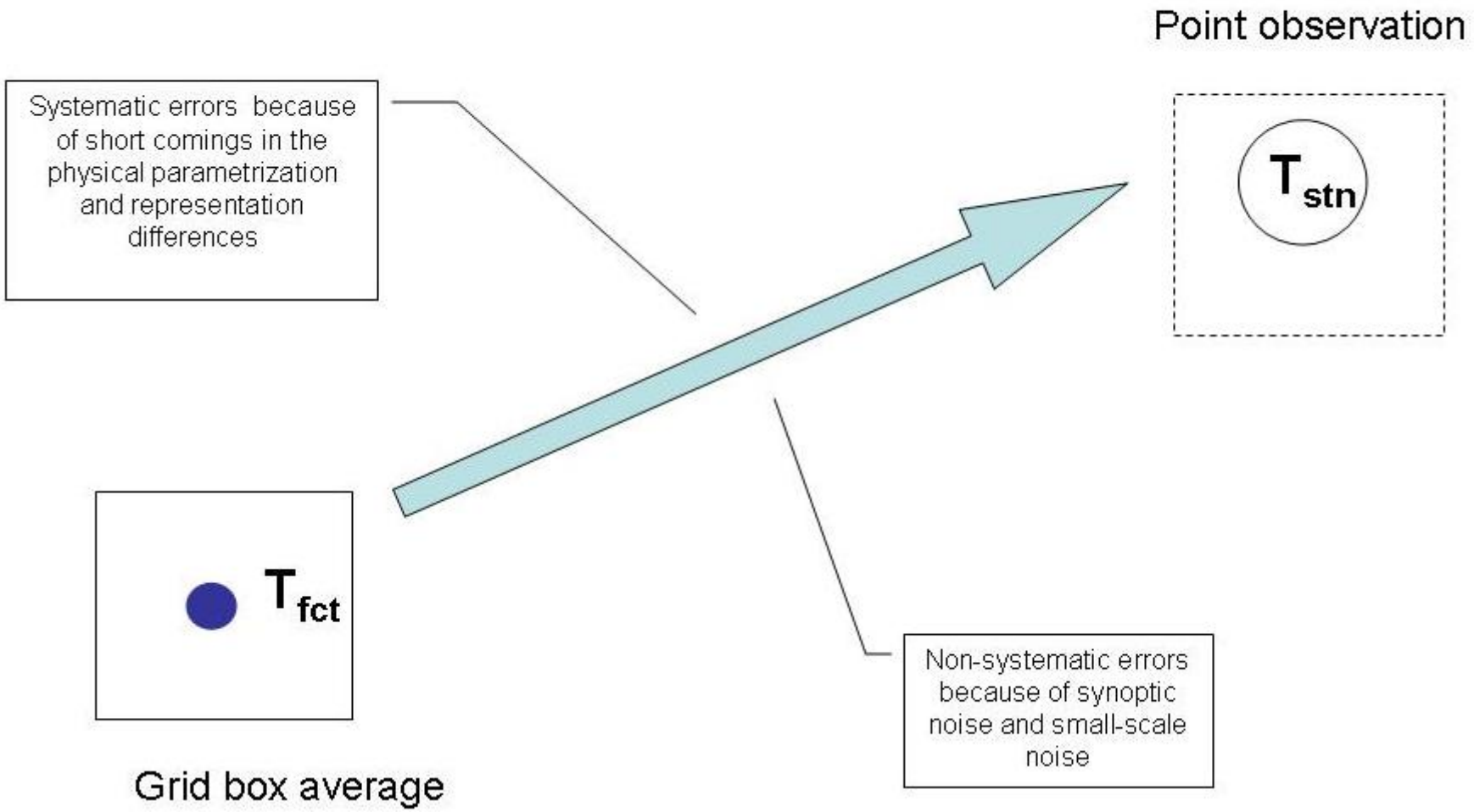
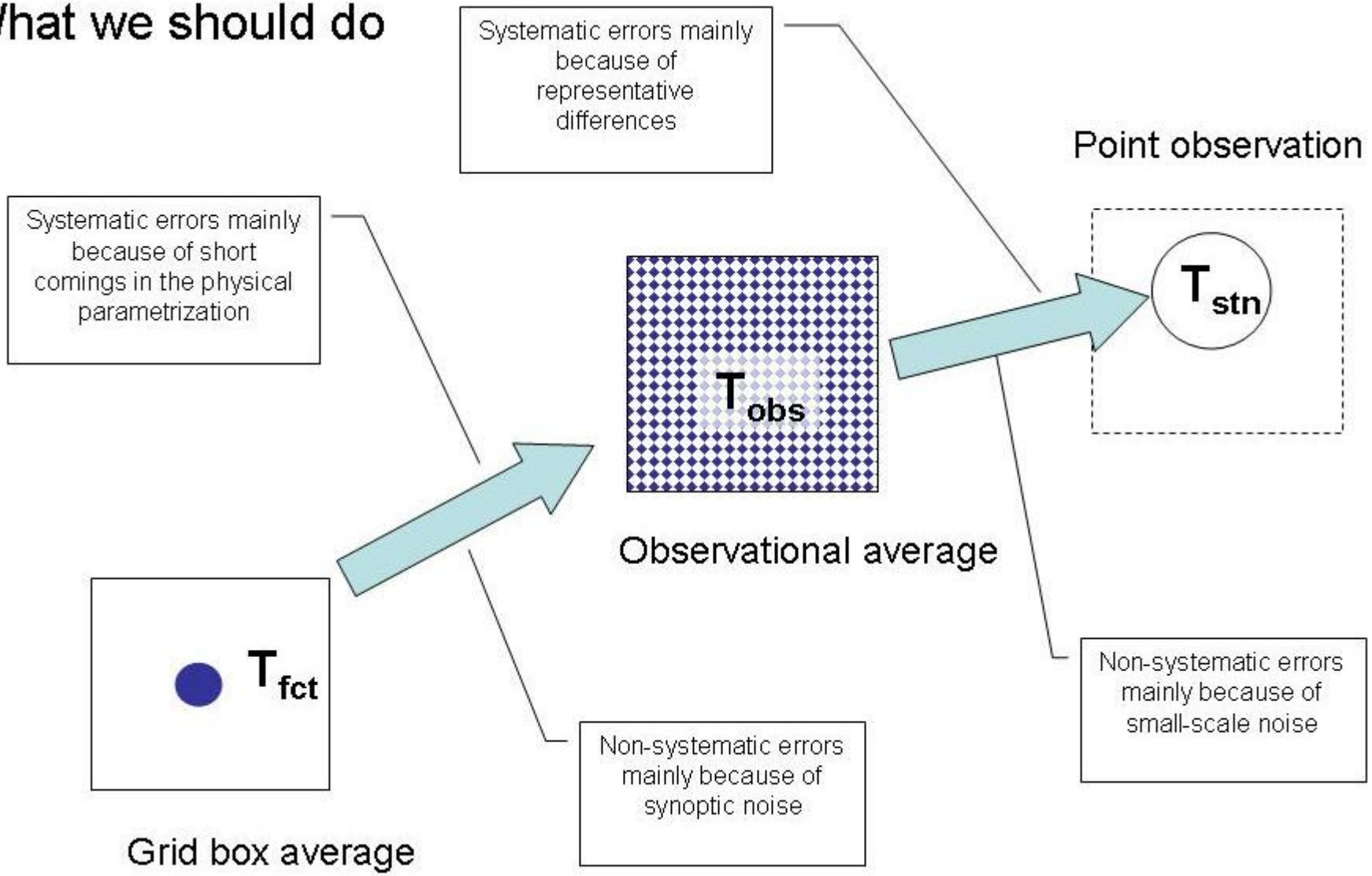
Statistical interpretation of Numerical Weather Prediction (NWP) output

What we do


Point observation
Systematic errors because of short comings in the physical parametrization and representation differences
T_{stn}
T_{fct}
Grid box average
Non-systematic errors because of synoptic noise and small-scale noise

What we should do



Four types of errors:

Model errors

Systematic errors

Representativeness

Synoptic errors

Non-systematic errors

Small scale “noise”

Four types of errors:

Systematic errors

Model errors

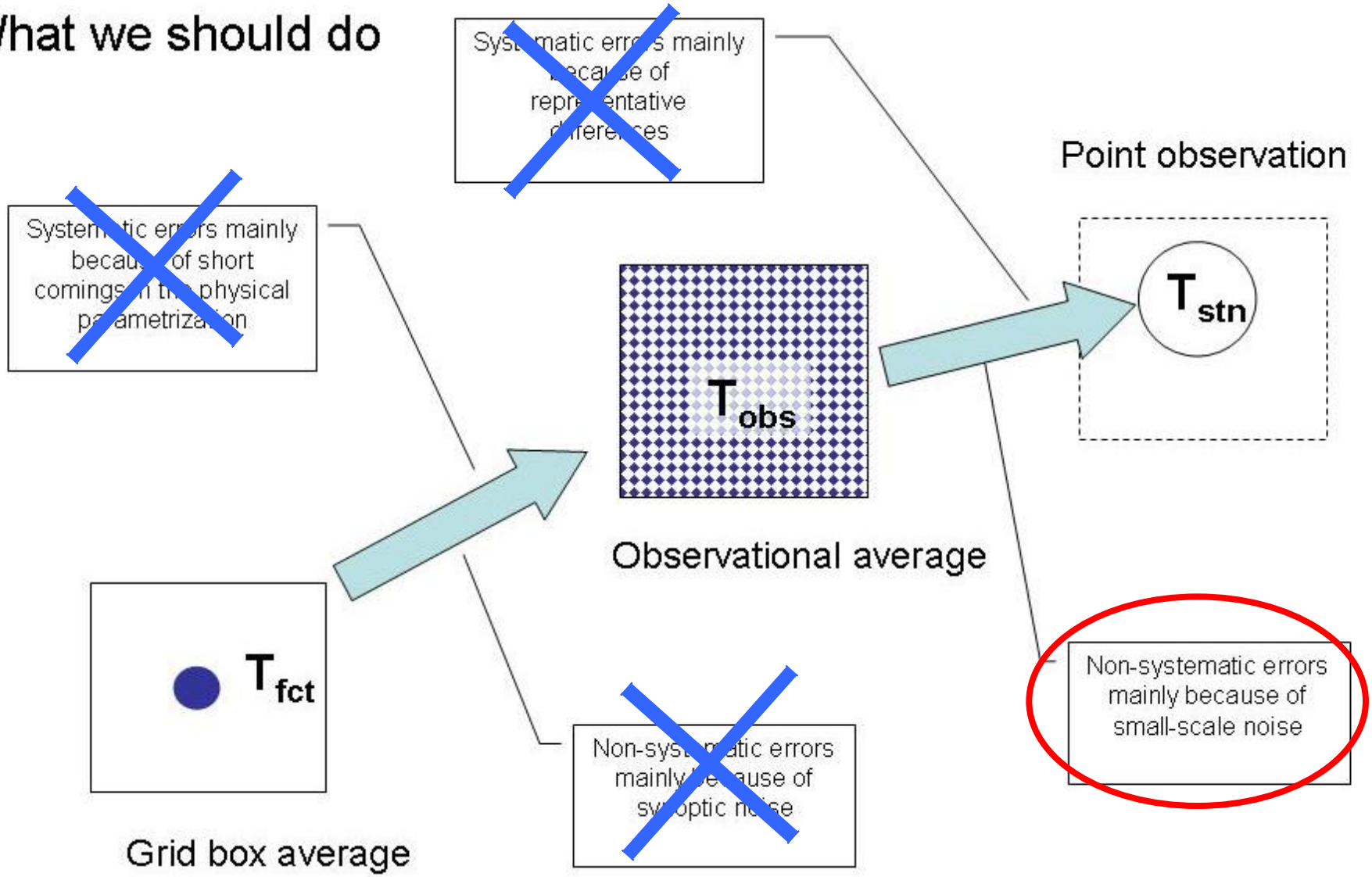
Representativeness

Non-systematic errors

Synoptic errors

Small scale “noise”

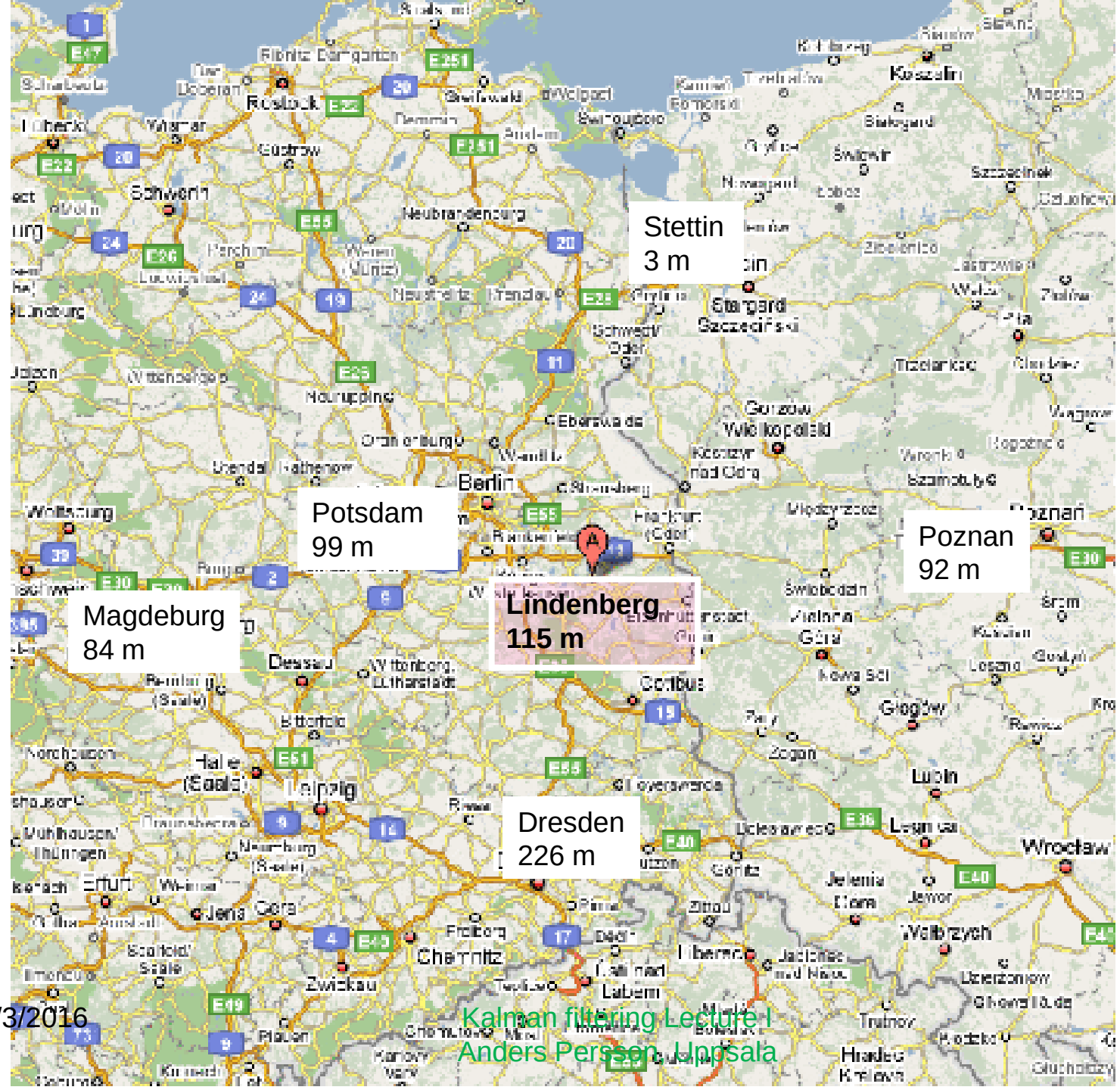
What we should do



Even when we get rid of systematic errors, make the synoptic forecast perfect and only verify against representative observations – the meso-scale "noise" will still yield "non-perfect" forecasts

The two neighbouring stations Potsdam and Lindenberg outside Berlin are just 75 kilometres apart and are situated in almost the same environment. **How well would a "forecast" based on the other one's observation verify**?

