NOAA Pacific Marine Environmental Laboratory
Ocean Climate Stations Project

TECHNICAL NOTE 10

Designing Stronger ATRH Mounts

Following Damage from Severe Wave Action

NOTICE

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Designing Stronger ATRH Mounts

Introduction

This report summarizes the testing of new ATRH mounts designed and built by OCS at PMEL. This is an effort to increase the strength and robustness of the mount without impacting the thermal properties of the sensor.

Bent ATRH Mounts, KE012 and KE014.

Background

ATRH sensor mounts on the OCS KEO mooring have repeatedly returned from sea bent at up to 90°. In the last 4 years, 8 of 12 sensors have returned from deployments damaged. The relatively thin aluminum mounts from RM Young are (presumably) bent by extreme wave action, though the mounts have proven satisfactory for years in the Global Tropical Moored Buoy Array (GTMBA). Increased typhoon and storm action at KEO likely contributes to the bending of the sensor mount and shield (designed for horizontal airflow and minimal water intrusion). Past a certain threshold, bent mounts may compromise the data quality and could potentially cause damage to the sensor.

A more robust sensor mount was sought that would not have any additional thermal effect on the ATRH sensor, having been a major concern with the development of the MP101 and Hygroclip ATRH sensors at PMEL. Special sensor housings and sun shields have been developed to protect the thermistor from bias from any heat retained by the sensor package.

Aluminum vs. Fiberglass Mount

The first prototype of a new mount was made from a thicker piece of aluminum. The standard mounts are 1/8" thick, powder-coated aluminum, angled to hold the sensor vertically. A new, ¼" thick mount was made from aluminum angle to fit all existing hardware, but tolerances were kept tight to minimize the total aluminum and its thermal influence. After testing this prototype, it was clearly evident that the thicker aluminum was being affected by higher temperatures more than the original mounts.

After extensive research into other materials, a second prototype was manufactured out of fiberglass reinforced plastic (FRP). FRP offers nearly the same tensile strength as aluminum (30k v. 35k psi), with a fraction of the thermal conductivity (4 vs. 150 BTU/ft^2/°F/in).

Details:
https://bedfordreinforced.com/app/uploads/2017/08/BRP-FRP-vs-Traditional-Materials.pdf

Testing

Sensors were set up in pairs under heat lamps. The lamps cycled on and off at 3-hour intervals. This was done to simulate the mounts absorbing heat in direct sunshine. Two MP101 ATRH's and two Hygroclips were used for the comparison. One of each sensor type (MP101 and Hygroclip) was matched with each type of mount (aluminum and FRP). Tests were run with combinations of sensors and mounts paired together.

The test setups were initially placed too close together, biasing each other with outside heat. Testing pairs were separated and sensor agreement improved.

Test Results

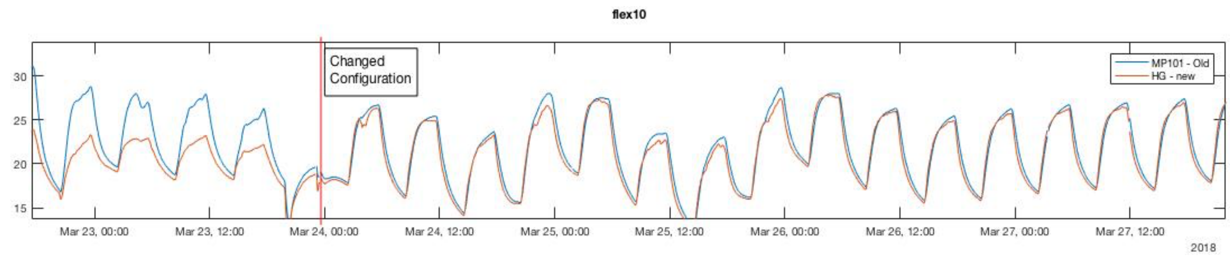

Figure 1: Results of test before and after instruments and heat lamps were separated to avoid biasing one another.

Heat lamp Testing 1: MP101 v. Hygroclip (*Figure 1)*

- No noticeable change in temperature profile from new mount.
- In both tests, the MP101 had a slightly higher temperature rise at peak temperatures than the Hygroclip.

Heat Lamp Testing 2: MP101 & Hygroclip. Same-Sensor Comparison (*Figures 2 and 3)*

- Neither test showed significant bias from the new mount.
- Differences between sensors did not increase at higher temperatures.
- The MP101 test had higher temperatures in the sensor with the old mount.
- Hygroclips were almost identical throughout the test.

