Journal of Geophysical Research: Solid Earth

Supporting Information for

Slow slip detectability in seafloor pressure records offshore Alaska

Erik K. Fredrickson[1], Joan S. Gomberg[2], William S. D. Wilcock[1], Susan L. Hautala[1], Albert J. Hermann[3,4], H. Paul Johnson[1]

[1]School of Oceanography, University of Washington, Seattle, Washington, USA

[2]U.S. Geological Survey, Seattle, Washington, USA

[3]Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Seattle, Washington, USA

[4]NOAA Pacific Marine Environmental Laboratory, Seattle, Washington, USA

Contents of this file

Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

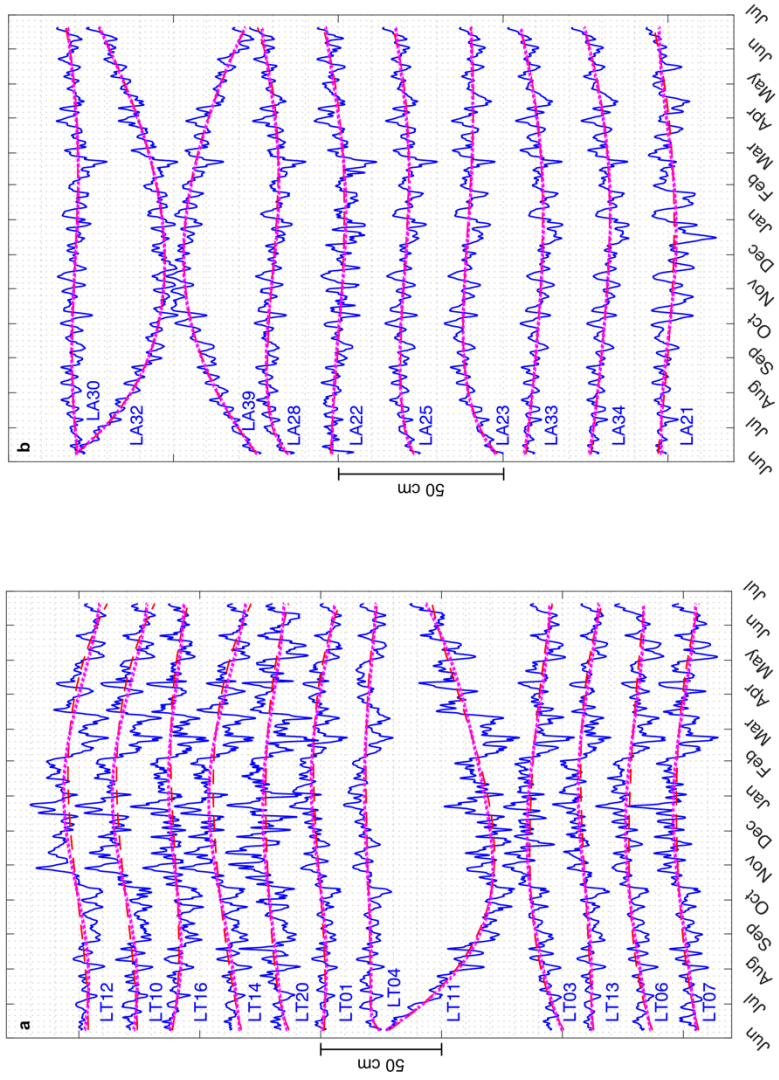

Figure S1. Time series of tidally filtered, detrended, and artificially offset pressure data (blue) along with the least-squares sinusoidal + exponential fit (pink, dotted) and 3rd order polynomial + exponential fit (red, dashed) for the shelf (a) and slope (b).

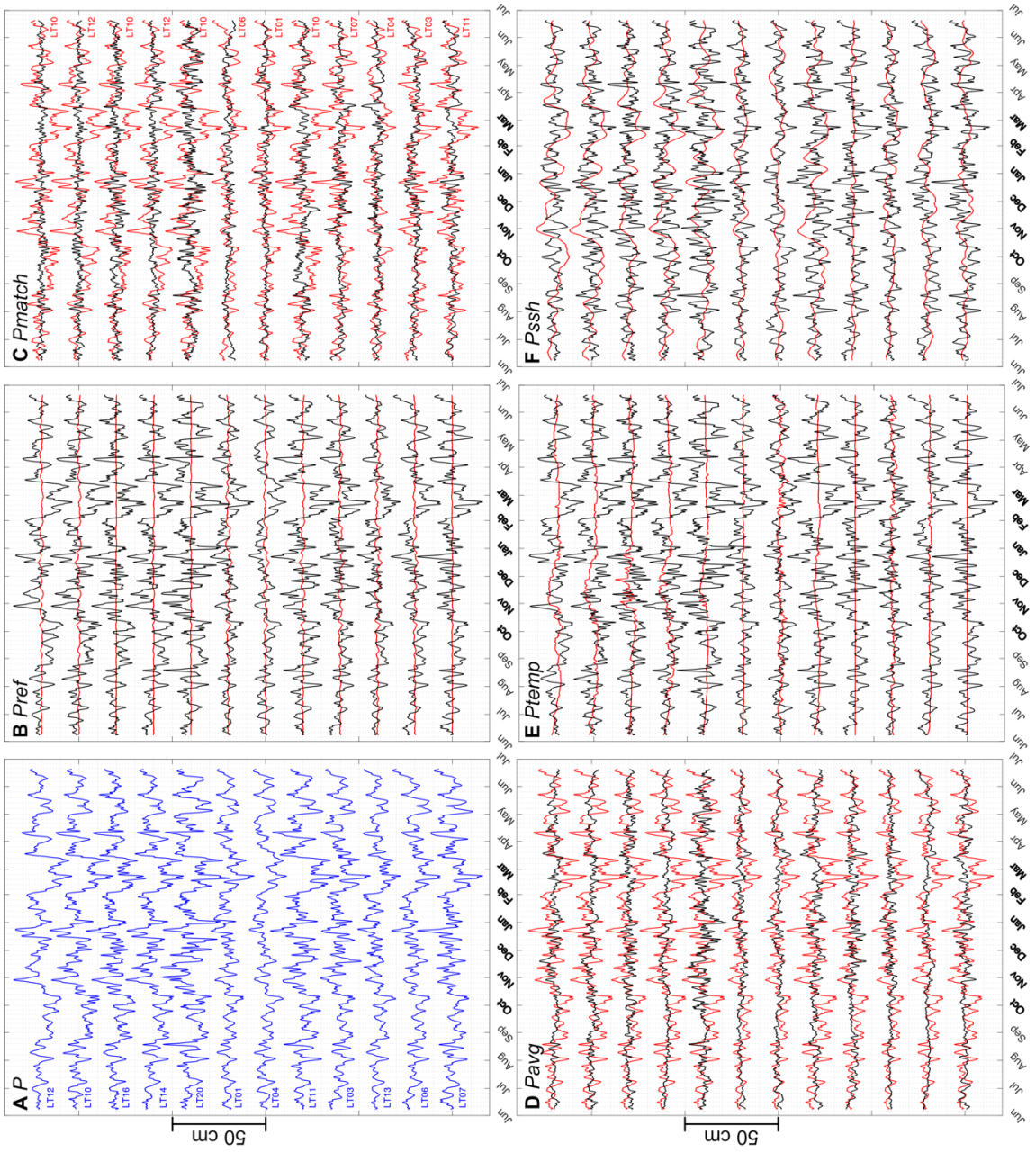

Figure S2. Time series of tidally filtered, drift and sinusoidal-corrected shelf pressure data (blue), scaled proxies (red), and proxy-corrected data (black), vertically offset with shallowest station at the top for display purposes. Winter months, when signals are anomalously large across observables, are labeled in bold. A) No proxy. B) Scaled reference station pressure (P_{ref}). C) Scaled depth-matched pressure (P_{match}), with matched station labeled in red text. D) Scaled network average pressure (P_{avg}). E) Scaled temperatures, lagged to maximize correlation (P_{temp}). F) Scaled sea surface height (P_{SSH}).

