Wavelets

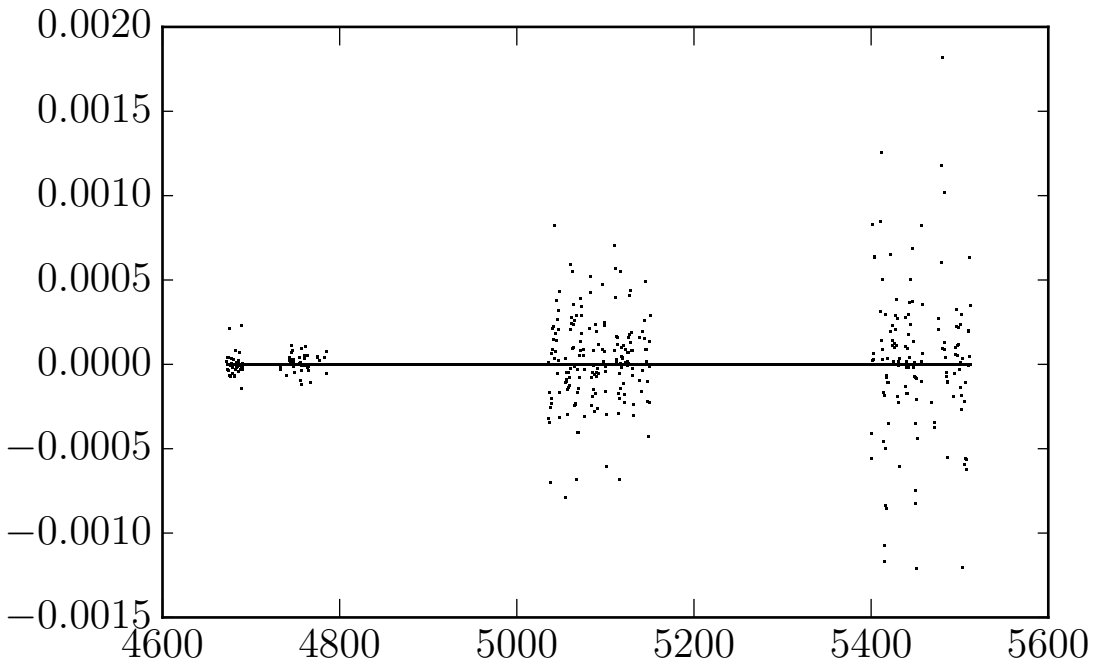
July 15, 2015

1 Attempt to implement Dave's wavelet algorith

Concerns:

- Can wavelets handle gaps in data?
- Looks like no (judging by input)
- Can wavelets handle uneven cadence?
- Looks like no (judging by input)
- How computationally heavy is wavelets? Do I need to bin?

