Stochastic Surfaces in the Least Squares Wavelet Analysis

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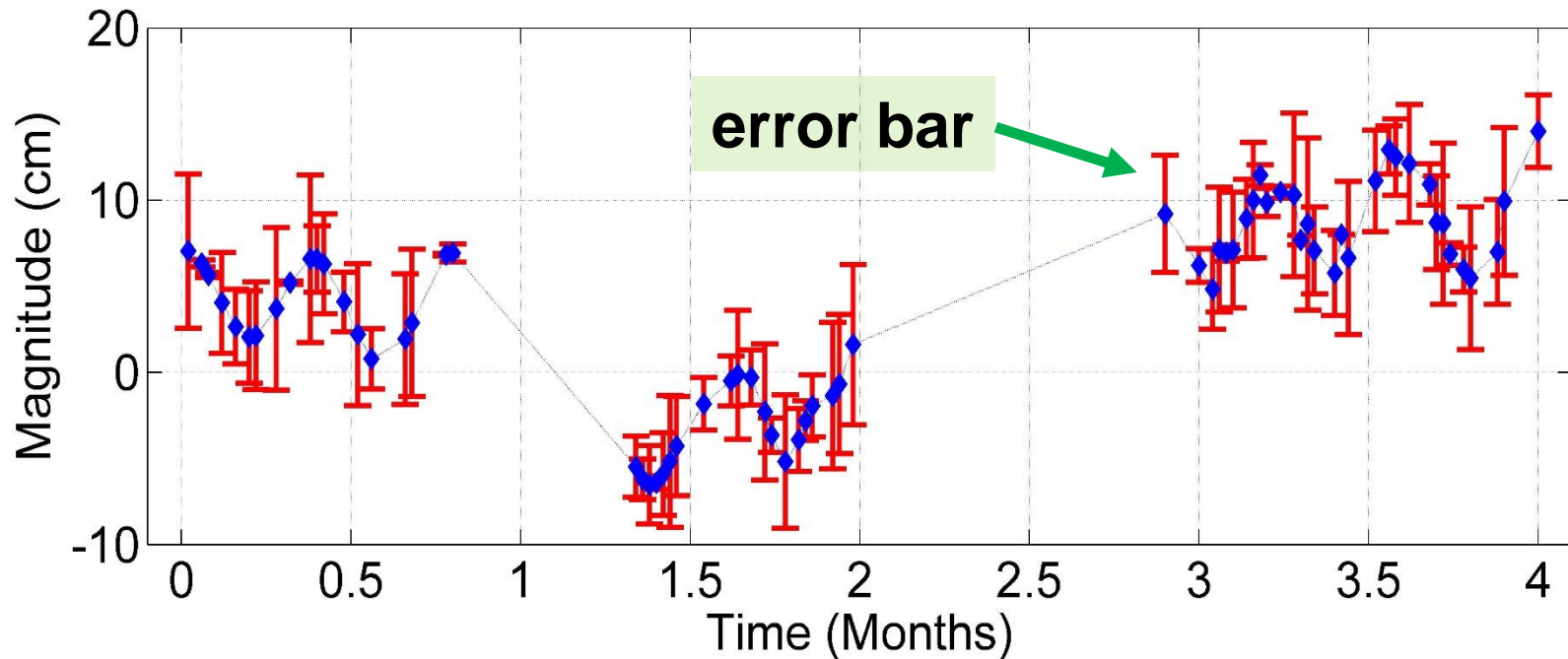
Montreal

May 4th 2015

Outline

- Time series with covariance matrix

- Weighted **L**east **S**quares **W**avelet **A**nalysis (LSWA)
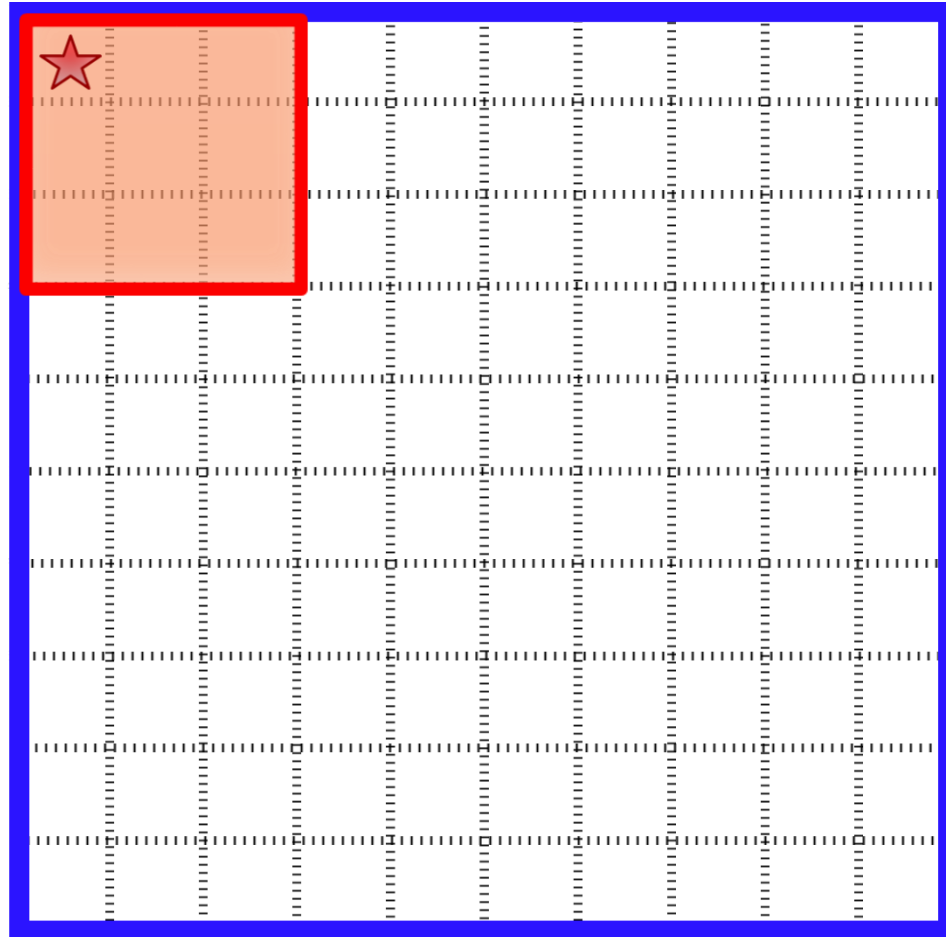
- Stochastic surfaces in the LSWA

