PP AWARE – TASK 3.4

Maria Stefania Tesini

Task 3.4 DIST methodology tuned on high-threshold events for flash floods forecast evaluation

This task proposed to explore (or highlight) the suitability of an evolution of the DIST methodology for the verification of HIW, such as high precipitation over catchment areas used operationally for issuing Civil Protection alerts.

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This task proposed to explore (or highlight) the suitability of an evolution of the DIST methodology for the verification of HIW, such as high precipitation over catchment areas used operationally for issuing Civil Protection alerts.

- Work done:
  - ✓ **Definition of the methodology and development of specific verification tools**

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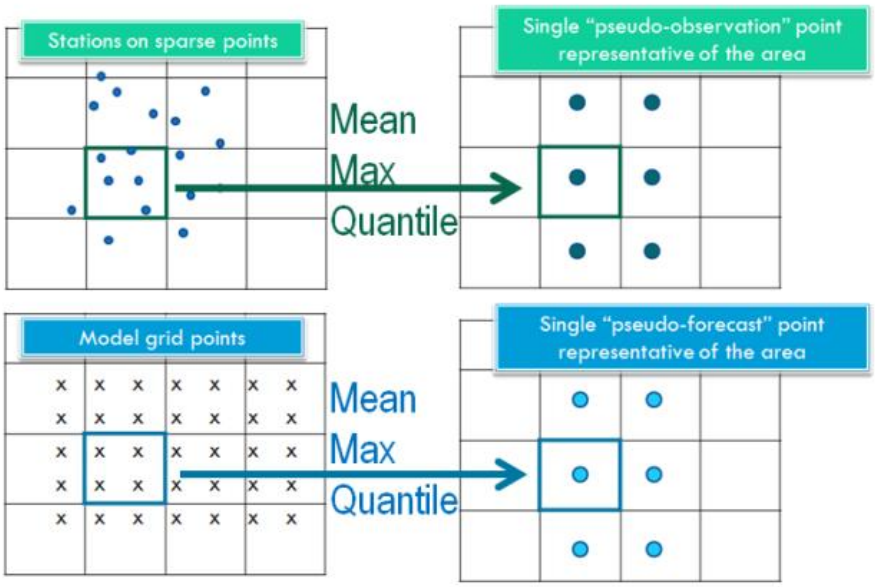
The verification system

- It is an evolution of **DIST**, a spatial verification method based on the verification of the precipitation distributions within boxes of selected size (Neighborhood obs – Neighborhood fcs)

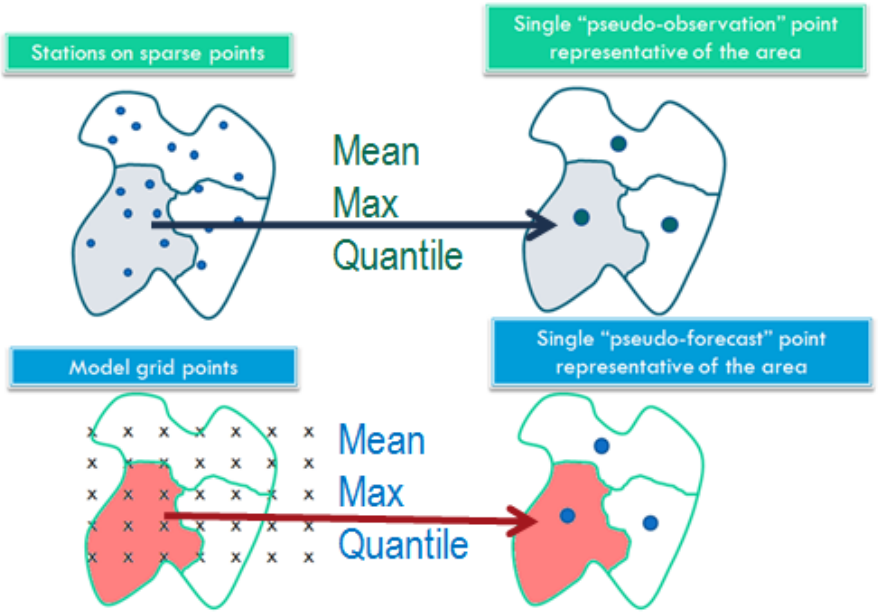


Marsigli, C., Montani, A. and Paccagnella, T. (2008), A spatial verification method applied to the evaluation of high-resolution ensemble forecasts. Met. Apps, 15: 125–143. doi: 10.1002/met.65

- The verification domain is subdivided into several boxes, each of them containing a certain number of observed and forecast values.
- For each box, several parameters of the distribution of both the observed and forecast values falling in it can be computed (mean, median, percentiles, maximum).
- Verification is then performed using a categorical approach, by comparing for each box one or more parameters of the forecast distribution against the corresponding parameters of the observed distribution, using a set of indices.

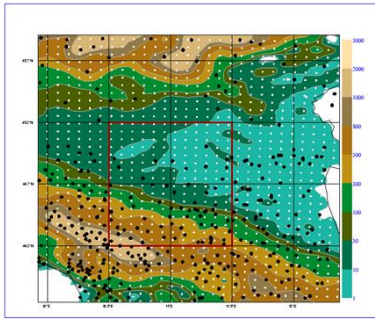
The verification system

- Squared regular boxes are replaced with catchment areas

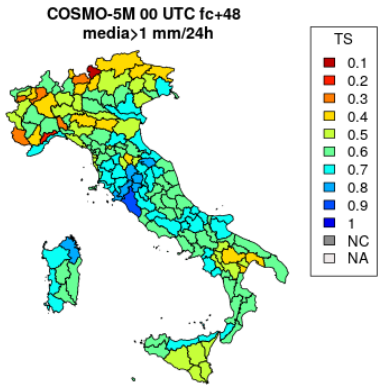


Some advantages of this choice:

- Reduce some problems related to complex terrain, e.g. if a ridge of a mountain divide the box this can give misleading results combining upwind and downwind situation



- Easier and more direct communication of the information about the usability of NWP data directly to forecasters or hydrologists e.g. scores are can be provided on each catchment area



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This task proposed to explore (or highlight) the suitability of an evolution of the DIST methodology for the verification of HIW, such as high precipitation over catchment areas used operationally for issuing Civil Protection alerts.

