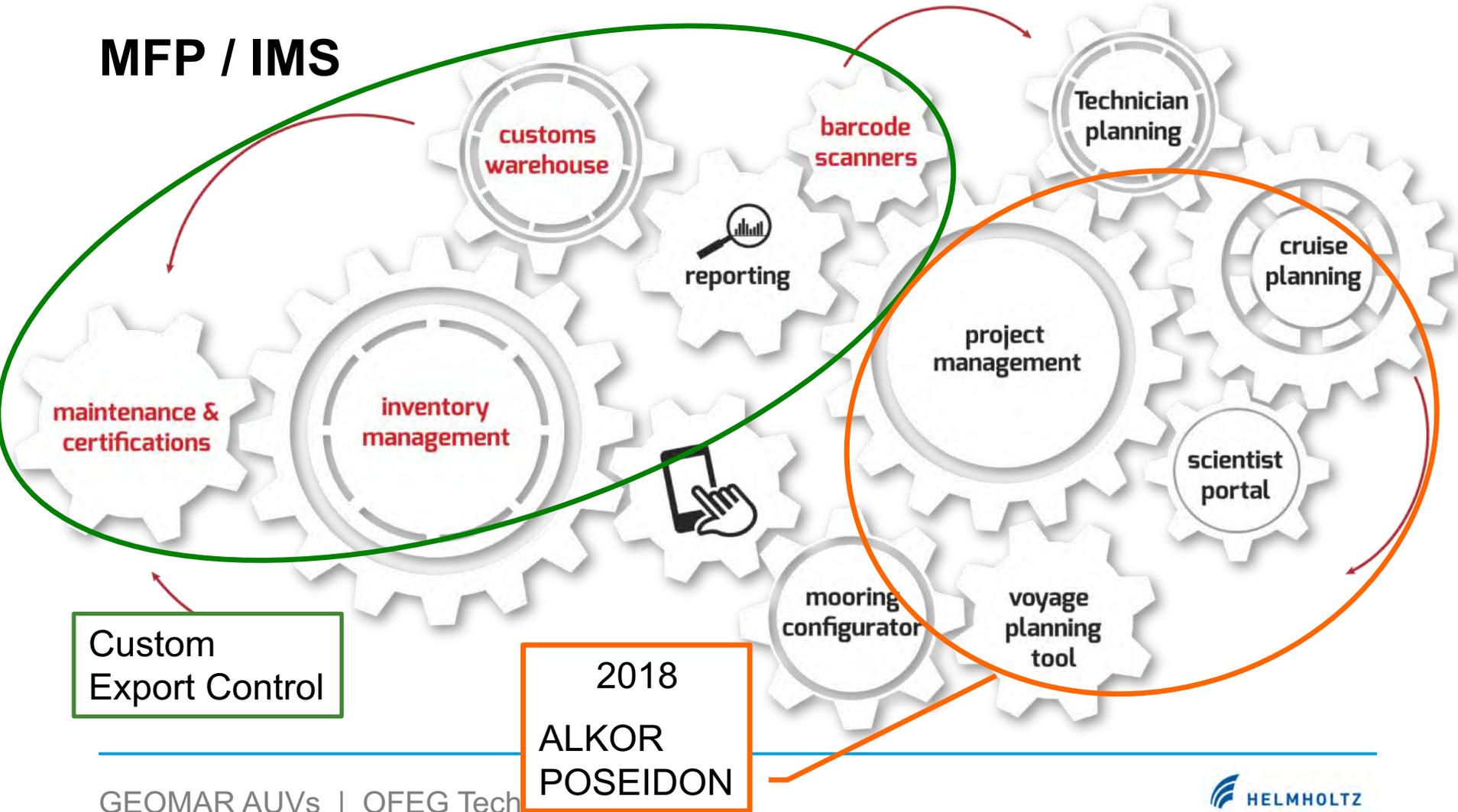


AUV development at GEOMAR



- Side note:
 - MFP / IMS
 - MEBO
 - LEDs
- Autonomous Vehicles @ GEOMAR
 - Gliders, Wave-gliders (not in here)
 - AUV ABYSS
 - Project MOSES
 - AUV AEGIR
 - AUVs GIRONA
 - Project ROBEX
 - Crawler VIATOR

