

Noise in GPS time series:

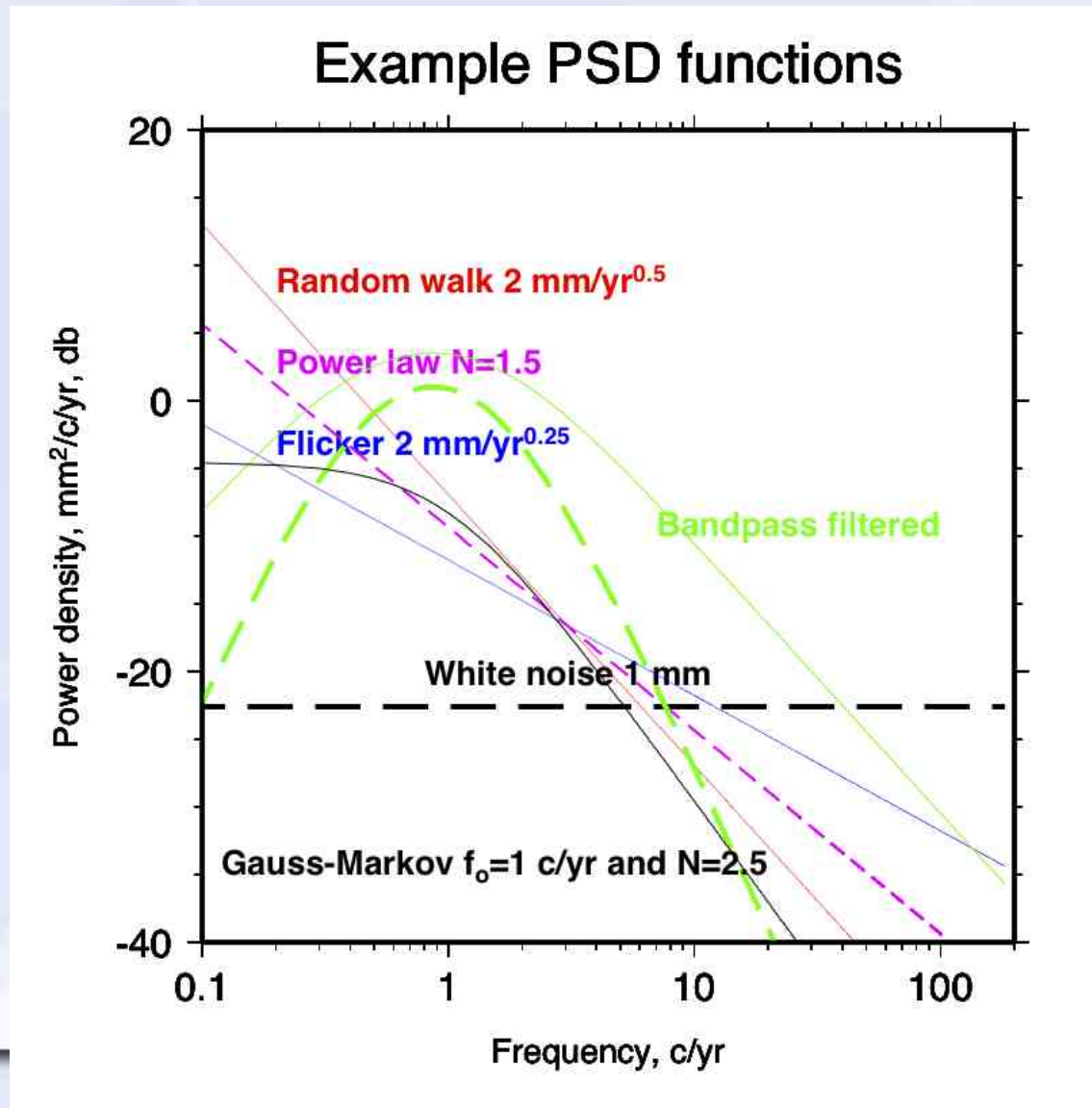
1) Appropriate noise models

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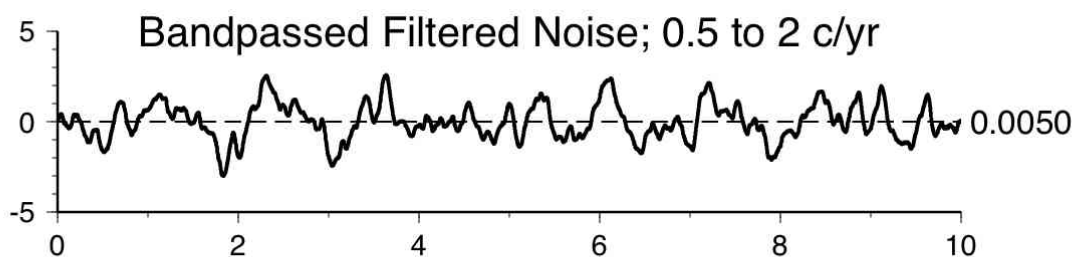
