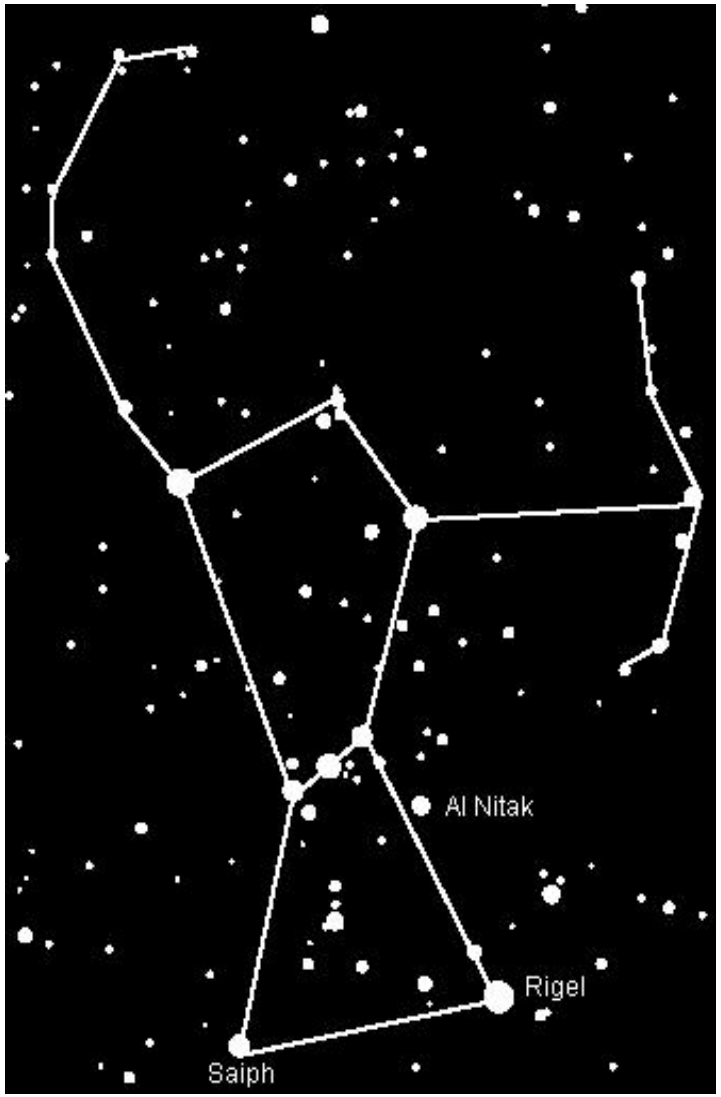
Statistics in meteorology without tears

Part IV: The psychology of probabilities

The problems with randomness



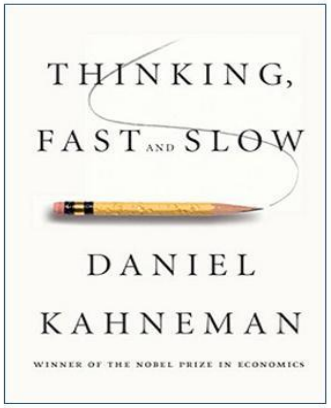
We want everything to have a cause, in particular if we are brought up in the Newtonian tradition

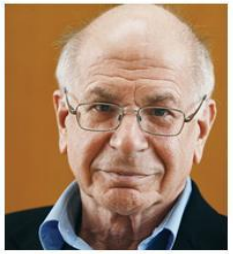
We always want to see patterns also in random data

When we indeed see a pattern we think that is shows real relationships

A surge of books on uncertainty and intuitive statistics

But above of all this "international best-seller"





Selected by the ***New York Times Book Review*** as one of the best books of 2011
A ***Globe and Mail*** Best "Books of the Year 2011". One of ***The Economist's*** 2011 "Books of the Year". One of ***The Wall Street Journal's*** "Best Nonfiction Books of the Year 2011"

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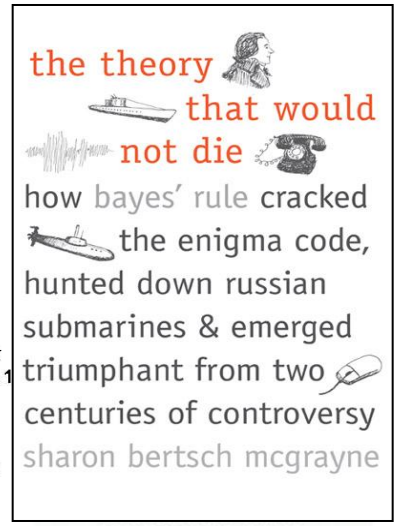
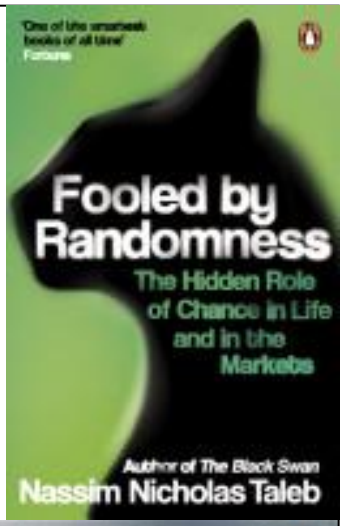
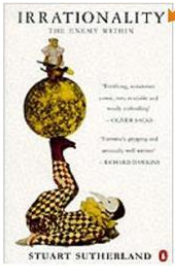
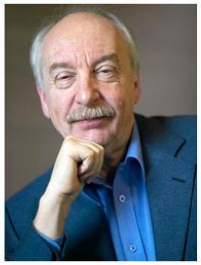


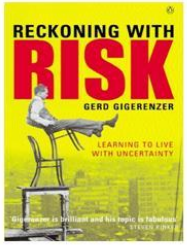


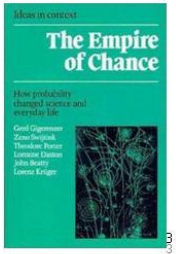
Good books on "intuitive statistics" and "rational thinking":

