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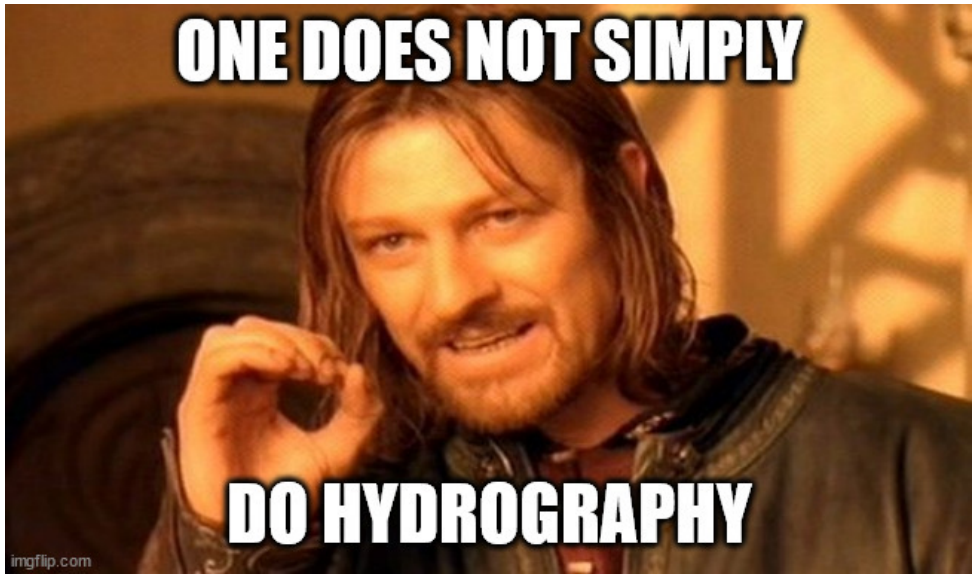
So, you want to be a Hydrographer?

Jonathan Beaudoin, Managing Director

HydroOctave Consulting Inc.

2024 OSBEELS Symposium, Sept 26 & 27, 2024



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What might it take for land surveyors to begin doing hydrographic work?

Commonalities and differences between the two types of surveying?

Challenging facets of doing survey work on or in the water?

After this presentation …

- You'll Know What You Don't Know
- You'll Know What to Google
- You'll Know That It's Possible
- You'll Know How to Get Help

Gathering Ideas, Advice, Musings & A Few Rants

ChatGPT

What advice would you give to a land surveyor wanting to do work in the field of hydrography?

ChatHumanity

One-on-one Conversations

Questionnaire via LinkedIn

LinkedIn Comments

Troy Greene • 1st
Instructor at Centre of Geographic Sciences
2d •••

Total station theory transferable to water: still direction and distance

Mark Biddulph • 1st
Chief Operations Officer at Seismic Asia Pacific
2d (edited) •••

It's a steep learning curve for someone coming from land to Hydro. With clients from all experiences both land air engineering and Hydro. SBES is doable fairly easily, its when you move into MBES 3DSS and SSS the learning curve that I have witnessed steeply rises for them.

Joshua Sampey (He/Him) • 1st
Technical Support at HYPACK, a Xylem Brand
2d •••

I've found that many are often unaware of beam footprints and think a sonar is the same as a survey rod point! The same point at any rod length.

Alex Howden • 2nd
Owner/President at CRA Canada Surveys INC
1d •••

Its doable, as said single beam is easy to attain.
Especially with a relatively flat bottom.
With steeper bottom profiles I've witnessed issues with latency and survey planning. Sonar beam width at depth, sounding at shoalest location within the beam footprint. ...more

Straud Armstrong • 1st
Director of Product and Sales at HYPACK, a Xylem Brand
2d •••

They tend toward negativity, relative to depth

Funny · 6 | Reply

Questionnaire

Jonathan Beaudoin • You
Hydrographic Consultant & Multibeam Nerd
2d •

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I've been asked to give a talk about hydrographic surveying at a land surveyors conference in a few weeks. I've decided to discuss what it might be like for a land surveyor to begin doing work in hydrography. I have my own perceptions but I'd like to round them out with viewpoints from other people. If you have any insights to share, I'd appreciate to hear your thoughts via the questionnaire link below:

https://lnkd.in/g7p7BTGH

What do land surveying and hydrographic surveying have **most** in common?

27 responses

What do land surveying and hydrographic surveying have **least** in common?

28 responses

What would be the most significant challenge for a land surveyor wishing to try out hydrographic surveying? Why?

28 responses

Following on from the previous question, how could a land surveyor overcome that challenge?

28 responses

If you have a land surveying background and you've managed to gain some success doing hydrographic work, what advice would you give to someone thinking of doing the same?

24 responses

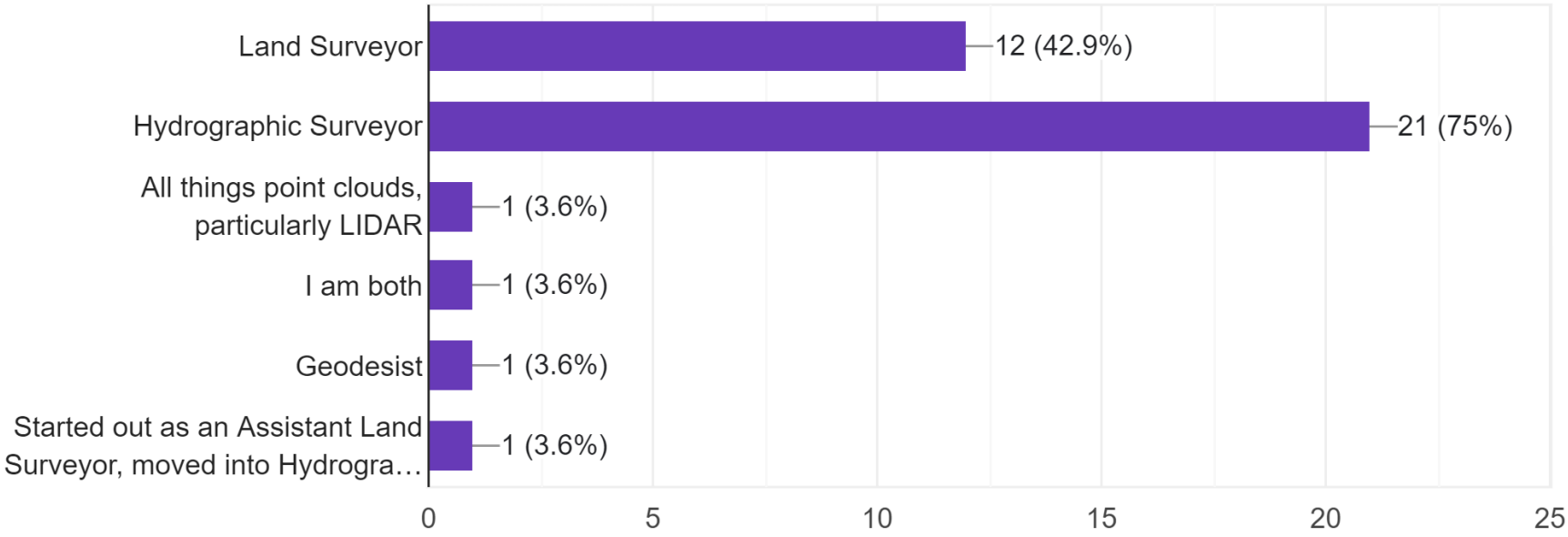
Is there anything else you would like to share about this topic?

20 responses

Questionnaire

What is your primary specialty/background?

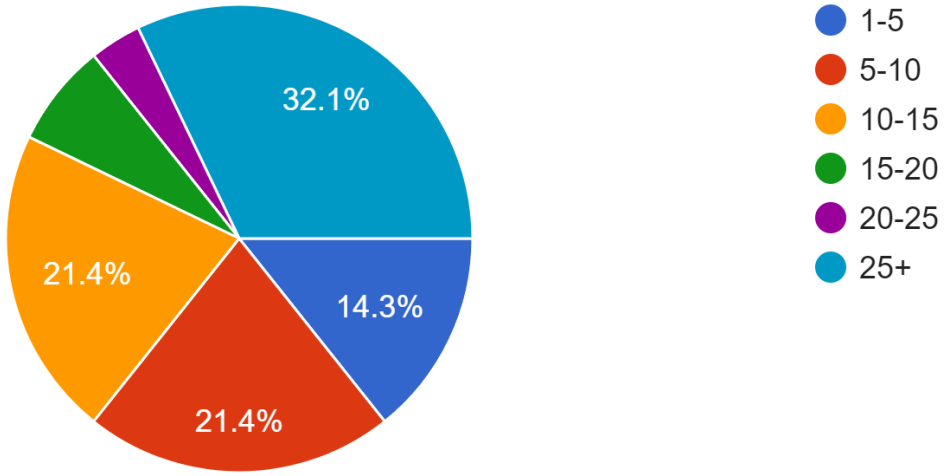
28 responses



Questionnaire

How many years of experience do you have as a surveyor?

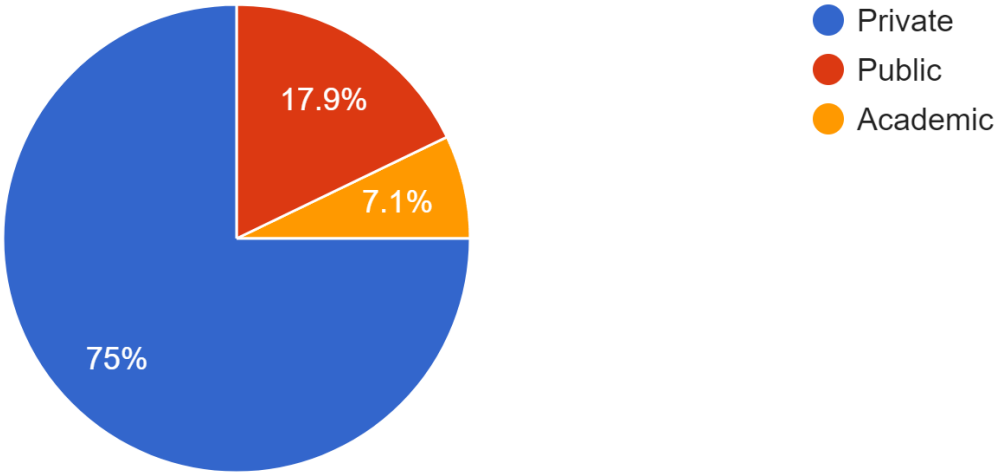
28 responses



Questionnaire

What sector do you fall in?