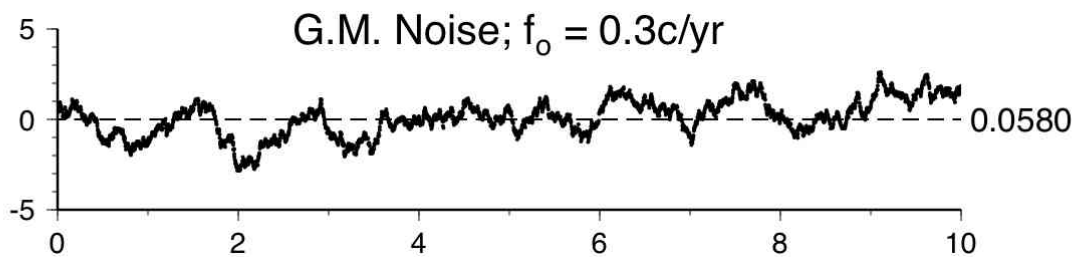
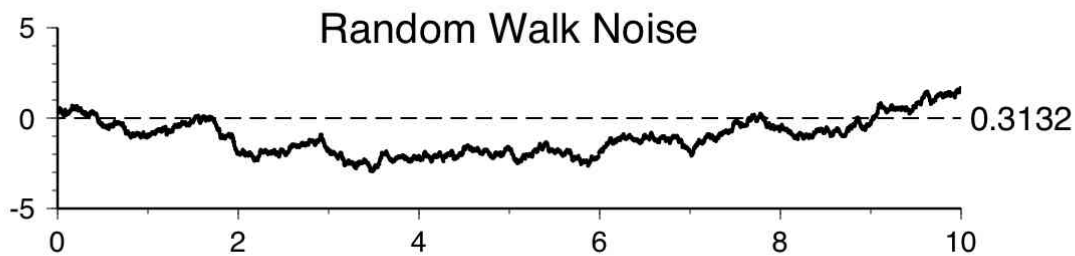
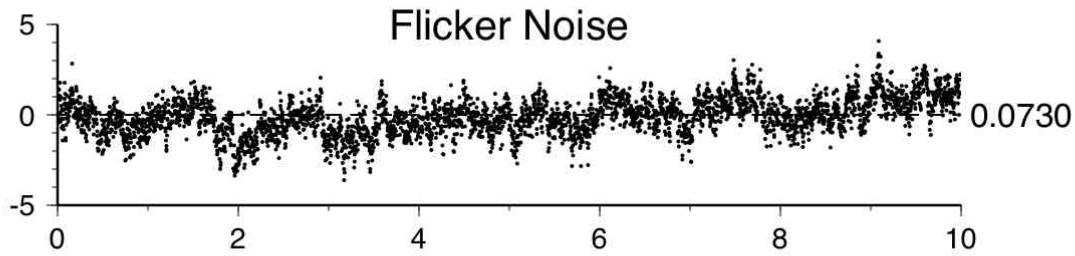
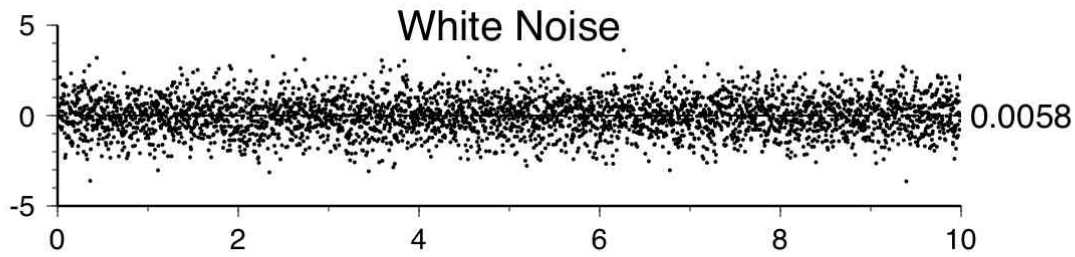
Summary

