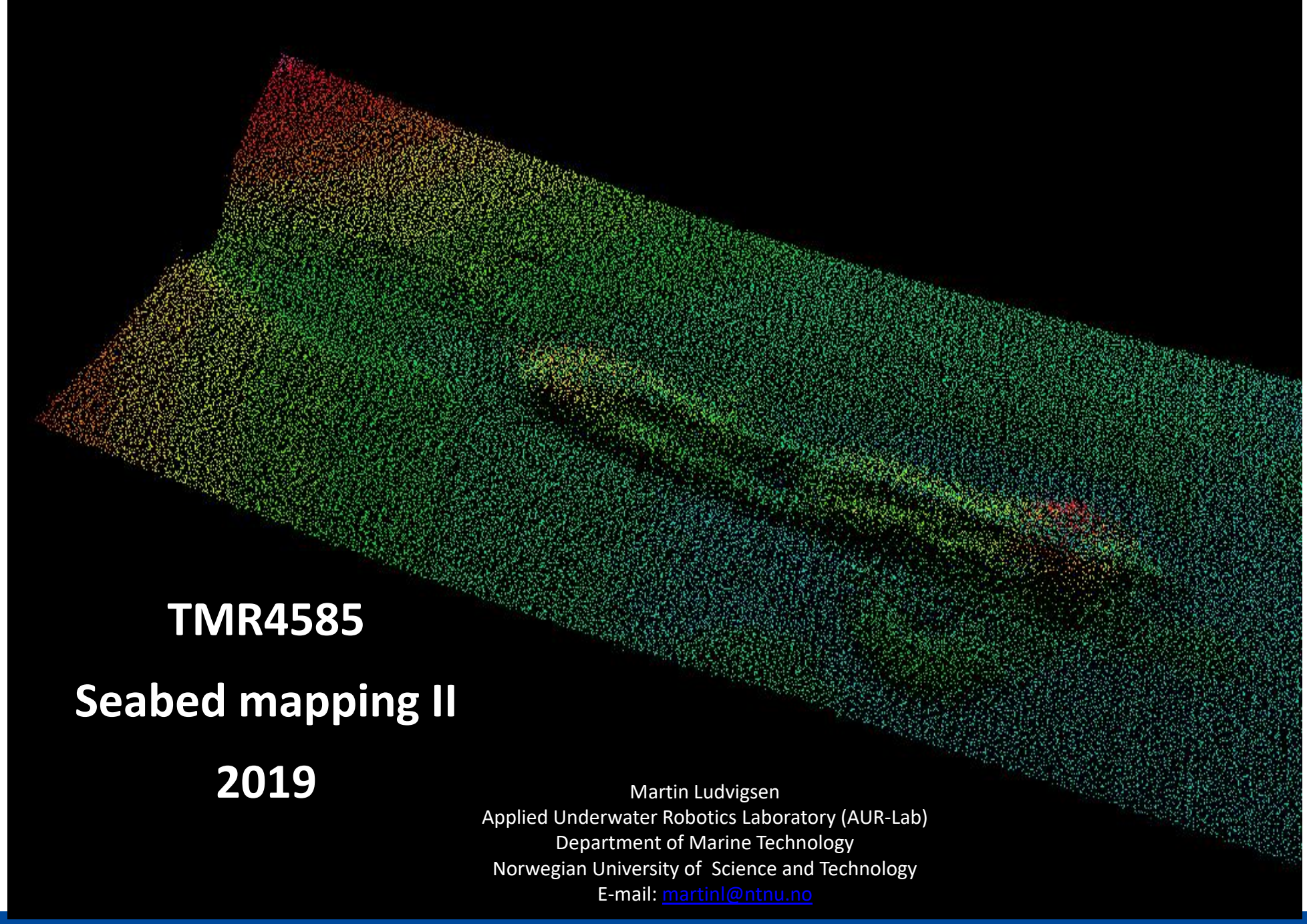

TMR4585

Seabed mapping II

2019

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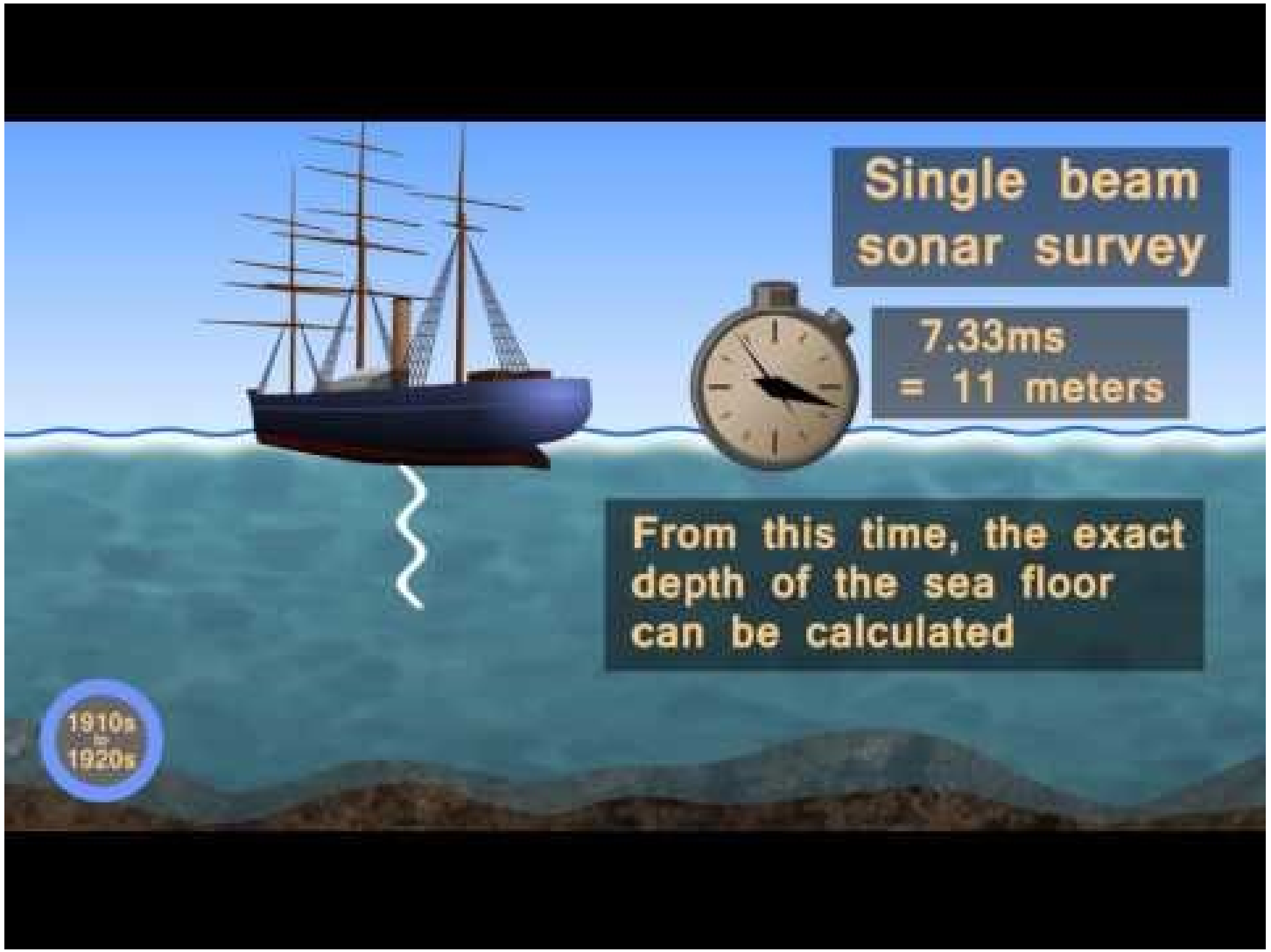
Summary Seabed Mapping

- Sensor platforms
  - Vessel
  - Towed vehicle
  - ROV
  - AUV
- Mapping sensor
  - Echosounders
    - Single beam
    - Multibeam
    - Sub bottom profiler
  - Side scan
- Imaging sensors
  - Side scan sonar
  - Scanning sonars
  - Forward look sonars
- Accuracy in mapping
- Environmental parameters

Seabed mapping video



Learning goals Seabed Mapping II

- Methodology and choice of sensors for application
- System knowledge
- Data processing for side scan, multi beam and sub bottom profiler
- Error sources and budgets
- Data processing

Calculations and equations

- Sources of inaccuracy
- Error budgets
- Coverage and resolution
- Error propagation in a system

Curriculum Seabed Mapping II

- Ludvigsen & Sørensen 2016
- Hansen 2012
- Bai et al 2012
- Lecture notes TMR4120

Online resource

https://dosits.org/

Terms and defintions

- Bathymetry
- Geodesy
- Geoide
- Ellipsoide
- Datum

Overview

1. Seabed surveys
2. Geodesy
3. Data acquisition
    1. Platforms
    2. Positioning systems
    3. Sonars
4. Processing
5. Accuracy

Seabed surveys

- Environmental survey
- High resolution geophysical surveys
  - Route surveys
  - Site survey
- Search

Environmental surveys

- Baseline surveys
- Sediment
- Video
- Bathymetry

Site surveys

- Seabed conditions
  - Bathymetry
  - Sediments classification
  - Seabed features
  - Habitats
- Sub seabed conditions
  - Geology
  - Sediment stability
- Potential geohazards
  - Stability

Route surveys

- Topography and character of the seabed
- Composition of seabed sediments
- Presence of debris on the seabed
- Confirm presence of know seabed structures
- Bathymetry along line
- Side scan along and parallel to pipe or cable
- Sub bottom profiles
- Magnetometer survey

Bathymetry

- Bathymetry is the study of underwater depth of lake or ocean floors. In other words, bathymetry is the underwater equivalent to hypsometry or topography.
- Bathymetric charts support safety of surface or sub-surface navigation, and usually show seafloor relief or terrain as contour lines and selected depths.
- Bathymetric maps may also use a Digital Terrain Model

Geodesy

- Geodesy is a with the measurement and representation of Earth, including its gravitational field. One subdiscipline of geodesy is concerned with the exact positioning of points on the surface of Earth, including datums and coordinate systems.