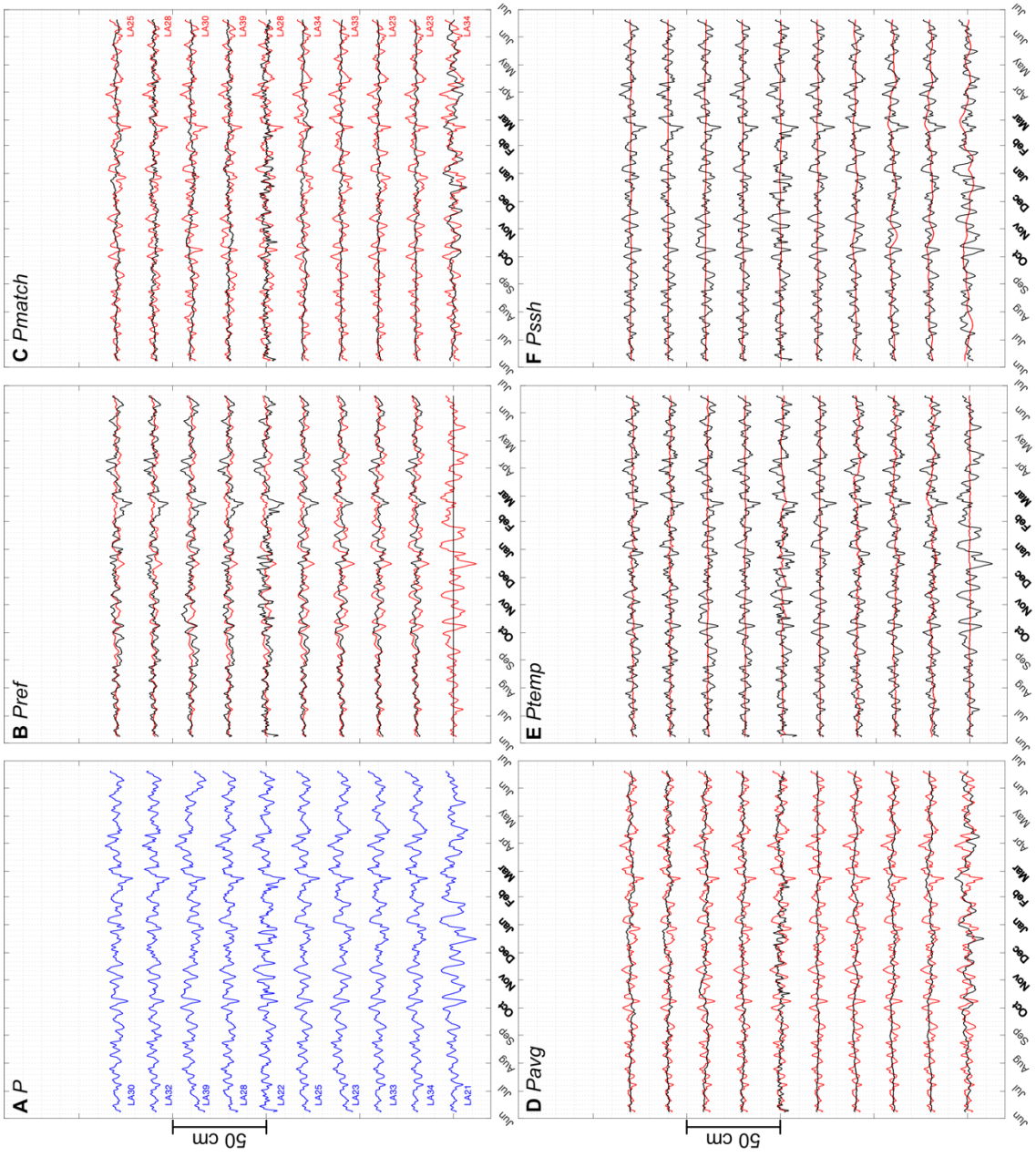

Figure S3. Time series of tidally filtered, drift and sinusoidal-corrected slope pressure data (blue), scaled proxies (red), and proxy-corrected data (black), vertically offset with shallowest station at the top for display purposes. Winter months, when signals are anomalously large across observables, are labeled in bold. A) No proxy. B) Scaled reference station pressure (P_{ref}). C) Scaled depth-matched pressure (P_{match}), with matched station labeled in red text. D) Scaled network average pressure (P_{avg}). E) Scaled temperatures, lagged to maximize correlation (P_{temp}). F) Scaled sea surface height (P_{SSH}).

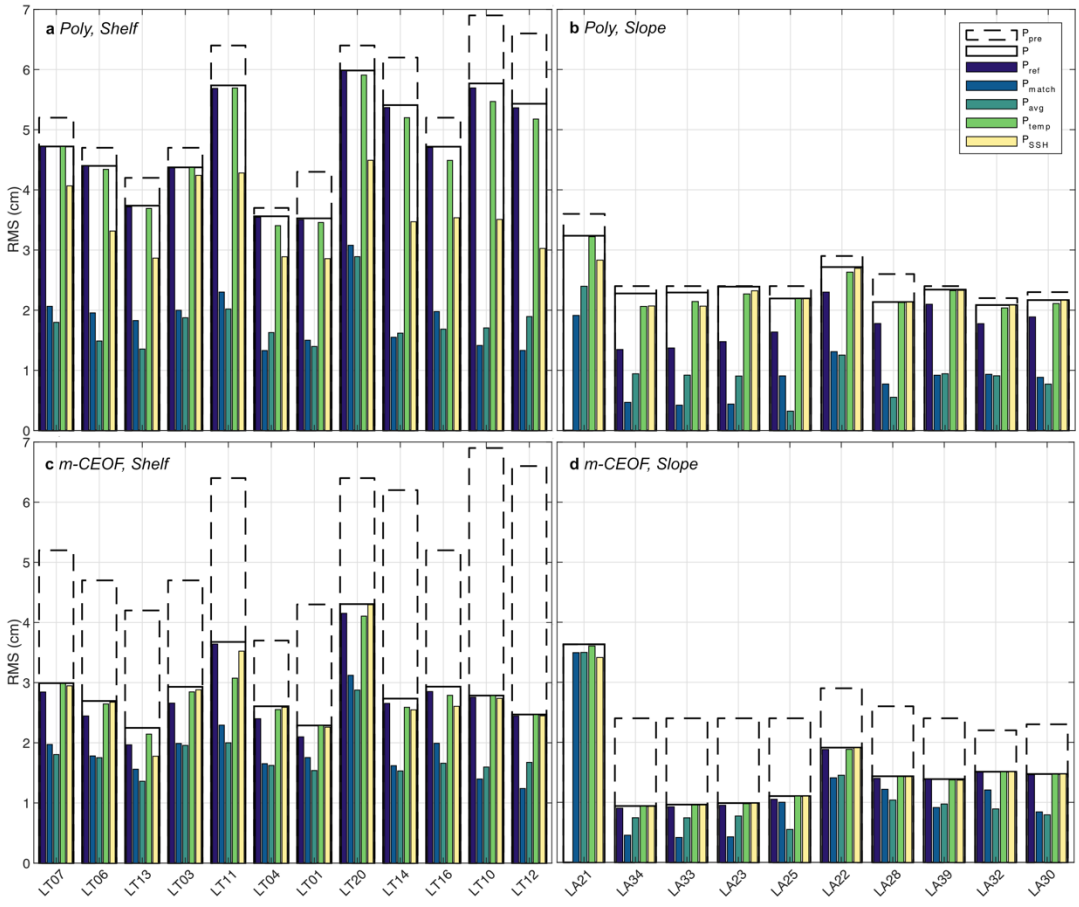

Figure S4. Proxy-corrected pressure RMS improvements for A) polynomially corrected shelf data, B) polynomially corrected slope data, C) multivariate-CEOF (m-CEOF) corrected shelf data, and D) multivariate-CEOF corrected slope data. The empty, black-outlined bars in the background show the RMS of the seasonally corrected pressure record prior to applying any proxy, while the thin colored bars show the RMS of each proxy corrected time series.

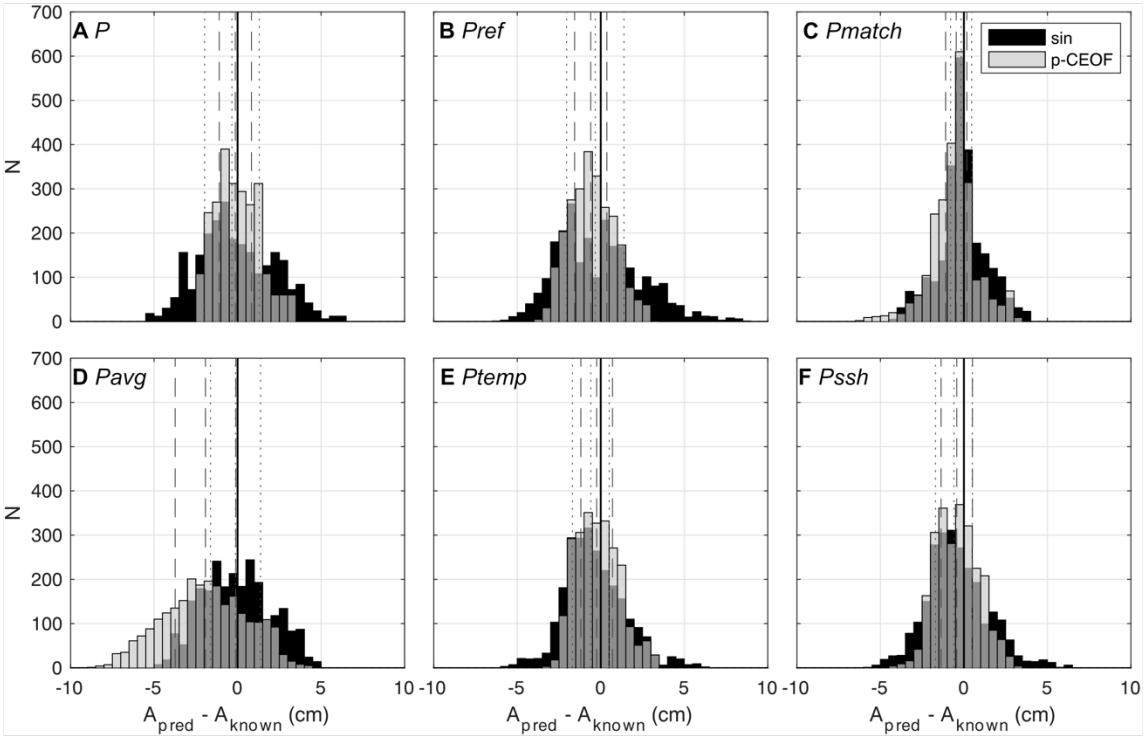

Figure S5. Amplitude recovery from synthetic detection analysis on the continental slope, when known onset time is assumed, sinusoidal (black), and pressure-CEOF (p-CEOF, translucent gray) seasonal corrections, for each of the proxies considered. The results from all synthetic ramp amplitude considered (0, 2, 4, 6, 8, and 10 cm) were combined, with ramp duration held at 14 days and onset times varied weekly from August 2018 through April 2019. A) No proxy. B) P_{ref}. C) P_{match}, D) P_{avg}. E) P_{temp}. F) P_{SSH}. Vertical solid lines show the input synthetic amplitude, vertical dotted lines show the median and ±MAD for the sinusoidal case, and vertical dashed lines show the same for the pressure-CEOF case.