28 responses



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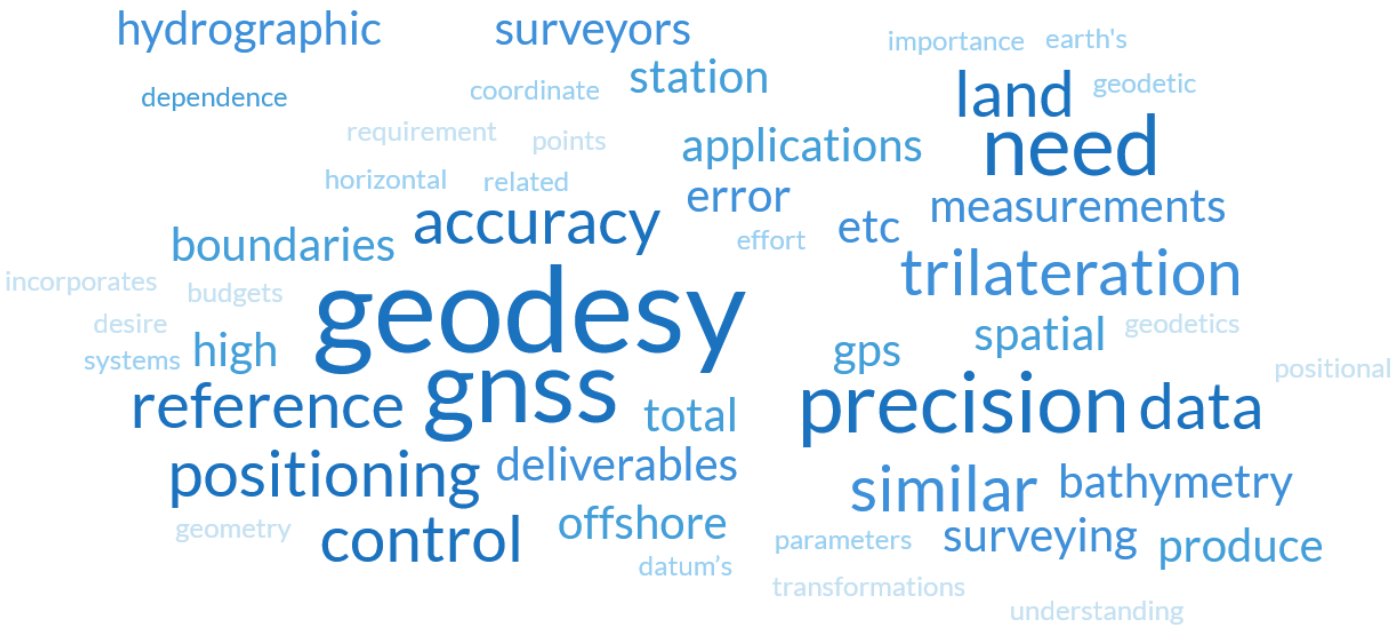

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What do land surveying and hydrographic surveying have **most** in common?

27 responses

Geodesy

- Dependence on geodesy and related geodetic parameters in effort to reference deliverables

Practices

- Requirement for accuracy, precision
- Understanding of error budgets
- Need for procedures, quality control, & due diligence to ensure measurements meet project requirements

Deliverables

- Spatial data linked to a spatial reference frame
- Plans, contours, elevation models, charts, spot heights, topographic maps, volumes

Tools

- GNSS, leveling
- GIS and CAD software
- Satellite corrections
- Computers

Math, Trigonometry, Geometry, Physics

- Triangulation, trilateration and traversing
- You don't need to be a Mathlete but it needs to add up

Land Surveyor Advantage

You know ALL of this and have mastered it

Entrants from other domains start from scratch

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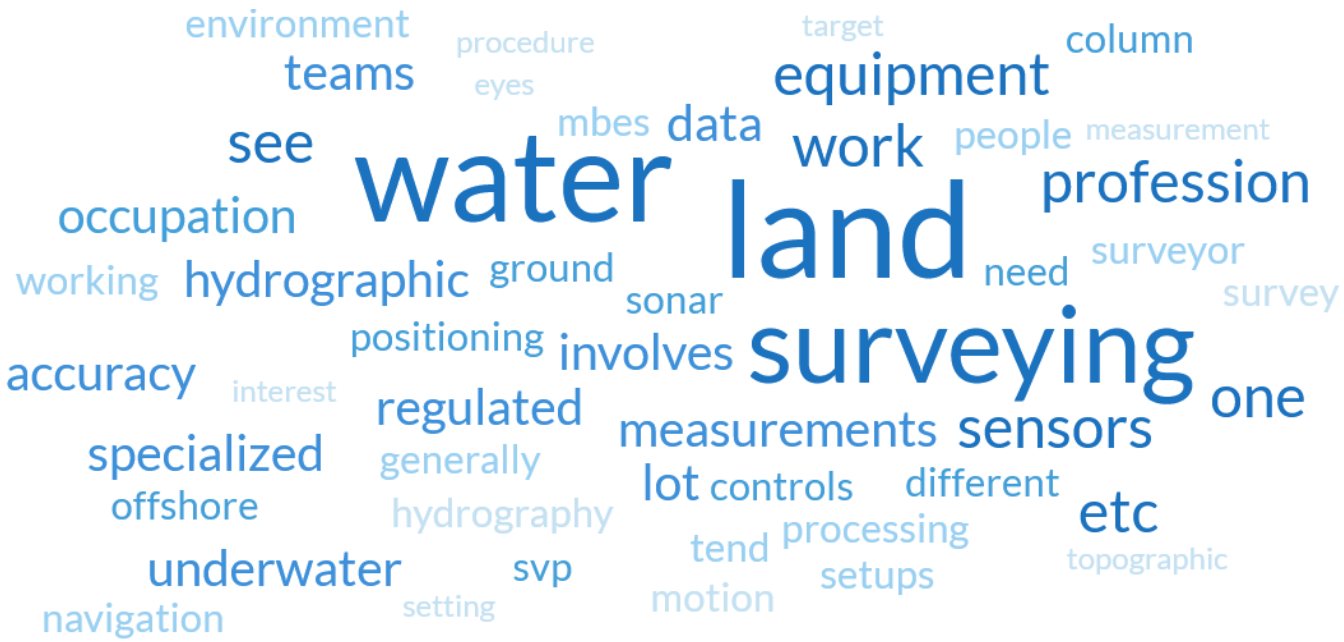
What do land surveying and hydrographic surveying have **least** in common?

28 responses



What do land surveying and hydrographic surveying have **least** in common?

28 responses

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Water

- Surveying on and through water
- Z positive down, sometimes
- **Boats** – Seasickness, Close quarters, Safety
- Cannot “see” what you map
- **Underwater Acoustics**

Mobile Mapping

- Everything is kinematic
- Motion compensation
- Incredible need for real-time integration & QC

Positioning, Geodetics, Datums

- Ground control non-existent offshore
- Real-time GNSS aiding (RTK, WAAS)
- Vertical datums offshore?

Equipment

- **Acoustic sensors – Single beam, sidescan, multibeam**
- Underwater positioning systems
- Inertial Navigation Systems (INS)
- 3D orientation
- Speed of sound sensors (surface and profiling)
- **Relative location/orientation of all sensors on platform**
- Precise timing

Measurements, Data & Processing

- Datagrams from sensors, MBES data processing
- Navigation and Processing Software
- Calibration & Measurement procedures

What do land surveying and hydrographic surveying have **least** in common?

28 responses

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Accuracy & Repeatability

- Dynamic 3D positioning at surface is only half the battle
- Range/bearing measurements through water – Oceanography, currents, T&S, refraction
- Accuracy & Repeatability is challenging
- Difficult to independently verify accuracy

IT & Computer Skills

- Networking
- Electronic communications – wired, wireless
- Firewalls

Teams & Lifestyle

- Hydrographic teams generally larger & multicultural teams
- Very mobile profession – work anywhere in the world
- Away from home a lot

Regulation & Certification

- Land surveying well regulated, infrastructure in place for education & certification, typically at state level
- Certification just starting with hydrography, typically at national level
- Becoming the norm to see Certification required for some contracts

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Boats

"The two best days in a boat owner's life are the day they buy a boat and the day they sell it"

"A boat is a hole in the water you throw your money in"

"The only thing better than owning a boat is having a friend that owns a boat."

