Marine Systems & Robotics Multidisciplinary Education

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http://impact.uni-bremen.de/

Outline

- Introduction
  - Heincke RV Excursion
  - Vulcano Summer School
  - Marine Robotics
- Lesson Learnt (& Adopted)
- Impact of COVID

Vulcano Summer School

- Setup in 2015
- Part of ROBEX - Helmholtz Alliance Ro
  Extreme Environments (ROBEX)
- Target Group - Undergrads, Graduate
  (marine/geoscience, engineering), In
  administrators, policy makers

Objectives

- Planetary science/analogues and technology (Land/Planetary Surface and Marine/subsurface) mission and experiments
- Provide a broad but solid background and case studies
  - Terrestrial vs. Marine, Surface vs. Subsurface, Earth vs. Moon (and beyond)
- Bring together researchers, engineers, science managers, graduate and postgraduate students
- Build networks, broaden horizons, encourage communication, build bridges, provide opportunities to learn new techniques, use new tools
- Aspects of Planetary Sciences, Remote Sensing, Geology, Geophysics, Oceanography, and Robotics

From the depth of the oceans to the planets and stars

Approach

- Hands-on and practical experience coupled with lectures
- Instructors with broad and complementary range of background
- Location: a demo planetary mission site (marine & terrestrial)
- Suitability: for Moon-like (and to some extent Mars-like) surface environment

Components

- Frontal **class** component: Planetary geology / Oceanography / Geophysics
- **Field** Component: field data collection, experiment operation, geological remote sensing + field geophycics, seismics, electrics, magnetometry, teleoperation
  - Terrestrial: drone mapping, gravity, magnetic, heat signatures, seismics, geology, soil sciences, telemetry, positioning, etc
  - Marine: acoustics, mapping, water properties, marine magnetics, video mapping, sampling water / sediment
- **Lab** component: Planetary Data analysis, Field data analysis , Marine data analysis = comparative planetology
- **Project** component: workgroup presentation of results
- **Training** component: students become teachers

