

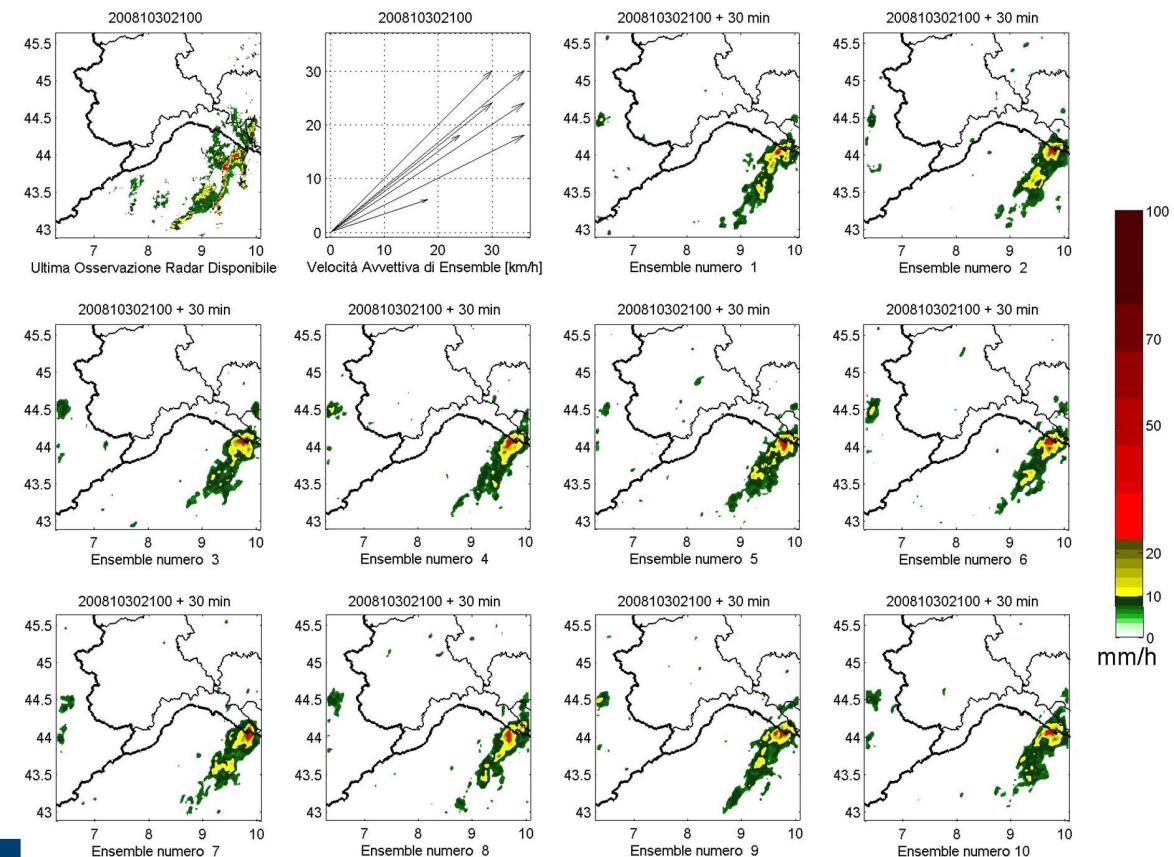
NOWCASTING - PHAST

A COSA SERVE?

Previsione meteorologica (pioggia) a
brevissimo termine

Fino a **1 - 2 ore a seconda del tipo**
di evento

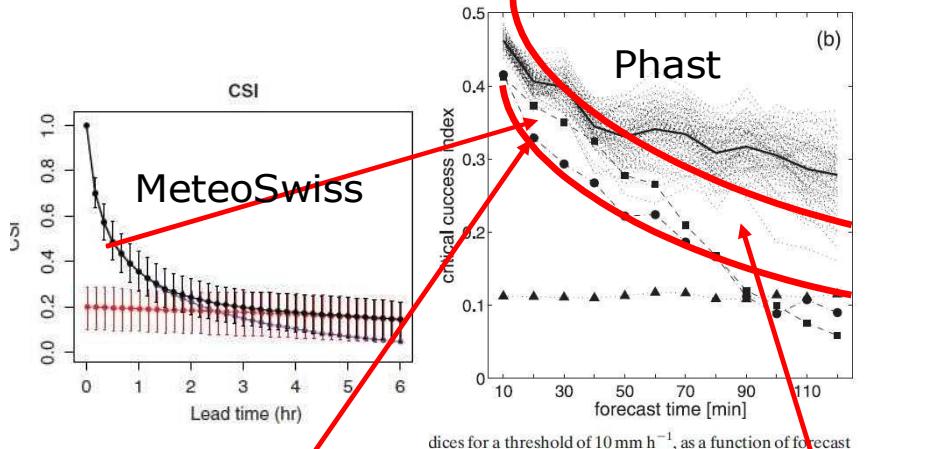
- E' utile in caso di eventi di **precipitazione intensa** caratterizzati da strutture anche persistenti, nonché per eventi maggiormente stratiformi





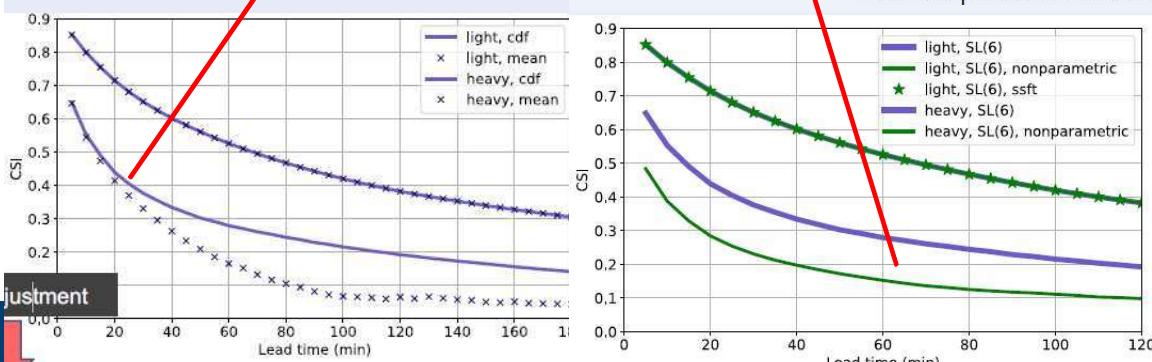
Gestione dell'incertezza previsionale

Ensemble nowcasting



SPROG parameters: Prob Matching @ light (0.1 mm hr^{-1}) and heavy (5.0 mm hr^{-1})

STEPS parameter: SL and masking



NOWCASTING – PHAST

Si basa su un modello stocastico (**PhaSt**) in grado di generare, a partire dalle osservazioni radar più recenti (**SRIadj**), un insieme di possibili realizzazioni del campo di precipitazione a brevissimo termine con update frequente (**ogni 10 minuti**).

