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OOI Coastal Endurance Equipment Engineering Considerations and Platform Descriptions

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Gliders

DESCRIPTION: Gliders dive from the surface to the seafloor and back to the surface as they transit across the continental shelf. They move about 1 foot a second, which seems slow, but it allows them to transect across the continental shelf weekly and it allows them to transect OOI's offshore glider lines monthly. They look like torpedoes, but they move with a buoyancy engine, not a rear propeller. To sink, the buoyancy engine sucks oil from a balloon in the nose of the glider, and to rise it pushes oil back into the balloon. Wings on the glider push it forward as it rises or sinks. OOI gliders have the same sensors as OOI wire following profilers.

WAVES: Gliders bob in the waves for up to a half hour at a time to send data home every 6 hours. They have a small balloon in their tail that inflates when they get to the surface so they can use a satellite phone in their tails.

BIOFOULING: Gliders spend most of the time deep enough that biofouling isn't a problem. Gliders in shallow waters get covered with gooseneck barnacles after 2-3 months. To reduce growth, the aluminum glider hulls are slathered with diaper cream before deployment. Gliders can dive down to 1000 m depth, but our shallow ones stay in the top 200 m.

POWER: Gliders get power from lithium batteries. Their efficient buoyancy engine allows them to operate for 3 months at a time. Buoyancy engines work like a nautilus, so gliders do not have a propeller. Gliders have only low-power instruments (e.g., salinity, temperature, oxygen, chlorophyll-a).

DEPLOYABILITY: Gliders are small enough to be deployed or recovered from almost any boat large enough to operate in the ocean safely. A glider can be carried by two people.

Wire Following Profiler Mooring

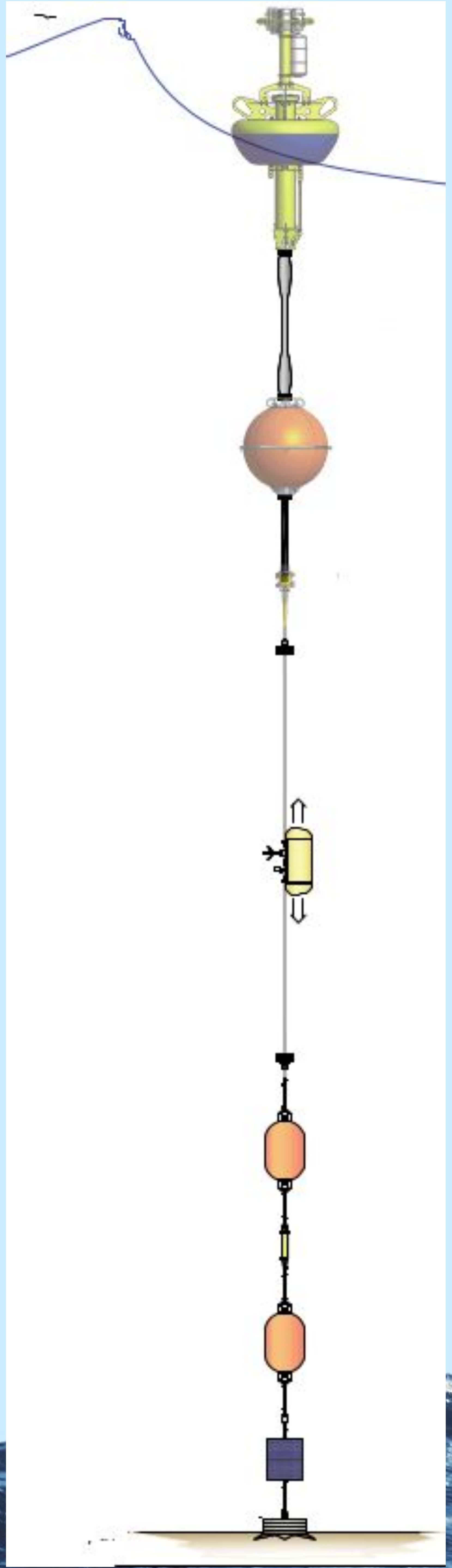
DESCRIPTION: OOI profilers measure every 25cm throughout the water column a few times a day. Each OOI surface mooring is paired with an adjacent profiler. At OOI's deeper sites (>100m), OOI uses Wire Following Profilers. They roll up/down a taut wire. The wire is made taut by a 5 ft. diameter sphere 15m below the water surface and a heavy (7000 lbs.) anchor on the seafloor. The profiler itself is the size of a large suitcase. It contains sensors that do not require much power, such as salinity, temperature, depth, oxygen, light, and chlorophyll fluorescence.