Coordinate systems

- Cartesian
- Geographical
  - Latitutde
  - Longitude
  - Degrees, minutes, seconds
- Projections
  - UTM
  - Zones

- Transfer coordinates between systems
- Which errors occurs

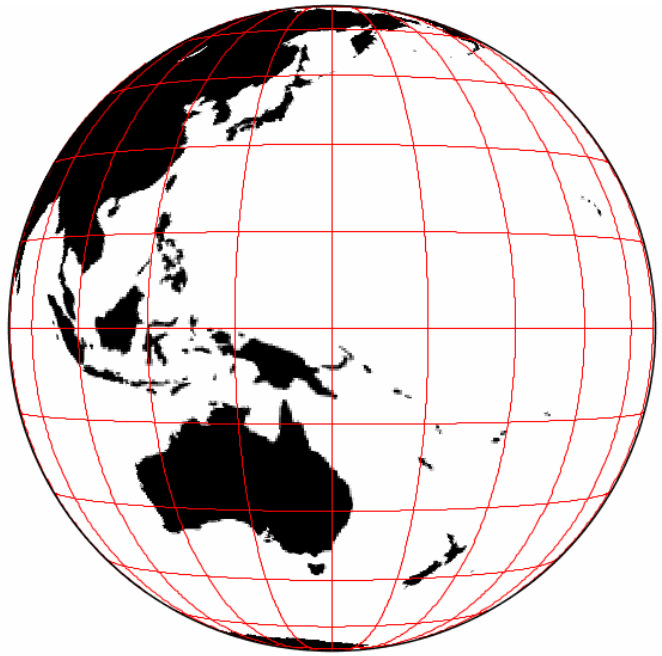
Datum

- A geodetic datum or geodetic system is a coordinate system, and a set of reference points, used to locate places on the Earth
- Datums starts with an ellipsoid, and then defines latitude, longitude and altitude coordinates. Several locations on the Earth's surface are chosen as anchor "base-points"

- WGS84
- EUR89
- ED50

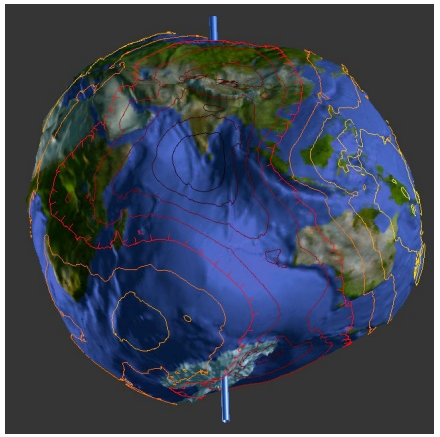
Ellipsoide

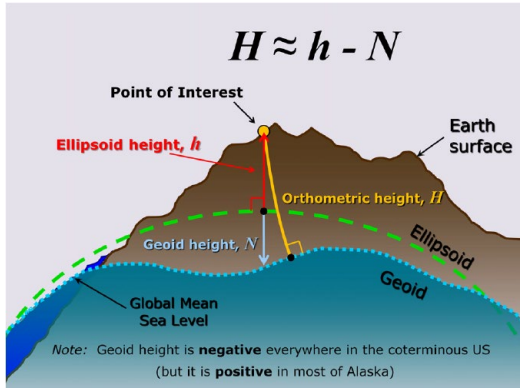
- Ellipsoid is a mathematically defined surface that approximates the geoid
- Because of their relative simplicity, reference ellipsoids are used as a preferred surface on which geodetic network computations are performed and point coordinates such as latitude, longitude, and elevation are defined.



Geoid

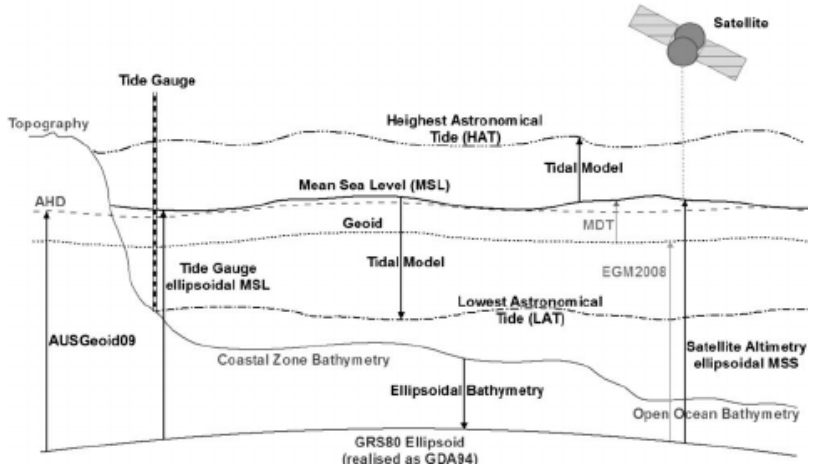
- The geoid is the shape that the surface of the oceans would take under the influence of Earth's gravity and rotation alone, in the absence of other influences such as winds and tides.
- Physical entity of irregular shape
- Perpendicular to the gravitational force





