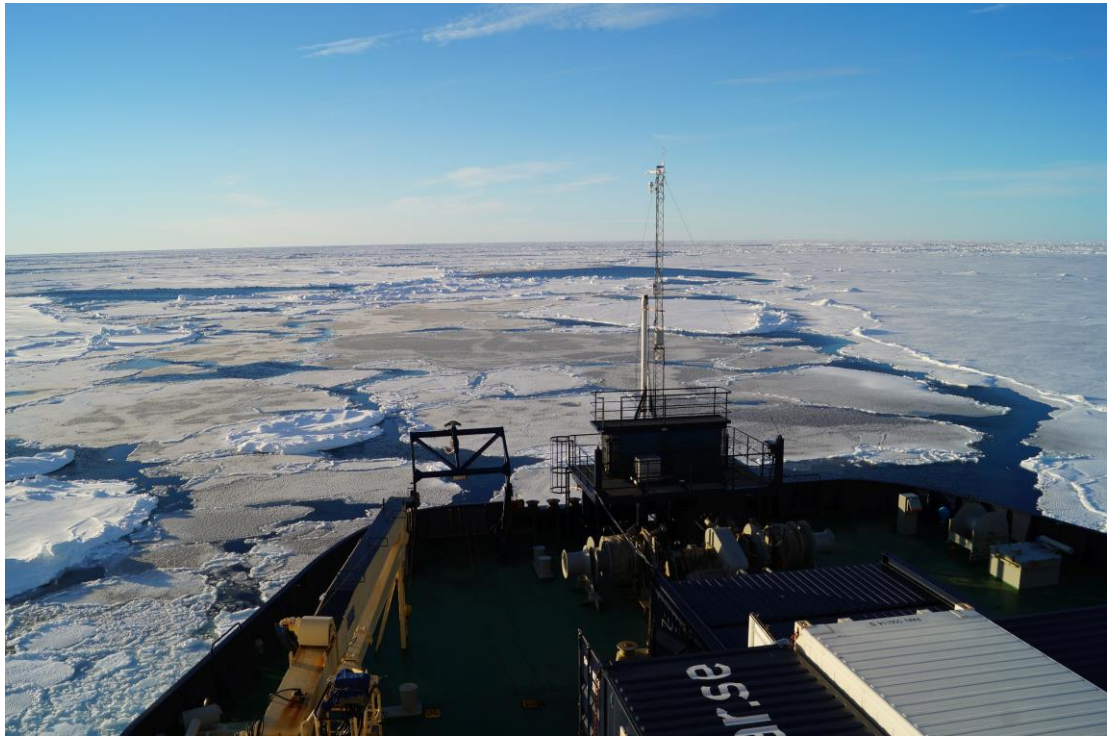
Ice surveillance at the Arctic Ocean 2016 expedition to the North Pole



Hans-Martin Heyn

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Content

1. Overall purpose of Arctic Ocean 2016
2. NTNU's involvement
3. Research ideas and outcomes

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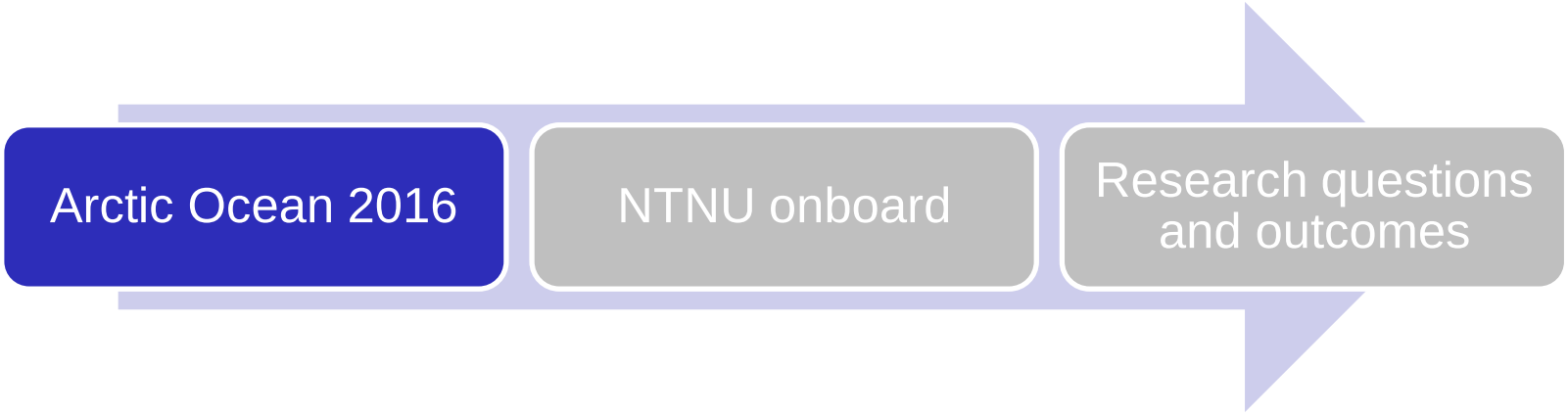

