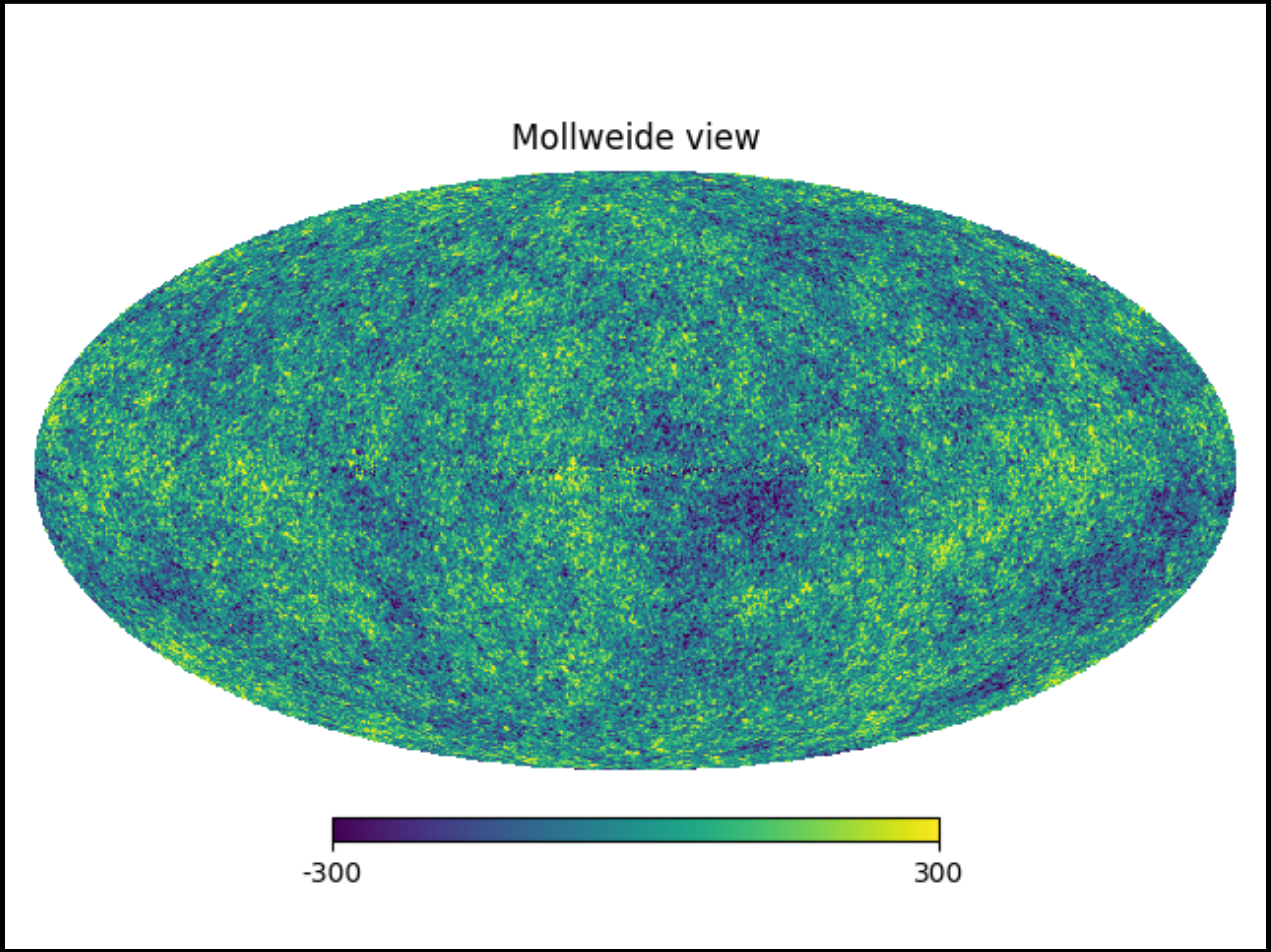
