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Enhancing early warnings in Africa with MTG LI observations

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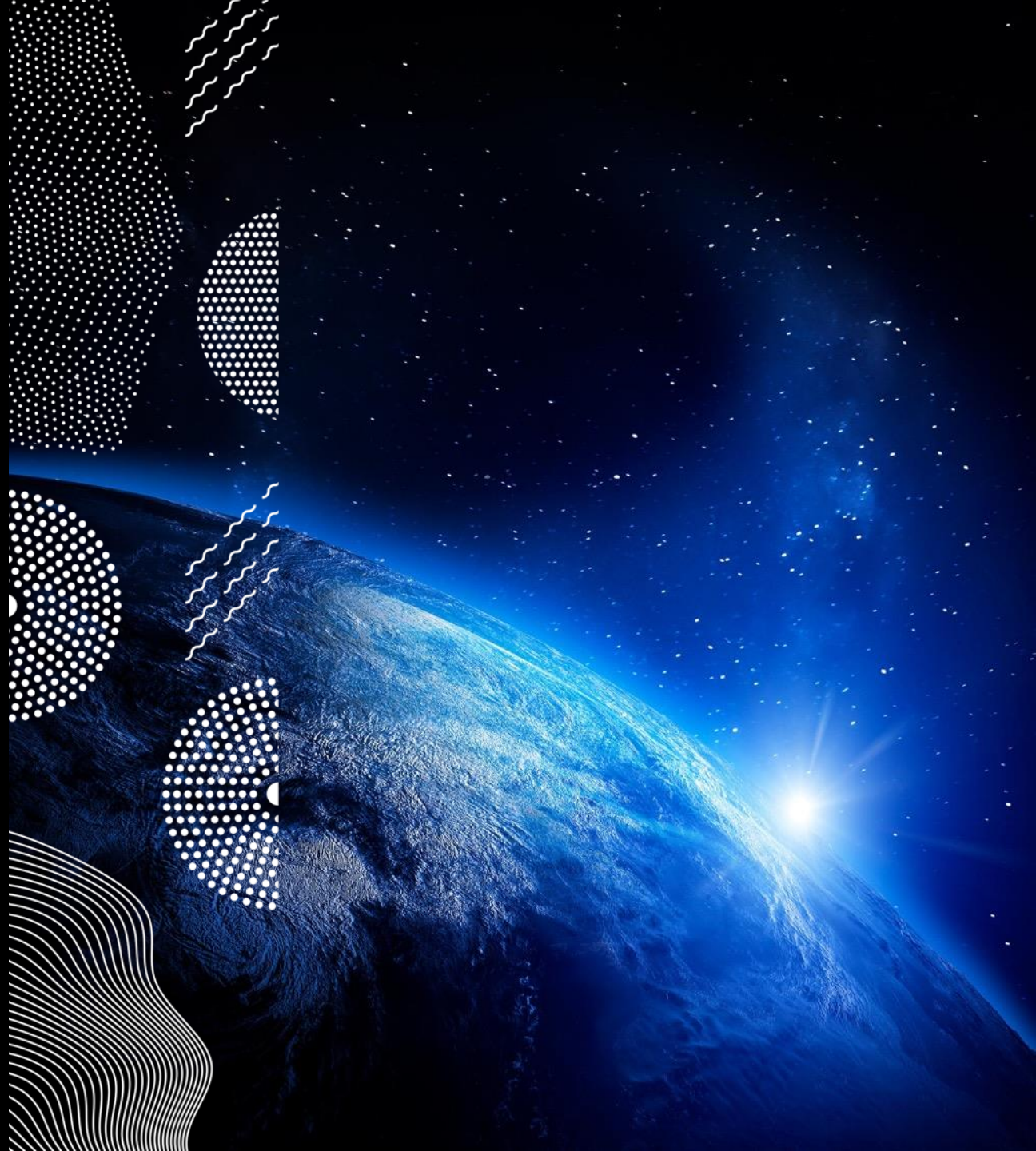

Challenges in forecasting tropical thunderstorms

1. **Rapid development** and localized events (a few kilometers wide)
2. **Boundary-layer processes** and interactions crucial in convective initation
   a) Global models' grid sizes too coarse to resolve individual thunderstorms
3. Over tropical oceans / remote land areas, **in-situ observations** are limited
4. Tropical regions are influenced by **large-scale phenomena**
   a) Madden-Julian Oscillation (MJO), easterly waves and monsoon circulations

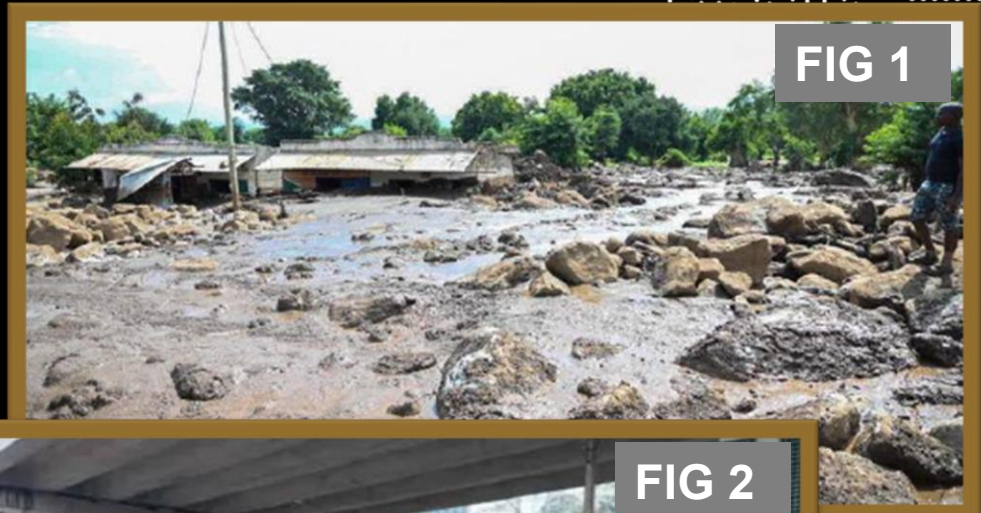

FIG 1: *The aftermath of a mudslide in the Chesongoch Area of Elgeyo Marakwet, November 1, 2025.*
FIG 2: *An example of effects of flash floods (By Antony Achayo, 6th October 2025, Switch Media)*