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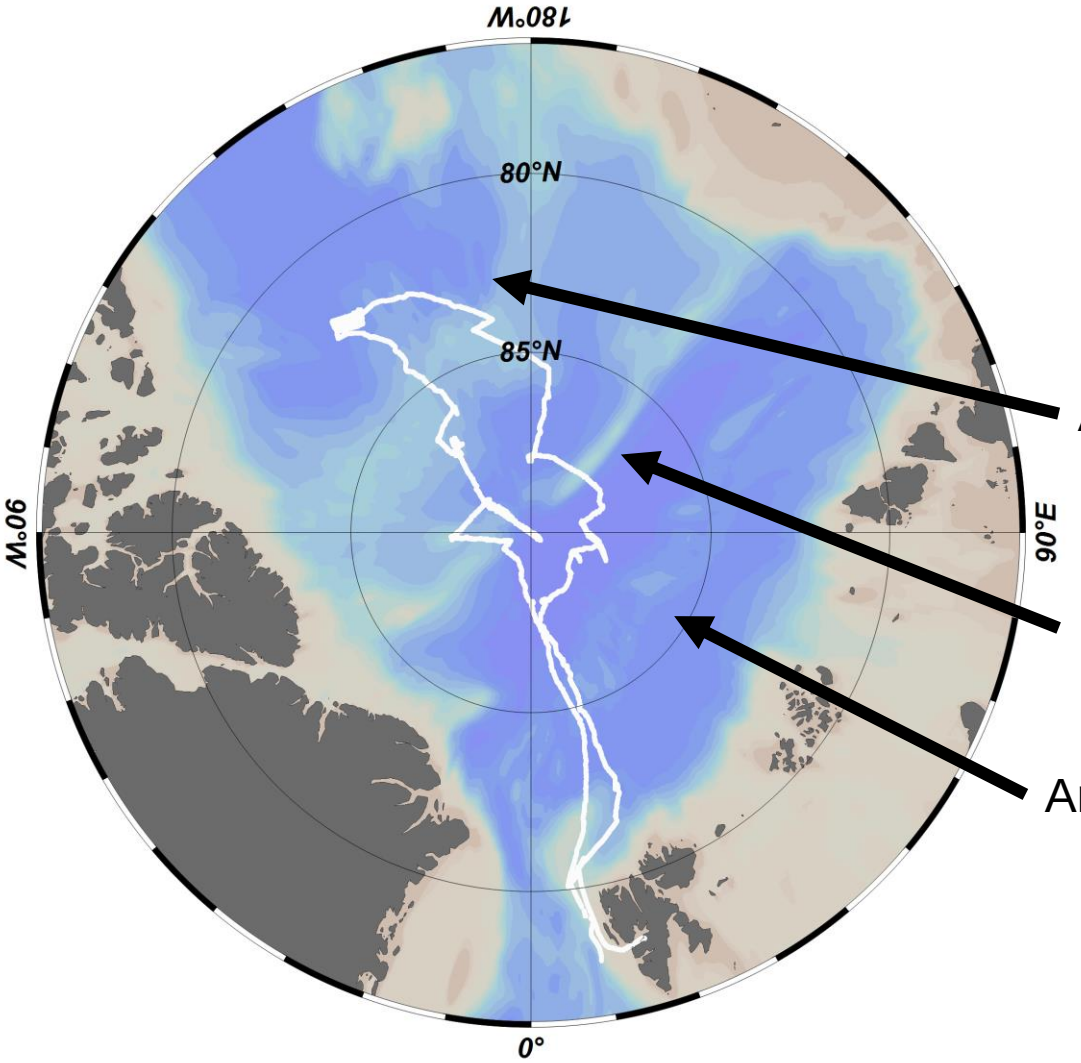
Purpose of Arctic Ocean 2016



