Arctic Ocean ecosystems: applied technology, biological interactions and consequences in an era of abrupt climate change (Arctic ABC)

Jørgen Berge[1,2,6], Bodil Bluhm[1], Philip Anderson[3], Jonathan Cohen[4], Finlo Cottier[3,1,], Malin Daase[1], Stig Falk-Petersen[1], Laura Hobbs[5,3], Erin Kunisch[1], Pedro De La Torre[6], Ingrid Ellingsen[7], Maxime Geoffroy[1], Bernard Hagan[3], Geir Johnsen[6,2], Kim Last[3], Martin Ludvigsen[6], Shane Rodwell[3], Janne Søreide[2], Asgeir J. Sørensen[6], Sturla Haltbakk[6,] Daniel Vogedes[1], Artur Zolich[6]

1 UiT, the Arctic University of Norway (UiT), 2 The University Centre at Svalbard (UNIS), 3 The Scottish Association of Marine Science (SAMS), 4 University of Delaware, 5 University of Strathclyde, 6 The Norwegian University of Science and Technology (NTNU), 7 SINTEF

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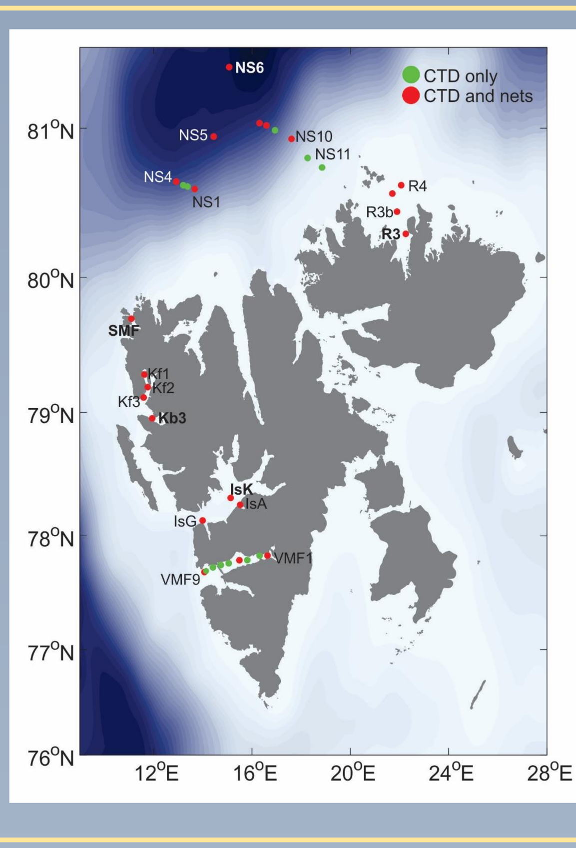
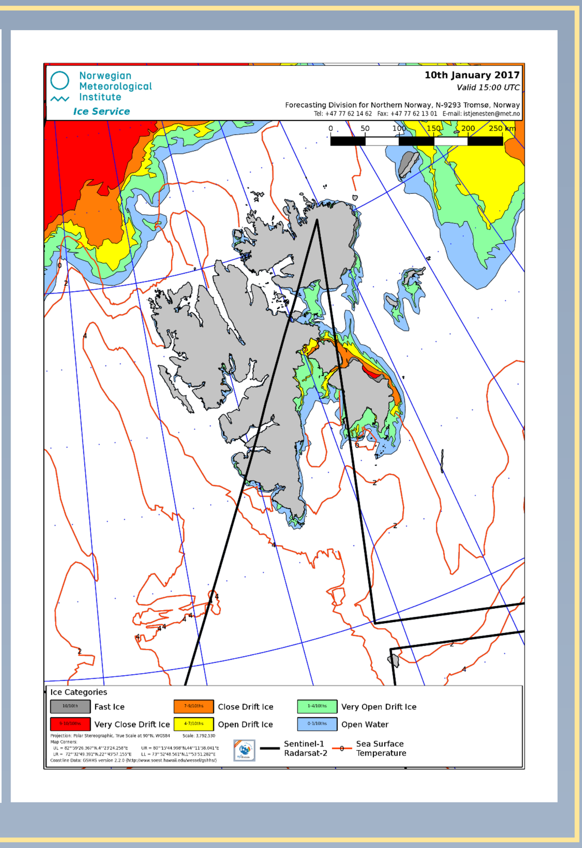
FIELD WORK

FIELD WORK in Jan 2017 on RV Helmer Hanssen occurred under very low ice conditions and in windy weather in Svalbard fjords and north of Svalbard. Similar locations were sampled in winter, spring and summer of 2016.

