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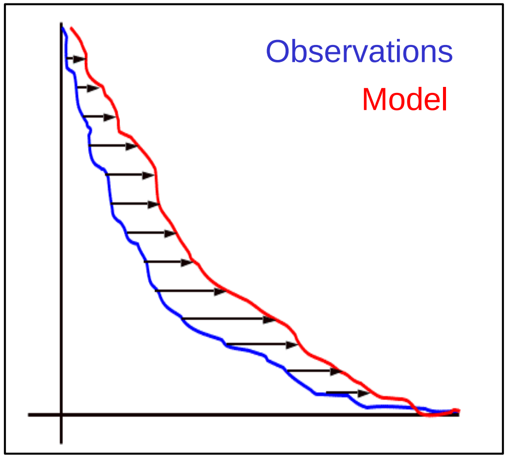
Quantile based point-to-point validations

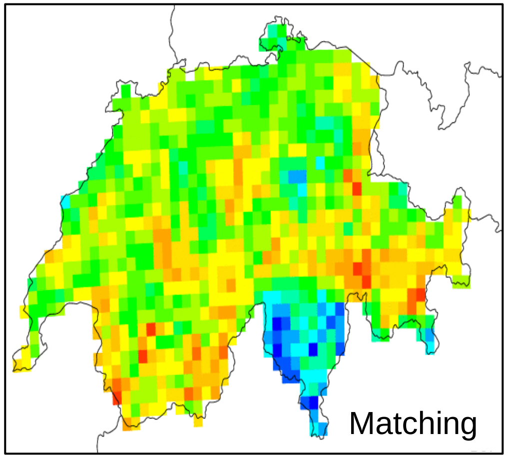
Pros and Cons of empirically bias corrected contingency tables



\+

hits	misses
false alarms	corr. neg.

=



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3rd International Verification Methods Workshop Reading UK 01/02/2007

Outline

- Motivation
- Methodology and Proceeding
- Present benefits and drawbacks
- Application to QPF in Switzerland
- Summary

