

1 **Observing tidal effects on the dynamics of the Ekström Ice**
2 **Shelf with focus on quarter- and terdiurnal periods**

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6 **SUPPLEMENT**

Listing 1. Output report from T_Tide for seismic noise (PPSD)

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7 nobs = 17460,  ngood = 17459,  record length (days) = 363.75
8 start time: 01-Jan-2020
9 rayleigh criterion = 1.0
10 Greenwich phase computed with nodal corrections applied to amplitude
11 and phase relative to center time
12
13 x0= -149, x trend= -1.03
14
15 var(x)= 75.9949   var(xp)= 7.0591   var(xres)= 68.7769
16 percent var predicted/var original= 9.3 %
17
18     tidal amplitude and phase with 95% CI estimates
19
20 tide      freq      amp      amp_err   pha      pha_err   snr
21 *SSA  0.0002282    0.6378    0.163    322.75    17.51     15
22 *MSM  0.0013098    0.9393    0.171    215.14    12.38     30
23 *MM   0.0015122    0.3284    0.159    300.16    29.30     4.3
24 *MSF  0.0028219    1.7665    0.154     17.14     4.97    1.3e+02
25 *MF   0.0030501    0.5093    0.165    104.69    19.72     9.5
26 ALP1  0.0343966    0.2256    0.160    227.25    40.91      2
27 2Q1   0.0357064    0.0870    0.147    281.99    99.99     0.35
28 *SIG1 0.0359087    0.4627    0.153    322.94    20.46     9.2
29 *Q1   0.0372185    0.3913    0.154    160.20    25.43     6.4
30 RH01 0.0374209    0.0459    0.117    258.87    147.53    0.15
31 *O1   0.0387307    1.1379    0.180    142.69     9.20     40
32 *TAU1 0.0389588    0.4452    0.161    205.46    20.66     7.6
33 BET1  0.0400404    0.1501    0.168    119.45    71.94     0.8
34 *NO1  0.0402686    0.2030    0.121    178.75    35.31     2.8
35 CHI1  0.0404710    0.1494    0.172    222.06    70.75     0.75
36 *P1   0.0415526    1.3120    0.167    137.08     7.86     61
37 *K1   0.0417807    0.9070    0.168    127.56    10.76     29
38 *PHI1 0.0420089    0.3072    0.147    317.17    34.47     4.3
39 *THE1 0.0430905    0.2623    0.165    307.87    34.77     2.5
40 *J1   0.0432929    0.3476    0.151     78.60    28.37     5.3
41 *S01  0.0446027    0.3123    0.173    164.24    31.98     3.2
42 *O01  0.0448308    0.2929    0.131    121.48    24.79      5
43 UPS1  0.0463430    0.0686    0.110     81.51    134.32    0.39
44 OQ2   0.0759749    0.0796    0.128    285.51    115.86    0.39
45 EPS2  0.0761773    0.1808    0.152     34.66    53.62     1.4
46 2N2   0.0774871    0.1036    0.144    349.50    83.64     0.52
47 MU2   0.0776895    0.1359    0.161     36.03    80.32     0.71
48 N2    0.0789992    0.2239    0.172    227.24    42.69     1.7
49 NU2   0.0792016    0.1988    0.172    134.33    51.35     1.3
50 *M2   0.0805114    0.5090    0.163    192.61    20.04     9.7

