Predicting Intense Precipitation Using Upscaled, High-Resolution Ensemble Forecasts

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Outline of talk

- A memorable rainfall event in Copenhagen
- Experimental HIRLAM-based ensemble prediction system
- Upscaling probability forecasts
- Case studies
- Verification for Aug 2010
- Conclusions

Copenhagen, 15 Aug 2010

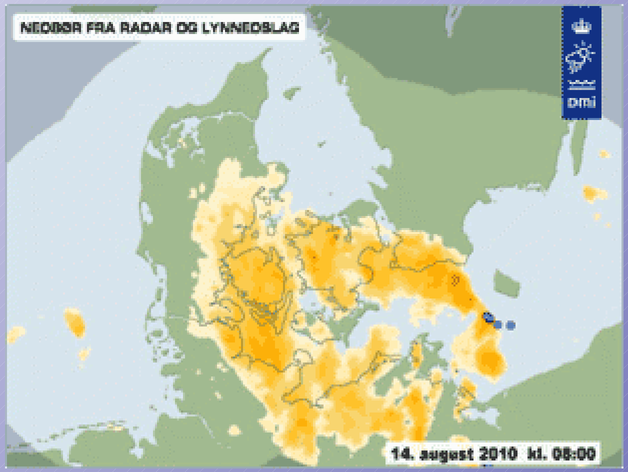
A memorable rainfall event

- Extreme event, extreme expenses
- DMI failed to forecast the event
- Questions in the Danish Parliament about the hit rate of DMI's forecasts
- Reminded many people at DMI that deterministic forecasts have their limitations
- Following this I have noticed an unprecedented interest in short-range ensemble predictions among forecasters at DMI