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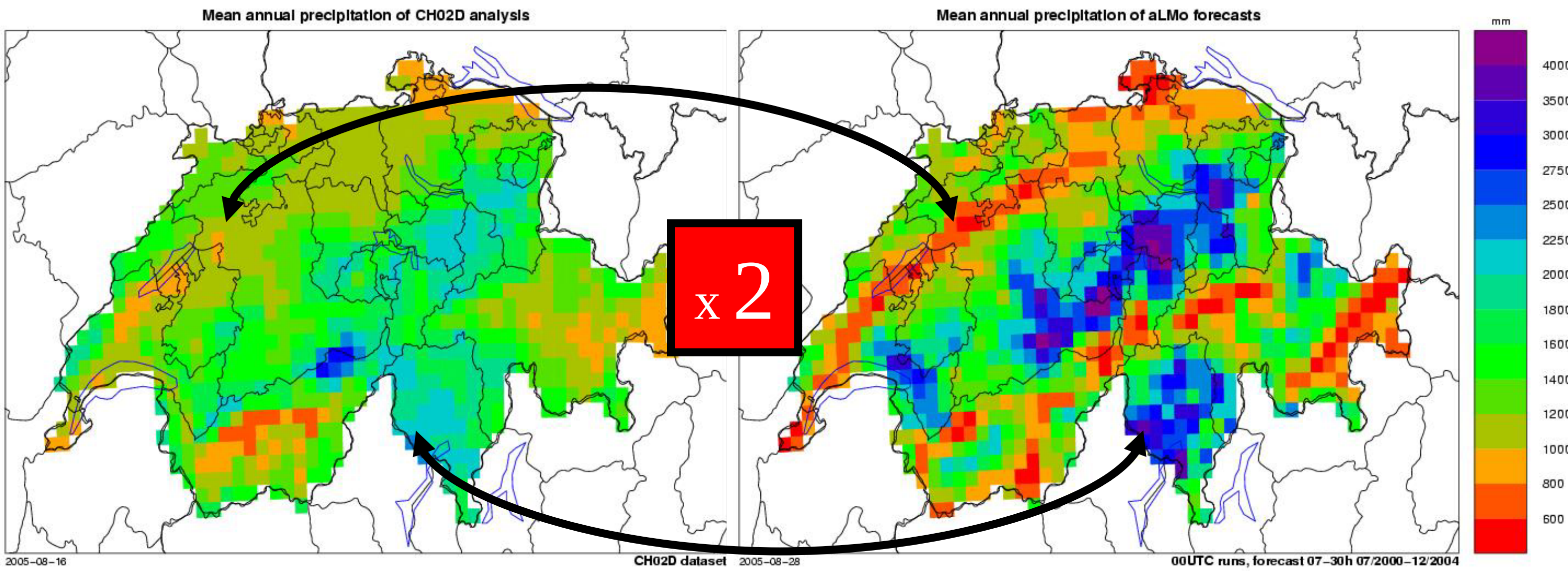
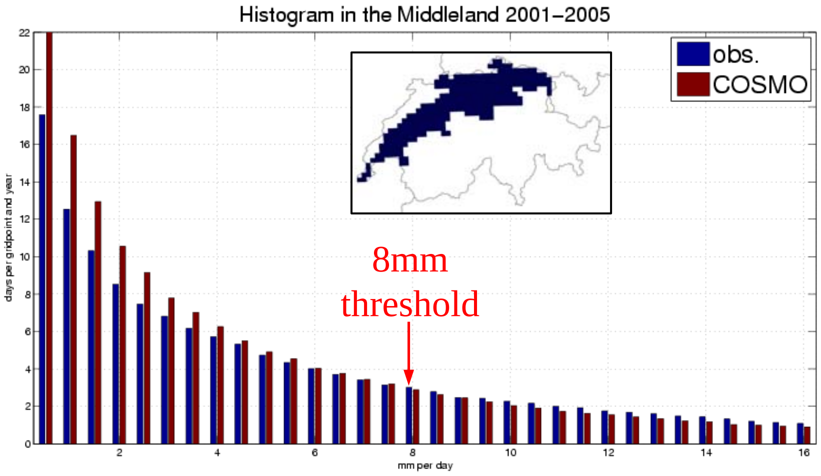
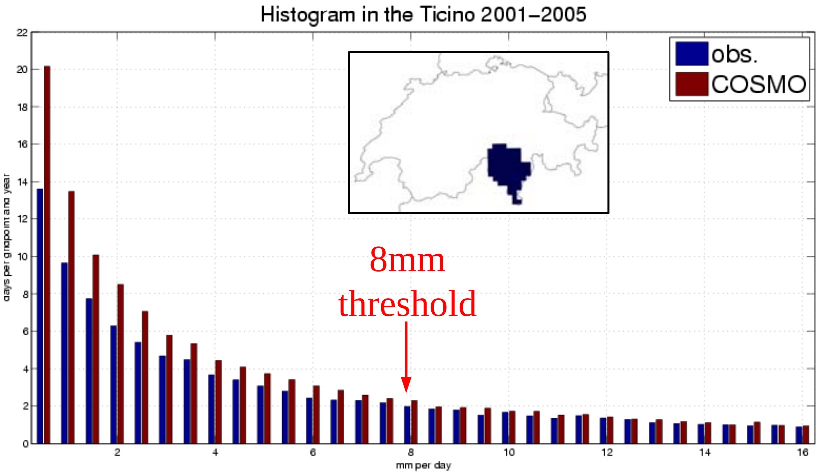
Motivation



Perfect matching possible at any gridpoint ?





Interpretation of (equitable) categorical scores ?