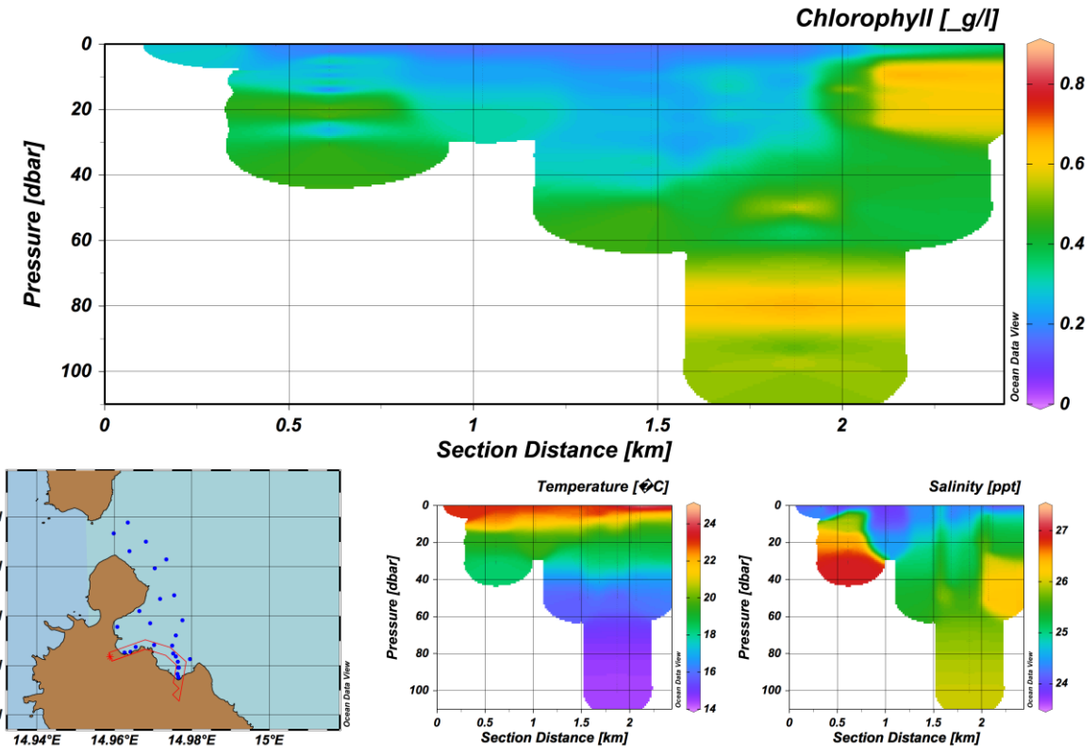
Size and Funding

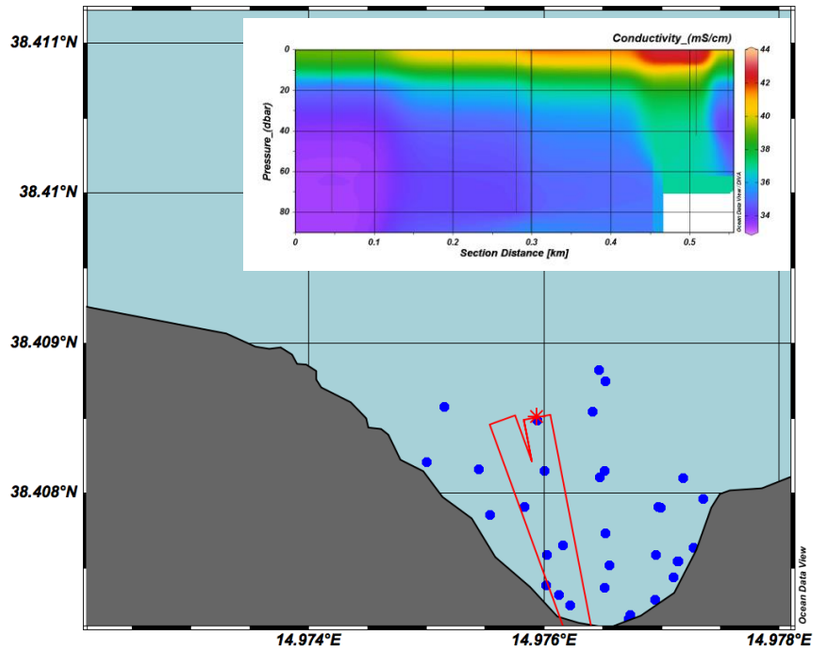
- 2 weeks (typically in June)
- 20-30 participants
- Costs in order of 20K euro
- Funded
  - 2015 - 2017 ROBEX and participating institutions
  - 2018 - only participating institutions and fees
  - 2019 - Europlanet

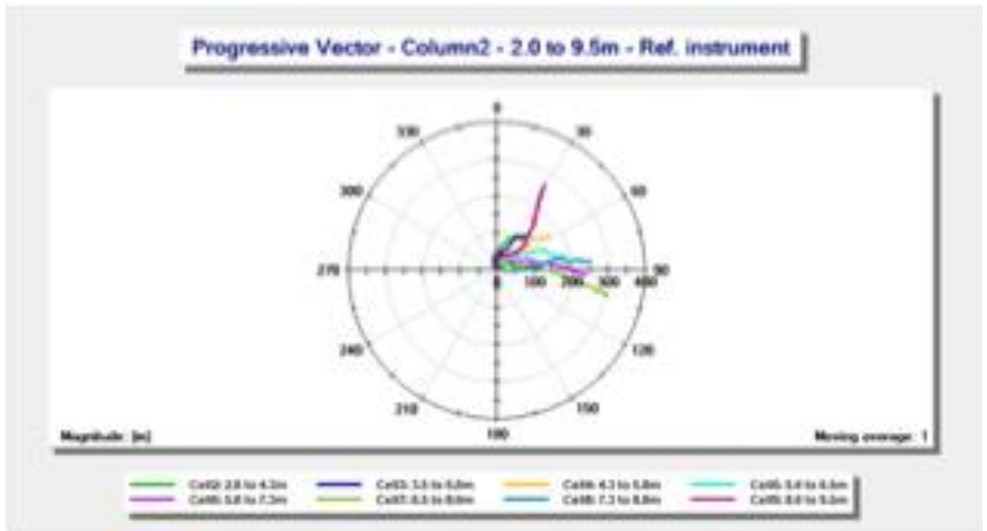
Overview of tools / methods

- Magnetic (gradiometer & marine magnetometer)
- Drones (Photogrammetry, Spectrometry)
- Geodetic Surveying Kinematic GPS
- Seismics (Passive, active refraction)
- Gravity
- Acoustics (echosounder, sidescan sonar)
- Ground Probing Radar
- CTD, ADCP
- Sampling (Water, Sediment)
- Underwater ROV
- Rover (Marine, Terrestrial)
- CO2, Ph sensor
- LISTT
- Drop camera (Cement Casing)
- Telescope (Astronomy)
- Infra Red Camera
- Research Vessel

