

A strategy for the optimization of quality control checks available in the titanlib open library

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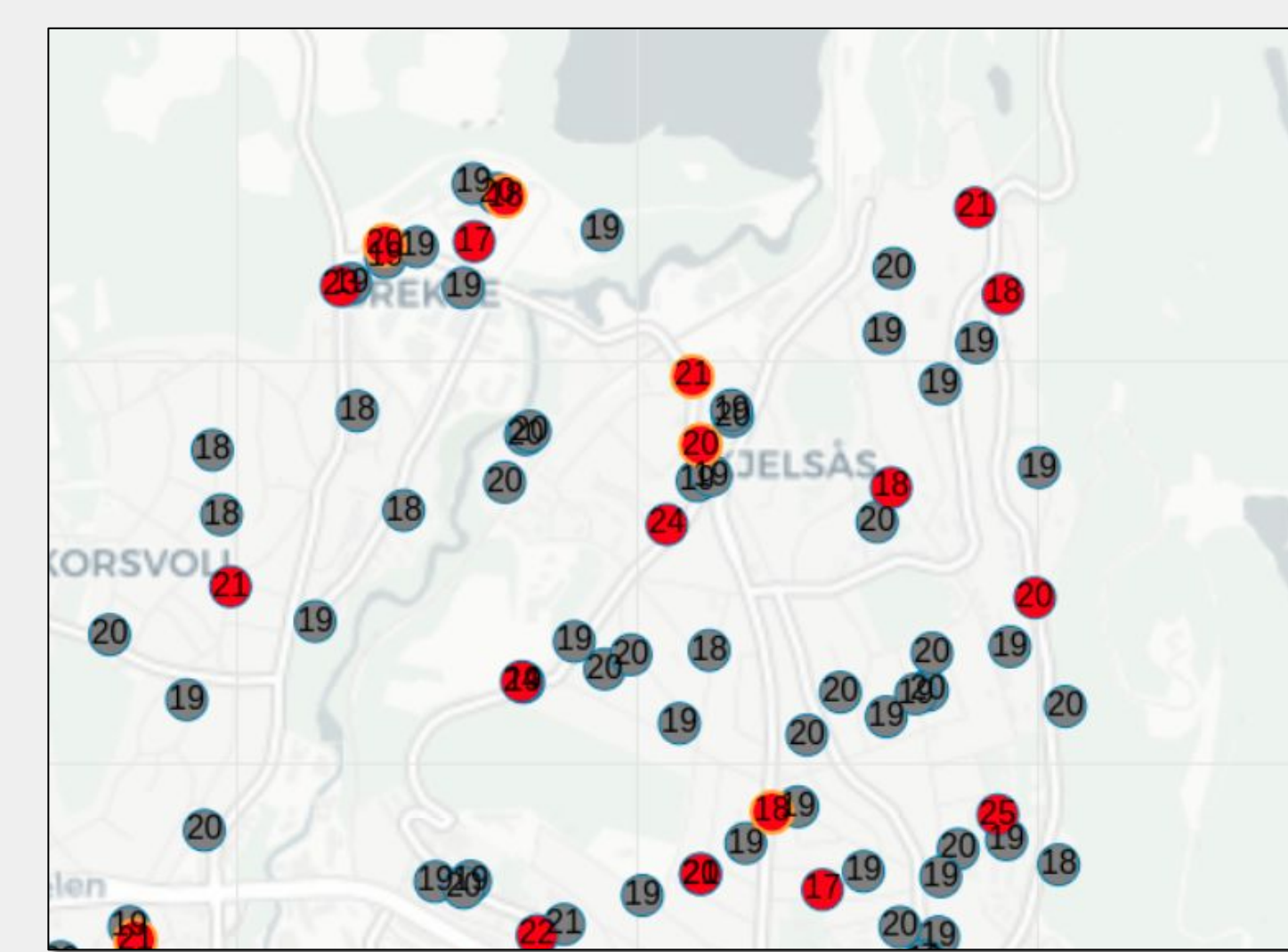
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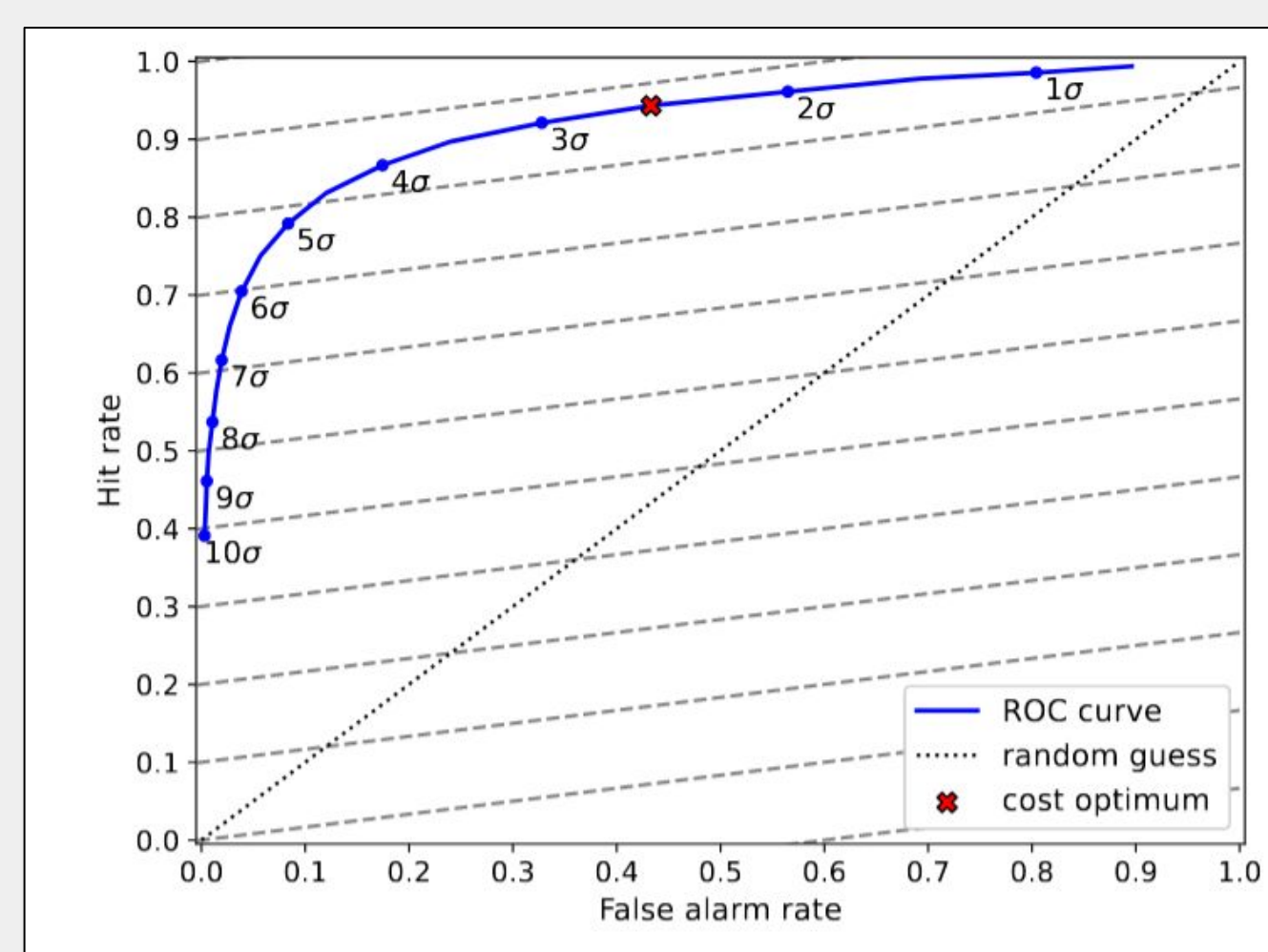
Introduction: *titanlib* is a library of functions for the automatic quality control of meteorological observations. Titanlib builds upon TITAN (Båserud et al., 2020) and it uses spatial quality control methods. The spatial methods compare each observation to what is expected given the other observations in the nearby area. If the deviation is large, the observation is removed.

