Application of neighborhood-based contingency scores to AROME verification

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Motivation

Météo-France main meteorological deterministic forecasting systems:

- **ARPEGE** : global low resolution (≈5km over France),
- **AROME** : regional high resolution (≈1.3km over France)

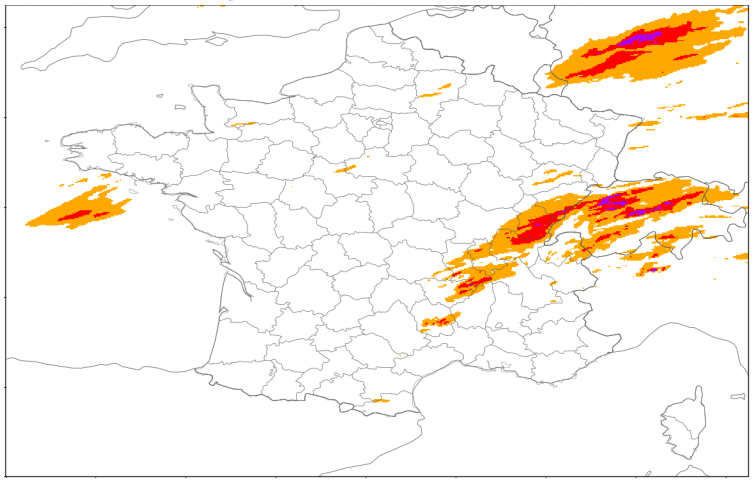
Goal: Define a new headline score for AROME:

- for precipipation events,
- without double penalty effects,
- user-friendly *(easy to explain)*.

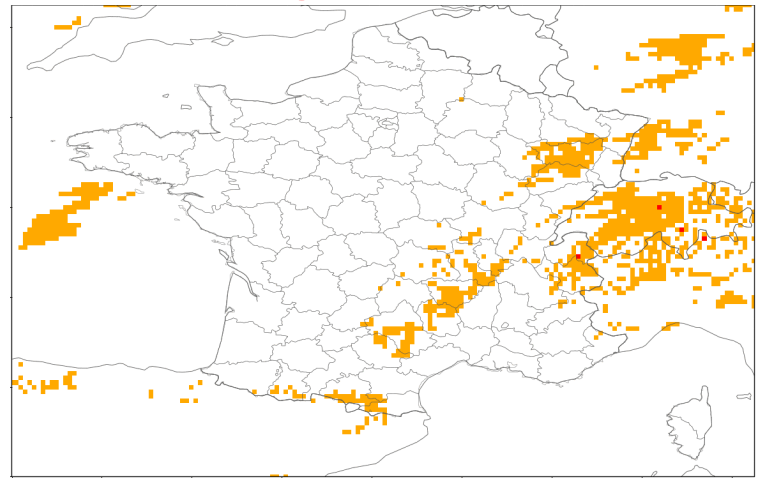
AROME verification - Case study

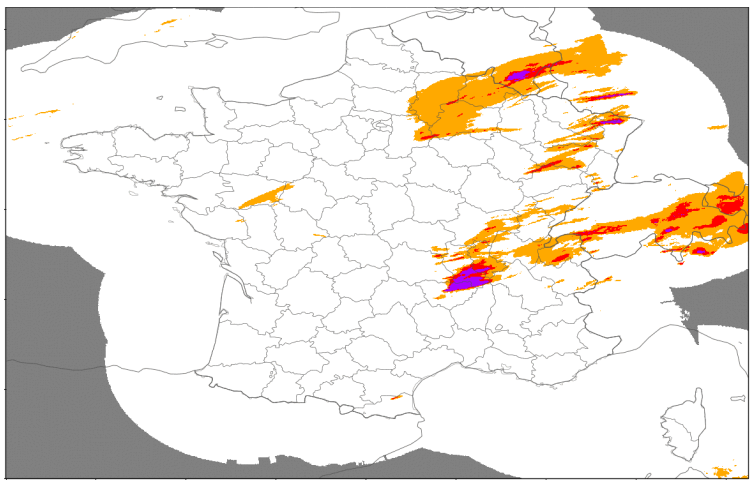
QPF between 18 and 21H UTC, August 6th 2019 (convective period).