Vertical datum

- Mean sea level
- LAT (Lowest astronomical tide)
- Geoid
- Ellipsoid
- Tidal corrections



Data acquistion

Platforms

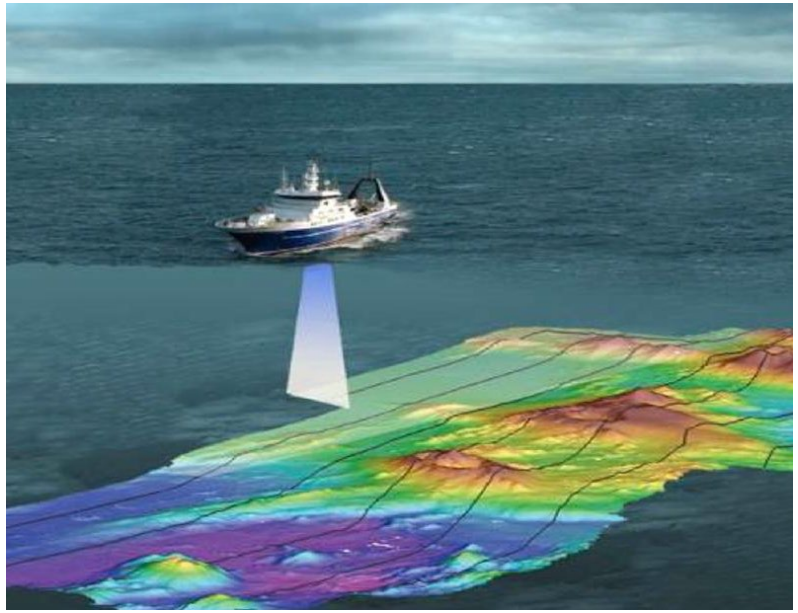
- Surface Vessel
- Towed Vehicle
- ROTV
- AUV
- ROV

Instruments

- Multibeam echosounder (MBES)
- Side scan sonar (SSS)
- Sub bottom profiles (SBP)
- Scanning sonar
- Navigation instruments