- Conclusions

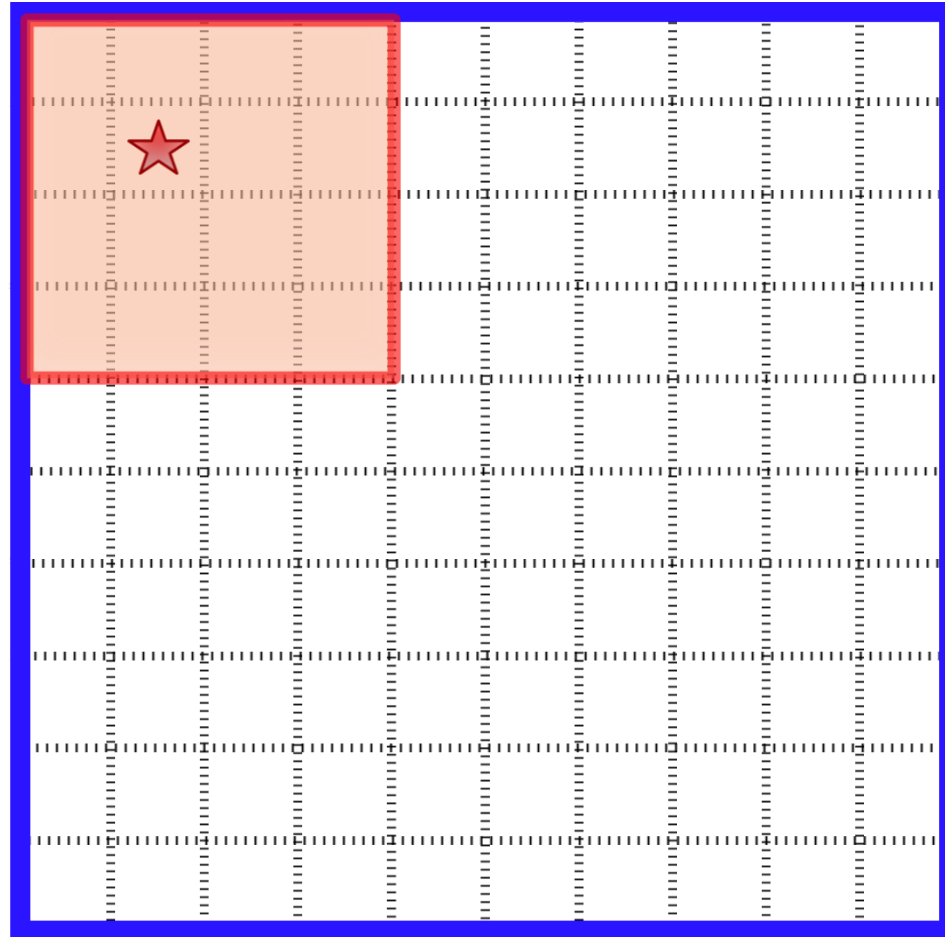# Time series with covariance matrix

- **Unequally weighted**

Weighted **L**east **S**quares **W**avelet **A**nalysis (LSWA)

