How much does the calibration fluctuate (S2)?

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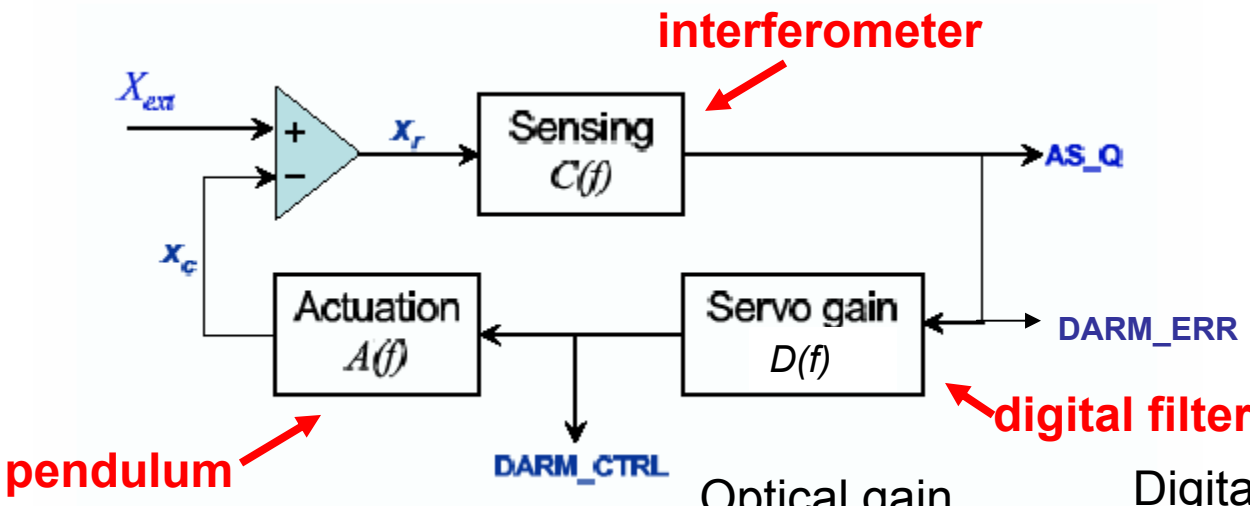
Calibration Basics



Optical gain

Digital gain

Open loop gain $$G(f,t) = A(f)\left(\alpha(t)C(f)\right)\left(\beta(t)D(f)\right)$$

Scale factor

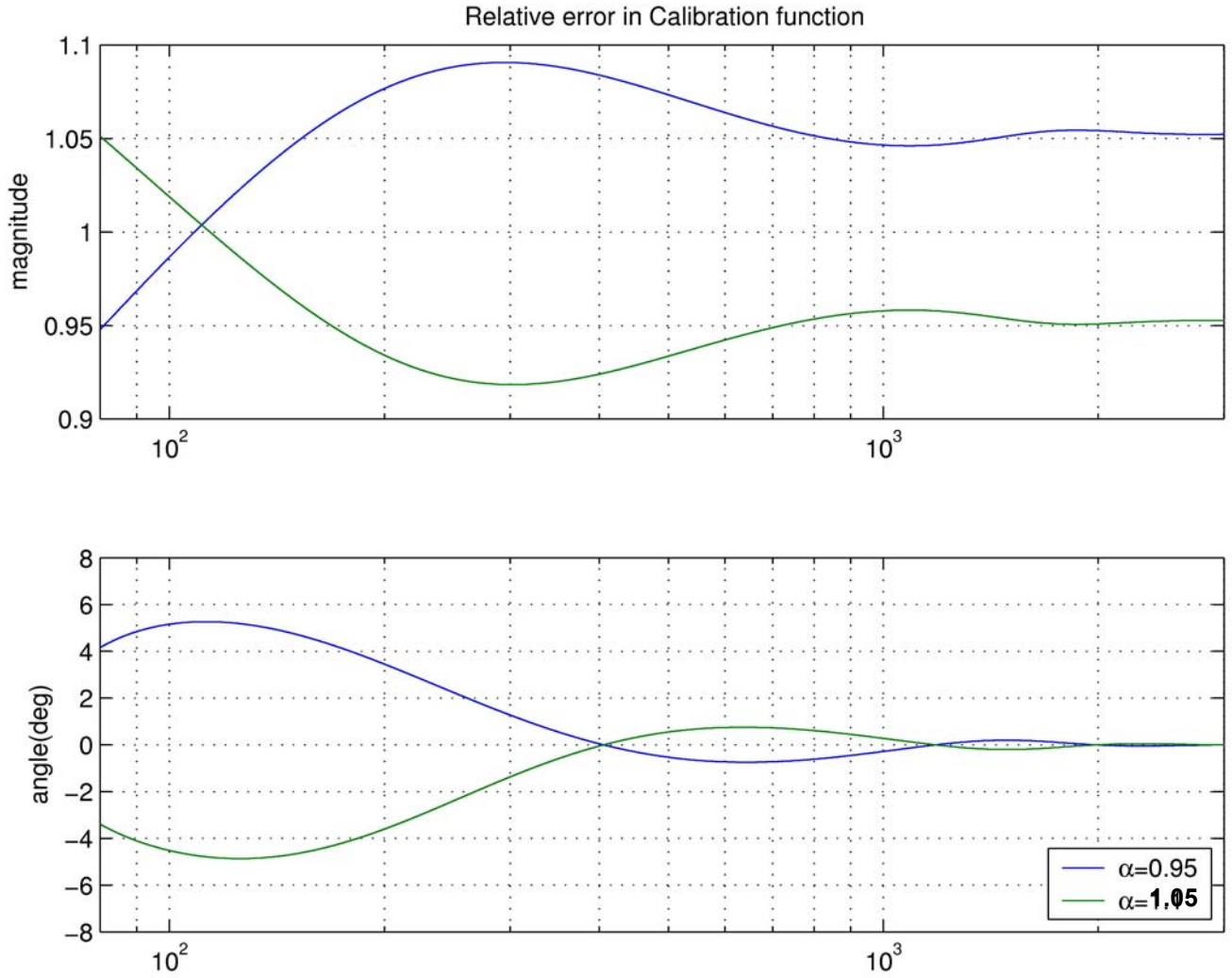
$$ASQ(f,t) = h(f)\frac{\alpha(t)C(f)}{1+\alpha(t)\beta(t)G(f)}$$

Freq dependent, magnitude and phase

α(t): depends on alignment, input power, offsets in error points…

β(t): digital gain: fixed in S2, dynamic in S3 to keep αβ "constant"