AROME leadtime 21H

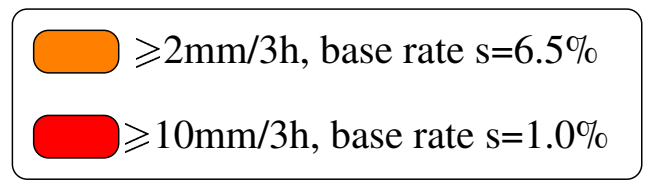


ARPEGE leadtime 21H





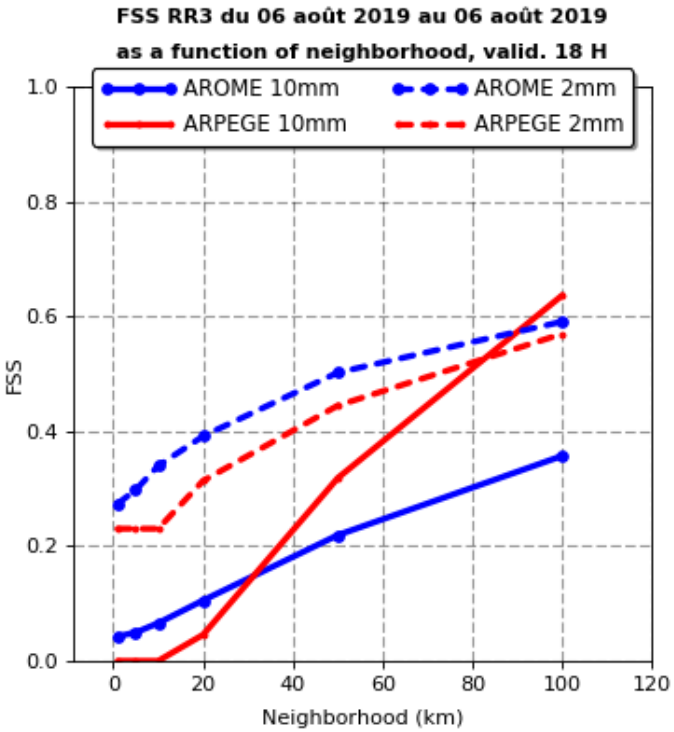
Reference (RADAR+obs)

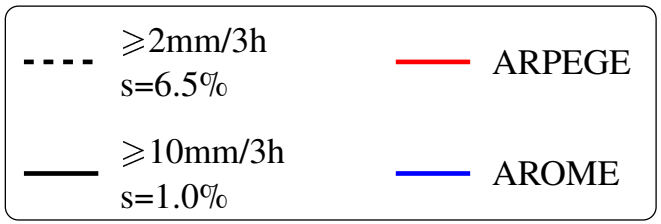


Forecasters/modelers prefer AROME (better location, patterns, maxima)

AROME verification - Case study

Currently, AROME headline score derives from FSS (Amodei et al (2015)).





Which model is better according to FSS ?

2mm : AROME better.

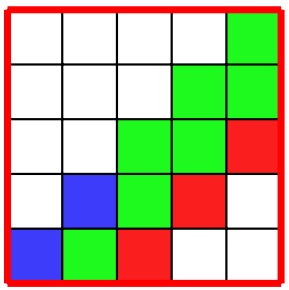
10mm : ARPEGE better for large neighborhoods.

