G R A S P

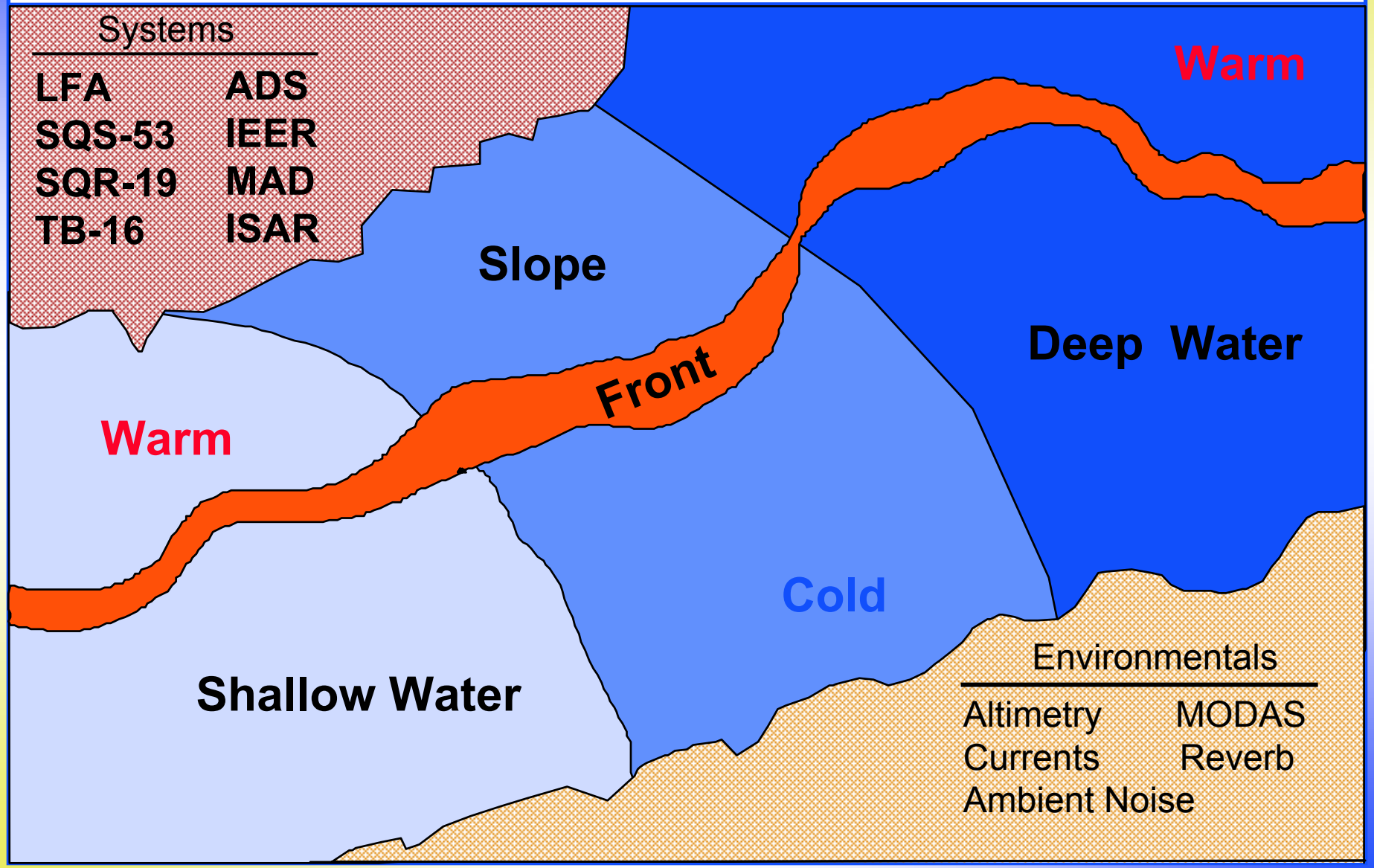
Genetic Range-dependent Algorithm for Search Planning

A New Approach to Develop and Evaluate ASW Search Tactics for Single & Multiple Sensors using MODAS Sound Speed nowcasts / forecasts in Dynamic, Littoral Environments

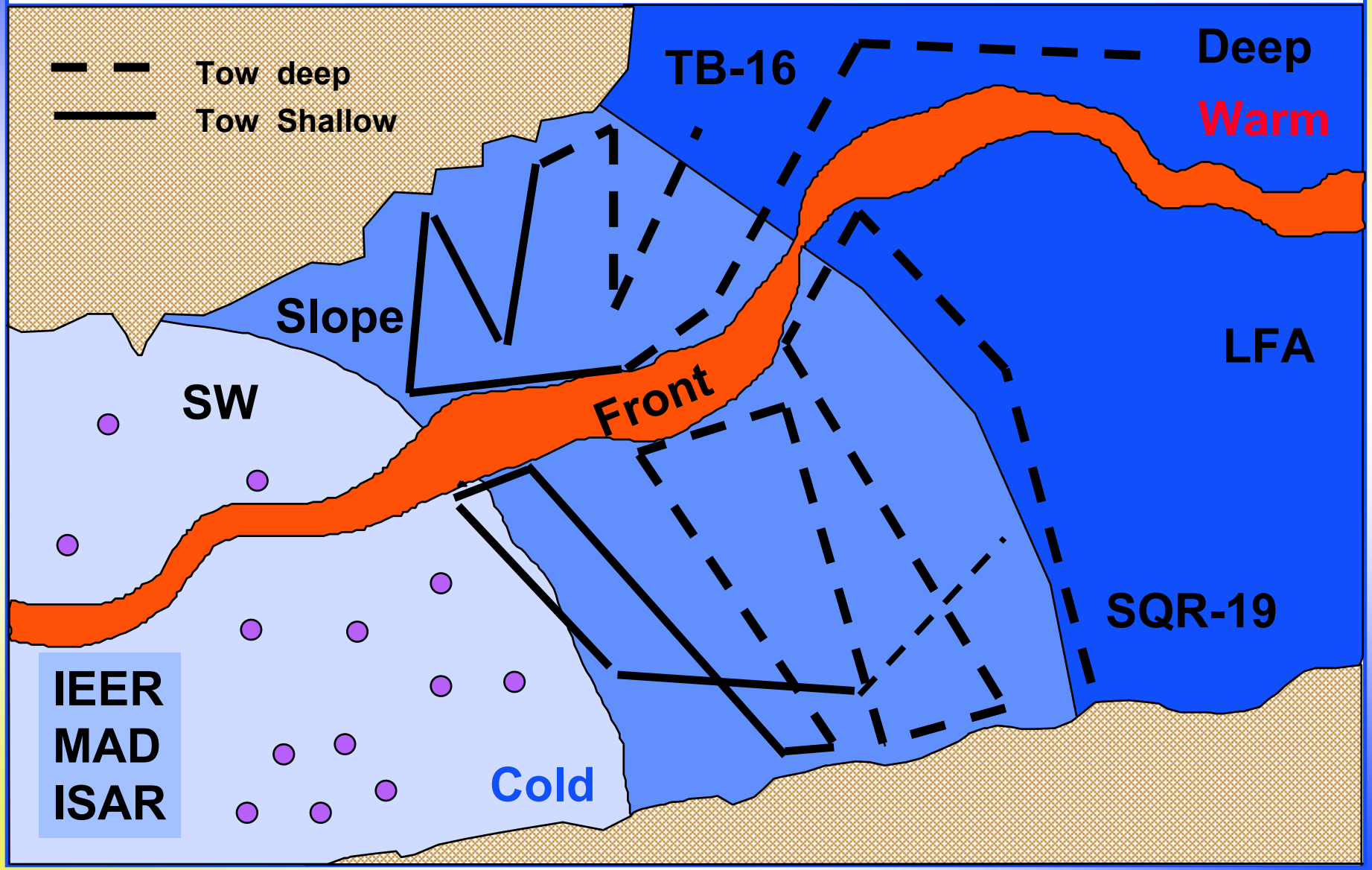
Don DelBalzo
Naval Research Lab
Stennis Space Center

delbalzo@nrlssc.navy.mil
228 - 688 -5458

ASSET ALLOCATION & ENVIRONMENTAL SUPPORT FOR LITTORAL ASW

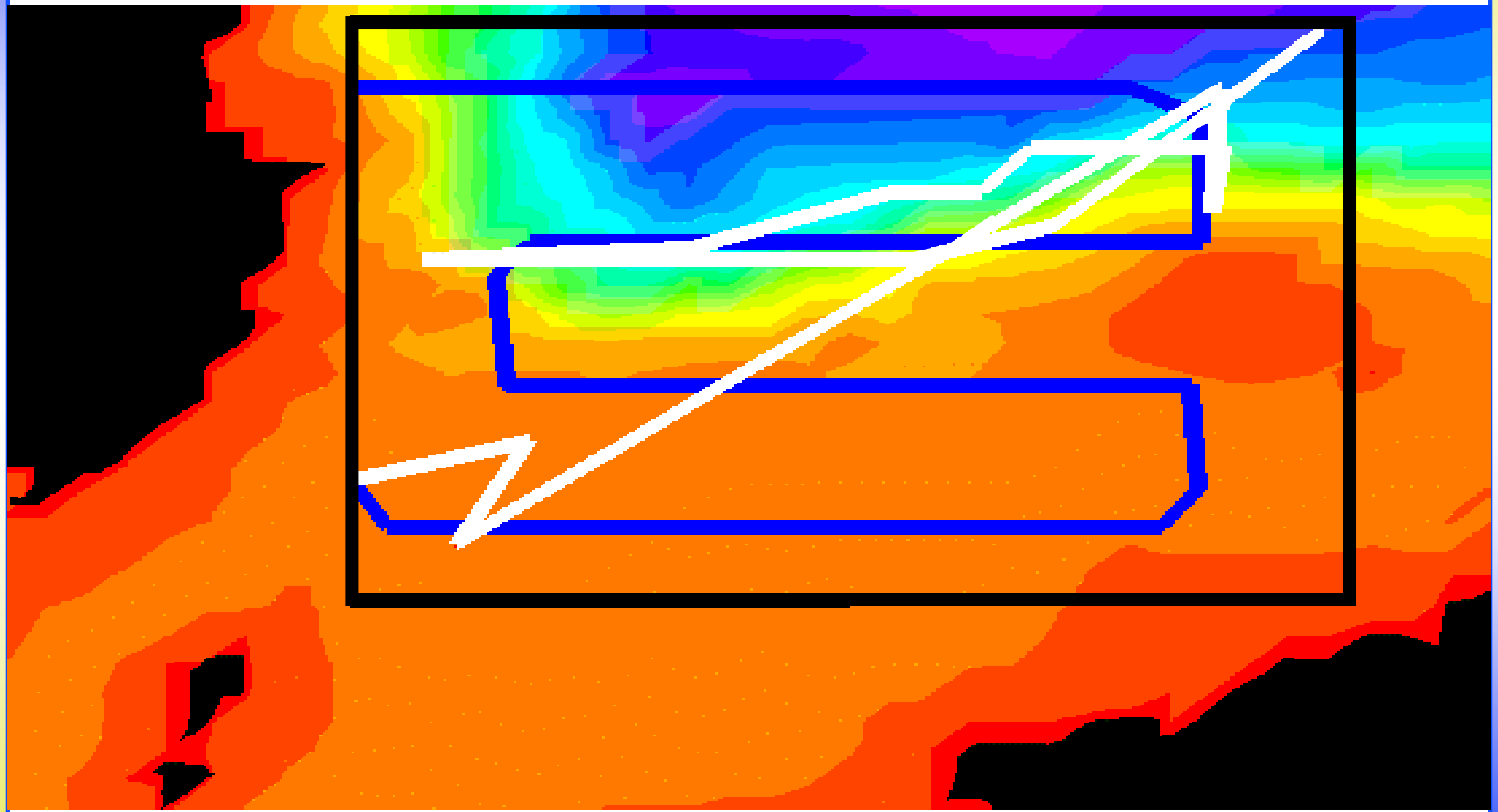


Environmentally Sensitive Sensor Mix & Best Tactics for Coordinated ASW



Genetic and Ladder Search Tactics
Strait of Korea / SQS - 53

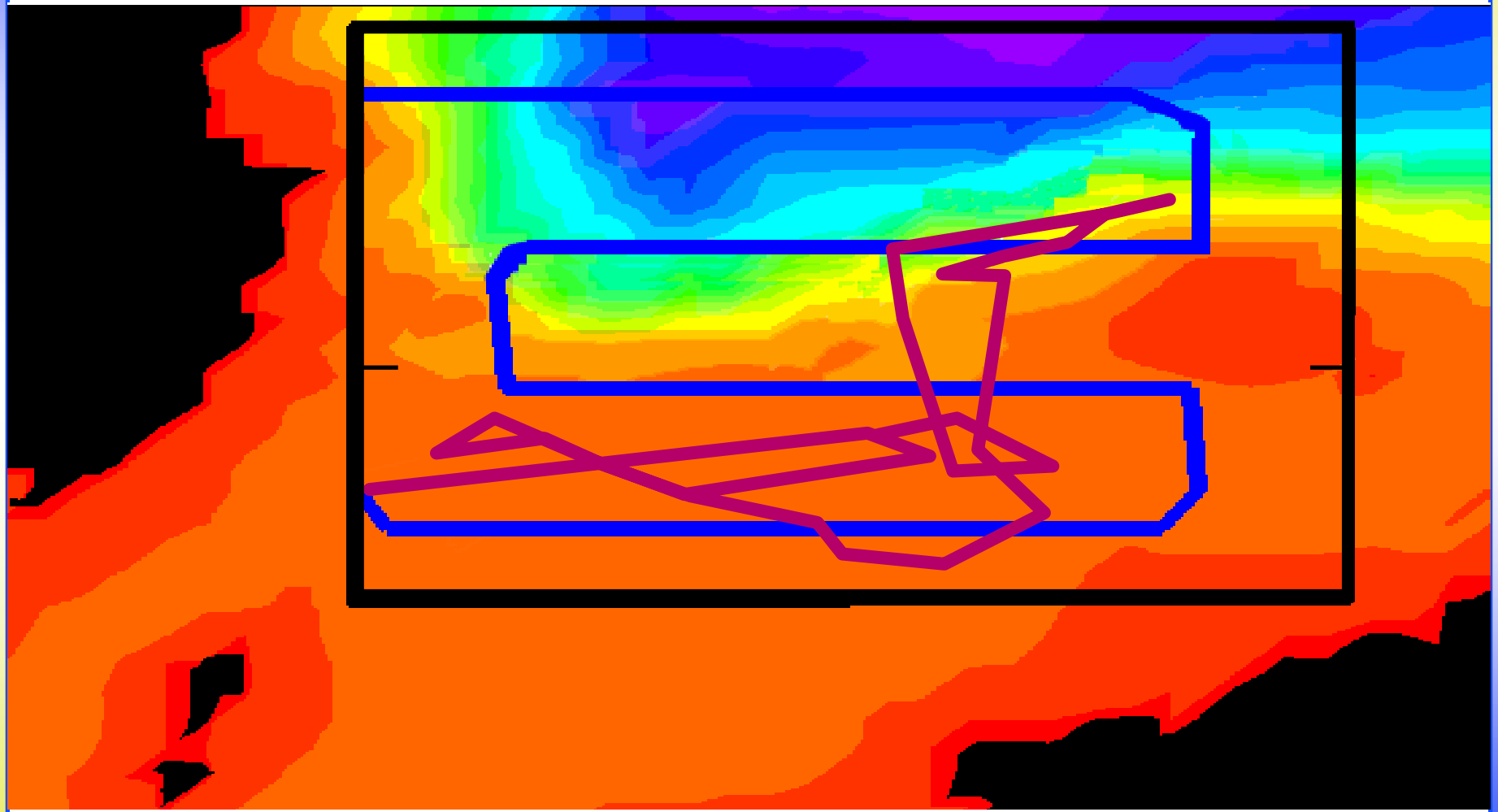
Uniform Threat Distribution



Genetic Algorithm CDP = 0.41 **Ladder Search CDP = 0.25**

Genetic and Ladder Search Tactics
Strait of Korea / SQS - 53

80 / 20 Threat Distribution



Genetic Algorithm CDP = 0.37

Ladder Search CDP = 0.16

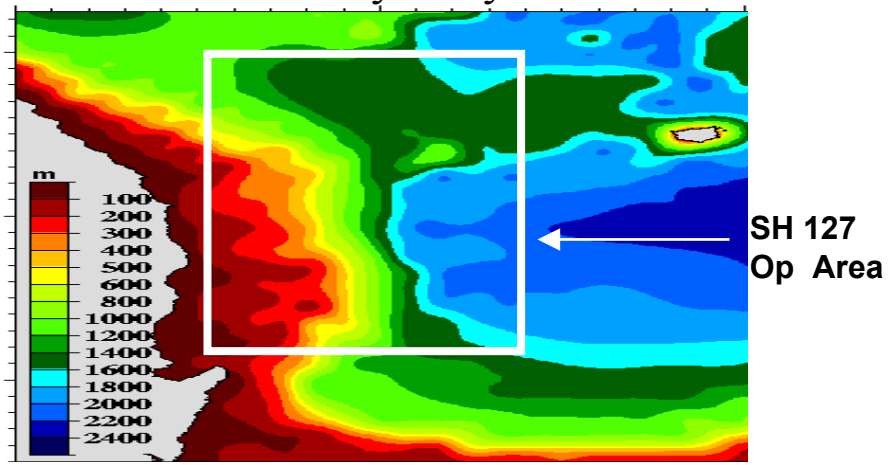
GRASP Fleet Demos

Sep 98	SHAREM 126	Sea of Japan
Feb 99	SHAREM 127	Sea of Japan
Mar 00	SHARK HUNT	W. Med
Aug 00	SHAREM 134	E. China Sea
Feb 01	DESRON 24	N. Atlantic
Apr 01	SHAREM 137	E. Med
May 01	DESRON 24	Caribbean