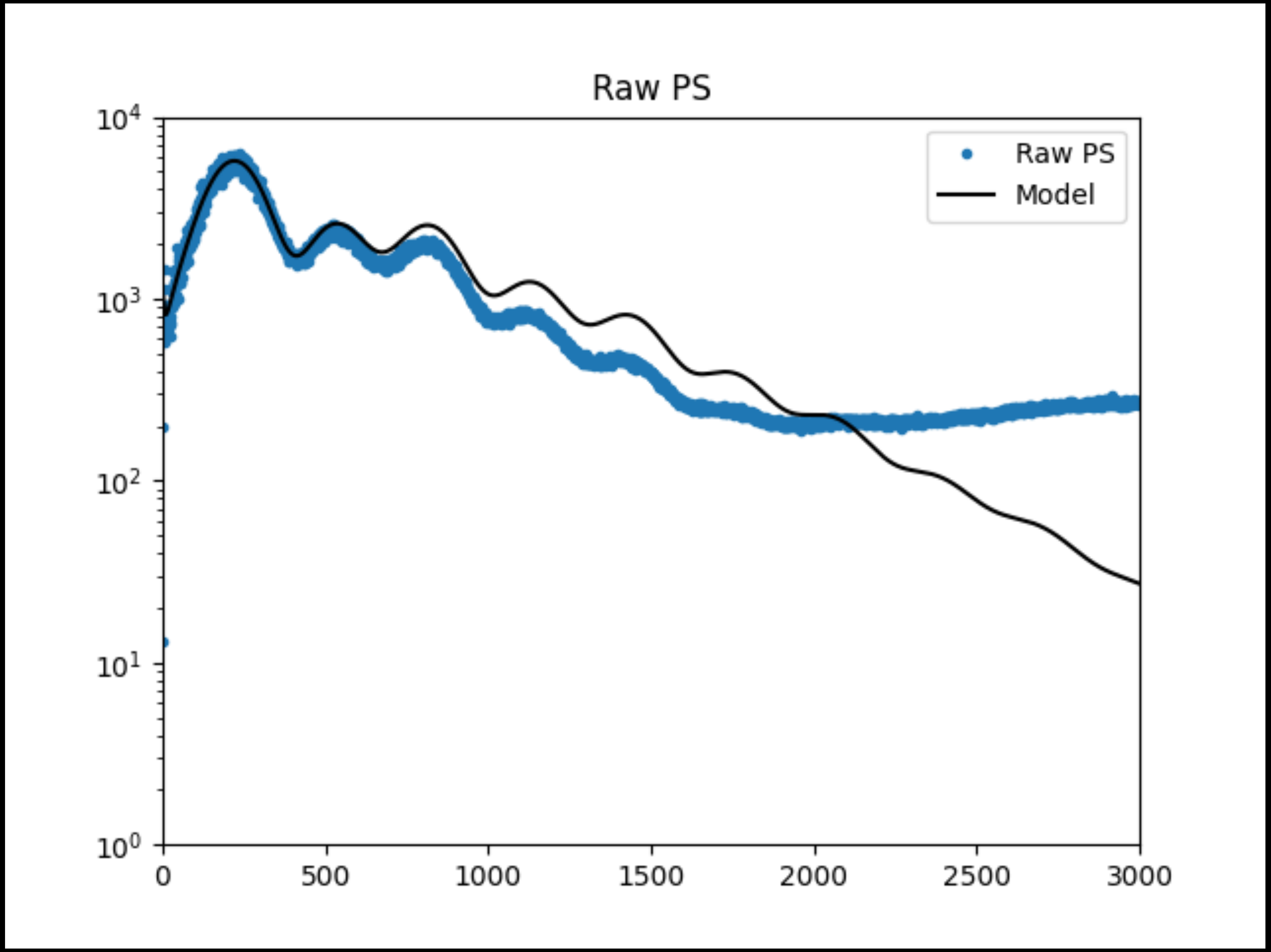
PS From All-sky Maps