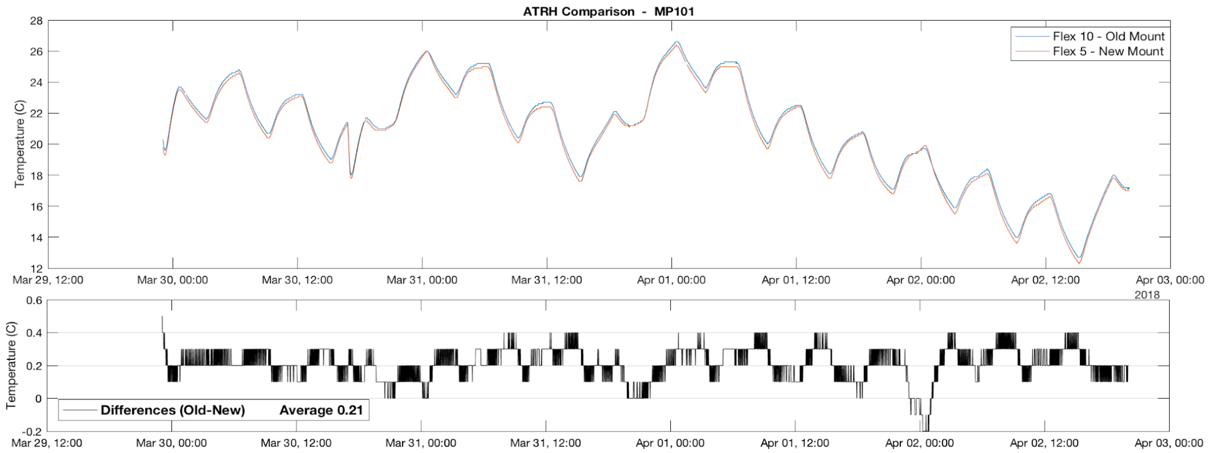

Figure 2: Comparison of MP101 ATRH Sensors.

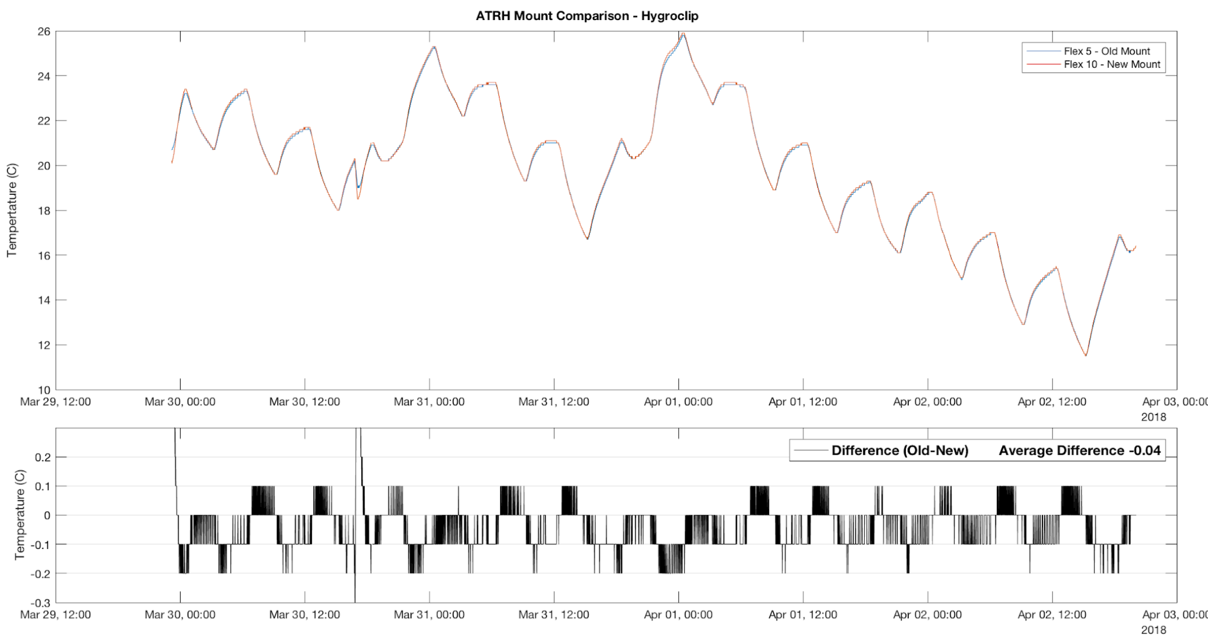

Figure 3: Comparison of Hygroclip ATRH Sensors.

Outdoor Testing: KEO Buoy Testing (*Figures 4 and 5*):

- Once the KEO mooring was set up for testing, the new mounts were set up on the primary systems to test real-world conditions.
- Sensors with new mounts did not seem to behave any differently than sensors with old mounts.
- When temperatures did fluctuate, the sensors with the new mounts reported both higher and lower temperatures. This would suggest that sensor bias is stronger than any bias introduced from the mount.

