Quantile regression analysis of climate time series

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Long term variability in climate time series is often characterised by linear trends fitted by ordinary least squares. However, this approach based on simple linear regression only estimates the rate of change in the mean of the distribution of observations, whereas climate variability can include not only changes in the central tendency but also changes in the spread and shape of the data distribution over time. Quantile regression allows to extend the classical linear regression framework of estimation of conditional mean models to the estimation of conditional quantile models. In this study, quantile regression is applied to the analysis of sea surface temperature and sea-level time series. For each series, linear slopes are estimated by quantile regression at quantiles 0.1, 0.25, 0.5, 0.75 and 0.9, corresponding respectively to 10%, 25%, 50%, 75% and 90% of the sorted observations. Statistical tests are applied in order to assess whether the differences between the estimated slopes are statistically significant. The results show that for some records the rate of change at the lower and upper quantiles are significantly different from the mean trend, i.e the extreme observations are changing at a different rate than the mean.