Maintenance, certification, insurance, liability, safety, training, weather, etc

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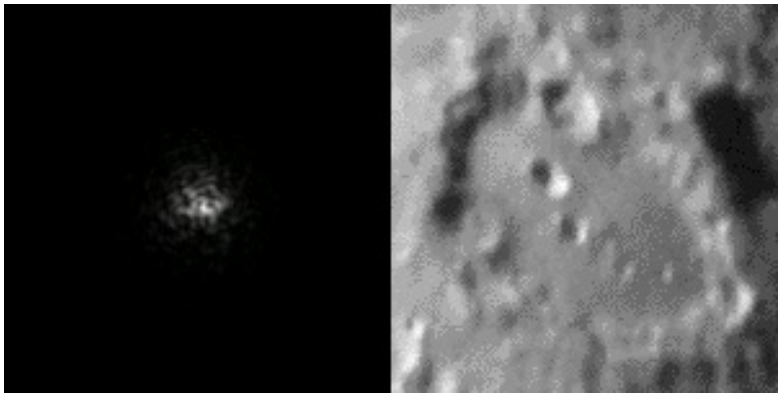
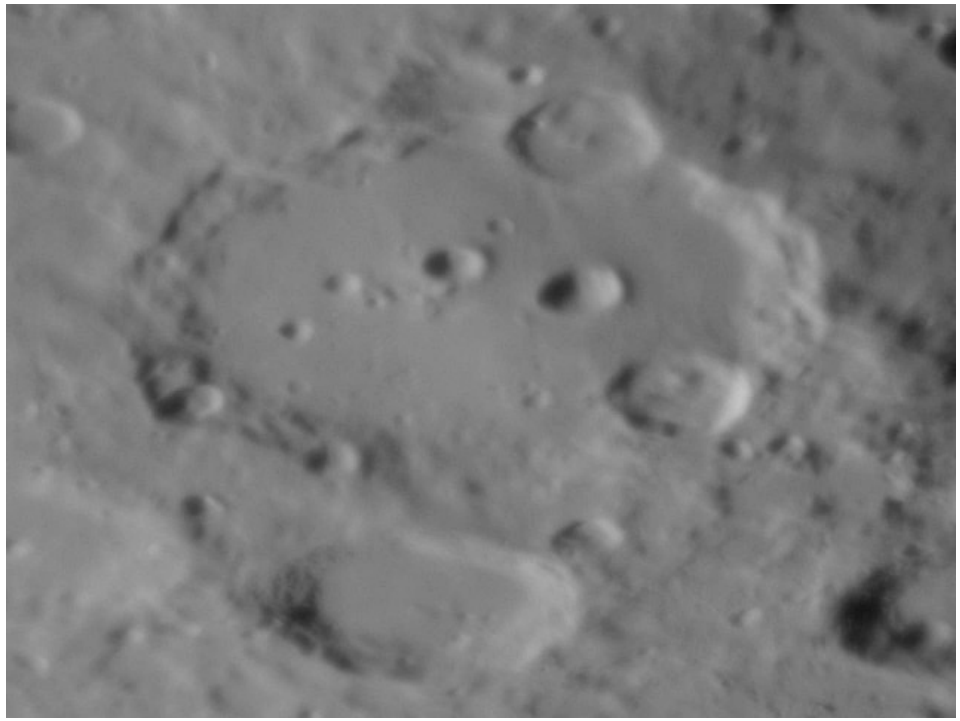
Underwater Acoustics



Variations in Seeing on Star and Moon
Credit: The Schools' Observatory

Temperature & Salinity layers cause acoustic refraction, distorting the travel path from acoustic sensor to target



https://www.handprint.com/ASTRO/seeing1.html

Tools of the Trade: Hardware

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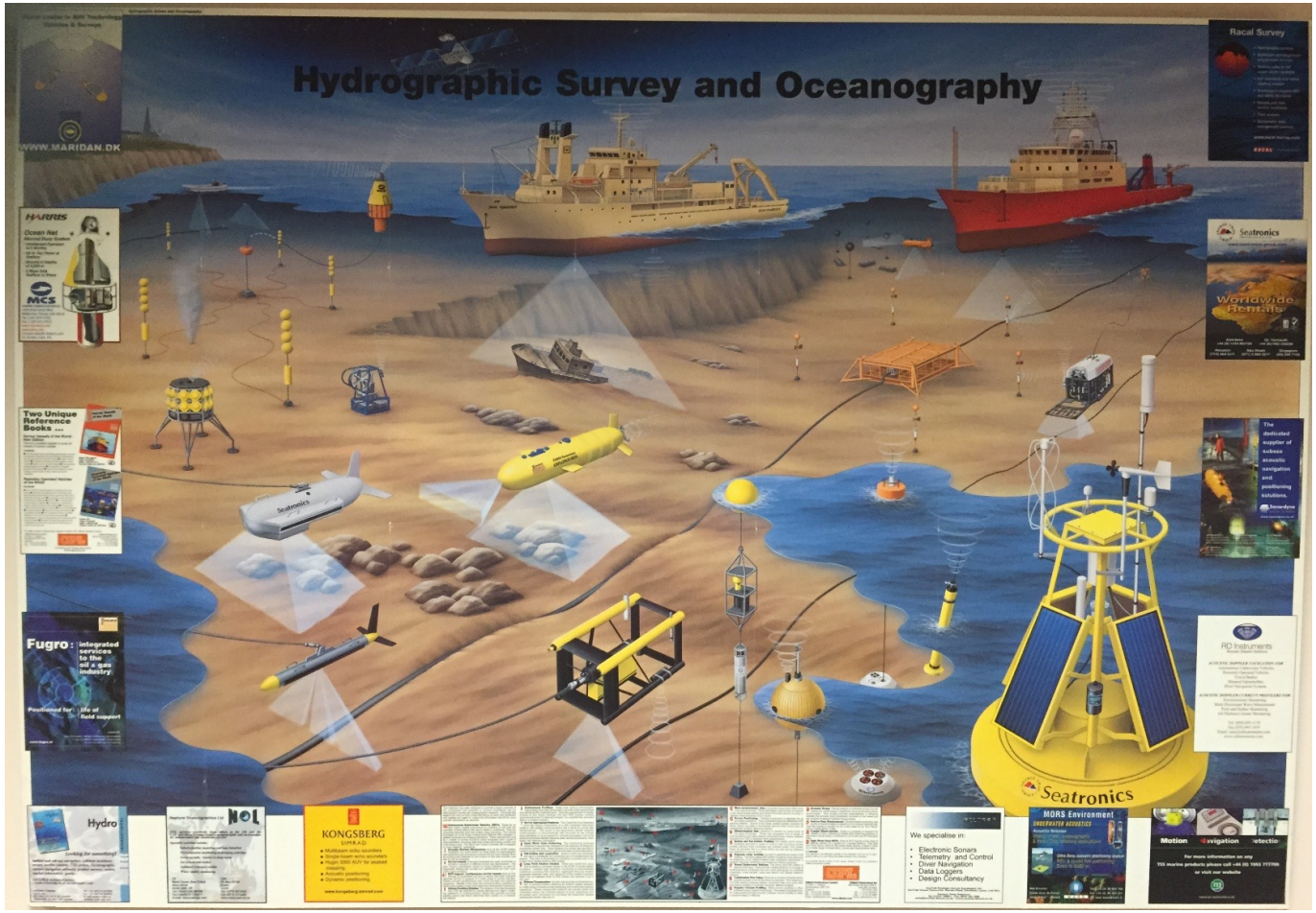