Idea: include neighborhood strategy in contingency tables

Neighborhood-based contingency tables - Definition

		Reference	
		yes	no
Forecast	yes	**a** *Hit*	**b** *False Alarm*
	no	**c** *Miss*	**d** *Correct rejection*

$$\begin{pmatrix} a & b \\ c & d \end{pmatrix}$$

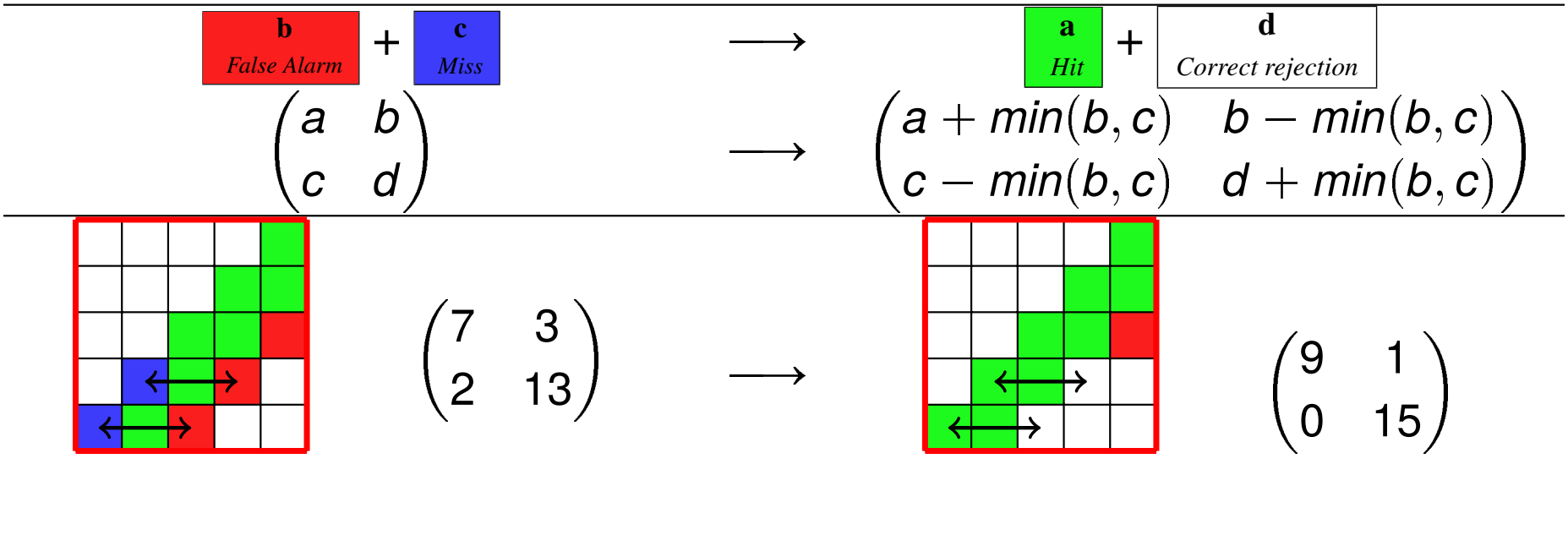


$$\begin{pmatrix} 7 & 3 \\ 2 & 13 \end{pmatrix}$$

Neighborhood-based contingency tables - Definition

Error compensation (Stein and Stoop (2019))

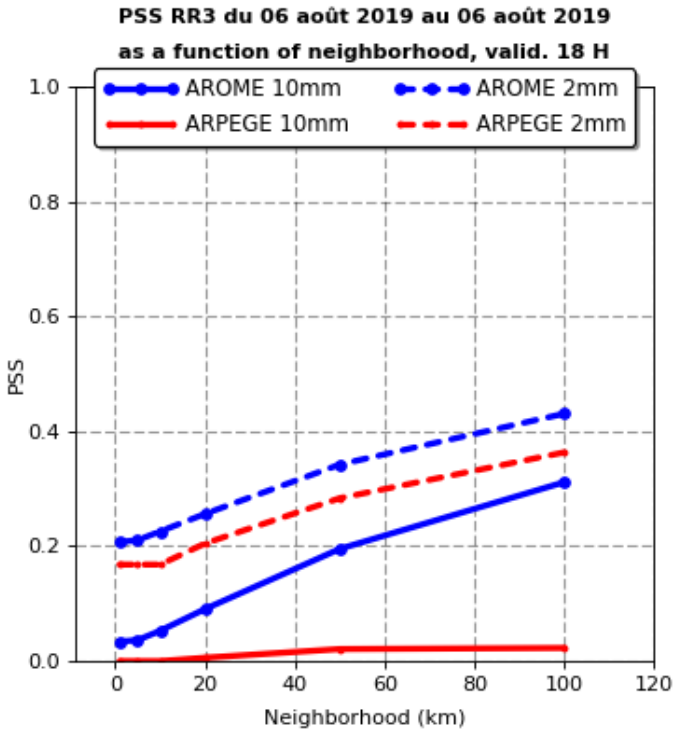
Others strategies exist (Schwartz (2017))



