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A new method for reconstruction of solar irradiance

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The purpose of this research is to show how time series should be reconstructed using an example with the data on total solar irradiation (TSI) of the Earth and on sunspot numbers (SSN) since 1749. The traditional approach through regression equation(s) is designed for time-invariant vectors of random variables and is not applicable to time series, which present random functions of time. The autoregressive reconstruction (ARR) method suggested here requires fitting a multivariate stochastic difference equation to the target/proxy time series. The reconstruction is done through the scalar equation for the target time series with the white noise term excluded. The time series approach is shown to provide a better reconstruction of TSI than the correlation/regression method. A reconstruction criterion is introduced which allows one to define in advance the achievable level of success in the reconstructed properly if the data are not treated as sample records of random processes and analyzed in both time and frequency domains.

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