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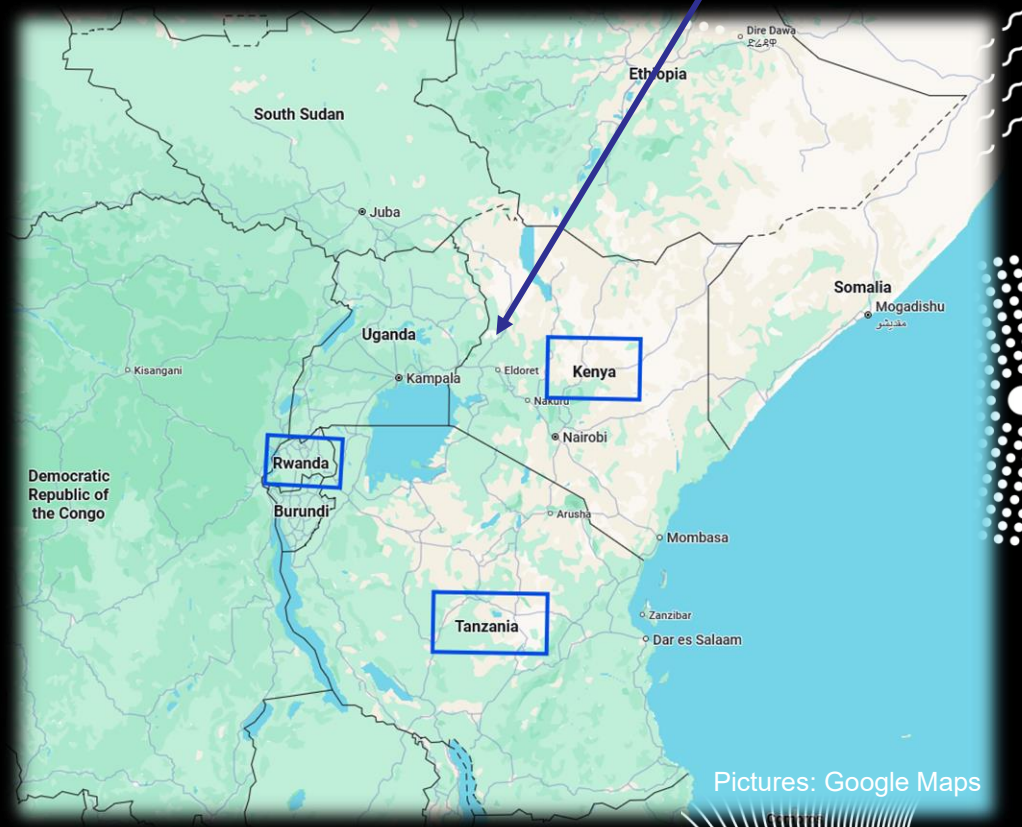
Background

1. FMI is coordinating FINKERAT project in East Africa. The three countries participating are **Rwanda**, **Kenya** and **Tanzania**
   a) Capacity building project
2. Weather forecasting data gathered from the summer 2025
   a) 4th of June
   b) 12th of June
   c) 31st of July
3. Forecast lengths used in the study 24h…84h
4. LI data = Observations



Pictures: Google Maps

Aim of this study is...

..to provide an initial assesment of the added value of the MTG LI for supporting thunderstorm forecasting and Early Warning Systems (EWS) in East Africa.

QUESTION:

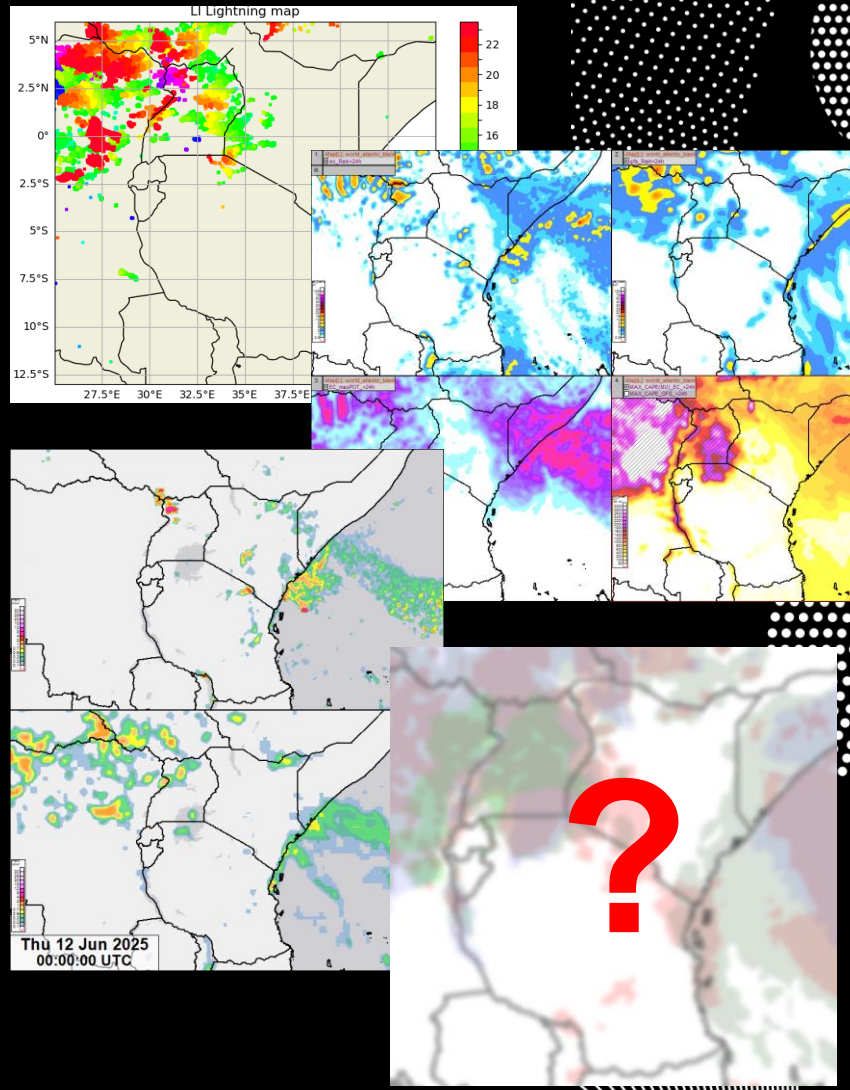
1. Is there a way to improve the forecasting quality (temporal or spatial) for thunderstorms?

METHOD:

2. Visually comparing the LI observation data NWP models → Verificate the models' behaviour
   a) ECMWF and GFS
   b) Derived calculations from available parameters

DESIRED OUTCOME:

3. Some suggestions to improve the current forecasting method for thunderstorms



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Impact of the study?

Kenyan weather forecaster:

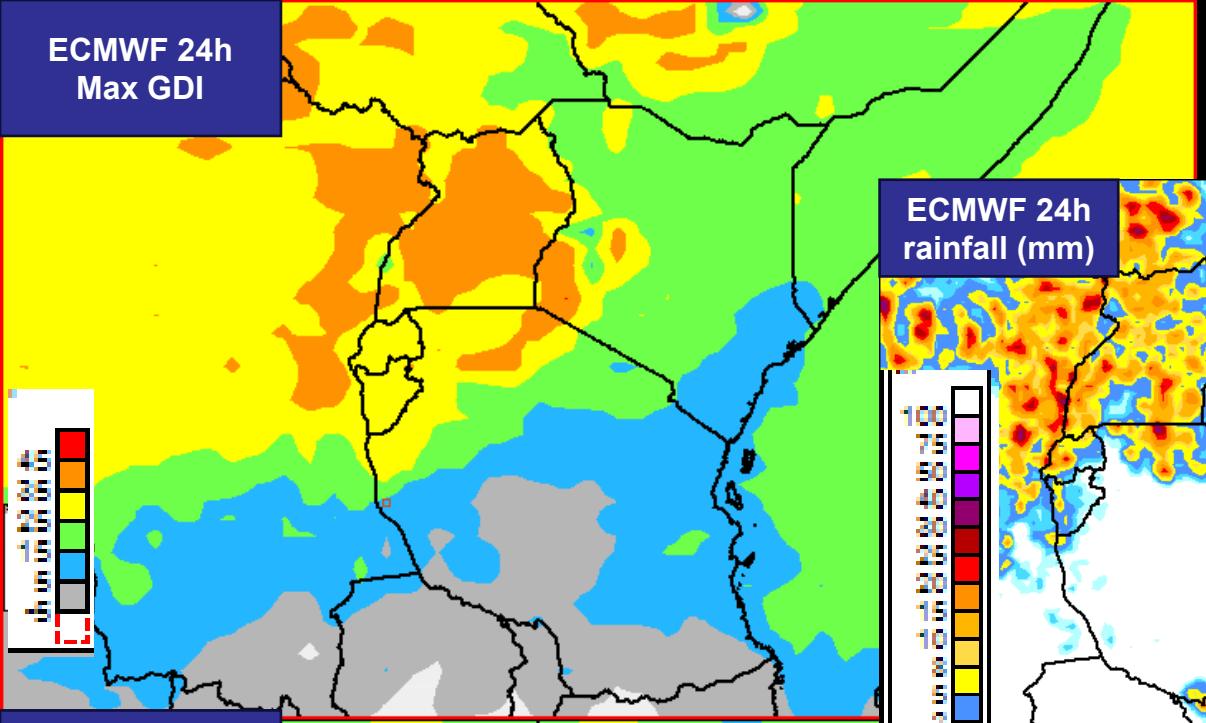
” Improving temporal and spatial accuracy of thunderstorm forecasts would bring major benefits to Kenya across multiple sectors. Because thunderstorms in Kenya are often intense, localized, and tied to agriculture, transport, and safety, ***even small improvements in forecast accuracy can yield large societal and economic gains****. ”*

