LDEO New Zealand Data Upload Notes: Version 1

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1. APGs (HDH and BKO)

5 Trawl-resistant LDEO BPRs (LBPR1-5); 5 UTIG BPRs (TXBP1-5); 7 LDEO OBSs with internal APGs. All 17 instruments had the same datalogger design and software. Pressure channel (**HDH**) ran at 100 sps; temperature channel (**BKO**) ran at 12.5 sps. Pressure transducer ranges varied. Stations are spread across two DMC network codes: 8F and YH.

Temperature units in miniseed are in millidegrees C. Pressure units in miniseed are 0.01 Pa and the estimated pressure at the surveyed depth in Pa has been subtracted to fit the data into miniseed. (This is why the pressure data disappears during deployment and recovery for some of the deeper sites.) At some point, this information will be moved into a Seed coefficient response blockette, but for now, the subtracted (also in Table 1) pressure is entered in the Seed channel comments.

Site	**Network**	**Drift, ms**	**Notes**	**Pressure correction (Pa)**
LBPR1	8F	67		884549
LBPR2	8F	-167		894591
LBPR3	8F	-130		834343
LBPR4	8F	-170		894591
LBPR5	8F	--	No final clock sync: recovered by dragging	874508
LOBS1	YH	-114		10082420
LOBS4	YH	--	No final clock sync	34643548
LOBS5	YH	-51		23808938
LOBS6	YH	-19		18908762
LOBS8	YH	-216		6638239
LOBS9	YH	-46		14731563
LOB10	YH	--	No final clock sync	14601025
TXBP1	8F	-88		36079460
TXBP2	8F	-244		7923531
TXBP3	8F	-72		10745149
TXBP4	8F	-13		14269661
TXBP5	8F	-210		12612839

Table 1. APG sites, network codes, and CSAC clock drifts, and miniseed pressure correction. Positive drift means there are more counts between the sync times than the nominal clock cout rate (1000/s) gives, i.e., clock is fast.

The HDH/BKO data at the DMC are all time-corrected assuming linear drift, except for LBPR5, LOBS4, and LOB10, which had no final clock sync and for which the data quality flag in the miniseed headers is set. All APGs had CSAC atomic clocks that gave very low drift rates, indicating that the maximum timing error on these three sites is probably 250 ms at the end of the experiment.

Site	HDH start	HDH end	HDH	BKO	Notes
LBPR1	2014132	2015172	OK	OK	
LBPR2	2014132	2015172	OK	OK	
LBPR3	2014132	2015172	OK	OK	
LBPR4	2014133	2015172	OK	OK	
LBPR5	2014133	2015180	OK	OK	Dragged up
LOBS1	2014134	2015172	OK	OK	
LOBS4	2014137	2015088	4-h spikes appear 2015081 and become stronger and more frequent to end (HDH and BKO); final time sync bad. Data stop early.		
LOBS5	2014135	2014155	HDH degraded and fell apart 2014155, consistent with observed leak; BKO seems OK to recovery (2015173)		
LOBS6	2014137	2015177	OK	OK	HDH=0 for first 48h
LOBS8	2014134	2015177	OK	OK	
LOBS9	2014131	2015174	OK	OK	
LOB10	2014131	2015152	~4-h Spikes appear 2015144; increase in strength and incidence towards end (HDH and BKO); final time sync bad. Data stop early.		
TXBP1	2014132	2015178	OK	OK	Corroded sensor
TXBP2	2014137	2015024	Running on deck for 3 days before deployment. 2015001, HDH starts to get bumps and spikes. Both channels end suddenly in garbage at 2015024. Corroded sensor.		
TXBP3	2014132	2014286	Bumps seen in HDH from start; associated with 0.8 degree drop-offs in BKO. Both channels end suddenly in garbage at 2014286. Corroded sensor.		
TXBP4	2014132	2014252	Data start on seafloor at 2014132. Both channels end suddenly in garbage at 2014252. Corroded sensor.		
TXBP5	2014131	2015066	Both channels end suddenly in garbage at 2015066. Corroded sensor.		

Table 2. Preliminary APG performance evaluation.

2. Seismometer channels

Channels **HHZ**, **HH1**, **HH2**: Trillium Compacts sampled at 100 sps. Seismometer responses are given in seed headers. Instruments included an experimental hydrophone channel (**EDH**), some of which appeared to work. However, **EDH** responses at DMC are nominal for now (actually, borrowed from WHOI).

