Operational verification using DIST: comparison of models with different resolution (COSMO1, COSMO-I2, COSMO-I7, IFS-ECMWF)

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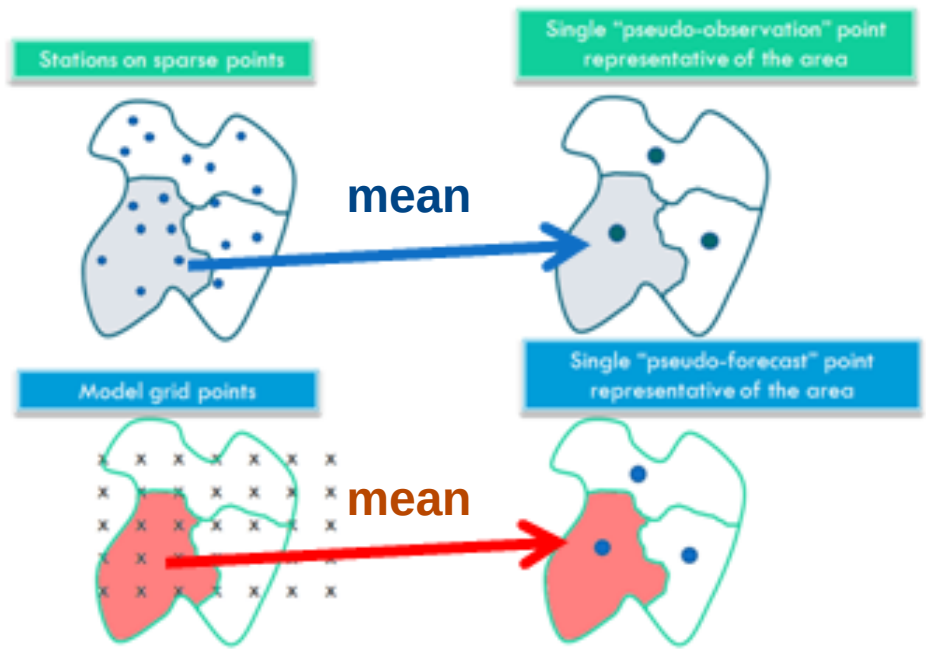
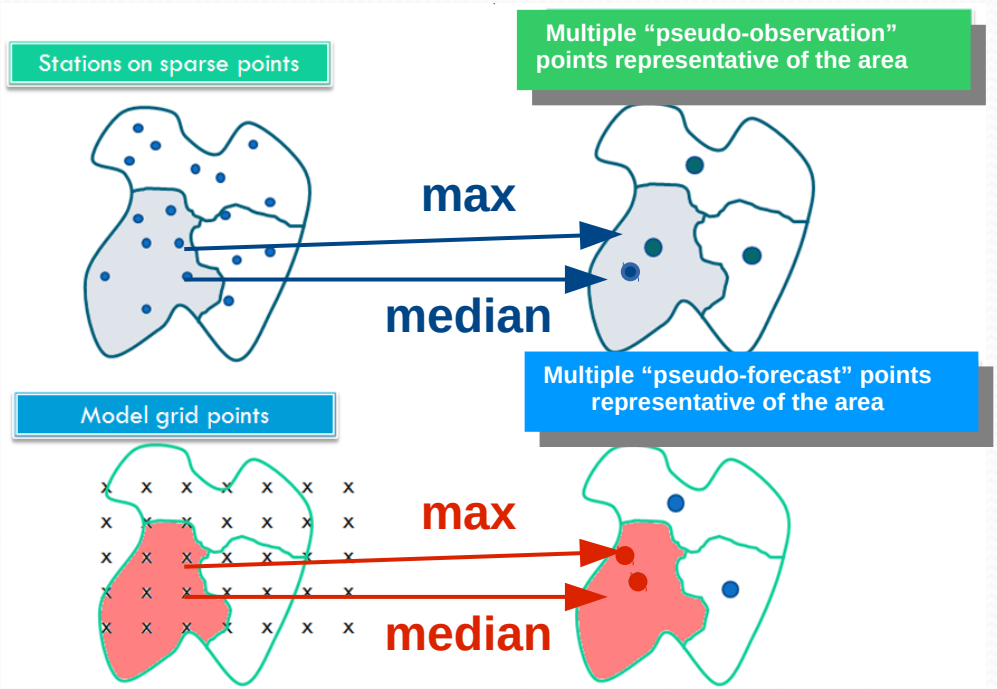
Background

- In previous presentations about DIST method the focus was mainly on technical detail on
  - how to evaluate the mean value of forecast and observed data over boxes or catchment area
  - how to perform the verification comparing the representative mean values for each area



Background

- Moreover DIST can be used to compare other parameter of the distribution:
  - Maximum
  - Median (50th percentile)
  - other percentile
  - a combination of them
  - (e.g. median > thr1 & max > thr2)



Overview

- How we used DIST for operational verification of precipitation at ARPA-SIMC
  - a way to compare model of various resolution from a user point of view
- Considering different parameters for the verification helps to highlight different aspects of the behavior of models
  - So that it is possible to give a simple “rule of thumb” for the use of the QPF

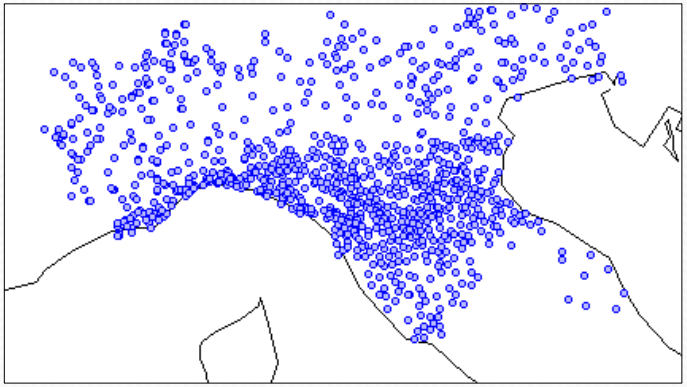
The user point of view

- It may seem that the principal purpose of DIST is to simplify the management, for verification application, of the large amount of data that comes from high-resolution rain-gauges network and models grid-points
- But this is not the main advantage, for many operational application forecasters need to know if the average value of precipitation that fall over an area exceed a warning threshold with a real hydrological meaning

- Moreover even if the average value is below any warning threshold, the possible presence of localized precipitation peaks is an important information for Civil Protection purpose and for issuing alerts
- The comparison of models considering these aspect can help the user to take decision when different models say different things

Dataset

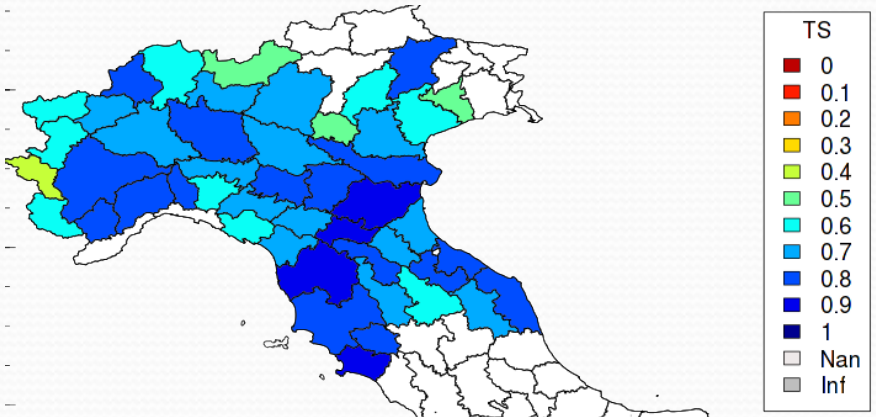
- MODELS:
  - IFS-ECMWF
  - COSMO-I7
  - COSMO-I2
  - COSMO1 (CH)
- OBSERVATION:



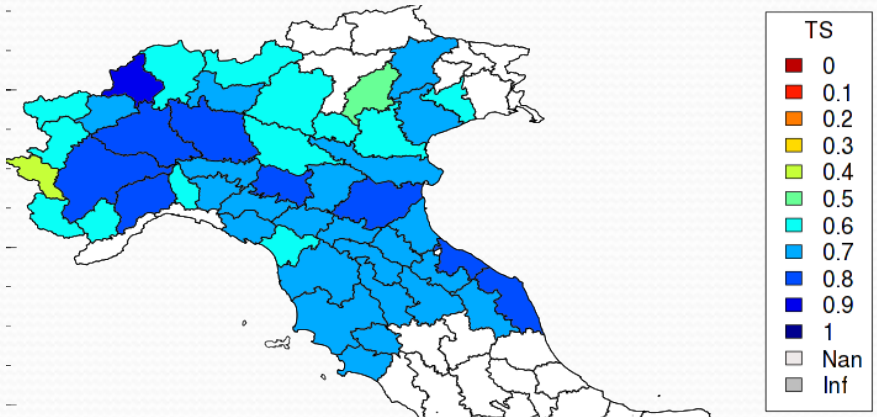
- FORECAST STEP
  - 0-72h (COSMO-I7,IFS-ECMWF)
  - 0-48h (COSMO-I2)
  - 0-24h (COSMO1)
- ACCUMULATION PERIOD
  - 24 h
  - 3 h
- SEASONAL VERIFICATION
  - JJA2014
  - SON2014
  - DJF2014-15
  - MAM2015