Sector	Benefit of Better Temporal Accuracy	Benefit of Better Spatial Accuracy
Agriculture	Timely warnings for rain events	Pinpoint which farms or zones are affected
Disaster Management	More lead time for alerts	Fewer false alarms, targeted evacuations
Transport	Safer flight and road scheduling	Avoid specific high-risk routes
Energy & Water	Optimized dam releases	Identify which catchments will receive rain
Public Safety	Improved readiness	Localized shelter and resource deployment

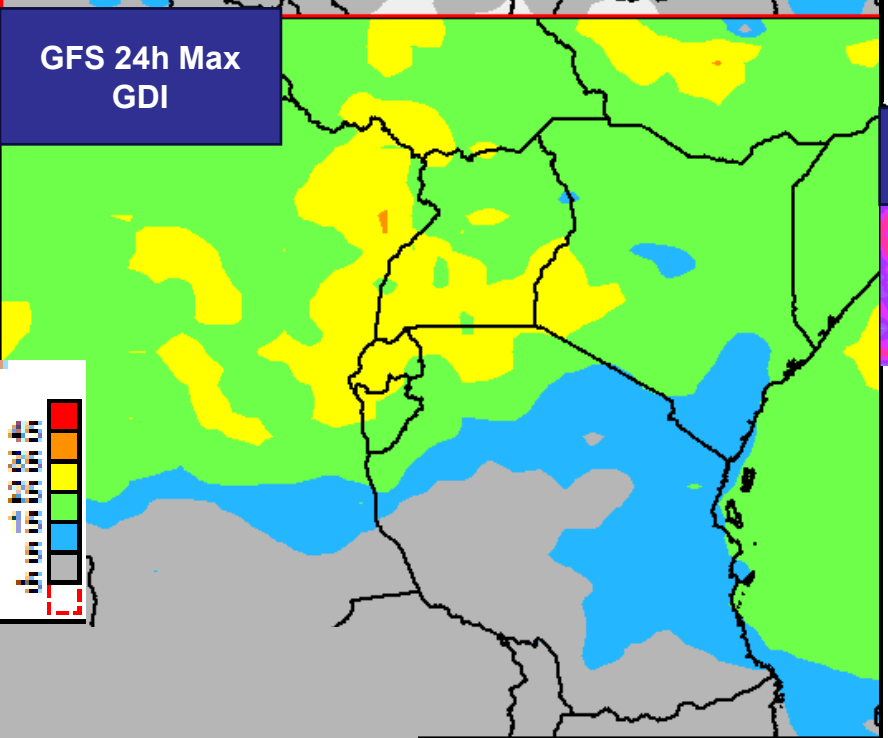
Credits: Scholastic Maloba

Jane Kalekye stands outside her home in the Mathare slum in Nairobi, which has been flooded almost every night as El Niño rains devastate Kenya. Photograph: Edwin Ndeke/The Guardian

