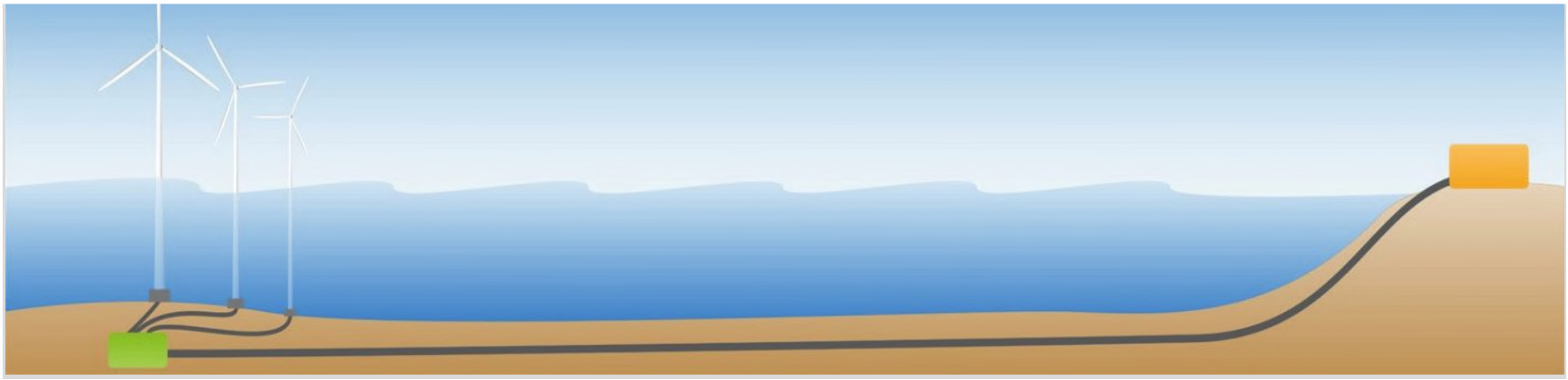
The challenge of choosing the right method for surveying power cables

Submarine power cables

- Wind farm
  - Inter- array
  - export cable
- Power supply
  - Islands
  - Offshore constructions
- Inter country
  - NorGer
  - BritNed



HVAC vs. HVDC

HVAC (high voltage **alternating** current)

HVDC (high voltage **direct** current)

