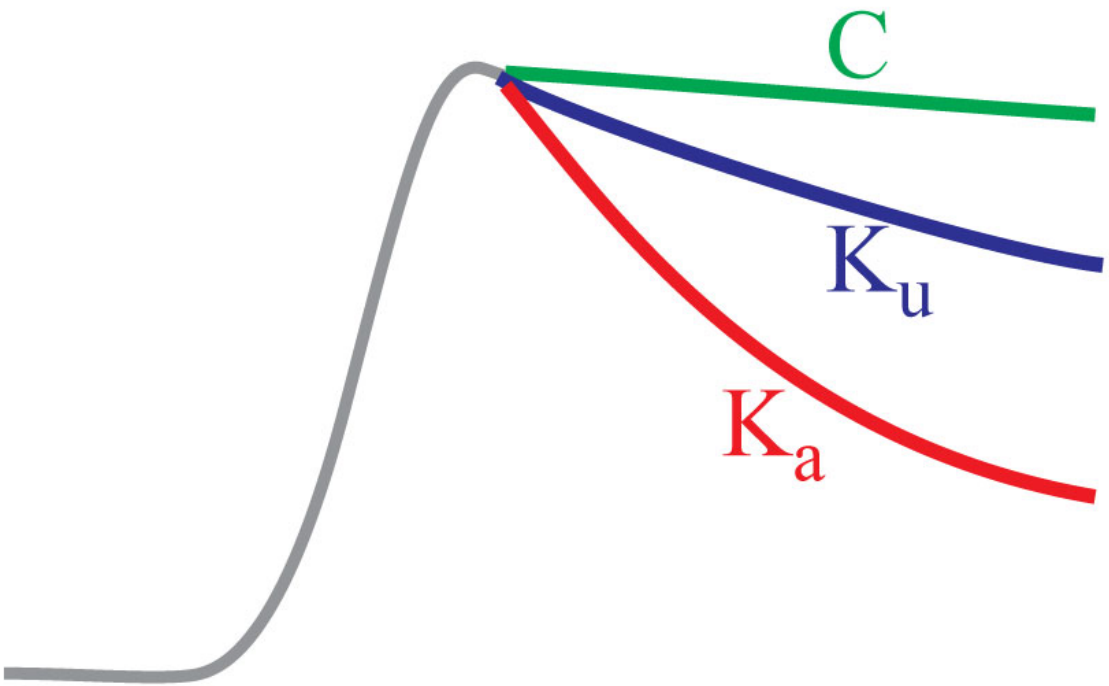
Waveform Characteristics of the AltiKa Altimeter