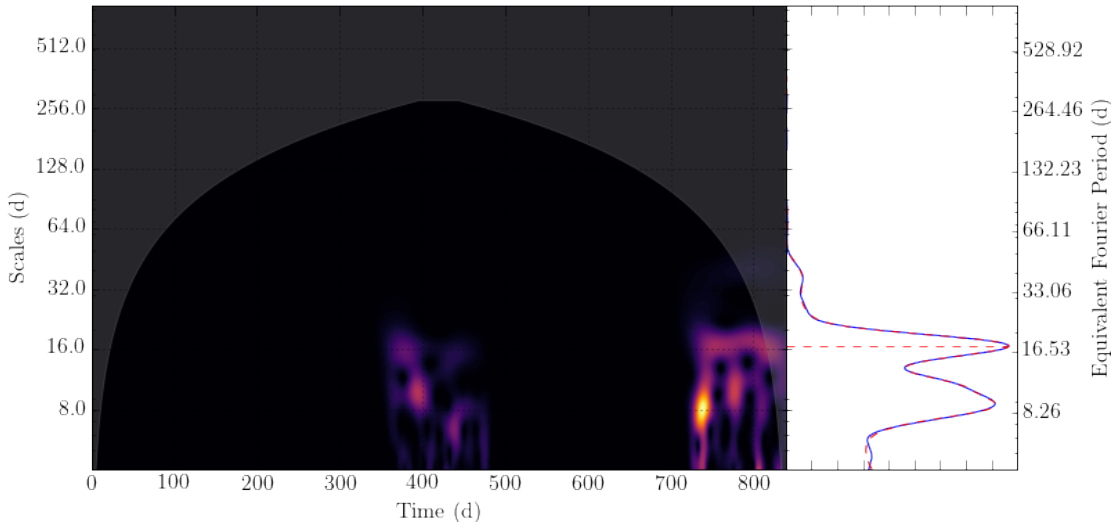
2 First look



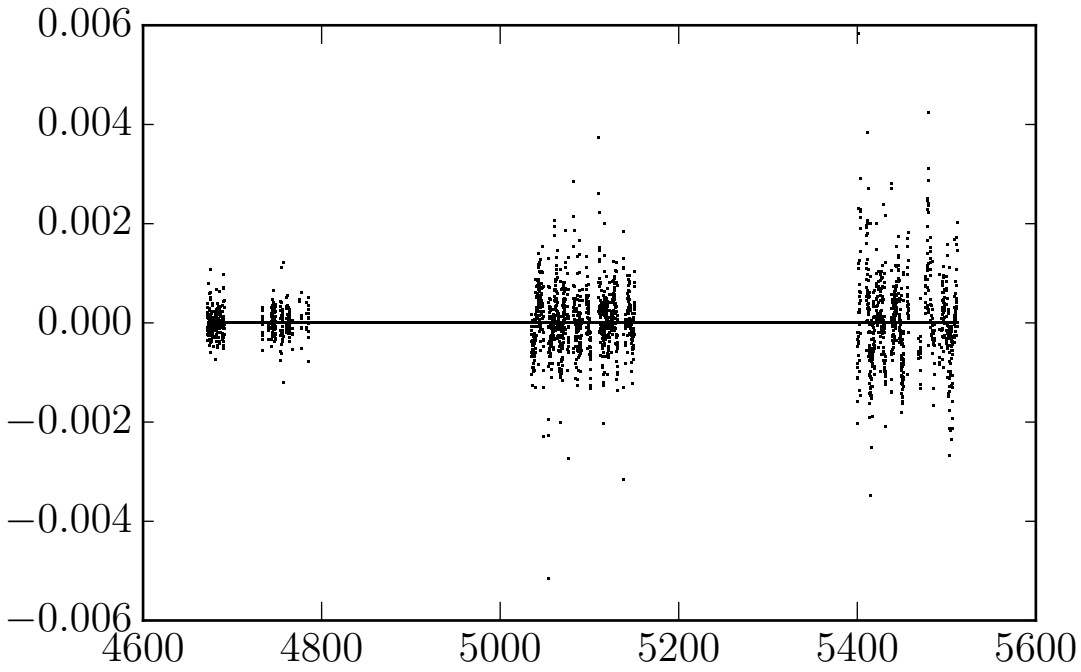

```
0.185104476728 0.185256918084
```

ehh... close enough for a first look

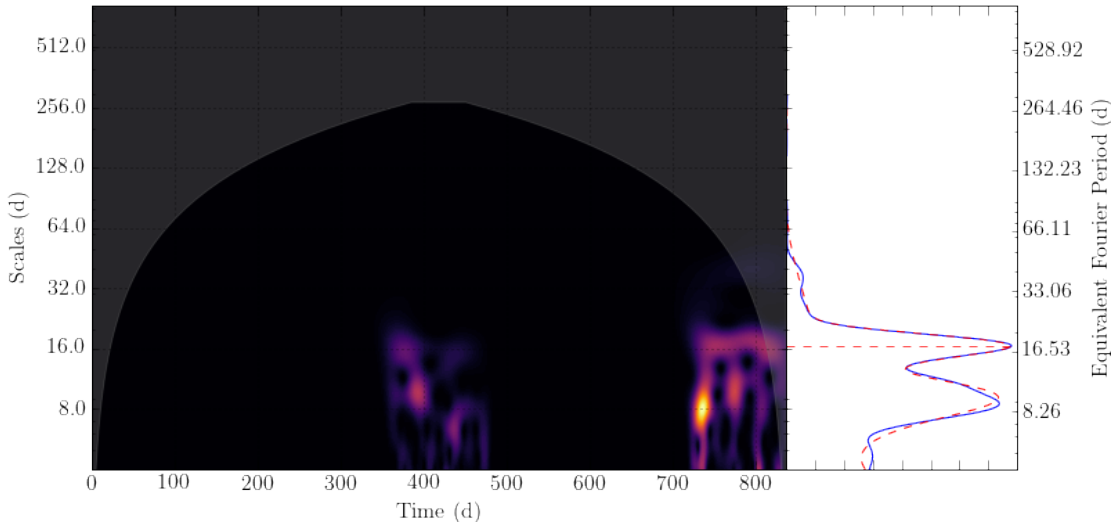
```
Wavelet GPS Peak Scale: 16.5586193382
Wavelet GPS Peak Period: 17.1057765229
```



3 same test, different scale

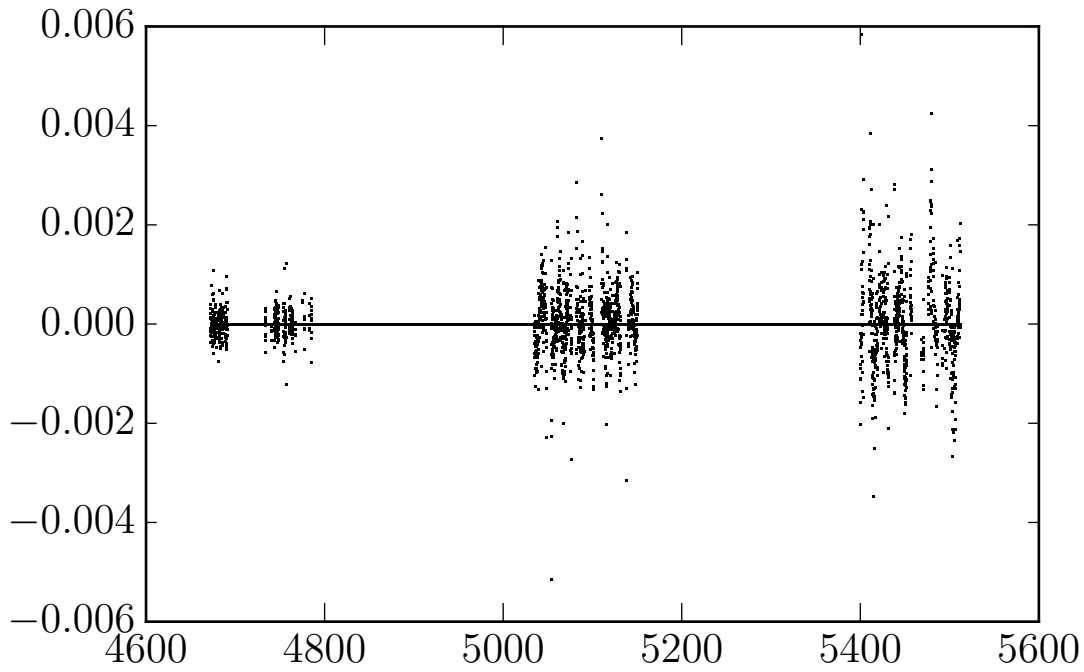



```
/home/astro/phrmat/anaconda/lib/python2.7/site-packages/scipy/optimize/minpack.py:421: RuntimeWarning: I
  warnings.warn(errors[info][0], RuntimeWarning)

Wavelet GPS Peak Scale: 16.4826276996
Wavelet GPS Peak Period: 17.0272738433
```

