Supplementary Material

3D crustal structure of the Ligurian Sea revealed by ambient noise tomography using ocean bottom seismometer data

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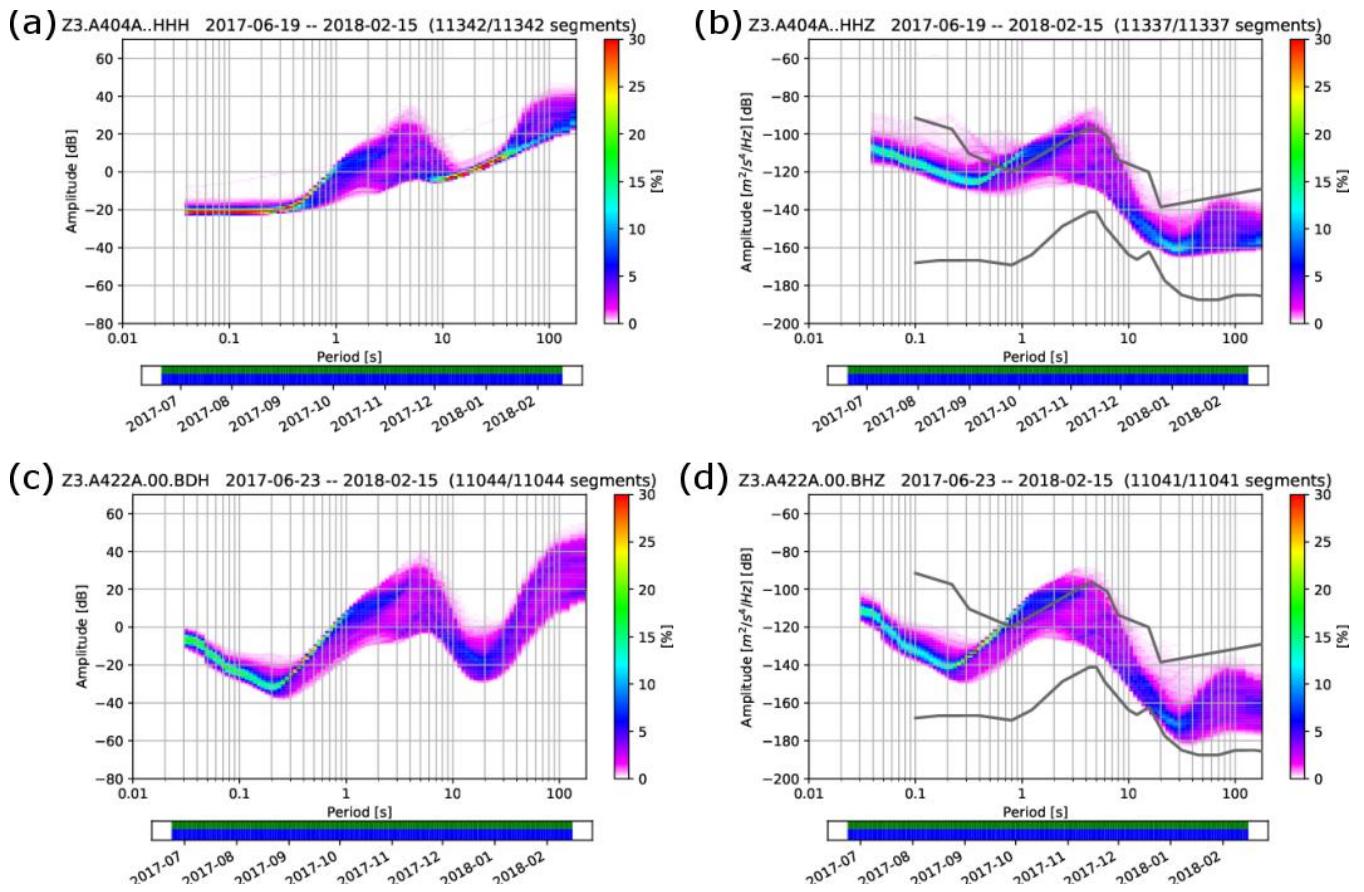


