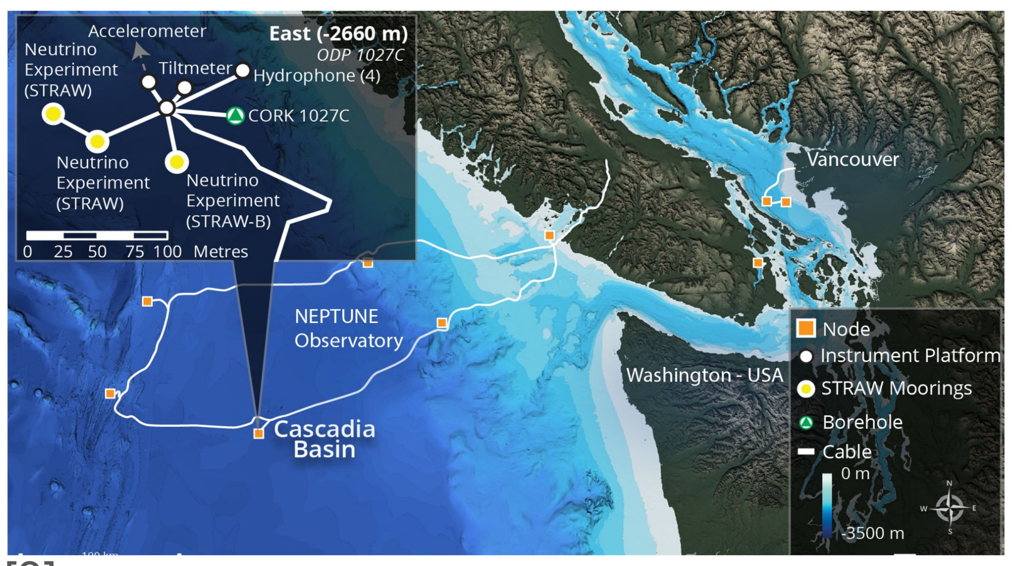
Sedimentation and Biological Fouling at the Future Site of the Pacific-Ocean Neutrino Experiment

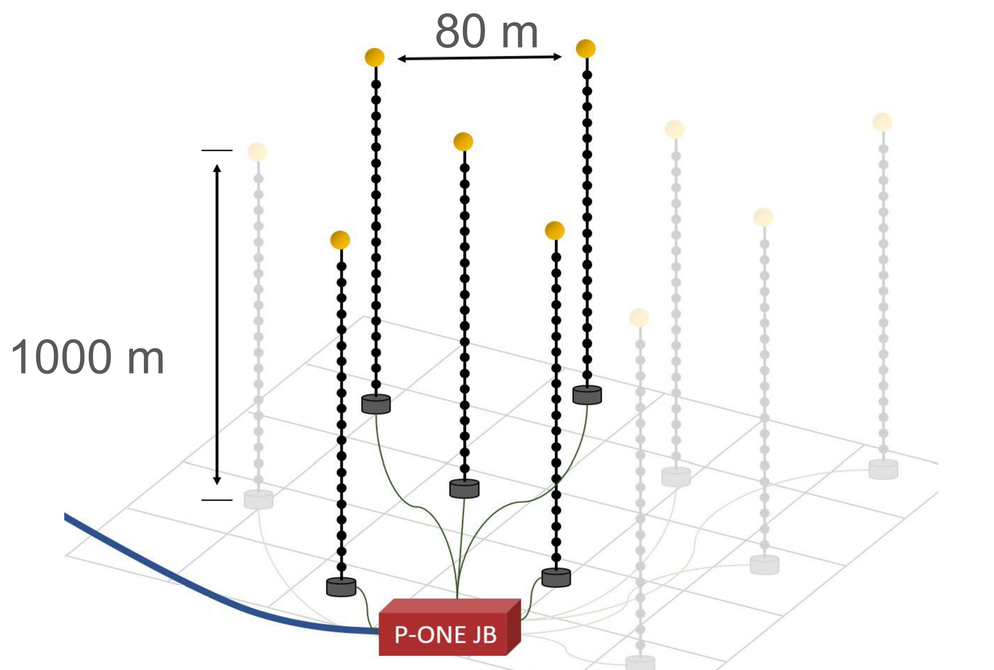
Braeden Veenstra for the P-ONE Collaboration
Presented by Jakub Stacho

