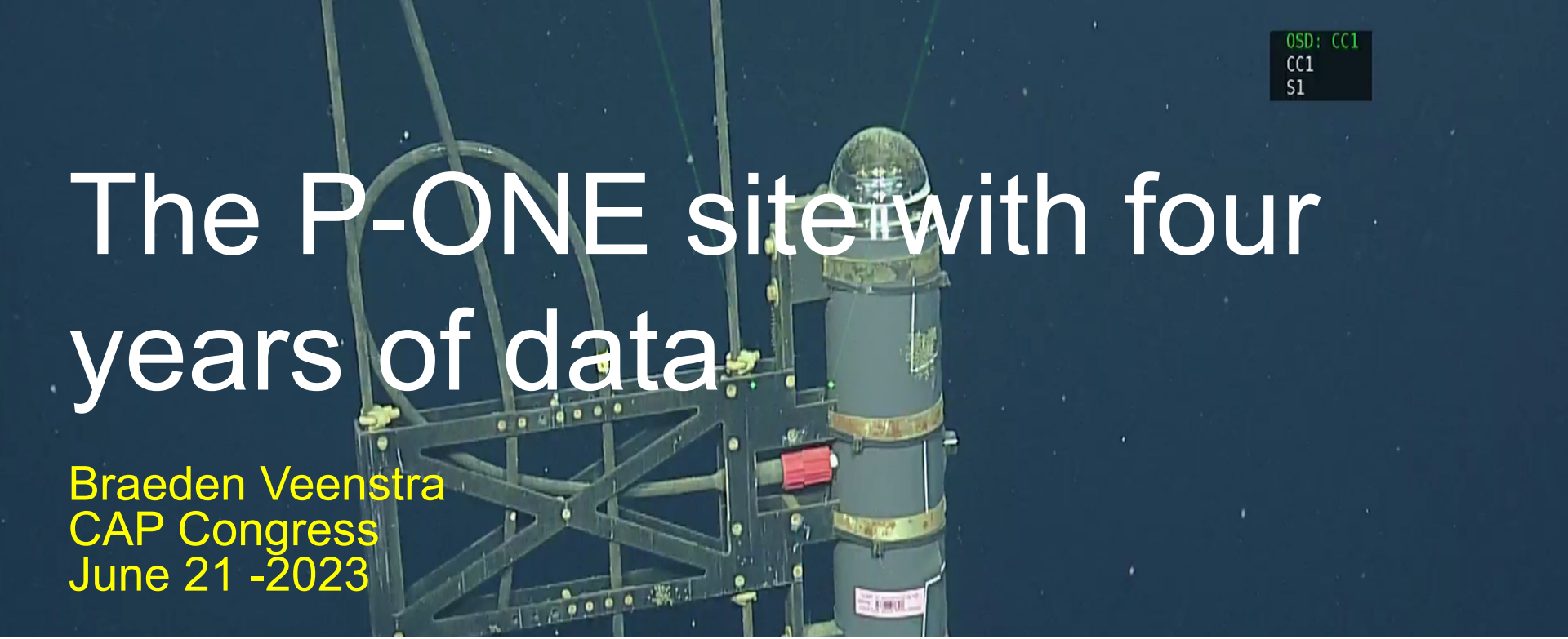


The P-ONE site with four years of data

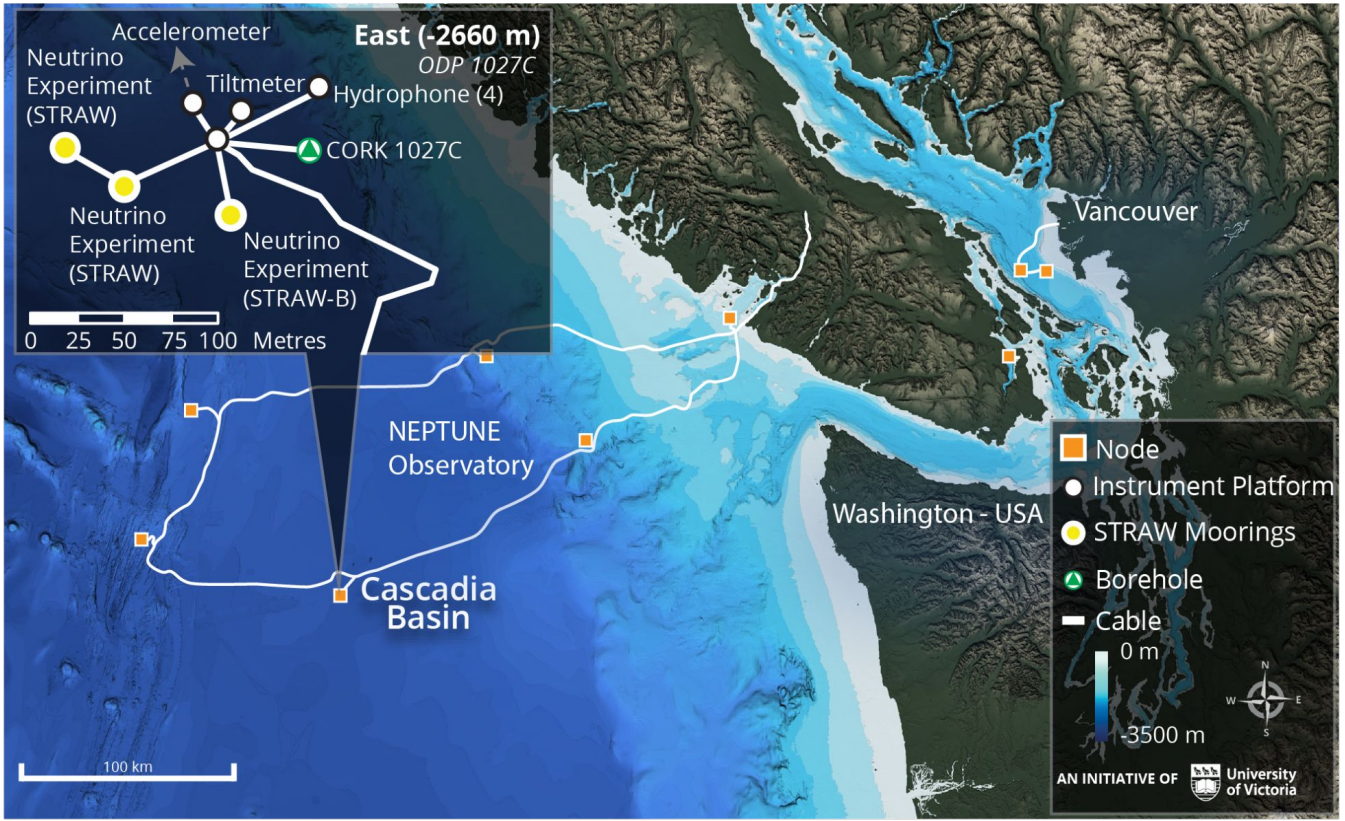
Braeden Veenstra
CAP Congress
June 21 -2023

UNIVERSITY OF ALBERTA

P-ONE

P-ONE

