

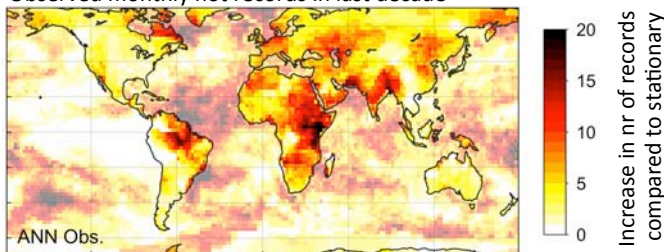


# Record monthly-temperature extremes

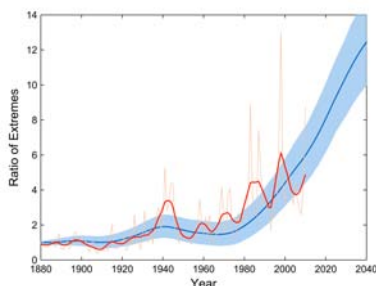
**Abstract** Worldwide, the number of local record-breaking monthly temperature extremes is now on average five times larger than expected in a stationary climate. Large regional differences exist in the number of observed records. Summertime records, which are associated with prolonged heat waves, increased up to a factor 12 in some continental regions including Europe, Africa, southern Asia and Amazonia. Overall, these high record numbers are quantitatively consistent with those expected for the observed climatic warming trend with added stationary white noise. In addition, we find that the observed records cluster both in space and in time. Strong El Niño years see additional records superimposed on the expected long-term rise.

## Observed Hot records

Observed monthly hot records in last decade

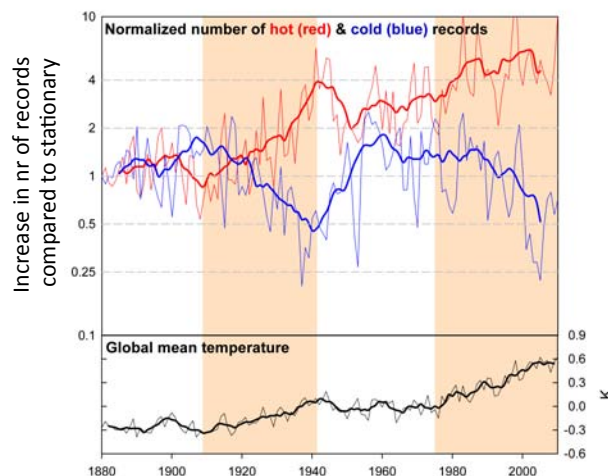


- Worldwide the nr of heat records is now **5-times larger** than in a stationary climate
- Records **cluster** both in **space** and in **time**. During strong El-Niño years many more records occur than expected solely by long-term warming. Non-linear mechanisms like blocking and soil-moisture feedback cause extremes to cluster in space



Evolution of the number of monthly hot records globally

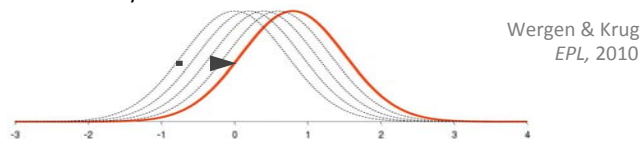
## Hot & Cold records



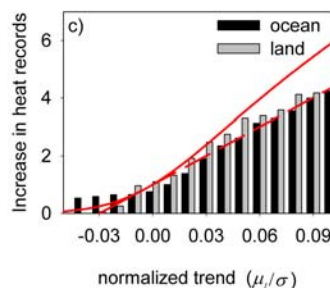
- On a global scale, the number of hot records increased to five times the number expected in a stationary climate
- The number of cold records only decreased to half the number expected in a stationary climate

## Theoretical Method

We use a statistical model consisting of a slowly changing mean plus stationary white noise:



This model can explain the number of observed records well when the time period is limited to the last 40 years over which global mean warming has been approximately linear.



To compare model and observations the data is limited to the post-1970 period

