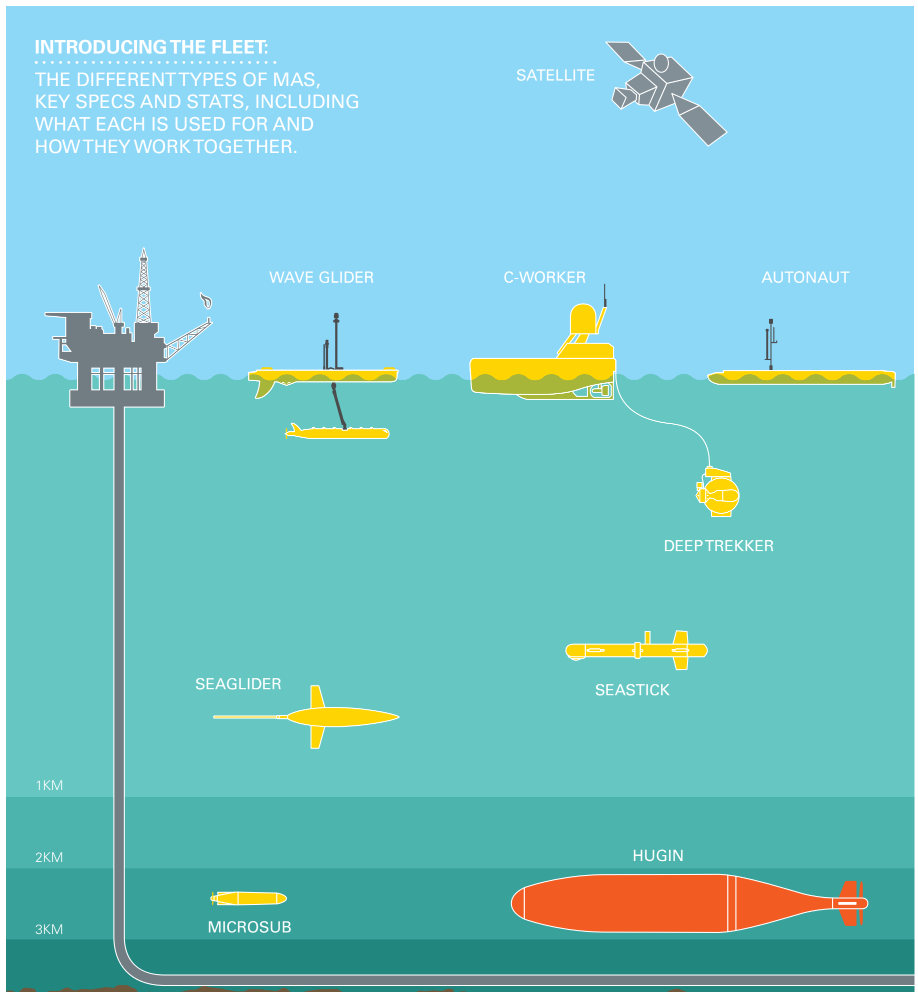
Robots to the rescue

From the ocean's surface to the seafloor, underwater robots known as 'marine autonomous systems' are revolutionising how BP understands its underwater operating environment.

It's been said we know more about the surface of the moon than the world's oceans, but that could soon change with the advance of marine autonomous systems (MAS). Loaded with sensors and cameras, these aquatic robots can capture data from the world's oceans faster, safer and cheaper than ever before.

MAS, which include both autonomous surface vehicles (ASVs) and autonomous underwater vehicles (AUVs), help BP freely explore its remote offshore operating



INTRODUCING THE FLEET

WAVE GLIDER
LENGTH: 3M
WEIGHT: 150KG
MAX DEPTH: 2M
ENDURANCE: UP TO 1 YEAR
MAX SPEED: 3KTS
BEST FOR: ENDURANCE

C-WORKER
LENGTH: 5.8M
WEIGHT: 3500KG
MAX DEPTH: 30M
ENDURANCE: 30 DAYS
MAX SPEED: 6KTS
BEST FOR: SUBSEA MONITORING

DEEP TREKKER
LENGTH: 125M TEATHER
ENDURANCE: 8 HOURS
BEST FOR: PORTABLE REMOTE-CONTROLLED HD CAMERA

AUTONAUT
LENGTH: 5M
WEIGHT: 230KG
RANGE: 800KM PER WEEK
MAX SPEED: 4KTS
BEST FOR: LONG RANGE AND ENDURANCE

SEAGLIDER
LENGTH: 2M
WEIGHT: 52KG
MAX DEPTH: 1KM
RANGE: 4,600KM (OR 650 DIVES TO 1KM)
MAX SPEED: 0.5KTS
BEST FOR: LONG RANGE