MAM2015 - TS mean> 5 mm/24h

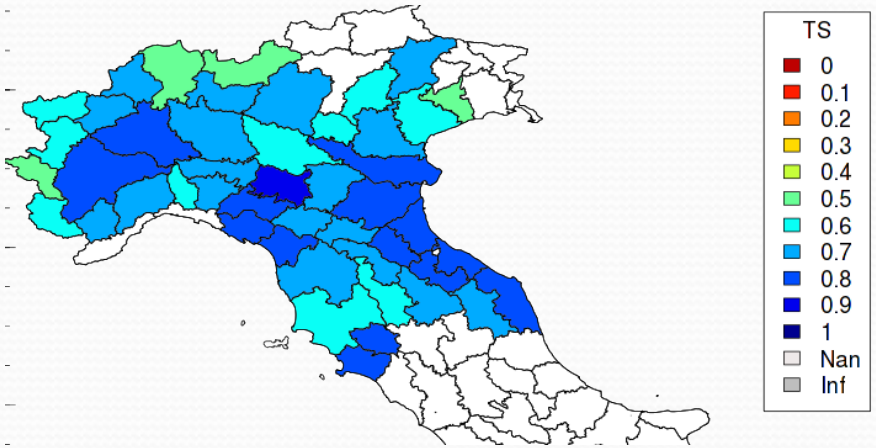
IFS-ECMWF



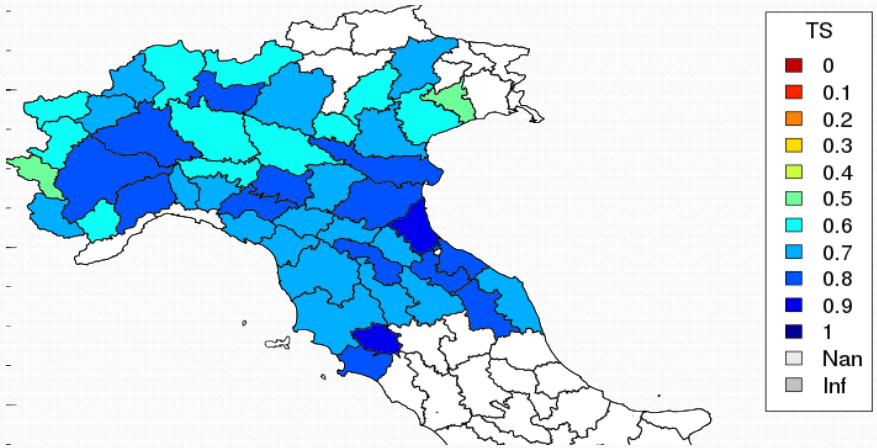
COSMO-I7



COSMO-I2

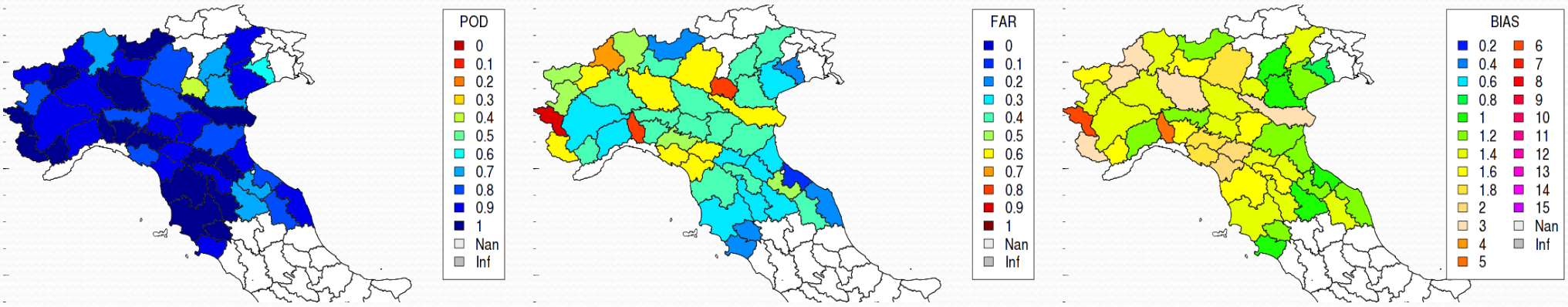


COSMO1-CH

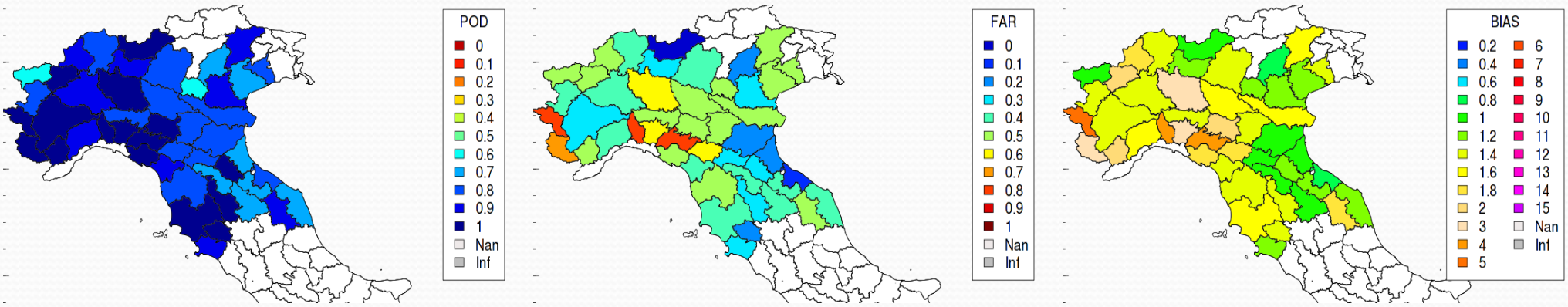


MAM2015: Mean > 10 mm/24

IFS-ECMWF

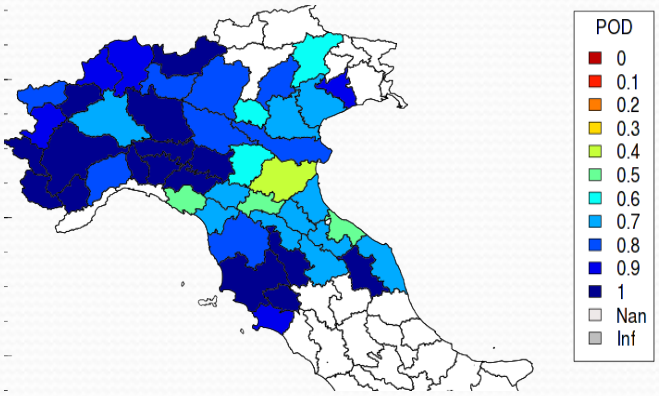


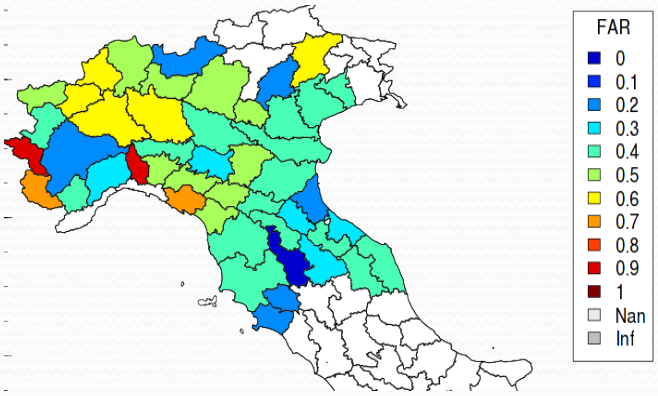
COSMO-I7

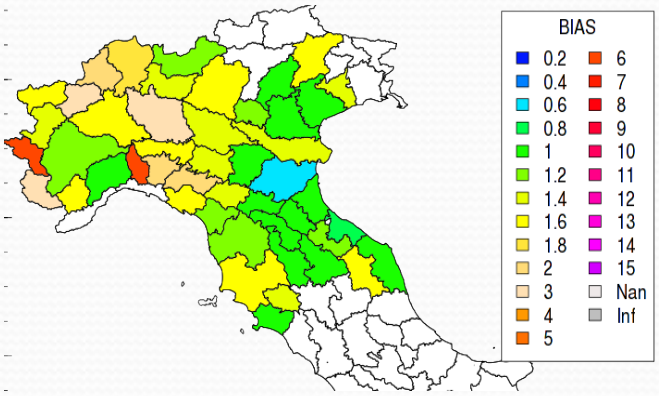


MAM2015: Mean > 10 mm/24

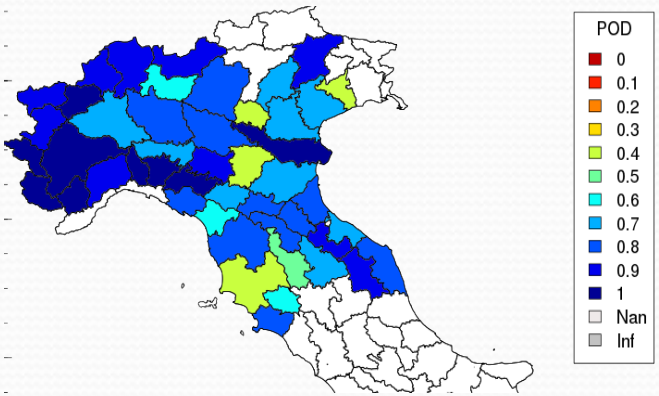
COSMO-I2

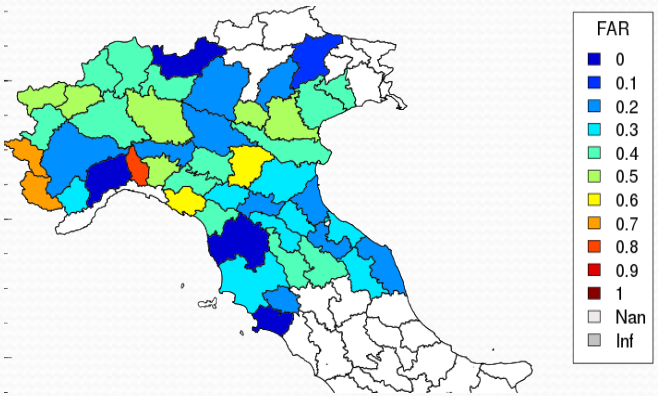


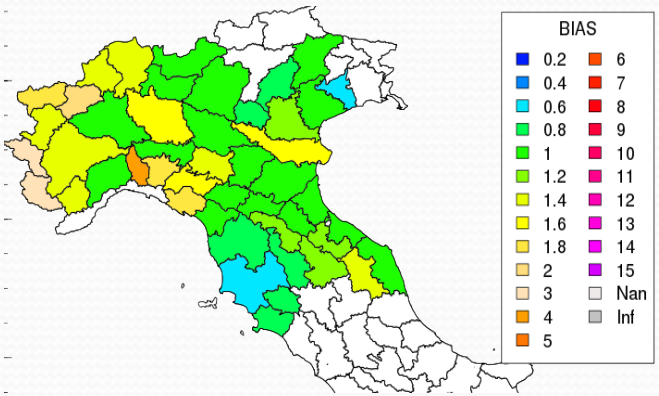




COSMO1-CH



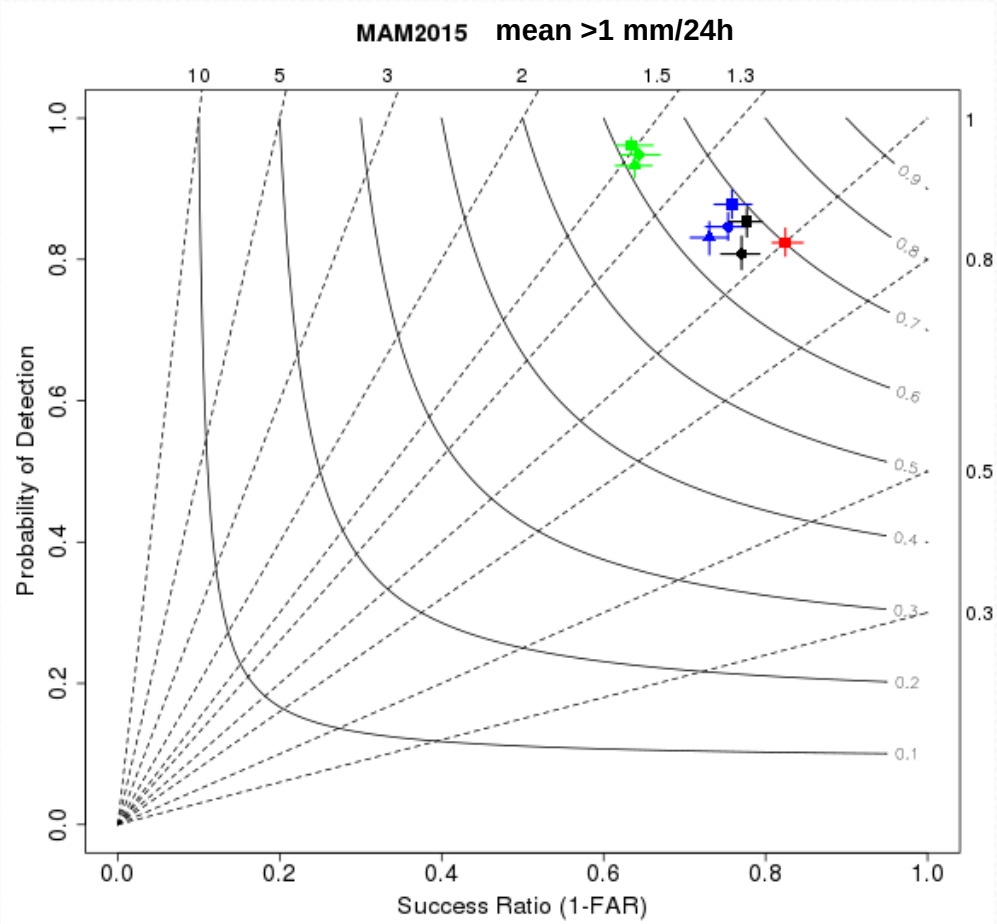




- For low threshold the global model seems to perform better than COSMO models
- Since these events represent the majority of the precipitation cases, forecasters (at least my colleagues!) tend to give more credit to IFS-ECMWF
- But there are many cases in which the higher resolution models are better and, most of all, valuable

MAM2015 – Mean value

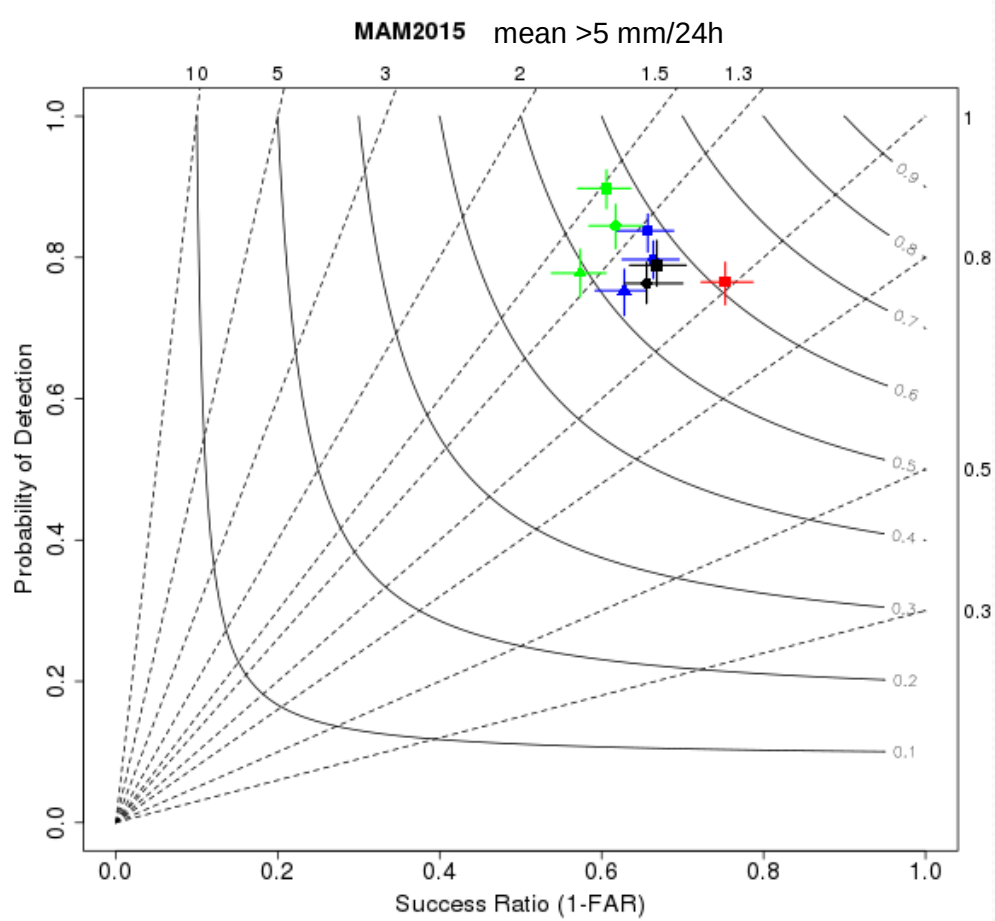
1 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Mean value

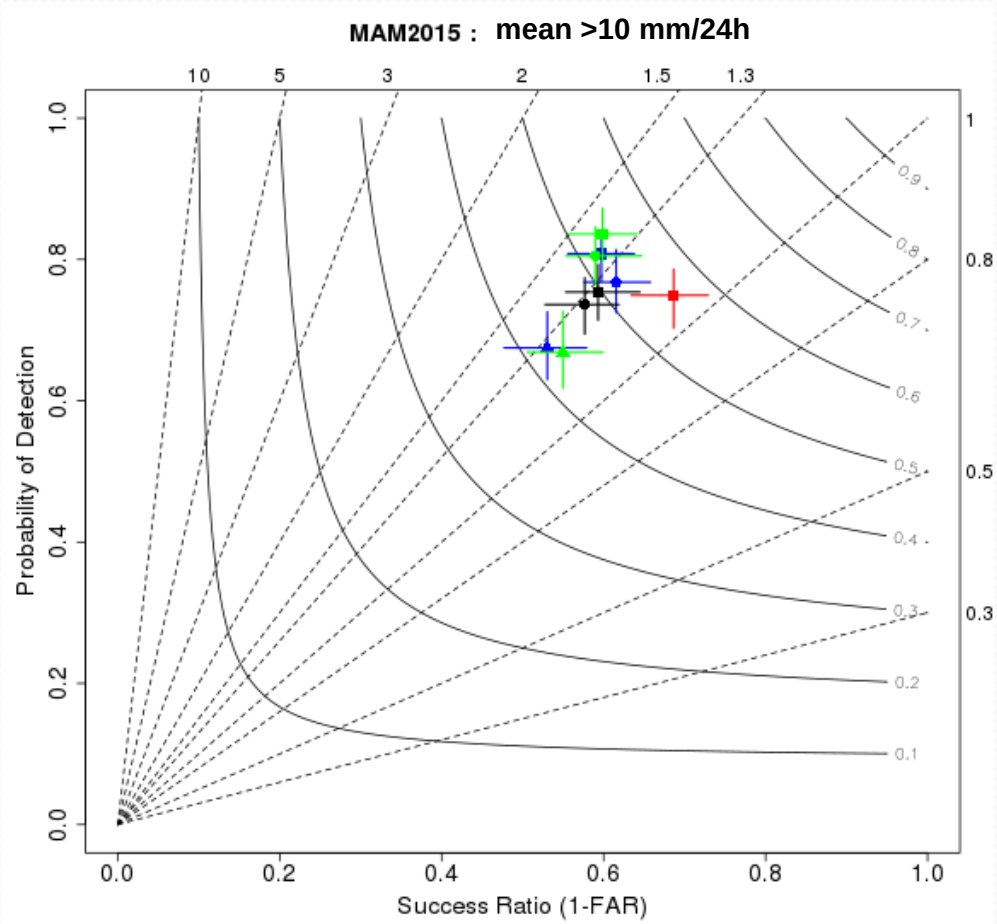
5 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Mean value

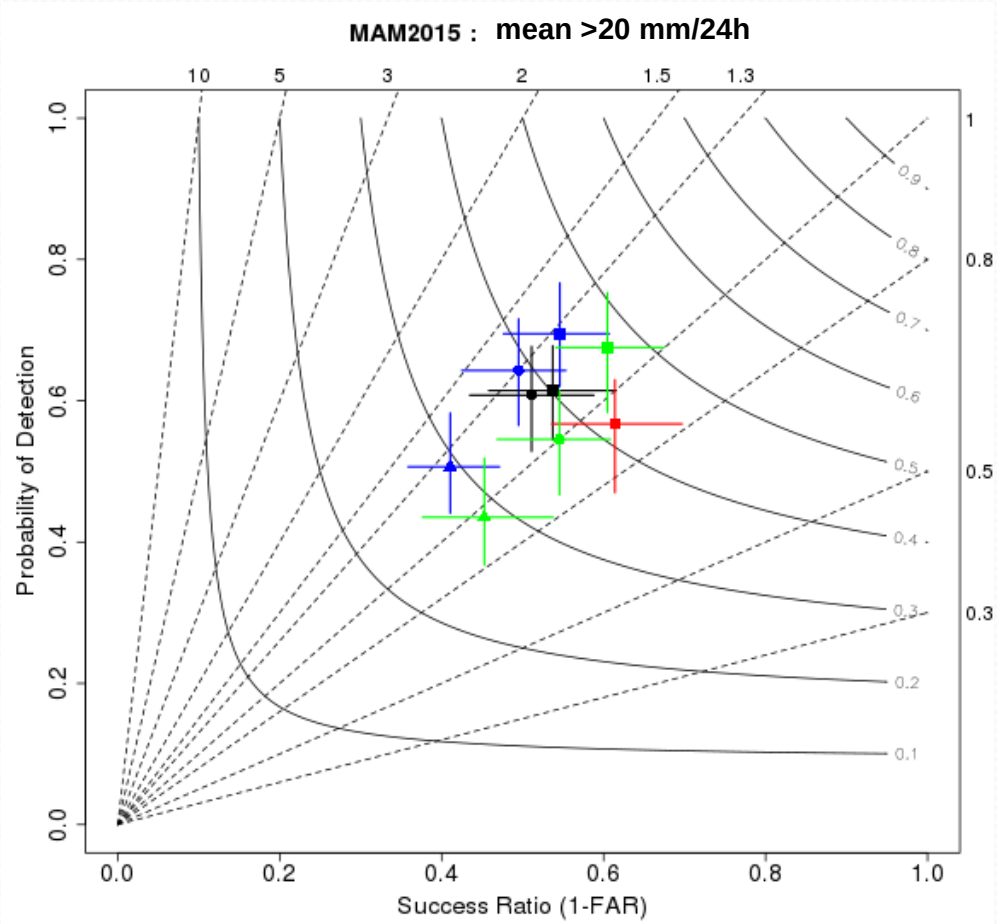
10 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Mean value

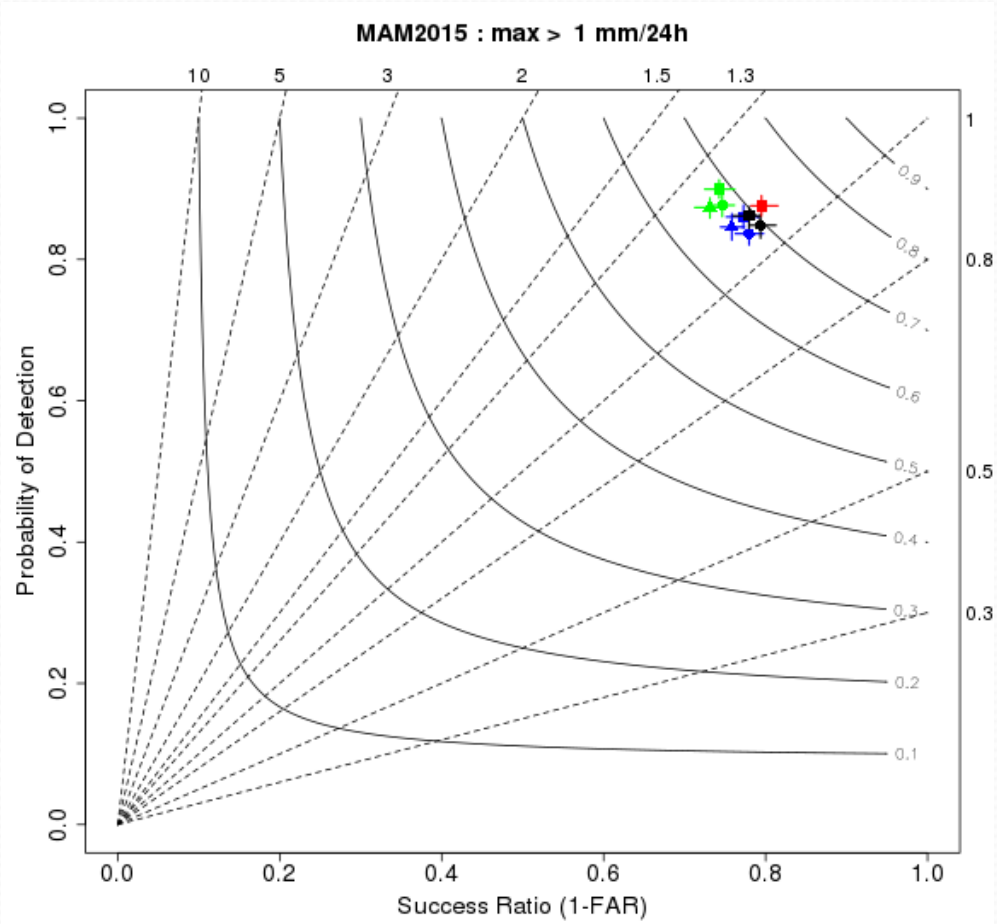
20 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Max value