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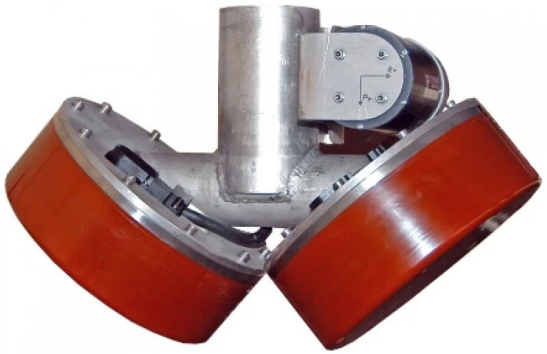
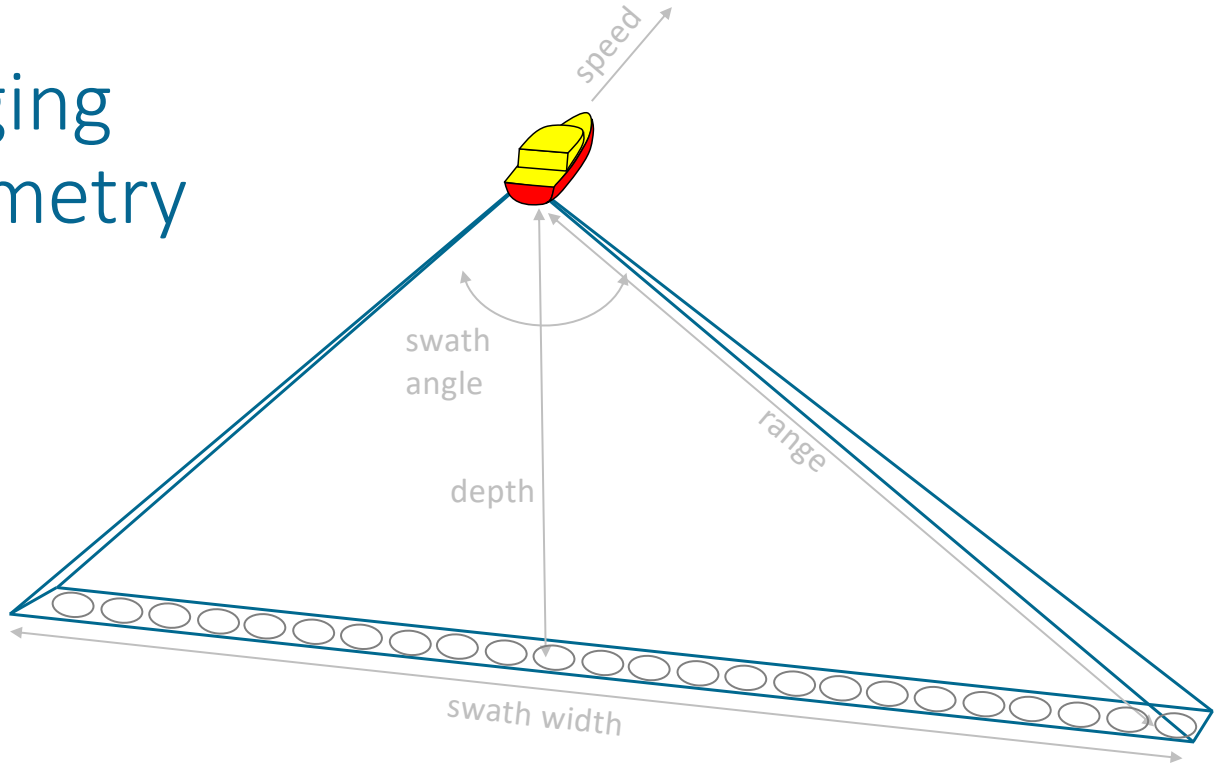
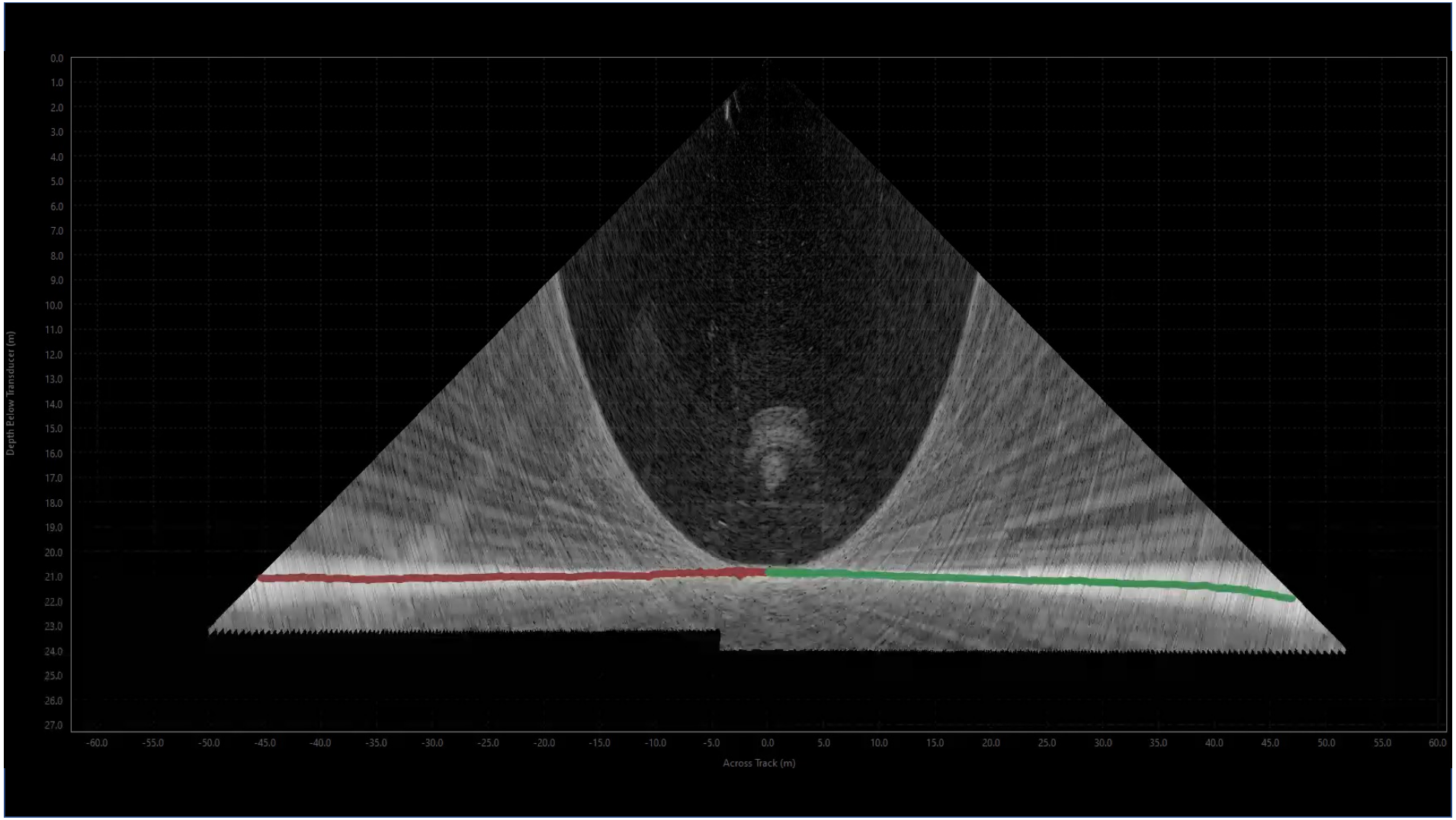
Multibeam Echosounders

- Number of beams
- Resolution
- Accuracy
- Repeatability
- Price
- Quality
- Warranty
- Customer Service
- Delivery Time



Imaging Geometry




Depth Below Transducer (m)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
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22.0
23.0
24.0
25.0
26.0
27.0
-60.0
-55.0
-50.0
-45.0
-40.0
-35.0
-30.0
-25.0
-20.0
-15.0
-10.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
55.0
60.0
Across Track (m)

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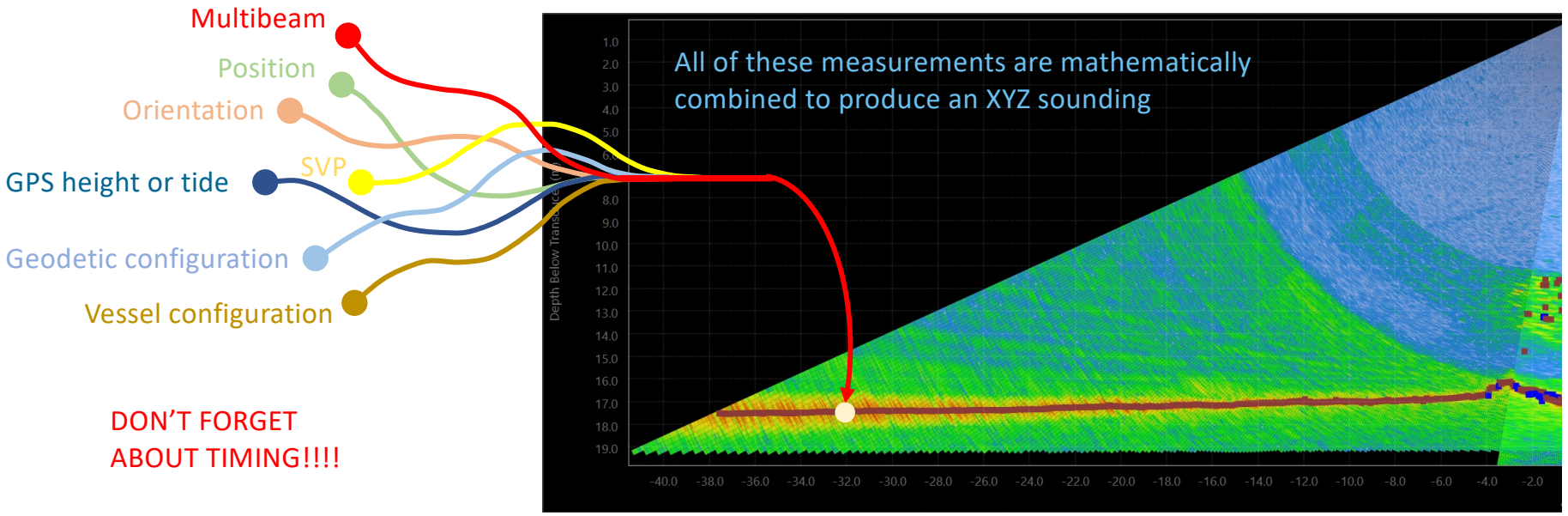
Hydrographic Processing Primer



DON'T FORGET
ABOUT TIMING!!!!

Typical deliverables are grids, point clouds

Input data comes from several sensors and config/metadata

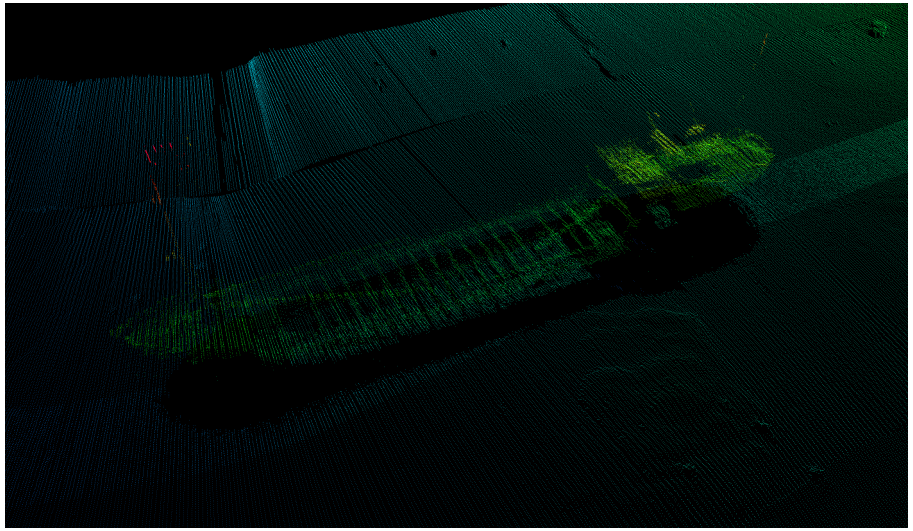
Point Clouds and Grids

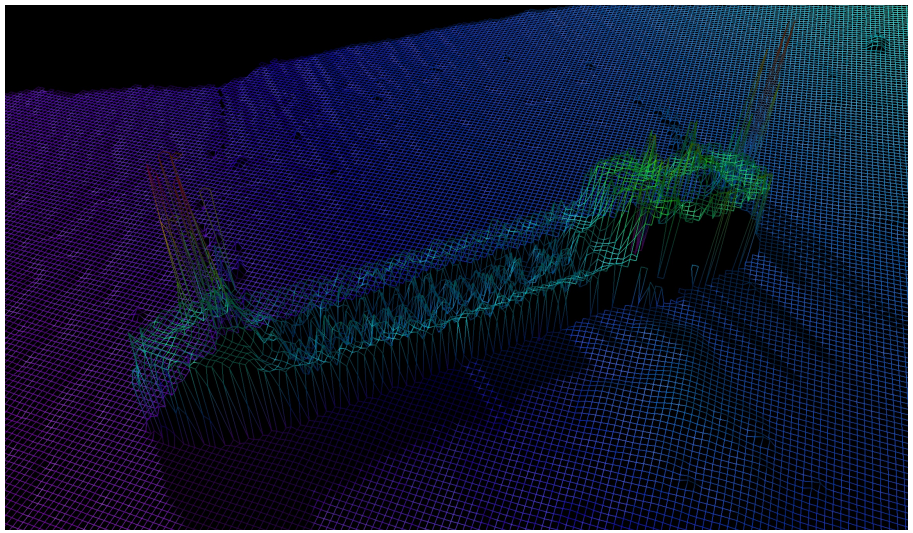
Point Cloud

- Set of 3D point measurements
- Distribution is often uneven
- Some points are wrong (outliers/noise)