- 08.08.2016 – 20.09.2016

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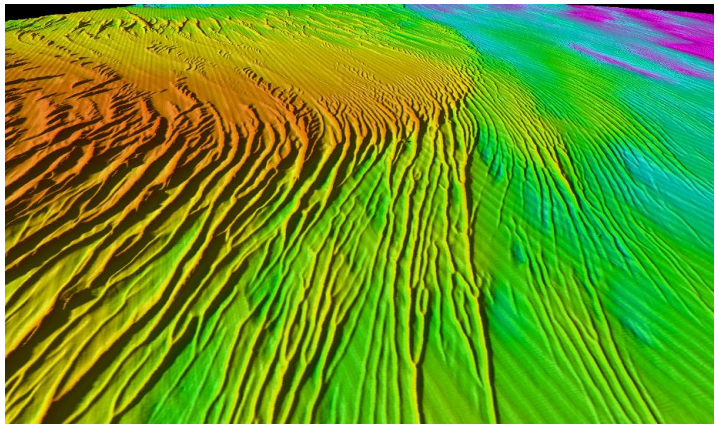
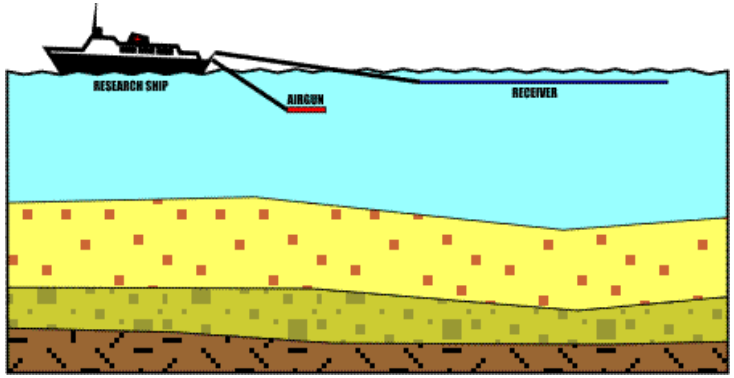
Purpose of Arctic Ocean 2016

- Swedish / Canadian joint venture to fullfill Canadas obligation due to UNCLOS





- UNCLOS prescribes a process to define the outer limits of the (continental) shelf
- Collecting seafloor data in support of Canada's submission

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Purpose of Arctic Ocean 2016

- 50 scientists were invited to participate
- Early career scientist program

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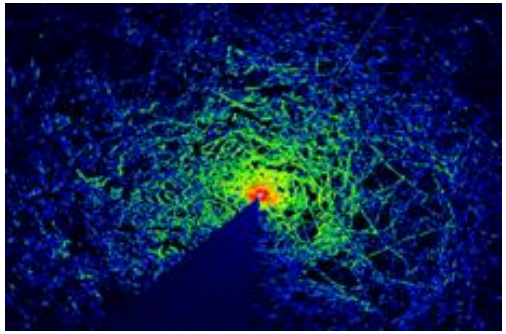
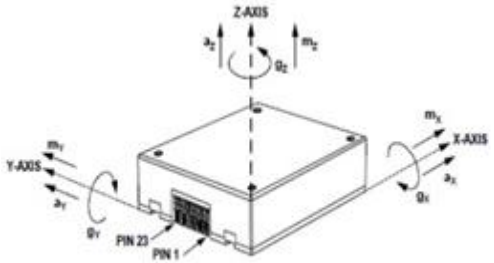
What did we do?



- Radar system for ice drift detection (Runa Skarbø)

- 3 camera systems with 11 lenses for optical ice condition and environmental monitoring (Martin Heyn)



Courtesy of Analog Devices

- 4 motion sensors to record ice induced motions (Martin Heyn)

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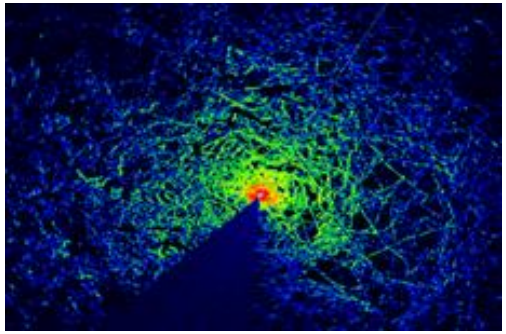
What did we do?



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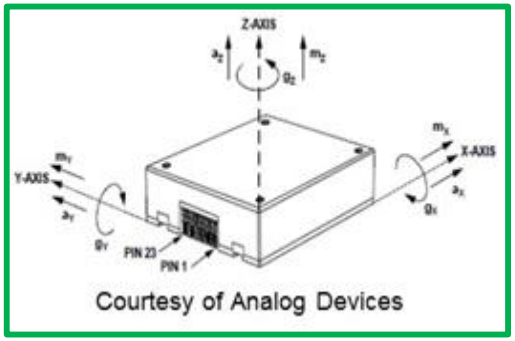