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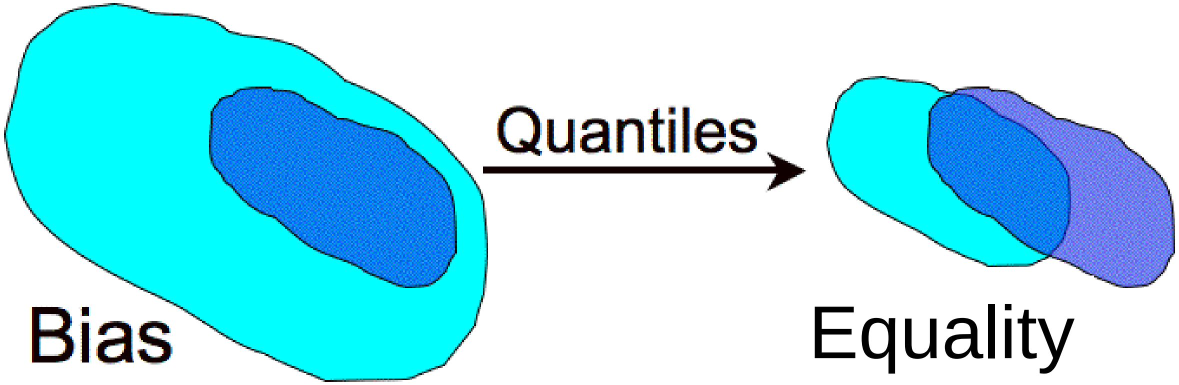
Methodology and Proceeding

1.) Computation of local precipitation quantiles
2.) Bias equal to quantile difference
3.) Advanced contingency table
4.) Determination of pattern overlap



	predicted yes	predicted no
observed yes	H	M
observed no	F	Z

$$M = F$$

$$Q = \frac{M+Z}{H+2M+Z} \rightarrow Z = \frac{Q}{1-Q}H + \frac{2Q-1}{1-Q}M$$

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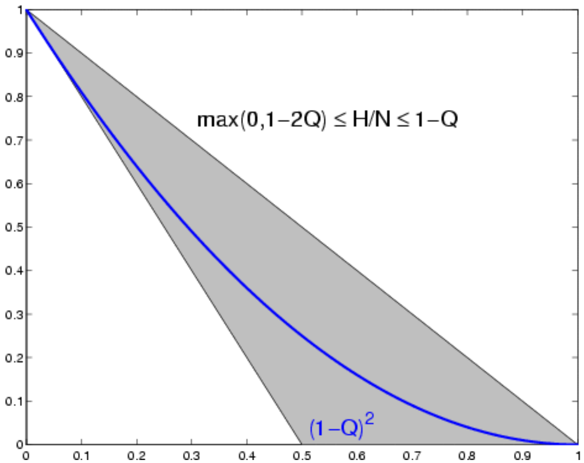
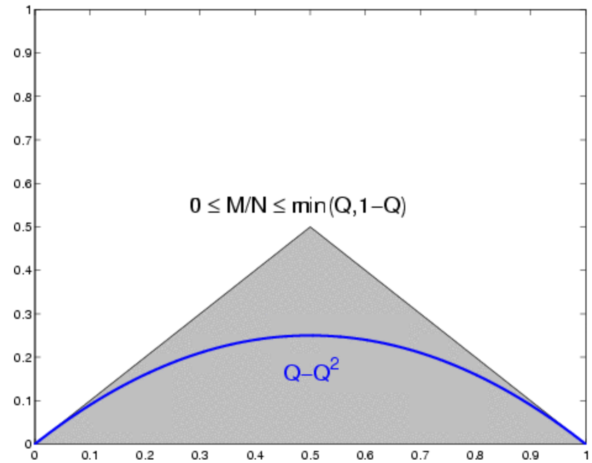
Methodology and Proceeding