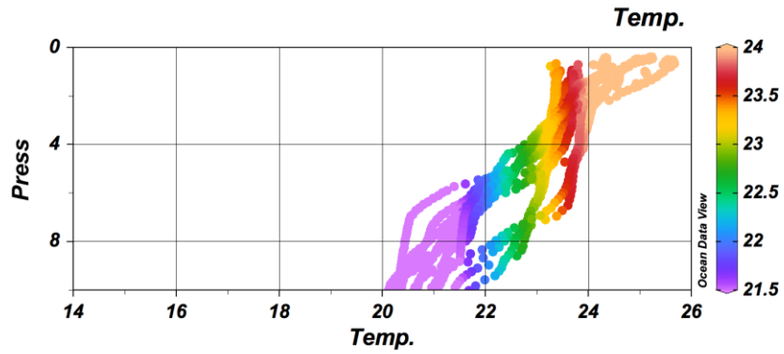
Marine (CTD/PLUME)

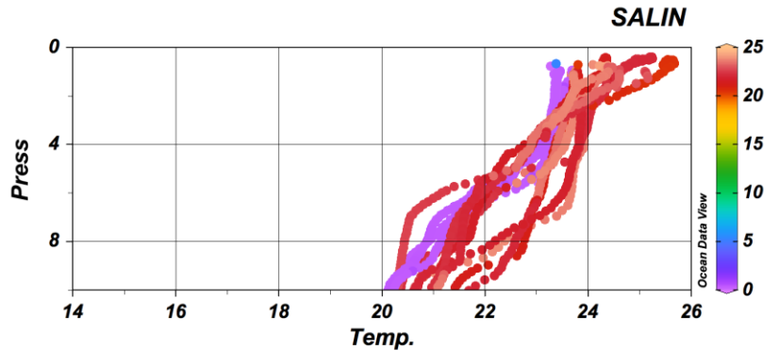


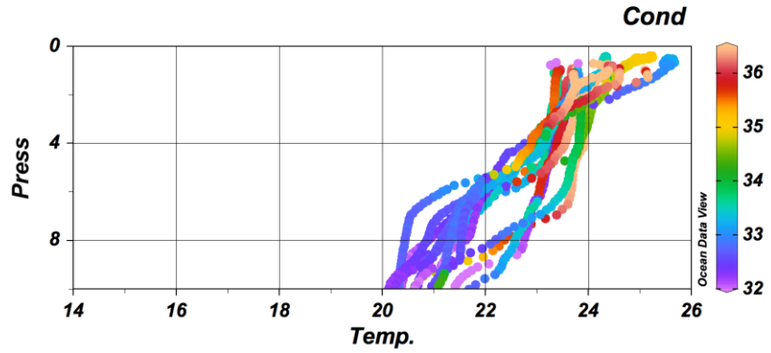


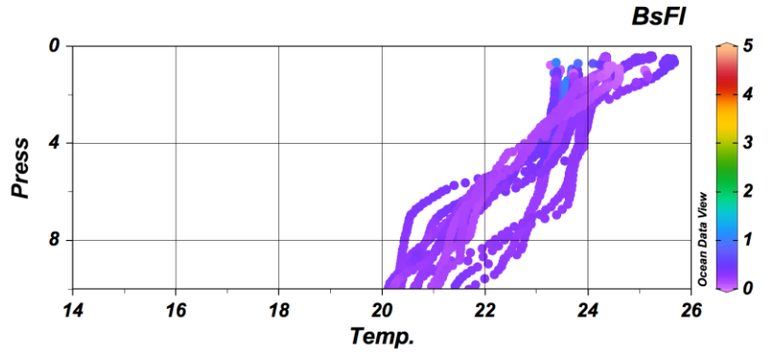


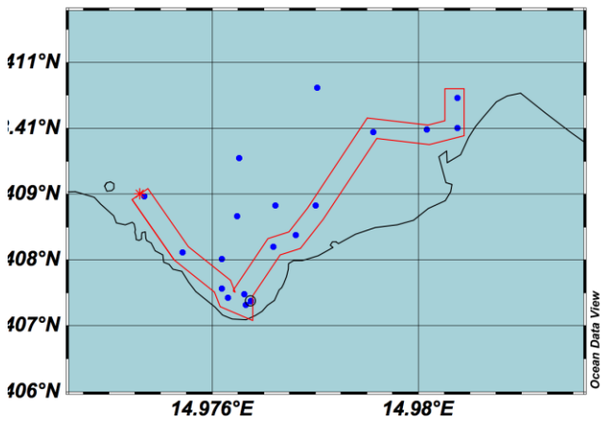
Marine (CTD/PLUME)