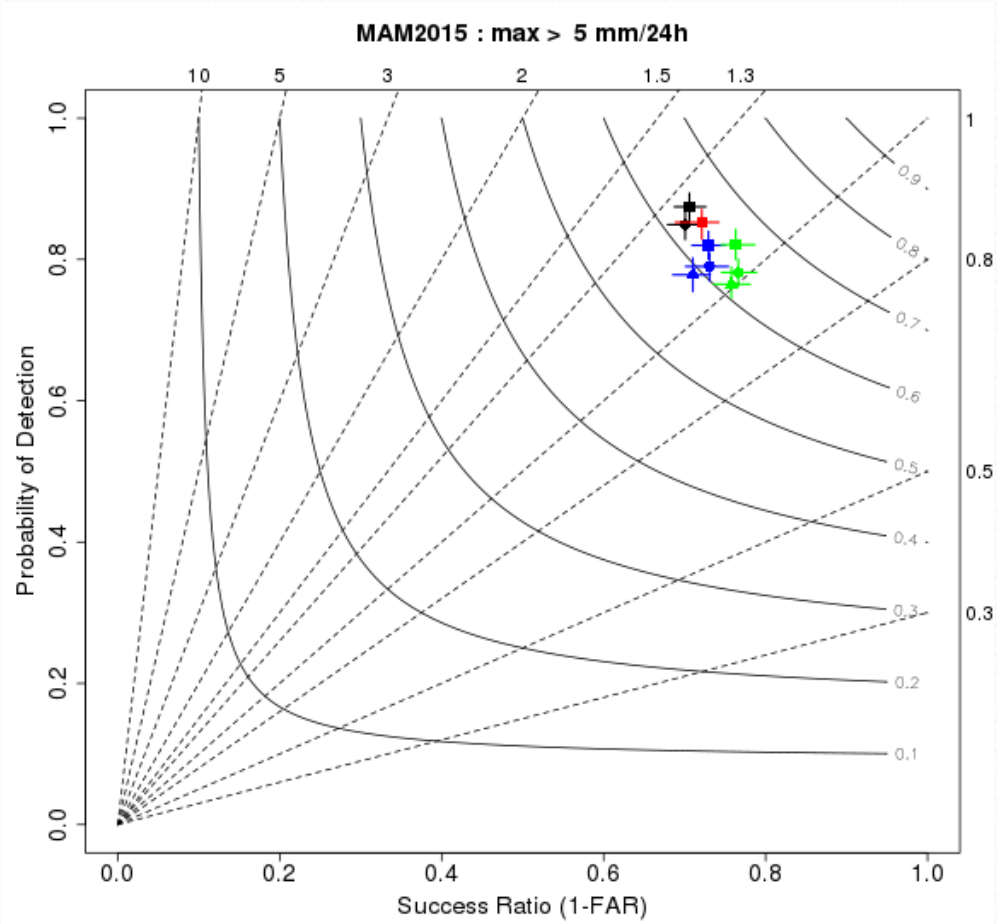
1 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Max value

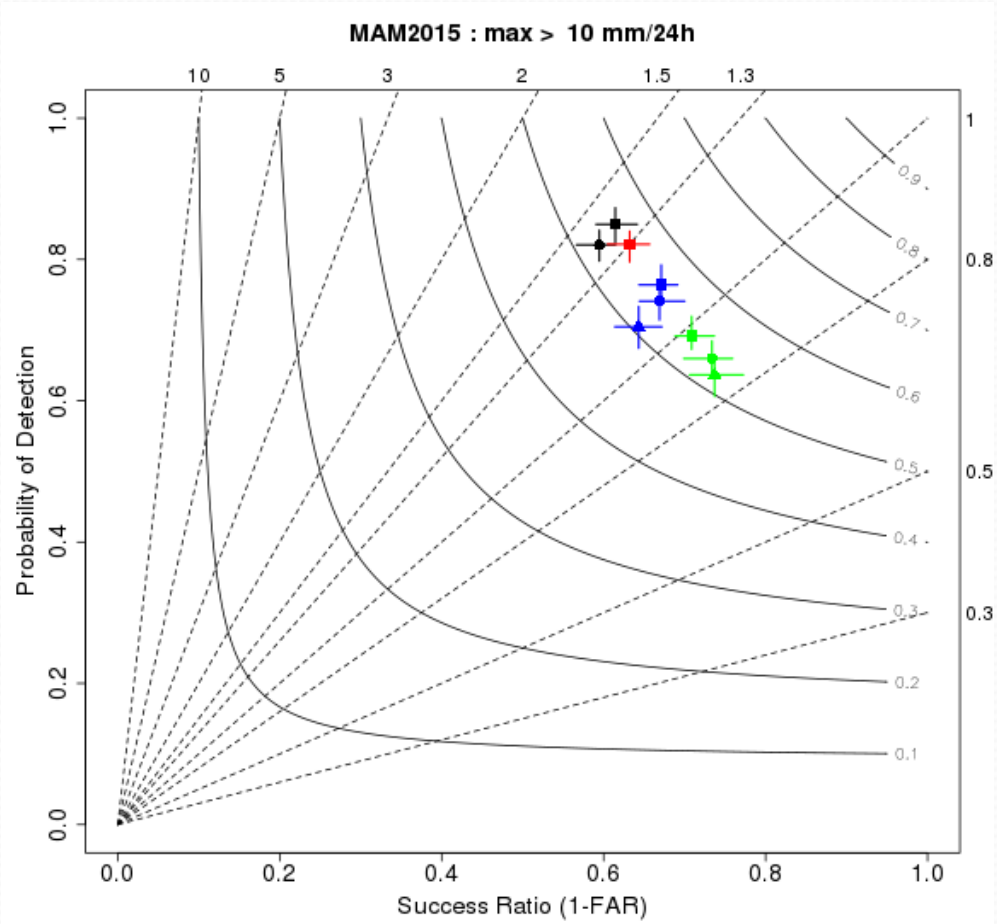
5 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Max value

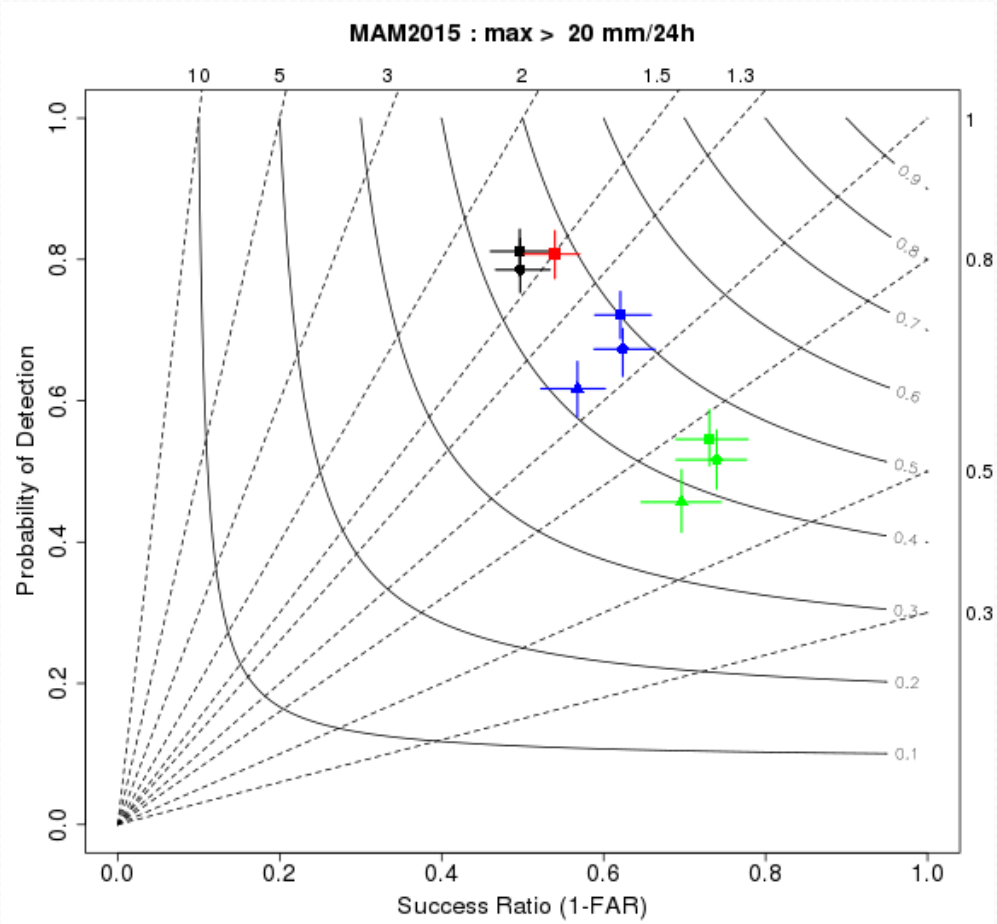
10 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Max value

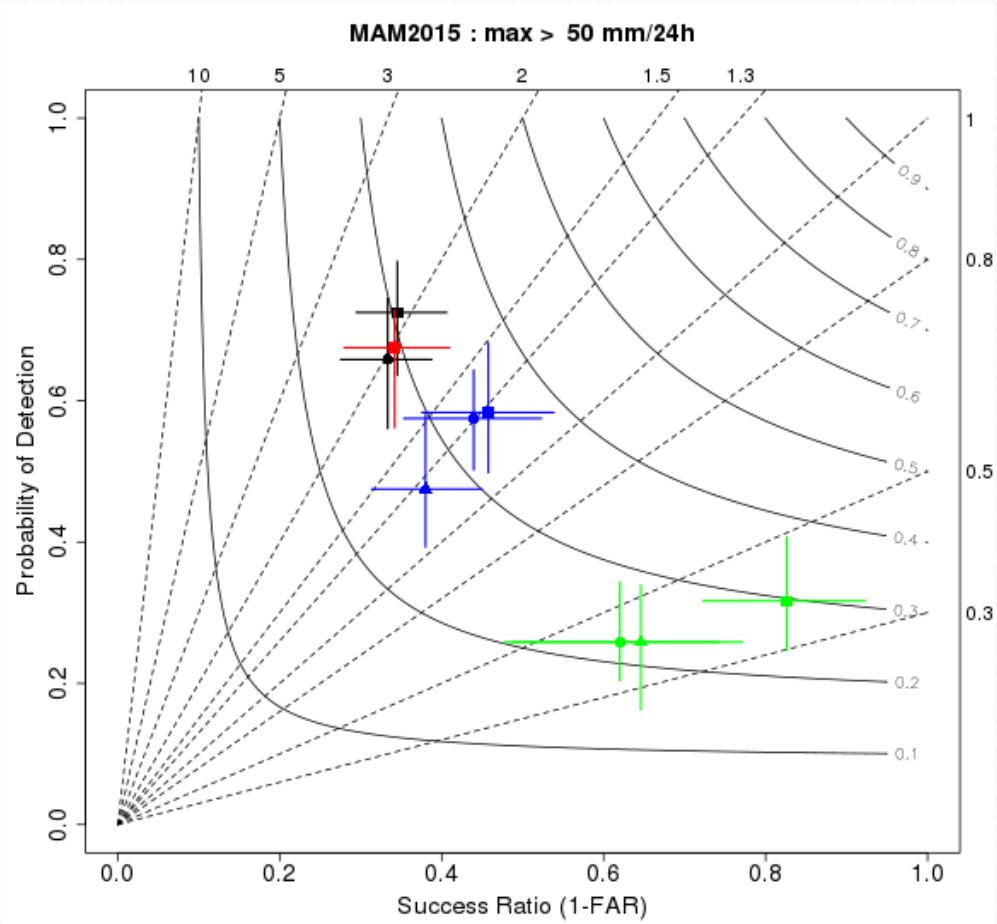
20 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Max value

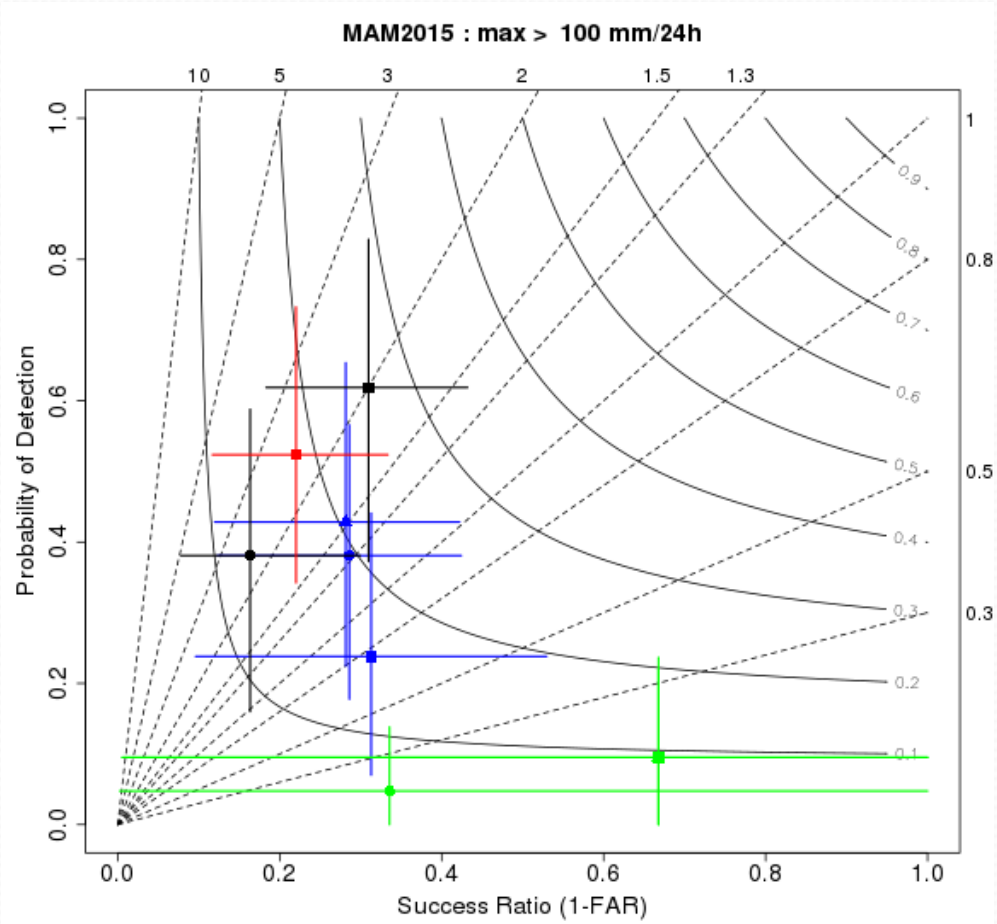
50 mm/24h



COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015 – Max value

100 mm/24h

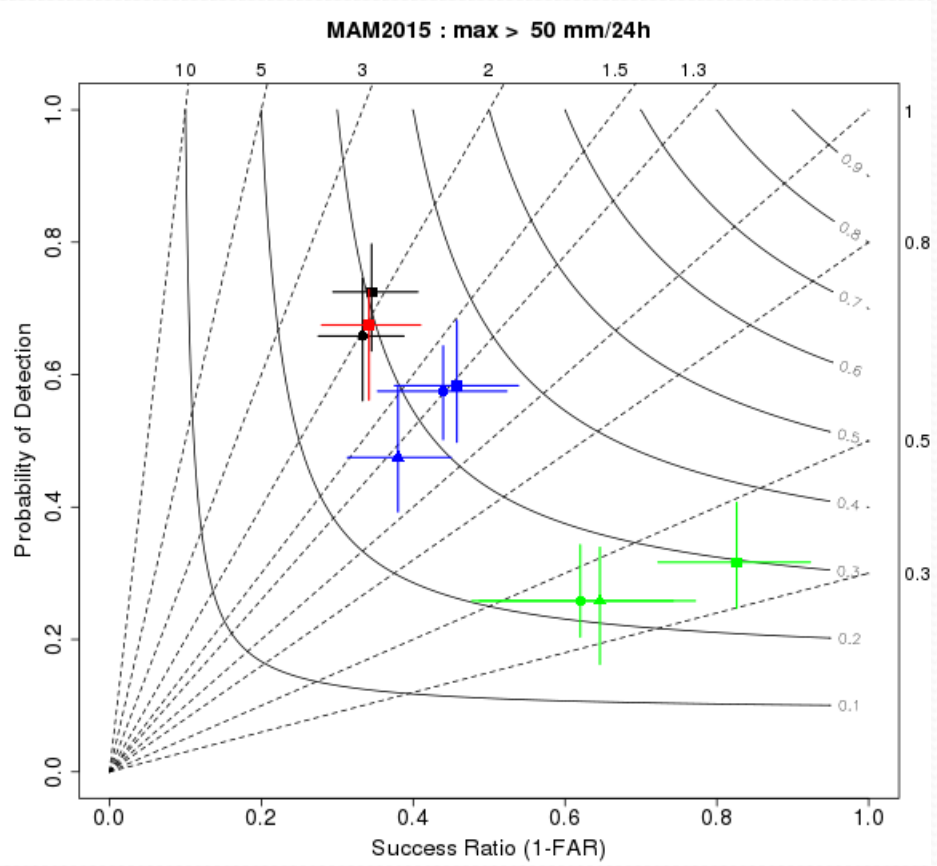


- For the mean value, the differences between model are small and the way in which the scores tend to get worse as threshold increases is nearly the same for all models
- For the maximum, the increase of the threshold produce a “graphical separation” in the scores of the models
  - COSMO-I2 and COSMO1 maintain a good POD but FAR and BIAS grow
  - IFS-ECMWF decrease rapidly the POD and the BIAS indicates a significant underestimation for high threshold (even if the few times that are forecast are correct)
  - COSMO-I7 takes a intermediate position, the scores decrease but the BIAS does not change