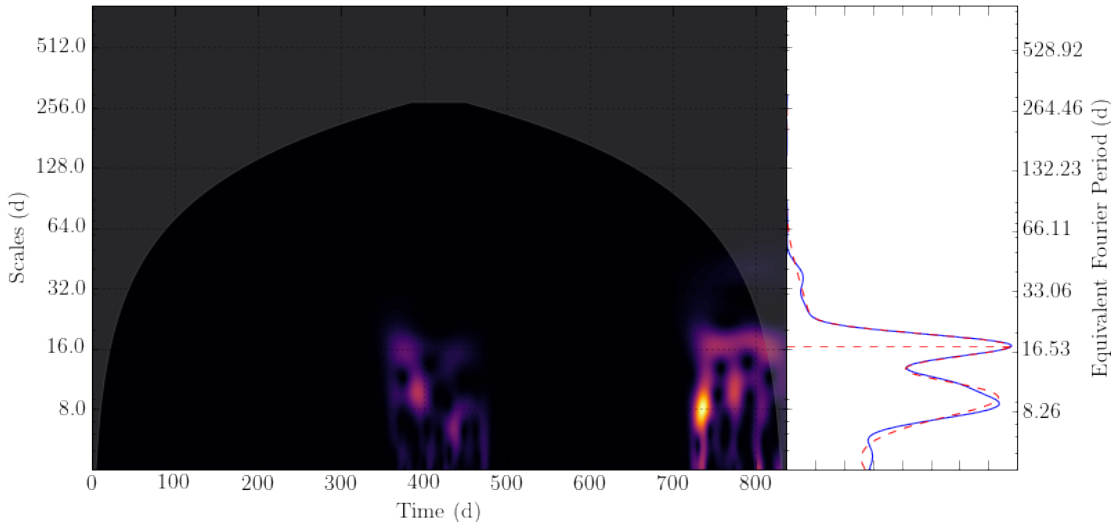


4 Same test, no binning

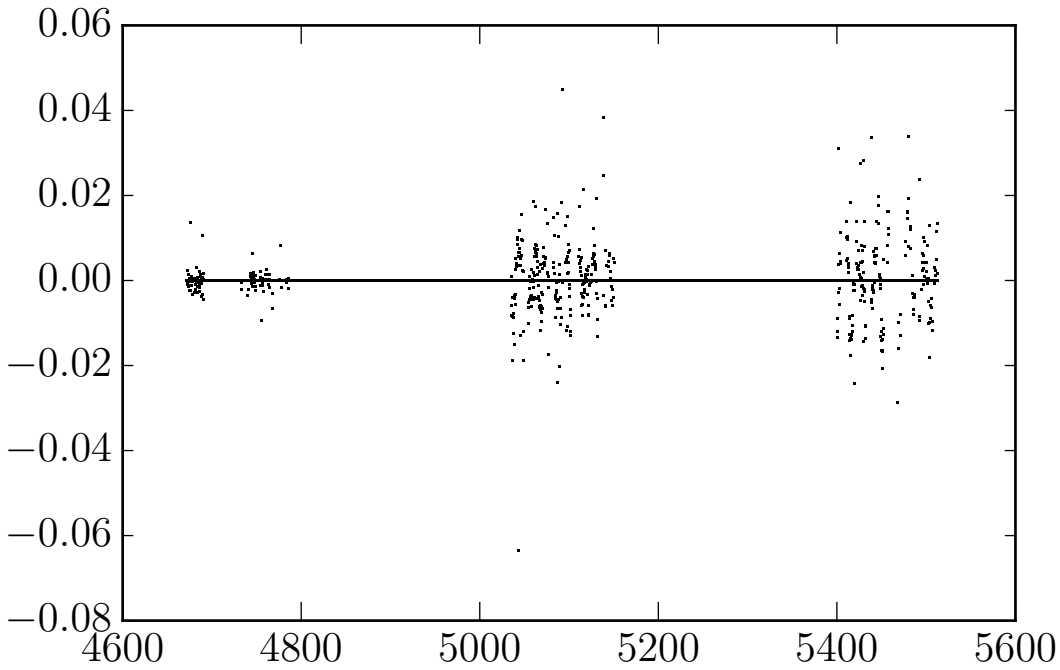
Ok... that caused a memory error on sirius. let's not. binning of 10?