Stuart Sutherland (1994):
Irrationality – The Enemy Within









Gerd Gigerenzer on risk and chance

14/10/2013

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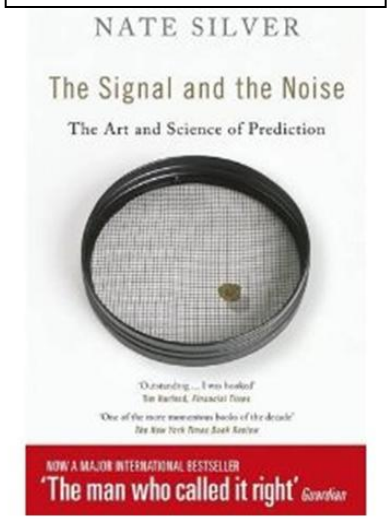
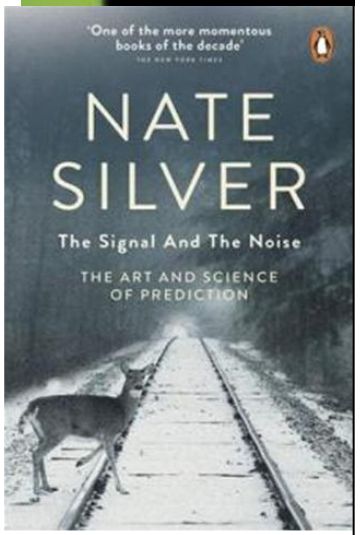
Anders Persson 3





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Some common pitfalls

1. Over-confidence
2. The Halo Effect
3. Representativeness bias
4. Confirmation bias
5. Availability effect
6. Misleading forecast consistency
7. **Regression to the mean effect**

Examples from meteorology

-It will surely rain in six days time!

-Model A is usually best!

-It either rains or it is dry – not half dry!

-It rains! At least in Riga . . . .

-Model A has nicer graphics – in colour

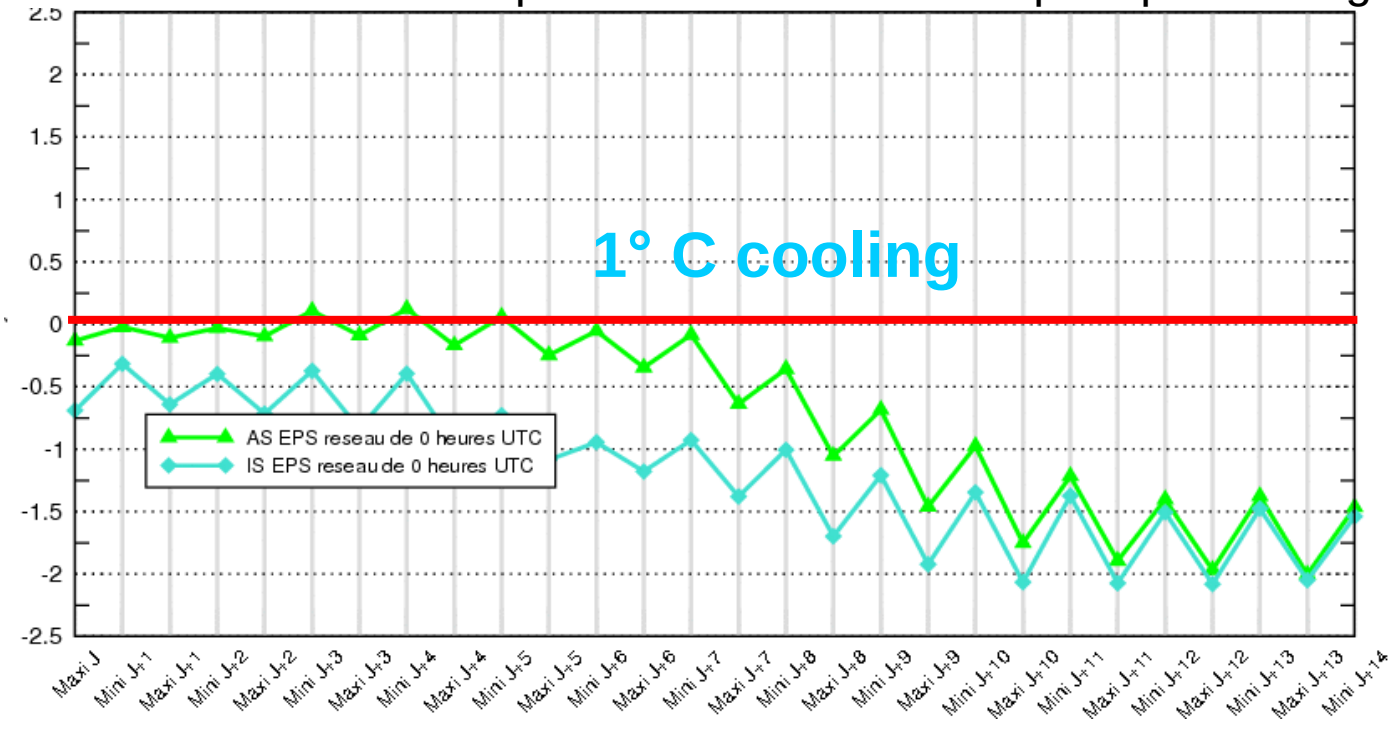
-Should we really change the forecast?

