

Statistical Analysis of Surface Water Data

Alluvial plots and Trend Filtering



Outline

- 1 Motivation
- 2 Alluvial plot
- 3 Trend Filtering
 - Methodology
 - Analysis for Sulphate
- 4 Discussion

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Surface Water Data

- It includes *irregularly* spaced time series of Barium and Sulphate concentrations at approx. 80 PA counties from 1921-2015
- Deciphering spatial and temporal correlations may provide important insights about water quality deterioration due to energy extraction processes
- **Challenges:** spatial and temporal “sparsity”
- **Our current work:**
 - Boxplots at different time granularities
 - Time series segmentation

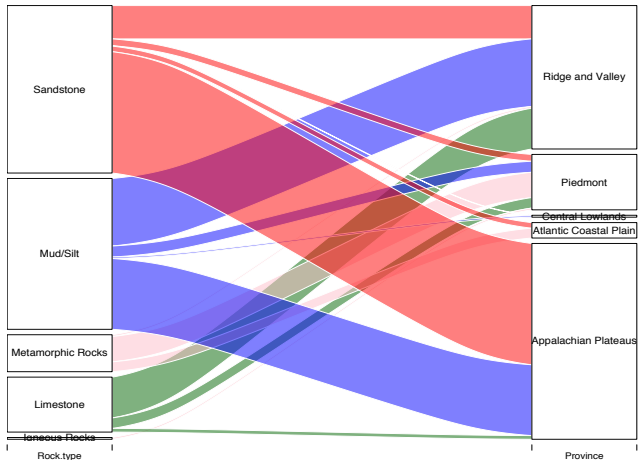
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Alluvial plot between rock type and province



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Methodology

- Goal: Estimation of piecewise linear trend¹.
- Given the time series, $y_t, t = 1, 2, \dots, n$, we want to estimate the slowly varying trend x_t by minimizing the following objective function:

$$(1/2) \sum_{t=1}^n (y_t - x_t)^2 + \lambda \sum_{t=2}^{n-1} |x_{t-1} - 2x_t + x_{t+1}|$$

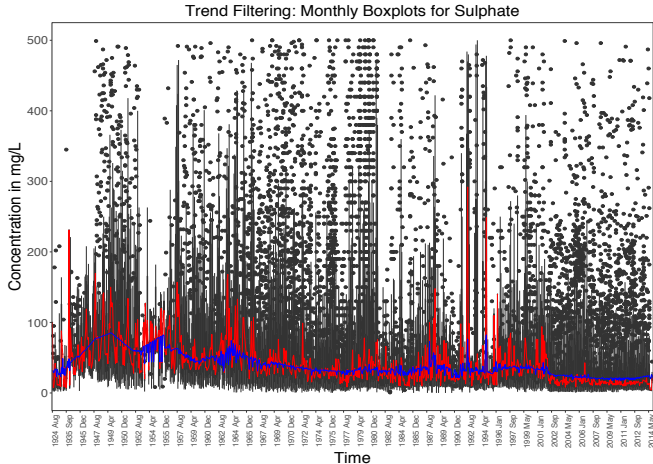
- $\lambda > 0$ controls trade off between
 - smoothness of x and
 - size of the residual

¹Kim, Seung-Jean, et al. " ℓ_1 Trend Filtering" SIAM review 51.2 (2009): 339-360

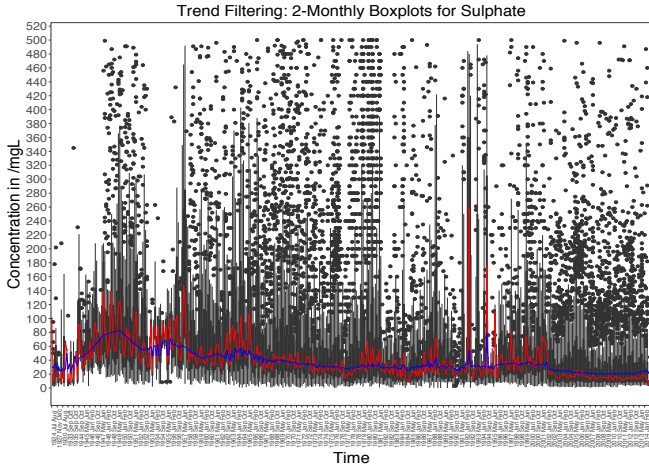
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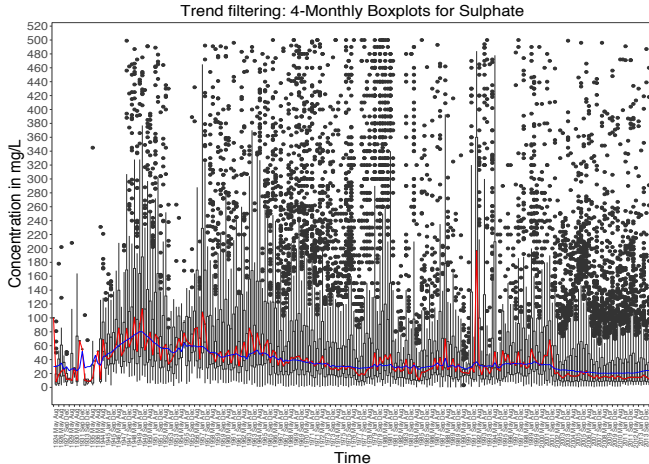
Monthly Boxplots



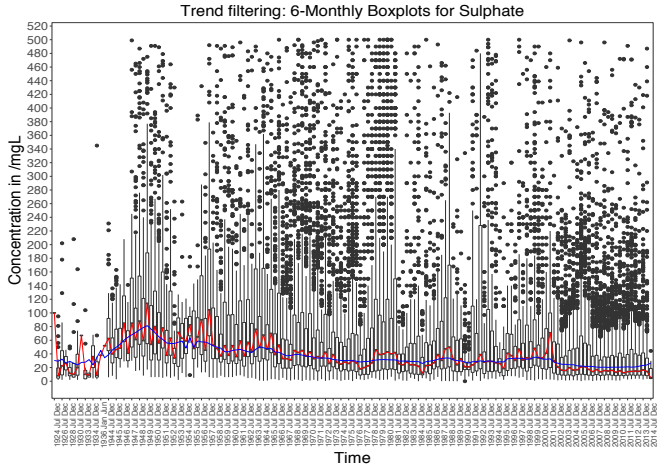
2-Monthly Boxplots



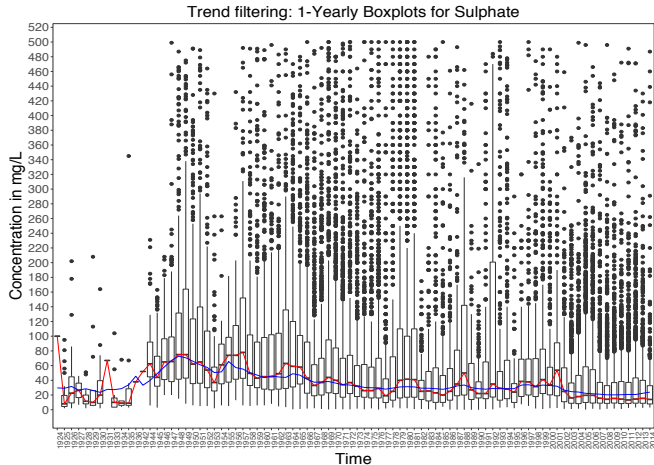
4-Monthly Boxplots



6-Monthly Boxplots



1-Yearly Boxplots



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Discussion

Summary of current works:

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Future works:

- Spatial clustering using river network data.

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