Final contingency table: summation over all neighborhoods

AROME verification - Case study

PSS



- - - - ⩾2mm/3h s=6.5%
——— ⩾10mm/3h s=1.0%
——— ARPEGE
——— AROME

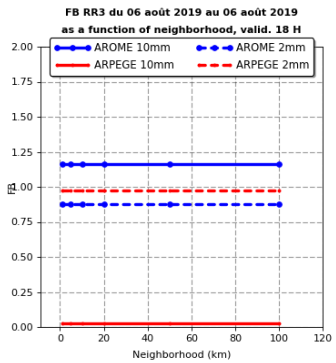
Which model is better according to PSS ?

2mm : AROME better.

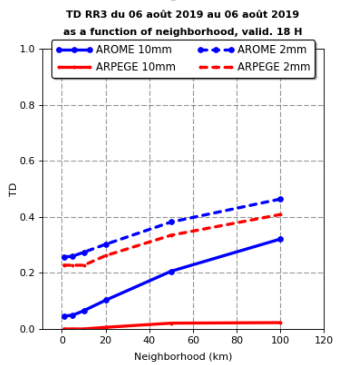
10mm : AROME better.

Bonus : Frequency bias, POD, FAR,...
Easier to explain.

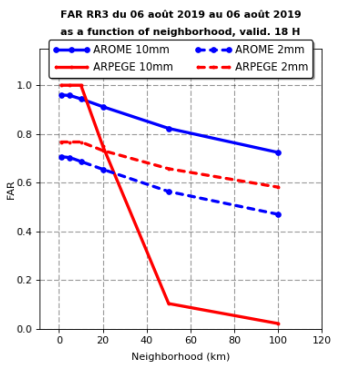
Frequency bias



POD



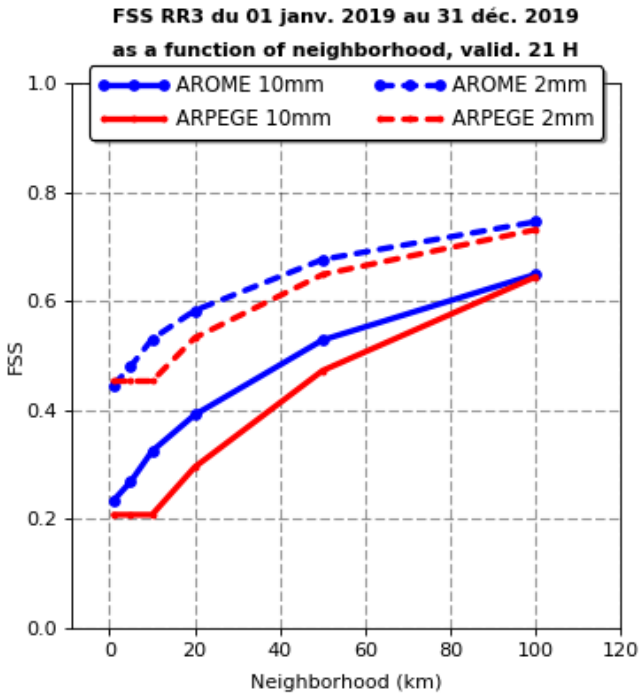
FAR

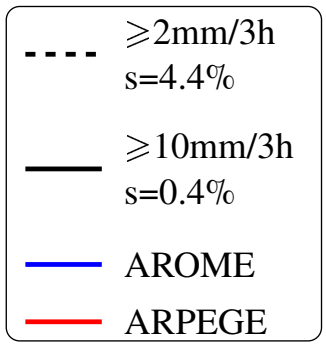


AROME verification - Results over 2019

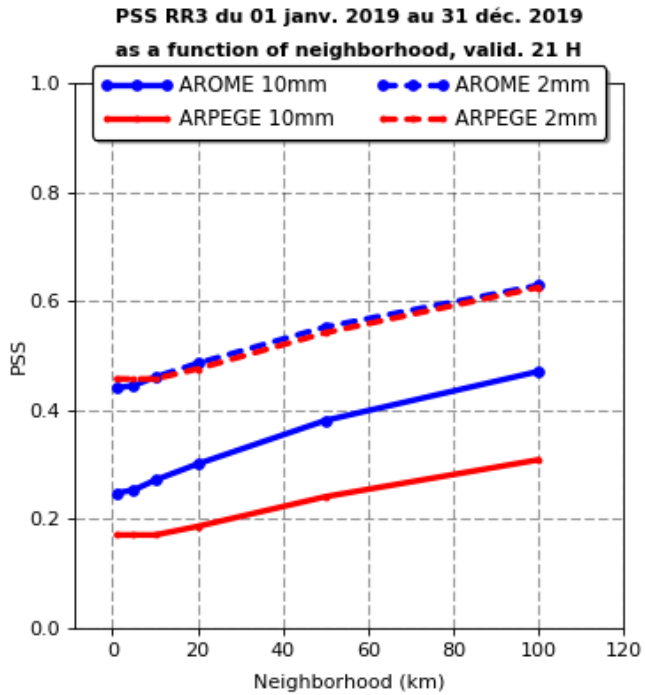
QPF between 18 and 21H UTC, leadtime 21H.