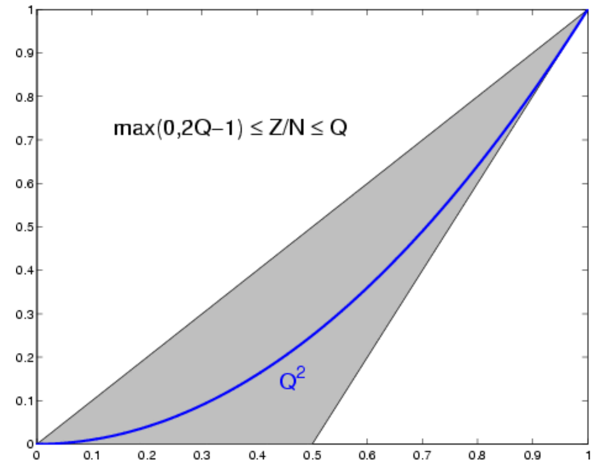
hits



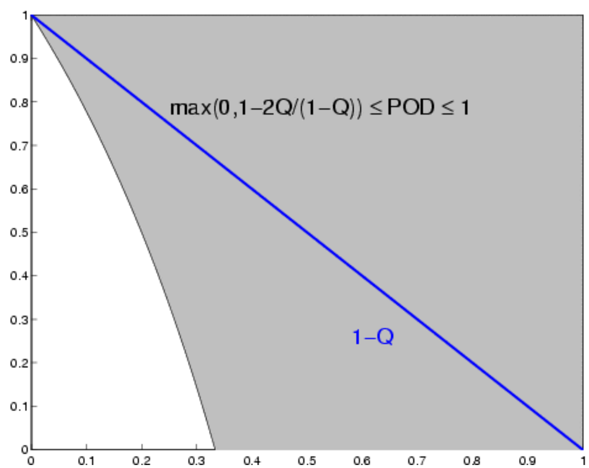
misses / false alarms



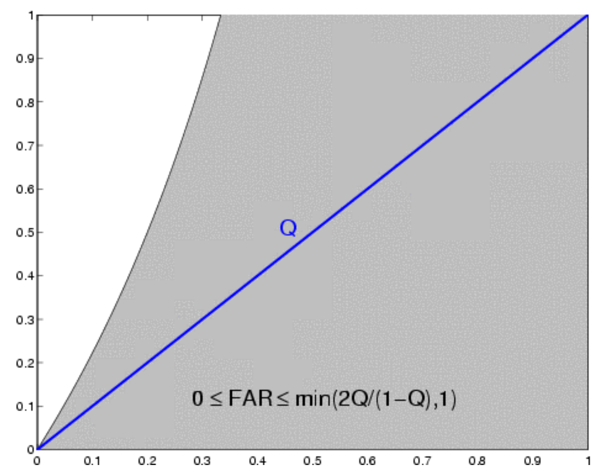
correct negatives



POD



FAR



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Methodology and Proceeding

Hanssen-Kuipers discriminant equal to Heidke skill score:

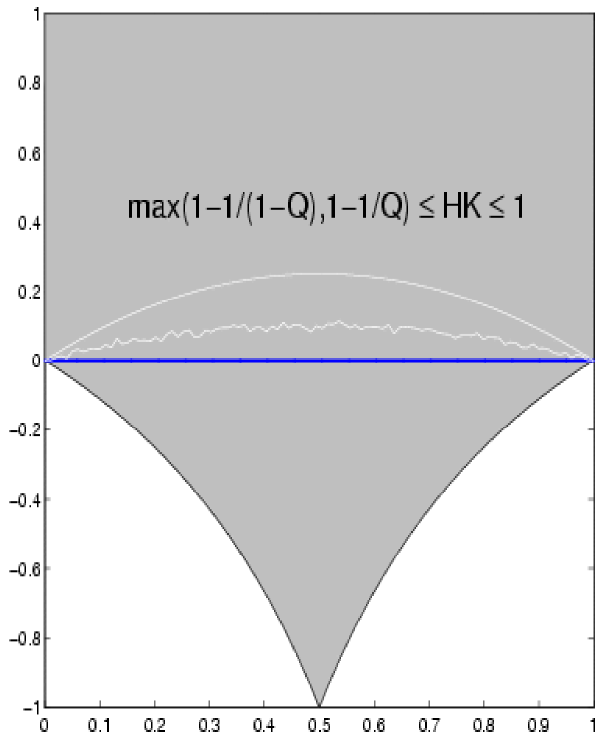
$$HK = \frac{H}{H+M} + \frac{Z}{Z+M} - 1$$
$$= 1 - \frac{M}{M_{rand}}$$