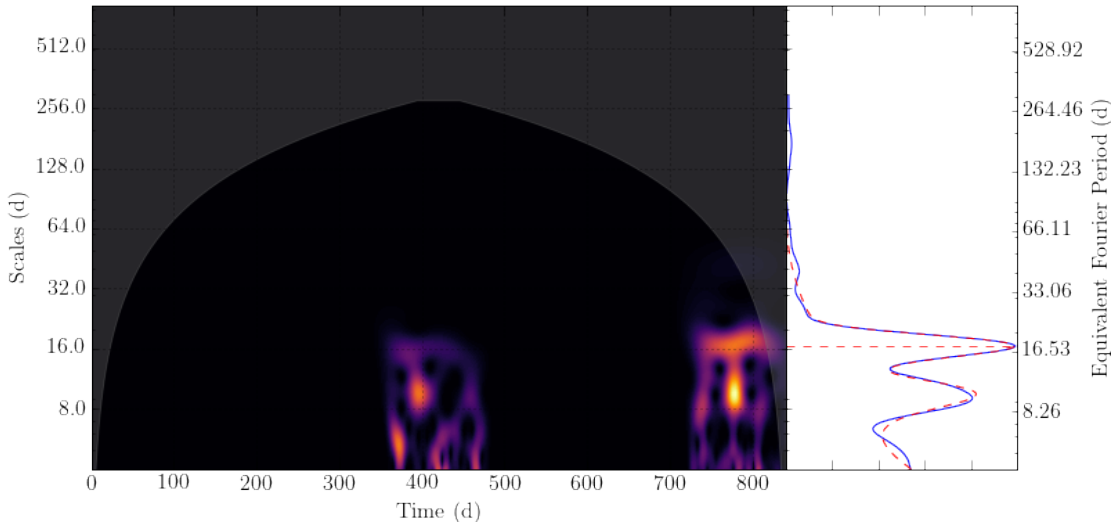

```
Wavelet GPS Peak Scale: 16.4826276996
Wavelet GPS Peak Period: 17.0272738433
```



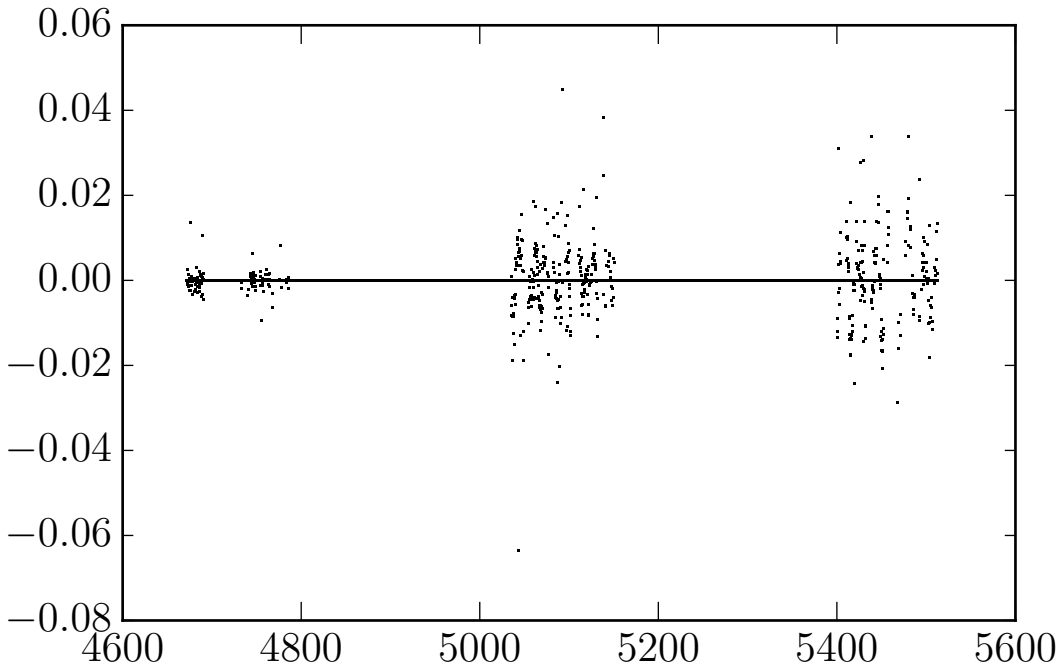
5 With nightly binning / even bin sizes



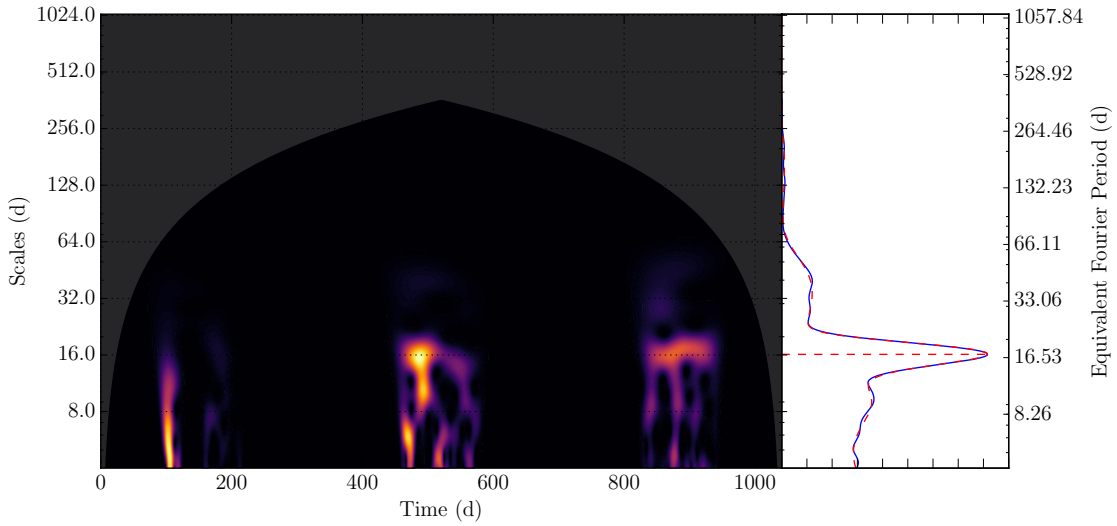

```
Wavelet GPS Peak Scale: 16.4631750627
Wavelet GPS Peak Period: 17.0071784203
```