WAVES: Wire following profilers (WFPs) avoid waves by never going shallower than 25 meters below the surface. Their moorings have a 1.5 meter diameter foam sphere at 20 meter depth that keeps their mooring line taut, allowing the WFP to roll smoothly up and down its wire. WFPs are deployed in waters up to 600 meters deep.

BIOFOULING: WFPs park at the bottom between profiles, so they are usually deep enough that biofouling isn't a problem. They are deployed for 6 months at a time.

POWER: WFPs use lithium batteries. They move by efficiently rolling up and down on their mooring line 4 times a day. They transmit their data to the surface inductively through their mooring line, so their data transfer rate is very slow, but it is efficient. WFPs have only low-power instruments, similar to gliders. Buoys at the top of WFP moorings send data to shore via a satellite phone.

DEPLOYABILITY: While a WFP is small enough for two people to carry it, the large subsurface sphere on the WFP mooring and the 7000 lbs. anchor needed to hold the sphere in place mean that a large research ship is needed to deploy or recover these platforms.



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Coastal Surface Piercing Profilers

DESCRIPTION: The Coastal Surface Piercing profiler is used at OOI's shallowest sites (<100m). They are buoyant and are tethered to a seafloor anchor. A winch inside these profilers allows them to climb up to the surface, make a phone call home to send data and get new commands, and then the return to the seafloor until the next time it is scheduled to profile. CSPPs have all of the instruments a WFP has plus a few moderately power-consuming ones such as a nitrate sensor. Only the surface moorings have instruments that consume a lot of power such as acoustic profilers and cameras.

WAVES: Coastal Surface Piercing Profilers (CSPPs) park most of each day safely near the seafloor. A few times a day they winch themselves up to the surface. Their winch spools in and out with the waves as they rise to keep the tension constant on their winch line. CSPPs are deployed close to shore so they can send data home via cell phone instead of satellite phone, which is faster, so they don't have to stay on the surface for very long. Their cell antenna is mounted on a 2 meter long fishing pool, which enables them to make reliable cell connections as long as waves are not taller than the top of the antenna. They communicate acoustically with a neighboring surface mooring so that they can be told "stay at the seafloor!" if there are rough seas.

BIOFOULING: CSPPs are covered with a combination of antifouling paint and copper tape to reduce biofouling. Biofouling is reduced on sensor surfaces with either UV light, a small windshield wiper, or diaper cream. CSPPs are deployed in 20 to 90 meter depth water, so the shallow ones are always exposed to light, which means they are subject to biofouling.

POWER: CSPPs use rechargeable lithium batteries, which enables them to profile a few times a day for two months at a time. In addition to low power instruments used by gliders, CSPPs also have medium-power instruments such as nitrate sensors. Most of a CSPPs power is used by its winch.

DEPLOYABILITY: CSPPs are small enough to be deployed by typical 60-foot ocean fishing boats, as long as they have a crane or an A-frame.

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Inshore Submersible Surface Moorings

