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

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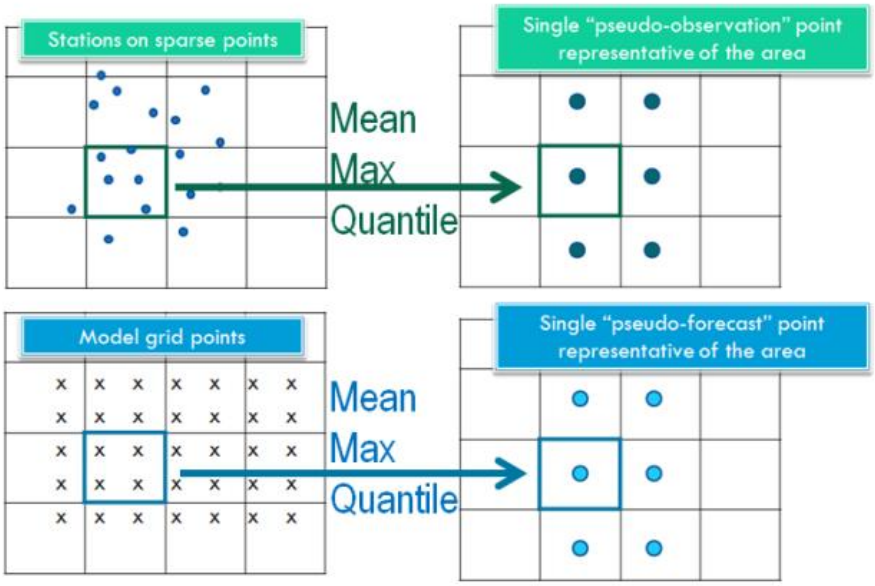
The verification system

- 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)

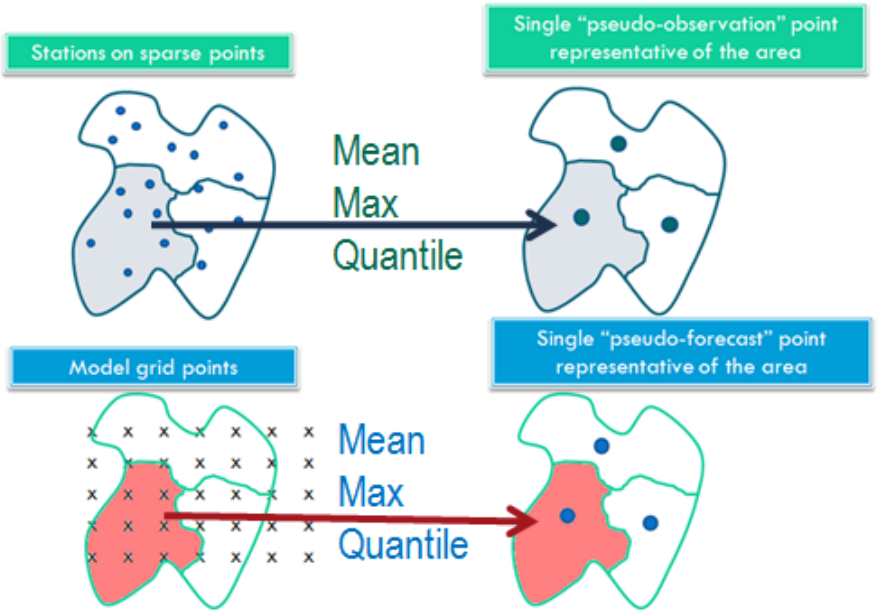


Marsigli, C., Montani, A. and Paccagnella, T. (2008), A spatial verification method applied to the evaluation of high-resolution ensemble forecasts. Met. Apps, 15: 125–143. doi: 10.1002/met.65

- 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.

