The Variance of GOES Fluxes:
What's in the power spectrum?

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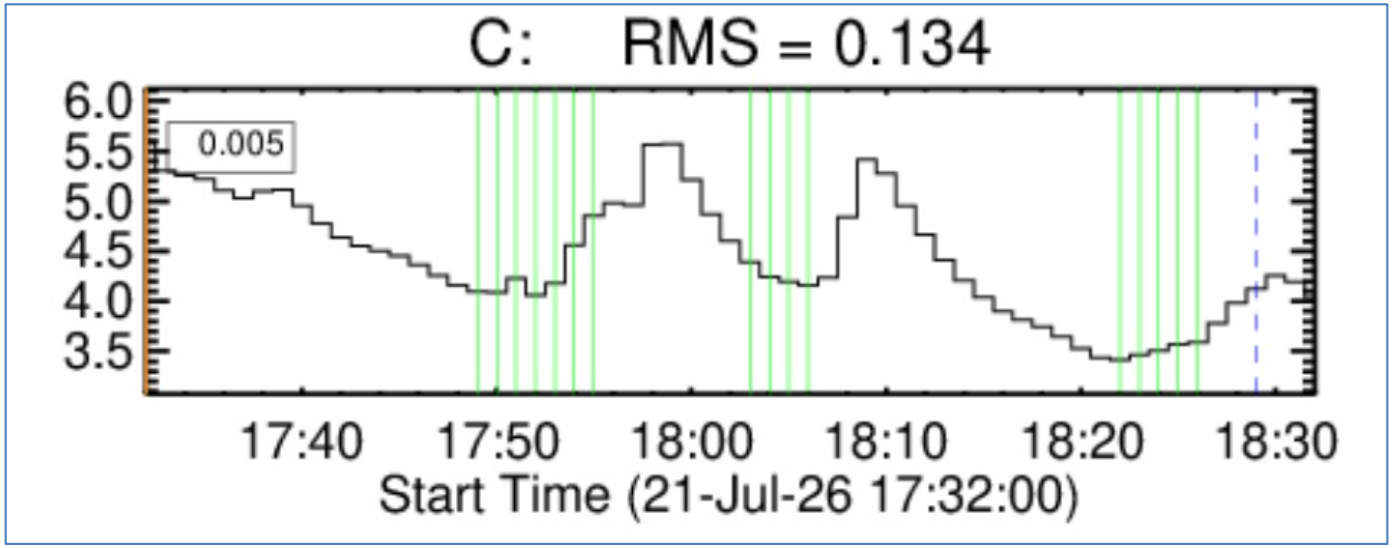
What is there between the flares?



https://www.astro.gla.ac.uk/users/hsh3f/scratch/fai.html

Statistical tools

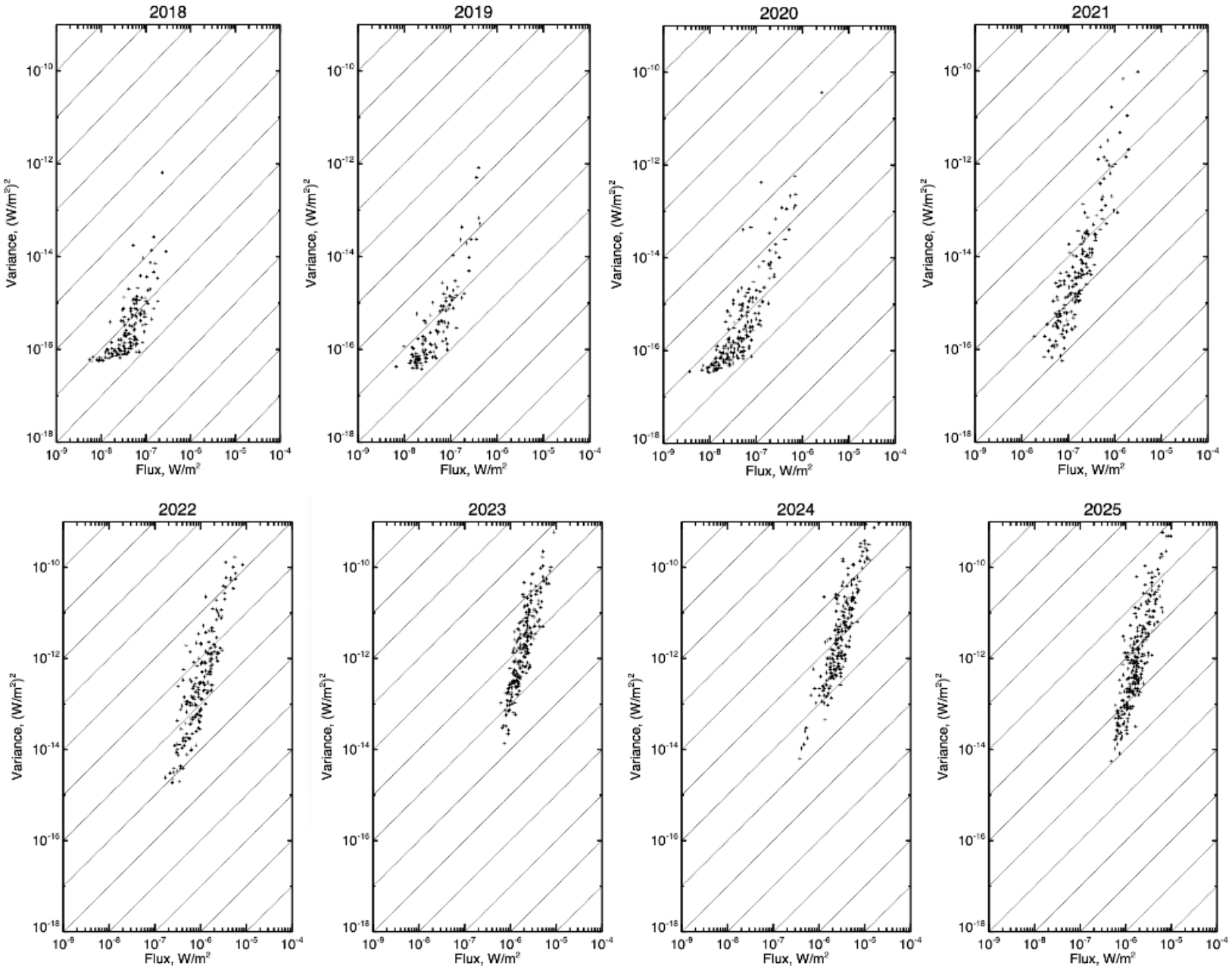
- Occurrence distribution function (e.g., Hudson 1991)
- Waiting-time distributions (e.g. Wheatland 1998)
- The variance (not analyzed before now)

Statistical tools

- Taylor's law (ecology): var(S) = aS^{α}, where a Poisson distribution has $\alpha = 1$. Many natural populations follow this empirical rule, with α ranging from <1 up to 5
- Large α generally means correlation, coherence, intermittency, non-random
- Flares have a heavy-tailed power law dN/dS, for which var(S) cannot be defined
- But we can test Taylor's law for intervals

Statistical tools II

- But we can test Taylor's law for intervals
- I've looked at 8 recent years of GOES data via 1-min sampling, and comparing mean and variance for all 1-day intervals
- Taylor's law holds and $\alpha = 3.06 \pm 0.05$ universally


2018
2019
2020
2021
2022
2023
2024
2025
Variance, (W/m²)²
Flux, W/m²

Conclusions

- All of the solar soft X-ray variability is due to flares, even at solar minimum
- The soft X-ray emission could result from episodic heating, but not from random “nanoflares”
- The interesting physics is in the coherence of the event occurrence