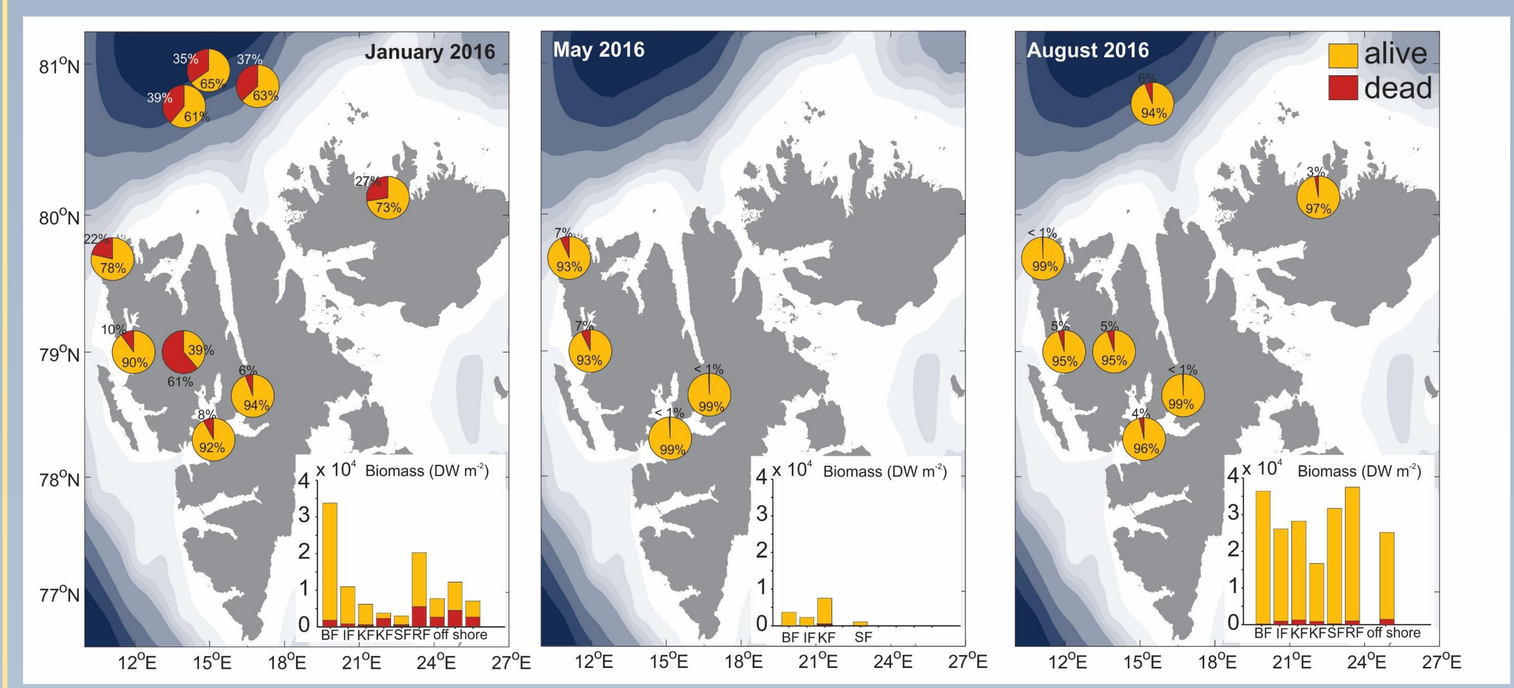




ABSTRACT. The Arctic Ocean faces rapid climate change, which impacts both physical and biological components of the marine ecosystem. Most observations so far have been conducted in the spring and summer. The Arctic ABC team, therefore (1) focuses on studying **pelagic processes during the dark winter period**, and (2) develops a set of **ice tethered observatories to facilitate year-round autonomous measurements**. Field activities are designed to inform the ongoing and planned autonomous observations,

Here we show (1) first project results documenting that pelagic communities are active in mid-winter, and (2) the concept and planned deployments of the ice buoys.

