# The NFLICS project: Nowcasting FLood Impacts of Convective storms in the Sahel

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**2020-IVMW-O Spatial methods**
17 November 2020

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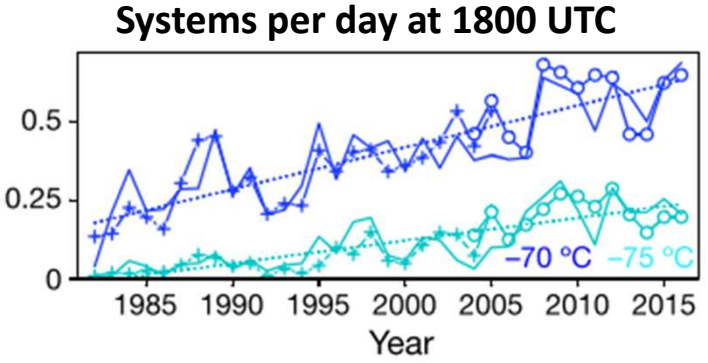
# Overview and motivations

- Flash flooding from heavy rainfall is a cause of major damage and loss of life in Africa[1]
- In the Sahel, Mesoscale Convective Systems are the main driver and have tripled in frequency since 1982[2]
- Rapid urban expansion and poor infrastructure means impacts of floods likely to worsen in future
- Availability and use of high resolution NWP products and nowcasting approaches is low




[2]*Taylor et al., Nature (2017)*

**November 2018 (dry season) Pikine commune, Dakar**

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[1]*Engal et al., J. Hydrometerol (2017)*

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# Nowcasting FLood Impacts of Convective storms in the Sahel

**Science**

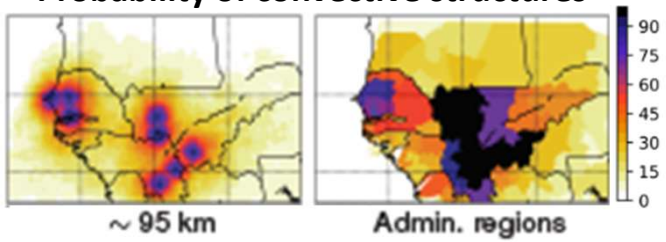
**New satellite nowcasting methods**

**New rainfall and flood risk products**

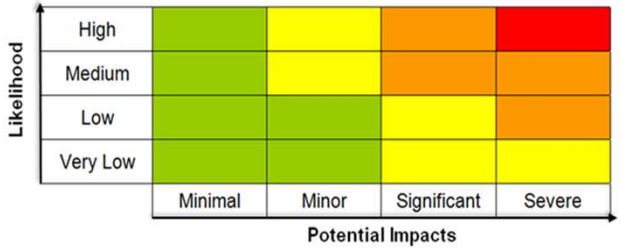
**Trial system**

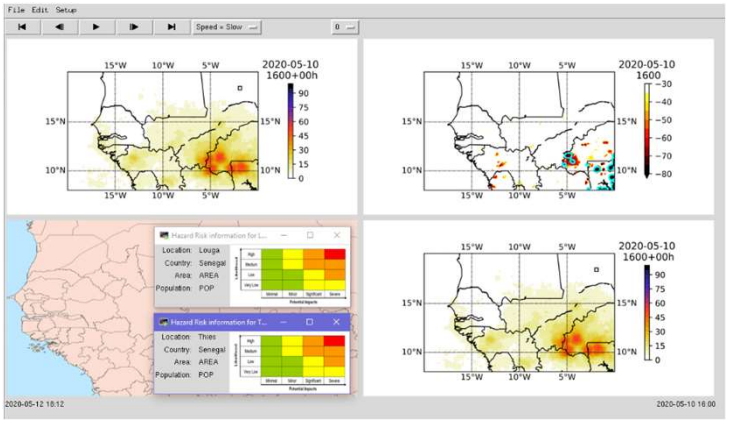
**Real-time prototype trial and evaluation in 2020 rainy season**

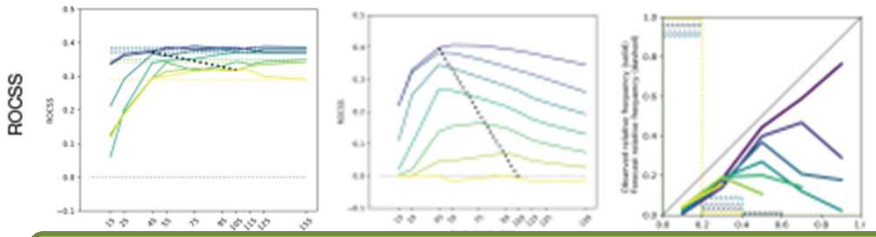
**Probability of convective structures**