Planck Map (Foreground-cleaned)



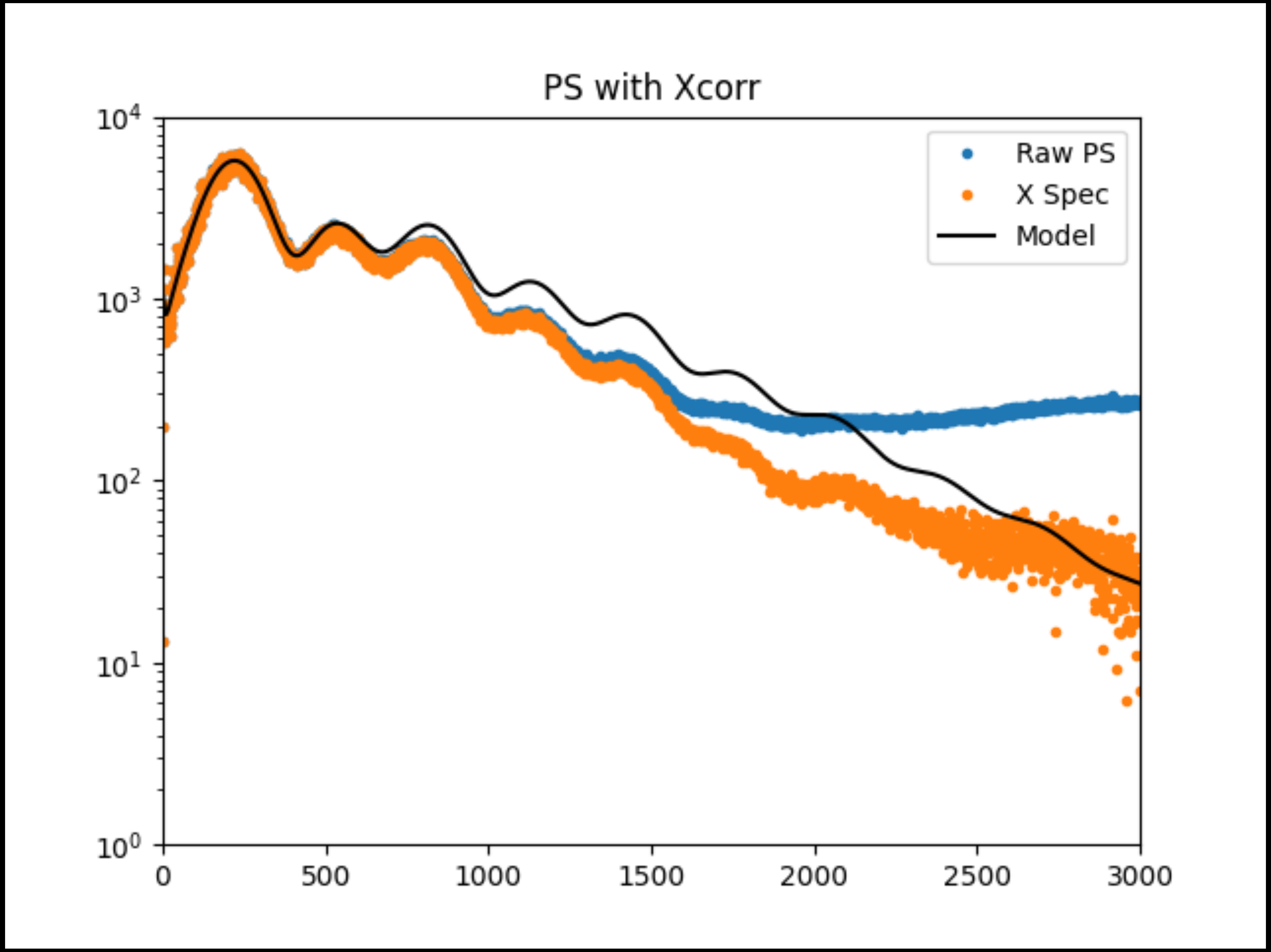
Raw PS

- Spectrum is clearly related, but some issues.
- Orange is best-fit from papers. Spectrum is below model at l=1500, above at l=2500.