N. Bailly et al. Eur. Phys. J. C, 81(1071), 2021.

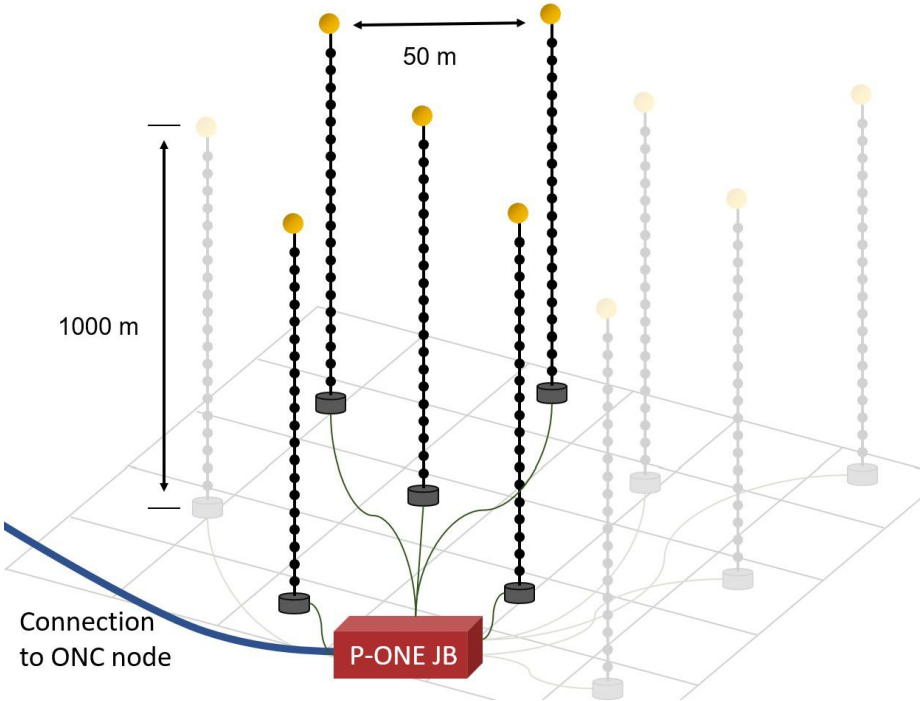


P-ONE is an initiative between physicists in Canada, Germany, the US, Poland and UK who are building a neutrino telescope in the North Pacific.

