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A procedure for seiche analysis with Bayesian information criterion

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Seiche is a standing wave in enclosed or semi-enclosed water body. Its amplitude irregularly changes in time due to weather condition etc. Then, extracting seiche signal is not easy by usual methods for time series analysis such as fast Fourier transform (FFT).
In this study, a new method for time series analysis with Bayesian information criterion was developed to decompose seiche, tide, long-term trend and residual components from time series data of tide stations. The method was developed based on the maximum marginal likelihood estimation of tide amplitudes, seiche amplitude, and trend components. Seiche amplitude and trend components were assumed that they gradually changes as second derivative in time was close to zero. These assumptions were incorporated as prior distributions. The variances of prior distributions were estimated by minimizing Akaike-Bayes information criterion (ABIC). The frequency of seiche was determined by Newton method with initial guess by FFT.
The accuracy of proposed method was checked by analyzing synthetic time series data composed of known components. The reproducibility of the original components was quite well. The proposed method was also applied to the actual time series data of sea level observed by tide station and the strain of coastal rock masses observed by fiber Bragg grating sensor in Aburatsubo Bay, Japan. The seiche in bay and its response of rock masses were successfully extracted.