Measurement of Antenna (Aluminum Base)

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Description

The main aspects of the measurements are:

- No shield
- Aluminum base
- Short cable between antenna and switch
- Antenna covered by foam box
- Measurement is 35-hour long

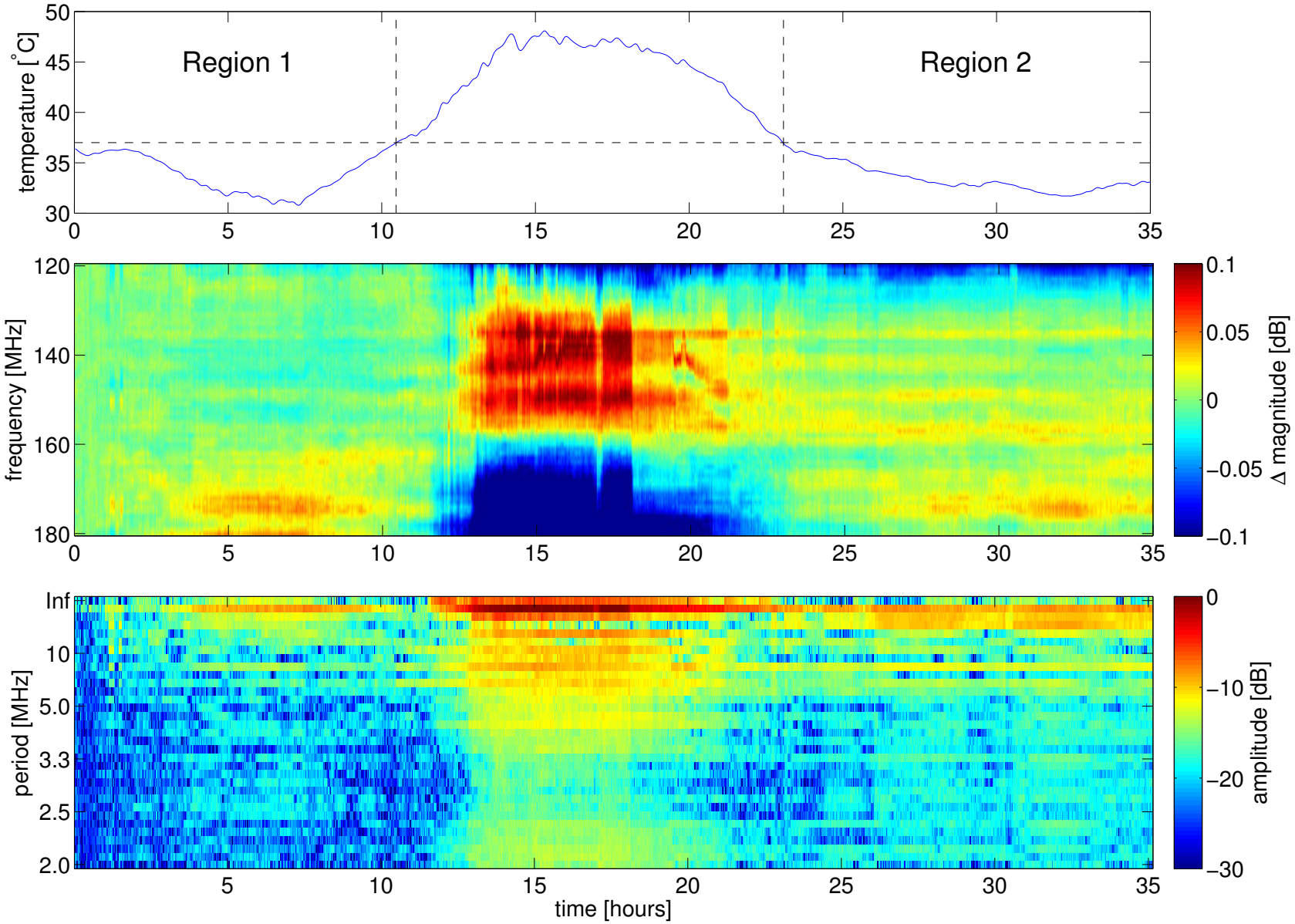


Figure: Results for the magnitude. Comments on the next page.

- (Top): The air temperature reached 48°C. Regions 1 and 2 are limited by 37°. For lower temperatures the antenna seems significantly more stable.
- (Middle): The variations are with respect to the initial trace. Regions 1 and 2 are fairly stable independently. The high-temperature region evidences the pattern due to a hot copper plate, pivoting at $\sim$ 160 MHz. Important jumps occur at 16.7 hours (it quickly returns to normal) and 18 hours (no return). Ripples in frequency, of $\sim$ 10 MHz, are present throughout the measurement.
- (Bottom): Spectra of the magnitude. The amplitude is in dB. The plot is normalized to the peak value in the data set. The y-axis corresponds to the period of each component in MHz. In general, low frequency oscillations are larger. An 8-MHz component is significant all along, but more evident in region 2.

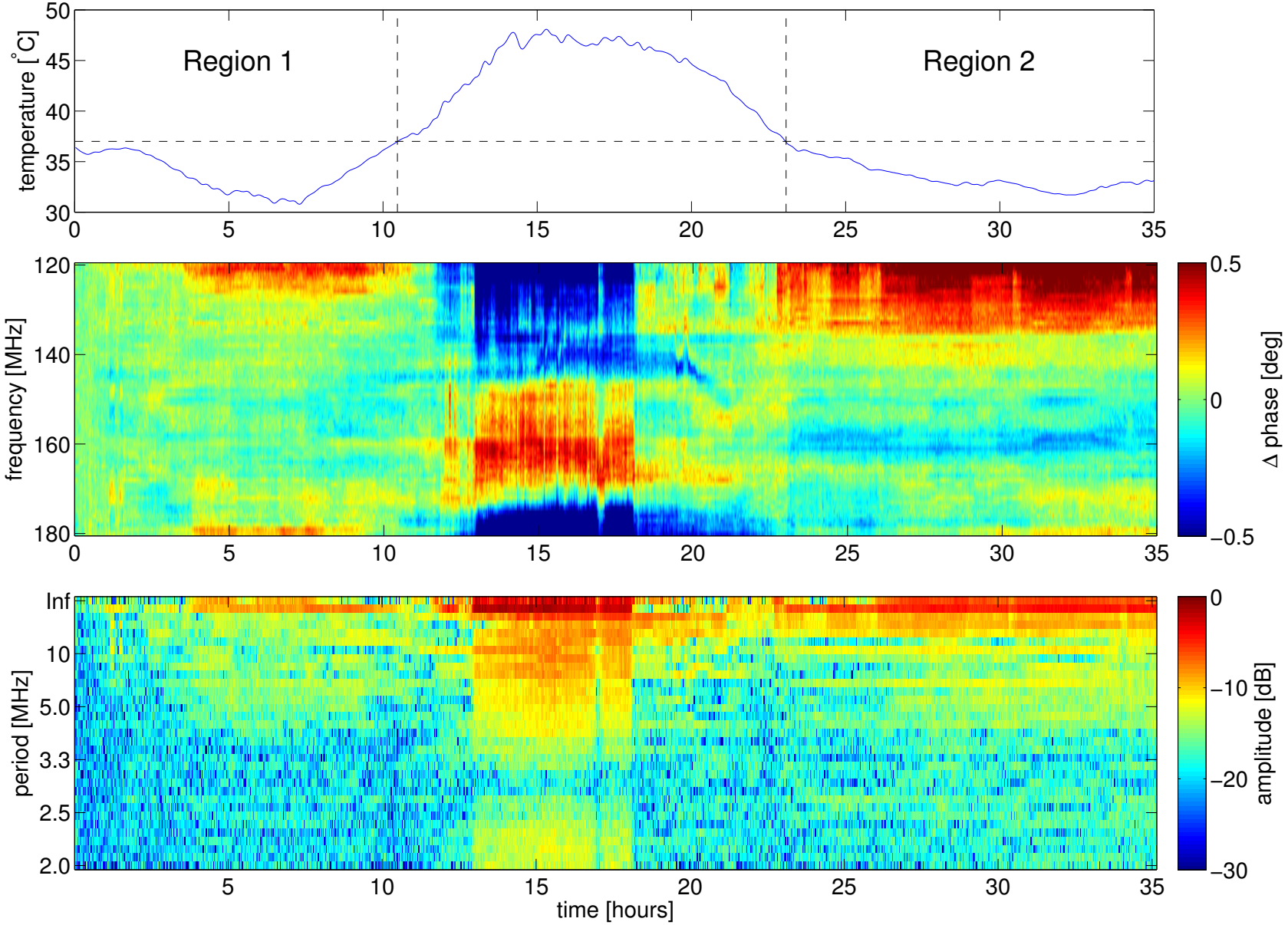


Figure: Results for the phase. Comments on the next page.

- (Top): Air temperature.
- (Middle): The variations are with respect to the initial trace. Regions 1 and 2 are fairly stable independently, especially region 2. The jumps at 16.7 hours and 18 hours are also evident.
- (Bottom): Spectra of the phase. The amplitude is in dB. The plot is normalized to the peak value in the data set. The y-axis corresponds to the period of each component in MHz. In general, low frequency oscillations are larger.

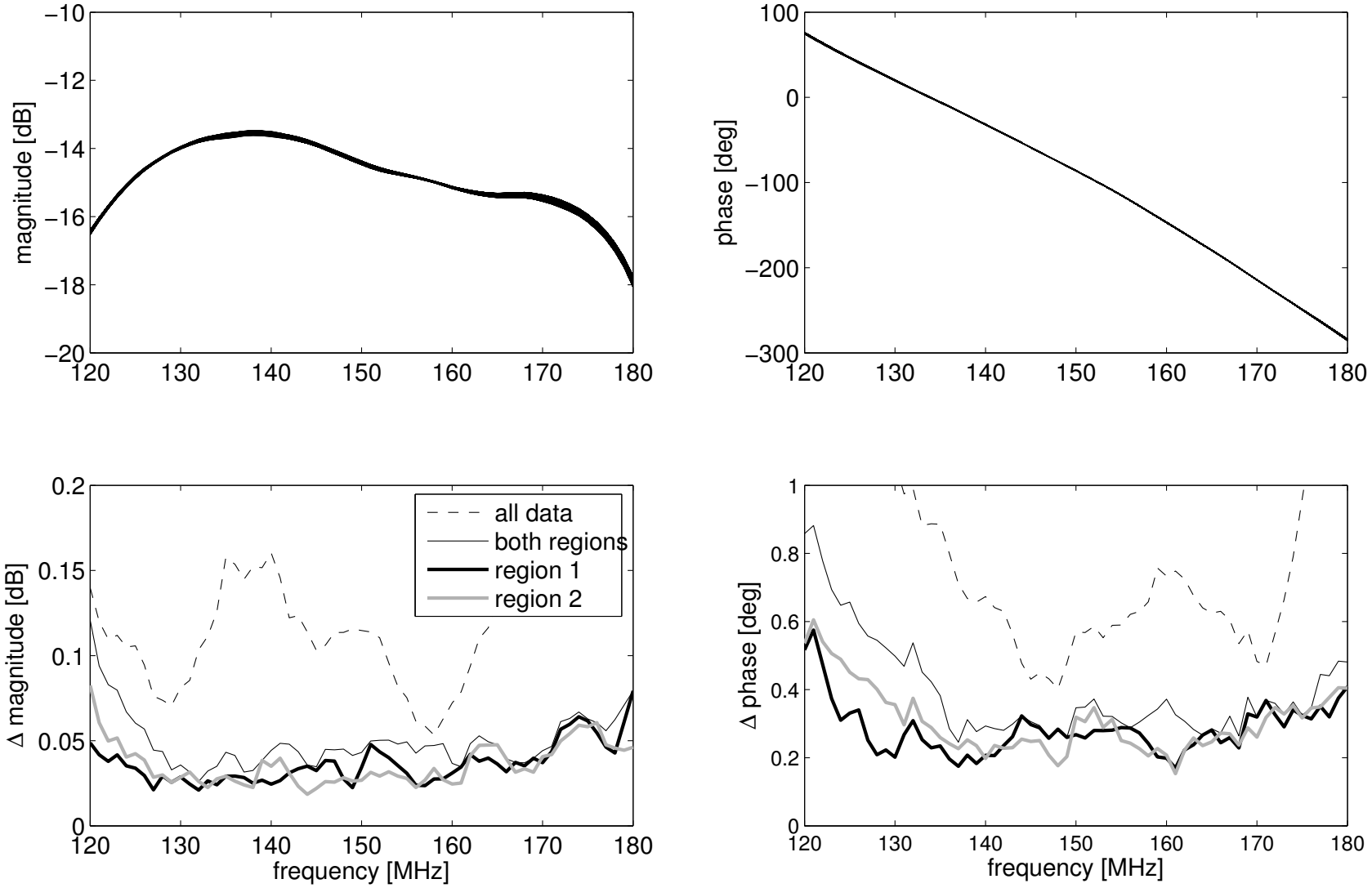


Figure: (Top) All data in magnitude and phase. (Bottom) Peak-to-peak scatter for different sections. The stability for regions 1 and 2 is of order 0.05 dB and 0.4°C in magnitude and phase respectively.

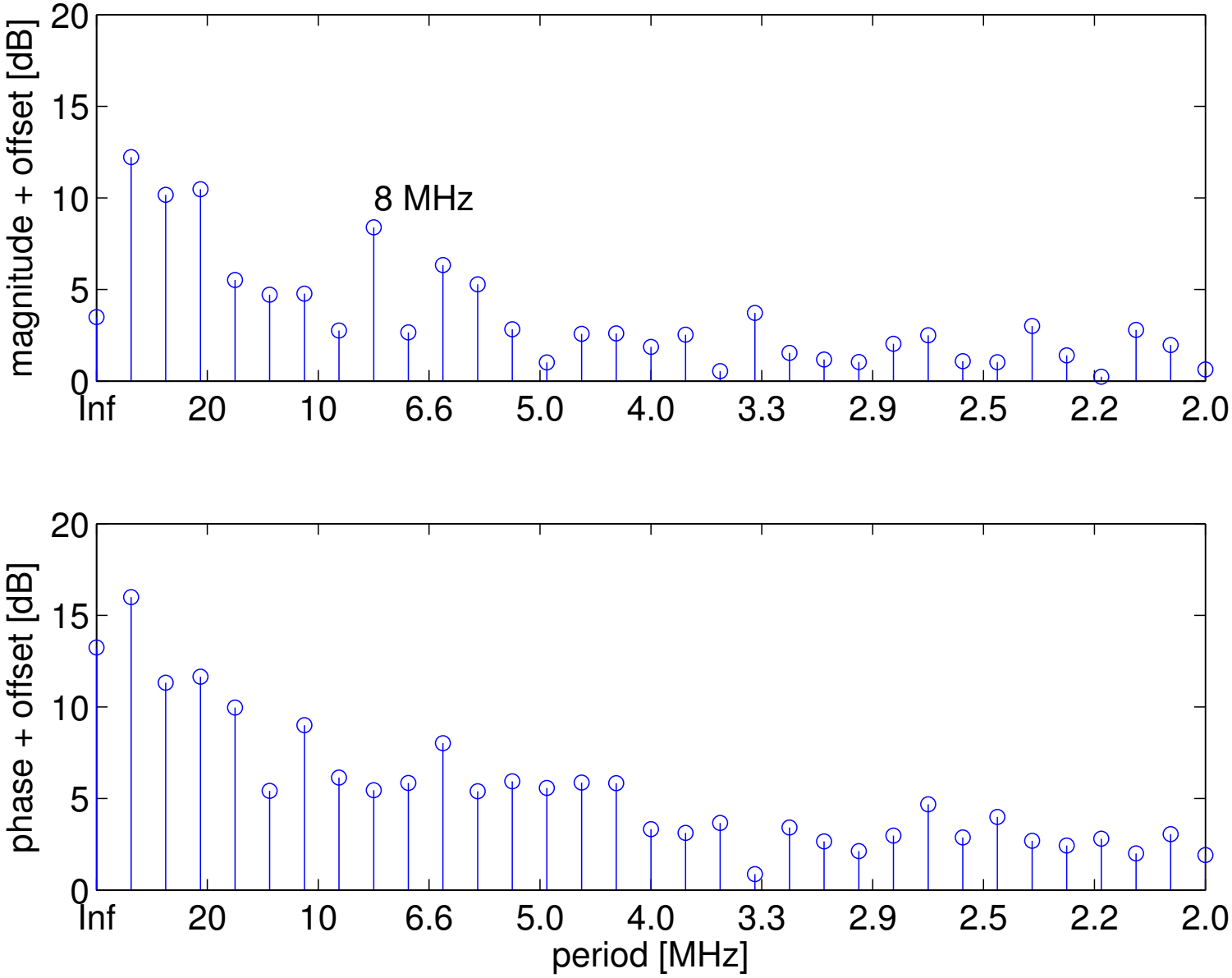


Figure: Average spectra of magnitude (top) and phase (bottom) for Region 2. An offset has been added so the amplitude is above zero. Long-period oscillations are dominant. A relevant component in magnitude is 8 MHz. In phase, the amplitude decreases in a smoother way.

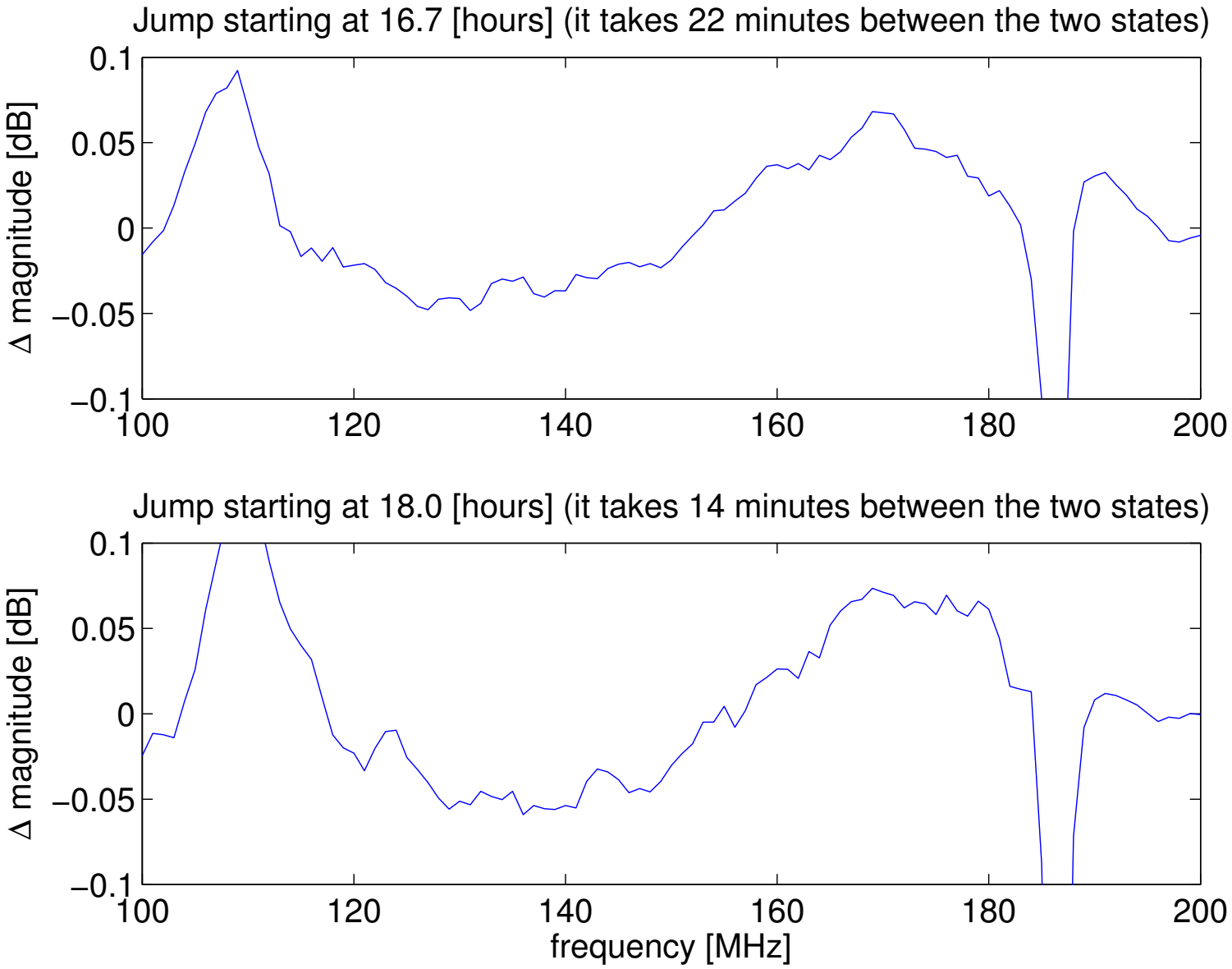


Figure: Jumps at 16.7 hours (top), and at 18 hours (bottom) during the high-temperature period. The Delta corresponds to After-minus-Before. The difference takes some minutes to establish. For the jump at the top, the antenna went back to its initial state very soon, as the figure on page 3 shows. The patterns fit very well the scenario of a varying top plate. In both cases, the After state corresponds to a case were the distance between the top plate and the panels increase.