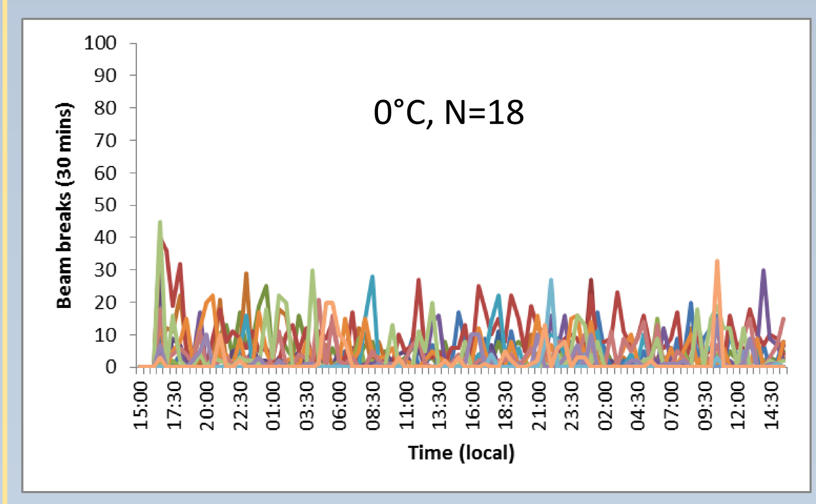
RESULT 1: HIGH COPEPOD MORTALITY DURING THE POLAR NIGHT

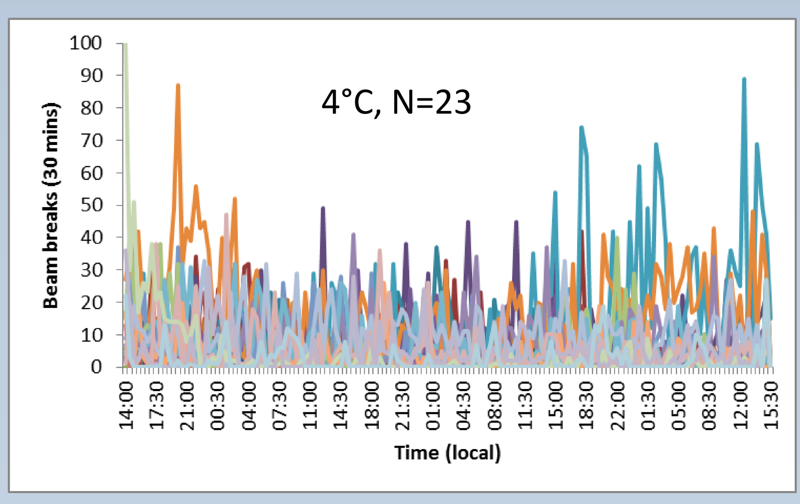


Contribution of dead copepods to the total copepod biomass in January, May and August 2016 in fjords and the waters north of Svalbard.

The dead biomass during the polar night consists mainly of *Calanus* spp., indicating **high winter mortality**, which leads to low abundance and biomass by the start of the spring bloom (May). The high occurrence of dead copepod biomass during the polar night may be important to sustain ecosystem functions during a season when primary production is absent.

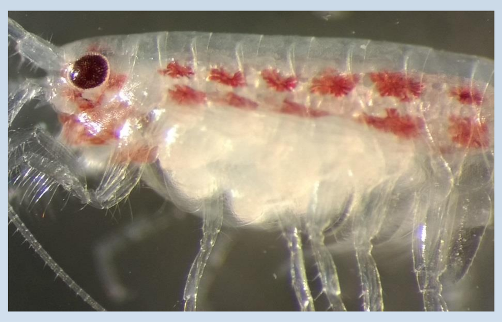
RESULT 2: COPEPODS ARE ACTIVE DURING THE POLAR NIGHT





