IMPROVING THE SUSTAINABILITY OF LONG-TERM UNCABLED HYDRATE OBSERVATORIES: TECHNOLOGIES FOR RENEWABLE POWER EFFICIENT DATA RETREIVAL

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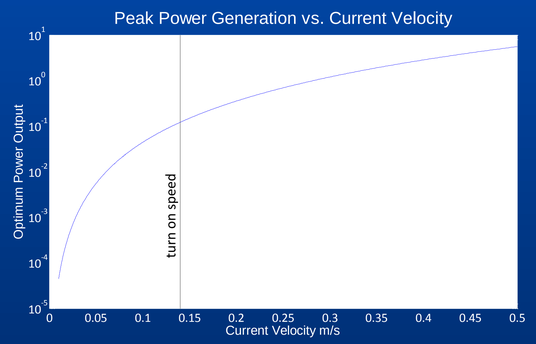
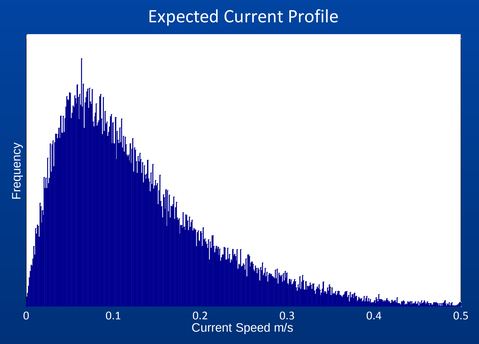
Uncabled seafloor observatories are a crucial technology in monitoring local chemical variability induced by hydrate deposits. Often these observatories are deployed for durations of up to a year and are only recovered for data retrieval, refurbishment, and redeployment. Accordingly the primary cost of operation after initial deployment is the infrastructure required for data collection and power supply servicing. Our work aims to improve both the operational endurance and data collection efficiency of seafloor moorings by demonstrating two new technologies on the Benthic Boundary Layer Array (BBLA) mooring at the Mississippi Canyon 118 hydrate observatory.

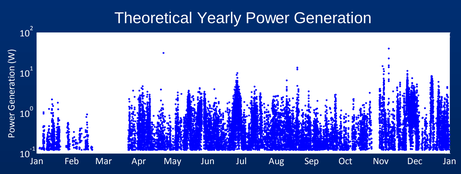
FLIPWING TURBINE POWER GENERATION

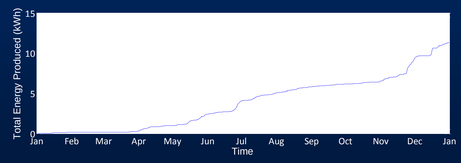
A drag-based flipwing turbine has been developed for extending the battery lifetime of instrumentation on benthic zone moorings, thereby reducing servicing frequency. The large flipwing design is optimized for semi-continuous power production in very low speed currents. This technology is directly applicable to low power sensor packages such as the BBLA at MC 118 which has a yearly power budget of around 10-20 kWh.