- Work done:
  - ✓ Definition of the methodology and development of specific verification tools
  - ✓ **Validation of the methodology comparing results of DIST method using the original "squared boxes" and the catchment areas:**
    - The improvement in the scores shows that using catchment area as reference for the verification seems to reduce some problems related to complex terrain.

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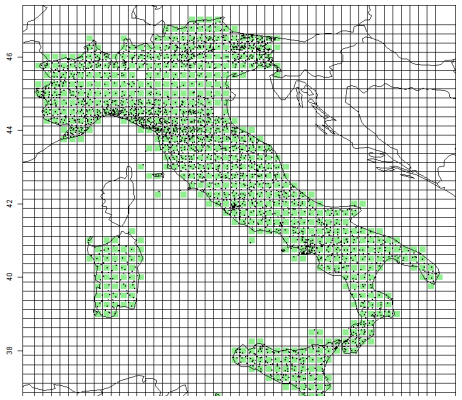
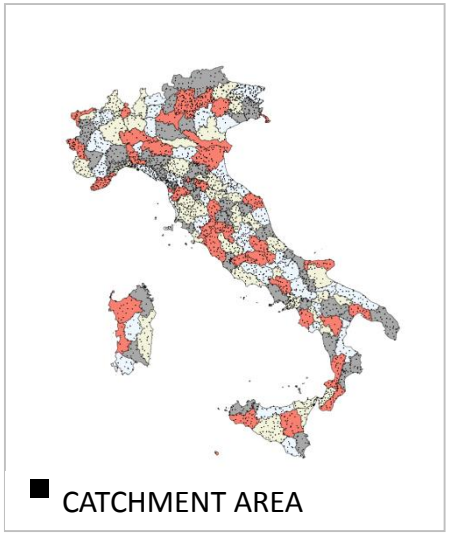
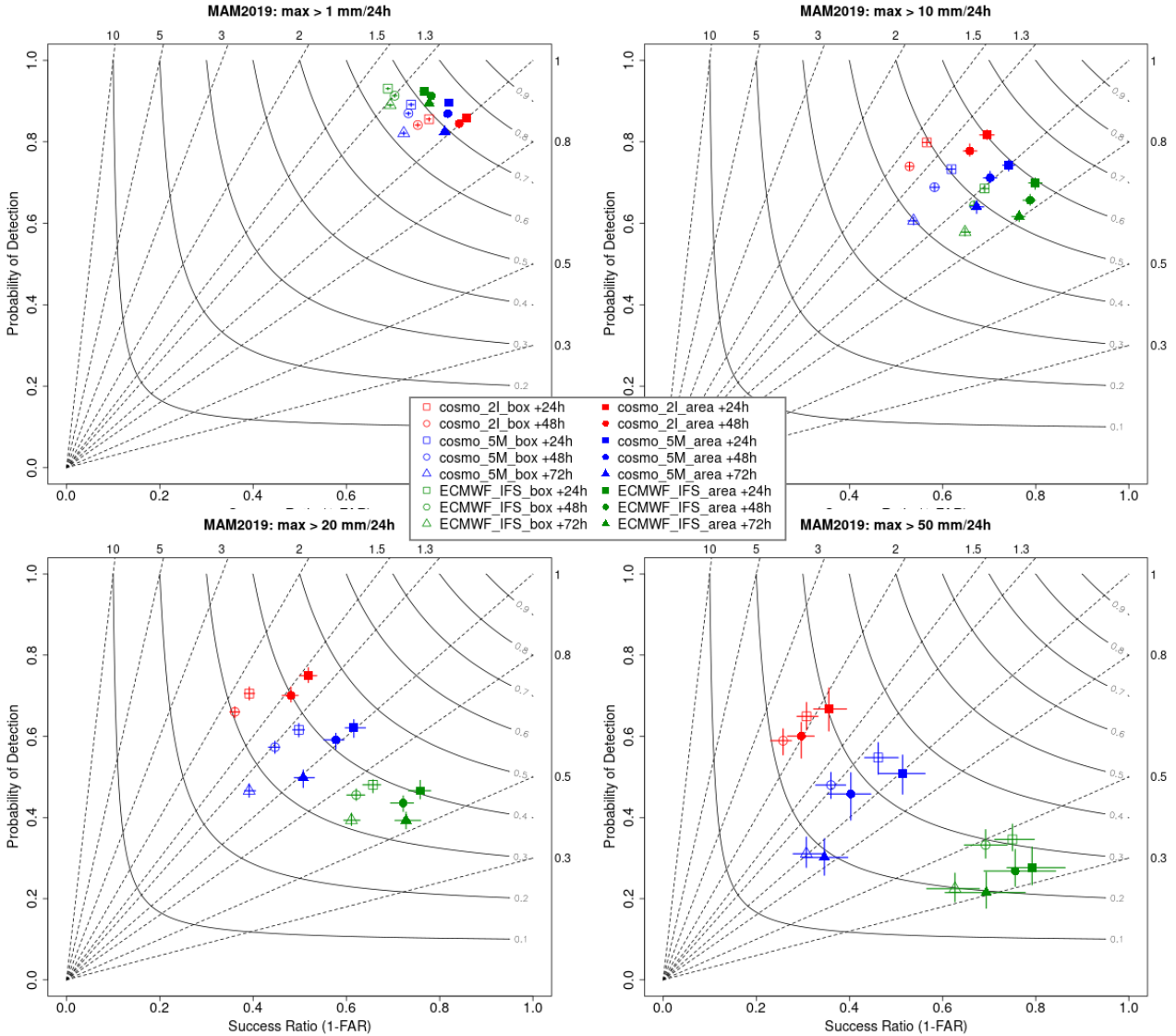
Comparison between boxes and catchment areas – max of precipitation



❑ BOX 0.25X0.25 DEGREE



■ CATCHMENT AREA



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This task proposed to explore (or highlight) the suitability of an evolution of the DIST methodology for the verification of HIW, such as high precipitation over catchment areas used operationally for issuing Civil Protection alerts.