We are partnered with Ocean Networks Canada, who have experience with deploying ocean based experiments, and maintain extensive undersea infrastructure.

Introduction

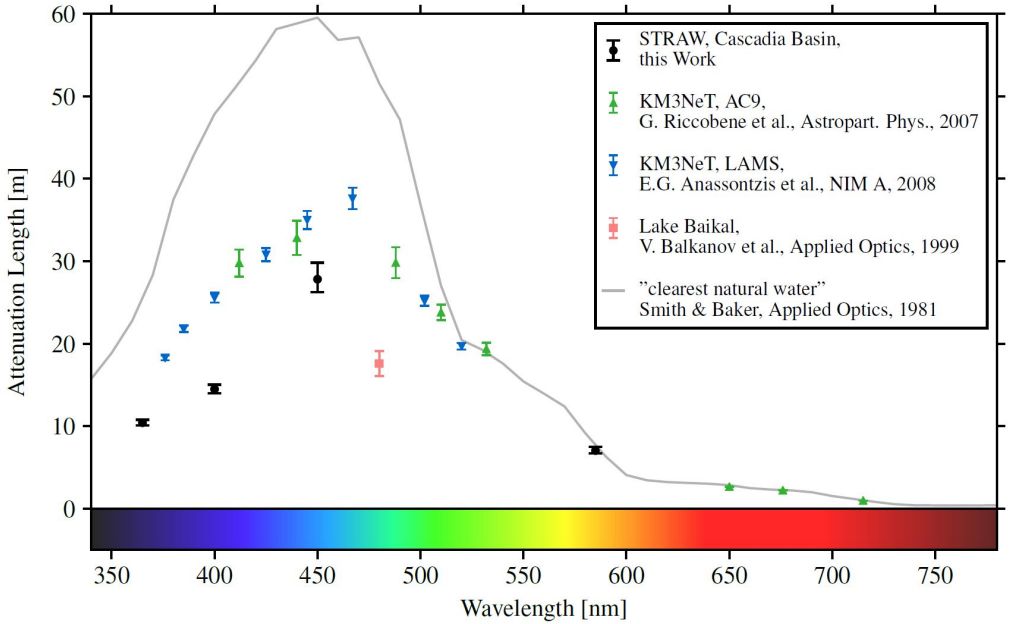
- Strings of optical modules instrumented with PMTs detect cherenkov light from charged particles produced in neutrino interactions.
- A large volume of water is required because neutrinos have a small interaction probability.
- Using a neutrino telescope, one can make high-energy cross-section and oscillation measurements, as well as look for point sources of cosmic neutrinos.

