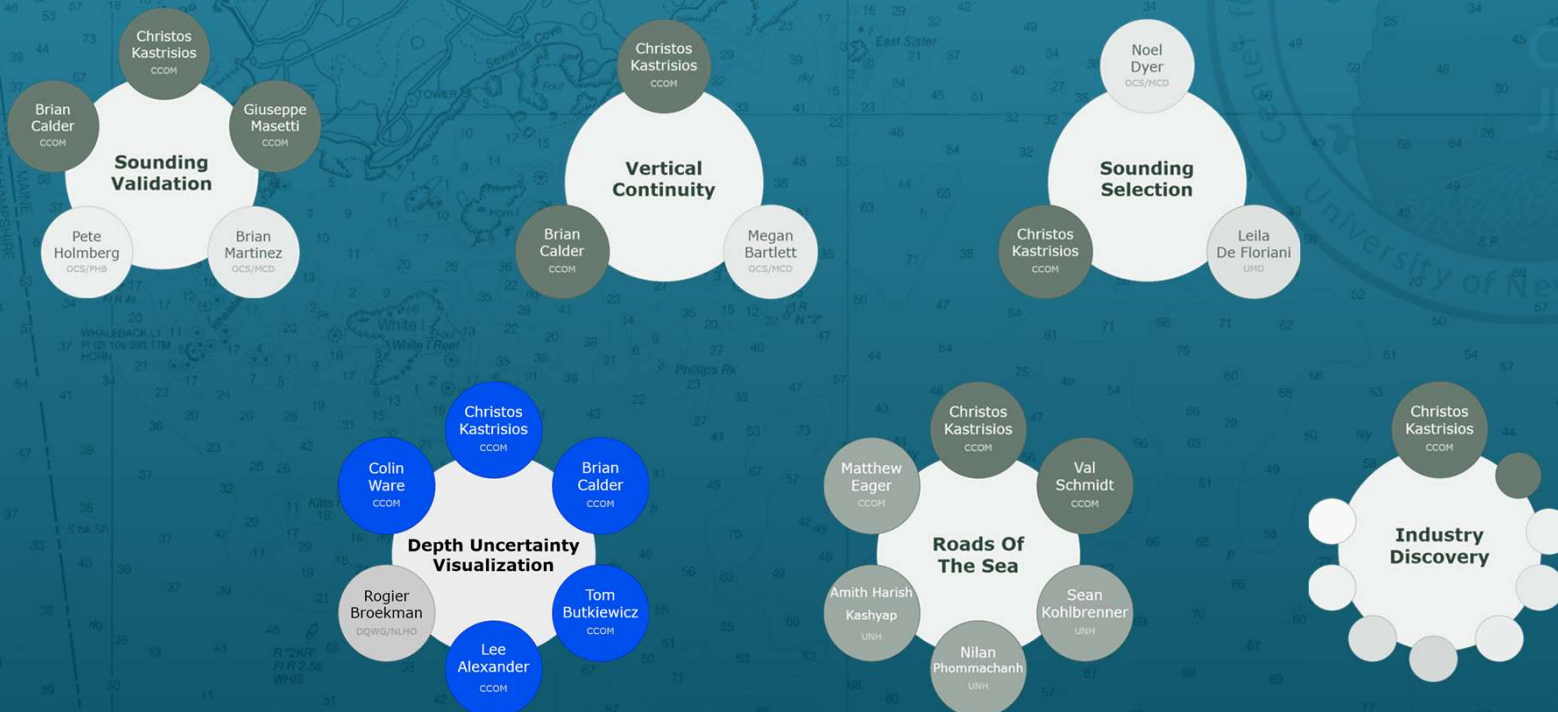




Data Quality  
Working Group

# BATHYMETRIC DATA QUALITY AND AUTONOMOUS NAVIGATION RELATED RESEARCH PROJECTS



CCOM

UNH

OCS/PHB

OCS/MCD

UMD

IHO

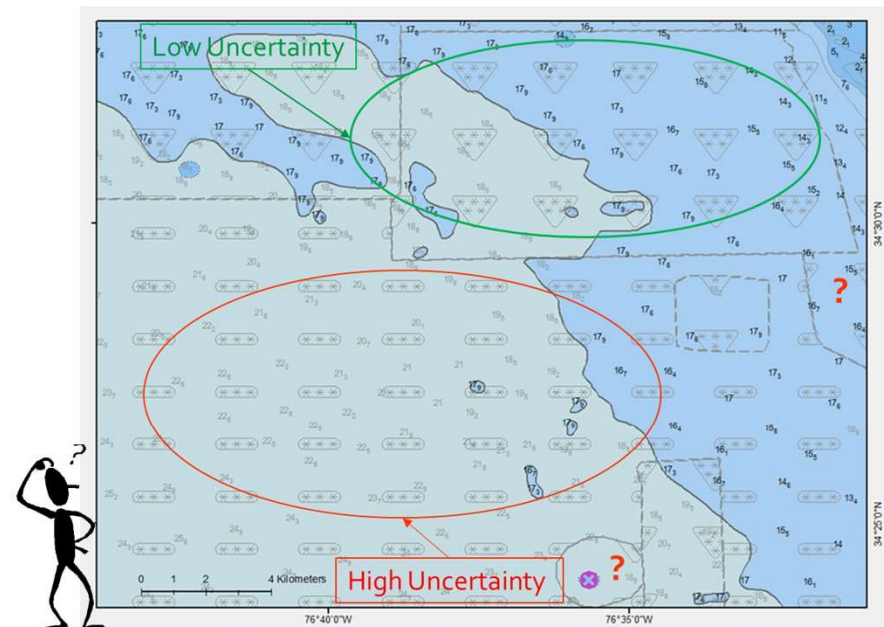


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# DEPTH UNCERTAINTY VISUALIZATION

## PROBLEMS

- CLUTTER
- Obscure high-quality more than low-quality data
