WS 2.3.A Streamflow variability caused by reservoir management in the Adige and Inn River Basins

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1. Introduction

In alpine catchments, fluctuations of river discharge occur at multiple temporal scales

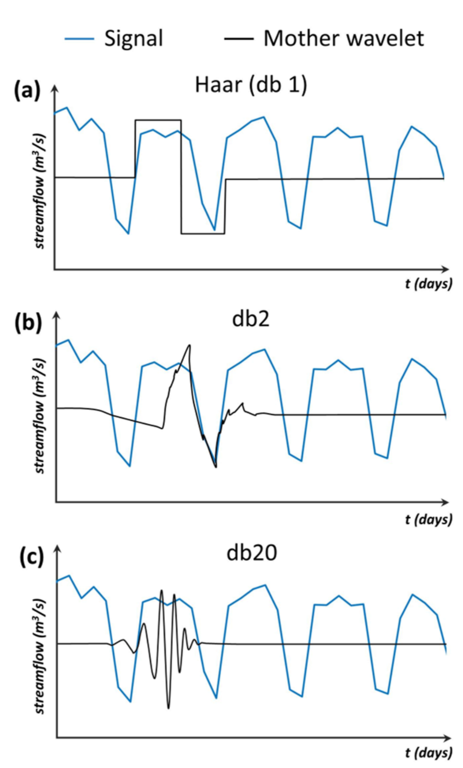
The alteration of the natural flow regime:

- is caused by construction of dams for hydropower production, changes in water management policies and climate
- has negative impacts on the freshwater biodiversity

Our work:

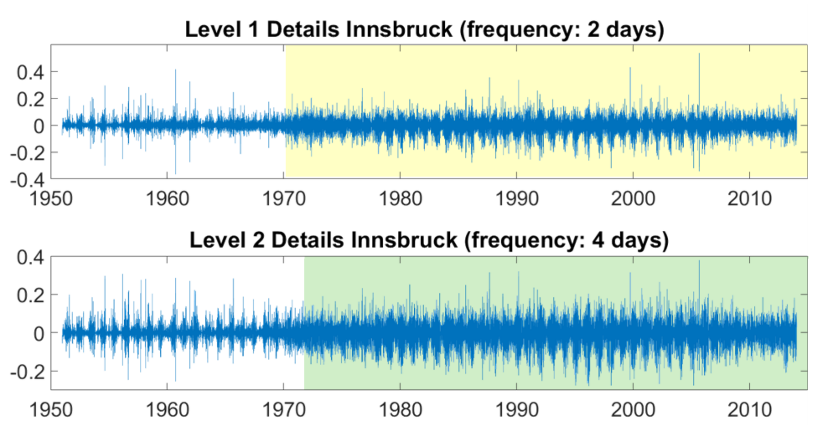
- focuses on changes associated to hydropower production
- Involves time series analysis for the Inn and the Adige river basins
- Applies multiresolution wavelet analysis and continuous wavelet transform
- Aims at identifying old breakpoints caused by dam construction and more recent breakpoints caused by changes in hydropower plants operation

2. Methods



A) Wavelet change point detection

Discrete Wavelet Transform (DWT) allows us to detect changes in the variance of a signal over different scales and determine changes



B) Continuous Wavelet Transform (CWT)

CWT is used to analyze frequency content and helps to reveal patterns in a noisy signal.

$$C(a, b; f(t); \psi(t)) = \int_{-\infty}^{\infty} f(t)\frac{1}{\sqrt{a}}\psi^{*}\left(\frac{t-b}{a}\right)dt \qquad \text{for } a,b \in R,\ a \neq 0$$

(*) complex conjugate
a scaling parameter (degree of compression)
b position or translation parameter (time location)
ψ mother wavelet . The Morlet function is used as "mother wavelet" due to its compromise between frequency and time localization

Highlights

- Multi-temporal scale analyses are important in obtaining a complete profile of the hydrological process.
- Wavelet analysis is able to identify breakpoints due to flow regime alterations at different temporal scales.
- Old breakpoints (up to 1990) are linked to sub-weekly, weekly and yearly scales and originated from dam and hydropower facilities construction.
- Recent breakpoints (since 1990) are mainly linked to short scales (from 2 days to one week) and originated from changes in hydropower plants management (changes in legislation and market regulation).