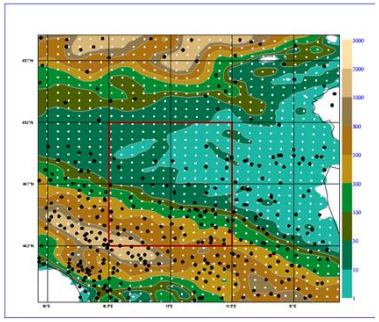
The verification system

- Squared regular boxes are replaced with catchment areas

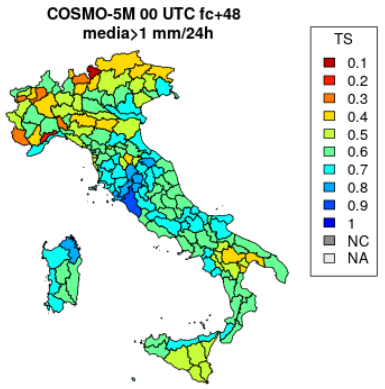


Some advantages of this choice:

- 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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  - ✓ 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:**
    - 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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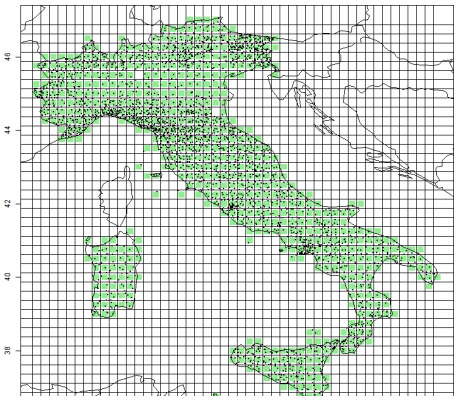
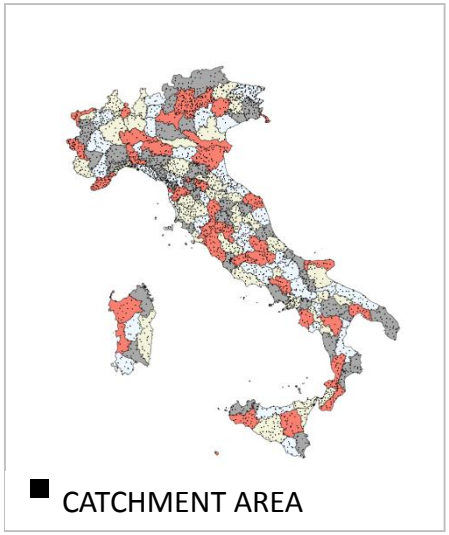
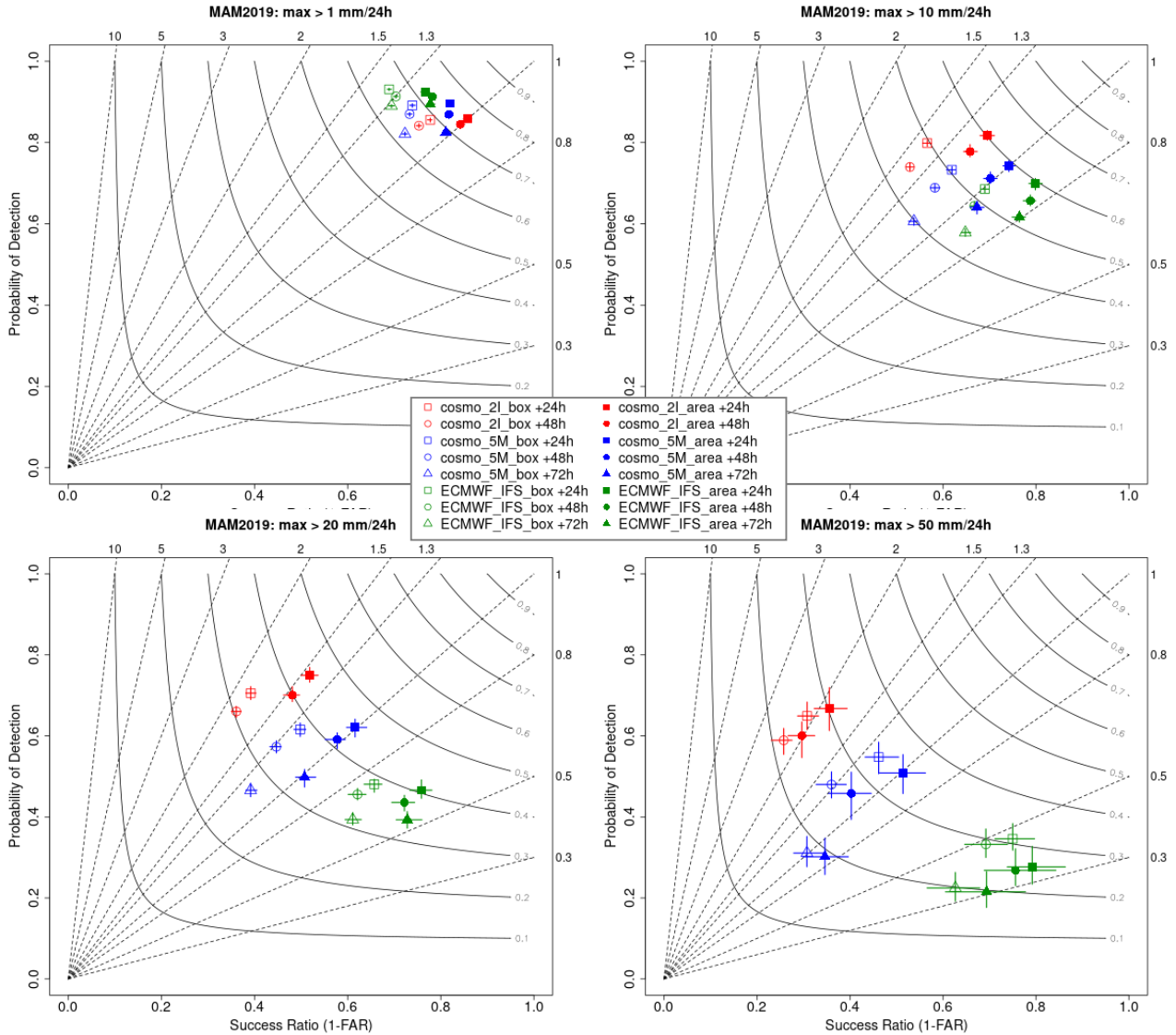
Comparison between boxes and catchment areas – max of precipitation



