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Detecting dynamical anomalies in time series from different palaeoclimate proxy archives using windowed recurrence network analysis

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Analysing palaeoclimate proxy time series using windowed recurrence network analysis (wRNA) has been shown to provide valuable information on past climate variability. In turn, it has also been found that the robustness of the obtained results differs among proxies from different palaeoclimate archives. To systematically test the suitability of wRNA for studying different types of palaeoclimate proxy time series, we use the framework of forward proxy modelling. For this, we create artificial input time series with different properties and compare the areawise significant anomalies detected using wRNA of the input and the model output time series. Also, taking into account results for general filtering of different time series, we find that the variability of the network transitivity is altered for stochastic input time series while being rather robust for deterministic input. In terms of significant anomalies of the network transitivity, we observe that these anomalies may be missed by proxies from tree and lake archives after the non-linear filtering by the corresponding proxy system models. For proxies from speleothems, we additionally observe falsely identified significant anomalies that are not present in the input time series. Finally, for proxies from ice cores, the wRNA results show the best correspondence with those for the input data. Our results contribute to improve the interpretation of windowed recurrence network analysis results obtained from real-world palaeoclimate time series.