- Work done:
  - ✓ Definition of the methodology and development of specific verification tools
  - ✓ Validation of the methodology comparing results from DIST original “squared boxes” and from new catchment areas:
  - ✓ **Interpretation of the verification results using some parameters (also combined) of the precipitation distribution (mean, median, maximum) within the catchment area:**
    - Verification results can be used directly to interpret how to use the forecast system and to decide in which situations one system is better than another.

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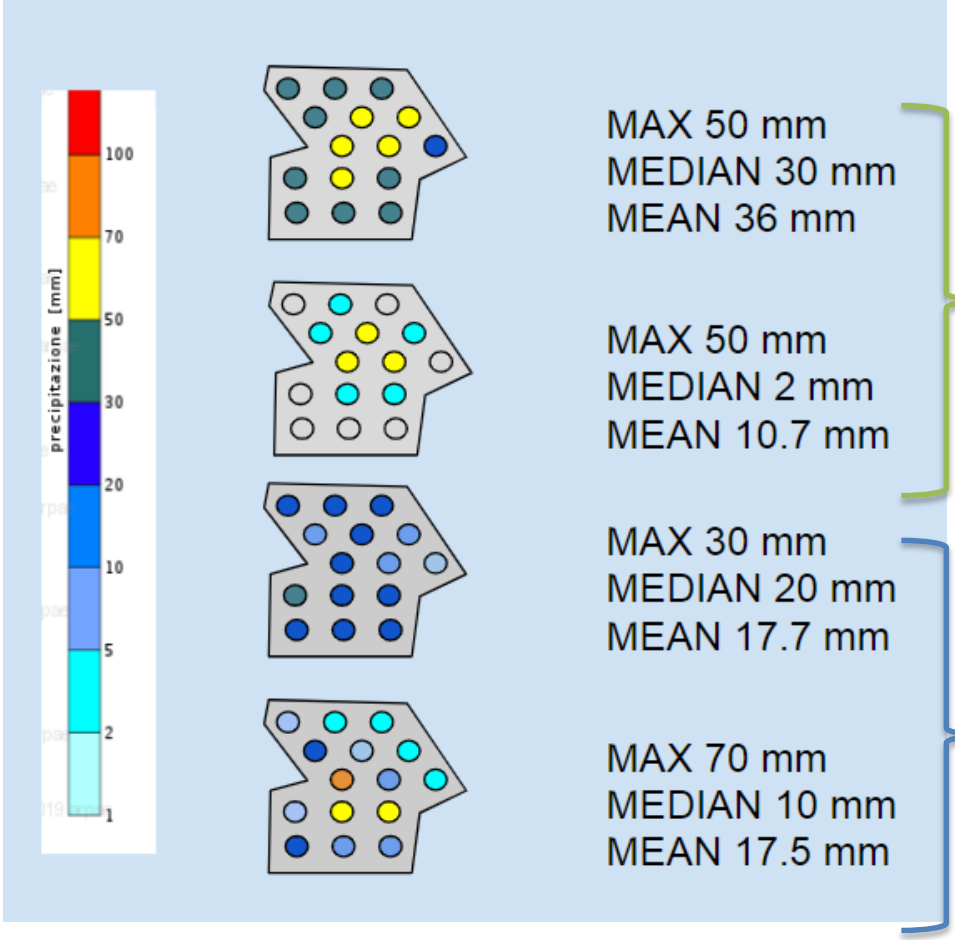
Operational use of DIST

- The verification is performed evaluating some characteristics of the precipitation field:
  - Average
    - It can be used to investigate the ability of models in reproducing different amounts of precipitation
  - Maximum
    - The use of the maximum of precipitation over the areas can provide some information on high precipitation, even if not in the correct location but in the neighborhood, represented by the catchment area.
  - Median & Maximum
    - The combination of a condition on the median and one on the maximum of precipitation can separate high localized precipitation from extensive precipitation.

Examples of precipitation distribution over an area



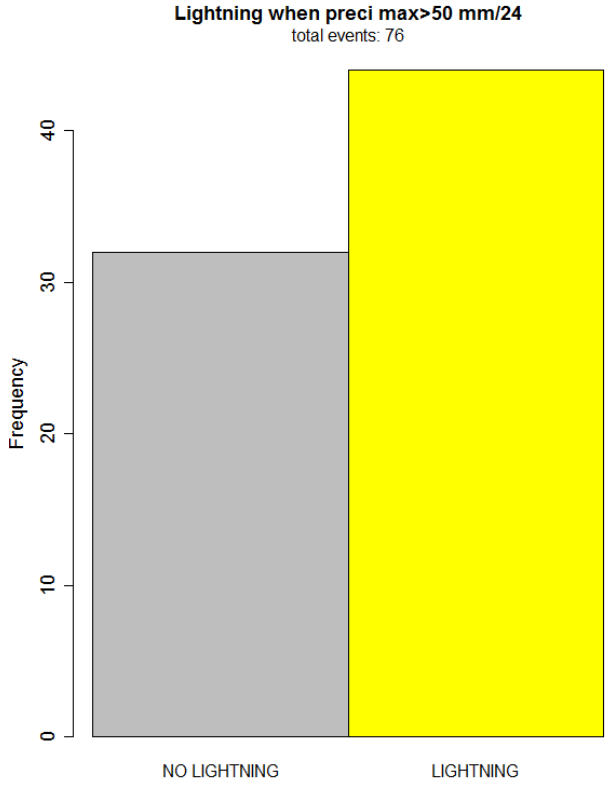
Classifying precipitation events using median and maximum