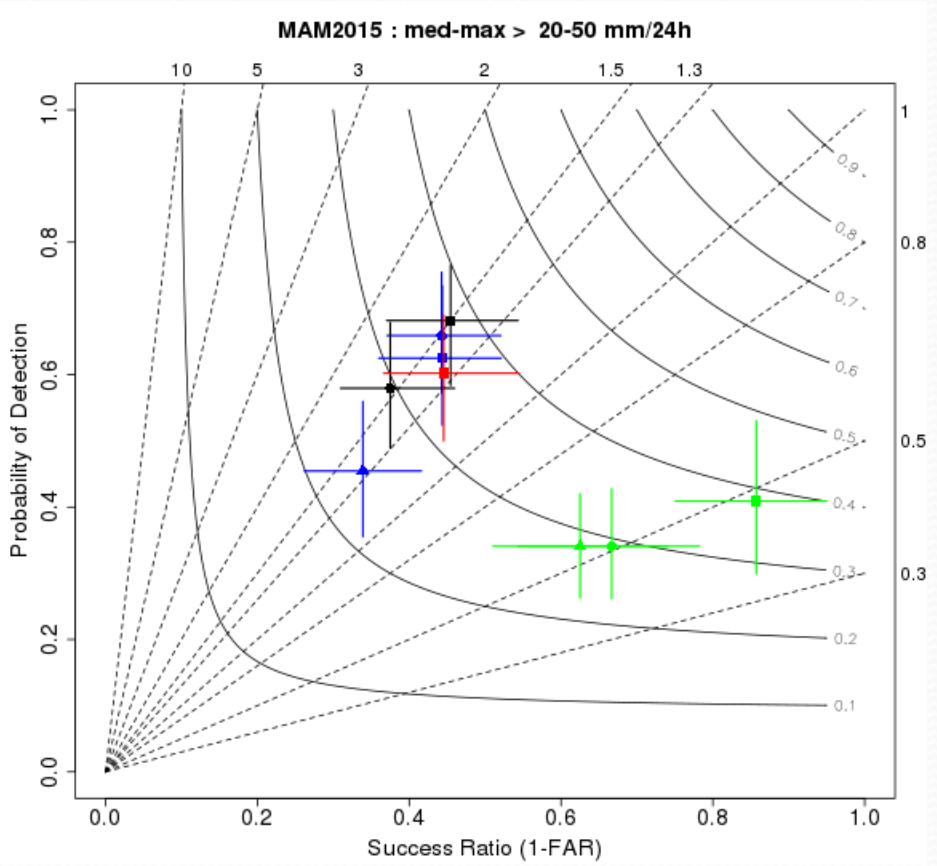
- For warning purpose, in my opinion, IFS-ECMWF is little helpful, but how can be handled the high number of false alarms of COSMO-1 and COSMO-I2?
- If we perform a conditional verification with one condition on the median (50% of the point in the area) and the second condition on the maximum we will find out that higher resolution models are able to well discriminate different rain regimes
- These results may help the user to give credit to high value of QPF

MAM 2015 – Median & Max

MAX > 50 mm/24h



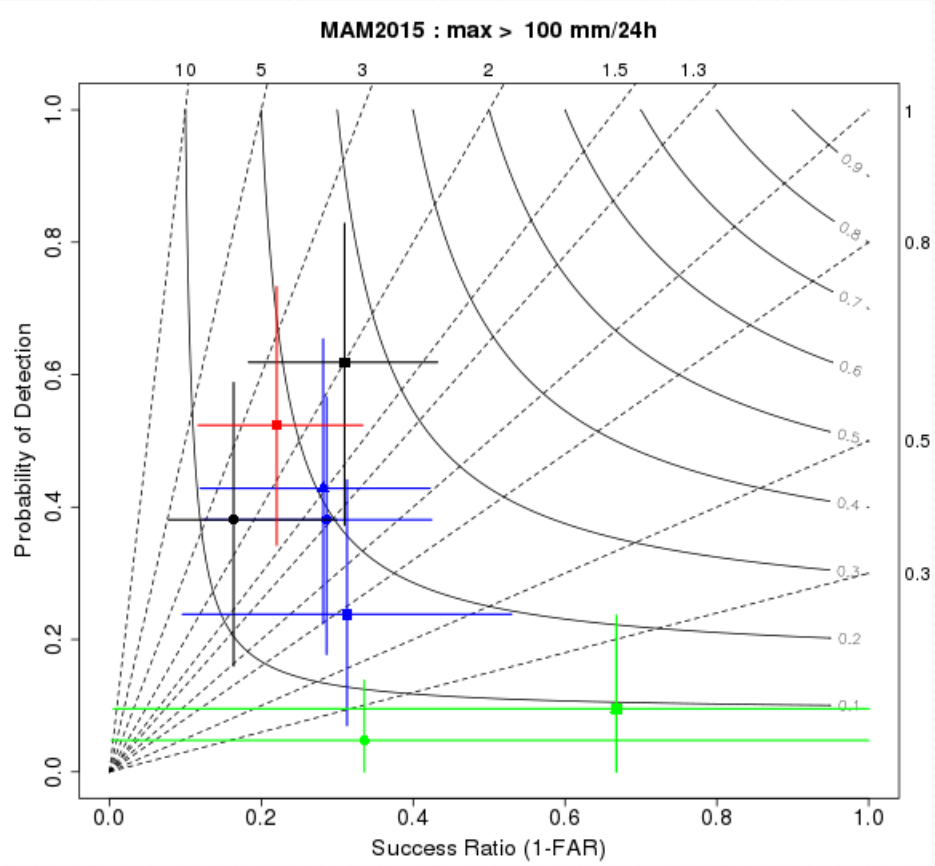
MED > 20 mm/24h & MAX > 50 mm/24h



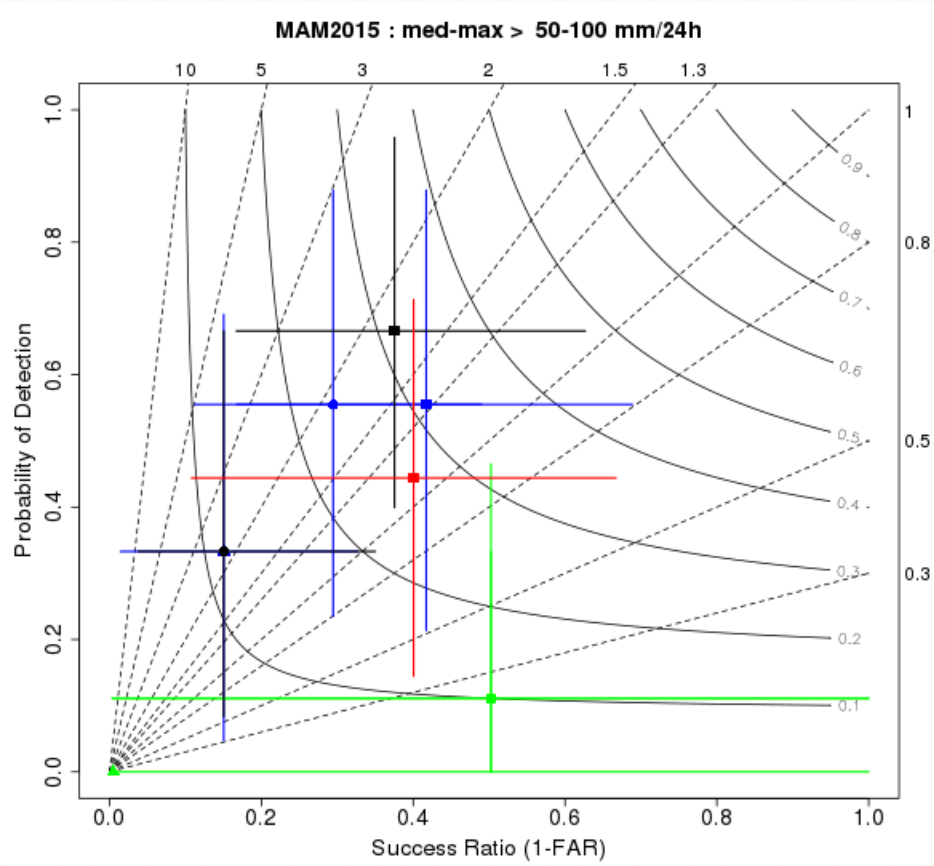
COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM 2015 – Median & Max

MAX > 100 mm/24h



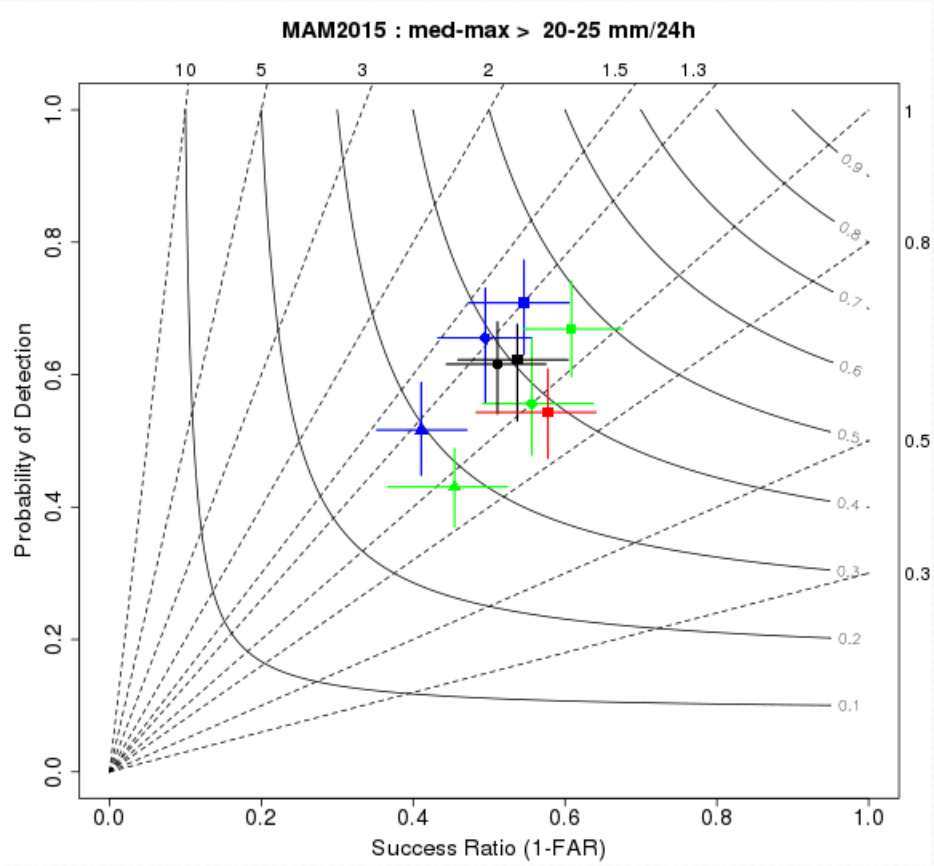
MED > 50 mm/24h &MAX > 100 mm/24h



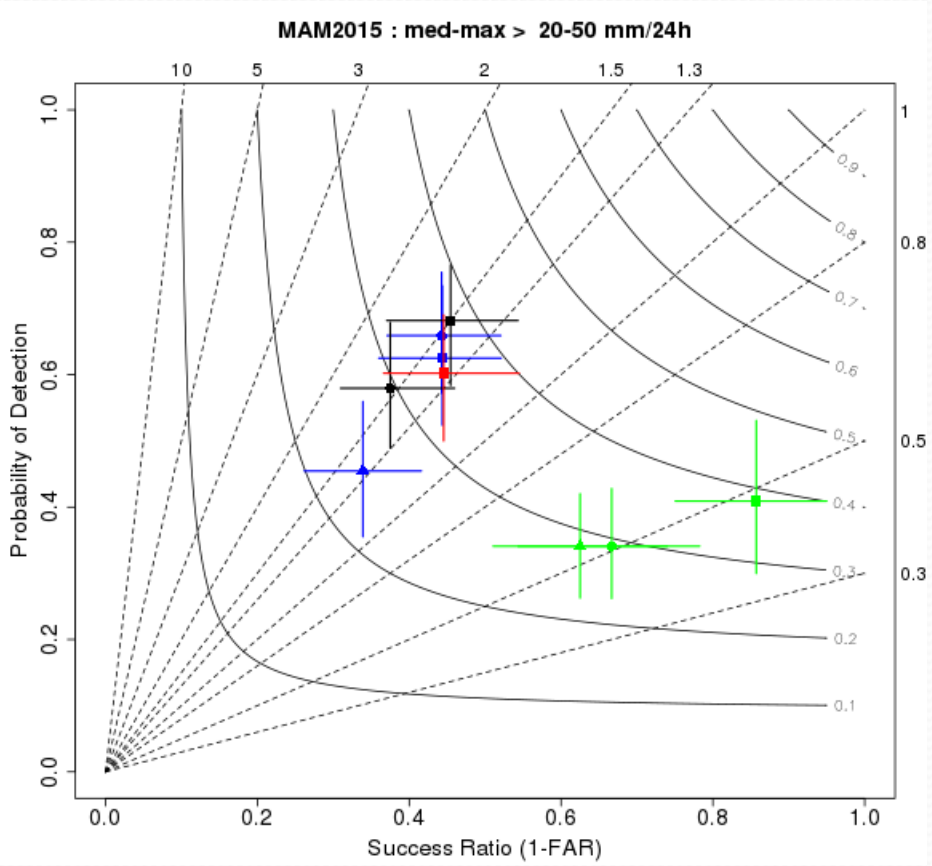
COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM 2015 – Median & Max

MED > 20 mm/24h &MAX > 25 mm/24h



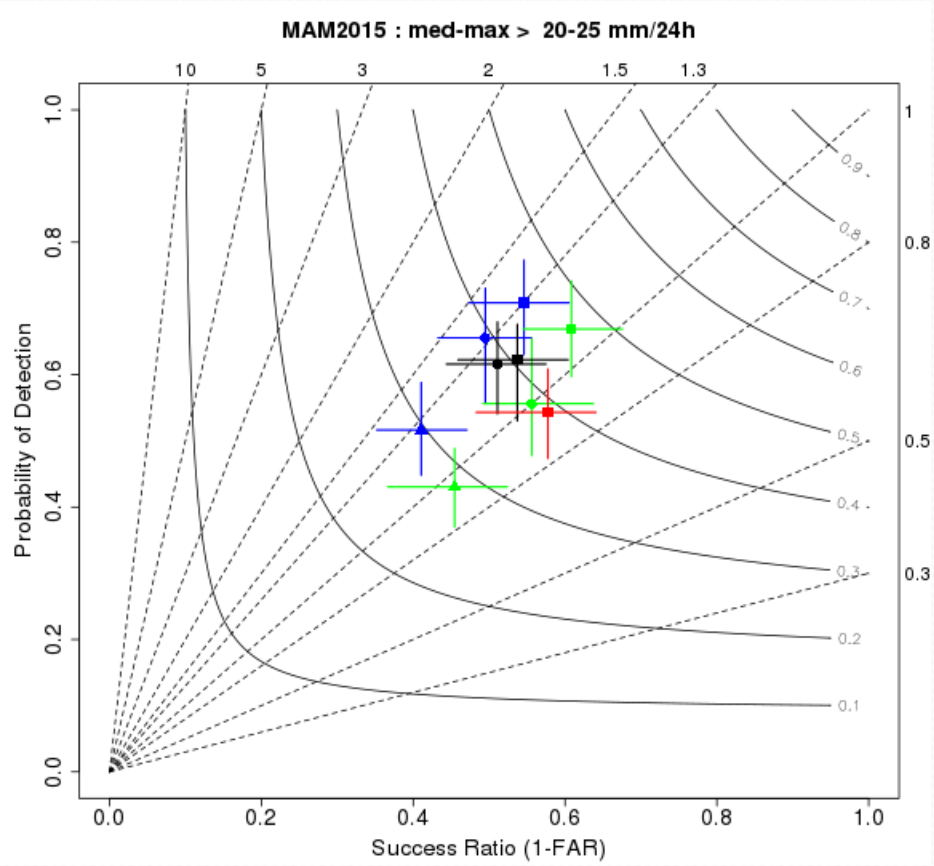
MED > 20 mm/24h &MAX > 50 mm/24h



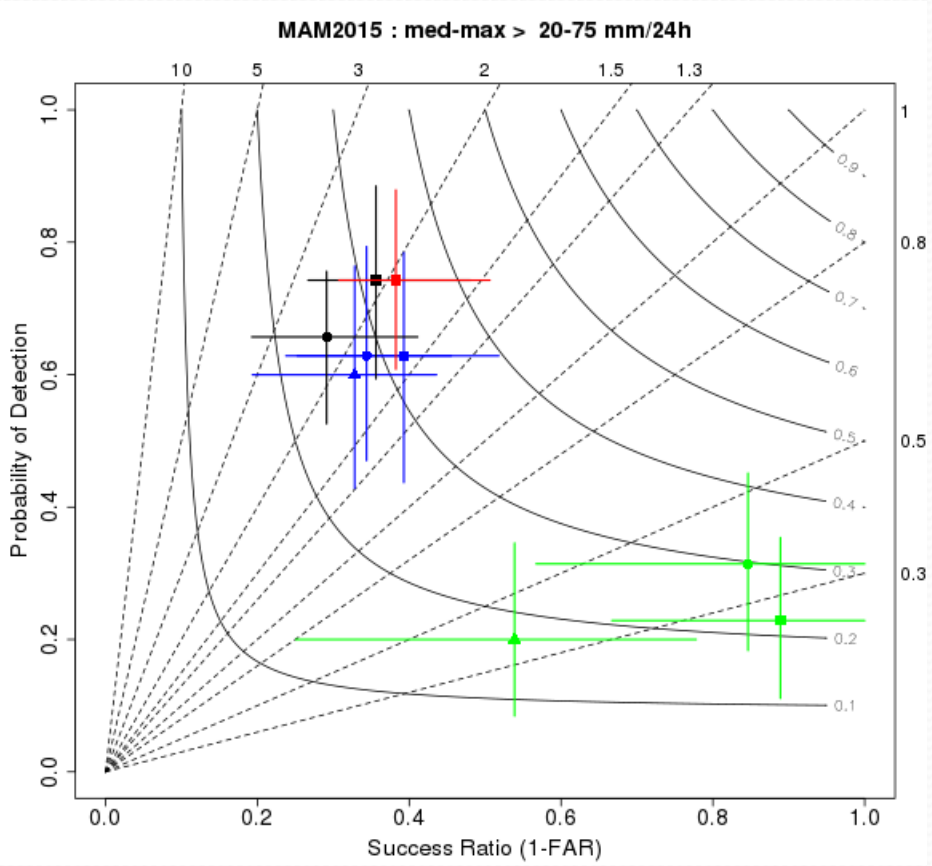
COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM 2015 – Median & Max