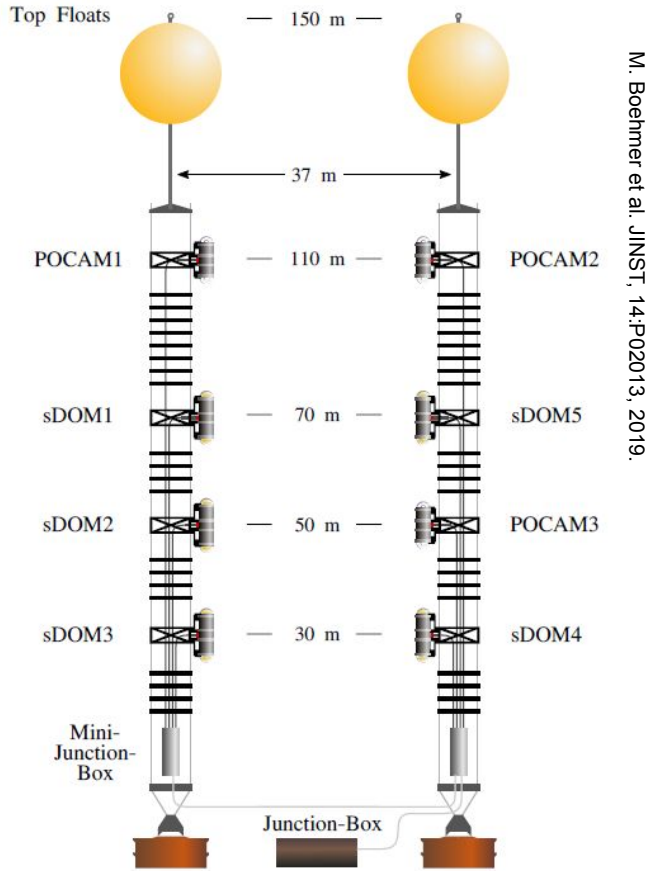


STRings for Absorption length in Water

- STRAW was deployed in 2018, to measure water clarity, which it confirmed is clear enough for a full detector
- Ongoing analyses of bioluminescence, **biofouling/sedimentation**, and atmospheric muons.