- Transformazione del campo osservato tramite FFT (Trasformata di Fourier)
- Evoluzione delle fasi nello spazio spettrale (Langevin + componente stocastica)
- Trasformata inversa (FFT-1) per ottenere N ensemble di campi di pioggia previsti

Il prodotto operativo

- Gli scenari di precipitazione vengono cumulati ottenendo mappe di pioggia **sulle successive 1 e 2 ore.**
- Vengono ordinati i valori su ogni pixel e viene poi considerato un certo percentile.
- Se consideriamo il percentile 100%, di fatto consideriamo ovunque il peggior scenario

Per costruzione, maggiore è il percentile e maggiormente il prodotto è cautelativo, andando a considerare per ogni punto nello spazio la potenziale condizione peggiore

Il sistema è funzionante in modalità pre-operativa tempo reale da fine 2019.

NOWCASTING PHAST – CALCOLO SCORES

Calcolo scores su circa 60 eventi selezionati fra Luglio 2018 – Dicembre 2019

Scores da letteratura per verifica
previsione:



		Utilizzo matrice contingenza	
		Observed	
Forecasted	Yes	True Positive (Hit)	False Positive (False Alarm)
	No	False Negative (Miss)	True Negative (Blank)

- Critical Success Index - CSI

$$CSI = \frac{Hit}{Hit + False\ Alarm + Miss}$$

- Accuracy - ACC

$$ACC = \frac{Hit + Blank}{Hit + False\ Alarm + Miss + Blank}$$

- Probability of Detection - POD