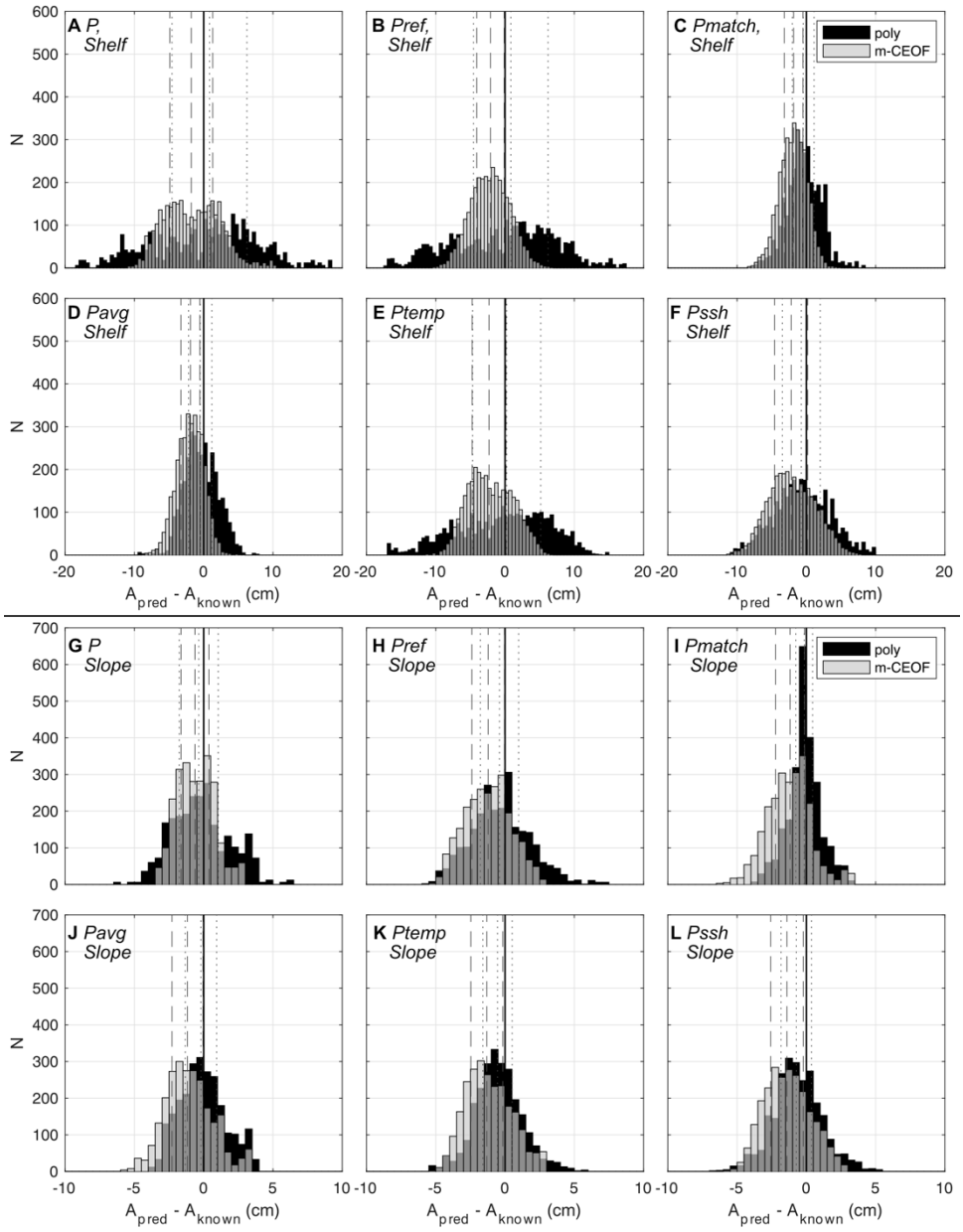

Figure S6. Amplitude recovery from synthetic detection analysis, when known onset time is assumed, for polynomial (black) and multivariate-CEOF (m-CEOF, translucent gray) seasonal corrections, for each of the proxies considered. A-F) Shelf amplitude predictions for no proxy, P_{ref}, P_{match}, P_{avg}, P_{temp}, and P_{SSH}, respectively. G-L) Slope amplitude predictions for no proxy, P_{ref}, P_{match}, P_{avg}, P_{temp}, and P_{SSH}, respectively. The results from all synthetic ramp amplitude considered (0, 2, 4, 6, 8, and 10 cm) were combined, with ramp duration held at 14 days and onset times varied weekly from August 2018 through April 2019. Vertical solid lines show the input synthetic amplitude, vertical dotted lines show the median and ±MAD for the polynomial case, and vertical dashed lines show the same for the multivariate-CEOF case.

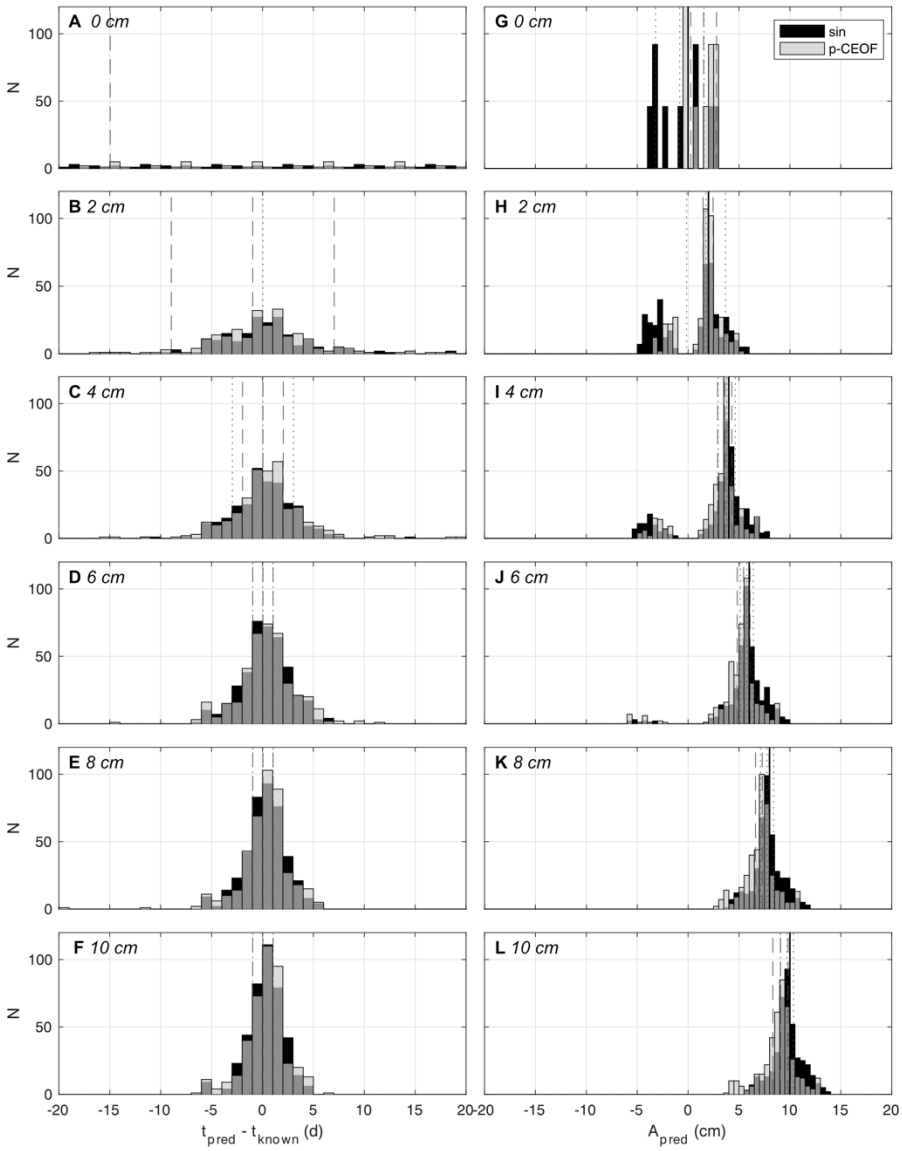

Figure S7. Histograms displaying SSE onset and amplitude prediction results from synthetic detection analysis on the slope, when unknown onset time is assumed, for sinusoidal (black) and pressure-CEOF (p-CEOF, translucent gray) seasonal corrections, using only our best-preforming proxy, P_{match}. Synthetic ramp duration was held constant at 14 days and onset times were varied weekly from August 2018 through April 2019 to generate the composite distributions shown. A-F) Timing recovery for synthetic ramps of 0, 2, 4, 6, 7, and 10 cm amplitude. Vertical dotted lines show the median and ±MAD for the sinusoidal case, while vertical dashed lines show the same for the pressure-CEOF case. G-L) Amplitude recovery for synthetic ramps of 0, 2, 4, 6, 8, and 10 cm amplitude. Vertical solid lines show the input synthetic amplitude, vertical dotted lines show the median and ±MAD, for the sinusoidal case, and vertical dashed lines show the same for the pressure-CEOF case.