FSS

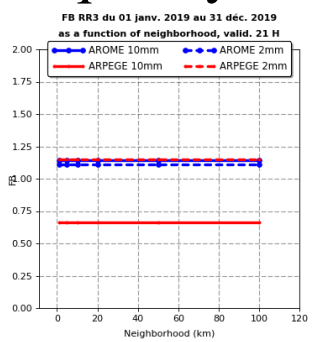




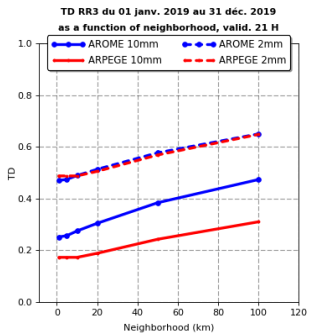
PSS



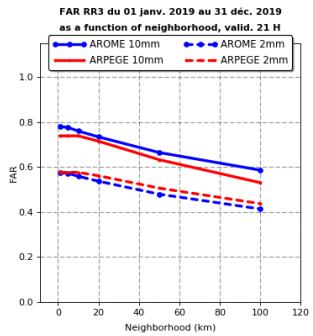
Frequency bias



POD



FAR



AROME verification - Conclusion

Use of neighborhood in contingency tables (error compensation).
Limit double penalty effects, like in the FSS.

Several benefits:

- contingency skill scores closer to forecasters/modelers insights than FSS,
- user-friendly measures (POD, FAR, ...)

$\Longrightarrow$ replacement of FSS by PSS as headline score.

Perspectives:

- application to probabilistic forecasts of events,
- application to other events (gust, fog, ...) and extreme events (SEDI).