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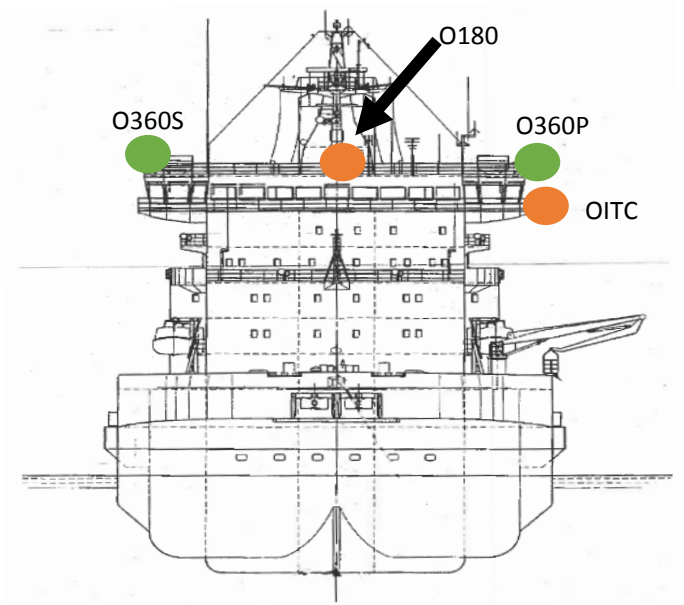
Camera system



- 3 camera systems with 11 lenses
- Automated image capturing
  - 1 image every 10 seconds from 11.08 to 29.08
  - 1 image every 5 seconds from 29.08 to 17.09
- Time synchronisation with other systems

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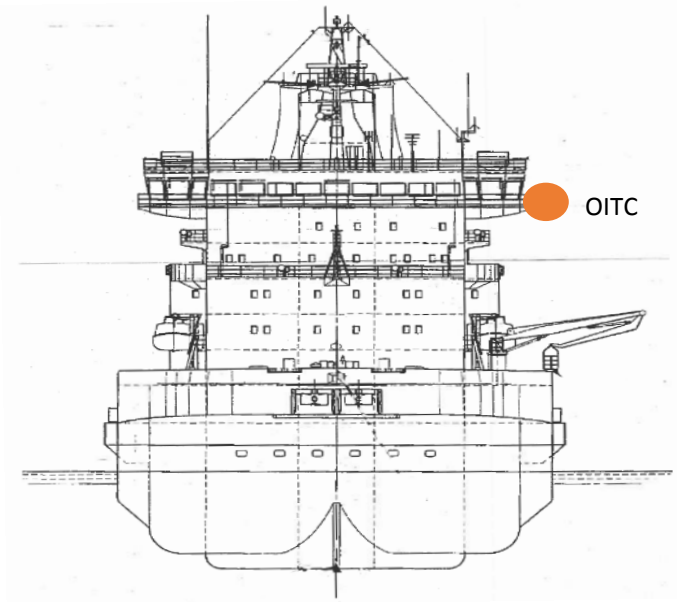
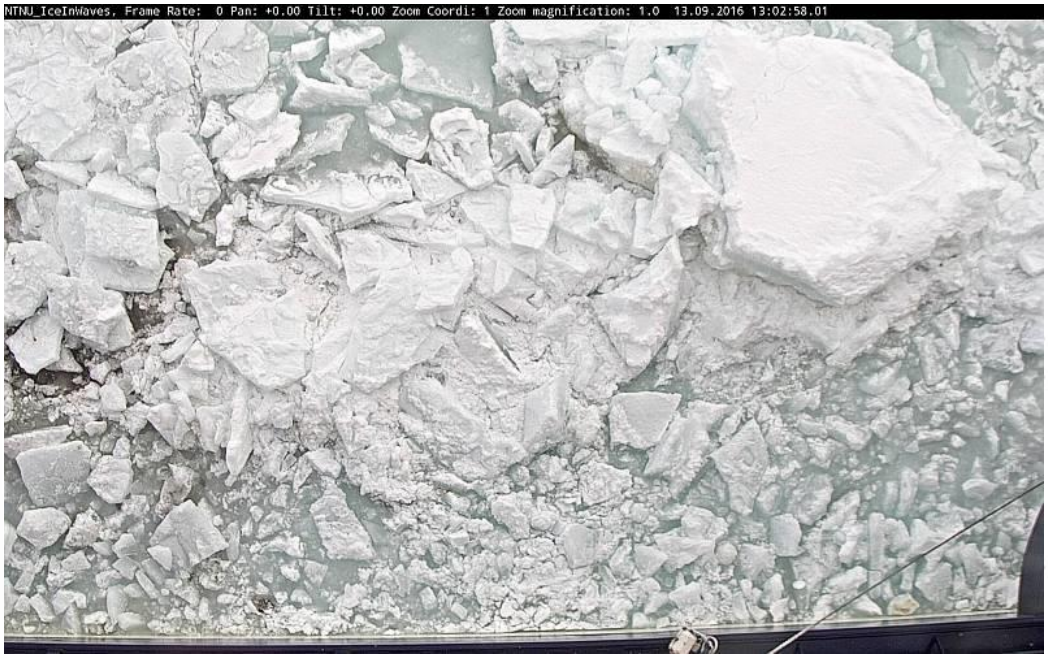
Camera system





- Camera looking directly down on the ice
- If ice floe flips around, ice thickness can be detected