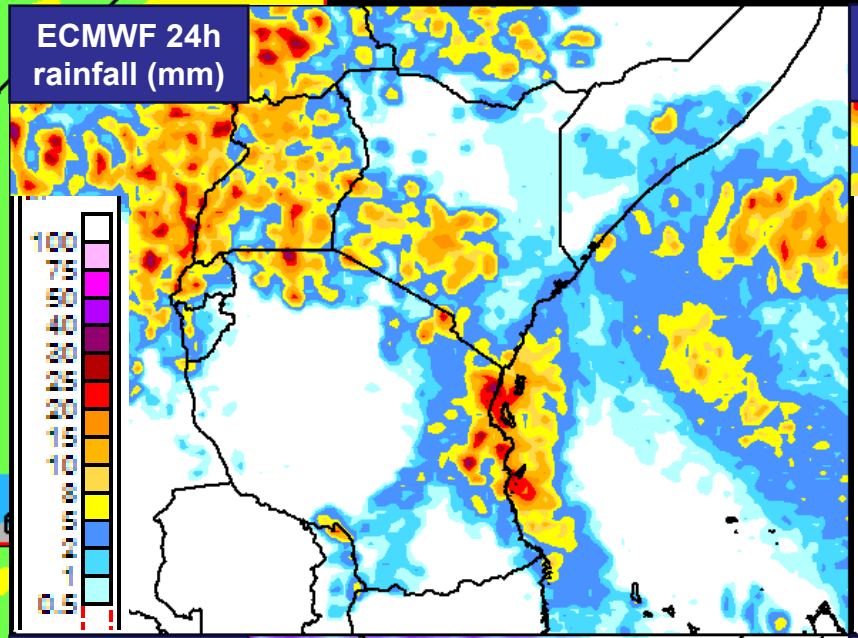
ECMWF 24h Max GDI



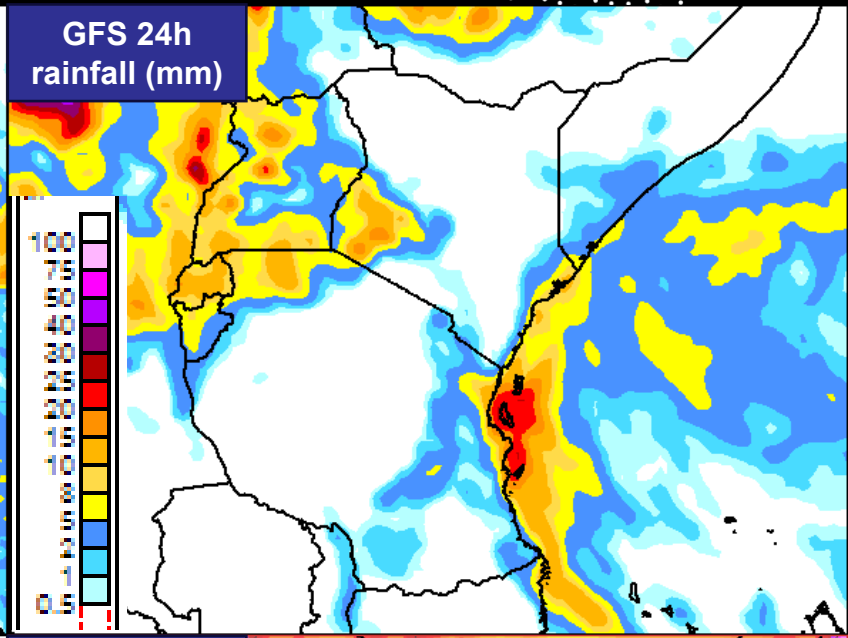
GFS 24h Max GDI



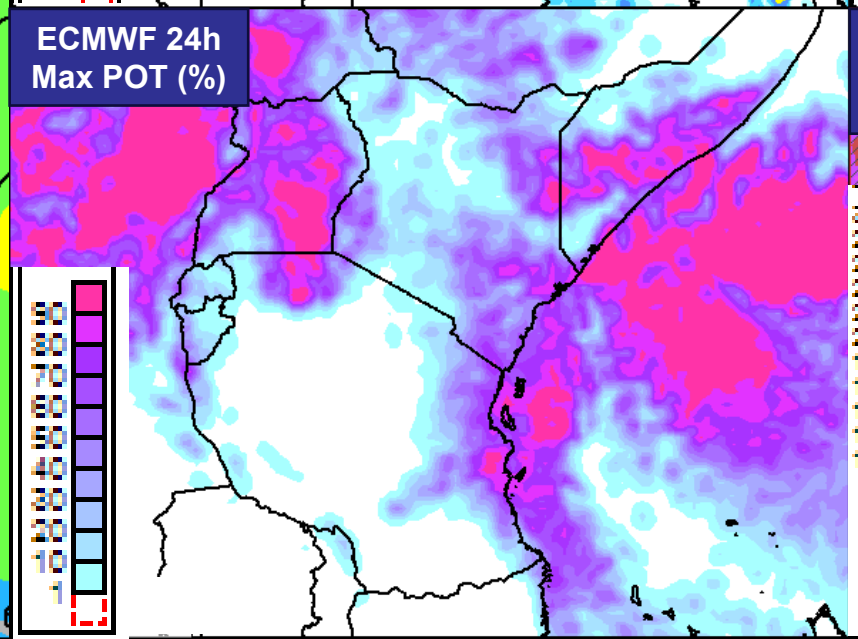
ECMWF 24h rainfall (mm)



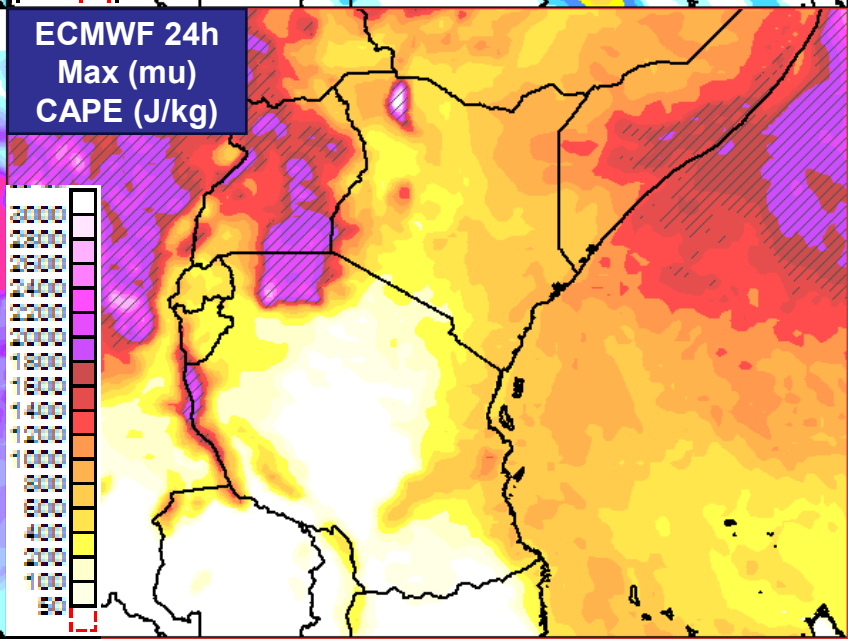
GFS 24h rainfall (mm)



ECMWF 24h Max POT (%)