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51	*MKS2	0.0807396	0.3071	0.163	340.81	33.53	3.5
52	LDA2	0.0818212	0.1393	0.153	121.14	66.00	0.83
53	L2	0.0820236	0.2663	0.232	254.03	42.59	1.3
54	*S2	0.0833333	0.2603	0.164	226.69	39.93	2.5
55	*K2	0.0835615	0.3769	0.164	268.63	23.09	5.3
56	MSN2	0.0848455	0.2046	0.161	122.18	54.39	1.6
57	ETA2	0.0850736	0.1032	0.132	83.56	83.36	0.61
58	*M03	0.1192421	0.4133	0.165	318.94	23.06	6.2
59	*M3	0.1207671	0.5705	0.183	144.32	14.66	9.7
60	*S03	0.1220640	0.6709	0.181	300.94	15.64	14
61	*MK3	0.1222921	0.8862	0.168	263.56	10.28	28
62	SK3	0.1251141	0.2092	0.162	312.12	44.34	1.7
63	MN4	0.1595106	0.2393	0.177	4.17	48.07	1.8
64	*M4	0.1610228	0.4576	0.153	11.36	22.11	8.9
65	*SN4	0.1623326	0.3179	0.163	88.85	32.24	3.8
66	*MS4	0.1638447	1.1217	0.180	9.84	8.76	39
67	MK4	0.1640729	0.2107	0.172	248.65	43.12	1.5
68	S4	0.1666667	0.2270	0.177	38.68	44.16	1.7
69	SK4	0.1668948	0.1273	0.156	338.56	73.15	0.67
70	*2MK5	0.2028035	0.2551	0.170	82.64	41.27	2.2
71	*2SK5	0.2084474	0.3499	0.166	285.53	30.41	4.4
72	2MN6	0.2400221	0.0981	0.127	290.86	100.48	0.59
73	M6	0.2415342	0.0811	0.150	216.97	109.55	0.29
74	*2MS6	0.2443561	0.2286	0.137	227.82	46.70	2.8
75	*2MK6	0.2445843	0.2471	0.150	146.30	39.04	2.7
76	2SM6	0.2471781	0.1051	0.125	95.93	86.84	0.71
77	MSK6	0.2474062	0.1037	0.134	173.74	89.23	0.6
78	3MK7	0.2833149	0.1148	0.141	64.68	90.18	0.67
79	M8	0.3220456	0.1201	0.170	256.94	90.21	0.5

Listing 2. Output report from T_Tide for elevation from GNSS data

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80 nobs = 45341,  ngood = 45341,  record length (days) = 314.87
81 start time: 20-Feb-2020 17:50:00
82 rayleigh criterion = 1.0
83 Greenwich phase computed with nodal corrections applied to amplitude
84 and phase relative to center time
85
86 x0= 81.5, x trend= -0.897
87
88 var(x)= 0.49817  var(xp)= 0.21902  var(xres)= 0.28098
89 percent var predicted/var original= 44.0 %
90
91     tidal amplitude and phase with 95% CI estimates
92
93 tide   freq      amp      amp_err   pha     pha_err   snr