X-Spec

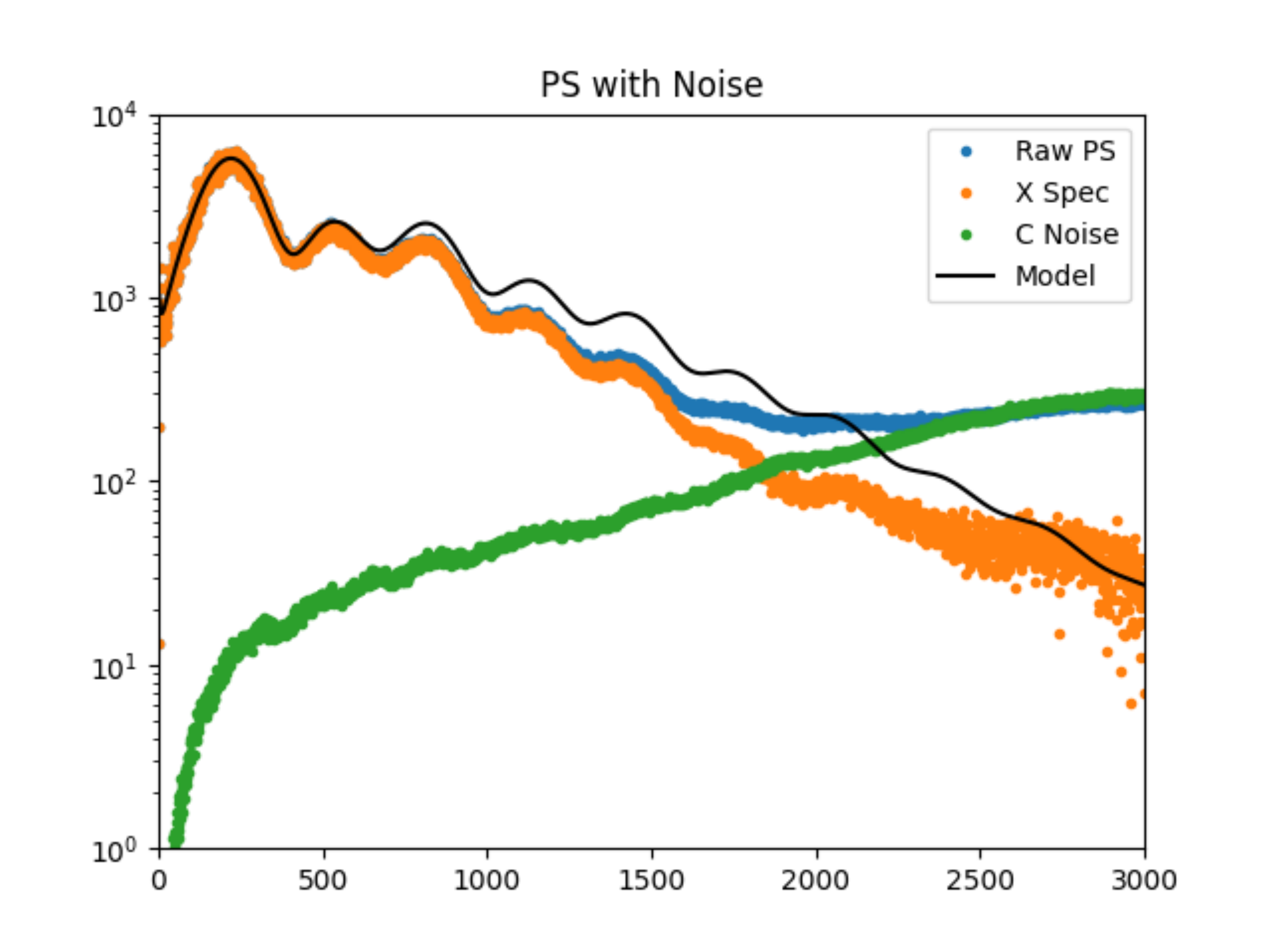
- Map=signal+noise
- $C_l = C_l(\text{signal}) + C_l(\text{noise})$
- Split data in half:
  a_{lm1}=SHT(map 1),
  a_{lm2}=SHT(map 2)
- $\langle a_{lm1}^{*} a_{lm2} \rangle = Cl(\text{signal}) + n_{lm1}^{*} n_{lm2} = Cl(\text{signal})$
- We've lost some SNR, but turns out with more splits we can buy back.