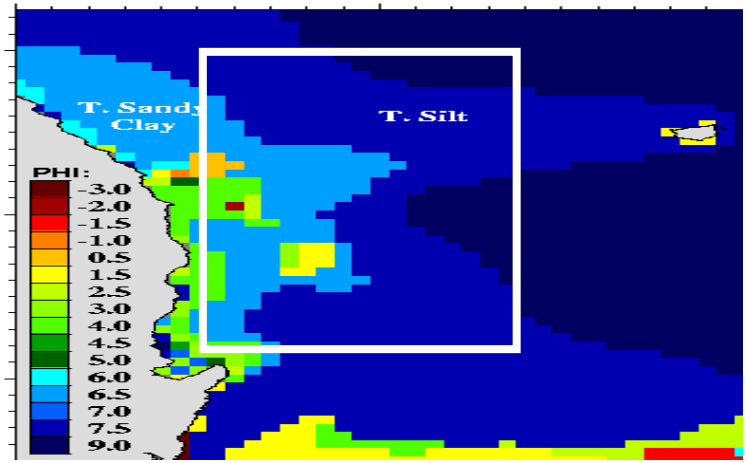
Environmental Descriptions

SHAREM 127

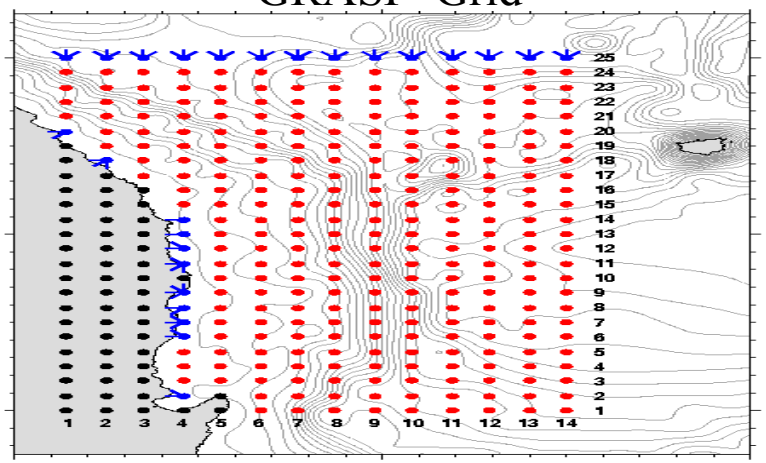
Bathymetry



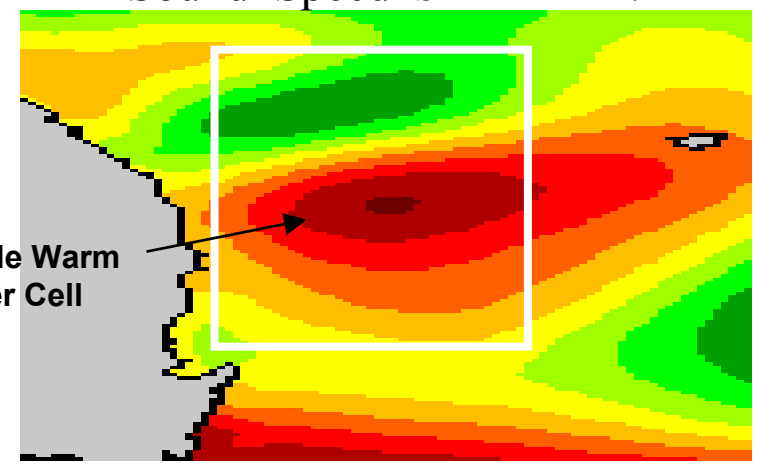
Bottom Type



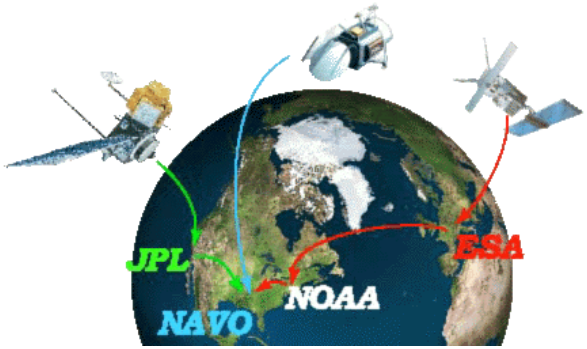
GRASP Grid



Sound Speed SHAREM 127



MODAS (MODULAR OCEANOGRAPHIC DATA ASSIMILATION SYSTEM)



Remote Sensors

MCSST & Altimetry

Air, Buoy, & Ship XBTs

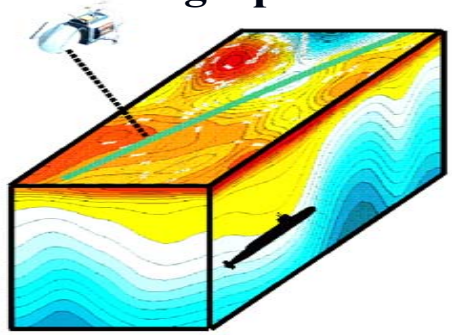
NAVOCEANO

Global Data Fusion

METOC Centers

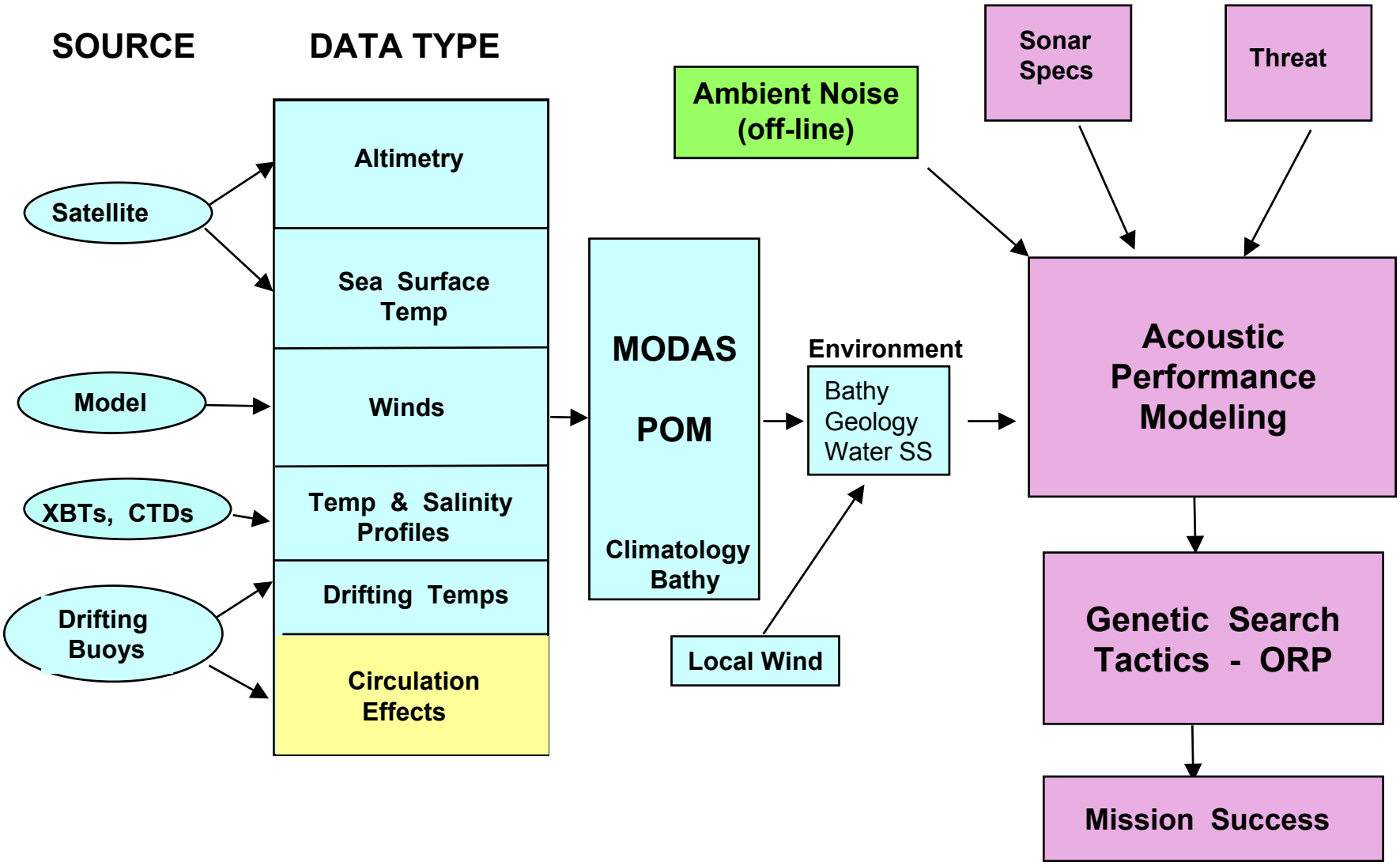
Regional Fusion &Tailored Operational Support

