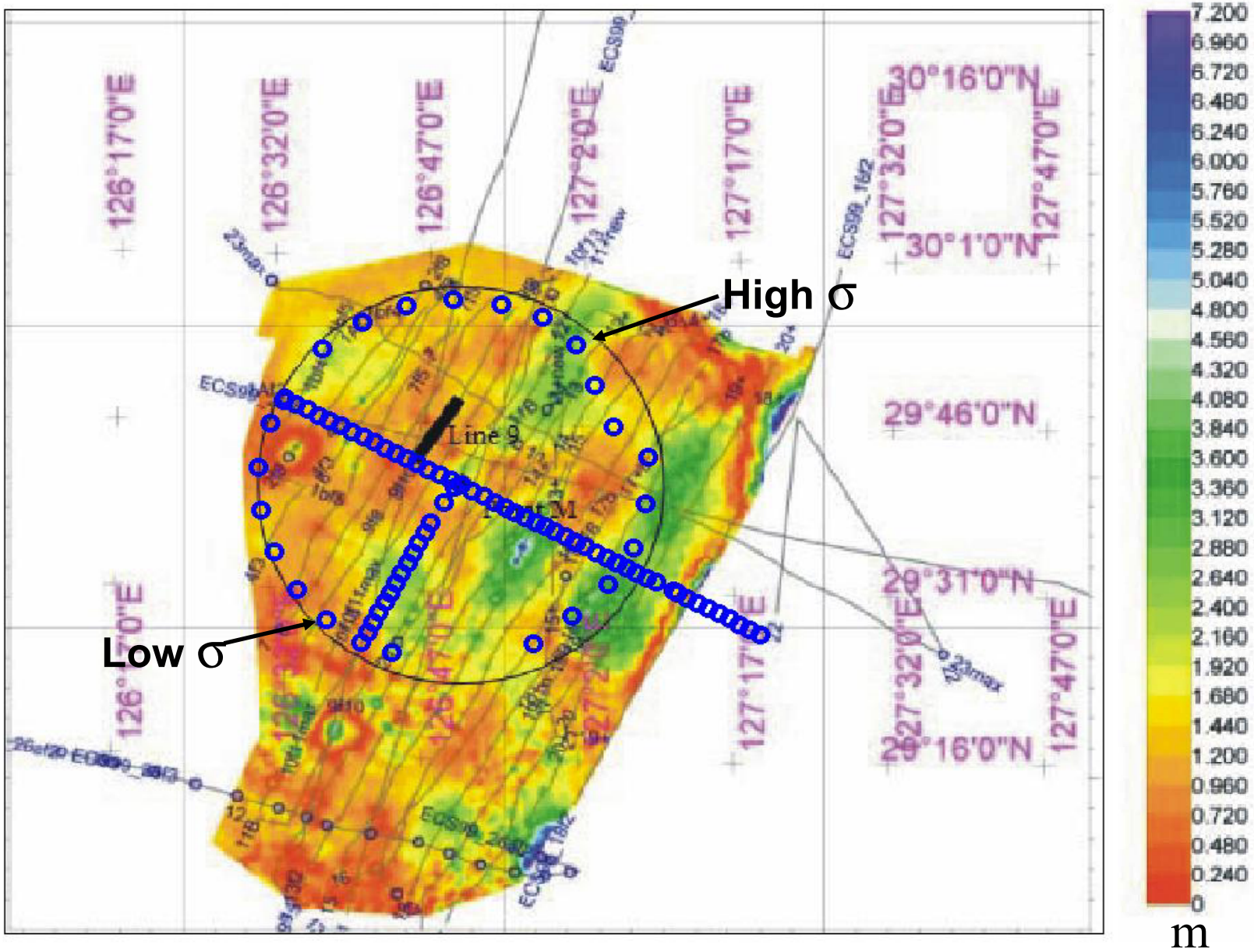


# Temperature Measured June 3, 2001 from VLA Deployed