Parameter Tuning: QC tests have many parameters that must be tuned. Two approaches:

1) Eyeballing



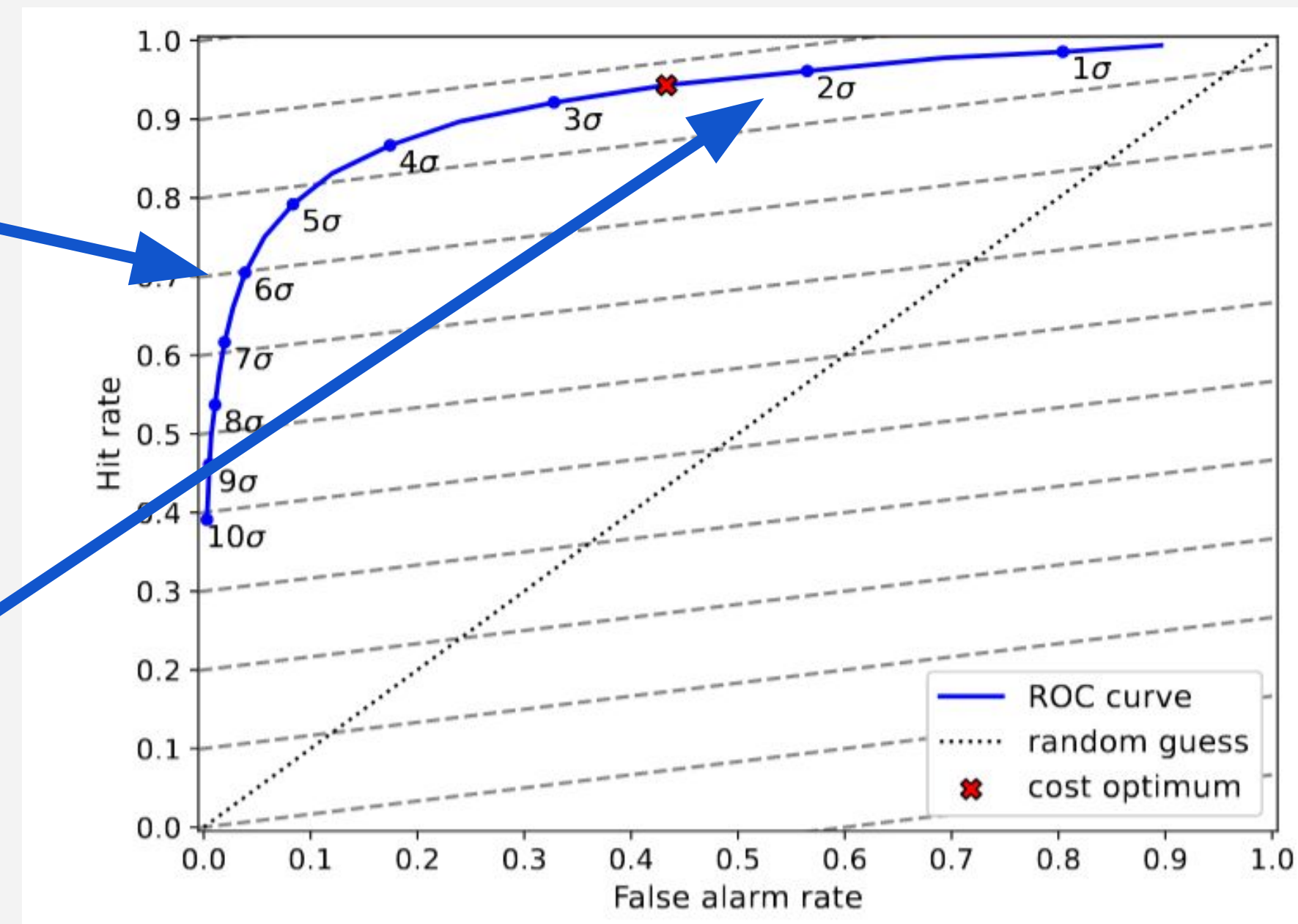
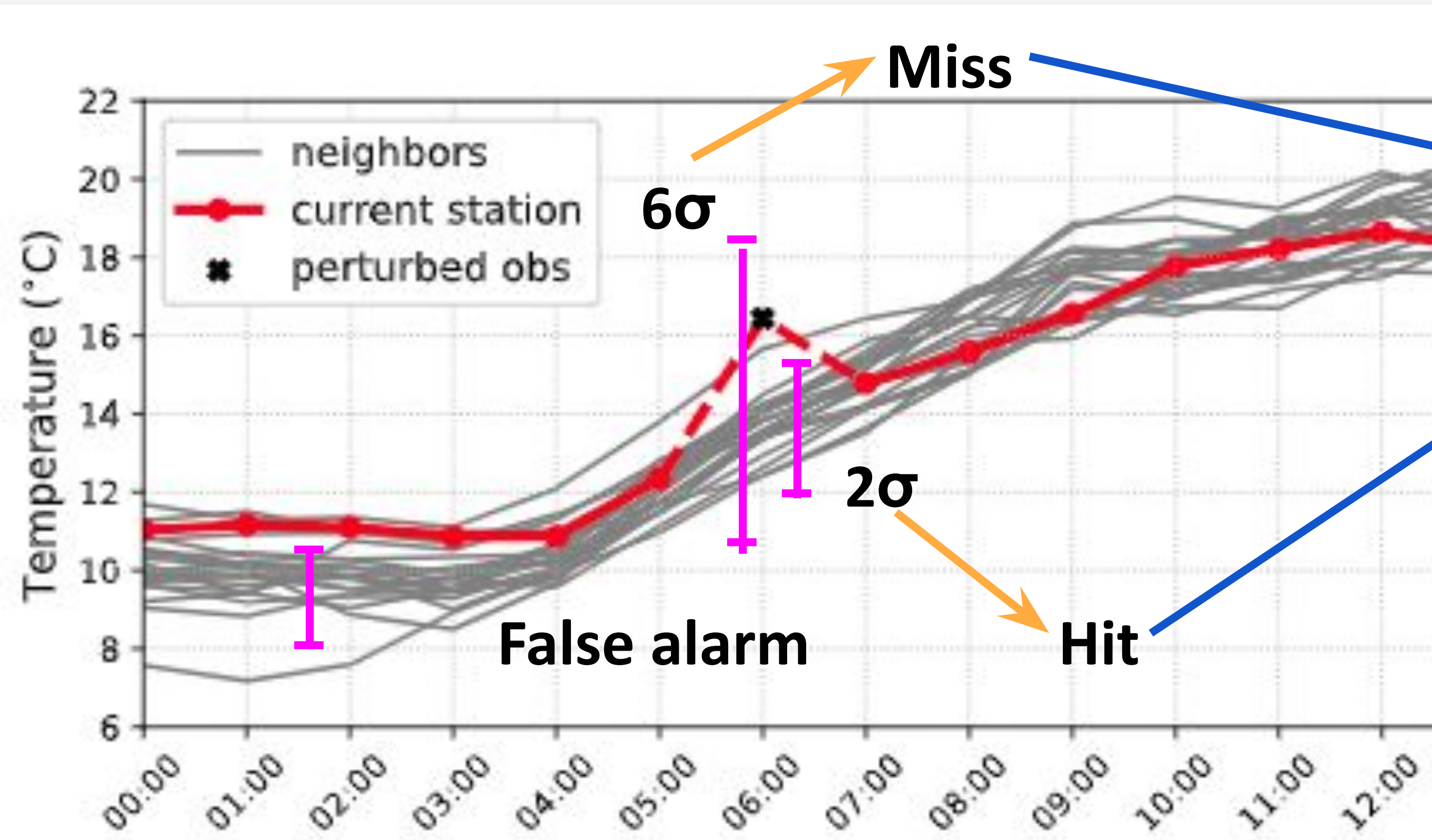
2) Scientific tuning: Optimization using a cost function (Alerskans et al. (2022), QC of hourly temperature measured from crowdsourced observations over Denmark).