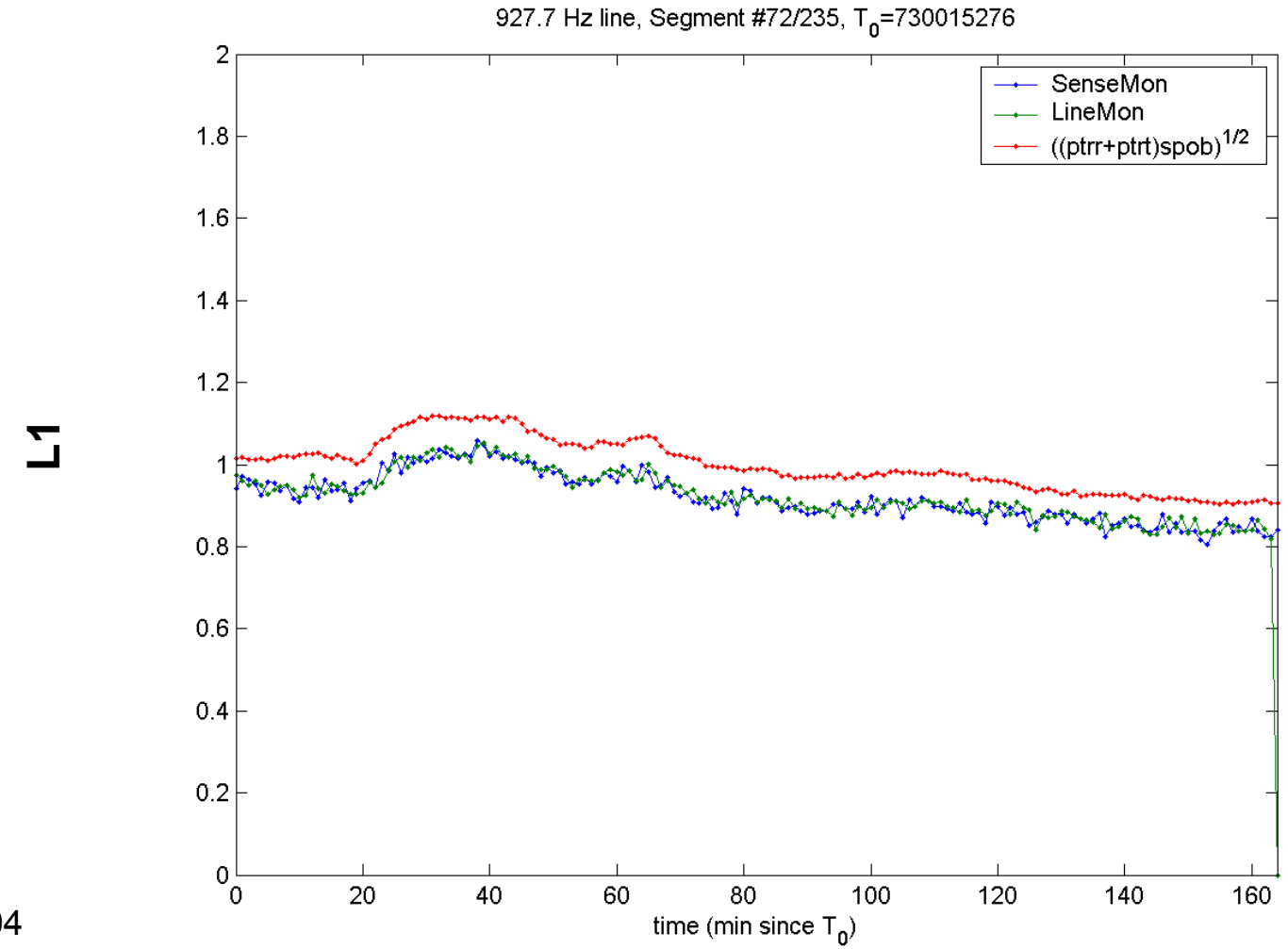
5% error in optical gain
=> freq. dep. error in calibration



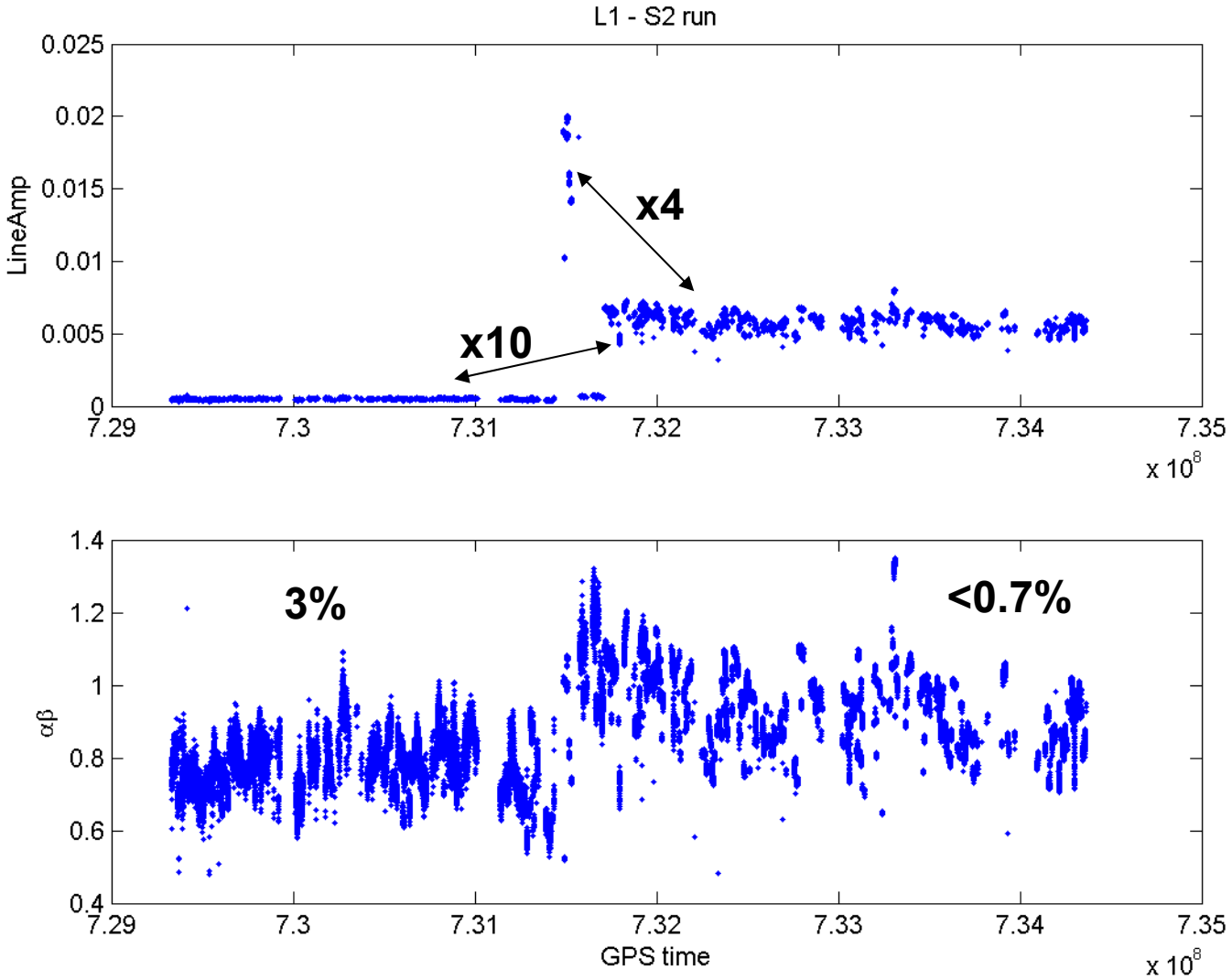
Measures of optical gain

-- Amplitude of calibration line (SenseMon, LineMon, demodulation)

