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Analyzing the significance of air temperature trends in the Arctic region

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The motivation for this work are the results of Franzke (2012), who found nearly no significant warming in the air temperature of the eurasian arctic region. This might lead to an underestimation of the danger of global warming.
The results of Franzke (2012) shall be verified by expanding the data base by using a climate model (CMIP5) and a model which includes actual observations (NCEP/NCAR Reanalysis 1), in addition to the use of station data.
After estimating the temperature trends in the time series, we want to decide if it is likely that they are caused by natural variability. Otherwise there is a long term trend in the time series which we call significant and is probably caused by humans.
First we compute many new time series, so-called surrogates, from each time series we want to test. These surrogates conserve the variability of the original time series but do not conserve possible long term trends. Afterwards we compare them with the original time series to estimate the significance of the trend.
This is very important in order to be able to make strong statements about the actual observed change of the air temperature and if it is natural or not.

To test the explanatory power of our results we use different data sets, lengths of the time series, methods of computing surrogates and estimating trends.

Our results show that the areas of significant warming strongly depend on the used data, the method of estimating the trend and the method of computing surrogates. Furthermore there is a strong spatial dependency of the trends and their significance. By using a long time series ($\sim$150 years) of CMIP5 data we derive smaller trends, but more of them are significant compared to the case in which we use only the last $\sim$60 years.
We figure out, that the data used by Franzke (2012) is not representative for the arctic region.

In this work the uncertainty of the measurements at the stations have no impact on the results, because we use very long time series to calculate the trend. But the variability causes an uncertainty in the estimation of the long term trend. We try to separate the cases where this uncertainty is as big as the derived quantity itself to increase the explanatory power of the estimated trend.

Furthermore, we use data from models to gain information about the temperature in the region of the arctic ocean, since there are no long time series from stations available. We want to include this region because it is very important for the global climate. We can see big differences between the datasets, so we have to be very careful with our results because we do not know which one is trustworthy, if any.

After all, we have been able to show that our well established method to work with uncertainty caused by natural variability is strongly dependent on several assumptions. Therefore it can not be taken as certain without further discussions.

C. Franzke. On the statistical significance of surface air temperature trends in the eurasian arctic region. Geophysical Research Letters, 39(23), 2012.