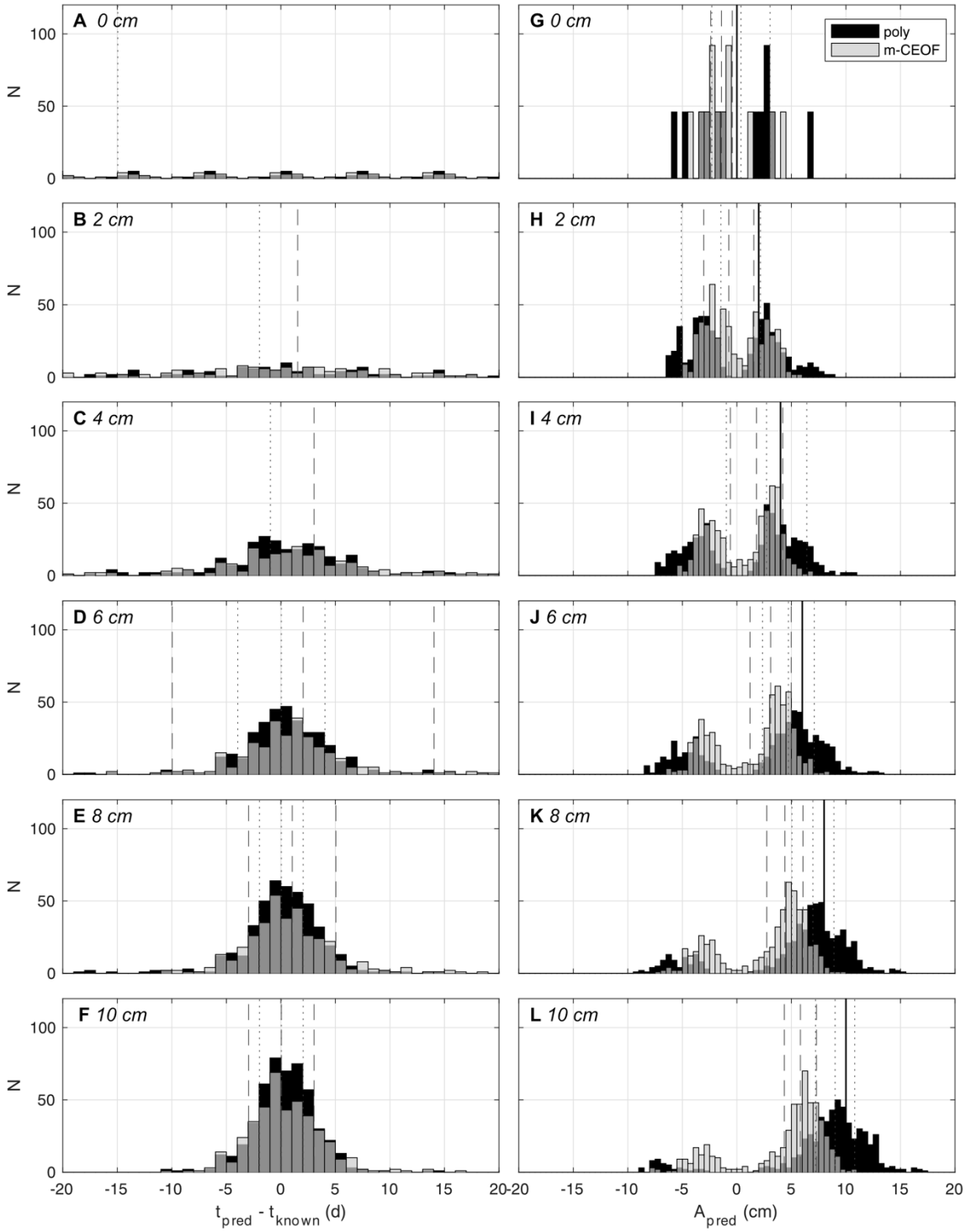

Figure S8. As in Figure S7, but on the shelf for polynomial and multivariate-CEOF (m-CEOF) seasonal corrections.

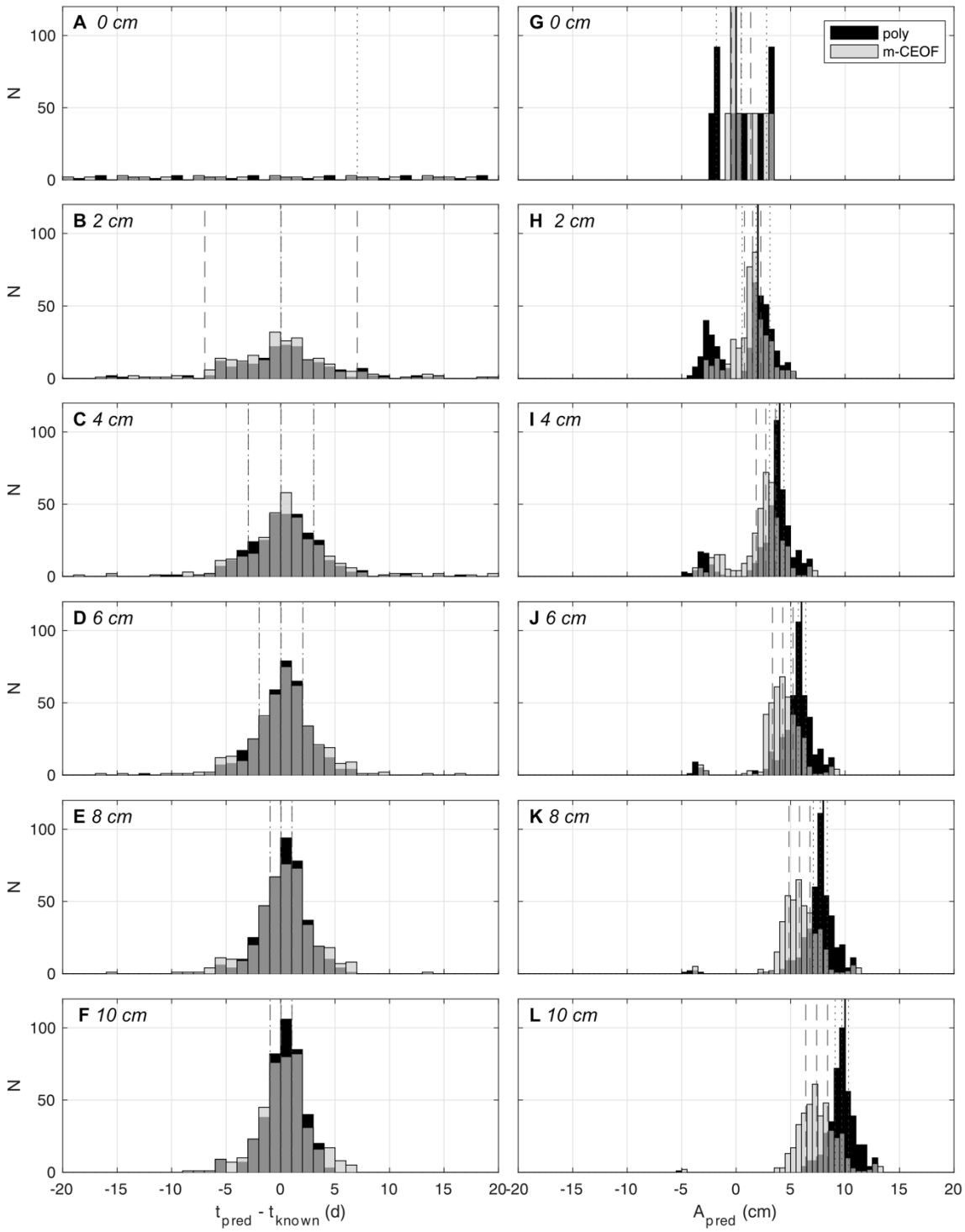

Figure S9. As in Figure S8, but on the slope.