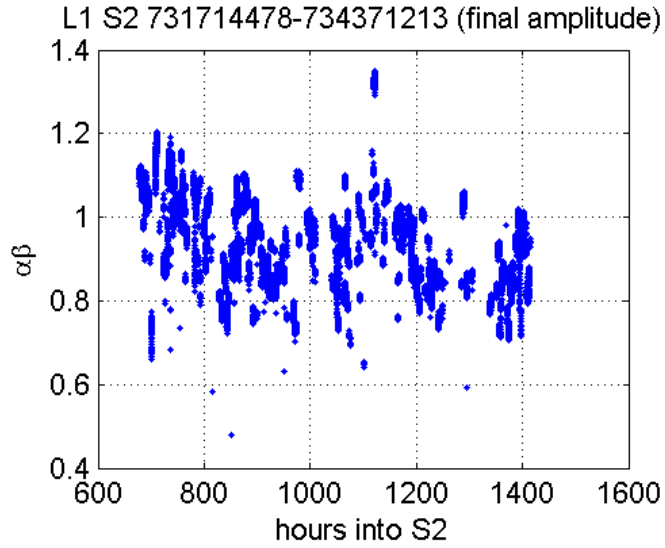
-- $\alpha \propto J_0 J_1 \propto \sqrt{(P_x + P_y)P_{sb}} \propto \sqrt{(QPDX + QPDY)SPOB}$

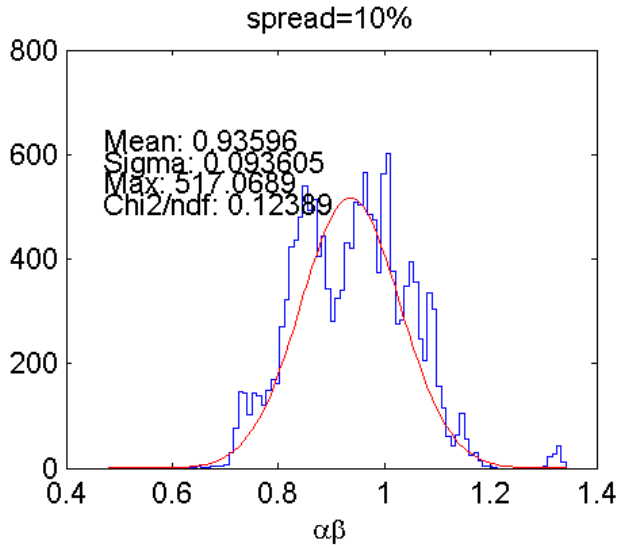


S2 L1 α, β

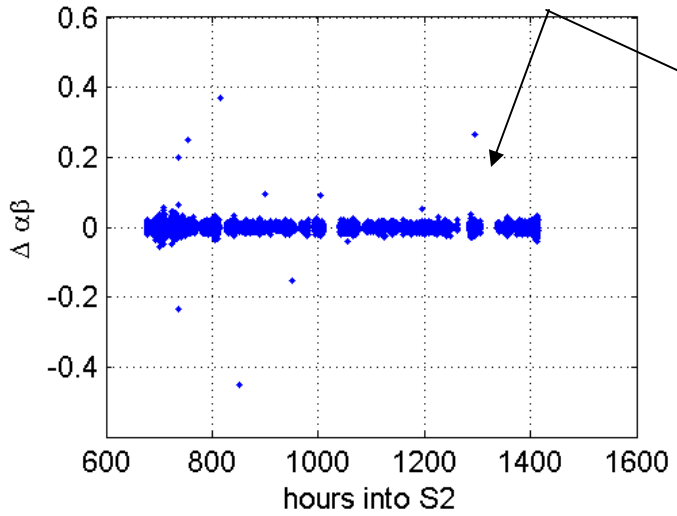

L1 - S2 run
LineAmp
0.025
0.02
0.015
0.01
0.005
0
x4
x10
7.29
7.3
7.31
7.32
7.33
7.34
7.35
x 10^8
αβ
1.4
1.2
1
0.8
0.6
0.4
3%
<0.7%
GPS time
x 10^8