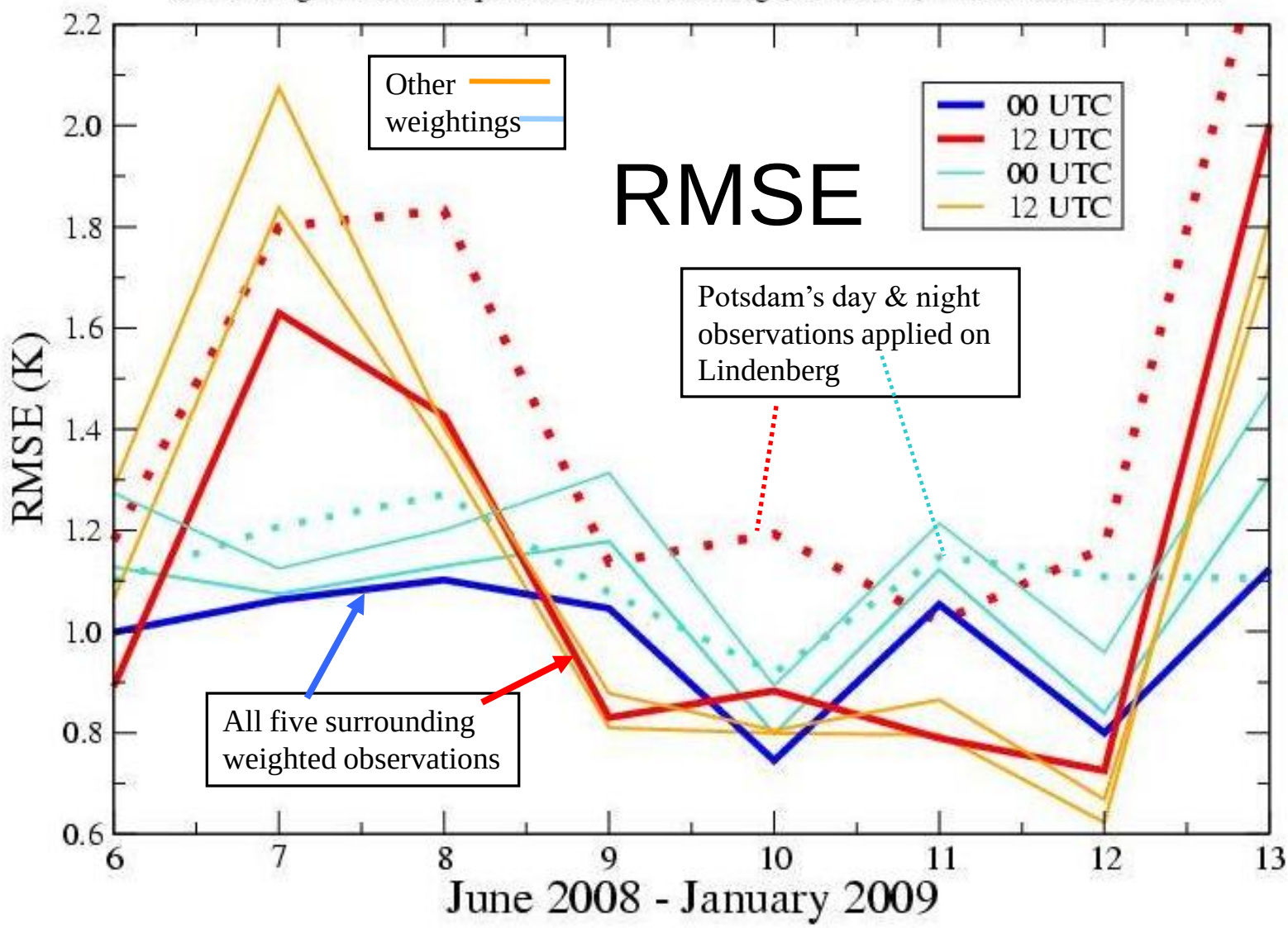
Other nearby stations were also used (Magdeburg, Dresden, Poznan and Stettin). They provided, together with the previous two data to calculate an average temperature as "forecast".


Stettin
3 m
Potsdam
99 m
Poznan
92 m
Magdeburg
84 m
Lindenberg
115 m
Dresden
226 m

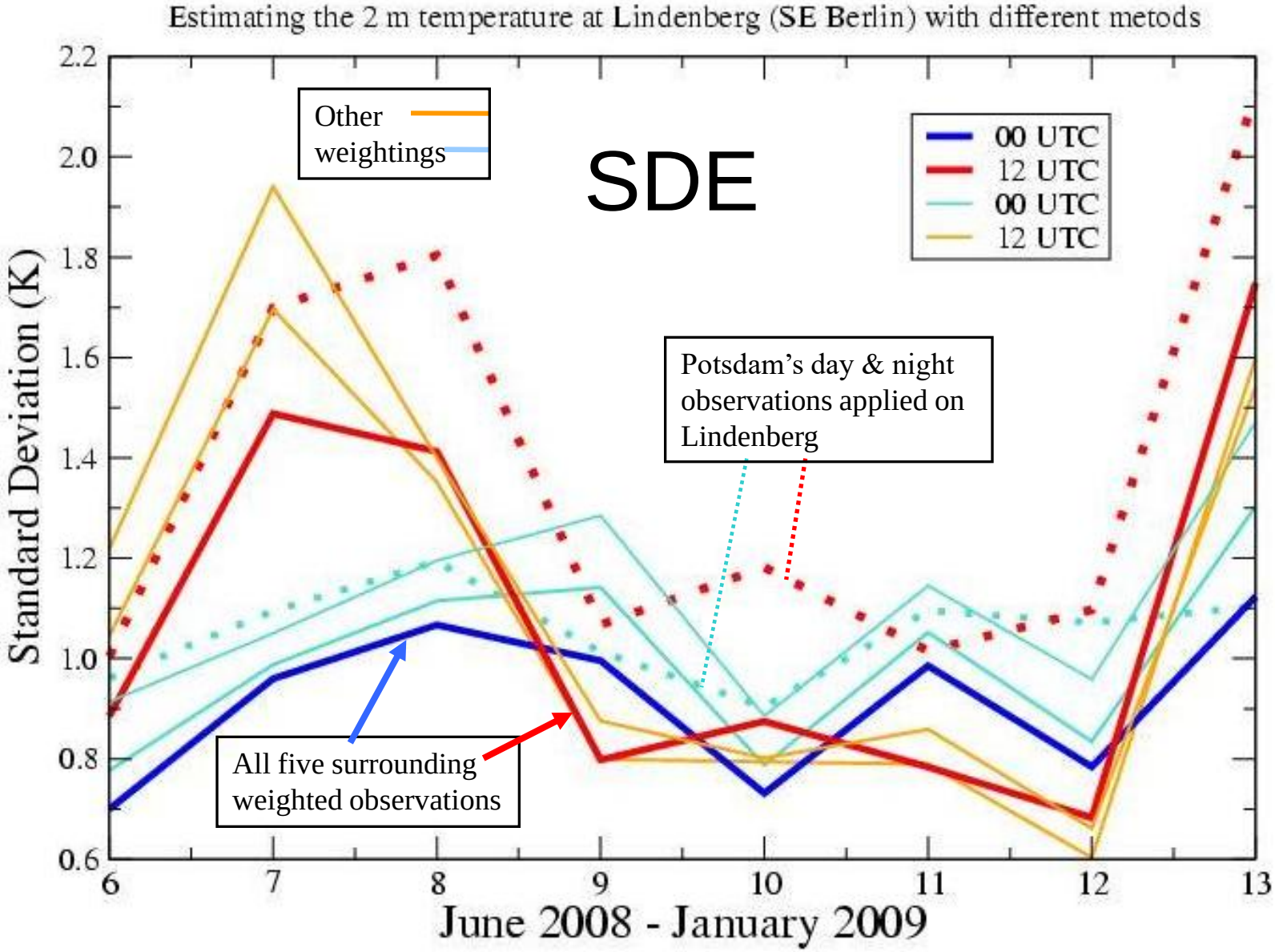
Four tests were conducted all with the objective to estimate ("forecast") the temperature at Lindenberg:

1. Using the observation from Potsdam as "forecast"
2. Using an average of all five surrounding stations
3. The same but with weights proportional to the square of the distance from Lindenberg
4. The same, but without using the observation from nearby Potsdam