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94	*SSA	0.0002282	0.0163	0.001	186.71	4.63	1.2e+02
95	*MSM	0.0013098	0.0259	0.002	220.31	3.39	2.8e+02
96	*MM	0.0015122	0.0348	0.002	204.03	2.70	5.3e+02
97	*MSF	0.0028219	0.0120	0.001	109.45	6.96	66
98	*MF	0.0030501	0.0174	0.001	177.52	4.54	1.5e+02
99	*ALP1	0.0343966	0.0036	0.001	314.38	23.11	8.1
100	*2Q1	0.0357064	0.0092	0.001	322.00	9.06	42
101	*SIG1	0.0359087	0.0123	0.001	340.71	6.09	86
102	*Q1	0.0372185	0.0638	0.001	340.45	1.35	1.9e+03
103	*RH01	0.0374209	0.0120	0.002	343.59	7.65	61
104	*O1	0.0387307	0.2765	0.001	348.91	0.28	5e+04
105	*TAU1	0.0389588	0.0048	0.001	352.59	18.50	12
106	*BET1	0.0400404	0.0025	0.001	5.40	29.18	3.3
107	*N01	0.0402686	0.0178	0.001	349.67	2.83	3.1e+02
108	*CHI1	0.0404710	0.0031	0.001	345.35	25.83	5.3
109	*P1	0.0415526	0.0902	0.002	353.89	0.93	3.5e+03
110	*K1	0.0417807	0.2622	0.002	353.84	0.27	3e+04
111	*PHI1	0.0420089	0.0044	0.001	352.95	17.91	10
112	*THE1	0.0430905	0.0024	0.001	346.58	32.66	4.7
113	*J1	0.0432929	0.0122	0.001	343.15	6.86	80
114	*S01	0.0446027	0.0022	0.001	355.81	37.12	3.1
115	*O01	0.0448308	0.0063	0.001	334.00	10.95	32
116	UPS1	0.0463430	0.0017	0.001	340.62	40.30	1.9
117	OQ2	0.0759749	0.0002	0.001	128.41	189.57	0.043
118	EPS2	0.0761773	0.0007	0.001	211.53	112.12	0.39
119	*2N2	0.0774871	0.0046	0.001	165.00	18.11	10
120	*MU2	0.0776895	0.0080	0.002	175.10	11.64	29
121	*N2	0.0789992	0.0659	0.001	173.56	1.23	2.1e+03
122	*NU2	0.0792016	0.0123	0.001	180.60	6.68	68
123	*M2	0.0805114	0.4066	0.002	194.66	0.17	6.5e+04
124	*MKS2	0.0807396	0.0023	0.002	217.69	40.03	2.3
125	*LDA2	0.0818212	0.0048	0.001	179.01	16.90	11
126	*L2	0.0820236	0.0218	0.002	143.59	5.34	97
127	*S2	0.0833333	0.2912	0.002	216.69	0.28	3.8e+04
128	*K2	0.0835615	0.1001	0.001	218.76	0.81	5.7e+03
129	MSN2	0.0848455	0.0011	0.001	41.63	76.74	0.75
130	*ETA2	0.0850736	0.0050	0.001	248.14	14.74	14
131	M03	0.1192421	0.0008	0.001	64.92	99.33	0.43
132	*M3	0.1207671	0.0031	0.002	183.50	24.01	4.3
133	S03	0.1220640	0.0005	0.001	355.92	163.48	0.23
134	MK3	0.1222921	0.0003	0.001	115.71	182.44	0.093
135	*SK3	0.1251141	0.0037	0.002	346.92	22.12	5.5
136	MN4	0.1595106	0.0018	0.001	111.71	46.95	1.7
137	*M4	0.1610228	0.0033	0.001	171.53	23.13	4.9
138	SN4	0.1623326	0.0003	0.001	141.88	181.83	0.1

139	MS4	0.1638447	0.0014	0.001	316.12	61.38	0.97
140	MK4	0.1640729	0.0002	0.001	210.81	207.88	0.053
141	S4	0.1666667	0.0012	0.001	246.85	72.74	0.68
142	SK4	0.1668948	0.0017	0.001	273.03	49.31	1.8
143	2MK5	0.2028035	0.0004	0.001	157.79	166.47	0.16
144	2SK5	0.2084474	0.0010	0.001	136.72	83.55	0.7
145	2MN6	0.2400221	0.0005	0.001	322.17	151.81	0.24
146	M6	0.2415342	0.0006	0.001	279.41	119.99	0.27
147	2MS6	0.2443561	0.0010	0.001	343.57	79.74	0.56
148	2MK6	0.2445843	0.0004	0.001	262.02	165.19	0.11
149	2SM6	0.2471781	0.0001	0.001	324.04	217.01	0.016
150	MSK6	0.2474062	0.0006	0.001	78.35	139.61	0.39
151	3MK7	0.2833149	0.0003	0.001	65.56	160.43	0.13
152	M8	0.3220456	0.0001	0.001	335.13	241.22	0.0032