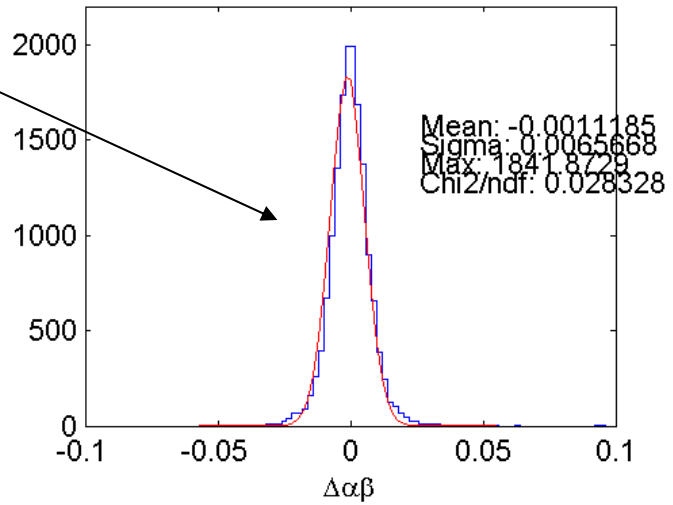
S2 L1 α, β



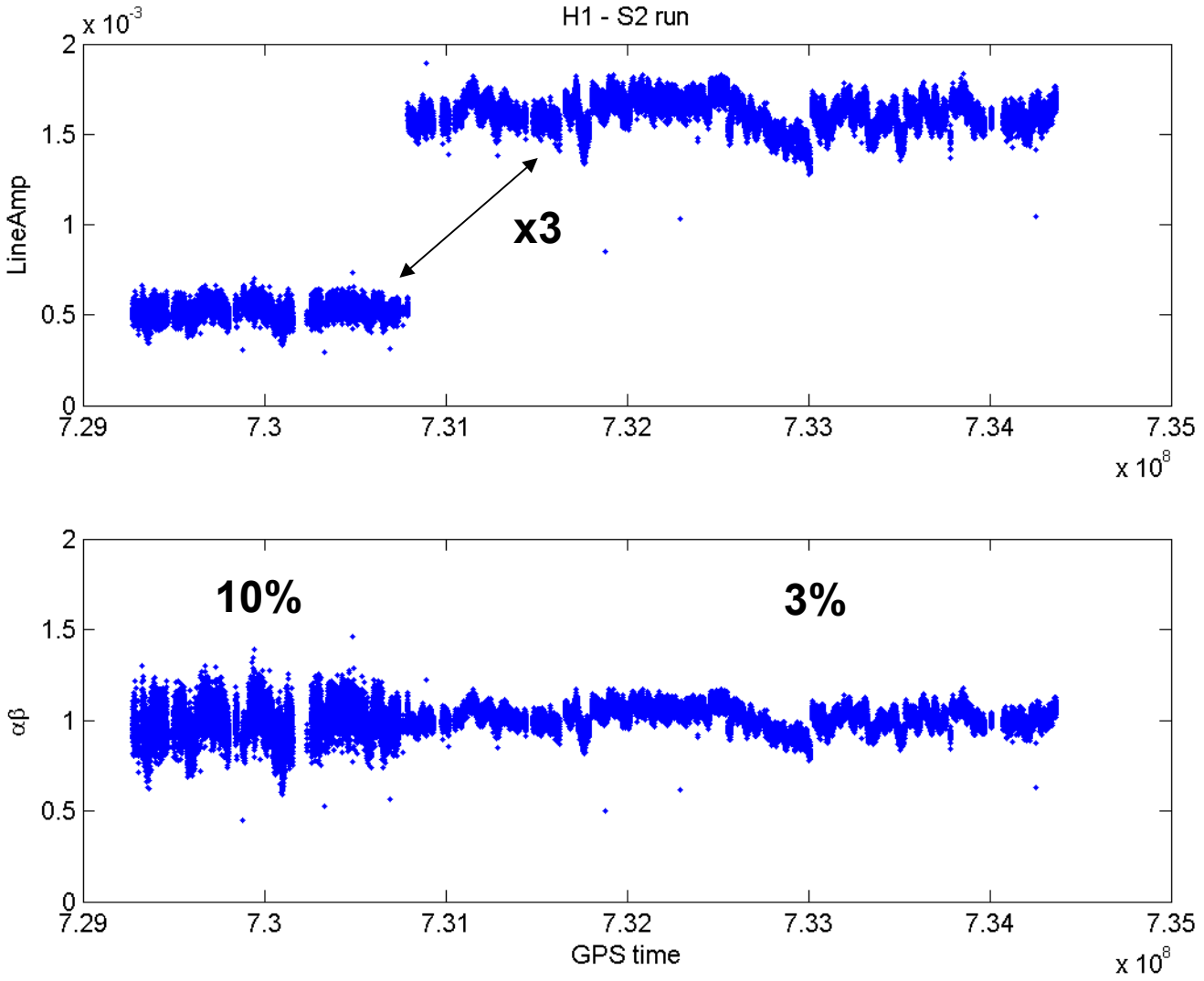


estimate error or true variation? error=0.7%



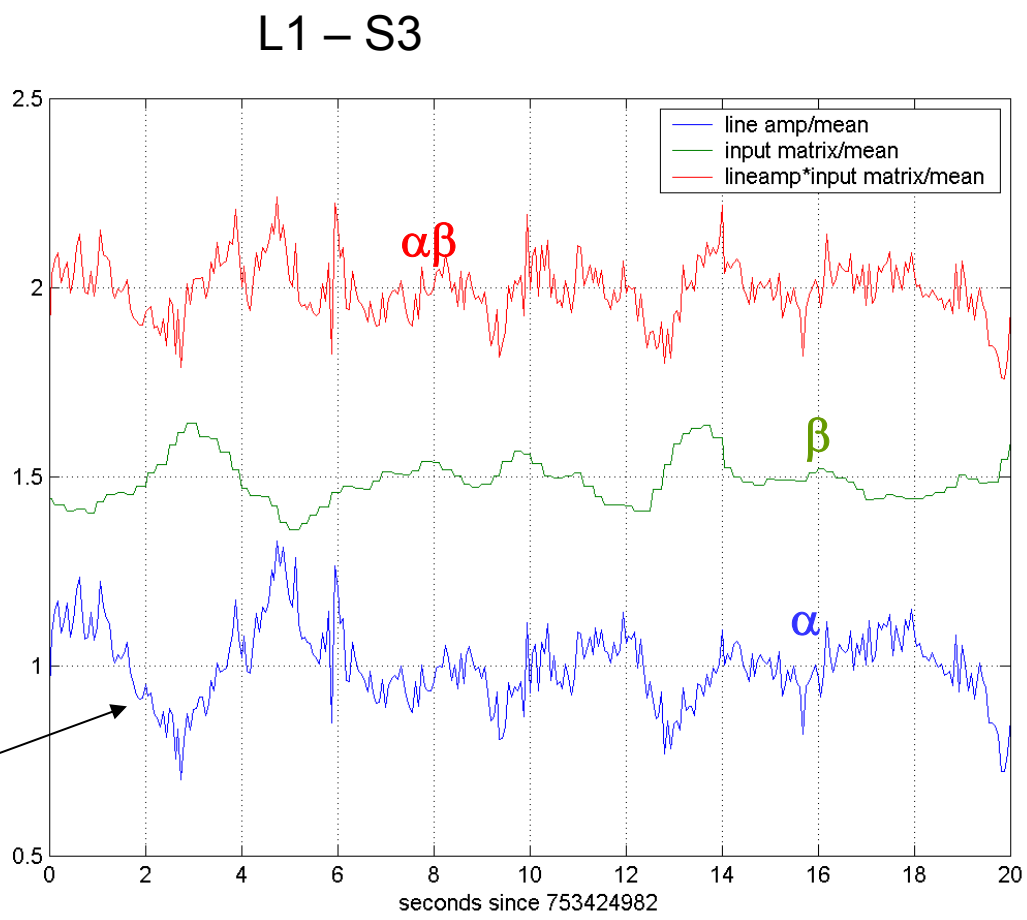


S2 H1 α, β



S3 calibration : dynamic β

A dynamic β:
calculated at 16384Hz,
low pass filtered at ~0.5 Hz,
Read at ~8 Hz(?),
written at 16 Hz,
averaged by SenseMon at 1/60s



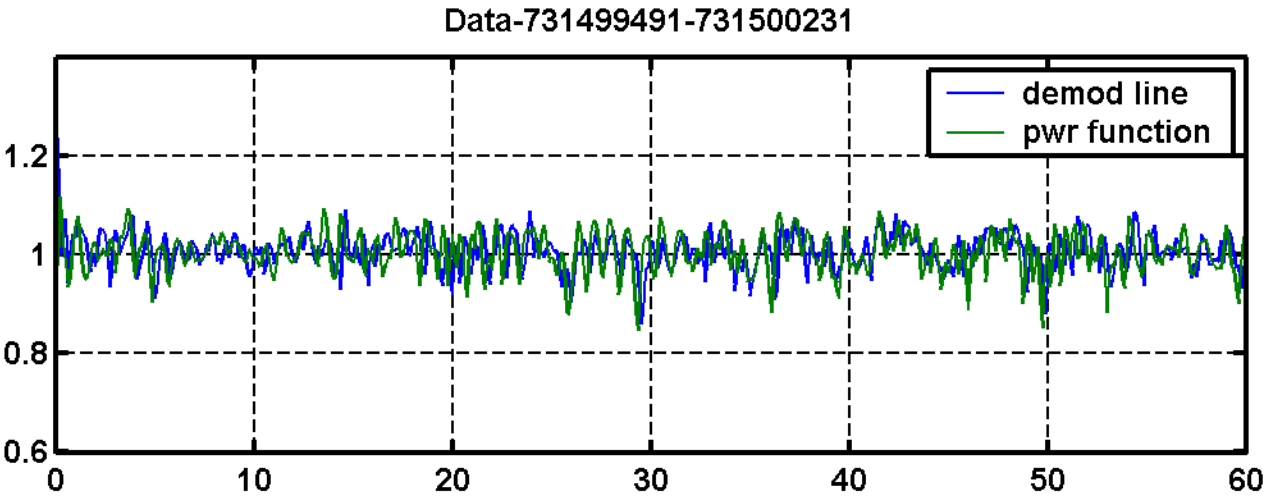
Notice the amplitude and time scale!!