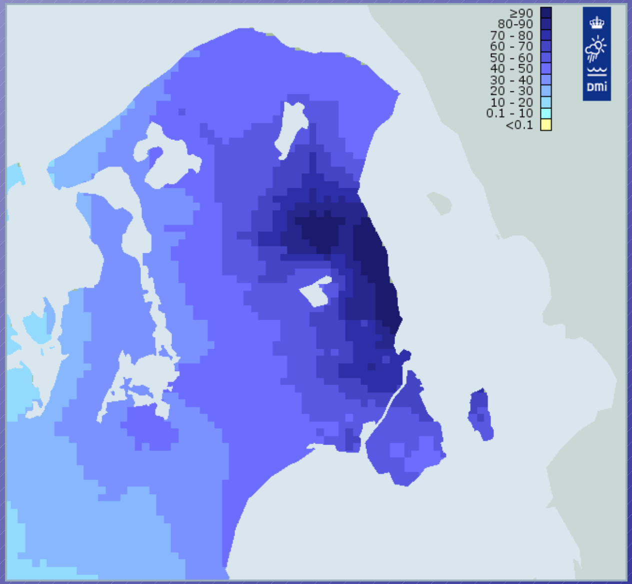
DMI

Observed rainfall 14 Aug 2010

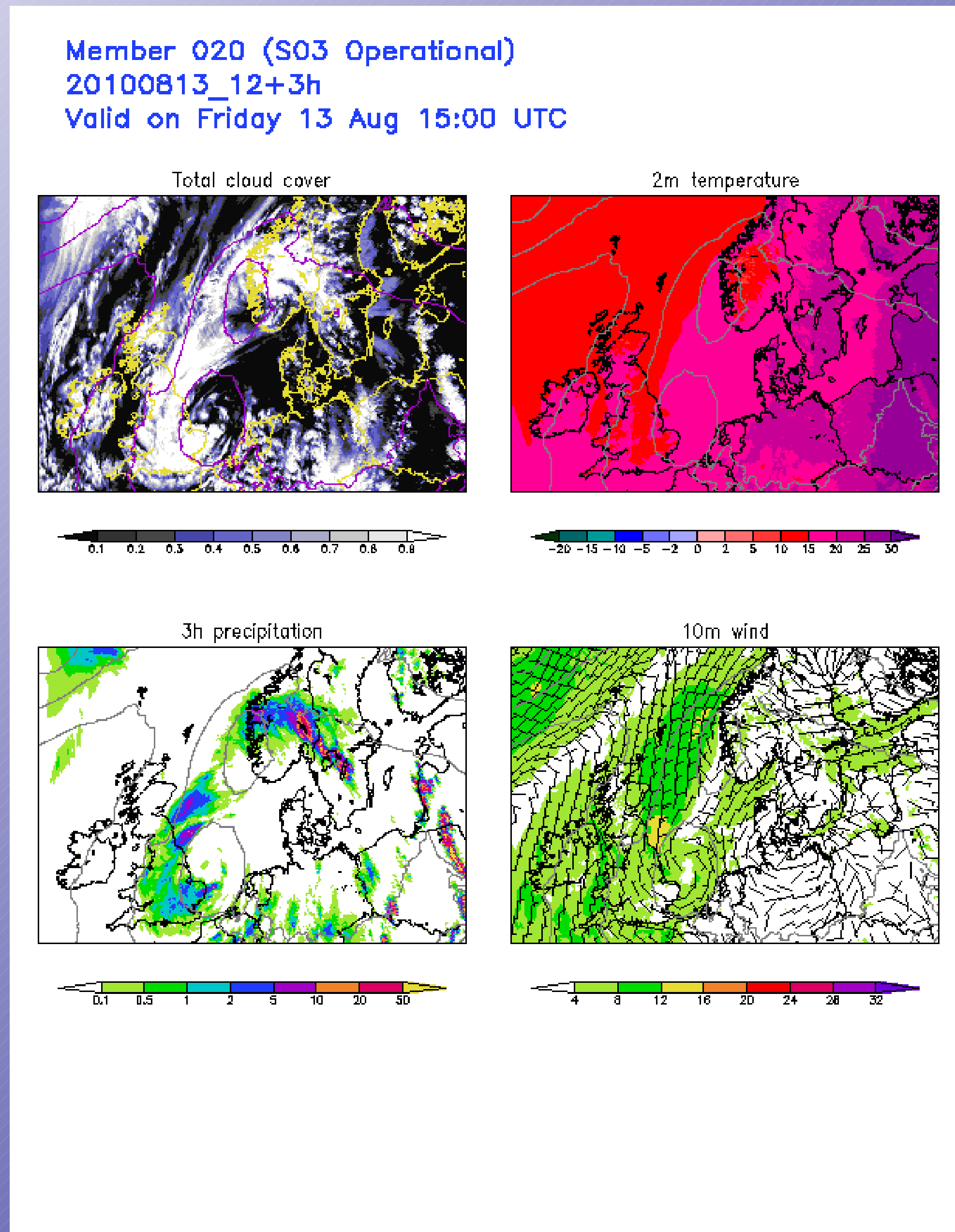
Radar animation



Gridded rain gauges

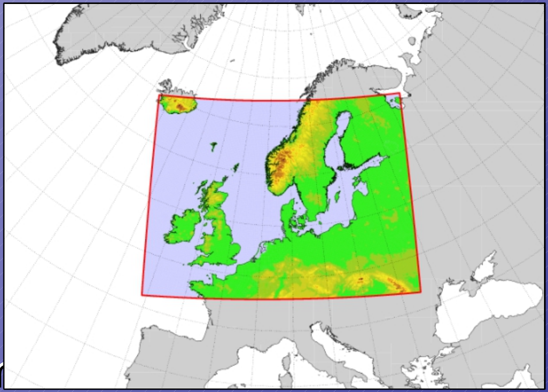


Model forecast



Ensemble system configuration

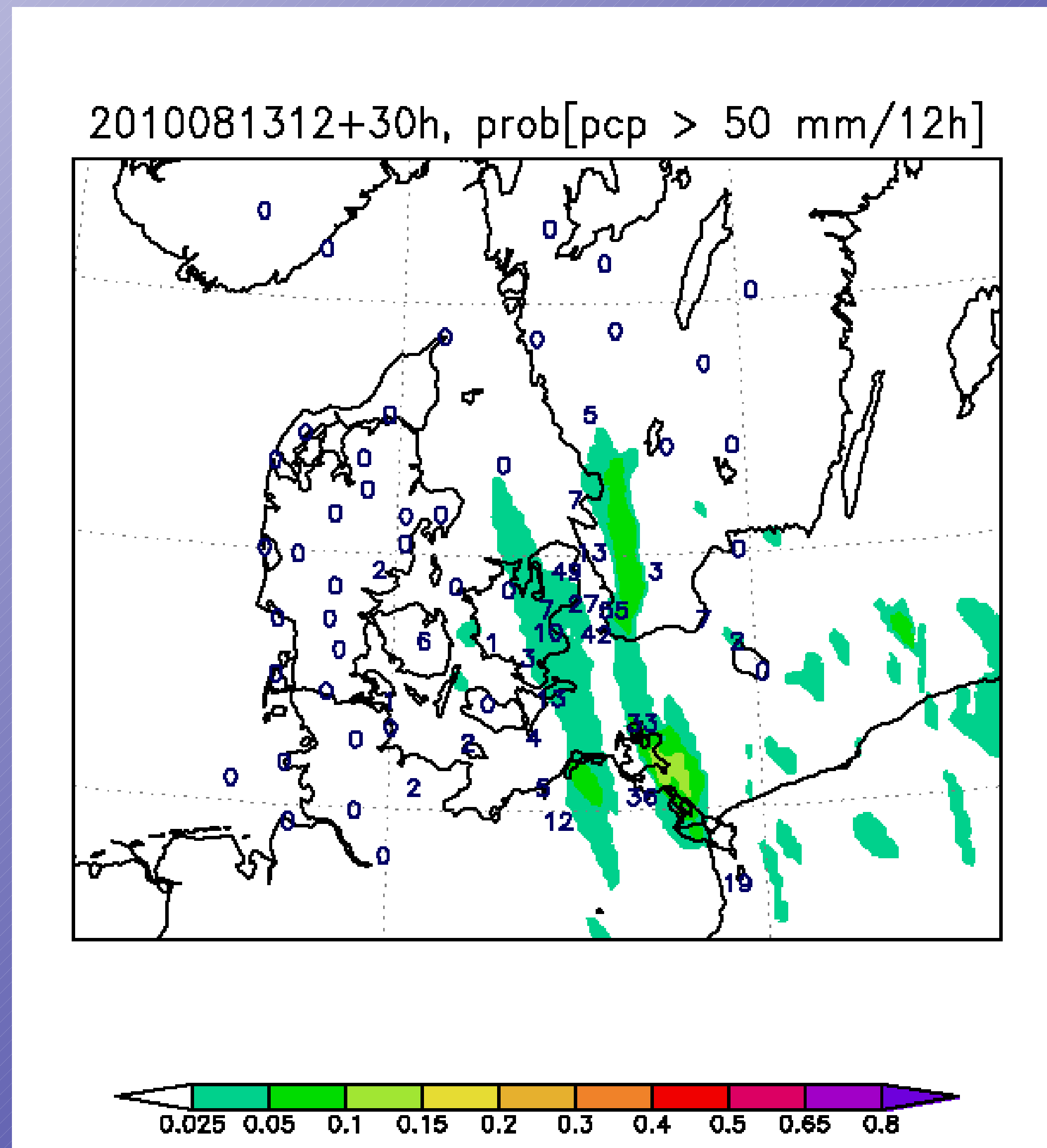
- Domain = DMI-Hirlam S05 (0.05° resolution, 40 vert. levels)
- Members = 25
- Forecast length = 36h (now: 54h)
- Forecast frequency = 4 times per day
- Initial and lateral boundary conditions = 5
  - Scaled Lagged Average Forecast (SLAF) error perturbatio



- Cloud schemes = 2
  - STRACO and KF/RK
- Stochastic physics = yes/no
- Surface schemes = 2
  - ISBA and ISBA/Newsnow
- Independent of ECMWF's ensemble prediction system