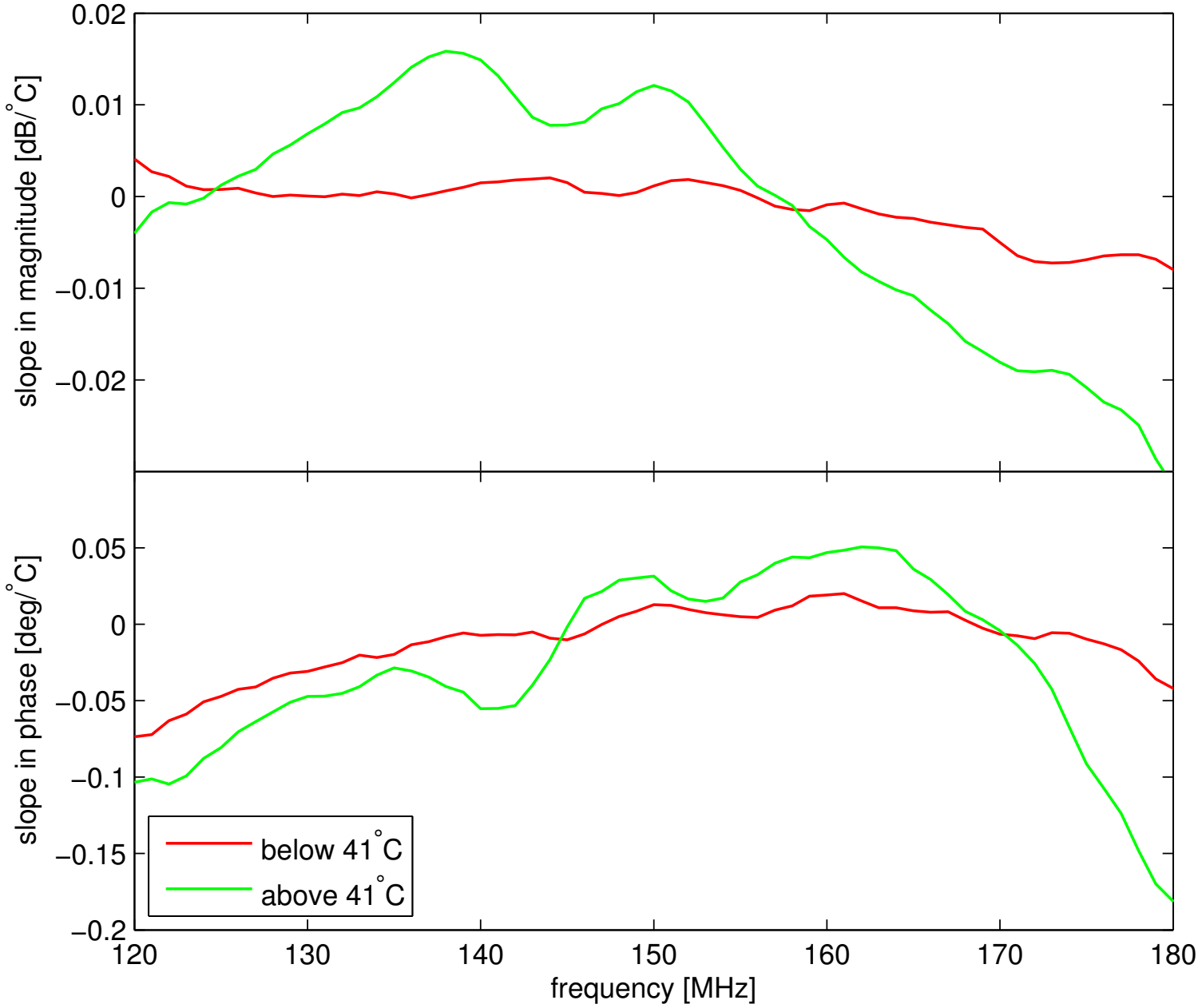
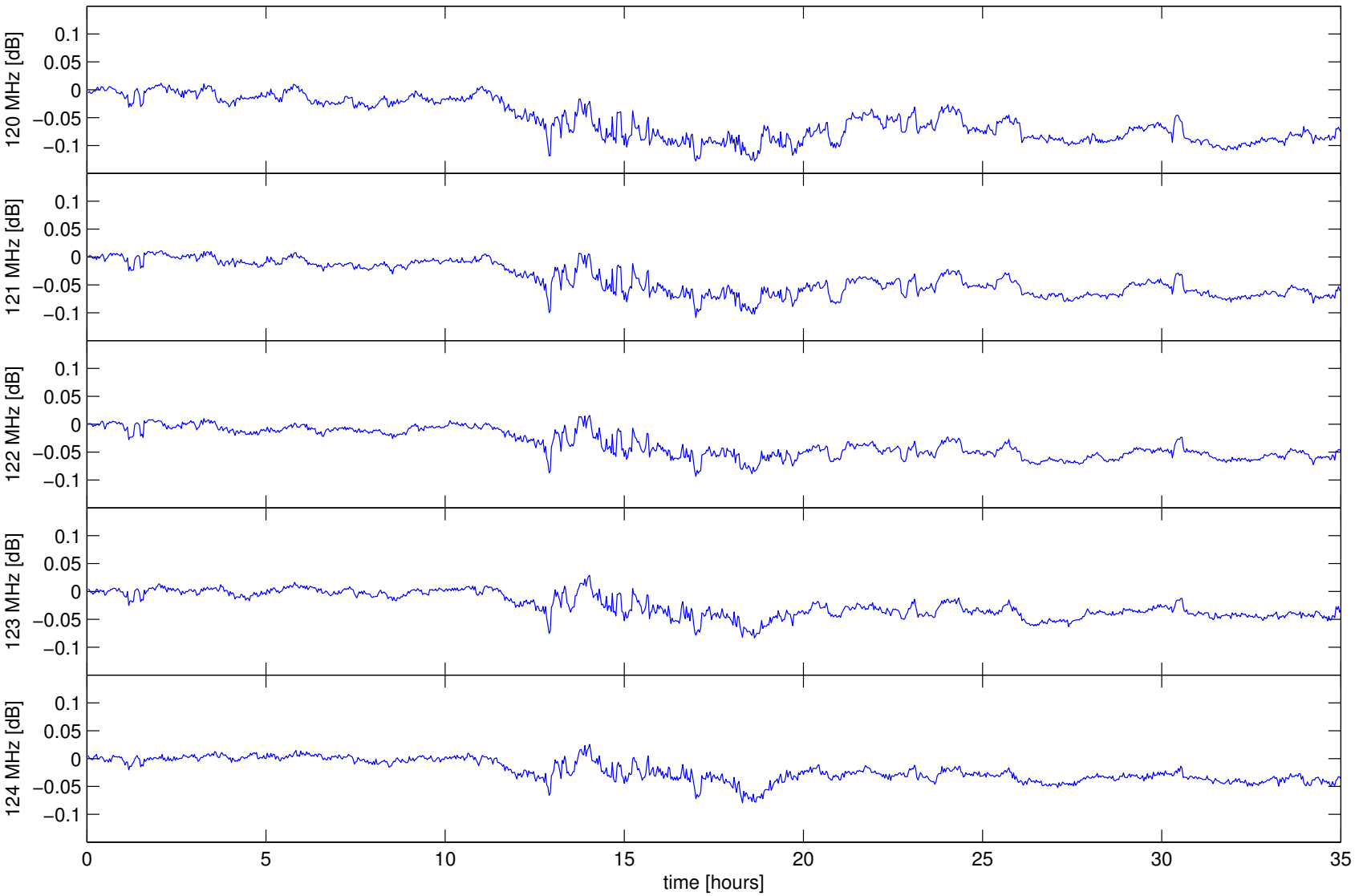


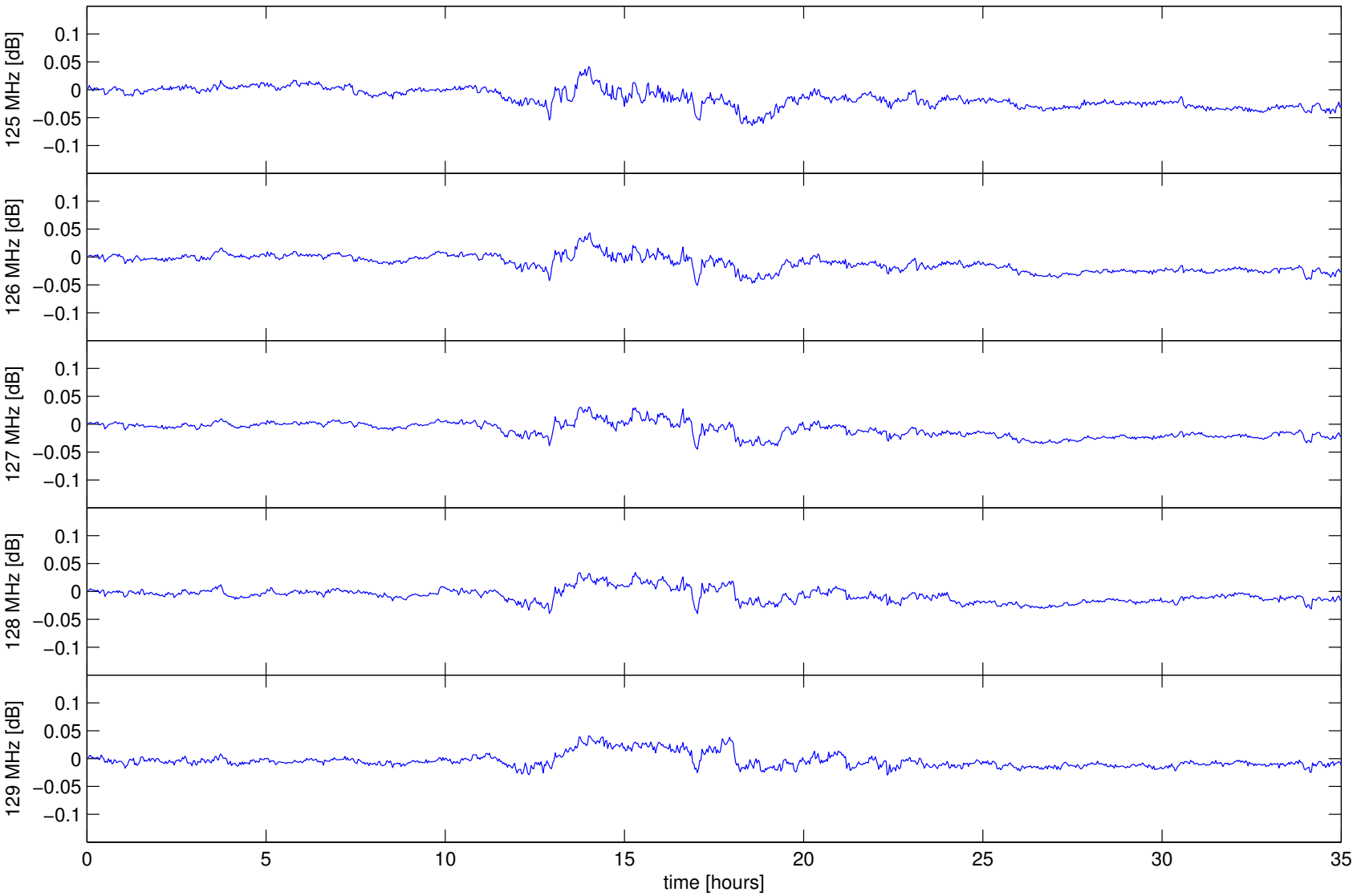
Figure: Temperature coefficient of the magnitude (top) and phase (bottom). Fits were performed for data below and above 41°C, since there is a distinctive change in behavior as the plots in Appendices 3 and 4 show. Clearly, the behavior is smoother, more repeatable and less dependent on temperature for data below 41°C.

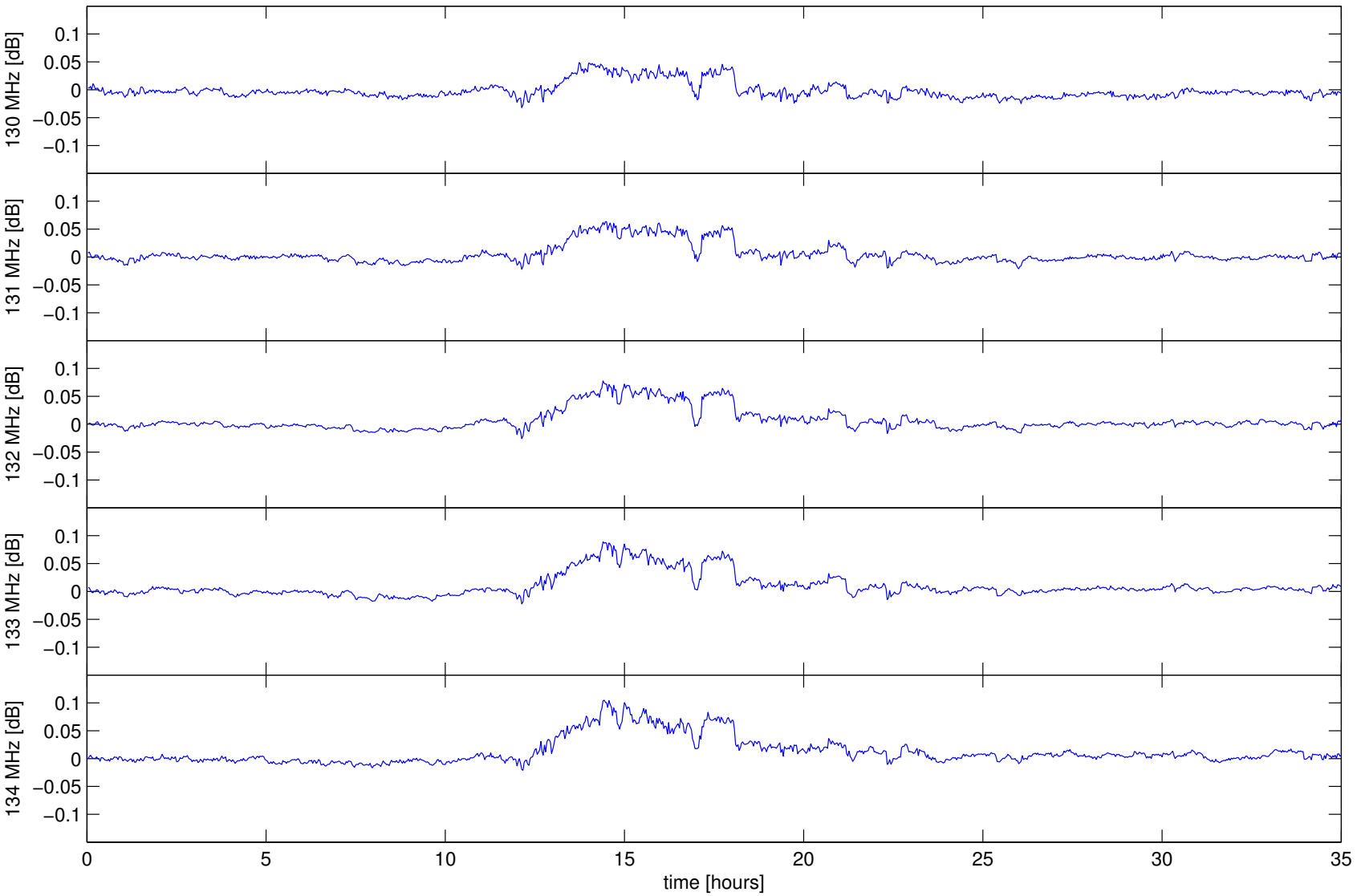
Conclusion

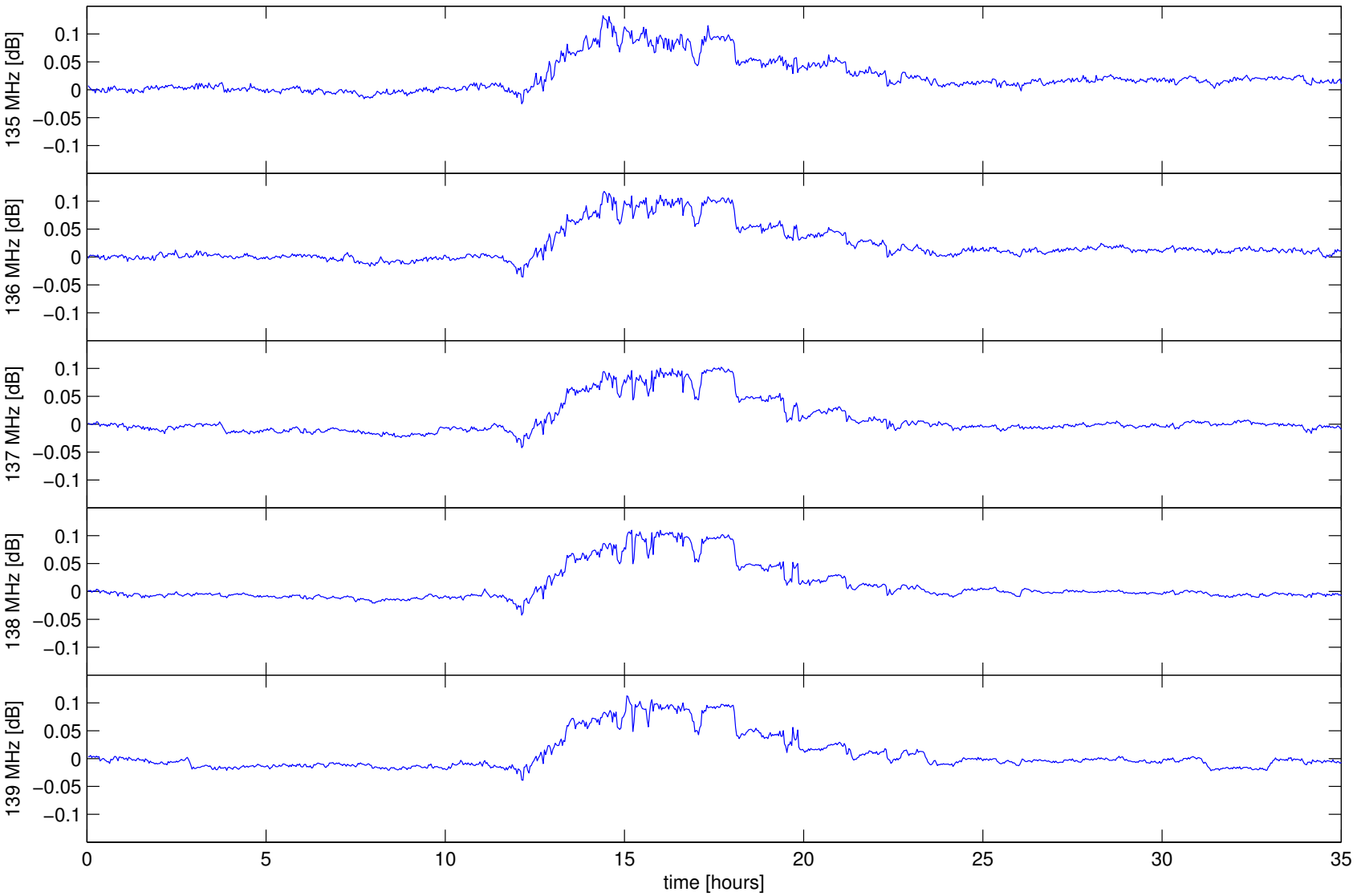
- The new aluminum base makes the antenna feel significantly stronger and more stable.
- Operation of the antenna under high temperatures seems to have helped to increase the preponderance of the top plate behavior. It is the dominant pattern for temperatures above 37°C.
- The jumps have been minimized, in particular for Regions 1 and 2. This is evidenced in the time streams shown in Appendices 1 and 2. In the high-temperature period, jumps still occur. The two largest occur at 16.7 and 18 hours, and their pattern in frequency indicates that it is due to changes in the top plate, specifically involving a decreasing capacitance. The overall reduction of jumps could be due to the stronger and more rigid aluminum base.
- An 8-MHz ripple in frequency is evident in the magnitude data. Clamp-on ferrites were used for the measurement. The most likely origin, as suggested by Alan, seems to be reflections from surrounding structures.
- Below 41°C, the data show smooth, linear variations with temperature (with few exceptions). For the magnitude, the temperature coefficient is $\leq$ 0.008 dB/°C in absolute value in the range 120-180 MHz. For the phase it is $\leq 0.07°/°$C. For temperatures above 41°C, jumps still impact the data significantly, and therefore the temperature-coefficient values obtained from the fits are not very representative.