❑ BOX 0.25X0.25 DEGREE



■ CATCHMENT AREA



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  - ✓ **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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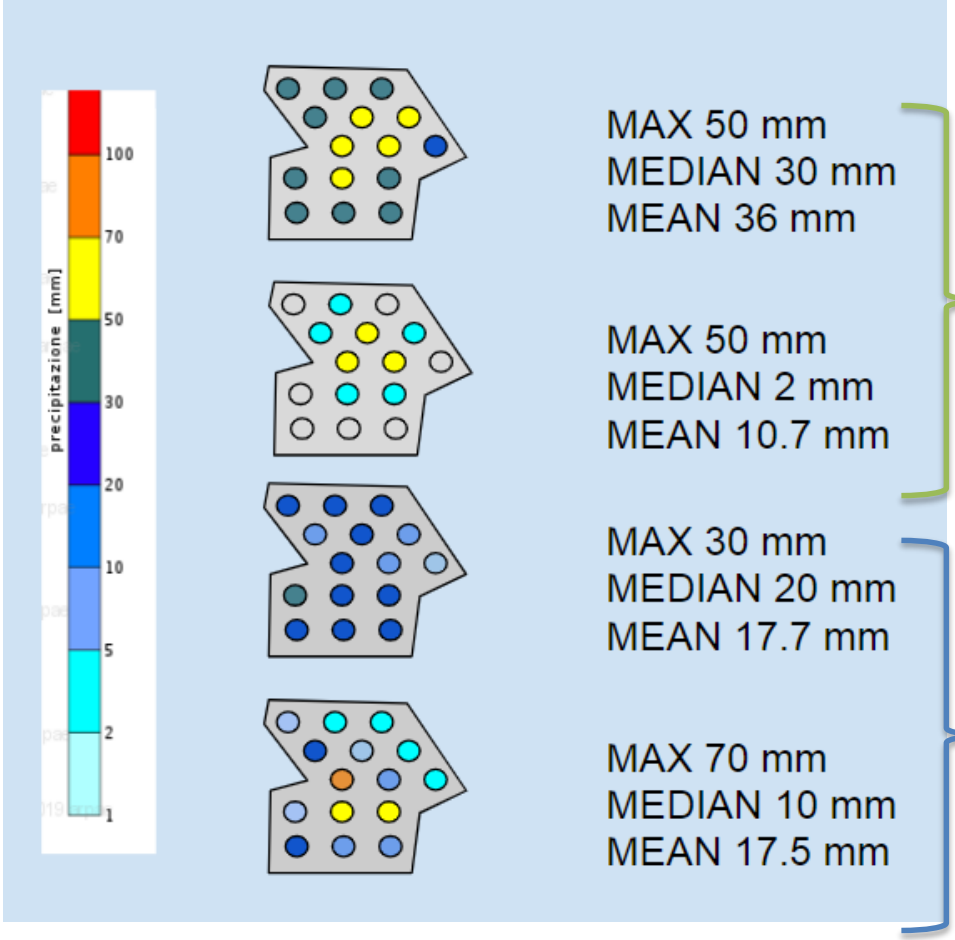
Operational use of DIST