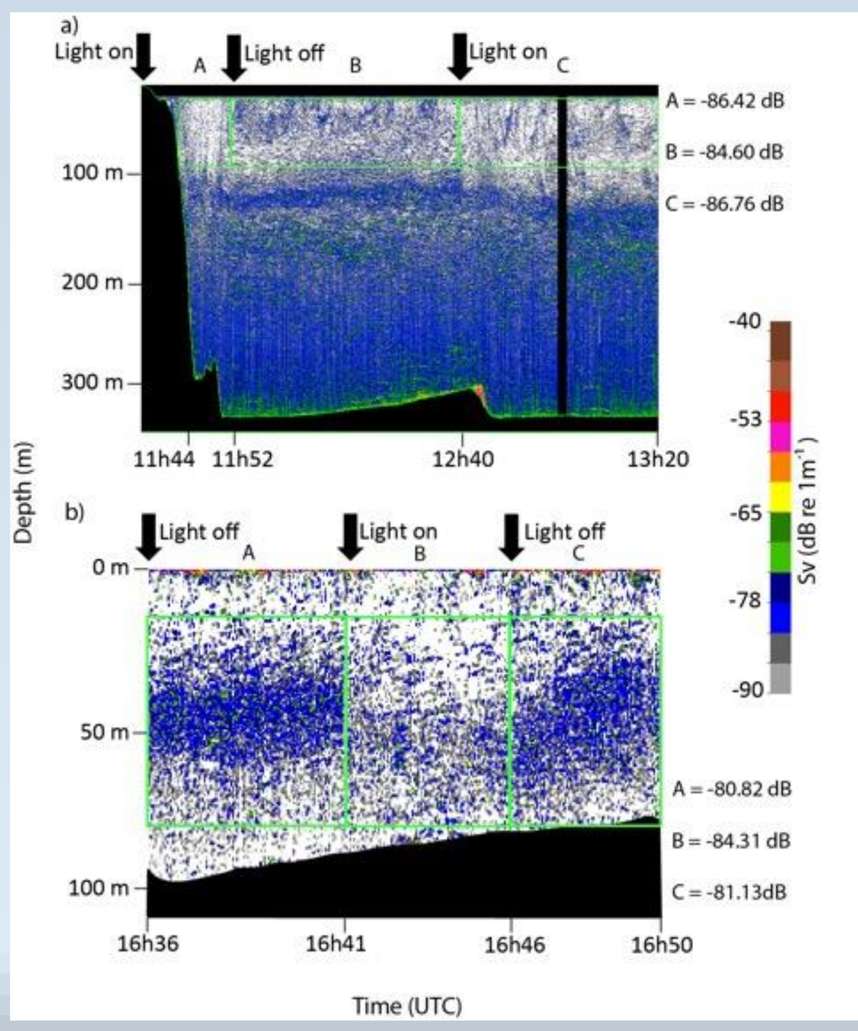
Copepod (*Calanus hyperboreus*) swimming activity at 0°C and 4°C representative of Arctic and Atlantic water masses, respectively. These preliminary data from ship-based experiments during the Polar Night show that small increases in water temperature result in large increases in swimming with as yet unknown metabolic/ecological consequences. Experiments were conducted under constant darkness.