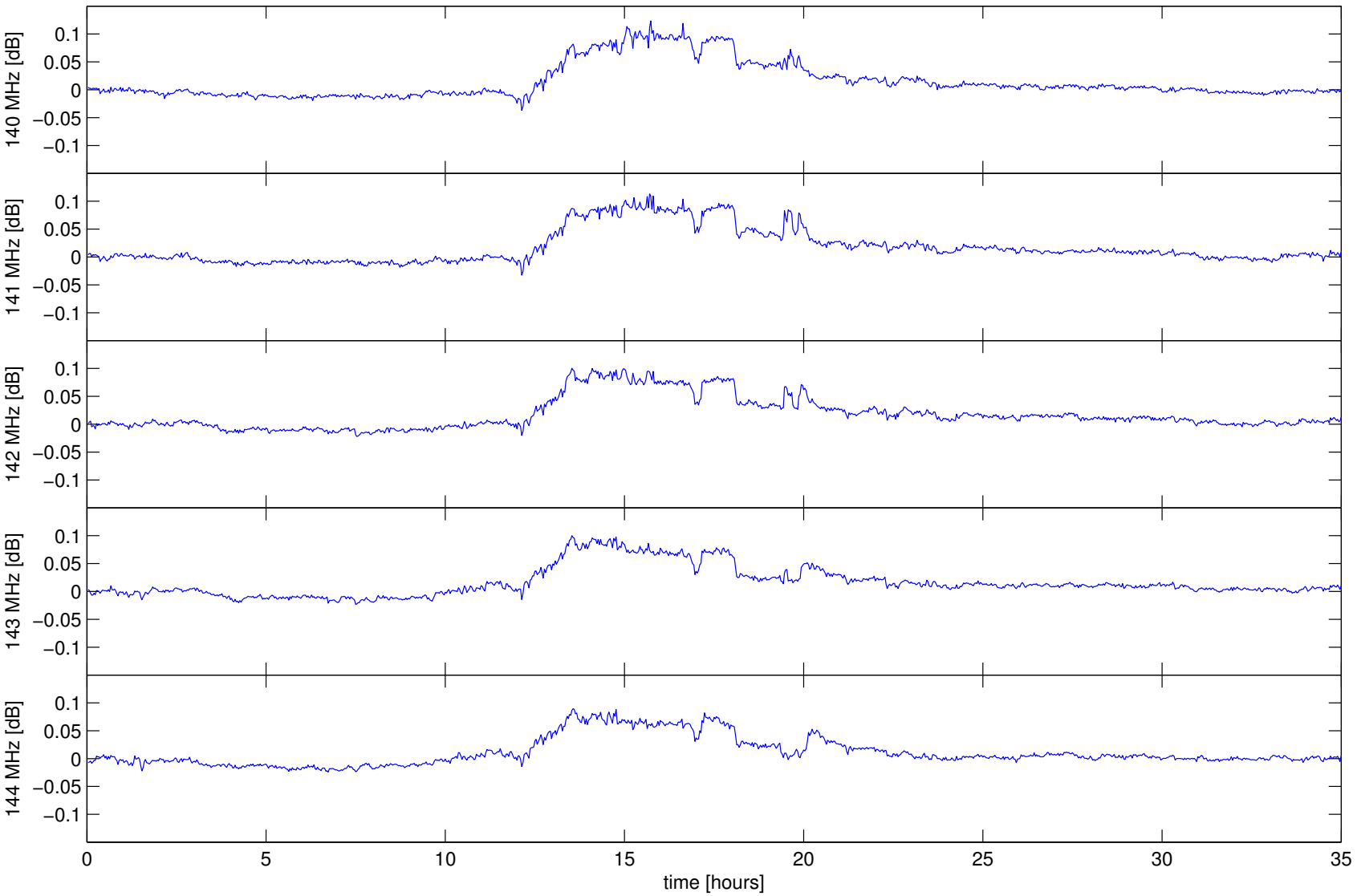
APPENDIX 1: Magnitude Time Streams for 120-180 MHz