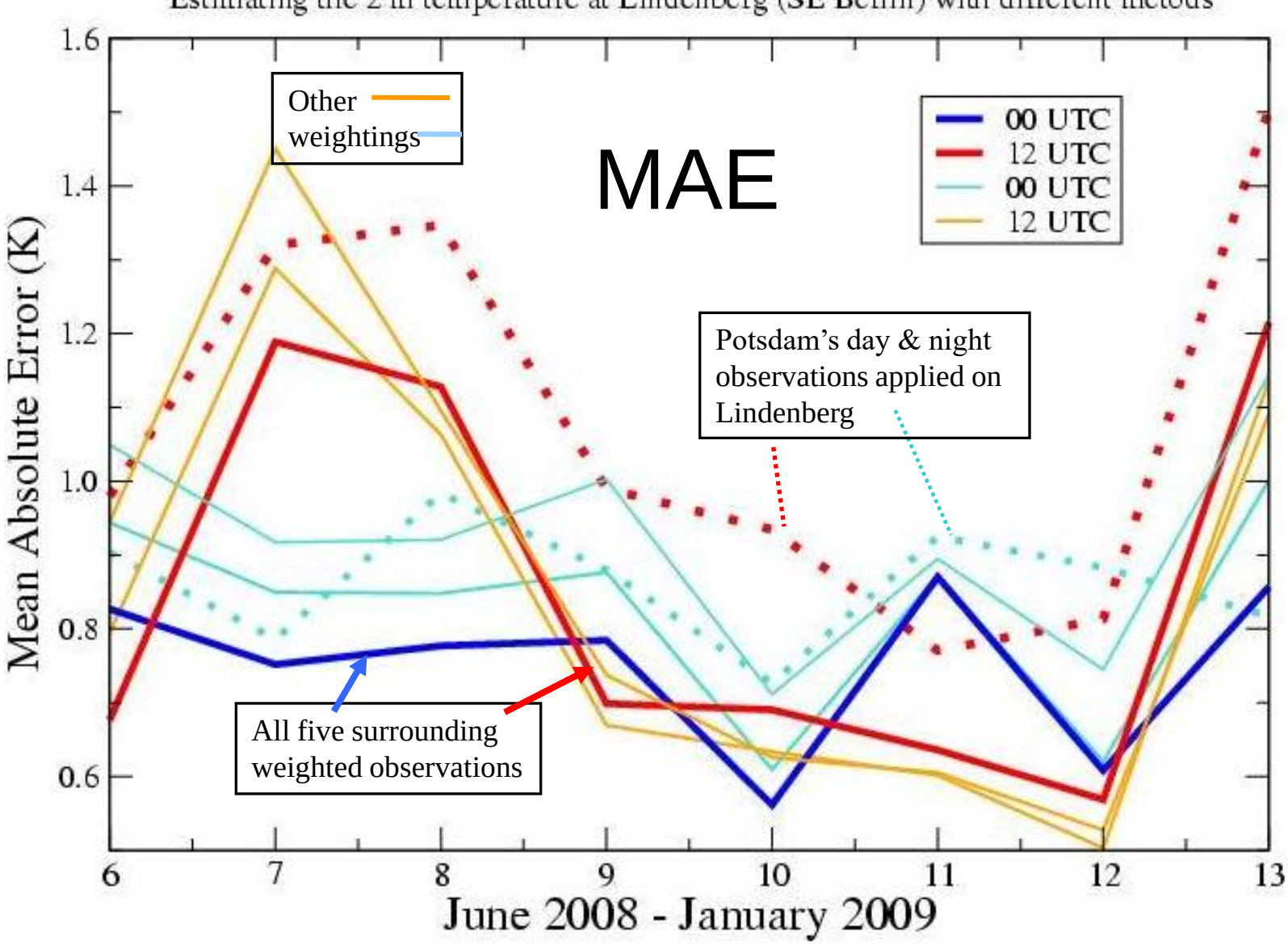
What is the lowest possible 2 m temperature forecast error?



What is the lowest possible 2 m temperature forecast error?



What is the lowest possible 2 m temperature forecast error?



Conclusions from this observation investigation:

1. During favourable conditions the lowest RMSE and SDE would be around 0.8ºK, for MAE 0.6ºK

2. During seasons when the temperature depends quite a lot on the clouds the values increase to around 2ºK resp. 1½ºK.

3. Verified against a specific site, the weighted area average (3) provided the best “forecast”, whereas the neighboring station observation method (1) provided the worst.

Conclusions for all kinds of forecasts beyond a few hours:

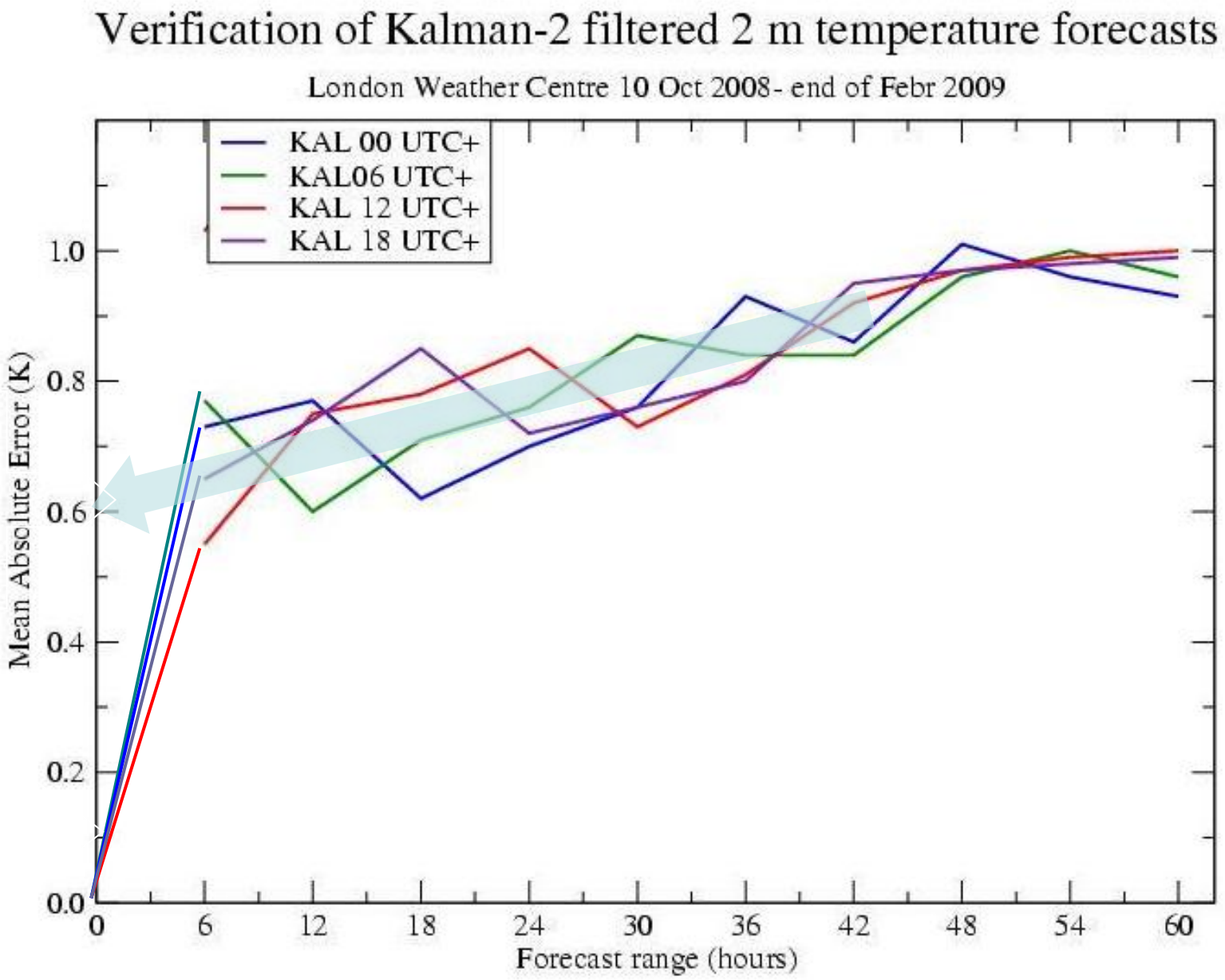
1. Due to micro-scale variability the 2 metre temperature is at present not possible to forecast with higher accuracy than 0.8ºK (RMSE,SDE) or 0.6ºK (MAE).

2. Provided homogenous environment an area average forecast, applied to a specific site, might be superior to a “site specific” .