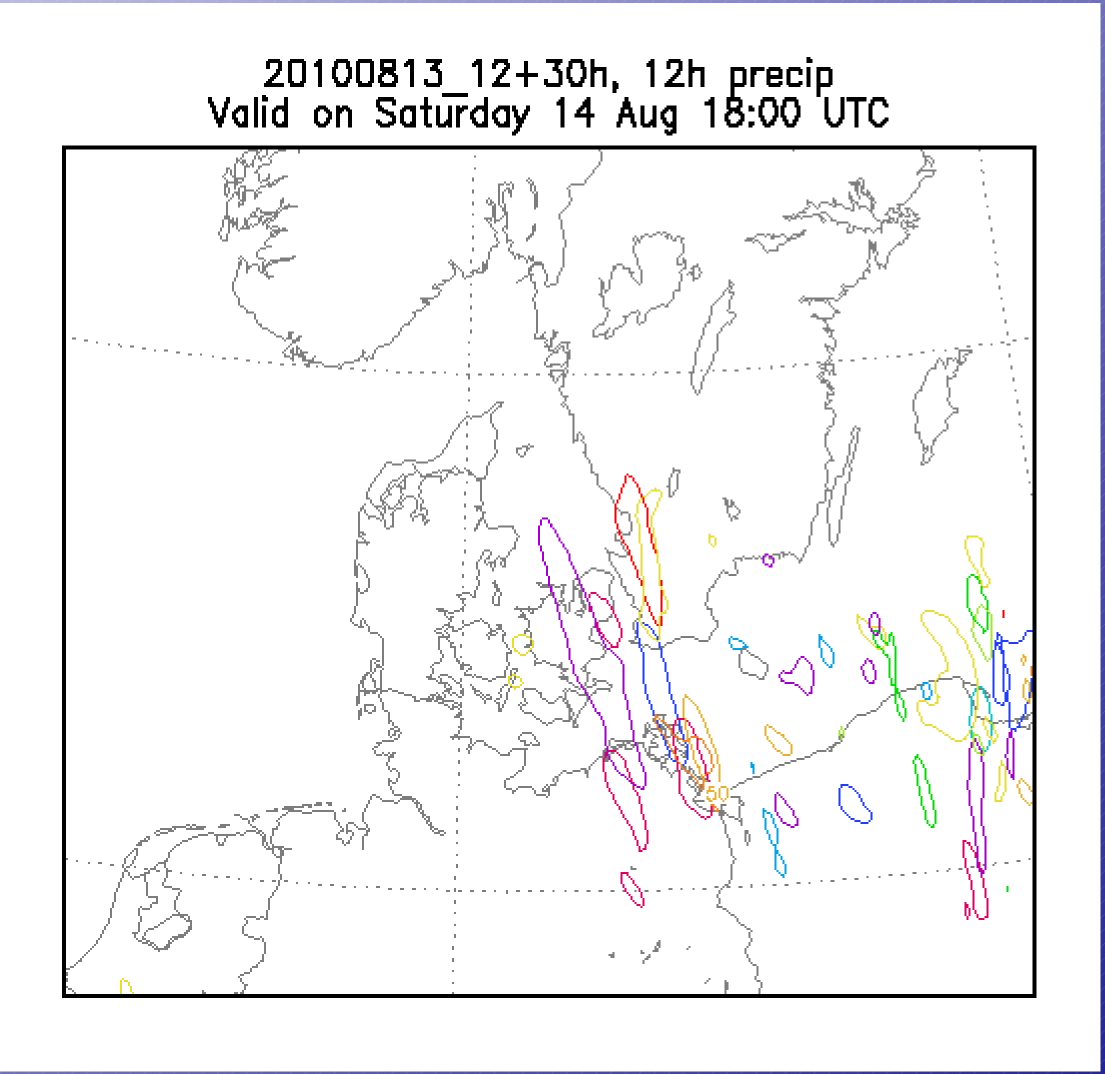
Ensemble forecast probabilities

- Numbers = observed rainfall 6-18 UTC, 14 Aug 2010



Precipitation "spaghetti" plot

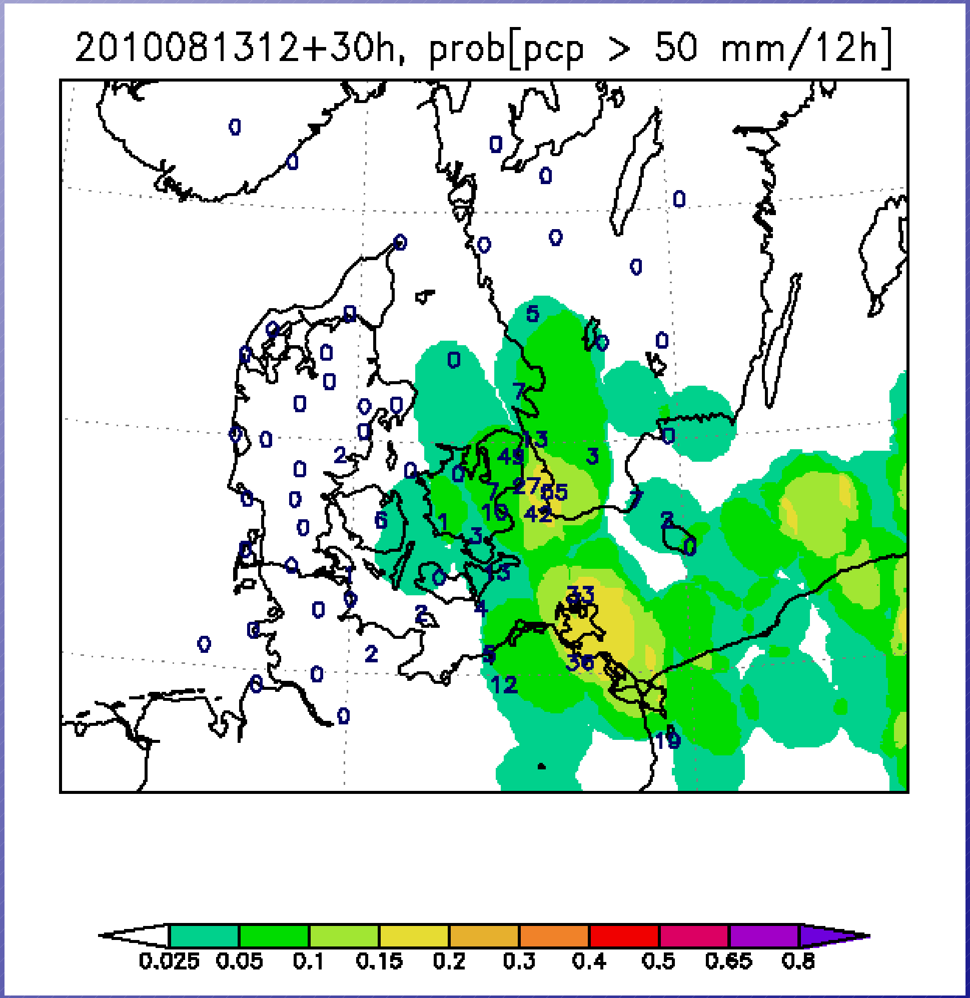
- 50mm contours
- Members in different colours