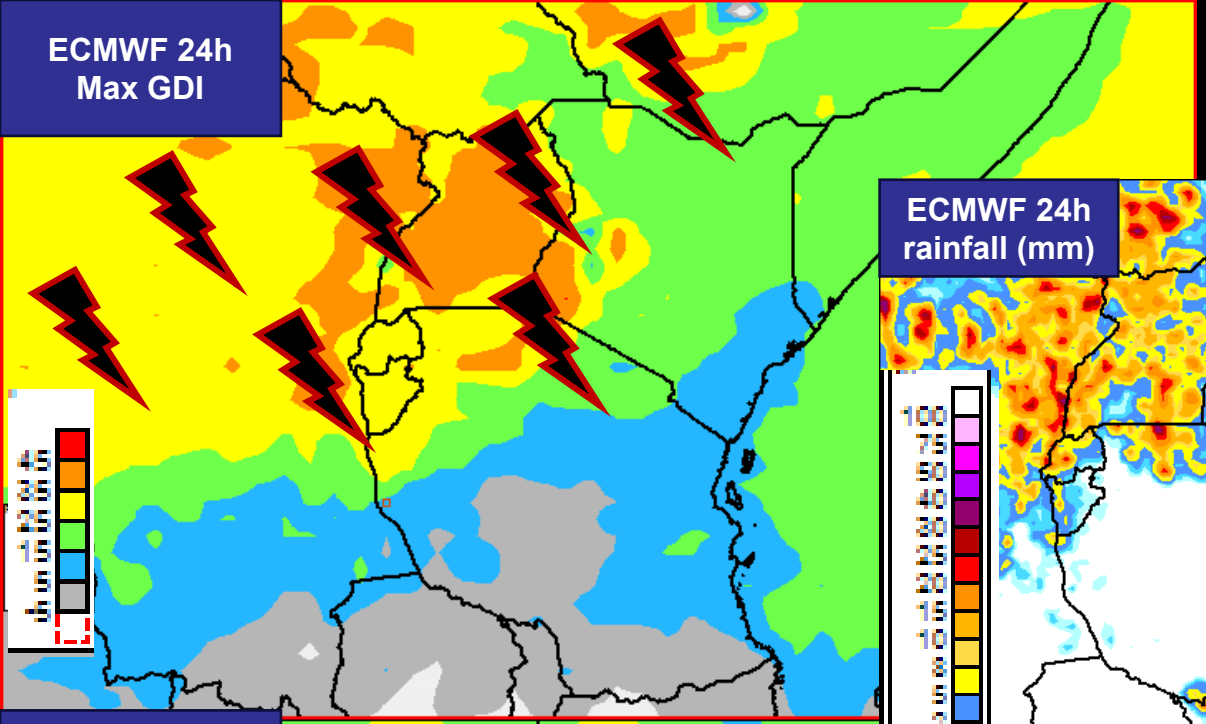


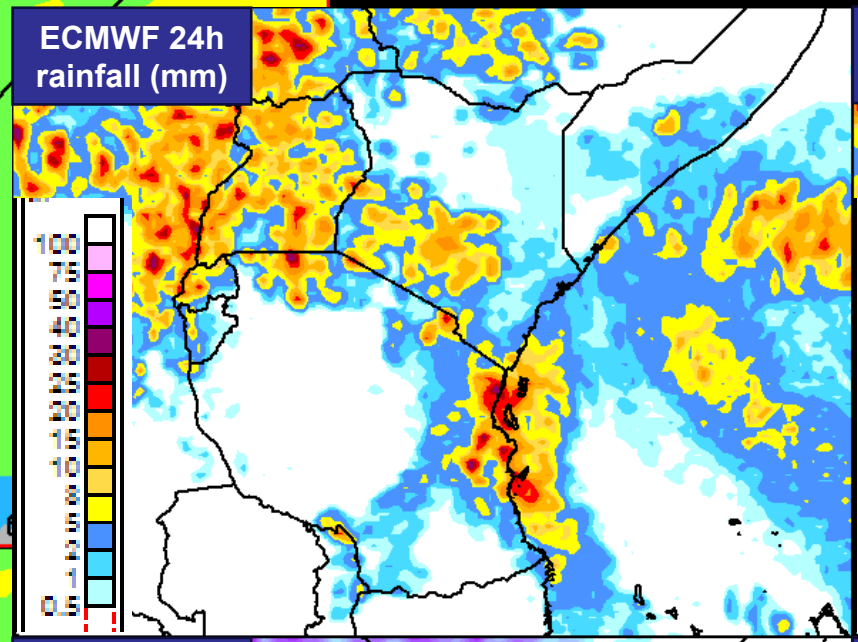
ECMWF 24h Max (mu) CAPE (J/kg)

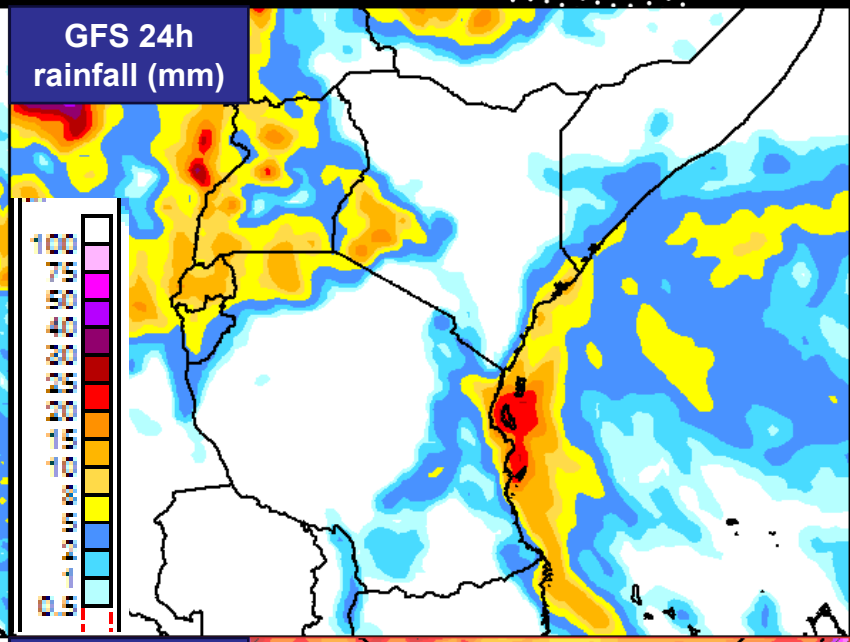


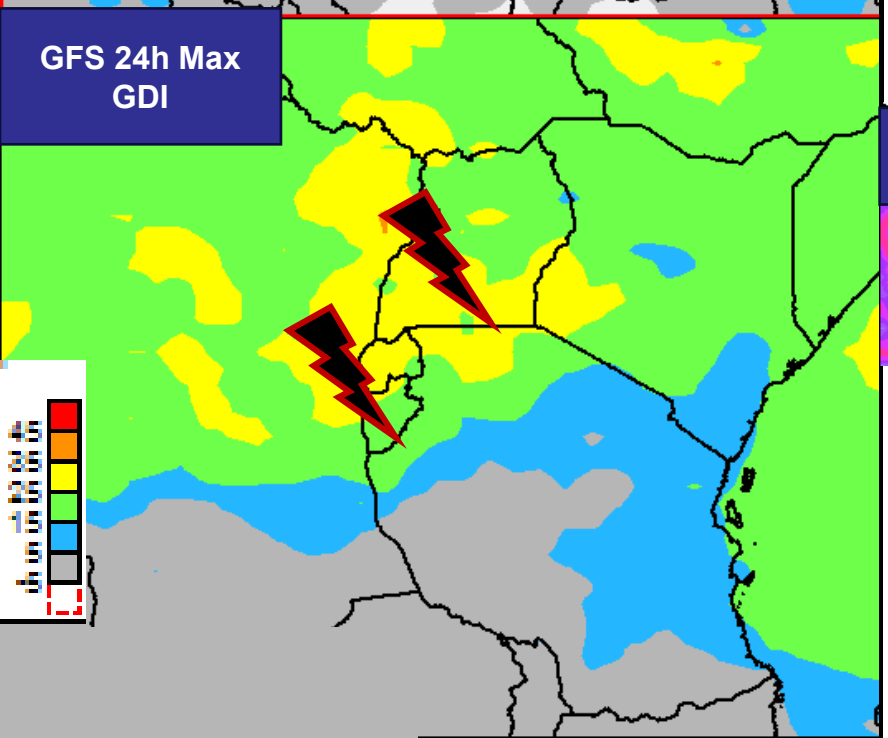
Thunderstorms?