Regression to the mean deceptions in weather forecast verification

Mean error for the 2m-temperature based on EPS

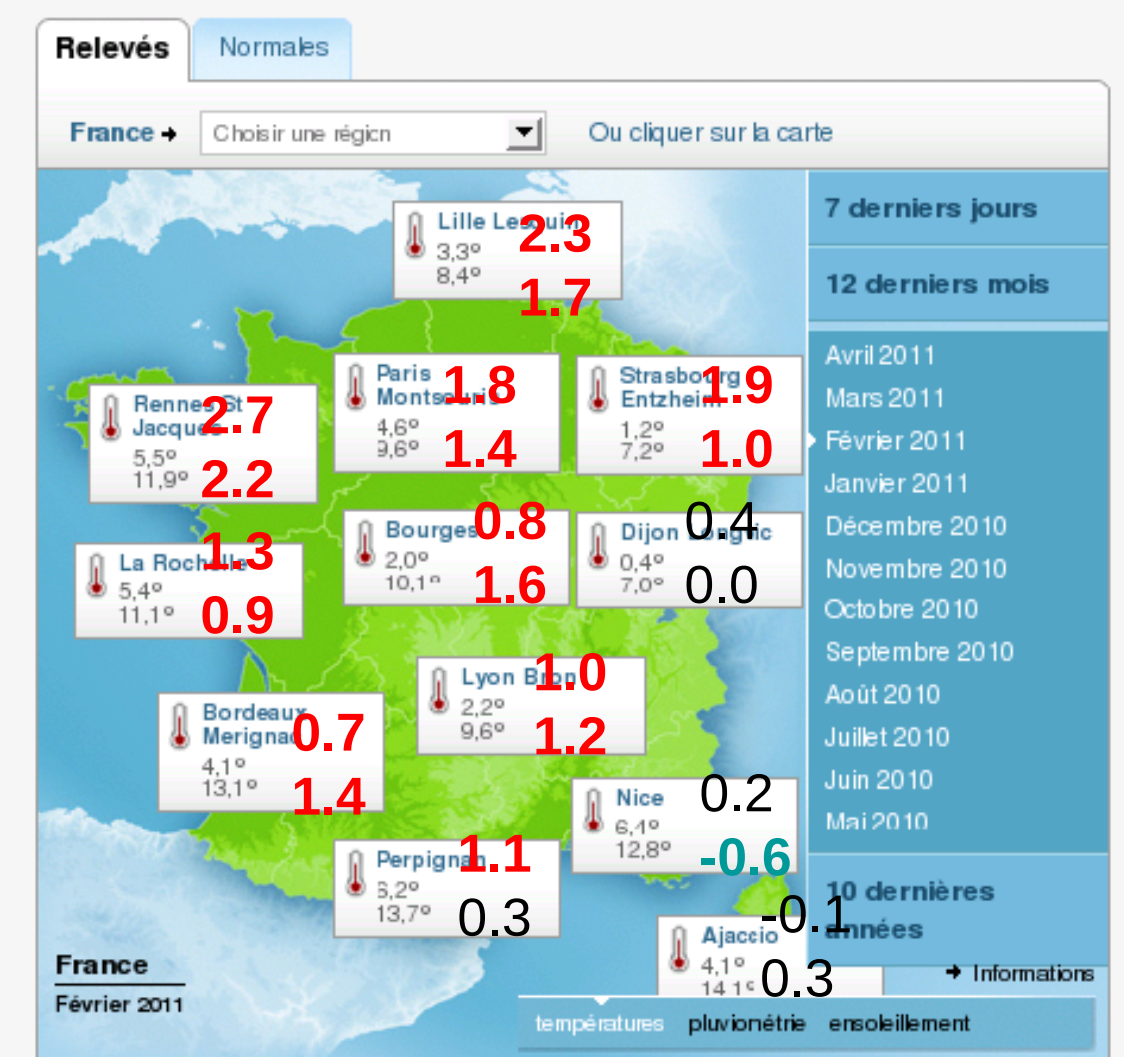
February 2011 – French stations

=direct model output = statistical post-processing



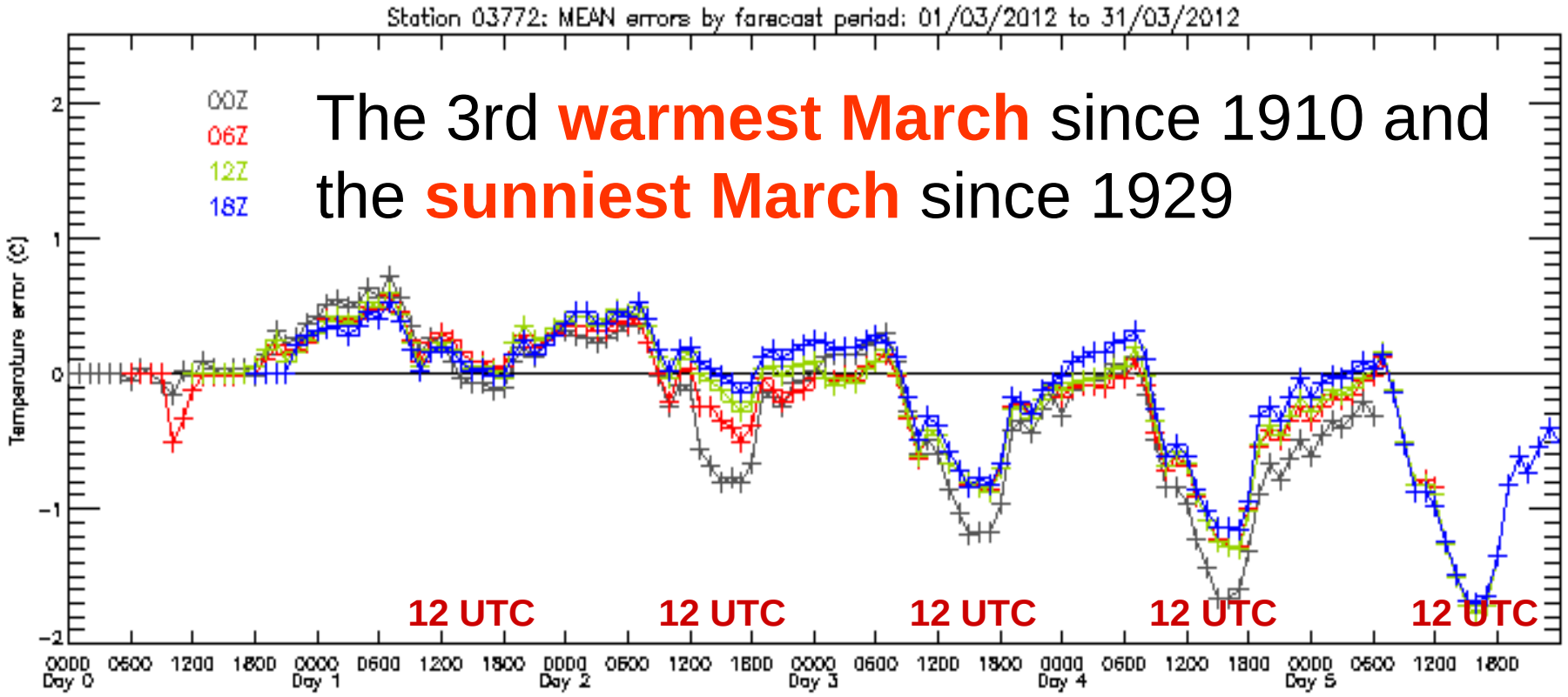
ECMWF Forecast Products Users Meeting – 9 June 2011