Grid

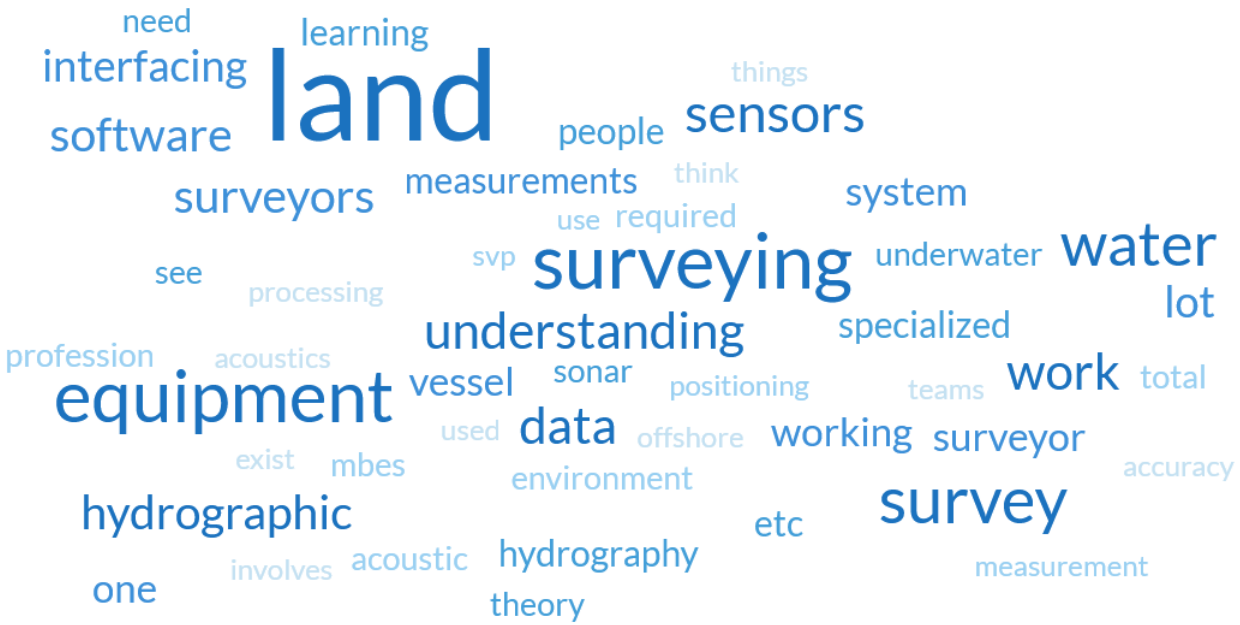
- 3D lattice with fixed interval
- Point clouds used to build grid
- Easy to display
- Easy to design algorithms, e.g. contouring, slope
- Efficient for storage/transmission/algorithms





What would be the most significant challenge for a land surveyor wishing to try out hydrographic surveying? Why?

28 responses



What would be the most significant challenge for a land surveyor wishing to try out hydrographic surveying? Why?

28 responses

Complexity

- Multiple sensors
- Multiple software packages – Real-time & Post-Processing
- Integration of hardware & software
- Workflow documentation, quality assurance
- Configuration of geodetics, especially vertical datums
- Mobilization is high stress, difficult
- IT, networking, electronic communications

Acoustics

- Understanding of acoustic sensors
- Propagation of sound in water
- Interaction of sound with seabed
- Acoustic aspects impacting choice, configuration and operation of instrumentation

Boats

- Dynamic observation platform – Seasickness, Data Quality
- Being comfortable at sea for extended periods of time
- Understanding vessel, ocean dynamics
- Finding a captain

Calibration, Precision & Accuracy

- Calibrating the equipment properly
- Processing/deliverables significantly more complex
- Accepting less accurate data (within +/- 0.10)

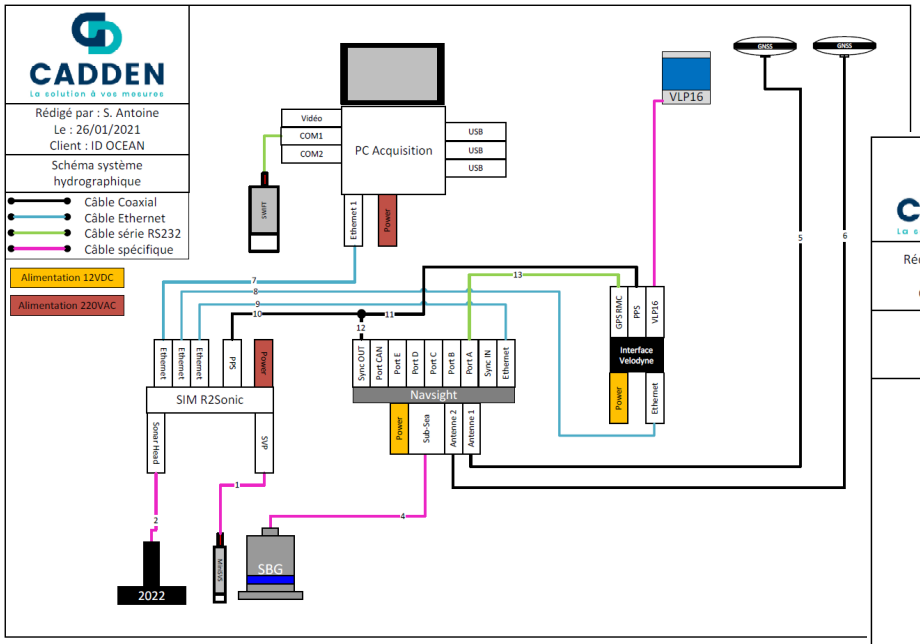
Education & Training

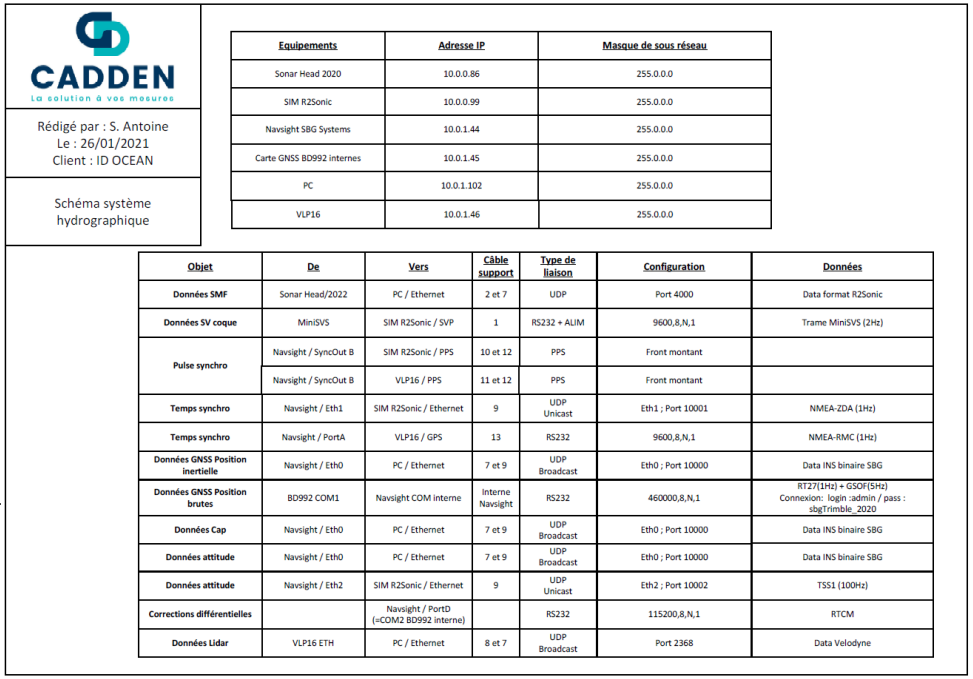
- Usually little hydrography in land survey education curriculum
- Hydrographic training courses are significant time investment

Lifestyle

- Lots of travel, limited contact with family and loved ones
- Cramped working conditions
- Work schedule/lifestyle