- Not intuitive
- May not fit in small areas
- Continuous zoom-in/out is required
- Dominate the screen





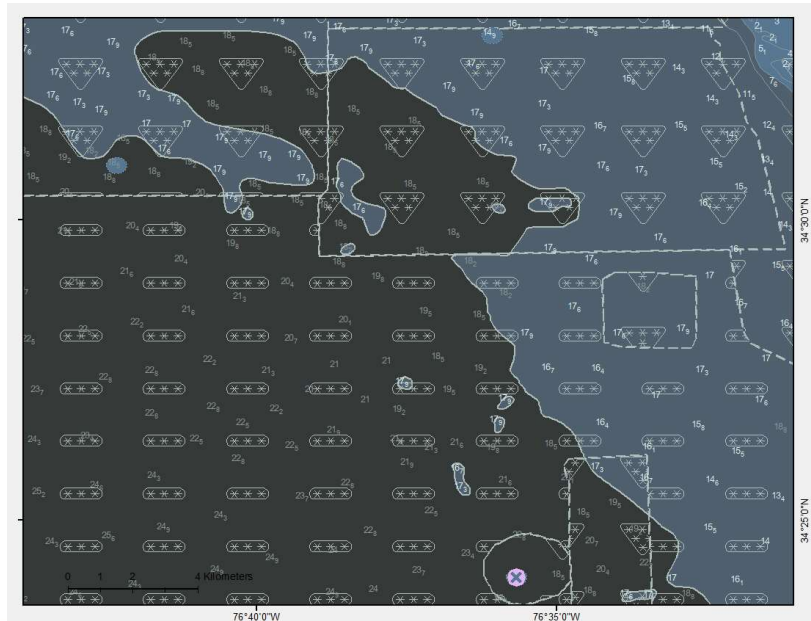
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# DEPTH UNCERTAINTY VISUALIZATION

## PROBLEMS

- CLUTTER
- Obscure high-quality more than low-quality data
- Not intuitive
- May not fit in small areas
- Continuous zoom-in/out is required
- Dominate the screen