MICROSUB
LENGTH: 0.5M
WEIGHT: 15KG
MAX DEPTH: 2.5KM
RANGE: 150KM
ENDURANCE: 48 HOURS
MAX SPEED: 4KTS
BEST FOR: RAPID RESPONSE

SEASTICK
LENGTH: 1.8M
WEIGHT: 93KG
MAX DEPTH: 1KM
ENDURANCE: 10 HOURS
MAX SPEED: 6KTS
BEST FOR: MANOEUVRABILITY

HUGIN
LENGTH: 4.7M
WEIGHT: 850KG
MAX DEPTH: 3KM
ENDURANCE: 24 HOURS
MAX SPEED: 6KTS
BEST FOR: DEEP WATER

Robots to the rescue

environments. These vehicles can transmit extraordinary amounts of data in near real-time, so scientists can accurately monitor the oceanic environment, assess risks, or effectively manage a crisis.

Battery-powered and pre-programmed, MAS can quickly launch from sea, shore or sky and remain independently active in the ocean for up to months at a time. While autonomous by design, you can communicate with the vehicles by satellite to give navigation commands or receive data. At the end of the mission, a surface vessel picks them up.

MAS have actually been around since the 1950s. But it's only in recent years, as technology has advanced and costs fallen, that these vehicles have become ready to take over underwater surveillance duties.

BP is currently putting MAS to the test and has recently has partnered with manufacturer Oceaneering for a large-scale AUV trial to survey pipelines and subsea infrastructure in the Gulf of Mexico, ahead of a large scale roll out.

The big picture

BP's global environmental response expert, Peter Collinson, says: "MAS opens up a new scale of environmental assessment: whether that's natural change, or the effects of industry operations. With more data, we have a clearer insight of what's actually going on.

While BP has a long history of using robotic underwater vehicles, autonomous capability is relatively new, as Joe Little, senior technology consultant in BP's digital innovation organisation, explains: "We use large-scale remotely operated vehicles (ROVs) and divers, but these need to be deployed and supported by very large crews and vessels."

Unlike ROVs, which need to be tethered to and controlled by a ship, an AUV can quickly launch and get straight to work. This is a massive advantage in an emergency, when greater awareness and faster response times can help minimise environmental damage.

Little adds: "The advancement of robotics has moved us to an entirely new class of vehicles that are significantly smaller and more agile. They're also considerably lower in cost [than ROVs], which means we can use more of them to multiply the data we can get, and therefore make more informed decisions."

Combined with a better understanding of the environment, the low cost of the vehicles could lead to more frequent and detailed inspections of subsea infrastructure, giving earlier warning of any potential issues. As well as this, in some situations, MAS avoids the need to send divers into the water, and allows exploration of areas that were previously inaccessible or inhospitable.

Underwater visibility

MAS offers more than just data in quantity. Quality is also improving. Murky images of the deep are now replaced by crystal clear feeds and pictures. For example, an AUV has photographed individual bolts on a sunken military boat more than 1km under the ocean's surface – a very useful feature during high-resolution surveys for sensitive species and archaeological artefacts.

Visibility is also improved by being able to access and examine exact locations. "We can now repeatedly measure the same square metre of seabed up to 3km deep, rendering objects in 3D and detecting change over time," explains Collinson.

This is a radical improvement on current underwater surveying techniques like grab samples, which involve taking intermittent photos of an area. Collinson says: "We might have just 100 images of 1,000 km2 of ocean seabed: tiny pinpricks of information across a vast area. With MAS, we're going to flip that around so we'll know everything with just a few pinpoints of uncertainty."

Rapid strike

Back in April 2010, Wave Glider surface vehicles were used during the Deepwater Horizon oil spill response to monitor for oil on the sea surface. Five years later, BP teamed up with the Scottish Association of Marine Science (SAMS) to test underwater vehicles' rapid-strike capability in the North Sea.

Responding to a simulated incident in an oilfield west of Shetland, a Seaglider AUV was launched to monitor the presence of hydrocarbons in the ocean. Diving up to 500m deep and surfacing regularly to transmit near real-time data back by satellite to decision-makers onshore.

"The data was filtered and became a new layer on our common operating response system. With one click you could see concentrations of hydrocarbon, temperatures, depth and track position," says Collinson.

Pool of knowledge

If the trails in the Gulf of Mexico are successful, BP plans to employ a fleet of AUVs to continuously monitor these pipelines, and may also expand the trial to several regions.

Back on dry land, BP regularly runs tests and demonstrations at the Marine Research Innovation Centre (MRIC) at the National Oceanography Centre, Southampton, UK. Collinson says: "Through membership of the MRIC, we get access to more than 20 years of autonomous systems technology and knowledge. It's a great forum for us to work with manufacturers and peers, and learn from sectors beyond oil and gas that may be more advanced with these systems." ■