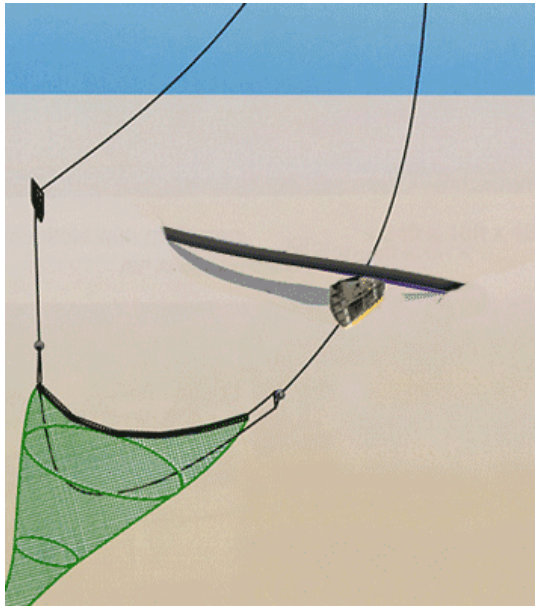
HVDC cable

Gotland 1 *1954, 98km*

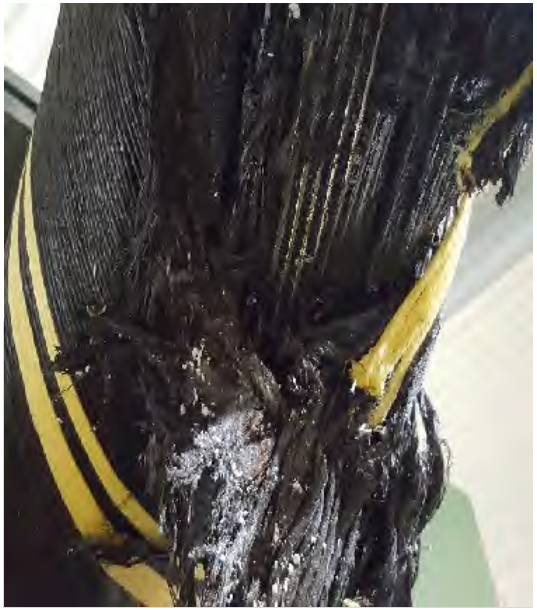
NorNed *2015, 580km*

Burial of cables

Anchor strikes, dragging fishing equipment



Poor planning



Erosion
2K Criterion

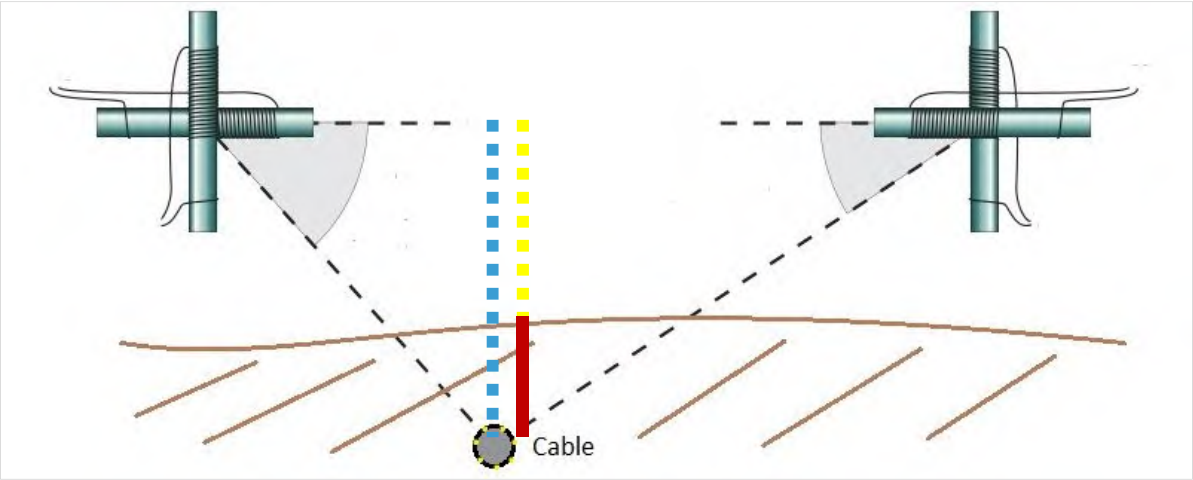
The burial of cables decreases the risk of external damage and furthermore fixes the cable to its projected position.

Detection systems

Passive Systems

Fixed baseline, triangulation

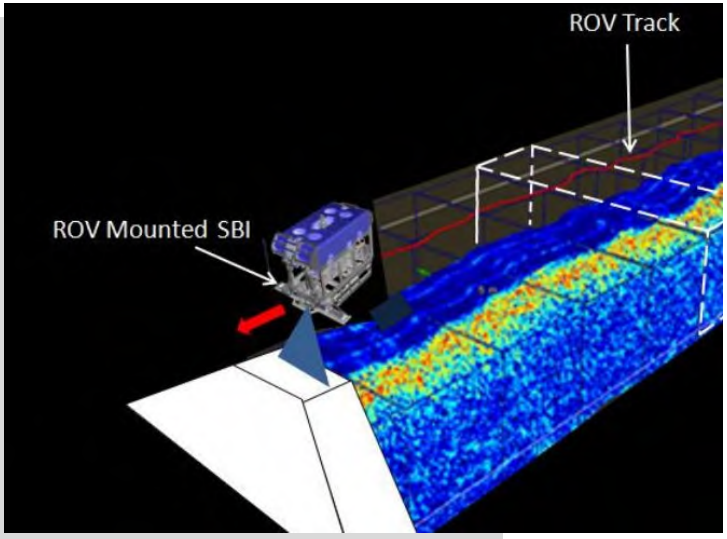
Range – Altimeter = Depth of burial (DOB)