$$POD = \frac{Hit}{Hit + Miss}$$

- False Alarm Rate - FAR

$$FAR = \frac{False\ Alarm}{Hit + False\ Alarm}$$

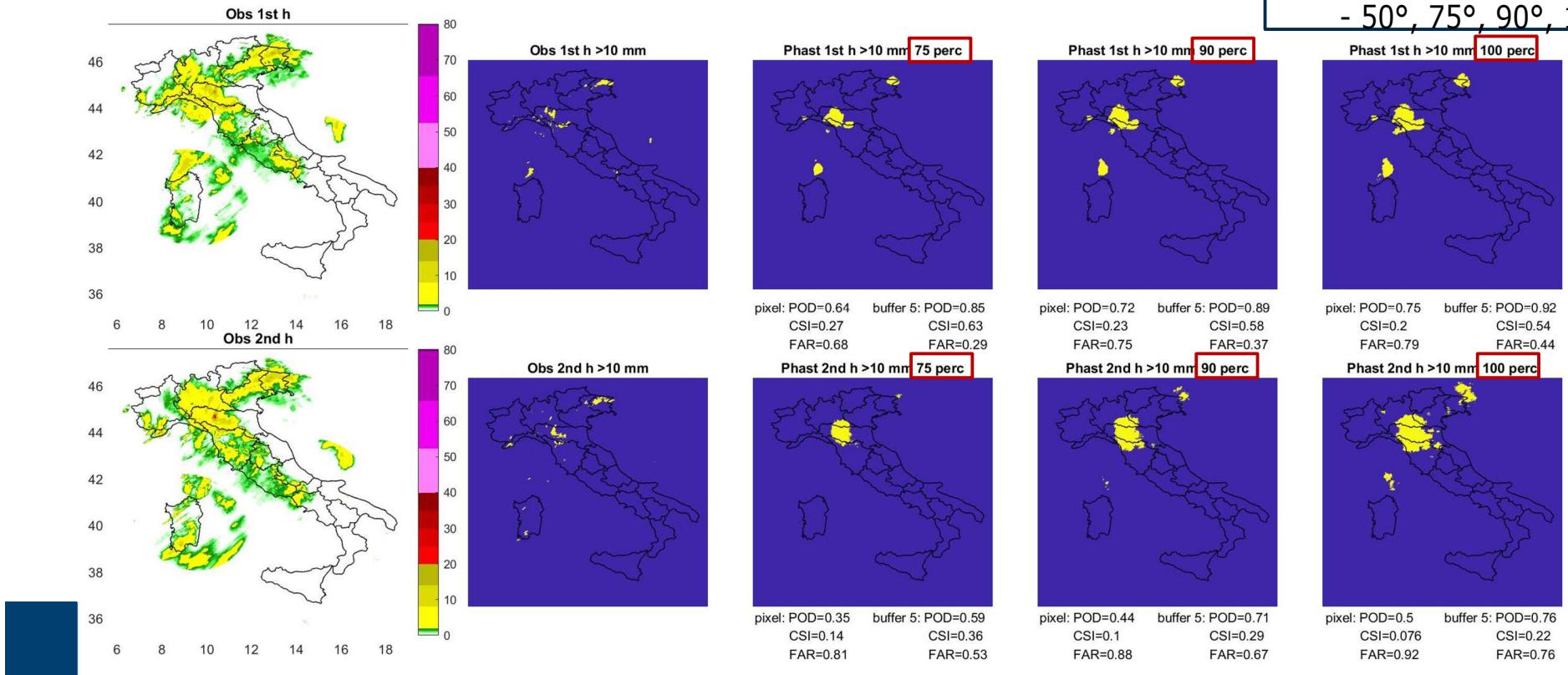
NOWCASTING PHAST – CALCOLO SCORES

Calcolo scores su circa 60 eventi selezionati fra Luglio 2018 –

Calcolati su diverse soglie
di pioggia oraria

Dicembre 2019

Observation - Phast Forecast 2019-02-02 @ 00:00 10 mm threshold

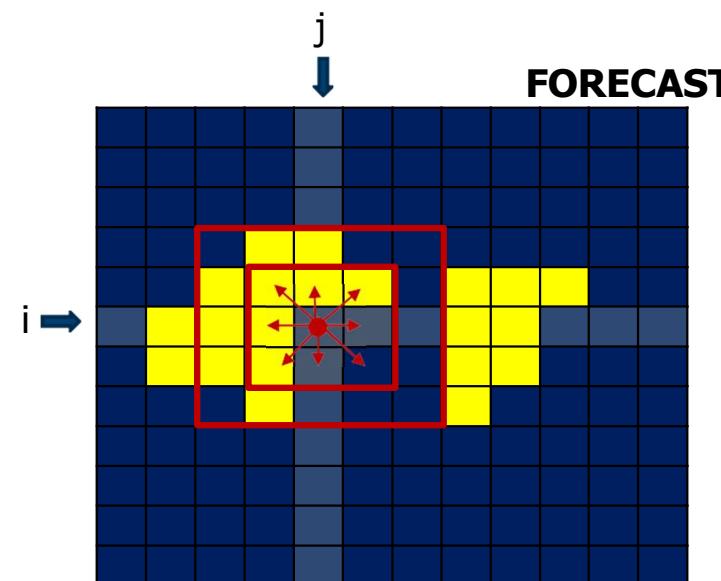
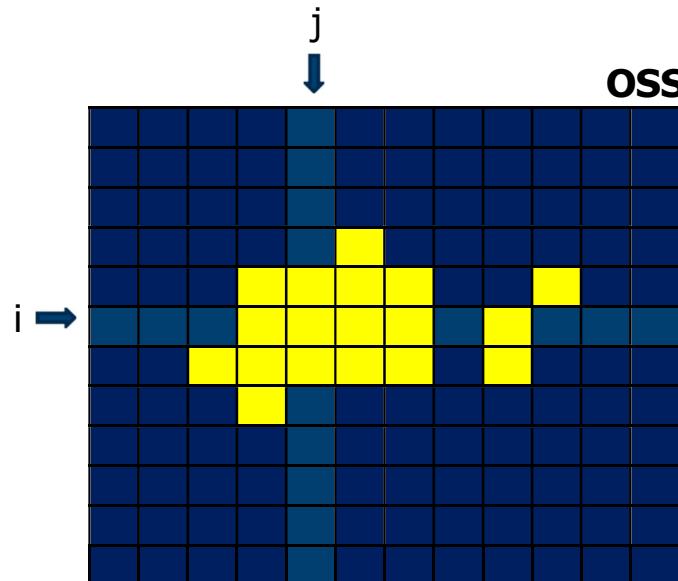


Calcolati per diversi
percentili:
- 50°, 75°, 90°, 100°

NOWCASTING PHAST – CALCOLO SCORES

Calcolo scores su Hindcast di circa **60 eventi**
selezionati fra Luglio 2018 – Dicembre 2019
(finestre temporali 12 – 48 ore)

⚠ **Confronto pixel a pixel**  “double penalty effect”



Anthes, 1983
Gilleland et al. 2009
Lovat et al., 2020

Calcolati su diverse soglie orarie

Calcolati per diversi percentili:
- 50°, 75°, 90°, 100°

Calcolati pixel a pixel o con buffer di 2, 3, 5, 7 km

NOWCASTING PHAST – CALCOLO SCORES

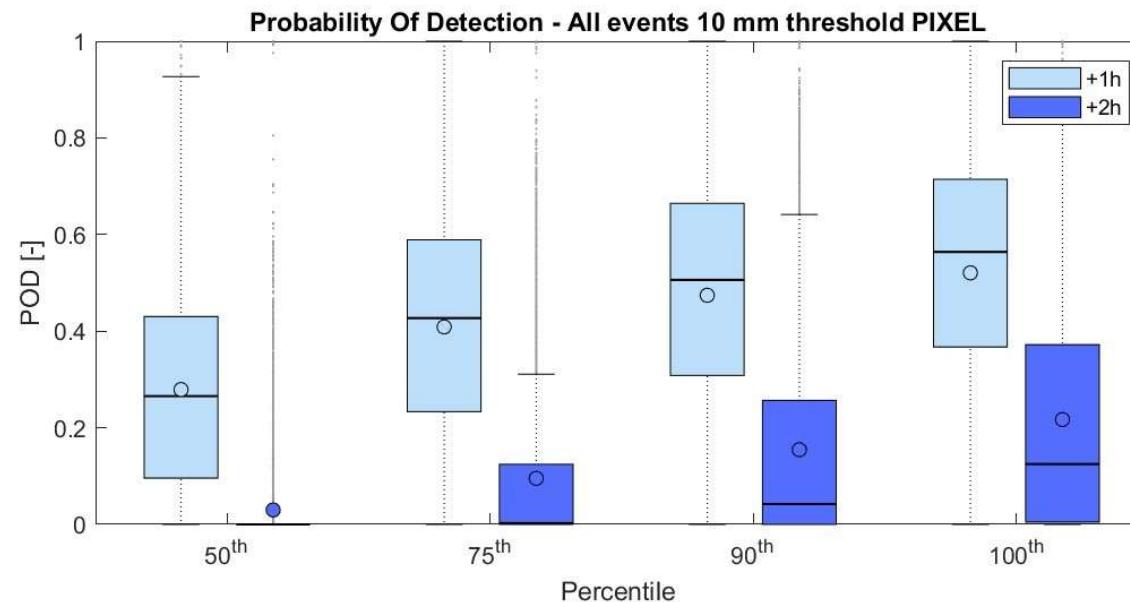
Matrice contingenza

		Observed	
		Yes	No
Forecasted	Yes	True Positive (Hit)	False Positive (False Alarm)
	No	False Negative (Miss)	True Negative (Blank)

**Probability of Detection -
POD**

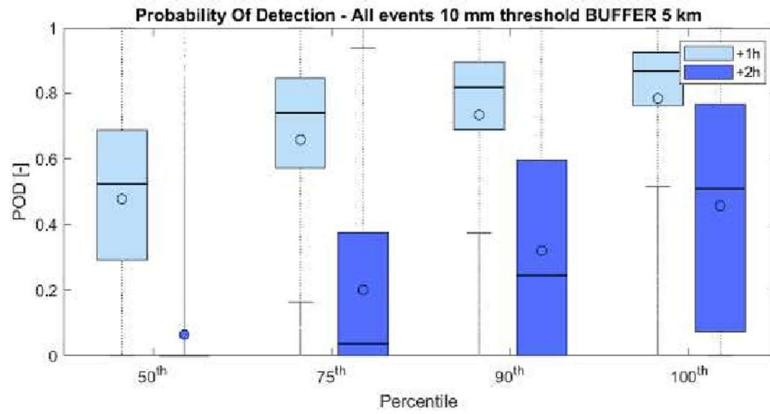
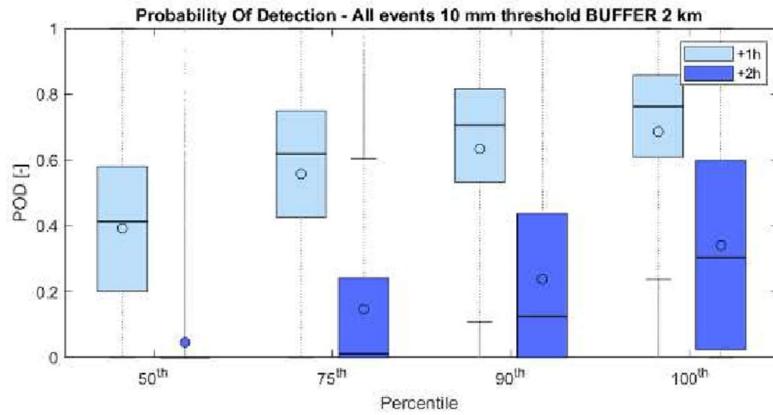
$$POD = \frac{Hit}{Hit + Miss}$$