RESULT 3: AMPHIPOD REPRODUCTION



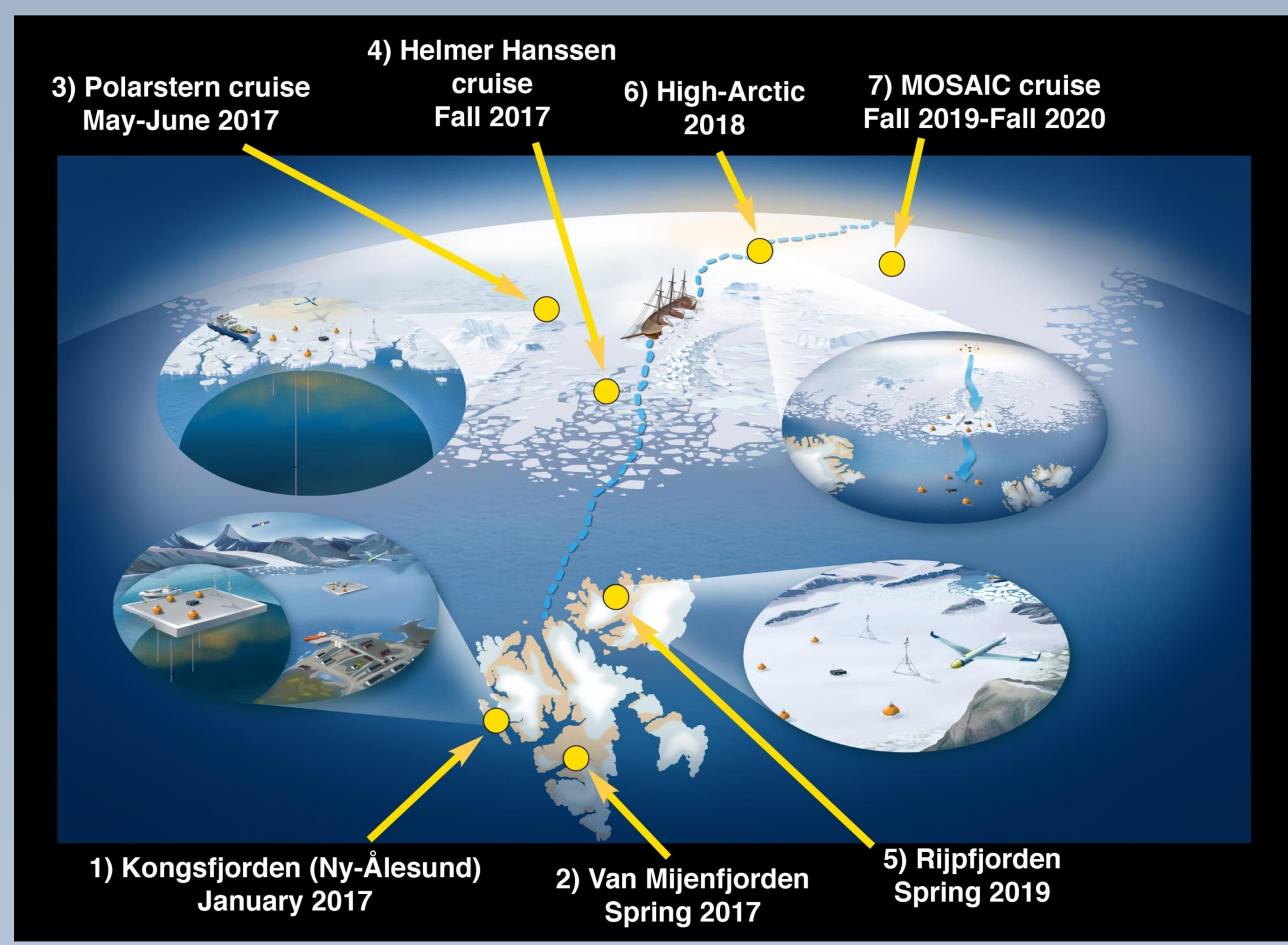
The sympagic amphipod *Apherusa glacialis* carries **eggs in mid winter**.

RESULT 4: ZOOPLANKTON RESPONSE TO LIGHT DURING POLAR NIGHT

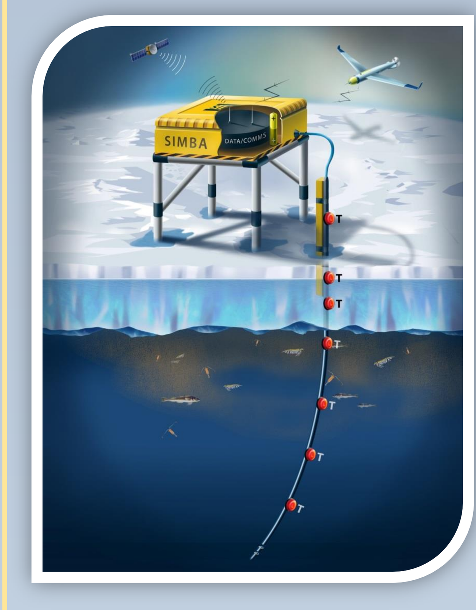


Responses of zooplankton to ambient versus artificial light. (a) EK60 echogram recorded at 120 kHz in Kongsfjorden 9 Jan 2017. (b) AZFP echogram at 125 kHz recorded from a small boat in Kongsfjorden 21 Jan 2017. Black arrows: lights turned off and on. Green boxes: mean acoustic backscatter (Sv) for each period in echograms. Black areas: mask near field region, noise and areas below the seafloor. **Zooplankton avoided the area affect by artificial light**, rendering it impossible to study natural zooplankton abundance, behaviour or migration in the upper ~100 m from a platform with artificial light.