**Flood Risk Matrix**
(river, tidal/coastal & surface water flooding)






**Verification of system performance**

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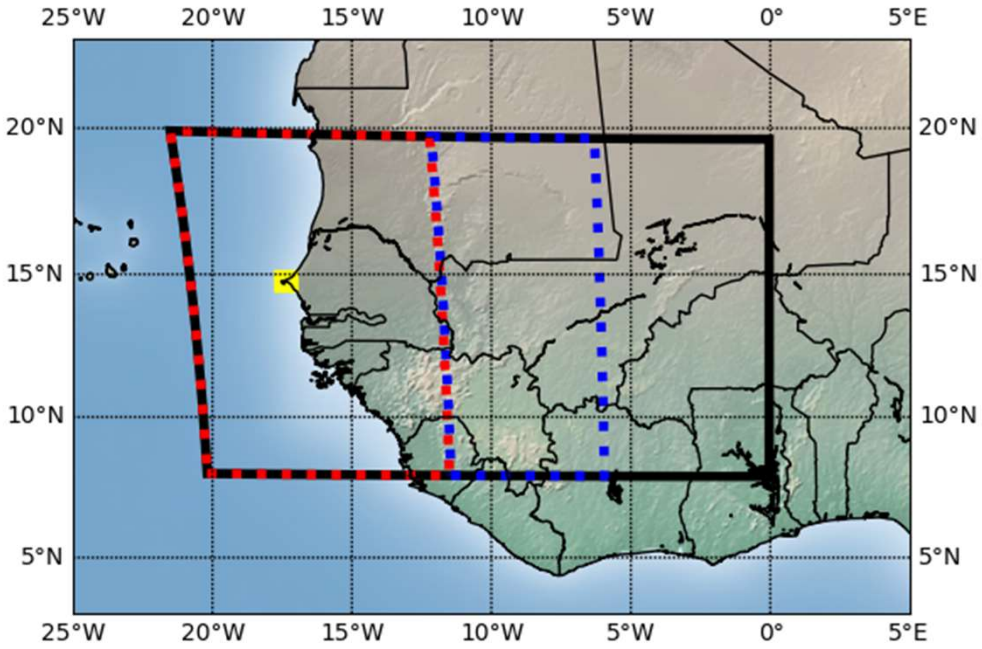
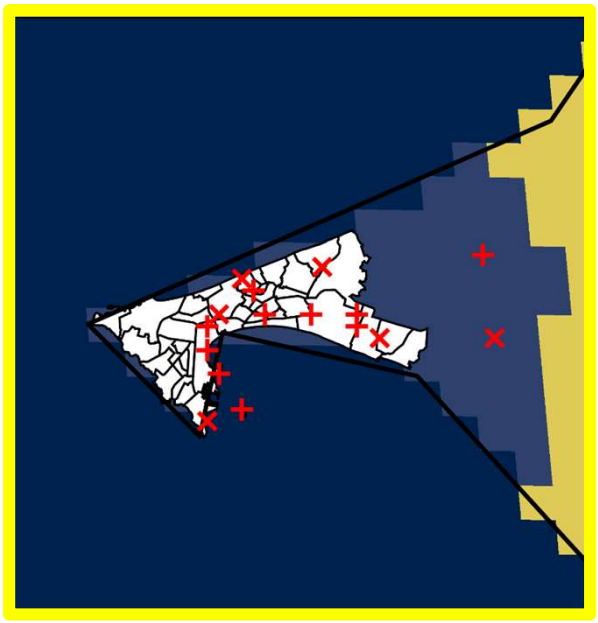
# Methods: data and domains considered



- Meteosat (ch9) data on **Cloud top temperature** for a **domain** covering the **Western Sahel (black** above**)**
- Three verification domains (dotted above, here we consider the western-most **red** domain)
- **24h raingauge data** over **Dakar** available for evaluation and verification in partnership with ANACIM

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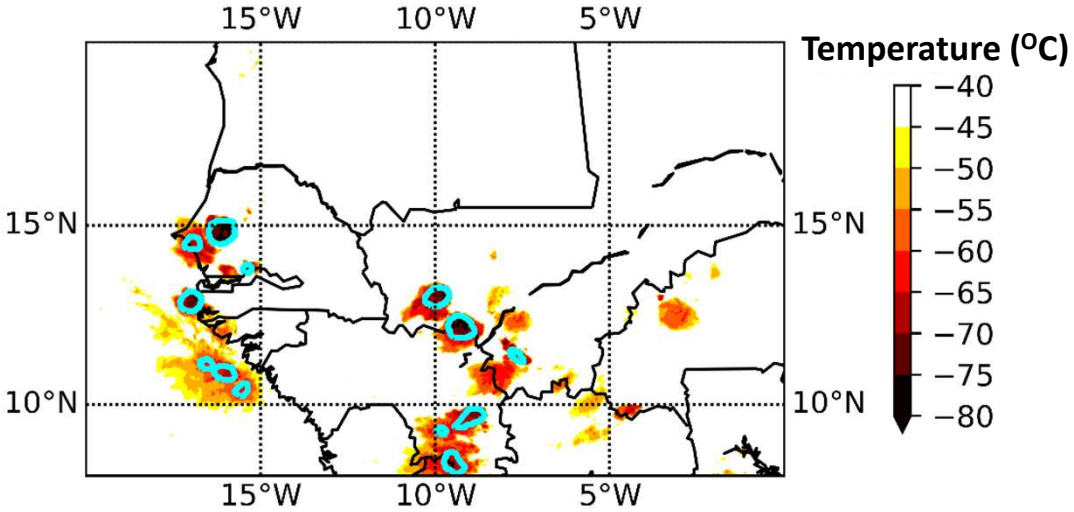
# Methods: convective structure identification

**Real-time brightness temperature image** with **convective structures identified**: example 26 August 2012 0000 UTC




- Wavelet transform method for identifying convective cores (Klein et al. 2018) shown by **blue contours**
- Applied in real-time every 15 minutes