Compressed Oceanographic Data



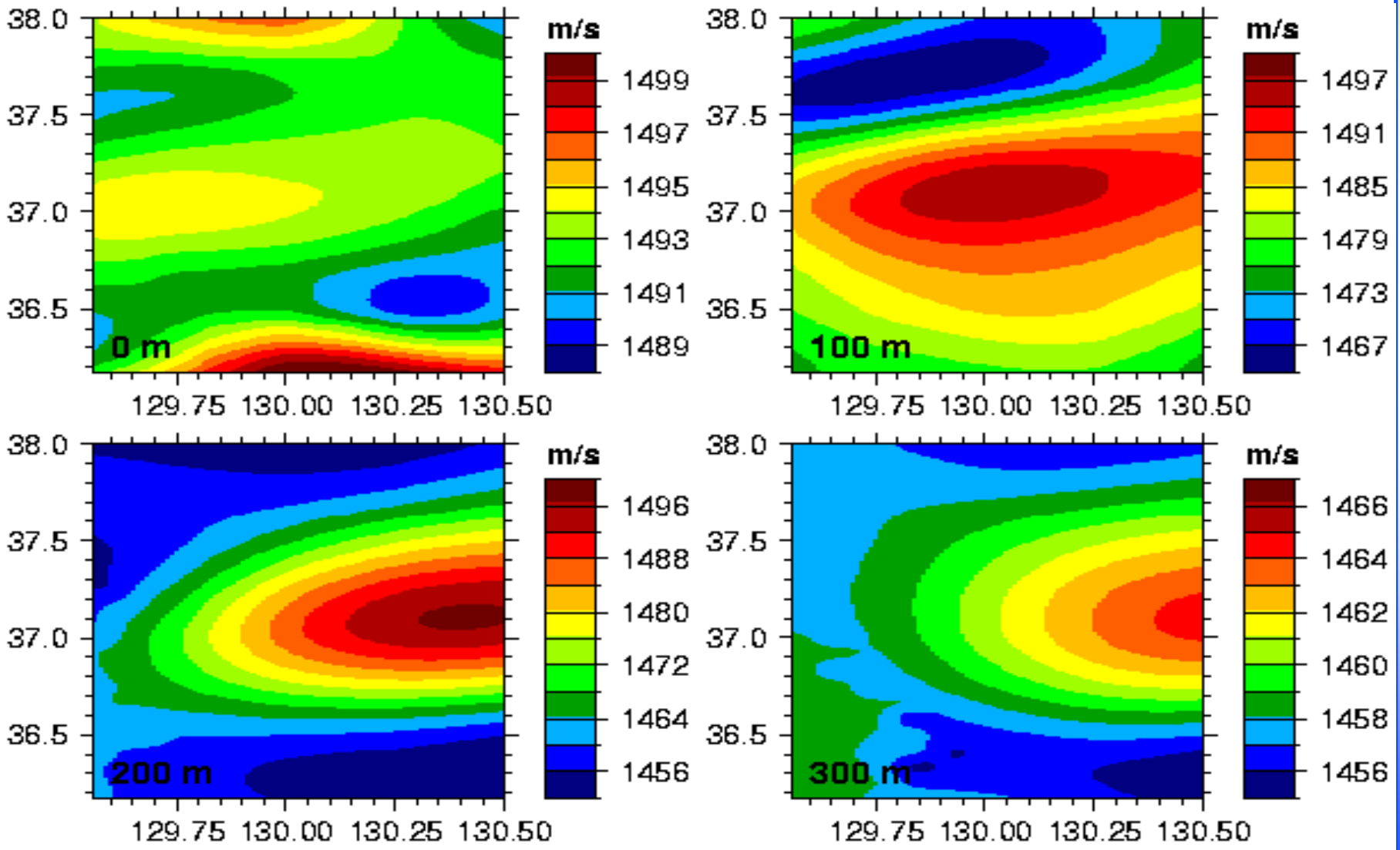
Local XBT Measurements

MODAS Concept & GRASP Application

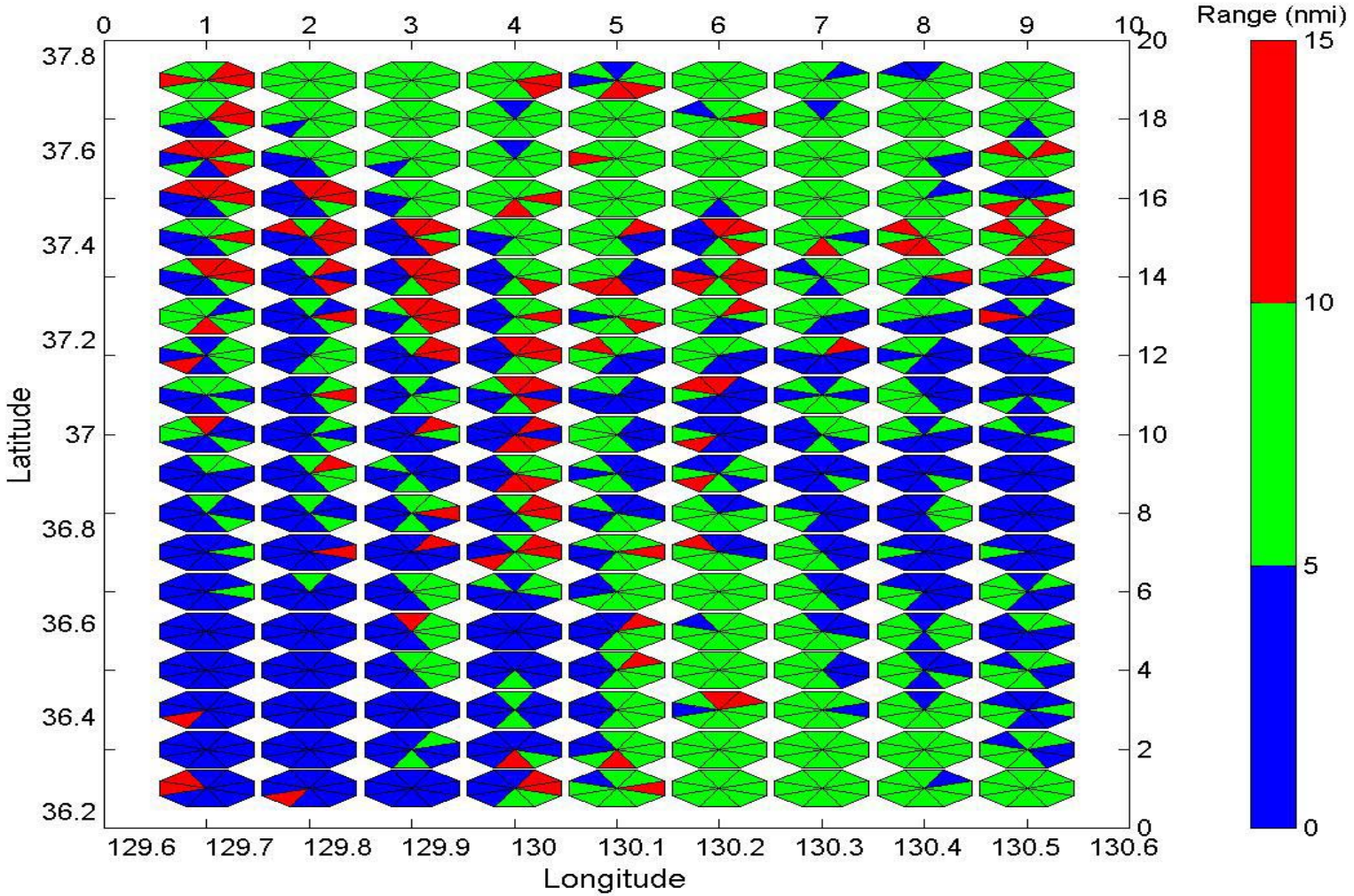


MODAS SOUND SPEEDS

SHAREM 127 (26 Feb 99)



MODAS - BASED PERFORMANCE
Detection range by sector



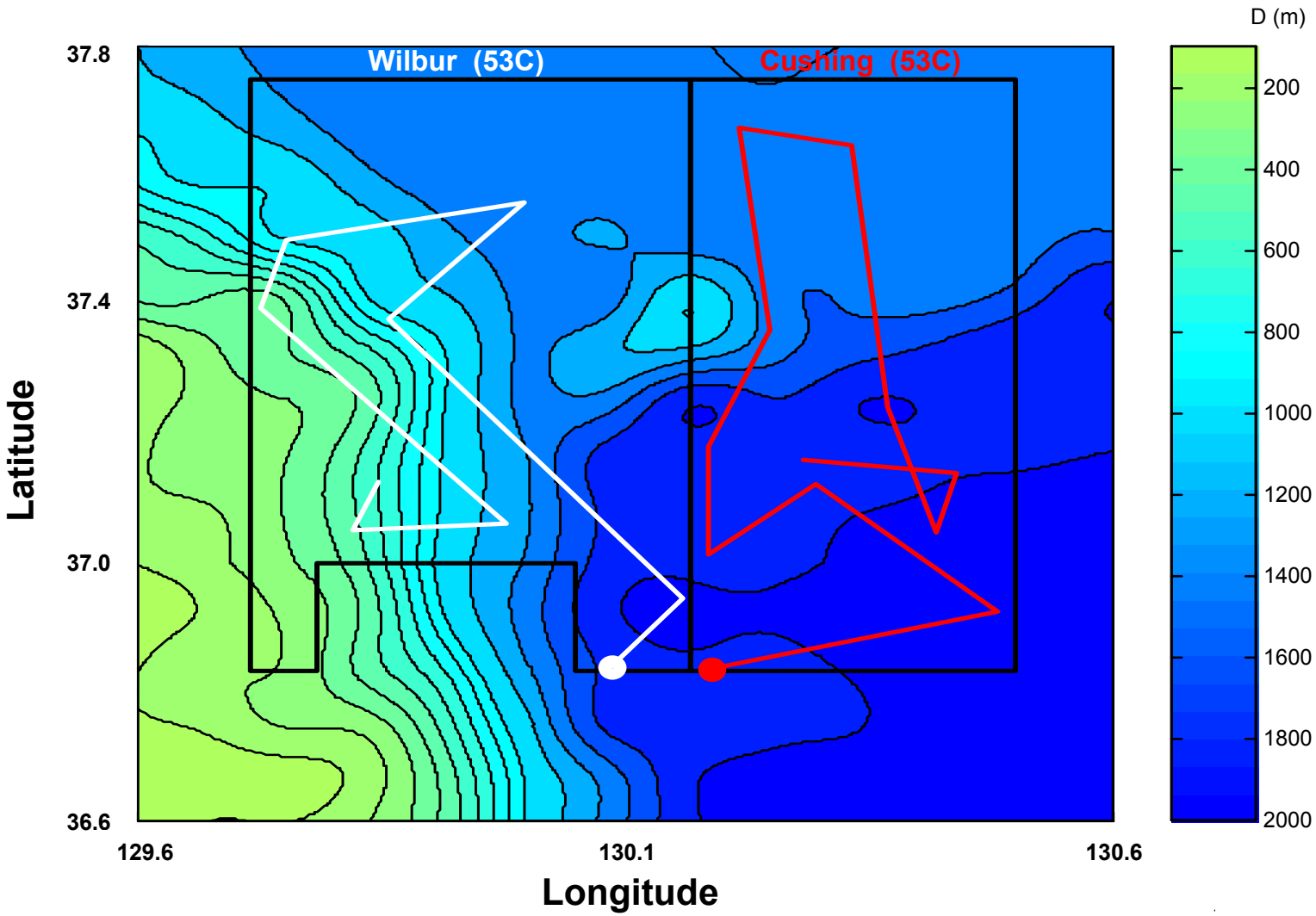
MODAS 3 Sep 98

Examples

Sea Tests and Benchmark Simulations

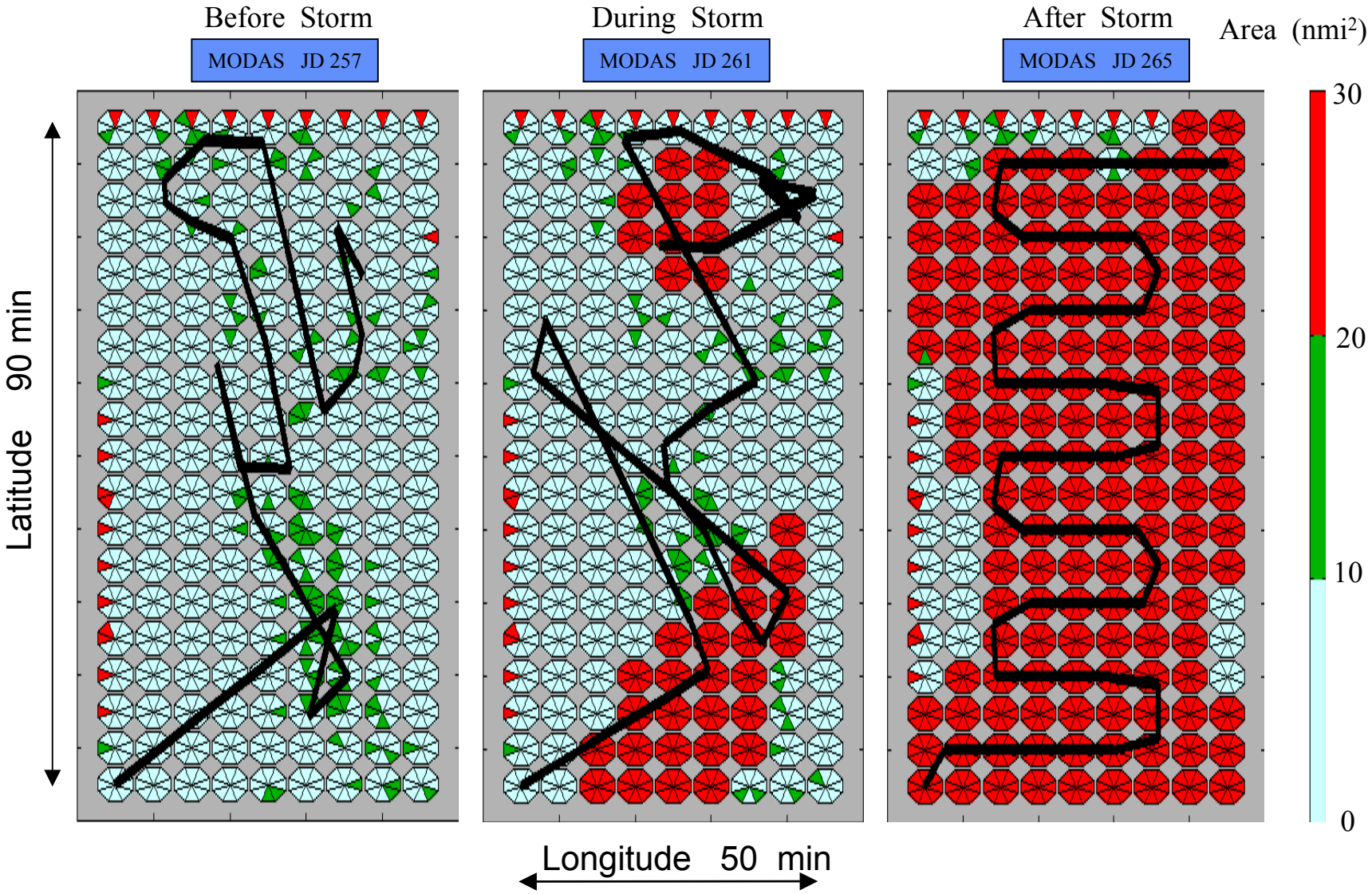
GRASP SEARCH TRACKS

SHAREM 126



SECTOR DETECTION AREA & GRASP TRACK

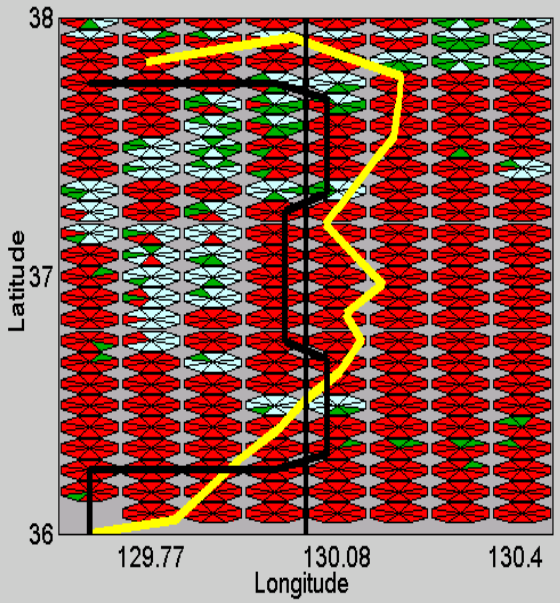
SHAREM 126 SQS-53C TD = 18 m

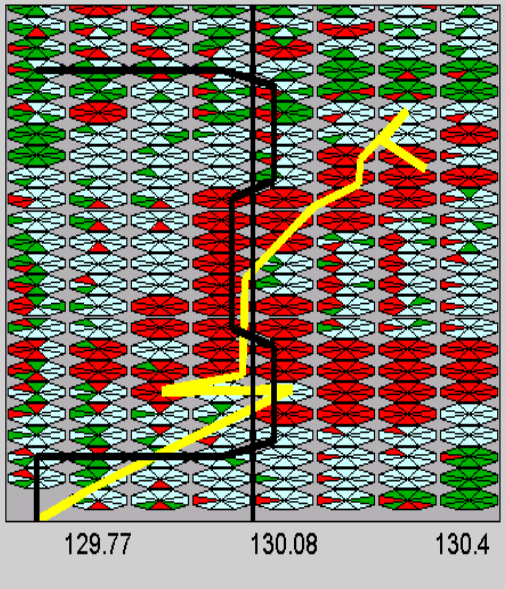


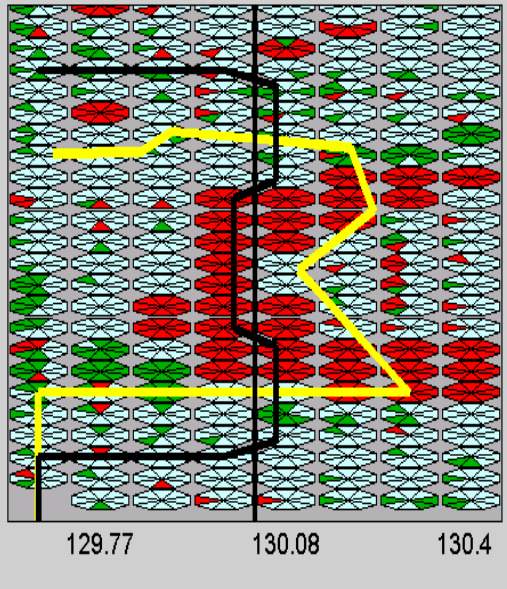
Wind Speed Study

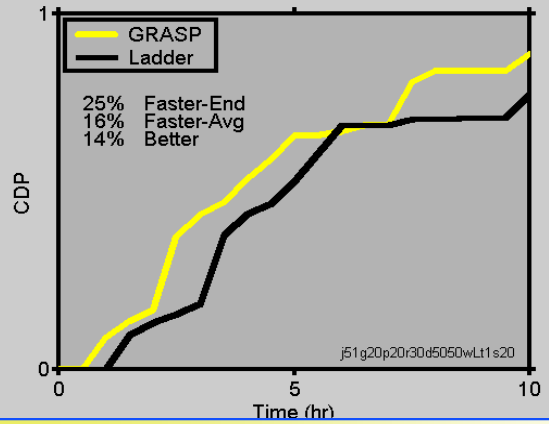
(53C TD=20 m ST=10 hr G=20 nmi)