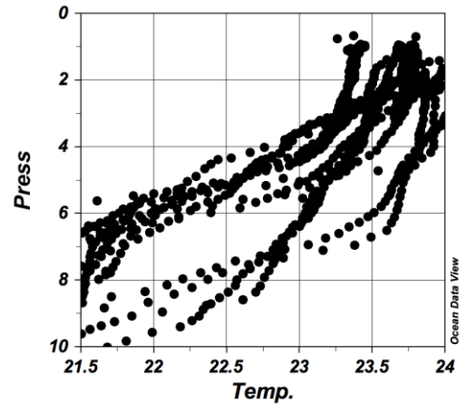


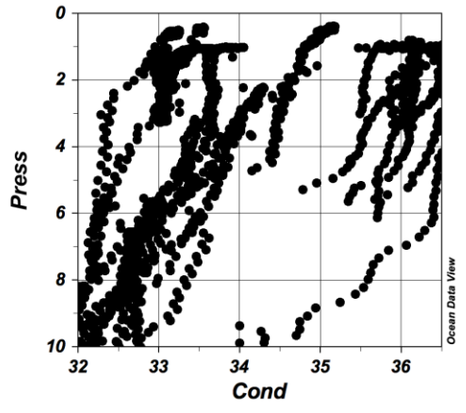












Achievements

- 5 field campaigns / Summer Schools; expertise, experience, data
- ~ 150 participants; building people networks
- Positive and constructive feedback used to further fine tune the summer school.
- Extensive database of data gathered; 4 year timeseries
- Successfully provided insights from Oceans to Planets and methods from Oceanography, Geophysics, Geology to Planetary Sciences
- Addon: 2 x BSc thesis, GeoBremen 2017, LPSC, presentations, manuscripts in preparation

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Feedback

2017 (28)	
Tim Jährig	Germany
Ludwig Reiser	Germany
Ibra Wane	Senegal
[illegible]	[illegible]
[illegible]	[illegible]
Lisa Schellenberg	Germany
[illegible]	[illegible]
Sarah-Lynn Haselbach	Germany
Christian Bühler	Germany
[illegible]	Germany
Janos Biwas	Germany
Florian Neu	Germany
Ben Gillard	Belgium
Damianos Chatzievangelou	Greece
[illegible]	Italy
Alejandro Avendano	Spain
Song Wang	China
Vik Unnithan	India
Laurenz Thomsen	Germany
Frank Sohl	Germany
Klaus Gwinner	Germany
Jean Pierre Devera	France
Thomas Bouvet	France
Veronica La Regina	France
Luisa Palamenghi	Italy
Melissa Anderson	Germany/ Canada

2016 (23)	
Jeroen Mesman,	Netherlands
Xiong Zhou	China
Alexandra Czeluschke	Germany
[illegible]	[illegible]
Eleni Kalogirou	Greece
Christian Bühler	Germany
Sebastian Wilhelm	Germany
Sven Klüper	Germany
[illegible]	[illegible]
Fawz Naim	India
[illegible]	[illegible]
Damianos Chatzievangelou	Greece
[illegible]	[illegible]
Frank Sohl	Germany
Klaus Gwinner	Germany
Jacob Schwendner	Germany
Matthias Höckelmann	Germany
Vik Unnithan	India
Laurenz Thomsen	Germany
Brigitte Knapmeyer-Endrun	Germany
Martin Knapmeyer	Germany
Riccardo Pozzobon	Italia
Igor Drozdovskiy	Russia

2015 (26)	
Felix Englert	Germany
Paulina Prodzinsky	Poland
Lihuang Tang	China
[illegible]	China
Rushana Karimova	Germany
Miriam Wulf	Germany
Ingo Wagner	Germany
Korinna Kunde	Germany
[illegible]	[illegible]
Christian Bühler	Germany
[illegible]	Germany
Sebastian Wilhelm	Germany
Alexandra Czeluschke	Germany
[illegible]	[illegible]
Daniel Wahl	Germany
Dimitra Intzekara	Russia
Damianos Chatzievangelou	Greece
Roland Rosta	Germany
Caroline Lange	Germany
Frank Sohl	Germany
Bernhard Rebele	Germany
Andrea Pacifici	Italy
Laurenz Thomsen	Germany
Autun Purser	Ireland
Jacob Schwendner	Germany
Matthias Höckelmann	Germany

Selected feedback from the Summer School ..