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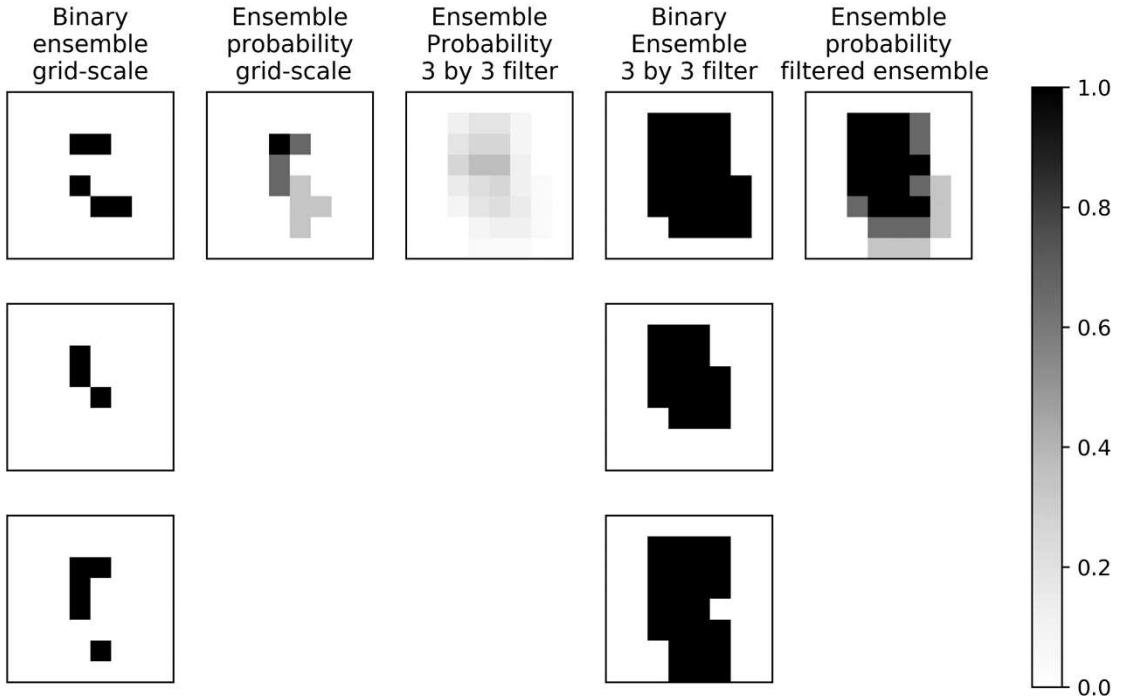
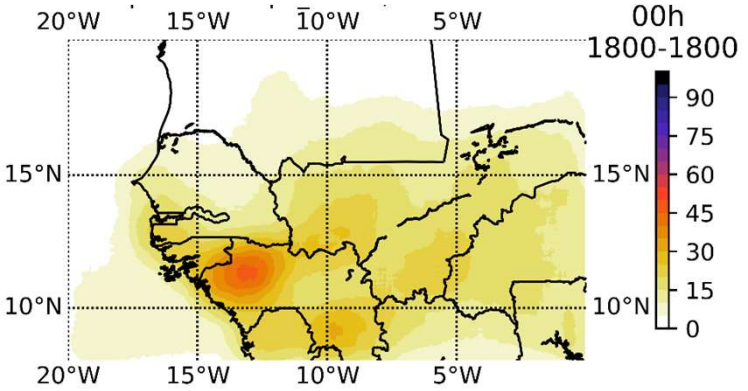
# Method: climatological probabilities – spatial approach

**Spatially-averaged probabilities ≠ probabilities calculated over spatial area (neighbourhood)**




- JJAS 2004 – 2019 for each time of day
- Probability values depend on spatial scale
- Need to use **verification** to identify **appropriate** and **skilful** spatial scales

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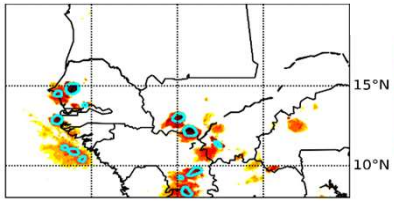
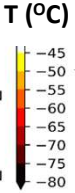
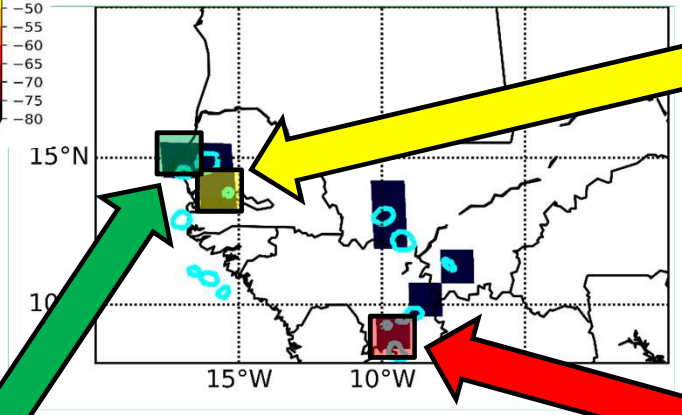
# Method: conditional climatological probabilities

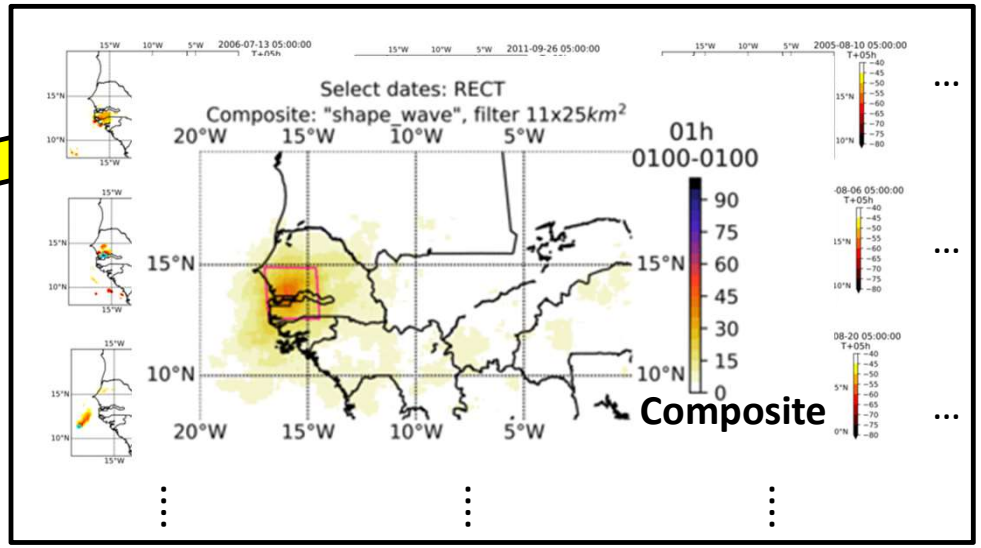
**Real-time convective structure identification**