N. Bailly et al. Eur. Phys. J. C, 81(1071), 2021.

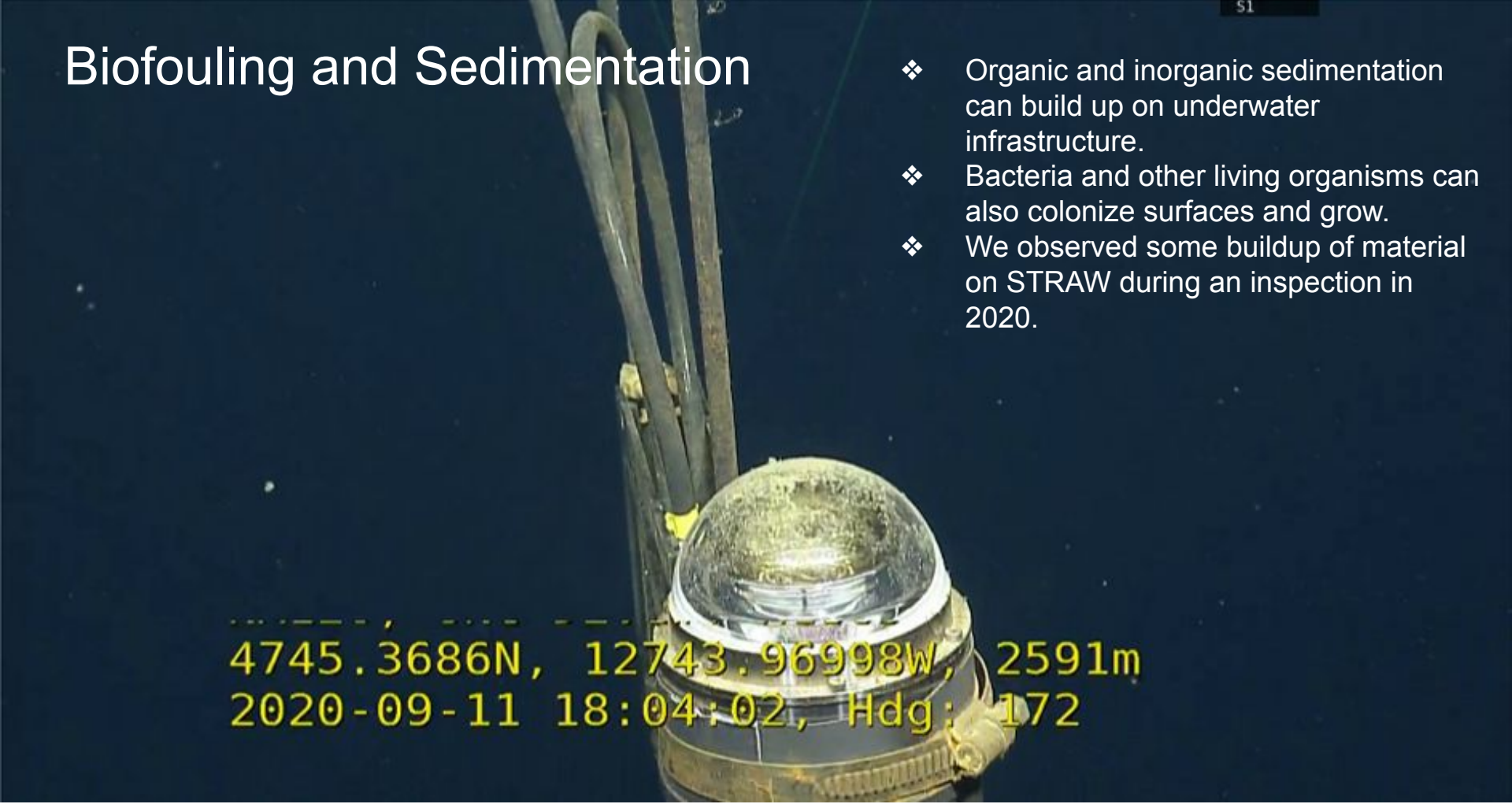




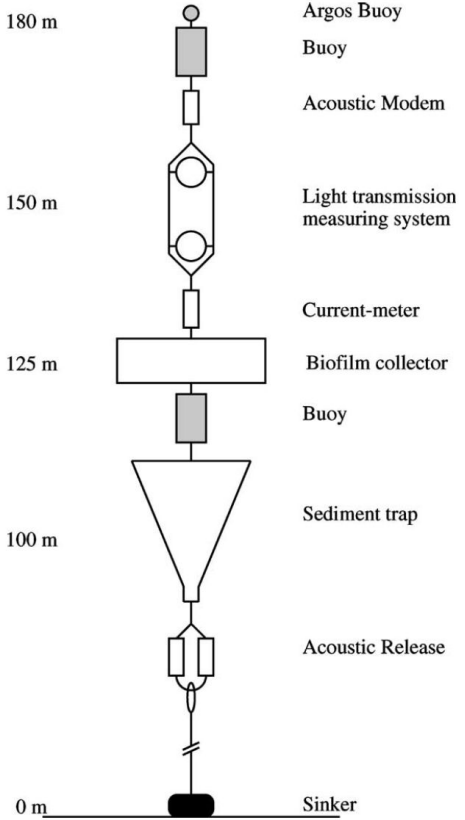
M. Boehmer et al. JINST, 14:P02013, 2019.

Biofouling and Sedimentation

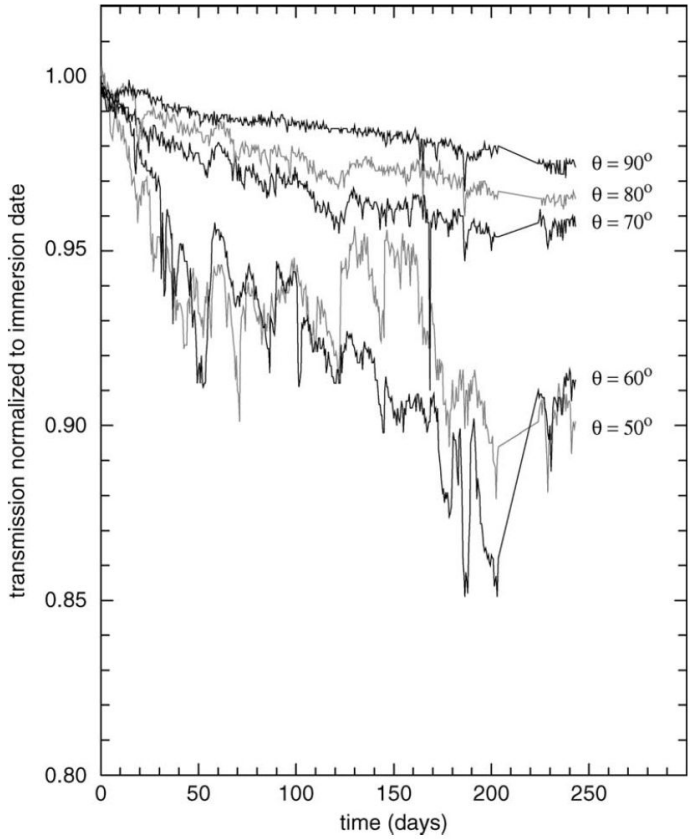
- Organic and inorganic sedimentation can build up on underwater infrastructure.
- Bacteria and other living organisms can also colonize surfaces and grow.
- We observed some buildup of material on STRAW during an inspection in 2020.