Soglia: 10mm
Confronto pixel a pixel



Soglia: 10 mm

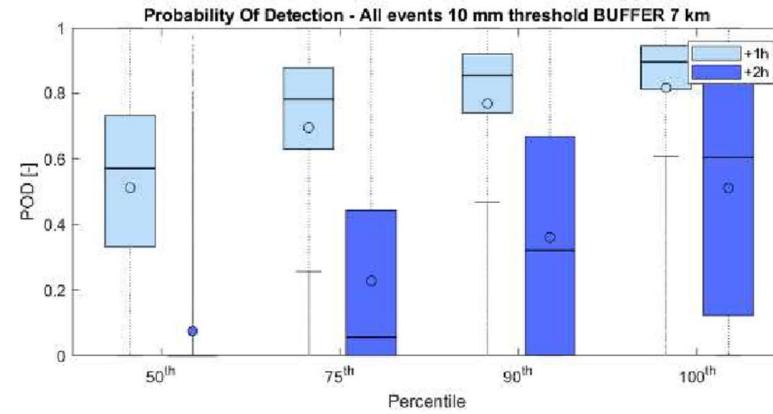
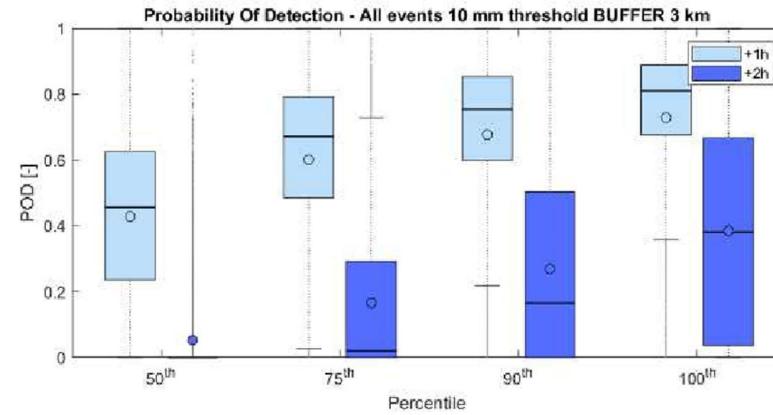
Buffer 2-3-5-7 km



NOWCASTING PHAST – CALCOLO SCORES

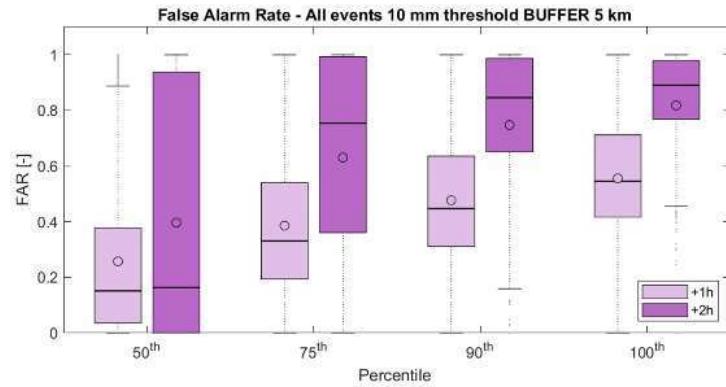
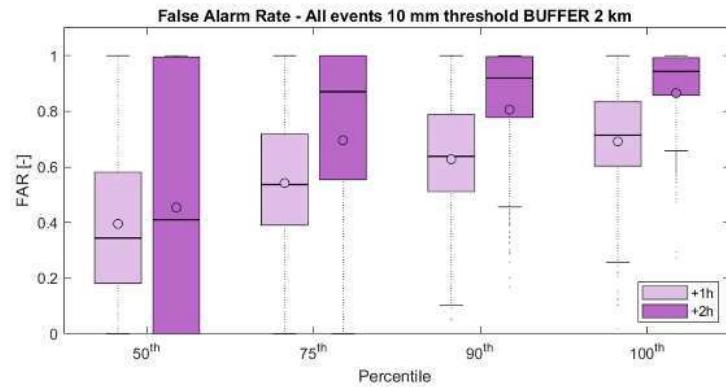
Probability of Detection - POD

$$POD = \frac{Hit}{Hit + Miss}$$



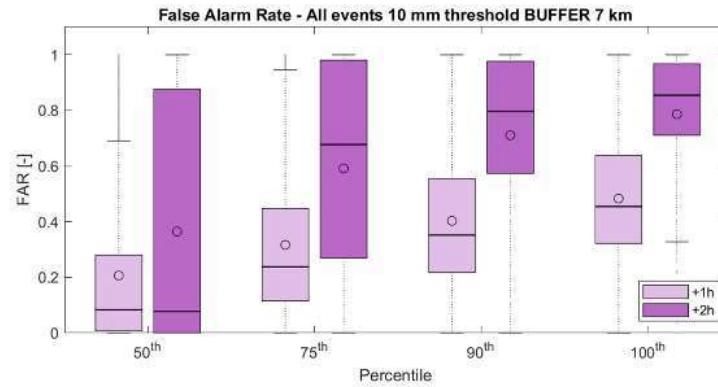
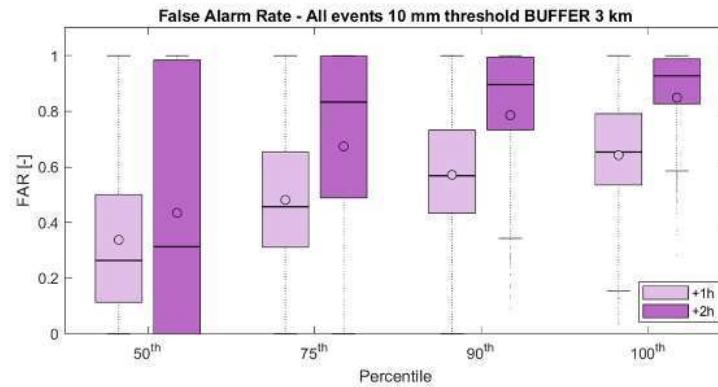
Soglia: 10 mm

Buffer 2-3-5-7 km



NOWCASTING PHAST – CALCOLO SCORES

$$\text{False Alarm Rate - FAR} \text{ FAR} = \frac{\text{False Alarm}}{\text{Hit} + \text{False Alarm}}$$