Introduction

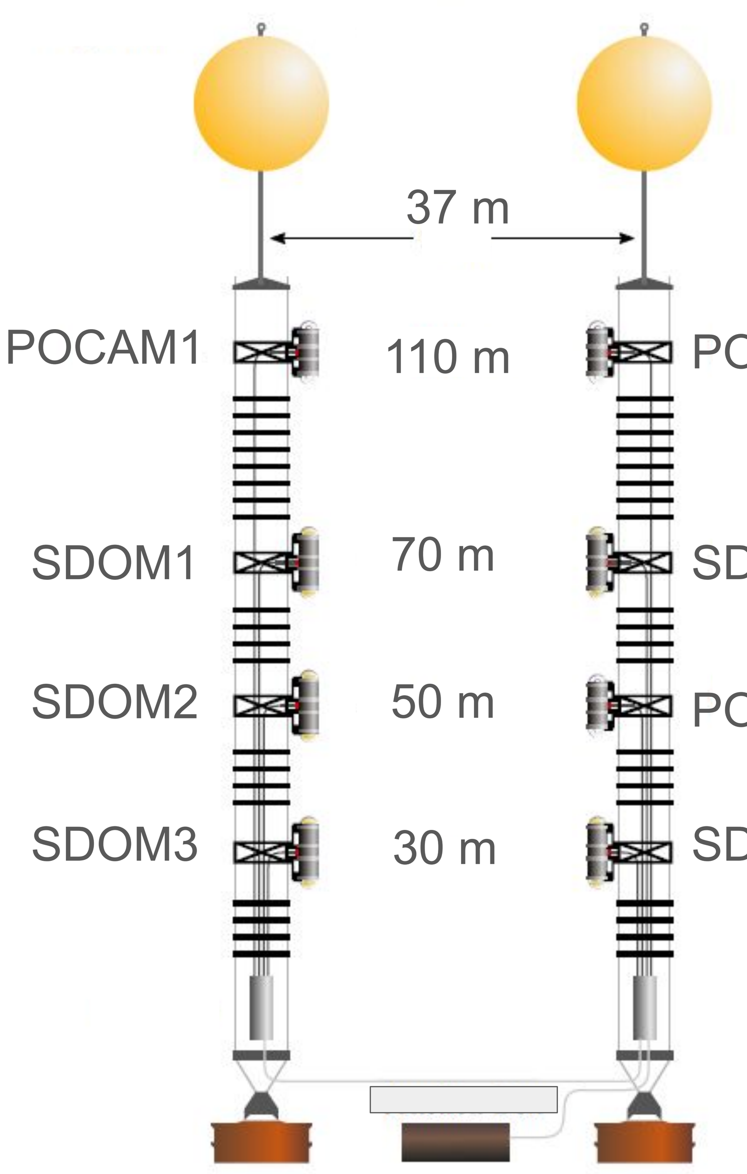


[3]

- The Pacific-Ocean Neutrino Experiment (P-ONE) is a cubic kilometre scale neutrino telescope that is under construction. [1]
- P-ONE will be located in the Cascadia Basin, 200 km off the coast of Vancouver Island, at a depth of 2.66 km.
- The detector is being optimized for searches for high energy astrophysical neutrinos.
- The first string will be deployed in 2025, and the five-string demonstrator will be deployed in following years.