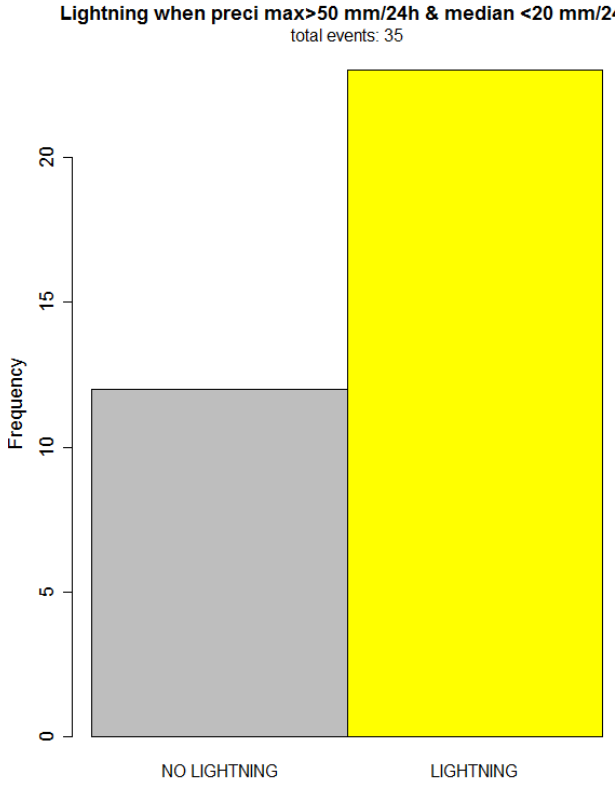
- Using the median in combination of maximum allows, in the first instance, to discriminate between high localized precipitation and more widespread rainfall
- Imposing the condition of median
  - Less than a thresholds means that in (at least) half of the points of the area it rained less than that value
  - Greater than a thresholds means that in (at least) half of the points of the area it rained more than that value
- We don't care the localization of the points → we are using DIST method to minimize spatial errors

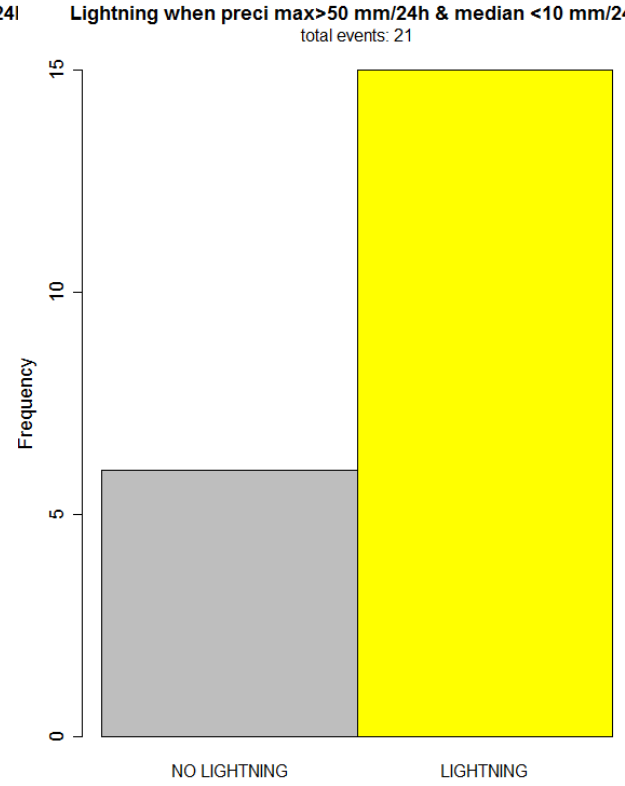
Precipitation and Lightening

- Assumption: If there is lightning precipitation can be considered convective
- **Is there a relation between parameters of the precipitation distribution (median and max) and lightning?**
- Dataset:
  - 270 day of observed precipitations described by median an maximum on the 8 alert areas of Emilia-Romagna region (March-November 2015)
    - 1571 rain event /2160 total cases
  - Corresponding total number of lightning per day simplified in LIGHTNING/NO LIGHTNING

Precipitation and Lightening





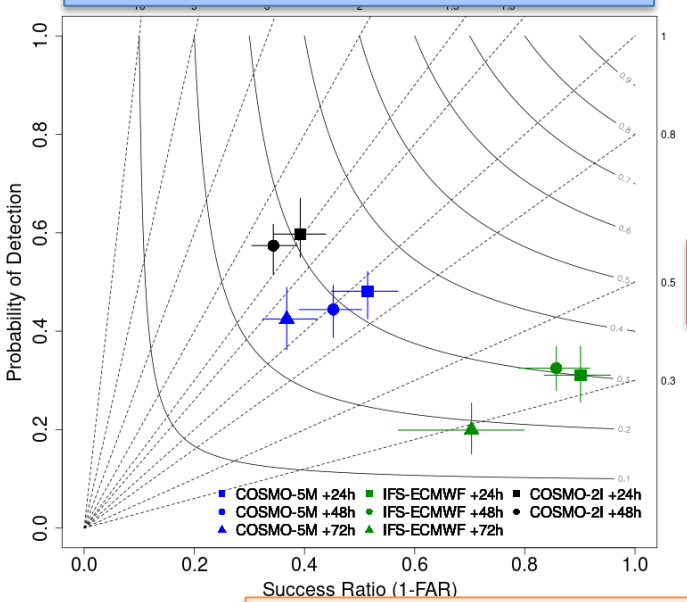


Events of precipitation with max > 50 mm/24h can be convective or not (42/58 %)