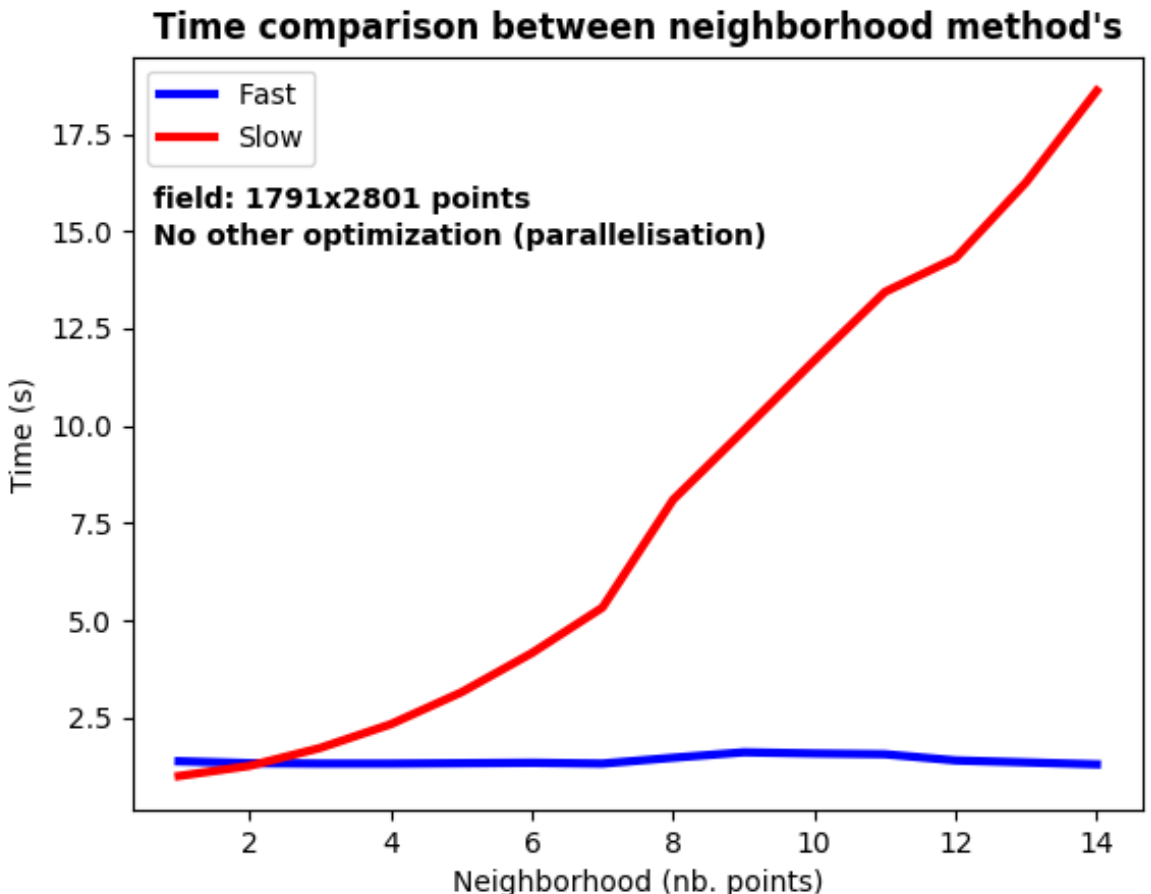
Merci

Additional content

Algorithm

Algorithm from Faggian et al (2015) (summed area tables) adapted to deal with:

- neighborhood contingency tables,
- masked data (useful for station data).



