R/V *Sikuliaq* Oceanographic Technical Services Update

AICC 2021 Winter Meeting

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Projects of Interest to the AICC

- Science seawater intake system for in-ice operation

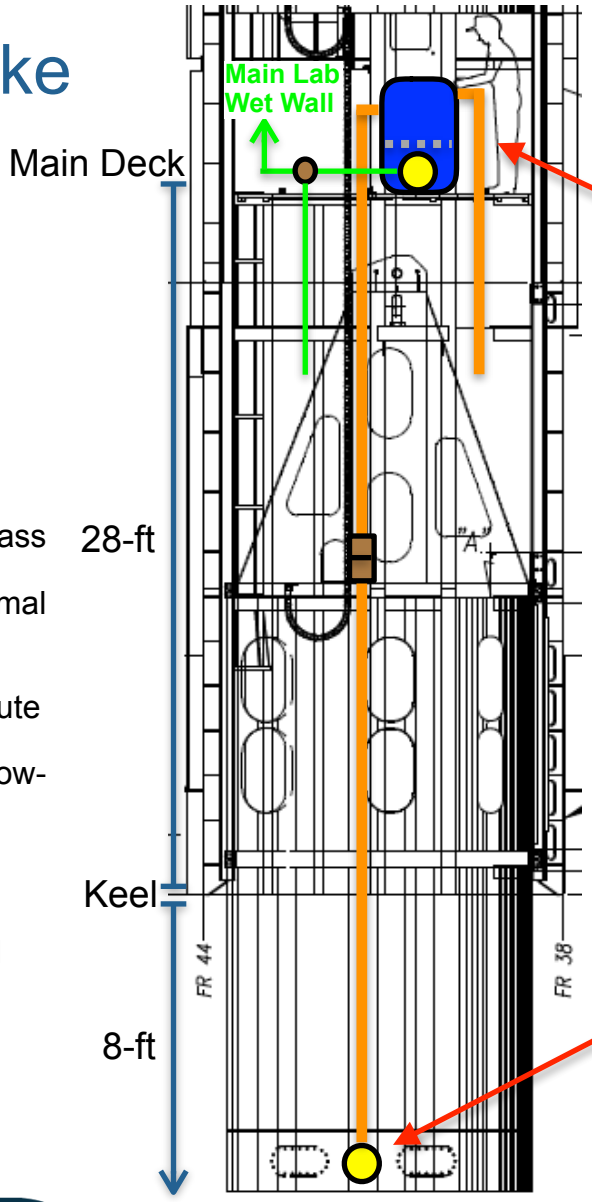
- Satellite communications at high latitudes
  - Geostationary (GEO) and Low Earth Orbit (LEO)

- Advanced shipboard computer cluster for data collection and network resources

Centerboard Seawater Intake

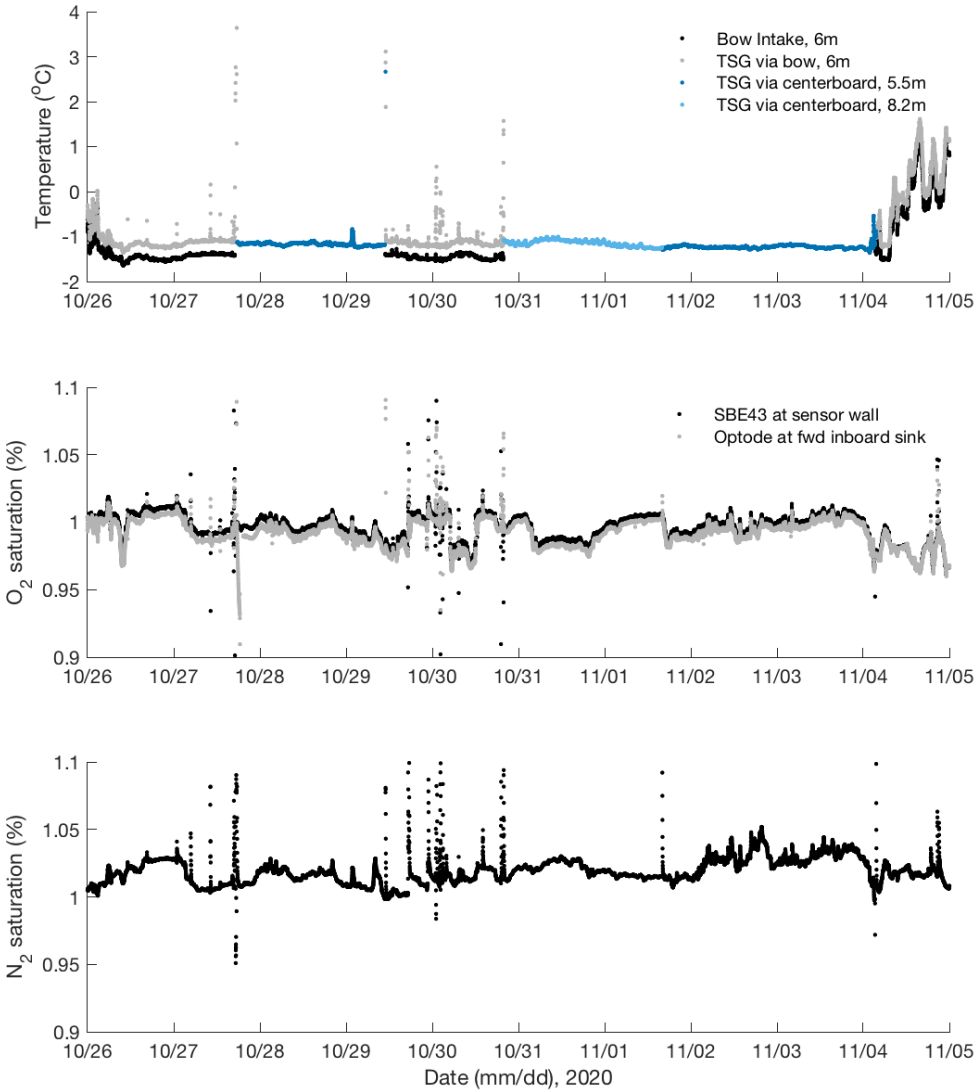
- Flooded transducer shoe provided the intake location
- Primary submersible intake pump, 38-54 GPM @ 22.5 psi [1-HP, stainless steel body, 52-ft max. head]
- 2-in discharge line running vertically through centerboard, configured for either deployed, flush, or safe positions
- 30-gallon polyethylene barrel for separating out sea ice
- Secondary submersible pump at the bottom of the barrel supplies the Main Lab through a 1-in discharge line w/ bypass
- Preliminary testing showed adequate overturning and minimal contamination when compared with bow intake
- Wet wall sensors ran with standard flow rate of 4 liters/minute
- Back-fed two lab sinks for science users to run their own flow-through systems
- Future improvements:

1. Convert one access hatch into an intake grate
2. Upgrade secondary supply pump (½ - ¾ HP) to back-feed entire Main & Wet Labs
3. Finer strainer mesh around secondary supply pump



Secondary

Primary



Dissolved gases are sensitive indicators of contamination due to pump cavitation, bubbles, and flow interruptions. Observations from SKQ202014S show no evidence of baseline shifts between bow and centerboard intake.

- Temperature shows offset in TSG relative to bow intake due to a ~0.2C warming. TSG temps similar after switch to centerboard intake.
- Spikes in Temp and gas saturations occurred while on bow intake due to ice-blockages of filter strainers. These spikes are nearly absent when drawing from centerboard.
- No change in O_2 or N_2 gas saturations evident when switching to centerboard intake (real environmental variability observed while each respective intake in use). N_2 saturation is a particularly sensitive indicator of atmospheric/bubble contamination.
- Very slight lag was observed between sensor wall and downstream sink O_2 sensor while on centerboard intake, likely due to reduced flow.

Credit: Laurie Juranek

Satellite Communication Systems

- **HiSeasNet** is now providing commercial lease options — **Marlink** is the service provider

- **Sealink** — Intellian v240M Gen-ll 2.4m Multi-Orbit C/Ku-band Dual Antenna System

  CIR shore-to-ship: 1024 kbps CIR ship-to-shore: 512 kbps

  MIR shore-to-ship: 4096 kbps MIR ship-to-shore: 1024 kbps

  - Can use spectrum on many satellites, so vessels generally have an easier time of staying online as a result.
  - With high-performance shipboard equipment, planning and funding, it is possible to operate Sealink at up to 80 Mbps.
  - Iridium CERTUS out-of-band management — Cobham Sailor 4300 (L-band)

- **Fleet Xpress** — Intellian GX100NX 1m Multi-Orbit Ka/Ku-band Dual Antenna System

  CIR shore-to-ship: 1024 kbps CIR ship-to-shore: 512 kbps

  MIR shore-to-ship: 8192 kbps MIR ship-to-shore: 4096 kbps

  - FleetBroadband backup system — Cobham Sailor 500 (L-band)

All of the hardware is LEO ready, but the tracking software needs to be modified for maritime antenna controllers. Cobham committed to this development, but Intellian has not yet.

2021 LEO Pilot with Kepler Communications

- **Kepler** demonstrated world's first polar wideband on *Polarstern* during the MOSAiC expedition.
  While vessel was at 85N latitude — MIR shore-to-ship: 140 Mbps, MIR ship-to-shore: 135 Mbps

- GEN1 consists of Ku-band store-and-forward file transfer service for large volumes of delay-tolerant data

- Leasing Cobham Sailor 600 VSAT Ku specially modified to track Kepler's constellation of 15 satellites

- North of the Arctic circle, there are 10 daily passes on a per-satellite basis

- Use cases: (1) download high-res ice imagery and forecast products, (2) demonstrate high-throughput ship-to-shore file transfer, (3) upload cruise data distribution to shore in near realtime

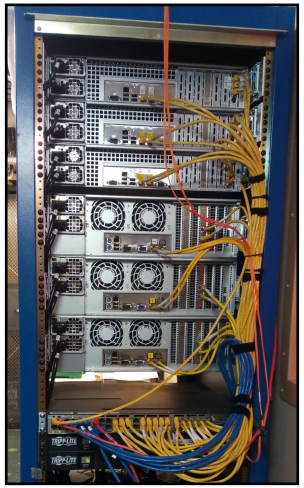
SKQ Polar Operations — NSF Specialized Service

- LEO testing in concert with supplemental Radarsat-2 Scan-SAR wide imagery from MDA

Software Defined Data Center (SDDC)

Before
2013-2020

- 6 Servers, 1 switch - 16u
- Storage: 69 TB
- VM: 72 CPU / 192 GB RAM
- Net: 1 GB Ethernet
- VirtualBox
- Redundant Power / Disk



Abstracting this hardware in the form of a **Software Defined Data Center** (SDDC) allows for maximum flexibility in allocating hardware resources and provides an extremely high level of resiliency for uninterrupted services.

New guest Operating Systems (Linux and Windows) can quickly and dynamically be carved out of the generalized SDDC hardware. Guests can also be migrated from on VM Server host to another allowing for a **fully zero single point** of failure design.

After
2020-2025

- 4 Servers, 2 switch - 7u
- Storage: 110 TB (SSD)
- VM: 64 CPU / 1024 GB RAM
- Net: 10 GB Ethernet
- VMWare
- Zero Single Point of Failure
  Power, RAID, Net, VM Hosts