



Capability Assessment of the DART-ETD Tsunami Buoy

Deep Ocean Assessment and Reporting of Tsunami – Easy To Deploy
November 2007

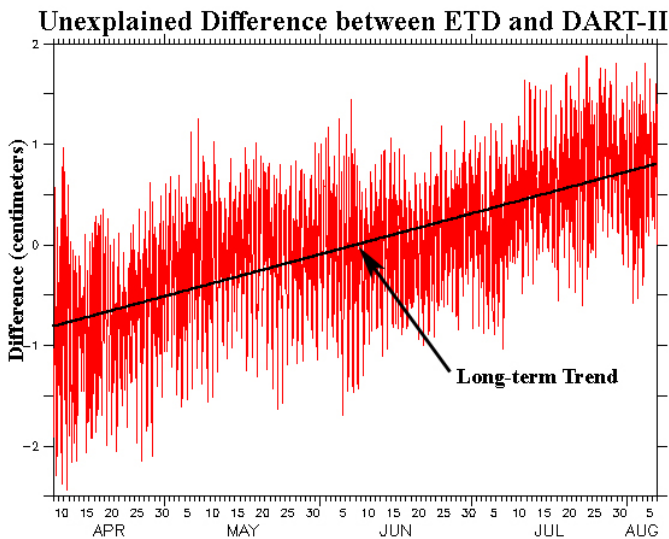
Pacific Marine Environmental Laboratory internally evaluated the performance of the DART-ETD tsunami Buoy in comparison to the DART II technology. The test bed, which included both a DART II and ETD system, was located approximately 120nm SE of Honolulu HI. The ETD was evaluated using the DART design capabilities test procedures found at:

http://www.ndbc.noaa.gov/dart/dart2_pc_1.shtml

1. Measurement: Sea-level amplitude at a continuous sample rate of 15 seconds over time.

Time series data from the ETD was downloaded and evaluated. This data showed continuous 15 second samples. The ETD meets/exceeds this evaluation parameter.

2. Measurement accuracy: Agreement within 5.0 cm in the observed tides deployed in similar depths off Hawaii within 100 nm of operational DART station using a standard tide model for tidal adjustments between stations.



The difference between the diurnal and semidiurnal tides is shown in the graphic; it amounts to some ± 3 cm. There are longer tidal components (annual and semiannual) that are not provided in the tidal model. These, plus other long-term trends associated perhaps with circulation

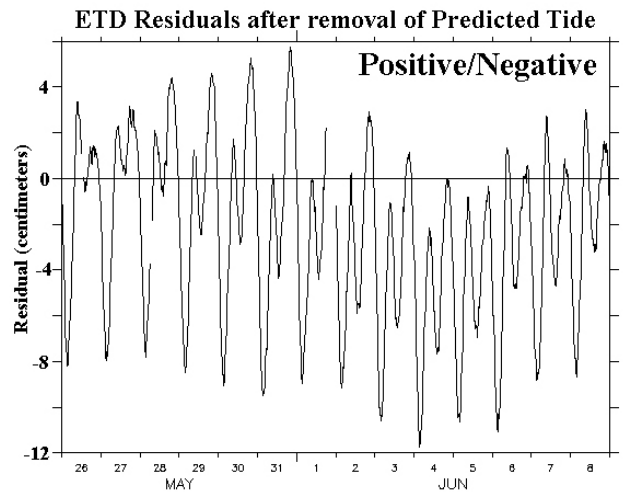
patterns, differential settling, and sensor drift also were subtracted with a linear trend.