from Shiyan-3 (3 km from R/V Melville)

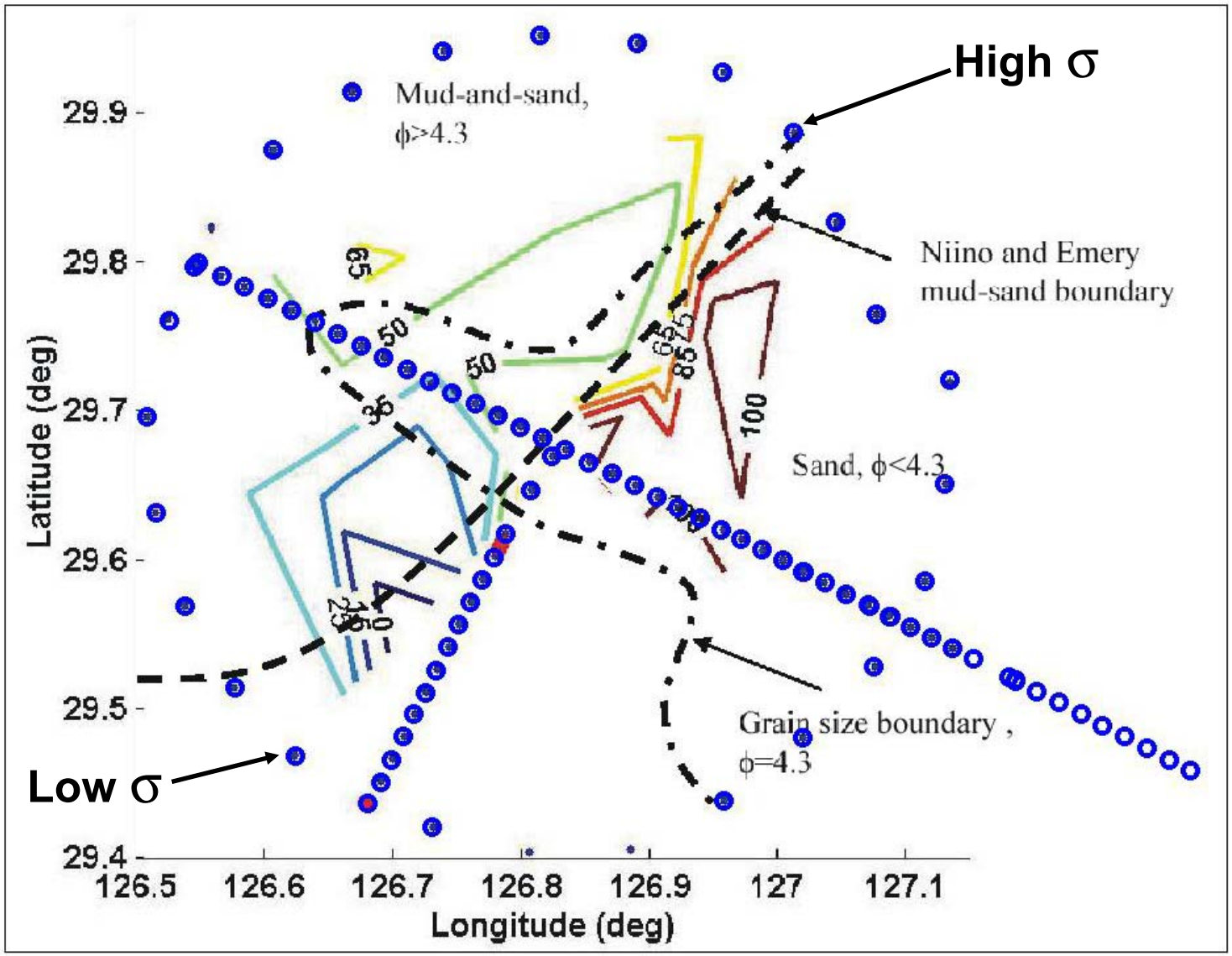



(From Z. Peng)

