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Bathyswath Data Examples

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LIST OF MODIFICATIONS

Version	Date	Modifications	Pages	Writer	Checker
1.00	04/01/16	Initial document	11	MFG	DMA

ITER SYSTEMS

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1 INTRODUCTION

1.1 REFERENCES

Ref 1 Bathyswath website, at http://bathyswath.com/
Ref 2 Bathyswath Technical Information document, available from
http://bathyswath.com/sites/default/files/documents/ETD_2002_Bathyswath%20information_EN.pdf

1.2 GLOSSARY & ACRONYMS

WORDS & ACRONYMS	DEFINITION
BSW	Bathyswath
Depth	In this document, the height of the sonar system above the seabed
Horizontal range	The distance from the sonar system to a point on the seabed in plan view
Range	The distance from the sonar system to a point on the seabed; in this document, "range" means the maximum range achieved
Slant range	The distance from the sonar system to a point on the seabed in a straight line
Swath width	The width of the strip of ground surveyed by the sonar in a single pass over the seabed; equal to twice the horizontal range

1.3 SCOPE

This document provides screen-shots of data from various versions of Bathyswath, to allow a comparison between the different systems and options in various environments.

1.4 METHOD

The screenshots below were obtained by running the Bathyswath Swath Processor program, and using its cross-profile display. The screen-shots were taken using the Windows Snipping Tool application.

2 BATHYSWATH PERFORMANCE

2.1 GENERAL

Information on Bathyswath can be obtained from the Bathyswath website [Ref 1]. For detailed technical information, see Ref 2.

2.2 VERSIONS AND OPTIONS

In 2015, a new version of Bathyswath was released: Bathyswath 2. This does the same job as the previous version, Bathyswath 1, but has new electronics and transducers, which improves the sonar performance.

Both Bathyswath 1 and Bathyswath 2 are available with three sonar frequencies: 468kHz, 234kHz and 117kHz. Lower frequencies give longer sonar ranges, but require larger transducers.

Bathyswath 1 is functionally very similar to the previous SWATHplus system; examples from SWATHplus are labelled “BSW 1” below.

2.3 LIMITS TO SONAR PERFORMANCE

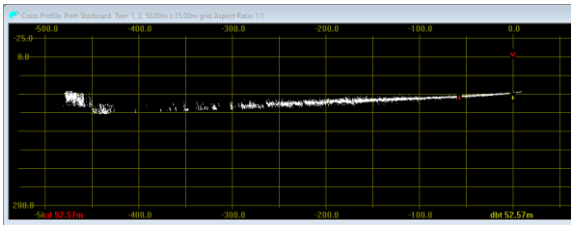
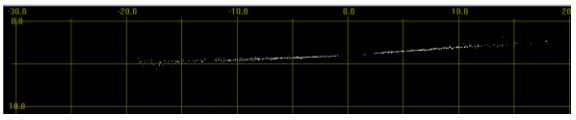
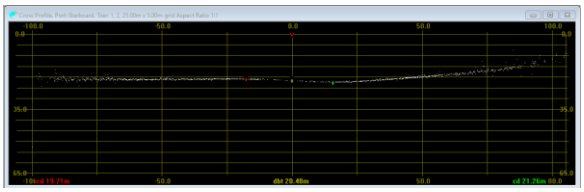
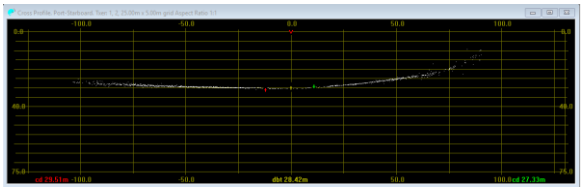
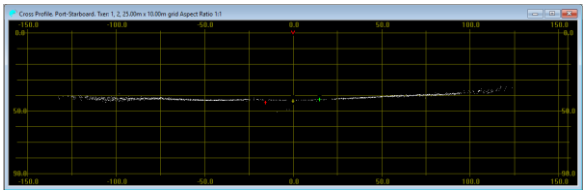
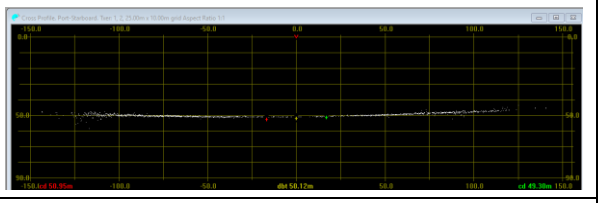
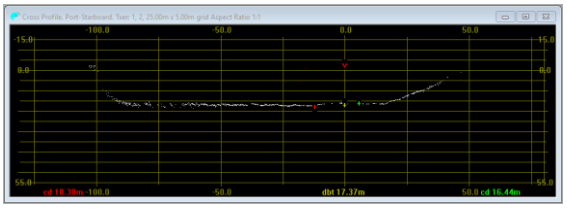
Sonar range and data quality are affected by:

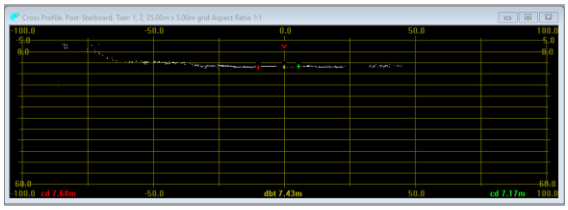
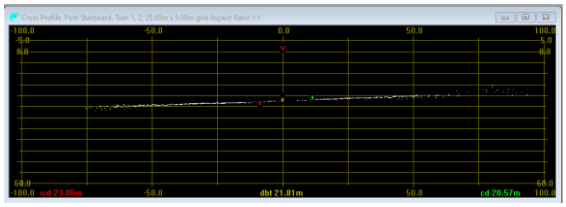
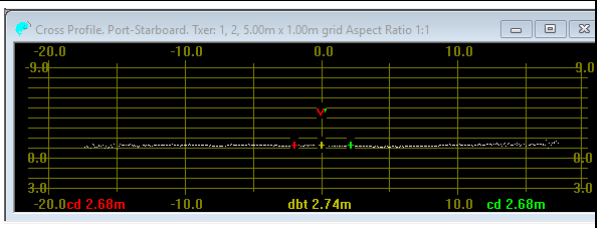
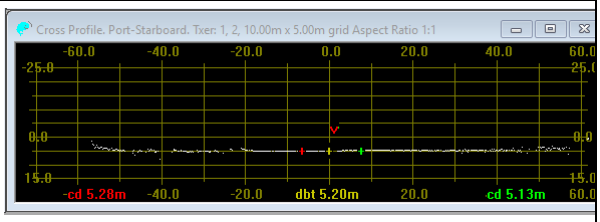
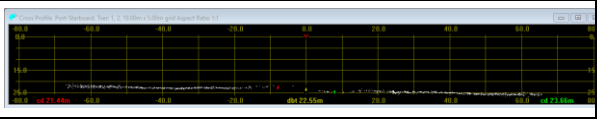
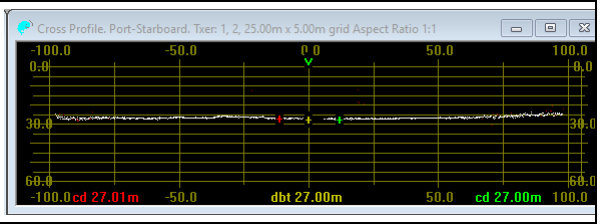
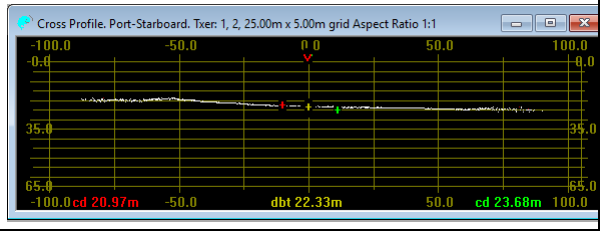
- Absorption of the sound wave in water: this is affected by the distance the sound travels (range) and sonar frequency: lower frequency is less affected by absorption
- The angle that the sound “ray” makes with the seabed: at far range in shallow water, the sound “ray” makes a very shallow angle with the seabed, and most of the sound bounces away rather than being scattered back to the receiver. This angle is determined by the depth of the water, so that longer ranges are obtained in deeper water.
- External noise signals: if external acoustic or electrical “noise” is too high, then the sonar signal is obscured by the noise. Bathyswath 2 is designed to be more immune to noise than Bathyswath 1.