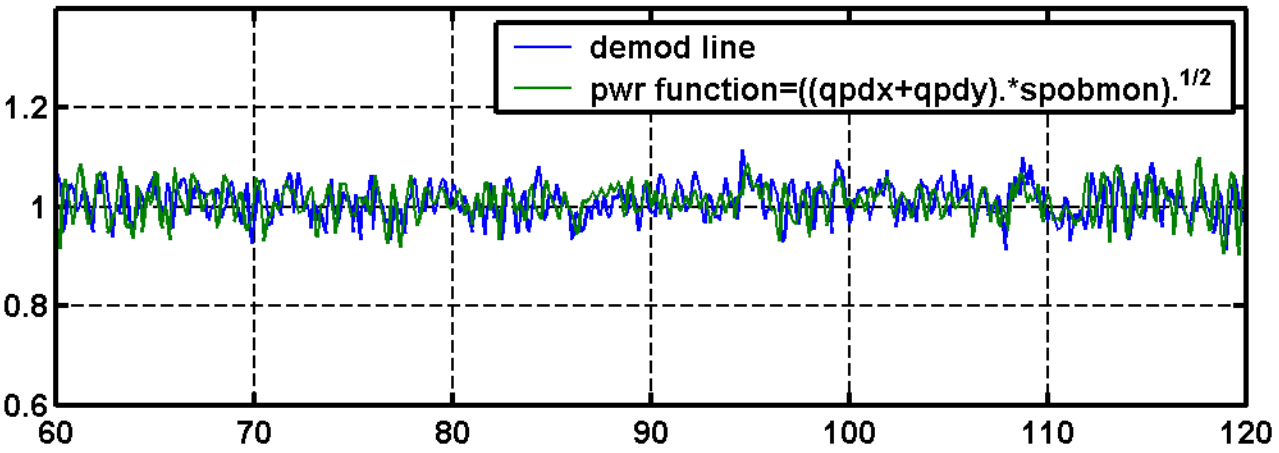
"Fast" fluctuations: S2 L1 examples

Largest CalLine amplitude (<0.5% error on a minute time scale)