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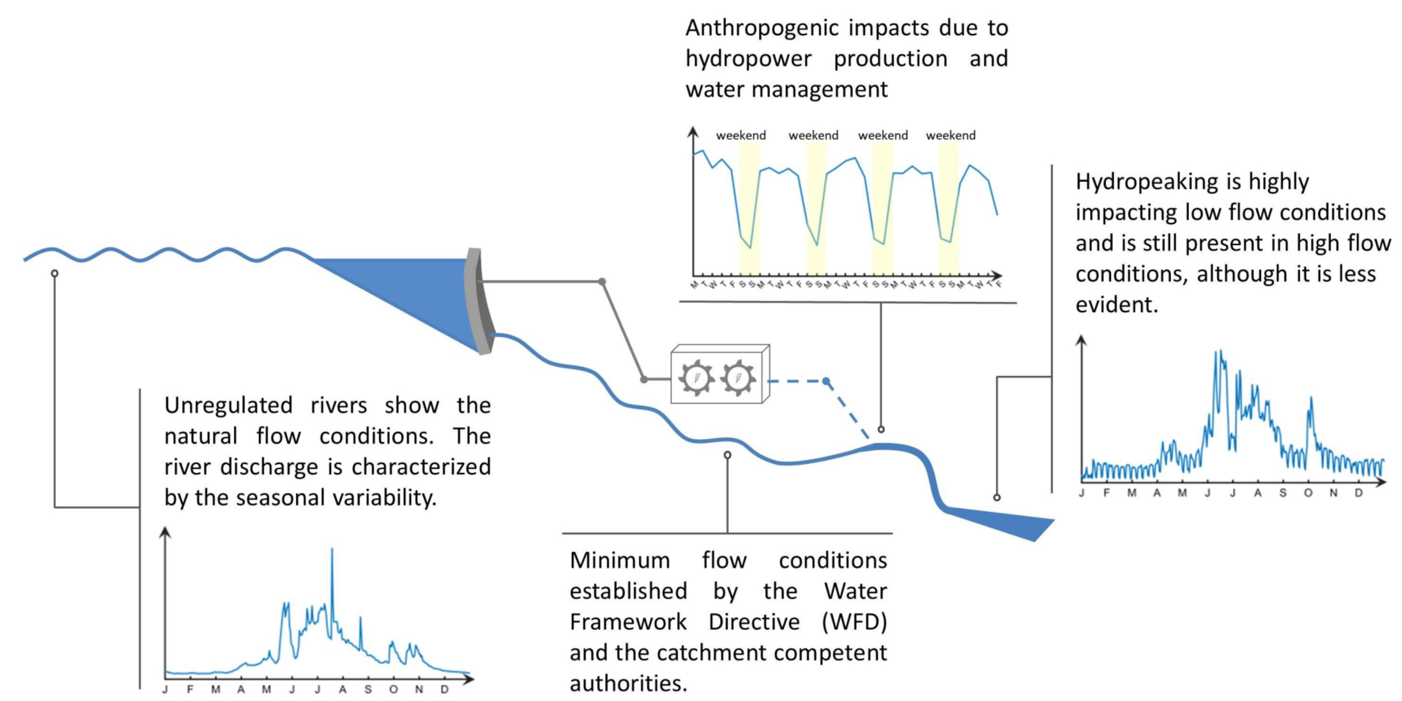
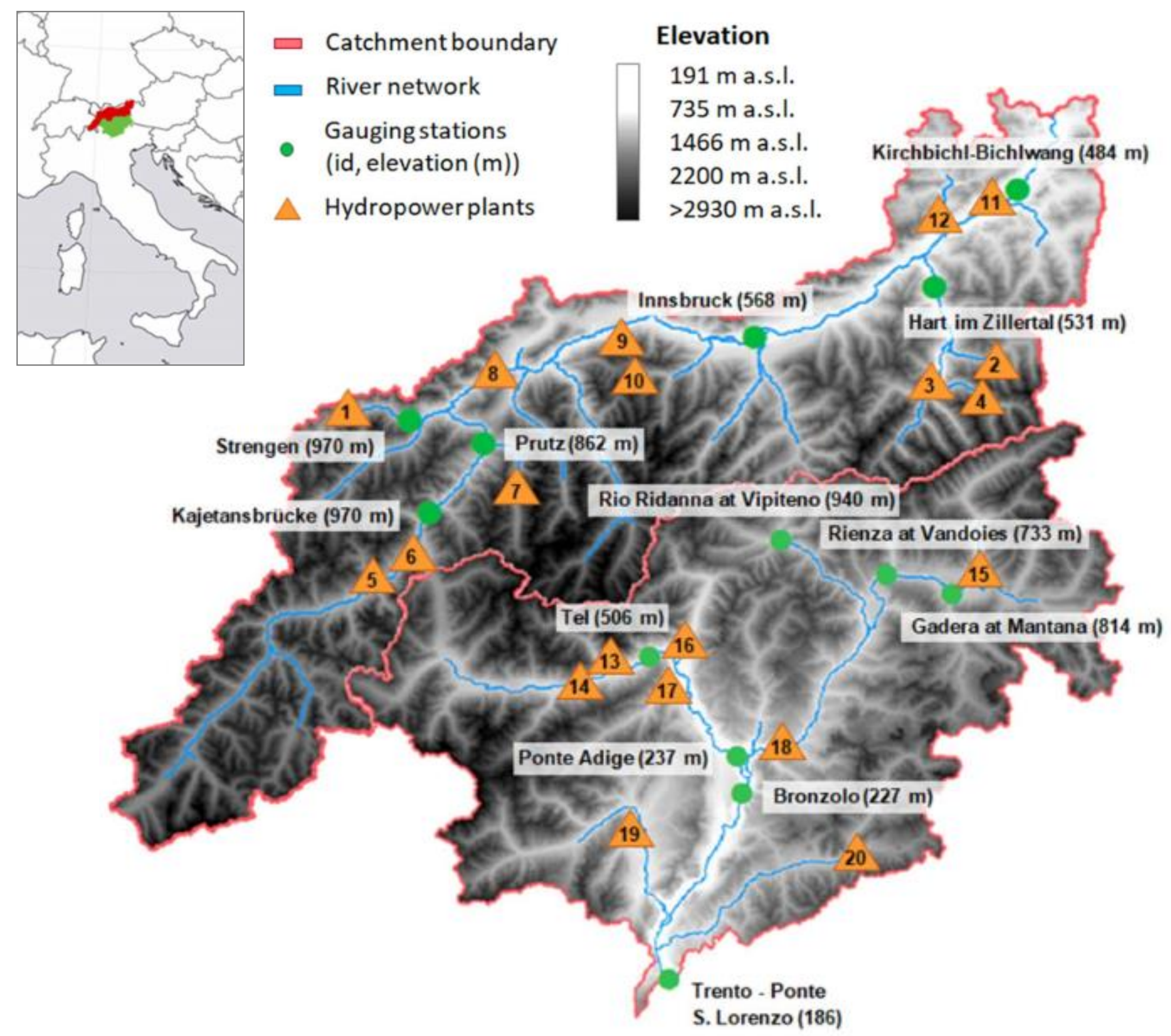