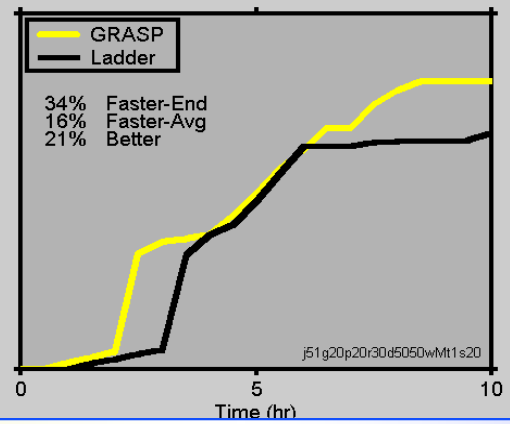
Low (10 kn)	Medium (16 kn)	High (22 kn)

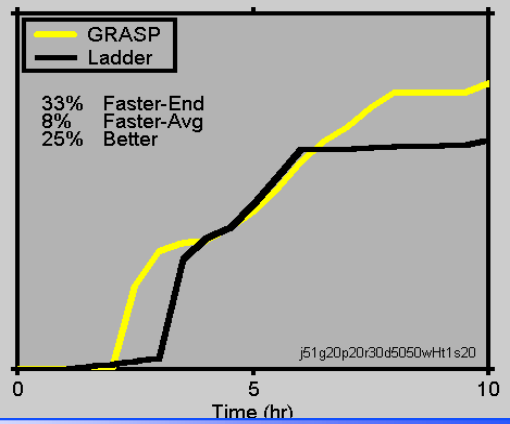






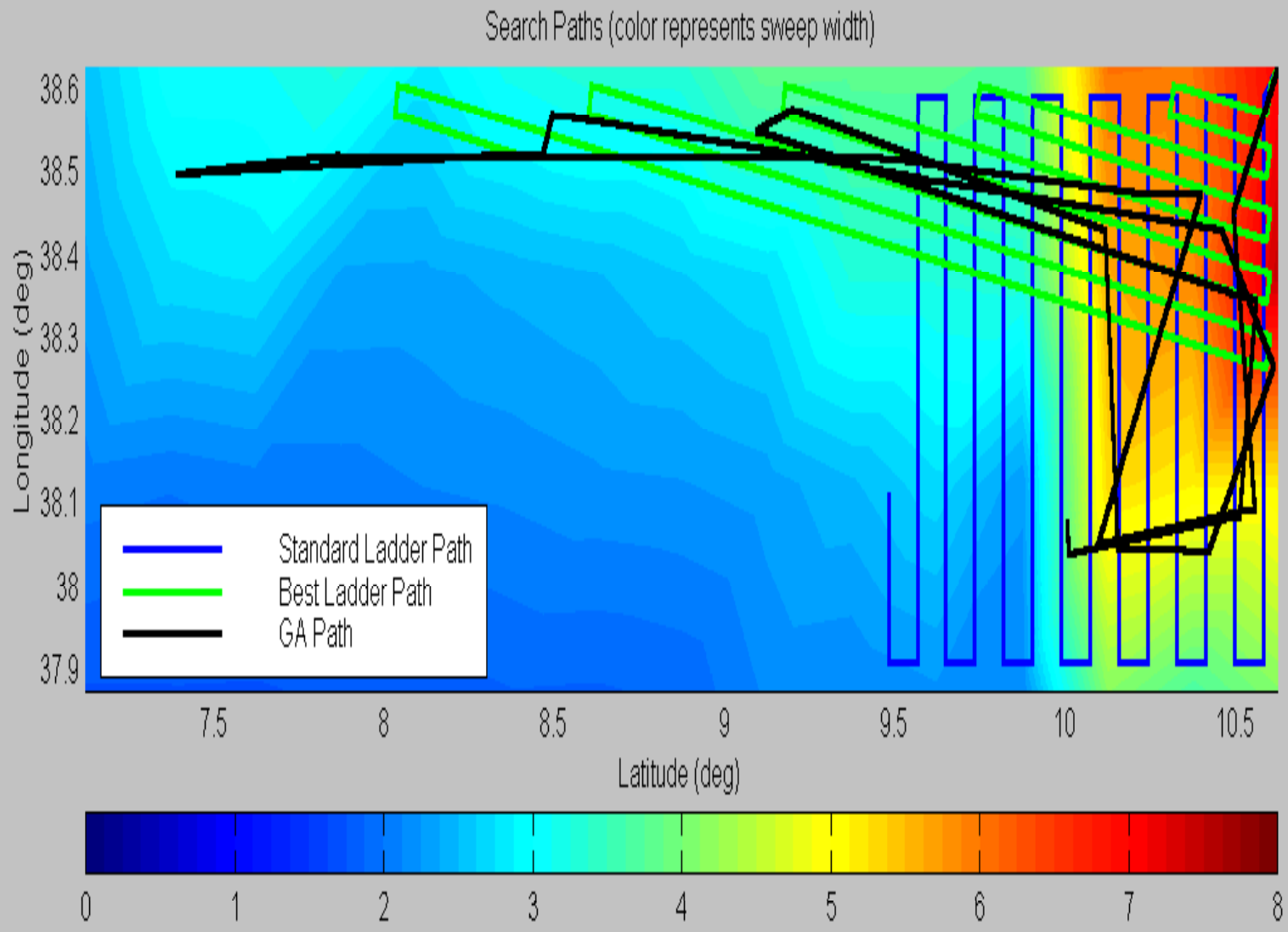






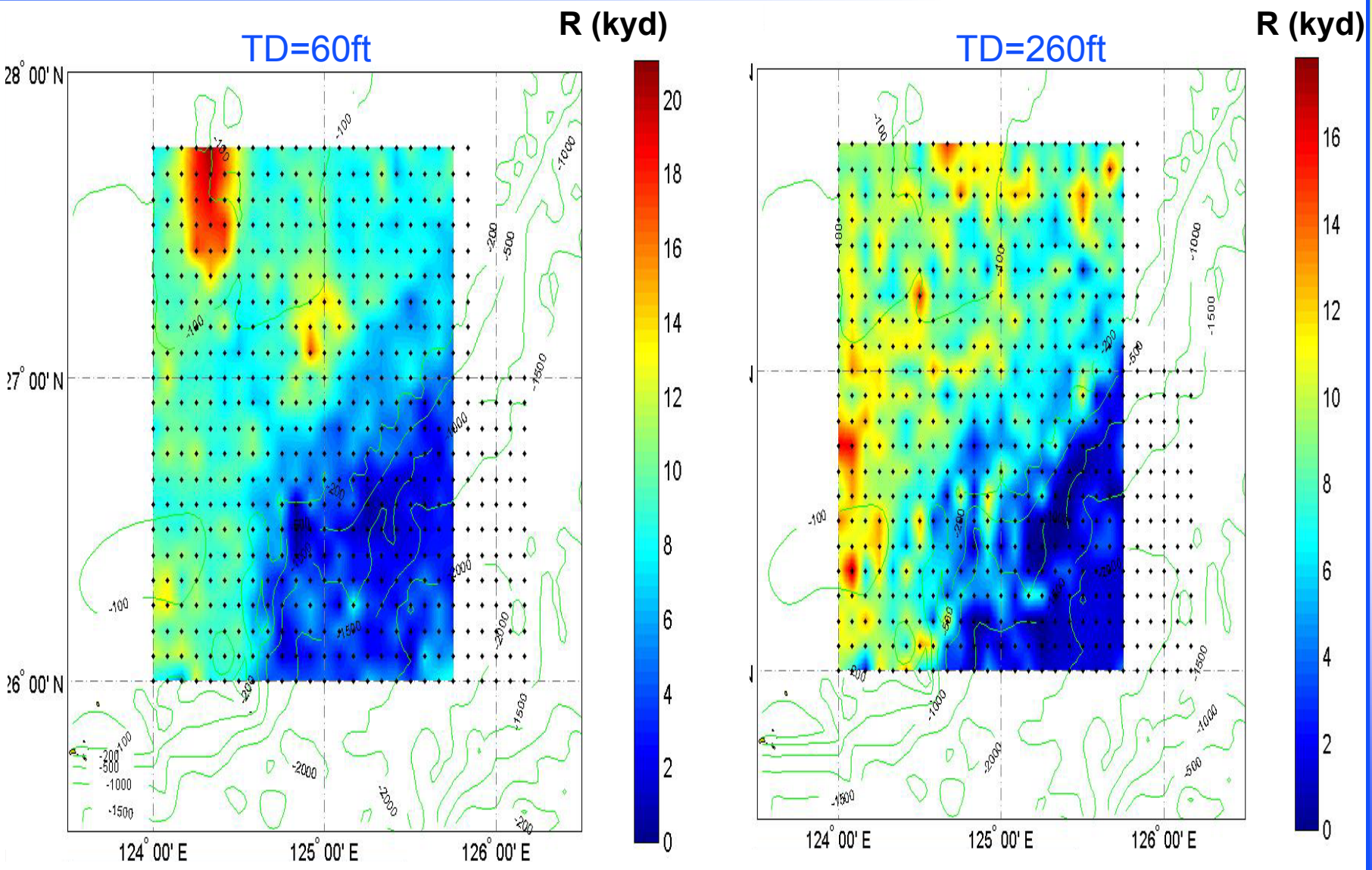
Mediterranean Shark Hunt 00-1 TB23 Passive TA

CDPs - Std Ladder=24%, Best Ladder=29%, GA=35%

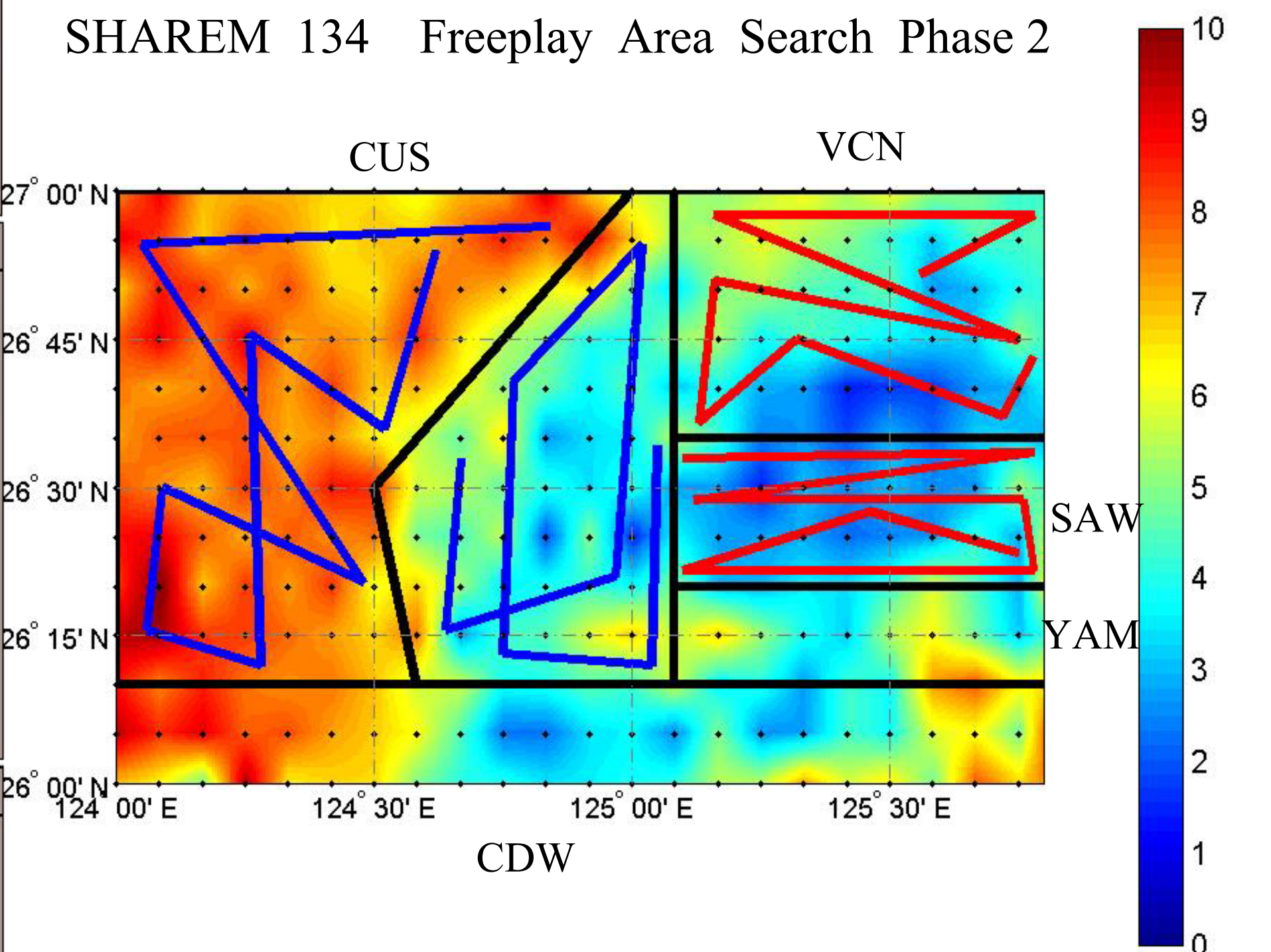


SHAREM 134 ECS

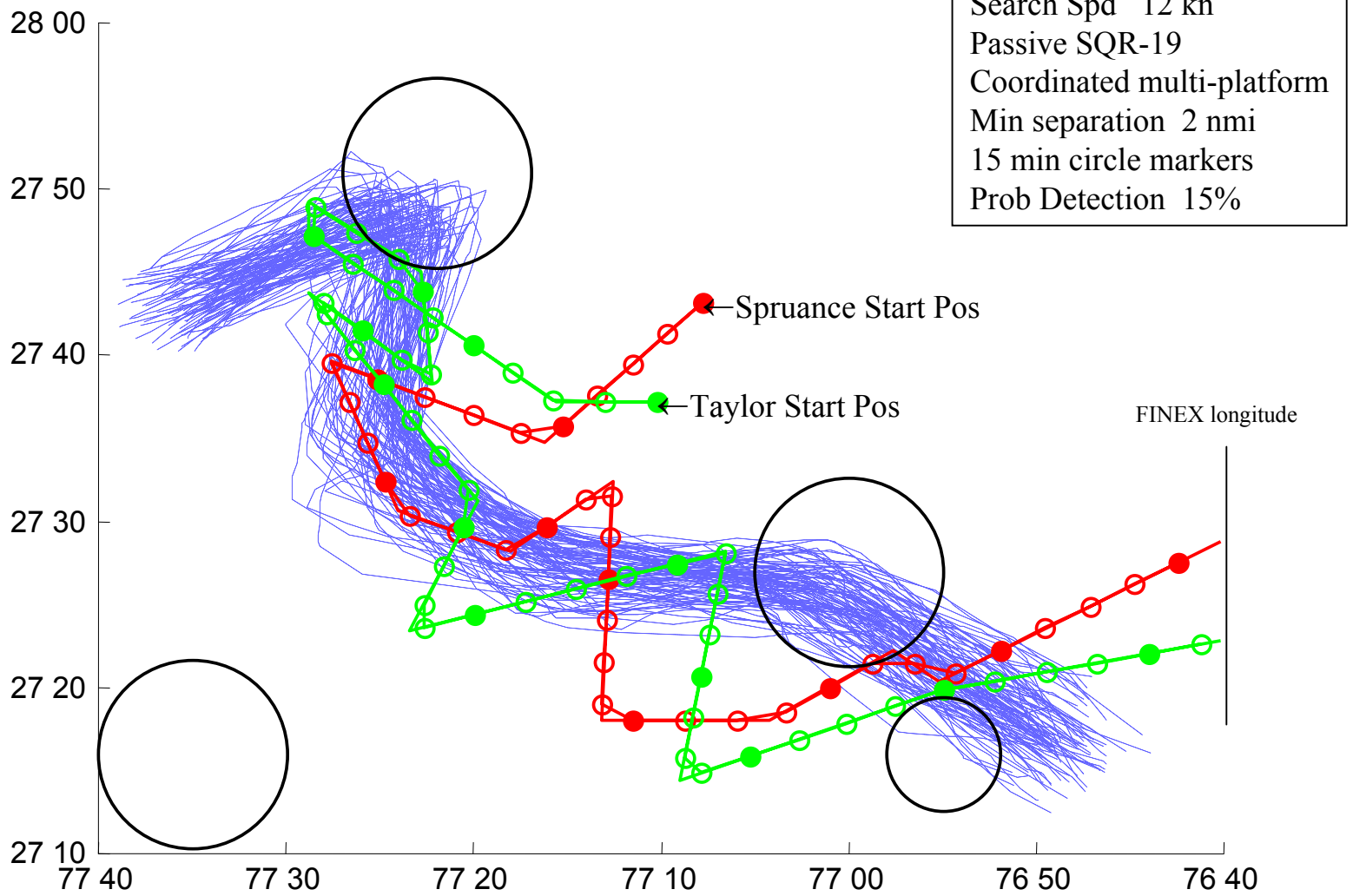
53C WS=15kn MODAS (1Aug00)