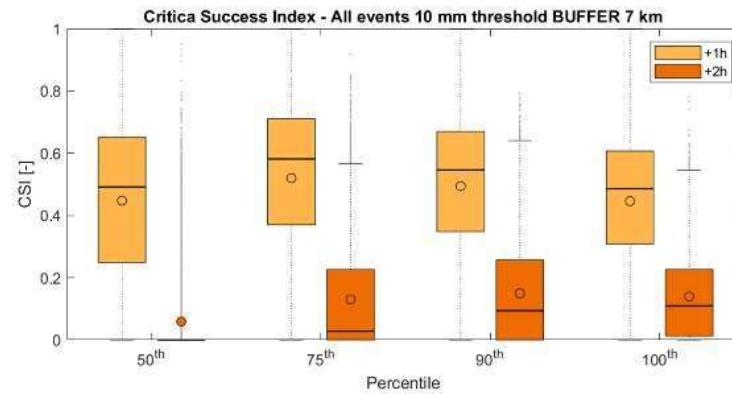
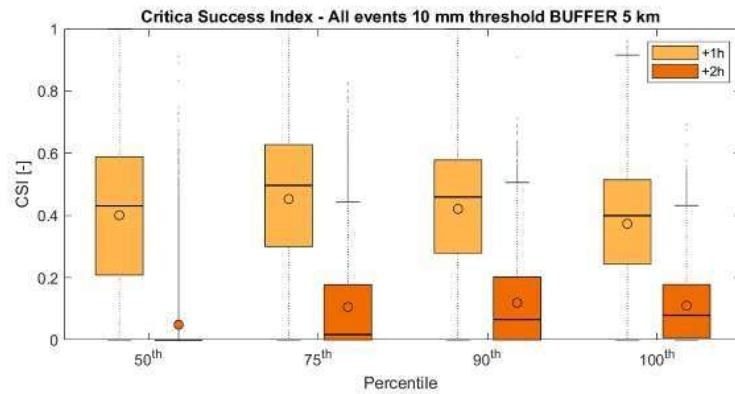
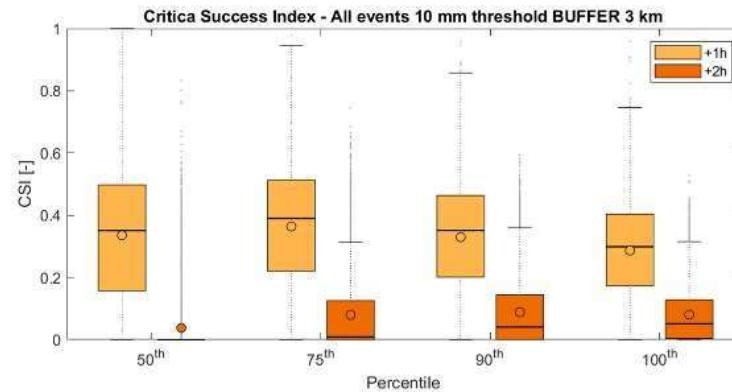
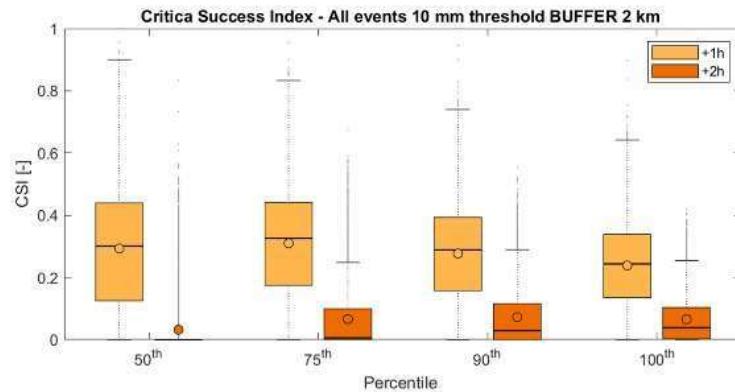


Soglia: 10 mm

Buffer 2-3-5-7 km

NOWCASTING PHAST – CALCOLO SCORES

Critical Success Index $CSI = \frac{Hit}{Hit + False\ Alarm + Miss}$



NOWCASTING PHAST – CALCOLO SCORES

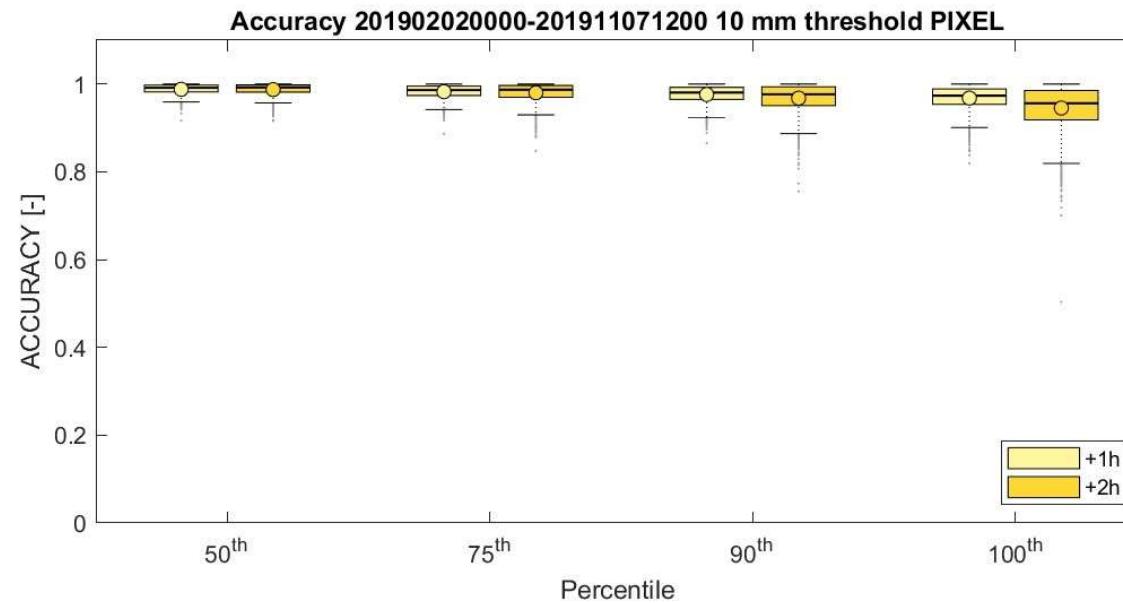
Matrice contingenza

		Observed	
		Yes	No
Forecasted	Yes	True Positive (Hit)	False Positive (False Alarm)
	No	False Negative (Miss)	True Negative (Blank)