# Top Layer Thickness, m, Mud/Sand and Sand (Bartek)



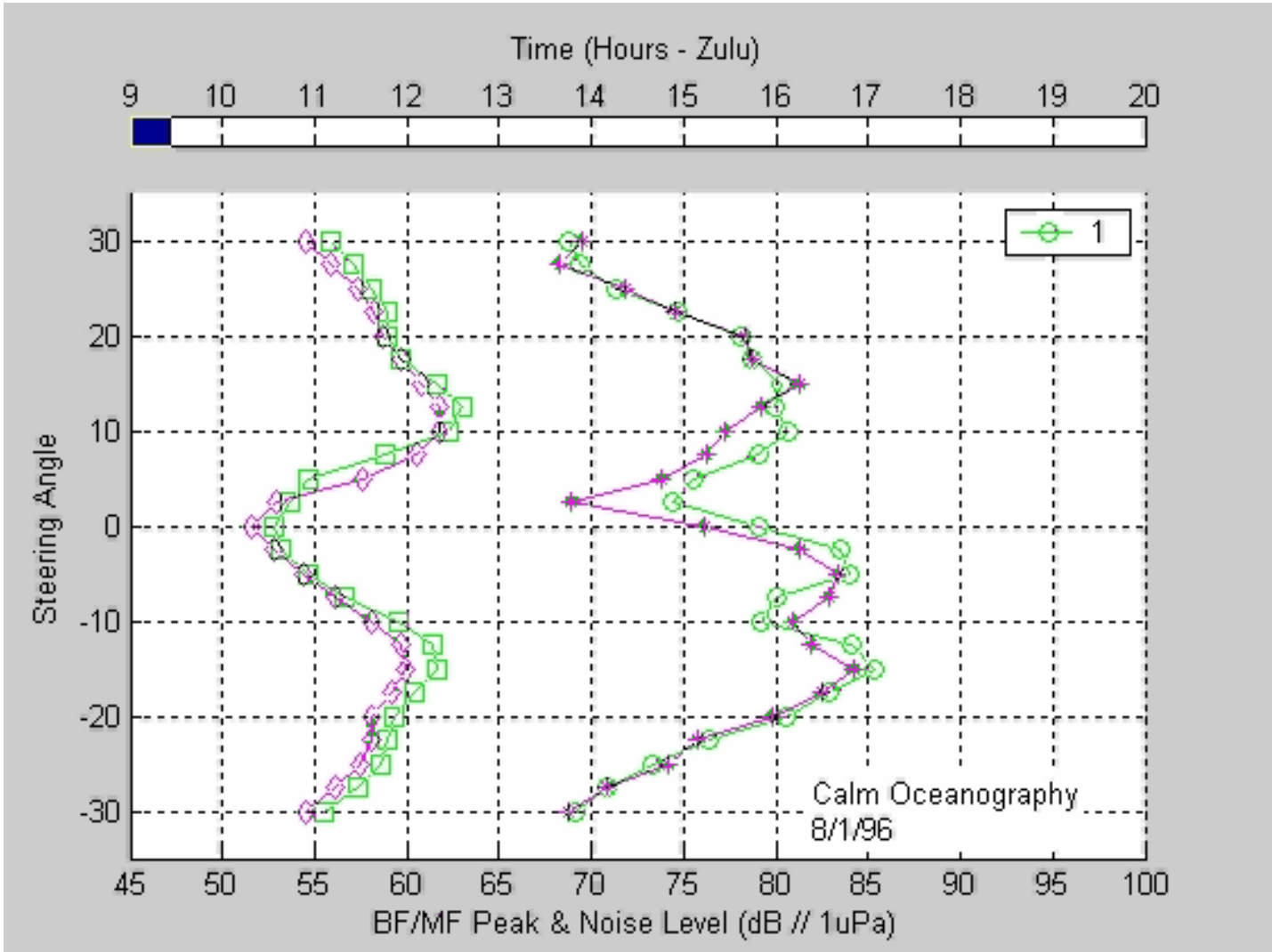
# Top Layer Compressional Wave Speeds, + 1600 m/s and Grain Size (Miller, Bartek)