Binomial distribution of misses:

$$var(M) = \begin{cases} NQp(1-p) & Q \leq 0.5 \\ N(1-Q)p(1-p) & Q \geq 0.5 \end{cases}$$

Variance of HK proportional to 1/N:

$$var(HK) = \begin{cases} \frac{1}{N}\frac{p(1-p)}{Q(1-Q)^2} & Q \leq 0.5 \\ \frac{1}{N}\frac{p(1-p)}{Q^2(1-Q)} & Q \geq 0.5 \end{cases}$$



→ multiple uncertainty for extreme quantiles!!!

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Present benefits and drawbacks

+ fair comparisons possible
+ useful information about model behaviour (**model developers**)
+ only misses are counted
+ accuracy limit can be implemented (pixels with a negligible absolute difference are omitted)

- definition of quantiles: samples with non-rain data not easy to handle / cut-off for low intensities necessary
- quantiles less intuitive than fixed thresholds (**end-users**)
- extreme quantiles ($Q < 0.05$ and $Q > 0.95$) suffer from small sample sizes

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Application to QPF in Switzerland

Comparison of daily precipitation sums:

1.) Observational analysis (provided by Christoph Frei)

- based on ~ 450 pluviometers
- gridded in connection with a monthly climatology

2.) Operational forecasts of the COSMO model (provided by MeteoSwiss)

- nonhydrostatic and fully elastic dynamics
- 7km grid spacing

→ period of 2001 - 2005

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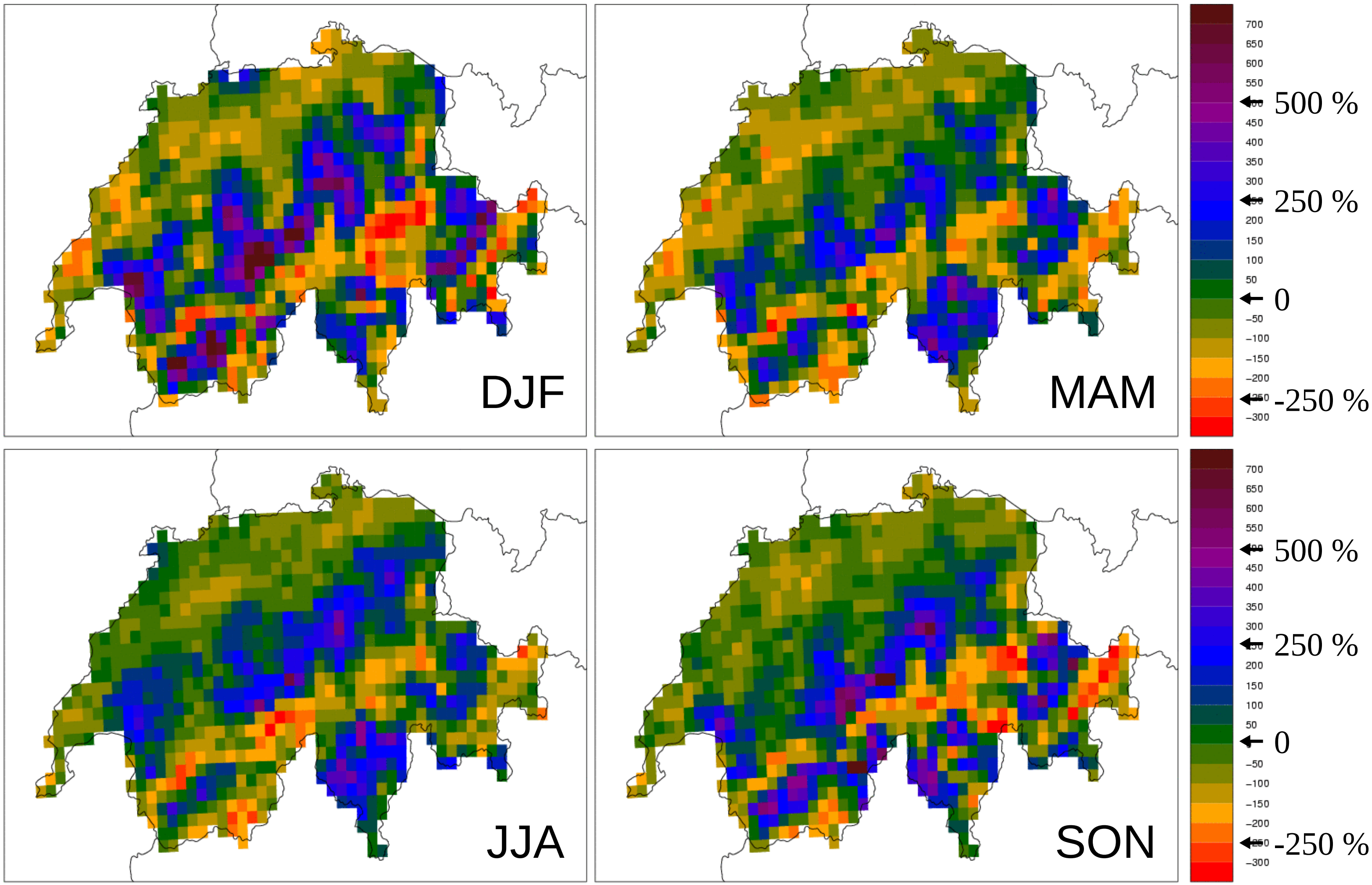
Application to QPF in Switzerland