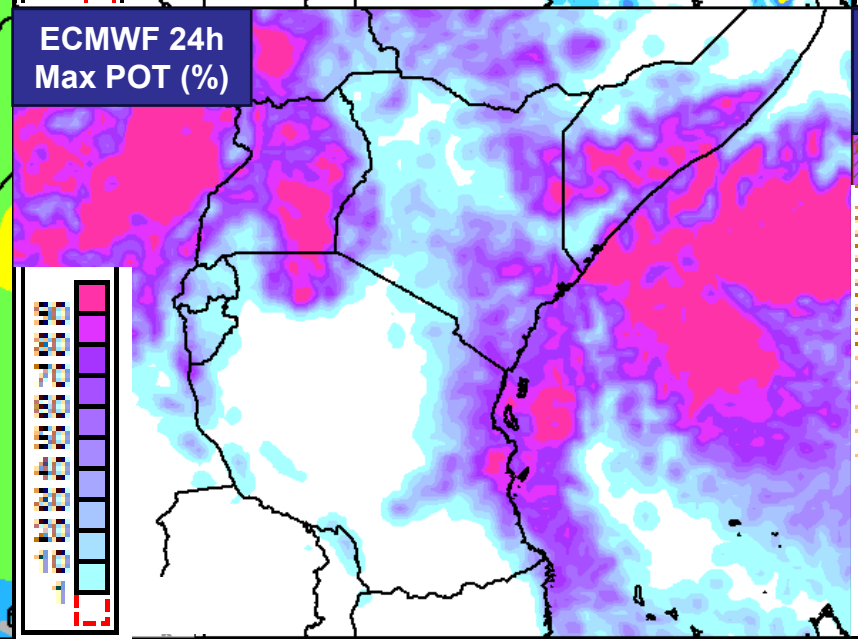
5th of June, 2025

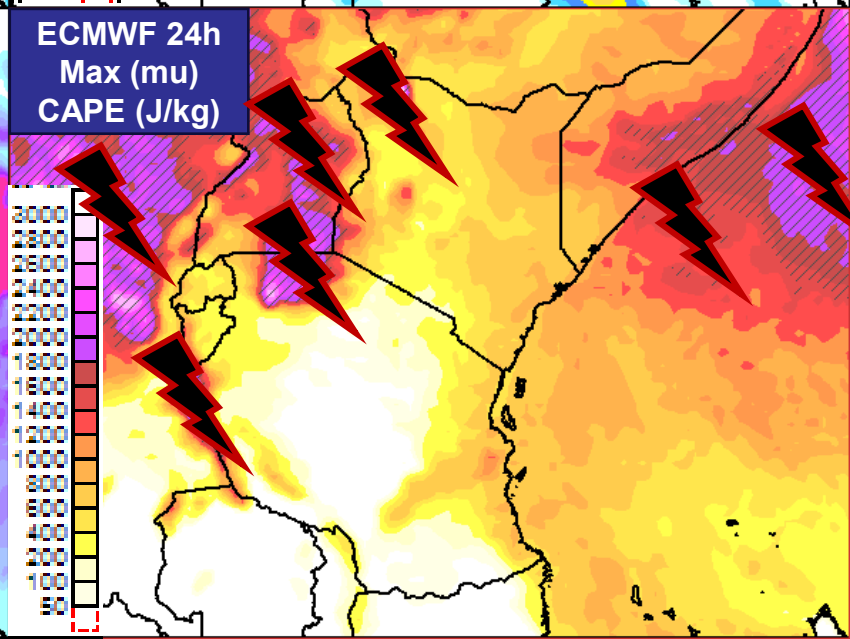










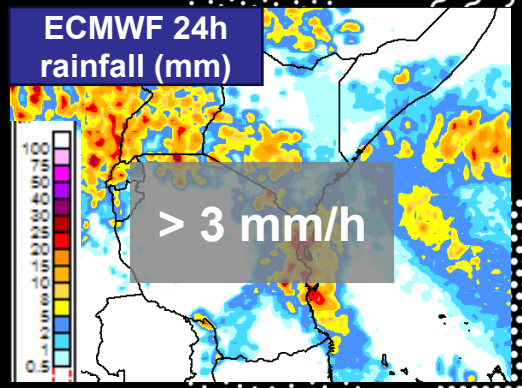


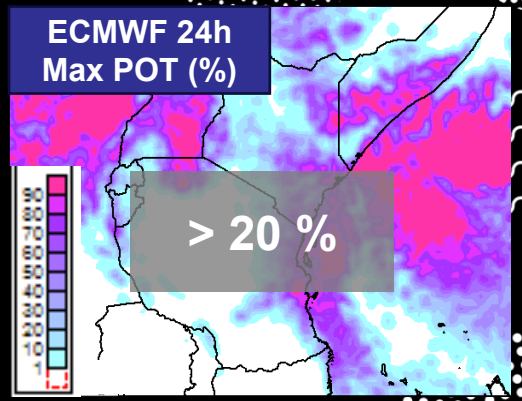
Results

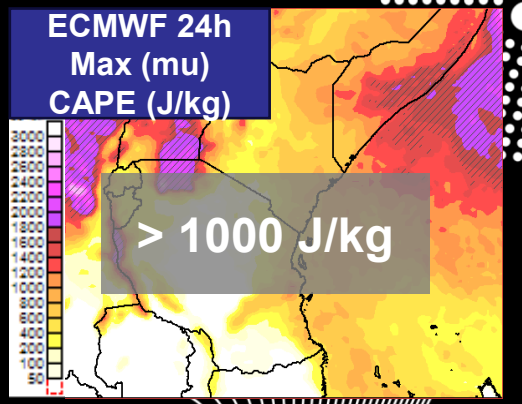
1. Combination of 24h calculations worked the best:
   a) Max CAPE
   b) Max POT (= Propability Of Thunderstrorms)
   c) Rainfall accumulation

2. GDI (Gálvez–Davison Index) was improving the emphasis of the most strikes (flash density), but wasn't adding value to the spatial forecast

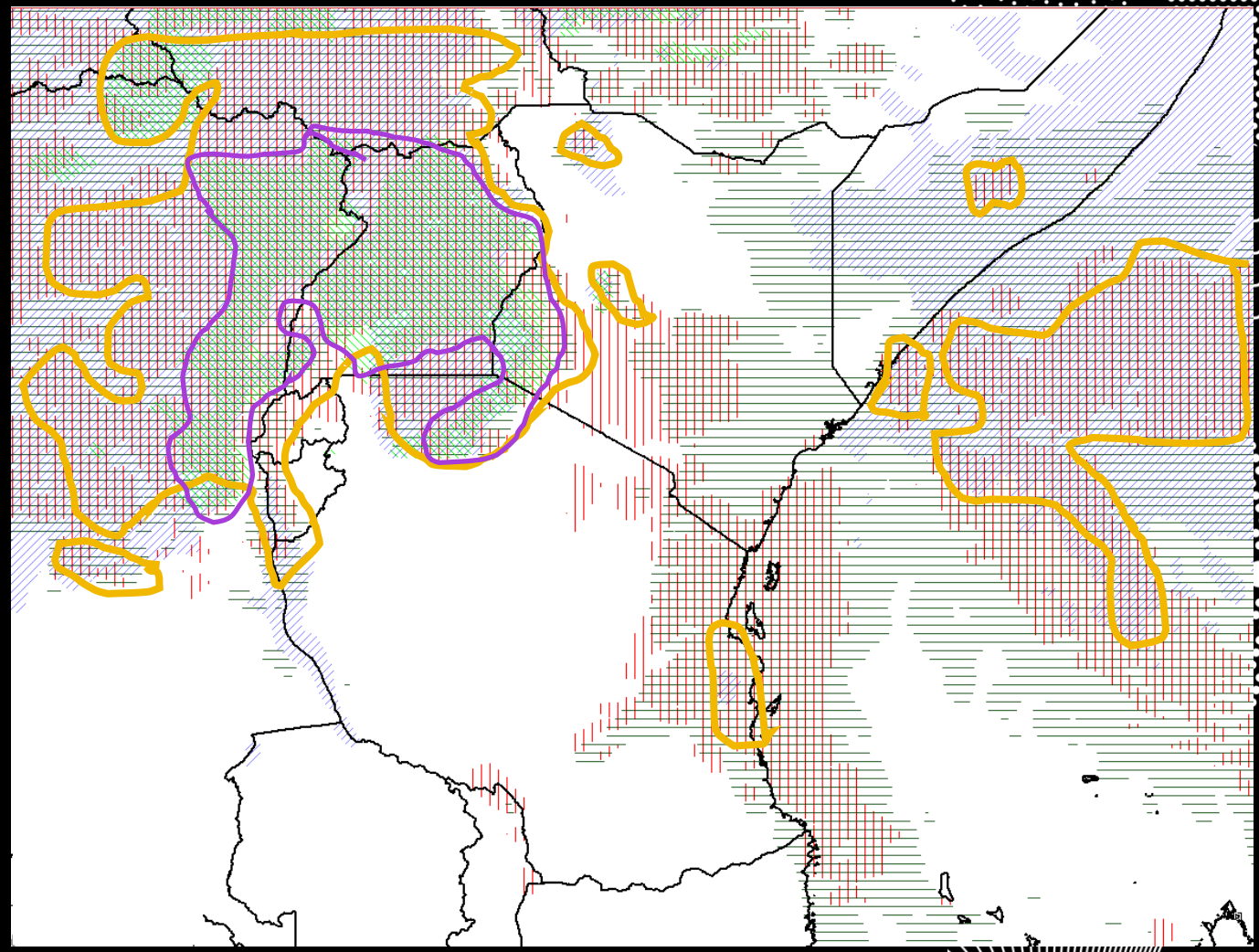
COMBINED INDEX







5th of June, 2025



Rainfall +24h (ECMWF)