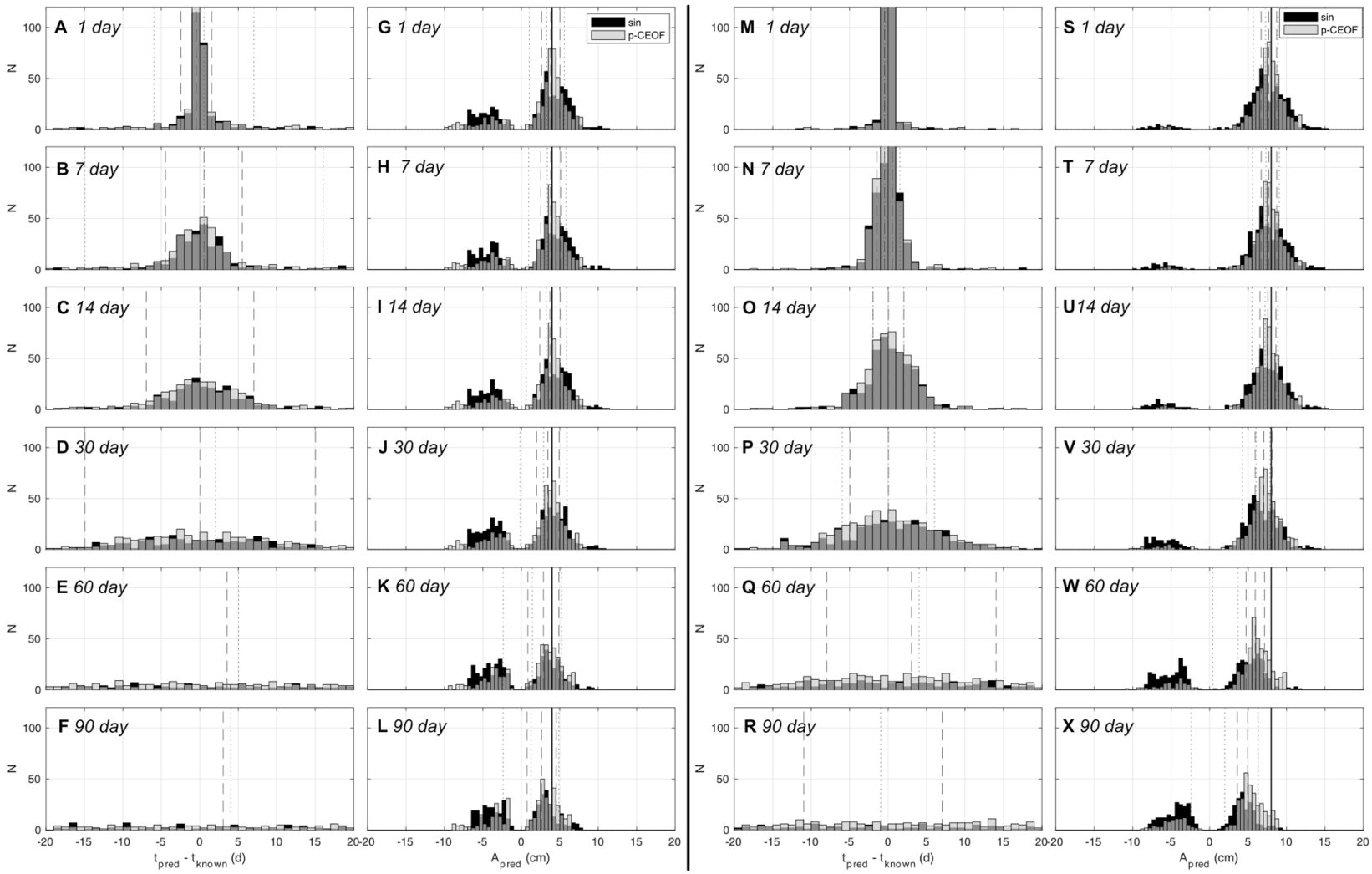
A 1 day
B 7 day
C 14 day
D 30 day
E 60 day
F 90 day
G 1 day
H 7 day
I 14 day
J 30 day
K 60 day
L 90 day
M 1 day
N 7 day
O 14 day
P 30 day
Q 60 day
R 90 day
S 1 day
T 7 day
U14 day
V 30 day
W 60 day
X 90 day
sin
p-CEOF
N
t_pred - t_known (d)
A_pred (cm)

Figure S10. Histograms displaying SSE onset and amplitude prediction results as a function of input ramp duration from synthetic detection analysis on the shelf, when unknown onset time is assumed, for sinusoidal (black) and pressure-CEOF (p-CEOF, translucent gray) seasonal corrections, using only our best-preforming proxy, P_{match}. A-F) Timing recovery for synthetic ramps of 1, 7, 14, 30, 60, and 90 day duration with amplitude held constant at 8 cm and onset times were varied weekly from August 2018 through April 2019. Vertical dotted lines show the median and ±MAD for the sinusoidal case, while vertical dashed lines show the same for the pressure-CEOF case. G-L) Amplitude recovery for the same suite of synthetics. Vertical solid lines show the input synthetic amplitude, vertical dotted lines show the median and ±MAD for the sinusoidal case, and vertical dashed lines show the same for the pressure-CEOF case. M-R) As for (A-F) but with amplitude held constant at 4 cm. S-X) Amplitude recovery for the same suite of synthetics.

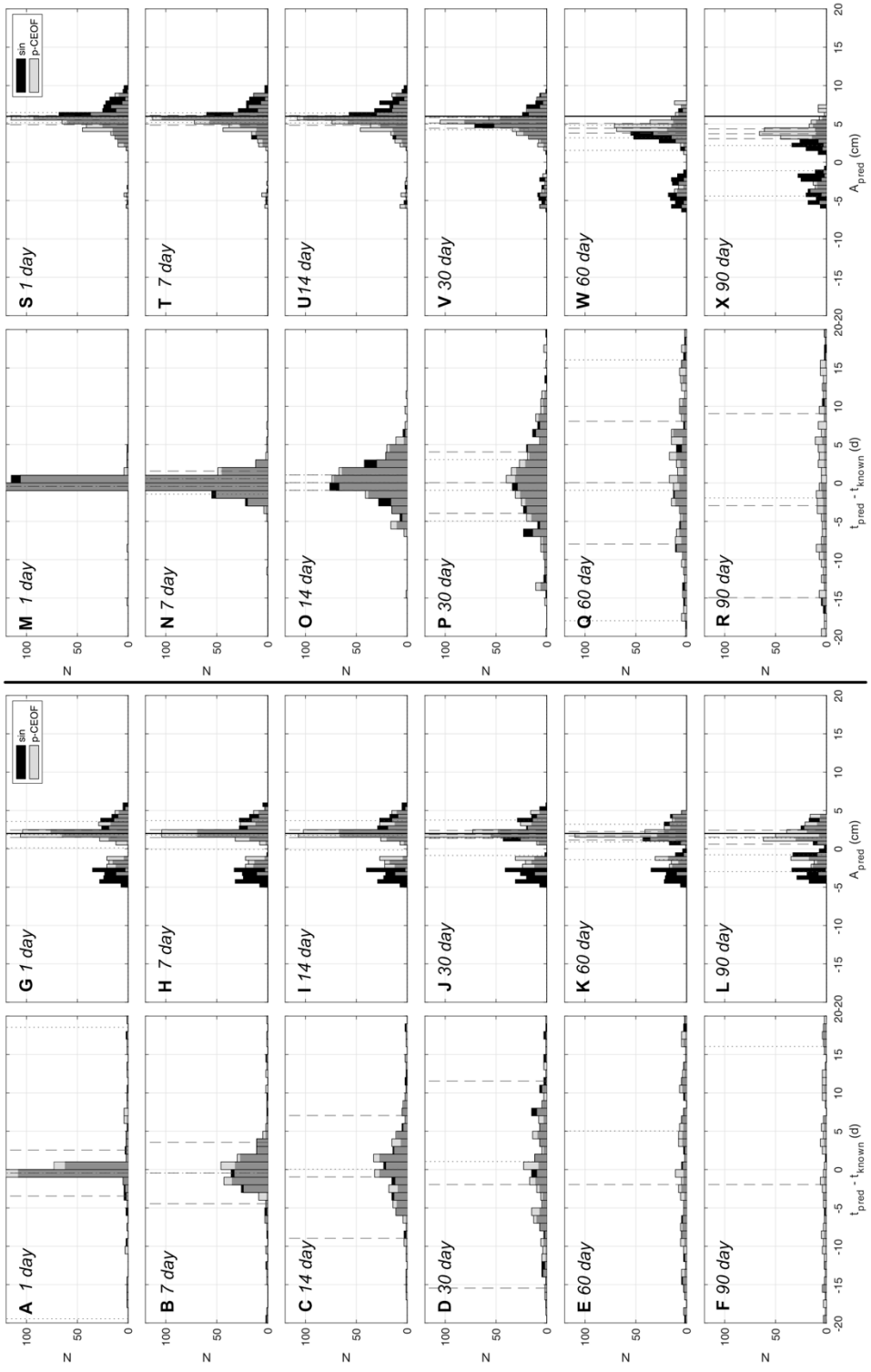

Figure S11. As for Figure S10, but for slope detections.