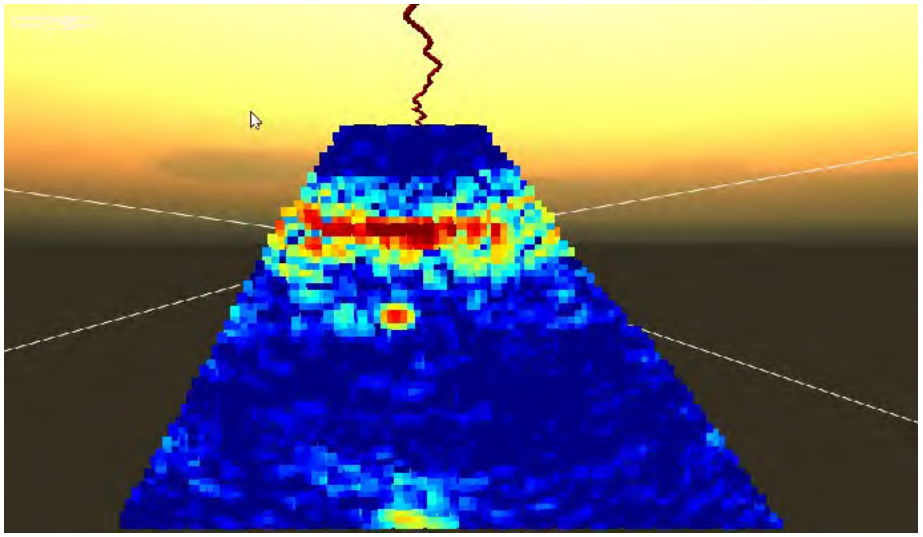


Detection Systems

Active Sytem

- Acoustics
- Pulse induction



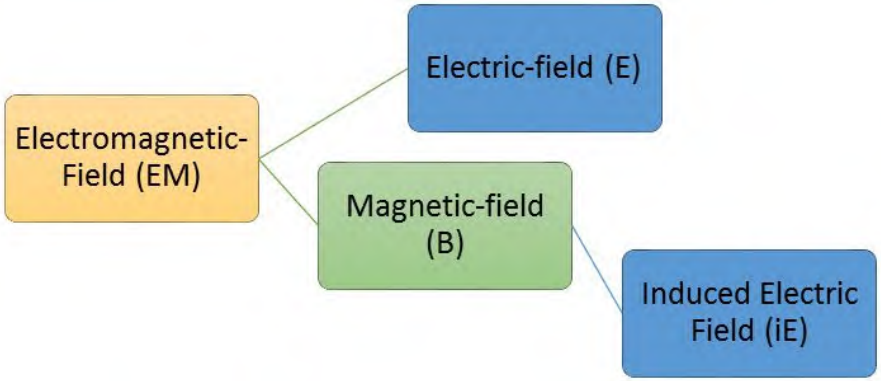


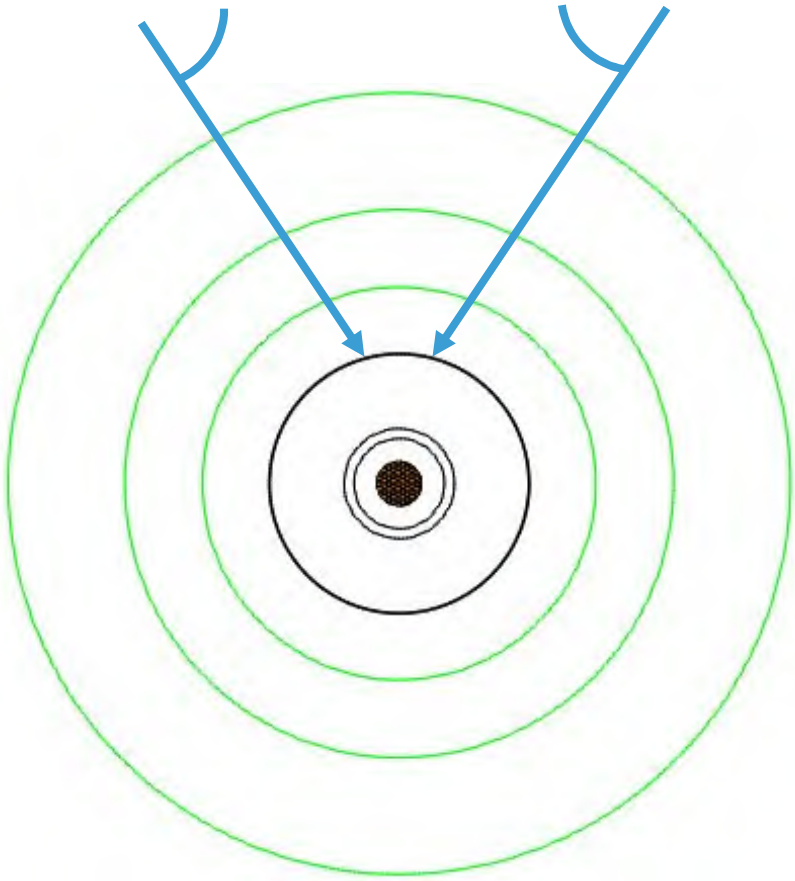
Detection Systems – Comparison Matrix

System	Technology	HVAC in operation	HVAC out of service	HVDC in operation	HVDC out of service	widely tested	easy to operate
Teledyne TSS 350	tone detection **passive**	✓	✓	✗	✓	✓	✓