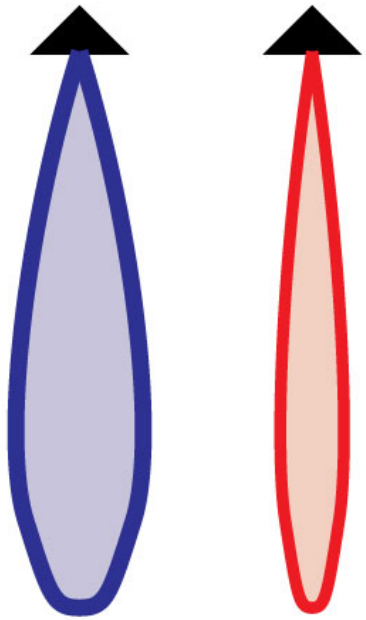
Graham Quartly

PML | Plymouth Marine Laboratory

Expected shape

Wf = (PTR * PDF (h) * FSR) X Rayleigh Noise
+ Instrumental artefacts

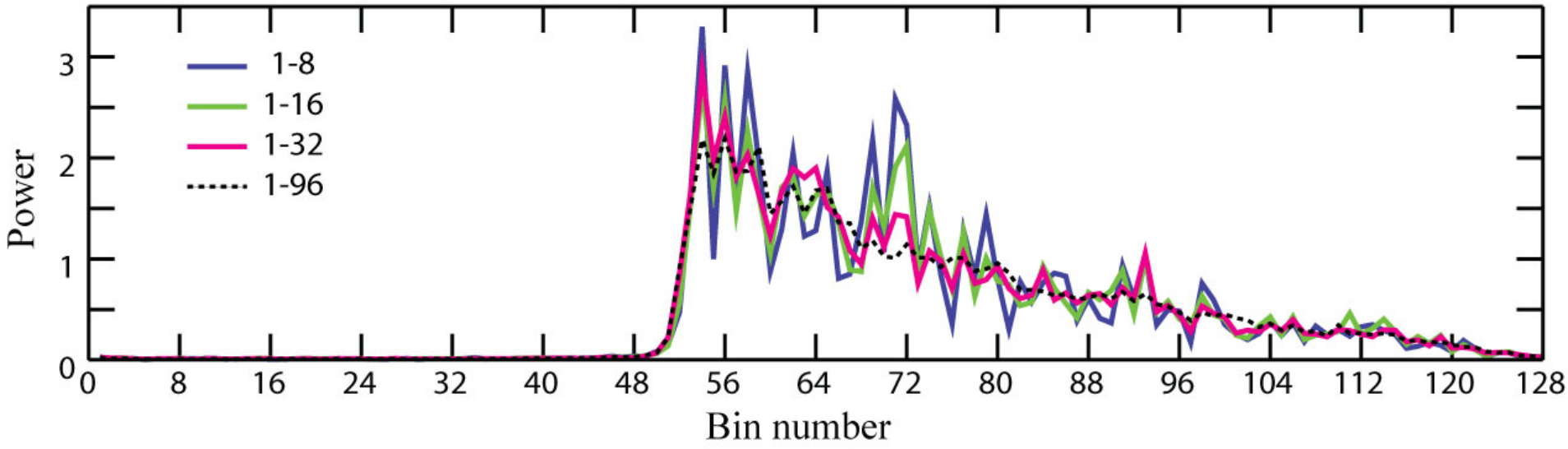




Individual Echoes

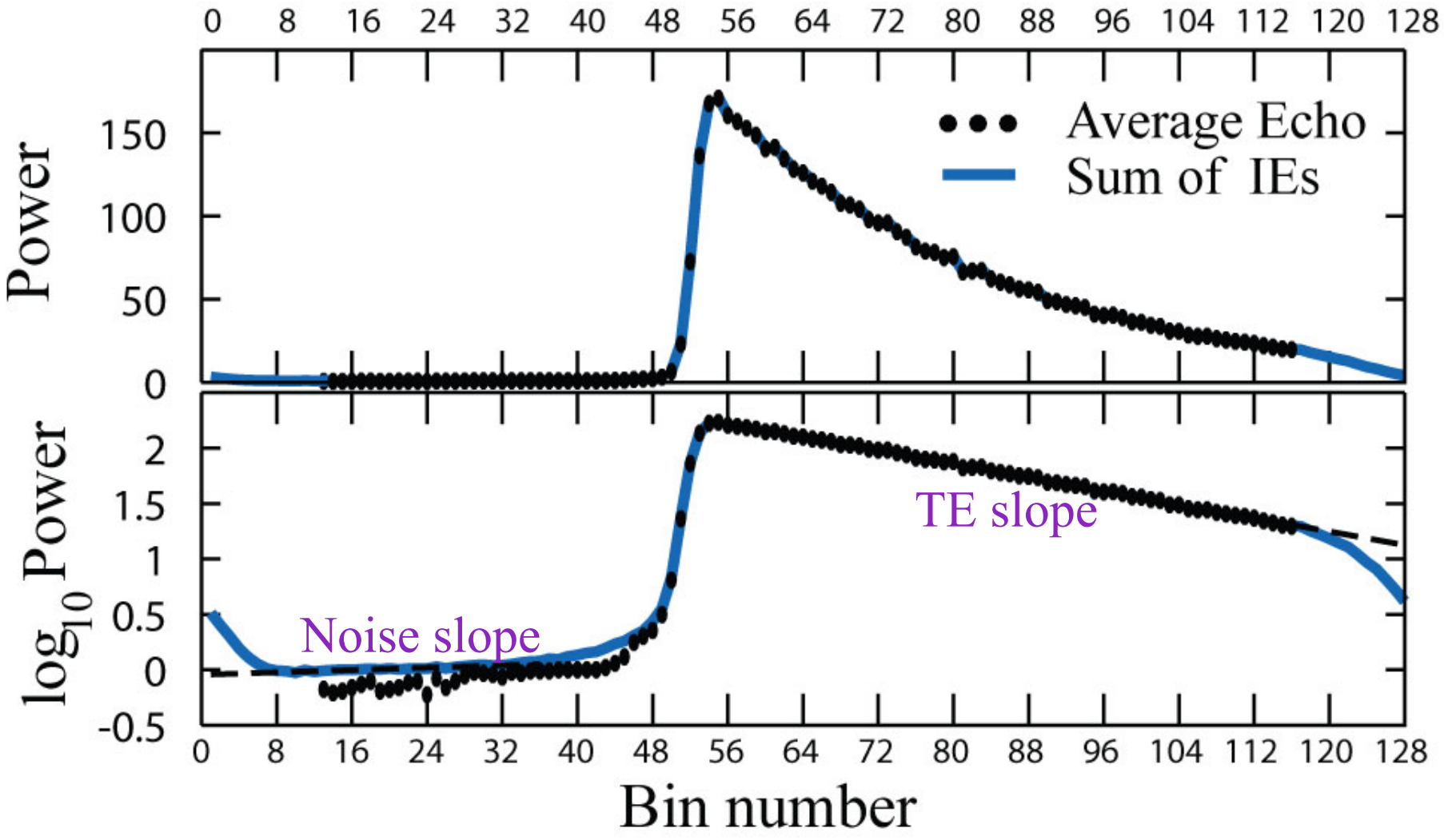
~40 Hz AEs
~3700 Hz IEs
Occasional 1.09s burst of IEs
(42 segments of 96 waveforms)