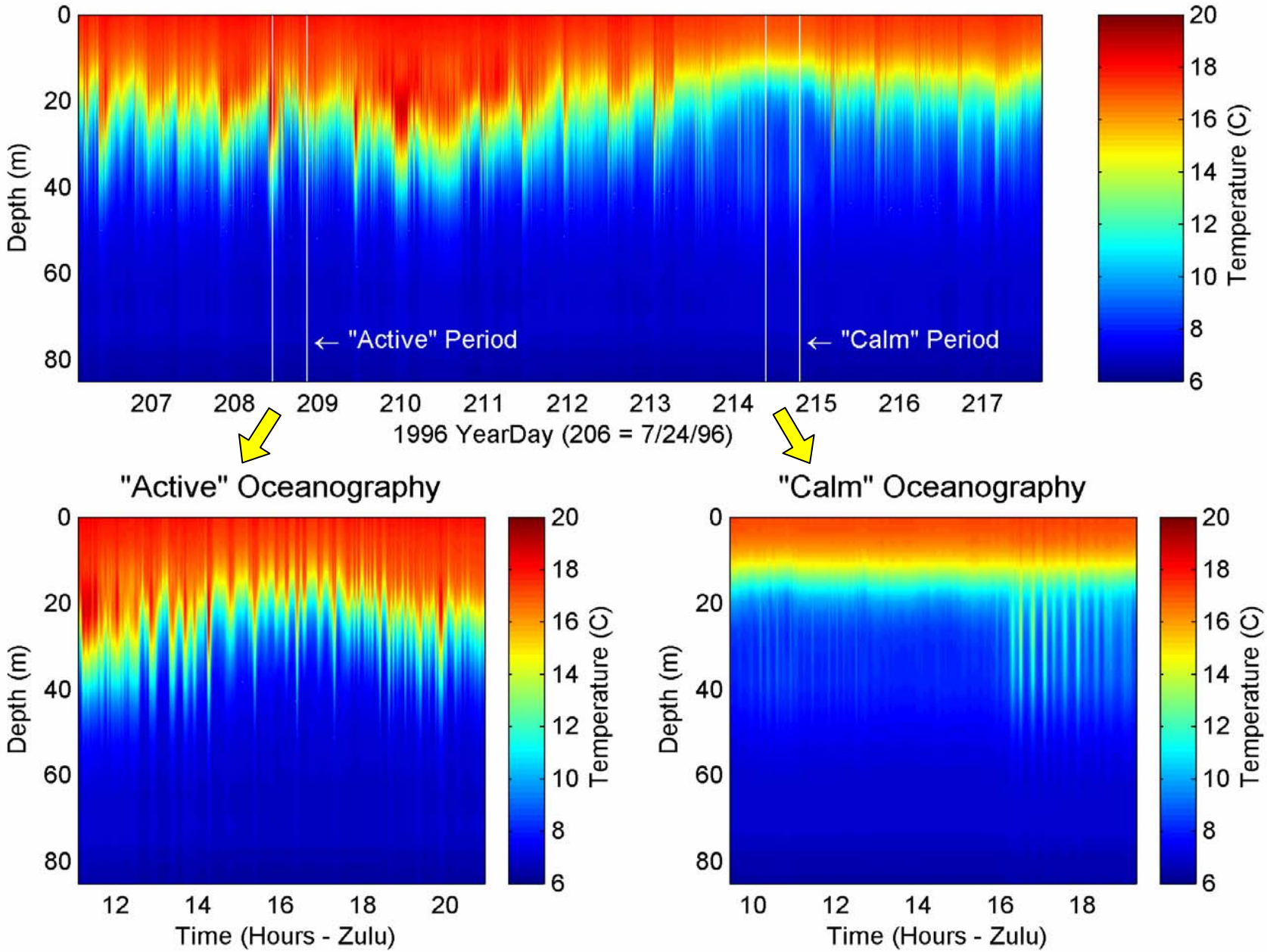
# ASIAEX/ECS Observations

- Mean TL depends on azimuth
  - distorted and translated circle
  - operationally: significant differences between detection/counter-detection
- $\sigma$'s averaged over azimuth are about 2 to 2.5 dB, depending on depth
  - In direction along bathymetry contour, $\sigma$ varies significantly from average, both below and above
- Spatially varying bottom affects TL azimuthal means and $\sigma$'s, as well as oceanography. Both appear important.
- Degree of statistical independence between ocean and bottom needs to be researched

