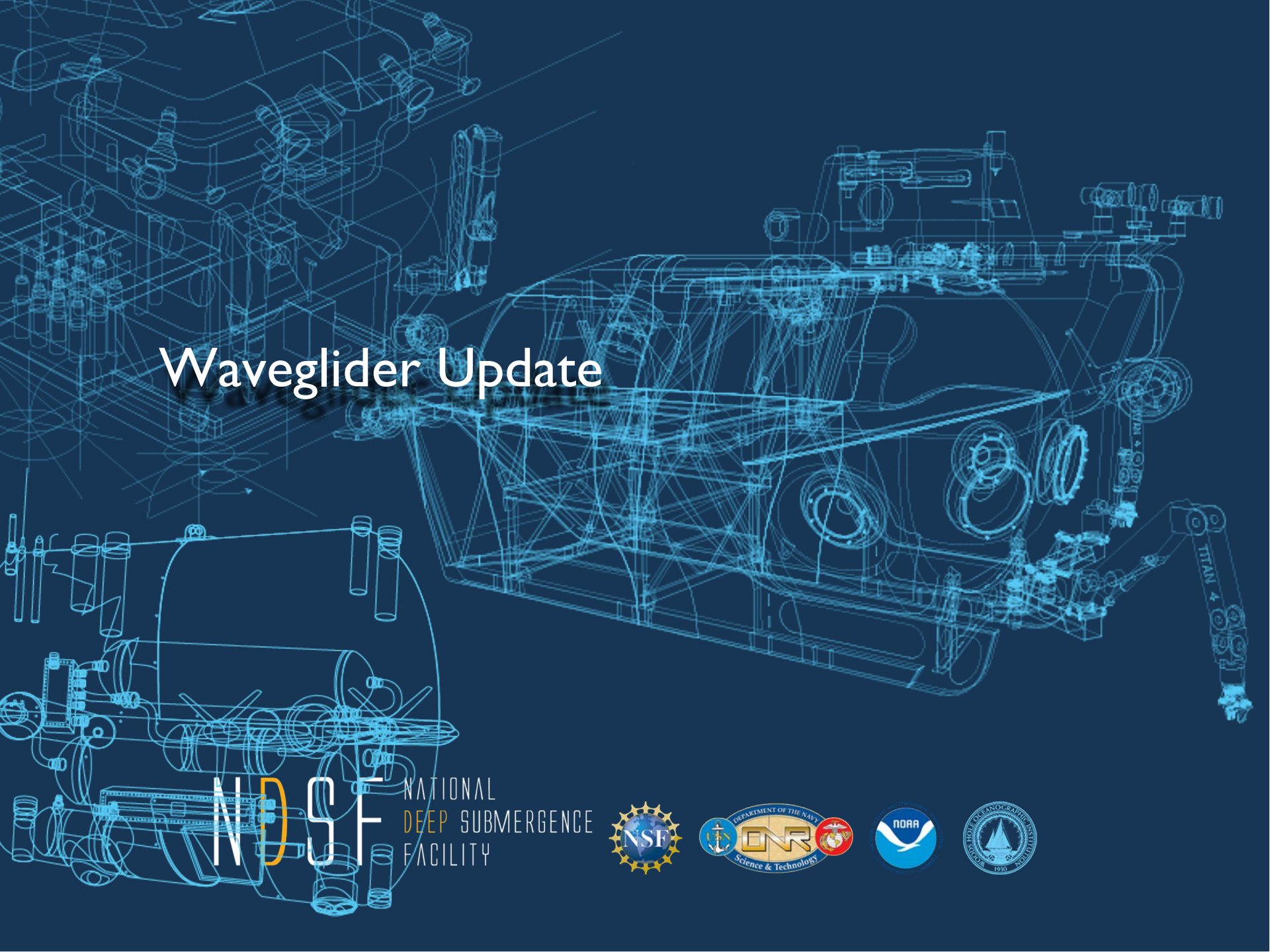


Waveglider Update

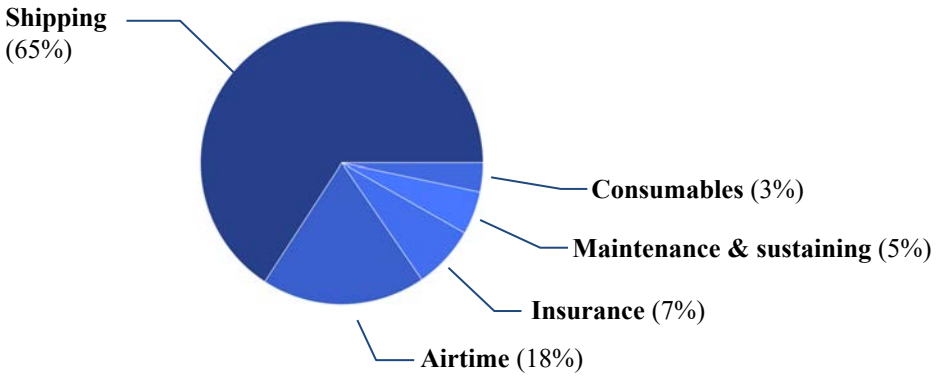
NDSF NATIONAL DEEP SUBMERGENCE FACILITY

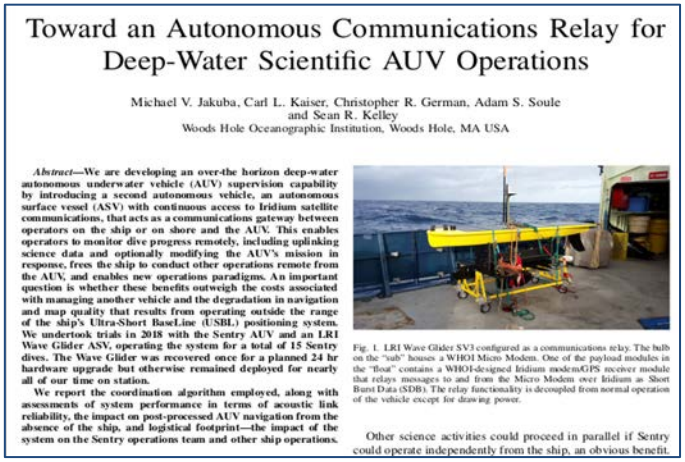
Waveglider

Impacts to NDSF & Science community

- Added Capability for over the horizon operations
- Increased overall efficiency of cruises
- Has “saved” several Sentry dives from abort
- Enables remote science with the NDSF vehicles
- Autonomous capability to work along side ANY of the NDSF vehicles
- Future use to be proposed by PI

Typical waveglider budget





Toward an Autonomous Communications Relay for Deep-Water Scientific AUV Operations

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Abstract—We are developing an over-the horizon deep-water autonomous underwater vehicle (AUV) supervision capability by introducing a second autonomous vehicle, an autonomous surface vessel (ASV) with continuous access to Iridium satellite communications, that acts as a communications gateway between operators on the ship or on shore and the AUV. This enables operators to monitor dive progress remotely, including uplinking science data and optionally modifying the AUV's mission in response, frees the ship to conduct other operations remote from the AUV, and enables new operations paradigms. An important question is whether these benefits outweigh the costs associated with managing another vehicle and the degradation in navigation and map quality that results from operating outside the range of the ship's Ultra-Short BaseLine (USBL) positioning system. We undertook trials in 2018 with the Sentry AUV and an LRI Wave Glider ASV, operating the system for a total of 15 Sentry dives. The Wave Glider was recovered once for a planned 24 hr hardware upgrade but otherwise remained deployed for nearly all of our time on station.

We report the coordination algorithm employed, along with assessments of system performance in terms of acoustic link reliability, the impact on post-processed AUV navigation from the absence of the ship, and logistical footprint—the impact of the system on the Sentry operations team and other ship operations.

Fig. 1. LRI Wave Glider SV3 configured as a communications relay. The hull on the "sub" houses a WHOI Micro Modem. One of the payload modules in the "float" contains a WHOI-designed Iridium modem/GPS receiver module that relays messages to and from the Micro Modem over Iridium as Short Burst Data (SDB). The relay functionality is decoupled from normal operation of the vehicle except for drawing power.