Relative quantile difference ($Q90_{COSMO}$ - $Q90_{obs.}$) / $Median_{obs.}$

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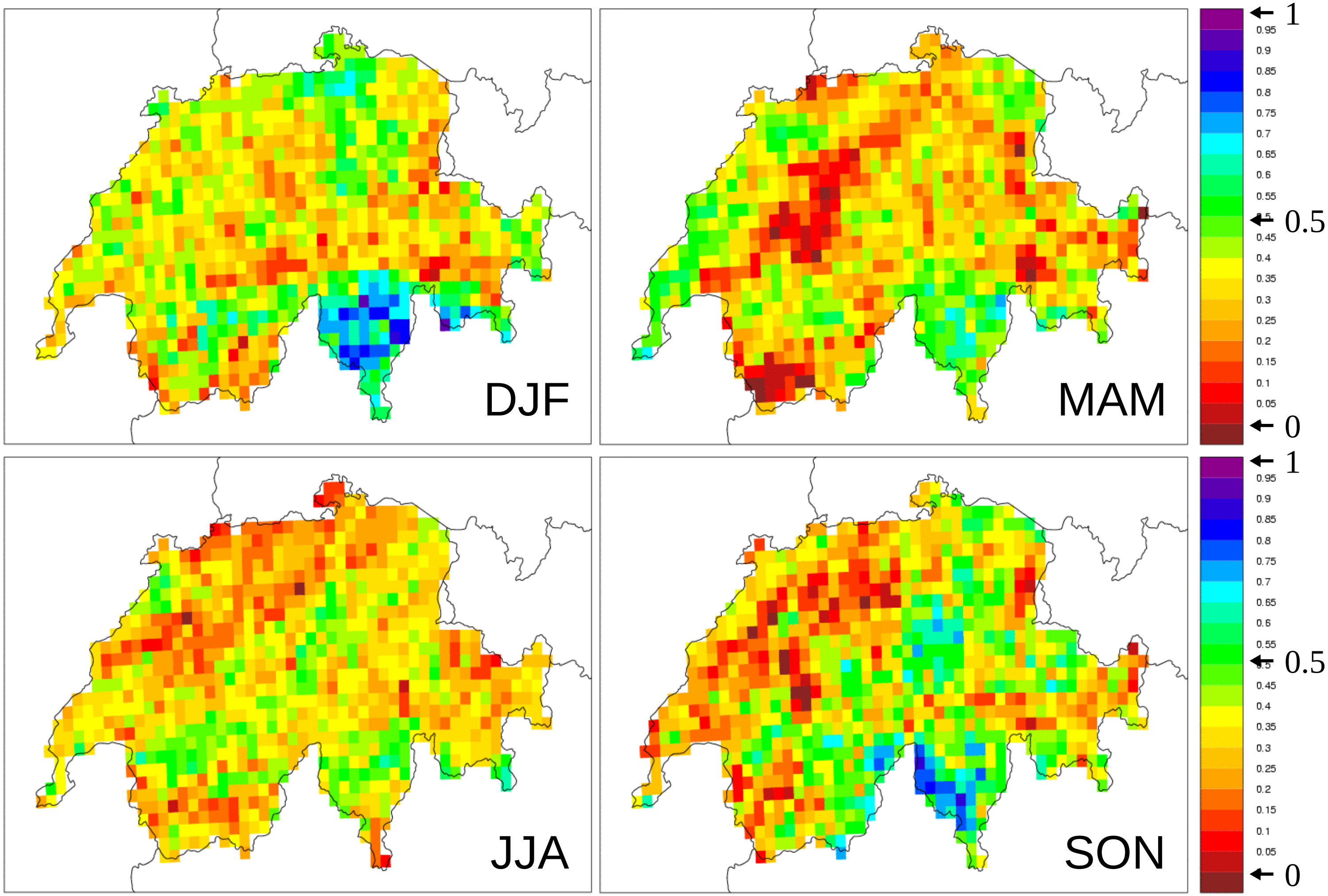
Application to QPF in Switzerland