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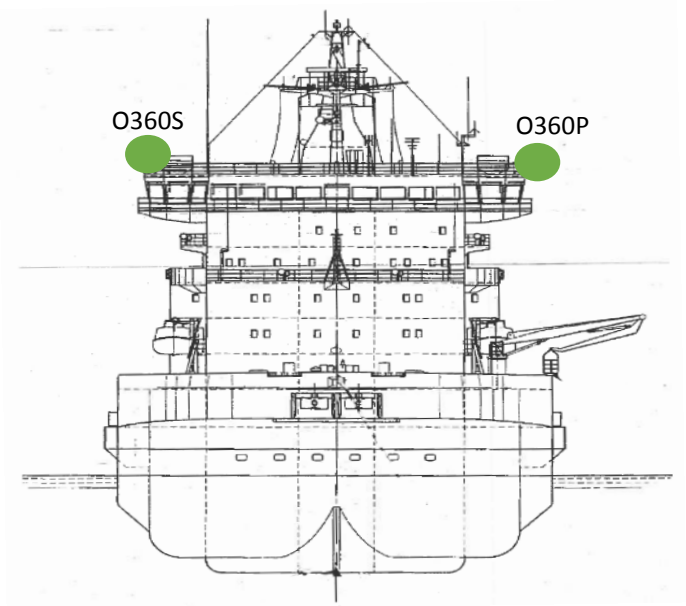
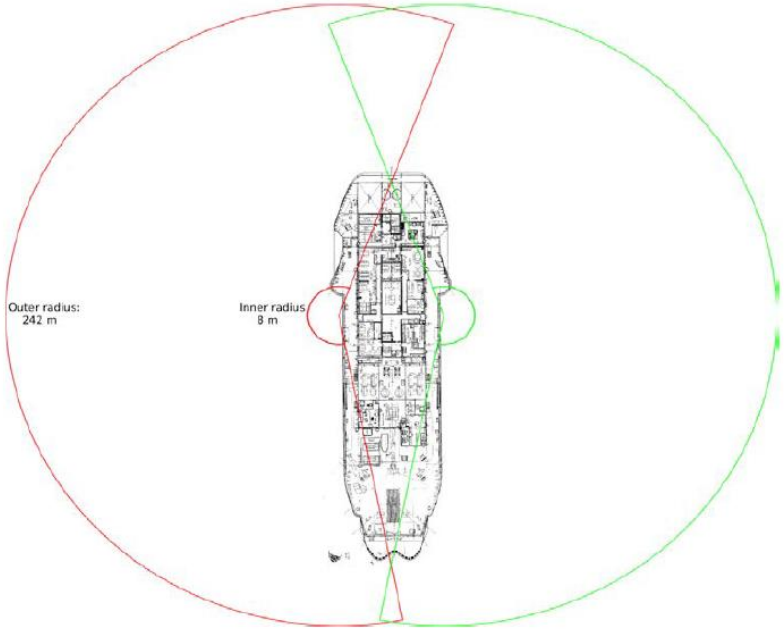
Camera system: 360° cameras