Upscaled probabilities

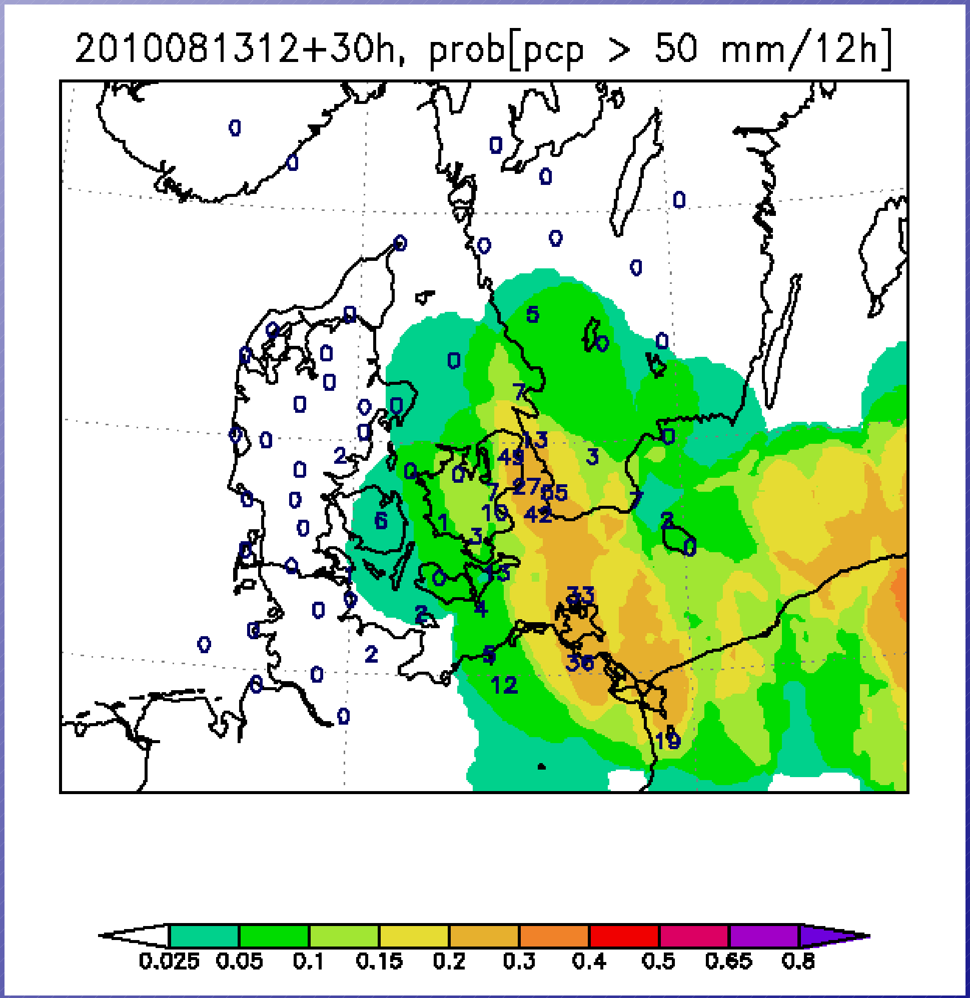
- For each grid point, count members that predict the event in a neighbourhood of the grid point