MED > 20 mm/24h &MAX > 25 mm/24h



MED > 20 mm/24h &MAX > 75 mm/24h

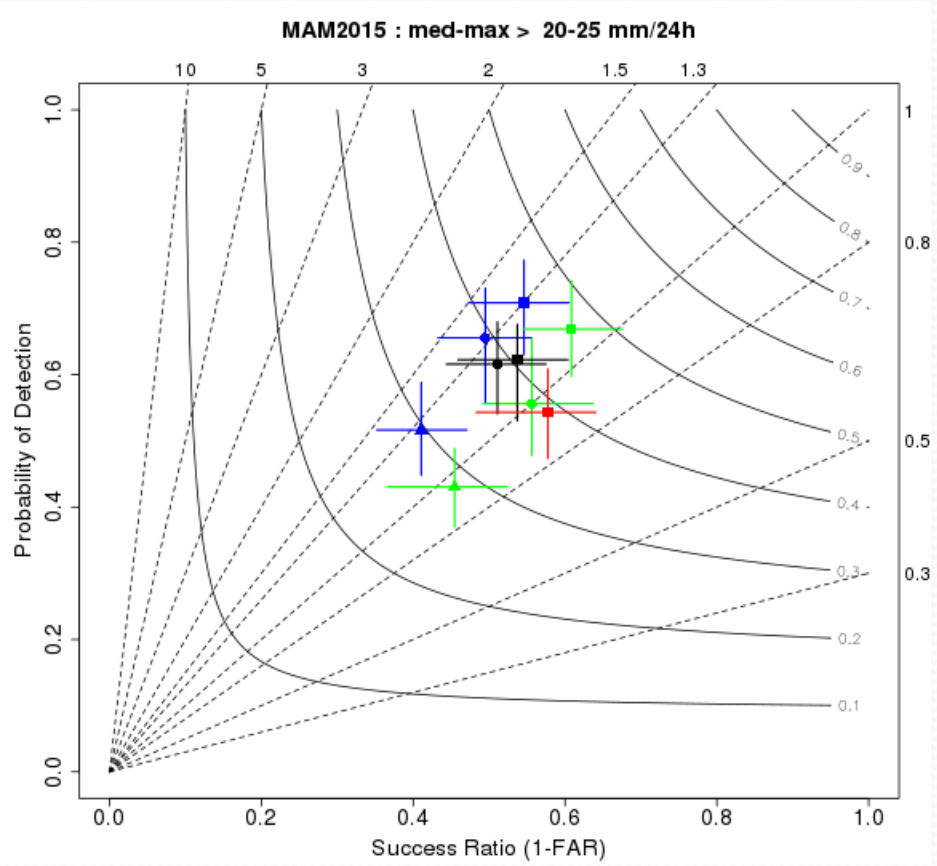


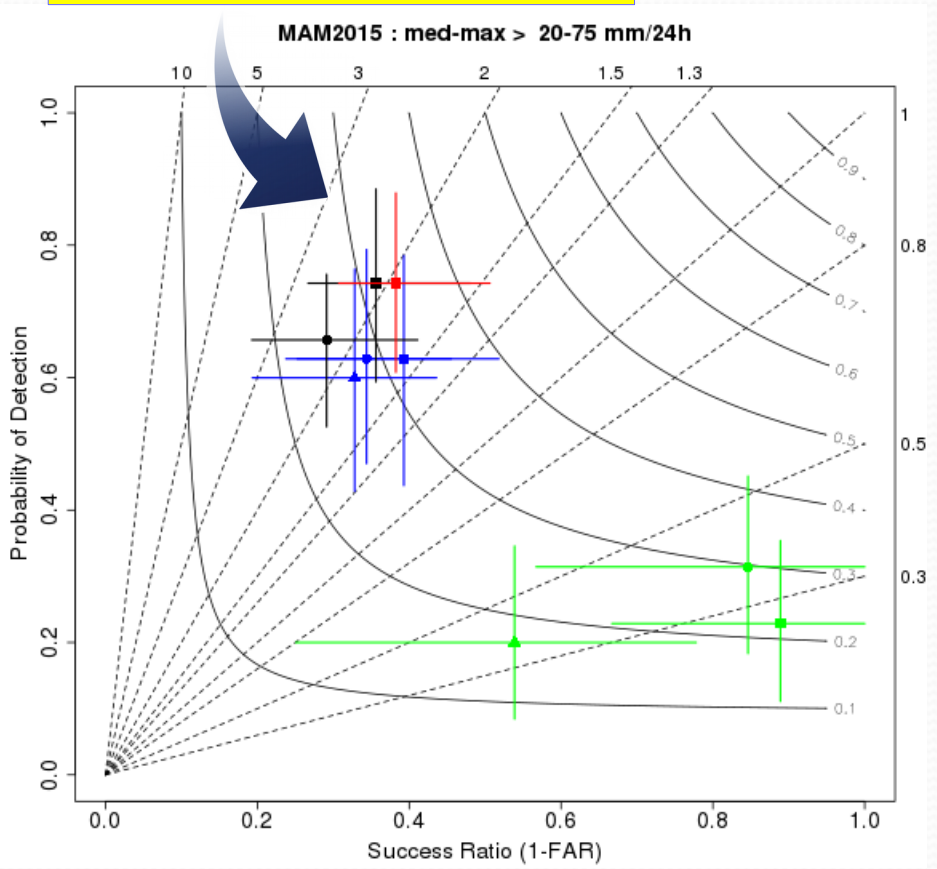
COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM 2015 – Median & Max

MED > 20 mm/24h &MAX > 25 mm/24h

More or less the same TS

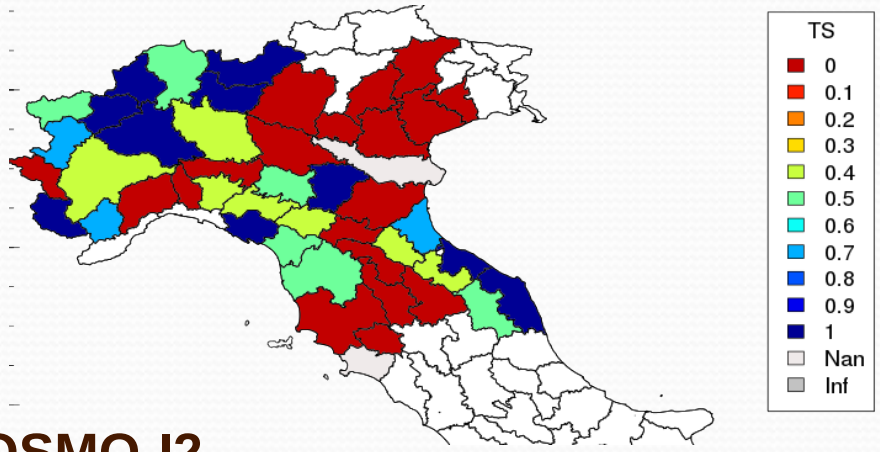




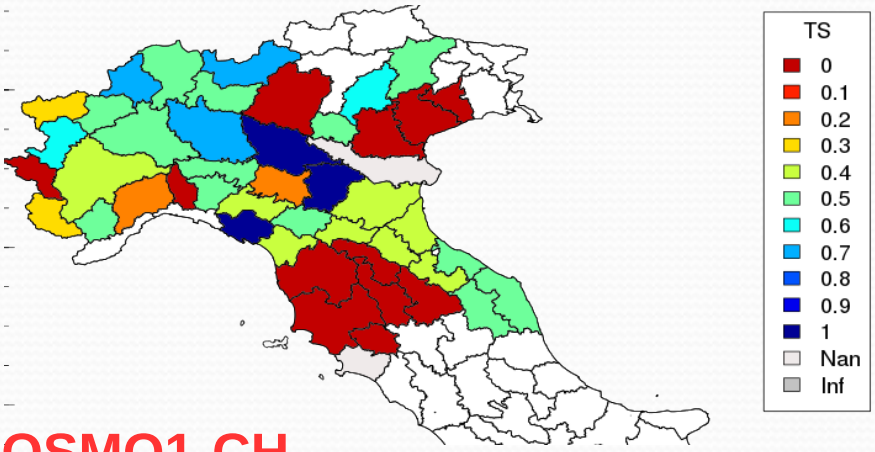
COSMO-I2_00 - fc + 24
COSMO-I2_00 - fc + 48
COSMO-I7_00 - fc + 24
COSMO-I7_00 - fc + 48
COSMO-I7_00 - fc + 72
COSMO1CH_00 - fc + 24
ECMWF_00 - fc + 24
ECMWF_00 - fc + 48
ECMWF_00 - fc + 72