SHAREM 134 Freeplay Area Search Phase 2

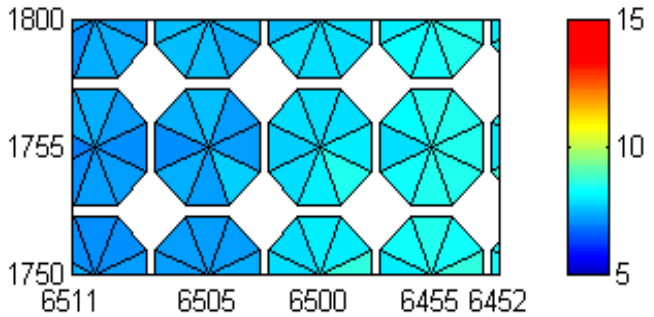


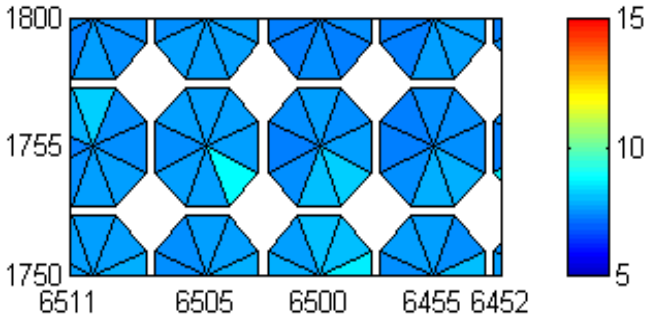
CDS-24 Group Sail (Feb 01)