- 2 cameras, 6 “fish-eye” lenses
- Allows 360° panorama

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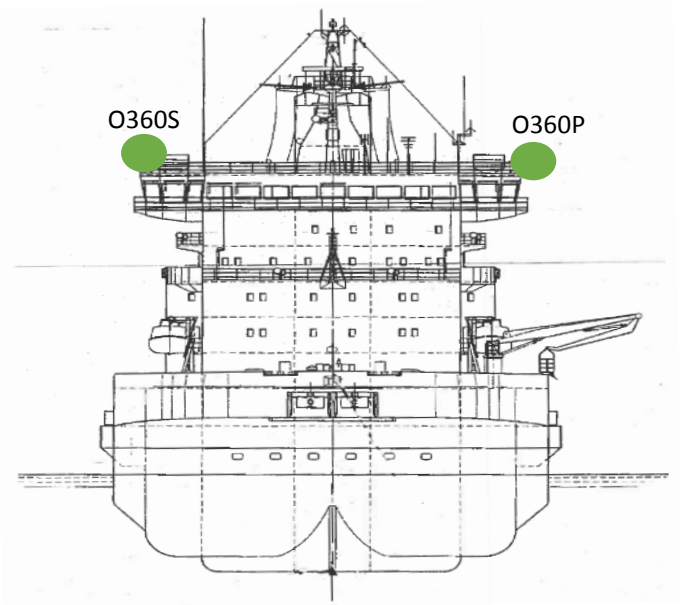
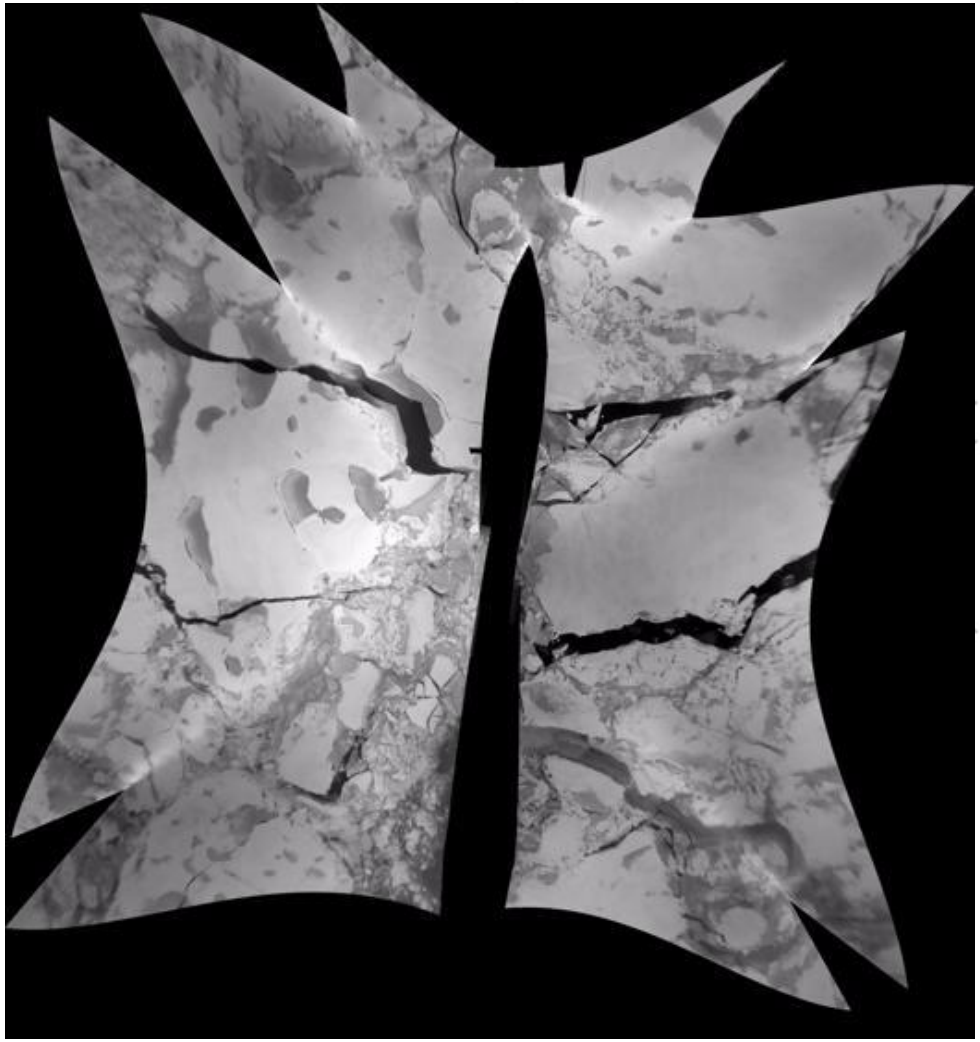
Camera system





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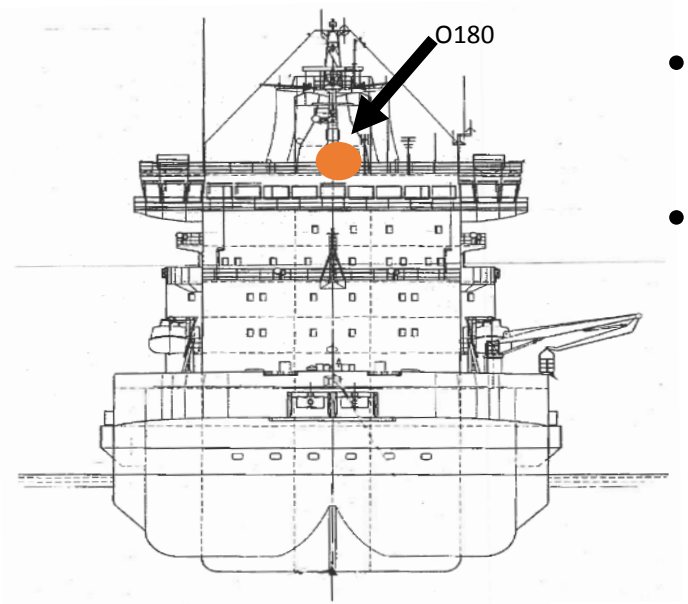
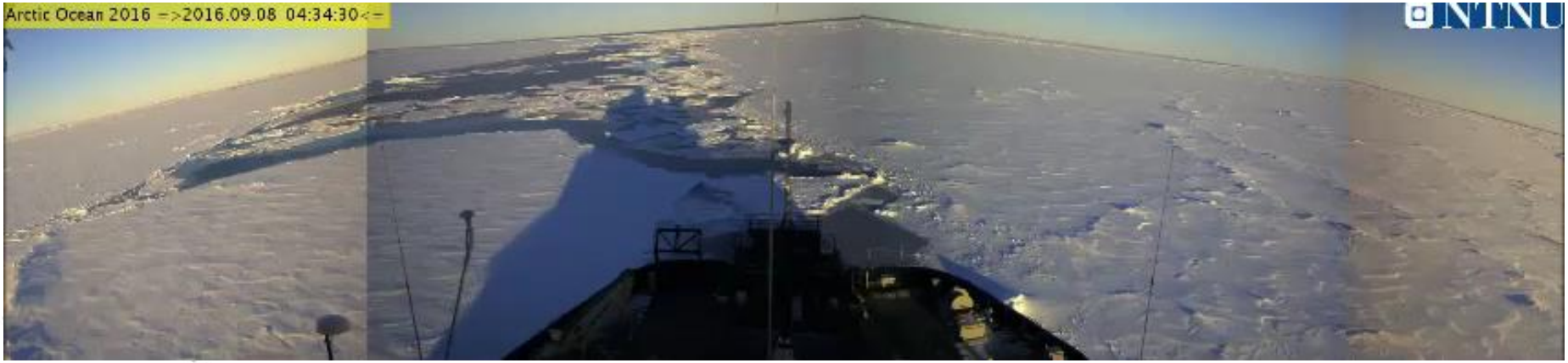
Camera system