MAM2015
median> 20 mm/24h & max > 50 mm/24h

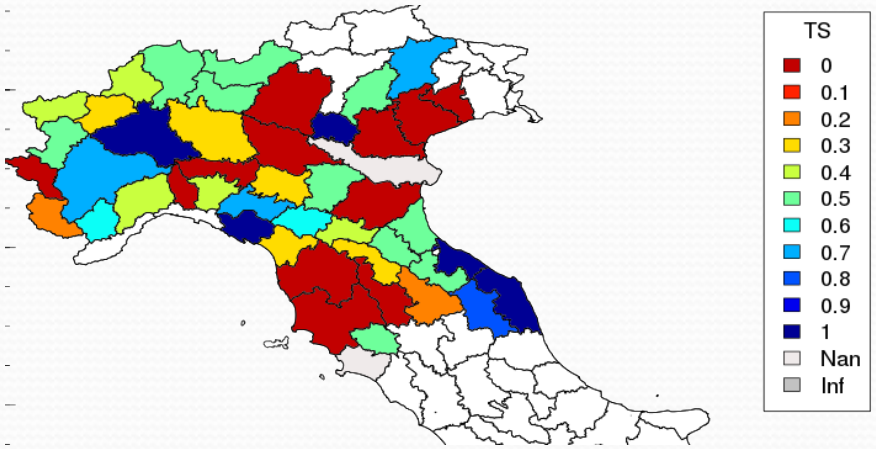
IFS-ECMWF



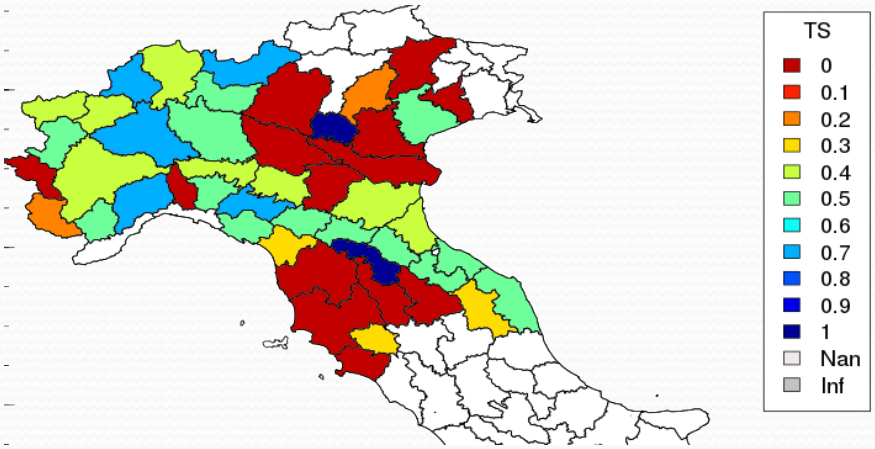
COSMO-I7



COSMO-I2

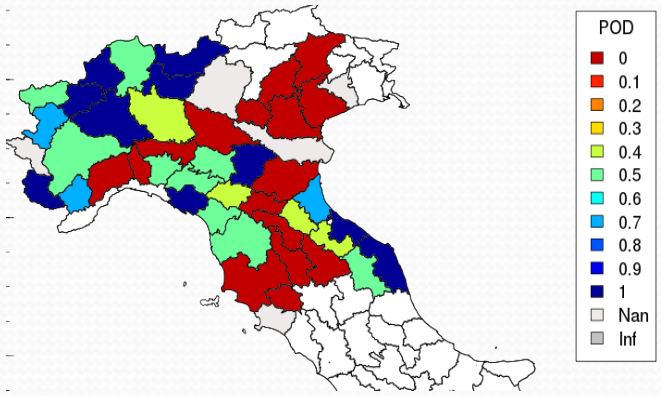


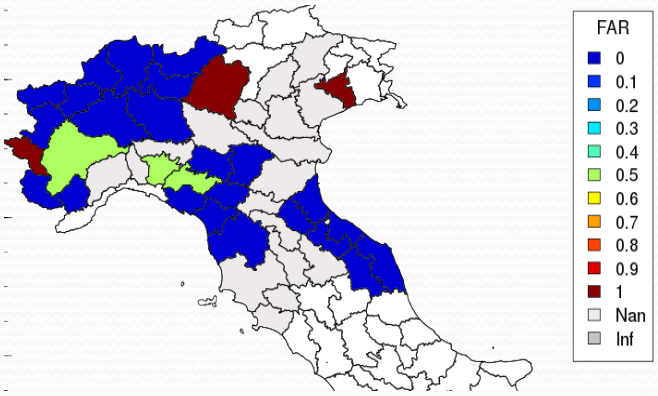
COSMO1-CH

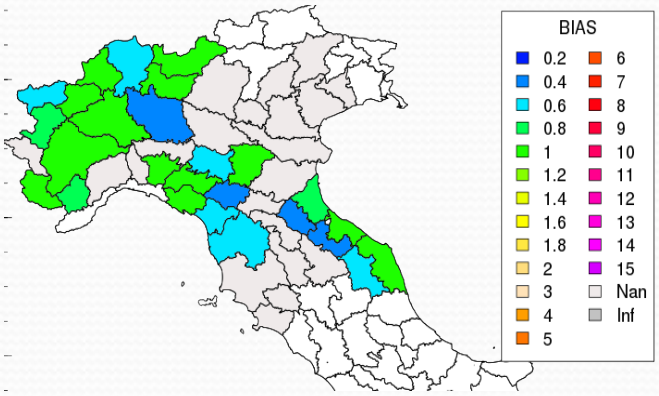


MAM2015
median> 20 mm/24h & max > 50 mm/24h

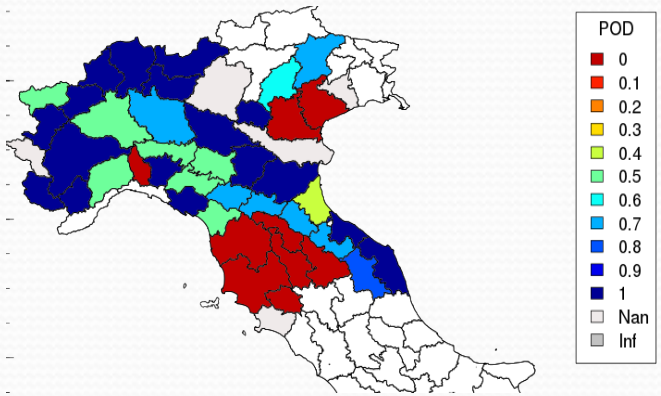
IFS-ECMWF

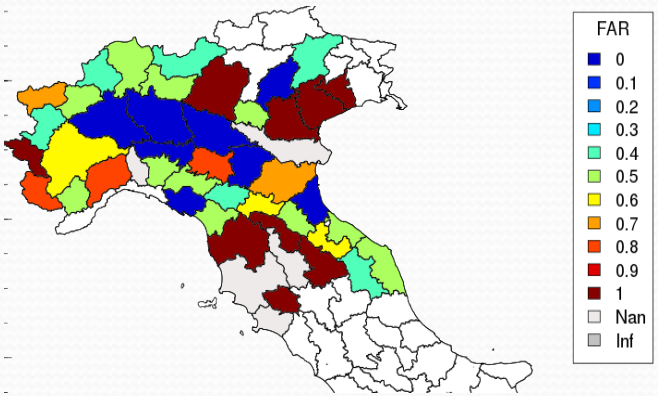


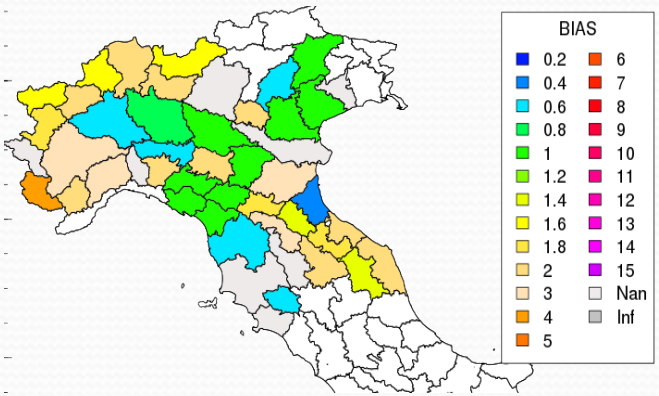




COSMO-I7

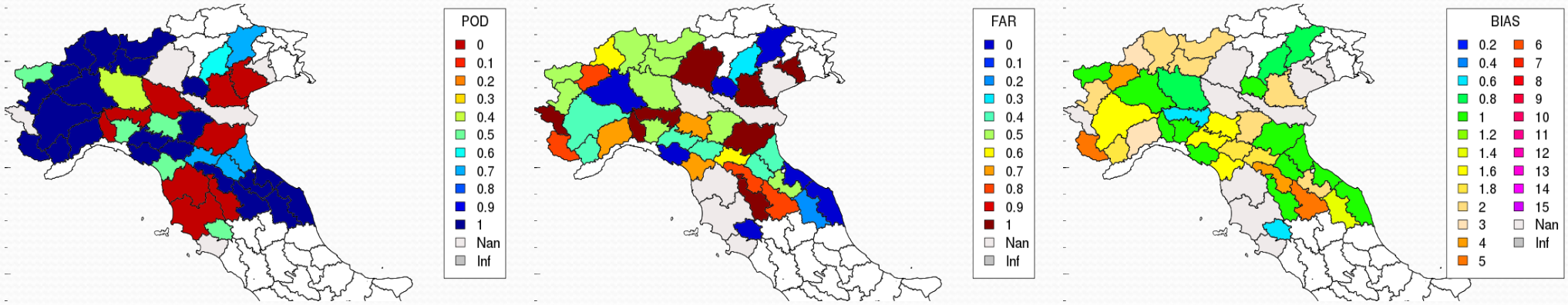




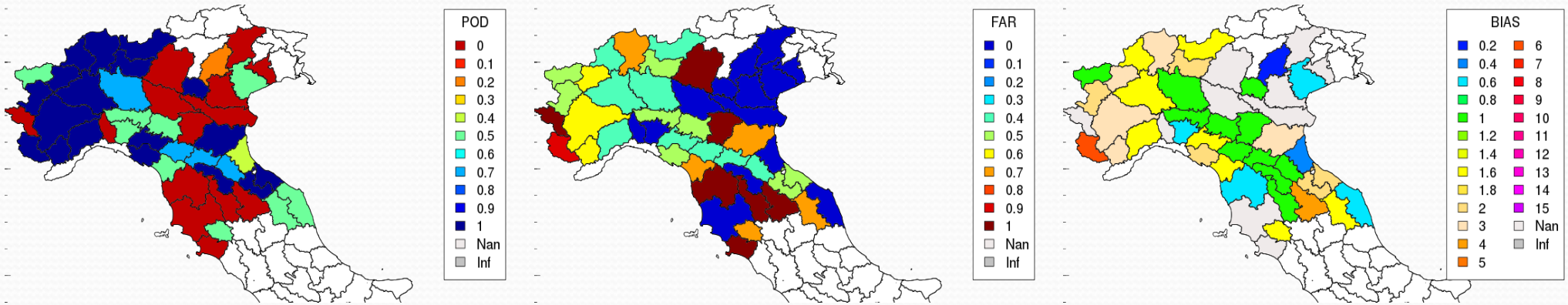


MAM2015
median> 20 mm/24h & max > 50 mm/24h

COSMO-I2



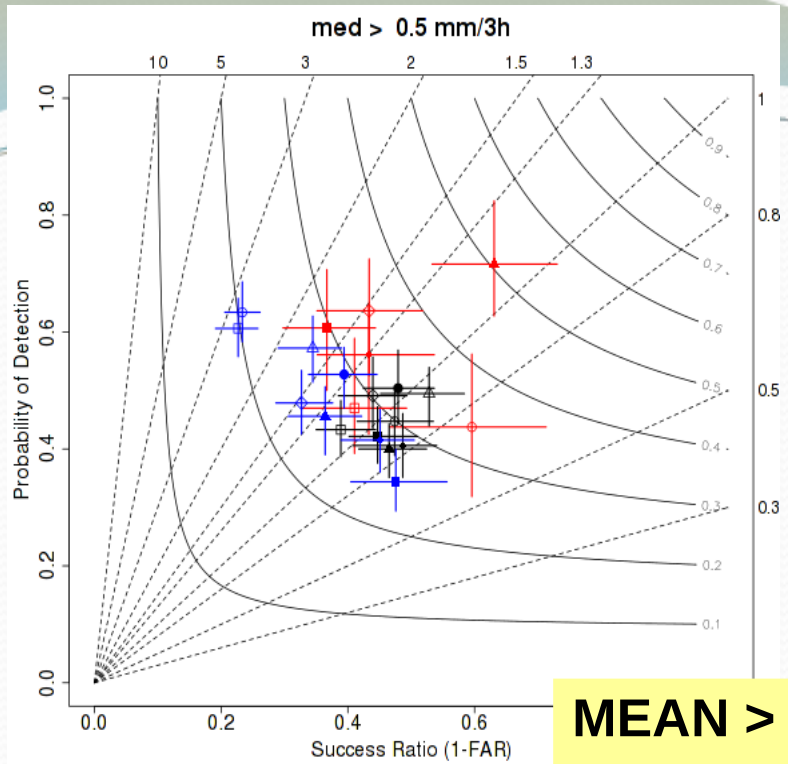
COSMO1-CH

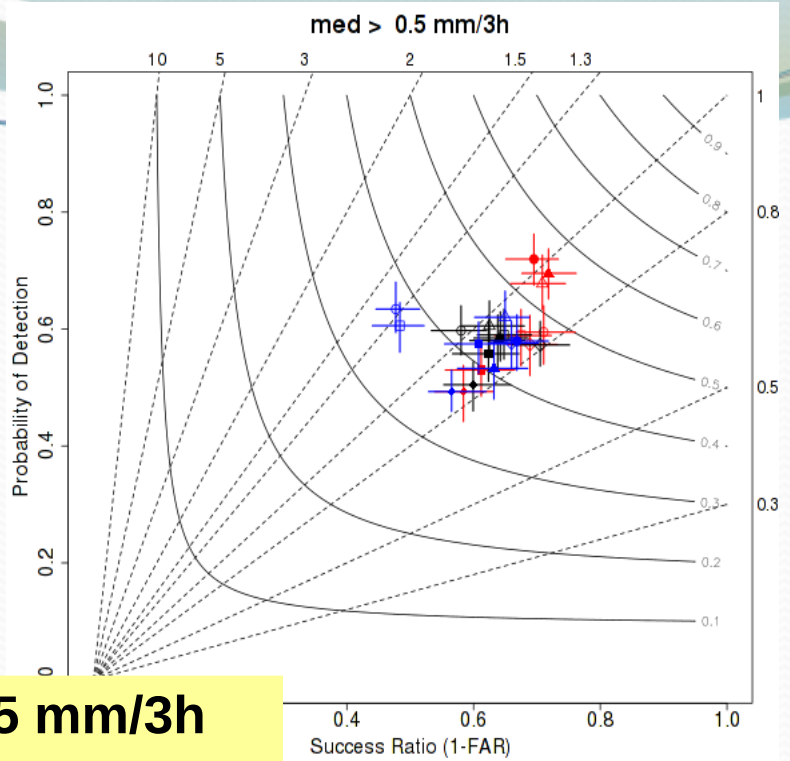


3 hours accumulation

- we have seen that there are many situation in which the higher resolution model is more valuable than the global model considering the 24 hours accumulation
- What happens if we consider shorter period of time, 3 hours in this case?
- Since we (at ARPA-SIMC) receive IFS-ECMWF products with steps of 6 hours, we performed the verification only COSMO models