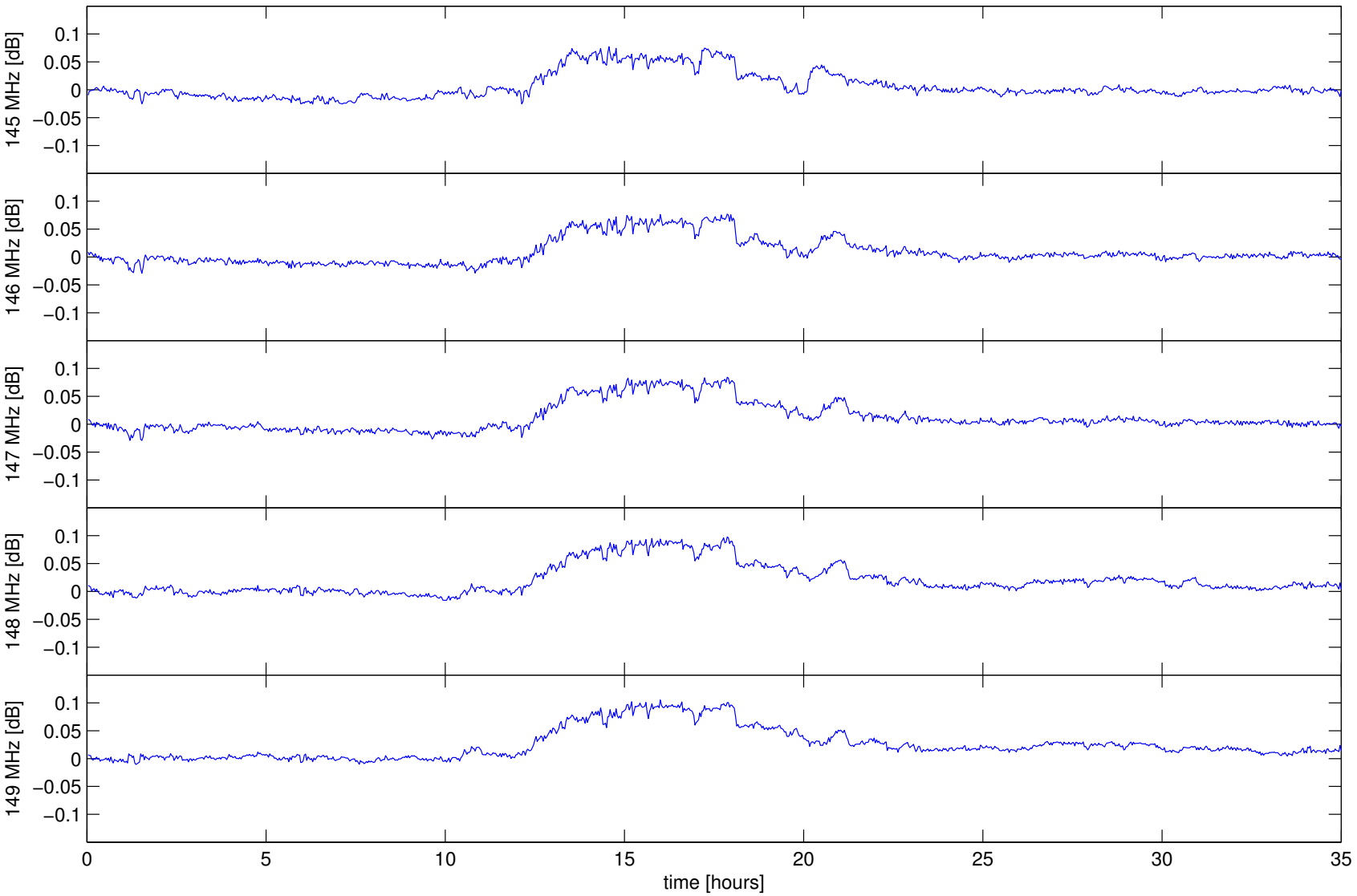

120 MHz [dB]
121 MHz [dB]
122 MHz [dB]
123 MHz [dB]
124 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

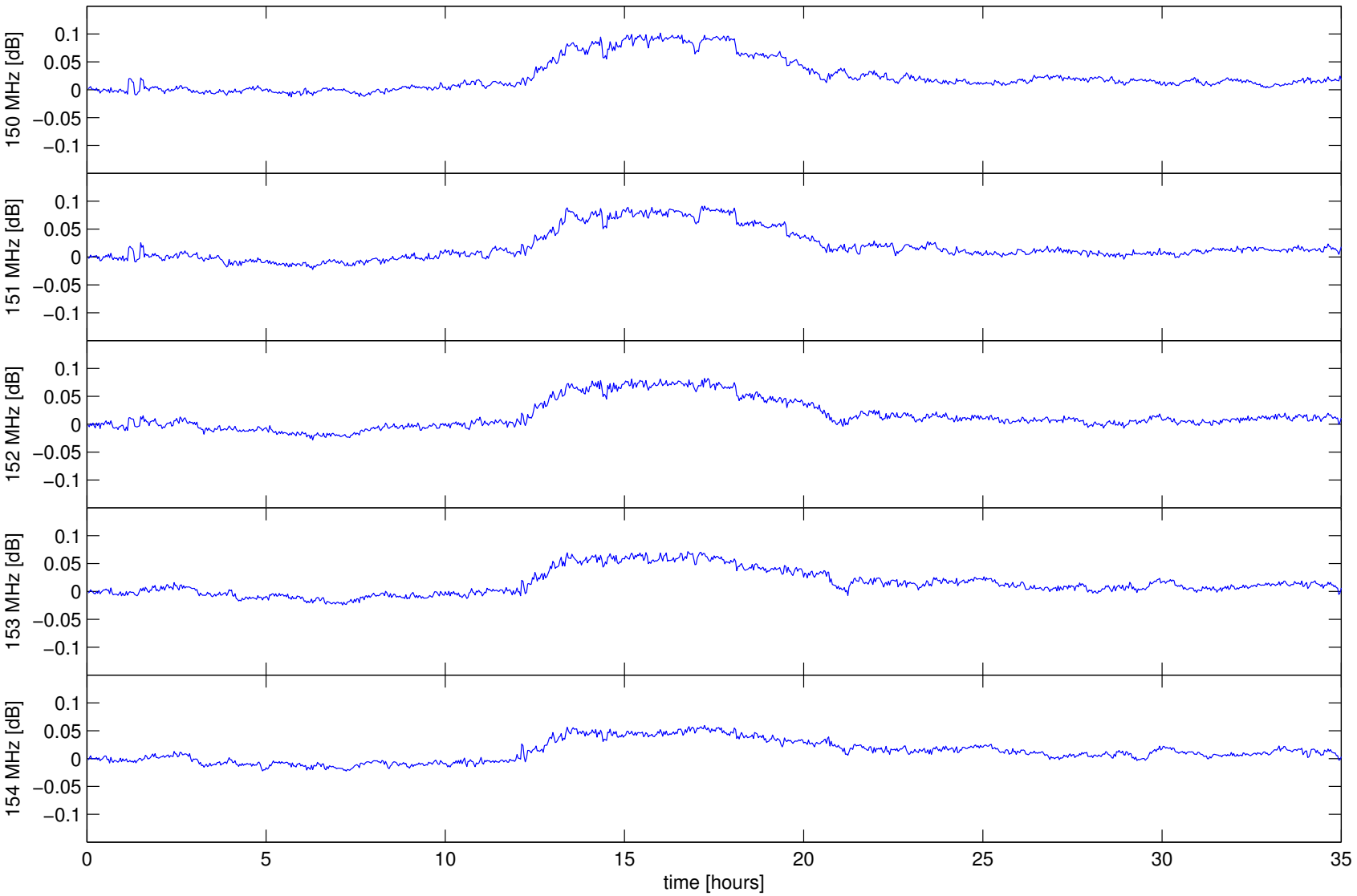

125 MHz [dB]
126 MHz [dB]
127 MHz [dB]
128 MHz [dB]
129 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

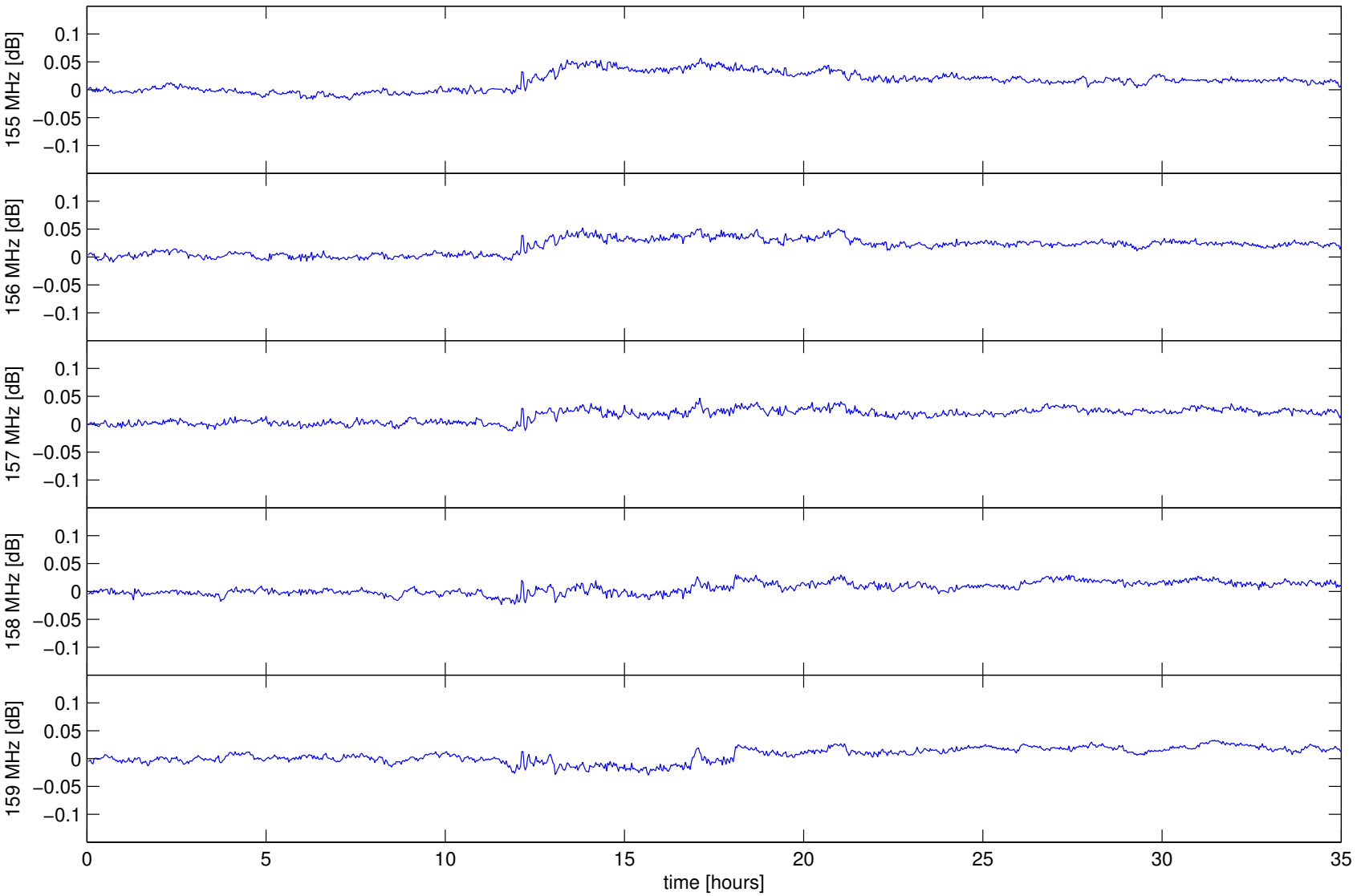

130 MHz [dB]
131 MHz [dB]
132 MHz [dB]
133 MHz [dB]
134 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

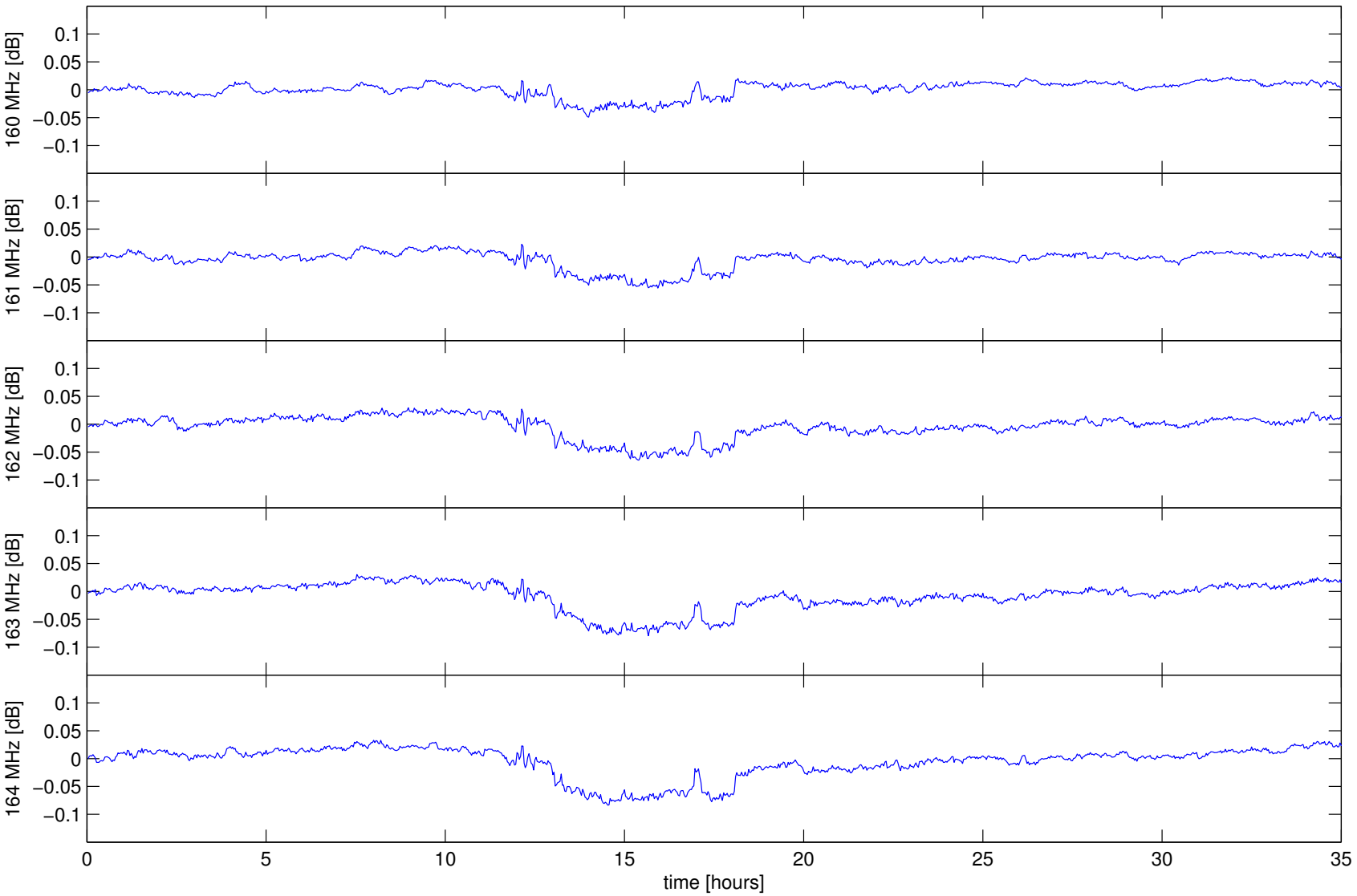

135 MHz [dB]
136 MHz [dB]
137 MHz [dB]
138 MHz [dB]
139 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

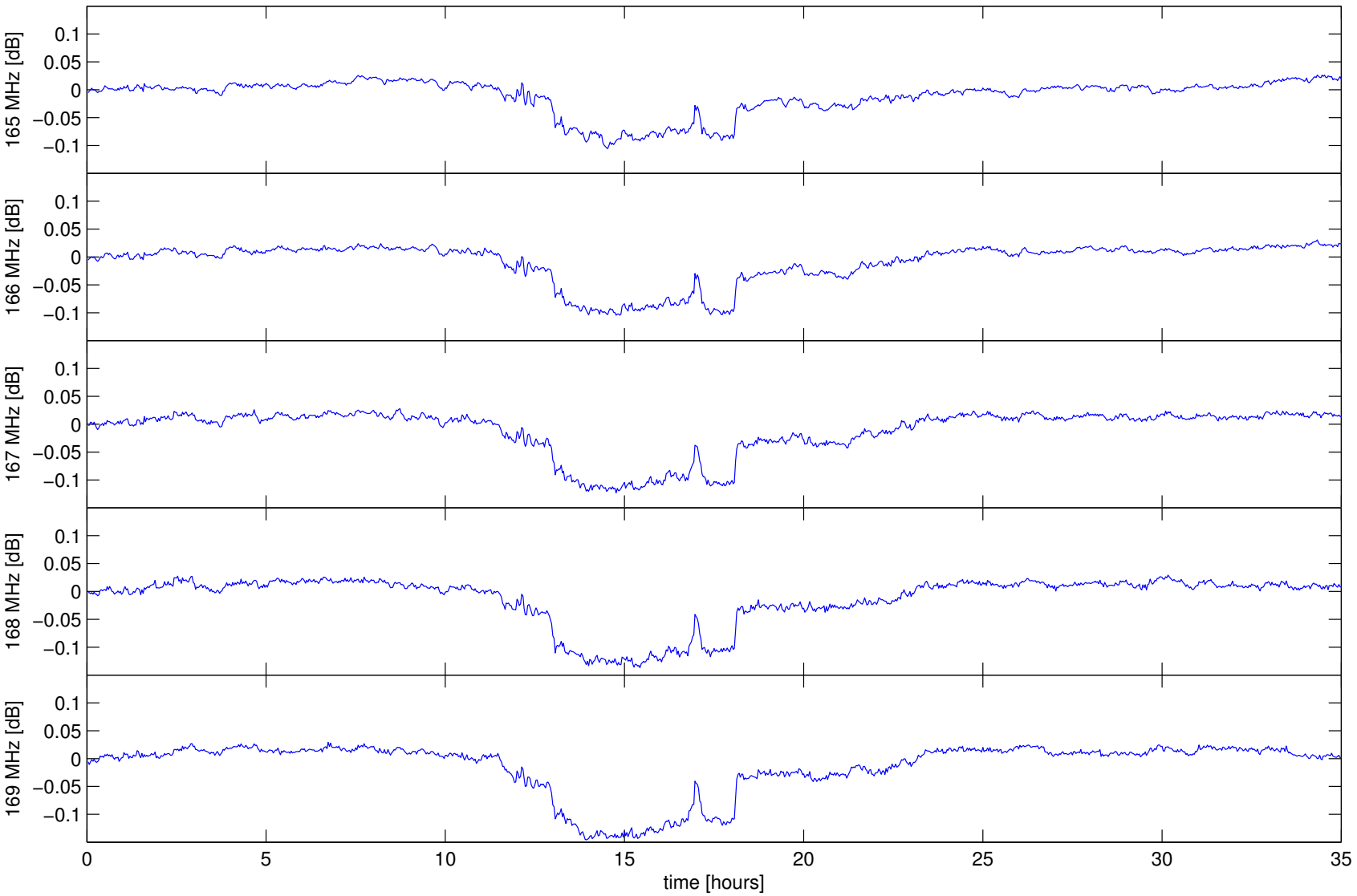

140 MHz [dB]
141 MHz [dB]
142 MHz [dB]
143 MHz [dB]
144 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

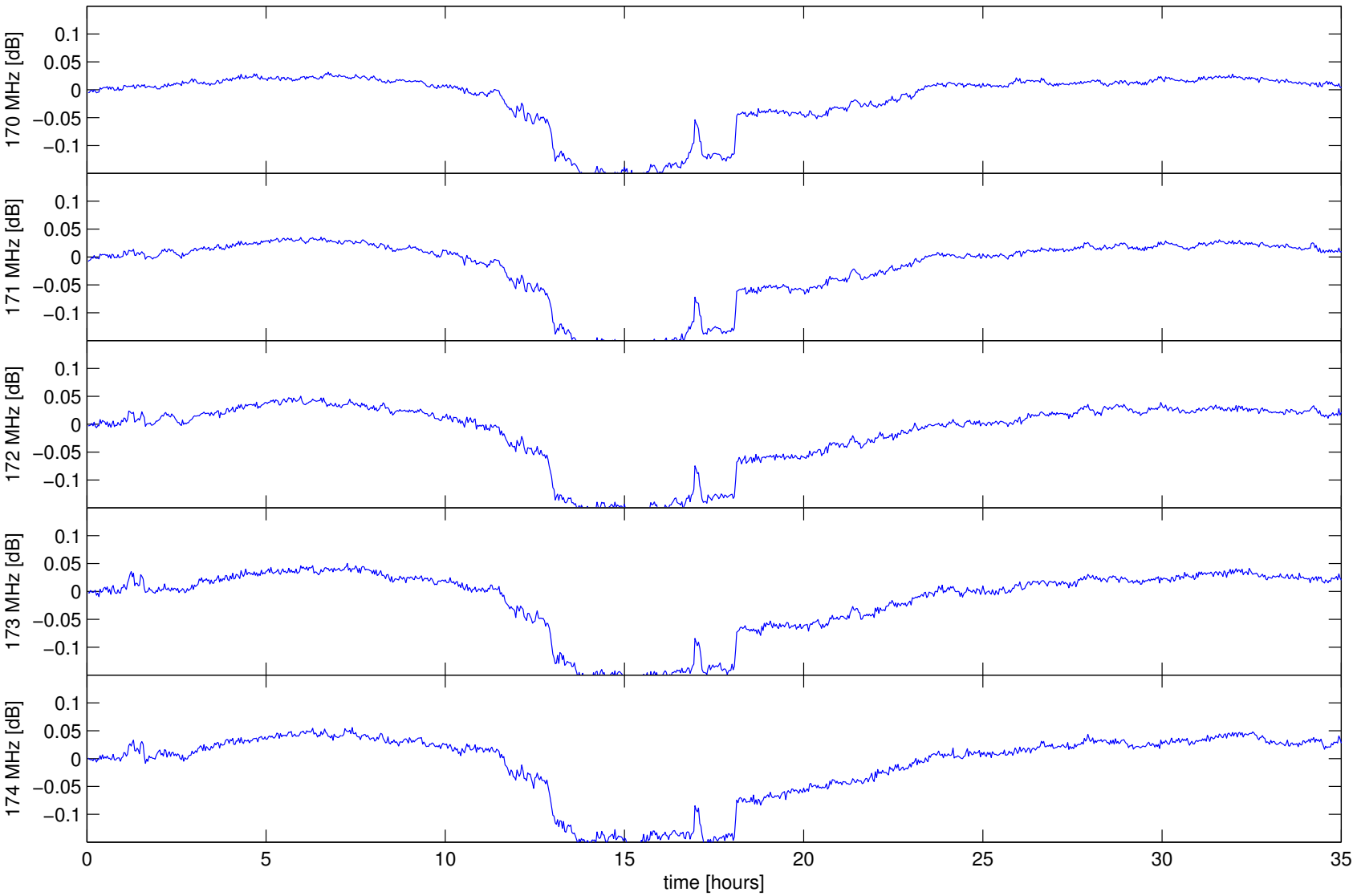

145 MHz [dB]
146 MHz [dB]
147 MHz [dB]
148 MHz [dB]
149 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

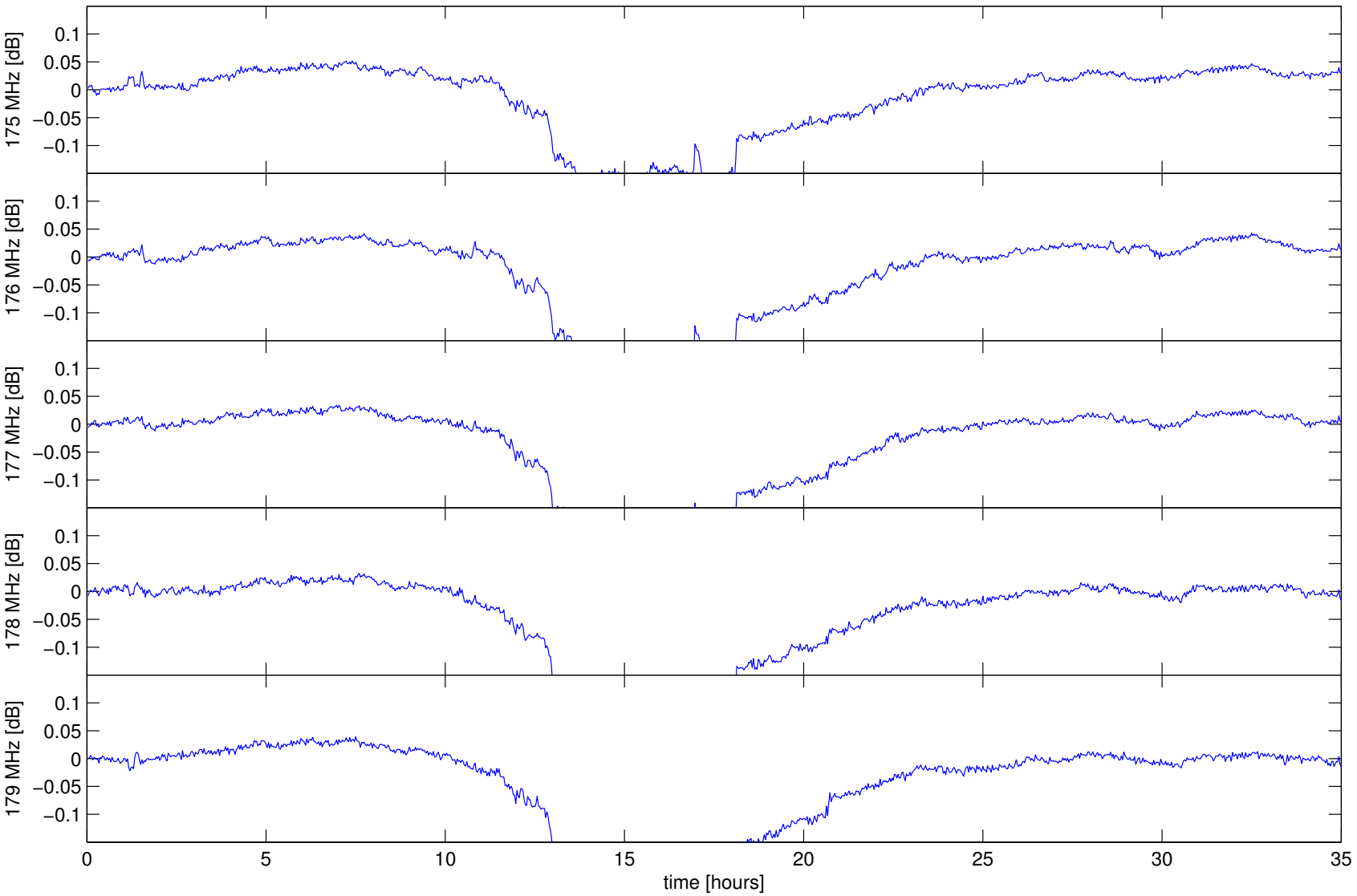

150 MHz [dB]
151 MHz [dB]
152 MHz [dB]
153 MHz [dB]
154 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]


155 MHz [dB]
156 MHz [dB]
157 MHz [dB]
158 MHz [dB]
159 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

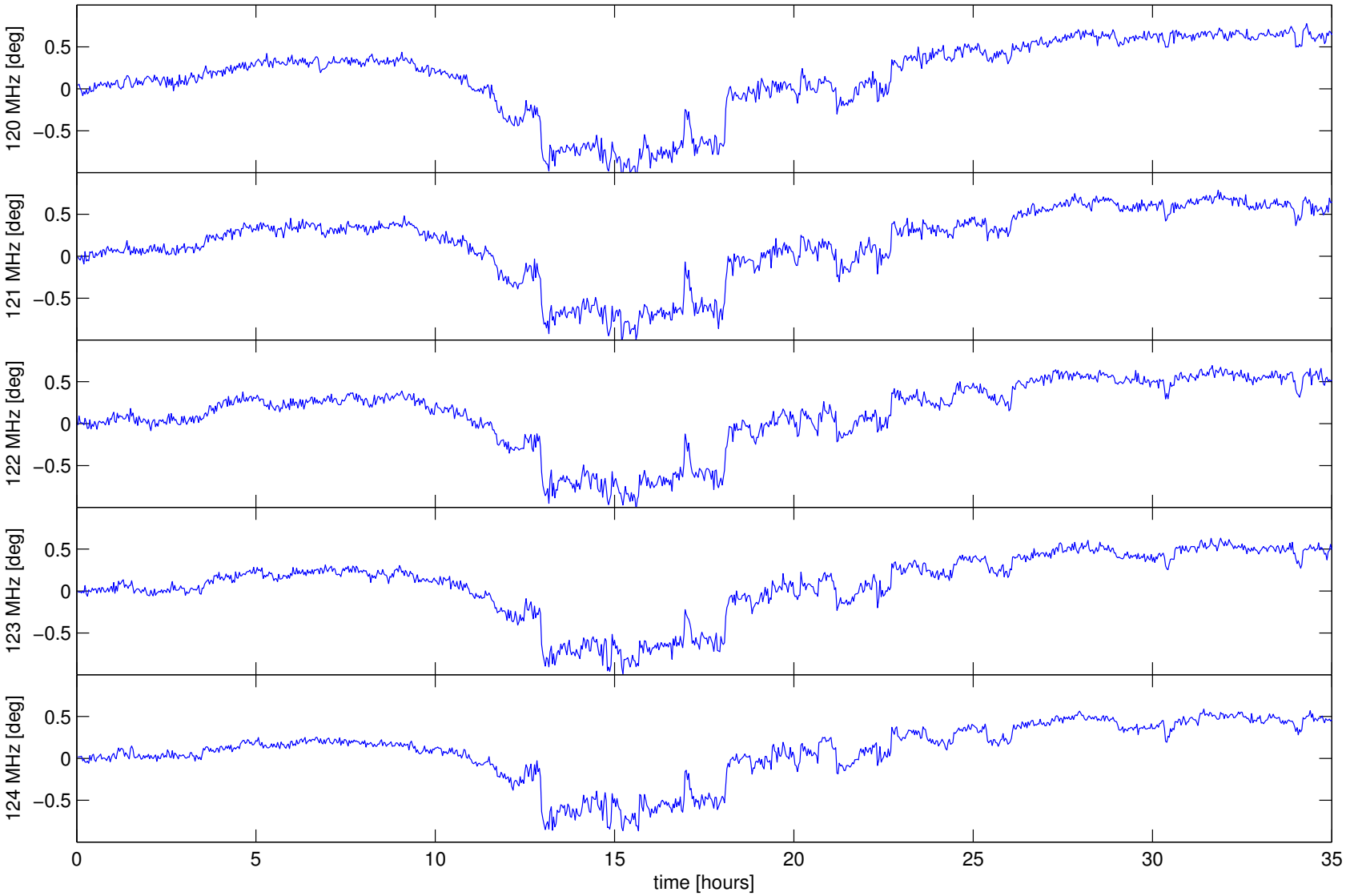

160 MHz [dB]
161 MHz [dB]
162 MHz [dB]
163 MHz [dB]
164 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

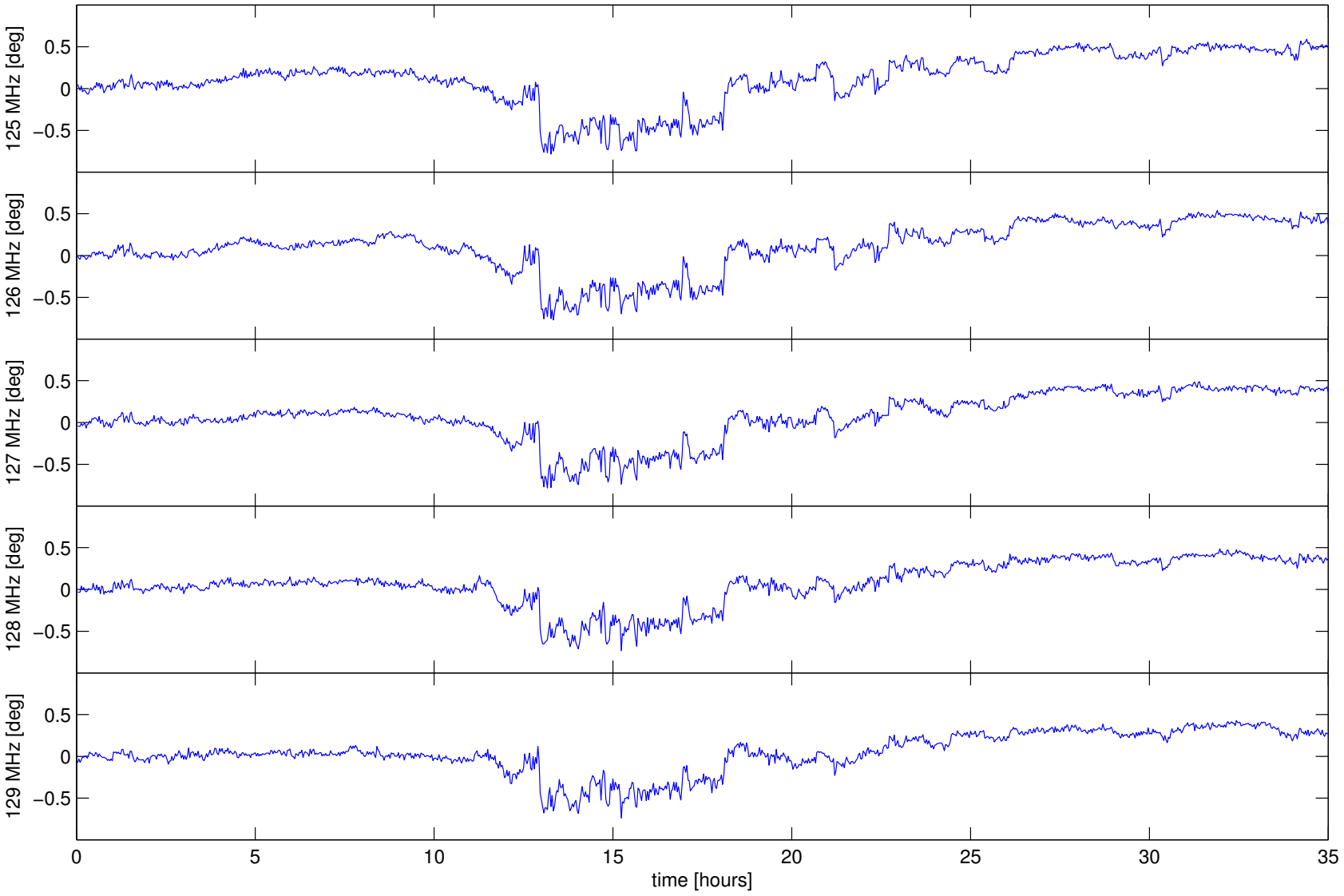

165 MHz [dB]
166 MHz [dB]
167 MHz [dB]
168 MHz [dB]
169 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

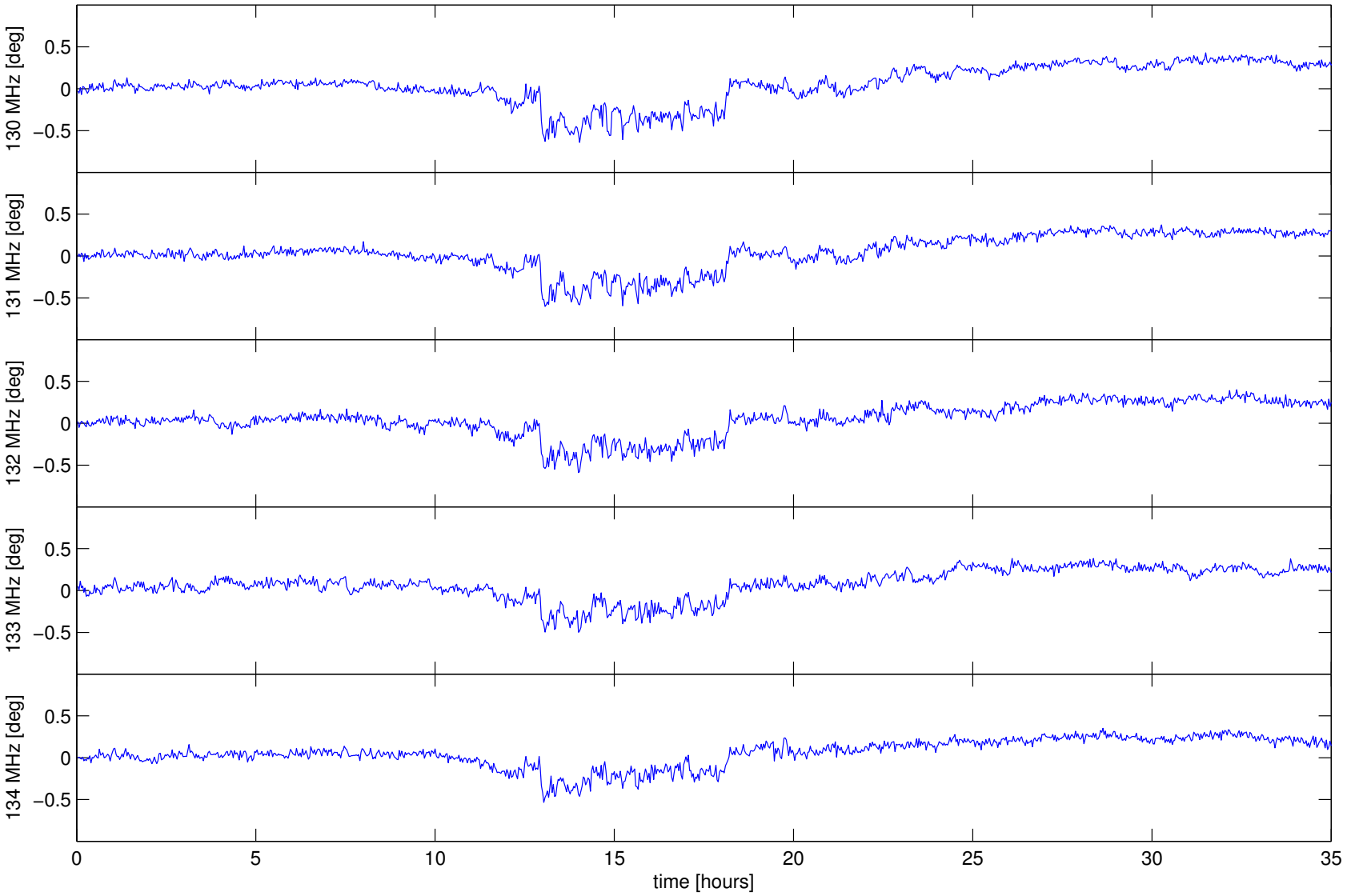

170 MHz [dB]
171 MHz [dB]
172 MHz [dB]
173 MHz [dB]
174 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

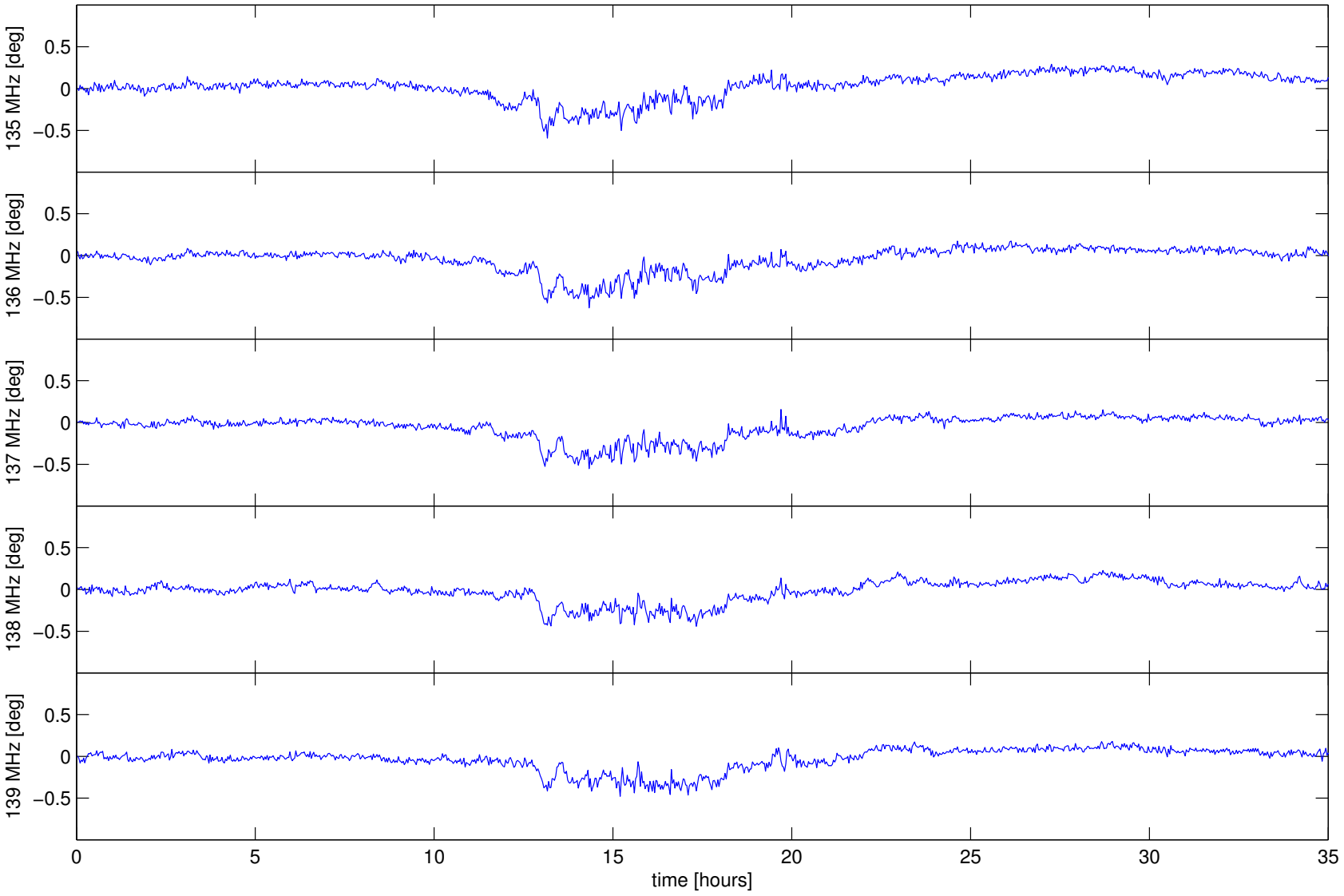

175 MHz [dB]
176 MHz [dB]
177 MHz [dB]
178 MHz [dB]
179 MHz [dB]
0.1
0.05
0
−0.05
−0.1
0
5
10
15
20
25
30
35
time [hours]