Wiring Diagrams



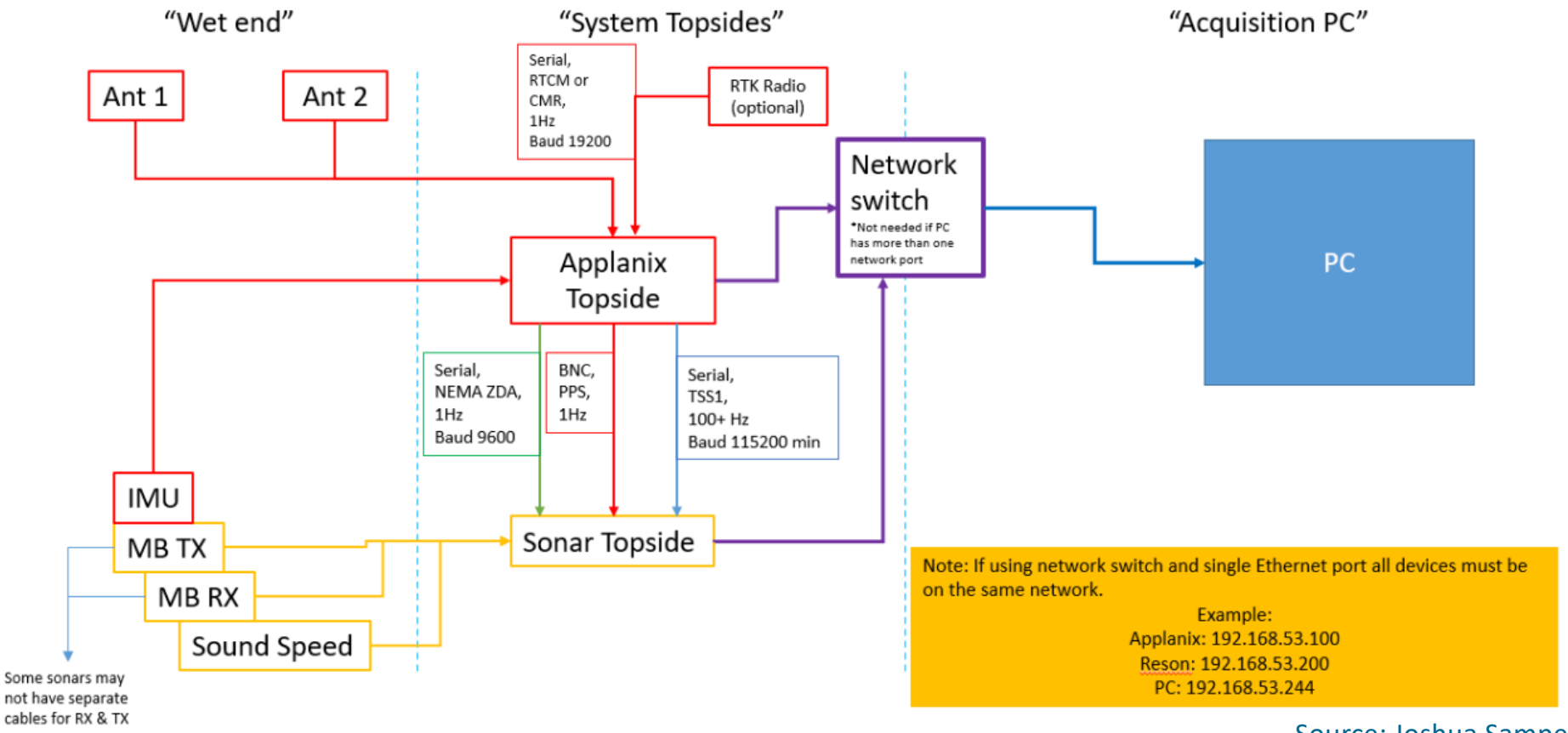


Equipements	Adresse IP	Masque de sous réseau
Sonar Head 2020	10.0.0.86	255.0.0.0
SIM R2Sonic	10.0.0.99	255.0.0.0
Navsight SBG Systems	10.0.1.44	255.0.0.0
Carte GNSS BD992 internes	10.0.1.45	255.0.0.0
PC	10.0.1.102	255.0.0.0
VLP16	10.0.1.46	255.0.0.0

Objet	De	Vers	Câble support	Type de liaison	Configuration	Données
Données SMF	Sonar Head/2022	PC / Ethernet	2 et 7	UDP	Port 4000	Data format R2Sonic
Données SV coque	MiniSVS	SIM R2Sonic / SVP	1	RS232 + ALIM	9600,8,N,1	Trame MiniSVS (2Hz)
Pulse synchro	Navsight / SyncOut B	SIM R2Sonic / PPS	10 et 12	PPS	Front montant	
	Navsight / SyncOut B	VLP16 / PPS	11 et 12	PPS	Front montant	
Temps synchro	Navsight / Eth1	SIM R2Sonic / Ethernet	9	UDP Unicast	Eth1 ; Port 10001	NMEA-ZDA (1Hz)
Temps synchro	Navsight / PortA	VLP16 / GPS	13	RS232	9600,8,N,1	NMEA-RMC (1Hz)
Données GNSS Position inertielle	Navsight / Eth0	PC / Ethernet	7 et 9	UDP Broadcast	Eth0 ; Port 10000	Data INS binaire SBG
Données GNSS Position brutes	BD992 COM1	Navsight COM interne	Interne Navsight	RS232	460000,8,N,1	RT27(1Hz) + GSOF(5Hz) Connexion: login :admin / pass : sbgTrimble_2020
Données Cap	Navsight / Eth0	PC / Ethernet	7 et 9	UDP Broadcast	Eth0 ; Port 10000	Data INS binaire SBG
Données attitude	Navsight / Eth0	PC / Ethernet	7 et 9	UDP Broadcast	Eth0 ; Port 10000	Data INS binaire SBG
Données attitude	Navsight / Eth2	SIM R2Sonic / Ethernet	9	UDP Unicast	Eth2 ; Port 10002	TSS1 (100Hz)
Corrections différentielles		Navsight / PortD (=COM2 BD992 interne)		RS232	115200,8,N,1	RTCM
Données Lidar	VLP16 ETH	PC / Ethernet	8 et 7	UDP Broadcast	Port 2368	Data Velodyne

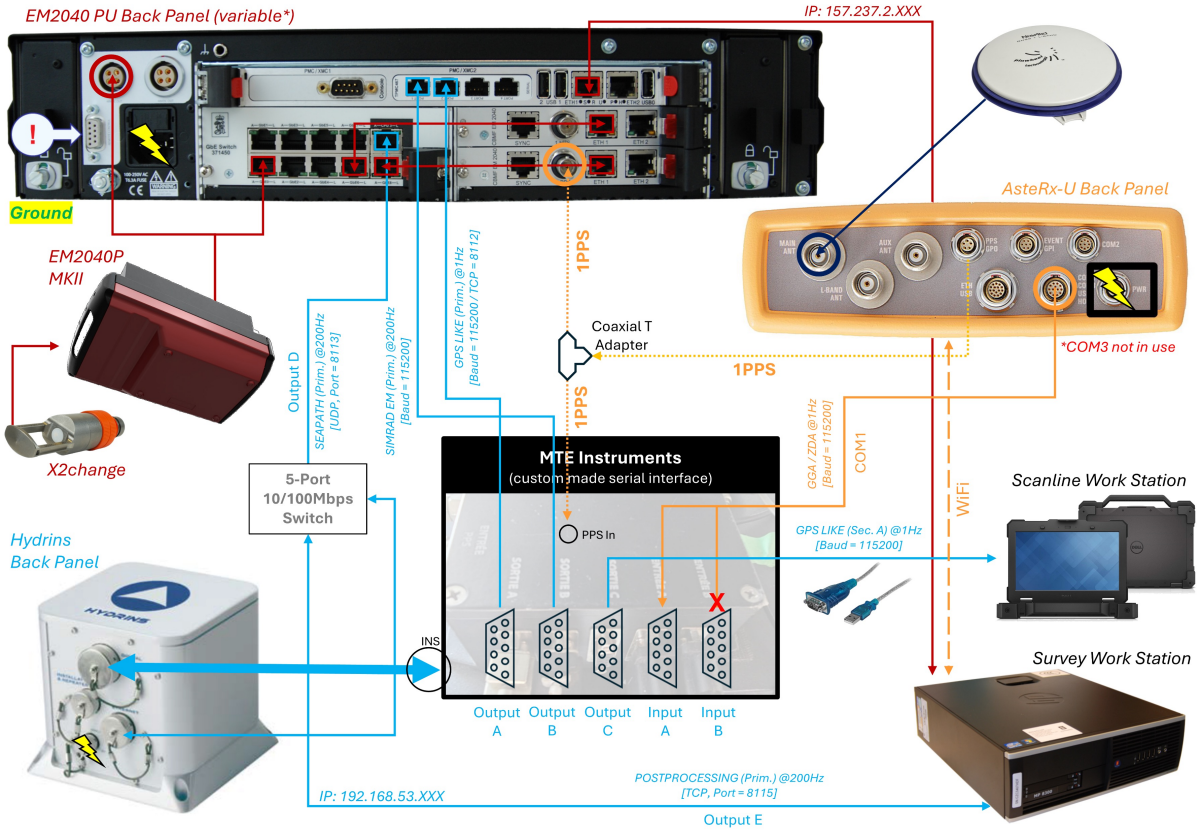
Source: Steven LE BARS

Wiring Diagram



Source: Joshua Sampey

Wiring Diagrams



Source: Ruaihri Strachan

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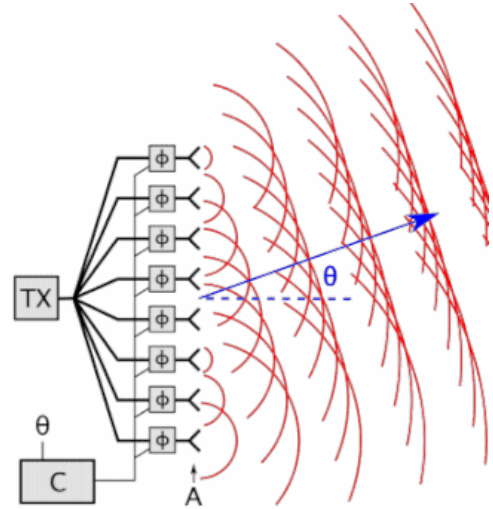
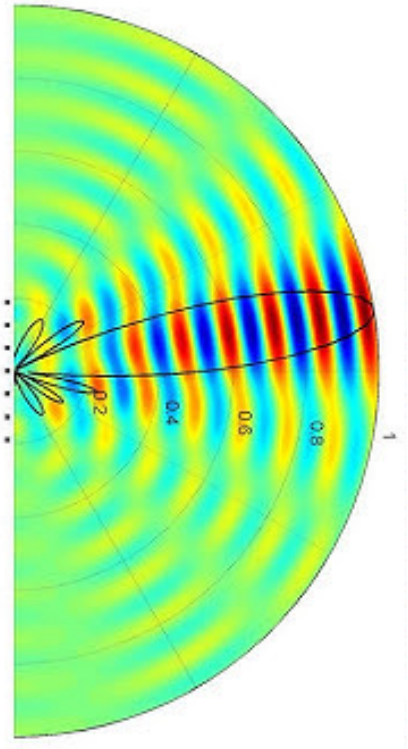
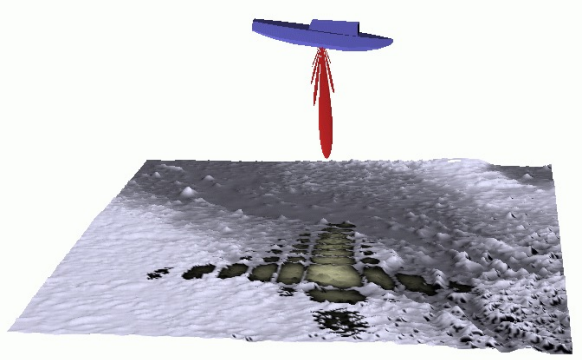
Beam Forming & Steering