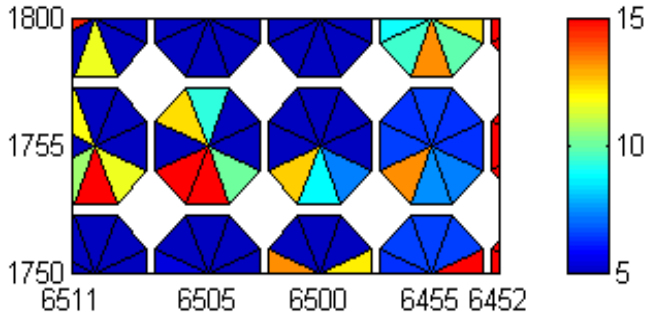


Detection Range Pinwheels (kyd) for MW7

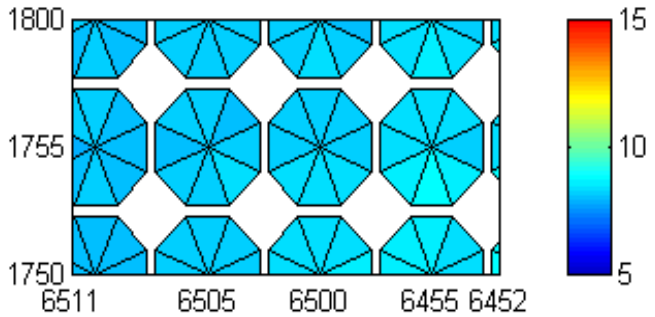
Target at 90 ft



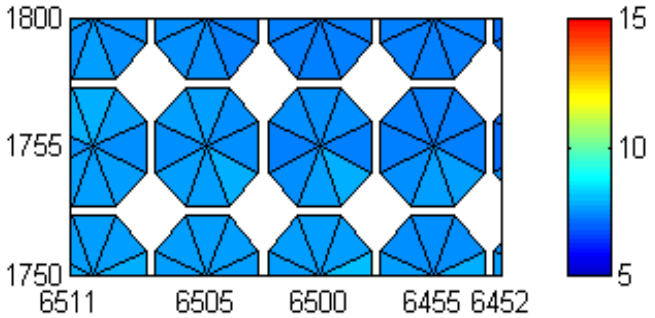




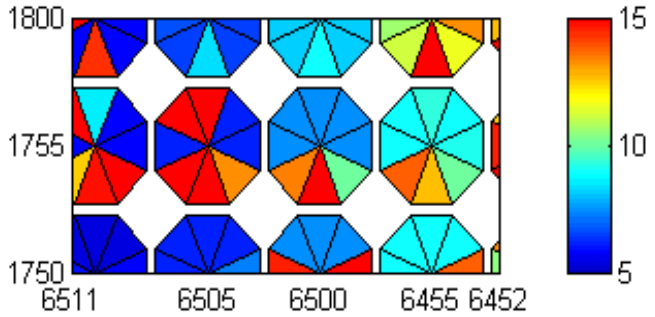
Target at 510 ft



19 at 150 ft

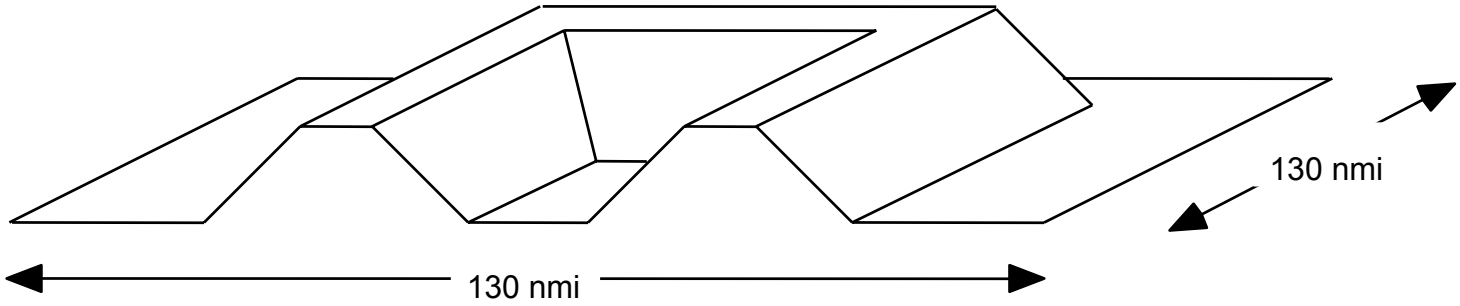


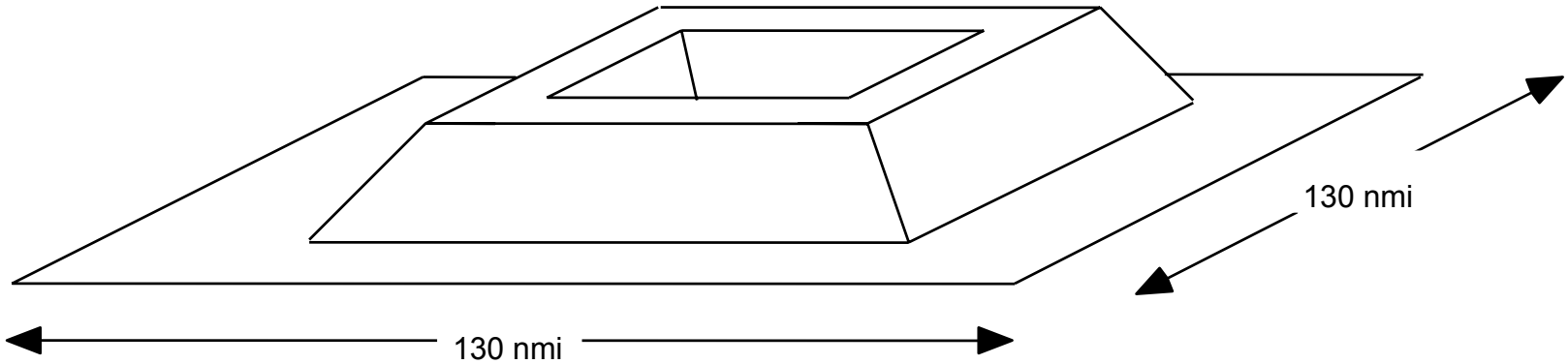
19 at 450 ft



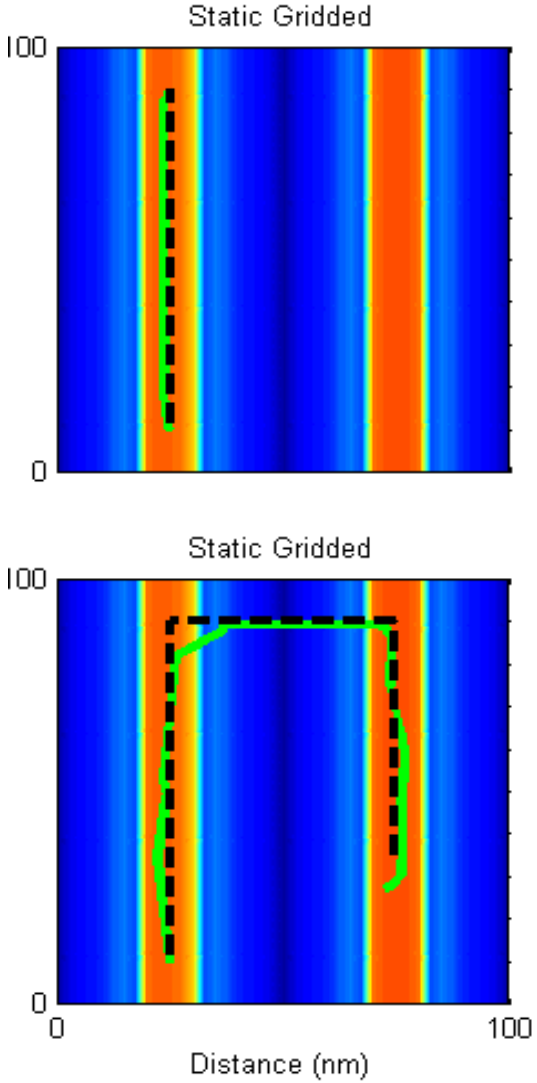
53

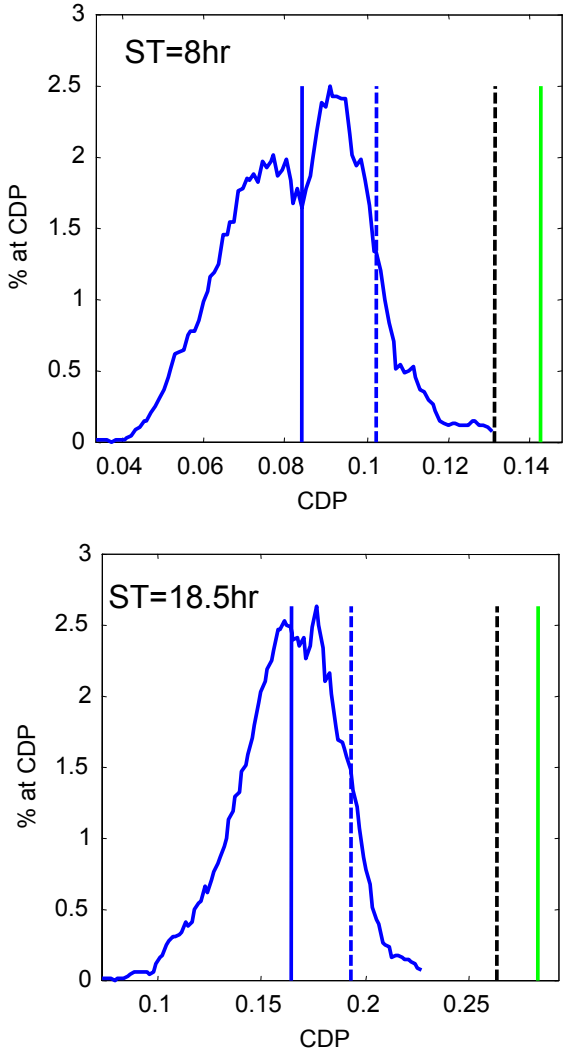
Acoustic Benchmark Study

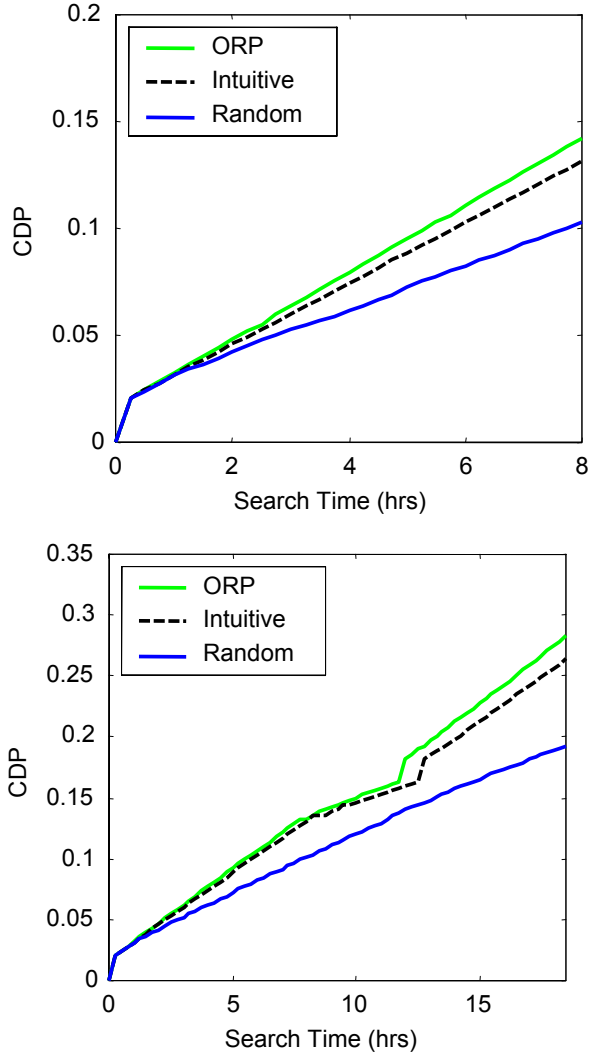




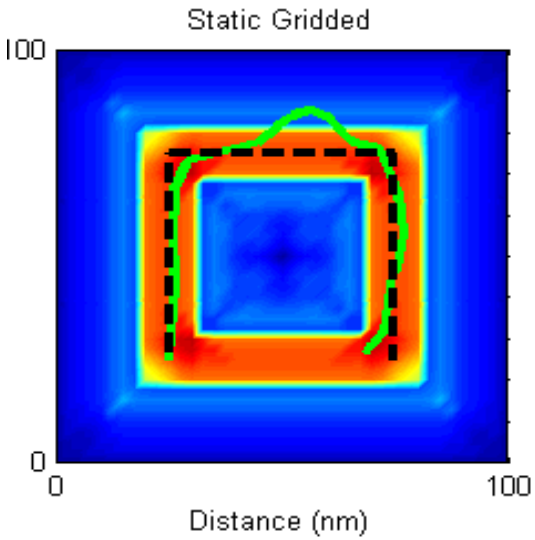
Acoustic Benchmark Study
Double Ridge

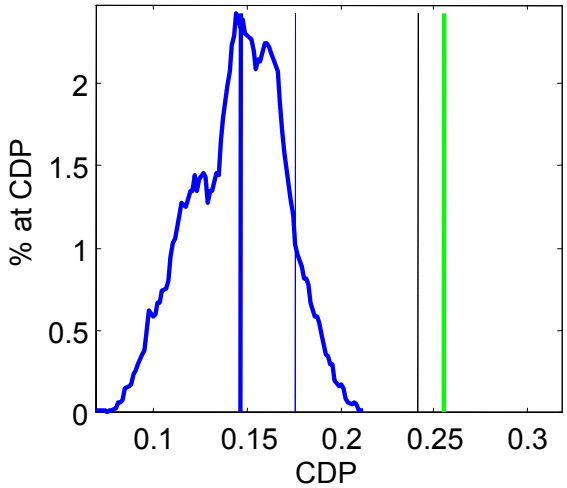


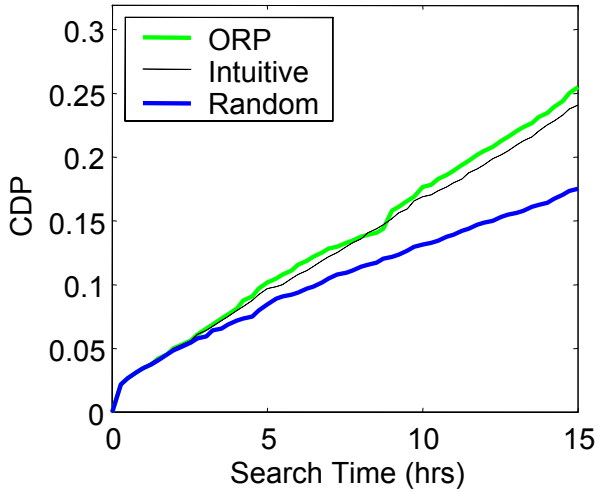


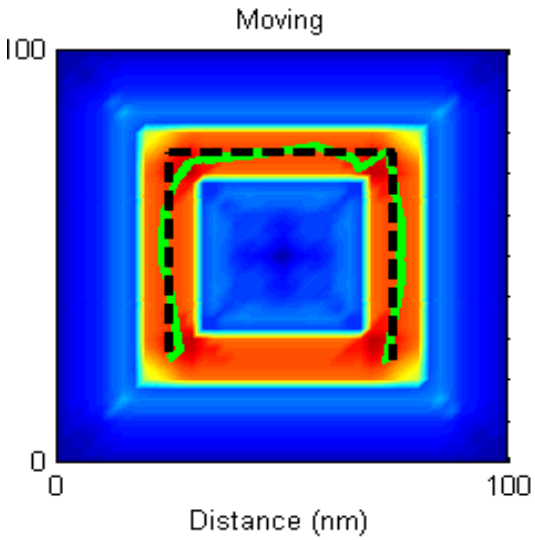


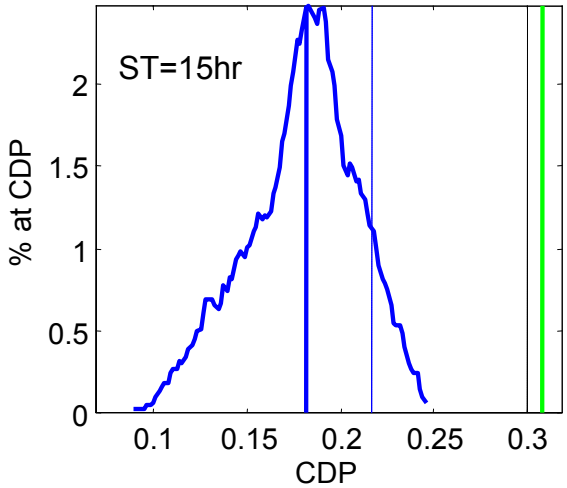
Acoustic Benchmark Study
Annulus

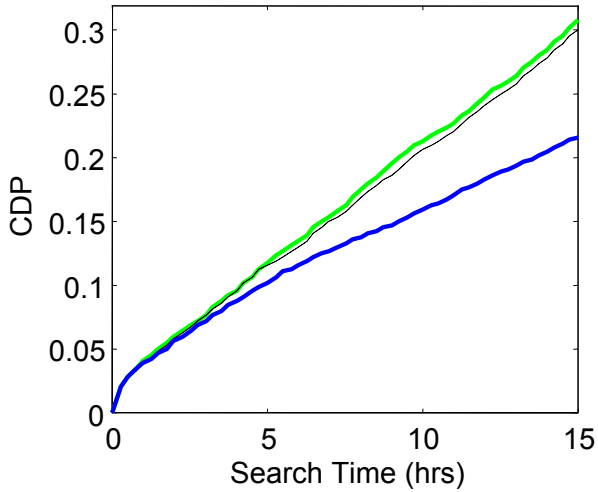




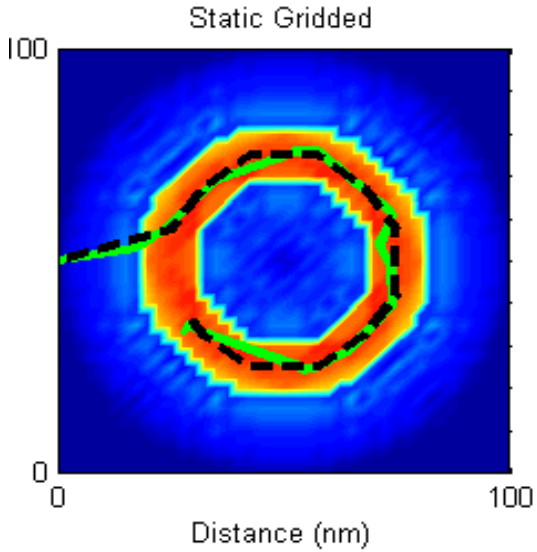


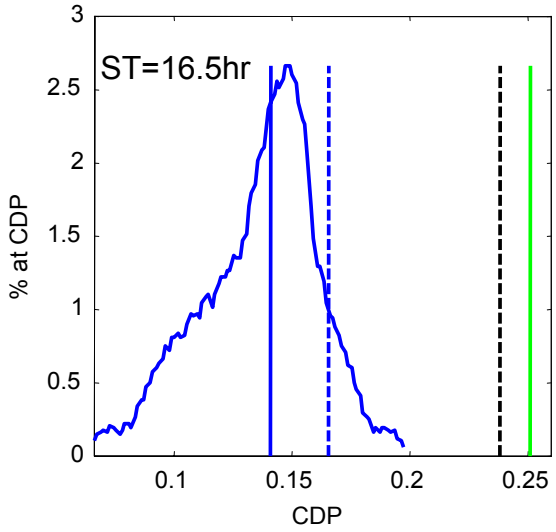


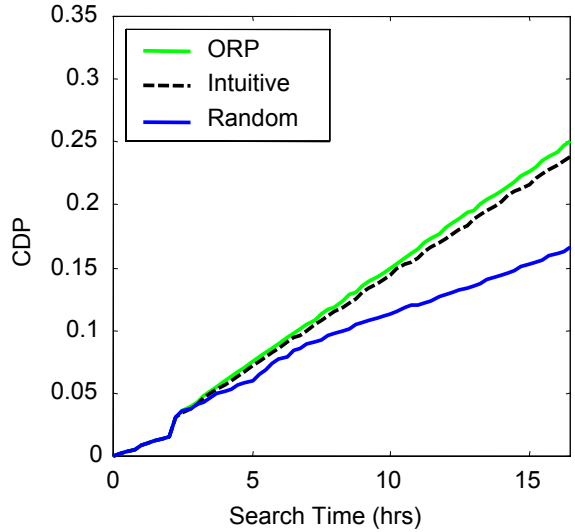




Acoustic Benchmark Study
Ring







Related Projects

MADTDA

Magnetic Anomaly Detection TDA

TAMDA

Tactical Acoustic Measurement and Decision Aid

MASDA

METOC Adaptive Sampling Aid Decision

Non-Acoustic ASW Net-Centric MAD TDA

RATIONALE

Diesel sub threat in dynamic, shallow - water littoral areas is a difficult problem for acoustic sensors.

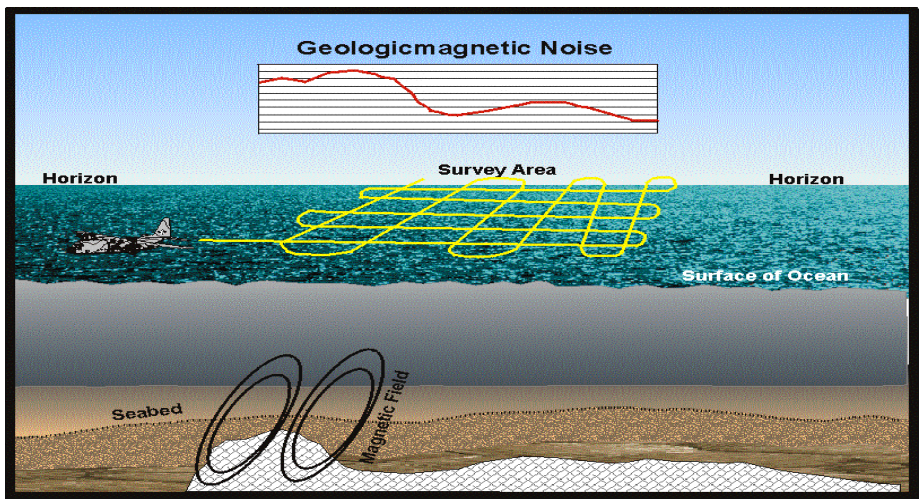
OBJECTIVE

Produce environmentally sensitive TDA for MAD with **quick** (3-yr) transition to Fleet using web-based net-centric approach. Coord w/ Beartrap, NAWC & NAVO.

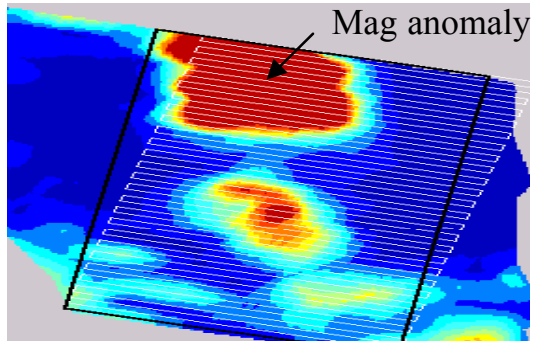
ADMIN

Joint research (7100 / 7400)
Joint funding (SPAWAR / NAVAIR)