- $C_f^{-1} = P =$

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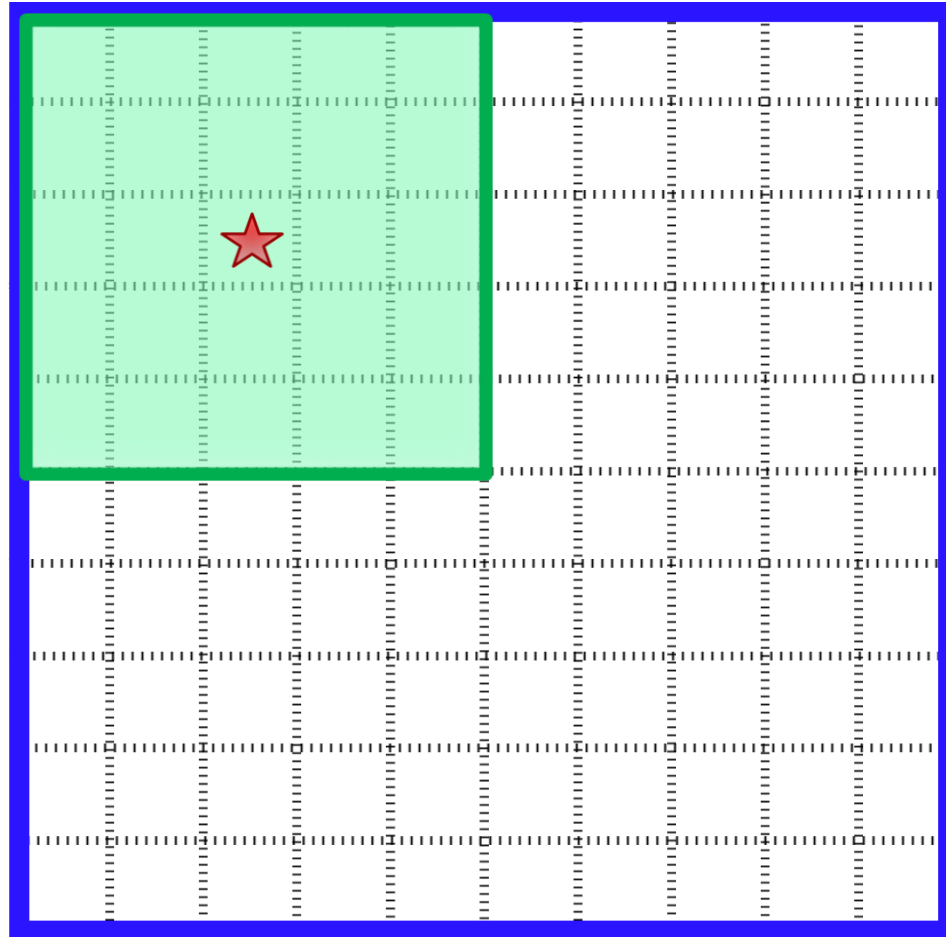
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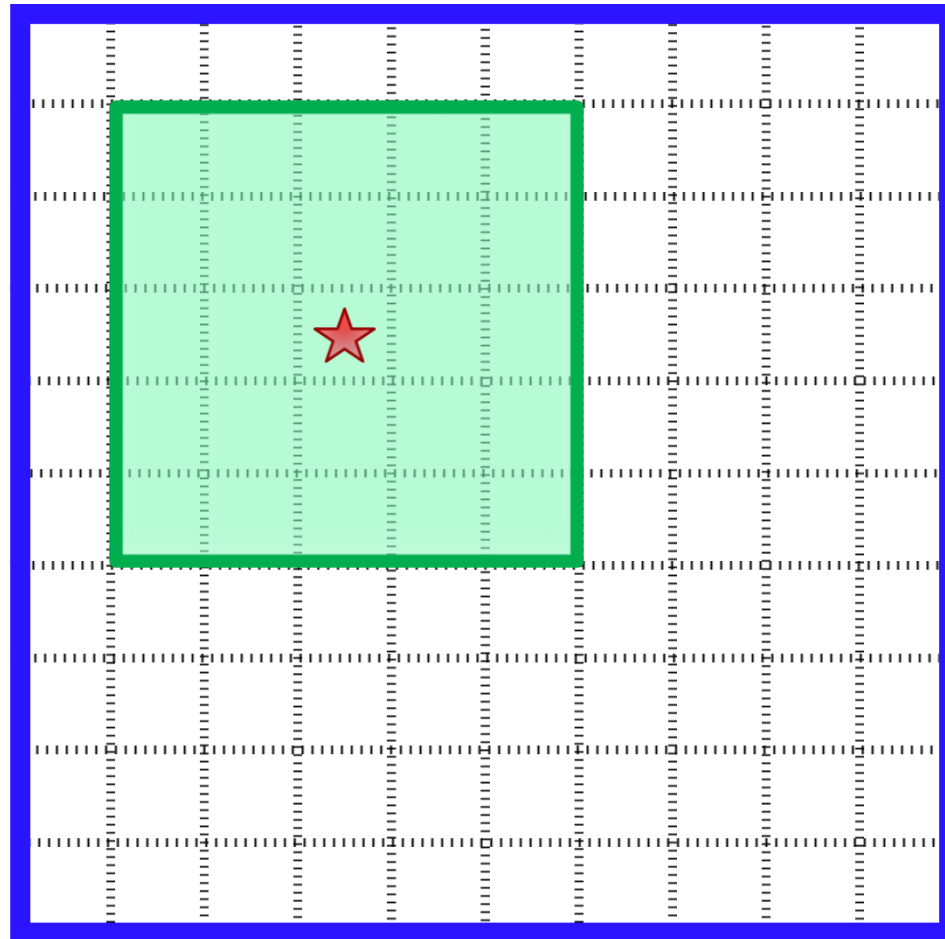
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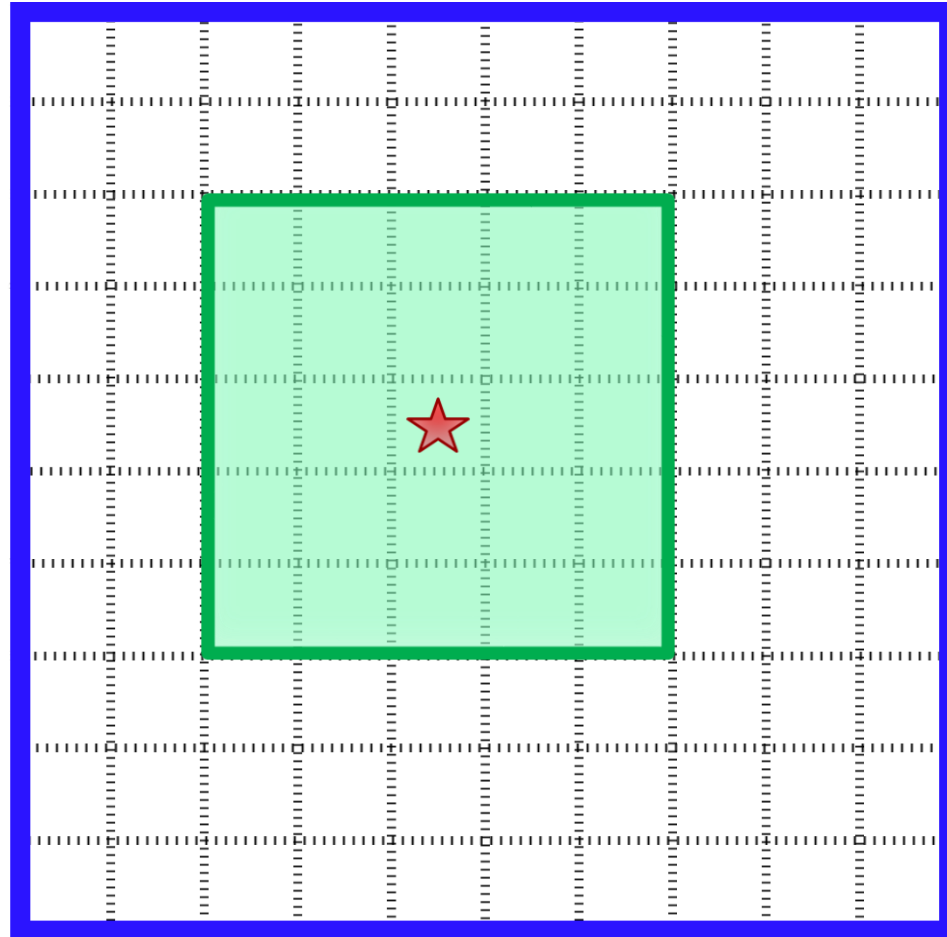
- $C_f^{-1} = P =$