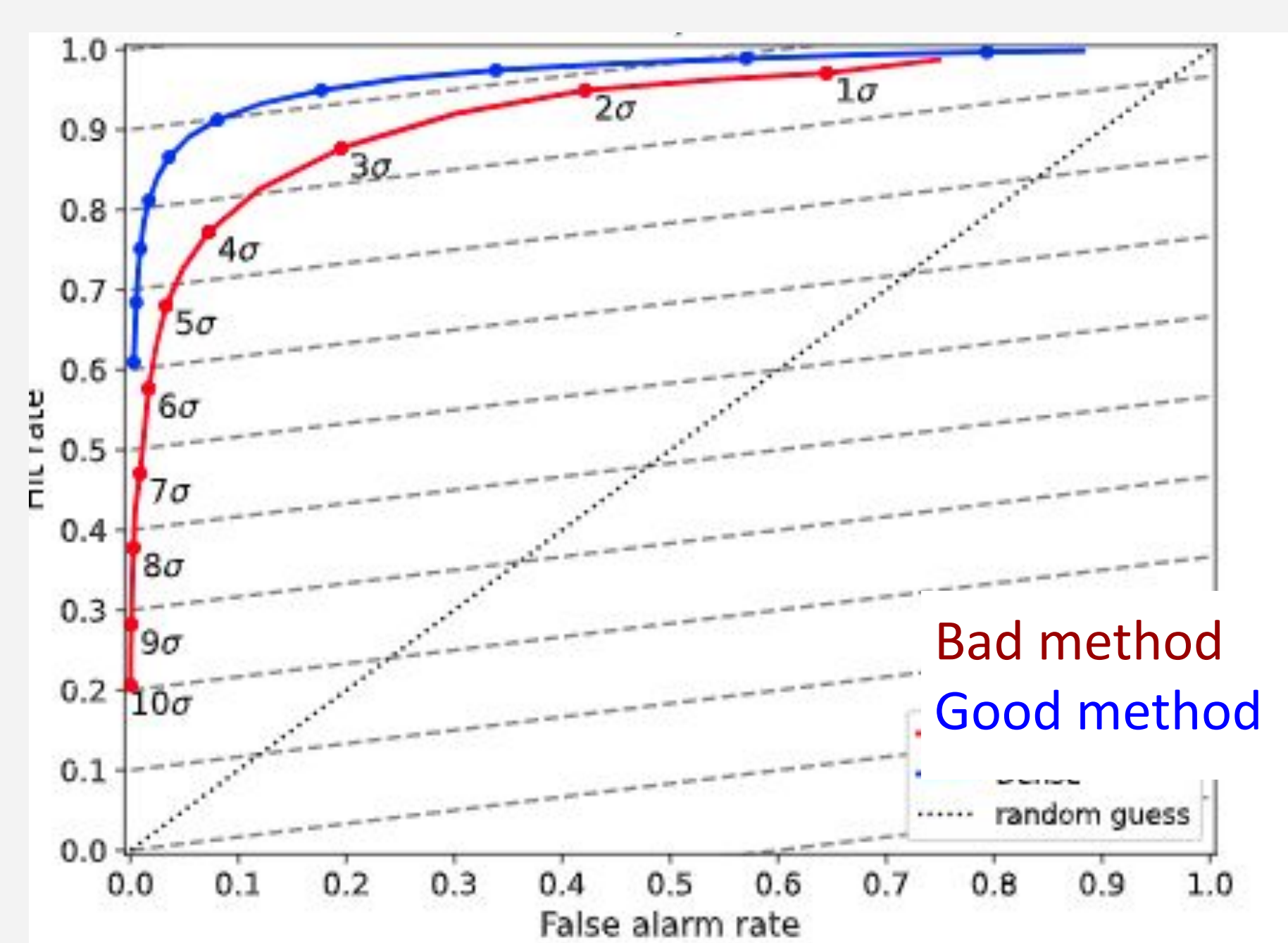
- Use a trusted data source (e.g. WMO network)
- Add “fake” errors (error seeding/perturbation)
- Compute hit, false alarm, miss, and correct rejection
- Define a cost function based on misses and false alarms
- Tune parameters to optimize the cost function
- Use a gradient descent algorithm to tune multiple interdependent parameters simultaneously