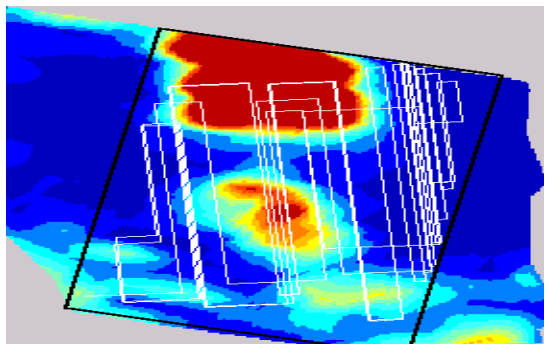
ISSUE



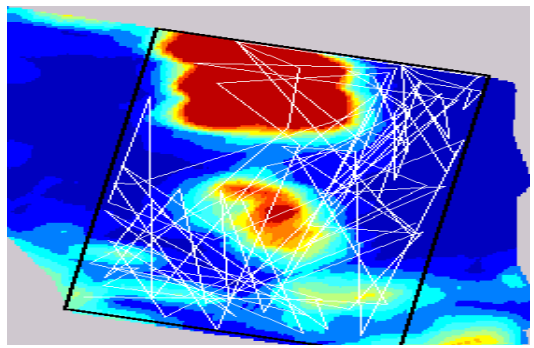
Standard Ladders PD=17%



Optimum Ladders PD=29%

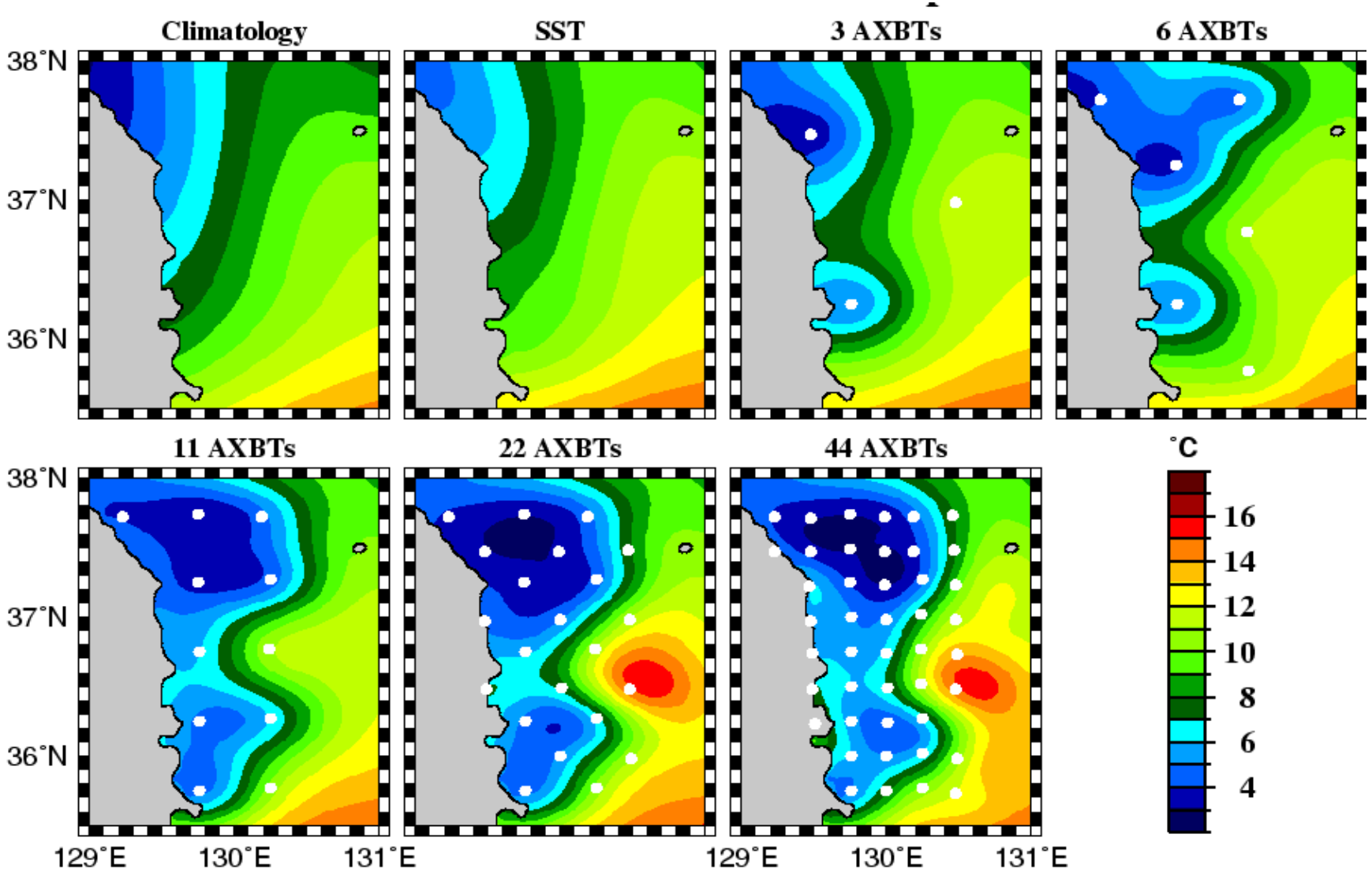


Optimum Tracks PD= 35%

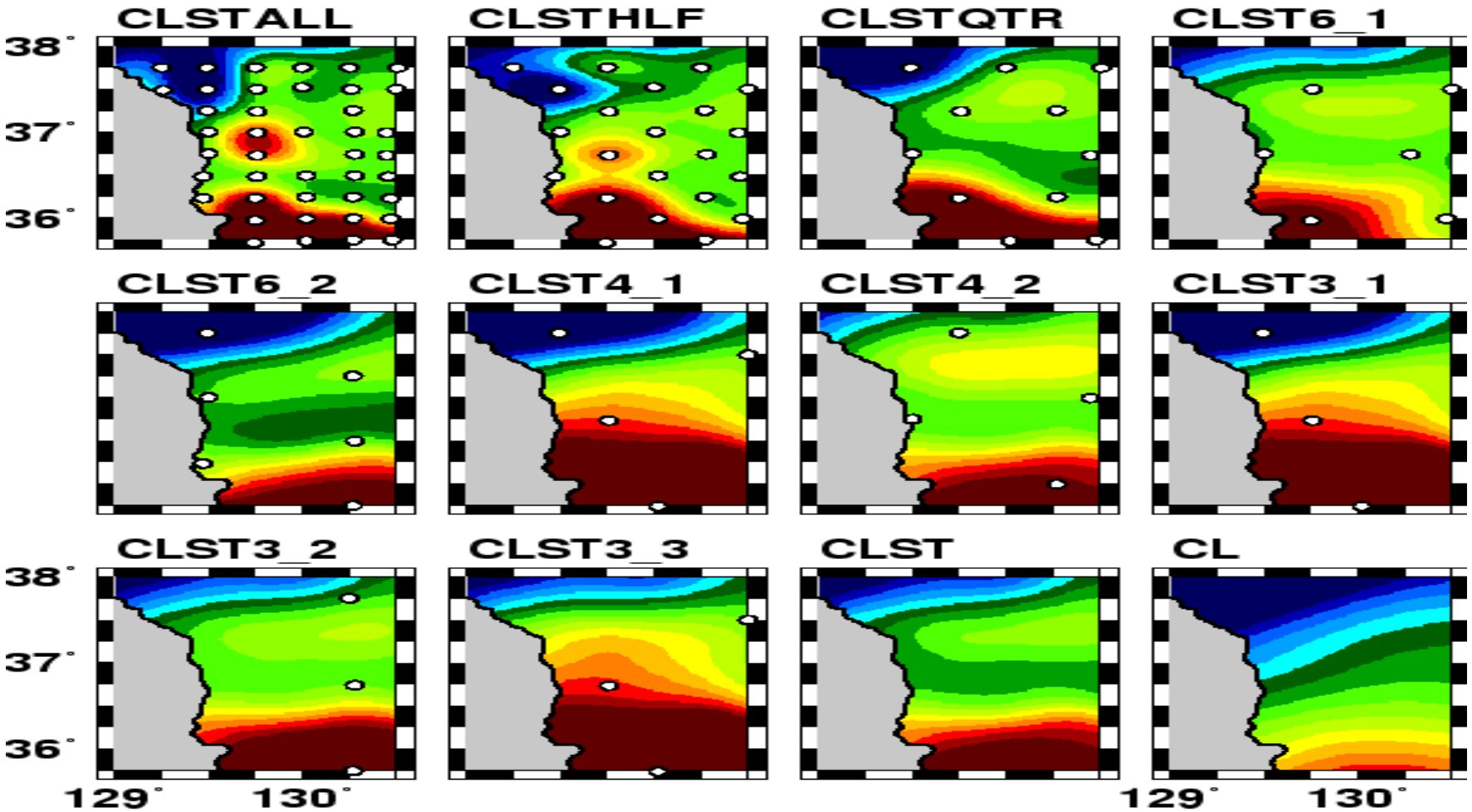


TAMDA

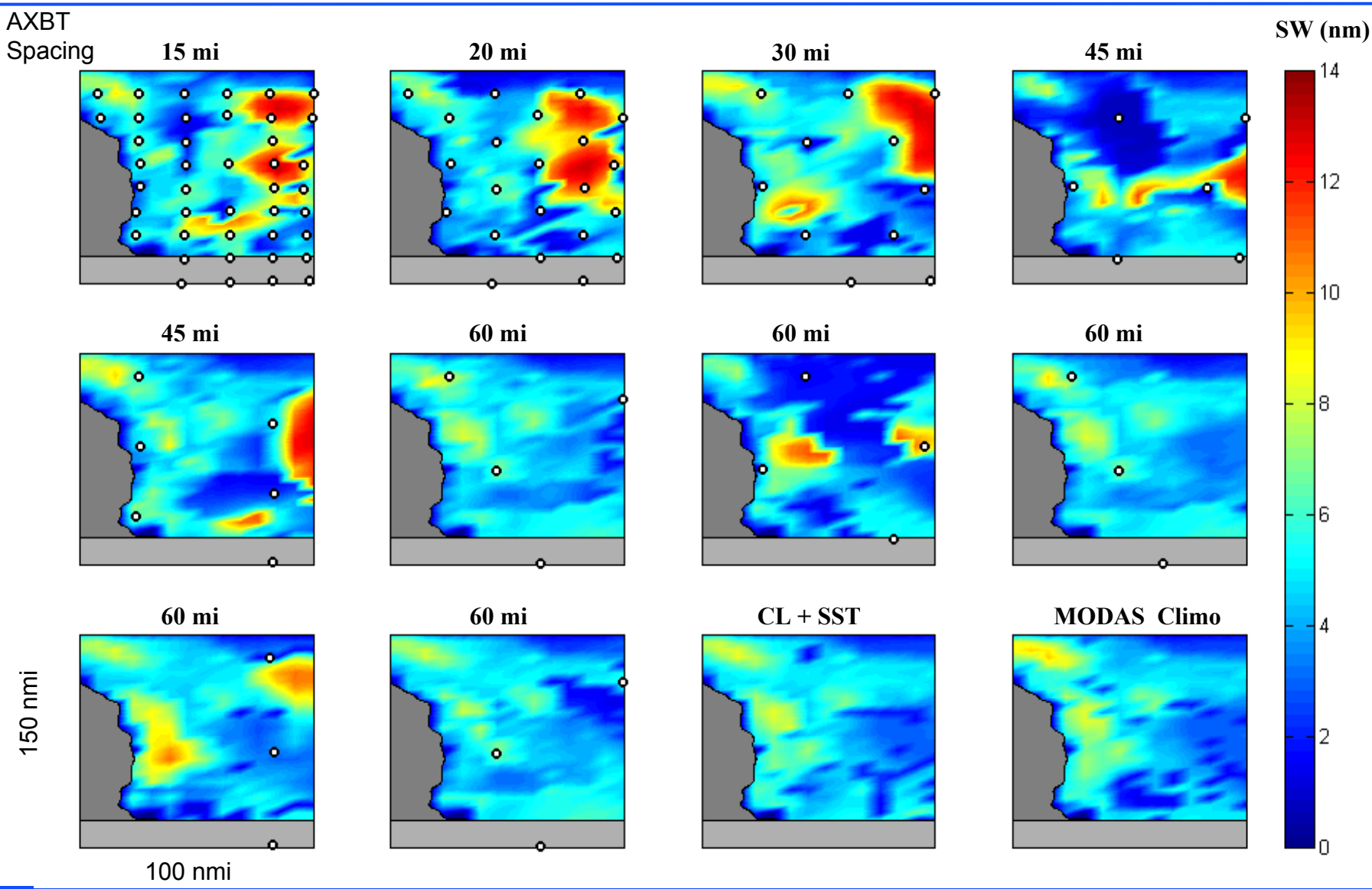
MODAS Temperatures * SOJ * 7 Sep 98 * 100m



MODAS Sound Speeds in SOJ at 50m on 02/17/99

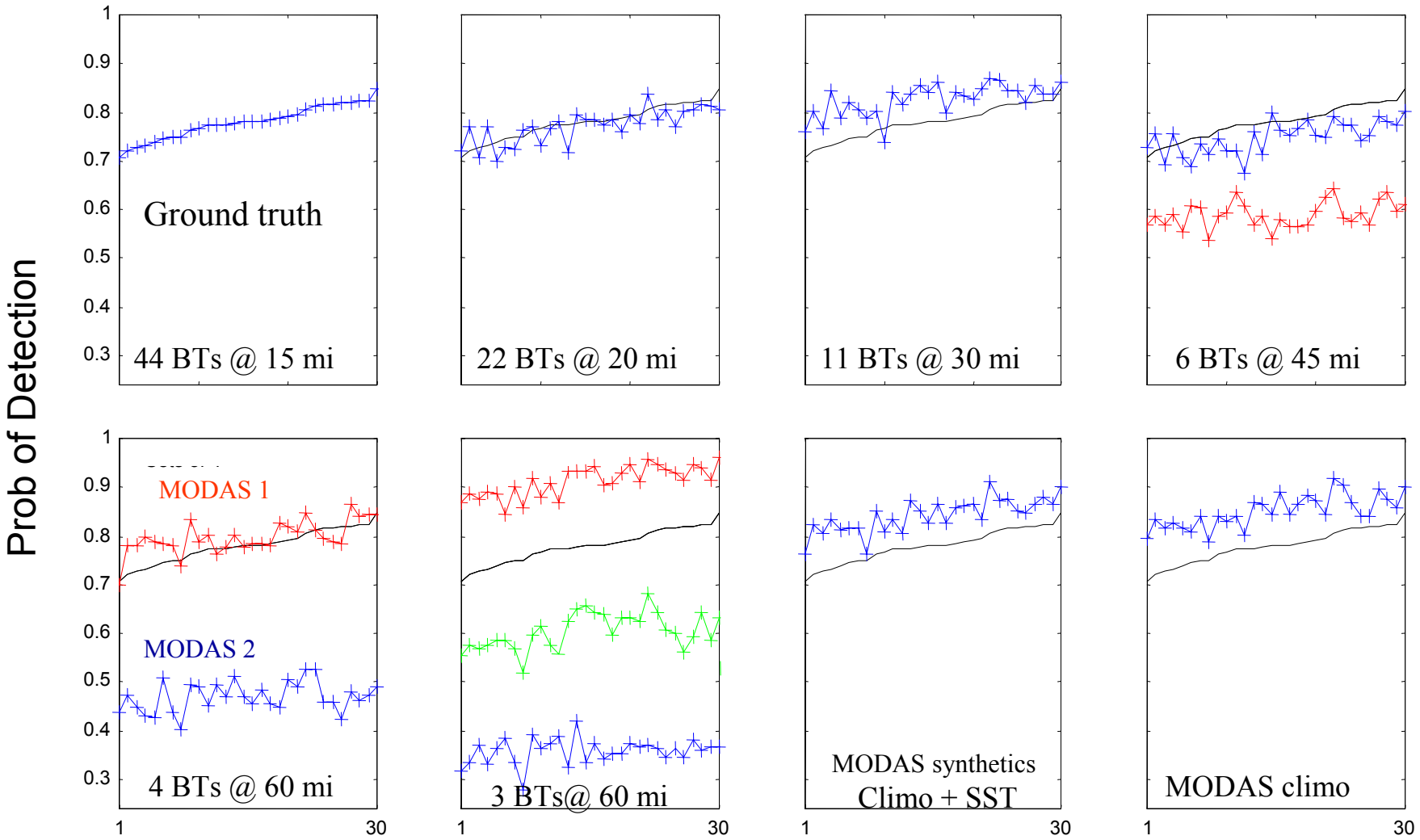


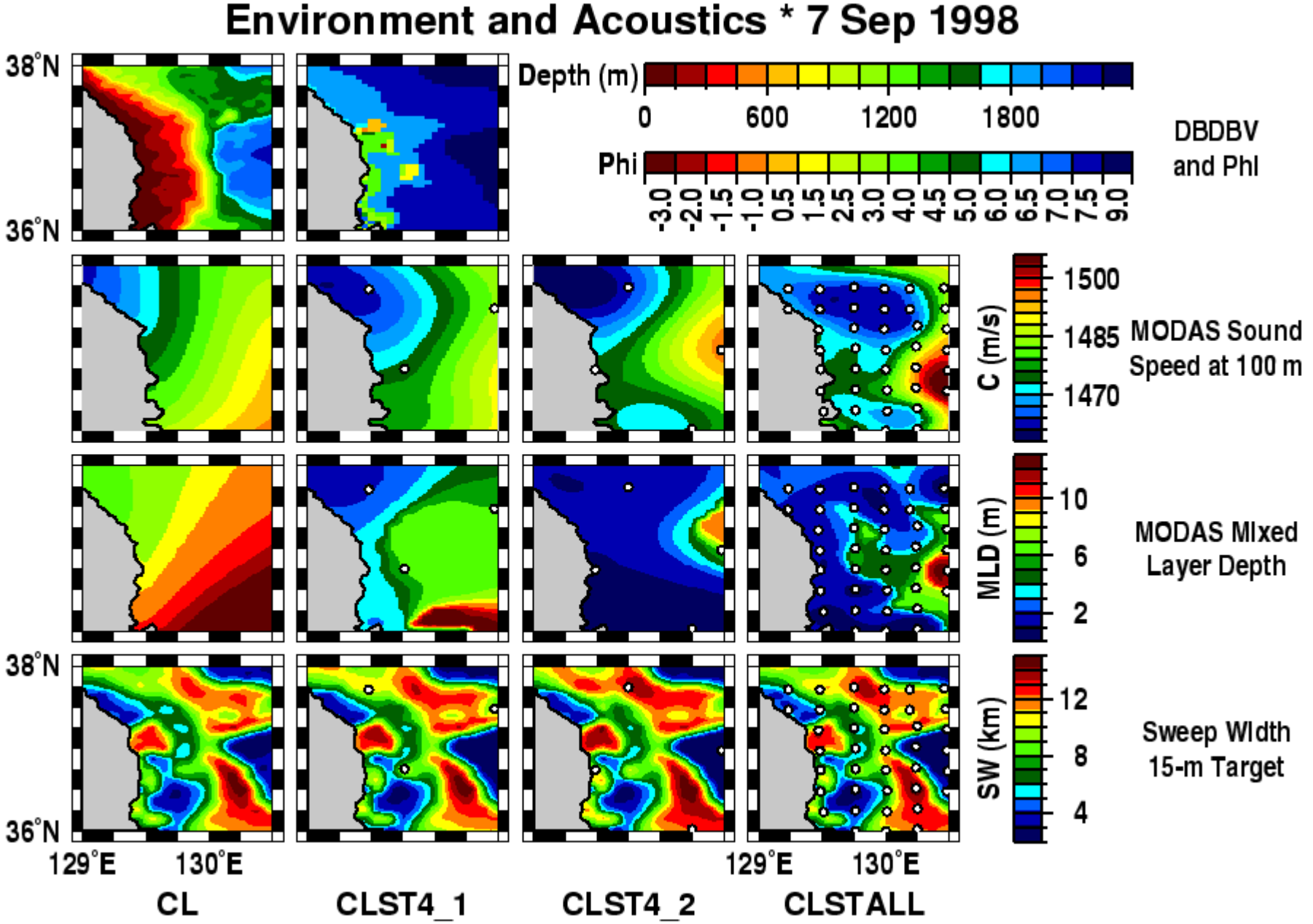
Sweep Width at 75m (17 Feb 99)