- Upscaling diameter ≈ 60 km



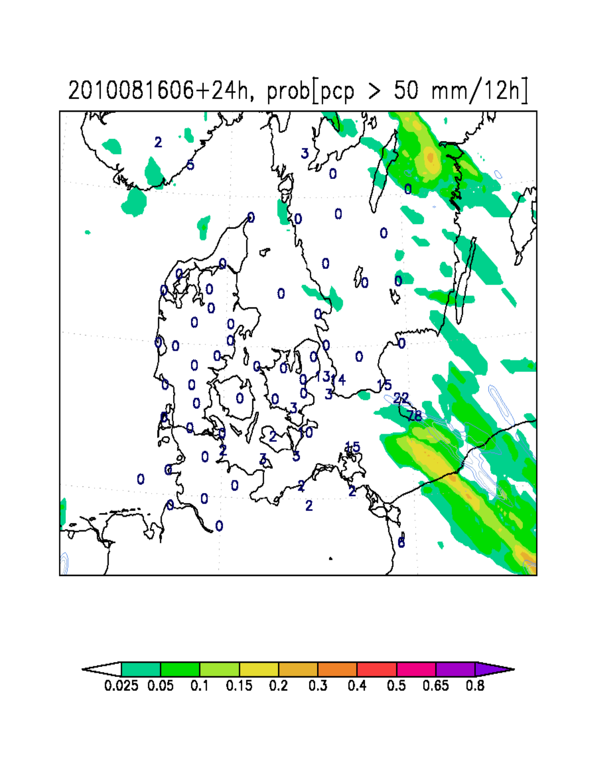
Upscaled probabilities

- Upscaling diameter ≈ 115 km

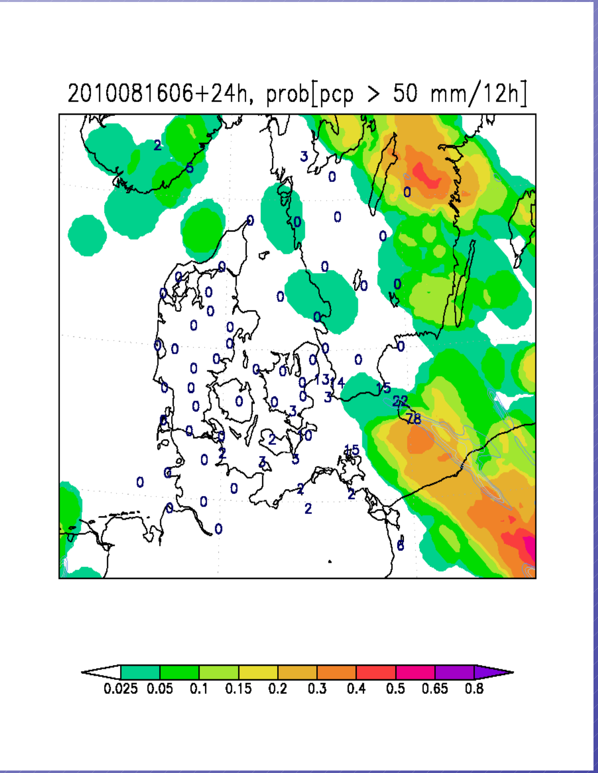


Case study: Bornholm 16 Aug 2010
Upscaled probabilities

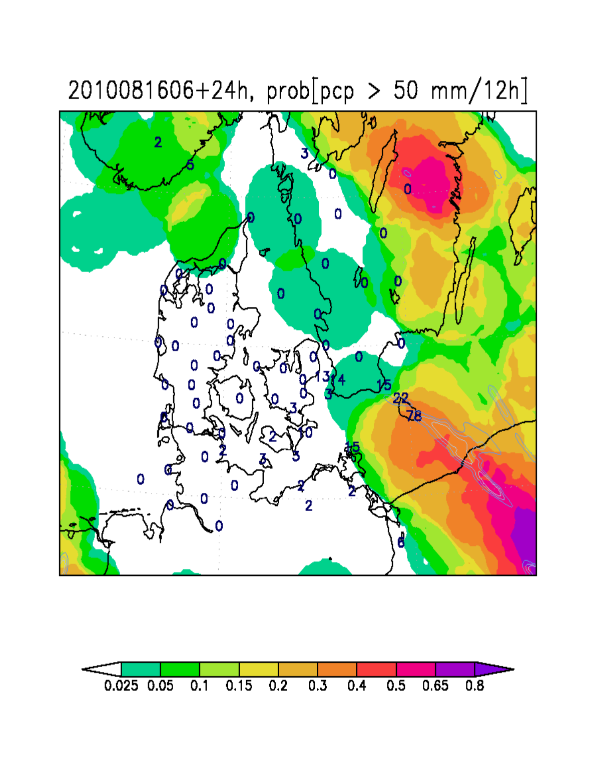