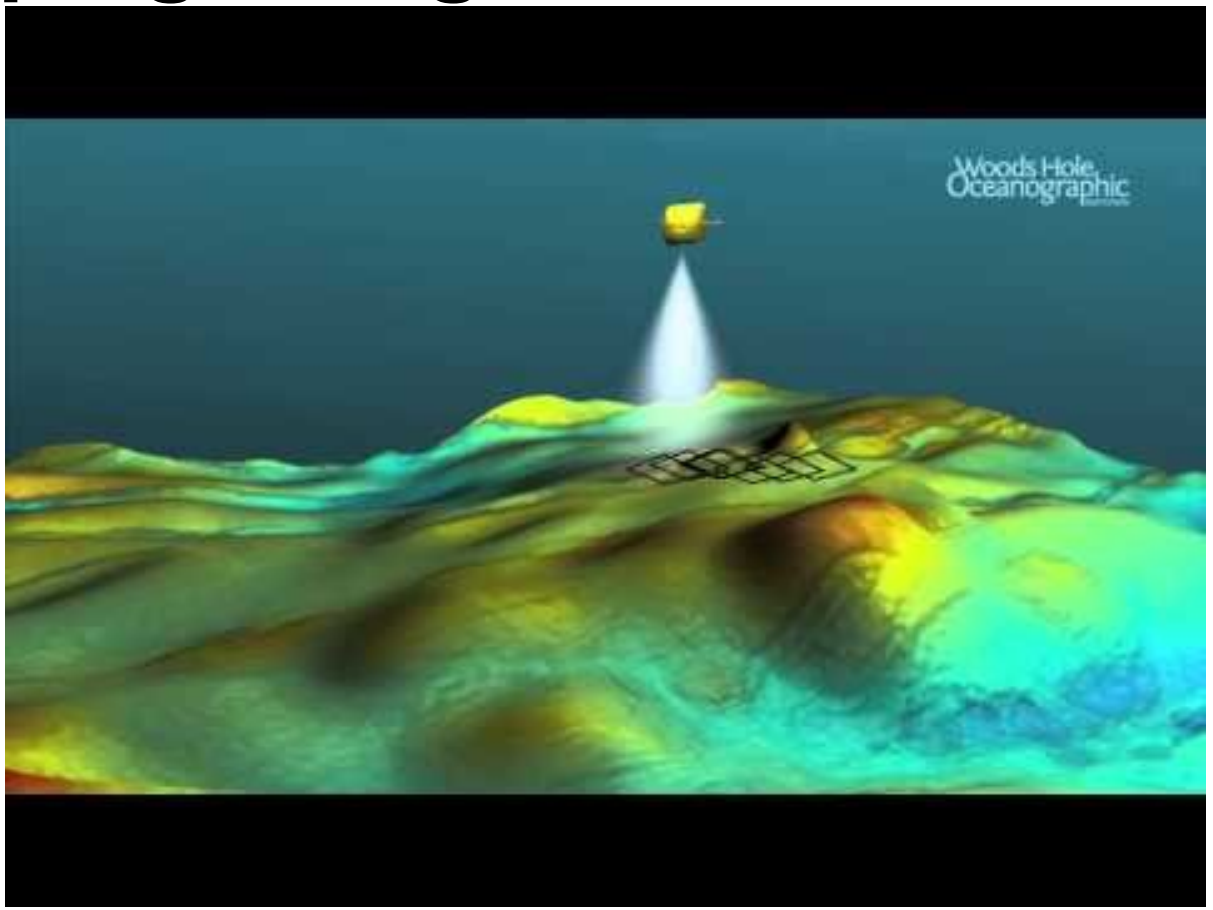
Survey vessel

- DGPS surface positioning system
- USBL subsurface positioning system
- North seeking gyro & motion sensor
- Dual head scanning profiler system
- High resolution sonar system
- Temperature / salinity probes



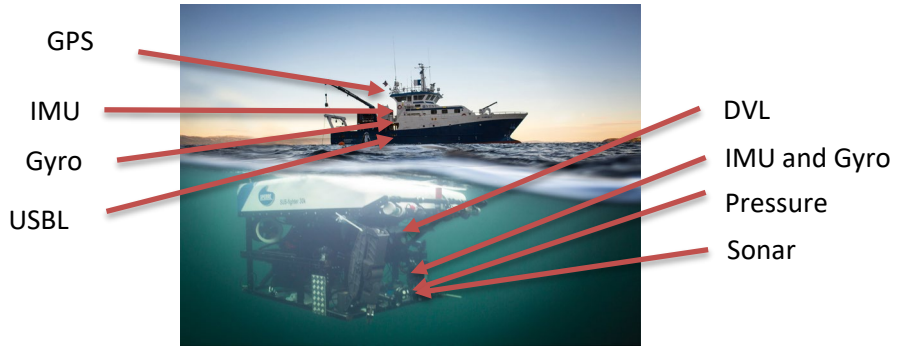
- On-line survey and navigation computer system
- Off-line data processing and charting computer system