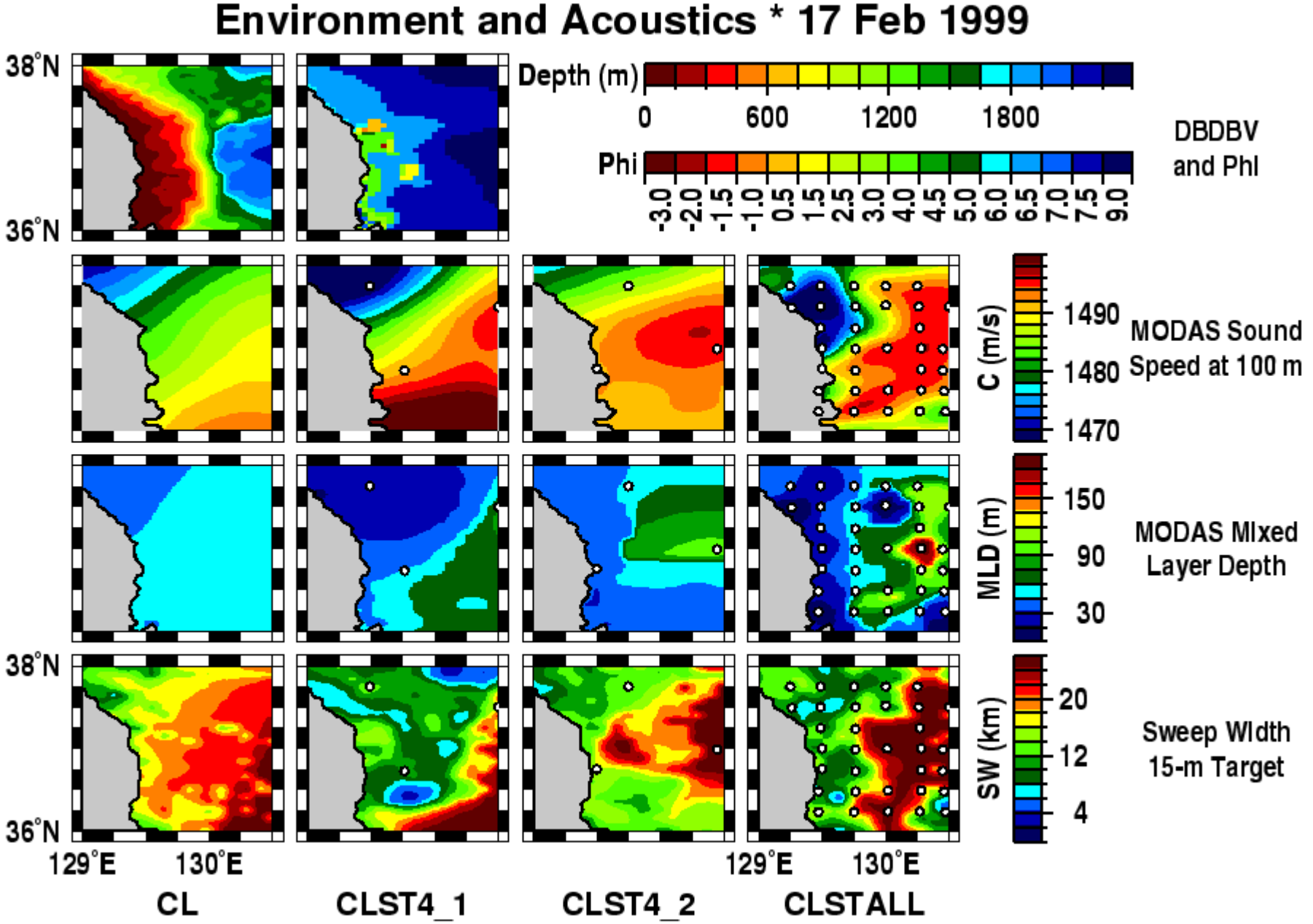


CDP Distribution (990217) TD=15

4-hr search of 5000 nmi² with monostatic IEER in SOJ




Environment and Acoustics * 7 Sep 1998
38°N
36°N
Depth (m)
0
600
1200
1800
Phi
-3.0
-2.0
-1.5
-1.0
0.5
1.5
2.5
3.0
4.0
4.5
5.0
6.0
6.5
7.0
7.5
9.0
DBDBV and Phi
C (m/s)
1500
1485
1470
MODAS Sound Speed at 100 m
MLD (m)
10
6
2
MODAS Mixed Layer Depth
SW (km)
12
8
4
Sweep Width 15-m Target
38°N
36°N
129°E
130°E
129°E
130°E
CL
CLST4_1
CLST4_2
CLSTALL


Environment and Acoustics * 17 Feb 1999
38°N
36°N
Depth (m)
0
600
1200
1800
Phi
-3.0
-2.0
-1.5
-1.0
0.5
1.5
2.5
3.0
4.0
4.5
5.0
6.0
6.5
7.0
7.5
9.0
DBDBV and Phi
C (m/s)
1490
1480
1470
MODAS Sound Speed at 100 m
MLD (m)
150
90
30
MODAS Mixed Layer Depth
SW (km)
20
12
4
Sweep Width 15-m Target
38°N
36°N
129°E
130°E
129°E
130°E
CL
CLST4_1
CLST4_2
CLSTALL

MASDA
METOC Adaptive Sampling Decision Aid

OBJECTIVE: Develop a tactically useful METOC decision aid for efficient XBT, AXBT & TAM measurements by adapting spatial samples to current environmental conditions (including MODAS error fields) & operational constraints.

WHY? (Cdr Van Gurley's "So what?")

- Increase environmental accuracy
- Decrease collection time
- Save money
- Better input to acoustic predictions

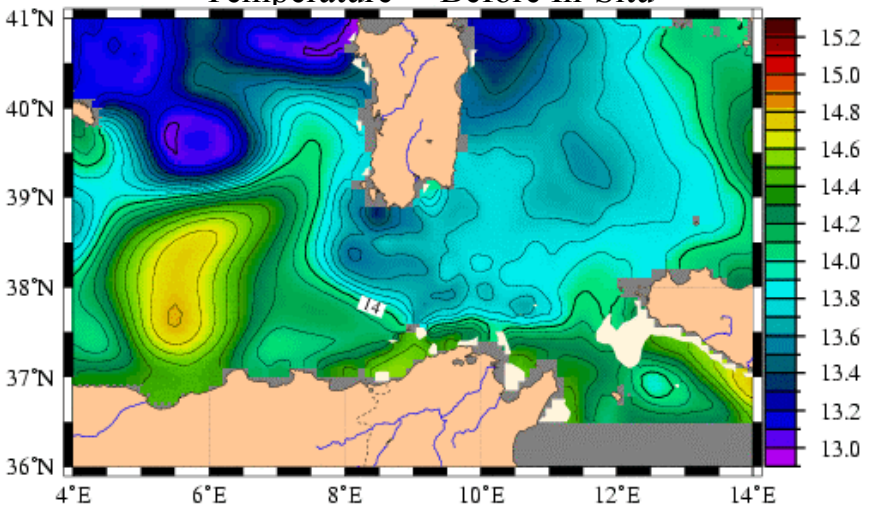
HOW?

- Use an error metric that combines env and acoustics

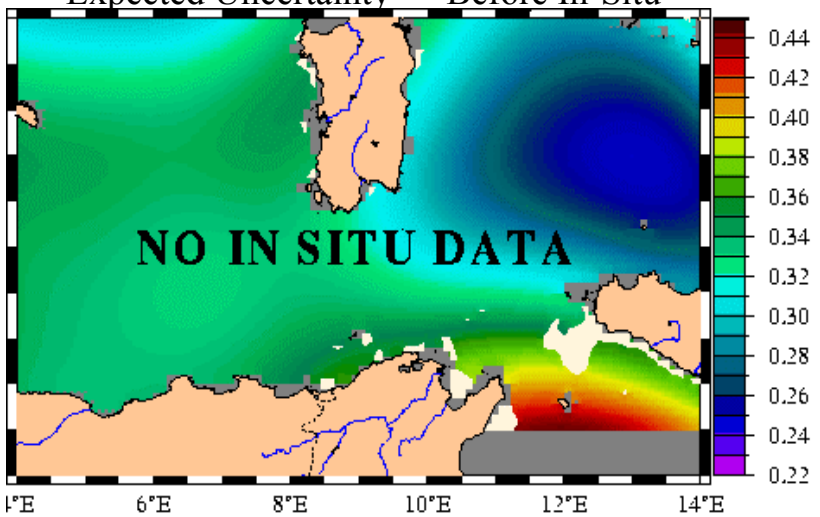
In-situ Data Impact on MODAS

(100m on 08 Mar 00 in West Med during SHARK HUNT)

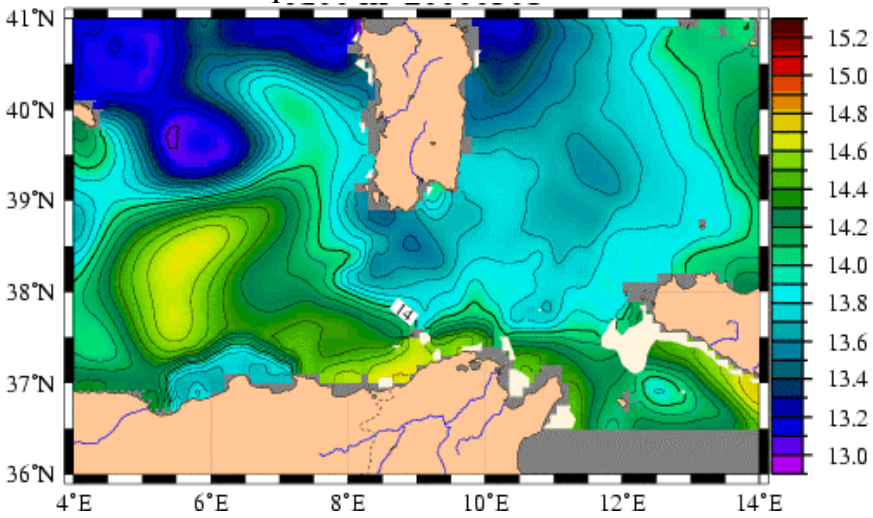
Temperature Before In-Situ



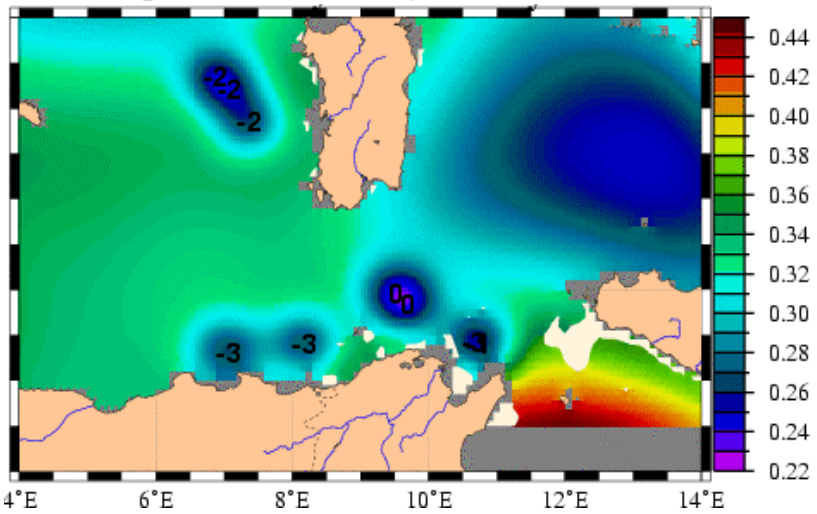
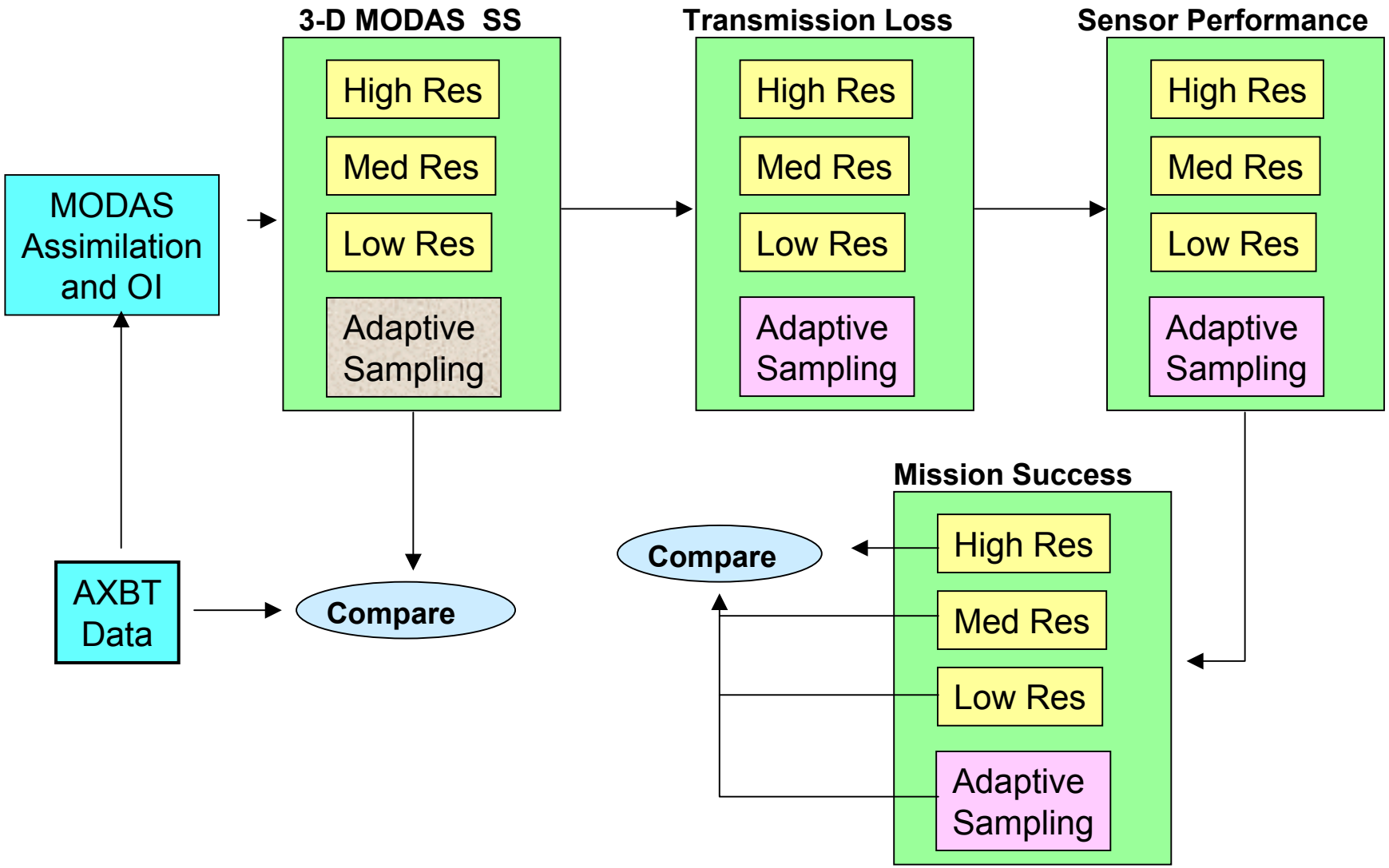
Expected Uncertainty Before In-Situ



Temperature After In-Situ



Expected Uncertainty After In-Situ



METOC Adaptive Sampling Decision Aid
MASDA - Technical Approach