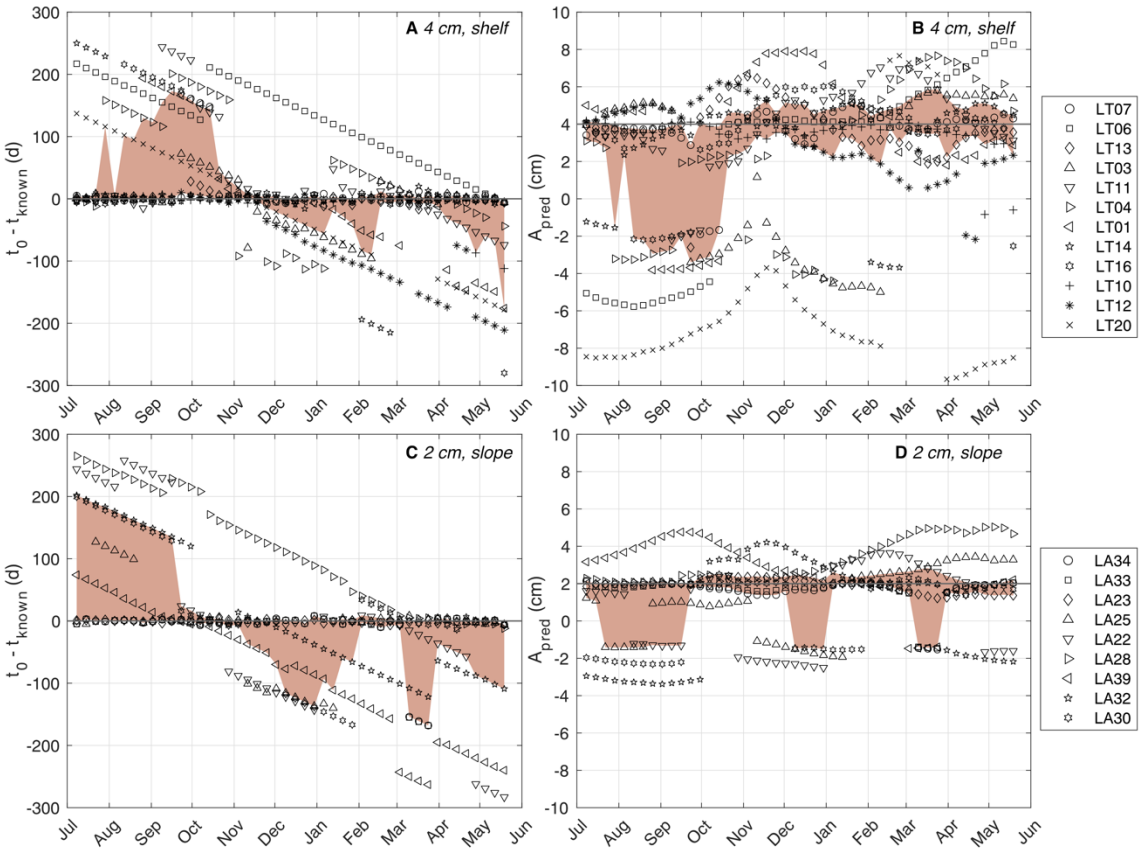

Figure S12. Scatter plots showing onset and amplitude prediction accuracy from pressure-CEOF corrected data with P_{match} applied. A) Timing prediction accuracy and B) amplitude prediction accuracy as a function of onset time for a 4 cm, 14-day ramp on the shelf. Pink infilled region contains the middle 50% (6/12 stations) of the detections for each synthetic onset considered. C) Timing prediction accuracy and D) amplitude prediction accuracy as a function of onset time for a 2 cm, 14-day ramp on the slope. Pink infilled region contains the middle 55% (5/9 stations) of the detections for each synthetic onset considered. Black horizontal lines indicate the known synthetic onset time and ramp amplitude, respectively. Symbols correspond to stations, as indicated in the legend, using the same shapes as in Figure 5.

Table S1. Shelf station parameters and RMS of difference for every possible pair.

Name	Depth (m)	Depth Dif (m)	Range (km)	RMS (cm)	Dif RMS (cm)
LT07	**262**	**–**	**–**	**4.5**	**–**
LT06	225	37	51.1	4.1	2.1
LT13	203	59	246.3	3.5	2.6
LT03	202	60	177.4	4.2	2.1
LT11	162	100	96.7	5.6	2.0
LT04	157	105	120.4	3.5	2.9
LT01	156	106	219.7	3.3	2.7
LT20	150	112	389.1	5.8	2.9
LT14	125	137	160.1	5.0	2.4
LT16	125	137	202.2	4.5	2.6
LT10	98	164	138.2	5.4	2.5
LT12	83	179	192.8	5.0	2.7
LT07	262	-37	51.1	4.5	1.9
LT06	**225**	**–**	**–**	**4.1**	**–**
LT13	203	22	212.5	3.5	2.0
LT03	202	23	214.3	4.2	1.9
LT11	162	63	83.5	5.6	2.4
LT04	157	68	96.9	3.5	2.1
LT01	156	69	222.1	3.3	2.0
LT20	150	75	373.3	5.8	2.7
LT14	125	100	138.9	5.0	2.3
LT16	125	100	181.4	4.5	2.3
LT10	98	127	105.7	5.4	2.4
LT12	83	142	158.2	5.0	2.5
LT07	262	-59	246.3	4.5	2.0
LT06	225	-22	212.5	4.1	1.7
LT13	**203**	**–**	**–**	**3.5**	**–**
LT03	202	1	423.3	4.2	2.2
LT11	162	41	155.6	5.6	2.0
LT04	157	46	283.4	3.5	1.7
LT01	156	47	422.4	3.3	1.8
LT20	150	53	194.0	5.8	2.3
LT14	125	78	97.3	5.0	1.8
LT16	125	78	73.8	4.5	1.8
LT10	98	105	108.4	5.4	1.8
LT12	83	120	54.3	5.0	1.8
LT07	262	-60	177.4	4.5	2.0
LT06	225	-23	214.3	4.1	2.0
LT13	203	-1	423.3	3.5	2.6
LT03	**202**	**–**	**–**	**4.2**	**–**
LT11	162	40	273.0	5.6	2.5
LT04	157	45	195.9	3.5	2.4
LT01	156	46	156.4	3.3	2.1
LT20	150	52	559.6	5.8	2.6
LT14	125	77	336.7	5.0	2.6
LT16	125	77	378.2	4.5	2.7
LT10	98	104	314.9	5.4	2.6
LT12	83	119	369.4	5.0	2.8
LT07	262	-100	96.7	4.5	2.5
LT06	225	-63	83.5	4.1	3.2
LT13	203	-41	155.6	3.5	3.2
LT03	202	-40	273.0	4.2	3.3
LT11	**162**	**–**	**–**	**5.6**	**–**
LT04	157	5	179.2	3.5	3.6
LT01	156	6	304.6	3.3	3.4
LT20	150	12	293.9	5.8	3.0
LT14	125	37	63.7	5.0	2.5
LT16	125	37	105.6	4.5	2.8
LT10	98	64	55.1	5.4	2.2
LT12	83	79	105.3	5.0	2.6
LT07	262	-105	120.4	4.5	2.3
LT06	225	-68	96.9	4.1	1.8
LT13	203	-46	283.4	3.5	1.7
LT03	202	-45	195.9	4.2	2.0
LT11	162	-5	179.2	5.6	2.3
LT04	**157**	**–**	**–**	**3.5**	**–**
LT01	156	1	139.3	3.3	1.3
LT20	150	7	460.4	5.8	2.5
LT14	125	32	228.1	5.0	2.2
LT16	125	32	268.7	4.5	2.2
LT10	98	59	187.7	5.4	2.1
LT12	83	74	232.0	5.0	2.1

Name	Depth (m)	Depth Dif (m)	Range (km)	RMS (cm)	Dif RMS (cm)
LT07	262	-106	219.7	4.5	2.0
LT06	225	-69	222.1	4.1	1.6
LT13	203	-47	422.4	3.5	1.7
LT03	202	-46	156.4	4.2	1.7
LT11	162	-6	304.6	5.6	2.1
LT04	157	-1	139.3	3.5	1.3
LT01	**156**	**–**	**–**	**3.3**	**–**
LT20	150	6	594.9	5.8	2.3
LT14	125	31	360.6	5.0	2.1
LT16	125	31	402.6	4.5	1.9
LT10	98	58	323.3	5.4	2.0
LT12	83	73	370.3	5.0	2.1
LT07	262	-112	389.1	4.5	3.7
LT06	225	-75	373.3	4.1	3.9
LT13	203	-53	194.0	3.5	3.9
LT03	202	-52	559.6	4.2	3.7
LT11	162	-12	293.9	5.6	3.1
LT04	157	-7	460.4	3.5	4.2
LT01	156	-6	594.9	3.3	4.0
LT20	**150**	**–**	**–**	**5.8**	**–**
LT14	125	25	234.4	5.0	3.1
LT16	125	25	192.3	4.5	3.4
LT10	98	52	272.7	5.4	3.0
LT12	83	67	233.8	5.0	3.4
LT07	262	-137	160.1	4.5	2.7
LT06	225	-100	138.9	4.1	2.8
LT13	203	-78	97.3	3.5	2.6
LT03	202	-77	336.7	4.2	3.1
LT11	162	-37	63.7	5.6	2.3
LT04	157	-32	228.1	3.5	3.2
LT01	156	-31	360.6	3.3	3.1
LT20	150	-25	234.4	5.8	2.7
LT14	**125**	**–**	**–**	**5.0**	**–**
LT16	125	0	42.7	4.5	2.0
LT10	98	27	45.0	5.4	1.5
LT12	83	42	57.1	5.0	1.6
LT07	262	-137	202.2	4.5	2.6
LT06	225	-100	181.4	4.1	2.6
LT13	203	-78	73.8	3.5	2.4
LT03	202	-77	378.2	4.2	2.9
LT11	162	-37	105.6	5.6	2.2
LT04	157	-32	268.7	3.5	2.9
LT01	156	-31	402.6	3.3	2.6
LT20	150	-25	192.3	5.8	2.7
LT14	125	0	42.7	5.0	1.8
LT16	**125**	**–**	**–**	**4.5**	**–**
LT10	98	27	81.6	5.4	2.0
LT12	83	42	60.9	5.0	2.1
LT07	262	-164	138.2	4.5	3.0
LT06	225	-127	105.7	4.1	3.2
LT13	203	-105	108.4	3.5	2.8
LT03	202	-104	314.9	4.2	3.4
LT11	162	-64	55.1	5.6	2.2
LT04	157	-59	187.7	3.5	3.3
LT01	156	-58	323.3	3.3	3.3
LT20	150	-52	272.7	5.8	2.8
LT14	125	-27	45.0	5.0	1.6
LT16	125	-27	81.6	4.5	2.4
LT10	**98**	**–**	**–**	**5.4**	**–**
LT12	83	15	54.6	5.0	1.4
LT07	262	-179	192.8	4.5	3.1
LT06	225	-142	158.2	4.1	3.1
LT13	203	-120	54.3	3.5	2.5
LT03	202	-119	369.4	4.2	3.4
LT11	162	-79	105.3	5.6	2.4
LT04	157	-74	232.0	3.5	3.1
LT01	156	-73	370.3	3.3	3.2
LT20	150	-67	233.8	5.8	2.9
LT14	125	-42	57.1	5.0	1.6
LT16	125	-42	60.9	4.5	2.3
LT10	98	-15	54.6	5.4	1.3
LT12	**83**	**–**	**–**	**5.0**	**–**

Note. The bolded row for each set indicates the station of interest, against which all others are differenced. The shaded row in each set indicates the choice of P_{match} for the bolded station used in this study (See Methods section 3.3, Proxies for oceanographic pressure, P_O*). Pressure records were de-tided, de-drifted, and corrected with a sinusoidal seasonal correction prior to differencing.*

Table S2. Slope station parameters and RMS of difference for every possible pair.