- 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



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  - ✓ **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 DJF2019-20)

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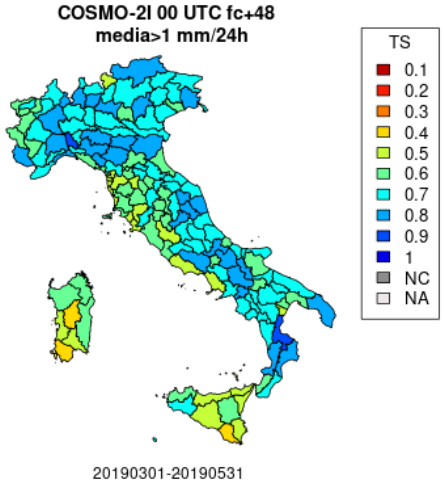
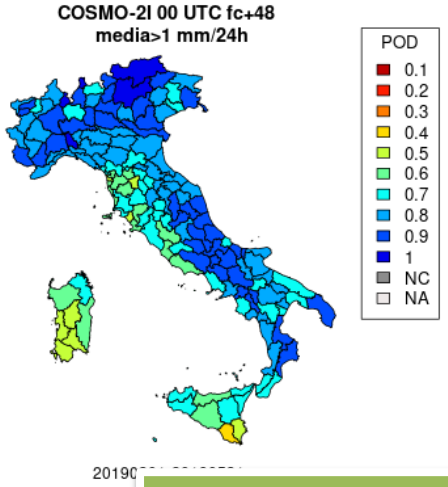
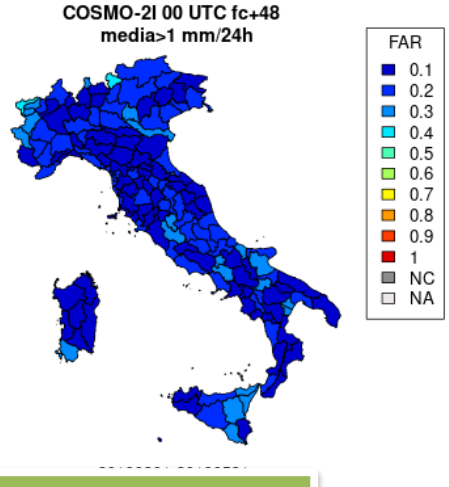
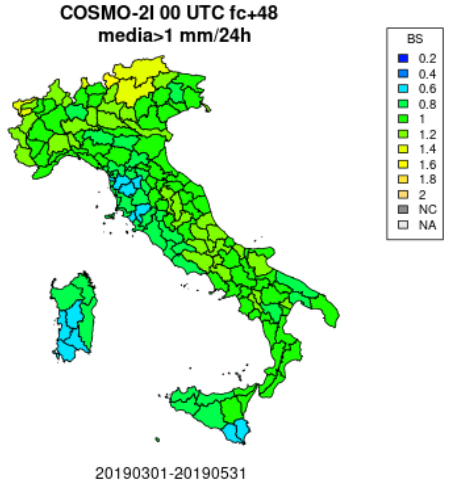
THRESHOLD 1 mm/24h