ECDIS Day Blackback Mode







# DEPTH UNCERTAINTY VISUALIZATION

## ➤ Requirements:

- ☐ Minimize the occlusion of navigational information.
- ☐ Increase visual weight with the increase of data uncertainty.
- ☐ Unambiguously visualize the different uncertainty levels.
- ☐ Be easy to memorize
- ☐ Maintain effectiveness in all ECDIS modes

ZOC	Symbol	THU (m)	TVU (m)	Full Seabed Coverage
A1		5	0.5 + 1%	Yes
A2		20	1 + 2%	Yes
B		50	1 + 2%	No
C		500	2 + 5%	No
D		> 500	> 2 + 5%	No
U		U	U	U



QoBD	Symbol	THU (m)	TVU (m)	Full Seabed Coverage
1	?	5	0.5 + 1%	Yes
2	?	20	1 + 2%	Yes
3	?	50	1 + 2%	No
4	?	500	2 + 5%	No
5	?	> 500	> 2 + 5%	No
U	?	U	U	U
O	?	-	-	-

# DEPTH UNCERTAINTY VISUALIZATION

## Proposed Solution:

Sequence of textures,  
created by combining two or more visual variables

### Benefits:

- ✓ Minimally used
- ✓ Minimally interfere with chart information
- ✓ The combination can be intuitive
- ✓ Good visual hierarchy



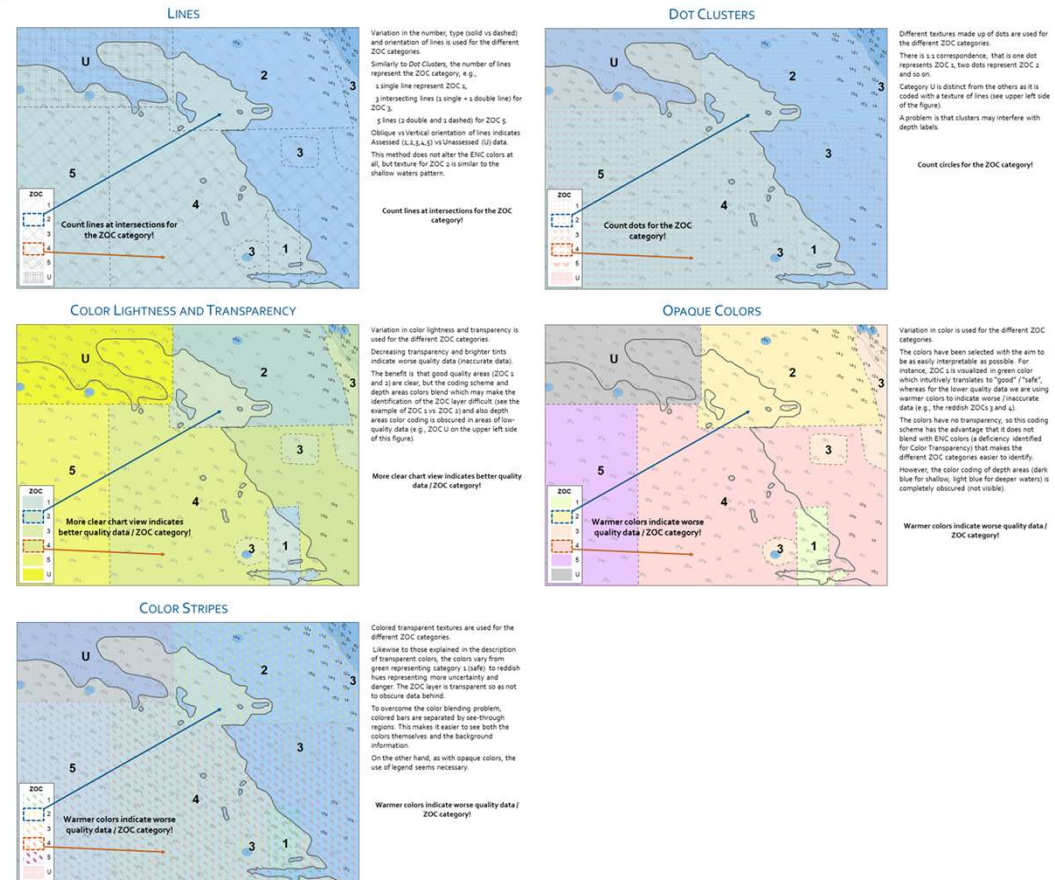
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# DEPTH UNCERTAINTY VISUALIZATION