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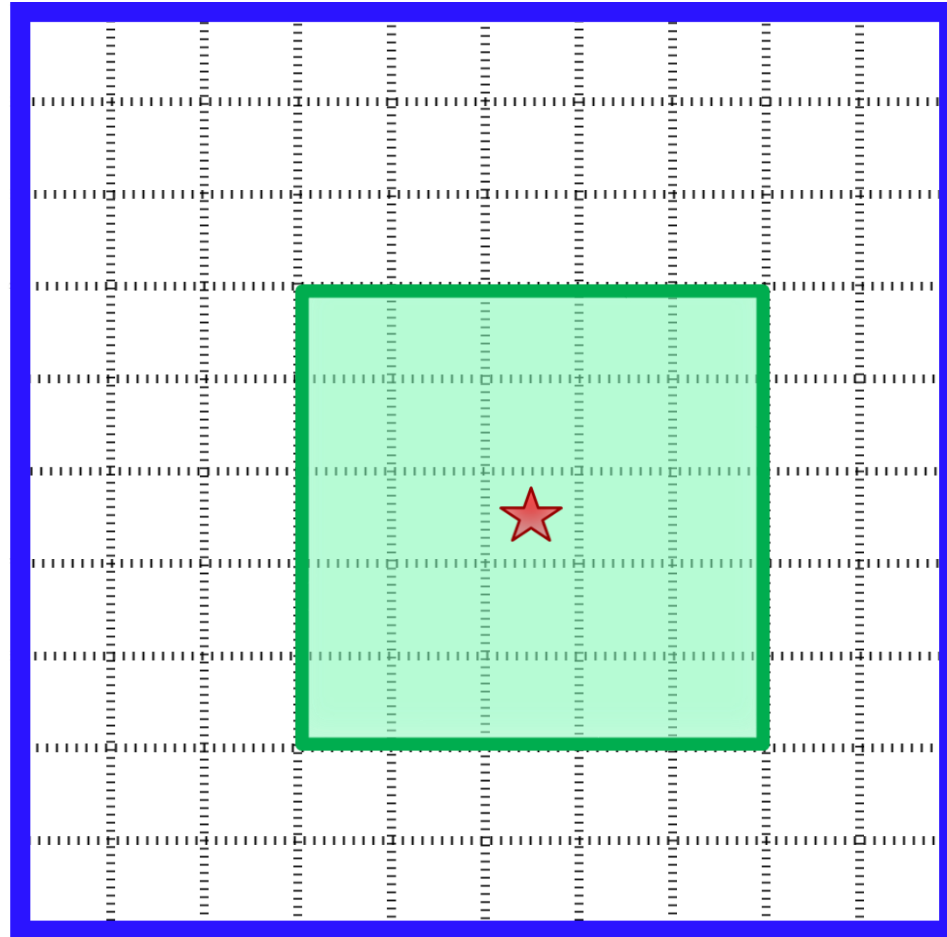
- $C_f^{-1} = P =$

Weighted **L**east **S**quares **W**avelet **A**nalysis (LSWA)
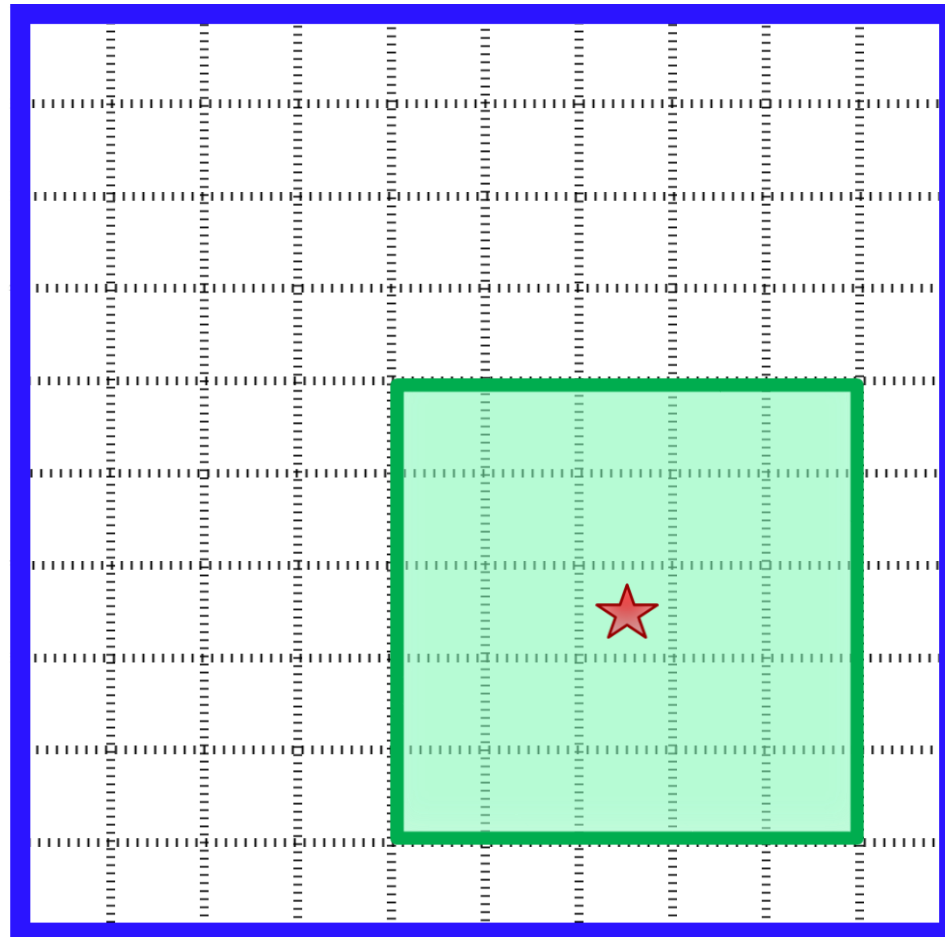
- $C_f^{-1} = P =$

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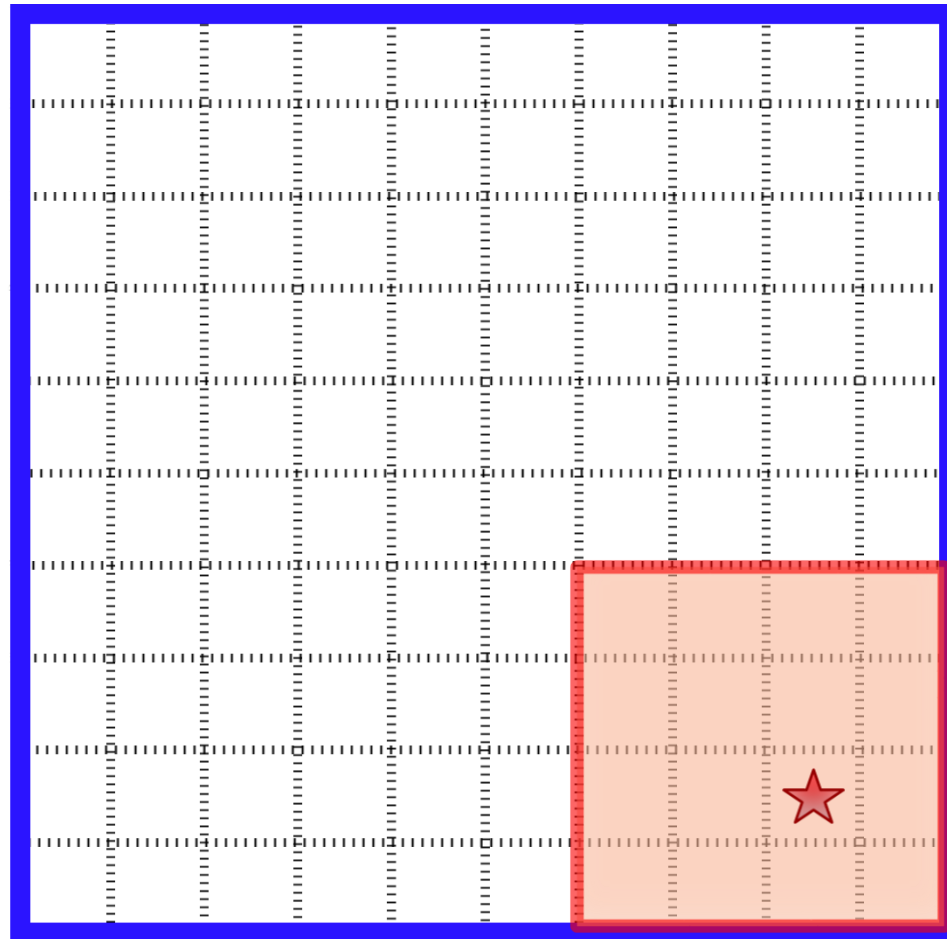
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Weighted **L**east **S**quares **W**avelet **A**nalysis (LSWA)