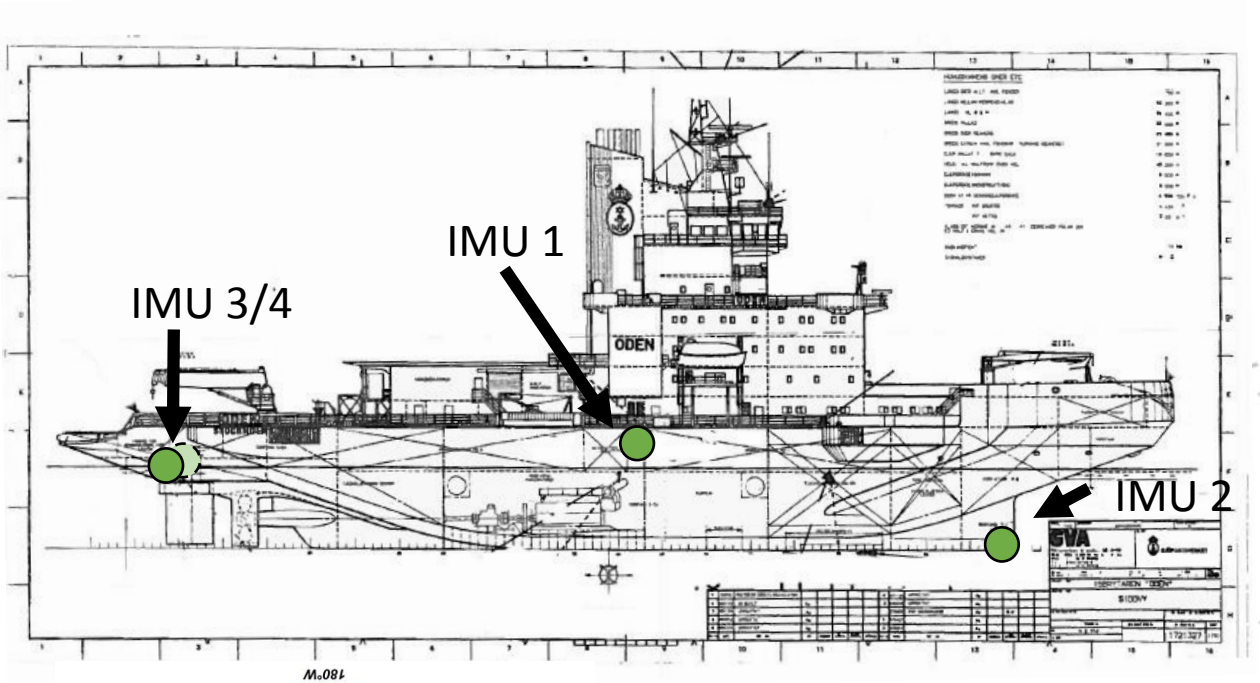


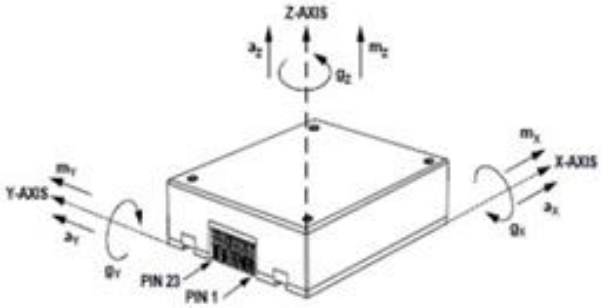
- 180° camera with 4 lenses looking towards the horizon
- “Normal” lenses, no fish-eye effect