Events of precipitation with max > 50 mm/24h & median <20 mm/24h are mostly convective (34/66 %)

Events of precipitation with max > 50 mm/24h & median 10 mm/24h are mainly convective (28/72 %)

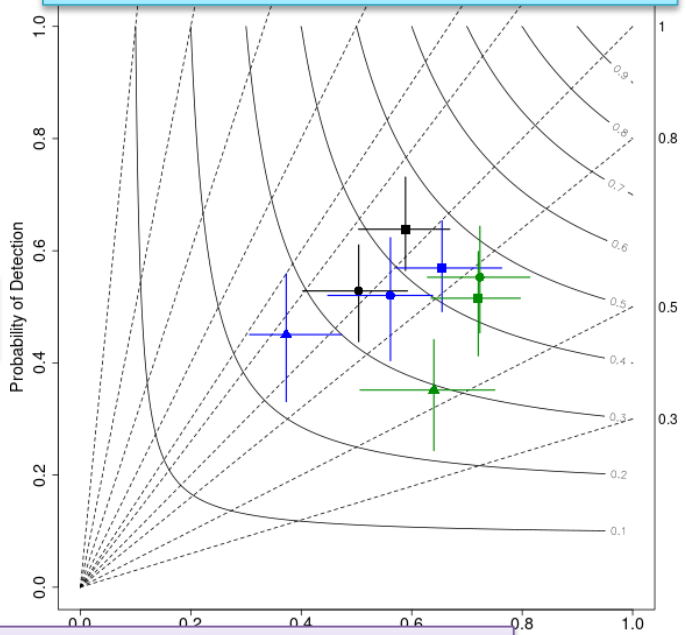
All events



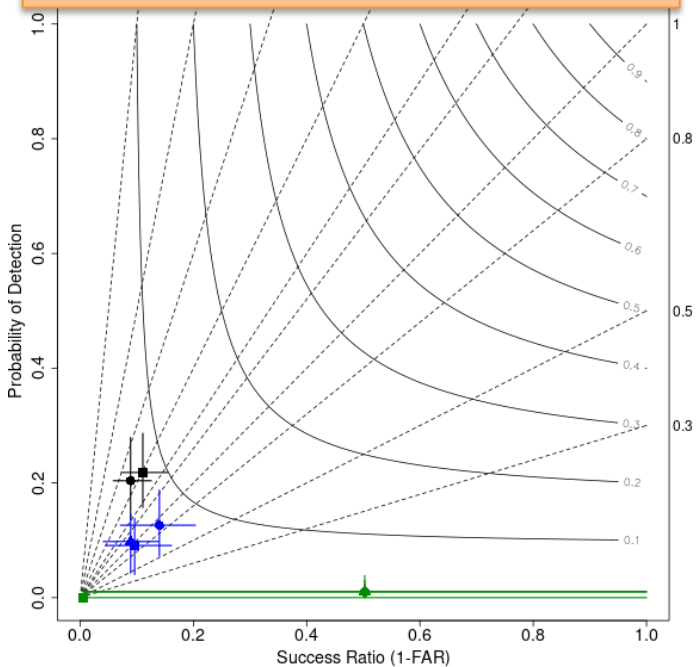
MAM 2020

max >50 mm/24h

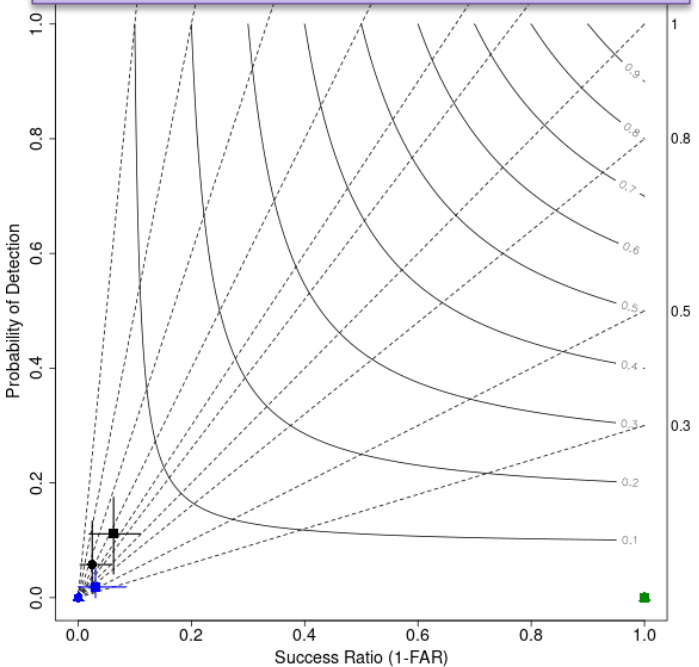