Listing 3. Output report from T_Tide for ice shelf velocity from GNSS data

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153 nobs = 45341,  ngood = 45341,  record length (days) = 314.87
154 start time: 20-Feb-2020 17:50:00
155 rayleigh criterion = 1.0
156 Greenwich phase computed with nodal corrections applied to amplitude
157   and phase relative to center time
158
159 x0= 166, x trend= 0.742
160
161 var(x)= 5608.1758   var(xp)= 832.9607   var(xres)= 4775.3501
162 percent var predicted/var original= 14.9 %
163
164     tidal amplitude and phase with 95% CI estimates
165
166 tide   freq      amp      amp_err   pha     pha_err   snr
167 *SSA  0.0002282    2.3800    0.898   126.03   22.28     7
168  MSM   0.0013098    1.0971    0.829    65.24   46.93    1.8
169 *MM    0.0015122    2.0573    1.006    10.28   22.91    4.2
170 *MSF  0.0028219   11.1673    0.897     0.49    3.89   1.6e+02
171 *MF    0.0030501    2.2620    0.809   139.03   21.02    7.8
172  ALP1  0.0343966    0.2678    0.599    57.54  142.34    0.2
173  2Q1   0.0357064    0.4957    0.695   357.49   91.91    0.51
174 *SIG1  0.0359087    1.7757    0.881   347.10   26.62    4.1
175 *Q1    0.0372185    2.3961    0.867   265.81   19.11    7.6
176  RH01  0.0374209    0.6416    0.839   168.39   77.48    0.58
177 *O1    0.0387307   10.0507    0.887   254.30    4.73   1.3e+02
178 *TAU1  0.0389588    1.4142    0.986   223.02   36.04    2.1
179  BET1  0.0400404    0.2912    0.578   161.46   157.19    0.25
180 *N01   0.0402686    1.1792    0.701   240.20   28.45    2.8
181  CHI1  0.0404710    0.4552    0.700   296.95  107.62    0.42

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182	*P1	0.0415526	5.6789	0.835	206.42	9.21	46
183	*K1	0.0417807	10.7688	0.842	240.66	5.19	1.6e+02
184	*PHI1	0.0420089	2.0631	0.897	193.33	22.35	5.3
185	THE1	0.0430905	1.0761	0.849	336.07	43.50	1.6
186	*J1	0.0432929	1.2521	0.838	241.27	41.95	2.2
187	*S01	0.0446027	4.2547	0.867	239.48	12.35	24
188	*001	0.0448308	1.8119	0.677	212.82	24.39	7.2
189	UPS1	0.0463430	0.3876	0.663	316.31	105.93	0.34
190	*0Q2	0.0759749	1.3575	0.753	47.26	32.01	3.3
191	EPS2	0.0761773	1.1440	0.871	239.38	46.78	1.7
192	*2N2	0.0774871	3.9037	0.999	141.93	12.96	15
193	*MU2	0.0776895	2.0901	0.943	329.16	22.22	4.9
194	N2	0.0789992	0.6604	0.853	183.47	79.62	0.6
195	*NU2	0.0792016	1.2706	0.846	177.99	34.76	2.3
196	*M2	0.0805114	14.8178	0.929	165.11	3.30	2.5e+02
197	MKS2	0.0807396	0.4938	0.731	178.44	96.02	0.46
198	*LDA2	0.0818212	2.0493	0.879	236.45	25.68	5.4
199	L2	0.0820236	1.1762	1.080	78.84	57.39	1.2
200	*S2	0.0833333	15.3883	0.898	165.23	3.30	2.9e+02
201	*K2	0.0835615	17.8345	0.885	323.97	2.52	4.1e+02
202	*MSN2	0.0848455	2.7734	0.837	225.53	18.37	11
203	ETA2	0.0850736	0.9737	0.699	119.22	42.34	1.9
204	*M03	0.1192421	7.1393	0.863	91.73	7.07	68
205	*M3	0.1207671	1.7894	0.890	34.24	28.07	4
206	*S03	0.1220640	5.5186	0.895	118.89	9.03	38
207	*MK3	0.1222921	2.7299	0.912	90.33	18.91	9
208	*SK3	0.1251141	8.2380	0.873	44.79	5.48	89
209	MN4	0.1595106	1.0206	0.878	269.75	46.00	1.4
210	*M4	0.1610228	6.0041	0.870	307.26	9.10	48
211	SN4	0.1623326	0.4437	0.732	2.53	105.83	0.37
212	*MS4	0.1638447	10.3518	0.926	313.70	5.26	1.3e+02
213	*MK4	0.1640729	3.1817	1.013	19.39	15.60	9.9
214	*S4	0.1666667	9.0402	0.970	359.46	5.57	87
215	*SK4	0.1668948	3.8288	0.952	141.70	14.31	16
216	2MK5	0.2028035	0.5131	0.665	118.89	96.67	0.6
217	*2SK5	0.2084474	1.7417	0.864	281.87	29.63	4.1
218	2MN6	0.2400221	0.8201	0.873	182.44	64.07	0.88
219	M6	0.2415342	0.2250	0.653	247.93	159.08	0.12
220	2MS6	0.2443561	0.8938	0.784	64.96	58.23	1.3
221	2MK6	0.2445843	0.5067	0.703	356.49	97.38	0.52
222	2SM6	0.2471781	0.3921	0.718	91.78	126.18	0.3
223	MSK6	0.2474062	0.7594	0.766	11.72	69.05	0.98
224	3MK7	0.2833149	0.5798	0.728	81.40	87.83	0.63
225	M8	0.3220456	0.8361	0.785	286.81	60.21	1.1