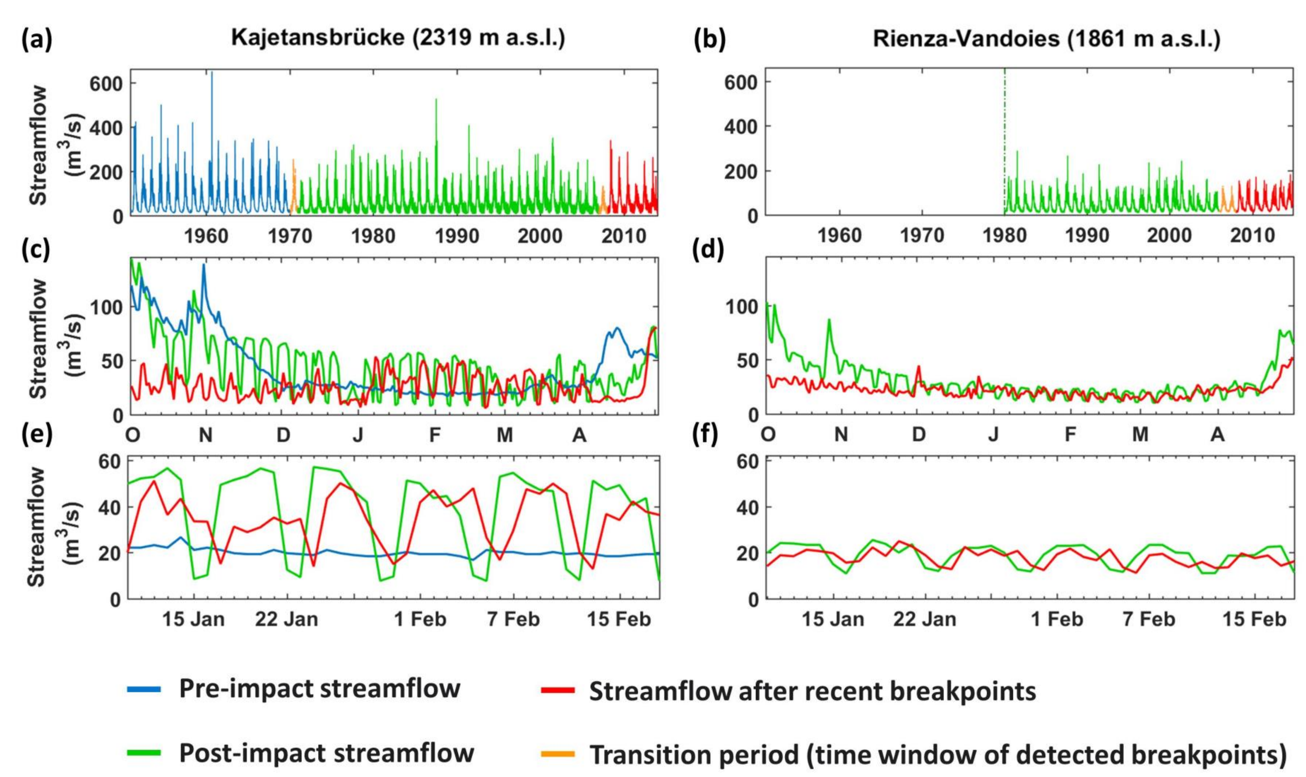