Site	EDH	APG ?	HH* Performance and power notes
LOBS1	OK	Yes	All stop 2014329:08:30.000. Did get ratty in the hours up to then. Datalogger ran until end and Seascan clock was OK. Startup/main analog depleted; digital OK
LOBS2	Bad	No	All stop 2014325:23:26:20. Did get ratty in the hours up to then. Datalogger ran until end and Seascan clock was OK. Startup/main analog depleted; digital OK
LOBS3	Good	No	All stop 2014286. Good up until then. Batteries OK on recovery
LOBS4	n/a	Yes	All bad from start. All stop 2014034:16:32:30 DOA, no tick counts
LOBS5	Flatlined	Yes	**Leaked.** Probably no usable data. Stopped 2014287. No power info.

LOBS6	Flatlined	Yes	Worked. Batteries OK on recovery
LOBS7	OK	No	Worked. Batteries OK on recovery
LOBS8	Good	Yes	Worked. Batteries OK on recovery
LOBS9	Good	Yes	Worked. Digital & analog slightly low
LOB10	Good	Yes	Went bad, then stopped. OK at start. DOA, no tick counts.

Table 3. Preliminary performance evaluation for seismometers. Three OBSs did not have APGs. Analysis is based on quick inspection of time series alone.

Site	**Drift, s**	**Style**	**Seismo clock**
LOBS1	1.212	Cascadia	Seascan
LOBS2	0.085	Cascadia	Seascan
LOBS3	6.62s	NZ	CSAC
LOBS4	--	NZ	CSAC
LOBS5	13.6s	NZ	CSAC
LOBS6	-0.590	Cascadia	Seascan
LOBS7	-4.6s	Cascadia	CSAC
LOBS8	-1.812	Cascadia	Seascan
LOBS9	43s	NZ	CSAC
LOB10	--	NZ	CSAC

Table 4. Seismometer clock description and performance. Red drifts are anomalously large and all for OBSs that shared CSAC clocks with APGs.

2.1. OBS performance notes

LOBS1 and LOBS2: Both went to 0 counts after several months. Analog power drained. Suspected cause is Trillium Compact remaining in high-power mode after leveling.

LOBS4 and LOBS10: They also stopped early and had depleted batteries (both digital and analog) on recovery. Not yet resolved. had no reliable final APG syncs either.

LOBS5: Leaked on deployment. Suspect is 12-pin sensor connectors/cables that were difficult to connect.

LOBS4 not uploaded to DMC. No usable data (although the real reason it wasn't uploaded was a mistake in the transcription that wasn't noticed until it was too late). For completeness, the plan is to upload it to the DMC in late October.

2.2. Seismometer timing

Four instruments (LOBS1, LOBS2, LOBS6, LOBS8) used a quartz Seascan clock for the seismometer/hydrophone datalogger, and a CSAC clock for the APG logger. The respective clock drifts were as expected for these instruments, with the Seascan drift an order of magnitude greater than the CSAC drift. Crude cross-correlation (generally a 1-4 h window at the start of each 12 or 24-h period) of the wave loading signal between APG and vertical seismometer (Figure 1) shows that LOBS1 had excellent timing to within 2 samples, or 20 ms. LOBS6 also had low drifts but an apparent mean offset of ~50 ms (the correlation quality was very low for LOBS6) and LOBS8 had a systematic parabolic drift with a peak at 30 ms.

LOBS 4 and LOB10 had no final clock sync, so the DMC data for these instruments are not clock-corrected. The data flags in the miniseed headers are set accordingly.

Some of the other instruments (LOBS 3, 5, 7, 9) shared a single CSAC clock for both APG and seismometer loggers. Although the APG timing was good, the seismometers had unreasonably high clock drifts (for a CSAC a few hundred ms is reasonable; 1 s is average for a Seascan clock over a year). The reason for this is not yet resolved but appears to be a degraded CSAC clock signal that is triggering false or missed counts on the seismometer logger (but not on the APG logger which has a different triggering algorithm).

If the APG timing was good, can the ocean wave signal be used to recover the OBS timing ?

Only partially. LOBS 5 flooded early; and LOBS 3 and 7 were two of the 3 OBSs that had no APGs. For LOBS9, the cross-correlation was successfully applied to the clock-drift-corrected data (i.e., after removing and assumed linear annual drift of 43s for LOBS9). Cross-correlation of the HDH and HHZ channels (0.1-1s) produced lags for which the local scatter was comparable to that of LOBS1. However, the lags are not linear and vary from +/- 0.5 s.

This suggests that for LOBS9, reasonable seismometer timing can be recovered from cross-correlation with the HDH channel, but only locally. Given that the linear correction reduced the timing error by two orders of magnitude (from 43 s to ~400 ms), it is possible that a linear correction to the LOBS3, LOBS5 and LOBS7, (which had lower overall drifts of 6, 13 and 4 s) reduces the timing error to 60, 130 and 40 ms.