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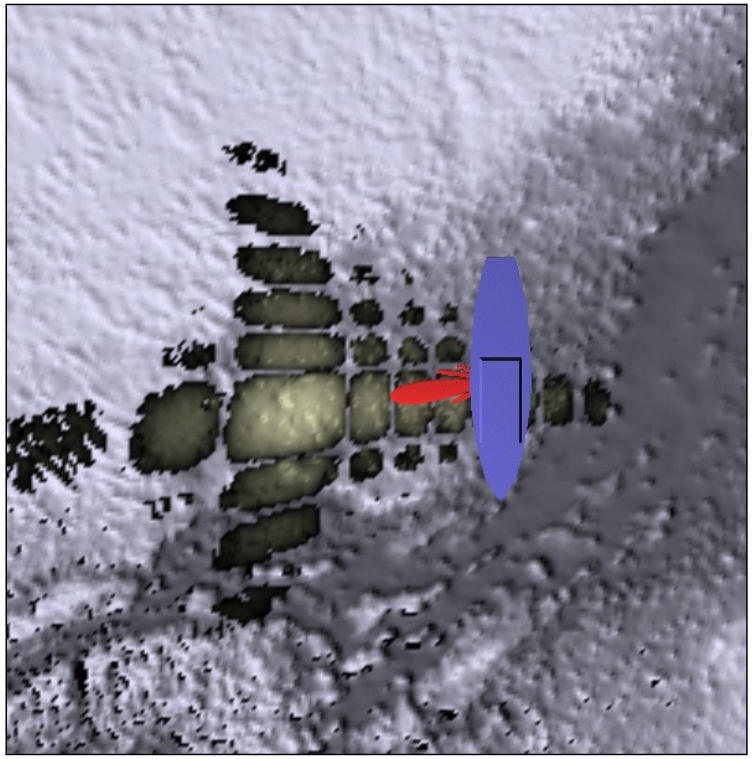
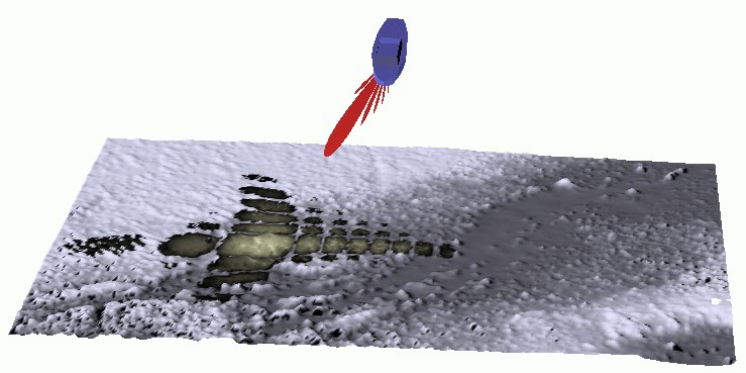
Multibeam Imaging Geometry

Beam pattern illumination

Illustrates intersection of main lobes and side lobes





Images from UNB GGE3353 Imaging and Mapping II
Credit: Dr. J.E. Hughes Clarke

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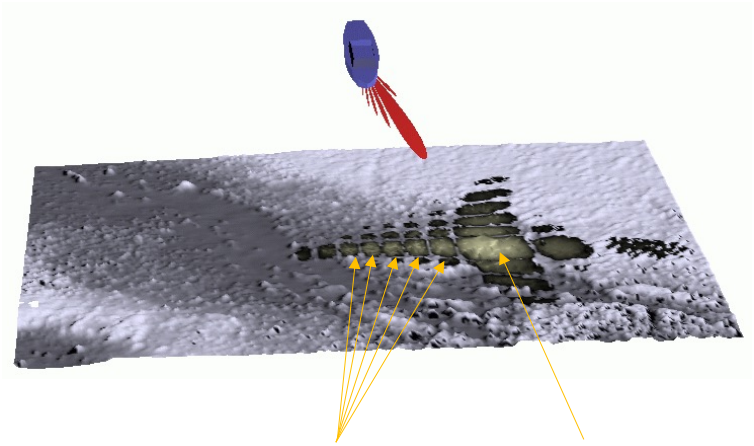
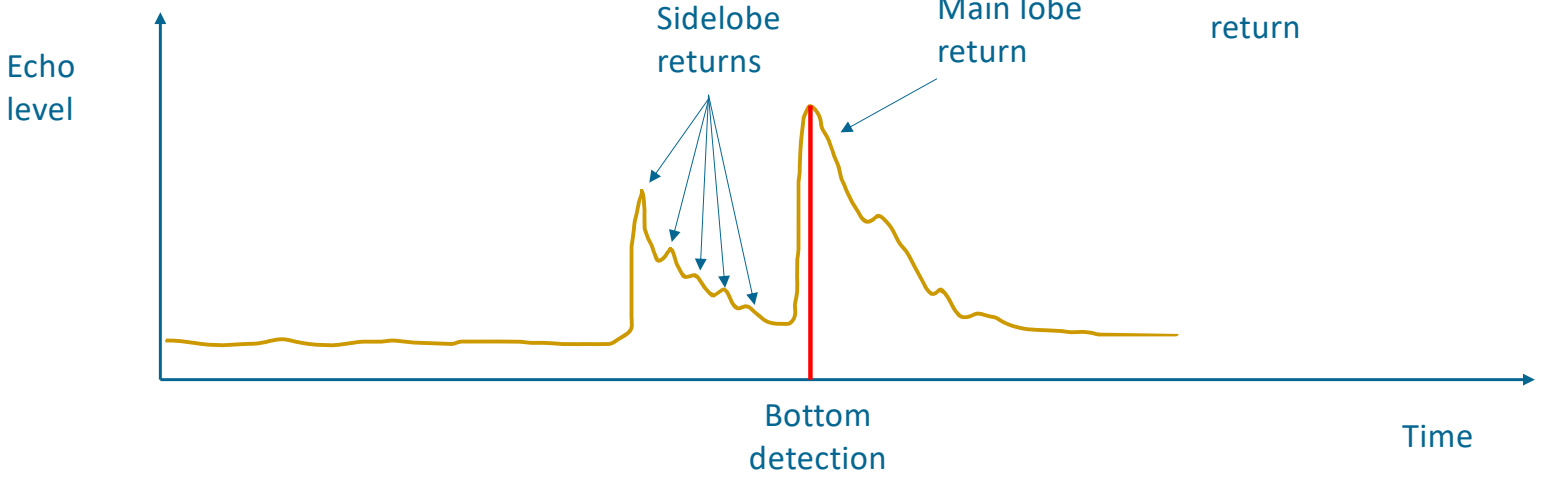


Success of bottom detection strongly relies on assumption that sidelobe returns are much weaker than main lobe return



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28 responses

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24 responses

Is there anything else you would like to share about this topic?

20 responses

Overcoming Challenges – Advice (1 of 2)

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Training

- Educate yourself – Formally and informally
- Access sources of information and hands-on workshops
- Attend industry seminars & webinars
- Seek out internships and similar opportunities
- Find practical training to augment classroom-based instruction
- Seek out smaller courses, micro credentials
- Learn fundamentals – Acoustics, sonars, software, interfacing

Get Advice

- Be advised by a hydrographer for planning and prep
- Consider partnering or a strategic hire
- Engage with specialists
- Spread your wings into different areas slowly and strategically

Study the Technology

- Understanding the technology
- Focus on physical theory of sonars
- Read manuals

Build Your Network

- Networking is key - Meet professionals across industry
- Attend Geospatial events (physical and virtual)
- Be curious & learn, ask lots and lots of questions

Get On The Water

- Get in the field, it is the best teacher
- Join as may installations and mobilizations as possible
- See if you have sea legs
- See if you have ability to work with several people for possibly many days/weeks in a confined space
- Join a hydrographic survey company

Overcoming Challenges – Advice (2 of 2)

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Strategic Employment

- Work for a company that has experts you can learn from
- Find a workplace / environment where others are happy to support and promote your learning in new areas of the geospatial sector

Attitude

- Be prepared for speed bumps along the way
- Continue to push for hydrography
- Keep an open mind
- Be willing to connect the dots of what you already know and what you hope to learn

Adapting

- It takes time to adapt, but VERY achievable
- Will, persistence & desire for knowledge will propel you
- Need to focus on mastery of new tools and techniques

Continual Professional Development

- Continual Learning
- Maintain and grow your skills

Opportunity & Advantage

- Shortage of skilled hydrographic surveyors
- Many non-surveyors filling the gaps
- Land surveyor advantage? Survey, Geodesy, Positioning, Charting
- Land surveyors have more overlap with hydro than other professions, e.g. civil engineering, GIS technician

Education & Training

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INTERNATIONAL FEDERATION OF SURVEYORS