- $C_f^{-1} = P =$

Stochastic surfaces in the LSWA

- Probability distribution function of LSWA spectrogram

Stochastic surfaces in the LSWA

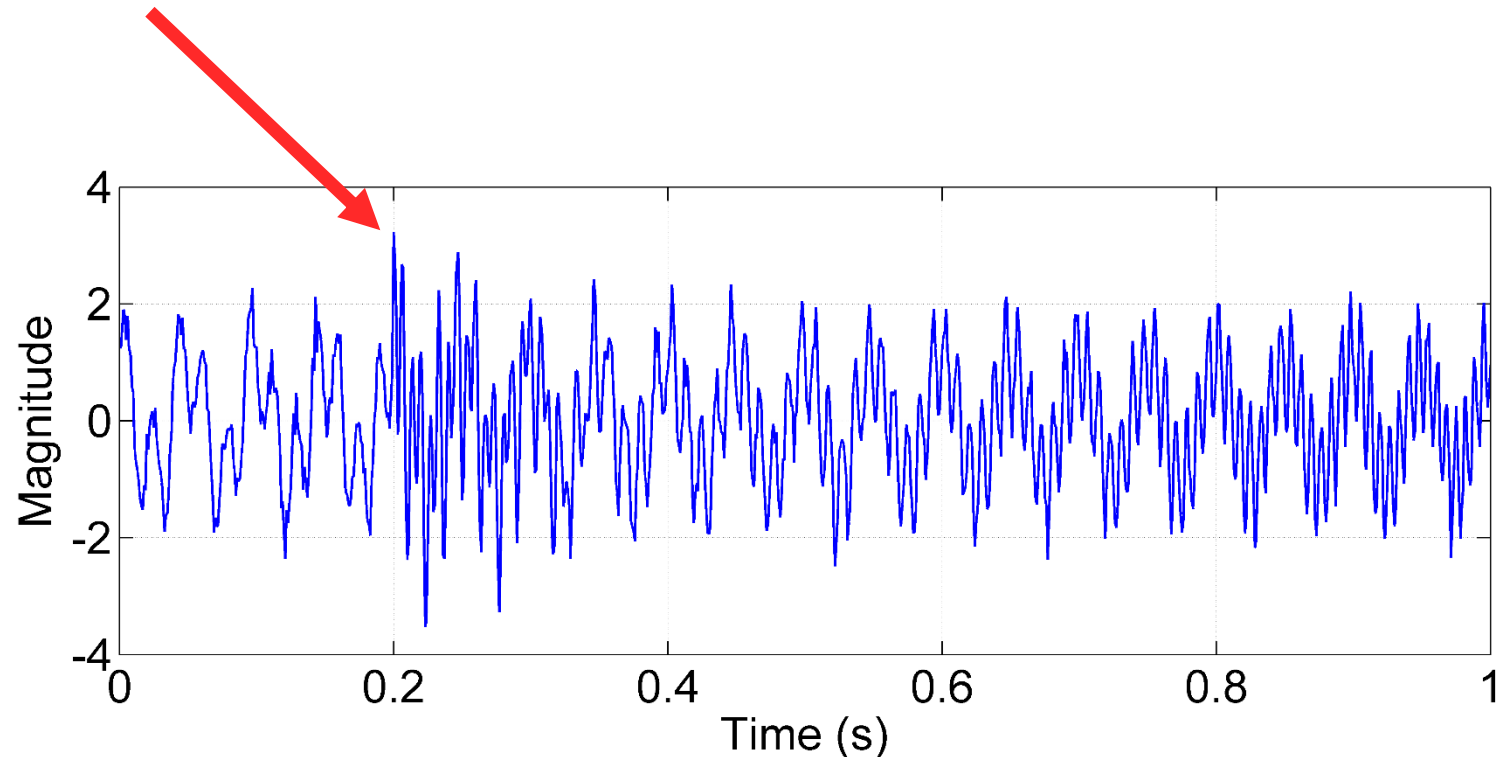- Probability distribution function of LSWA spectrogram
  - Beta distribution