JJA
2014

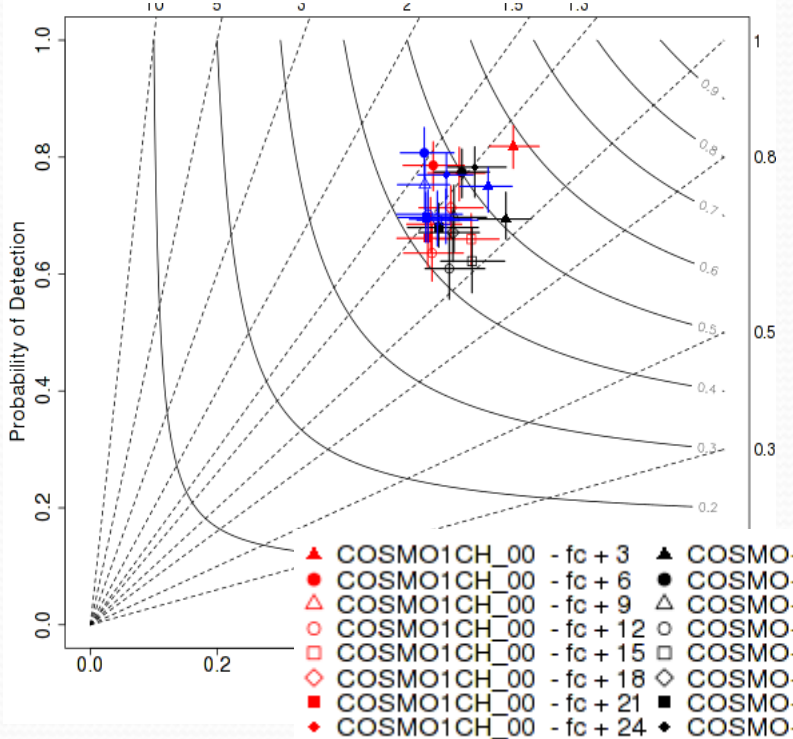


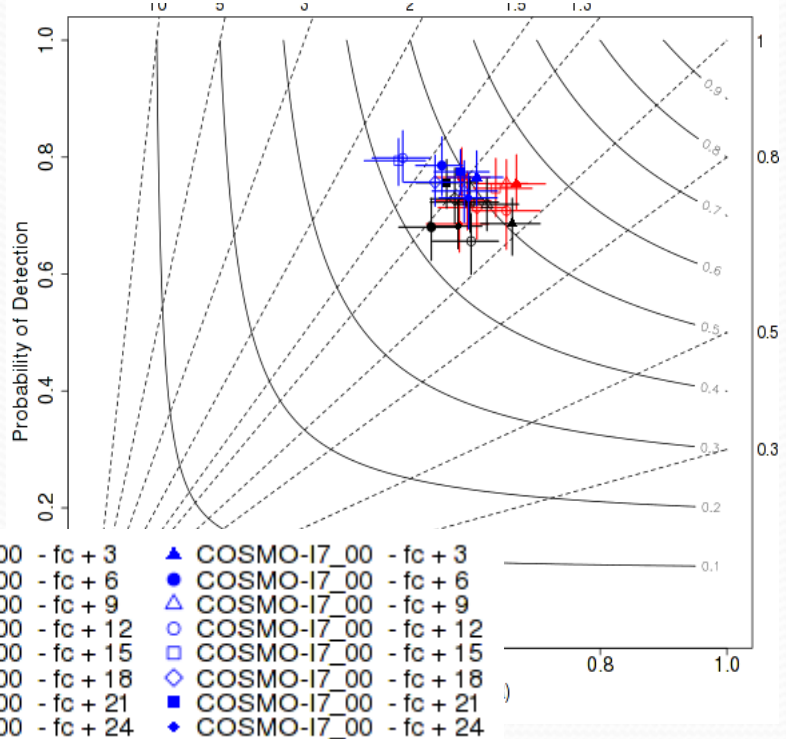


SON
2014

MEAN > 0.5 mm/3h

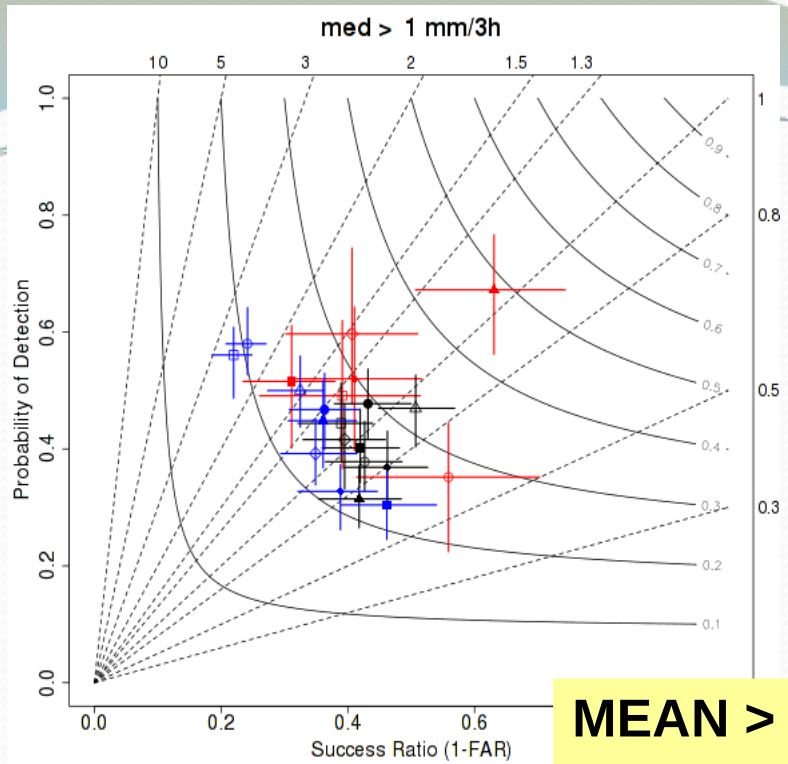
DJF
2014-15

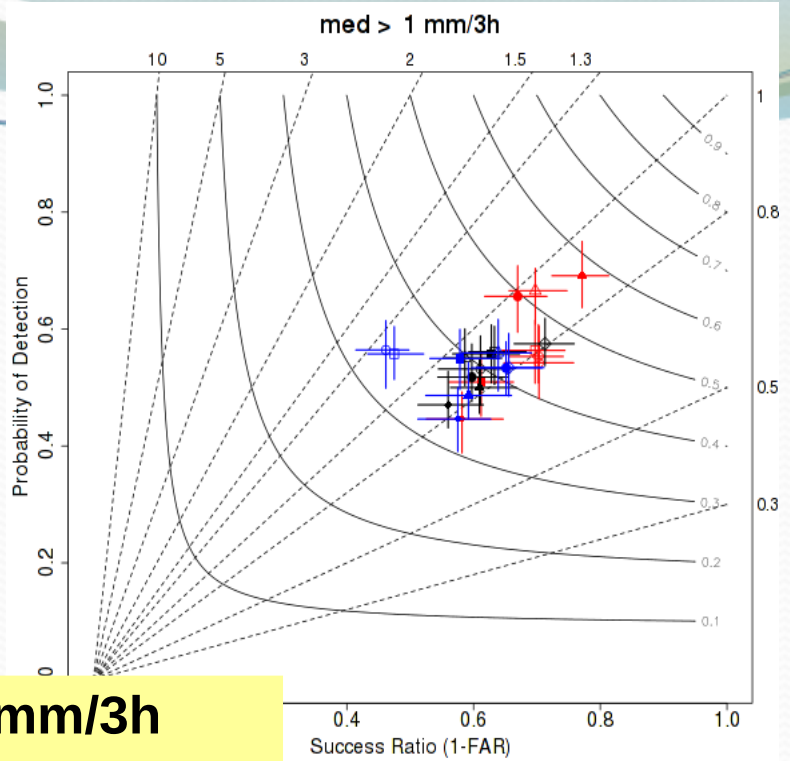




MAM
2015

JJA
2014

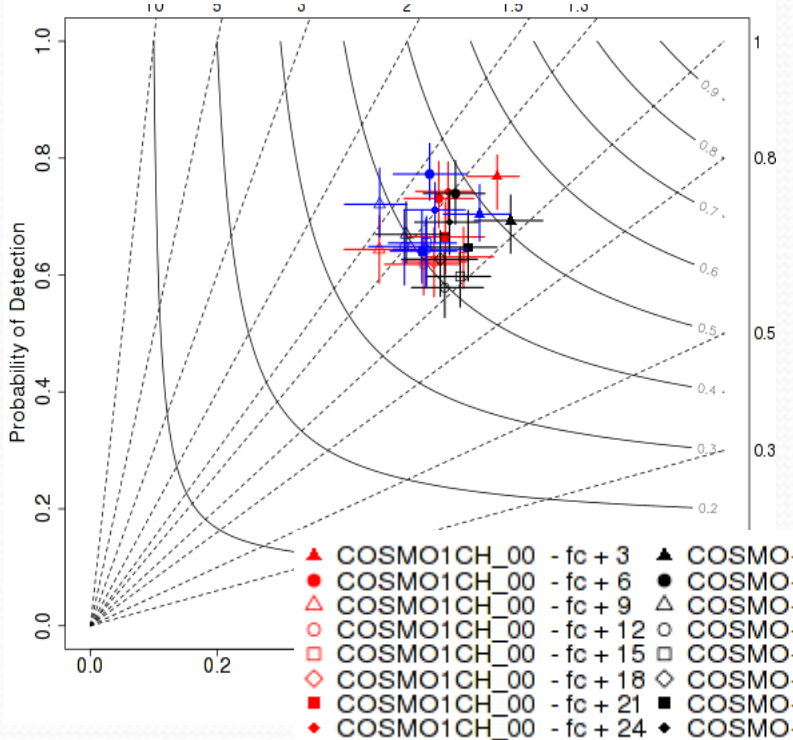


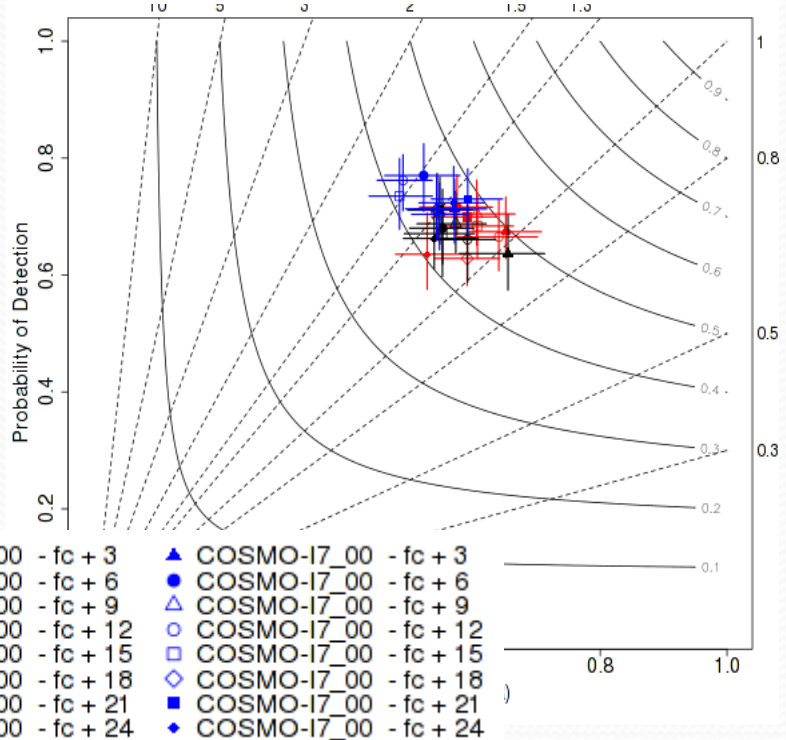


SON
2014

MEAN > 1 mm/3h

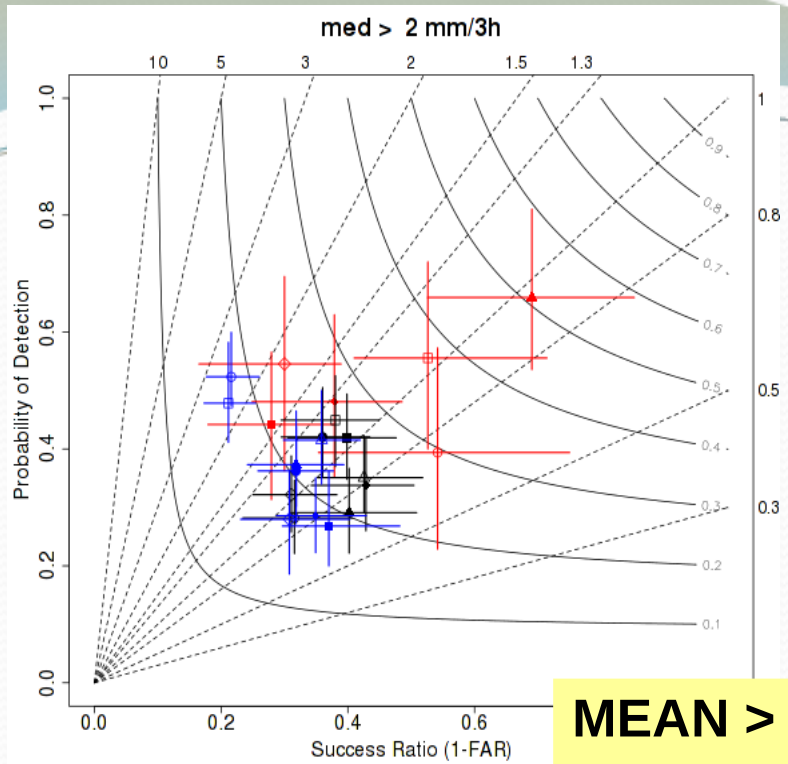
DJF
2014-15

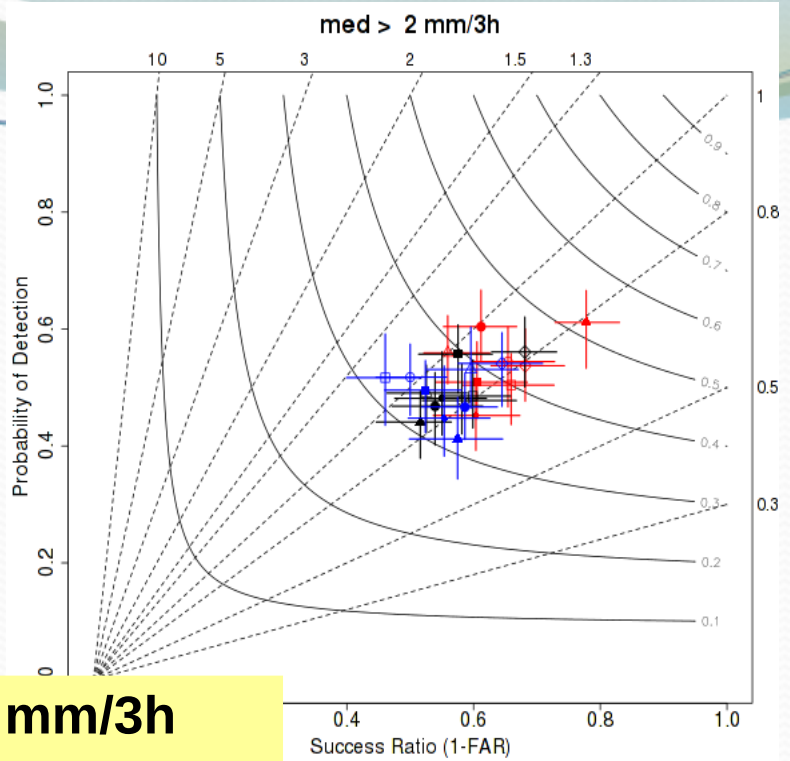




MAM
2015

JJA
2014

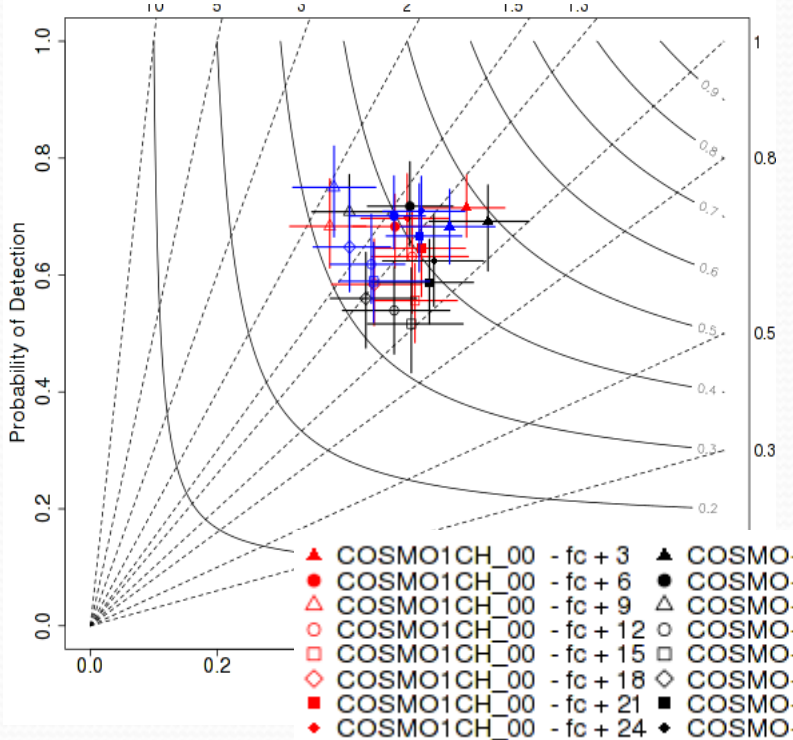


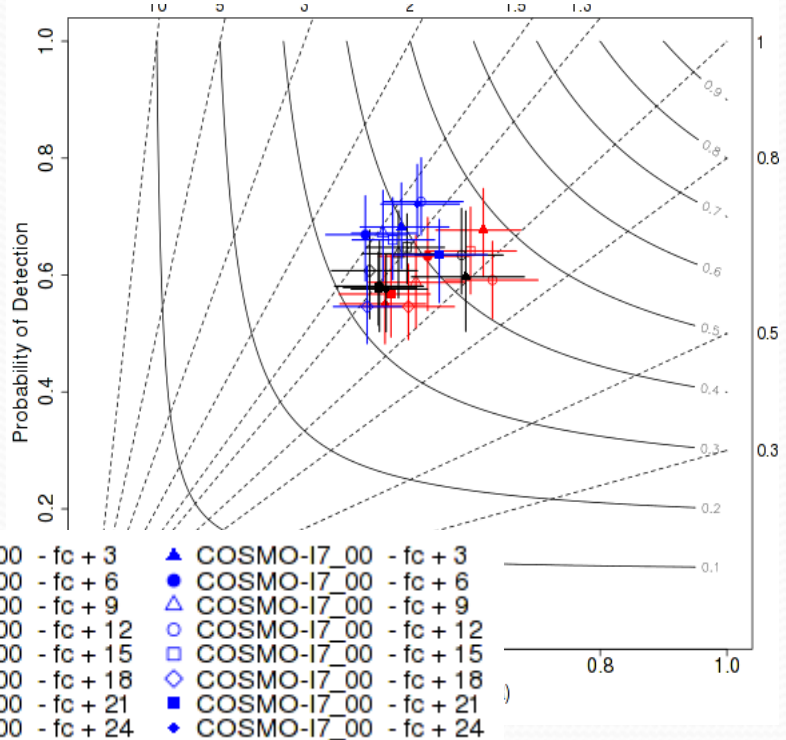


SON
2014

MEAN > 2 mm/3h

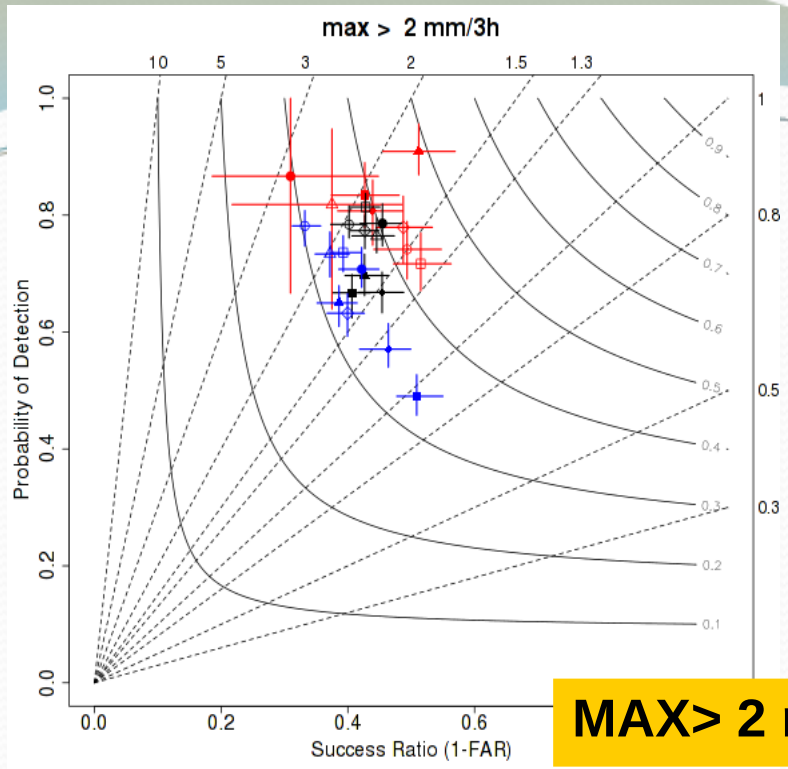
DJF
2014-15

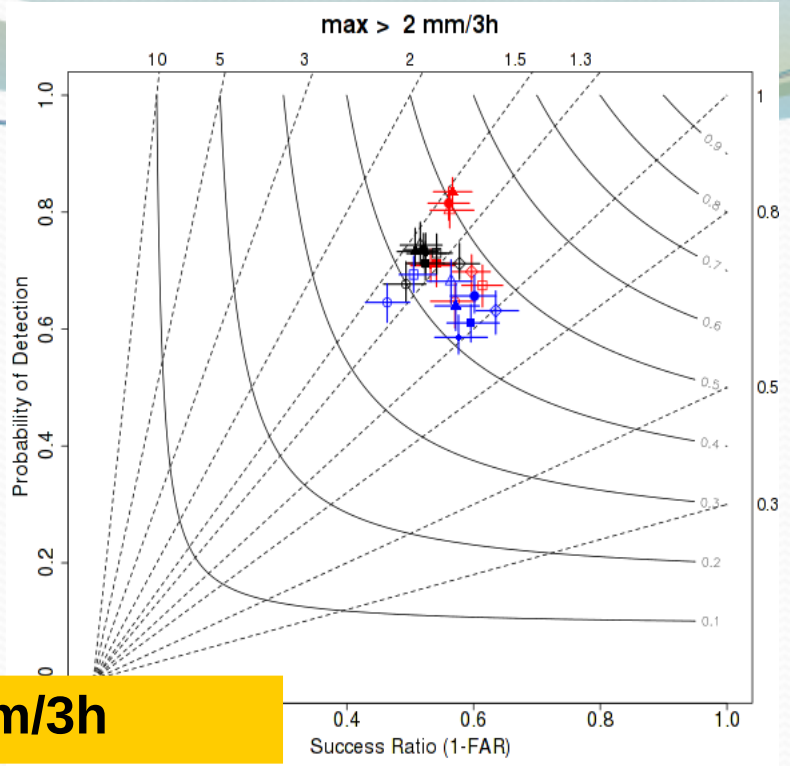




MAM
2015

JJA
2014

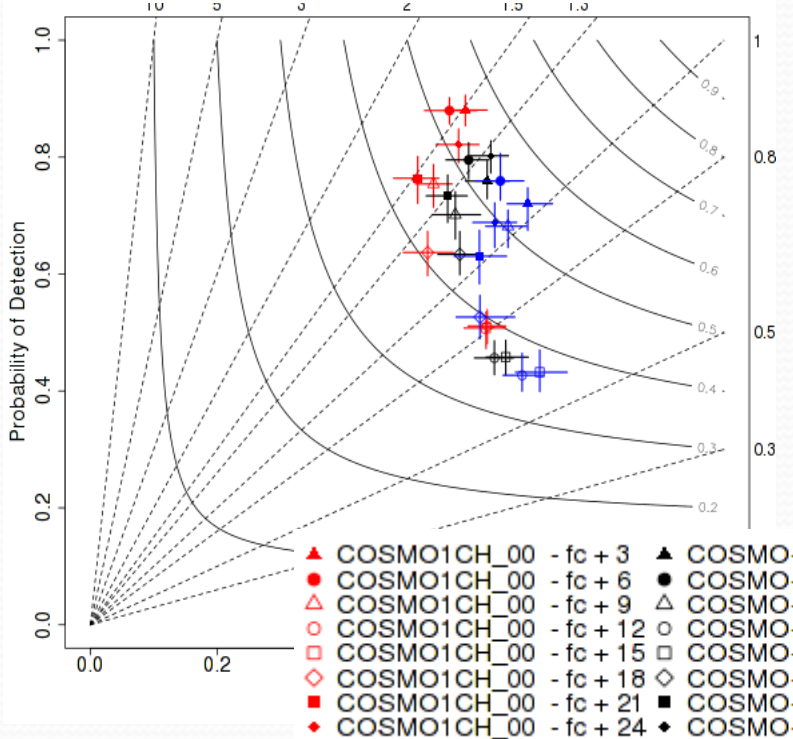


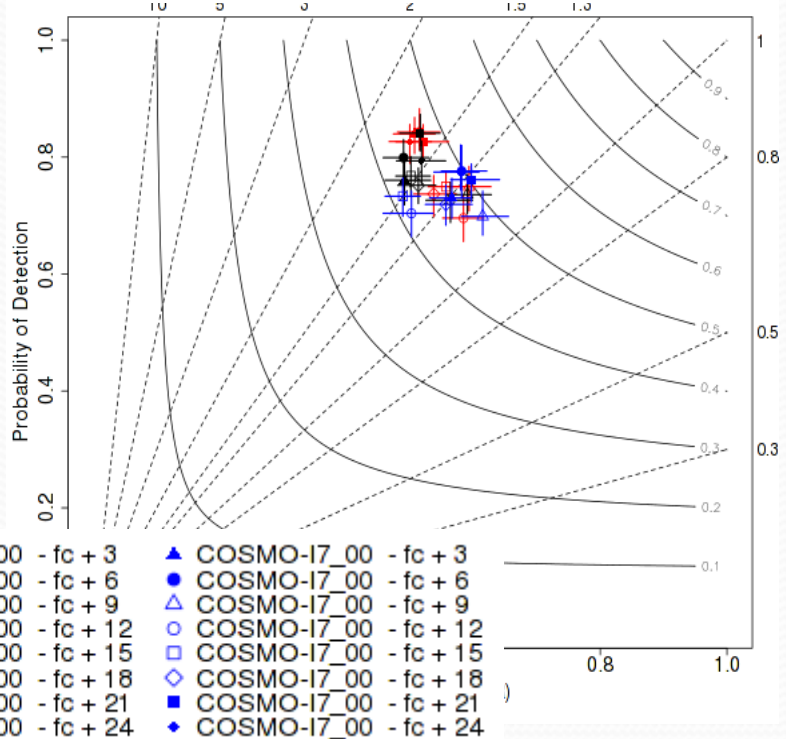


SON
2014

MAX> 2 mm/3h

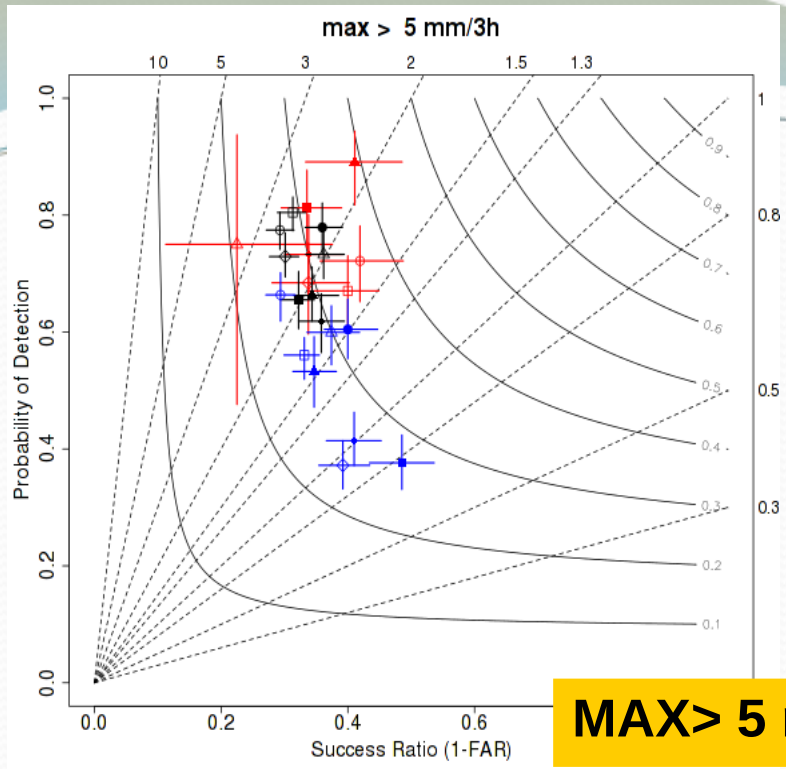
DJF
2014-15

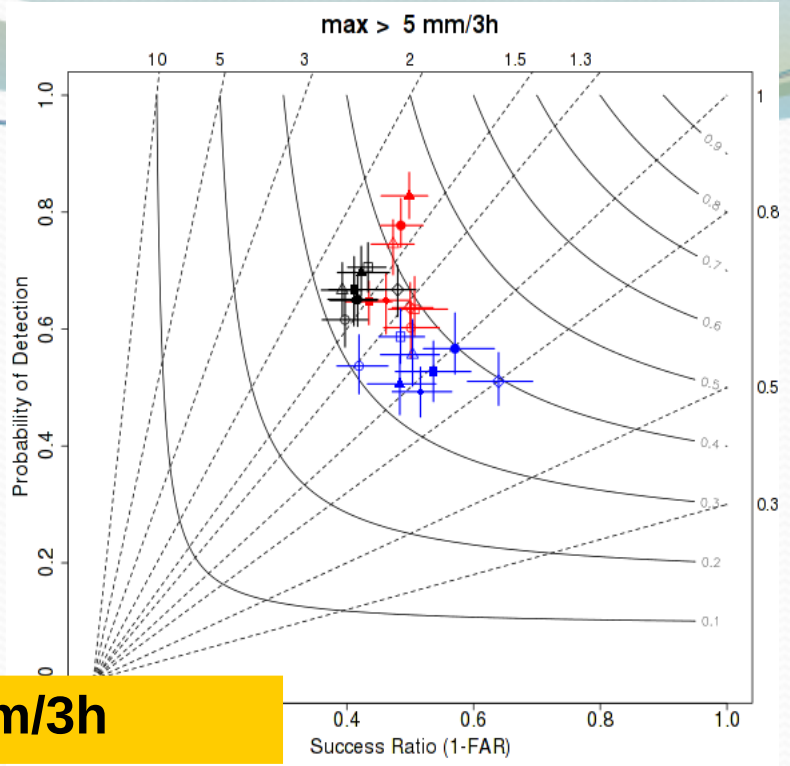




MAM
2015

JJA
2014

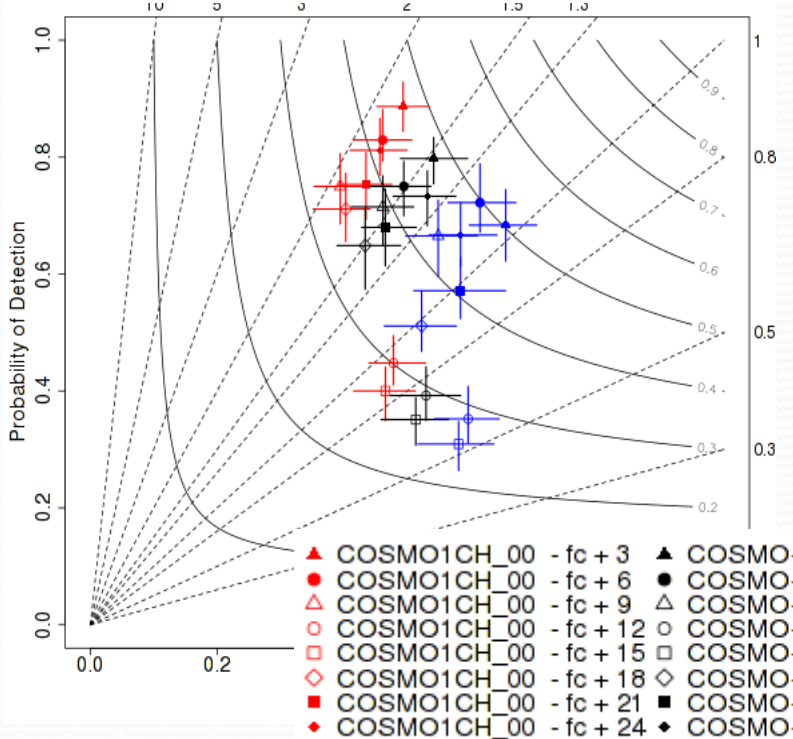


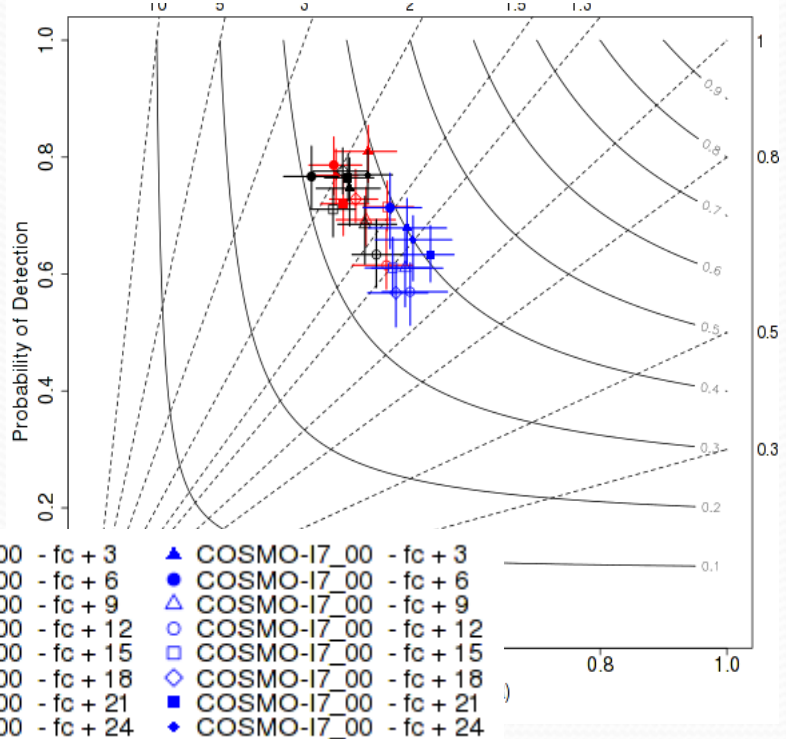


SON
2014

MAX> 5 mm/3h

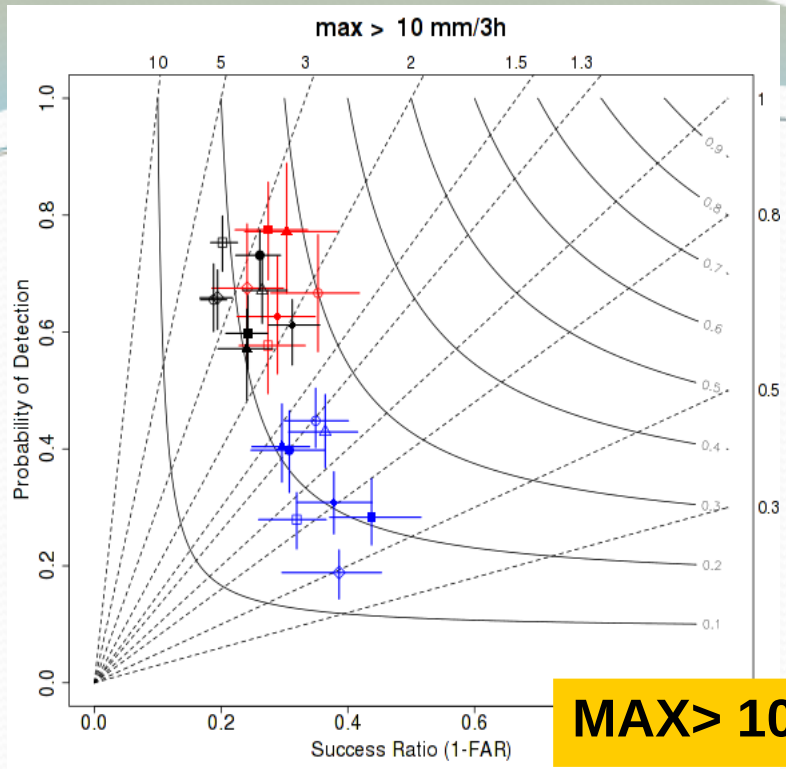
DJF
2014-15

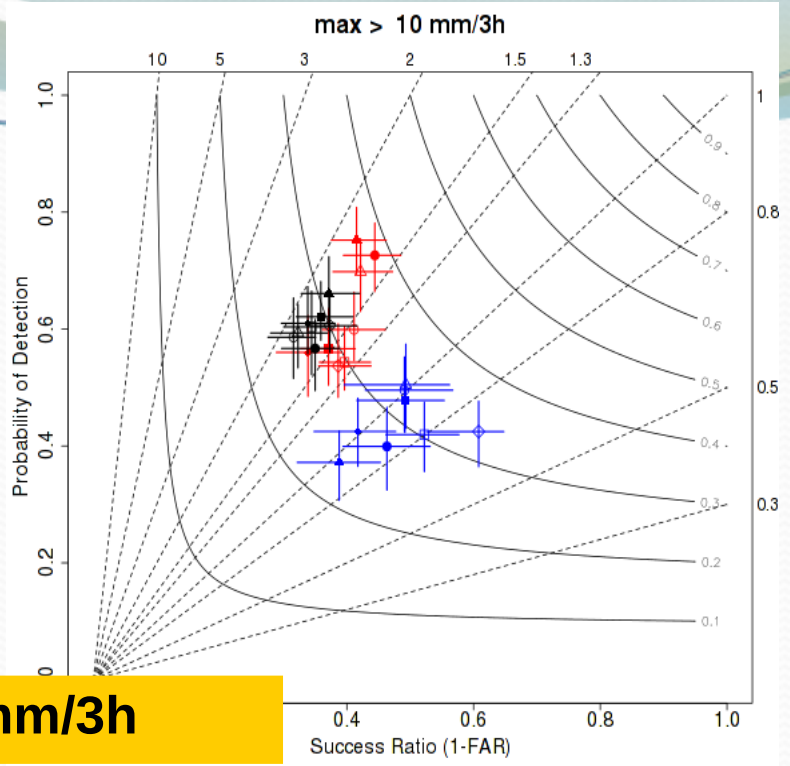




MAM
2015

JJA
2014

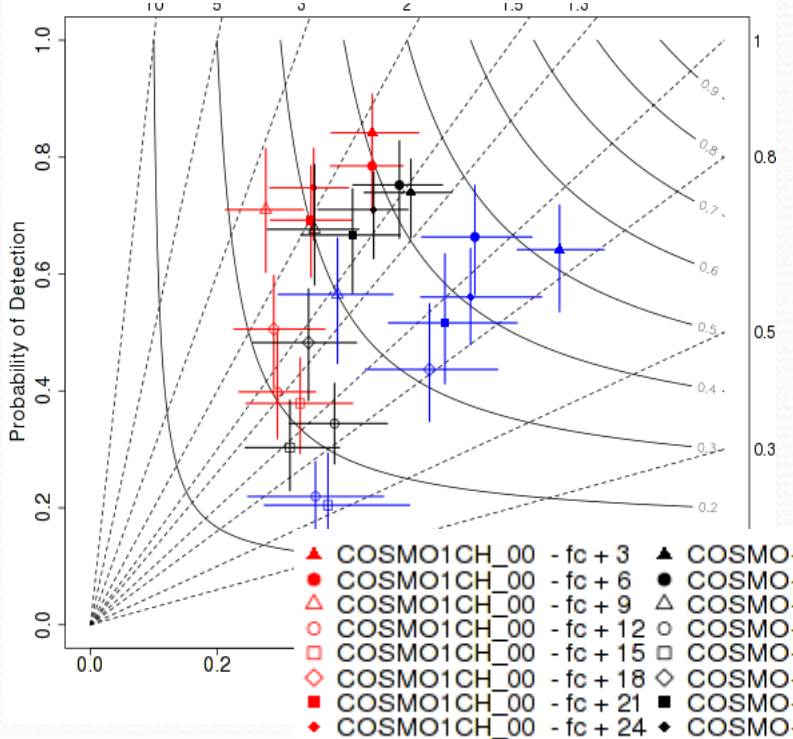


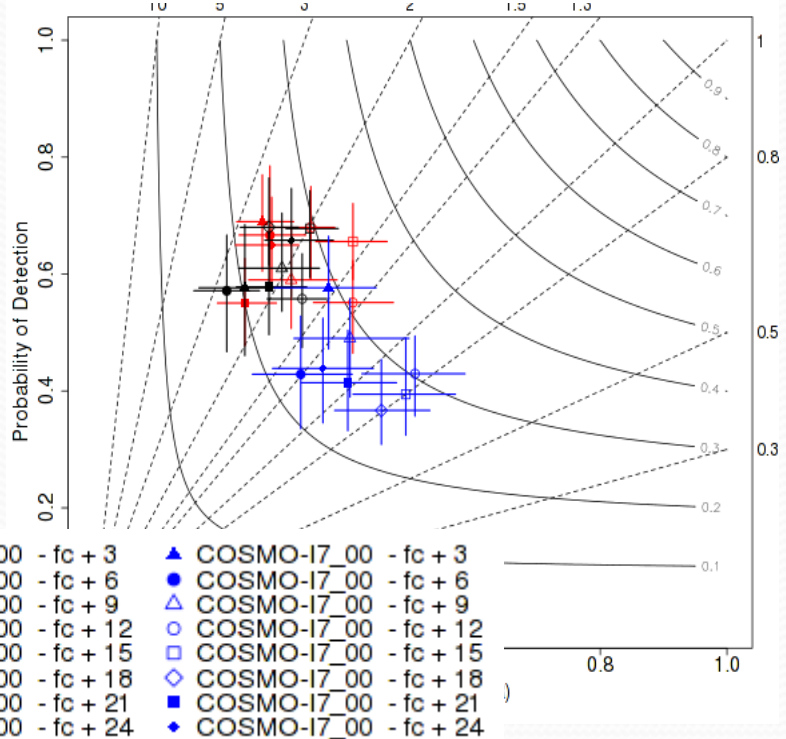


SON
2014

MAX> 10 mm/3h

DJF
2014-15





MAM
2015

- The POD for the 3hrs accumulation are surprisingly good for all the COSMO models, but the number of False Alarm are greater than for 24h accumulation
- COSMO1 perform definitely better with respect to respect to COSMO-I2 and COSMO-I7, especially during summer 2014
- Higher values of precipitation seems to be better forecast in the first hours of the run, both for mean and for the maximum

Conclusion

- DIST verification applied to catchment areas help to highlight different aspects of model behavior
- Taking into account the mean value over the area, no big difference appear between IFS-ECMWF and the COSMO models.
- COSMO models in general tend to perform better when the precipitation is not uniform over the area, showing a good ability to predict higher value, even if the number of False Alarm is still high
- The FAR improve if relative high value of rain is forecast at the same time at least in half of the points of the area
  - This could be a good hint for the forecaster when they have to decide to give credit to high QPF value
- COSMO models and especially COSMO1 show good scores also for the 3 hours accumulation

THANKS FOR YOU ATTENTION