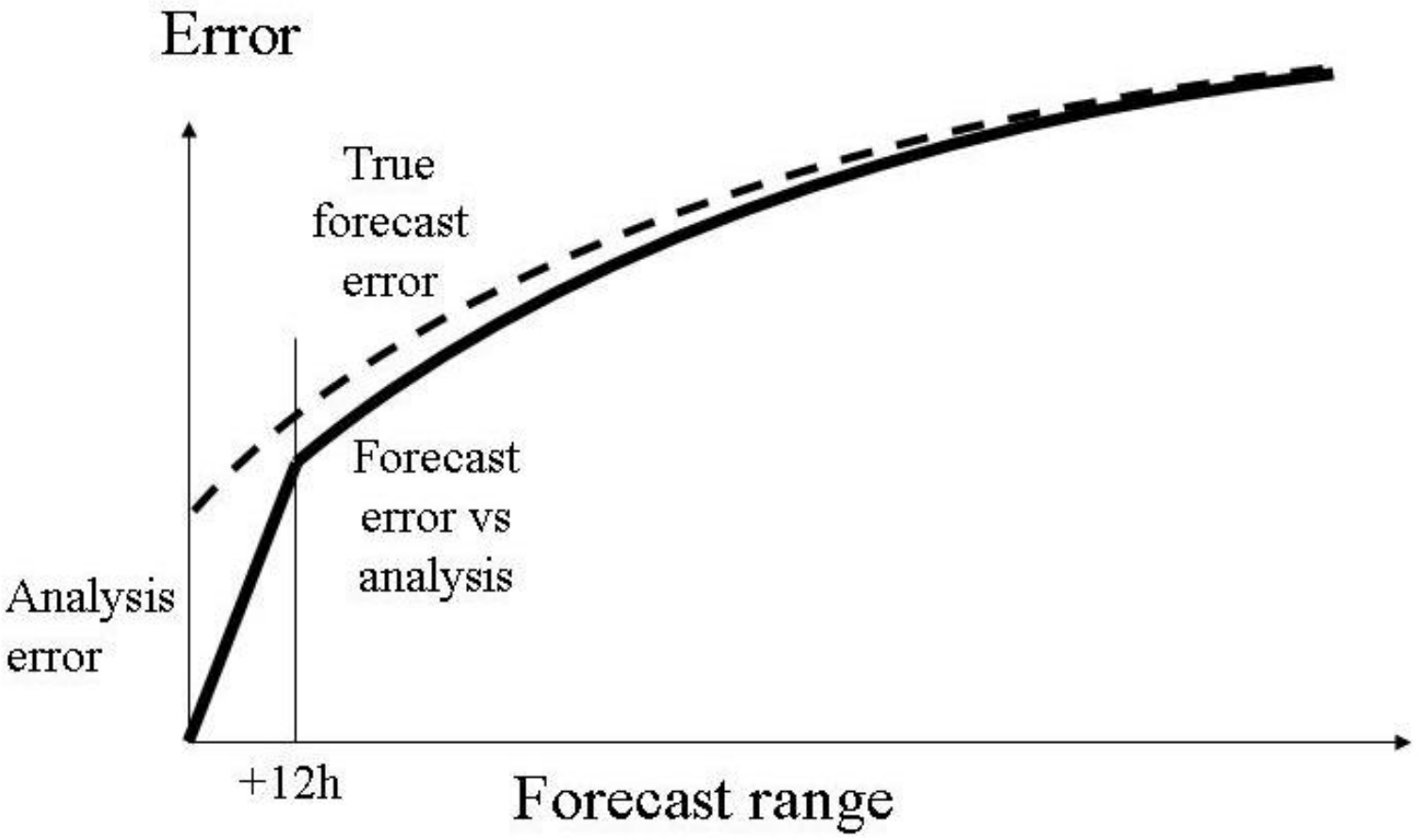
3. “Site specificness” only has meaning if the site is not representative to the area, if its climate is different to the area as a whole.

Rather 0.6°

Error=0 at t=0?



True and “false” error curves



Four types of errors:

Model errors

Systematic errors

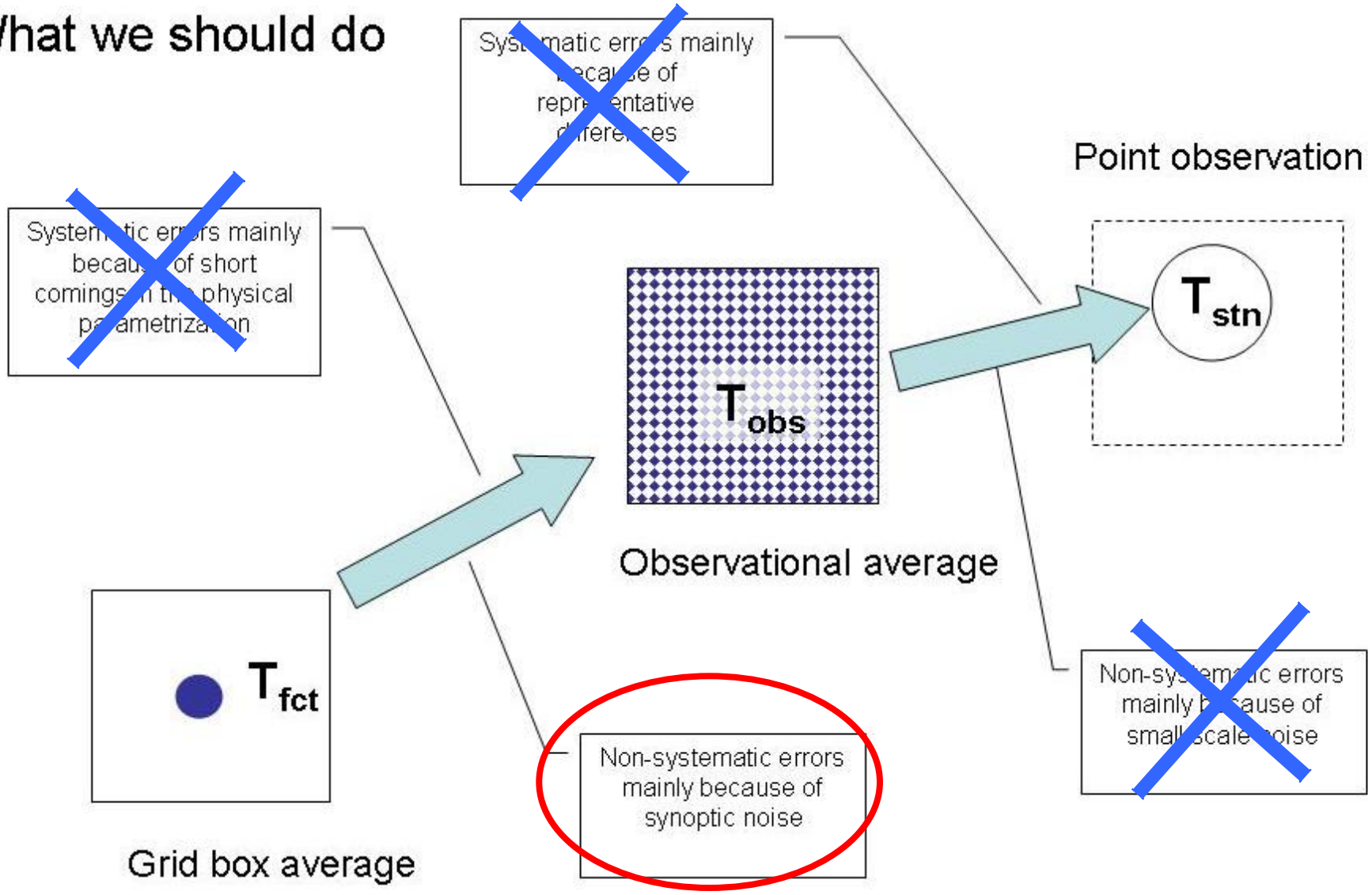
Representativeness

Synoptic errors

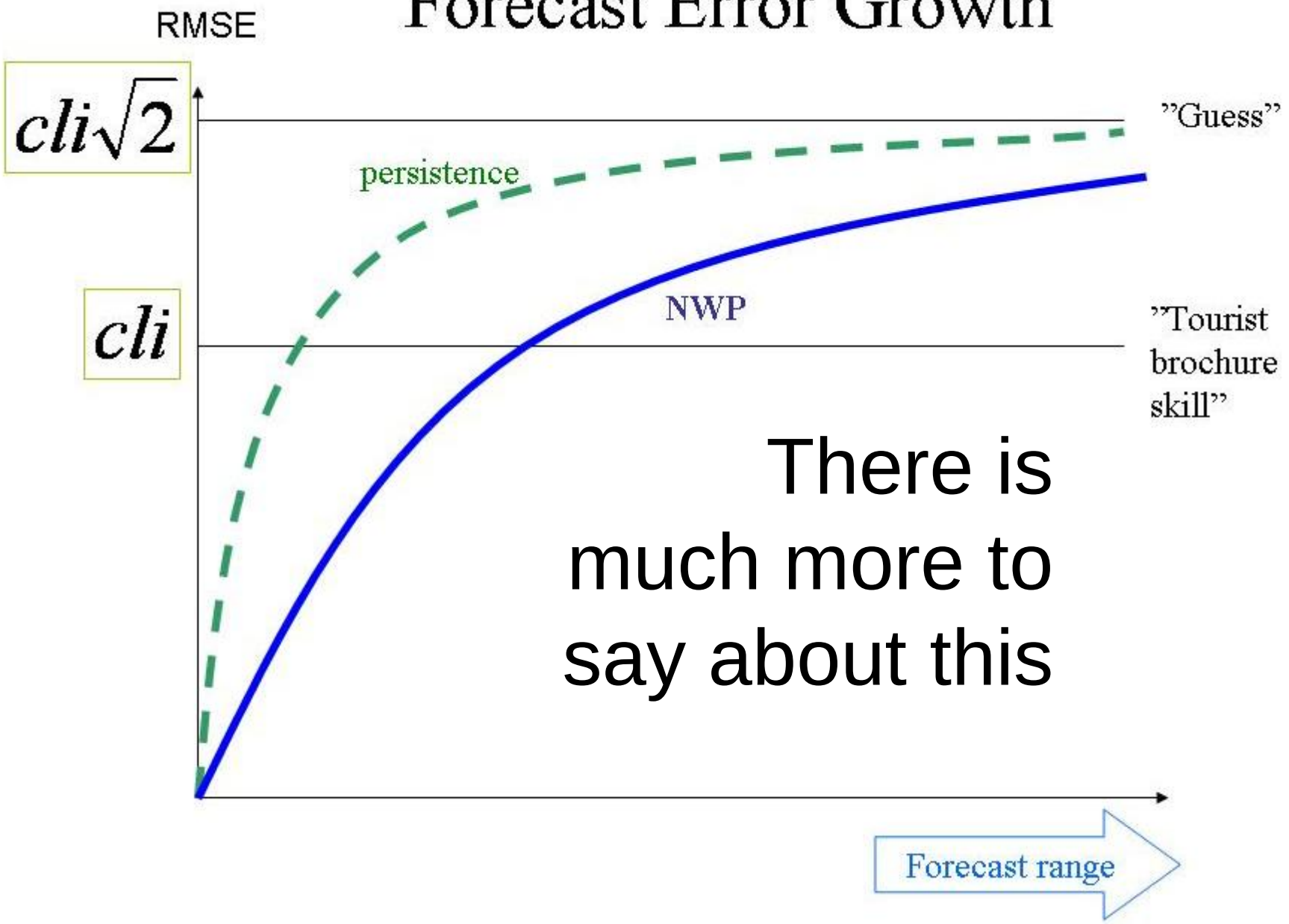
Non-systematic errors

Small scale “noise”

What we should do



Forecast Error Growth



There is much more to say about this

Four types of errors:

Model errors

Systematic errors

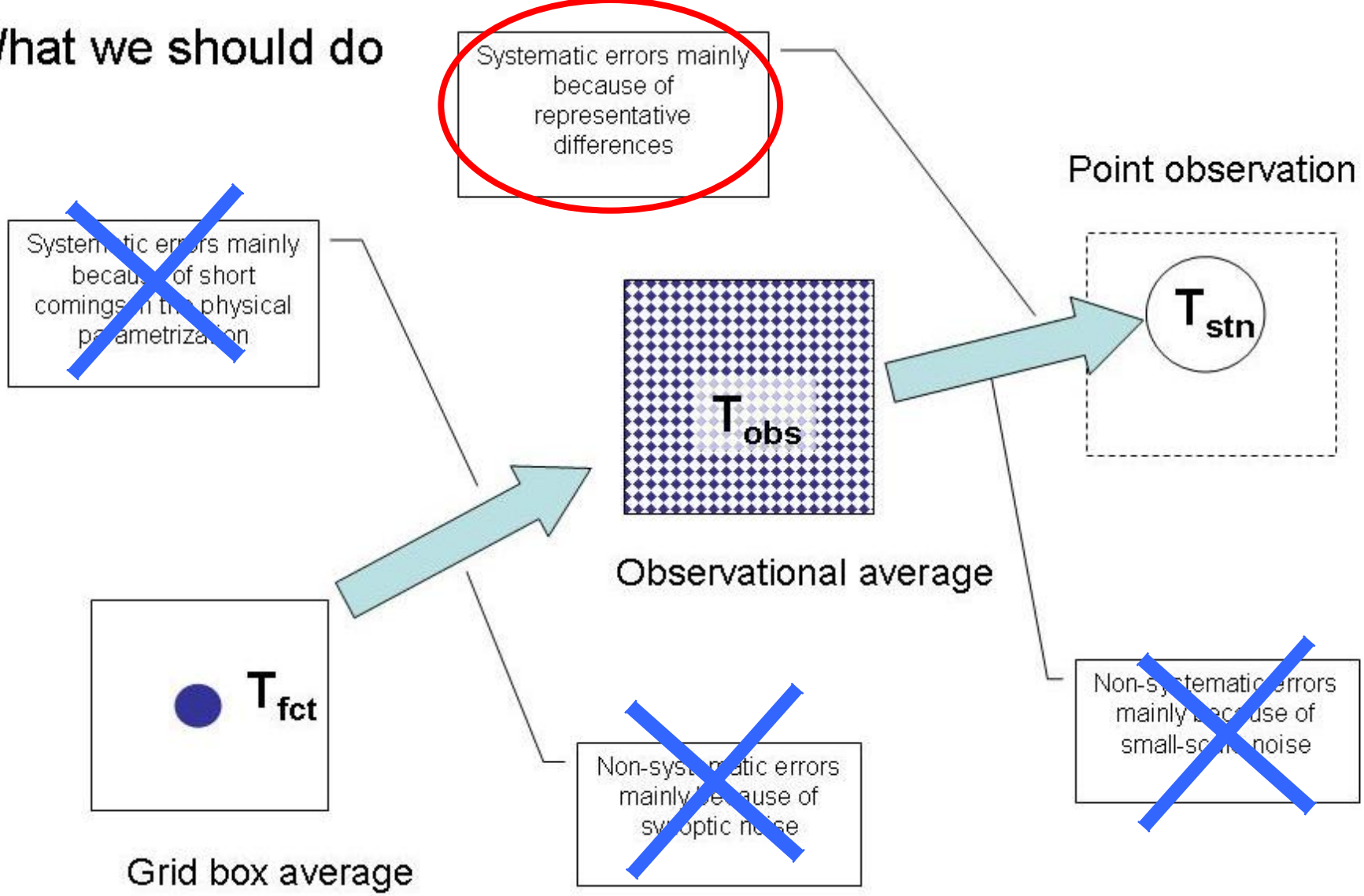
Representativeness

Synoptic errors

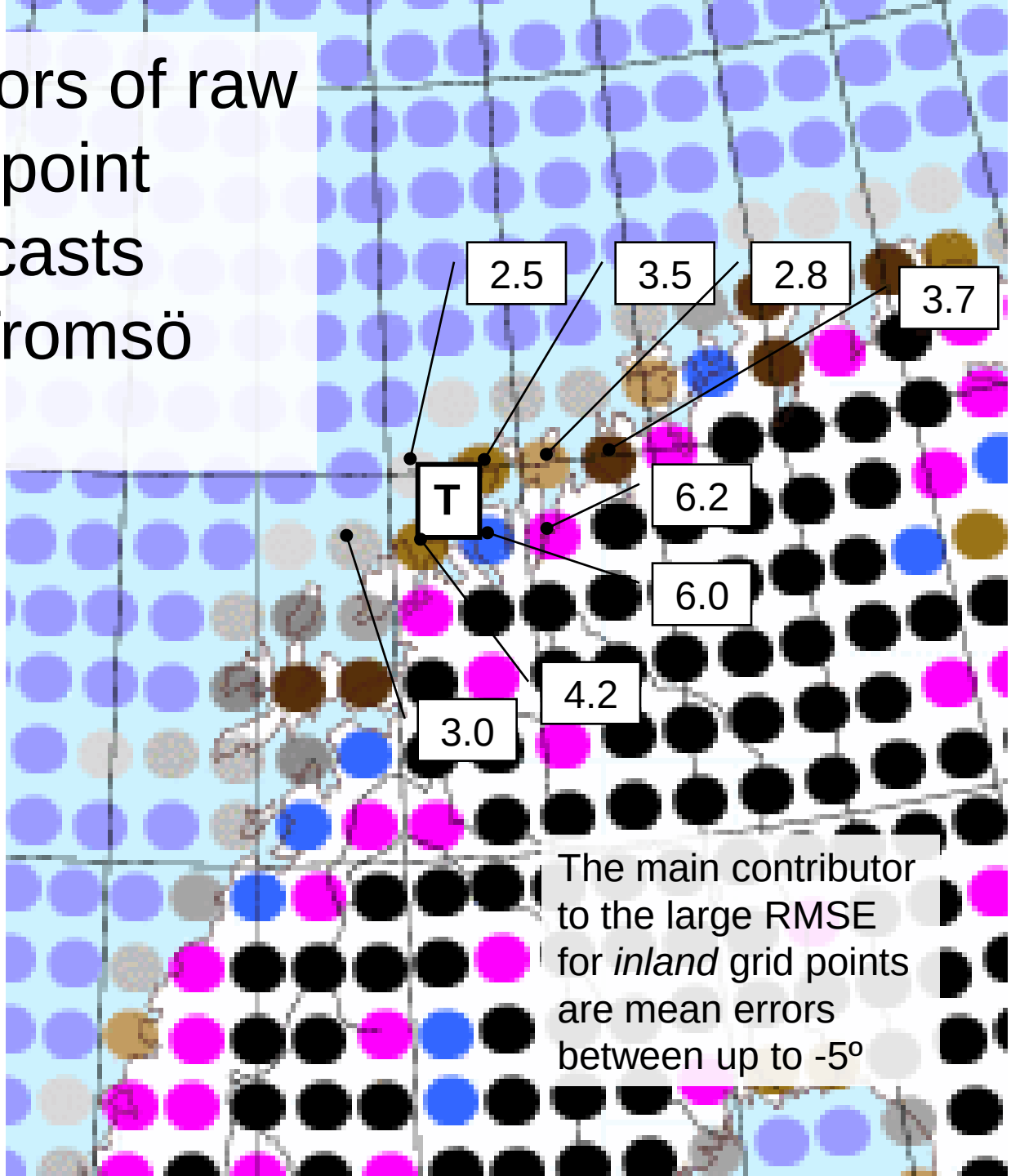
Non-systematic errors

Small scale “noise”

What we should do

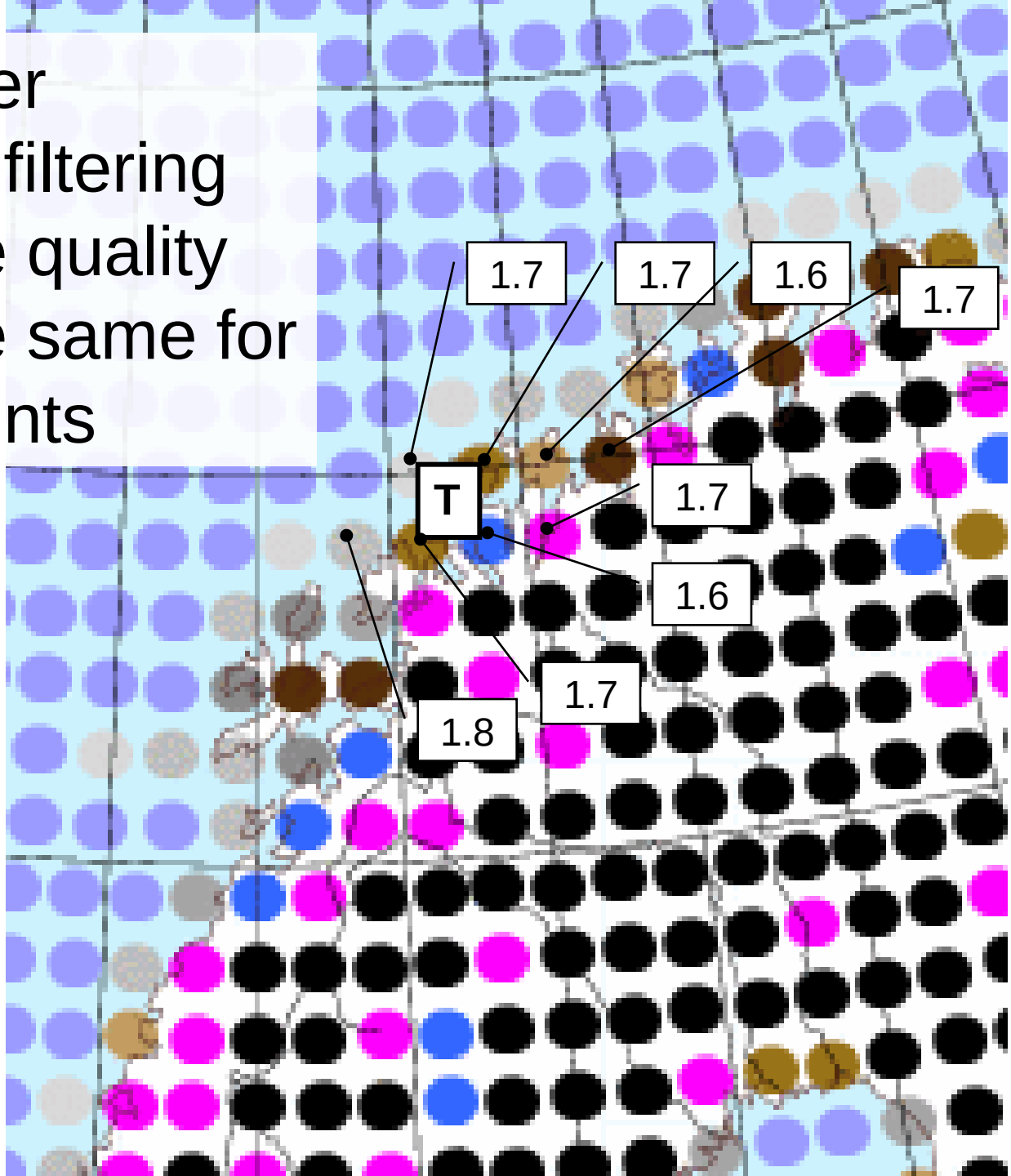


RMSE errors of raw T399 grid point +24h forecasts 2007 for Tromsö airport [**T**]



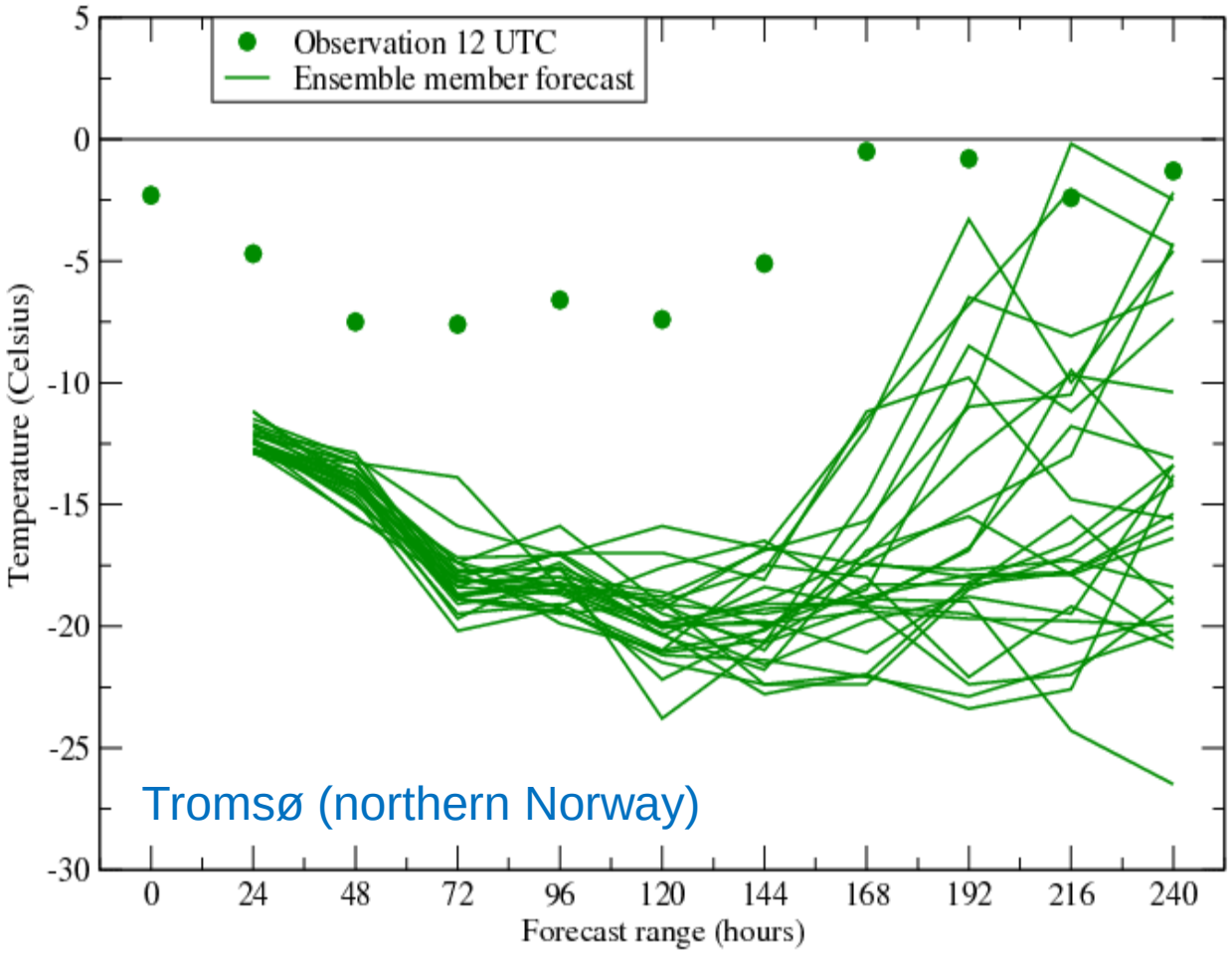
The main contributor to the large RMSE for *inland* grid points are mean errors between up to -5º