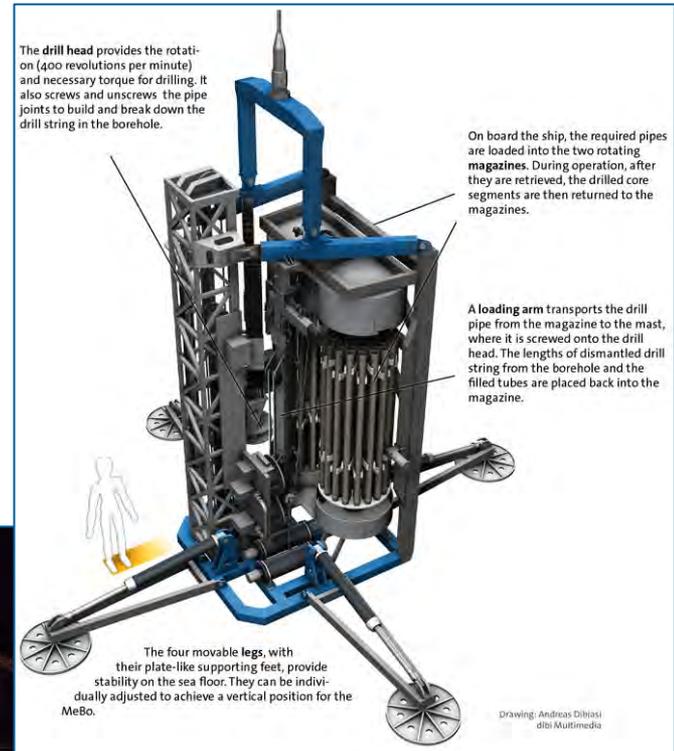
MFP / IMS



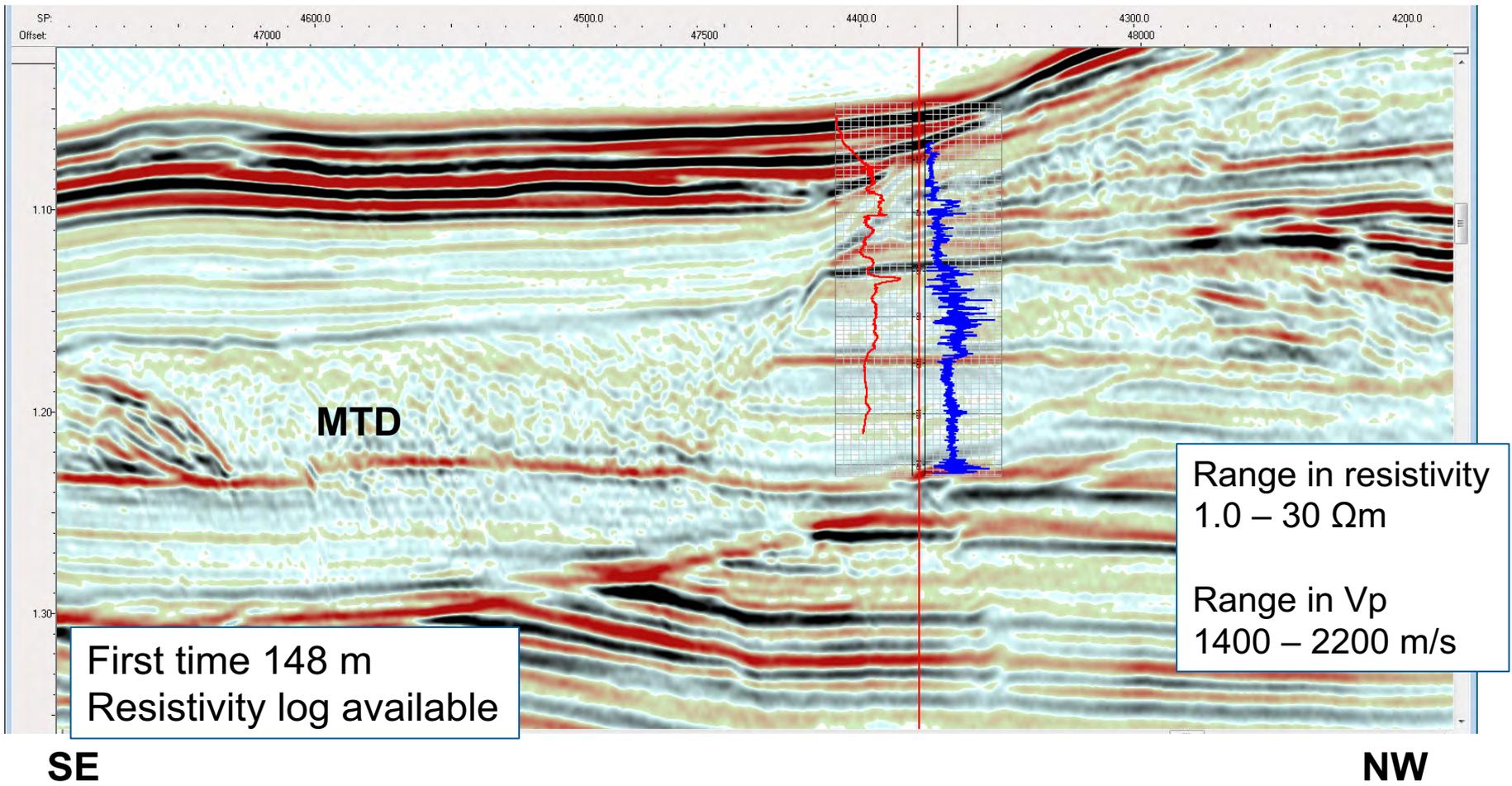
MEBO 200



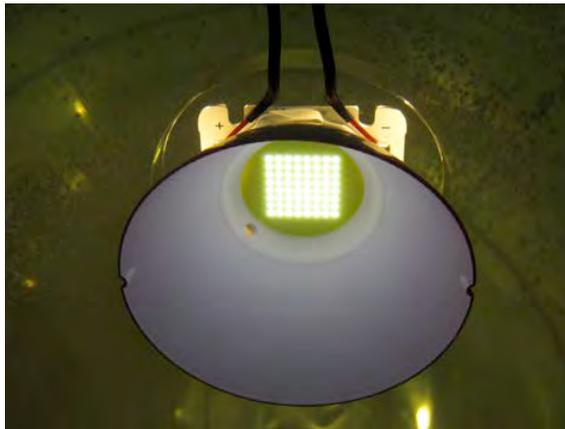
Weight: 110 tons
Sails with eight 20" containers
Depth rated 2700 m



Drilling a BSR at 148 m bsf



High power low cost deep sea LED light



Mechanical properties:

- pressure neutral cast
- highly transparent polyurethane
- shore hardness 45D
- 600 bar/6000m pressure tested
- field proven with several AUV dives 4000m+

Dimensions:

- 72mm diameter
- 44mm height with reflector, 10mm without reflector
- weight: in air 80g, in water approx. 45g

Optical properties:

- color temp. 5600K, cool white [other on request available]
- reflector 74° FWHM [w/o available]

Electrical properties:

continuous light

- 22W power, 22V@1A
- flux 2.800lm
- 50.000h lifetime [70%]

flash light

- for up to 10ms pulses and 10Hz rep. rate
- 160W power, 35V@5A
- flux 15.000lm

Organization

German AUV Groups @ GEOMAR, Kiel & MARUM, Bremen

Two applications @ GEOMAR

- AUV Development and operation with limited support from GEOMAR
- Crawler Development and operation funded through research projects

Permanent team of seven persons for AUV

- technical leader (Marcel Rothenbeck – mrothenbeck@geomar.de)
- mechanic and electronic engineer
- navigation technician
- software engineers
- co-operation with partners (TH Kiel, IQUA Robotics)