Noise Spec

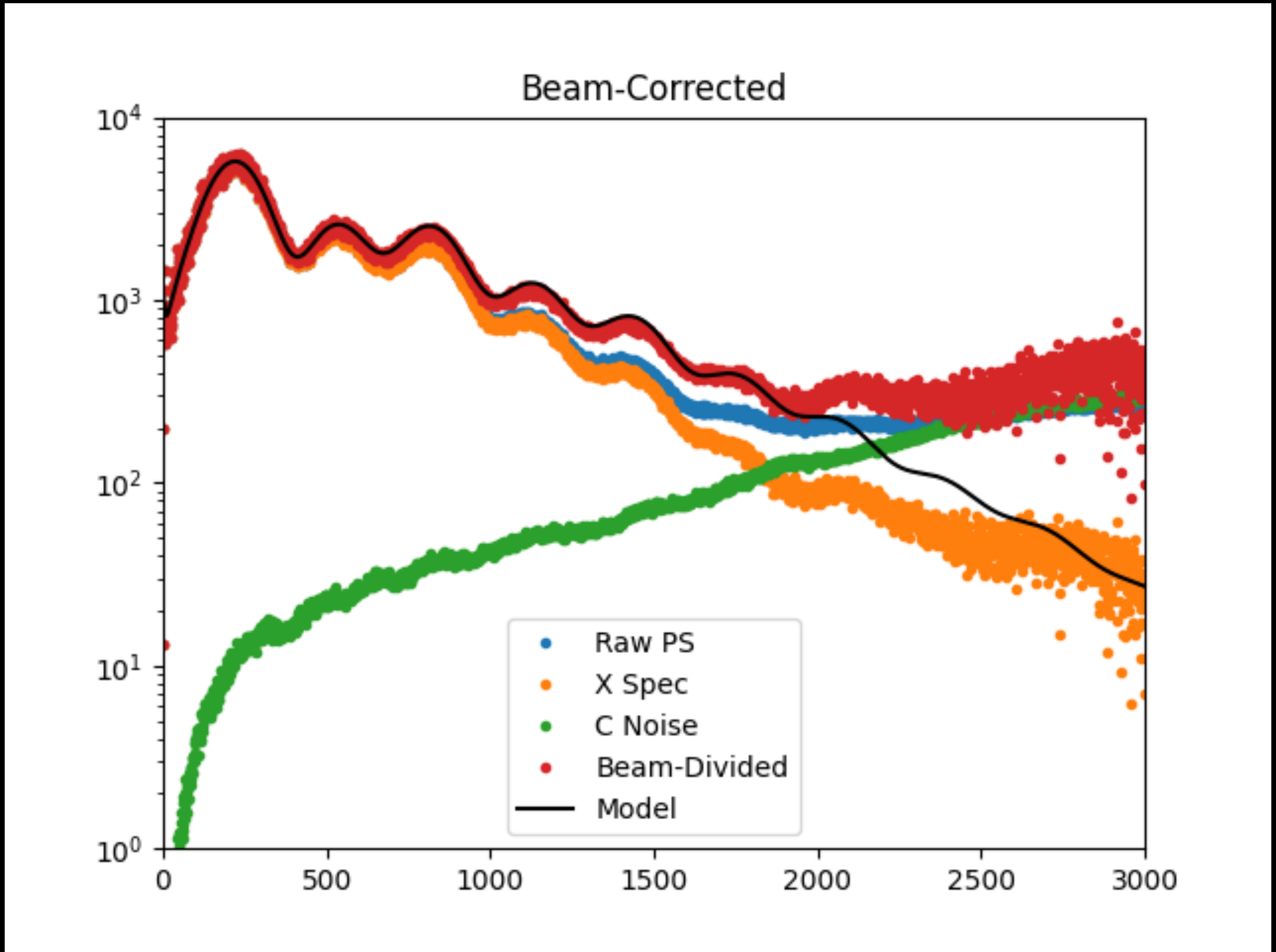
- We can also check PS of map difference. Gives us estimate of noise.

- NB - $\sigma(m1-m2)=2\sigma((m1-m2)/2)$



Beams

- In real space, we measure sky convolved with instrument beam.
- In FT, we then measure sky transform times beam transform
- SHT similar (for circular beam): $C_{l,obs}=C_{l,true}B_l$.
- B_l=Gaussian, σ~1300



What Else could be Wrong?

- Our beam guess was sloppy. Should really use real beam
- Beam also frequency-dependendent. This map combination of others, so should use all beams for all frequencies
- Foregrounds - point sources dominate at high ell (small scales). Residual source contamination could be problem.

Masking

- Often we don't have full sky/need to remove map regions.
- We call this *masking*, and need to account in taking PS.
- One way (polspice) - estimate angular correlation function $C(\theta)$.
- C_l is P_l transform of $C(\cos(\theta))$.
- Estimate $C(\theta)$ only over unmasked pixels. Will introduce noise correlations, but will get unbiased estimate of PS.