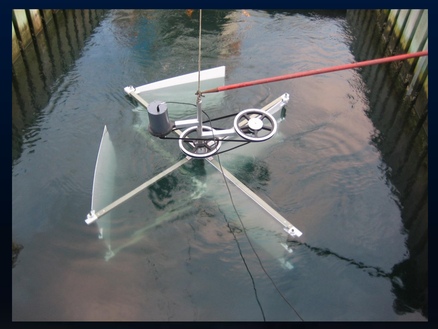


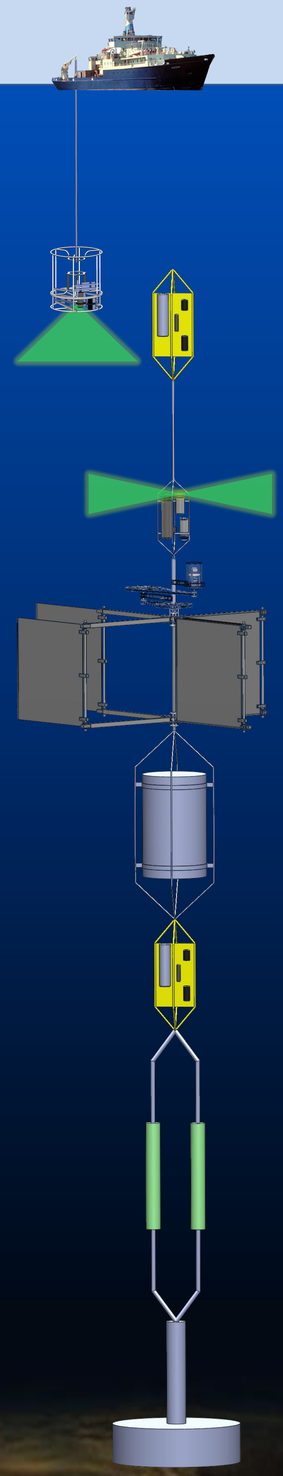
According to models the turn on current speed for the turbine is 0.14 m/s, and it can generate up to 5W of power in currents of up to 0.5 m/s. Estimates of current velocities near the MC 118 site at NDBC 42364 suggest that speeds generally range from 0.01 to 0.5 m/s. Although the current is above the turn on speed only 35% of the time, this does not limit total power output since the turbine design captures power most effectively in water speeds above the turn on speed. Modeling indicates that an average turbine power output of 0.25 W and a yearly renewable power budget of over 10 kWh is attainable.





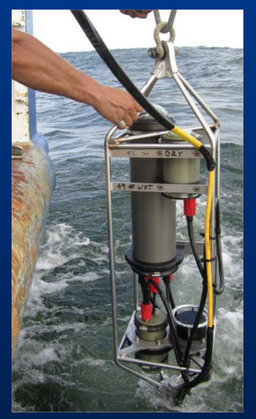
Recently we performed a test deployment of a full-scale prototype of the turbine in a well at the WHOI dock. The turbine was deployed for several hours during which the current ranged from <0.1 to 0.3 m/s. The turn on speed for the turbine was measured to be very close to 0.1 m/s. For most of the test, the current was very close to 0.2 m/s and the turbine output power was consistently around 1 W. The power peaked at close to 2W for a current of 0.3 m/s. These results agree well with the theoretical predictions, and the test showed the turbine to be robust and capable of generating the power required to sustain low power moorings. Future work will include long term tests of the prototype turbine in preparation for deployment on the BBLA.





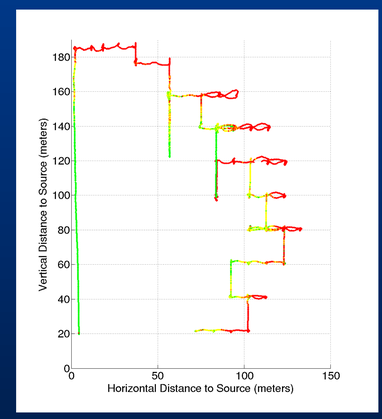
OPTICAL TELEMETRY DATA RETRIEVAL

We have developed and deployed a new optical/acoustic telemetry system (OTS) on the Benthic Boundary Layer Array (BBLA) mooring at MC 118. The OTS allows for high bandwidth low latency optical communication which, in contrast to the usual data retrieval method of instrument recovery, enables very rapid communication rates and significantly reduces the time and infrastructure required for data offload. Data recovery can be done with minimal personnel using just a receiver package lowered on a cable from a ship of opportunity. Accordingly, mooring recovery is not required, and the use of ROV's is unnecessary. Furthermore, slower acoustic communications are minimized since they are only required to wake up the seafloor instruments and to initiate data transfer. The OTS was deployed on the BBLA in June 2011, and during a data retrieval expedition in September 2011 one person equipped with an OTS receiver package was able optically offload three months worth of sensor data in 15 minutes. In the summer of 2012 we will return to MC 118 once more to recover a full year's worth of data with the OTS.



OTS system deployed on the MC 118 mooring in June 2011. Includes two emitters, receiver, acoustic modem.

OTS depressor package. Includes optical receiver/ controller, acoustic modem, transmissometer, USBL comms, depth sensor.



Data transfer rates for the OTS system reach as high as 10 Mbps and its range extends to > 100m. Red indicates high error rates at the OTS range limit.

In the future, autonomous vehicles could retrieve data from seafloor observatories in a "data-mule" configuration. The vehicle would then return to a cabled node or its deployment site to offload data, potentially eliminating expensive ship time and manpower. This technology offers immediate opportunities increasing the endurance and sustainability of seafloor observatories where cabling to shore is either impractical or not yet feasible.