## 5 Coding Schemes :

- Line textures
- Dot clusters
- Color lightness and transparency
- Opaque colors
- Color stripes

An online survey has been developed for their evaluation in 4 different areas



Online Survey: [https://unh.az1.qualtrics.com/jfe/form/SV\\_gtPKpnrcZusJ4RT](https://unh.az1.qualtrics.com/jfe/form/SV_gtPKpnrcZusJ4RT)

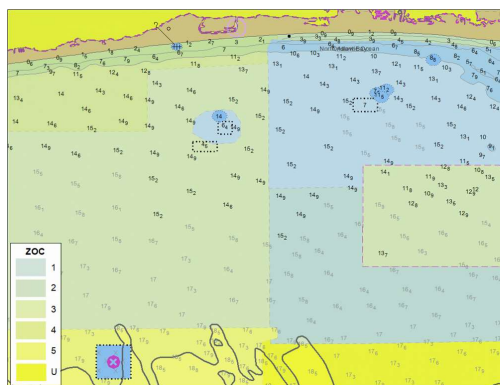




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# DEPTH UNCERTAINTY VISUALIZATION

## 4 Areas (3 in day bright, 1 in dusk ECDIS mode)



Timing

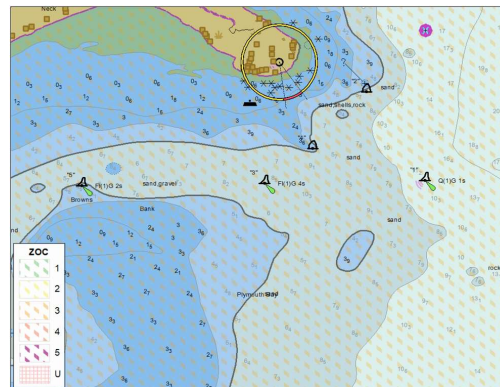
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Last Click 0 seconds  
Page Submit 0 seconds  
Click Count 0 clicks

### COLOR LIGHTNESS TRANSPARENCY

Please evaluate the following:

	0	1	2	3	4	5	6
Are the different ZOC categories distinct / unambiguous? (0=Not At All, 6=Very Much)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How quickly can you identify the different ZOC categories? (0=Very Slowly, 6=Very Quickly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is the coding easy to remember? (0=Not Easy, 6=Very Easy)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How much does the coding interfere with depth, depth areas, and other chart information? (0=Very Little, 6=A Lot)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are the areas of worse quality data more emphasized? (e.g., ZOC 4, ZOC 5) (0=Not At All, 6=Very Much)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Timing

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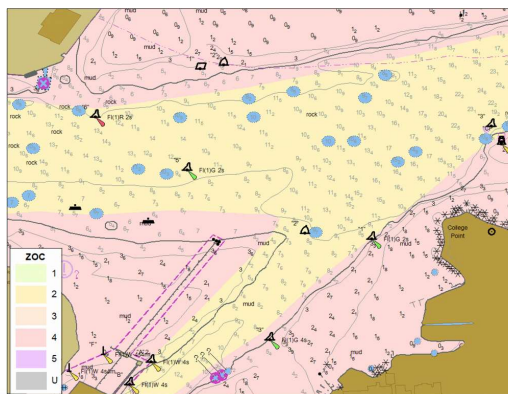
First Click 3.412 seconds  
Last Click 3.412 seconds  
Page Submit 0 seconds  
Click Count 1 clicks

### COLOR STRIPES

There is only one ZOC category in the view/area. What is that?

