Recurrence based entropies

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Dynamical processes in Earth sciences are often considered to be of complex nature. The term complexity is often used for processes that are either unpredictable (e.g. nonlinear dynamics), consist of many different components, or exhibit regime transitions (e.g. tipping points). To measure complexity, the Shannon entropy is often used.

Here we present various entropy measures that have been defined on the base of the recurrence plot. Because of the different features that are used, these entropy measures represent different aspects of the analysed system and, thus, behave differently. In the past, this fact has lead to difficulties in interpreting and understanding those measures. We summarize the definitions, the motivation and interpretation of these entropy measures, compare their differences and discuss some of the pitfalls when using them.

Finally, we illustrate their potential in an application on palaeoclimate time series. Using entropy measures, changes and transitions in the climate dynamics in the past can be identified and interpreted.