February 2011 was around 1½° warmer than normal



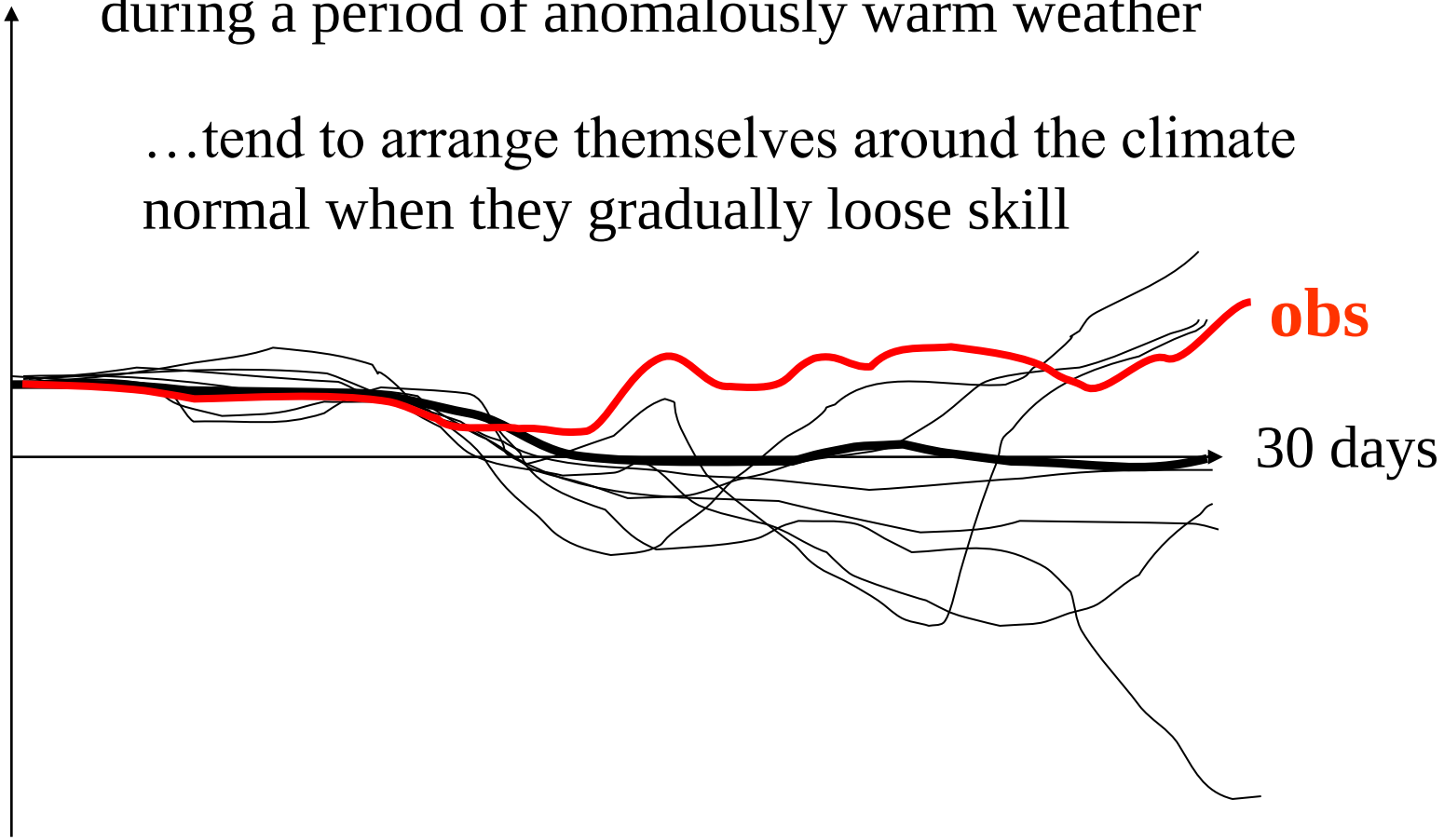
A similar example from the other side of the Channel in March 2012

Mean error of UKMO 2 m temperature forecasts 03772 Heathrow



Consecutive or ensemble 30 day forecasts
during a period of anomalously warm weather

…tend to arrange themselves around the climate normal when they gradually loose skill