Seabed mapping using AUV

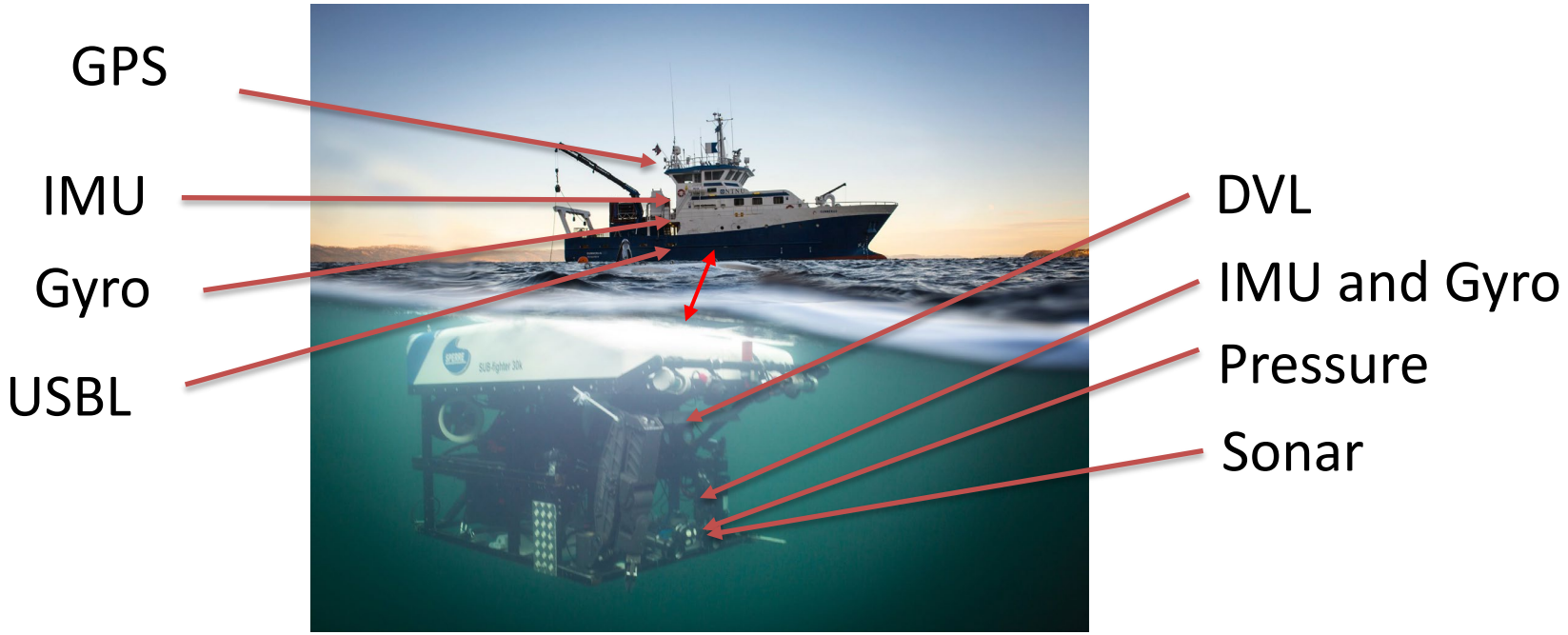


Positioning and navigation

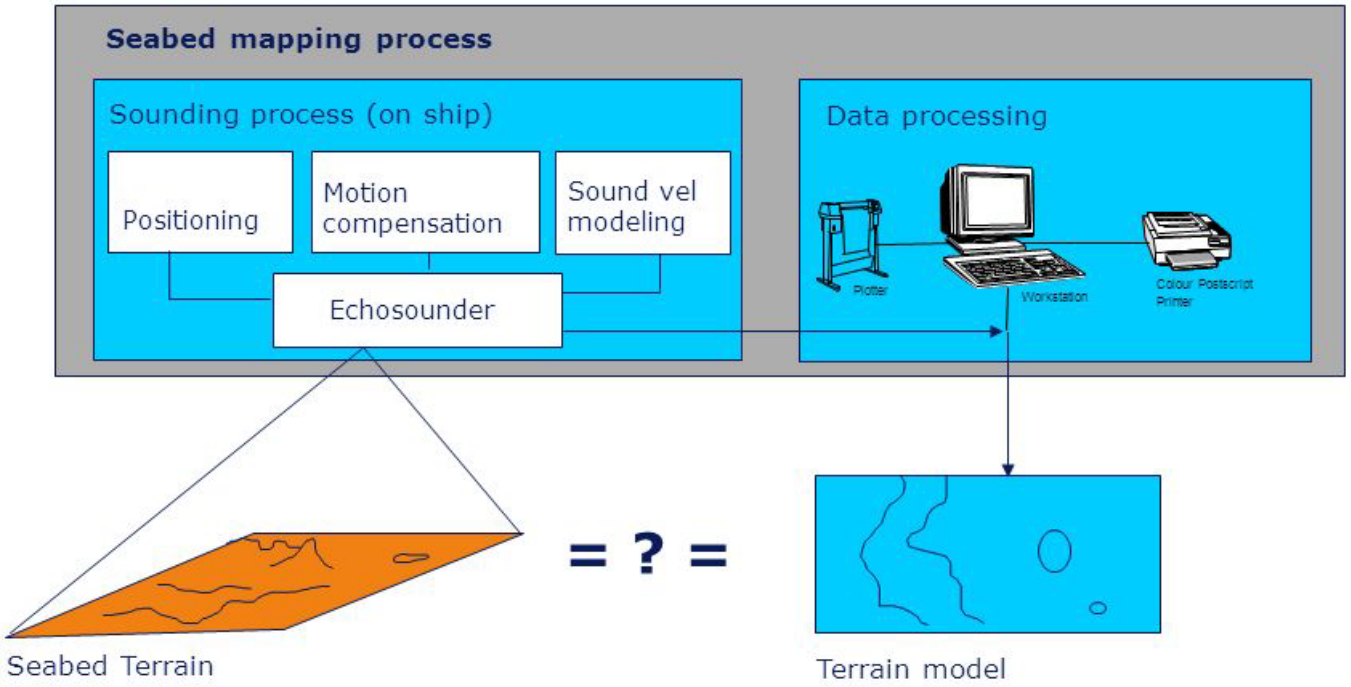
- GPS
- Range and bearing systems
- Underwater positioning
  - USBL
  - LBL
- Heading
- Speed
- Attitude
- INS and combined systems