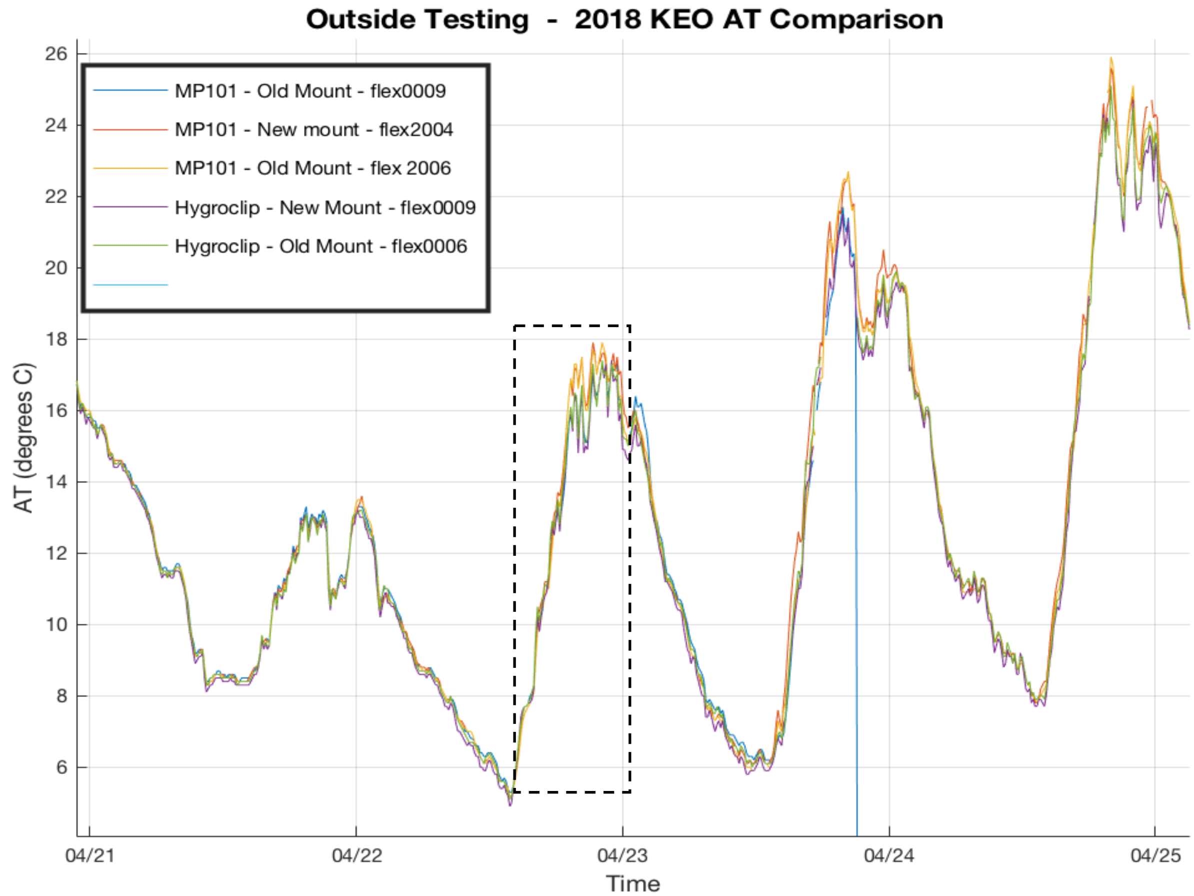

Figure 4: Comparison of all ATRH sensors testing for KE016.

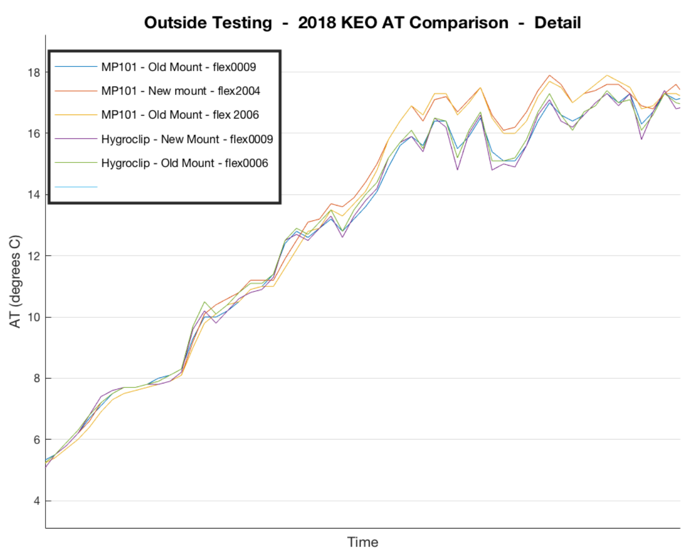

Figure 5: Zoomed box from Figure 4.

Summary

- Overall, testing indicates that the FRP mount offers no thermal bias to the ATRH sensors.
- New mounts are significantly stronger than existing mounts.
- New mounts are easily manufactured at PMEL.
- Recommend implementation of FRP mounts at all sites.

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