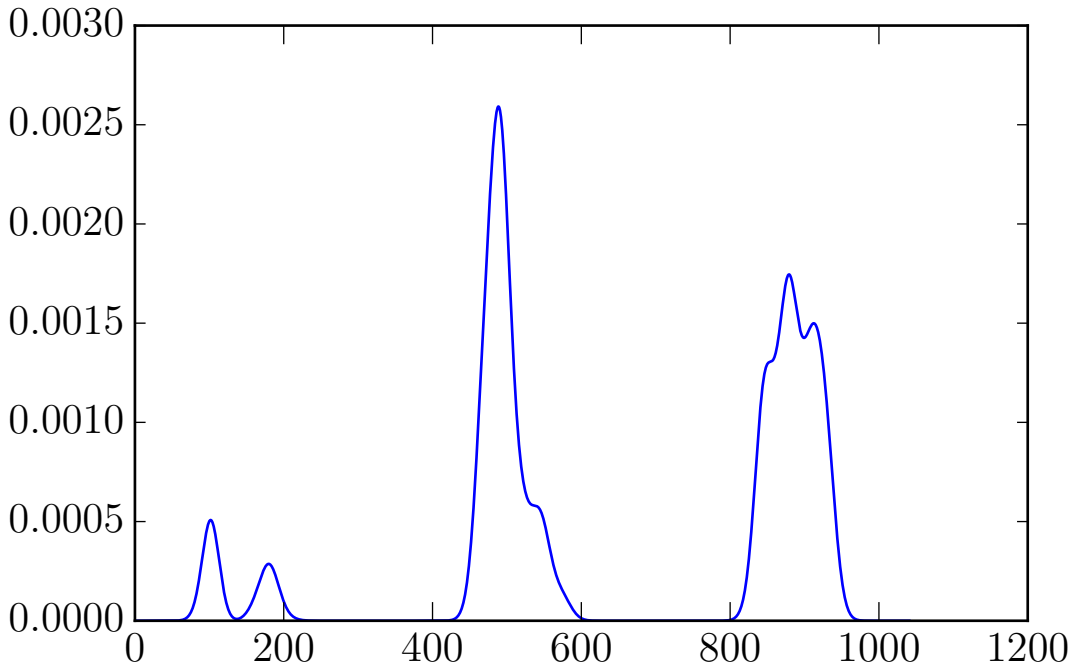


6 New formatting...




```
Wavelet GPS Peak Scale: 16.1243678192
Wavelet GPS Peak Period: 16.6571757496
```

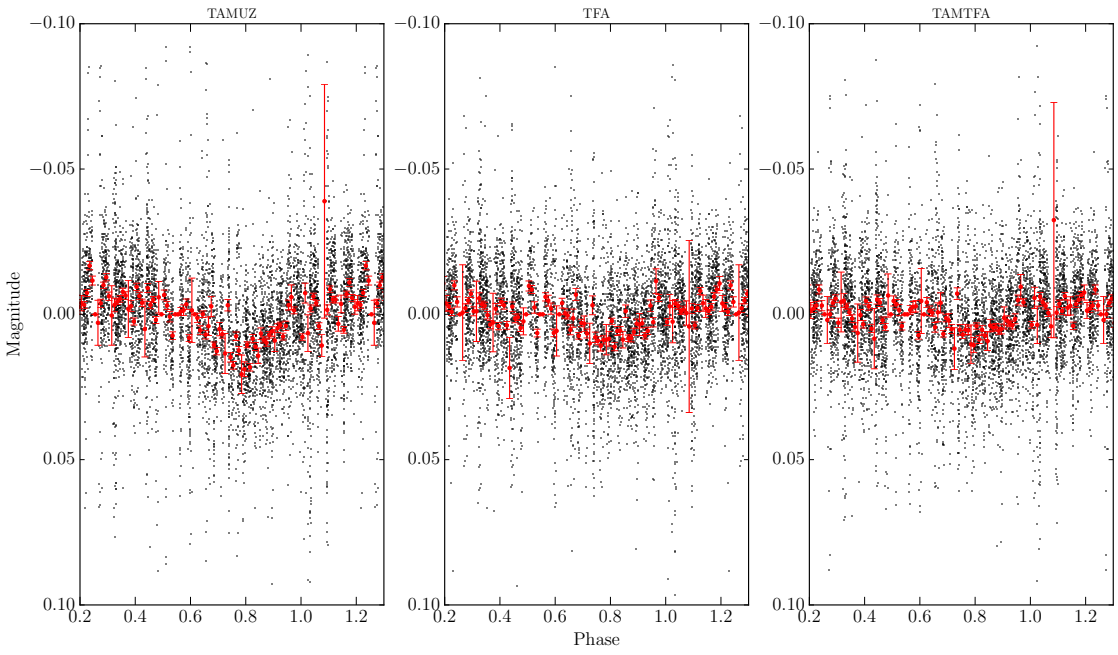




7 Fold lightcurves on best period

Taking the best period from the previous segment, let's fold on that period.