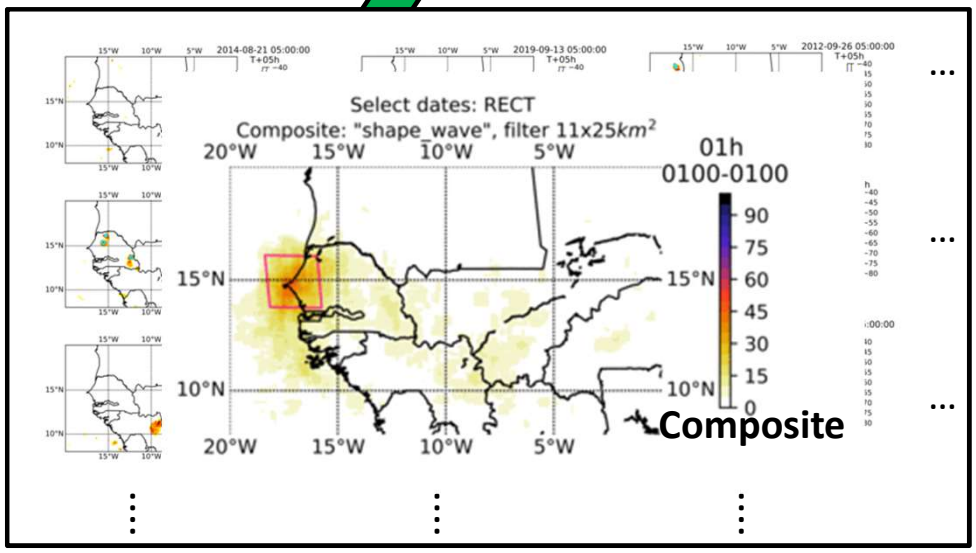


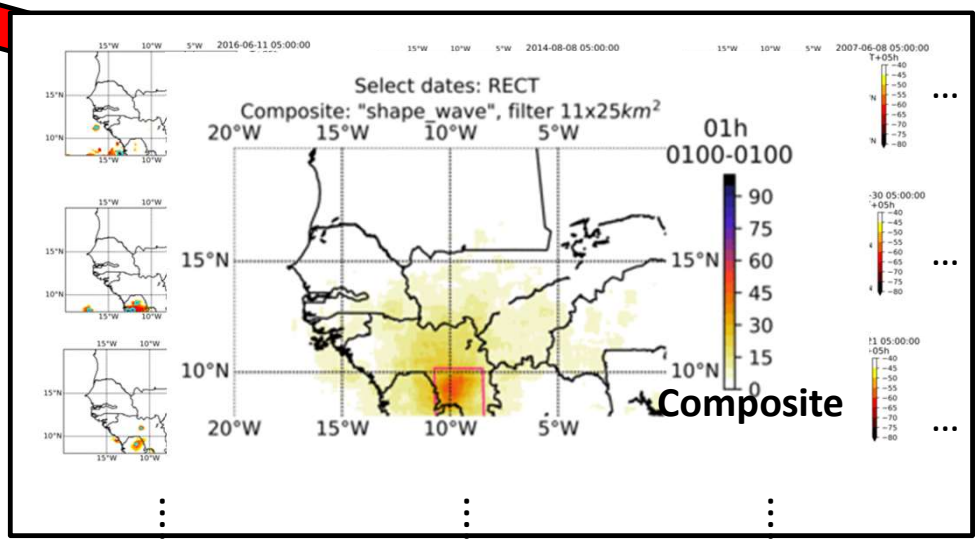




**Look-up pre-calculated database** of conditional climatological probabilities



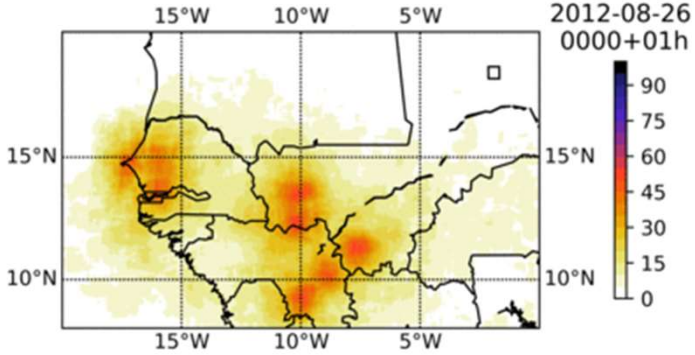



# Method: producing nowcasts

**Probability of convective structure (%)**
**over a spatial scale shown by the square**

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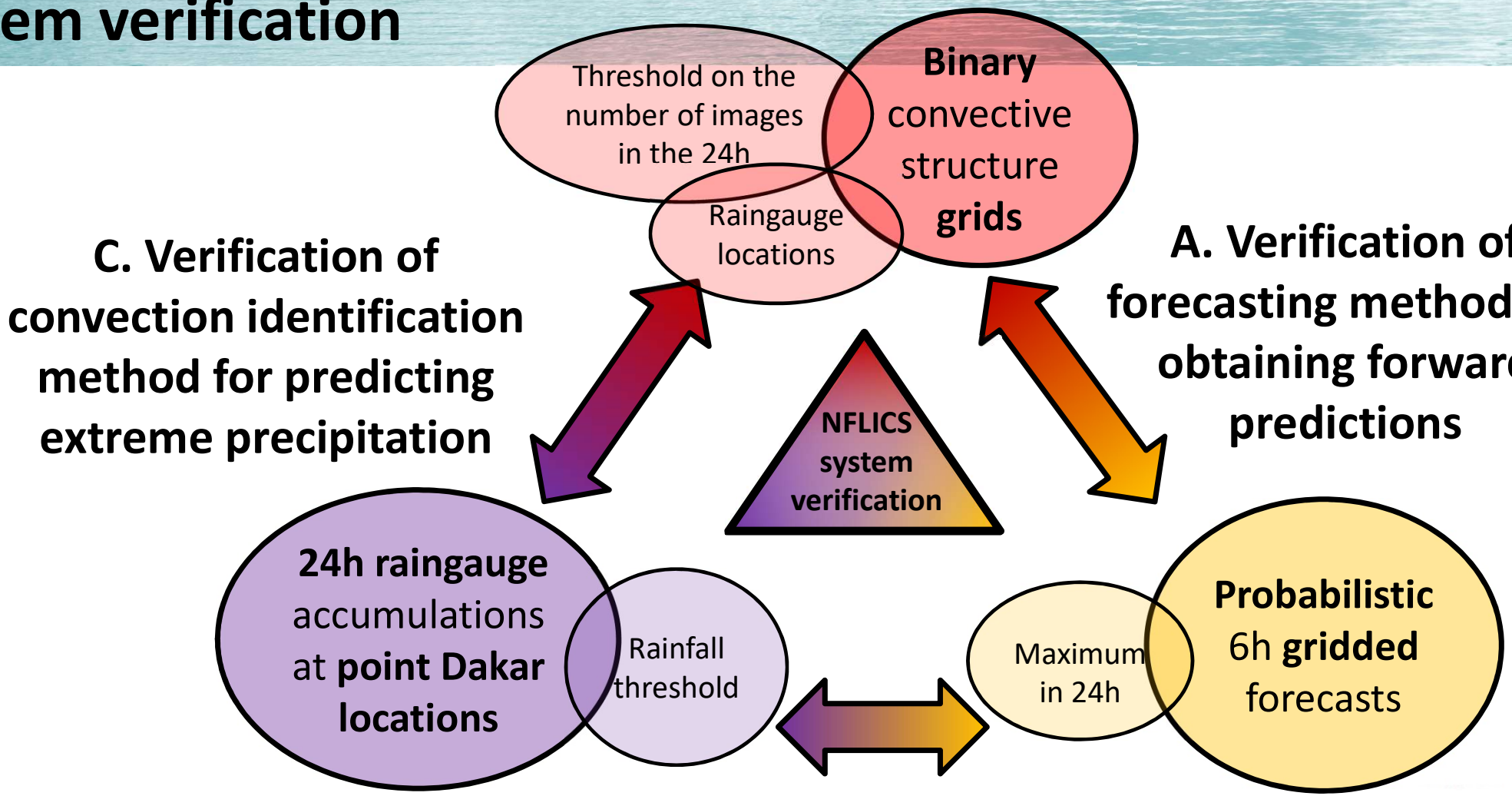
# System verification