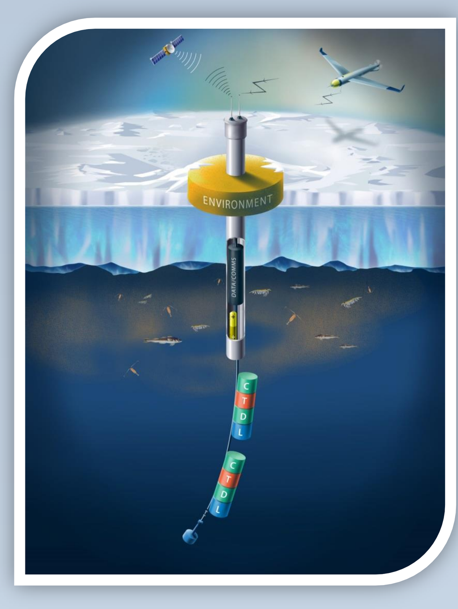
ICE TETHERED OBSERVATORIES



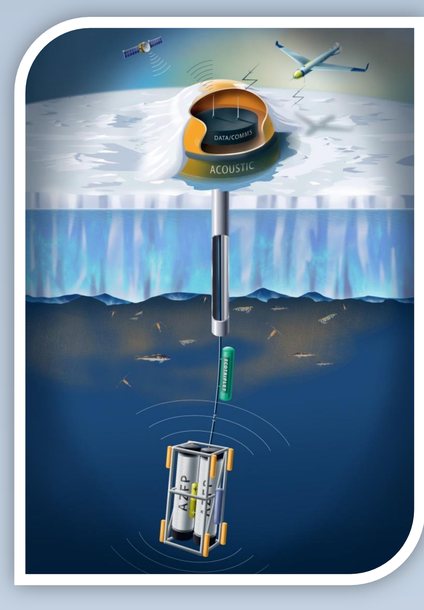
Ongoing and planned deployments of ice-tethered observatories by Arctic ABC group over the next years.



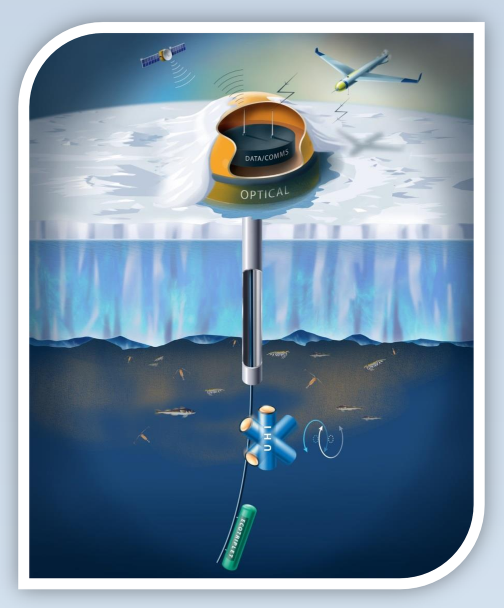
Unit 1: Sea Ice Mass Balance Array (Jackson et al. 2013) for measurements of temperature in air, ice and upper water column.



Unit 2: Array of **light, temperature and salinity** sensors below the ice, at discrete depths.



Unit 3: Acoustic Zooplankton Fish Profilers (AZFP, ASL Environmental Sciences Inc, Canada), upward and downward looking with 4 frequencies: 38, 125, 200 and 455kHz. EcoTriplet (Wet Labs, USA) for chl a, cDOM and total suspended matter



Unit 4: Bio-optics. Underwater hyperspectral imager (Ecotone, Norway) and HD camera are connected with an umbilical line through the ice to data logger at surface. Both have pan, tilt, and compass sensors and measure spectral radiance and day length at different angles. The devices can map objects based on optical fingerprints per image pixel (Johnsen et al. 2013).

Unit 5: Autonomous Weather Station. Measures wind temperature, barometric pressure, net radiation, snow depth and has a GPS antenna. Sensors are WMO certified.

Data backup unit. Iridium SBD modem for data transmission in KB range. Backs up data by other units. It is enabled with radio wireless communications.

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References

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