3. Measurement Resolution: 0.25mm at depths 1000-6000 meters.

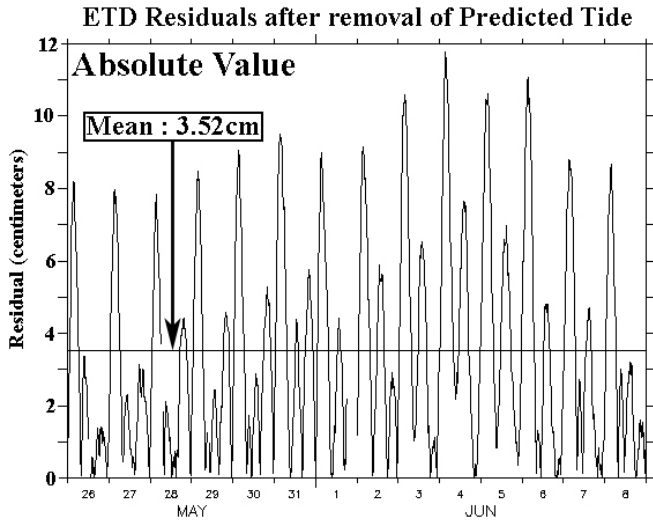
Since the ETD uses the NOAA DART electronic design, it meets/exceeds this evaluation parameter.

4. Performance measure: Comparison of Standard Mode data with harmonic tidal analysis shows agreement within 5 cm (average) over a 14 day period during the 120 day evaluation period.

The figure below shows a comparison of Standard mode data over a 14-day period. There is very good agreement with phase and some minor differences in amplitude that can most likely be attributed to the grid size resolution of the model.



The mean of the absolute value of the residuals for the data from the ETD for the dates of May 26- June 9 is 3.52 centimeters, which falls with the <5cm design capability. The plot of the values from which this was calculated is shown below.



The ETD meets/exceeds this evaluation parameter.

5. Reliability: 80% or better data return rate over 120 consecutive days.

Over a 120 day evaluation period the ETD performed at a 99.3% data return ratio. The ETD meets/exceeds this evaluation parameter.

6. False triggers, not related to natural events: None during 120 day evaluation period.

Over a 120 day evaluation period no false triggers were identified. The ETD meets/exceeds this evaluation parameter.

7. Data delivery; Request Mode: Gage Trip: Elapsed time from request for data to receipt of data at the Pacific Marine Environmental Laboratory's server less than 10 minutes. Gage 15sec data (1-hour duration): Elapsed time from request for data to receipt of data at the Pacific Marine Environmental Laboratory less than 15 minutes.

On 10/24/07 @ 2032Z the ETD was requested to trip into Event Mode. The ETD delivered simulated tsunami alert at 2037Z. The ETD meets/exceeds this evaluation parameter.

On 10/15/07 at 1816Z the ETD was requested to deliver 15 second data for the hour beginning at 08/16/07 1300Z. The ETD delivered the complete data block by 1825Z. The ETD meets/exceeds this evaluation parameter.

8. Data delivery; Event Mode: Gage Trip: Elapsed time from trip to receipt of data at the Pacific Marine Environmental Laboratory's server: less than 3

minutes; and display on the PMEL web site: less than 5 minutes (pre-selected times via software setup)

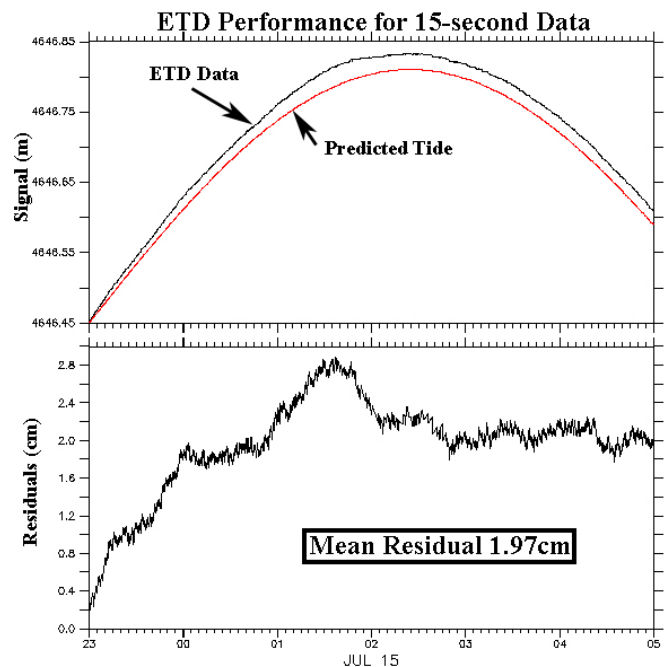
There was no seismic event that was over the tsunami threshold during the evaluation period.