Pathfinder

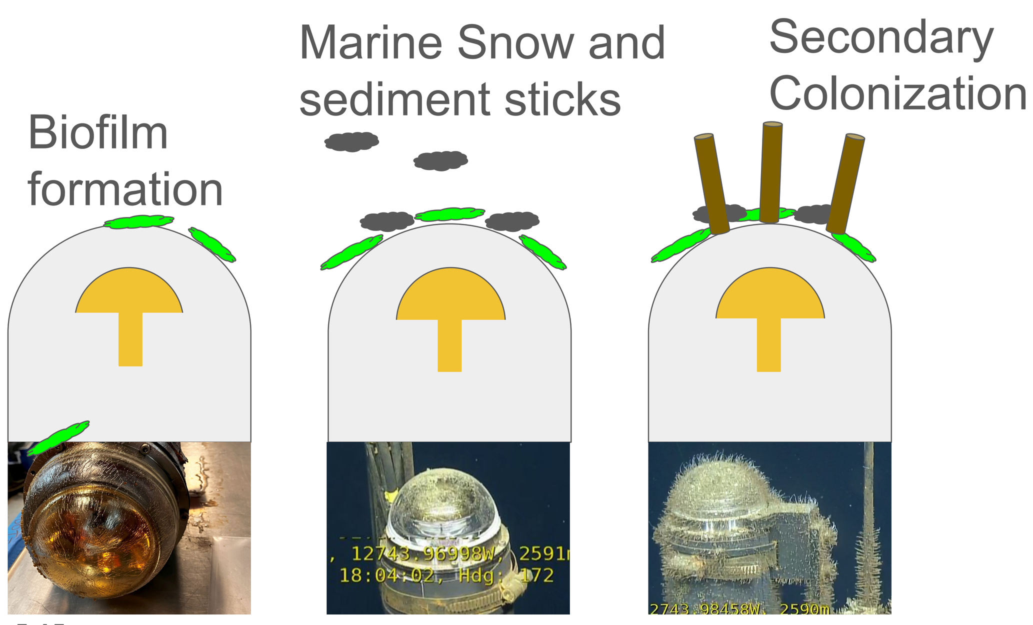


POCAMs were LED based flasher units used for calibration

SDOMs consisted of one upwards and one downwards facing PMT.

- STRings for Absorption Length in Water (STRAW) was a pathfinder instrument deployed in 2018 and recovered in 2023. [2]
- STRAW made measurements of the ambient light spectrum and attenuation length of the water. [3]

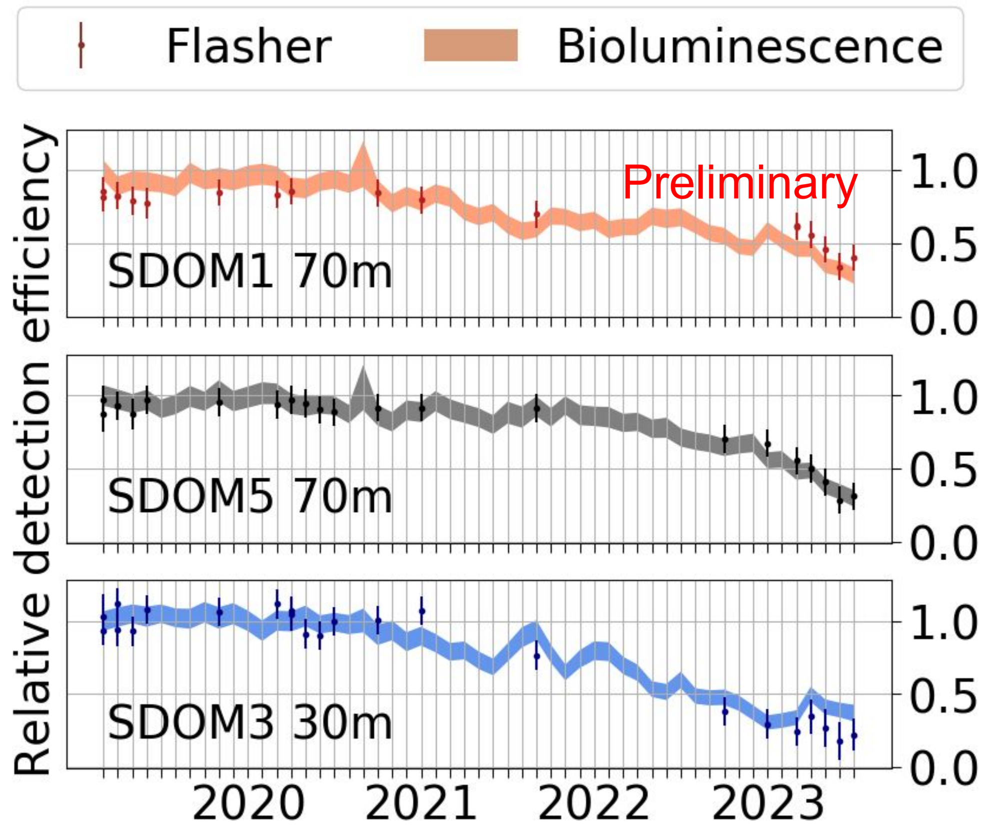
Biofouling and Sedimentation



[4]

- Nutrients settle on infrastructure that is placed in natural water.
- Microbes use these nutrients to colonize surfaces and form what is called a biofilm [5].
- The effect is more prominent on upwards facing surfaces, as these are exposed to organic material and sediments.
- Biofilms reduce the efficiency with which currents remove debris and allow for larger organisms to grow [6][7].
- In the case of a neutrino telescope, this causes the upwards facing modules to become less transparent over time.