ANTARES Pathfinder - Biofouling Results (Amram et al 2003)



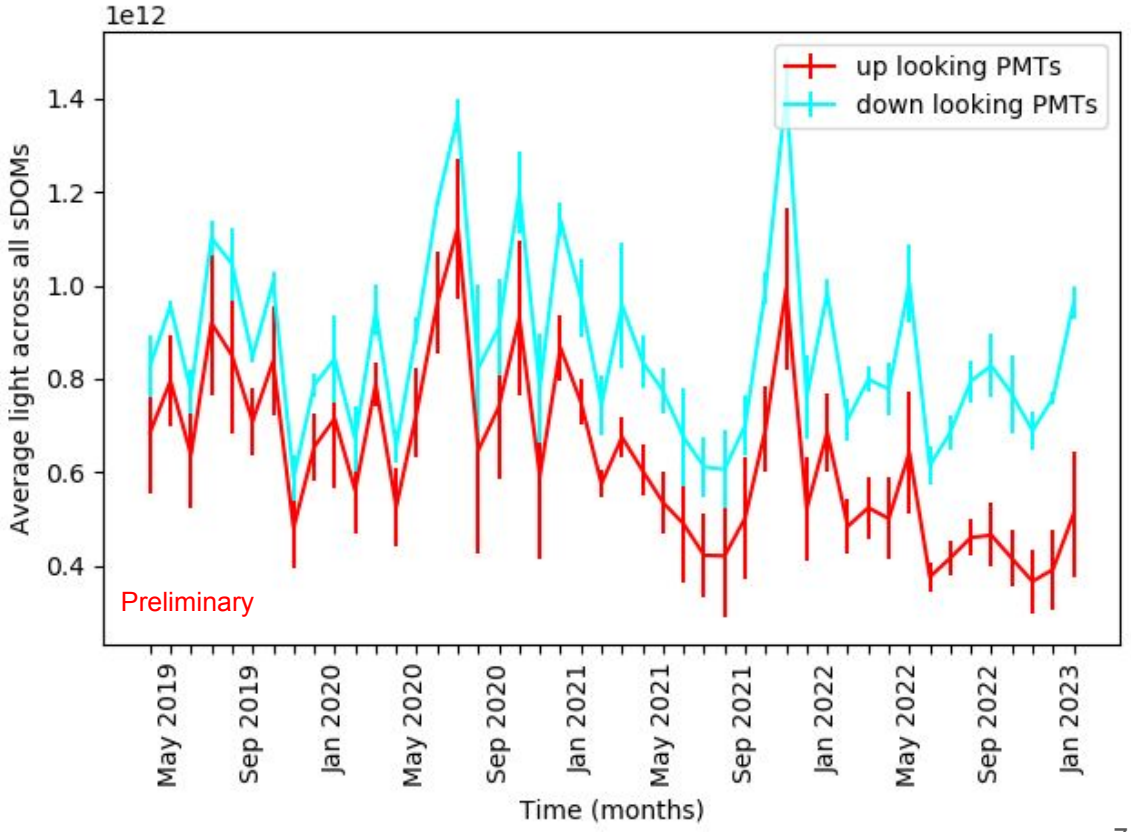
P.Amram et al. *Astropart. Phys.*, 19:253-267, 2003.



- The ANTARES collaboration measured the fouling of their optical surfaces in the Mediterranean.
- They extrapolated an annual efficiency loss of 2.4%.

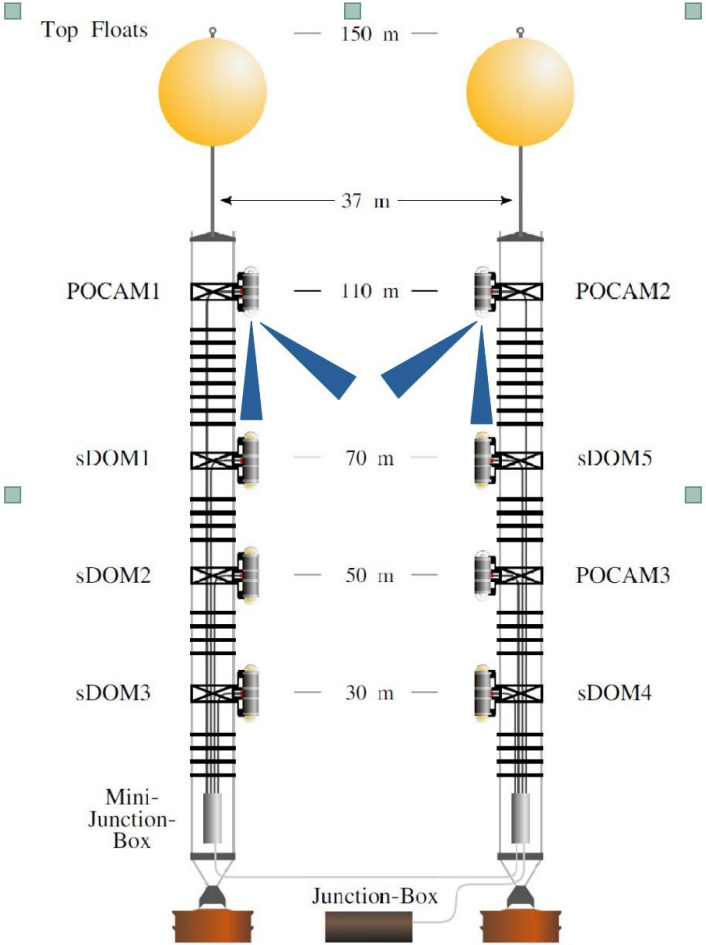
Method Using Natural Light (Bioluminescence)