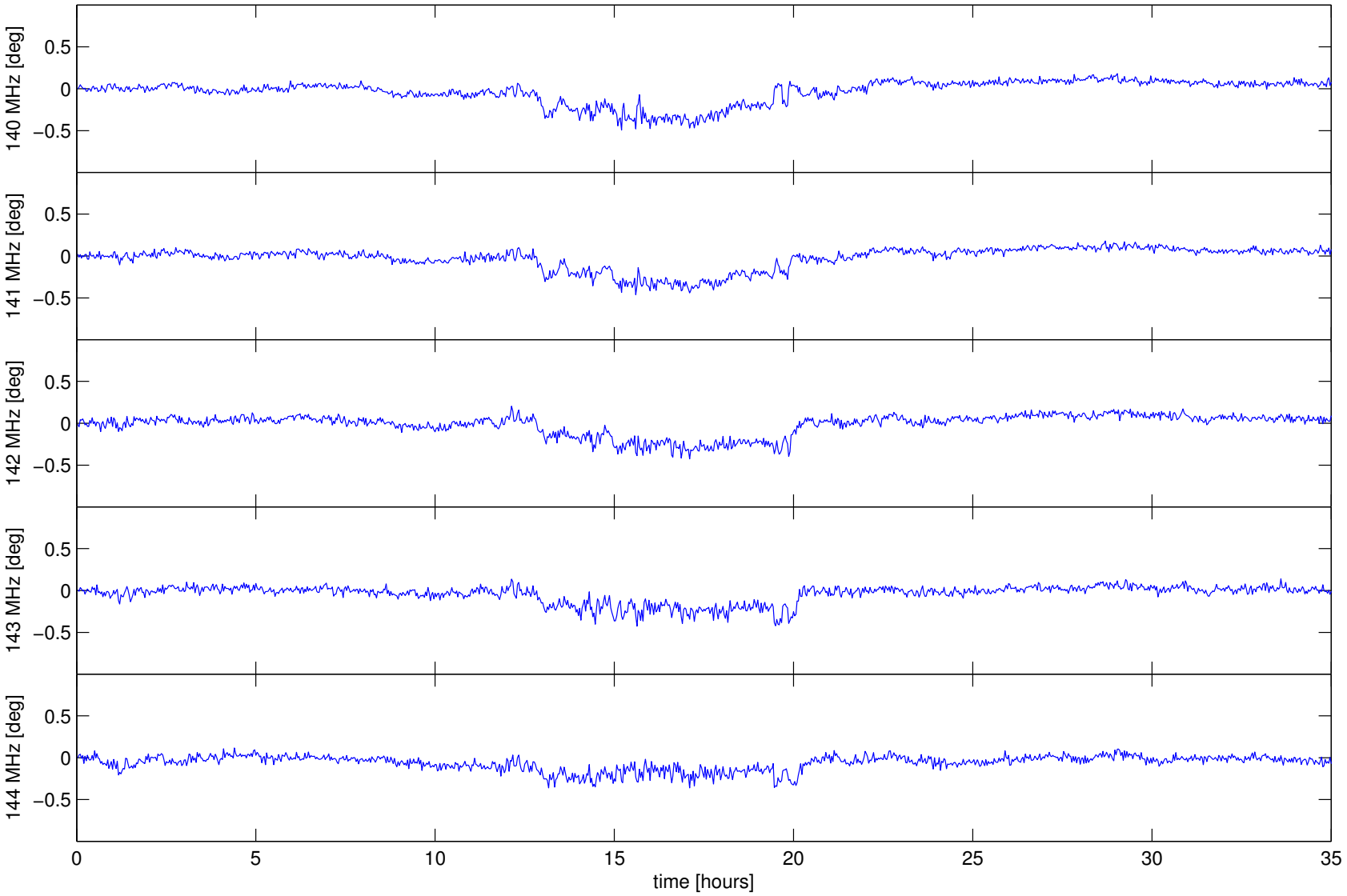
APPENDIX 2: Phase Time Streams for 120-180 MHz