Stochastic surfaces in the LSWA

- Probability distribution function of LSWA spectrogram
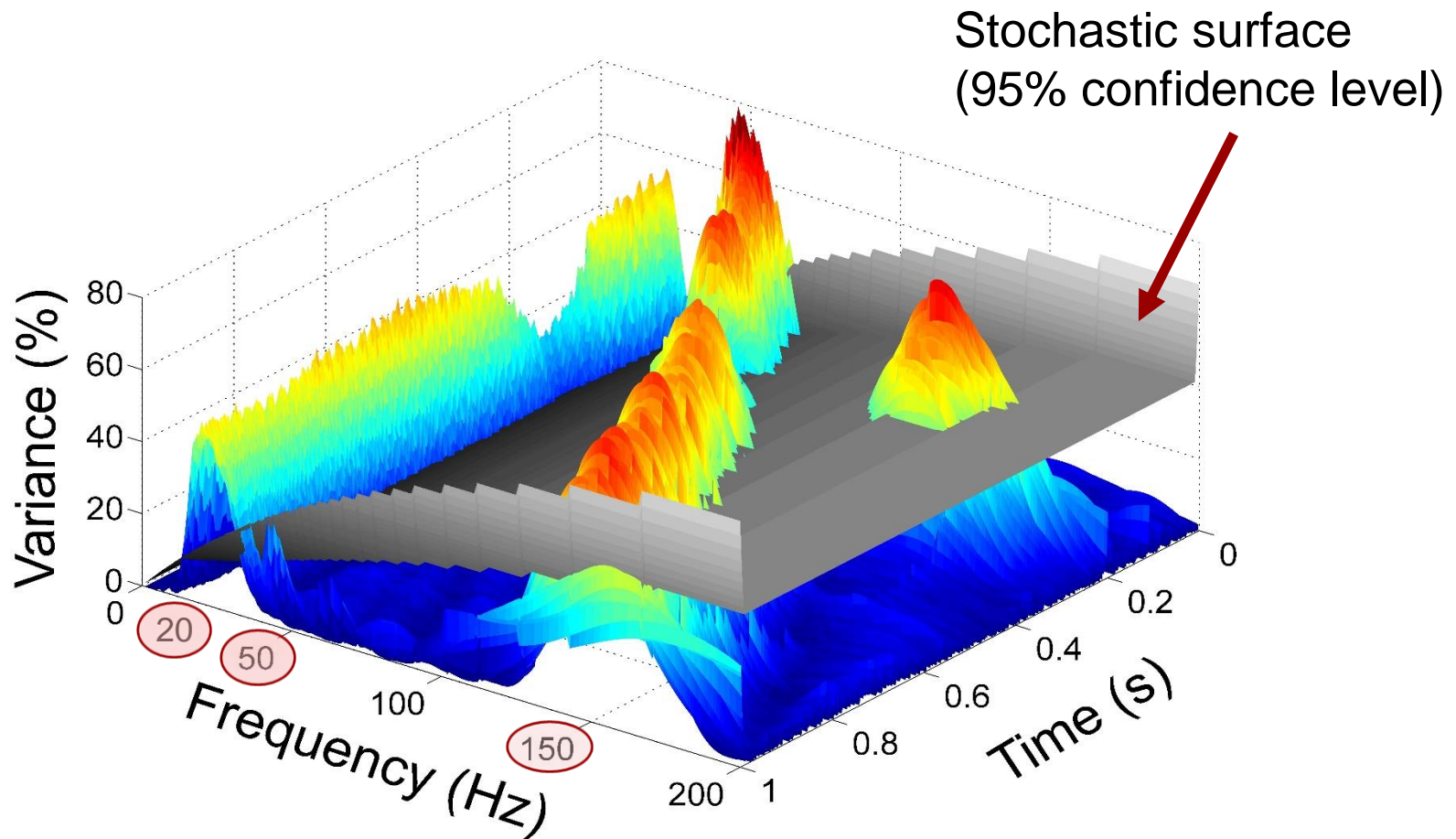 - Beta distribution
  - Confidence level (usually 95% or 99%)

Example:

$$f(t) = \sin(\mathbf{50} \times 2\pi(t + t^2)) + \cos(\mathbf{20} \times 2\pi t) + g(t) + \varepsilon$$

$$g(t) = \begin{cases} (4 - 10t)\cos(\mathbf{150} \times 2\pi t) & \mathbf{0.2} \leq t \leq \mathbf{0.4} \\ 0 & O.w. \end{cases}$$

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LSWA spectrogram and its stochastic surface

Stochastic surface
(95% confidence level)