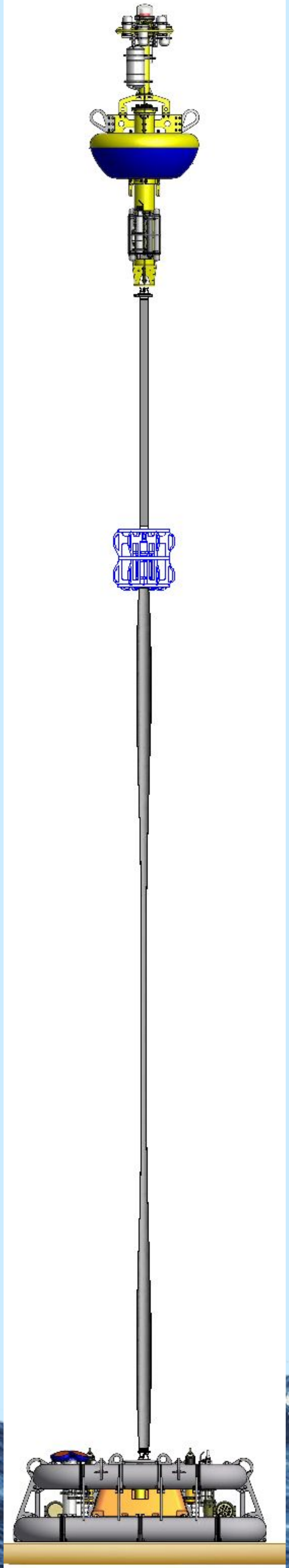
DESCRIPTION: In shallow water (25-30 m) winter storms would tear apart mooring designed like a Coastal Surface Mooring (CSM), so the Inshore Submersible Moorings have a small buoy that submerges under the crests of large waves. The small ISSM buoy does not have the meteorological instruments a CSM has, but otherwise the mooring measures the same water properties as the CSM.

WAVES: Inshore Submersible Surface Moorings (ISSMs) are deployed in shallow water, slightly deeper than where waves break in large winter storms. (Waves break when their height is about half of the water depth. In Oregon, winter storm waves can be 12-15 meter tall.) Inshore Surface Mooring buoys are small, so they duck under the crests of large waves. Buoys are attached to anchors with 15-20 meter long stretch hoses that act like bungee cords.

BIOFOULING: ISSMs are covered with a combination of antifouling paint and copper tape to reduce biofouling. Biofouling is reduced on sensor surfaces with either UV light, a small windshield wiper, or diaper cream.

POWER: ISSMs use lithium batteries, which enable them to sample hourly for 6 months at a time. These large moorings can hold many batteries, so they can operate high-power instruments such as bioacoustic sonars, cameras, and ocean acidification sensors (pH and pCO_2).

DEPLOYABILITY: A large research ship is needed to deploy or recover these ISSM platforms because their bottom instrument frame/anchor weighs almost 12,000 lbs.