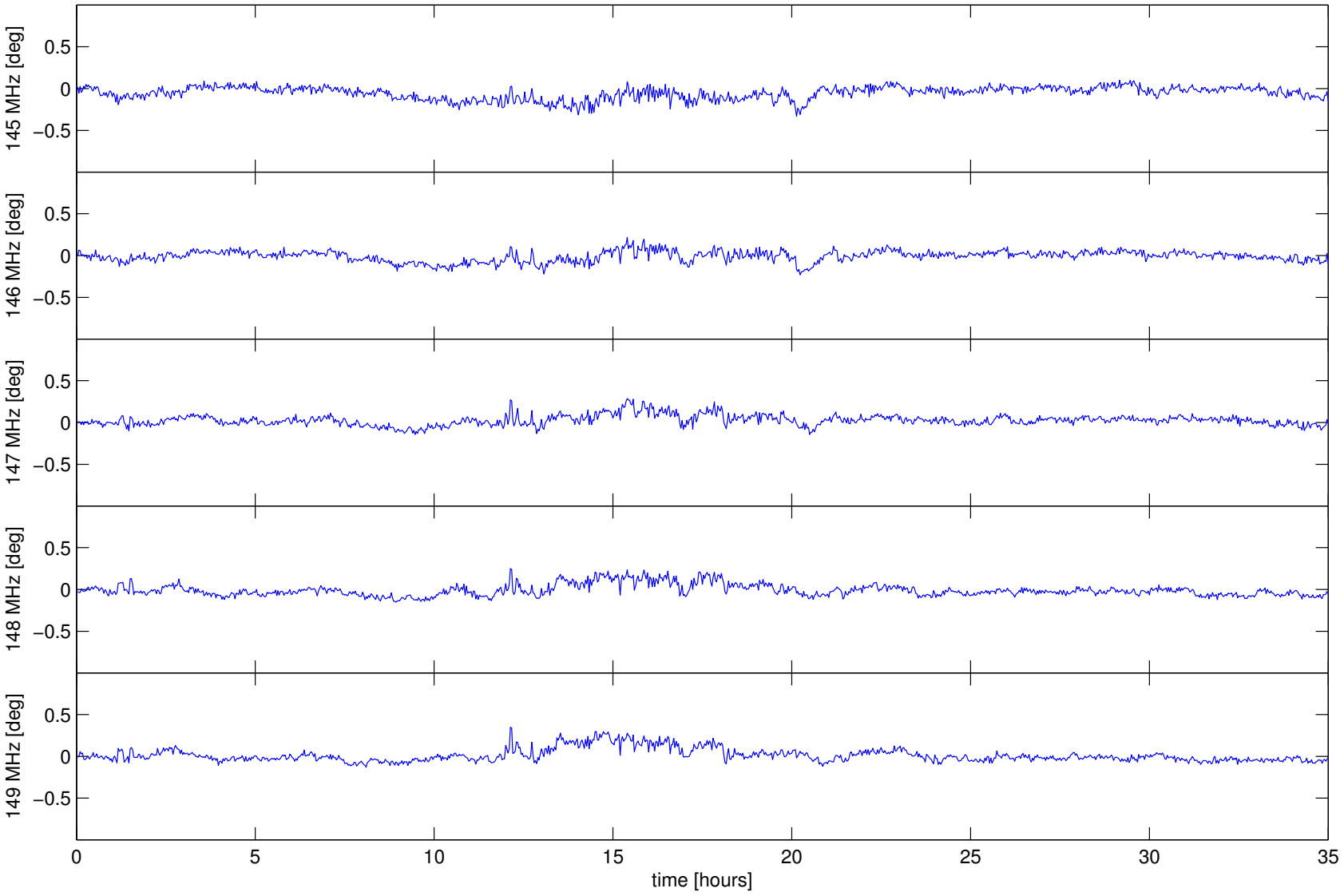

120 MHz [deg]
121 MHz [deg]
122 MHz [deg]
123 MHz [deg]
124 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

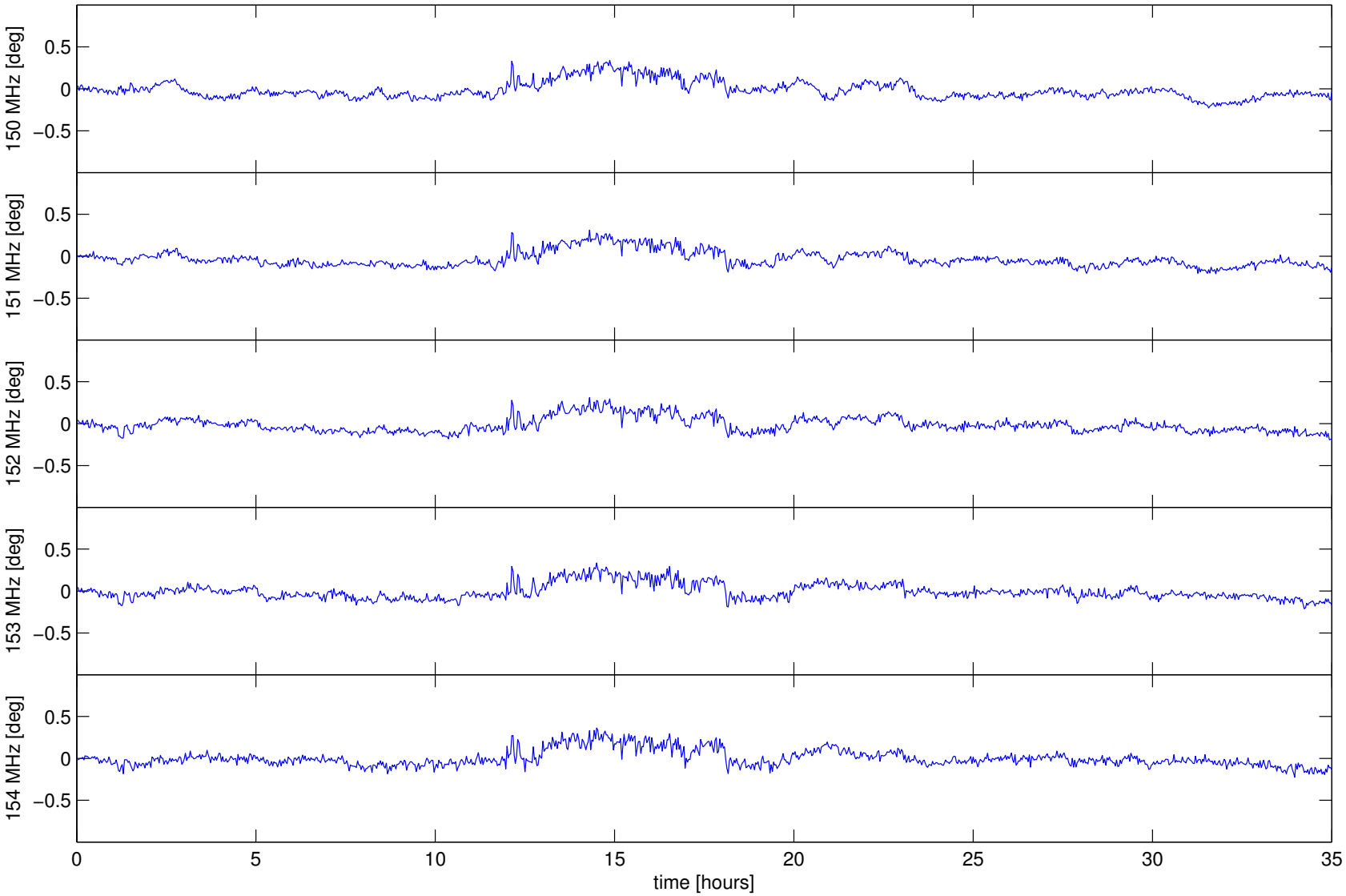

125 MHz [deg]
126 MHz [deg]
127 MHz [deg]
128 MHz [deg]
129 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

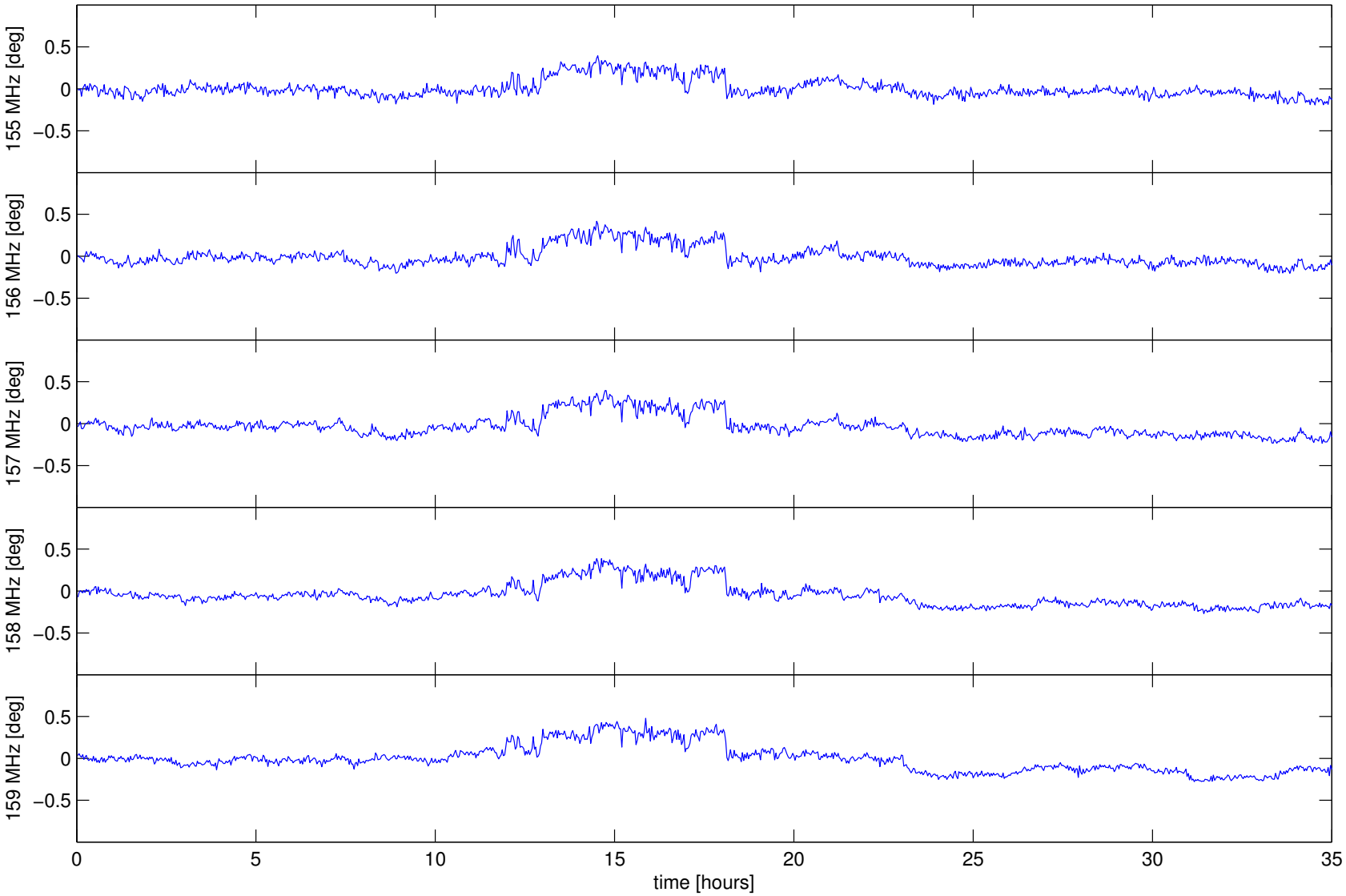

130 MHz [deg]
131 MHz [deg]
132 MHz [deg]
133 MHz [deg]
134 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

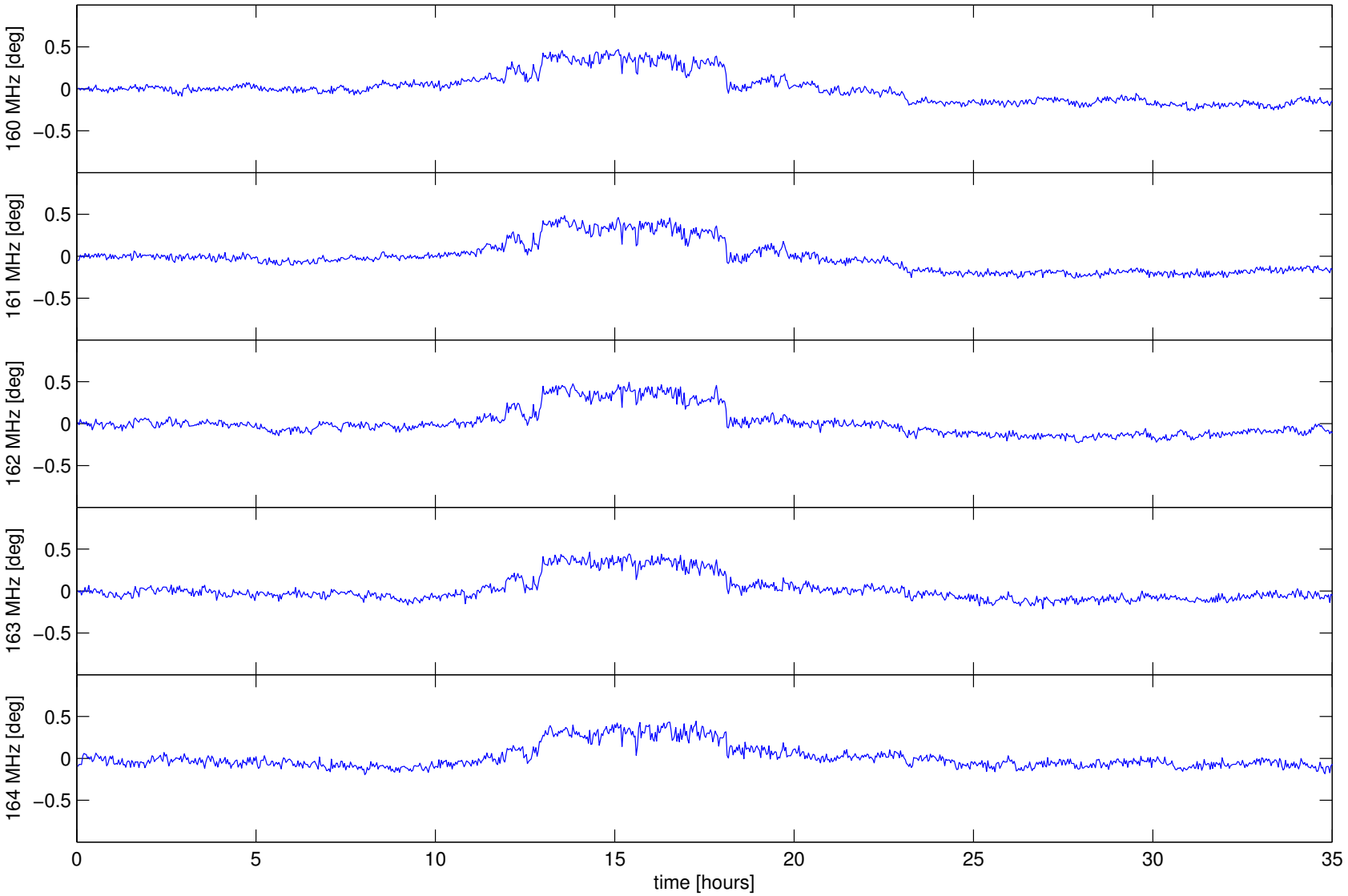

135 MHz [deg]
136 MHz [deg]
137 MHz [deg]
138 MHz [deg]
139 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

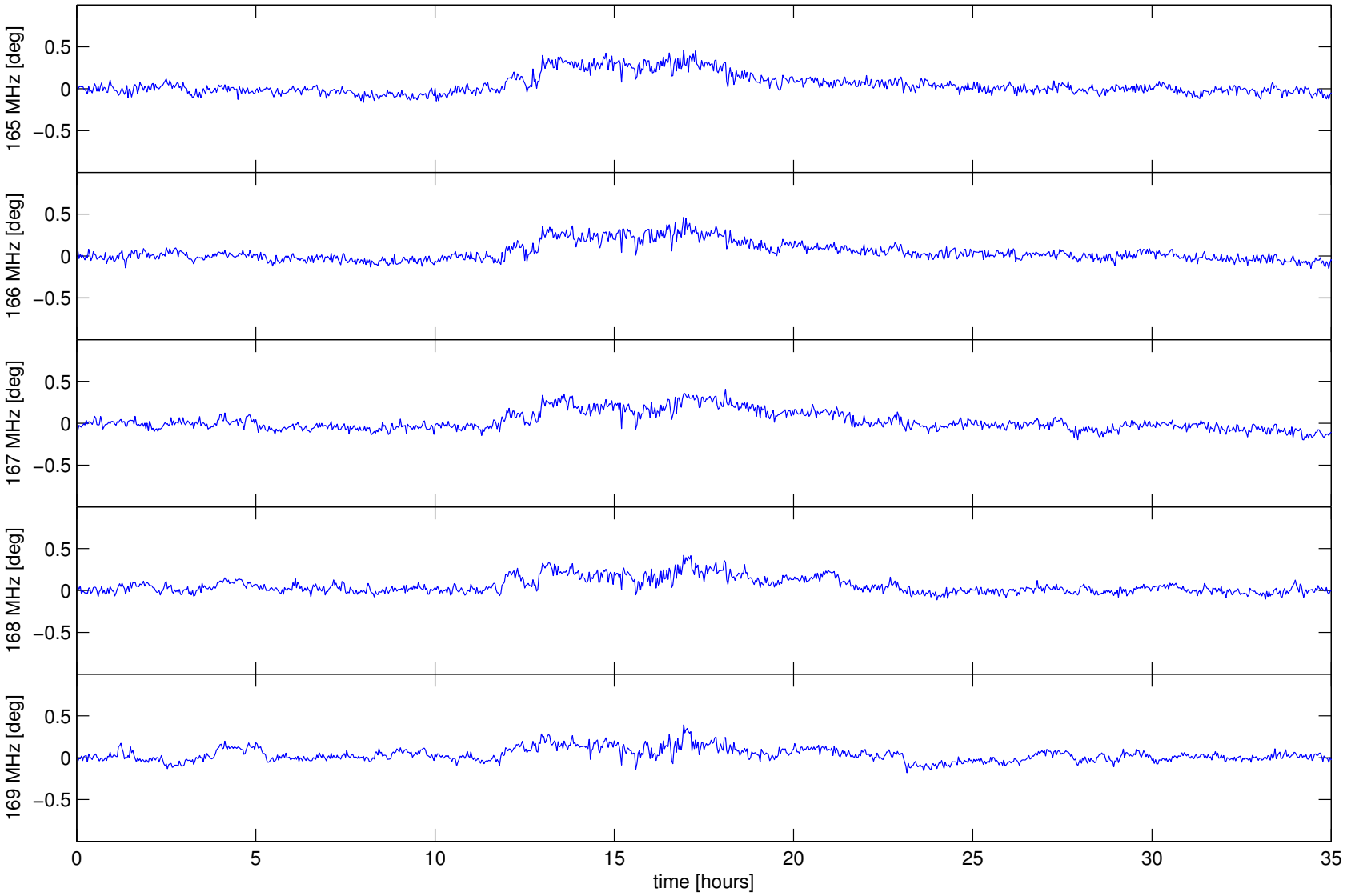

140 MHz [deg]
141 MHz [deg]
142 MHz [deg]
143 MHz [deg]
144 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

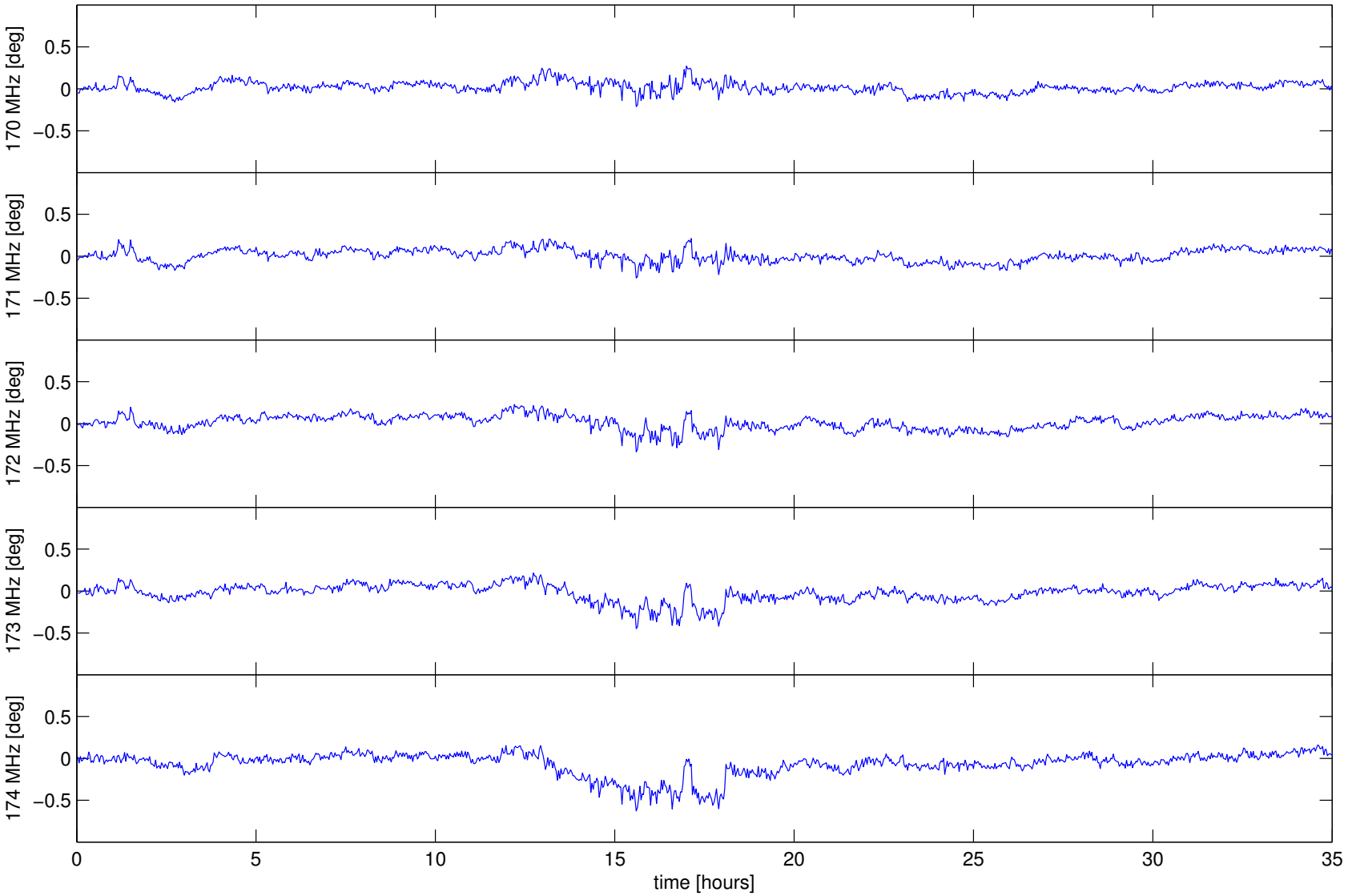

145 MHz [deg]
146 MHz [deg]
147 MHz [deg]
148 MHz [deg]
149 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

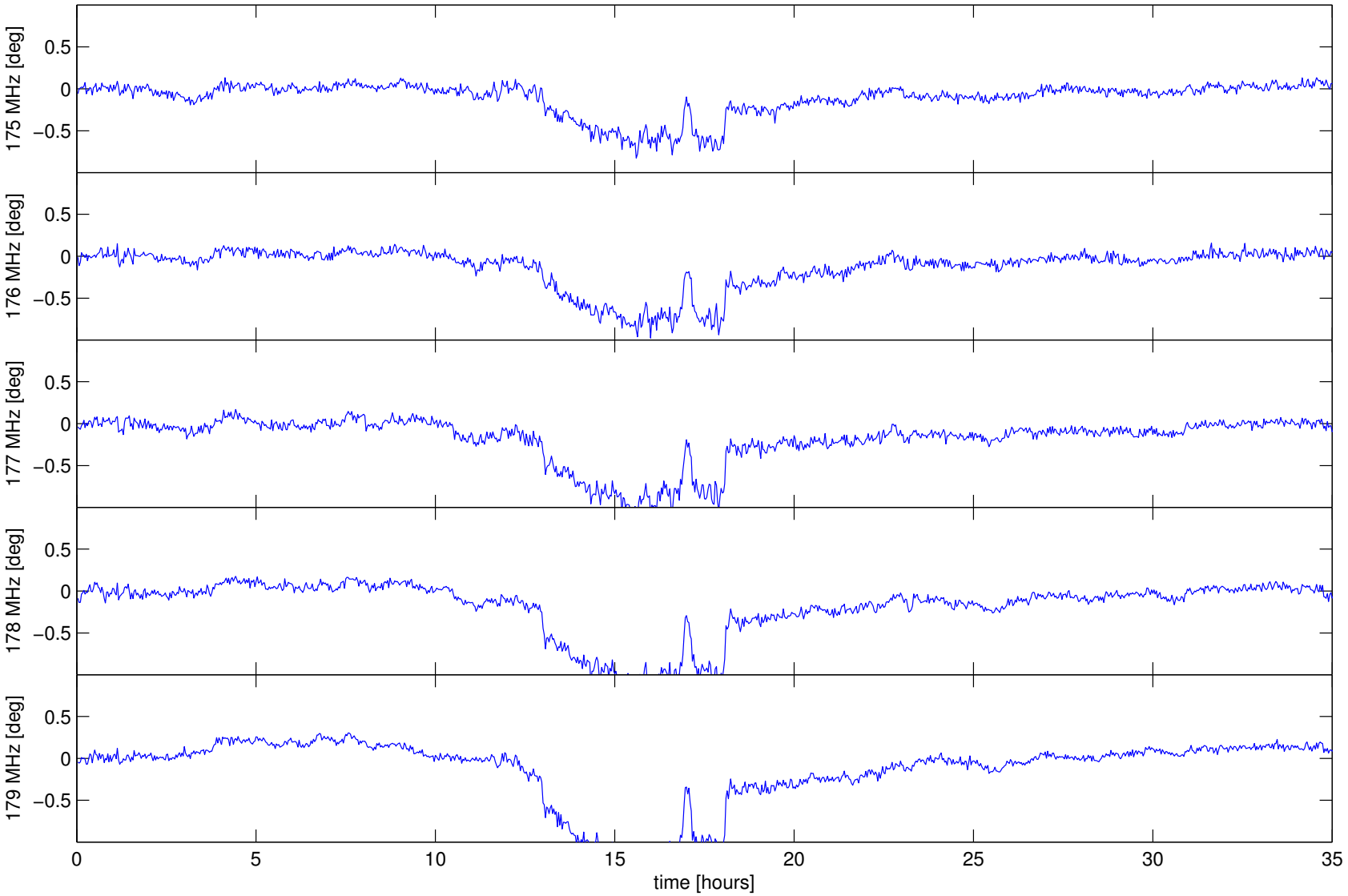

150 MHz [deg]
151 MHz [deg]
152 MHz [deg]
153 MHz [deg]
154 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]


155 MHz [deg]
156 MHz [deg]
157 MHz [deg]
158 MHz [deg]
159 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

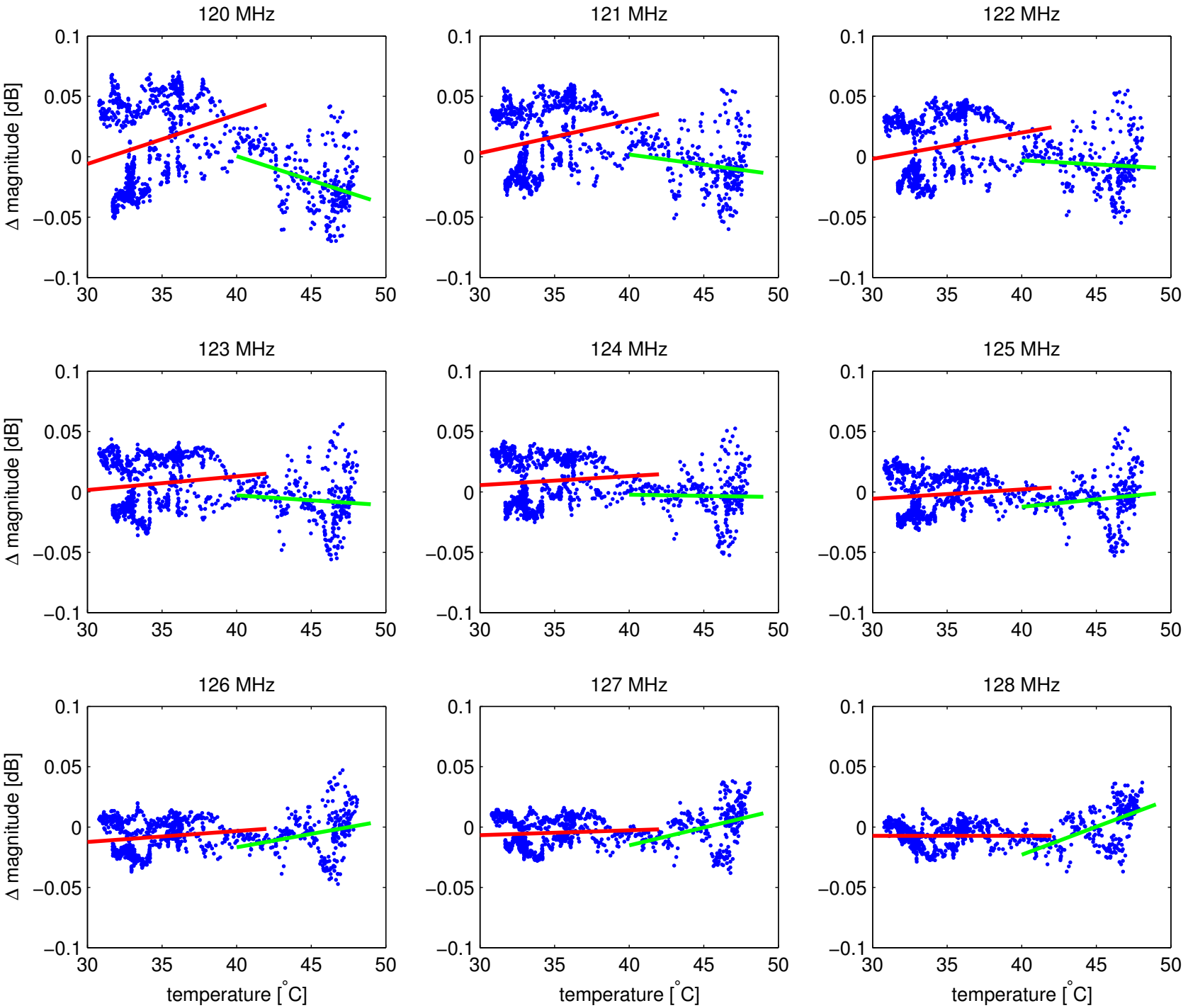

160 MHz [deg]
161 MHz [deg]
162 MHz [deg]
163 MHz [deg]
164 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