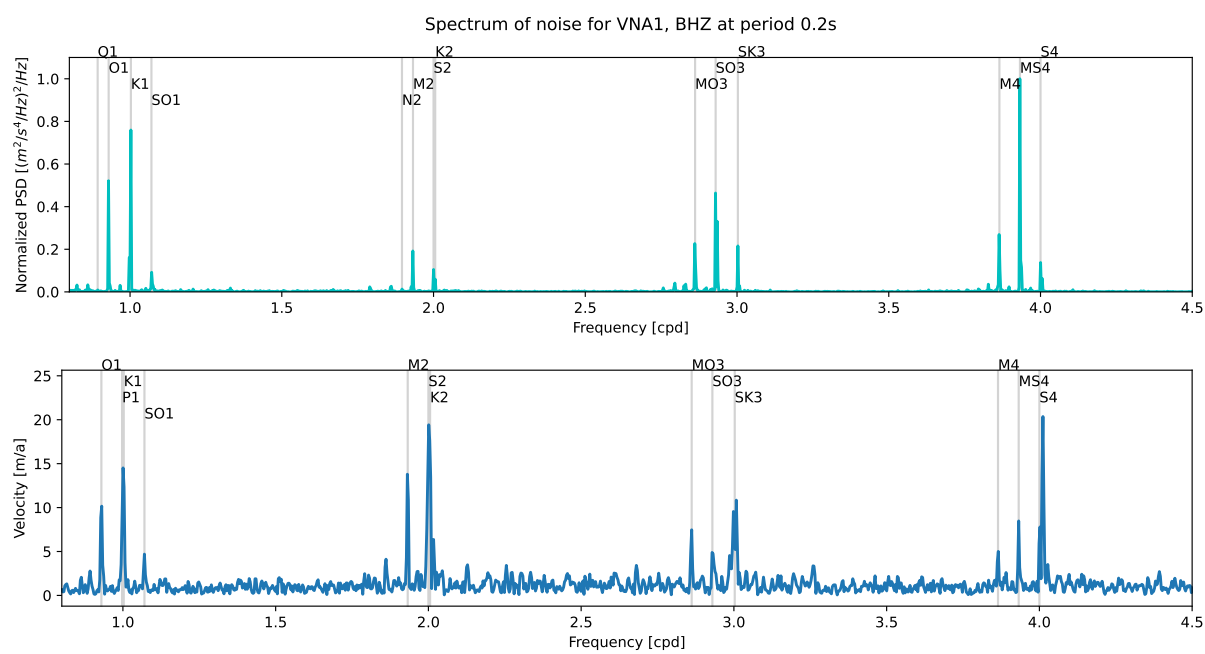


Fig. S1. The spectral analysis using FFT reveals an unbiased spectral content of the time series for seismic noise (upper panel) and ice velocity (lower panel).