18

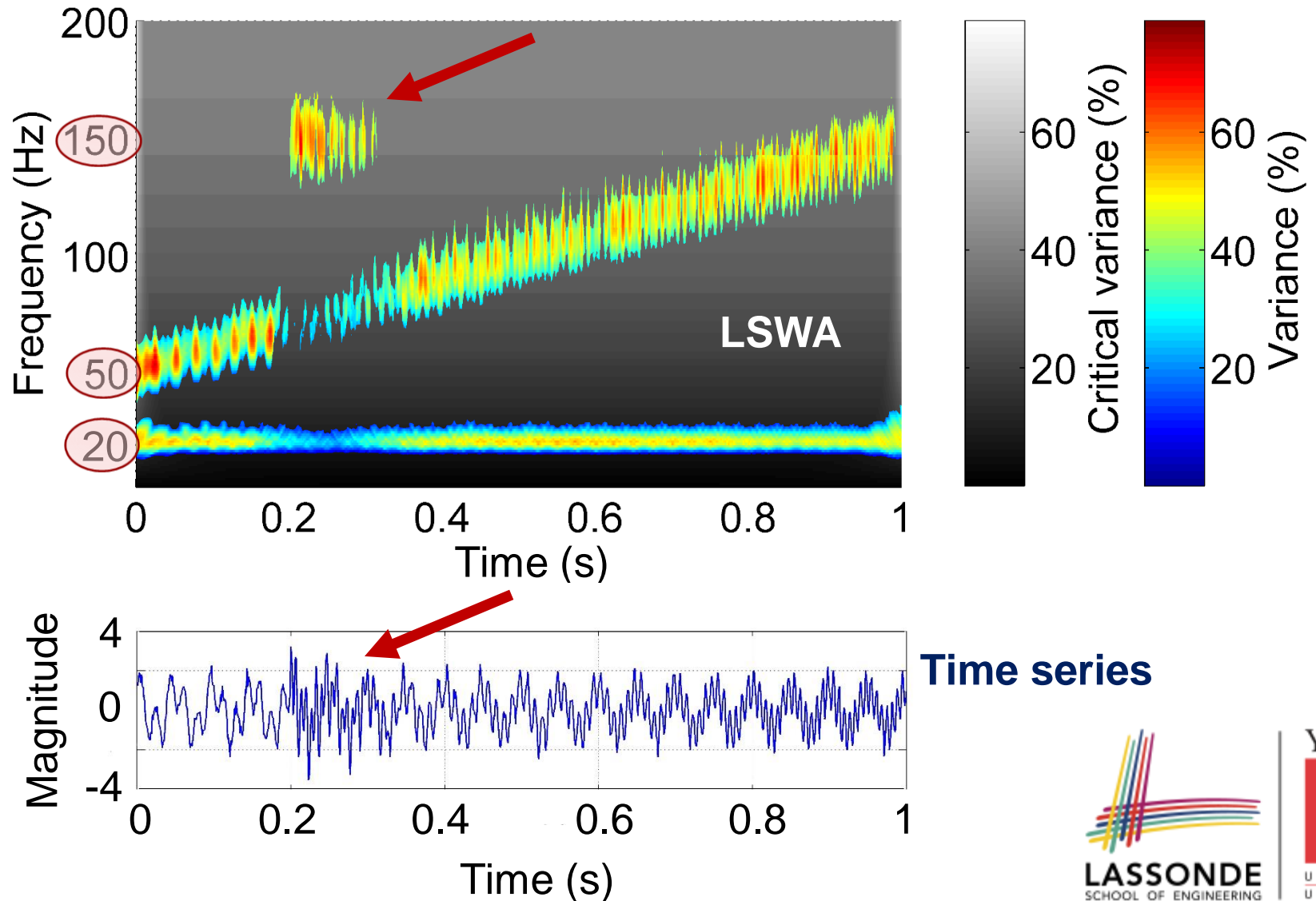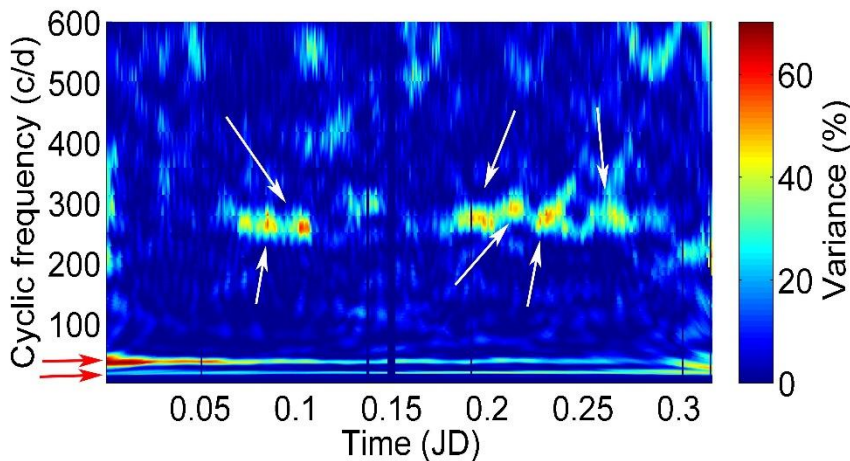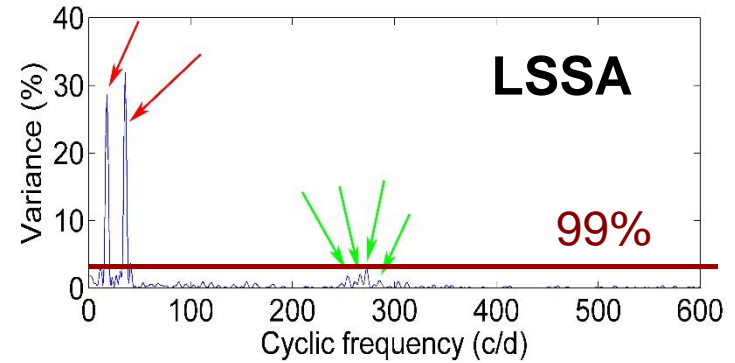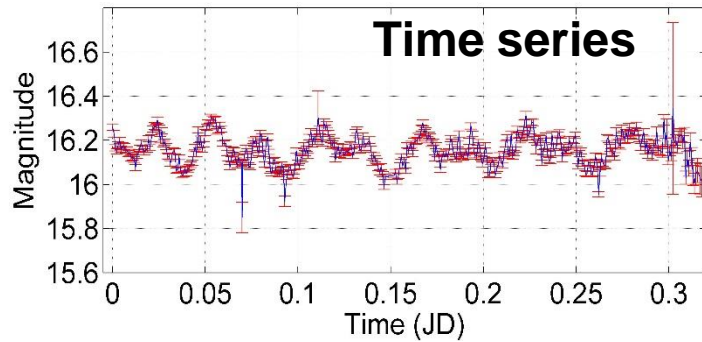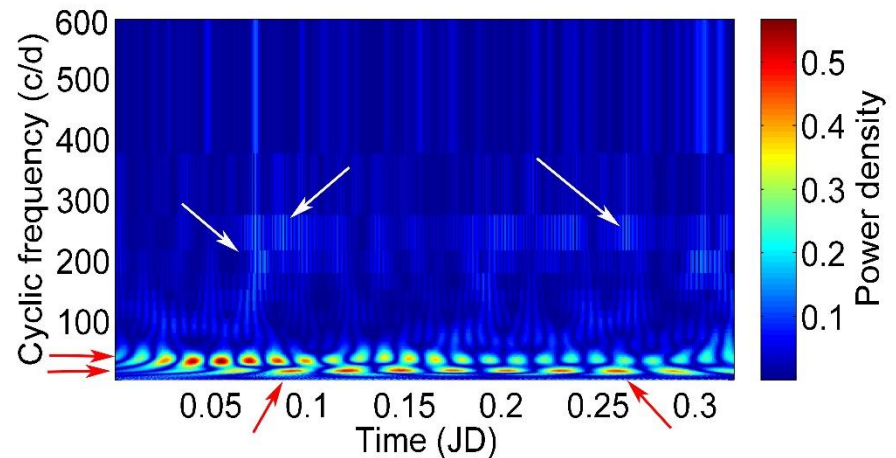# LSWA spectrogram and its stochastic surface