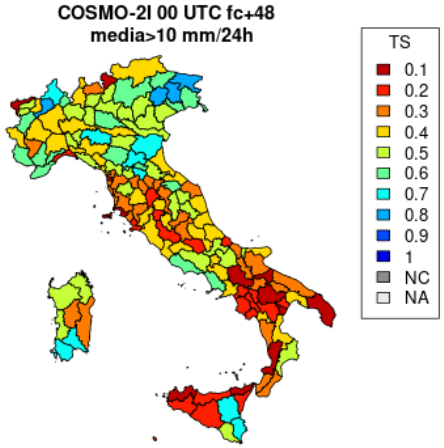


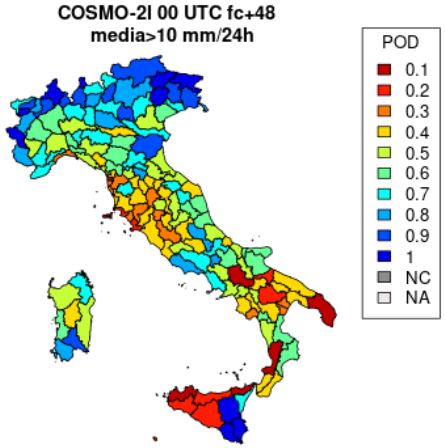


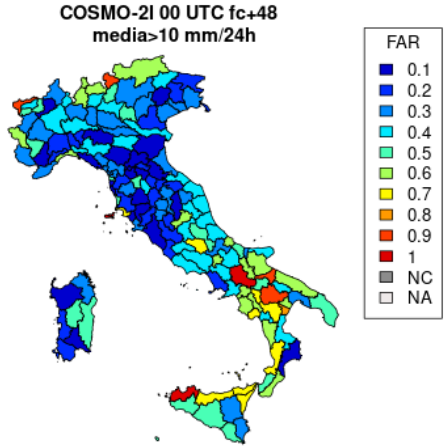


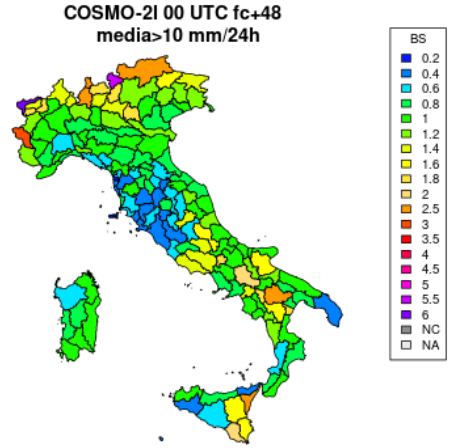


THRESHOLD 10 mm/24h









THREAT SCORE

POD

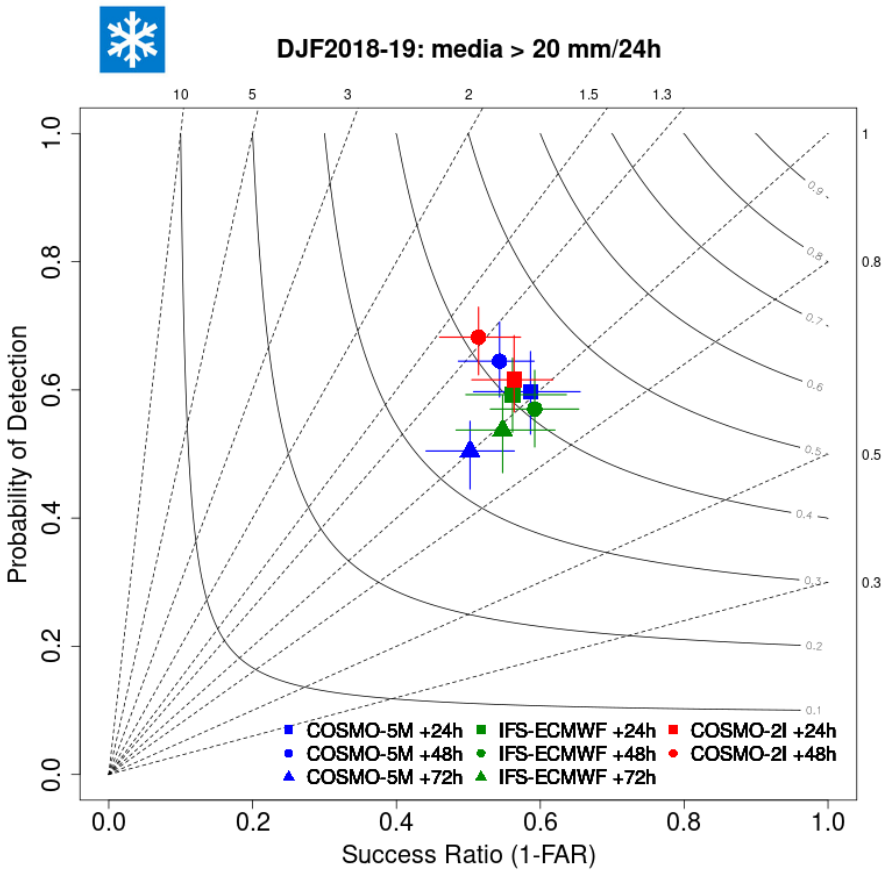
FAR

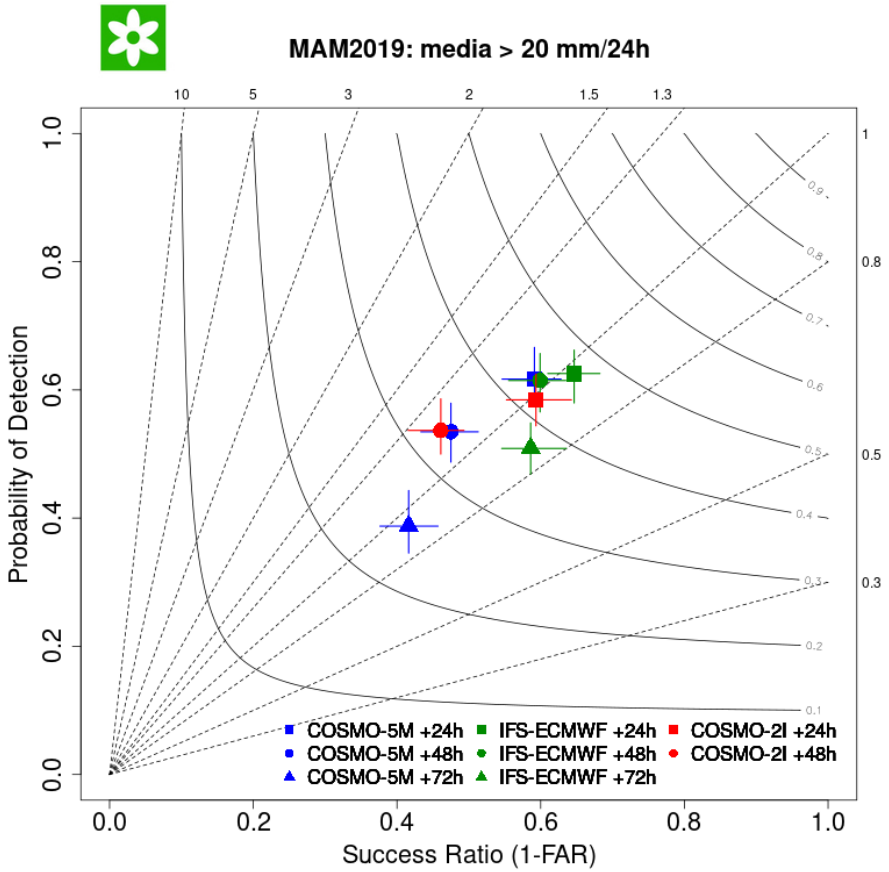
BIAS SCORE

AVERAGE

COSMO-2I MAM2019 fc+48