Survey set up

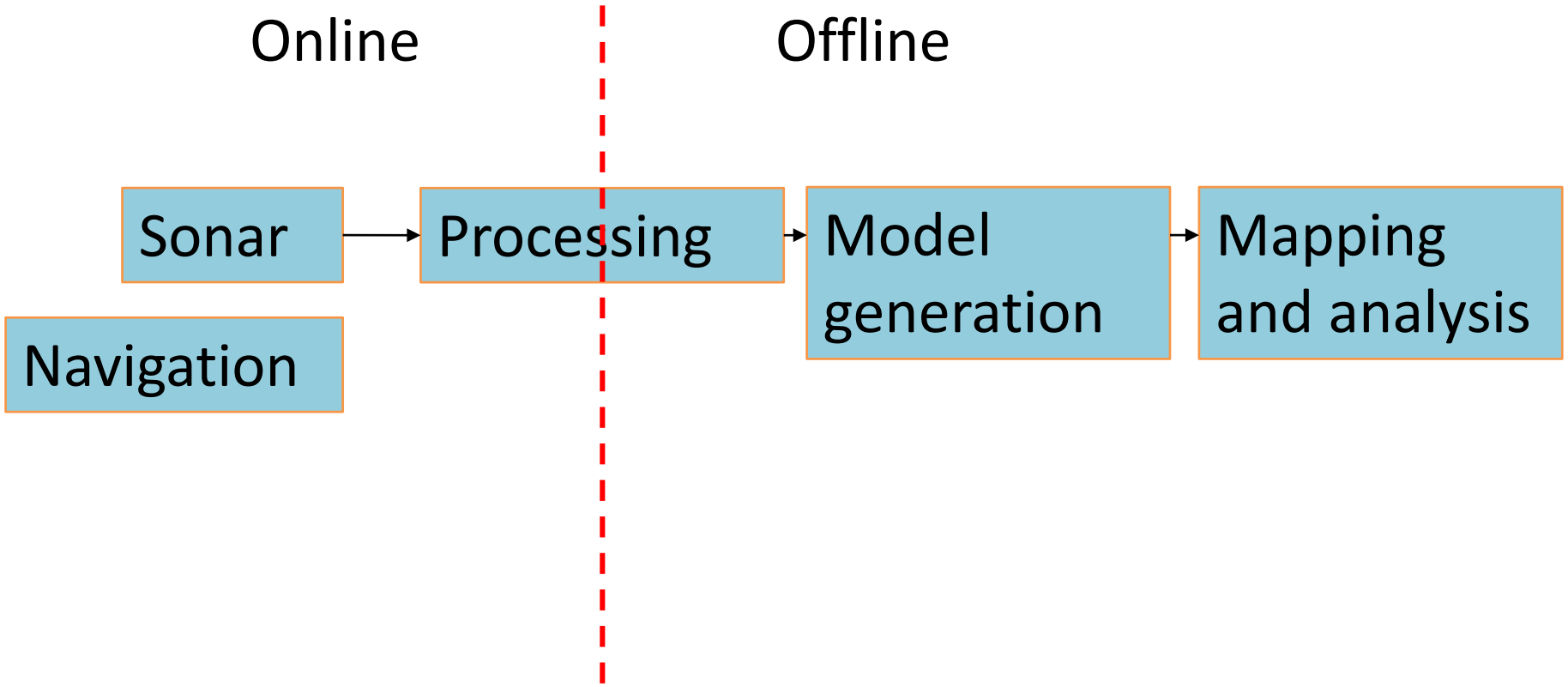


Seabed mapping from ping to map



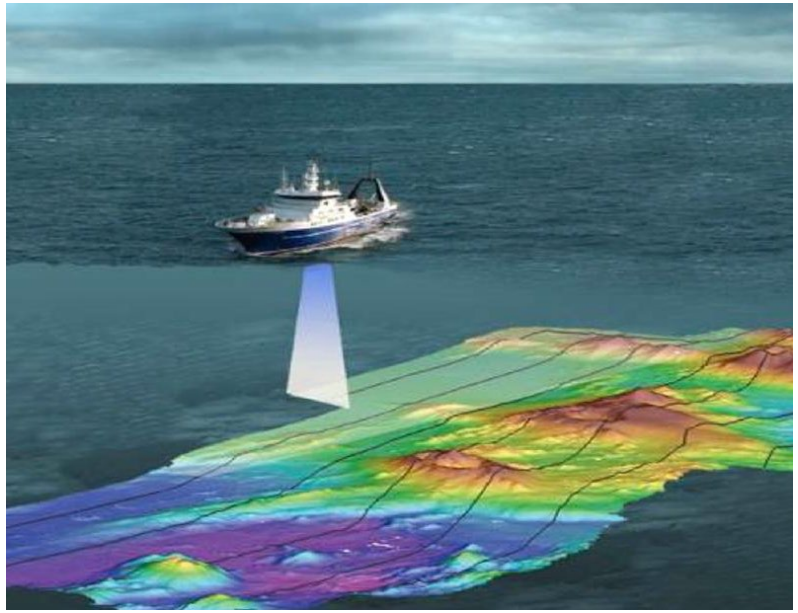
How well does the terrain model represent the seabed terrain?

