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The trendy trends: a fashion or a science story?

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The Nobelist physicist Niels Bohr once said that prediction is very difficult, especially if it is about the future. Nowadays, the scene has changed. It seems that since the scientific community accepted, in its majority, that the earth's climate is rapidly changing, an opinion that also echoes in public, scientists all over the world have identified significant trends in many climate related processes e.g. global temperature, rainfall, river discharges, ice melting etc. Furthermore, if we adopt the suggested trends in those natural processes and their future projections we should expect a horrifying future. But is that so? How consistent and scientifically sound are these trend based scenarios? A trend in its most common form can be expressed as a linear regression line fitted to an observed sample of the natural process under investigation. In addition, the decision of whether or not a trend is significant is based on inferences regarding the regression line coefficients. However, classical statistics inferences of the regression line coefficients assume normal and independent data, assumptions that are generally not valid in natural processes. Particularly, while the assumption of normality may hold in some cases, it is well documented that natural processes exhibit a great variety of autocorrelation structures, exponential or power type, and thus the assumption of independently distributed data is violated. In this study, we investigate based on Monte Carlo simulations the effect of different autocorrelation structures in the inference of the trend line significance. We demonstrate that trends considered as significant in a classical statistics framework are actually insignificant if autocorrelation structures are incorporated.