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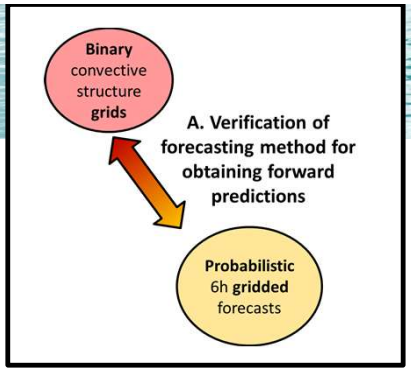
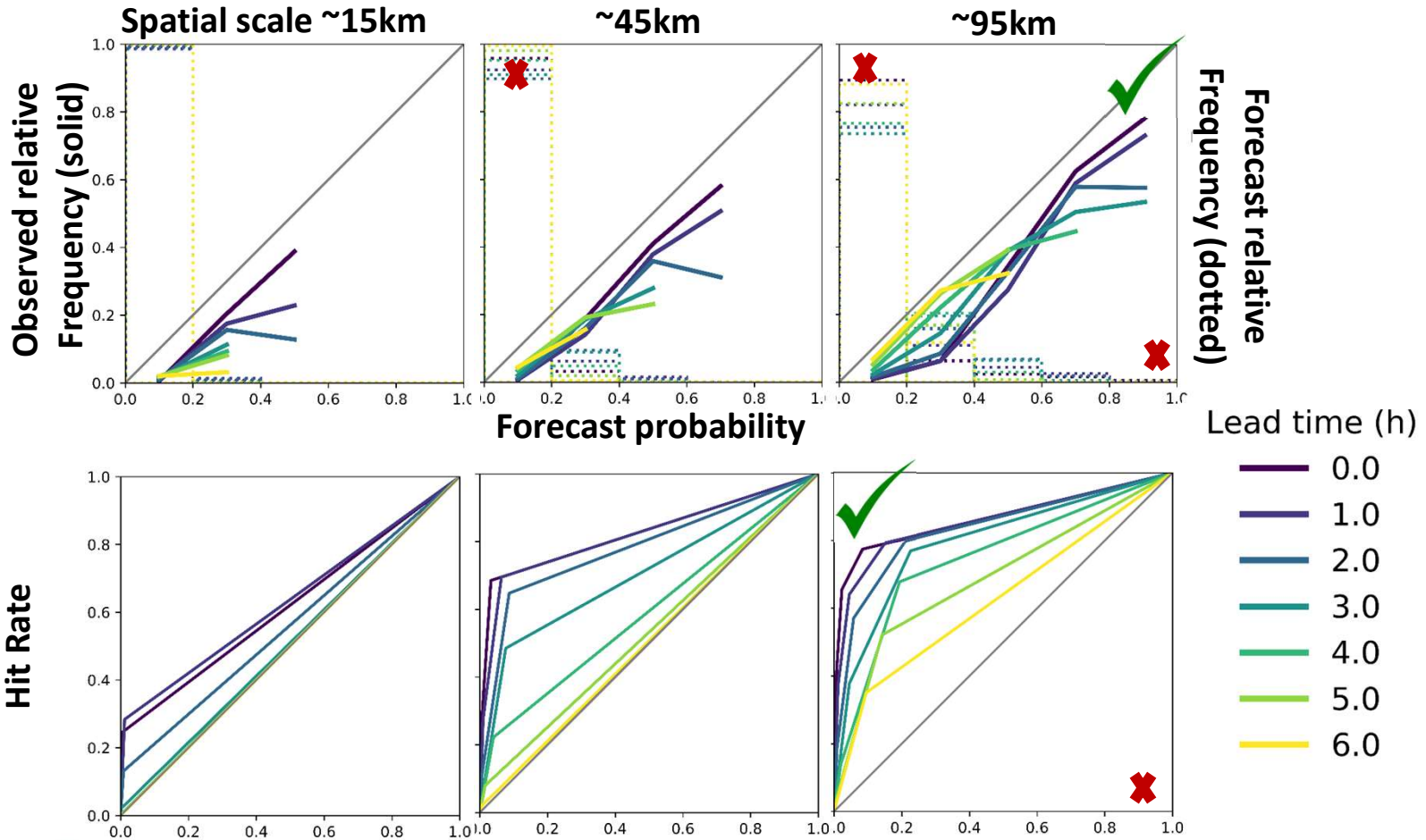
# A. Verification of forecasting method - accuracy




- **Higher probabilities** and **better performance** for larger spatial scales
- Overall **performance decreases** with **lead-time** but not linearly (and there are exceptions!)