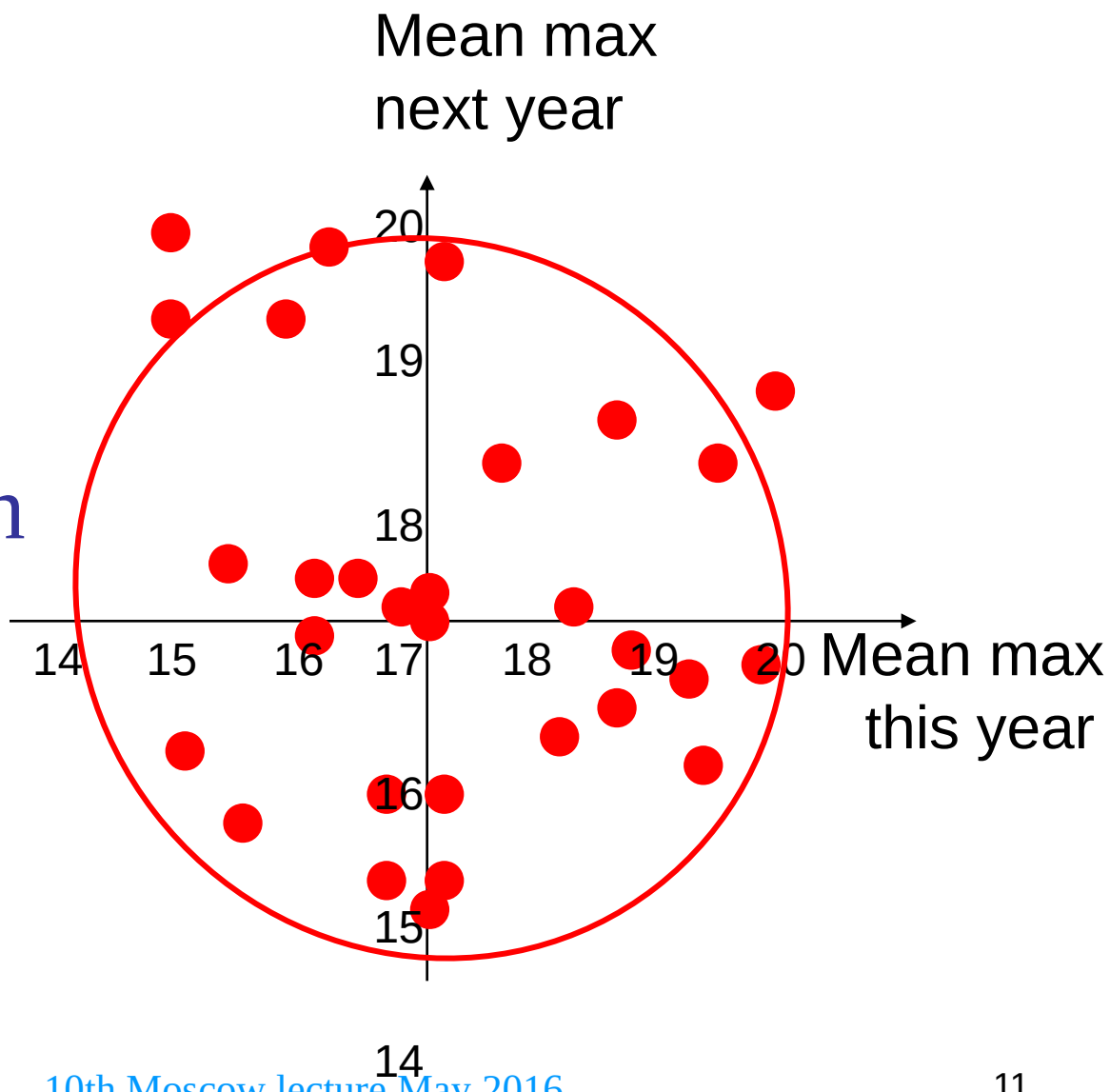


The result gives the impression of a mean error (“bias”)

New question: -Is it possible to forecast temperature changes 365 days ahead with a correlation >70%?

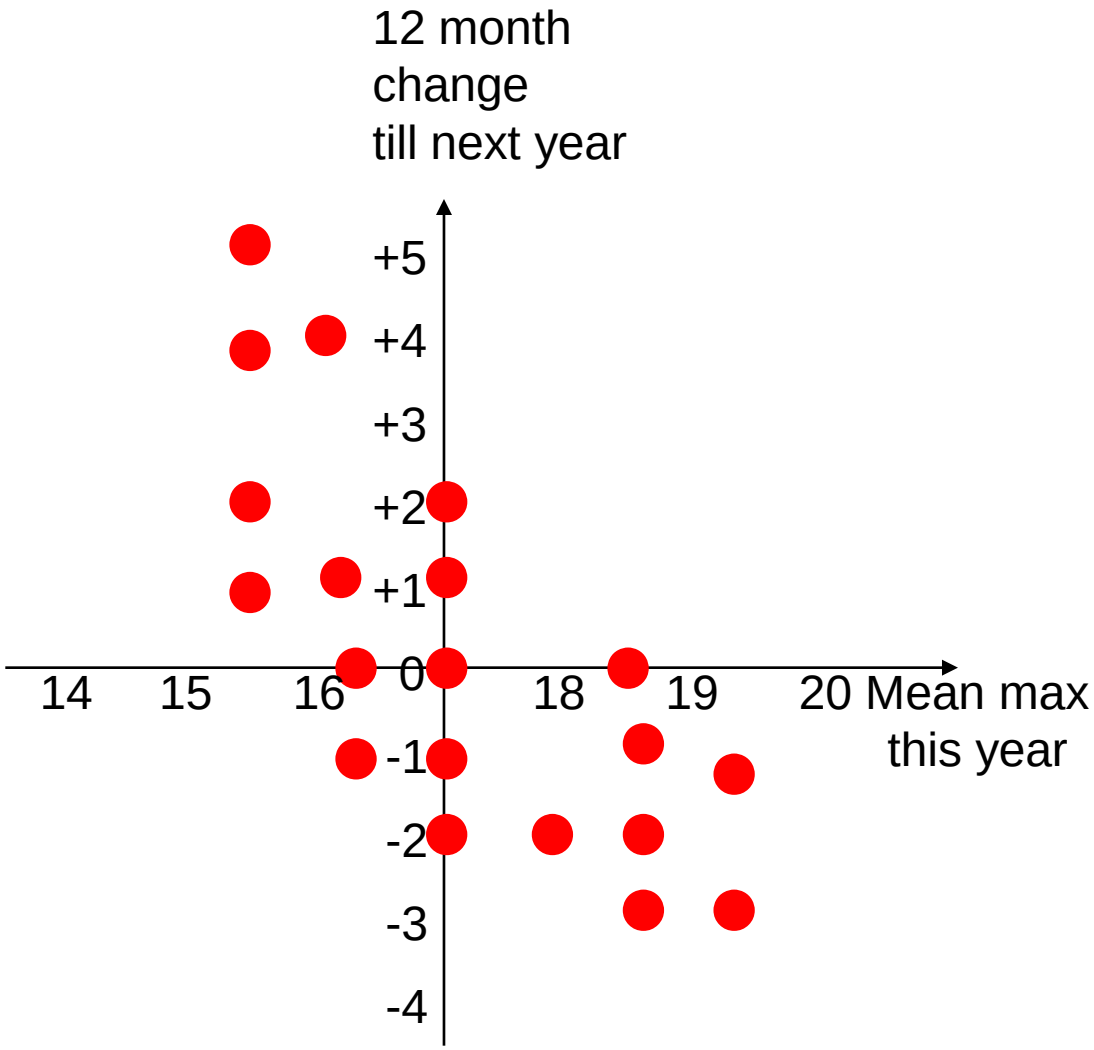
Mean monthly maximum temperature at Heathrow 1948-1977

As might be expected, there is no clear correlation between the mean maximum temperature one year (the x-axis) and the next year (y-axis)