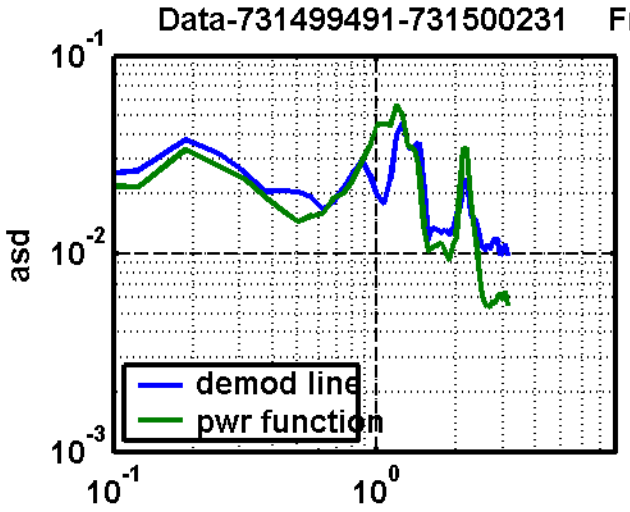
~10-15%pp

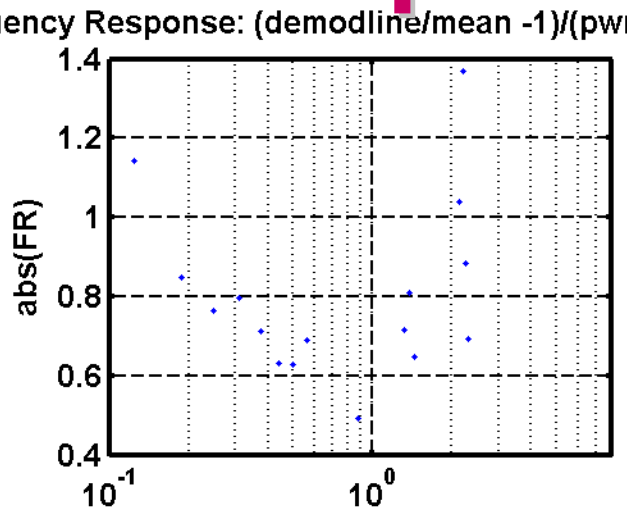
Time scales:
~ few seconds
~ 1-2 Hz

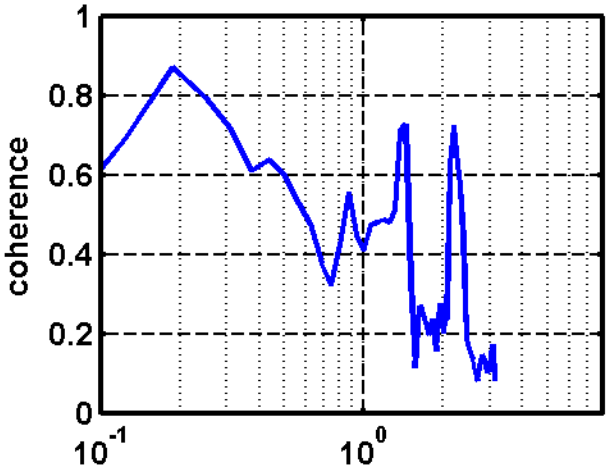


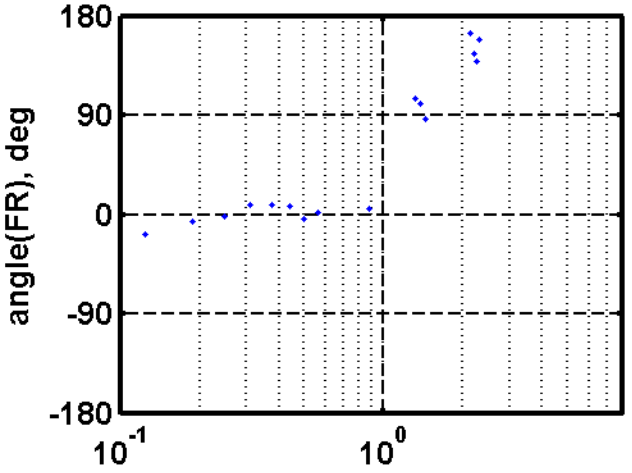


S2 L1 examples





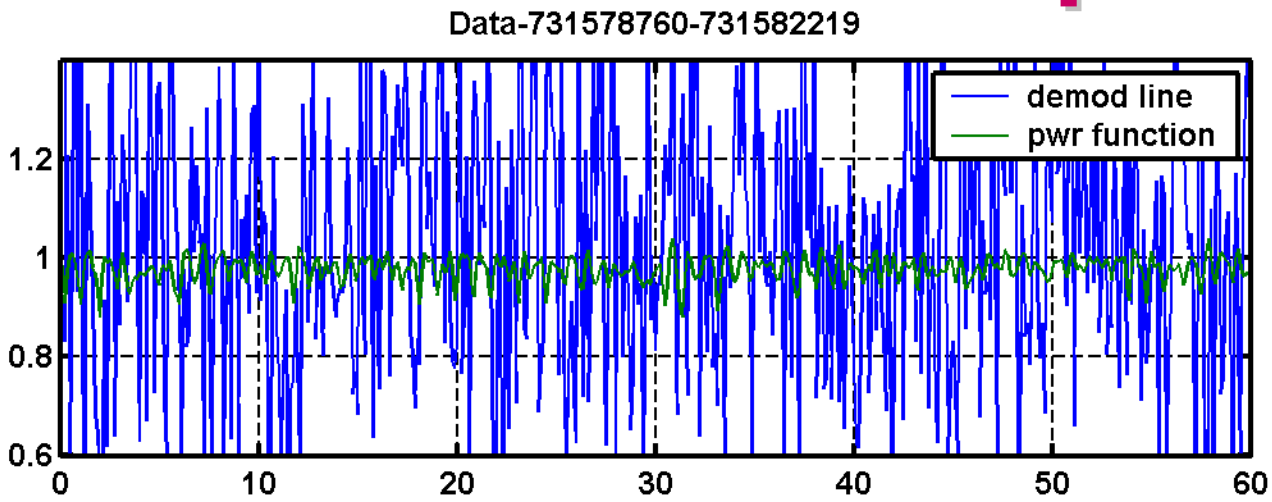


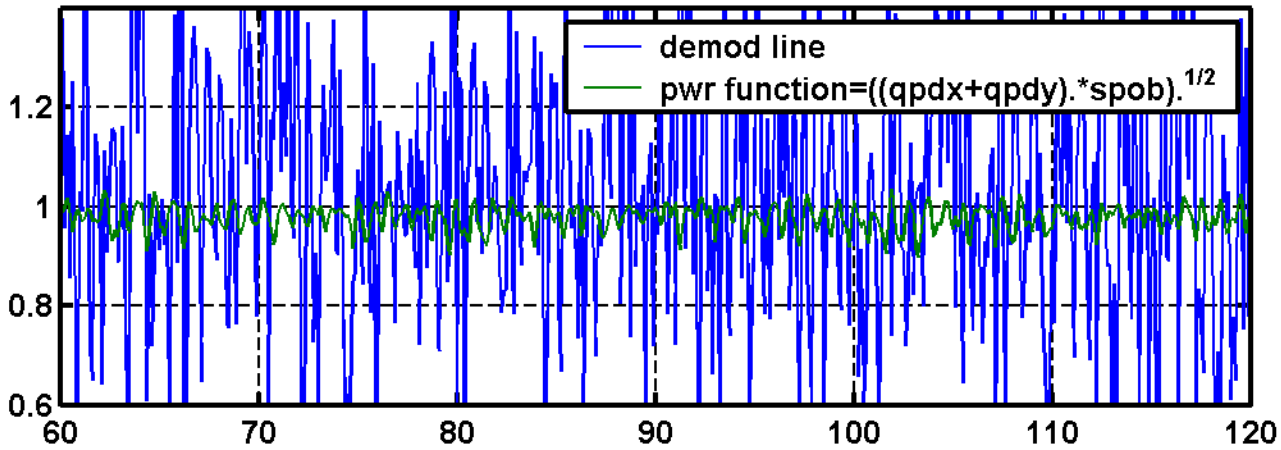


Rough consistency between line amplitude and power function

Freq Resp: pole in power function? (not always there?)