Optimal Ranging Field Sense	tone detection **passive**	✓	✓	✗	✓	✗	✓
Teledyne TSS 440	pulse Induction **active**	✗	✓	✗	✓	✓	✓
Innovatum Smartrak 9	gradiometer **passive**	✓	✓	✓	✓	✓	✓
Pangeo SBI	acoustic **active**	✓	✓	✓	✓	✓	✗

Challenges

Passive Systems assume a radial electric field.

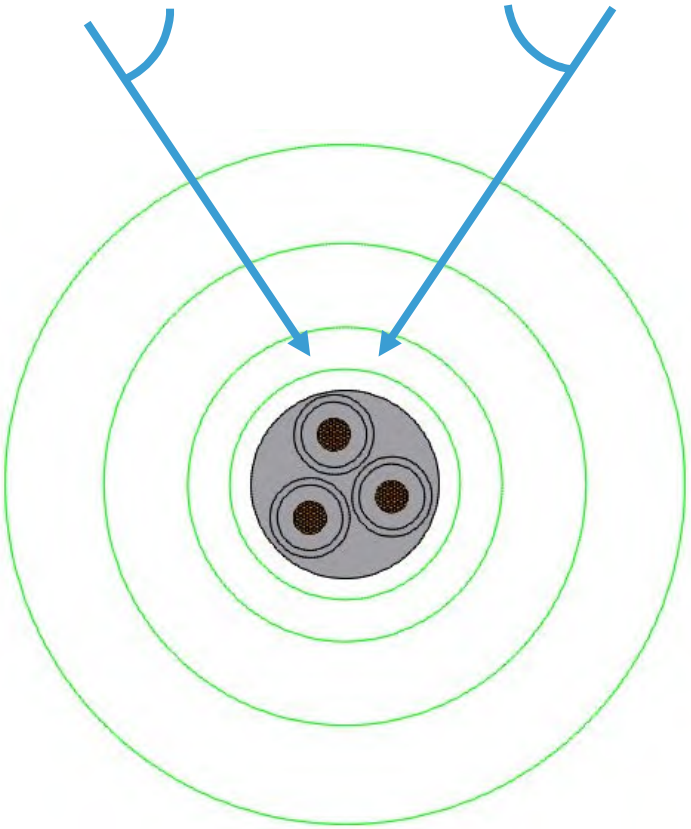




Challenges

Passive Systems assume a radial electric field.