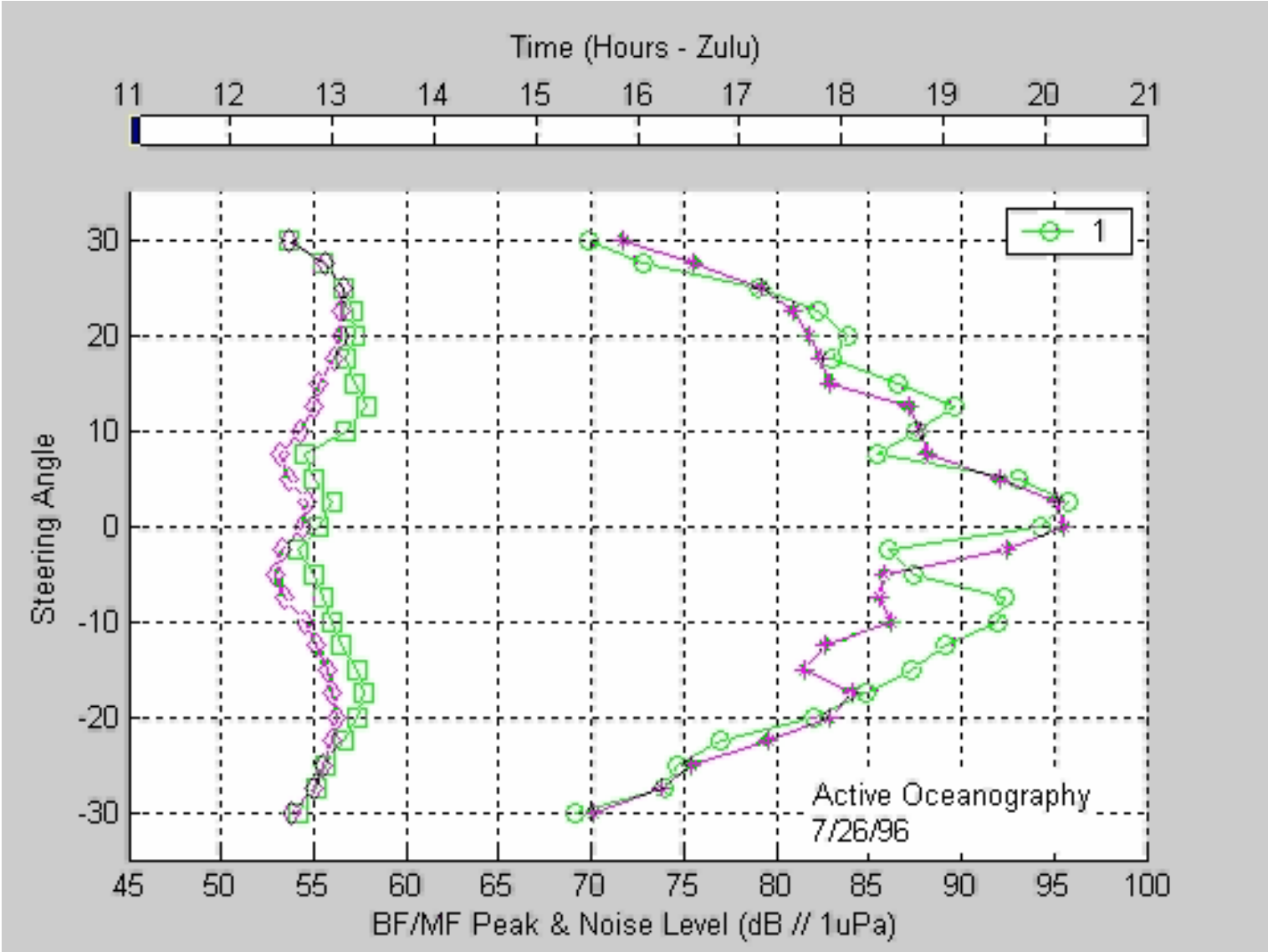
# “Calm” Oceanography



# Vertical Line Array Temperature Profiles

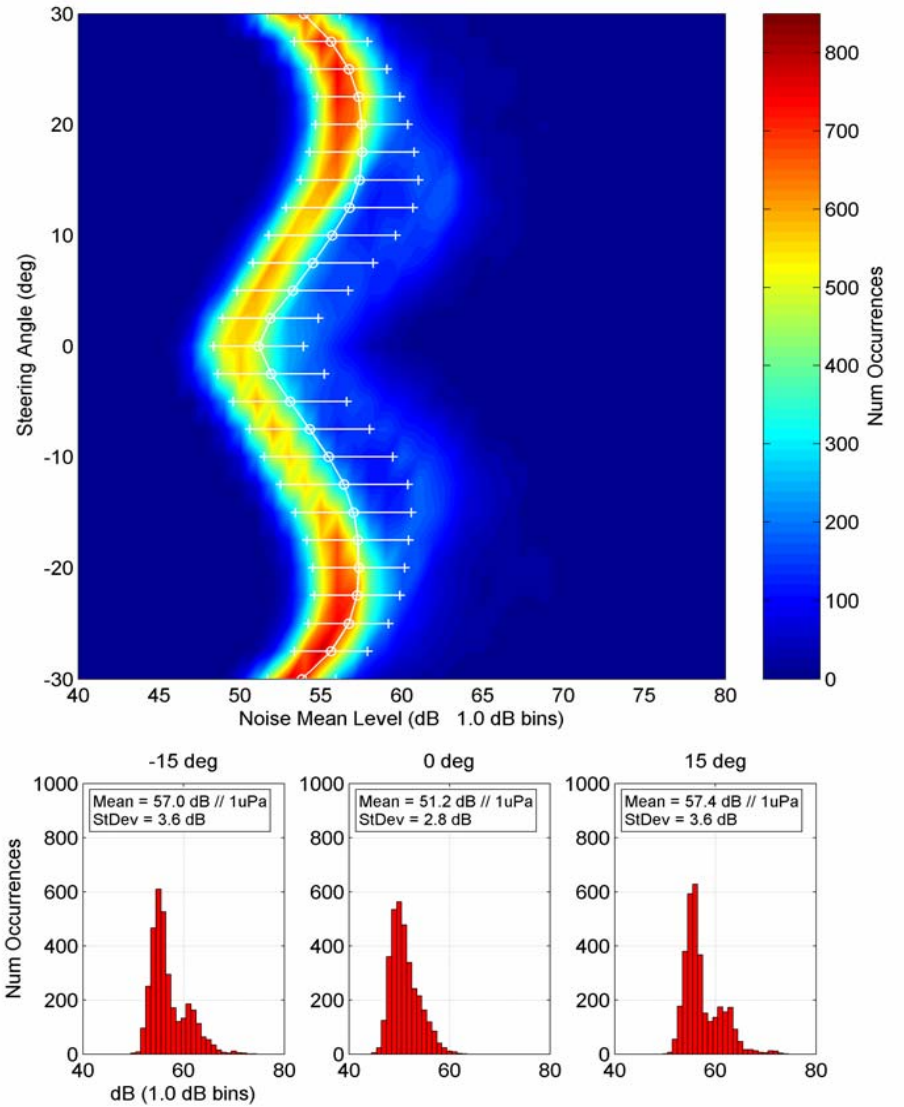