No upscaling



Upscaling
diameter ≈ 60 km



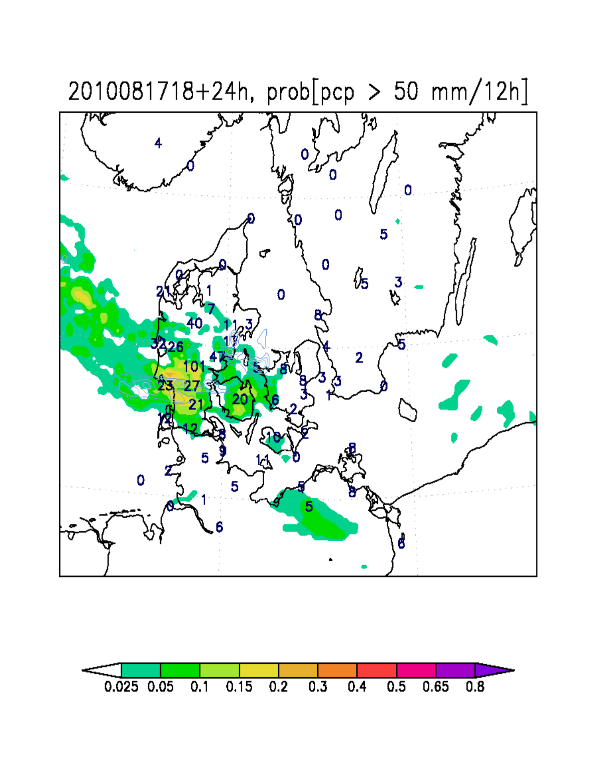
Upscaling
diameter ≈ 115 km



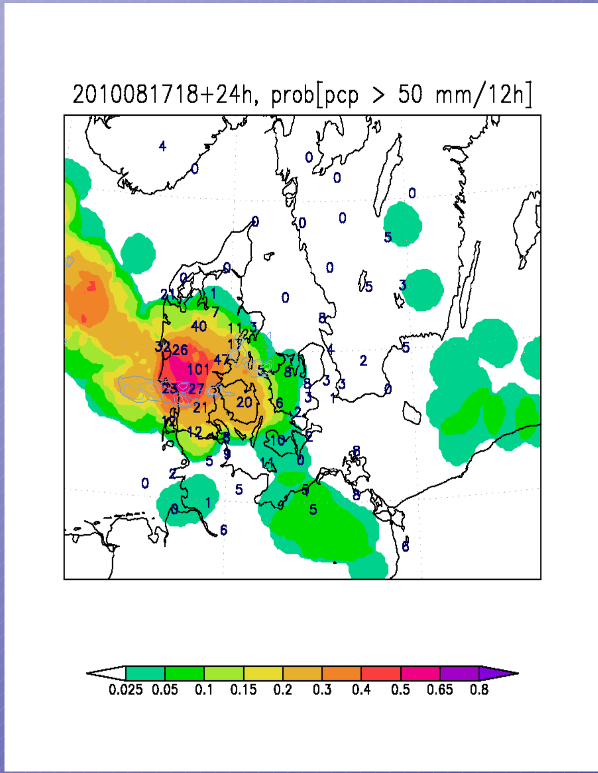
DMI

Case study: Billund 18 Aug 2010
Upscaled probabilities

