



Eagle Ray deep sea mapping AUV

The *Eagle Ray* autonomous underwater vehicle, or AUV, follows a pre-programmed mission to map the seafloor independently of its support vessel. This AUV can reach depths of 3000 meters and has mapped many regions off the US east coast and northern Gulf of Mexico, surveying features of geological, biological, and archaeological interest.

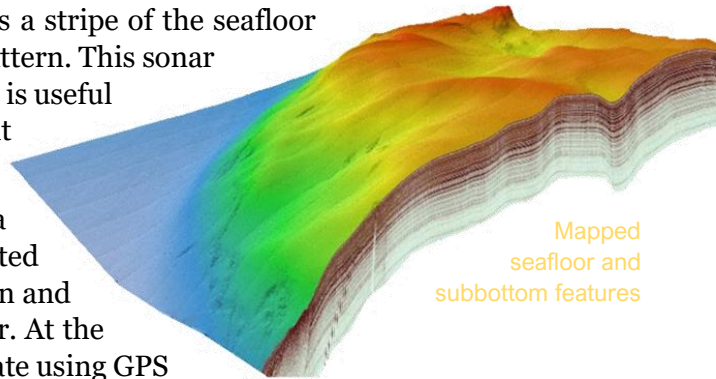
Eagle Ray is equipped with a multibeam echosounder, which maps a stripe of the seafloor below it, obtaining full coverage by surveying in a back-and-forth pattern. This sonar also returns the backscatter intensity of the bottom reflection, which is useful in assessing bottom type and for both geological surveys and habitat mapping. A subbottom profiler is used to look below the seafloor.

Eagle Ray is launched from a support ship by an articulated ramp that extends off the stern and lowers the AUV into the water. At the surface, the vehicle can navigate using GPS and communicate by wireless ethernet or even satellite for longer distances. These signals cannot pass through seawater, so once *Eagle Ray* dives toward a survey target, it relies on slow, low-bandwidth, acoustic communication and inertial navigation aided by acoustic sensors. All data are recorded internally and downloaded upon recovering the vehicle while it charges for its next mission.

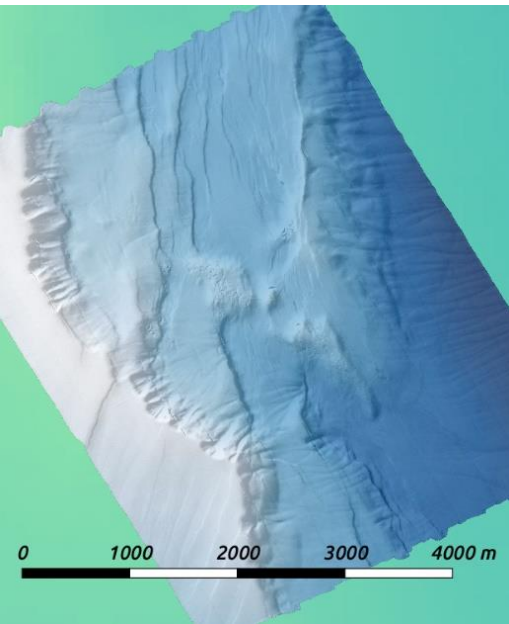
For a general overview survey, *Eagle Ray* positions itself 50 meters above the seafloor and follows a grid pattern with line spacing from 150 to 180 meters depending on roughness of the terrain. During the survey, *Eagle Ray* can map approximately 25 square kilometers, with total coverage depending on