- GPS position time-series are temporally correlated (*ie* C is NOT diagonal!)
- A variety of models exist that help characterize temporal correlations
- Characteristics of temporal correlations at longest periods are poorly determined
- Yet, selection of model of temporal correlations at longest periods have a significant impact on the computed value of error in rate
- For short and intermediate periods, correlations are better determined
- More info – Langbein, 2012 *J. Geod* – provides method to estimate upper bound for error on rate

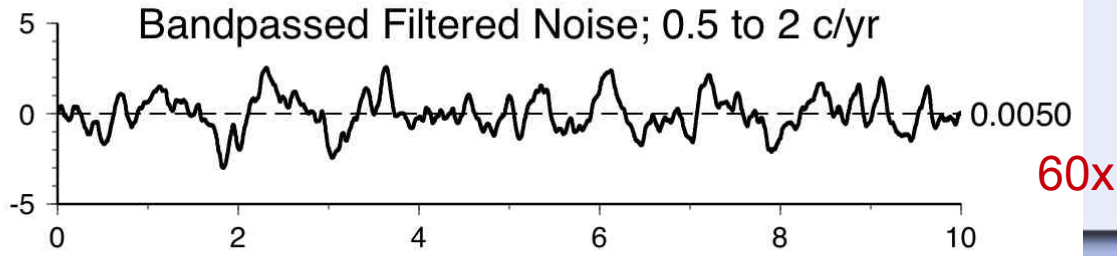
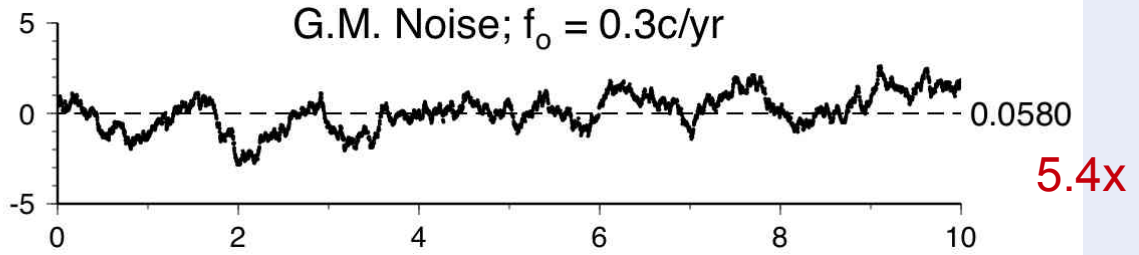
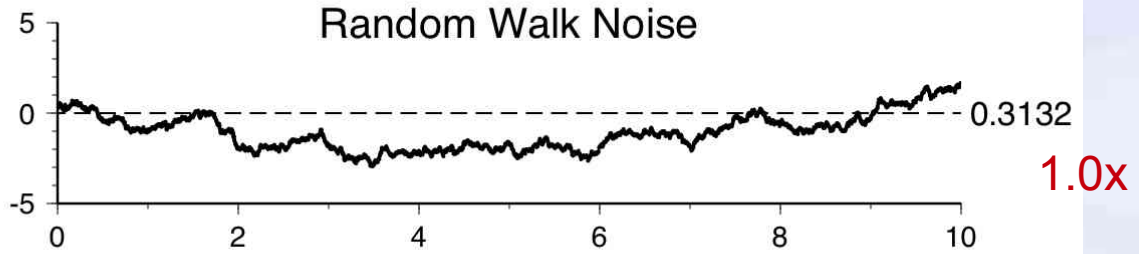
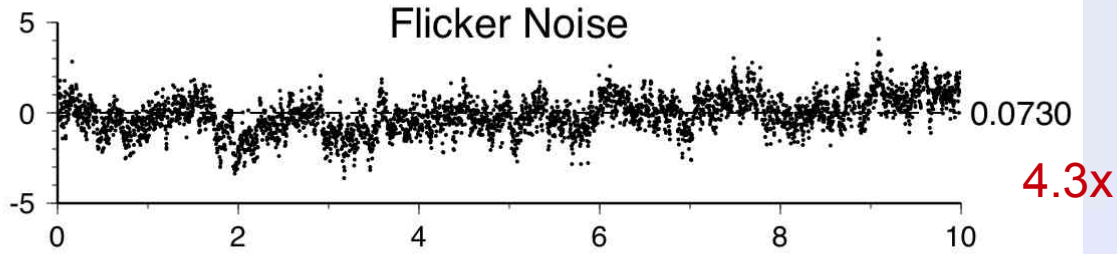
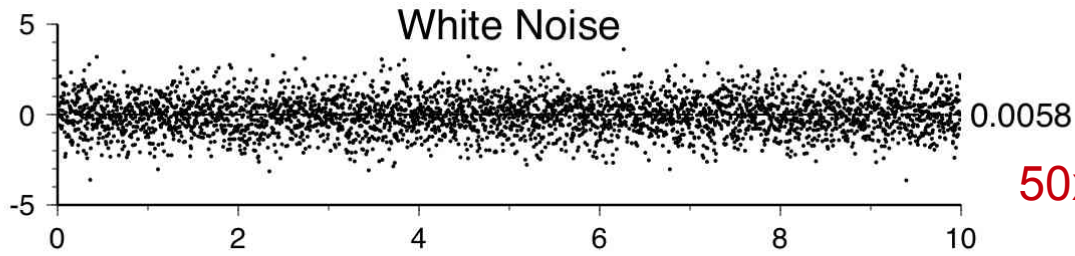
Noise models