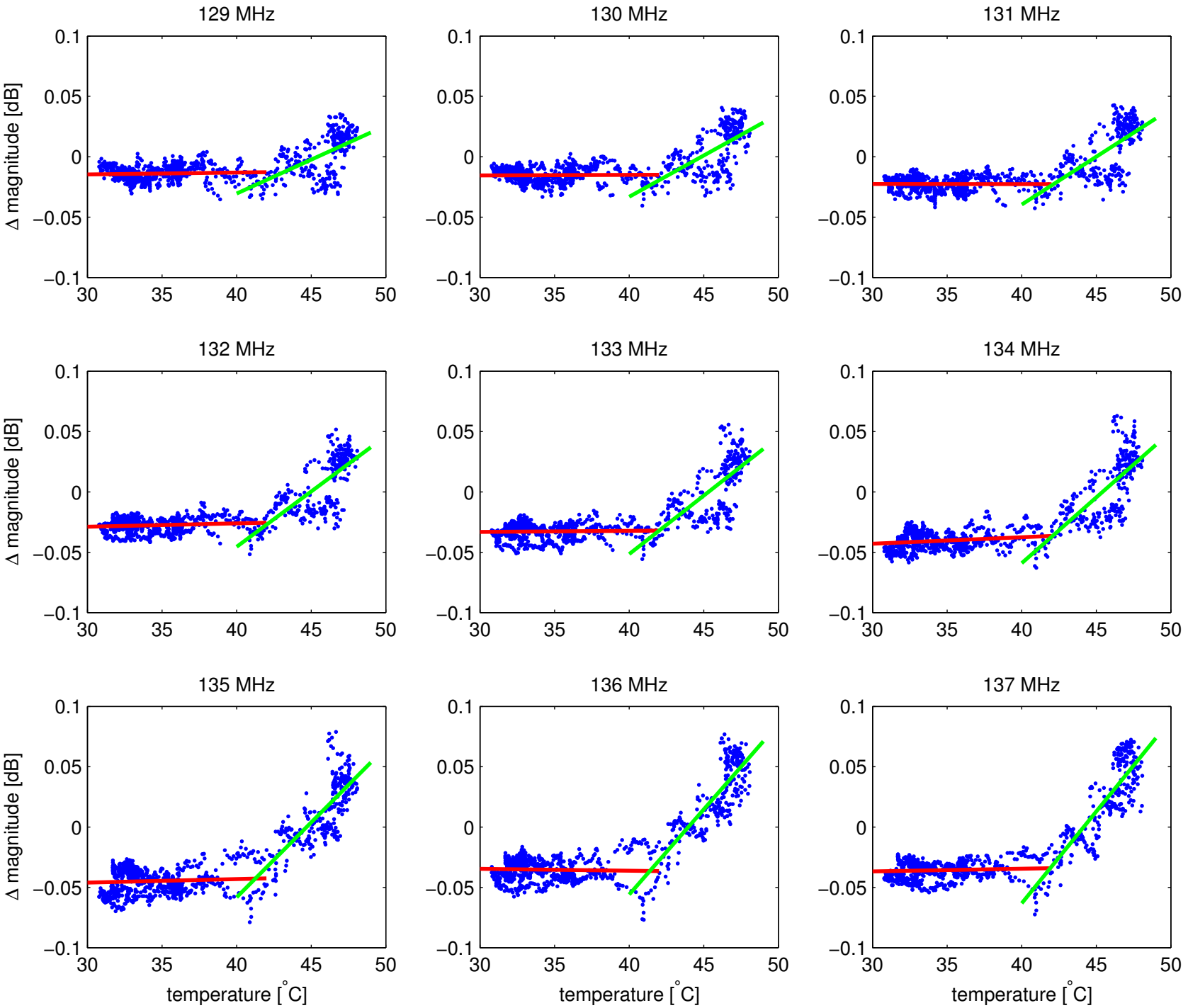

165 MHz [deg]
166 MHz [deg]
167 MHz [deg]
168 MHz [deg]
169 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

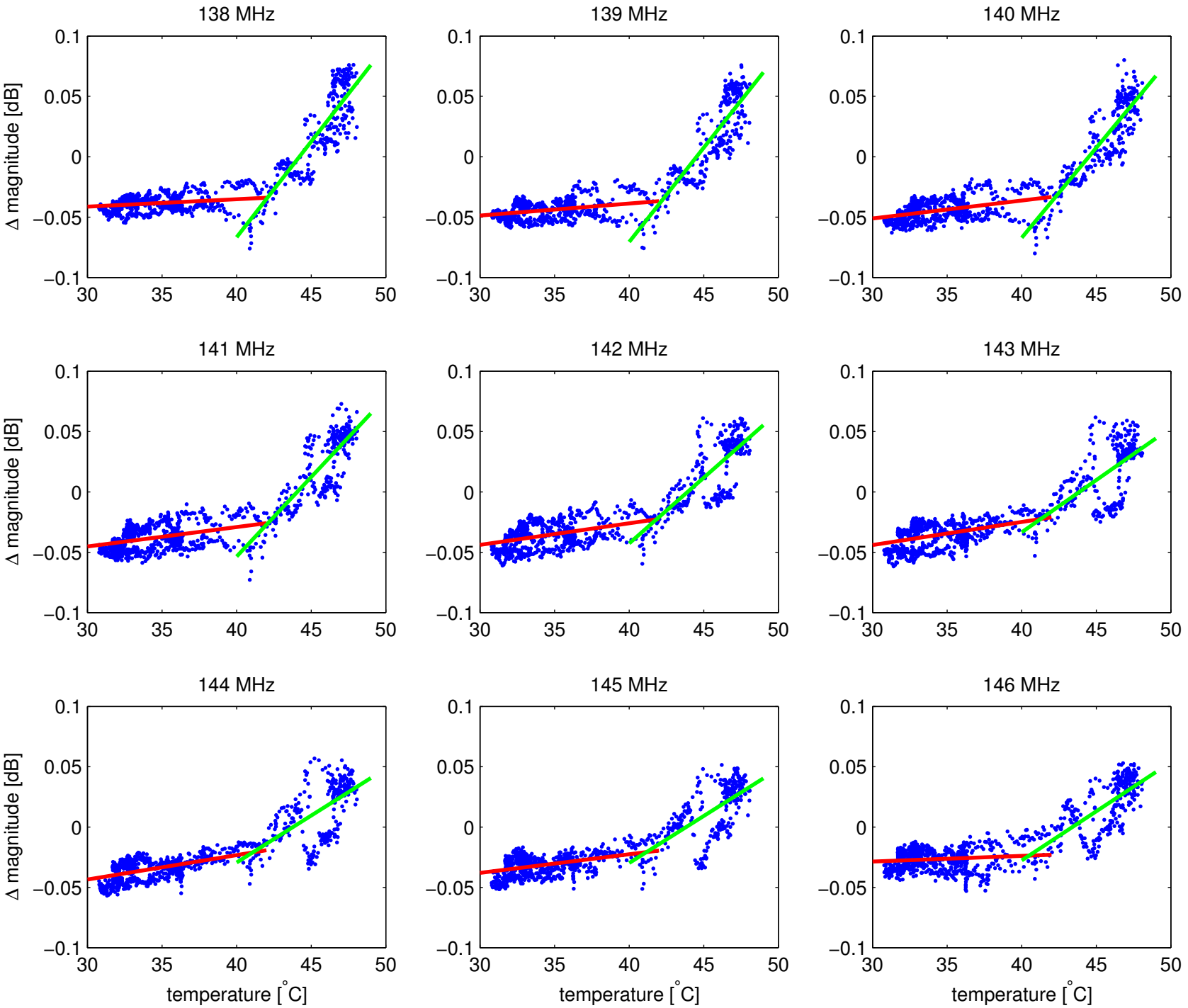

170 MHz [deg]
171 MHz [deg]
172 MHz [deg]
173 MHz [deg]
174 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

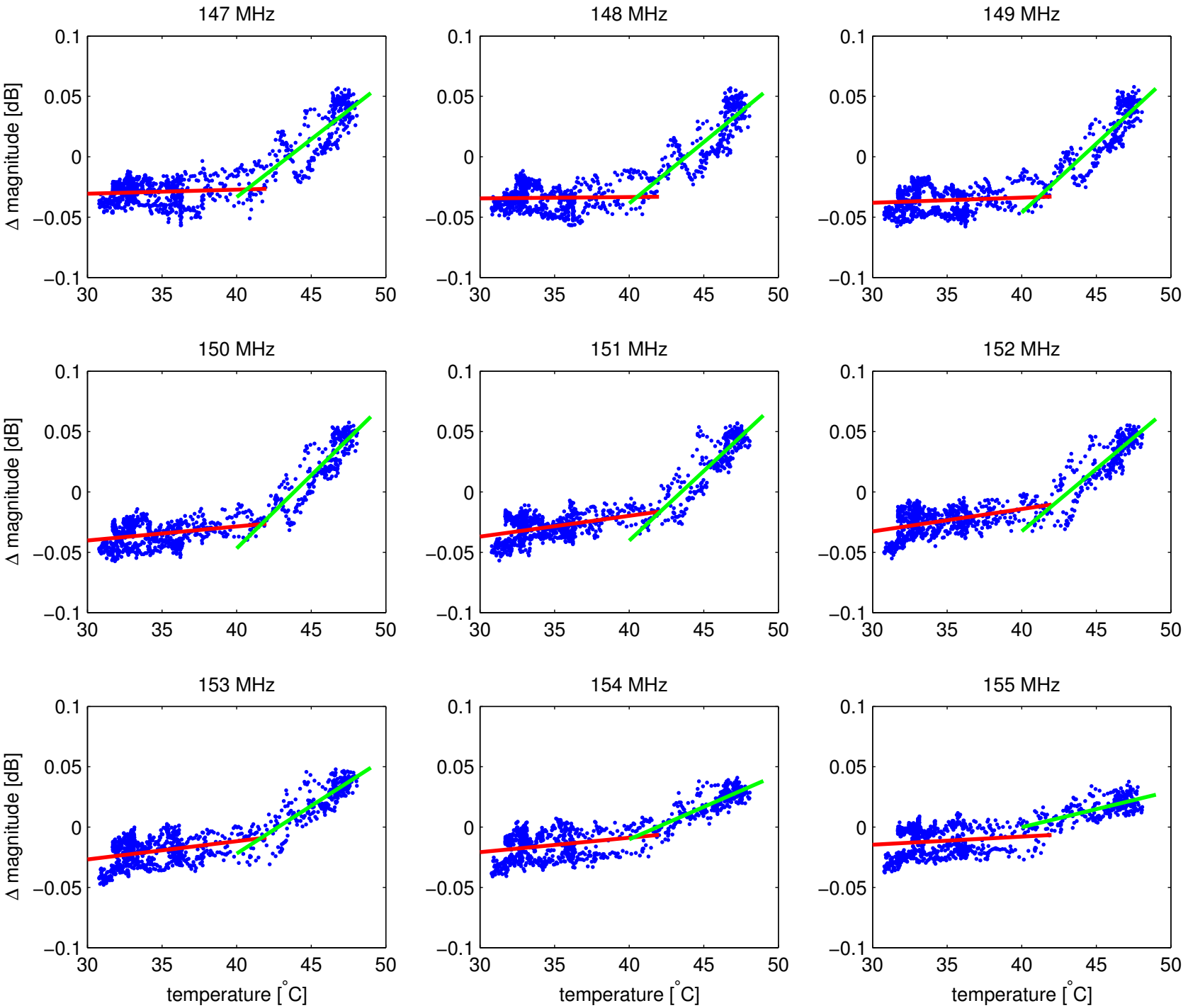

175 MHz [deg]
176 MHz [deg]
177 MHz [deg]
178 MHz [deg]
179 MHz [deg]
0.5
0
−0.5
0
5
10
15
20
25
30
35
time [hours]

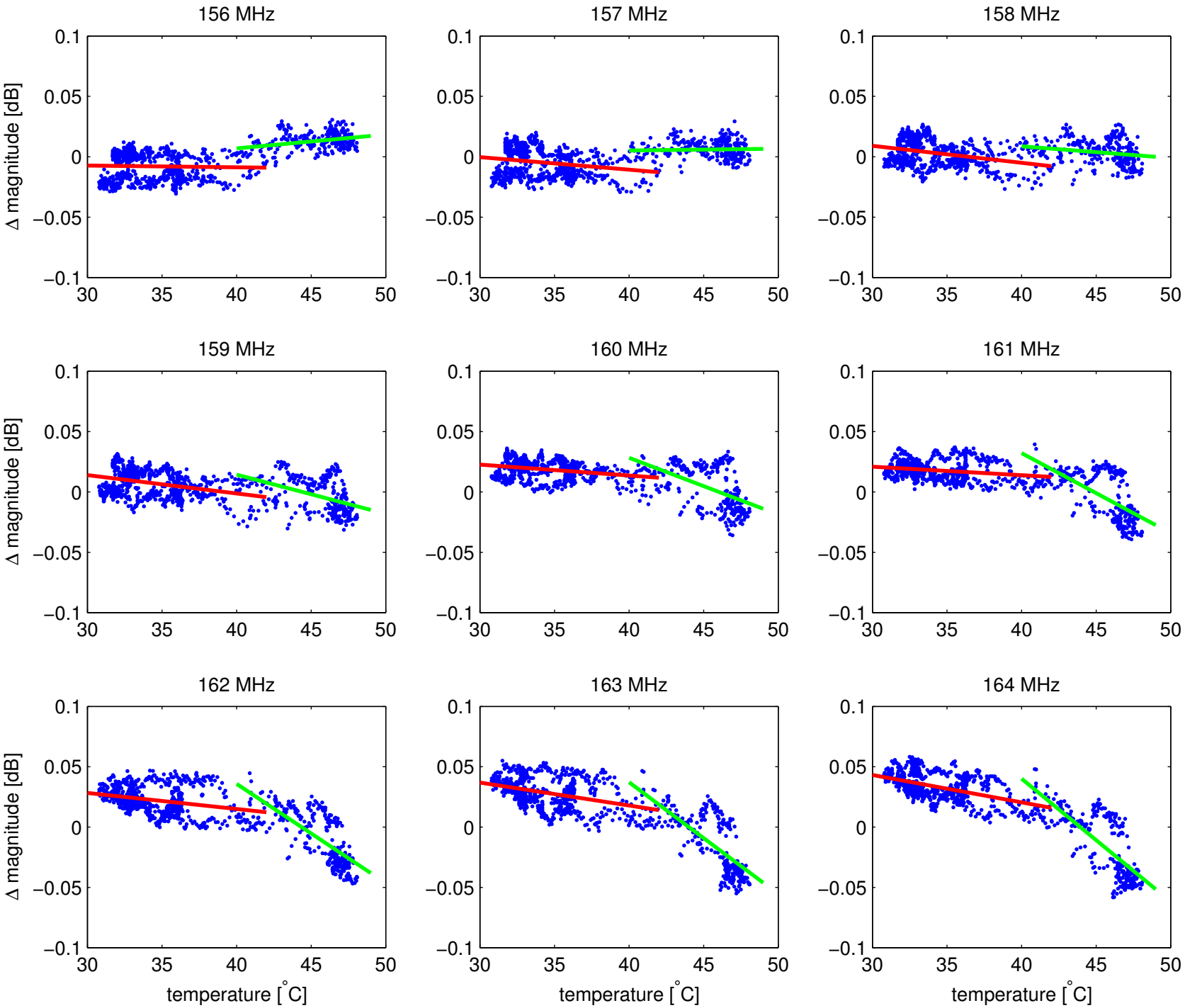
APPENDIX 3: Magnitude Temp. Coeff. for 120-180 MHz

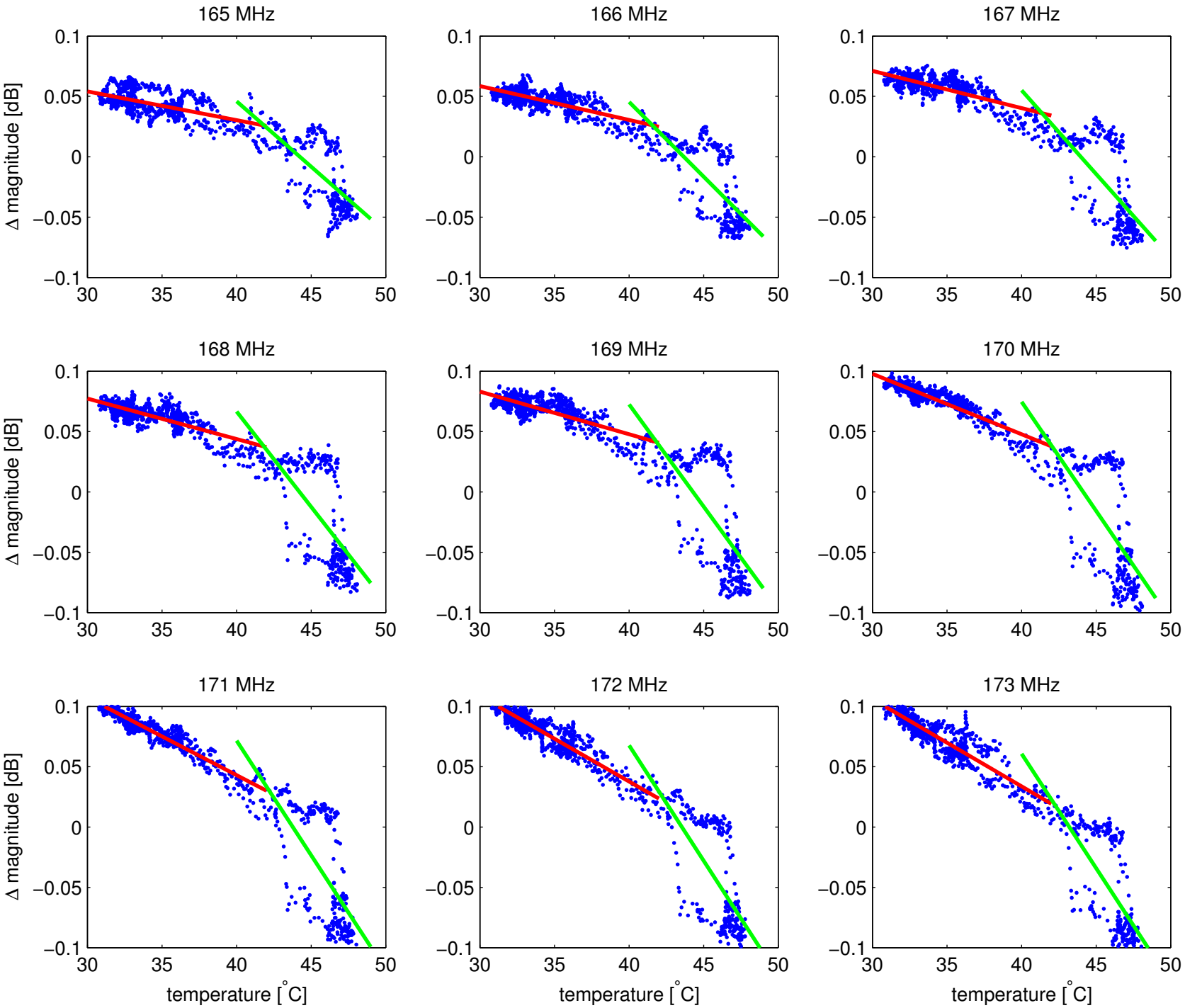

120 MHz
121 MHz
122 MHz
123 MHz
124 MHz
125 MHz
126 MHz
127 MHz
128 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50

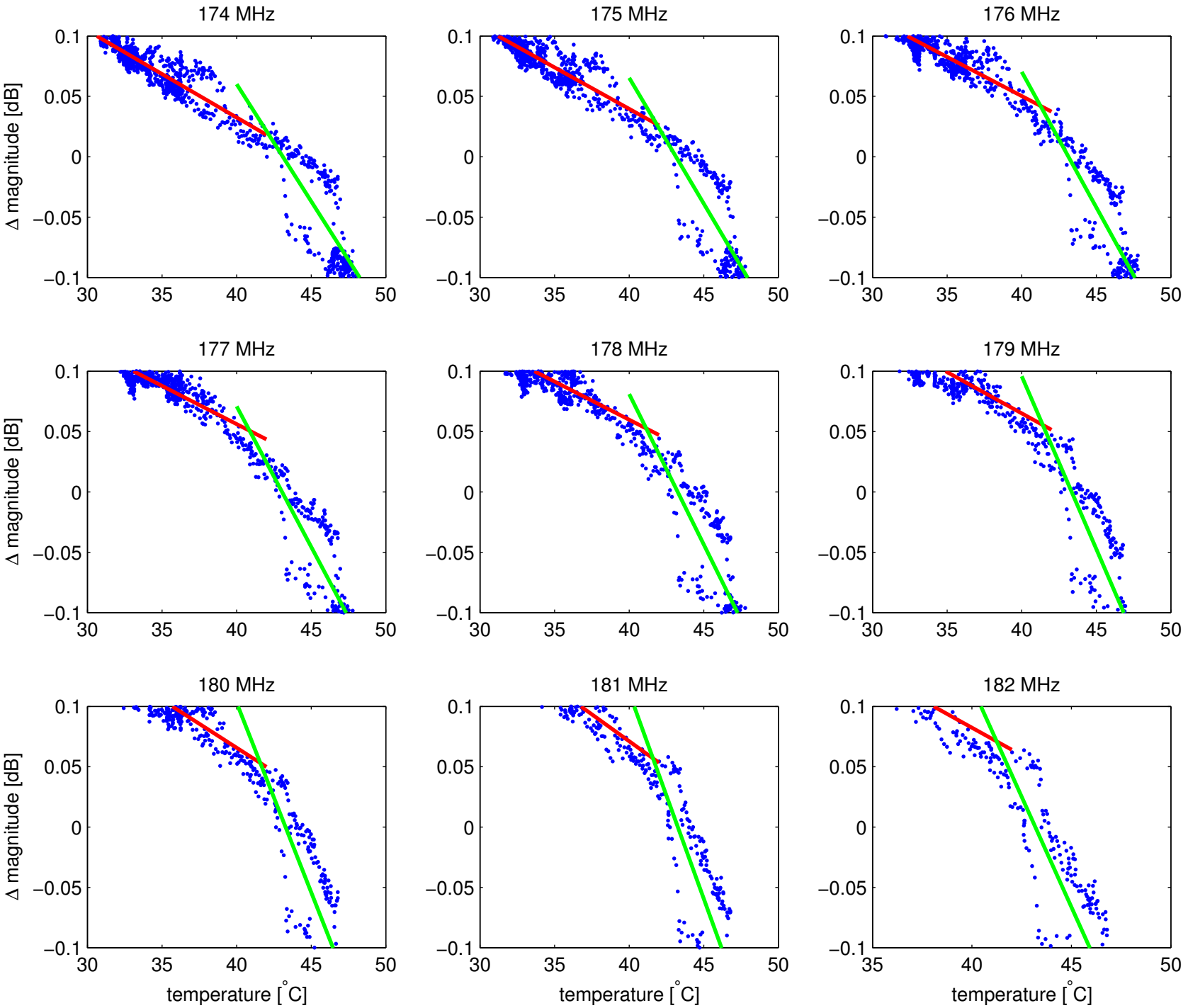

129 MHz
130 MHz
131 MHz
132 MHz
133 MHz
134 MHz
135 MHz
136 MHz
137 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50


138 MHz
139 MHz
140 MHz
141 MHz
142 MHz
143 MHz
144 MHz
145 MHz
146 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50

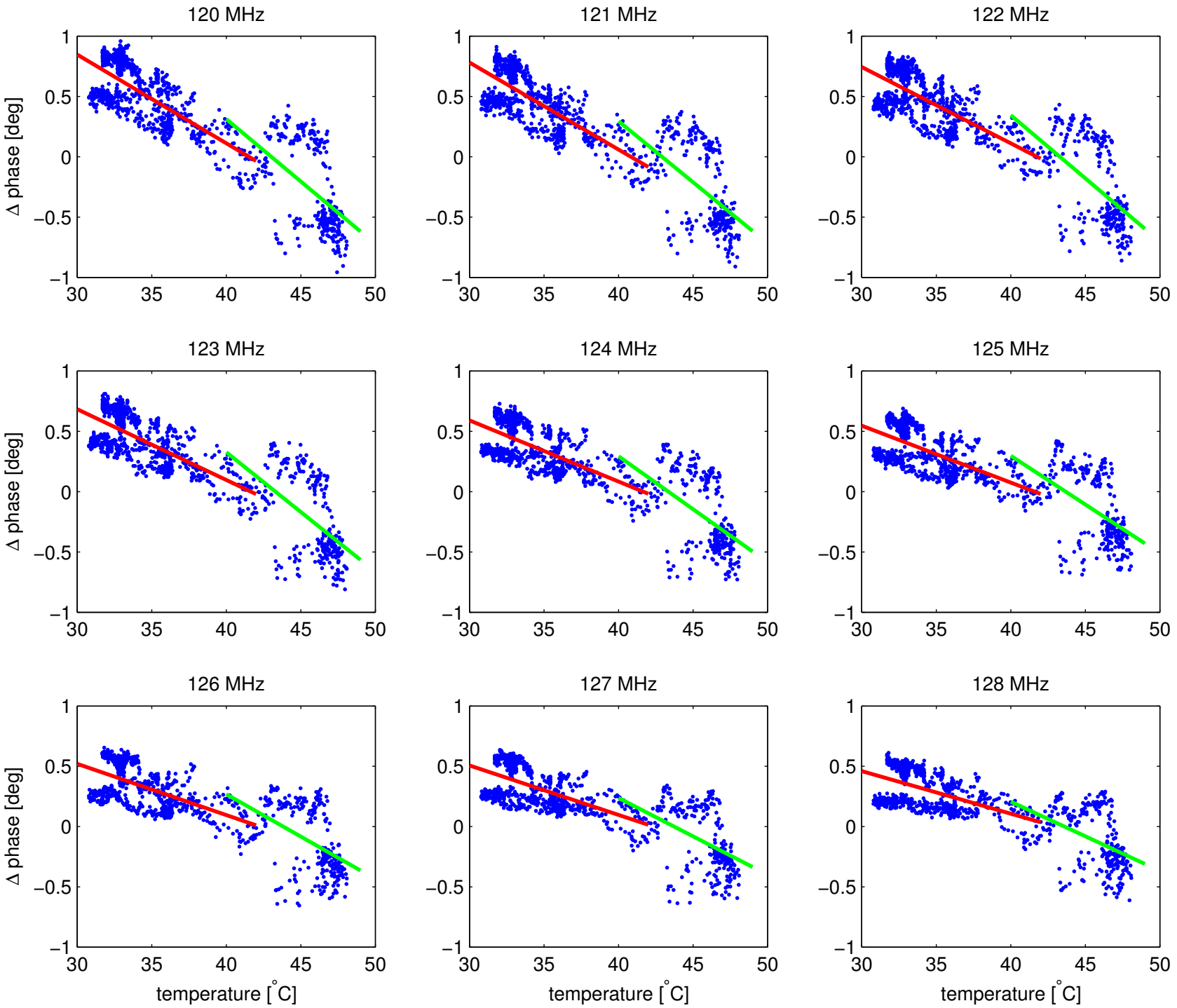

147 MHz
148 MHz
149 MHz
150 MHz
151 MHz
152 MHz
153 MHz
154 MHz
155 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50

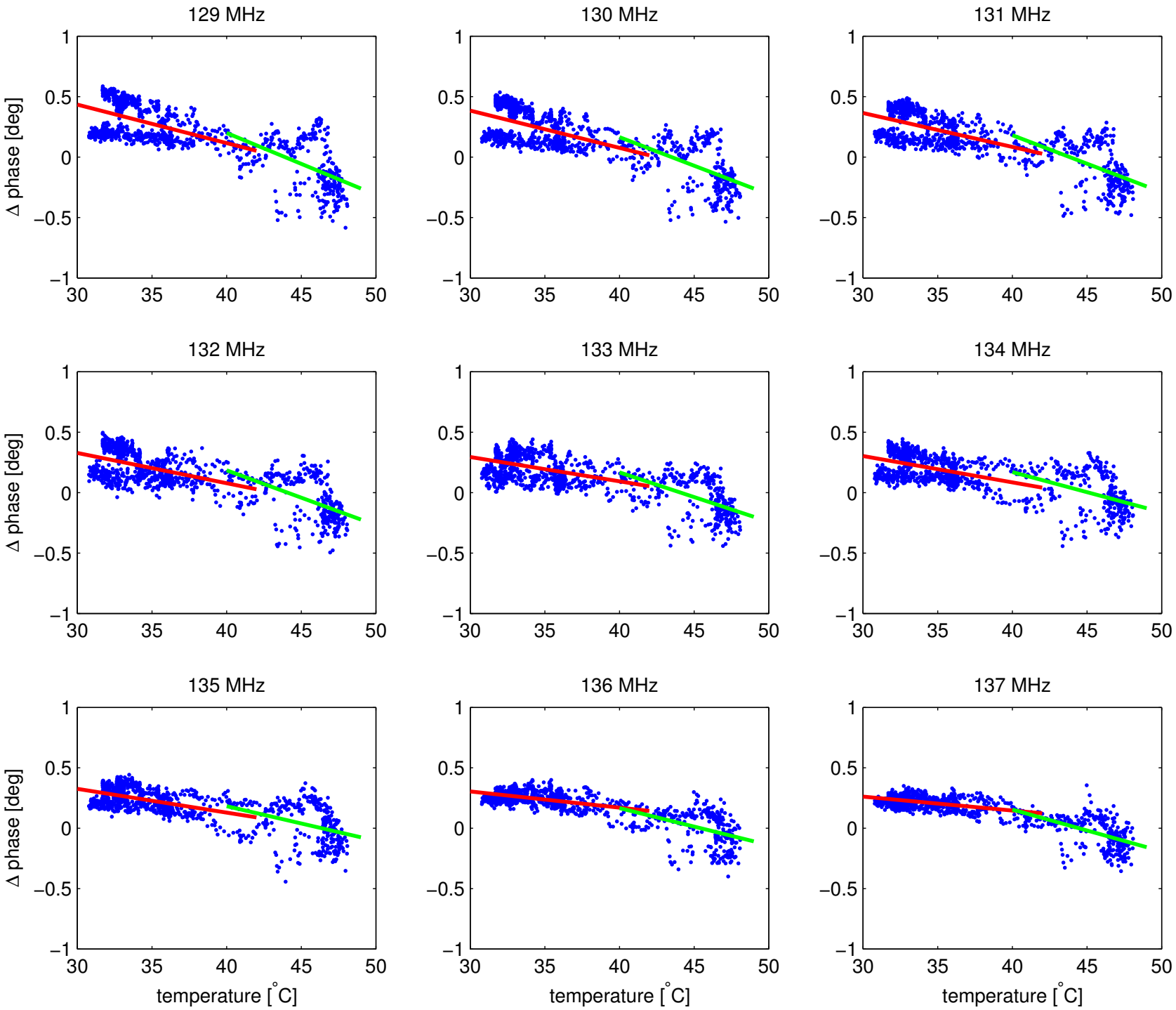

156 MHz
157 MHz
158 MHz
159 MHz
160 MHz
161 MHz
162 MHz
163 MHz
164 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50