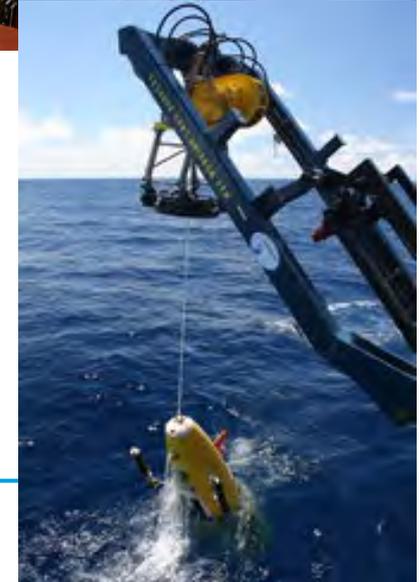
Research team of three persons for crawler

- scientific leader (Sascha Floegel – sfloegel@geomar.de)
- mechanical and electronic engineer
- co-operation with partners (AIRBUS, DFKI, DLR, ISeaMC)

AUV ABYSS

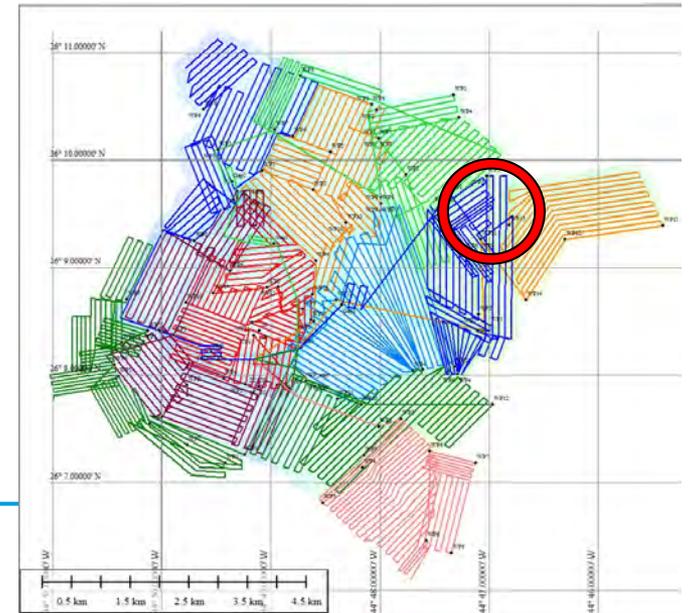
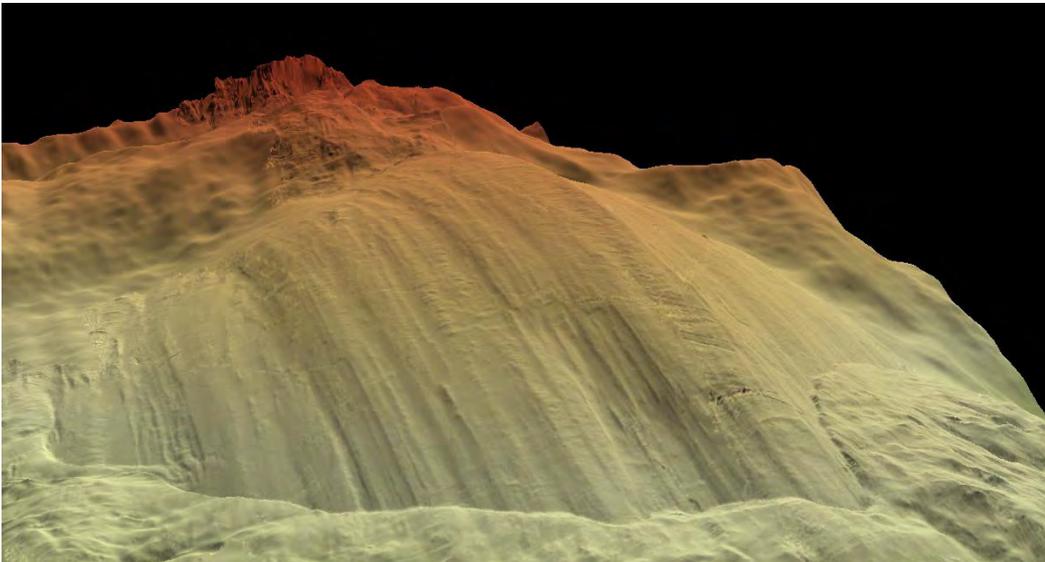
REMUS 6000