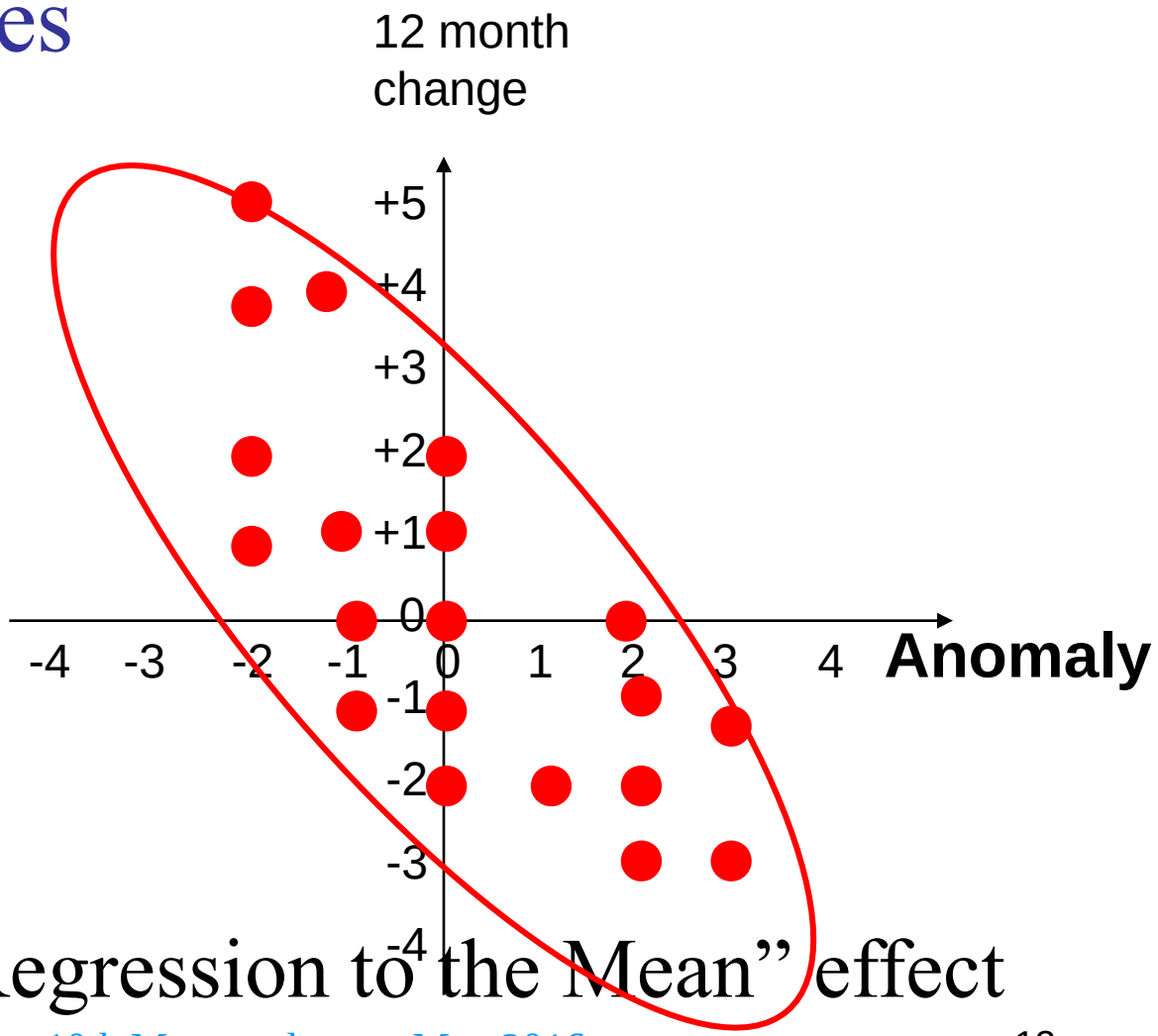
Mean monthly maximum temperature at Heathrow 1948-1977

However, when we plot the change over 12 months versus the mean max value the first year a clear correlation turns up

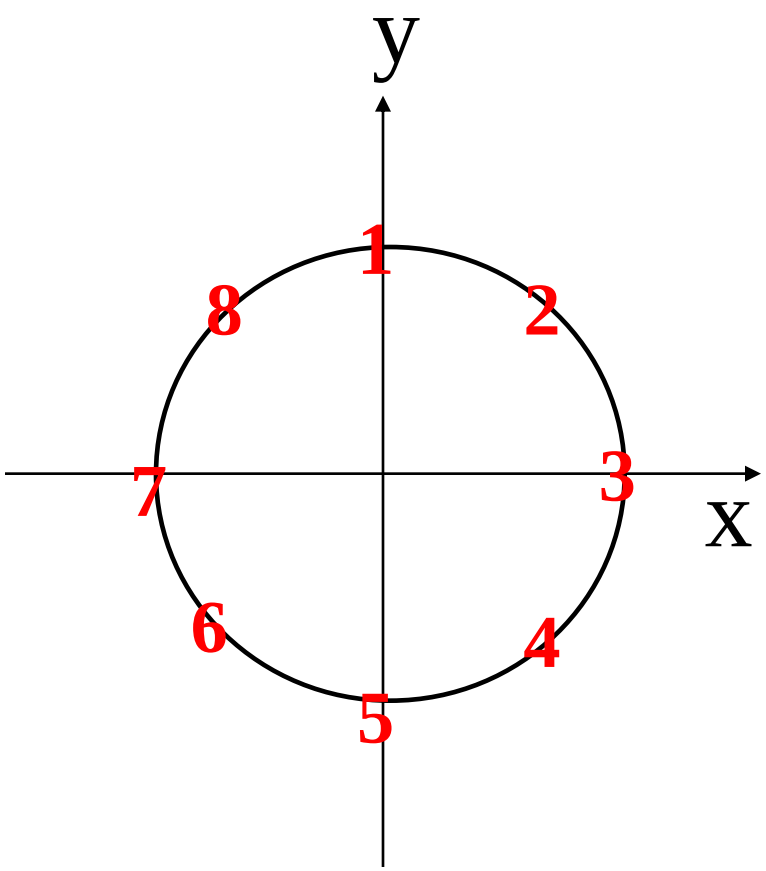


Mean monthly maximum temperature at Heathrow 1948-1977

The "trick" becomes obvious if we express this year's temperature as an anomaly: it will correlate around 71% with the observed change.



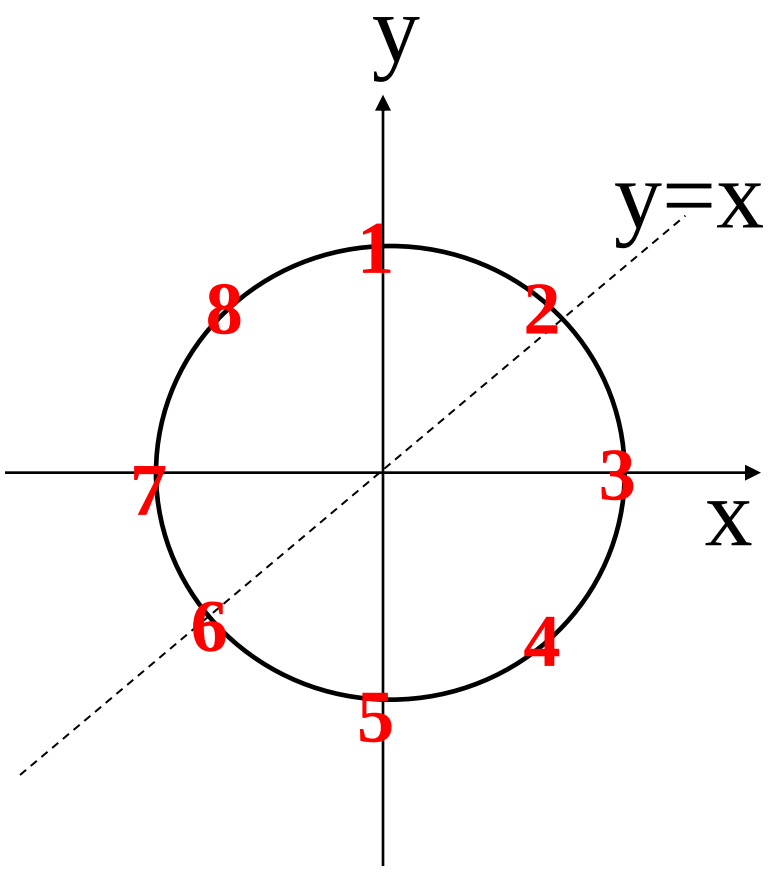
...thanks to the "Regression to the Mean" effect



