

Temperature rise, sea level rise and increased radiative forcing – an application of cointegration methods

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We analyse the statistical relationship between changes in global temperature, global steric sea level and radiative forcing in order to reveal causal relationships. There are in this, however, potential pitfalls due to the trending nature of the time series. We therefore apply a statistical method called cointegration analysis, originating from the field of econometrics, which is able to correctly handle the analysis of series with trends and other long-range dependencies.

Further, we find a relationship between steric sea level and temperature and find that temperature causally depends on the steric sea level, which can be understood as a consequence of the large heat capacity of the ocean. This result is obtained both when analyzing observed data and data from a CMIP5 historical model run.

Finally, we find that in the data from the historical run, the steric sea level, in turn, is driven by the external forcing. Finally, we demonstrate that combining these two results can lead to a novel estimate of radiative forcing back in time based on observations.