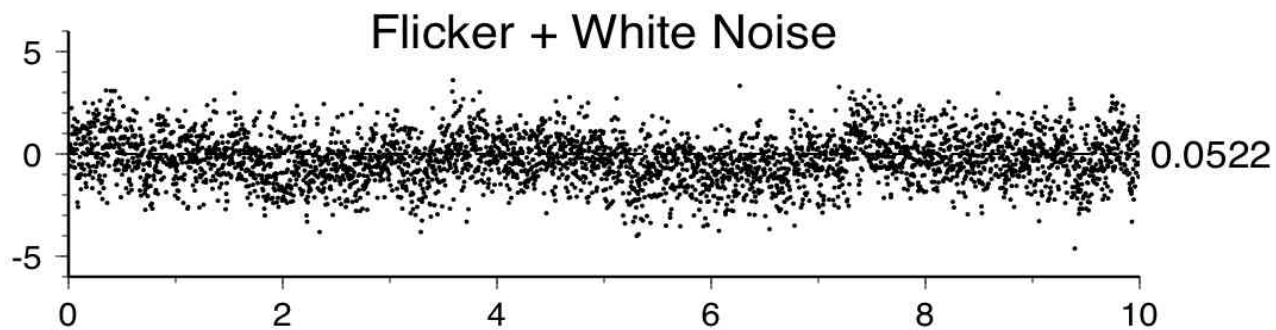
Noise Models & error in rates



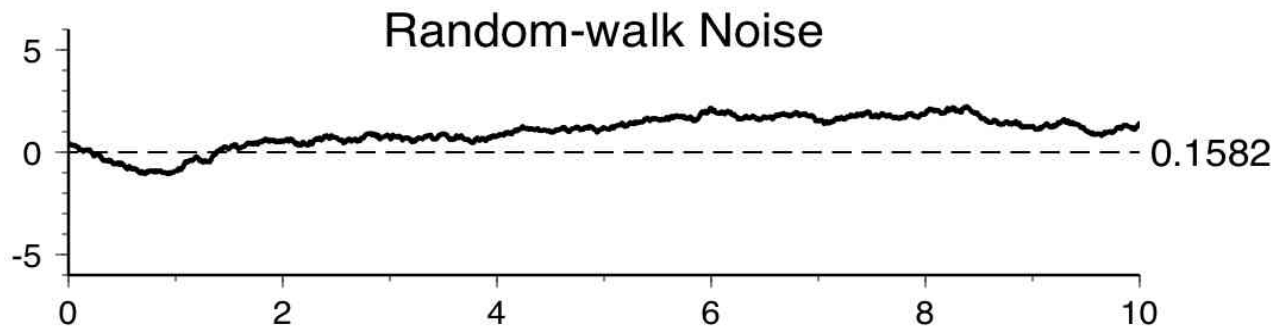
Noise Models & error in rates



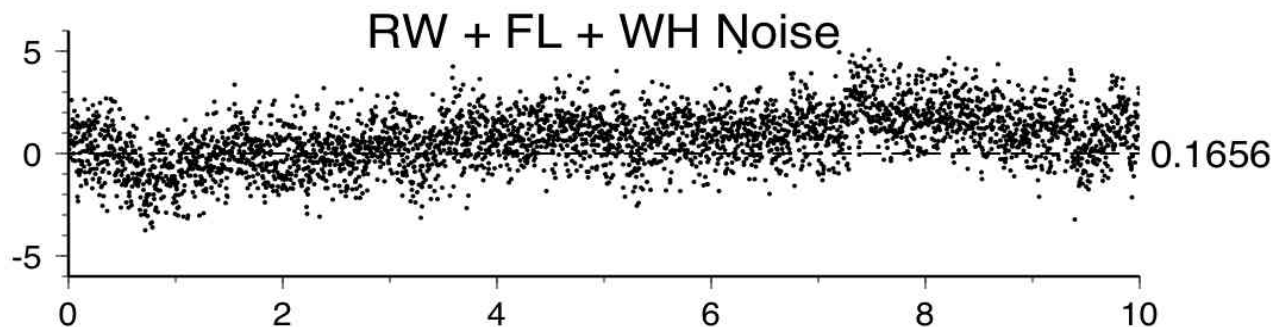
A time domain example: extracting RW from FL+WN noise