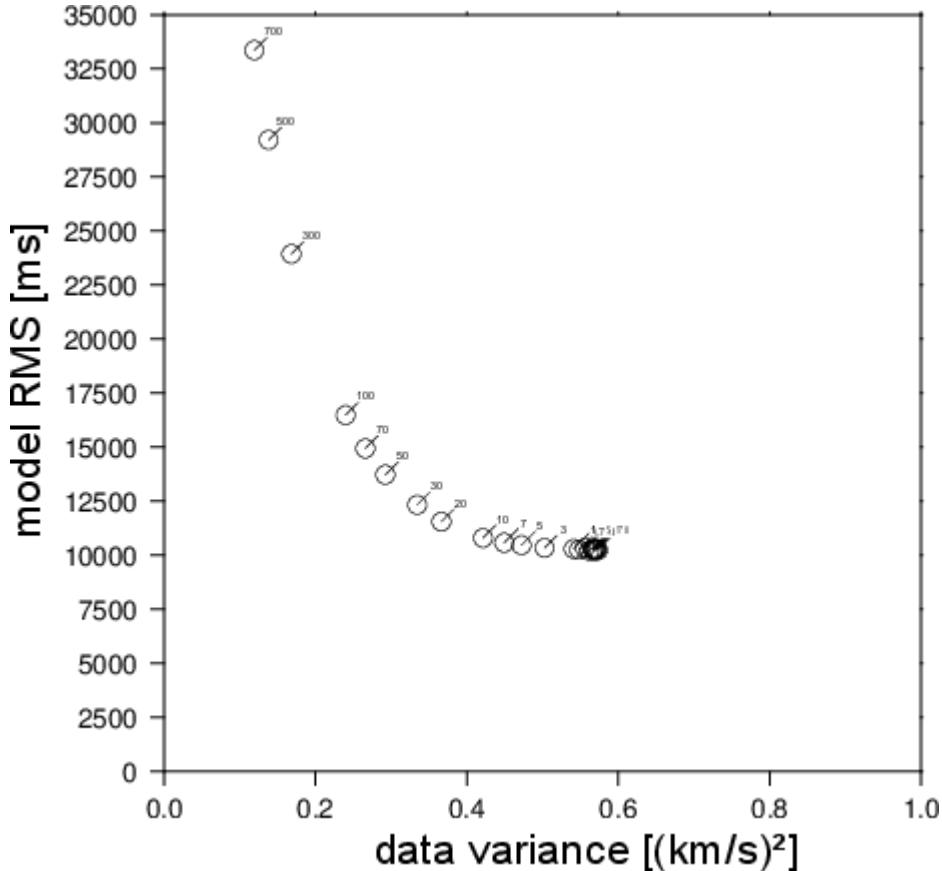
Figure S1: PPSD plots after McNamara (2004). The top row (a and b) shows instruments on OBS A404A, and the bottom row shows PPSDs of A422A (c and d). The left column shows hydrophone (top) or DPG (bottom), the right column shows vertical seismometer components. Grey lines in b and d are the mean minimum and maximum noise levels for land stations (Peterson, 1993).

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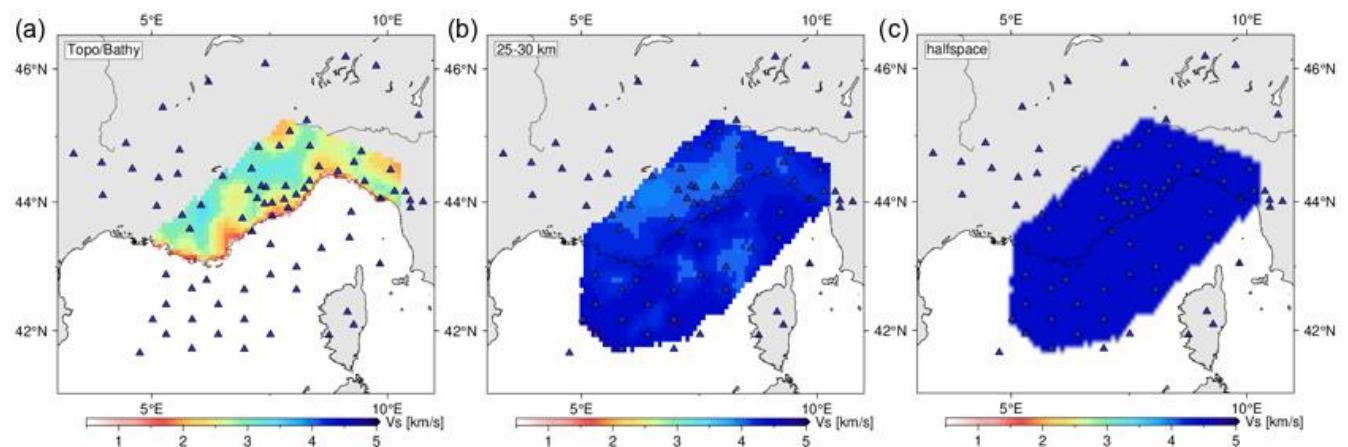
Figure S2: L-curve for a period of 8 s, fixed smoothing factor (SF = 10) and varied damping factor (DF, labelled in the figure). The data fit (RMS) is plotted against the model roughness (variance). Parameter sets close to the origin of the coordinates provide a reasonable trade-off between model roughness and data fit.