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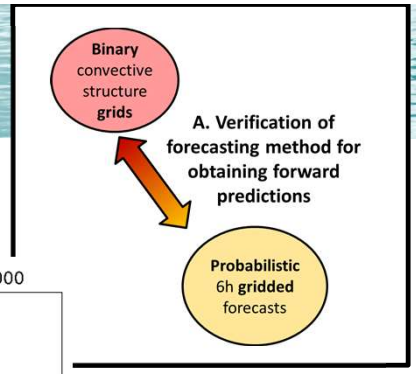
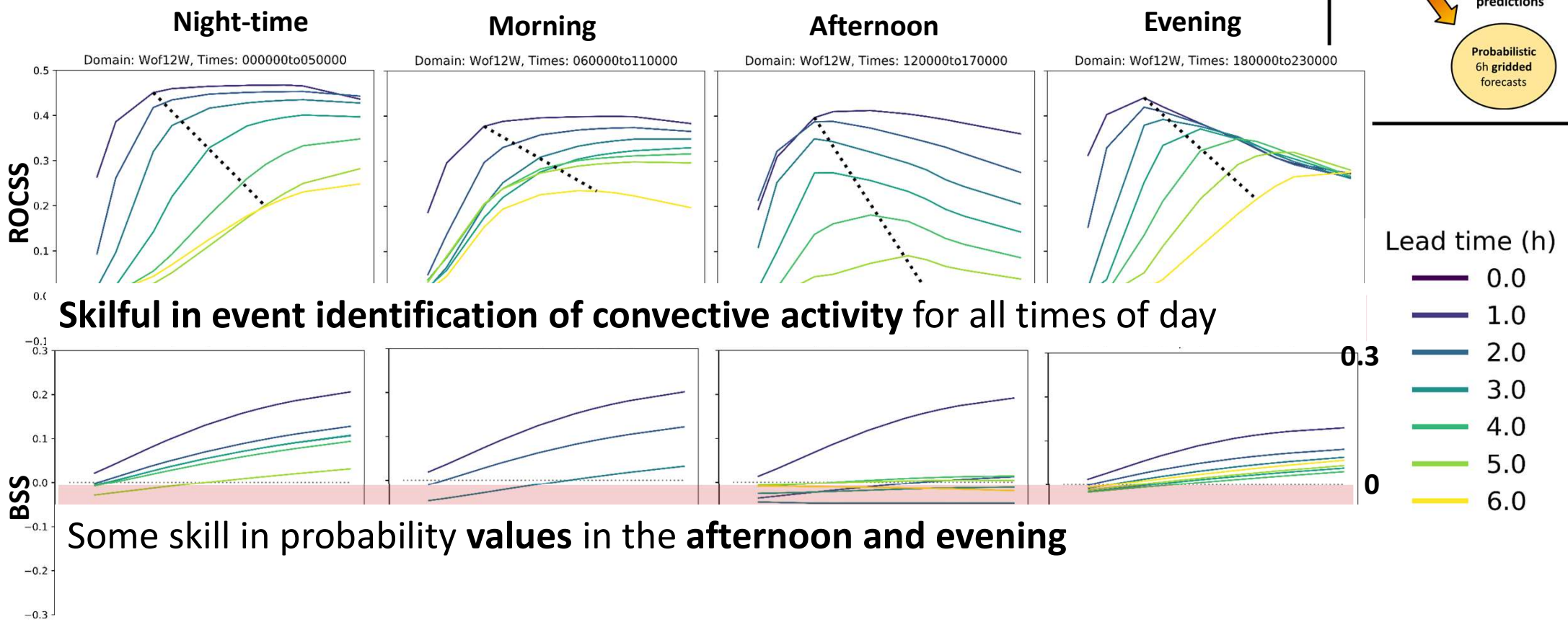
# A. Verification of forecasting method – skill