# “Active” Oceanography

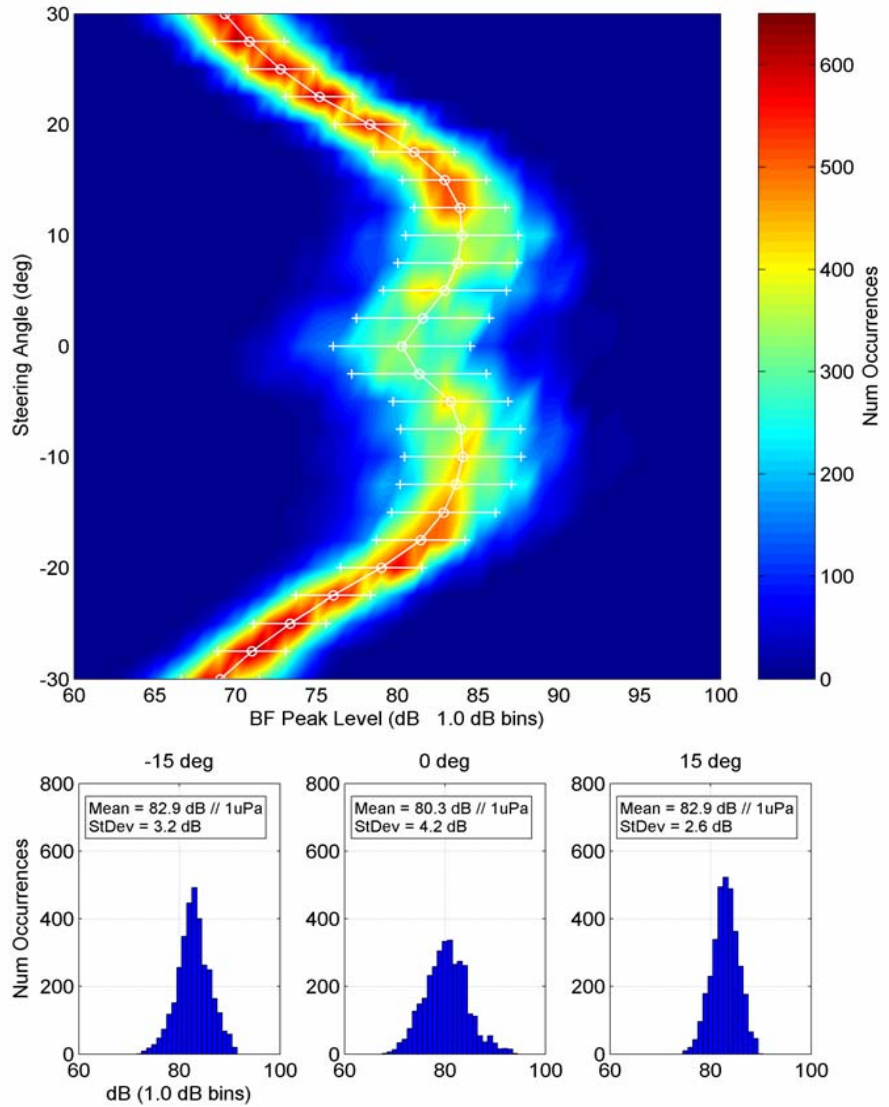


# Beamformed Outputs, “Calm” Oceanography
# Signal and Noise Histograms over 10 hours, 3332 Pings

Noise