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Figure S3: 2D shear velocity maps resulting from the depth inversion. Layer depth is stated in the upper left corner. Depths (in km) are relative to the sea surface. Layer 1 (a) is set up to show S-wave velocity for layers above sea level onshore and the water column; therefore, there is no v_S offshore in panel (a). The velocity below 30 km (halfspace, panel c) was fixed during the inversion.

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Table S1: List of all stations used in this study.

network	station name	Latitude [°]	Longitude [°]	Elevation [m]
Z3	A402A	42,8793	5,3005	-1632
Z3	A404A	42,1782	5,0193	-2013
Z3	A405A	42,4116	5,3036	-2192
Z3	A406A	42,6180	5,5885	-2399
Z3	A409A	43,3482	7,5167	-1981
Z3	A412A	41,6476	4,7448	-2519
Z3	A413A	41,9430	5,3035	-2278
Z3	A414A	42,1783	5,8583	-2463
Z3	A415A	42,4119	6,4109	-2595
Z3	A416A	42,6467	6,9634	-2757
Z3	A417A	42,8796	7,5178	-2677
Z3	A418A	42,9999	8,0709	-2632
Z3	A419A	43,2904	8,6009	-2588
Z3	A420A	43,4537	9,1949	-1354
Z3	A421A	41,7153	5,8499	-2525
Z3	A422A	41,9434	6,4101	-2543
Z3	A423A	42,1784	6,9641	-2706
Z3	A425A	42,6471	8,0703	-2713
Z3	A428A	41,7102	6,9639	-2734
Z3	A429A	41,9434	7,5167	-2773
Z3	A430A	42,1779	7,9809	-2752
Z3	A434A	43,8503	9,2299	-1133
Z3	A062A	46,1808	9,1126	1783
Z3	A178A	45,8107	6,2004	660
Z3	A184A	44,8920	4,4516	750
Z3	A186B	44,7930	5,5892	978
Z3	A187A	44,7343	3,3398	935
Z3	A188A	44,6001	3,9367	1085
Z3	A192A	44,5069	4,5869	249
Z3	A193A	44,3711	5,1476	390
Z3	A194A	44,3933	6,5023	1255
Z3	A215A	45,4307	5,2323	450
Z3	A216A	44,4291	5,5499	1245
Z3	A281A	44,8534	7,7099	292
Z3	A283B	45,2380	8,2885	195
Z3	A289A	46,0473	9,7610	1780
Z3	A313A	45,3135	10,6628	64
Z3	A317A	43,0499	9,8424	35
GU	BHB	44,8352	7,2633	585
IV	BOB	44,7679	9,4478	910
GU	BURY	43,7825	7,5569	20
GU	CANO	44,2075	8,2372	638
GU	CARD	44,0261	10,4821	380
CH	DIX	46,0801	7,4082	2410
GU	ENR	44,2267	7,4203	1160