3-core cables behave comparable to 1 core conductors

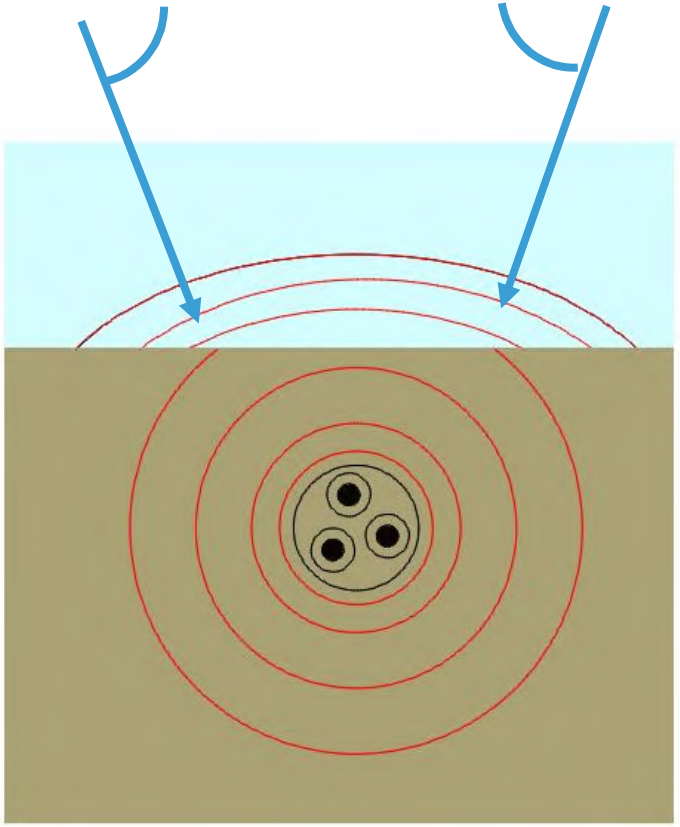


Challenges

Passive Systems assume a radial electrical field.

3-core cables behave comparable to 1 core conductors

Electrical field is disturbed by seabed and seawater flow.