Processing sonar mapping data



Survey vessel

- On-line survey and navigation computer system
- Off-line data processing and charting computer system



Sonar survey data processing

Online

- Logging
- Data storage
- Data integrity
  - Frozen signals
  - Standard deviation
  - Jumps

Offline

- Compensation
  - Motion
  - Speed of sound
- Data filtering
- Gridding
- Modelling
- Maps

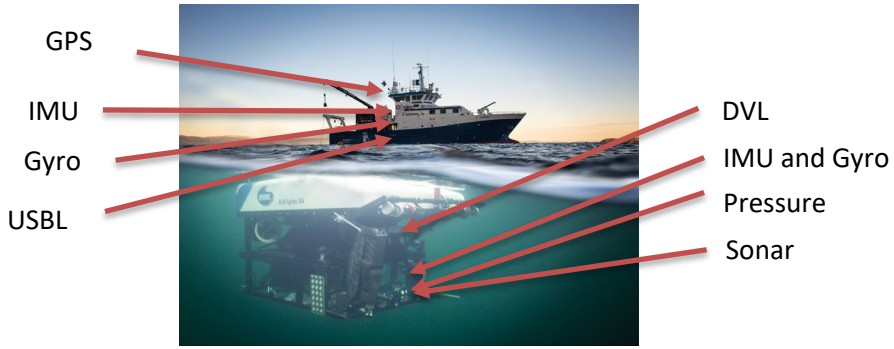
Accuracy in seabed mapping

- Errors
  - Stocastics
  - Systematic errors
  - Blunders

- Instrument accuracy
- Navigation accuracy
- Set up integrity
  - Offset
    - Time
    - Angular
    - Level arms
- Environmental parameters

Calibrations

- Navigation
  - GPS
  - Gyro
  - IMU
  - Underwater
- Timing
- Sonars
  - Patch test



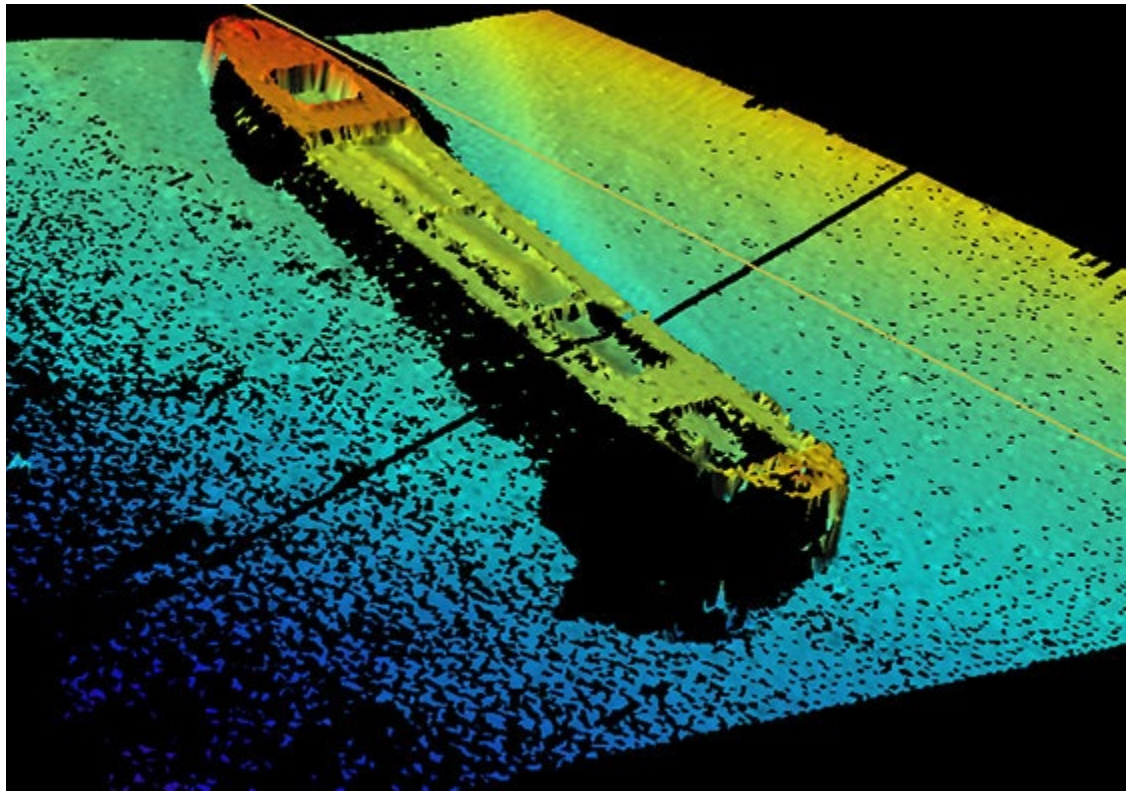
Bathymetric Systems – The Issues

- Calculation of depth – what is involved
- Water column density – and changes
- Changes in Atmospheric Pressure
- Quality Control
  - Certification
- Latency
- Installation
- Calibration Offset
- Thrusters
- Quality Control !!!

Environmental parameters

- Speed of sound
- Density
- Atmospheric pressure
- Tide
- Gravity

Kahoot



Summary

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