S2 examples



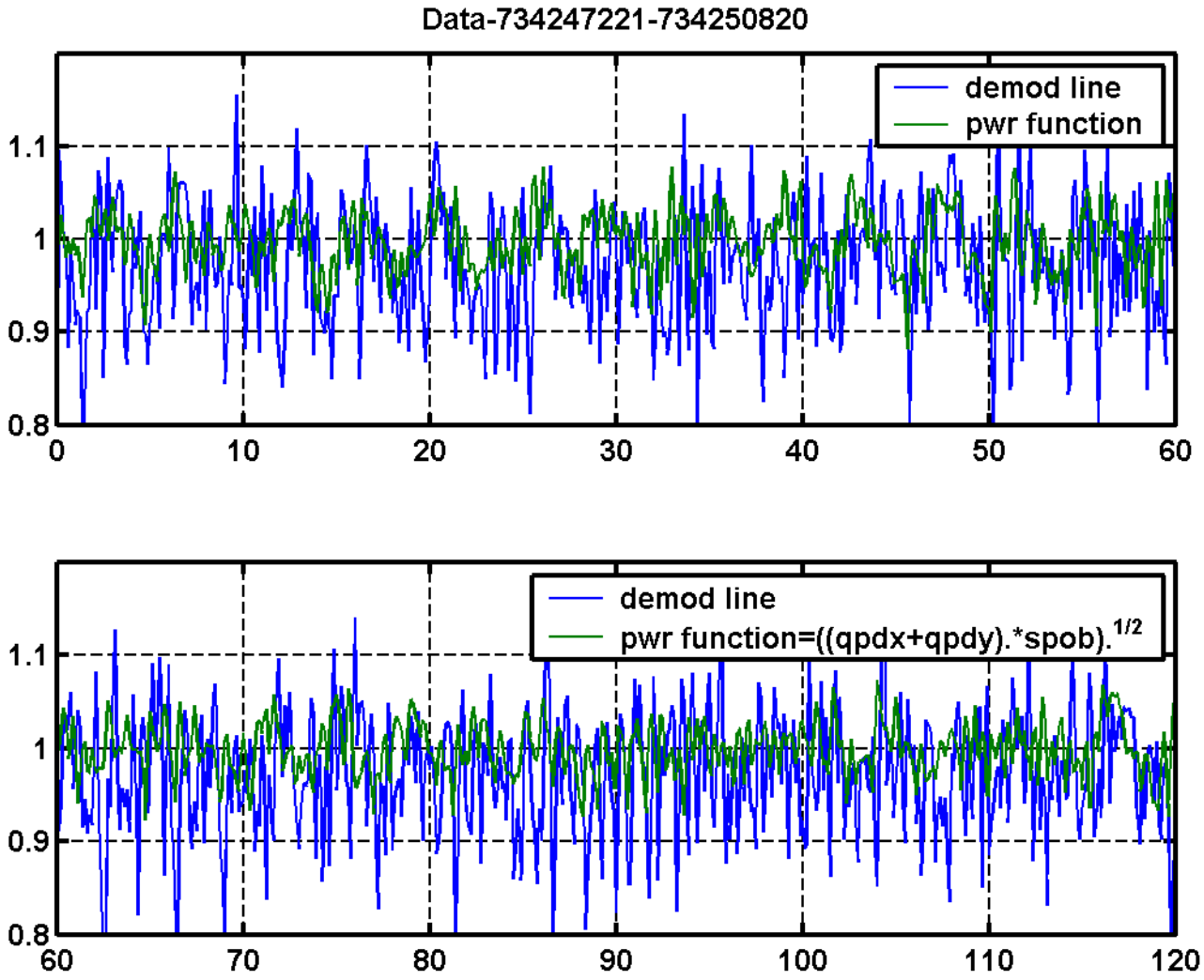


Lowest cal line amplitude (10% error in minute time scale):

no information on fast fluctuations from demod line,

similar information from pwr function (less useism, same 1-2 Hz)