Other science activities could proceed in parallel if Sentry could operate independently from the ship, an obvious benefit.

Future capabilities

- Waveglider is necessary for bootstrapping multivehicle ops in NDSF and other vehicles.
- Potential use with Alvin/Jason to monitor seafloor equipment such as elevators or landers during cruise?
- Real time sensor data passthrough, enhancing users experience.

Recommendations & Path forward

Facility/logistics

- Allocate staffing/support for waveglider on shore
- Blend waveglider into logistics and shipping plans
- Address more complex mobilizations for Sentry/Jason with waveglider component

Reduce operating costs

- An expected decrease in costs once spares are better allocated for the vehicle from more frequent use.
- Reduce shipping shipping costs by integrating into existing systems.
- Reduction in airtime costs with reduced and more efficient data transfer.

Schedule requirements

- Understand requirements moving forward for scheduling waveglider on future cruises and expanding access to waveglider.

Path forward

1. Enable user access

Through existing vehicle day rates, provide funding and support for the waveglider with requesting the waveglider will be part of the STR and thus embedded in associated facility day rate.

1. Analyze past technical issues to ensure reliability

Ensure future use of the waveglider is robust and able to support the demands of the science users. Learning from past issues and roll this into a system that will provide the capability for extensive use.

1. Purchase waveglider and integrate into facility

The integration of the waveglider into our facility will provide a more robust funding structure for the PI's and the facility. By securing a waveglider for the facility the request and funding structure will be simplistic and provide a means for science users to have easy access to the vehicle.

1. Promote and communicate capability to the science community

Provide material and instructions on how science users can include and integrate the waveglider into their science program, using past examples to highlight how efficiency can be increased with the waveglider and enhance the science user experiance.