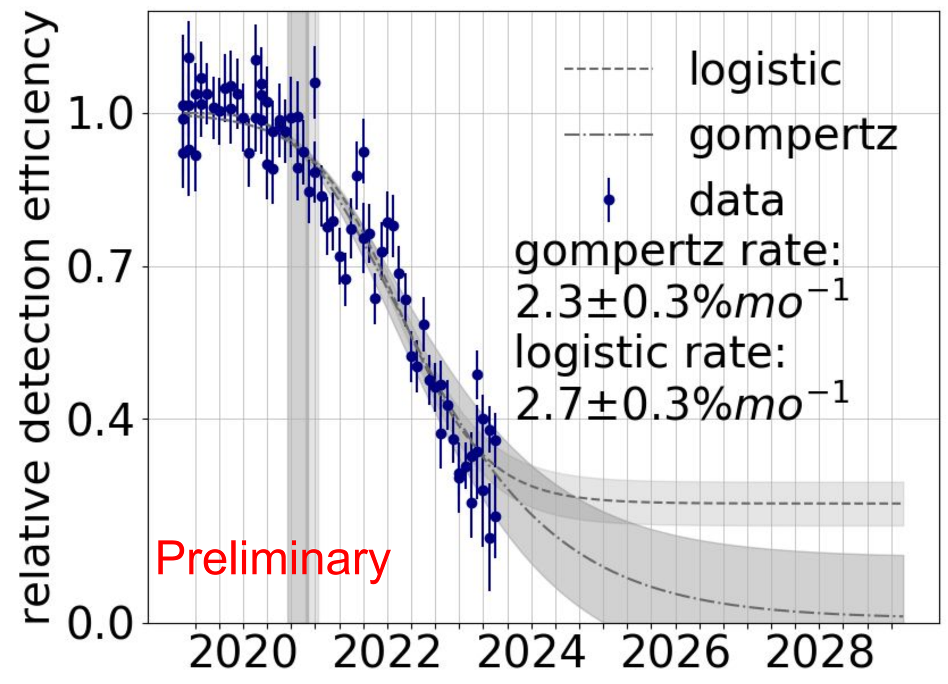
Biofouling Observations with STRAW



- Ambient light due to bioluminescence was monitored continuously [3]
- Most downlooking STRAW PMTs showed negligible growth. [8]
- The ratio of upwards to downwards PMT counts was used to estimate the efficiency evolution (thick band shows 1σ-confidence interval) [9]
- This was verified using flasher measurements (data points) [9]

[4]

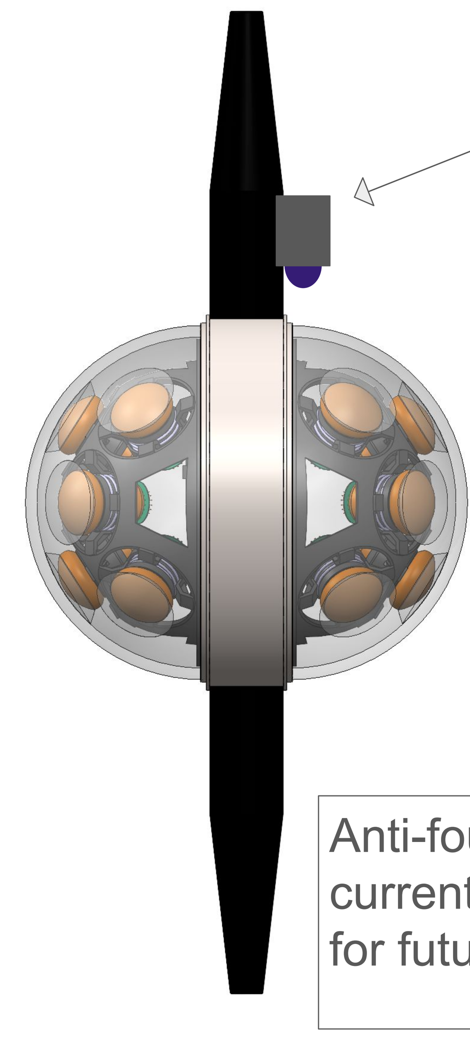
Biological Models



- The gompertz and logistic growth models were fit to data from each STRAW module. These are parameterized by a relative growth rate, carrying capacity and inflection time. [10][11]
- Fit parameters are used to estimate the time where fouling becomes significant, the relative efficiency extrapolated to 10 years and rate of efficiency loss for each model. Confidence intervals for these estimates are shown, using SDOM3 data as an example.

Anti-Fouling

UV-C is well motivated for fouling mitigation[12]



Thin coatings are the current industry standard for biofouling prevention. Optically transparent options are available [13]

Anti-fouling strategies are currently under investigation for future P-ONE moorings.

References

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