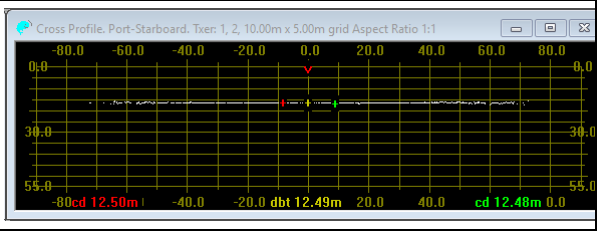
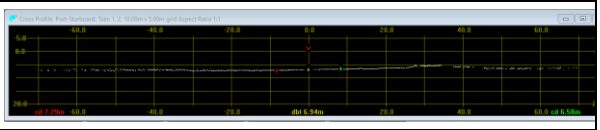
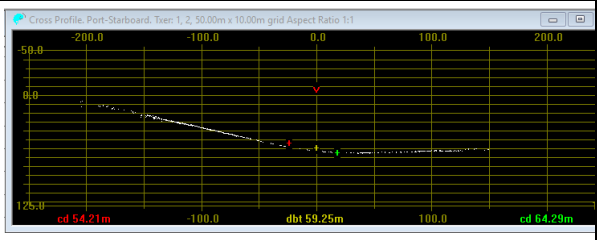
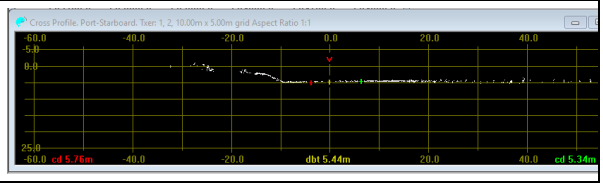
So:

- In very shallow water (less than about 20m depth), range is between 5 and 10 times the depth
- In deeper water, range is greater when using lower sonar frequency and in cooler, clearer water.

3 DATA EXAMPLES

Ref.	System	Freq. /kHz	Depth	Range	Location	Conditions	Cross-Profile
1	BSW 2	234	50	475	Annecy, France	Cool clear water, mud & rock	
2	BSW 2	468	1	18	Annecy, France	Cool clear water, mud & rock	
3	BSW 2	468	20	100	Annecy, France	Cool clear water, mud & rock	
4	BSW 2	468	30	100	Annecy, France	Cool clear water, mud & rock	
5	BSW 2	468	40	125	Annecy, France	Cool clear water, mud & rock	
6	BSW 2	468	50	125	Annecy, France	Cool clear water, mud & rock	
7	BSW 2	468	17	100	Vizag, India	Warm, turbid water, mud bottom	

Ref.	System	Freq. /kHz	Depth	Range	Location	Conditions	Cross-Profile
8	BSW 2	468	7	75	Vizag, India	Warm, turbid water, mud bottom	
9	BSW 2	468	20	75	Vizag, India	Warm, turbid water, mud bottom	
10	BSW1	468	2.7	17	Ghent, Belgium	Turbid canal water, mud bottom	
11	BSW1	468	5	55	Dublin, Ireland	Cool, turbid sea water	
12	BSW1	117	22	70	Portsmouth, NH, USA	Cool sea water	
13	BSW1	234	27	100	Portsmouth, NH, USA	Cool sea water	
14	BSW1	468	22	75	Portsmouth, NH, USA	Cool sea water	