- Rated 6000 m
- Up to 20 hrs operation
- Sensors:
 - CTD
 - Particle sensor (ECO)
 - Multibeam
 - Sidescan Sonar
 - Sediment echosounder
 - Still camera
 - Self potential



AUV ABYSS

- Operational use since 2009 on 21 cruises
- 271 dives with an average duration of 13 h
- 16.500 km vehicle track
- Operates independent from surface vessel



AUV AEGIR



- Learning and testing with minimal logistics
 - Team preparation for the GIRONA AUVs
 - Compatibility from the beginning
- Development of a shallow-water AUV
 - Light weight: < 50 kg
 - Small dimensions: < 1.2 m
- Minimal costs to be covered from department
- Working towards simultaneous operation of three AUVs
- Mechanical development @ GEOMAR
- Software under license of IQUA Robotics



AUV AEGIR

- Test dive in pool successful
- Work to be done
 - Navigation Kalman-Filter integration
 - Feedback control
 - Modem connection
- Test dive in open sea in summer 2018
- Project requests for
 - Detection of warfare dump sites
 - Seaweed monitoring
 - Midwater ecology (towed camera)





Modular Observation Solutions for Earth Systems

Event-oriented observation and research

- Short-term events and long-term trends
 - Heat waves
 - Hydrological extremes
 - Ocean eddies
 - Permafrost thaw
- Novel observing system of the Helmholtz Association
 - 9 Helmholtz Centres from “Earth and Environment”
 - Highly flexible and mobile observation modules
 - Investigate interactions across Earth compartments



- coastal and marine mobile systems
- marine fixed point observations
- **marine autonomous vehicles**



GIRONA 500

- 2 AUVs G500 (IQUA Robotics) in 2018
- Comprehensive GUI for all AUVs
- Single and combined dives (also with AEGIR)
- Conception of Underwater Communication



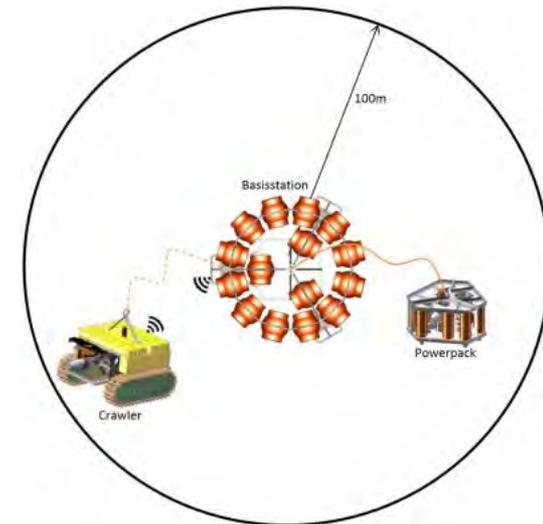
ROBEX

„Robotic Exploration of Extreme Environments – ROBEX“

- 16 institutions from all over Germany
- world’s first integrated space and deep-sea research group
- jointly developing technologies to improve the exploration of environments with extreme conditions (Polar Regions, the Earth’s moon and other celestial bodies)

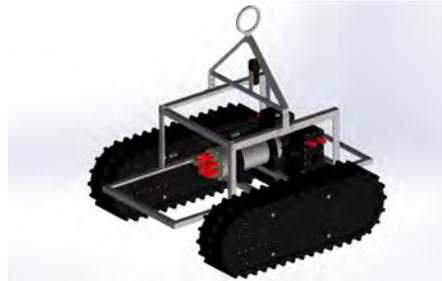
„Deep-sea demo-mission“

- autonomous mobile 4D (3D spatial and 1D for time) observation system
- capture spatial and temporal variation over larger areas and tidal or seasonal cycles
 - (I) environmental parameters (e.g. water chemistry, nutrients)
 - (II) bio-geo-chemical process rates
 - (III) biological diversity