1	2	3	4	5	U
---	---	---	---	---	---

How quickly did you identify this ZOC category? (0=Very Slowly, 6=Very Quickly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How confident are you that you have identified the ZOC category correctly? (0=Not At All Confident, 6=Very Confident)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Would you be able to identify the ZOC category without the use of the legend/key? (0=Not At All, 6=Absolutely)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Timing

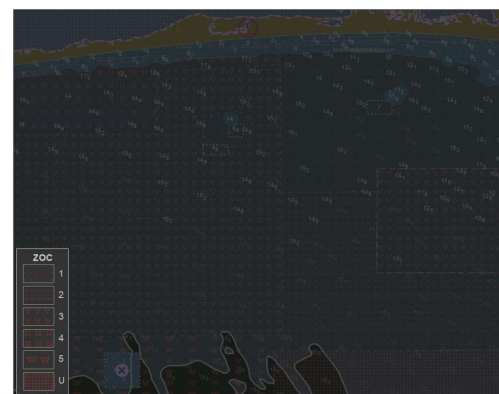
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First Click 0 seconds  
Last Click 0 seconds  
Page Submit 0 seconds  
Click Count 0 clicks

### OPAQUE COLORS

Please evaluate the following:

	0	1	2	3	4	5	6
Are the different ZOC categories distinct / unambiguous? (0=Not At All, 6=Very Much)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How quickly can you identify the different ZOC categories? (0=Very Slowly, 6=Very Quickly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is your ability to separate shallow from deep waters affected by the coding scheme? (0=Very Little, 6=A Lot)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How much visual clutter does the coding scheme add? (0=Very Little, 6=A Lot)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Are the areas of worse quality data more emphasized? (0=Not At All, 6=Very Much)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>



Timing

These page timer metrics will not be displayed to the recipient.

First Click 4.7659999999999999 seconds  
Last Click 4.7659999999999999 seconds  
Page Submit 1.26 seconds  
Click Count 1 clicks

### DOT CLUSTERS

Please evaluate the following:

	0	1	2	3	4	5	6
Are the different ZOC categories distinct / unambiguous? (0=Not At All, 6=Very Much)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How quickly can you identify the different ZOC categories? (0=Very Slowly, 6=Very Quickly)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is the coding easy to remember? (0=Not Easy, 6=Very Easy)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How quickly can you identify shallow/deeper waters using the coding scheme? (0=Very Little, 6=A Lot)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
How quickly can you read and identify shallow/deeper waters? (0=Not Easy, 6=Very Easy)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

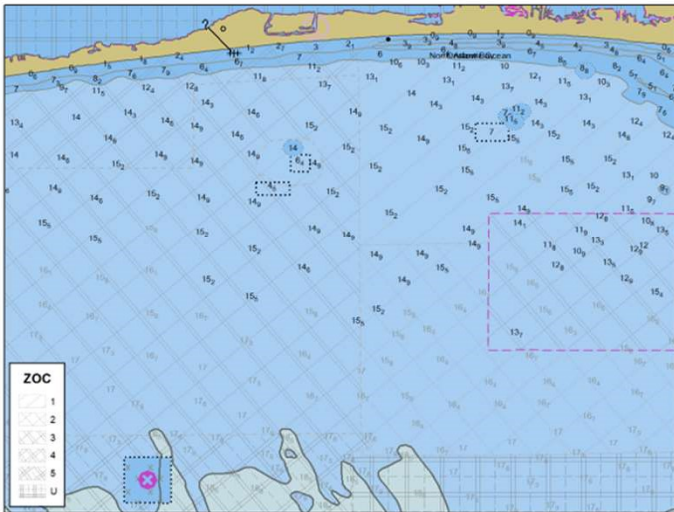
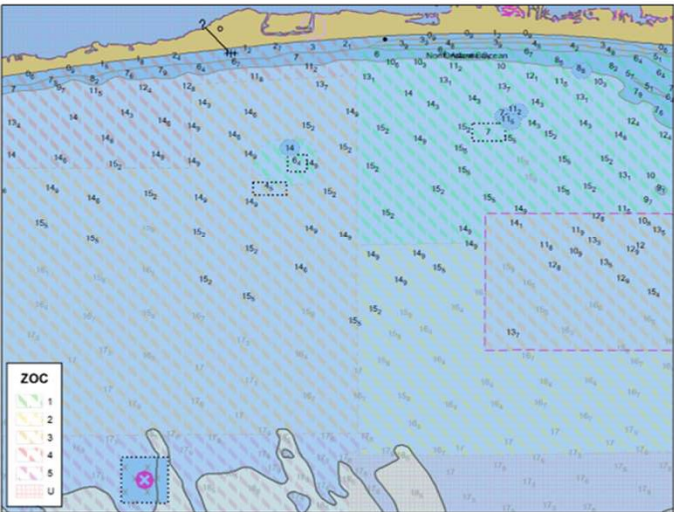