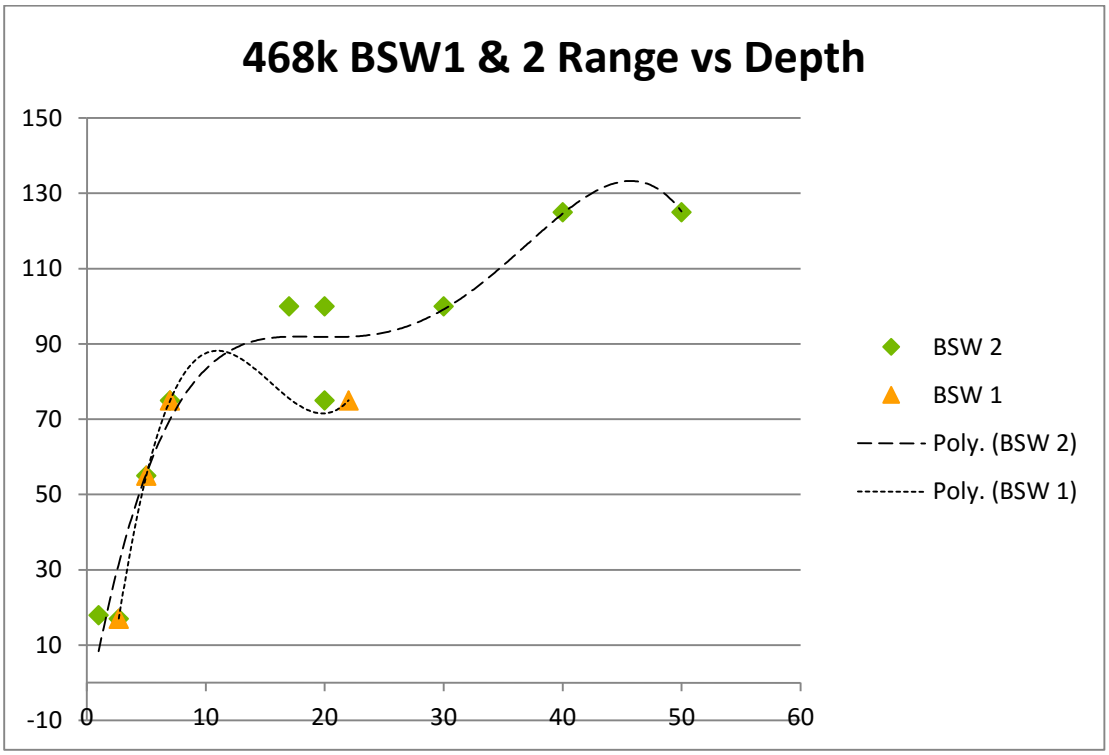
Ref.	System	Freq. /kHz	Depth	Range	Location	Conditions	Cross-Profile
15	BSW1	234	12	70	Falmouth, MA, USA	Cool clear sea water, sand bottom	
16	BSW1	468	7	75	Belle River, MI, USA	Cool clear sea water, sand bottom	
17	BSW1	117	60	200	Green-land	Cold clear sea water	
18	BSW1	117	5.5	50	Vietnam	Warm sea water	

4 ANALYSIS

There are several variables: sonar version (Bathyswath 1 and Bathyswath 2), sonar frequency, depth, and sonar conditions (turbidity, water temperature, bottom type), so it is difficult to analyse the sonar performance for all of them with the profiles shown above. However, a few points can be brought out from the data above.

4.1 ANGLE AND ABSORPTION

The following plot shows the ranges achieved at various water depths using Bathyswath 1 and Bathyswath 2.



The following observations can be made:

- Both Bathyswath 1 and Bathyswath 2 have a linear relationship between range and depth up to a depth of about 10 metres, with a ratio of about 7 to 1. This limit comes from the angle of incidence between sound ray and seabed at far range.
- Beyond a range of about 70m, the Bathyswath 1 data is limited to about 75 metres, and Bathyswath 2 is limited to about 120m. Bathyswath 2 data has been observed to 150m in other tests. This limit comes from the absorption of the sound wave in the water.

4.2 BATHYSWATH 1 AND BATHYSWATH 2

Ranges for Bathyswath 2 systems are considerably greater than Bathyswath 1 in similar frequencies and environments, where the range is limited by absorption. This is mostly because of better signal-to-noise from the Bathyswath 2 electronics and transducers.

The 475m return with the 234kHz Bathyswath 2 is partly as a result of looking at a hard rock cliff at far range, giving a very strong return. Nonetheless, the 234kHz Bathyswath 2 systems give better returns than Bathyswath 1.

4.3 EFFECT OF ENVIRONMENT

The results shown in ref 3 and ref 9 were obtained using the same system, a few weeks apart, at similar water depths. The first was in the cool clear water of Lake Annecy, giving a range of 100 metres, with little variation of the profile out to 75m. The second was in warm, salty water on the east coast of India, giving ranges to 75m, with good quality out to 50m. The difference is due to increased absorption of the sound signal in the warmer, saltier, more turbid water.

In such more absorbent conditions, it is often better to use the 234kHz option rather than 468kHz, as absorption increases with increasing sonar frequency.

4.4 SONAR FREQUENCY

The results above confirm that range increases with decreasing sonar frequency.