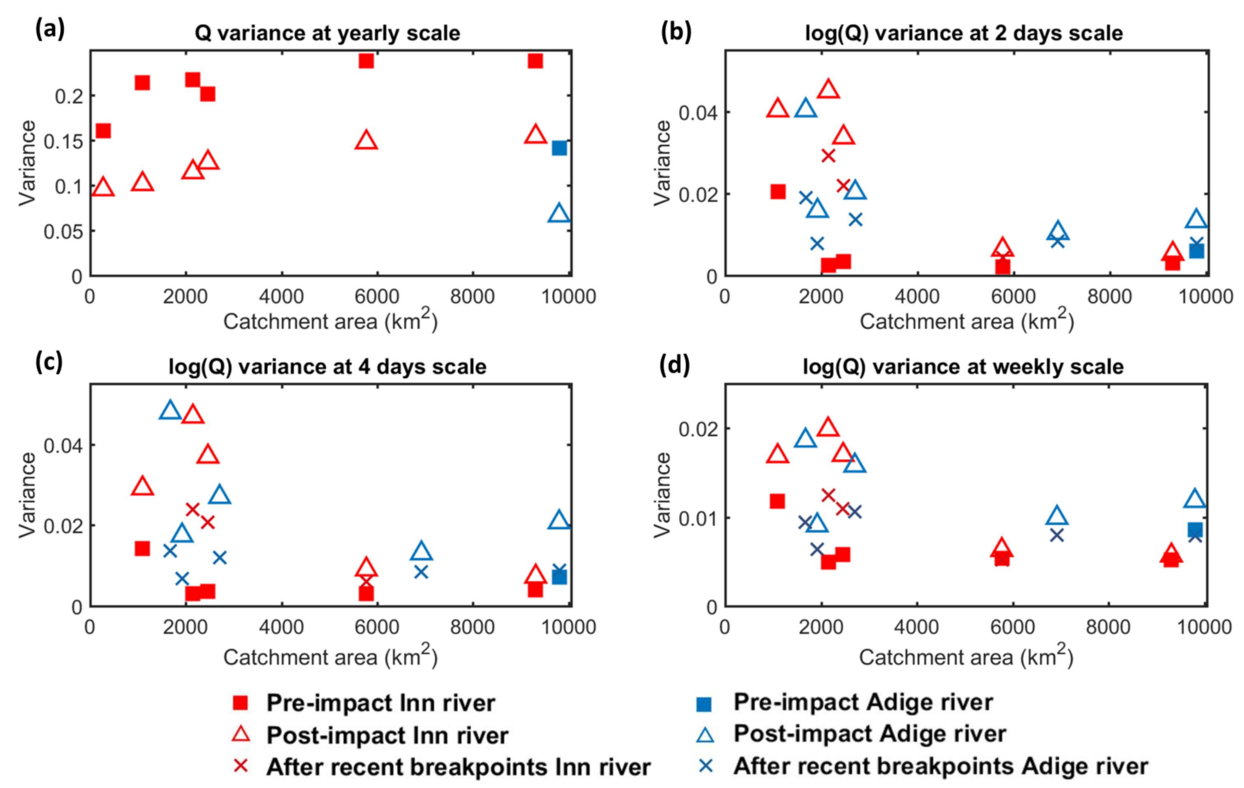
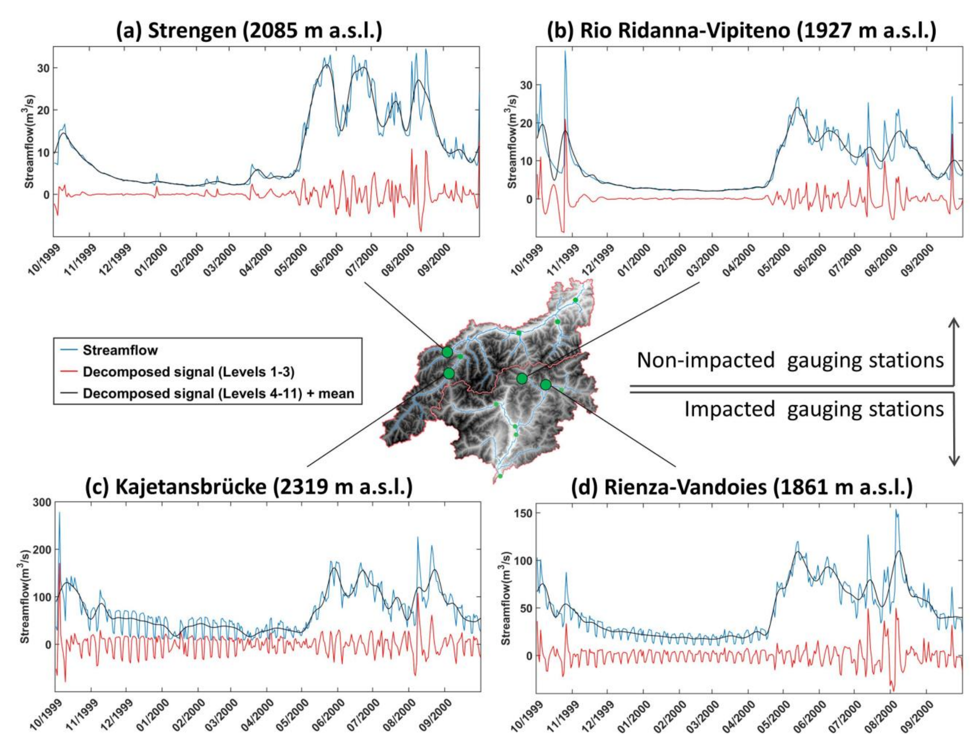