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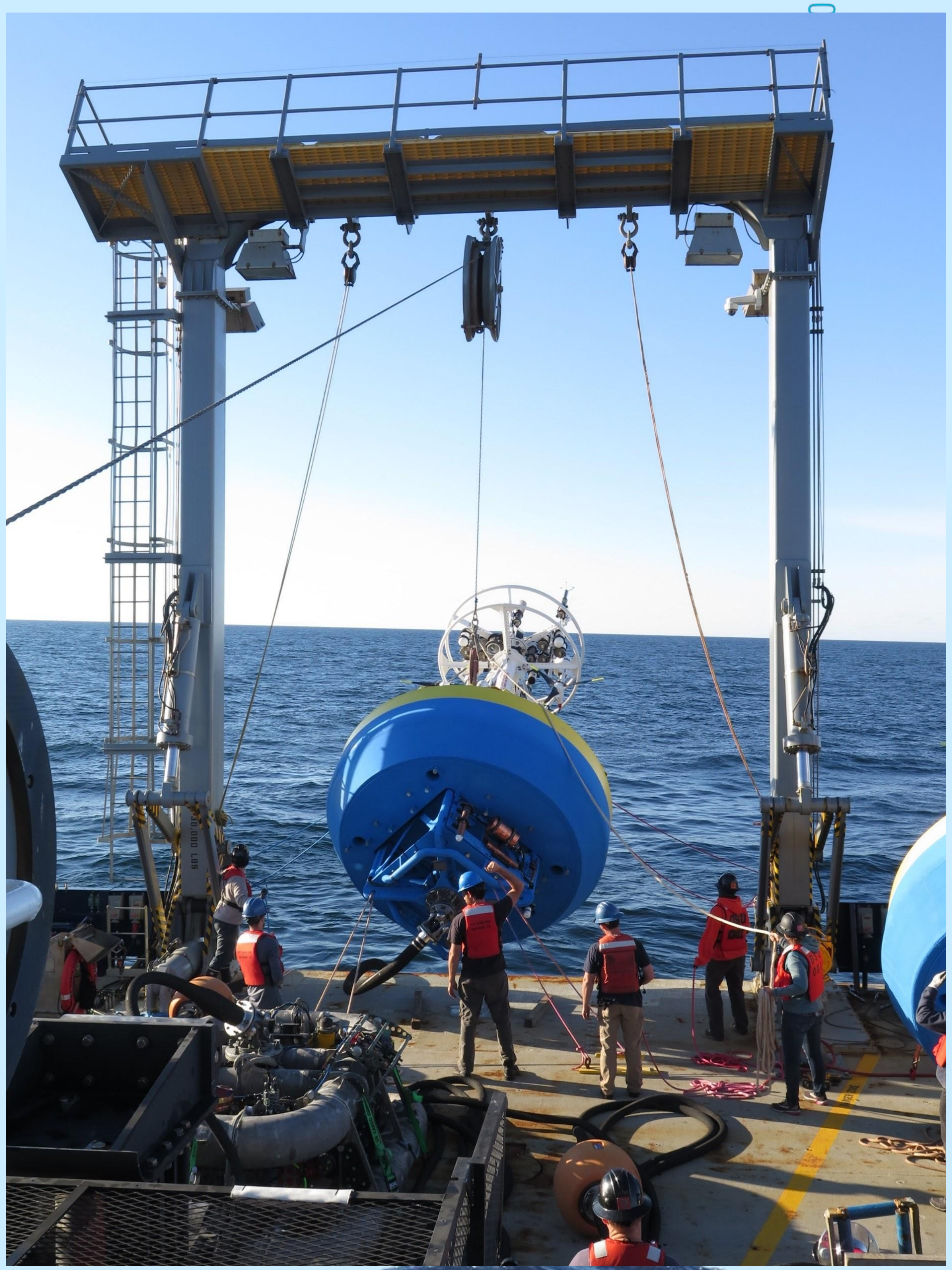
Coastal Surface Moorings



DESCRIPTION: A Coastal Surface Mooring (CSM) consists of a giant buoy that sits on the sea surface tethered to an anchor on the seafloor. The buoy measures waves and has meteorological sensors that measure wind, sunlight intensity, air temperature, humidity, rainfall, and air pressure. It also measures carbon dioxide concentration in the air and in the surface water so one can calculate air-sea exchange of carbon dioxide. The bottom of the buoy has other sensors used for air-sea exchange calculations including salinity, temperature, and water velocity. The seafloor anchor has an instrument frame covered with sensors, and there is a similar frame of instruments at 7m depth below the buoy. Most of the instruments sense a water property at one location, but a couple, including the velocity and bioacoustic instruments, use sound to measure throughout the water column. The CSM is powered by two wind turbines and four solar panels.

WAVES: Coastal Surface Moorings have large buoys that sit on top of waves. Their 3-meter diameter foam sits on the water. Lead weights on the bottom of the buoy keep it vertical so that the wind turbines don't submerge. Each CSM has 3-4 stretch hoses that act as bungee cords so the mooring can flex up and down with each wave.

BIOFOULING: The bottom of CSMs is deep enough to not biofoul, but the near surface underwater instruments are in the photic zone, so they are protected like instruments on the Inshore Surface Moorings and CSPPs - diaper cream, copper paint, UV light, etc. CSMs have large buoys, so sea lions sit on them. Cables and connectors on the buoy are protected from biting or sitting by sea lions.

POWER: CSMs have two wind turbines and four solar panels. Oregon is relatively windy and foggy or cloudy, so wind provides most of the power. The buoy has 8 large rechargeable marine batteries that store enough energy to keep the moorings going between windy or sunny periods. The buoy sends power to all instruments, including ones on the seafloor.

DEPLOYABILITY: A large research ship is needed to deploy or recover these platforms because their bottom instrument frame/anchor weighs almost 12,000 lbs. and their 9000 lbs. buoys are almost 7 meters tall.

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