RMSE after Kalman-2 filtering makes the quality almost the same for all grid points

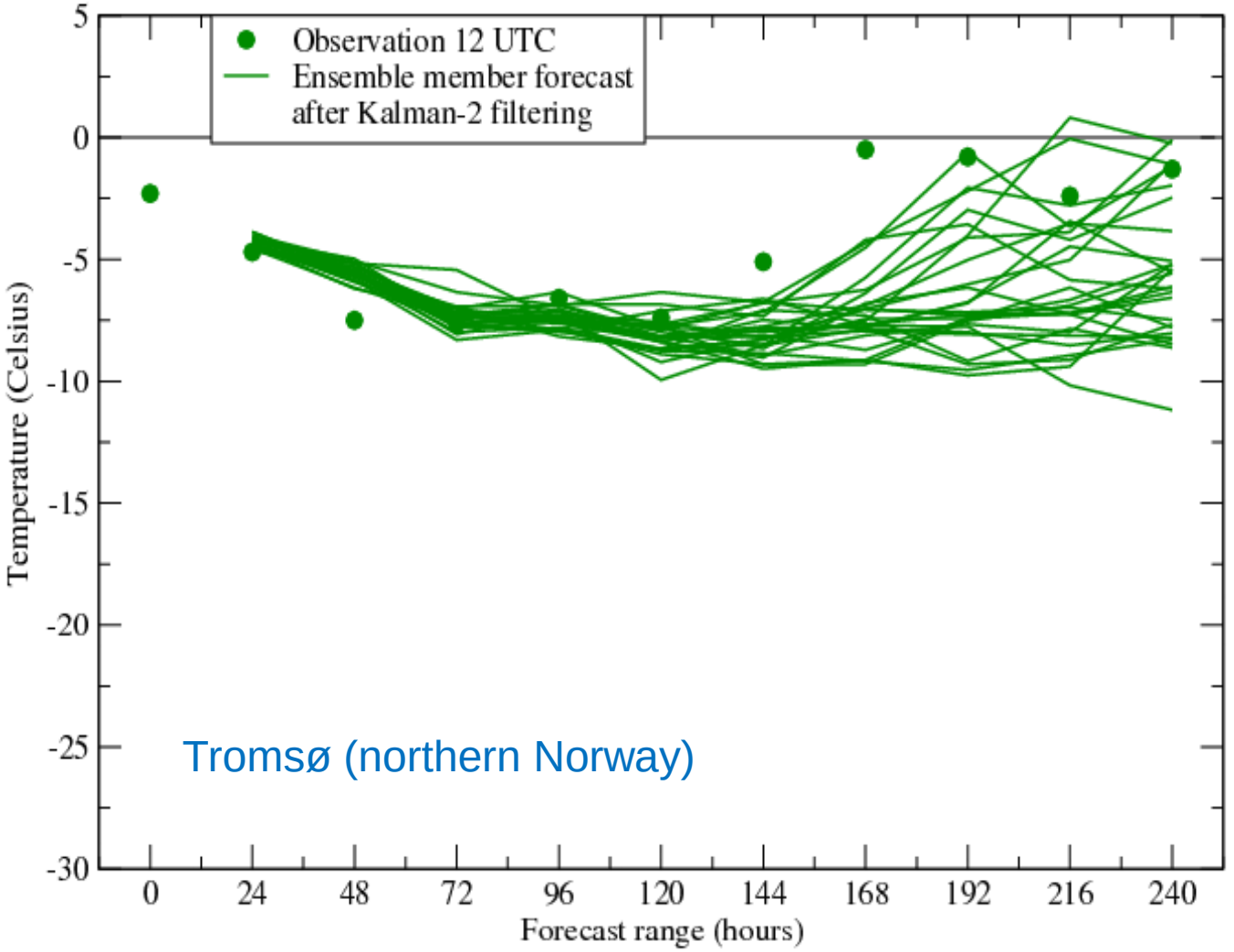


Statistical correction, calibration or interpretation:

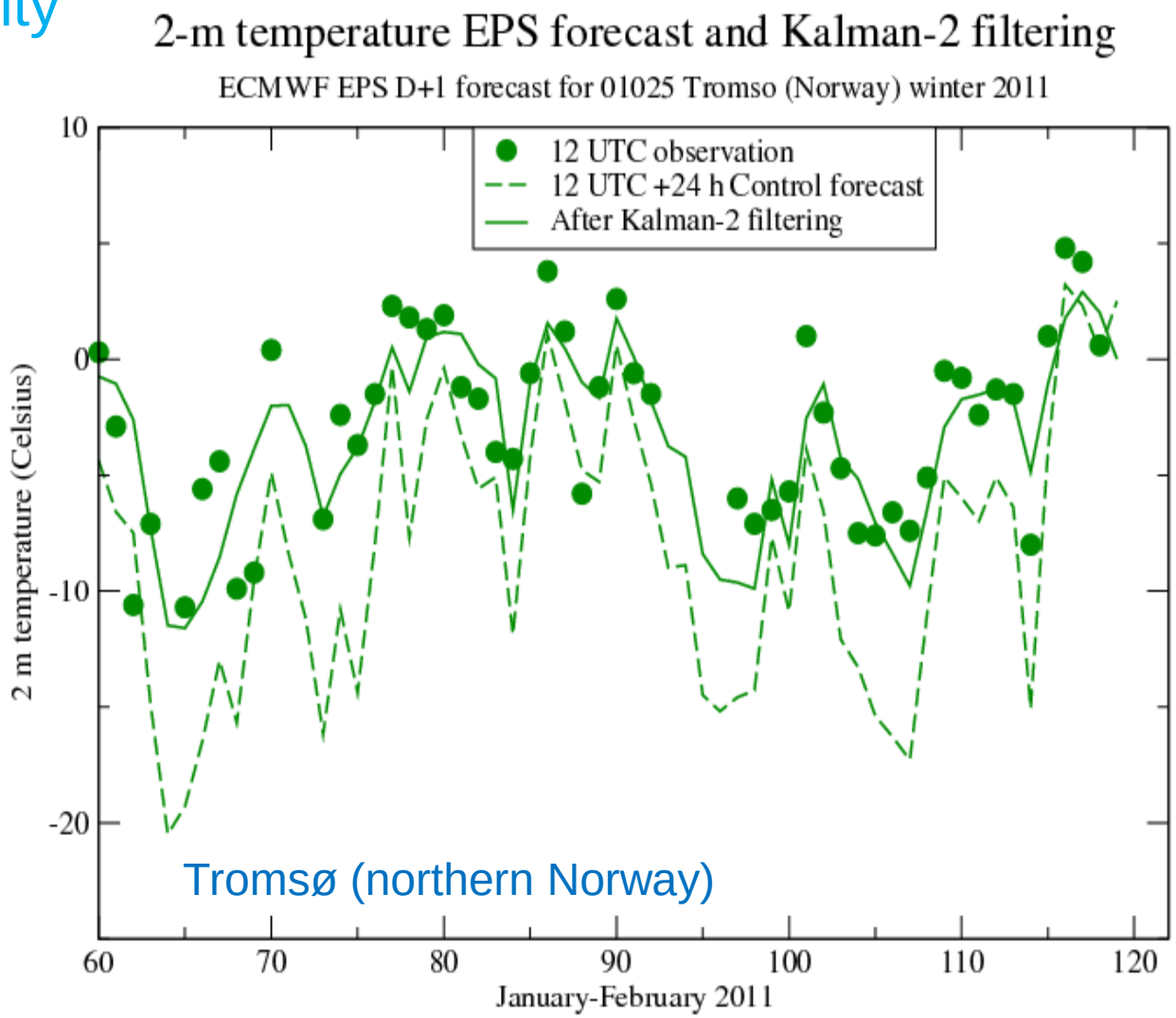
A heavily biased temperature forecast



The EPS plume after statistical correction



The forecast (- - - -) varies more than reality. The adaptive statistical filtering corrects for both mean error and over-variability



No simple, straight bias. The mean error depends on the forecast