1.0 mm white
1.6 mm/yr^{0.25} Flicker

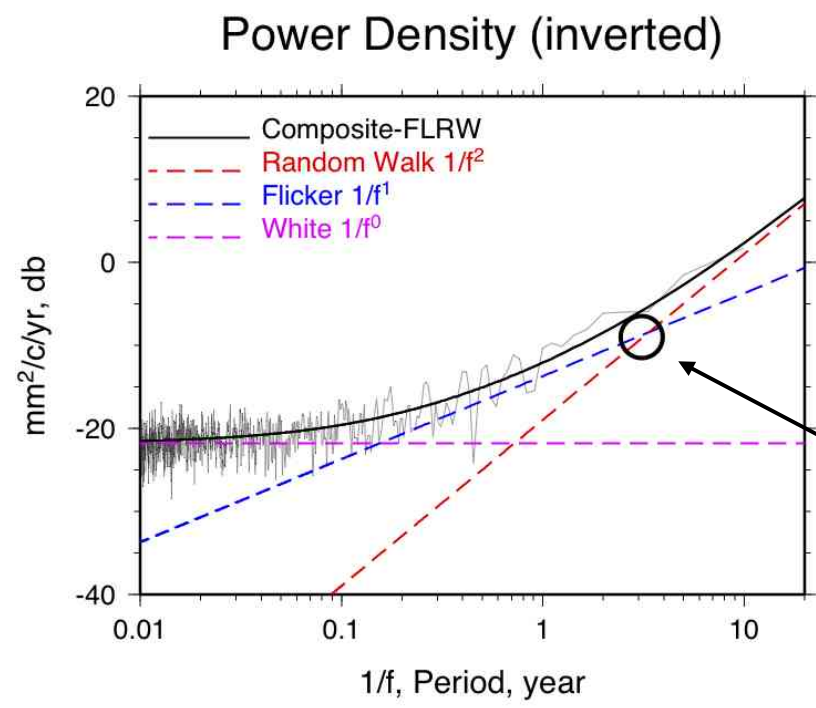


0.5 mm/yr^{0.5} RW



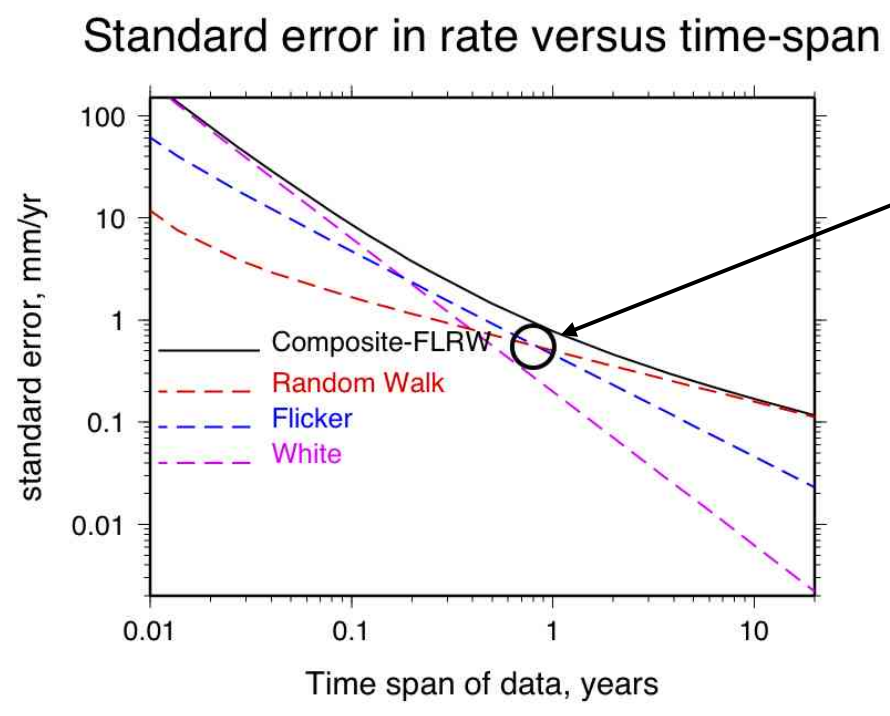
Standard error in
rate **3X** of FL+RW

Power spectra and Rate



RW and FL noise have equal noise at ~3 years

But....