Hanssen-Kuipers score for 90%

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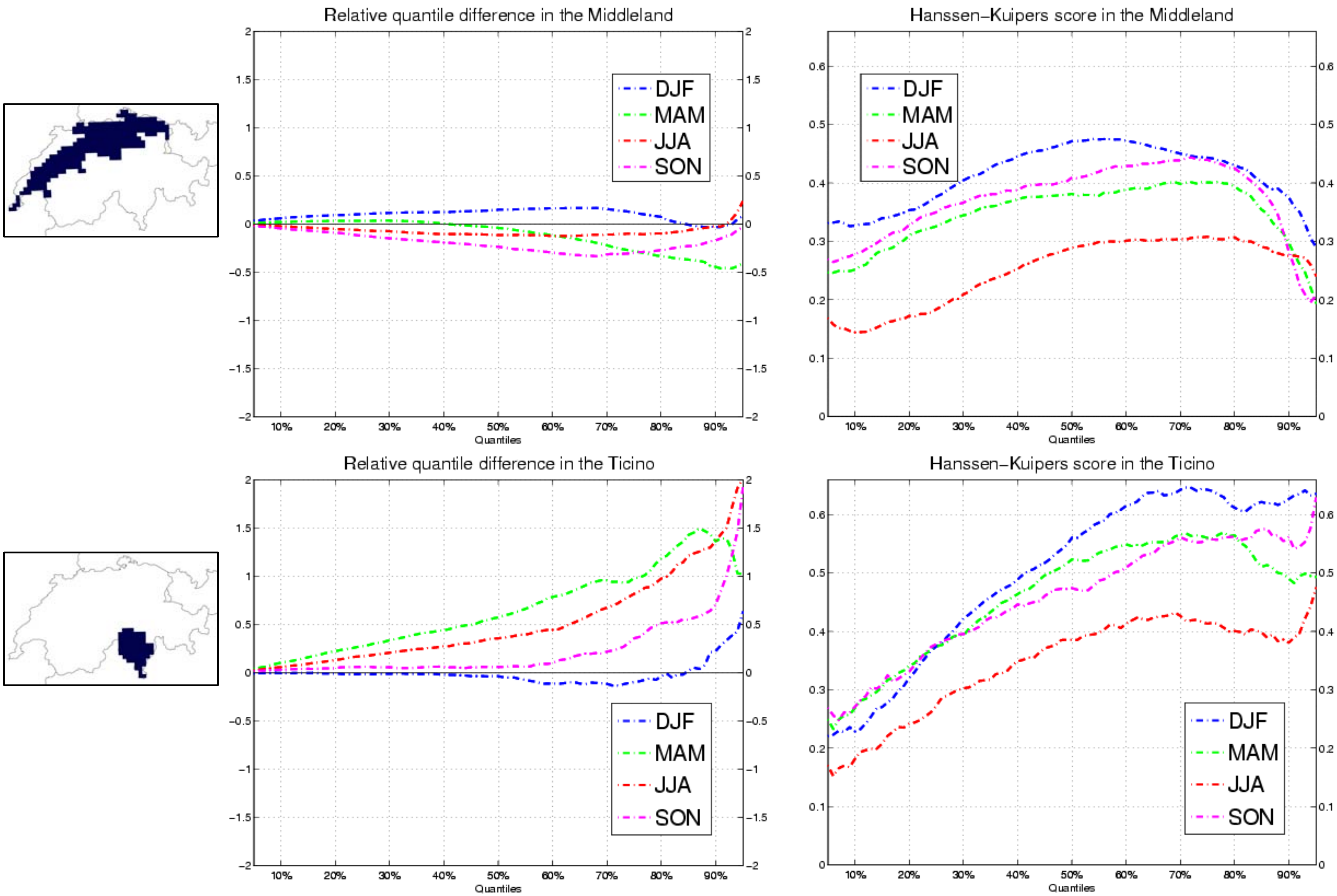
Application to QPF in Switzerland