Name	Depth (m)	Depth Dif (m)	Range (km)	RMS (cm)	Dif RMS (cm)
LA21	**5113**	–	–	**3.2**	–
LA34	4612	501	231.4	2.3	1.9
LA33	4478	635	198.9	2.3	2.0
LA23	3977	1136	61.8	2.4	2.0
LA25	2622	2491	80.4	2.2	2.4
LA22	2130	2983	98.9	2.7	2.7
LA28	1852	3261	114.7	2.1	2.6
LA39	1628	3485	378.7	2.3	2.8
LA32	1595	3518	180.3	2.1	2.7
LA30	1564	3549	155.2	2.2	2.8
LA21	5113	-501	231.4	3.2	1.4
LA34	**4612**	–	–	**2.3**	–
LA33	4478	134	33.1	2.3	0.1
LA23	3977	635	237.1	2.4	0.5
LA25	2622	1990	195.2	2.2	1.0
LA22	2130	2482	258.8	2.7	1.6
LA28	1852	2760	159.5	2.1	1.4
LA39	1628	2984	572.5	2.3	1.5
LA32	1595	3017	69.5	2.1	1.6
LA30	1564	3048	102.9	2.2	1.6
LA21	5113	-635	198.9	3.2	1.4
LA34	4612	-134	33.1	2.3	0.1
LA33	**4478**	–	–	**2.3**	–
LA23	3977	501	204.1	2.4	0.4
LA25	2622	1856	162.5	2.2	1.0
LA22	2130	2348	226.4	2.7	1.6
LA28	1852	2626	128.0	2.1	1.4
LA39	1628	2850	540.6	2.3	1.5
LA32	1595	2883	42.0	2.1	1.6
LA30	1564	2914	73.2	2.2	1.6
LA21	5113	-1136	61.8	3.2	1.5
LA34	4612	-635	237.1	2.3	0.5
LA33	4478	-501	204.1	2.3	0.4
LA23	**3977**	–	–	**2.4**	–
LA25	2622	1355	45.1	2.2	0.9
LA22	2130	1847	38.3	2.7	1.6
LA28	1852	2125	87.3	2.1	1.4
LA39	1628	2349	342.8	2.3	1.5
LA32	1595	2382	174.3	2.1	1.6
LA30	1564	2413	142.5	2.2	1.6
LA21	5113	-2491	80.4	3.2	1.6
LA34	4612	-1990	195.2	2.3	0.9
LA33	4478	-1856	162.5	2.3	0.9
LA23	3977	-1355	45.1	2.4	0.8
LA25	**2622**	–	–	**2.2**	–
LA22	2130	492	64.7	2.7	1.1
LA28	1852	770	42.4	2.1	0.7
LA39	1628	994	379.3	2.3	0.9
LA32	1595	1027	130.3	2.1	1.1
LA30	1564	1058	97.9	2.2	0.9

Name	Depth (m)	Depth Dif (m)	Range (km)	RMS (cm)	Dif RMS (cm)
LA21	5113	-2983	98.9	3.2	2.3
LA34	4612	-2482	258.8	2.3	1.9
LA33	4478	-2348	226.4	2.3	1.9
LA23	3977	-1847	38.3	2.4	1.8
LA25	2622	-492	64.7	2.2	1.4
LA22	**2130**	–	–	**2.7**	–
LA28	1852	278	100.6	2.1	1.3
LA39	1628	502	314.7	2.3	1.5
LA32	1595	535	192.2	2.1	1.5
LA30	1564	566	158.7	2.2	1.3
LA21	5113	-3261	114.7	3.2	1.7
LA34	4612	-2760	159.5	2.3	1.3
LA33	4478	-2626	128.0	2.3	1.3
LA23	3977	-2125	87.3	2.4	1.2
LA25	2622	-770	42.4	2.2	0.7
LA22	2130	-278	100.6	2.7	1.1
LA28	**1852**	–	–	**2.1**	–
LA39	1628	224	413.0	2.3	0.8
LA32	1595	257	91.8	2.1	0.9
LA30	1564	288	58.1	2.2	0.6
LA21	5113	-3485	378.7	3.2	2.1
LA34	4612	-2984	572.5	2.3	1.6
LA33	4478	-2850	540.6	2.3	1.5
LA23	3977	-2349	342.8	2.4	1.5
LA25	2622	-994	379.3	2.2	1.0
LA22	2130	-502	314.7	2.7	1.3
LA28	1852	-224	413.0	2.1	0.9
LA39	**1628**	–	–	**2.3**	–
LA32	1595	33	504.3	2.1	1.3
LA30	1564	64	470.4	2.2	0.9
LA21	5113	-3518	180.3	3.2	1.8
LA34	4612	-3017	69.5	2.3	1.5
LA33	4478	-2883	42.0	2.3	1.4
LA23	3977	-2382	174.3	2.4	1.4
LA25	2622	-1027	130.3	2.2	1.0
LA22	2130	-535	192.2	2.7	1.2
LA28	1852	-257	91.8	2.1	0.9
LA39	1628	-33	504.3	2.3	1.2
LA32	**1595**	–	–	**2.1**	–
LA30	1564	31	33.9	2.2	0.8
LA21	5113	-3549	155.2	3.2	1.9
LA34	4612	-3048	102.9	2.3	1.5
LA33	4478	-2914	73.2	2.3	1.5
LA23	3977	-2413	142.5	2.4	1.4
LA25	2622	-1058	97.9	2.2	0.9
LA22	2130	-566	158.7	2.7	1.1
LA28	1852	-288	58.1	2.1	0.7
LA39	1628	-64	470.4	2.3	0.9
LA32	1595	-31	33.9	2.1	0.8
LA30	**1564**	–	–	**2.2**	**0.0**

Note. As for Table S1, but for slope stations. The lone abyss station, LA21, is included for the sake of comparison.

Table S3. Pressure RMS and RMS reduction after sinusoidal and proxy corrections.

		Tides + Drift	Seasonal		Pref			Pmatch			Pavg			Ptemp			Psh		
	Depth (m)	RMS (cm)	RMS (cm)	Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)
LA21	5113	3.6	3.2	12%	0.0	100%	100%	1.9	39%	46%	2.4	26%	35%	3.2	0%	12%	2.8	12%	23%
LA34	4612	2.4	2.3	3%	1.4	39%	41%	0.5	79%	80%	1.0	58%	59%	2.1	9%	12%	2.1	9%	12%
LA33	4478	2.4	2.3	3%	1.4	38%	40%	0.4	81%	82%	0.9	59%	60%	2.2	6%	9%	2.1	10%	13%
LA23	3977	2.4	2.4	2%	1.5	37%	38%	0.4	81%	82%	0.9	61%	62%	2.3	5%	7%	2.3	3%	5%
LA25	2622	2.4	2.2	11%	1.6	26%	34%	0.9	57%	61%	0.3	84%	86%	2.2	0%	11%	2.2	1%	11%
LA22	2130	2.9	2.7	8%	2.3	14%	21%	1.3	50%	54%	1.2	54%	57%	2.6	3%	11%	2.7	0%	8%
LA28	1852	2.6	2.1	17%	1.7	17%	32%	0.8	63%	69%	0.6	72%	77%	2.1	0%	17%	2.1	0%	17%
LA39	1628	2.4	2.3	2%	2.1	11%	13%	0.9	60%	61%	0.9	60%	61%	2.3	1%	3%	2.3	0%	2%
LA32	1595	2.2	2.1	3%	1.8	16%	18%	0.9	56%	57%	0.9	57%	59%	2.0	2%	5%	2.1	0%	3%
LA30	1564	2.3	2.2	6%	1.9	13%	19%	0.9	59%	62%	0.8	64%	66%	2.1	3%	9%	2.1	1%	7%
Minimum		2.2	2.1	2%	1.4	11%	13%	0.4	50%	54%	0.3	54%	57%	2.0	0%	3%	2.1	0%	2%
Maximum		3.6	3.2	17%	2.3	39%	41%	1.3	81%	82%	1.2	84%	86%	2.6	9%	17%	2.7	10%	17%
Median		2.4	2.3	3%	1.7	17%	32%	0.9	60%	62%	0.9	60%	61%	2.2	3%	9%	2.1	1%	8%
LT07	262	5.2	4.5	13%	4.5	0%	13%	2.0	55%	60%	1.8	60%	65%	4.5	0%	13%	4.1	10%	21%
LT06	225	4.7	4.1	13%	4.1	1%	14%	1.9	53%	59%	1.6	62%	67%	4.1	1%	14%	3.5	14%	26%
LT13	203	4.2	3.5	17%	3.4	2%	18%	1.7	51%	59%	1.3	62%	68%	3.4	2%	19%	2.9	18%	32%
LT03	202	4.7	4.2	11%	4.1	1%	12%	2.0	53%	58%	1.8	56%	60%	4.2	0%	11%	4.1	1%	12%
LT11	162	6.4	5.6	13%	5.5	0%	13%	2.2	60%	65%	2.0	64%	69%	5.5	1%	14%	4.2	24%	34%
LT04	157	3.7	3.5	6%	3.4	1%	7%	1.3	62%	64%	1.6	54%	57%	3.3	6%	11%	2.9	16%	21%
LT01	156	4.3	3.3	22%	3.3	2%	23%	1.6	52%	62%	1.4	58%	67%	3.3	0%	22%	2.8	15%	34%
LT20	150	6.4	5.8	8%	5.8	0%	8%	3.0	49%	53%	2.8	51%	55%	5.8	1%	9%	4.4	24%	30%
LT14	125	6.2	5.0	19%	5.0	0%	19%	1.6	68%	74%	1.6	68%	74%	4.7	6%	23%	3.6	28%	41%
LT16	125	5.2	4.5	14%	4.5	0%	14%	2.0	56%	62%	1.7	63%	68%	4.3	5%	18%	3.5	22%	33%
LT10	98	6.9	5.4	22%	5.4	1%	22%	1.4	74%	79%	1.7	68%	75%	5.1	5%	25%	3.5	35%	49%
LT12	83	6.6	5.0	24%	5.0	0%	25%	1.3	74%	80%	1.9	63%	72%	4.7	5%	28%	3.0	40%	54%
Minimum		3.7	3.3	6%	3.3	0%	7%	1.3	49%	53%	1.3	51%	55%	3.3	0%	9%	2.8	1%	12%
Maximum		6.9	5.8	24%	5.8	2%	25%	3.0	74%	80%	2.8	68%	75%	5.8	6%	28%	4.4	40%	54%
Median		5.2	4.5	14%	4.5	0%	14%	1.8	55%	62%	1.7	62%	68%	4.4	2%	16%	3.5	20%	32%