Stochastic surface
(95% confidence level)
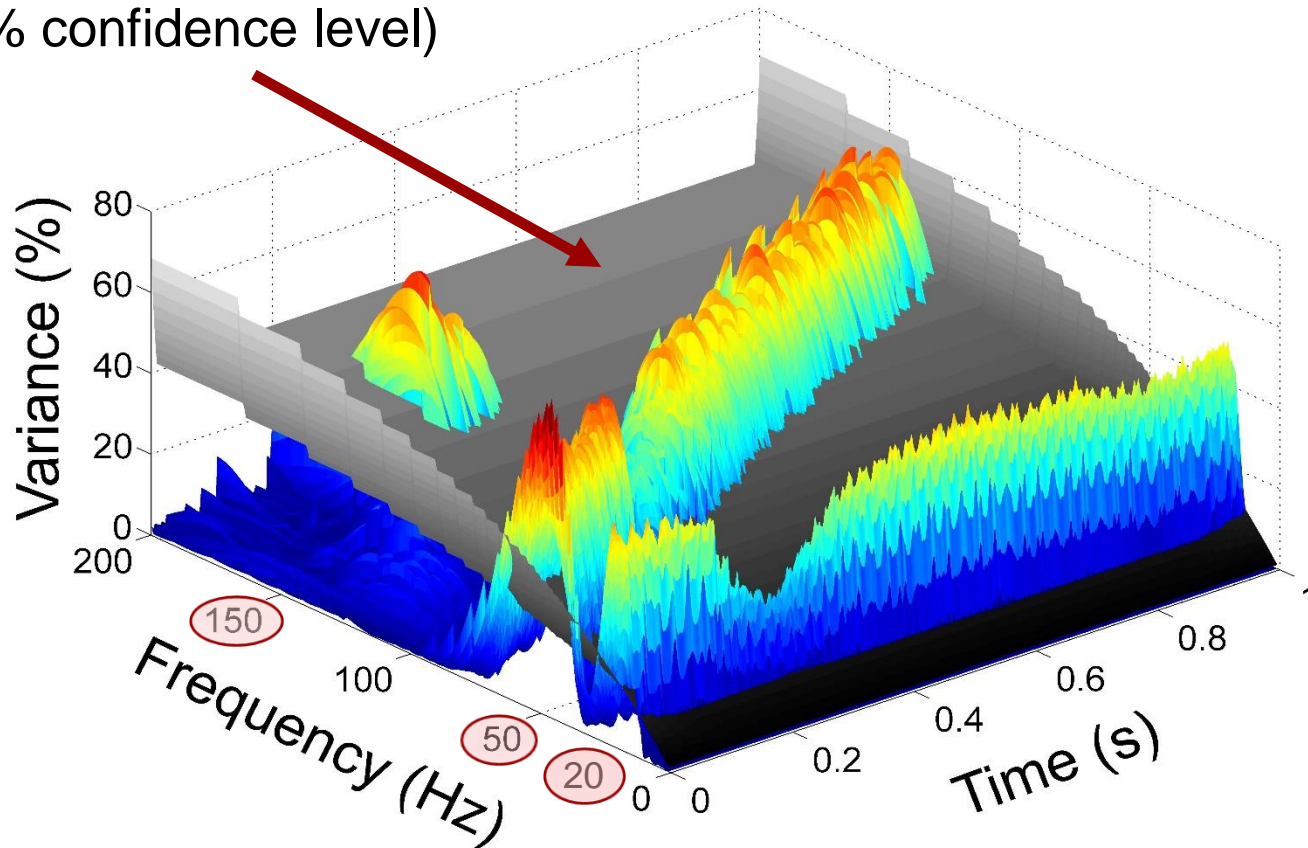
2D representation of LSWA spectrogram with its stochastic surface and the time series
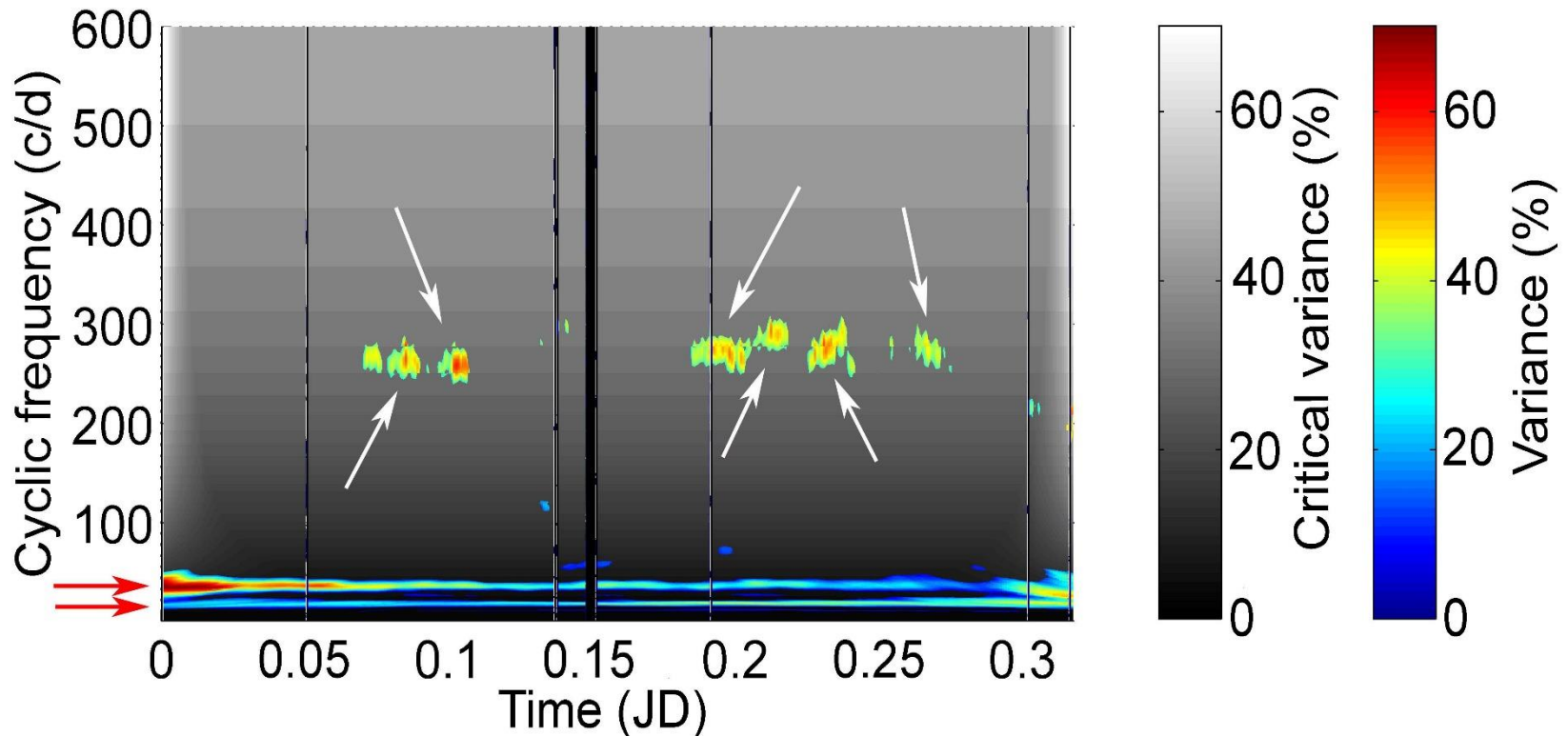
A real time series (Andromeda) with its analyses

LSWA spectrogram and its stochastic surface for the real time series (99% confidence level)

Conclusions

- **The LSWA considers the associated covariance matrices of the time series segments.**

- **The LSWA detects the significant peaks for a given confidence level.**

- **In the LSWA, we can suppress the significant spectral peaks to search for other peaks.**

- **The LSWA rigorously analyzes any time series.**

Thank you for your attention!

Any questions or comments?