S2 examples

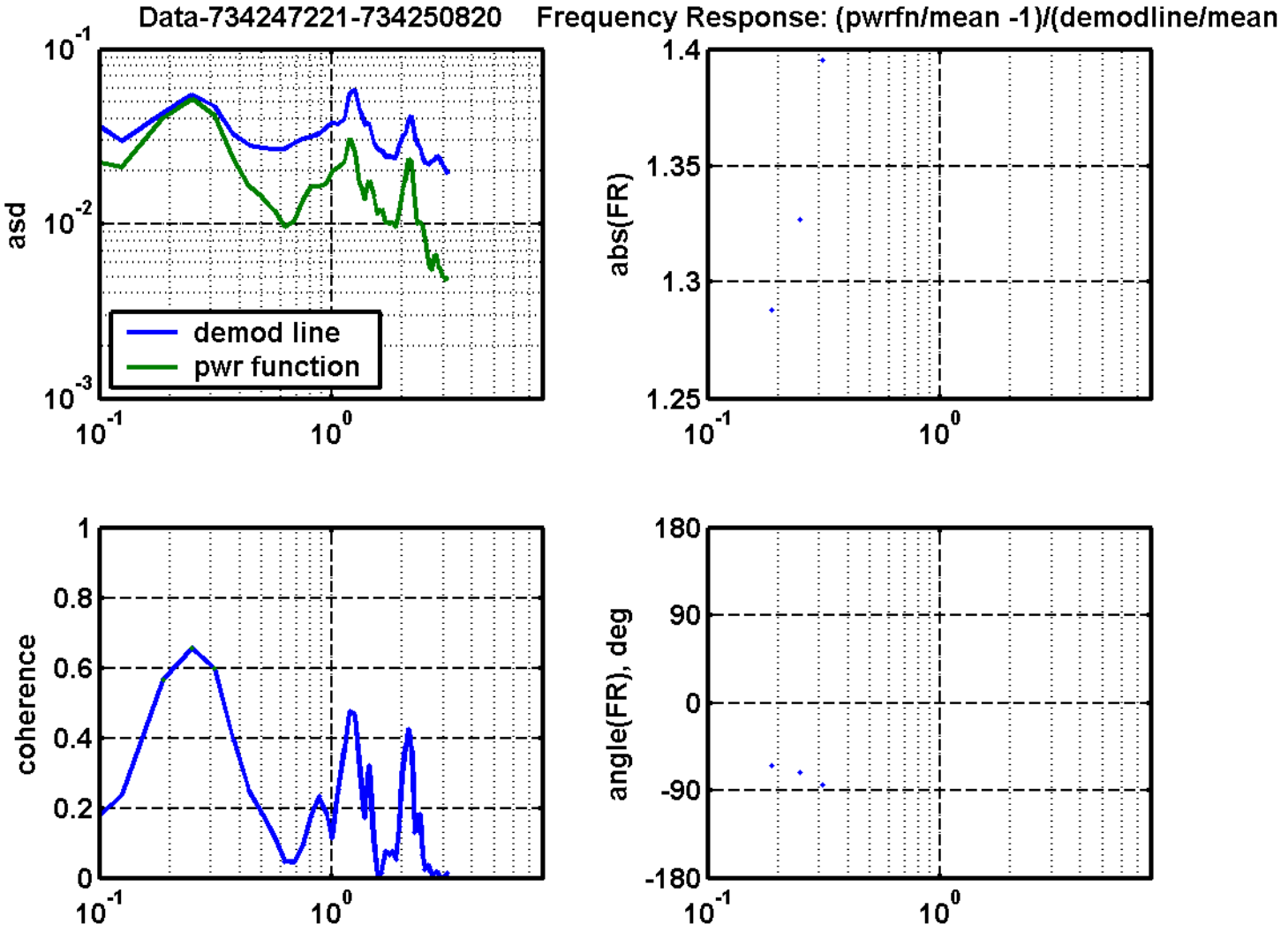


Large (not largest) line amplitude

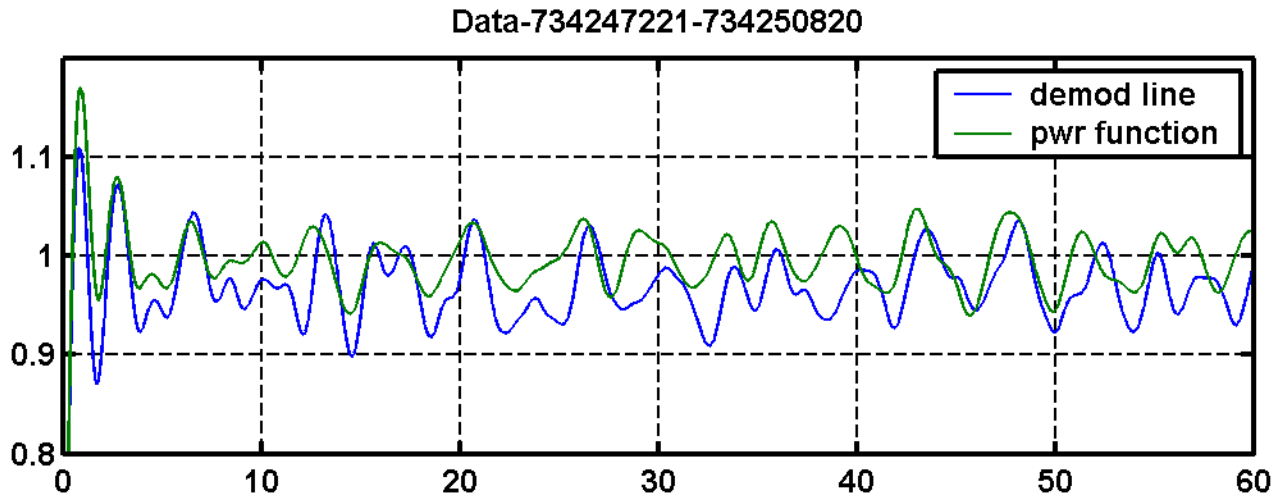
-Consistent low freq amplitude

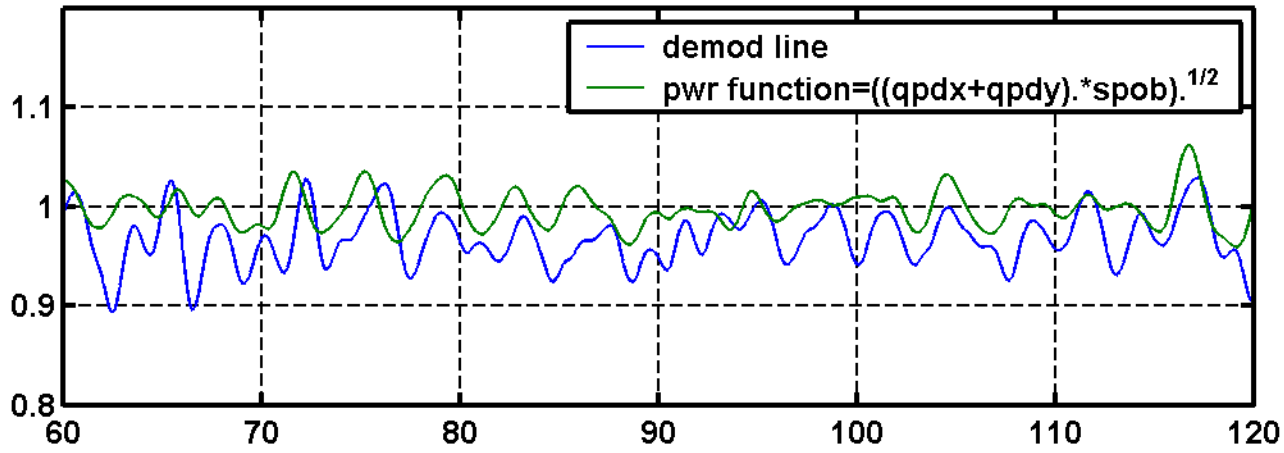
- Large (too large?) 1-2 Hz fluctuations

S2 examples


Data-734247221-734250820
Frequency Response: (pwrfn/mean -1)/(demodline/mean
asd
demod line
pwr function
abs(FR)
coherence
angle(FR), deg

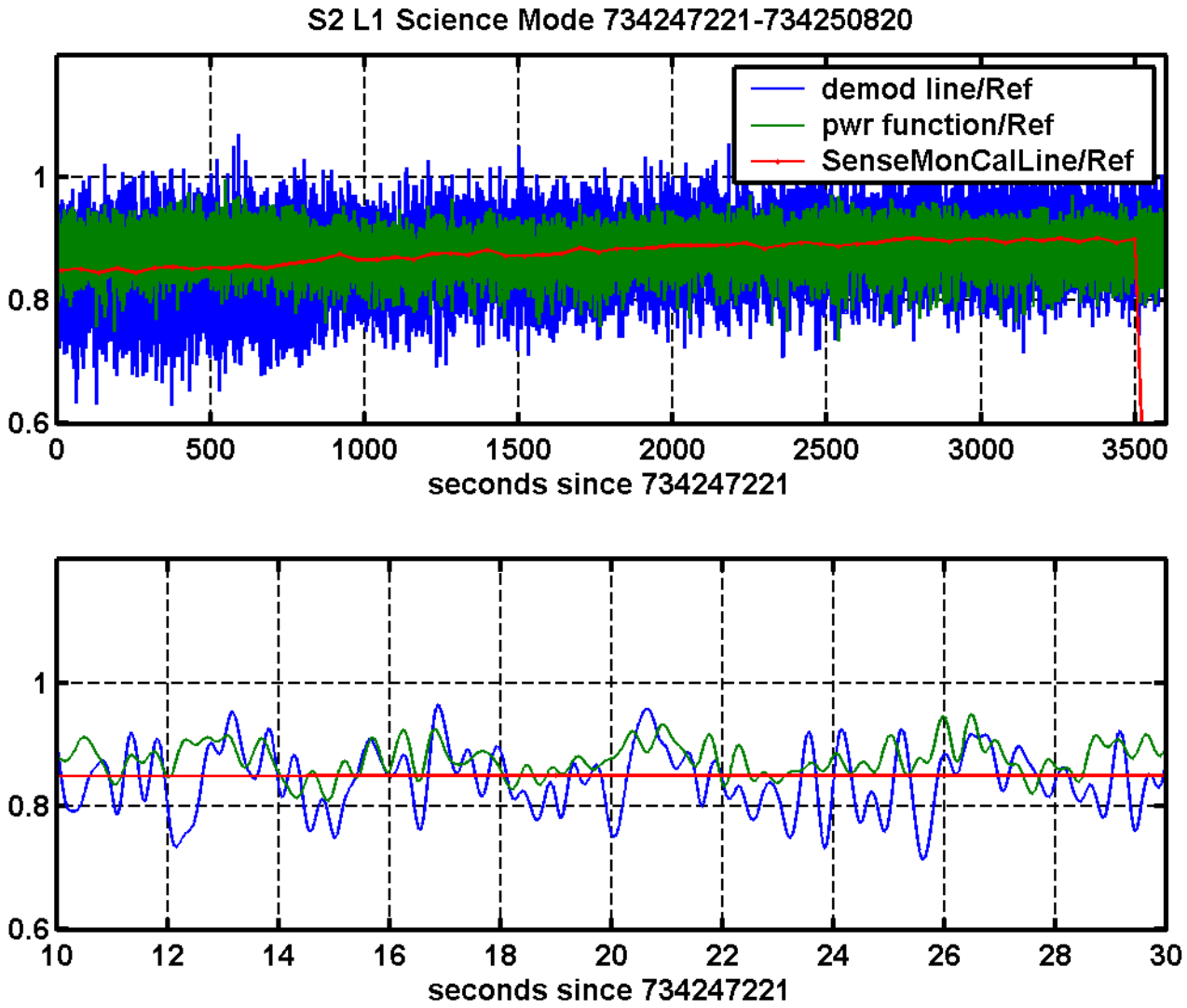
S2 examples





Same as before, filtered below 0.5 Hz.

S2 examples



Scaled by the reference value at the same time than for the SenseMon line, long time trends are consistent with demodulation, not so clear with pwr function.

Conclusions

- Fast fluctuations can be 10-15% pp, mostly at 0.1-0.2 Hz and 1-2 Hz
- 0.1-0.2 Hz fluctuations may be reconstructed from Power Function, not clear for long trends or for 1-2 Hz
- Fluctuations can be measured from demodulated line IF amplitude is large enough.
- Estimates on magnitude of fluctuations (but probably not measurements of fluctuations) may be obtained from blrms tools or seismometer channels.
- Lots of work!