& Median > 30 mm/24h



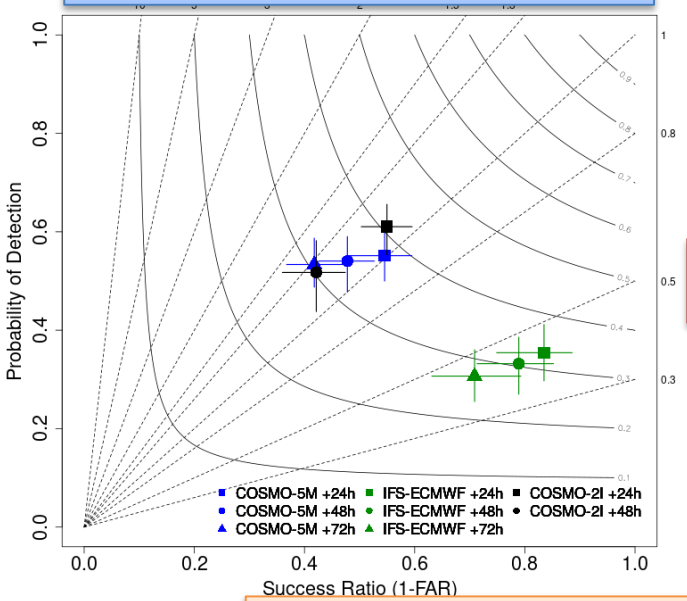
& Median < 20 mm/24h



& Median < 10 mm/24h



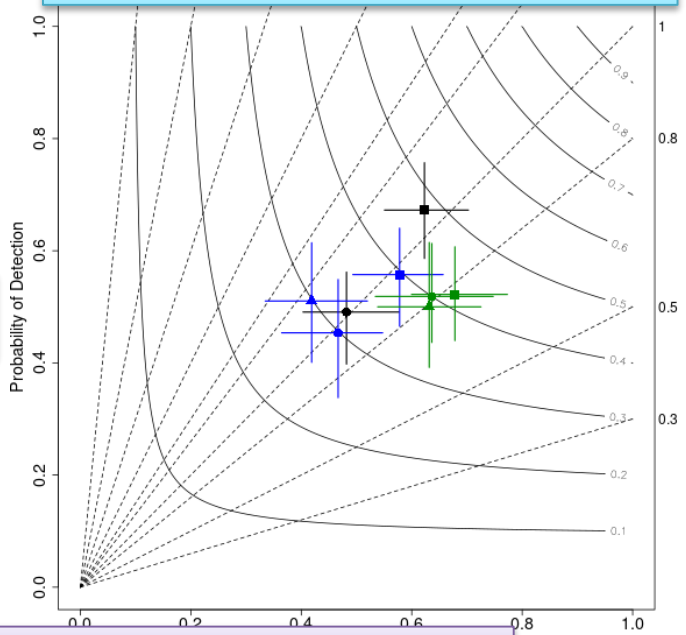
All events



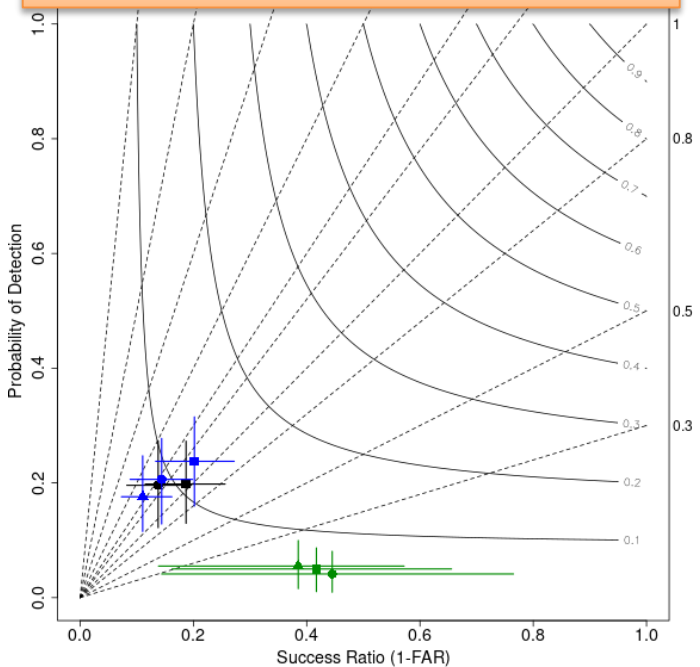
DJF 2019-20

max >50 mm/24h

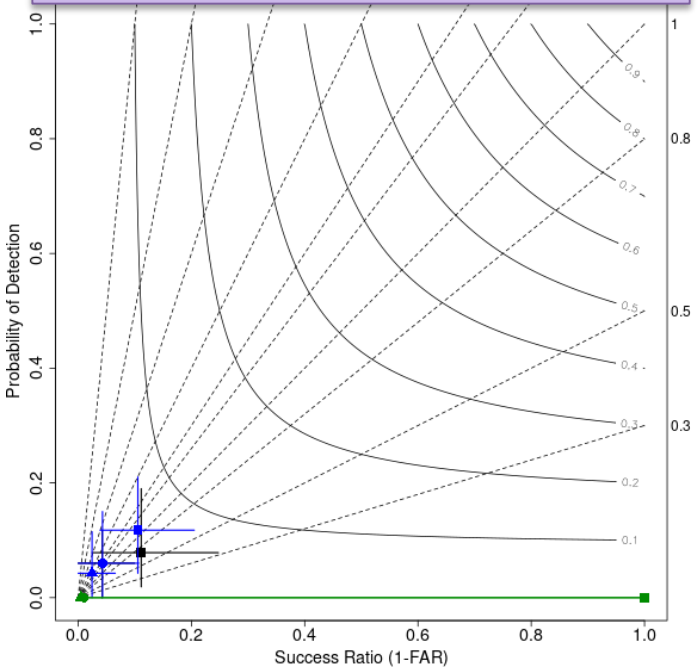
& Median > 30 mm/24h



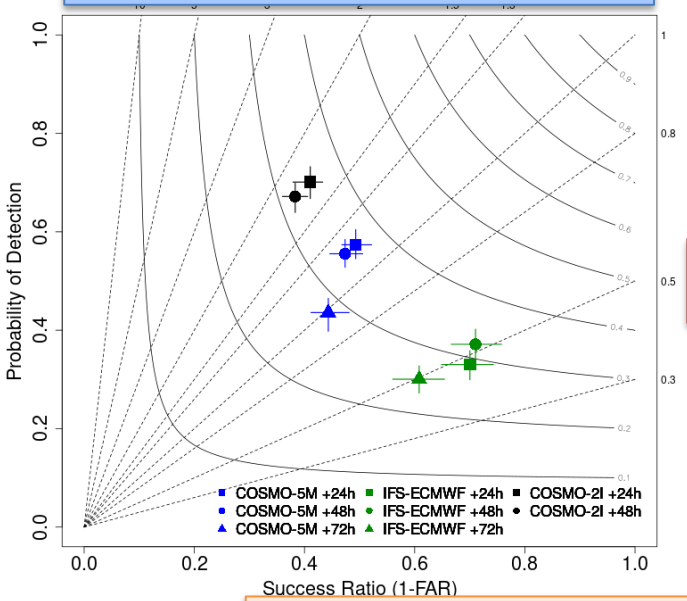