Note. For each station, RMS and RMS reduction are summarized after correction with a sinusoidal seasonal fit and each proxy considered in this study. For the proxy corrections, 'Net Reduction' indicates the RMS reduction relative to the detided and de-drifted input signal. The lone abyss station, LA21 (highlighted in gray), is included for comparison but is excluded from the minimum, maximum, and median calculations.

Table S4. Pressure RMS and RMS reduction after pressure-CEOF and proxy corrections.

	Depth (m)	Tides + Drift	Seasonal		Pref			Pmatch			Pavg			Ptemp			Pssh		
		RMS (cm)	RMS (cm)	Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)	RMS (cm)	Reduction (%)	Net Reduction (%)
LA21	5113	3.6	3.6	0%	0.0	100%	100%	3.5	4%	4%	3.5	3%	3%	3.6	1%	1%	3.5	5%	5%
LA34	4612	2.4	1.0	59%	0.9	4%	61%	0.5	51%	80%	1.0	1%	60%	1.0	0%	59%	0.8	19%	67%
LA33	4478	2.4	0.9	60%	0.9	4%	62%	0.4	55%	82%	0.9	1%	60%	0.9	1%	61%	0.8	13%	66%
LA23	3977	2.4	1.0	61%	0.9	3%	62%	0.4	55%	83%	0.9	2%	61%	0.9	1%	61%	0.9	1%	61%
LA25	2622	2.4	0.5	80%	0.5	3%	81%	0.5	0%	80%	0.2	62%	93%	0.5	1%	80%	0.5	0%	80%
LA22	2130	2.9	1.4	53%	1.4	0%	53%	1.3	4%	55%	1.4	0%	53%	1.3	4%	54%	1.4	1%	53%
LA28	1852	2.6	0.9	63%	0.9	0%	63%	0.9	0%	63%	0.8	18%	70%	0.9	1%	64%	0.9	6%	65%
LA39	1628	2.4	1.0	58%	0.9	8%	61%	0.9	6%	60%	0.9	6%	60%	1.0	0%	58%	1.0	0%	58%
LA32	1595	2.2	1.0	56%	0.9	3%	57%	1.0	0%	56%	0.9	3%	57%	0.9	1%	56%	1.0	0%	56%
LA30	1564	2.3	0.8	66%	0.8	4%	67%	0.8	0%	66%	0.8	1%	66%	0.8	1%	66%	0.8	0%	66%
Minimum		2.2	0.5	53%	0.5	0%	53%	0.4	0%	55%	0.2	0%	53%	0.5	0%	54%	0.5	0%	53%
Maximum		3.6	3.6	80%	1.4	8%	81%	1.3	55%	83%	1.4	62%	93%	1.3	4%	80%	1.4	19%	80%
Median		2.4	1.0	60%	0.9	3%	62%	0.8	4%	66%	0.9	2%	60%	0.9	1%	61%	0.9	1%	65%
LT07	262	5.2	1.7	67%	1.7	0%	67%	1.7	3%	68%	1.7	1%	67%	1.7	3%	68%	1.7	0%	67%
LT06	225	4.7	1.7	64%	1.7	2%	65%	1.6	8%	67%	1.5	10%	68%	1.7	1%	64%	1.6	7%	66%
LT13	203	4.2	1.4	68%	1.3	4%	69%	1.3	2%	69%	1.4	0%	68%	1.3	4%	69%	1.3	0%	68%
LT03	202	4.7	1.9	59%	1.9	4%	60%	1.8	5%	61%	1.6	18%	66%	1.9	0%	59%	1.9	0%	59%
LT11	162	6.4	2.0	69%	1.9	3%	70%	2.0	2%	69%	2.0	2%	69%	2.0	0%	69%	2.0	0%	69%
LT04	157	3.7	1.7	54%	1.6	6%	57%	1.6	8%	58%	1.4	15%	61%	1.7	2%	55%	1.6	6%	57%
LT01	156	4.3	1.6	63%	1.5	1%	64%	1.6	0%	64%	1.6	0%	64%	1.5	1%	64%	1.5	7%	66%
LT20	150	6.4	2.9	54%	2.9	0%	54%	2.9	0%	54%	2.9	3%	55%	2.9	2%	55%	2.9	2%	55%
LT14	125	6.2	1.7	73%	1.6	5%	74%	1.3	22%	79%	1.2	27%	80%	1.6	1%	73%	1.5	10%	76%
LT16	125	5.2	1.7	68%	1.7	0%	68%	1.6	1%	69%	1.5	13%	72%	1.7	1%	68%	1.7	1%	68%
LT10	98	6.9	1.8	73%	1.6	16%	77%	1.2	36%	83%	1.3	27%	80%	1.8	0%	73%	1.7	9%	76%
LT12	83	6.6	2.1	69%	1.8	14%	73%	1.3	36%	80%	1.6	23%	76%	2.1	0%	69%	1.9	9%	72%
Minimum		3.7	1.4	54%	1.3	0%	54%	1.2	0%	54%	1.2	0%	55%	1.3	0%	55%	1.3	0%	55%
Maximum		6.9	2.9	73%	2.9	16%	77%	2.9	36%	83%	2.9	27%	80%	2.9	4%	73%	2.9	10%	76%
Median		5.2	1.7	67%	1.7	4%	68%	1.6	4%	68%	1.5	11%	68%	1.7	1%	68%	1.7	4%	68%

Note. As for Table S3, but for the pressure-CEOF seasonal correction.

Table S5. Summary of synthetic detectability results when onset is assumed unknown, for only 1.5 cm amplitude synthetic ramp on the slope and 3.5 cm amplitude synthetic ramp on the shelf.

Aknown (cm)	Proxy		Shelf				Slope			
			Onset Recovery Error (d)		Amplitude Recovery (cm)		Onset Recovery Error (d)		Amplitude Recovery (cm)	
			median	mad	median	mad	median	mad	median	mad
1.5	POLY	P	--	--	--	--	22.0	65.5	2.5	1.1
		Pmatch	--	--	--	--	0.0	46.0	1.3	1.8
		Pavg	--	--	--	--	3.0	62.0	3.0	1.0
	SIN	P	--	--	--	--	12.0	61.5	2.8	1.3
		Pmatch	--	--	--	--	1.0	45.0	1.2	2.3
		Pavg	--	--	--	--	-2.0	58.0	3.1	1.8
	m-CEOF	P	--	--	--	--	-14.0	90.5	-0.3	1.7
		Pmatch	--	--	--	--	-1.0	20.0	1.1	0.9
		Pavg	--	--	--	--	11.5	81.0	1.3	1.5
	p-CEOF	P	--	--	--	--	-14.0	90.5	-0.4	2.3
		Pmatch	--	--	--	--	-1.0	22.0	1.5	0.7
		Pavg	--	--	--	--	-5.0	100.0	0.2	1.7
3.5	POLY	P	32.0	81.0	-12.5	2.4	--	--	--	--
		Pmatch	-1.0	50.0	2.2	4.0	--	--	--	--
		Pavg	-2.0	62.0	3.2	2.3	--	--	--	--
	SIN	P	36.0	84.0	-11.5	2.8	--	--	--	--
		Pmatch	1.0	47.5	2.8	2.9	--	--	--	--
		Pavg	-1.0	58.5	3.5	2.8	--	--	--	--
	m-CEOF	P	17.5	81.5	4.4	2.1	--	--	--	--
		Pmatch	3.0	52.0	1.1	2.6	--	--	--	--
		Pavg	3.0	52.5	0.9	2.3	--	--	--	--
	p-CEOF	P	0.0	26.0	3.6	1.7	--	--	--	--
		Pmatch	0.0	18.0	3.2	1.3	--	--	--	--
		Pavg	0.0	26.0	2.3	3.6	--	--	--	--

Note. Onset recovery error and amplitude recovery for the unknown onset case is summarized as median and MAD errors for each ramp amplitude considered herein for all seasonal corrections, and the proxy corrections P, P_{match}, and P_{avg}, with shelf and slope presented separately. m-CEOF = multivariate-CEOF, p-CEOF = pressure-CEOF.