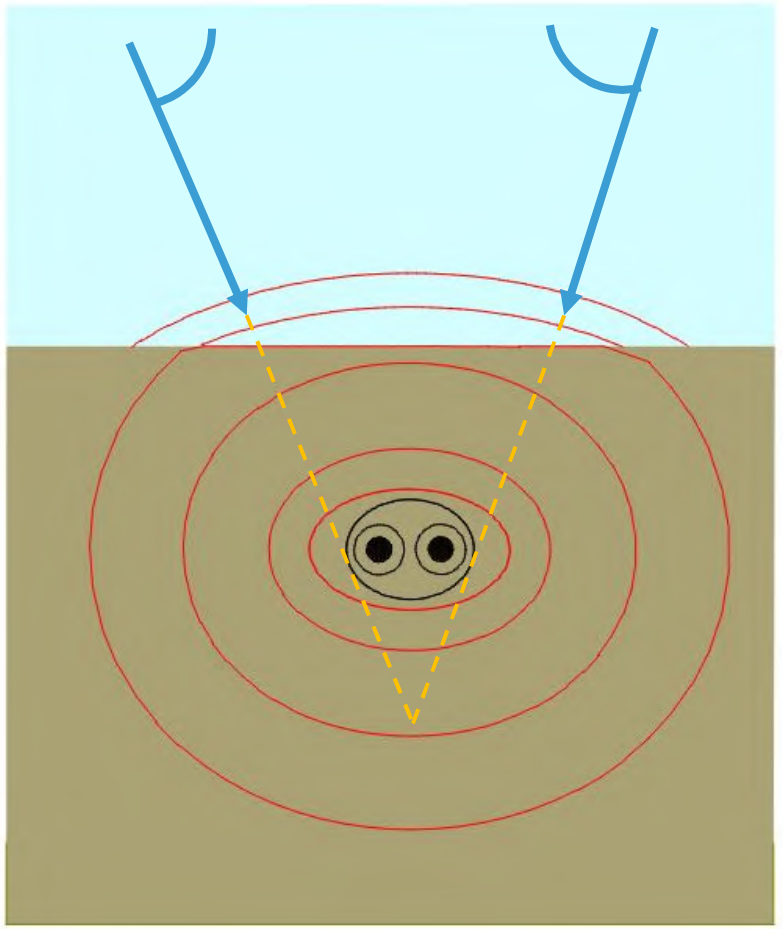
Challenges

Passive Systems assume a radial electrical field.

3-core cables behave comparable to 1 core conductors

Electrical field is disturbed by seabed and seawater flow.

2-core cable design is conflicting with the radial electrical field model



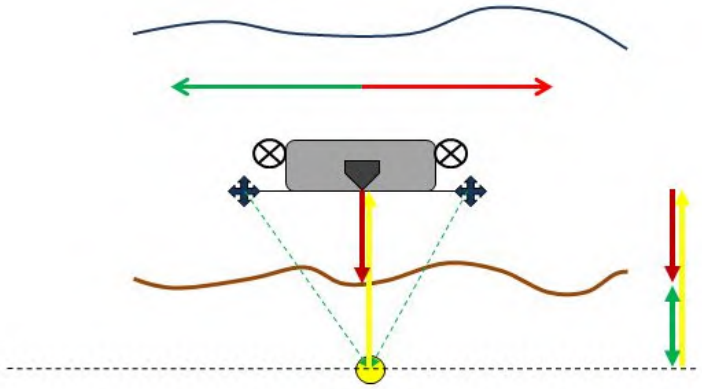
Accuracy

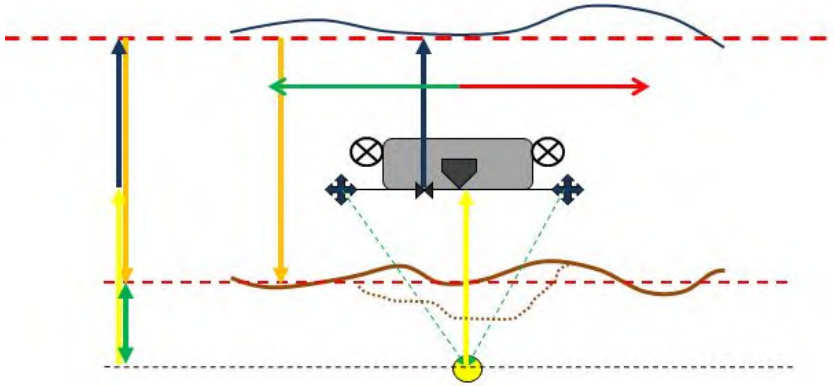
Accuracy requirements of federal- or private clients are derived from cable tracking specs.

Vertical-, horizontal accuracy of tracking system itself

Multisensor system is involved:

- DGNSS
- USBL system
- Altimeter readings of seabed
- Tidal effects
- Pressure sensors
- Latency effects