"Thank You.....

.....for the unforgettable experience in Vulcano!.....

..... learning by doing .... is very important ...

..... insights from other fields is really useful ..."

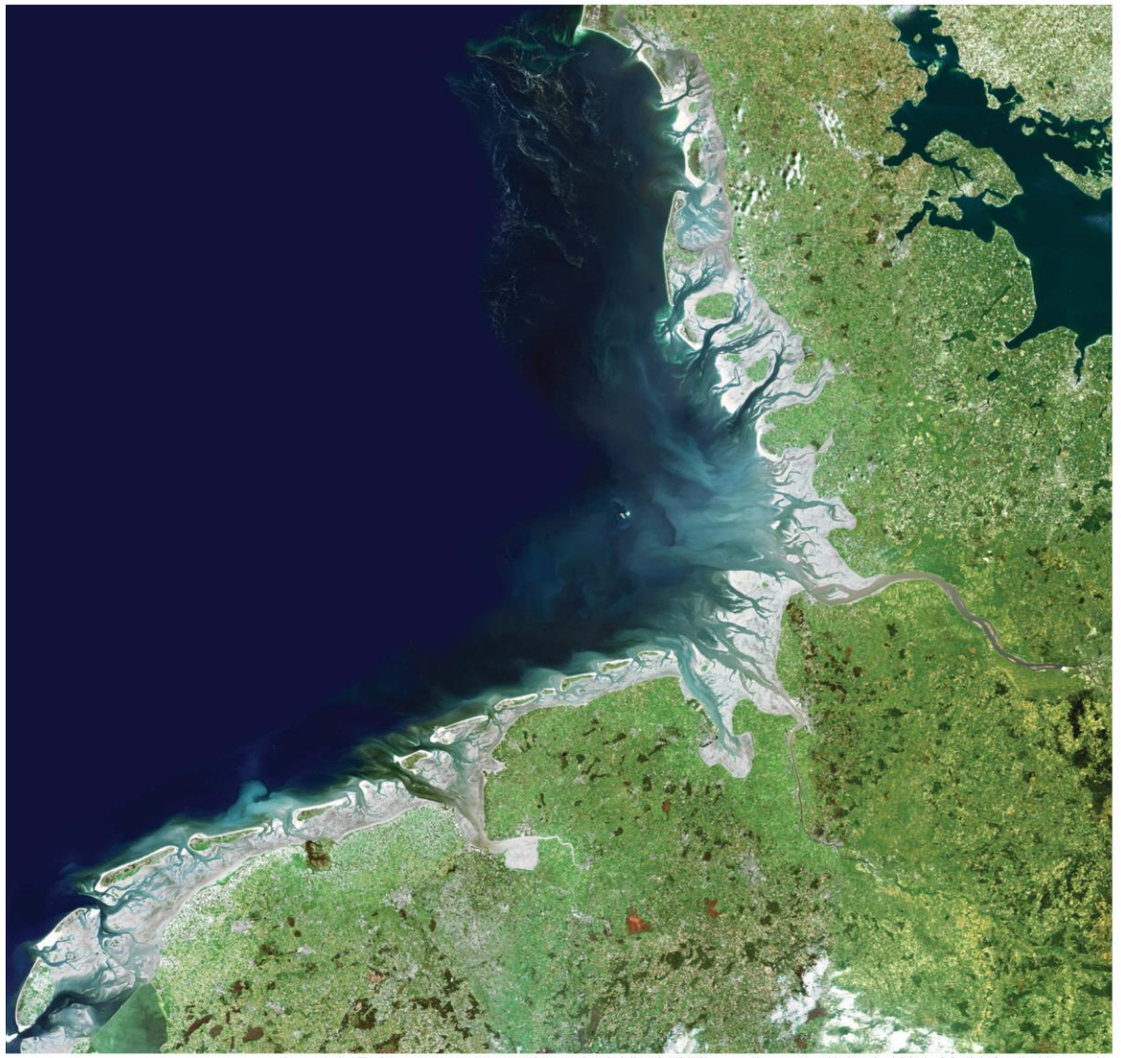
Heincke RV Excursion

- **Possible due to collaboration, co-operation and support of AWI**
- **Since 2007 - today**
- **Undergrads -> research scientists**