Multi-categorical tables

k classes

Classical	Error compensation
$\begin{pmatrix} t_{1,1} & \cdots & t_{1,k} \\ \vdots & \ddots & \vdots \\ t_{k,1} & \cdots & t_{k,k} \end{pmatrix}$	$\begin{pmatrix} t'_{1,1} & \cdots & t'_{1,k} \\ \vdots & \ddots & \vdots \\ t'_{k,1} & \cdots & t'_{k,k} \end{pmatrix}$

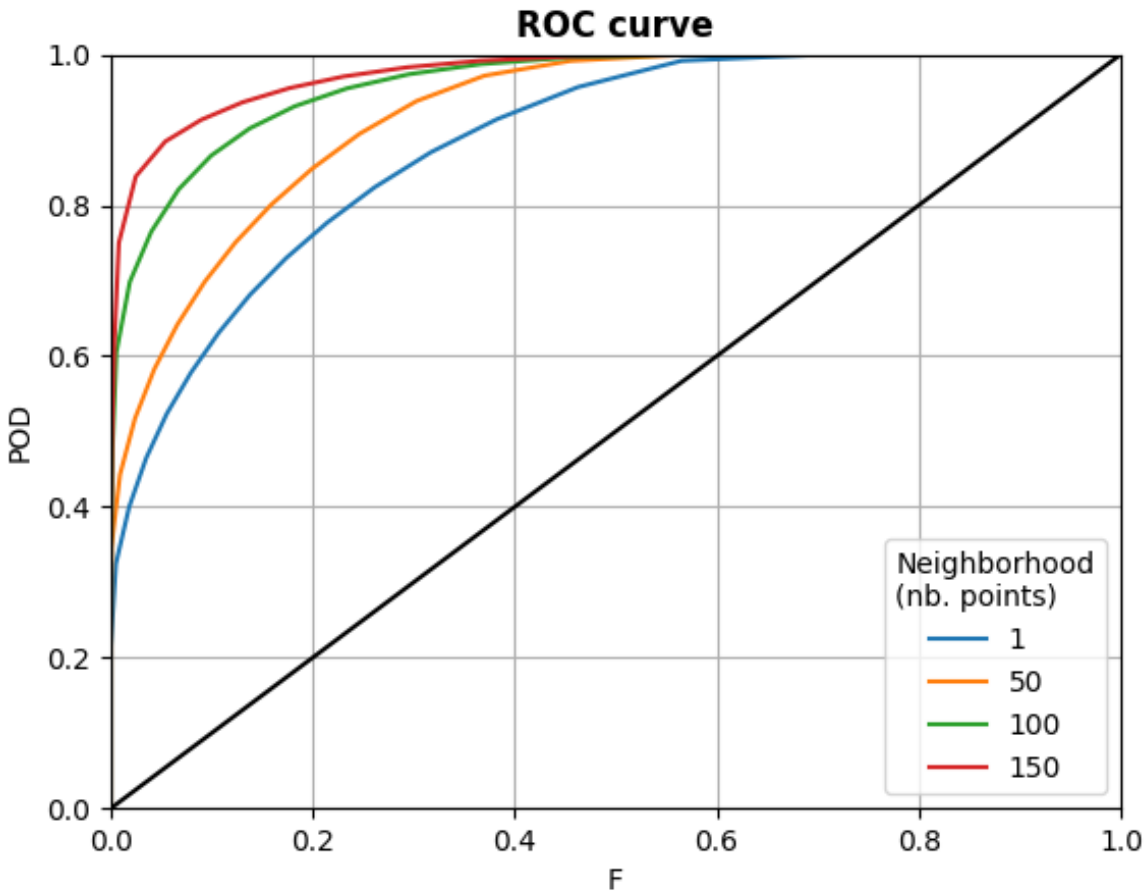
with:

$t'_{i,i} = t_{i,i} + \sum_{j=1..k} min(t_{i,j}, t_{j,i})$ for $i = 1..k$

$t'_{i,j} = t_{i,j} - min(t_{i,j}, t_{j,i})$ for $i \neq j$

Links with probabilistic scores - In progress

Each grid point : event if $p \geqslant p_t$
Contingency tables evaluated for each threshold p_t (+error compensation)



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Schwartz, C. S., 2017: A comparison of methods used to populate neighborhood-based contingency tables for high-resolution forecast verification. *Wea. Forecasting*, **32**, 733-741

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