- Organisms in the water produce light, a phenomenon known as bioluminescence.
- Fouling accumulates more quickly on upwards facing substrates (ANTARES)
- Large fluctuations track between upwards and downwards PMTs.
- We can estimate efficiency losses due to fouling by taking the ratio of up/down as a function of time.

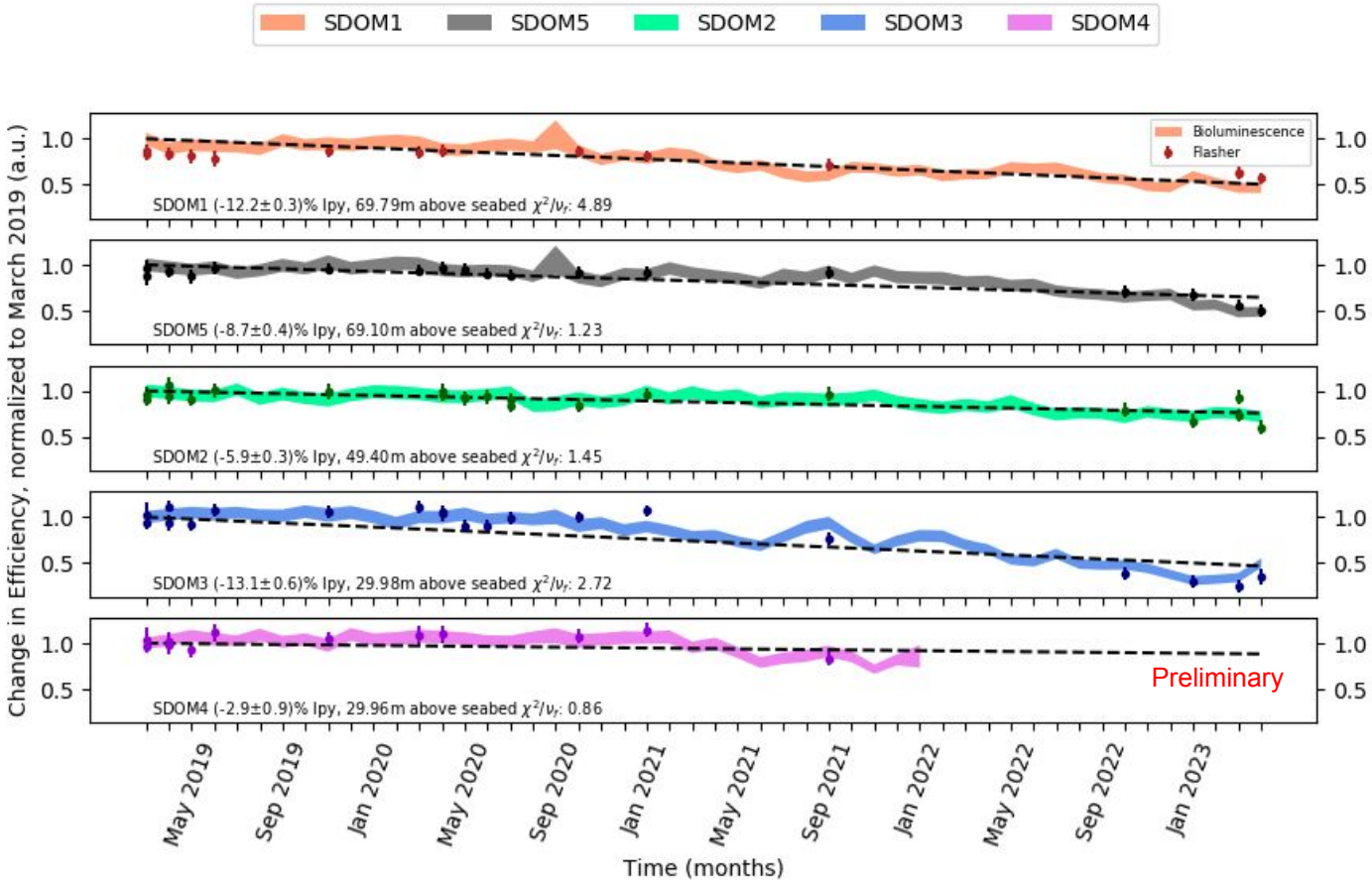


Measuring Fouling Directly with the Flasher

- Pulses from the LED flasher are counted in every second in a 20-60 second run.
- The expected number of flashes is then calculated based on the flasher frequency, and measured live-time.
- So long as the properties of the water don't change significantly, any decrease in the detection probability can be attributed to efficiency losses.