INTERNATIONAL HYDROGRAPHIC ORGANIZATION

INTERNATIONAL CARTOGRAPHIC ASSOCIATION

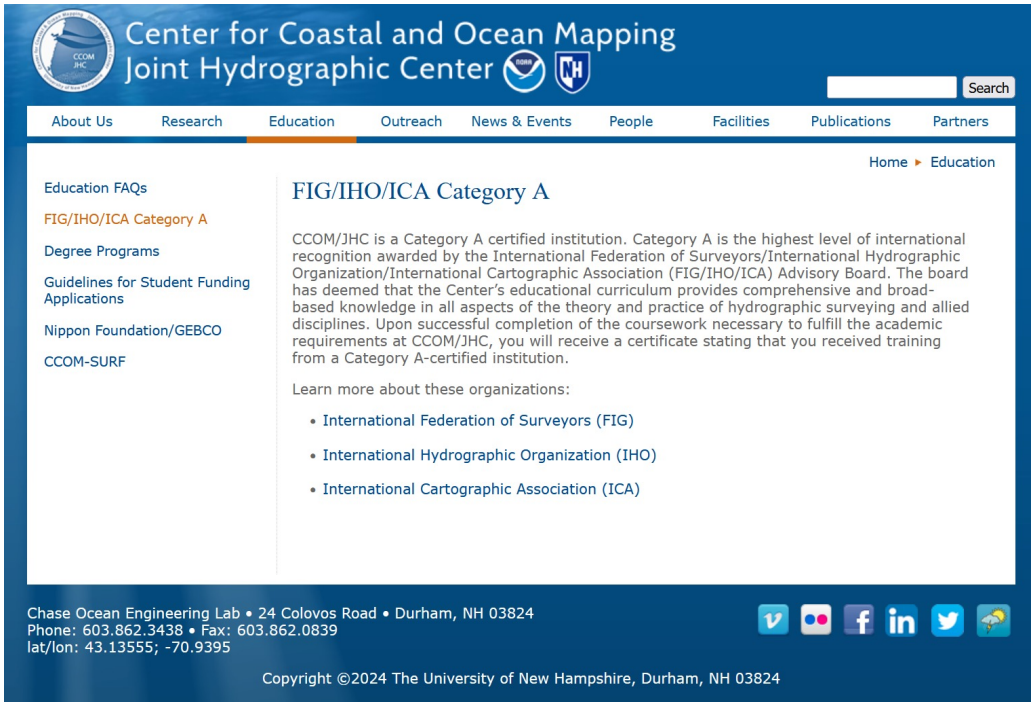
STANDARDS OF COMPETENCE FOR CATEGORY "A" HYDROGRAPHIC SURVEYORS

Publication S-5A
First Edition
Version 1.0.2 - June 2018

"Standards indicate the minimum competences necessary for hydrographic surveyors. Standards recognize two levels of competence. Category "A" programmes introduces competences from the underlying principles level. Category "B" programmes introduce the competences from a practical level.

The intention is that a Category "A" individual with appropriate experience, would be a senior professional in their chosen field (government, industry, academia). Category "B" individuals with appropriate experience would be technical professionals leading and delivering products and services to meet specifications and outcomes."

Education & Training – Cat A



https://ccom.unh.edu/certification

2-year commitment

Education & Training – Cat B

		MODULE	STUDY PERIOD
E-learning	GSR	Geodesy and Geo-referencing	October - December
	POS	Positioning	
	ENV	Environment	
	TID	Tide and water levels	January - March
	BAT	Bathymetry	
	NSC	Nautical Science	
	HYD	Hydrography	March - May
	HDPM	Hydrographic Data Processing and Management	
	LA	Legal Aspects	
On site (Rimouski)	PFCT	Practical exercise & Final field project (7 weeks)	June - July

10-month commitment

https://www.cidco.ca/en/education-and-training/hydrographic-survey-category-b-course

Education & Training – Microcredentials

Multibeam Acquisition Fundamentals

A practical workshop style training for multibeam hydrographic surveying

Overview

This course will fill help you understand which sonar settings and survey design decisions are most impactful towards your survey goals. Practical instruction demonstrates clearly how surveyors can add value in their operational decision making. Theoretical topics are covered lightly when necessary to give practical instruction some backing without overwhelming the core concepts. The aim is to provide practical and actionable ideas to help a hydrographic surveyor the very next time they go to the field, making confident and informed decisions that achieve results. In-class instruction is cemented with time in the field operating hardware and software discussed in the classroom.

Key Learning Outcomes

- Learn to estimate your ability to detect, resolve and characterize objects on the seafloor with understanding of multibeam resolution fundamentals.
- Master the art of juggling vessel speed, swath width and ping rate to achieve targeted sounding density (hit count) to ensure target detection/resolution.
- Understand major sources of uncertainty, how to plan for them beforehand and how to monitor and adapt your survey operations to achieve accuracy targets.

Topics

1. Multibeam Resolution
   a. Review of Multibeam Fundamentals: Imaging Geometry
   b. Review of Resolution: Beamwidth, beam steering and pulse length
   c. Practical sensor specific advice and tips
2. Multibeam Density (Hit Count)
   a. Speed, Swath/Beam geometry, Ping rate, Dual/Single Swath
   b. Real-time Monitoring of Density
   c. Other Effects: Motion effects, line planning/running, stabilization
   d. Practical sensor specific advice and tips
3. Multibeam Uncertainty
   a. Survey Accuracy Standards & Orders
   b. Achieving Standards – In Theory (TPU Tune-Up) & In Practice
   c. Practical sensor specific advice and tips
4. Multibeam Backscatter
   a. Review of Backscatter Fundamentals
   b. Impact of sonar settings changes
   c. Backscatter Acquisition – General, Sensor Specific & Software Specific
5. Geodesy, GNSS & INS Positioning
   a. Common Horizontal datums and transformations
   b. Vertical datums, Separation Models, VDATUM
   c. Real-Time Corrections & Reduction to Datum
   d. Post-Processed GNSS

Sausalito, California, Nov 19-22, 2024

HydroOctave CONSULTING

Tuition: $2,650 (covers tuition only)
Format: In-Person, Classroom & Vessel Based
Registration Contact: info@hydrooctave.com

4-day course on multibeam acquisition fundamentals, classroom & vessel based

4-day commitment

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ChatHumanity vs ChatGPT

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What can I help with?

What advice would you give to a land surveyor wanting to do work in the field of hydrography?

Create image | Analyze data | Make a plan | Summarize text | More

1. Expand Your Knowledge Base
2. Get Proper Certification and Training
3. Understand the Equipment
4. Focus on GIS and Data Processing
5. Gain Field Experience
6. Develop Marine Navigation Skills
7. Stay Updated on Industry Trends

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1. Expand Your Knowledge Base

Study Hydrography: Gain a solid understanding of hydrographic principles, including the mapping and charting of bodies of water, underwater topography, tides, and currents. A land surveyor's skills in measurements and geospatial analysis can transfer well, but understanding the marine environment is critical.

Learn Bathymetric Surveying: Bathymetry deals with measuring the depths and shapes of underwater terrain. Familiarize yourself with techniques and technologies specific to underwater surveying, such as sonar systems (single and multi-beam), side-scan sonar, and LiDAR (Light Detection and Ranging).

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2. Get Proper Certification and Training

Certifications: Consider obtaining certification in hydrographic surveying. Look for programs recognized by international bodies such as the International Federation of Surveyors (FIG) or the International Hydrographic Organization (IHO). Level 1 or 2 hydrographic surveyor certification can add to your credibility.

Hydrography Courses: Enroll in courses related to marine geodesy, oceanography, and remote sensing. Institutions like the International Hydrographic Organization (IHO) or local maritime academies often offer specialized training.

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3. Understand the Equipment

Familiarize Yourself with Hydrographic Tools: Hydrographic work often uses different technology than land surveying. Tools like echo sounders, GPS systems adapted for marine use, ROVs (Remotely Operated Vehicles), and acoustic Doppler current profilers (ADCP) are important to master.

Surveying in Marine Environments: Learn about the challenges and intricacies of operating surveying equipment in an aquatic environment, such as adjusting for water density, waves, currents, and tides, which influence accuracy.

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4. Focus on GIS and Data Processing

GIS and Data Analysis: Much of hydrographic data is processed and interpreted through Geographic Information Systems (GIS). Mastering GIS software (e.g., ArcGIS, QGIS) is essential for visualizing and analyzing underwater terrain and features.

Data Accuracy and Precision: Hydrography requires a high level of precision, particularly when surveying areas for safe navigation or infrastructure projects. Ensuring that your data collection methods account for underwater distortions and are processed accurately is crucial.

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5. Gain Field Experience

Hands-On Practice: Working on hydrographic vessels, helping with surveys for ports, harbors, or offshore infrastructure, and participating in real-world hydrographic projects can provide valuable experience. Seek internships or partnerships with hydrographic firms to get practical exposure.

Understand Environmental Factors: Water bodies are dynamic. Tides, weather patterns, and salinity can affect survey conditions. Developing an understanding of these variables is key to successful hydrographic work.

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6. Develop Marine Navigation Skills

Maritime Navigation: Learn the basics of marine navigation, including chart reading and the use of electronic navigation systems. These are essential for coordinating hydrographic surveys and ensuring safe and effective work on water bodies.

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7. Stay Updated on Industry Trends

Emerging Technologies: Stay informed about advancements in hydrographic equipment and methodologies, such as satellite-derived bathymetry, autonomous survey vessels (USVs), and integrated GIS platforms for marine data.

Attend Industry Events: Networking and participating in conferences or workshops related to hydrography will help you stay current with the latest trends and innovations.

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Take Home Messages

Similarities?

- Geodetics
- Positioning
- Uncertainty/Error Budgets
- Duty of Care for measurements
- Measurement Geometry

Differences?

- Surveying on an unstable platform
- Acoustics, oceanography
- You can't see what you measure
- Achievable accuracy, precision and resolution
- Very different lifestyle
- Regulation, certification are different and evolving

Success determinants?

- Grit
- Determination
- Persistence
- Perseverance

Way Forward?

- Land Surveyors have Advantage
- Get advice
- Map out a plan
- Get training

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Questions?

Jonathan Beaudoin
jonathan@hydrooctave.com