ACCURACY $ACC = \frac{Hit + Blank}{Hit + False\ Alarm + Miss + Blank}$

Soglia: 10mm

Confronto pixel a pixel



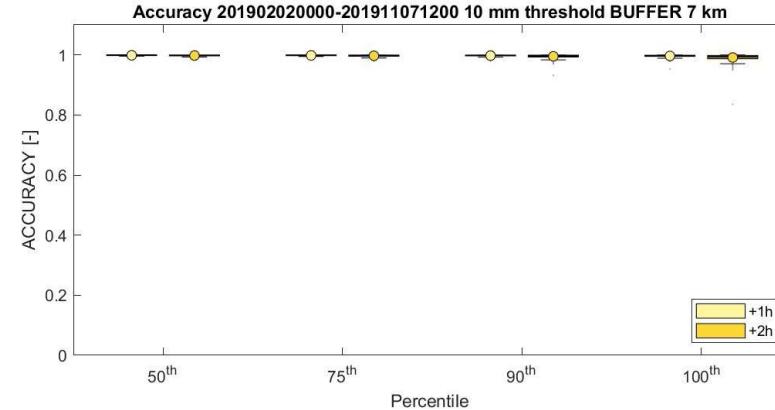
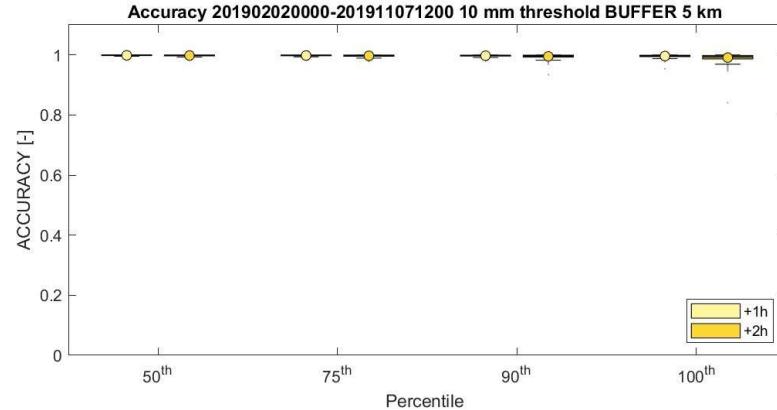
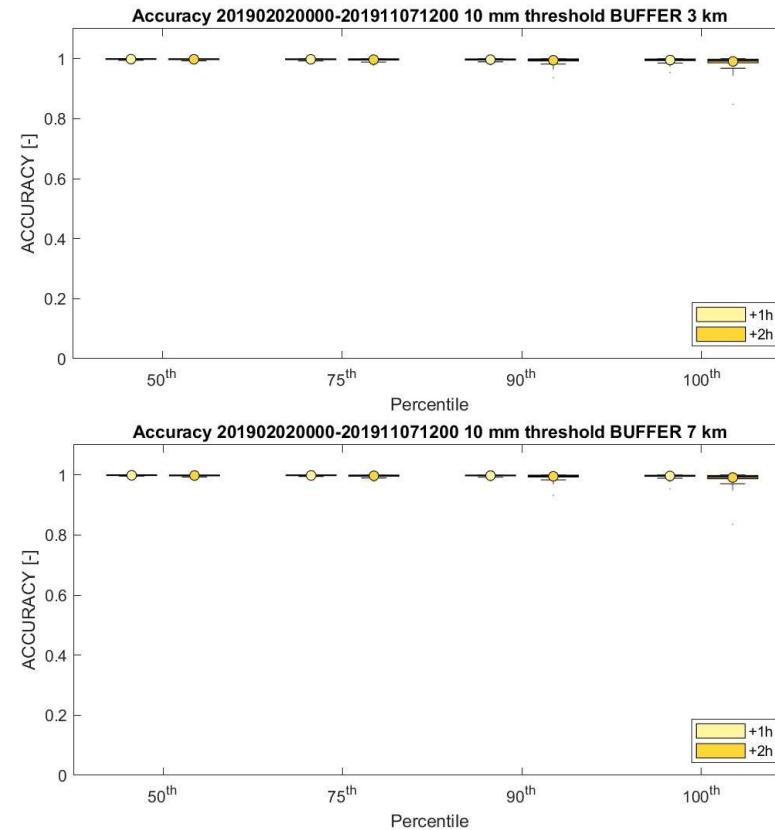
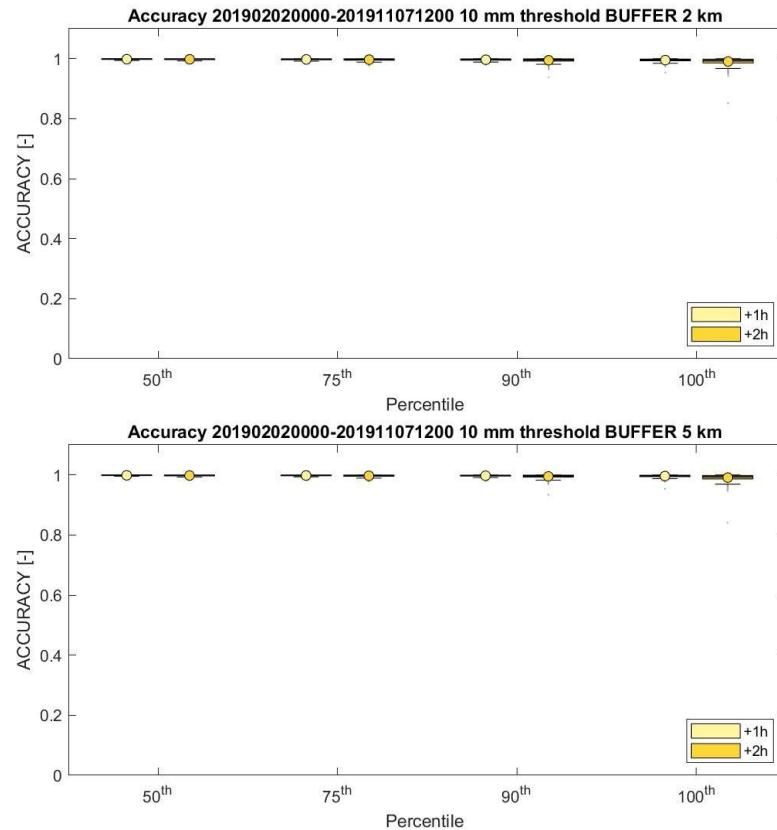
Soglia: 10 mm