GU	EQUI	44,1660	10,1530	350
GU	GBOS	44,2416	7,8399	897
GU	GORR	44,6071	9,2926	609
GU	GRAM	44,4913	10,0658	850
IV	IMI	43,9105	7,8932	840
GU	MAIM	43,9142	10,4915	200
GU	MGRO	44,0424	7,8081	1689
IV	MONC	45,0739	7,9271	480
IV	MSSA	44,3163	9,5174	930
GU	PCP	44,5413	8,5452	770
IV	PLMA	44,0498	9,8537	22
GU	POPM	44,0045	10,7570	440
GU	PZZ	44,5068	7,1160	1430
IV	QLNO	44,3243	8,3459	547
GU	RNCA	44,4712	8,9512	235
GU	RORO	44,1122	8,0662	260
GU	ROTM	44,8493	8,3527	221
GU	STV	44,2455	7,3260	930
MN	VLC	44,1594	10,3864	555
FR	AJAC	41,9279	8,7630	27
FR	ARBF	43,4917	5,3325	185
FR	ARTF	43,5882	5,8067	510
FR	ASEAF	42,7948	6,1635	2470
FR	BLAF	43,9510	6,0450	590
FR	BSTF	43,8009	5,6433	500
FR	CALF	43,7528	6,9218	1242
FR	CORF	42,298	9,1530	475
FR	EILF	43,5479	7,1312	30
FR	ISO	44,1840	7,0500	910
FR	SAOF	43,9860	7,5532	595
FR	SAUF	43,9377	5,1064	230
FR	SMPL	42,0945	9,2847	405
FR	SPIF	44,0558	7,2366	1380
FR	TRBF	44,1054	3,9587	120
FR	TURF	43,9749	7,3919	1650

Table S2: Number of station pairs per period and background velocity for FMST.

Period	traveltimes used	Initial velocity [km/s]	pick error [s]	final RMS [s]
5	843	1.05	±0.750	11.21
6	872	1.00	±0.833	11.33
7	891	0.94	±0.917	12.08
8	890	0.87	±1.000	11.79
9	861	0.91	±1.083	11.50
10	846	1.44	±1.167	10.15
12	881	2.72	±1.250	8.73
15	741	3.25	±2.333	8.40
20	955	3.52	±1.417	5.07
30	1026	3.73	±1.500	4.62
40	999	3.83	±1.583	4.11
50	973	3.90	±1.667	4.00
60	899	3.90	±1.750	4.17
70	817	3.90	±1.833	4.75
80	703	3.90	±1.917	5.32
90	602	3.90	±2.000	5.21

Table S3: FMST parameter settings. We only state settings that were changed from their default values.

number of iterations	10
N-S range of grid (degrees)	46.5-41
W-E range of grid (degrees)	3-11
number of grid points in theta (N-S)*	28
number of grid points in phi (E-W)*	35
background velocity (km s^{-1})	period dependent (see S2)
damping factor (epsilon)	20 for periods $\leqq$ 15 s; 10 else
smoothing factor (eta)	10
checkerboard (optional):	
maximum perturbation of vertices	25 %
checkerboard size (NxN grid cells)	2

35   * The grid gets refined during the tomography. The final outcome is a grid of 406x511 grid points.

Table S4: Starting model for 1D depth inversion. The inversion tool solves for v_S, v_P is calculated using $v_P/v_S = 1.78$.

	Onshore model	Offshore model
Layer 1	Topography to sea surface; v_S=2.2472 km s^{-1}	Sea surface to seafloor; v_P=1.52 km s^{-1}, v_S=0 km s^{-1} (fixed)
Layer 2	Sea surface – 4 km; v_S=2.2472 km s^{-1}	Seafloor – 4 km; v_S=1.4045 km s^{-1}
Layer 3	4-6 km; v_S=2.2472 km s^{-1}	
Layer 4	6-9 km; v_S=3.0809 km s^{-1}	
Layer 5	9-12 km; v_S=4.2135 km s^{-1}	
Layer 6	12-15 km; v_S=4.2135 km s^{-1}	
Layer 7	15-18 km; v_S=4.2135 km s^{-1}	
Layer 8	18-21 km; v_S=4.2135 km s^{-1}	
Layer 9	21-25 km; v_S=4.6 km s^{-1}	
Layer 10	25-30 km; v_S=4.6 km s^{-1}	
Layer 11	halfspace; v_S=4.6 km s^{-1} (fixed)	