Max POT + 24h (ECMWF)

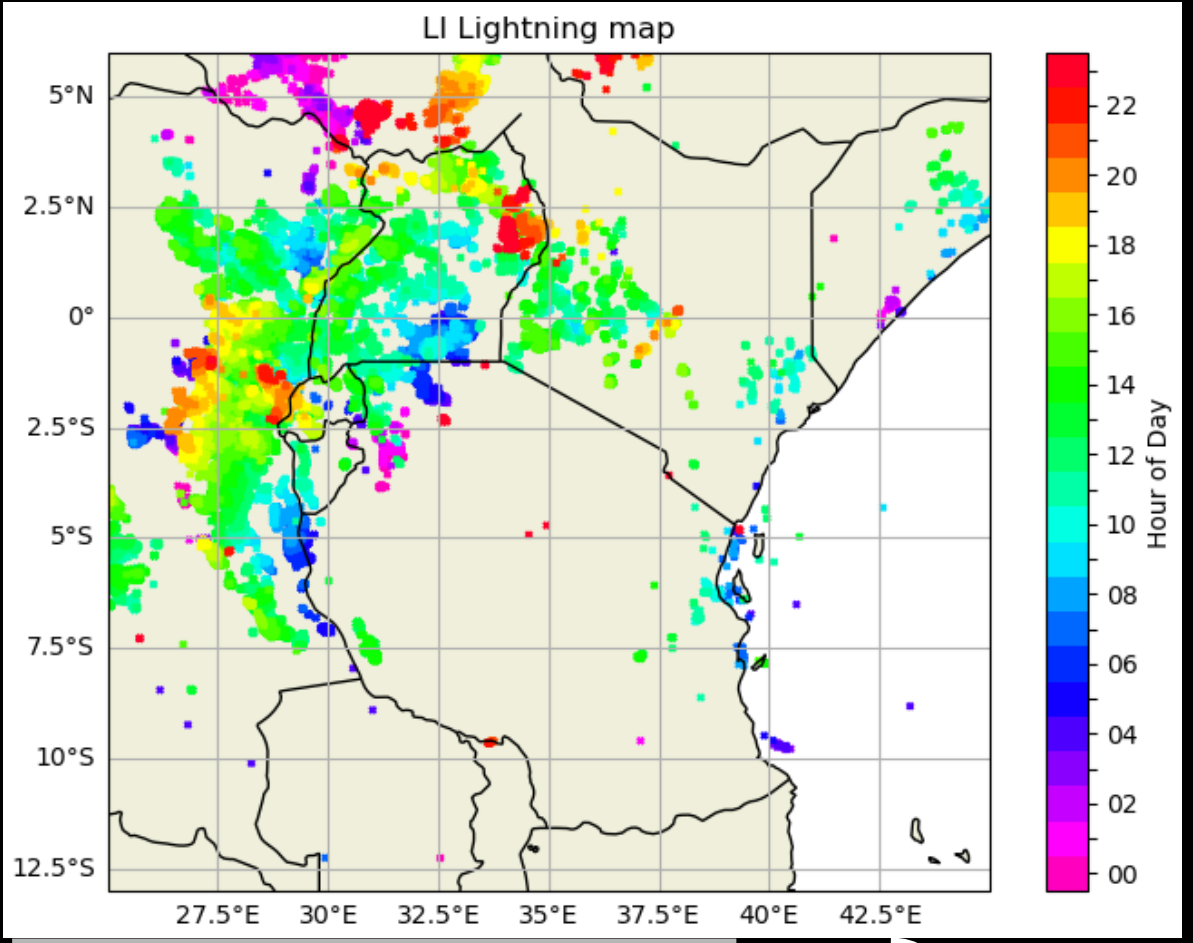
Max (mu) CAPE + 24h (ECMWF)

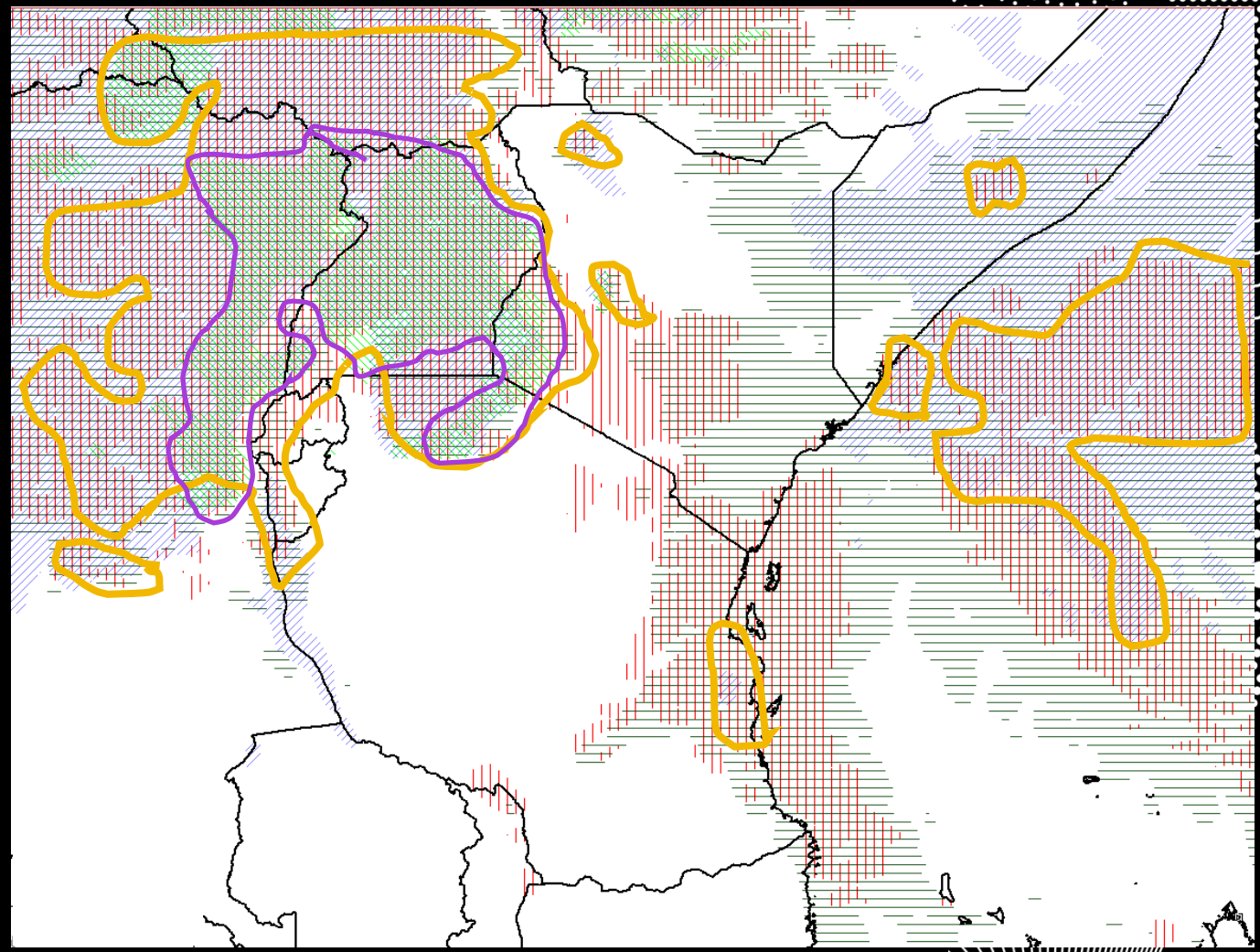
Max GDI + 24h (ECMWF)