Preliminary result with 4-years of data

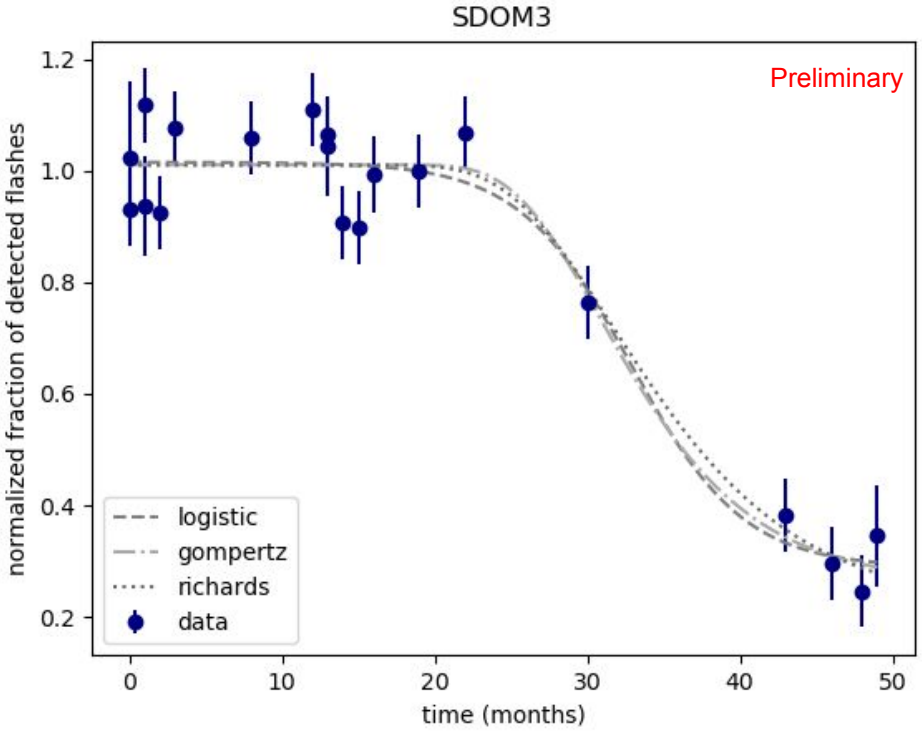


- A significant loss in efficiency is observed over time.
- The most extreme losses are in the module closest to the sea-floor.

Biologically Motivated Models

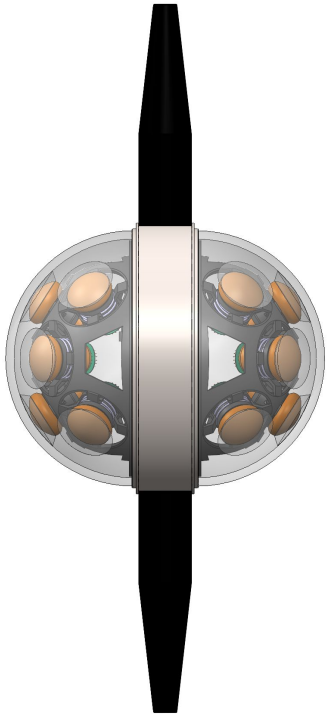
- A linear fit is a useful benchmark, but what we actually see is a delay with minimal losses followed by a rapid transition.

- To characterize this, we fit biophysical models for population growth, since our underlying assumption is that the efficiency losses are driven by biofouling.



Summary and Next Steps

- Biofouling and sedimentation are effects that are relevant to neutrino experiments in natural water.
- Analysis of 4-years of data using the first P-ONE pathfinder show a significant drop in transparency of the optical surface.
- The P-ONE collaboration is preparing a paper on these results, pending cross-checks and input from the Biology/Marine Science community on the composition of fouling samples.
- Our next step is to evaluate anti-fouling techniques that can be deployed with future phases of P-ONE.



Questions

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