More waveforms ; more bins ; more radiometric resolution



→ Passaro et al (poster)

Actual shape

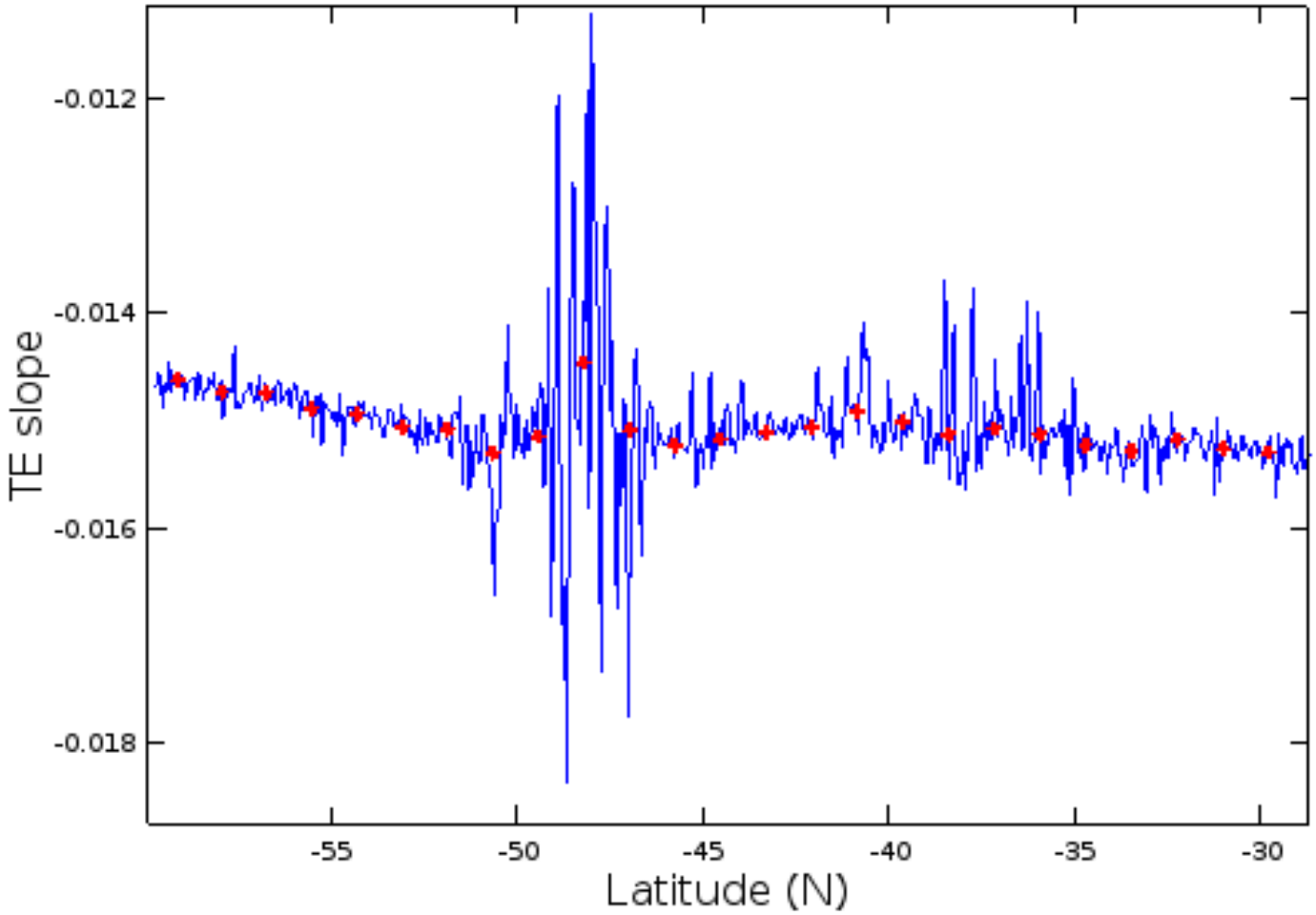