& Median < 20 mm/24h



& Median < 10 mm/24h



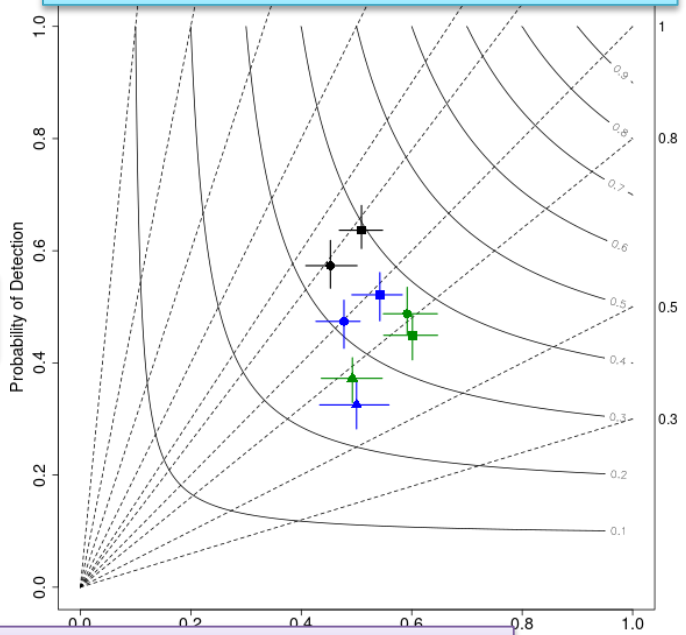
All events



SON 2019

max >50 mm/24h

& Median > 30 mm/24h



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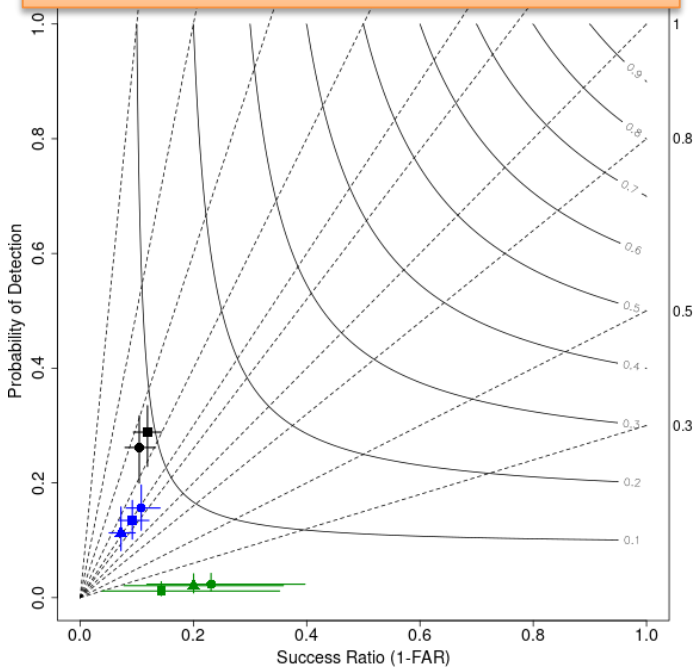

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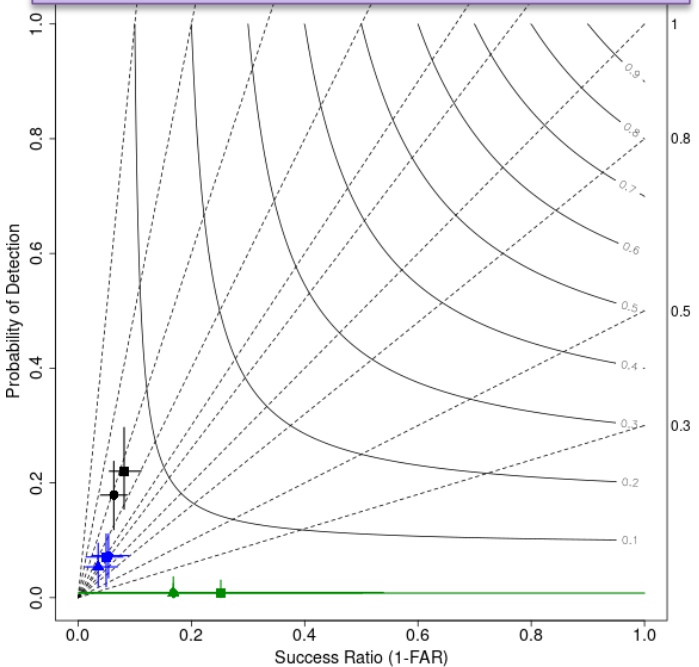