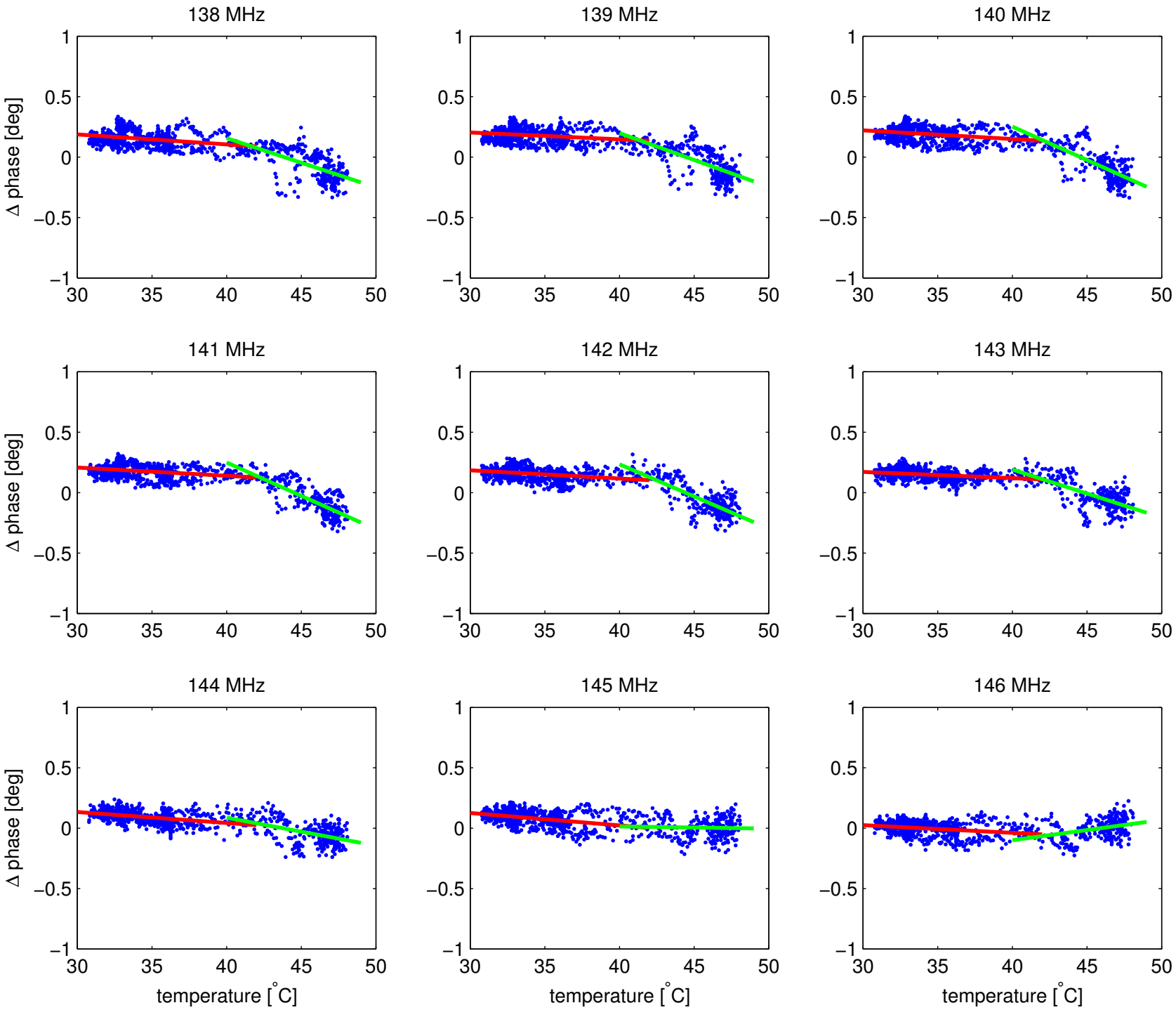

165 MHz
166 MHz
167 MHz
168 MHz
169 MHz
170 MHz
171 MHz
172 MHz
173 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50

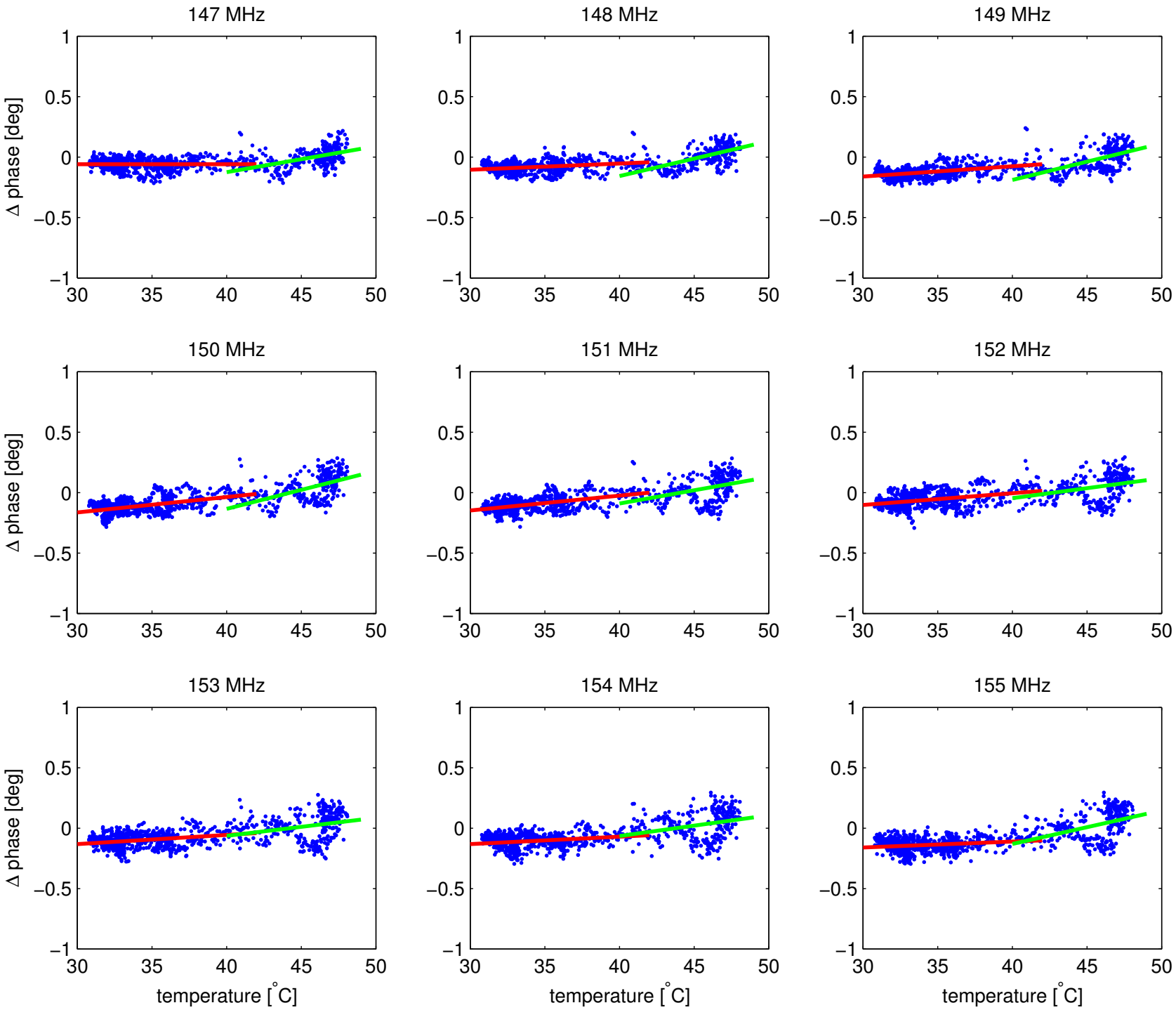

174 MHz
175 MHz
176 MHz
177 MHz
178 MHz
179 MHz
180 MHz
181 MHz
182 MHz
Δ magnitude [dB]
temperature [°C]
0.1
0.05
0
−0.05
−0.1
30
35
40
45
50

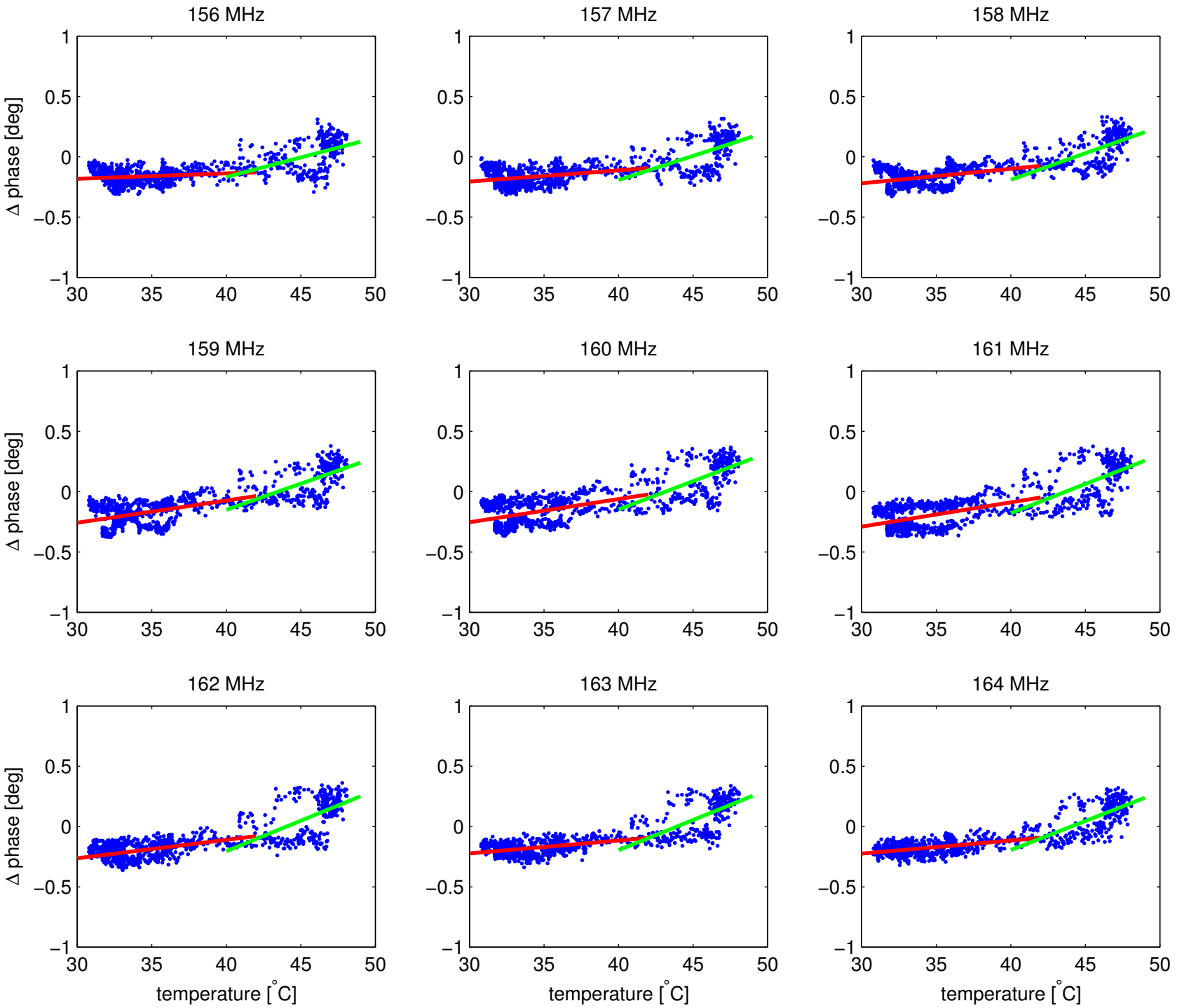
APPENDIX 4: Phase Temp. Coeff. for 120-180 MHz

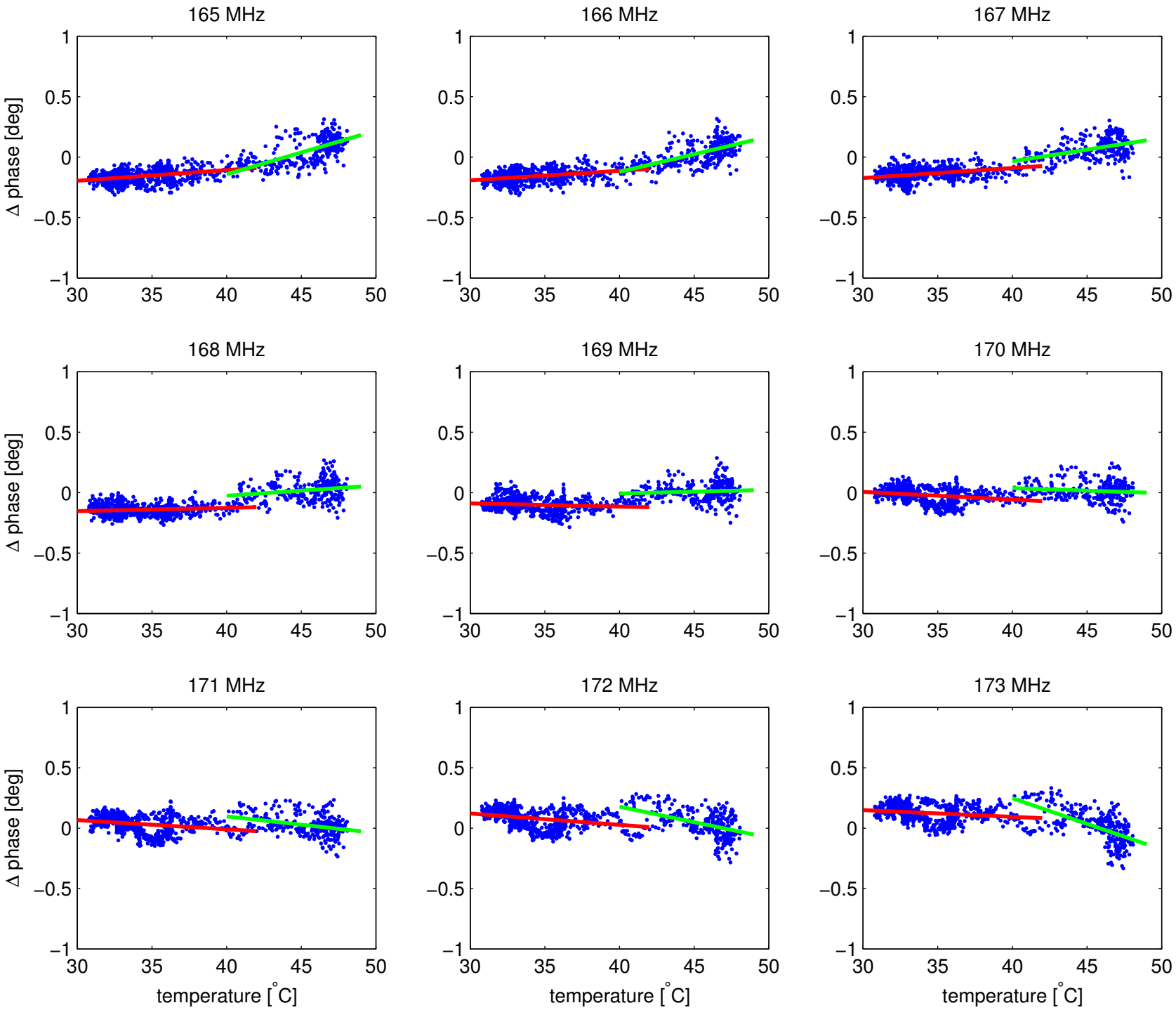

120 MHz
121 MHz
122 MHz
123 MHz
124 MHz
125 MHz
126 MHz
127 MHz
128 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50

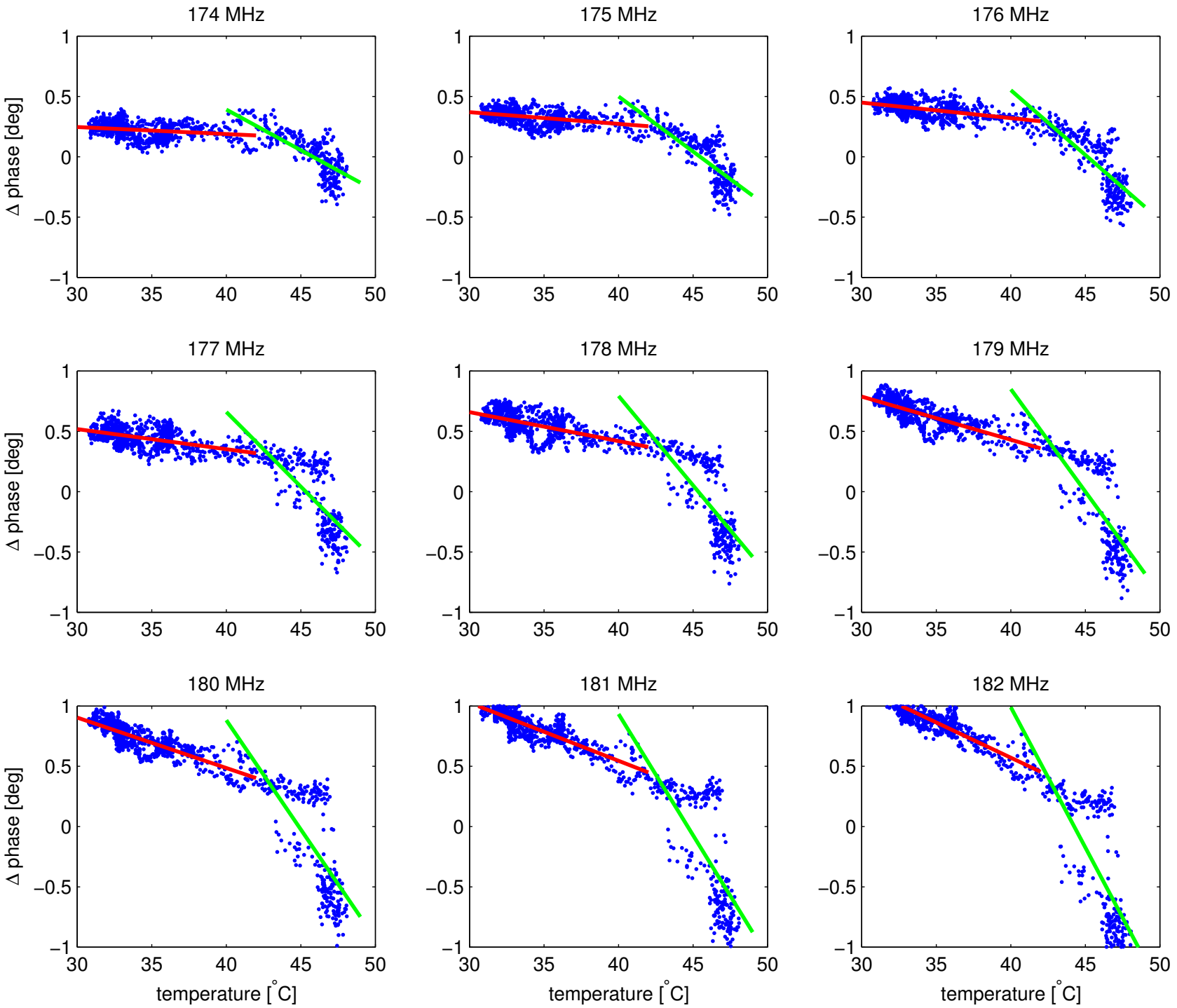

129 MHz
130 MHz
131 MHz
132 MHz
133 MHz
134 MHz
135 MHz
136 MHz
137 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50


138 MHz
139 MHz
140 MHz
141 MHz
142 MHz
143 MHz
144 MHz
145 MHz
146 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50


147 MHz
148 MHz
149 MHz
150 MHz
151 MHz
152 MHz
153 MHz
154 MHz
155 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50


156 MHz
157 MHz
158 MHz
159 MHz
160 MHz
161 MHz
162 MHz
163 MHz
164 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50


165 MHz
166 MHz
167 MHz
168 MHz
169 MHz
170 MHz
171 MHz
172 MHz
173 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50


174 MHz
175 MHz
176 MHz
177 MHz
178 MHz
179 MHz
180 MHz
181 MHz
182 MHz
Δ phase [deg]
temperature [°C]
1
0.5
0
−0.5
−1
30
35
40
45
50