Results: all Italian catchment areas

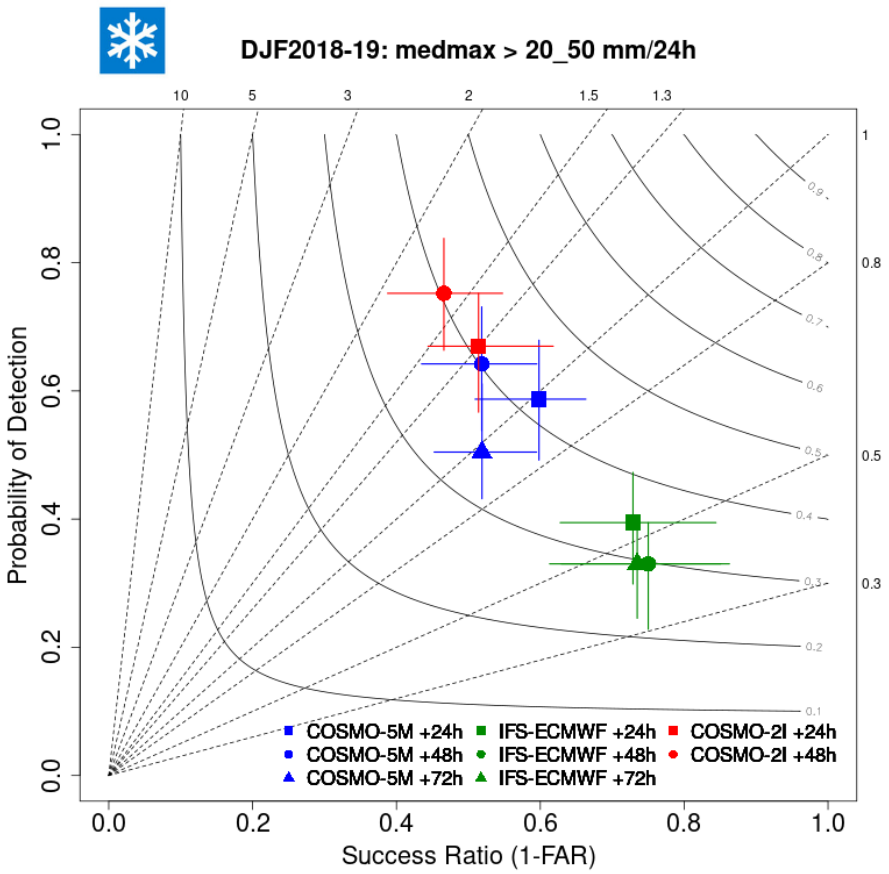


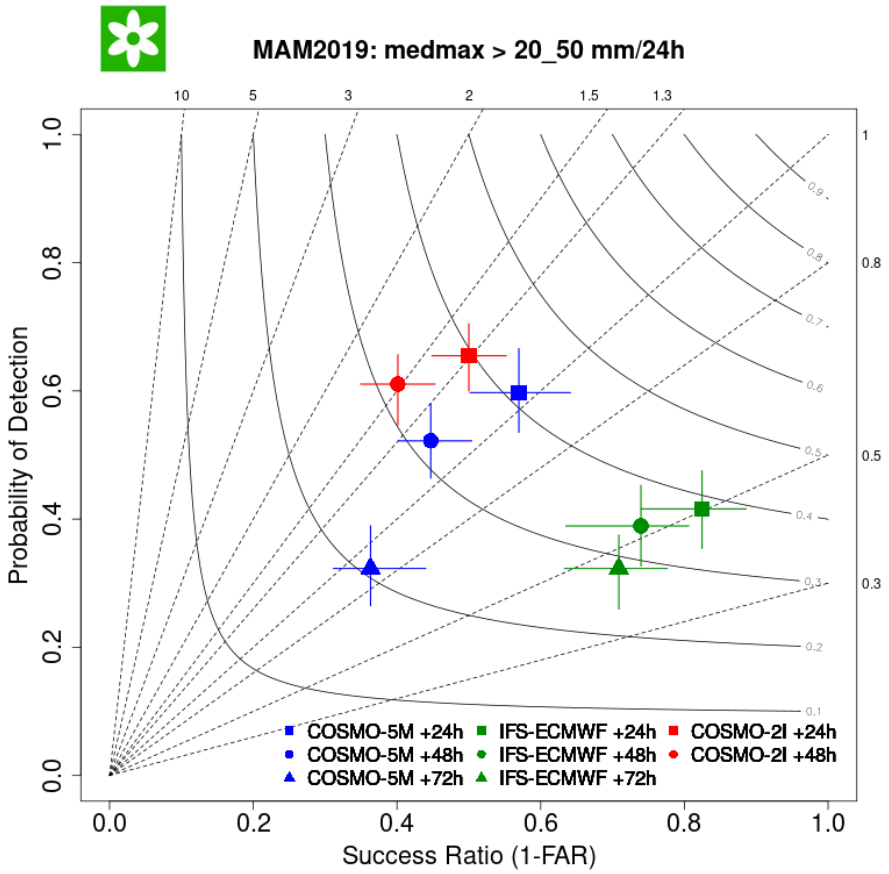


AVERAGE > 20 mm/24h

COSMO-2I (2.2 Km) ■ +24h
COSMO-5M (5.0 Km) ● +48h
IFS-ECMWF (~9 Km) ▲ +72h

Results: all Italian catchment areas





MAX> 50 mm/24h
&
MEDIAN > 20 mm/24h

COSMO-2I (2.2 Km) ■ +24h
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    - **Do we need a specific report format for AWARE?**

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

- **To be done:**
  - ❑ Produce reports on results for AWARE (if necessary)
  - ❑ Produce short report with the work accomplished

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