$x^2 + y^2 = 1$

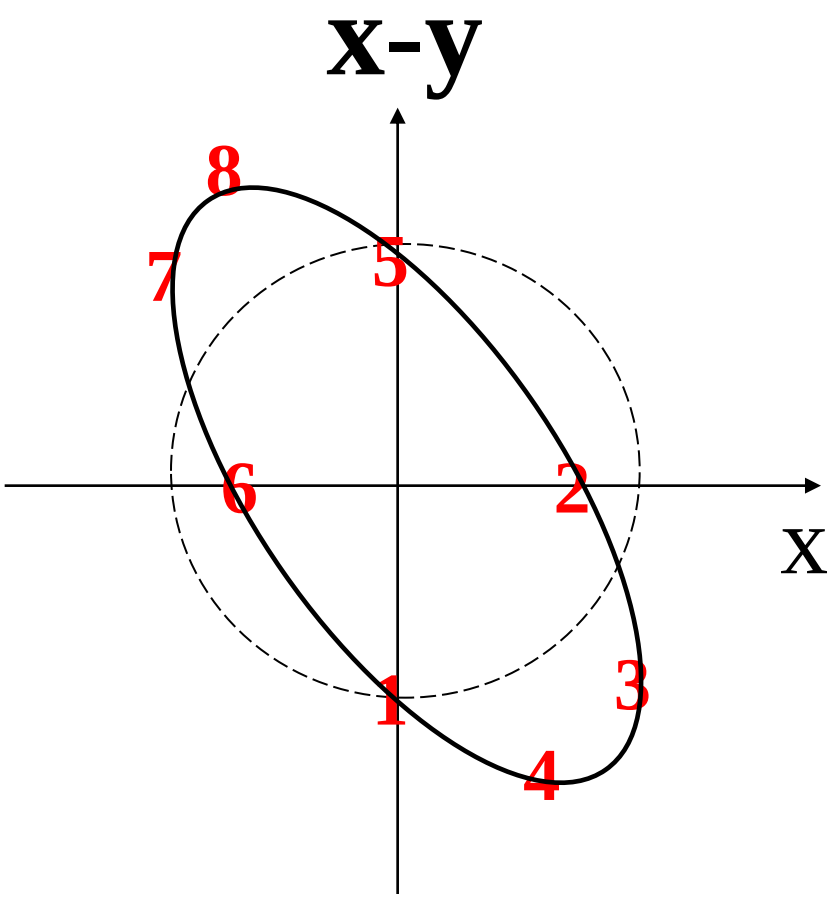
Consider eight values along a circle. They are uncorrelated in a x-y representation, **but not in an x, y-x representation**

No correlation



$x^2 + y^2 = 1$

71% correlation



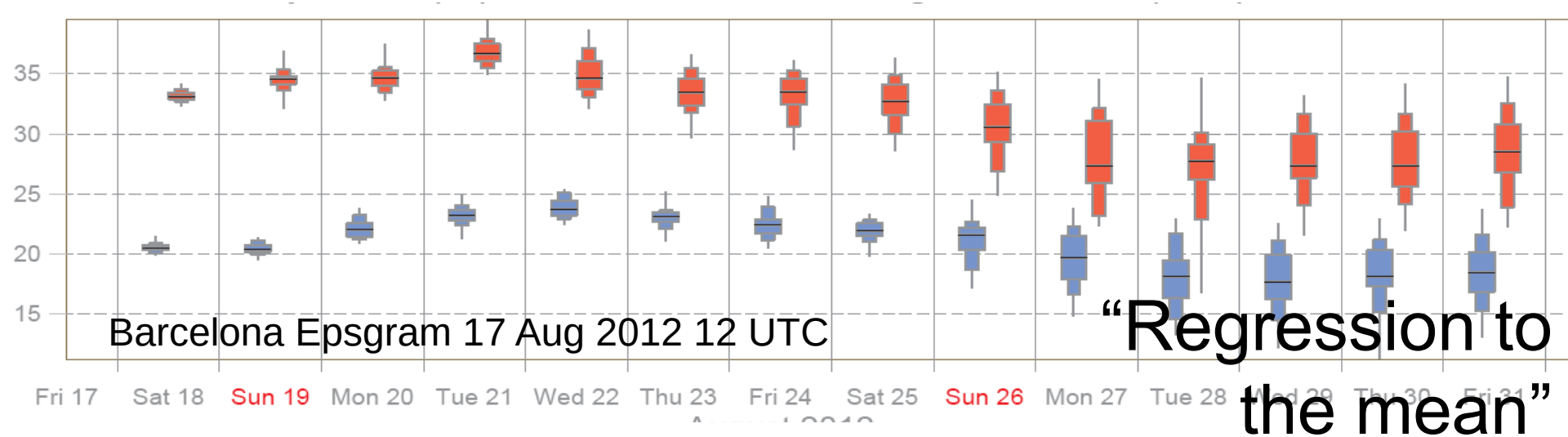
$(x-y)^2 = 1 \pm 2x\sqrt{1-x^2}$

Regression to the mean effect in medium range ensemble forecasts

During an anomalous period the ensemble probabilities will, due to *non-systematic* forecast errors, *systematically* drift towards the climatological average.