Online Survey: [https://unh.az1.qualtrics.com/jfe/form/SV\\_gtPKpnrcZusJ4RT](https://unh.az1.qualtrics.com/jfe/form/SV_gtPKpnrcZusJ4RT)

Please rank the 5 alternatives from 1-best to 5-worst for the Day Bright Mode.

CATZOC Visualization Scheme

		Opaque Colors	Color Transparency	Color Stripes	Dot Clusters	Lines
Your Ranking	1 Best	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	2	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	3	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	4	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	5 Worst	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>







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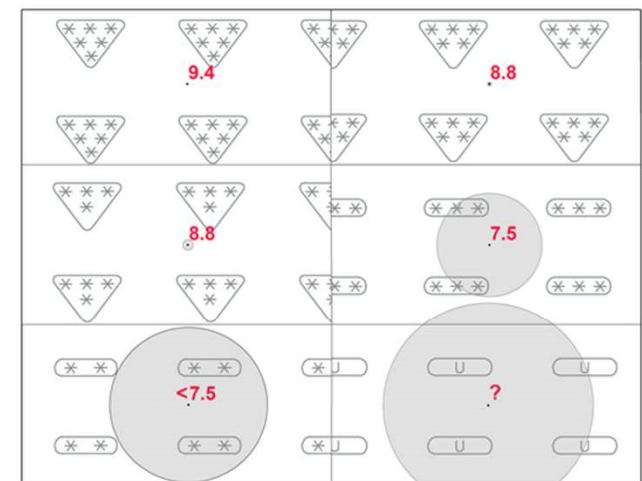
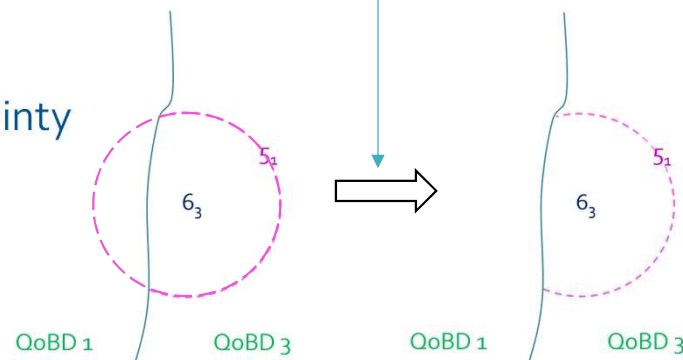
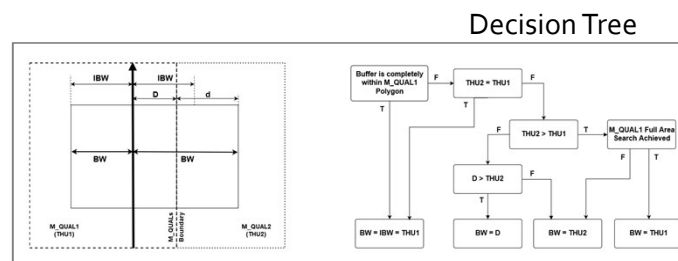
# DEPTH UNCERTAINTY INTEGRATION

## ➤ Individual Features:

- What?
- Where?
- When?
- How?

## ➤ Factors:

- Position uncertainty
- Depth Uncertainty
- Cartographic uncertainty





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