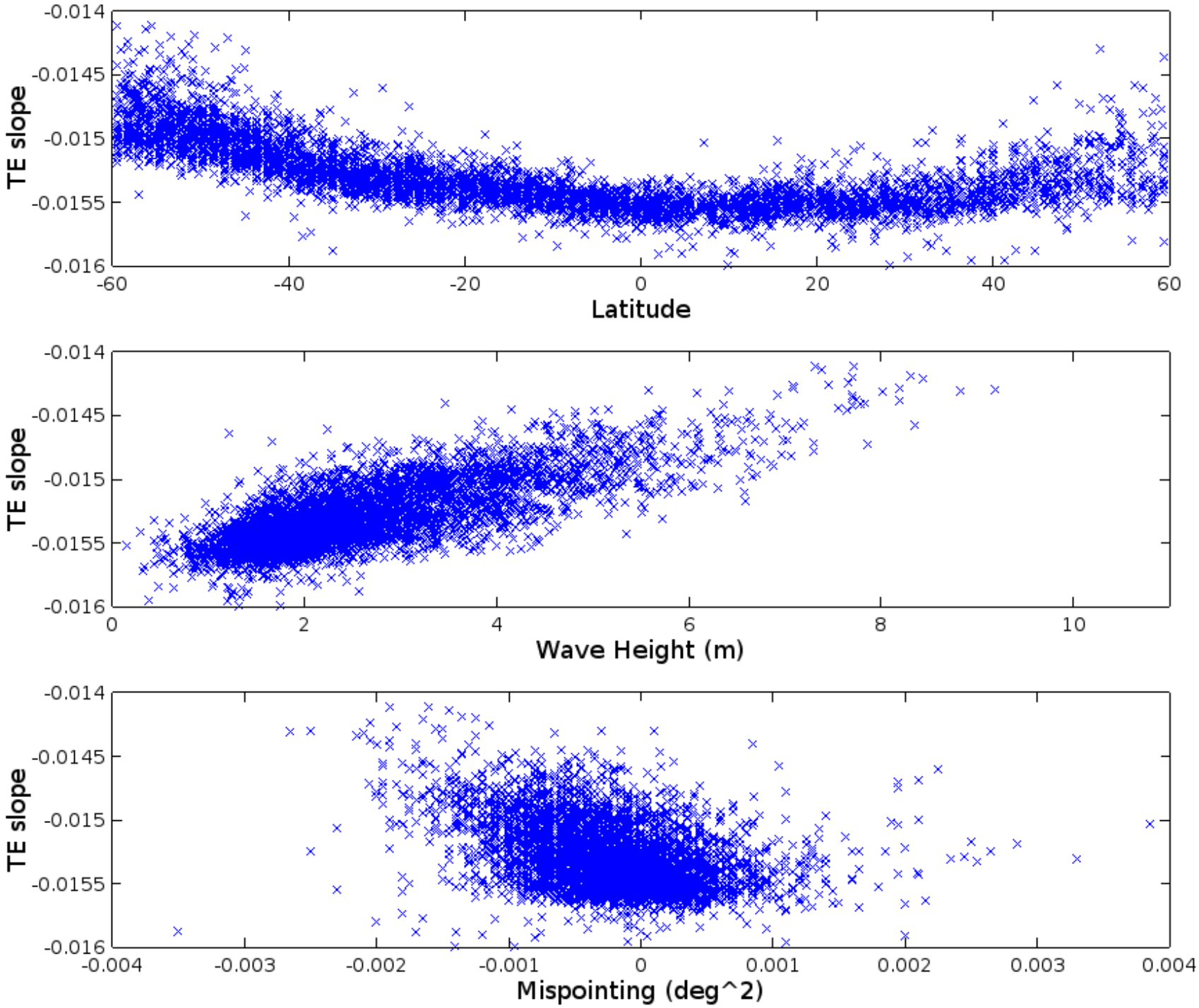
Typically bins 1-8 & 117-128 show FFT 'wrap-round' effects