RW starts to affect error in rate at ~9 months

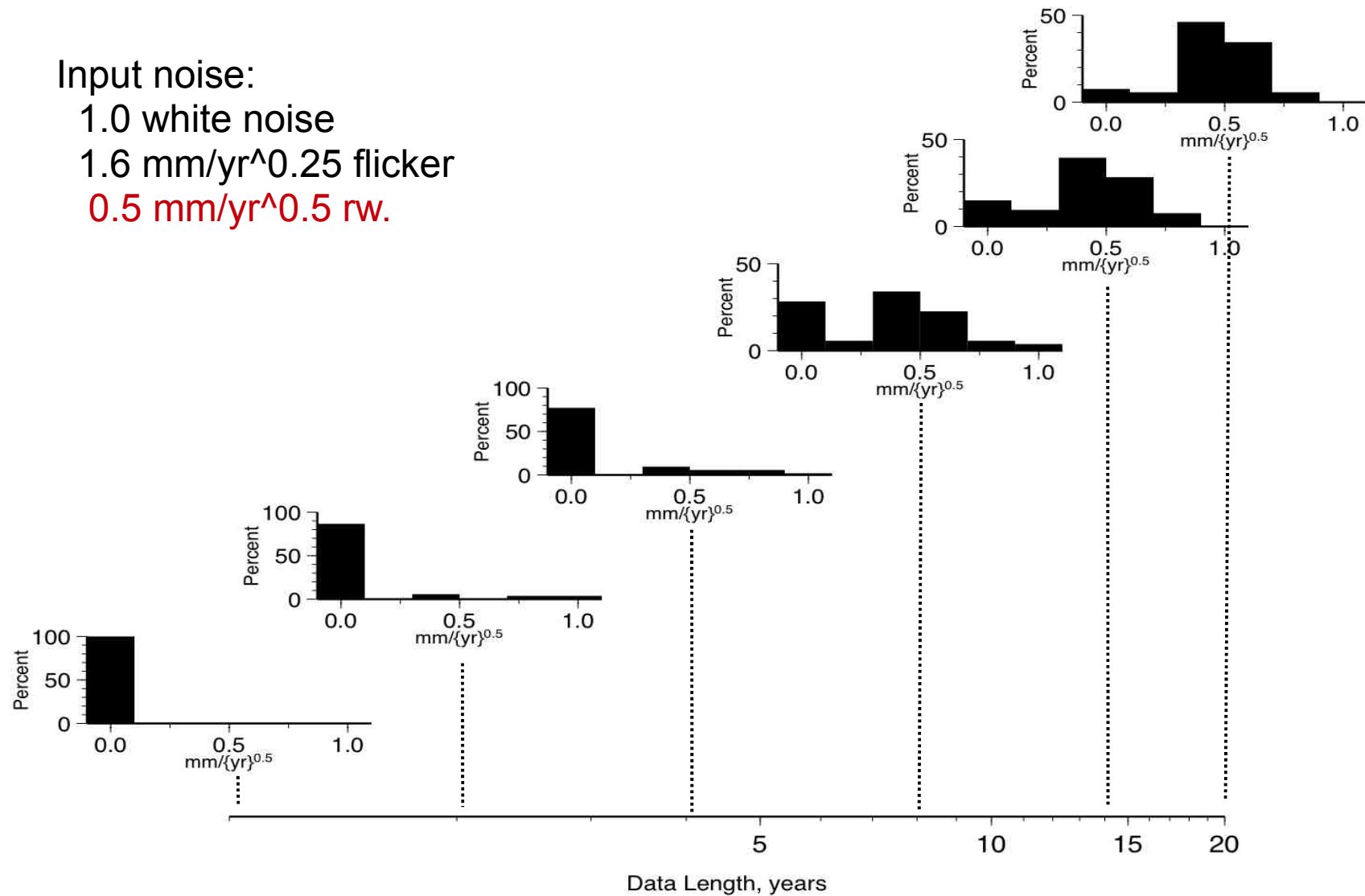
Detecting Random Walk noise

Input noise:

1.0 white noise

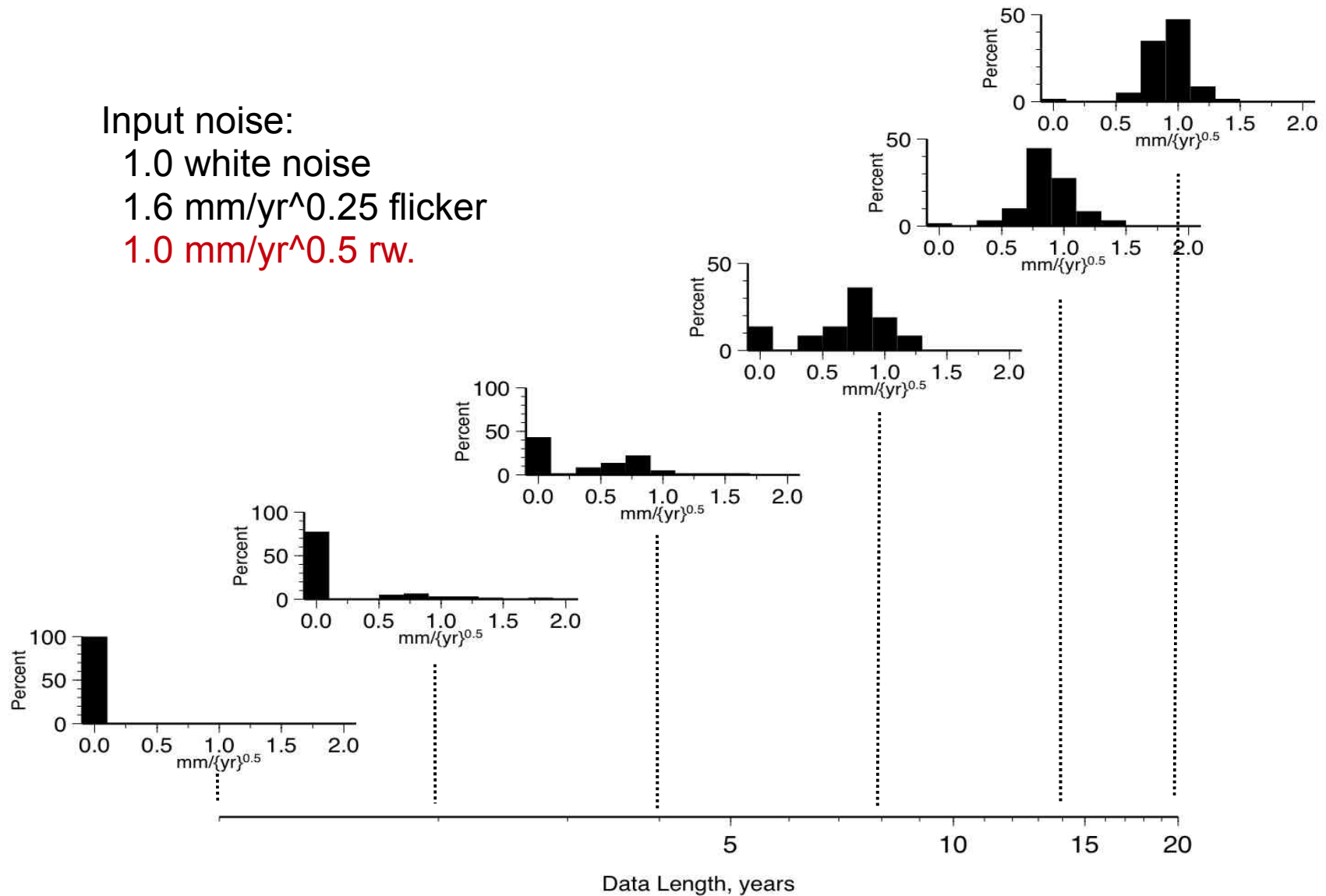
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0.5 mm/yr^{0.5} rw.



Detecting Random Walk noise

Input noise:
1.0 white noise
1.6 mm/yr^{0.25} flicker
1.0 mm/yr^{0.5} rw.



Code to estimate rates and data covariance

- `est_noise` (Langbein, JGR, 2004)

ftp://ehzftp.wr.usgs.gov/langbein/est_noise/

- `cats` (Williams, GPS Solutions, 2008)
- `hector` (Bos et al., J. Geod, 2012)

<http://segal.ubi.pt/hector/>

Comparison

- Both `est_noise` and `hector`:
 - Parameters of data covariance
 - White noise, flicker, RW, G-M, BP-filtered
 - Rates, offsets, sinusoids
 - Data can have gaps
 - Provides unbiased estimates of rates, offsets, etc
- `Hector` runs **>10X faster** than `est_noise`
- `est_noise` has additional functions to fit:
 - Omori and exponential for postseismic trends
 - Changes in rate
 - Input other independent data; pressure, temperature, etc

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