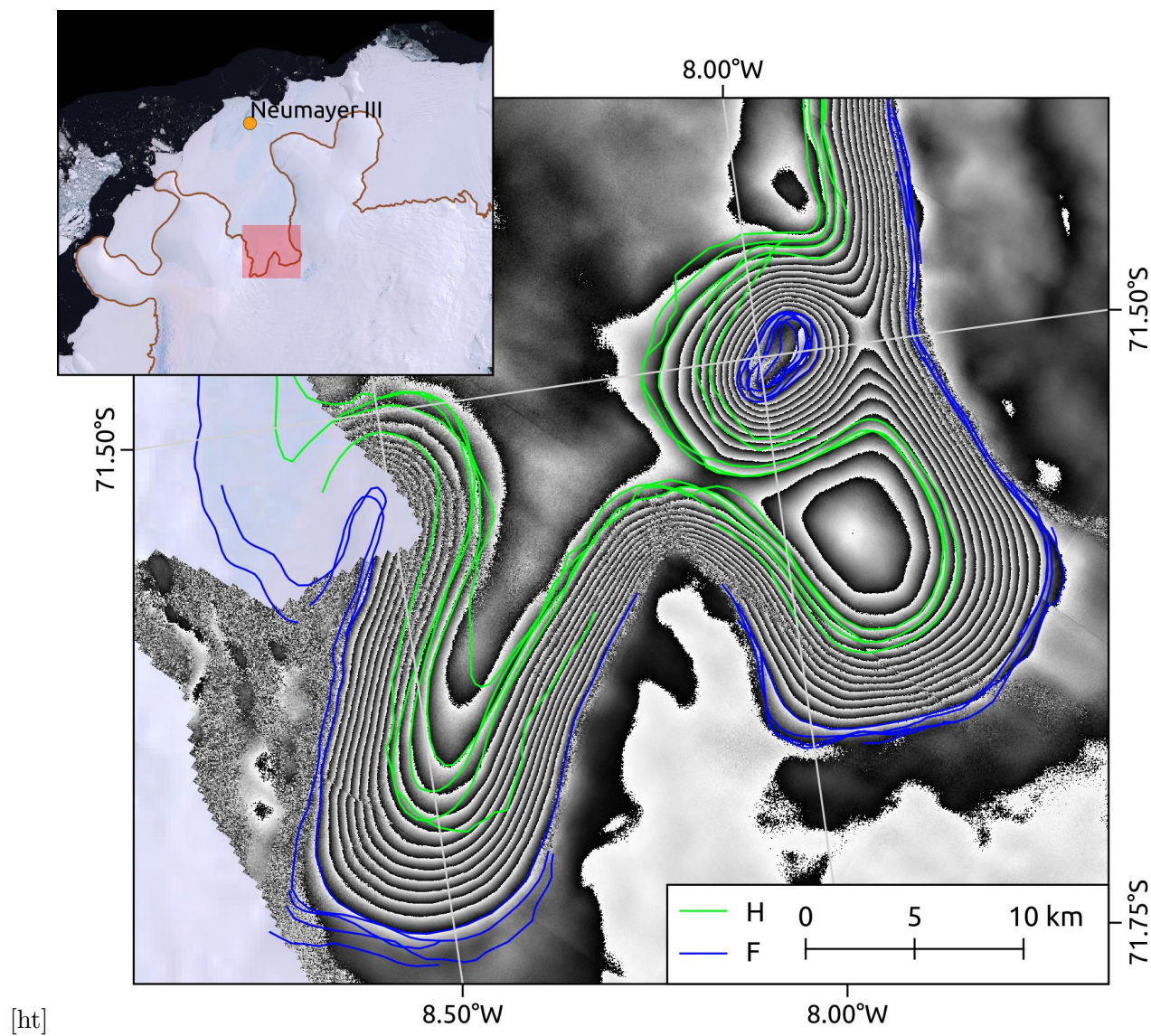


Fig. S2. Transition between grounded and floating ice at Ekström ice shelf as seen by Sentinel-1 Synthetic Aperture Radar (SAR) Interferometry. Data to form the displayed double differential interferogram were acquired on 2016-08-23, 2016-09-04 and 2016-09-16. F and H are the upper limits of tidal flexure and the landward limit of hydrostatic equilibrium (freely floating ice) at different times respectively (Figure provided by N. Neckel).