ROBEX

three mission specific systems



TRAMPER
AWI

MANSIO-VIATOR
GEOMAR

iWally
JUB

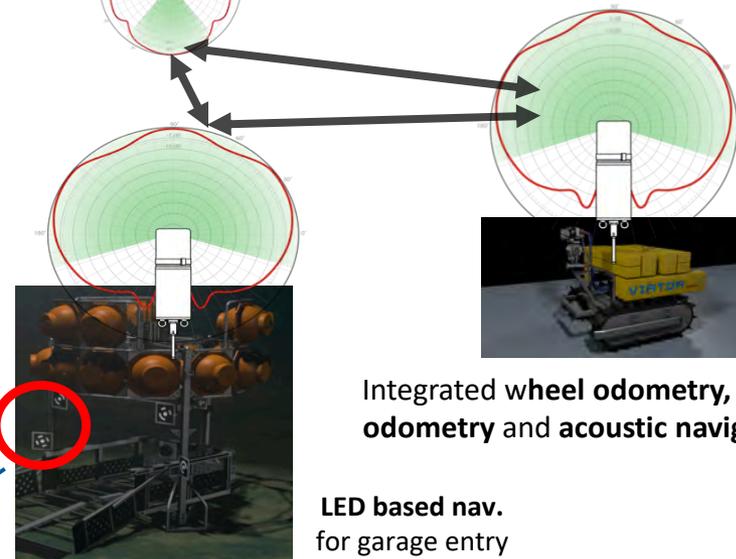


VIATOR & MANSIO



MANSIO-VIATOR navigation

USBL



processed image

- ... active LED markers work up to a distance of 10 m
- ... 7 LEDs per marker -> pose estimation



VIATOR



- Camera and laser scanner - mapping and navigation
- LED marker-based system - docking (near-field navigation)
- USBL system - communication and far-field navigation
- Energy supply: 12 kW LiPo, inductive recharge
- Max. 6000 m



- pH, O₂, conductivity, temperature, pressure, turbidity, chlorophyll a, currents, ...
- ... modular add-ons, e.g. CH₄

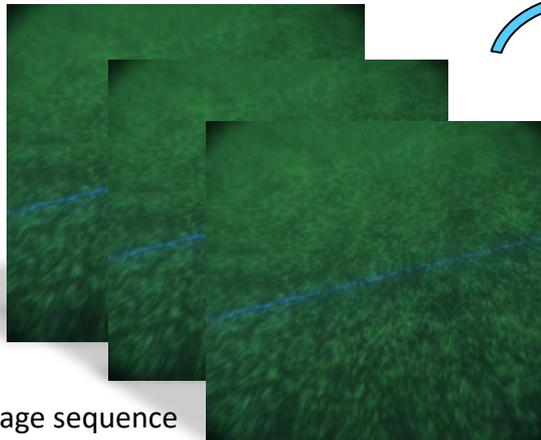
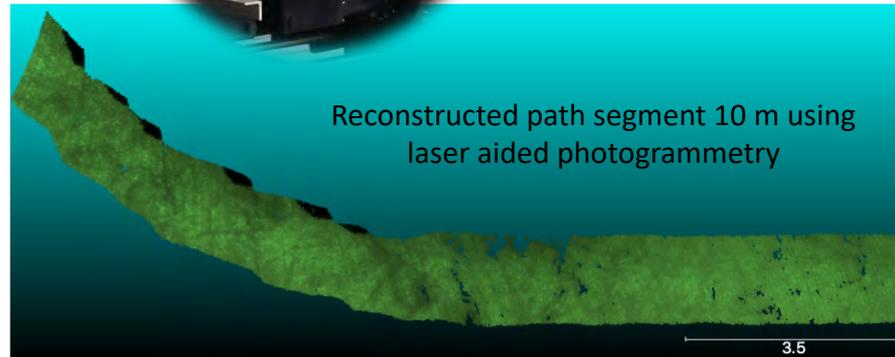


Image sequence



Reconstructed path segment 10 m using laser aided photogrammetry

Thank You