For these four sites, the data at the DMC were clock-drift corrected for linear drift.

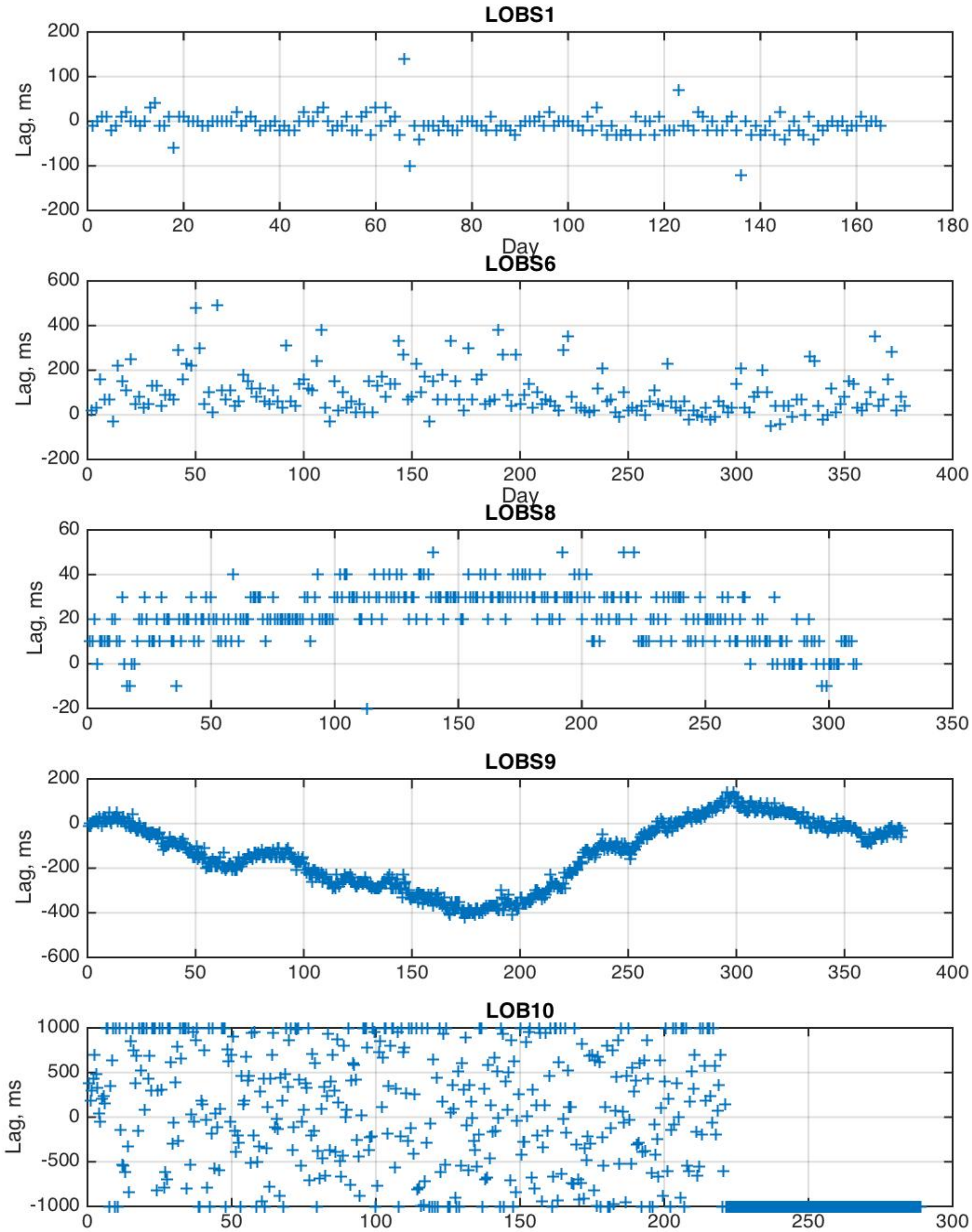

Figure 1. Lags between HDH and HHZ for ocean waves for five instruments. (LOBS1) good agreement between atomic CSAC and quartz Seascan clocks; (LOBS6) poorer agreement with possible ~50 ms offset but no apparent drift difference; (LOBS8) very good agreement, systematic max drift of ~30 ms; (LOBS9) good lag estimates but large, nonlinear variation for same CSAC clock; (LOB10) no coherence. In all cases, the linear clock-drift correction made before cross-correlating.