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Prediction of Dansgaard-Oeschger events using machine learning

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The Dansgaard-Oeschger (DO) events are one of the most striking examples of abrupt climate change in the Earth's history, representing temperature oscillations of about 8 to 16 degrees Celsius within a few decades. DO events have been studied extensively in paleoclimatic records, particularly in ice core proxies. Examples include the Greenland NGRIP record of oxygen isotopic composition.
This work addresses the anticipation of DO events using machine learning algorithms. We consider the NGRIP time series from 20 to 60 kyr b2k with the GICC05 timescale and 20-year temporal resolution. Forecasting horizons range from 0 (nowcasting) to 400 years. We adopt three different machine learning algorithms (random forests, support vector machines, and logistic regression) in training windows of 5 kyr. We perform validation on subsequent test windows of 5 kyr, based on timestamps of previous DO events' classification in Greenland by Rasmussen et al. (2014). We perform experiments with both sliding and growing windows.
Results show that predictions on sliding windows are better overall, indicating that modelling is affected by non-stationary characteristics of the time series. The three algorithms' predictive performance is similar, with a slightly better performance of random forest models for shorter forecast horizons. The prediction models' predictive capability decreases as the forecasting horizon grows more extensive but remains reasonable up to 120 years. Model performance deprecation is mostly related to imprecision in accurately determining the start and end time of events and identifying some periods as DO events when such is not valid.