Spatial means of intensity spectrum

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Summary

1.)

Simplification of contingency table

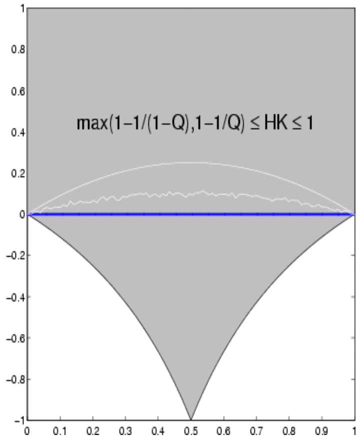
$$Q = \frac{M+Z}{H+2M+Z} \quad \xrightarrow{M=F} \quad Z = \frac{Q}{1-Q}H + \frac{2Q-1}{1-Q}M$$

2.)

Amplitude and matching errors independent from each other

3.)

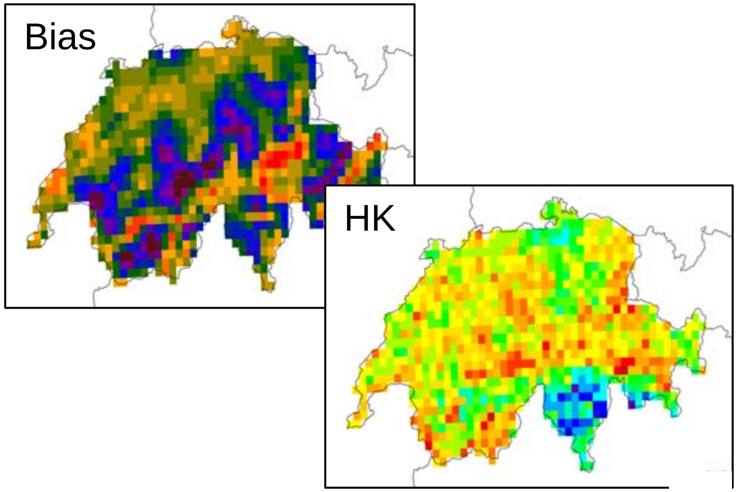
Symmetric setting of HK beneficial



$$var(HK) = \begin{cases} \frac{1}{N}\frac{p(1-p)}{Q(1-Q)^2} & Q \leq 0.5 \\ \frac{1}{N}\frac{p(1-p)}{Q^2(1-Q)} & Q \geq 0.5 \end{cases}$$

4.)

Straightforward application



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