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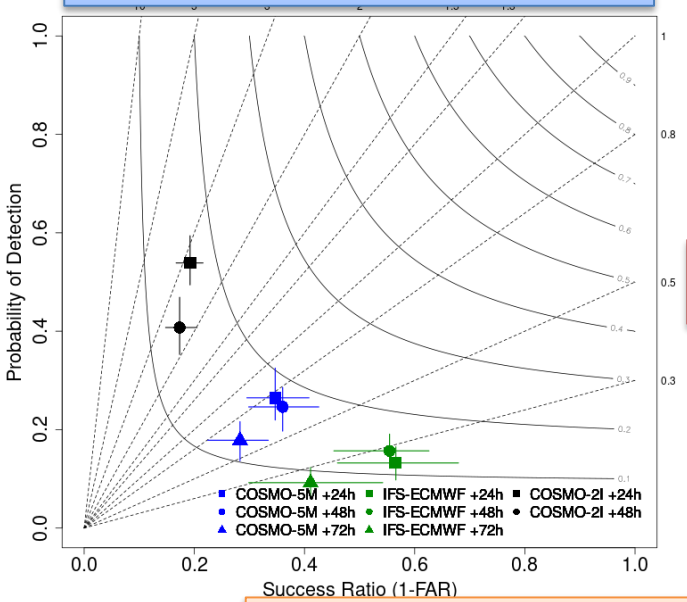

JJA 2019

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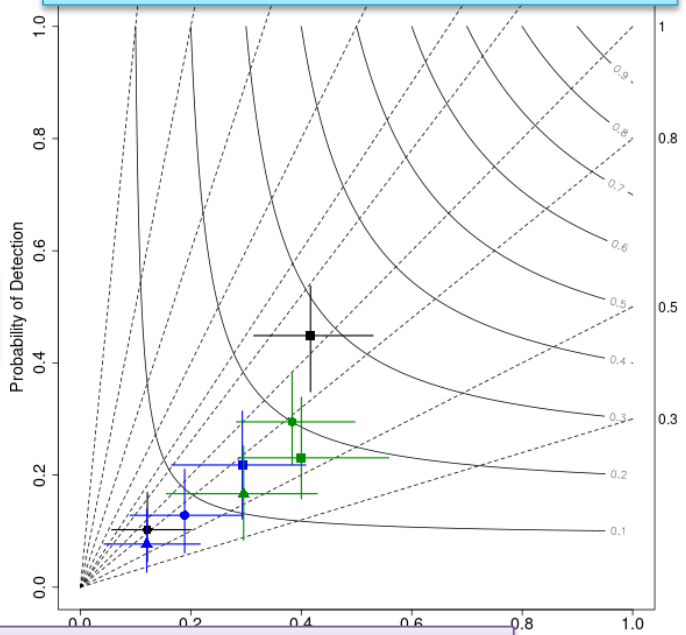

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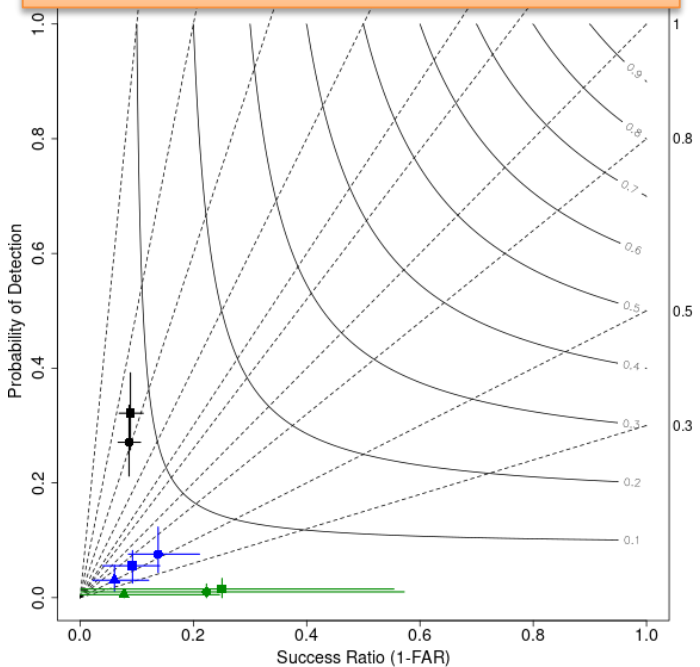

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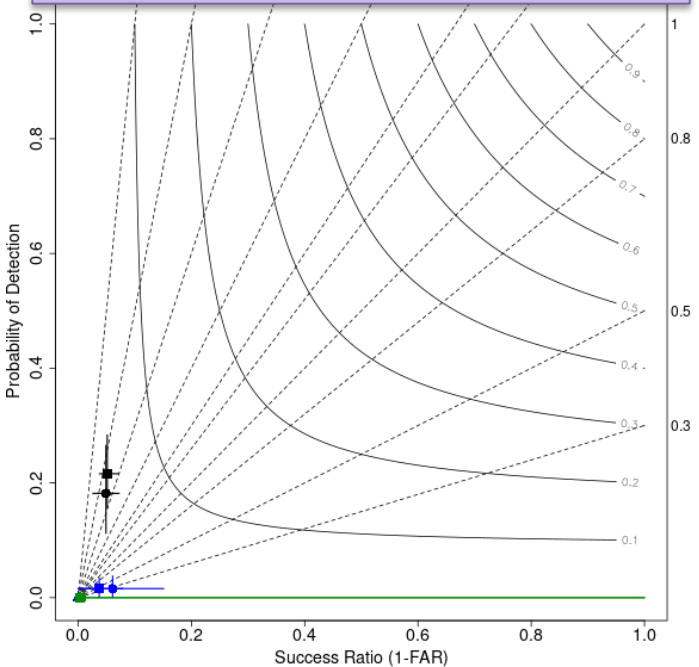

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  - ✓ Interpretation of the verification results using some parameters (also combined) of the precipitation distribution (mean, median, maximum) within the catchment area
  - ✓ **Reports on verification results using model with different resolution for different period of time**
    - Reports are produced internally for Arpae and Civil Protection usage (updated to MAM2020) but maybe it's better to prepare an excerpt/summary of them

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  - ✓ Reports on verification results using model with different resolution for different period of time

- **To be done:**
  - ❑ Produce reports on verification results specific for AWARE
  - ❑ Produce short report with the work accomplished

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