- Tonnage: 1322 GT / 396 NT Length: 54.59 m
  Speed: 12.5 kn
- Cruising radius: 7500 sm (30 days) 4 Laboratories: (wet, dry, thermo, and multifunctional-lab)
- Berths for scientists: 12
  Mulitple cranes and winches Operational: ca. 200 days a year. Operational costs: ca. 10k€ per day
- Named after the founding director of the „Königlichen Biologischen Anstalt Helgoland", Prof. Dr. Friedrich Heincke (1852-1921).

Goals

- Hands-on experience working at sea
- Oceanography (physical, biological)
- Marine geophysics (acoustics, magnetics navigation)
- Marine Robotics
- Sedimentary Geology (sedimentary structures, processes)
- Instruments and techniques in marine biogeosciences and geophysics
- Understanding and seeing environmental impacts caused by Climate change and Anthropogenic activity
- Mapping, GIS and data management



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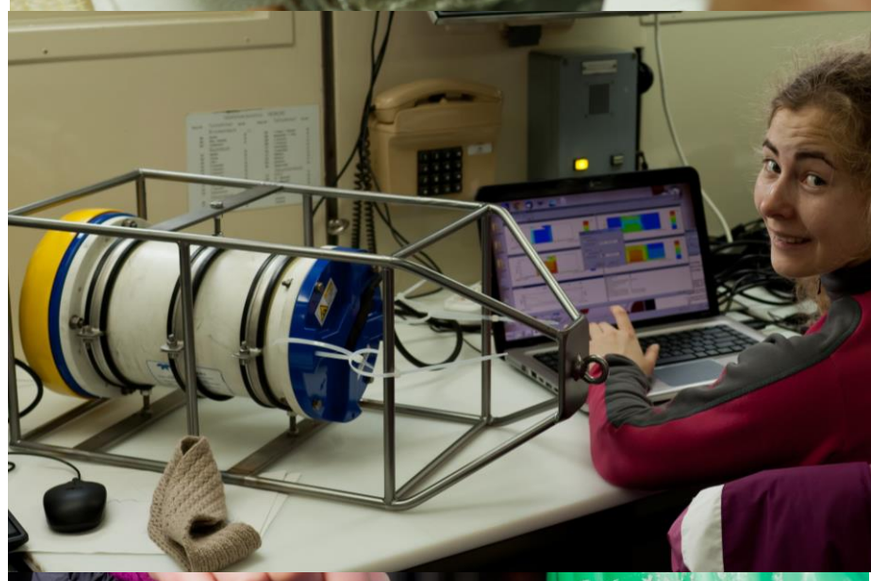
Approach

- Hands-on and practical experience onboard coupled with lectures on key marine topics (robotics, climate change, biogeosciences, geophysics)
- Instructors with broad and complementary range of background
- Location: highly dynamic intertidal German Wadden Seabight region
- Suitability: studying dynamic shallow water systems

Components

- Frontal **class** component onboard: Geology / Oceanography / Geophysics
- **Field** Component: field data collection, experiment operation,
  - Acoustics, robotics, sediments, water samplings, plankton and biological sampling, physical oceanography, geophysics
- **Lab** component: Analysis of samples post cruise
- **Project** component: workgroup presentation of results onboard, with more detailed report that forms part of the cruise report
- **Training** component: students have the opportunity to **"become" scientists / chief scientist** - to organise, and run the excursion of one day !!



Achievements

- Over 15 years of marine education to 400+ students and researchers
- Better understanding of marine methods, techniques and processes
- Discussion and quick implementation of student feedback at the end of each excursion.