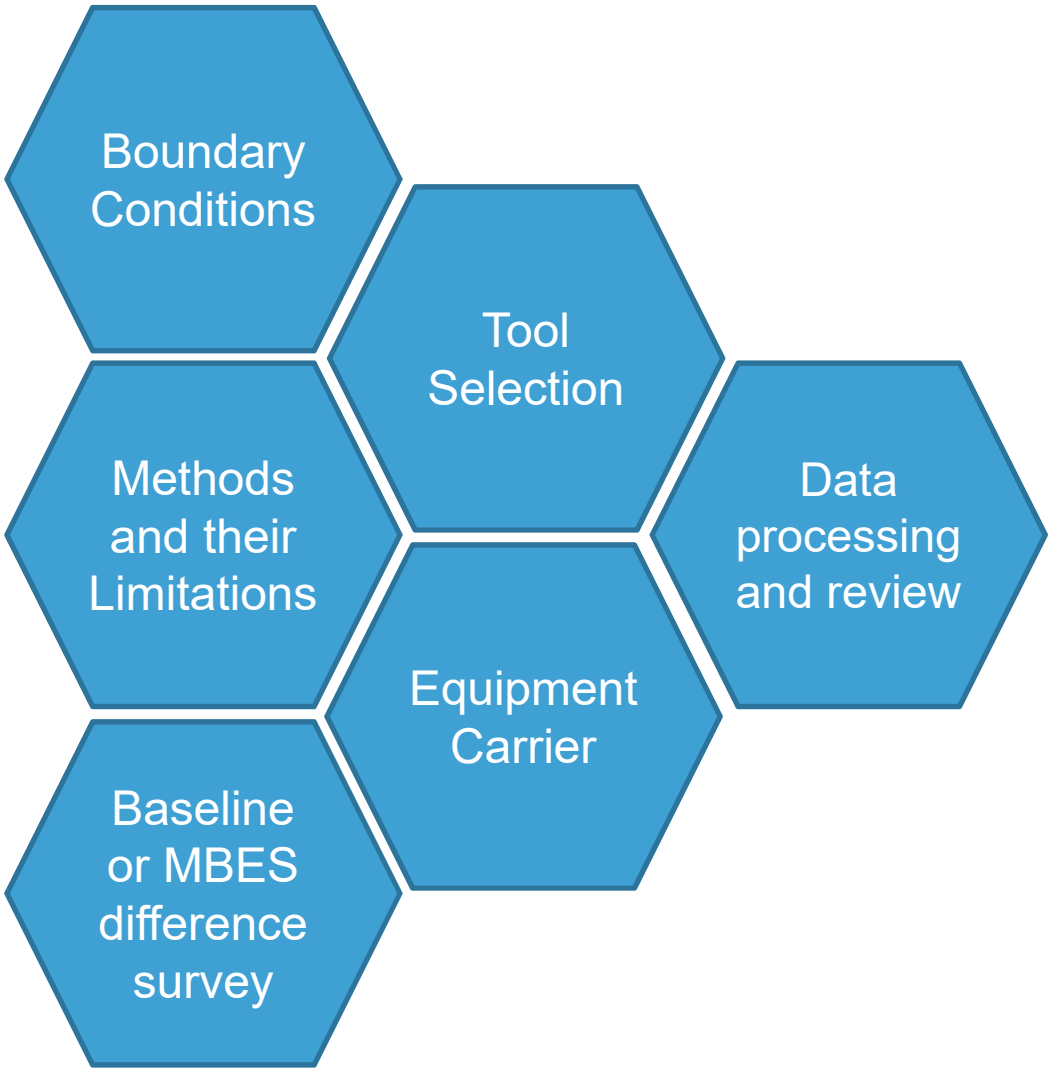




Seabed difference as burial survey

Epoch	Classic approach	MBES seabed difference
Cable lay (by barge)	cable location from laying barge	Cable location from laying barge +MBES
1st by survey vessel	**cable tracking survey**	**cable tracking survey** + MBES
2nd by survey vessel	**cable tracking survey**	MBES difference
3rd by survey vessel	**cable tracking survey**	**cable tracking survey**
	Time consuming / higher costs	Faster / possible cable impacts detectable

Summary



Presentation of results

Report Charts

Thank you for your attention

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HYDRO 2016
ROSTOCK-WARNEMÜNDE
08.–10. NOVEMBER