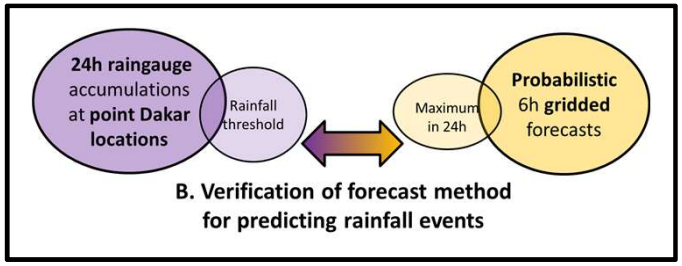



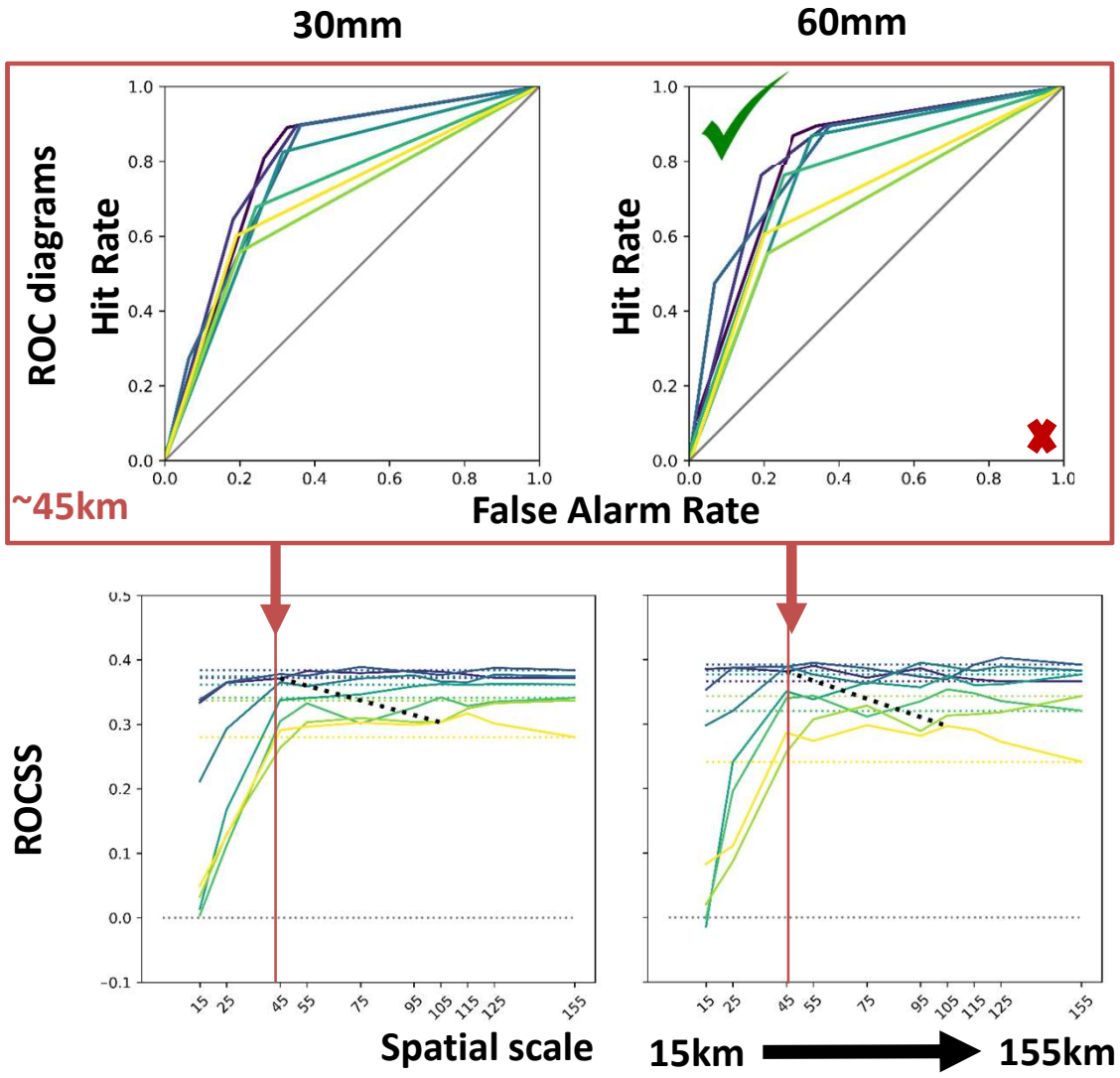

**Skilful in event identification of convective activity** for all times of day

Some skill in probability **values** in the **afternoon and evening**

**Initially skill** in event identification **increases with spatial scale before levelling off or decreasing** slightly ➡ there is an **optimum spatial scale** for nowcast skill

# B. Verification of forecasts against rainfall events




- **Skill exists** for predicting **extreme rainfall events**
- **Similar** results **for 90mm** threshold
- Despite differences in data types and a limited sample it *is* possible to say something

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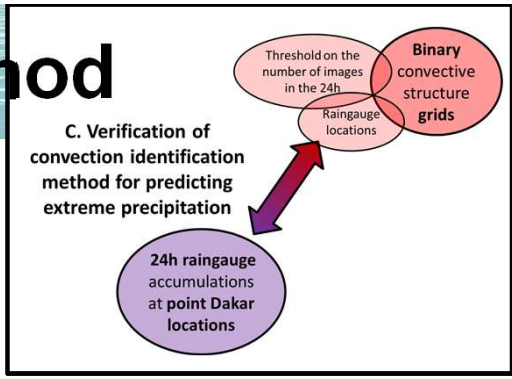
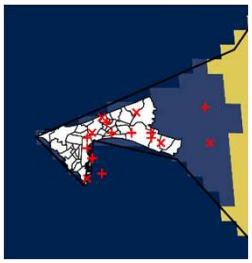
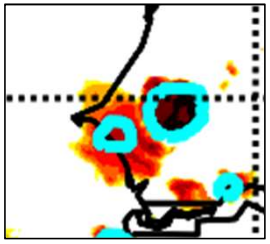
# C. Verification of convection identification method