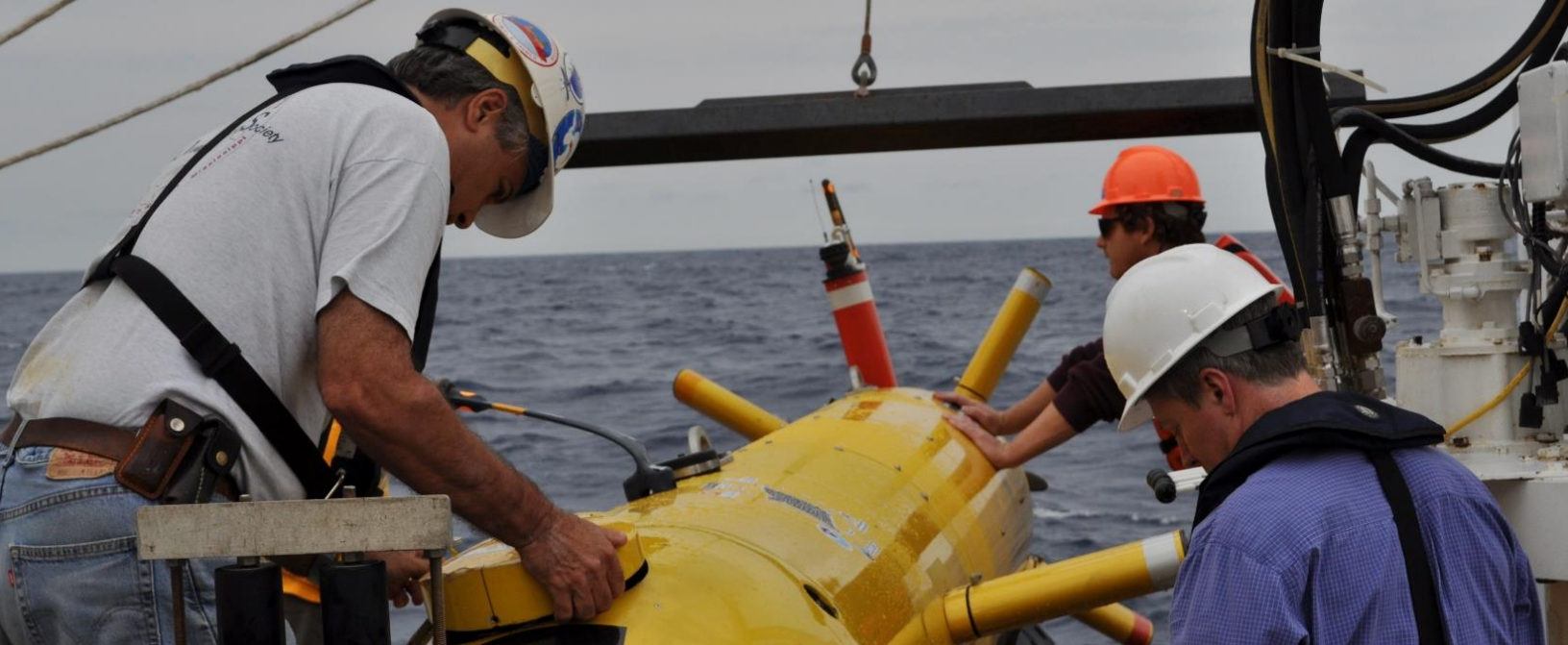
varying conditions of this extreme environment.

At 50 meters above the seafloor, a resulting map is generally resolved to 1-meter blocks; dropping to a 25-meter altitude for a detailed survey increases this resolution to a half-meter. Tighter grids have been used for detailed subbottom studies, and lower-altitude runs have been made during chemical surveys in areas of active hydrocarbon venting.



Mapped
seafloor and
subbottom features





Since taking delivery of *Eagle Ray* in 2006, the University of Southern Mississippi has developed an experienced team of engineers, geophysicists, and hydrographers focused on AUV operations and data processing. The University of Southern Mississippi operates the research vessel *Point Sur* and will soon operate the upcoming regional-class research vessel *Gilbert Mason* along with consortium partners. With thriving graduate and undergraduate degree programs, and specialist certificates offered in both hydrography and uncrewed maritime systems, facilities are located across the Mississippi Gulf Coast, including those at Stennis Space Center, the Marine Research Center at the Port of Gulfport, as well as the Gulf Coast Research Lab and Marine Education Center of Ocean Springs.

Max. depth: 3000 m

Size: 5 m length, 0.7m diameter

Mass: 1000 kg

Endurance: up to 30 hours, 180 km

Typical survey parameters: 15 to 50 m altitude, 1.75 m/s speed

Launch and recovery: articulated stern ramp with rack and pinion drive, crane lift lugs, recovery float with line

Scientific payload: Norbit WBMS multibeam echosounder, GeoAcoustics polarity-preserving chirp subbottom profiler, SeaBird FastCAT CTD, wet and dry space for additional payloads

Navigation: IXblue Phins C7 inertial navigation system, Nortek 600 kHz Doppler velocity log, SOSI GPS receiver, Paroscientific depth sensor, Kongsberg forward-looking altimeter

Maneuvering: Single thruster, fore planes, and aft planes, allowing rapid pitched transit to survey altitude and stable heave-mode depth keeping while on survey

Communication/Tracking: *surface* – DataRadio 900 MHz ethernet, Iridium satellite modem, Novatech beacons (VHF, Argos, strobe) *submerged* – LinkQuest USBL tracking transponder and acoustic modem

Shipboard equipment: Computer rack and multiple monitors for vehicle operation and mission management, deck-mounted launch and recovery system, 20' maintenance container (also houses chargers), LinkQuest USBL transceiver on pole or hull-mount for comms and tracking

Safety: Self-powered tracking transponders/beacons, ISE bottom avoidance routine, ISE fault response logic, emergency drop weight

Batteries: 30 kWh Li-ion from 18 Onyx 48V modules within the pressure housing

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