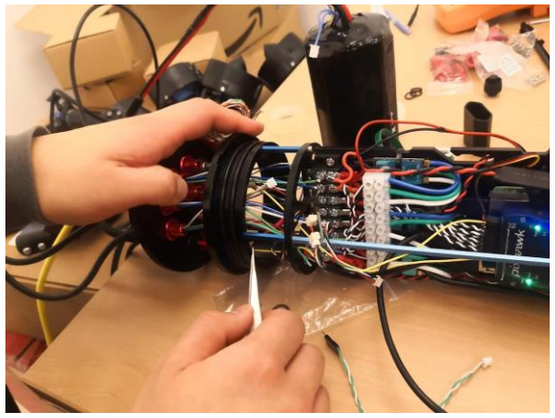
Marine Robotics

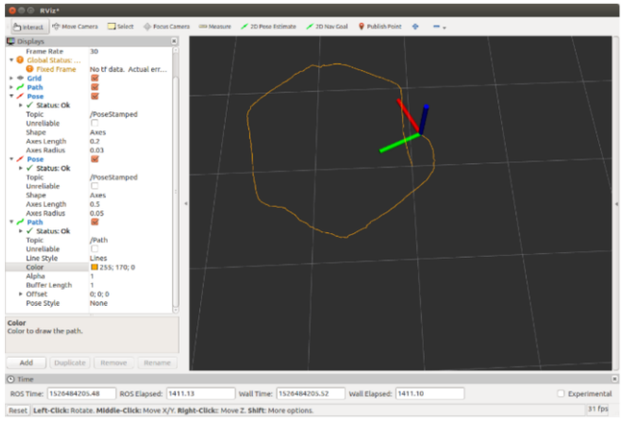
- Specialisation course for BSc students in Robotics and Intelligent Systems and Computer Science
- Mix of theory (lectures) and practice (team work)
- Visit of nearby institutions

DFKI, MARUM, AWI

Marine Robotics

- Working on a "project" is an essential part of the learning aspect.
- Different people have different interests
- Research-oriented

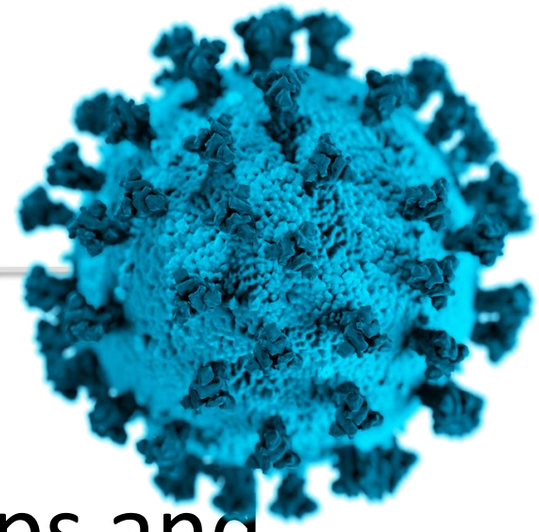




Lessons Learnt

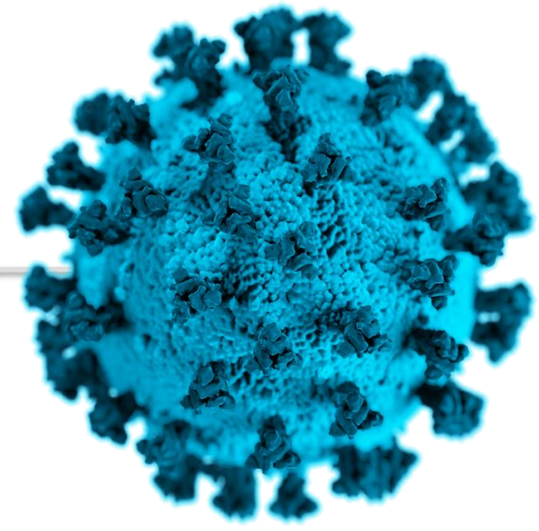
- Field-based teaching is a vital component in th
(even more important)
  - right balance of topics, good mix of junior ar
scientistic, engineers and politicians is neede
- Requires still more emphasis in curriculum dev
- Funding remains one of the important stumbli
excursions are not a good replacement

COVID



- Resulted in the cancellation of all field camps and excursions !!
- Seeking alternatives in terms of virtual excursions, shorter and closer-to-home practical sessions
- None of these measures can provide the same range and scope of learning opportunities.

COVID



- Marine Robotics lectures on-line
- Marine Robotics activities partially in presence, with increased hygiene measures:
  - Negative test
  - Washing hands before and after
  - Corona-app
  - FFP2 mask
  - (distance)

Thank you ..

Image Credits: Vulcano Summer School participants, permission to use for educational purposes

Questions ?

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