9. Data acquisition tests: At least one successful test acquiring one hour of 15 second data during 120 day evaluation period.

On 10/15/07 at 1816Z the ETD was requested to deliver 15 second data for the hour beginning at 08/16/07 1300Z. The ETD delivered the complete data block by 1825Z. The ETD meets/exceeds this evaluation parameter.

10. Performance measure: Comparison of 15 sec data with DART station data with harmonic tidal analysis shows agreement within 5 cm (average) over a 1 hour period during the 120 day evaluation period.

The plot below shows 15sec data from the ETD buoy for the hours of 2300-0500 on 07/14/07 GMT (in black) and the tidal prediction based on the OSU tidal model (in red). There appears to be about a 30-second offset between them, which is most likely because the grid on which the OSU model is available is too coarse to provide predictions for this purpose. When adjusting for this time difference, the measured amplitude agrees within <5cm of computed tidal amplitude. The ETD meets/exceeds this evaluation parameter.



11. Other Bottom Pressure Recorder (BPR) commands tests: At least one successful test for each of the following during 120 day evaluation period.

- **Turn on "deployment mode" for 30 minutes.**

The station was called on 10/22/07 at 14:39Z and commanded to enter deployment mode. The ETD began transmitting deployment mode data and continued to do so for 30 minutes as expected. ETD meets/exceeds this evaluation parameter.

- **Retrieve engineering data from gage.**

The station was called on 10/22/07 at 07:38Z to request engineering data. The ETD responded with its configuration information as expected. ETD meets/exceeds this evaluation parameter.

- **Reboot BPR gage electronics.**

The station was called on 11/19/07 at 15:46Z to request a Bottom Pressure Recorder reboot. The BPR rebooted successfully. The ETD meets/exceeds this evaluation parameter.

- **Reboot buoy electronics.**

The station was called on 11/19/07 at 19:31Z and the buoy was commanded to reboot. The ETD rebooted successfully. The ETD meets/exceeds this evaluation parameter.

- **Change tsunami detection threshold.**

The station was called on 10/25/07 at 18:31Z to change the detection threshold to 80 mm. The change was verified using the Retrieve Engineering Data command. Then the threshold was returned to 30 mm. The ETD responded appropriately. The ETD meets/exceeds this evaluation parameter.

12. Tsunami Test Mode: In the event of a detectable tsunami the test buoy tsunami data will be compared with operational DART II station data. Amplitude and phase comparison should show 90% or better agreement after properly taking into account the differences in tsunami amplitude differences and arrival times between the two stations.

Both the DART-II and the ETD registered the small tsunami produced off Peru on 15-Aug-2007. The wave took over 12 hours to reach the Hawaii Tsunameters which were not tripped by the event; the four-hour records of 15-second data used were downloaded subsequently by interrogation. Modeling at NCTR has led to the estimation of the source and predictions of the signal's propagation throughout the Pacific basin. In particular, offshore of Hawaii, the model predicts similar amplitude at both the DART-II and ETD sites with the DART-II leading by 15 minutes. The image below shows the de-tided signals at the two Tsunameters. The observed time lag at 14.25 minutes is close to the expected 15 minutes. Assuming the DART-II signal as truth, a 90% tolerance window has been constructed for amplitude and phase at the ETD. The observed first wave peak at the ETD falls within this window. The ETD meets/exceeds this evaluation parameter.