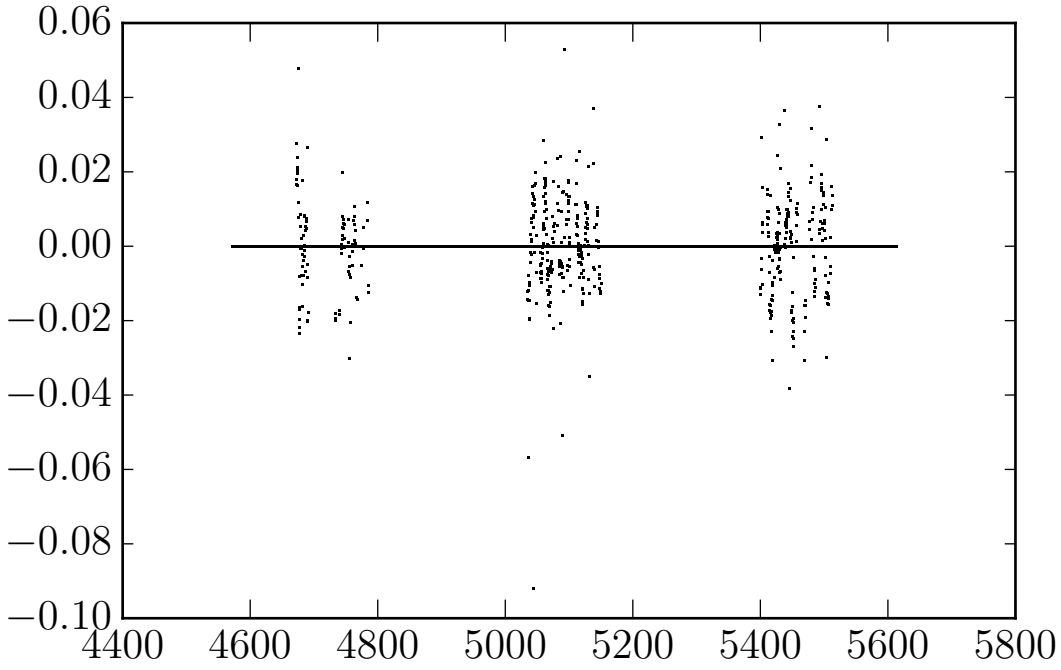
I just want to compare with the WASP-52 detection paper for now, to make sure that some variability is showing up, so I take their period 0f 16.38 for their 'season 2'



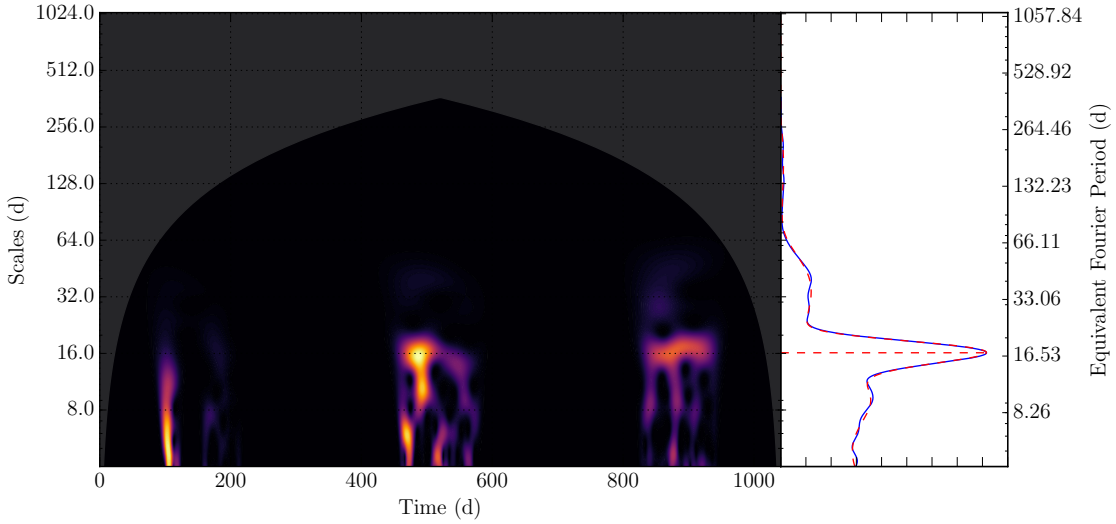
TFA algorithm has a tendency to decrease the strength of the signal - TAMTFA is even worse, it can reverse it! This means I should make the wavelets plot again with TAMUZ detrending only.

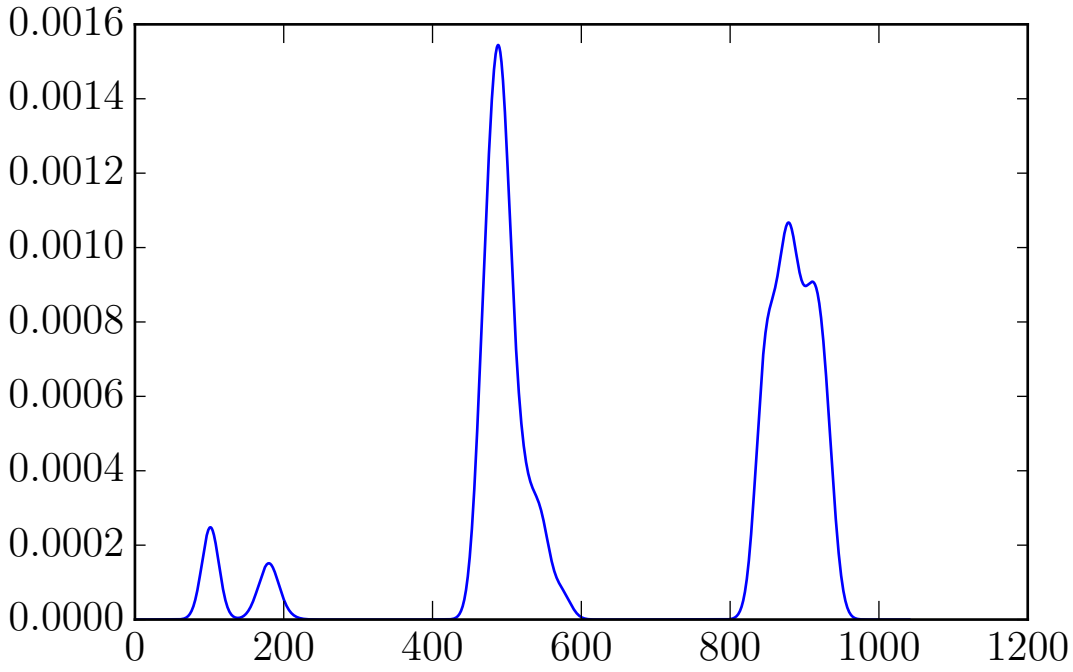
8 Wavelets using the TAMUZ lightcurves

```
The autoreload extension is already loaded. To reload it, use:
  %reload_ext autoreload
```

