# Enhanced Observations of Rainfall Rates on Pacific Ocean TAO Buoys

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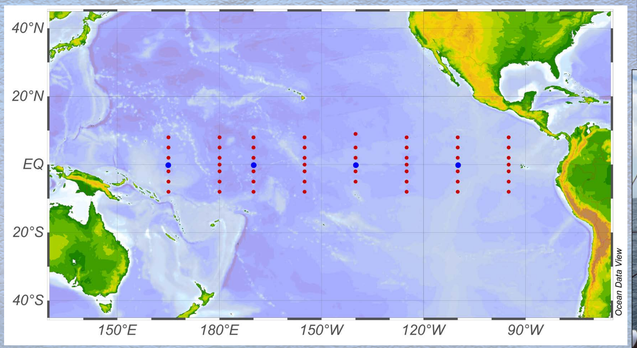
## INTRODUCTION

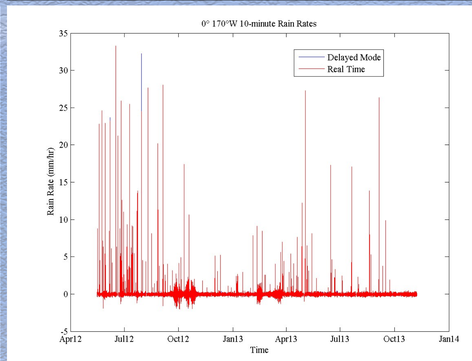
- National Data Buoy Center (NDBC) replaced obsolete sensors that were part of the TAO Legacy buoys with commercial off-the-shelf (COTS) sensors on the TAO Refresh buoys
- Shift in processing data from on board the buoy to a shore-side processing systems
- Rain data affected by this processing shift
- Historical real-time rain data limited to a daily average of rainfall rate, standard deviation, and percent time raining
- TAO Refresh buoys transmit 60 rain data messages per hour via the Iridium satellite system
- Rainfall rates are then calculated shore-side using a similar method as historical observations (Serra et al. 2002)
- Existing quality control and post-recovery processing methods utilized
- Real-time processes were compared to the existing post-recovery processes using recently recovered Refresh data

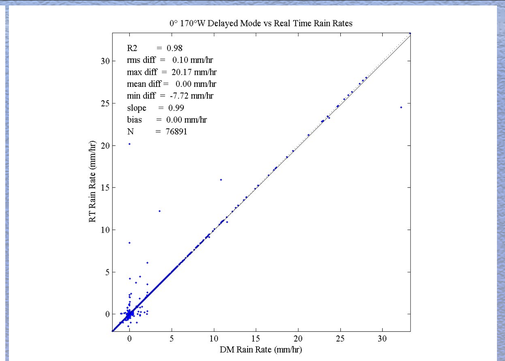


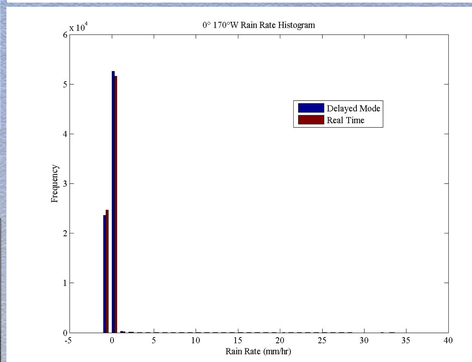

TAO buoy being deployed

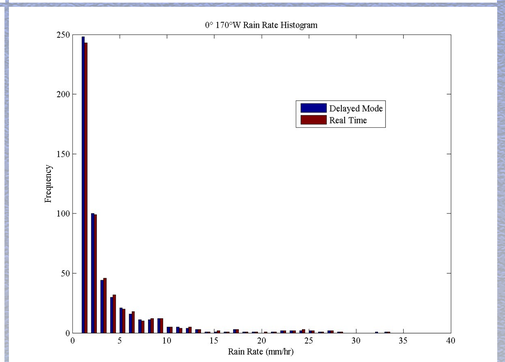
TAO buoy  TAO buoy with rain gauge

## RESULTS




99% of data with a rain rate less than 1 mm/hr. When rain events occurred, 92% of rain events had a rain rate of less than 10 mm/hr. Mann-Whitney U test results in a *p*-value of 0.5051, indicating that the Delayed Mode and Real Time distributions are the same.

**Reference:** Serra, Y.L., P. A'Hearn, H.P. Freitag, and M.J. McPhaden, 2002: ATLAS Self-Siphoning Rain Gauge Error Estimates. *J. Atmos. Oceanic Technol.*, **18**, 1989-2002.

### Statistical Comparison

| | Mean | Standard Deviation |
|---|---|---|
| Delayed Mode | 0.02 | 0.54 |
| Real Time | 0.02 | 0.54 |

| Mean Difference | Difference RMS | Max Difference | Min Difference |
|---|---|---|---|
| 0.00 | 0.10 | 20.17 | -7.72 |

| Abs Mean Error | % Mean Error | Slope | Y-Intercept | $R^2$ |
|---|---|---|---|---|
| 0.00 | 3.55% | 0.99 | 0.00 | 0.98 |

## CONCLUSIONS

- Real Time algorithm is equivalent to the Delayed Mode
- NDBC is better positioned to support timely analyses of high frequency rainfall events
- Empower users of the high-resolution data to create their own custom filters and statistics to meet their specific needs
- Reduced sampling error due to the temporal averaging
- Data analysts are now able to pinpoint a sensor malfunction down to a specific time rather than a day

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