CONVECTION

Density

5th of June, 2025





Rainfall +24h (ECMWF)

Max POT + 24h (ECMWF)

Max (mu) CAPE + 24h (ECMWF)

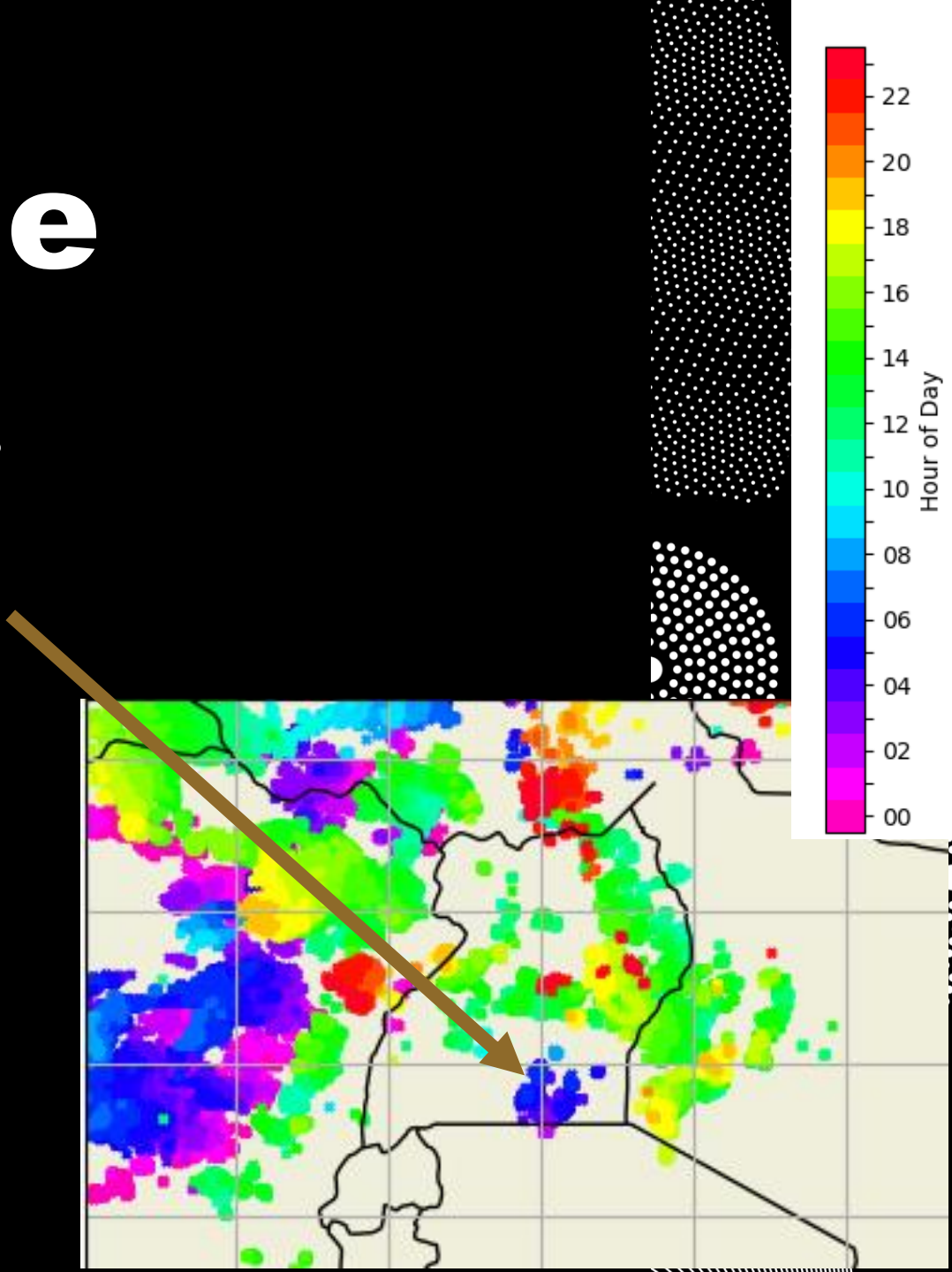
Max GDI + 24h (ECMWF)

CONVECTION

Density

Results continue

- None of the indices works well alone → together spatial resolution of the forecast was improved
- Bonus: **Lake Victoria's** nightly thunderstorm activity was quite well catched by ECMWF model. Even the timing of initiation was ok, but models tend to over/underestimate the longetivity of the storms.
- Bias over the sea area → models have too much of precipitation over the coastal area.

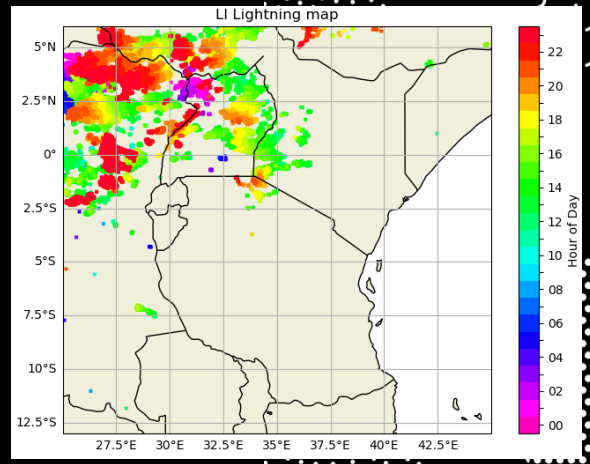


LI data → nowcasting → early warnings?

Benefits of LI data to Africa:

1. Early Detection of Thunderstorm Development
2. Improved Nowcasting and Severe Weather Warnings
3. Better Understanding of Thunderstorm Life Cycles
4. Filling Observation Gaps in Data-Sparse Areas
5. Aviation and Transport Safety
6. Climate and Hydrological Applications
7. Integration with Other Satellite and Ground Observations

Suggestions



1. More data → more possibilities to try to improve the forecast
2. Training on convective weather forecasting in developing countries, especially in the tropics
3. RGB reading skills need improvements
   a) Most forecasters don't know how to read and stick with the IR images
4. From a capacity-building perspective, it would be more efficient for a single facility to produce lightning maps rather than creating separate data reception centers in each country.

   → One central hub in Africa could manage and maintain this service for the entire region.

Thank you for your attention!

We thank Sven-Erik Enno / EUMETSAT for supporting the data analyses

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