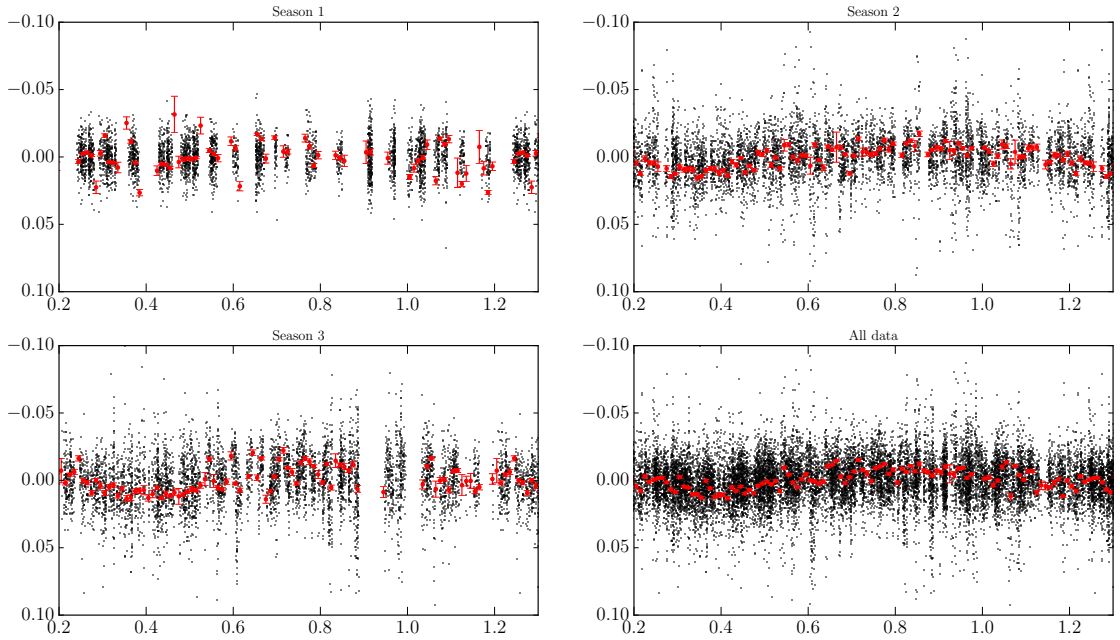


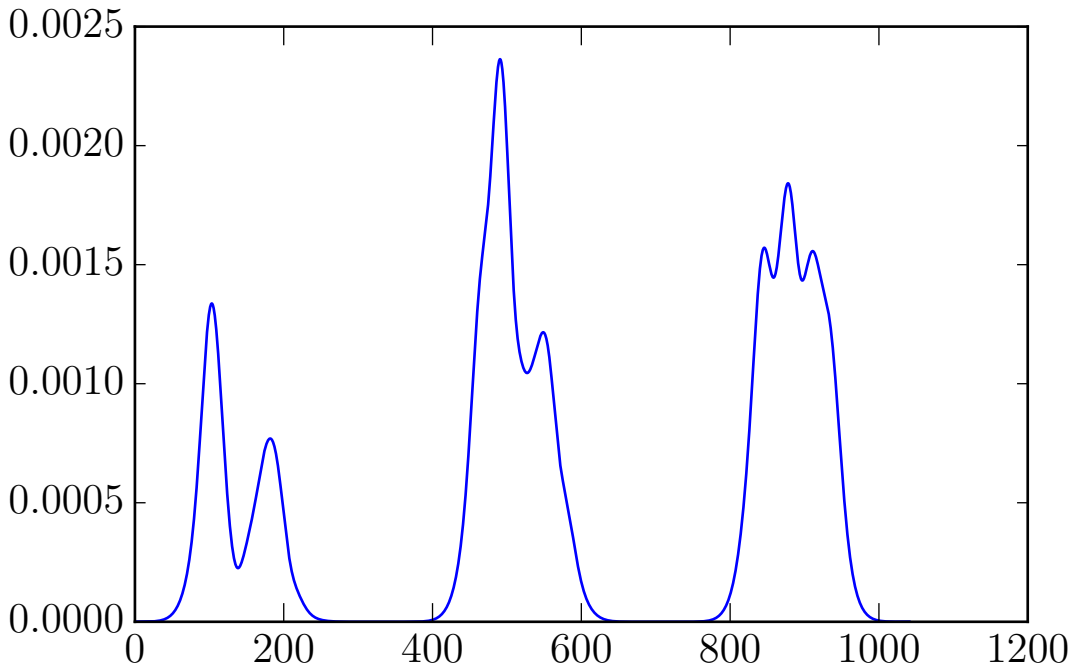
```
/home/astro/phrmat/anaconda/lib/python2.7/site-packages/scipy/optimize/minpack.py:421: RuntimeWarning: I
  warnings.warn(errors[info][0], RuntimeWarning)

Wavelet GPS Peak Scale: 16.1243678192
Wavelet GPS Peak Period: 16.6571757496
```





much better! it's much clearer what's going on now, and the recovered period is significantly closer to the previously reported data.