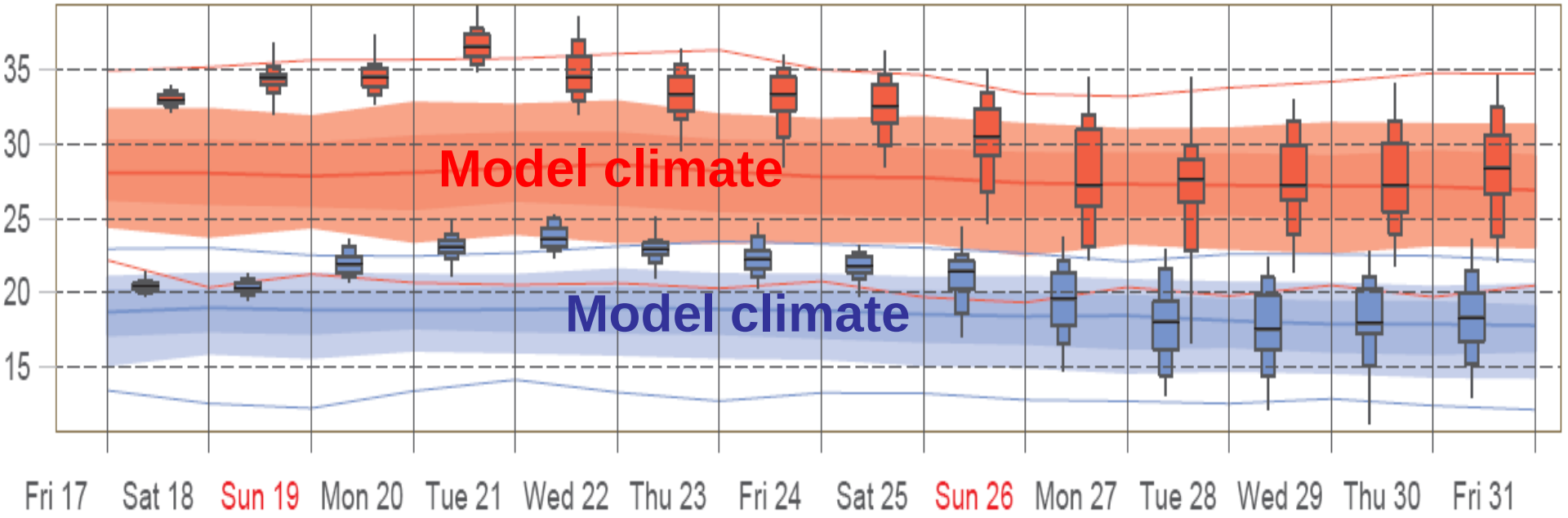
During a heat wave the weather seems to be cooling in the ensemble forecasts, during a prolonged cold spell the forecasts seem to indicate return to milder conditions.

Example of underestimation of randomness



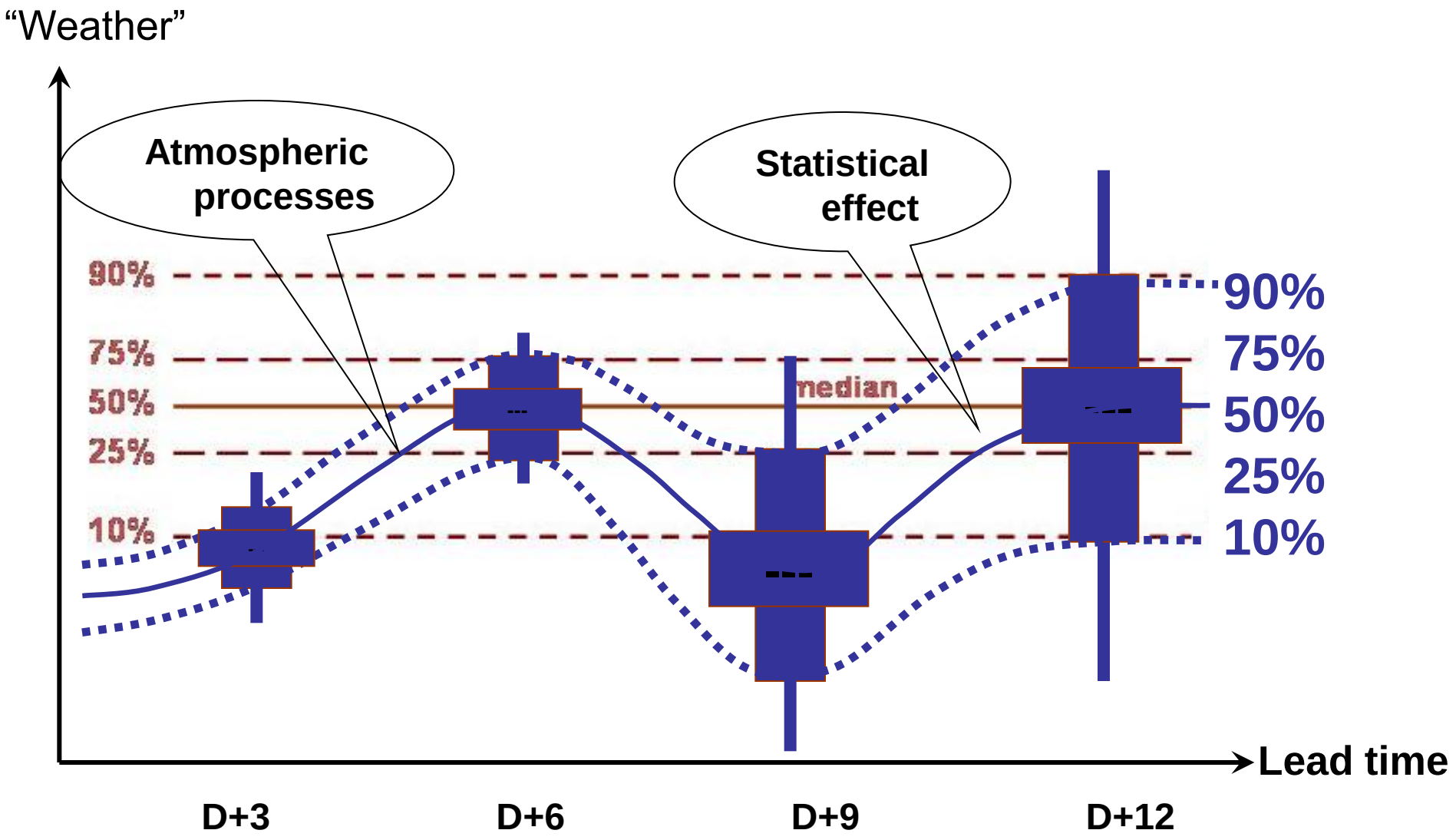
Barcelona Epsgram 17 Aug 2012 12 UTC

"Regression to the mean"



Has randomness a message?

An example of the “regression to the mean effect”



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