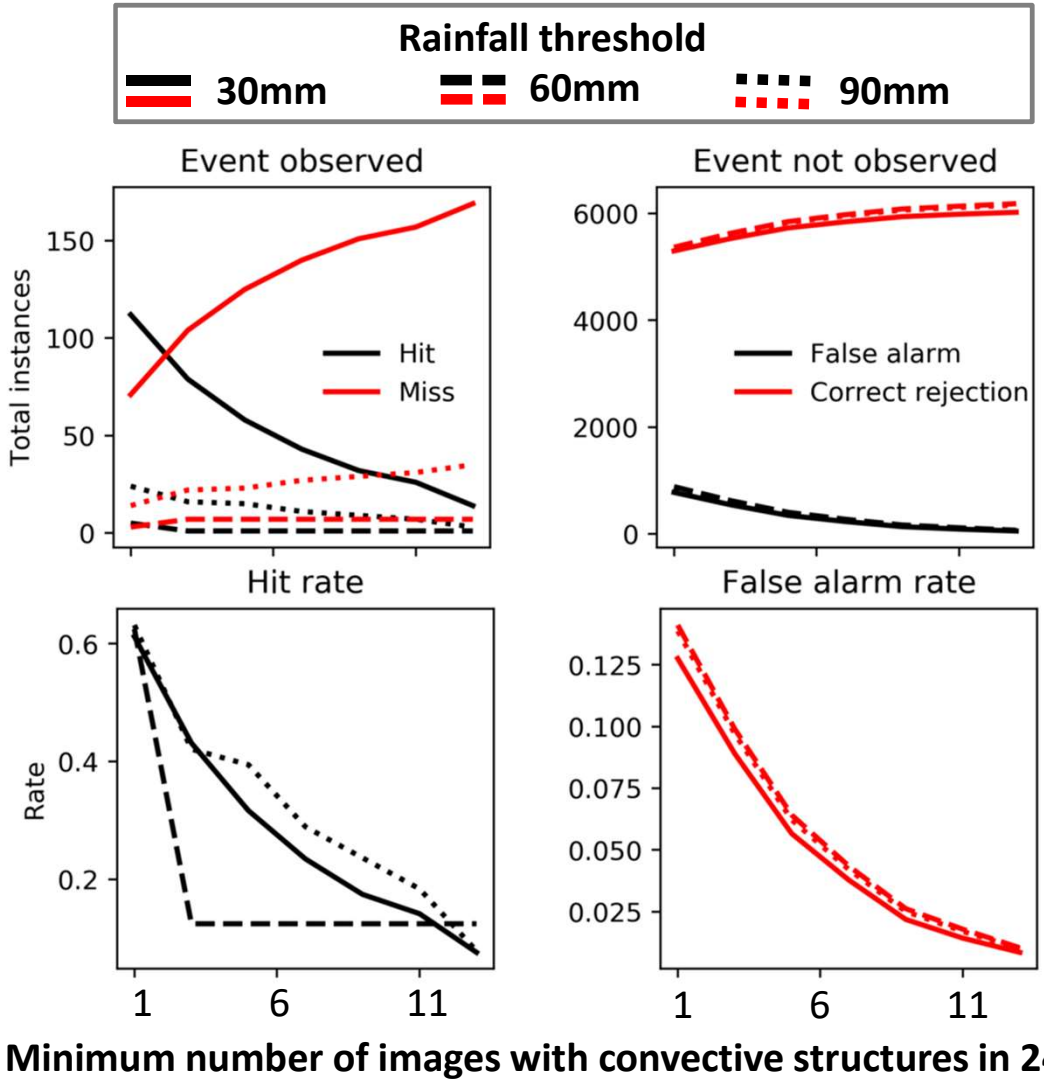



24h **raingauge** data for Dakar



**Convective structure** data at raingauge locations






- **Hit rate** for 1 to 1.5h of convective activity ~ 0.3-0.6
- **False alarm rate** very small due to high instance of non-events
- Full climatological rate of events is much smaller

# Summary and conclusions

- **Spatial methods** and **ensemble techniques** can be applied to develop **novel forecasting solutions**
- **Informed decisions** about **appropriate spatial scales** can be formed based on the verification information
- **Verification** (of some form) is **possible** even given data limitations and differences
- **Multiple aspects** of the **system** need to be verified to get an **overall picture** of forecast behaviour, and to **enable informed use**

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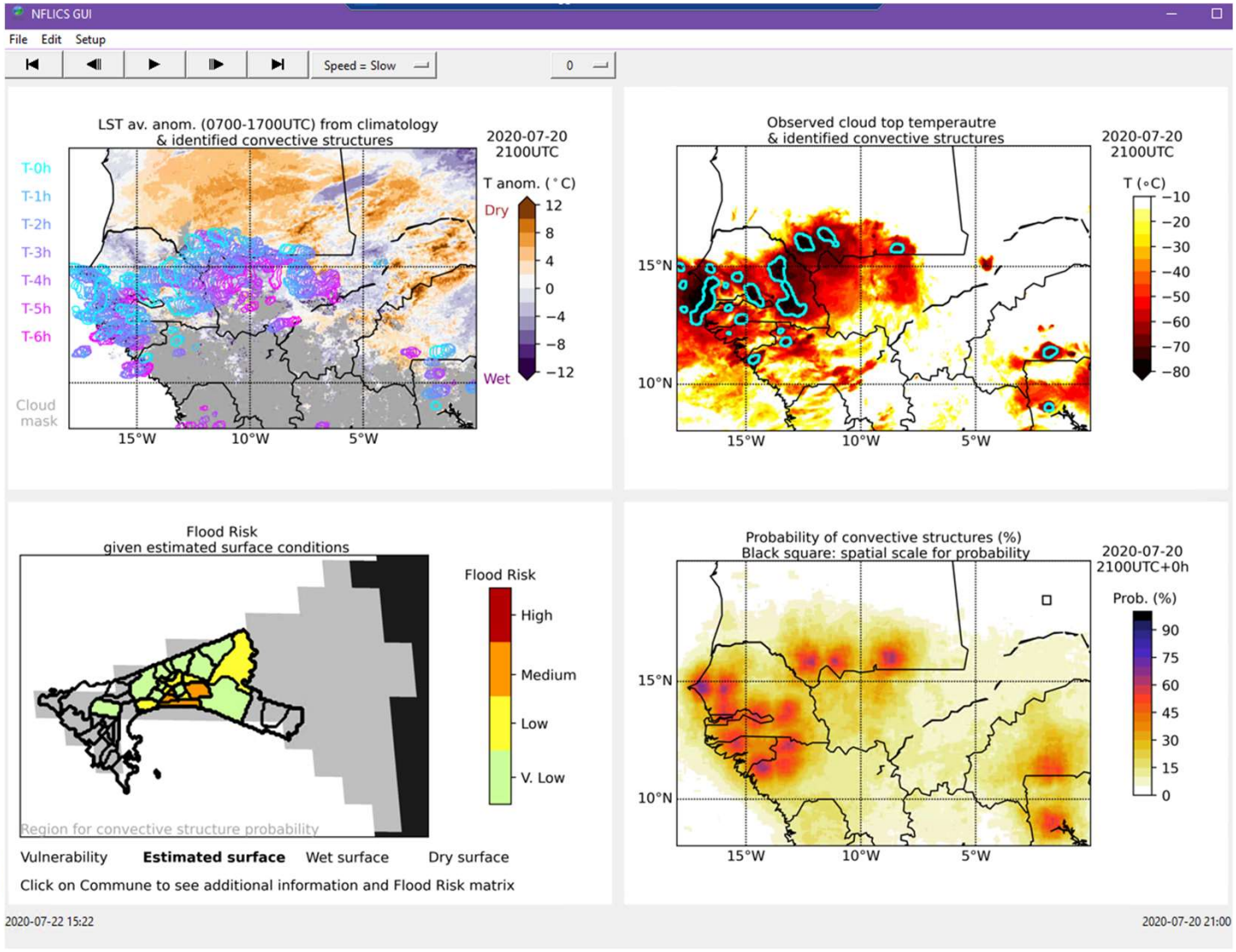
# NFLICS GUI for real-time display




**Thank you for your attention.**

**Are there any questions?**

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