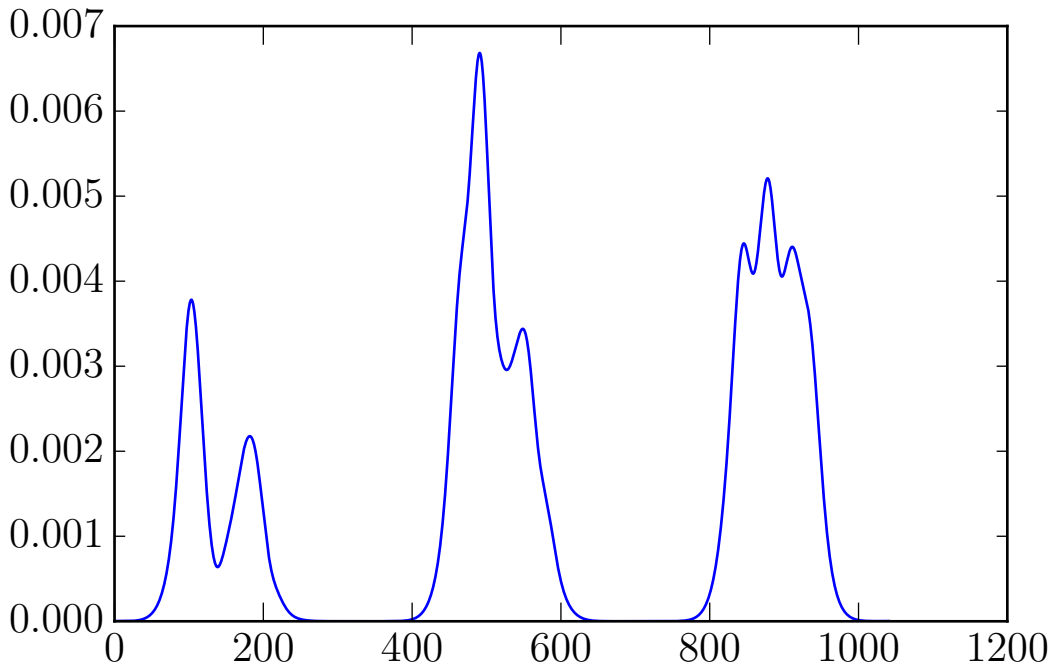
I'm interested in how the amplitude is changing over time. If I assume the wave is a sine wave (questionable) then from https://en.wikipedia.org/wiki/Root_mean_square#RMS_of_common_waveforms

$Amplitude = \sigma\sqrt{(2)}$

and if we also assume that this is purely due to spots, then

$Dimming = 2\sigma\sqrt{(2)}$

Then, I can assume either coverage % or temperature to explore what's feasable

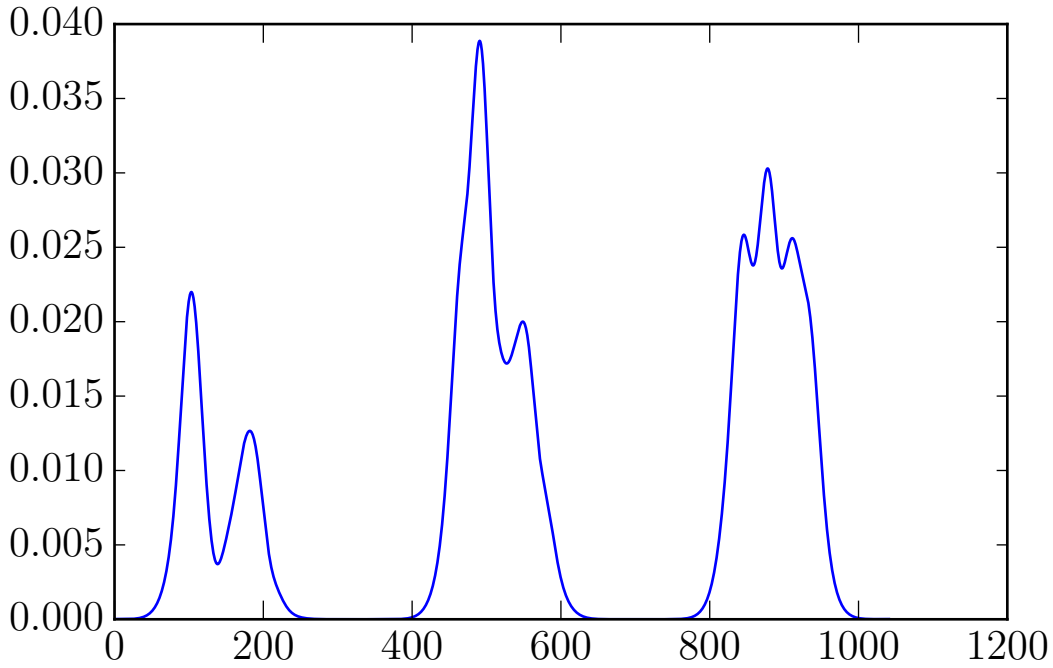


So, according to this, I think that the variability of the star during the second season is of order 5 mmag, which means the spot/nonspot difference is ~ 1% let's make a quick first order approximation

$fluxratio = \left(\frac{T_{spot}}{T_{star}}\right)^4$
$1 - fluxdimming = 1 - spotcoverage + fluxratio * spotcoverage$
$1 - fluxdimming = 1 - spotcoverage * (1 - fluxratio)$
$spotcoverage = (fluxdimming)/(1 - fluxratio)$

```
0.0290782204129
```

So at the very worst, the spot coverage was ~ 3%. This seems reasonable.


0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
200
400
600
800
1000
1200