Error seeding Errors (e.g. +3°C) are added at known times

ROC curve Tradeoff between false alarms and misses



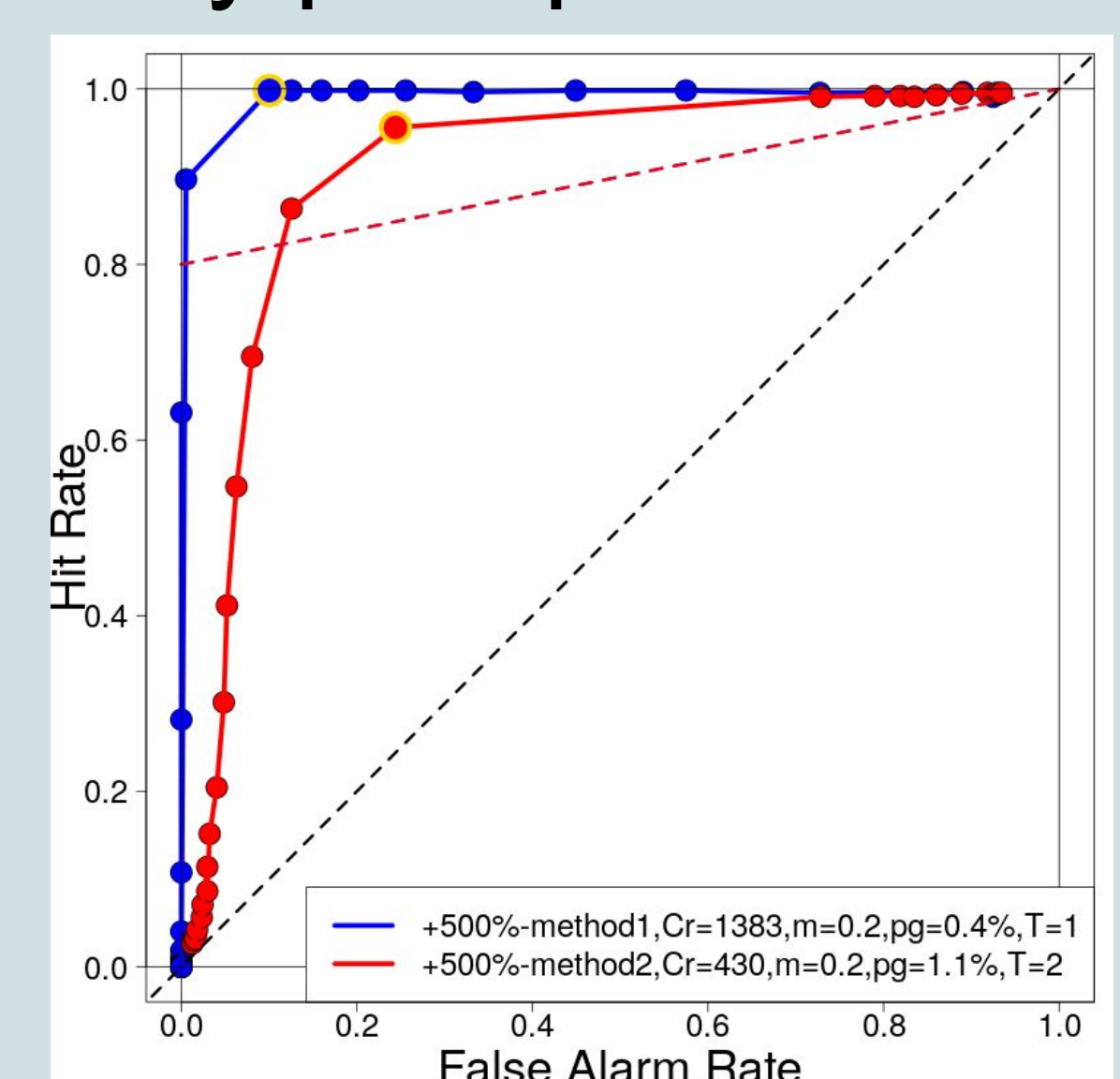
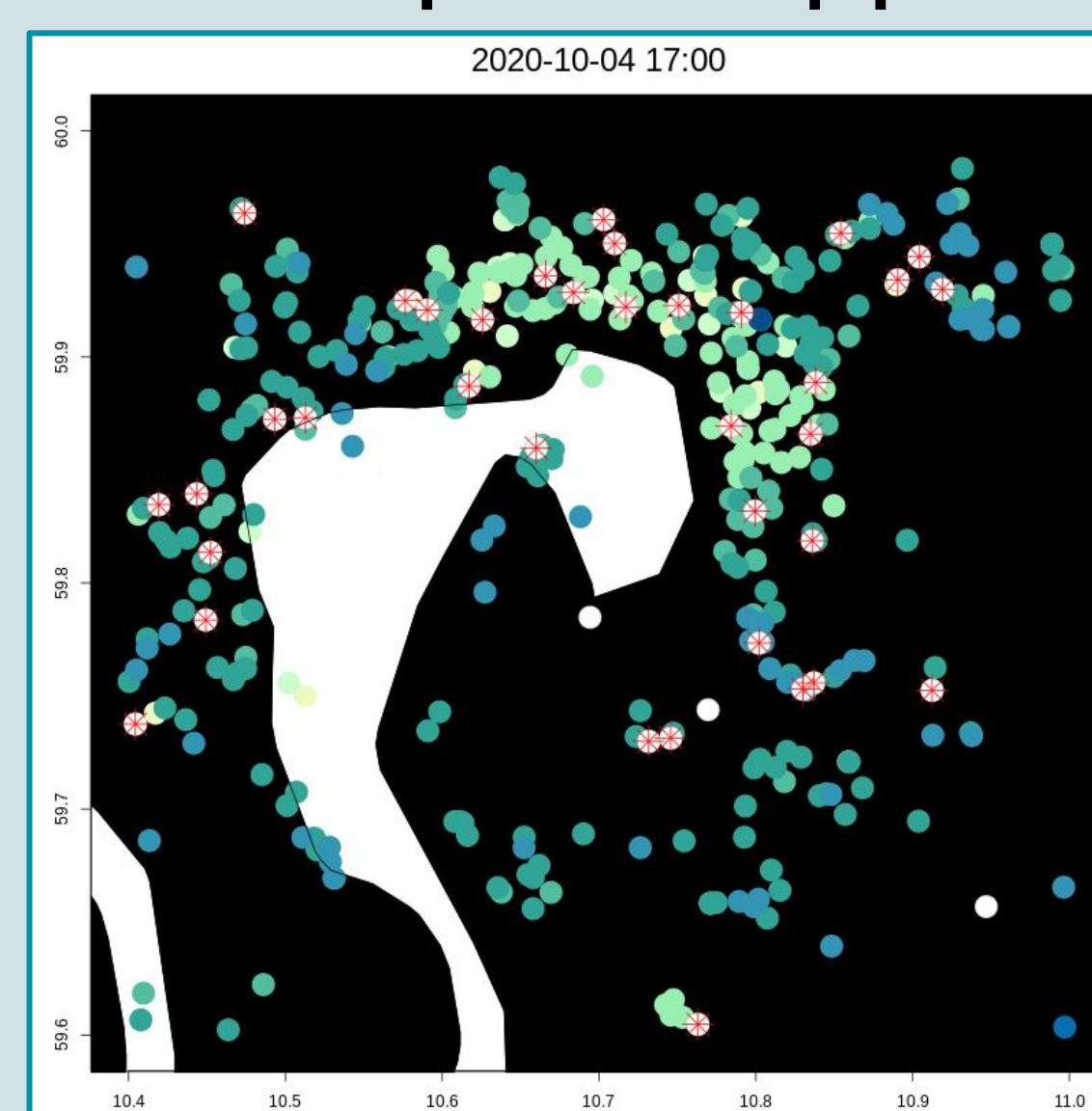
Figures. Perturbed observations can result in a hit (SCT flags the “fake” error) or a miss (SCT doesn’t flag) depending on the threshold used.



Comparing methods

Different methods have different abilities to detect errors. This approach can be used to determine the optimal ones.

Example of application on hourly precipitation



SCT applied on hourly precipitation data over the Oslo fjord. There are several gauges that are stuck to 0 mm. The strategy proposed allows us to evaluate the SCT performances with different thresholds and to select the best

Alerskans, E., Lussana, C., Nipen, T. N., Seierstad, I. A., (2022): **Optimizing spatial quality control for a dense network of meteorological stations**, Journal of Atmospheric and Oceanic Technology (JTECH)

Båserud, L., Lussana, C., Nipen, T. N., Seierstad, I. A., Oram, L., and Aspelien, T. (2020): **TITAN automatic spatial quality control of meteorological in-situ observations**, Adv. Sci. Res., 17, 153–163

The *titanlib* library is publicly available on github:
github.com/metno/titanlib

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