Mean (2.5 sec) Histogram




Matched Filter Peak Signal Histogram



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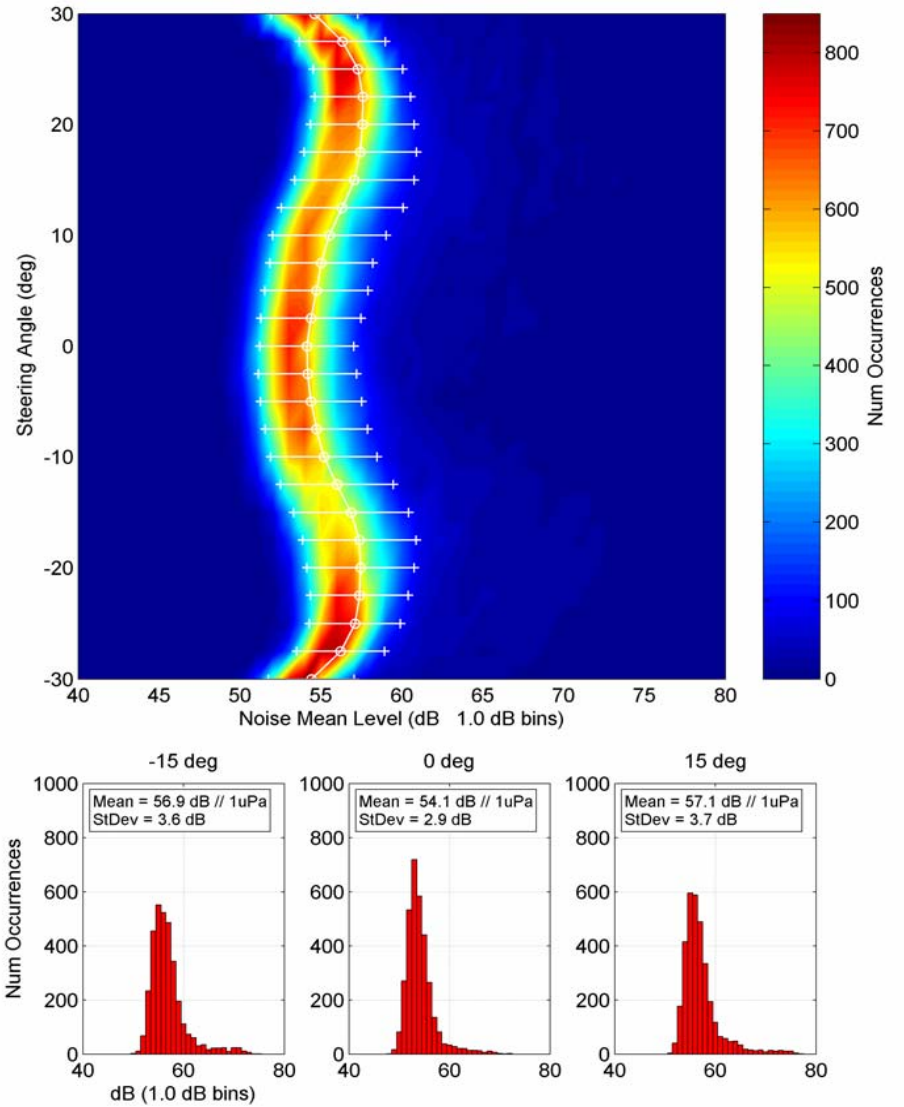