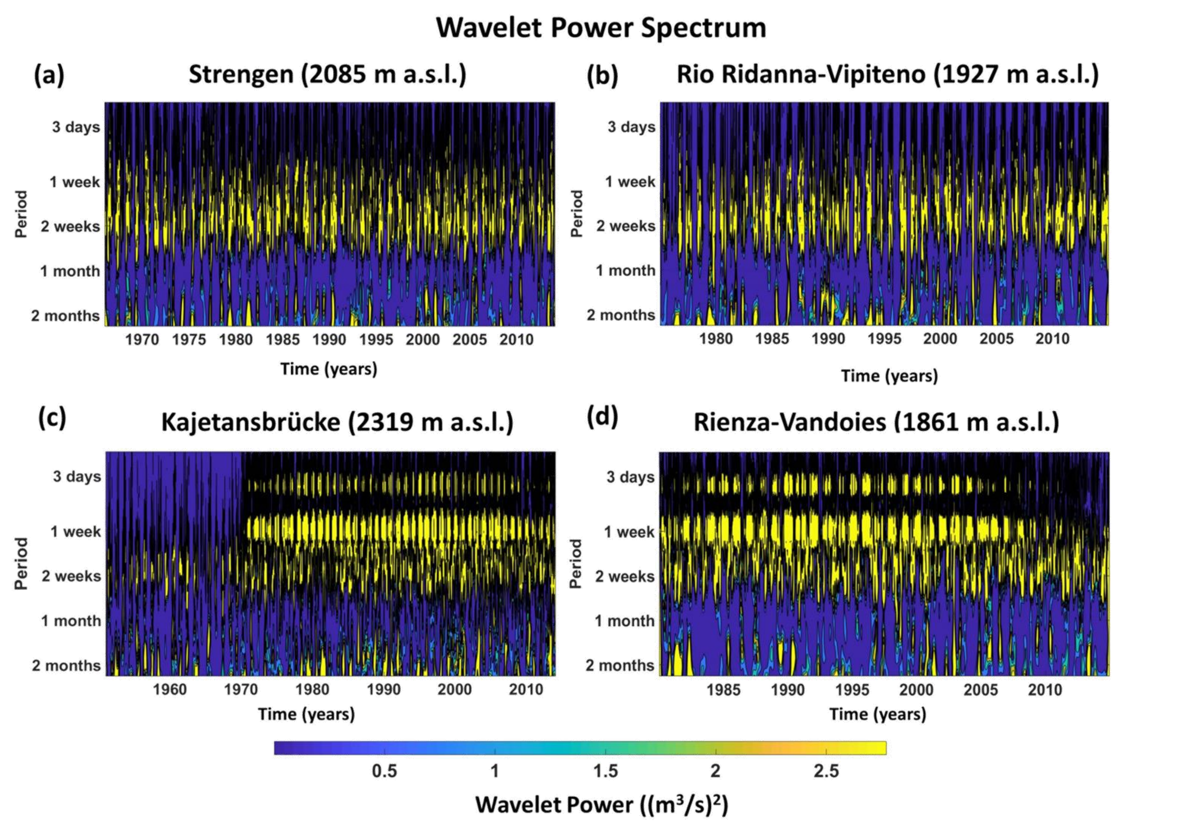


3. Results









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