Buffer 2-3-5-7 km

NOWCASTING PHAST – CALCOLO SCORES

ACCURACY

$$ACC = \frac{Hit + Blank}{Hit + False\ Alarm + Miss + Blank}$$

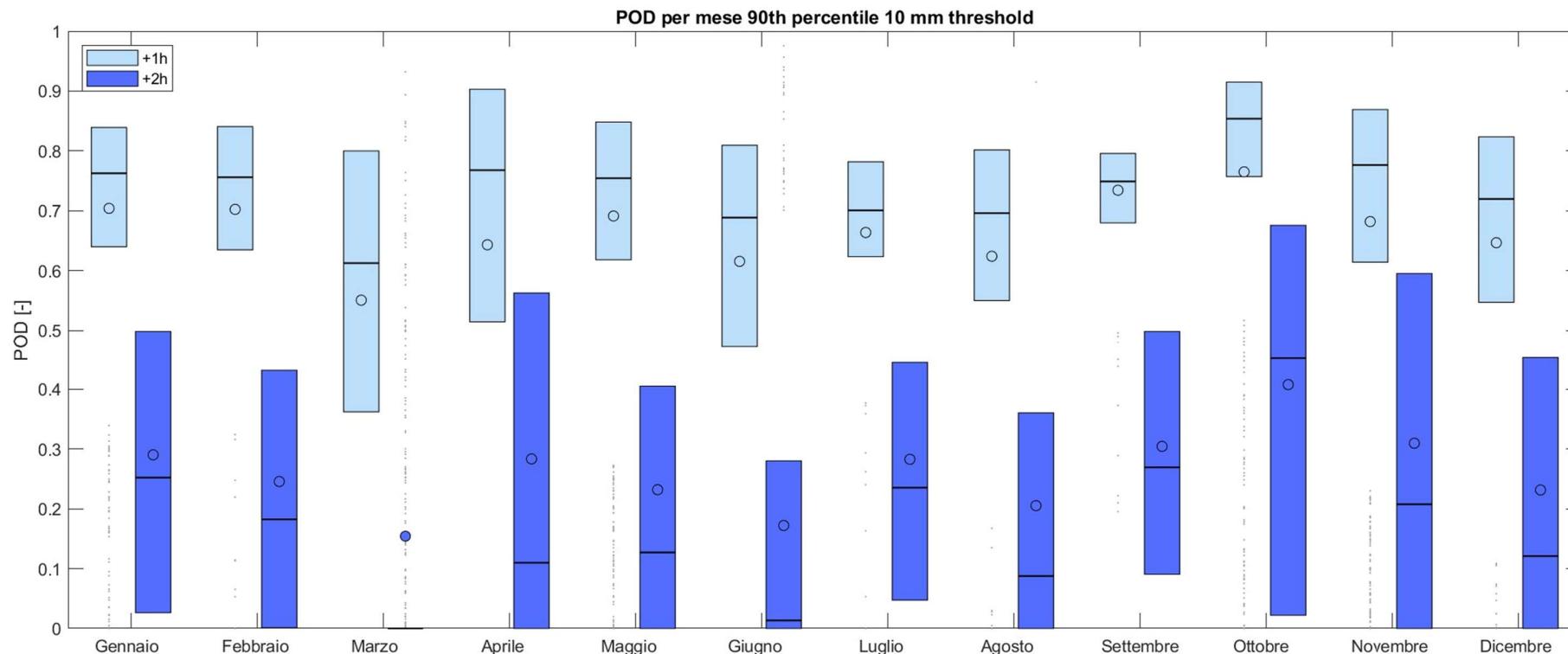


NOWCASTING PHAST – CALCOLO SCORES

**Probability of Detection
- POD**

**Soglia 10 mm – 3 km
buffer**

**Analisi scores per
mese**

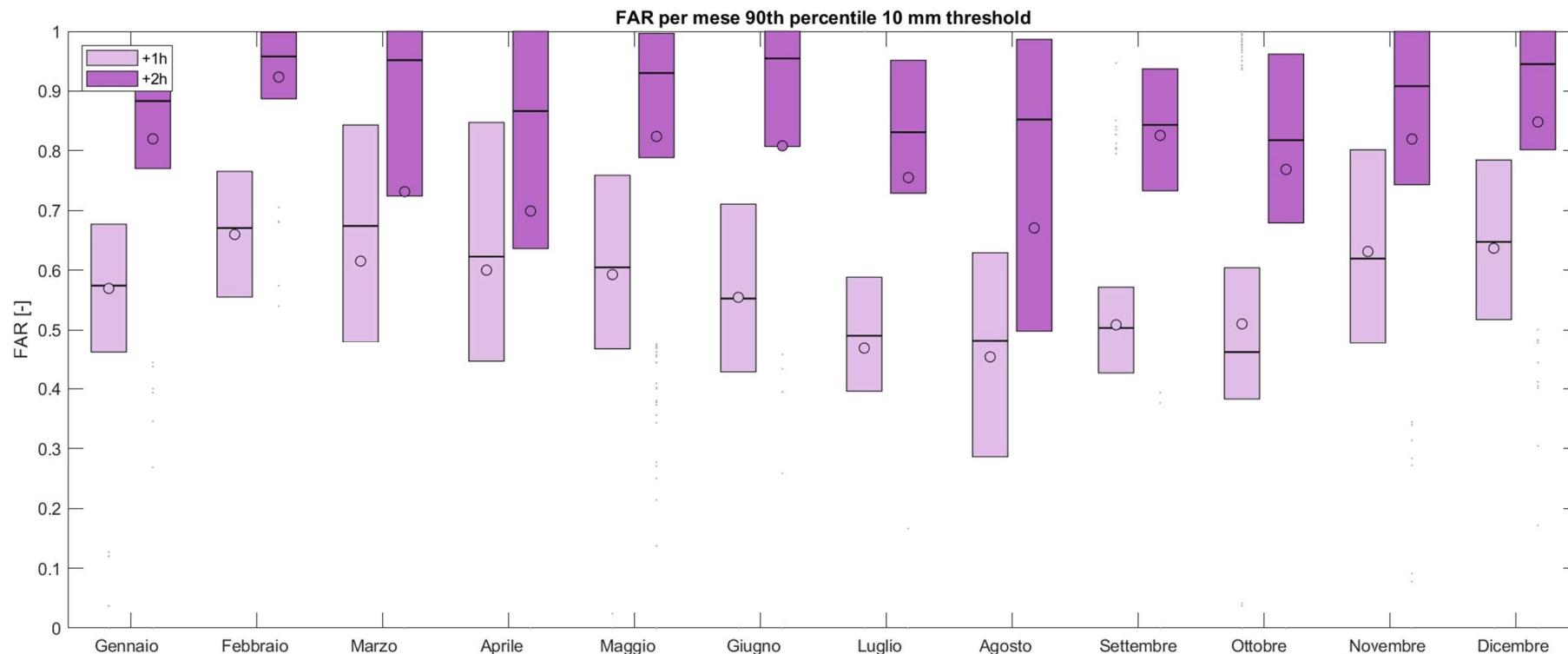


NOWCASTING PHAST – CALCOLO SCORES

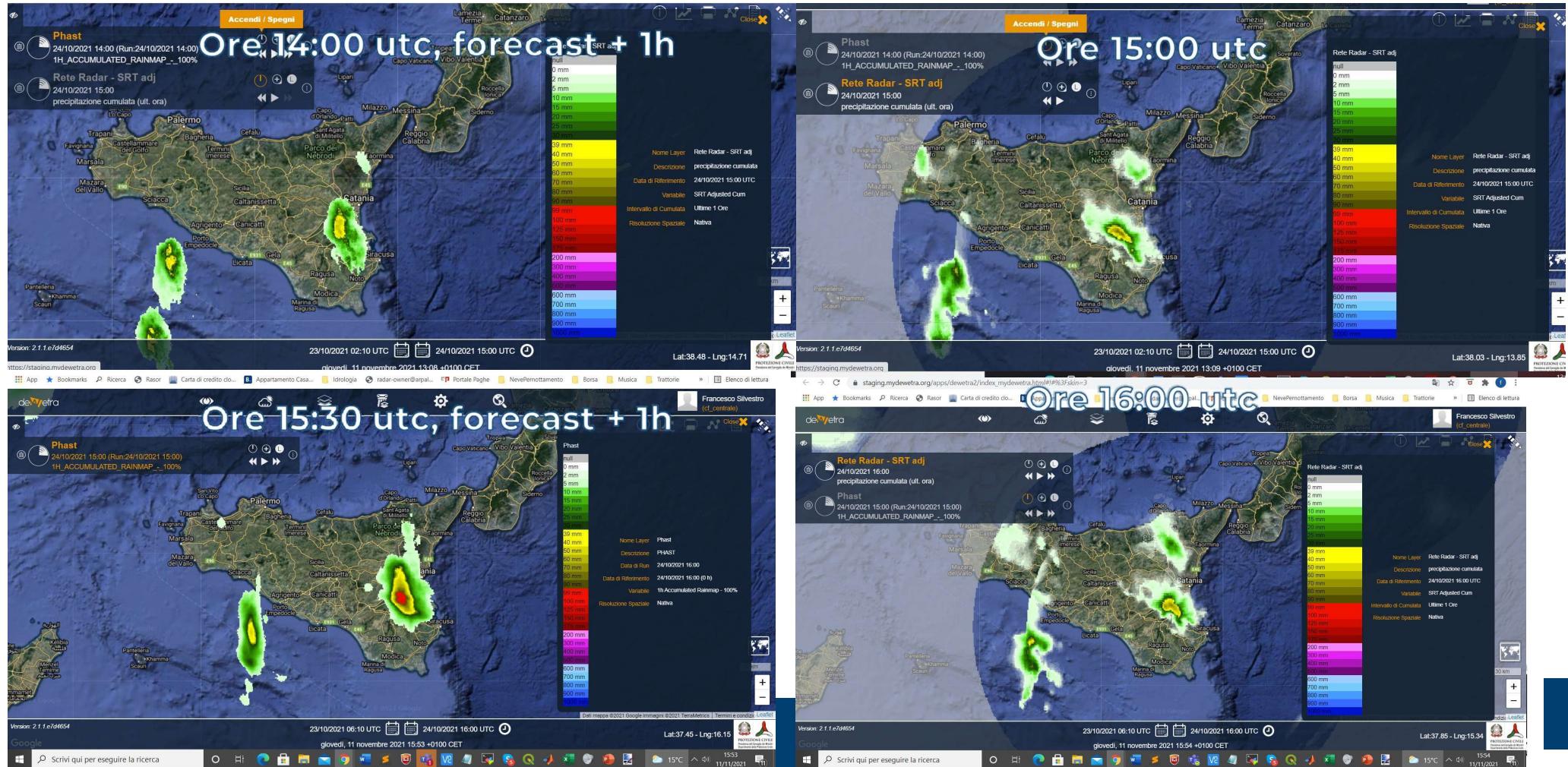
False Alarm Rate - FAR

Soglia 10 mm – 3 km buffer

Analisi scores per mese



24/10/2021 Esempio a 1 h



METTA, S., VON HARDENBERG, J., FERRARIS, L., REBORA, N., AND PROVENZALE, A.: PRECIPITATION NOWCASTING BY A SPECTRAL-BASED NONLINEAR STOCHASTIC MODEL. JOURNAL OF HYDROMETEOROLOGY, 10(5), 1285-1297, [HTTPS://DOI.ORG/10.1175/2009JHM1120.1](https://doi.org/10.1175/2009JHM1120.1), 2009

SILVESTRO, F. AND REBORA, N.: OPERATIONAL VERIFICATION OF A FRAMEWORK FOR THE PROBABILISTIC NOWCASTING OF RIVER DISCHARGE IN SMALL AND MEDIUM SIZE BASINS, NAT. HAZARDS EARTH SYST. SCI., 12, 763-776, [HTTPS://DOI.ORG/10.5194/NHES-12-763-2012](https://doi.org/10.5194/nhess-12-763-2012), 2012B.