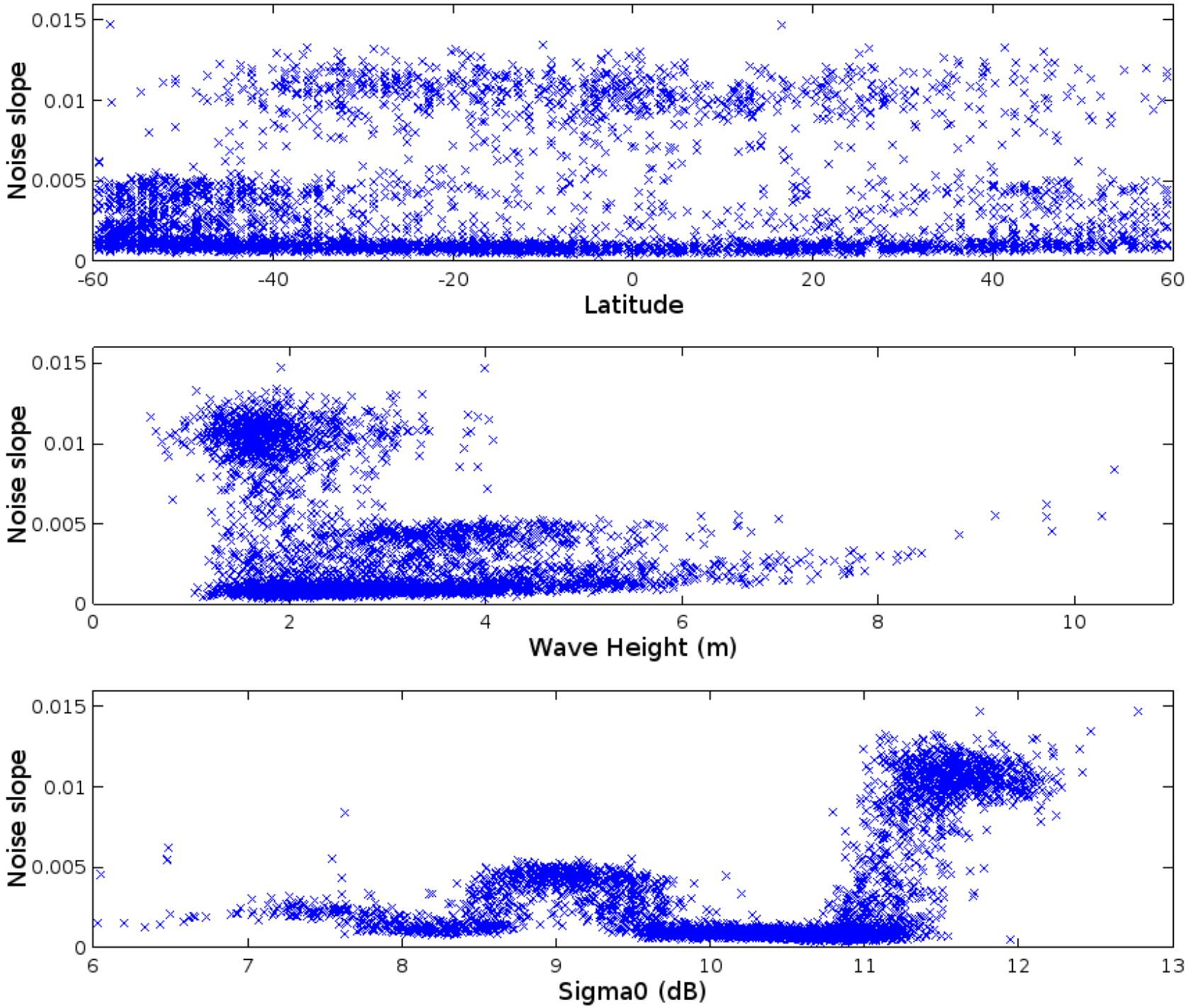
Variations in TE slope - I

Slope responds to inhomogeneities within footprint —
rain cells, sigma0 blooms, ...

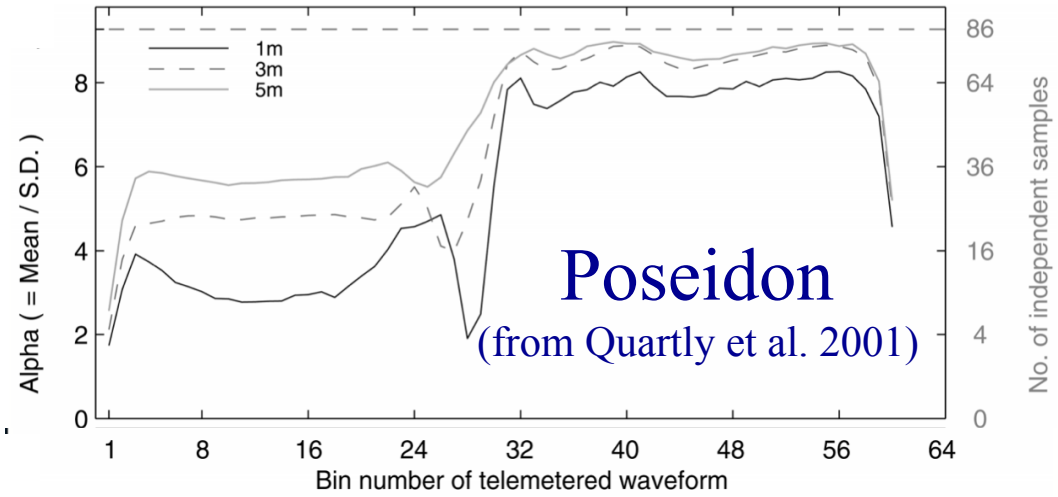
Concentrate on slow variations — 1 Hz waveforms, 20-pt median