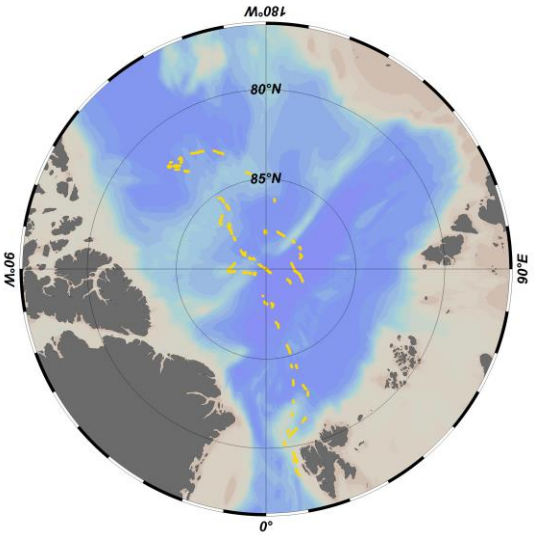
IMU system

- 4 ADIS 16364 IMUs
- 300 Hz sample rate
- Accelerations and angular rates (6 DOF)
- 307 hours of motion measurements





Courtesy of Analog Devices



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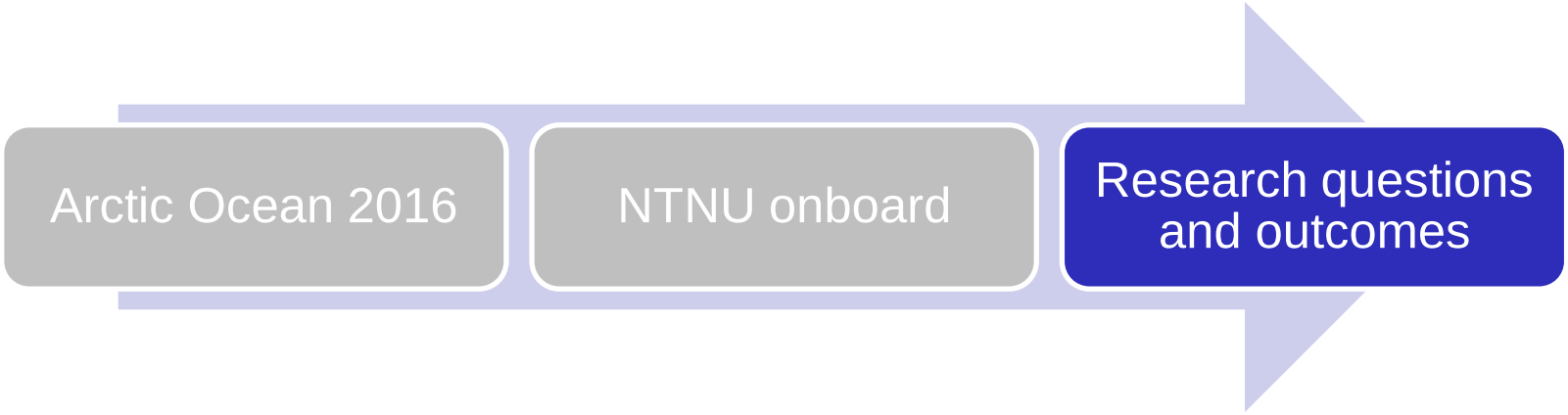

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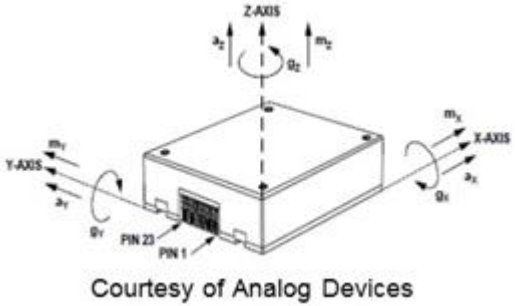
Research ideas



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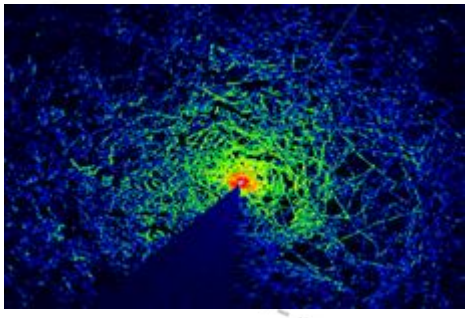

Estimation of extreme ice accelerations based on signal detection

Spatial and frequency sensitive detection of accelerations in ice-infested waters

Automated ice concentration and floe size distribution detection with optical cameras and comparison with results from acceleration measurements in the ship

Ice drift prediction using multi-sector detection (Cooperation paper of Runa, Martin and Jon)

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