SILVESTRO, F., REBORA, N., CUMMINGS, G., AND FERRARIS, L.: EXPERIENCES OF DEALING WITH FLASH FLOODS USING AN ENSEMBLE HYDROLOGICAL NOWCASTING CHAIN: IMPLICATIONS OF COMMUNICATION, ACCESSIBILITY AND DISTRIBUTION OF THE RESULTS. J. FLOOD RISK MANAGE., [HTTPS://DOI.ORG/10.1111/JFR3.12161](https://doi.org/10.1111/jfr3.12161), 2015A

GARVIN R. CUMMINGS, DOCTORAL DEGREE IN ENGINEERING IN SYSTEMS MONITORING AND MANAGEMENT OF ENVIRONMENTAL RISKS
– CYCLE XXVI FLOOD SCENARIOS AND RAINFALL NOWCASTING: TOWARDS BUILDING A RELIABLE FLOOD NOWCASTING PROCEDURE FOR SMALL AND VERY SMALL BASINS (2015)

POLETTI, M. L., SILVESTRO, F., DAVOLIO, S., PIGNONE, F. & REBORA, N. 2019 USING NOWCASTING TECHNIQUE AND DATA ASSIMILATION IN A METEOROLOGICAL MODEL TO IMPROVE VERY SHORT RANGE HYDROLOGICAL FORECASTS. HYDROLOGICAL EARTH SYSTEM SCIENCES, 23, 3823–3841. [HTTPS://DOI.ORG/10.5194/HESS-23-3823-2019](https://doi.org/10.5194/hess-23-3823-2019)

RAPPORTI SEMESTRALI CONVENZIONE DPC-CIMA WP5.1, IN PARTICOLARE ANNI 2020-2021