TE slope
-0.014
-0.0145
-0.015
-0.0155
-0.016
-60
-40
-20
0
20
40
60
Latitude
TE slope
-0.014
-0.0145
-0.015
-0.0155
-0.016
0
2
4
6
8
10
Wave Height (m)
TE slope
-0.014
-0.0145
-0.015
-0.0155
-0.016
-0.004
-0.003
-0.002
-0.001
0
0.001
0.002
0.003
0.004
Mispointing (deg^2)

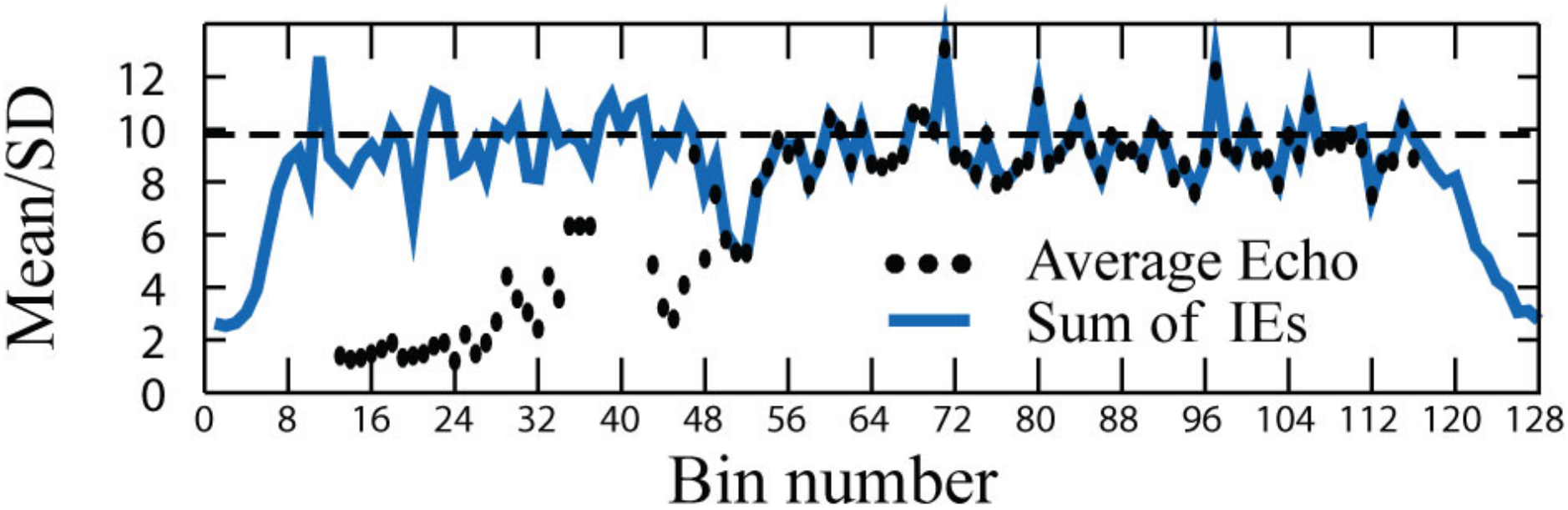

Noise slope
0.015
0.01
0.005
0
-60
-40
-20
0
20
40
60
Latitude
Noise slope
0.015
0.01
0.005
0
0
2
4
6
8
10
Wave Height (m)
Noise slope
0.015
0.01
0.005
0
6
7
8
9
10
11
12
13
Sigma0 (dB)

Waveform independence



P.D.F. of powers
-> No. of independent echoes per AE:

$Mn / SD = \sqrt{N}$

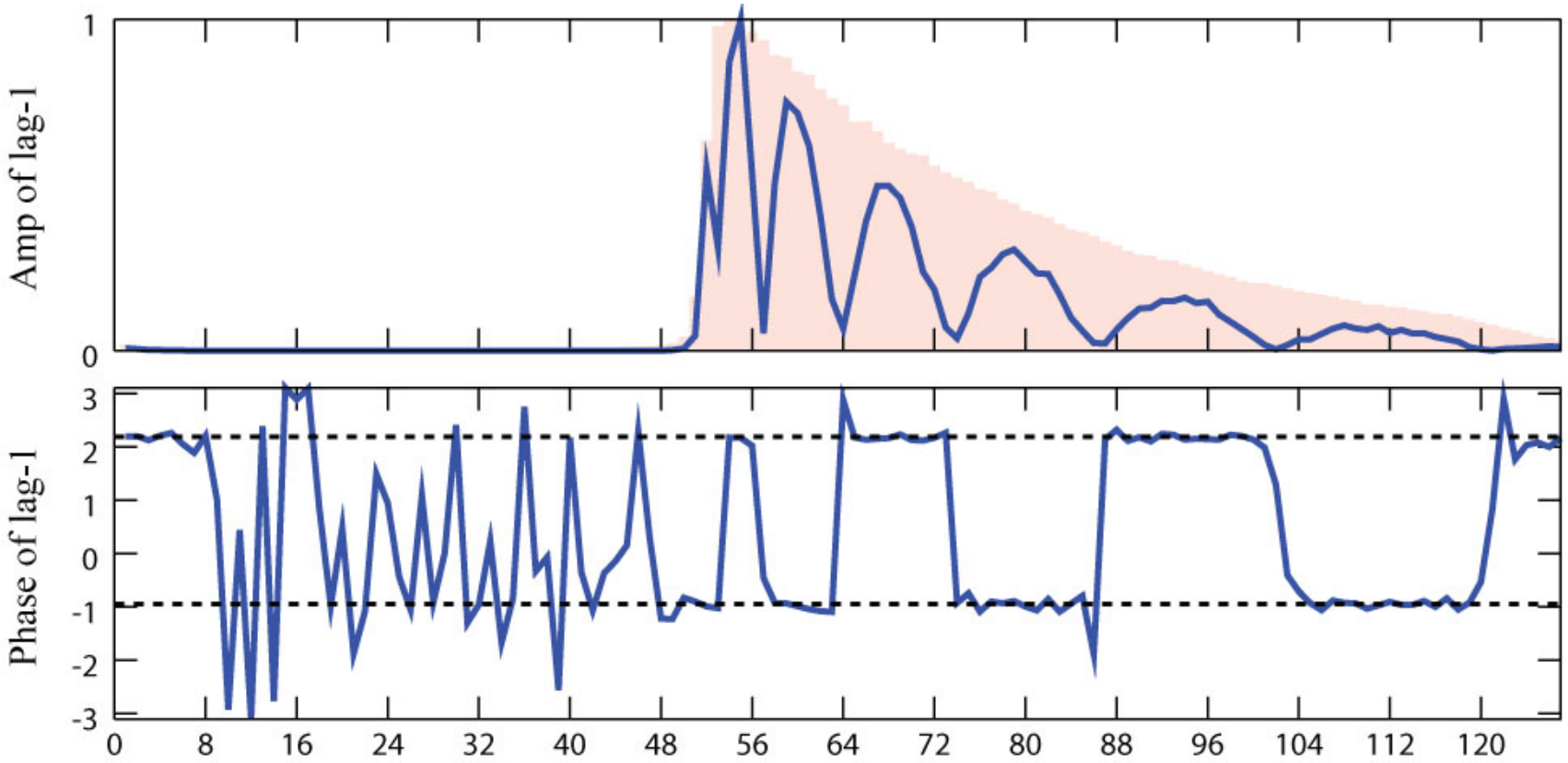


Analysing complex echoes

$$Wf_i = \sum_{j=1}^{n} c_{j,i} \; c^*_{j,i}$$

waveform j
bin i

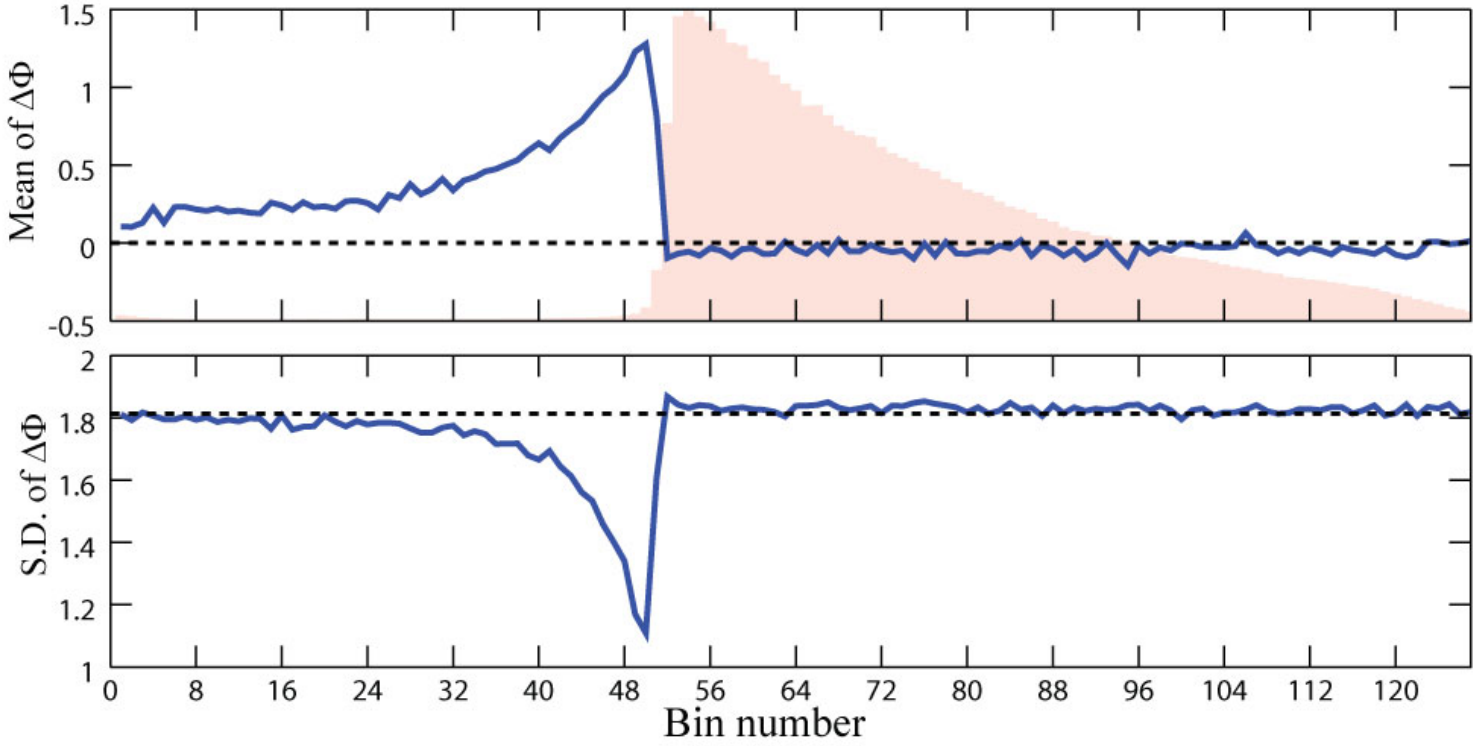
$$\text{1-lag covariance} = \sum_{j=1}^{n-1} c_{j,i} \; c^*_{j+1,i}$$

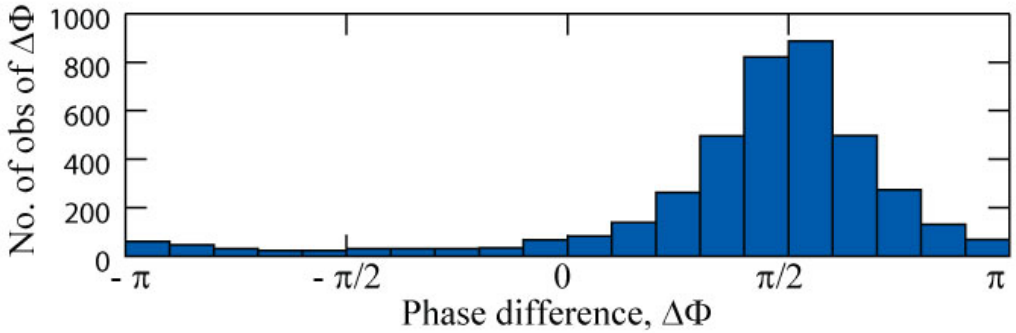


IE phase difference

$$\Delta\Phi = \Phi_{j,i+1} - \Phi_{j,i}$$

Expectation: Mn=0 ; S.D. = $\pi/\sqrt{3}$





Summary

Some things much **as expected**; some **a little surprising;** some **quite bamboozling**.

Mean waveform shape is very smooth (no ripple)

— possible to retrack sum of 16 IEs accurately (240Hz)

— excision of 1st 12 and last 12 bins justified

— peculiar power growth in thermal region

Power in IEs is independent; clear phase coherence

There is a phase relationship between successive bins

— occurs at toe of leading edge