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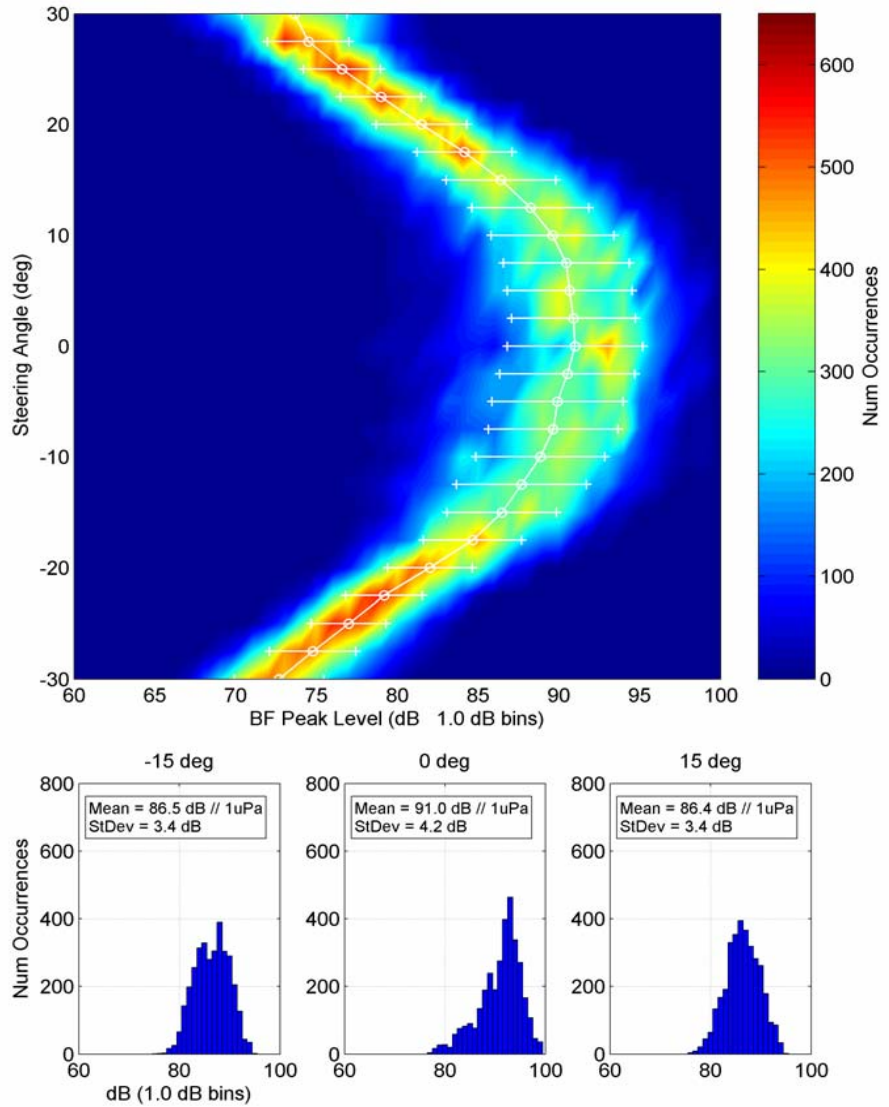

# PRIMER Vertical Beamformer Results

- Signal and noise notches present in calm oceanography
- Vertical distribution of signal and noise strongly affected by active oceanography
  - signal and noise notches fill in
  - Strong scattering by internal waves, fish and/or the bottom?