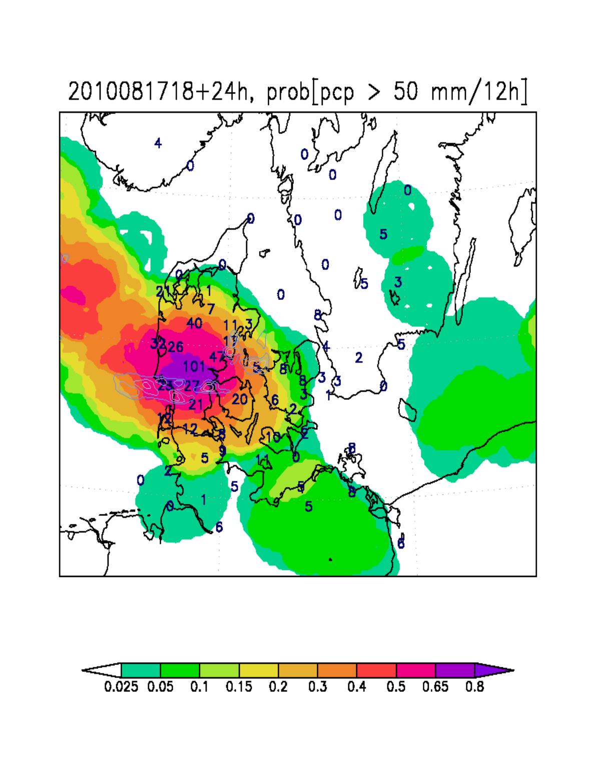
No upscaling



Upscaling diameter ≈ 60 km



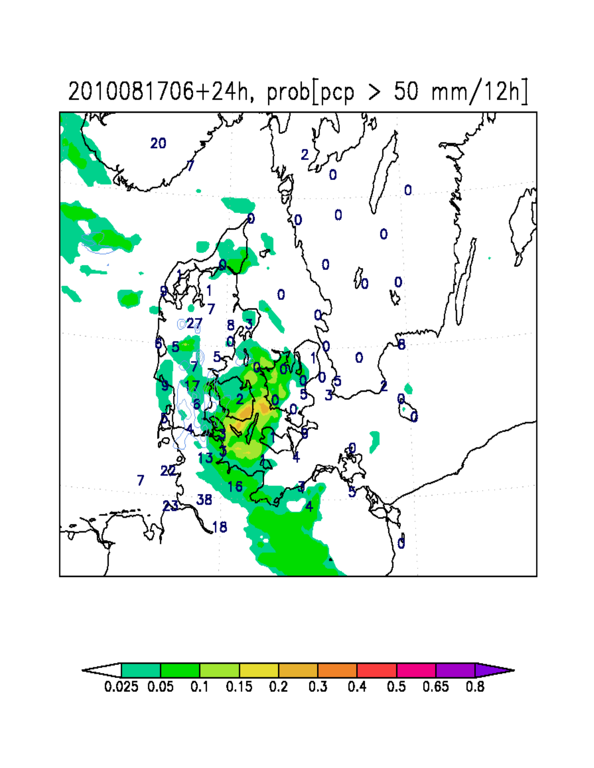
Upscaling diameter ≈ 115 km



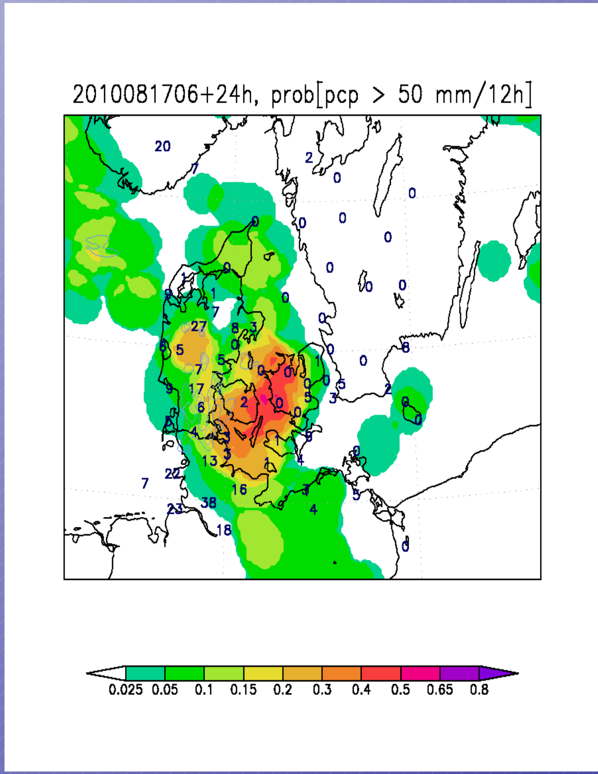
DMI

Case study: False alarm 18 Aug 2010
Upscaled probabilities

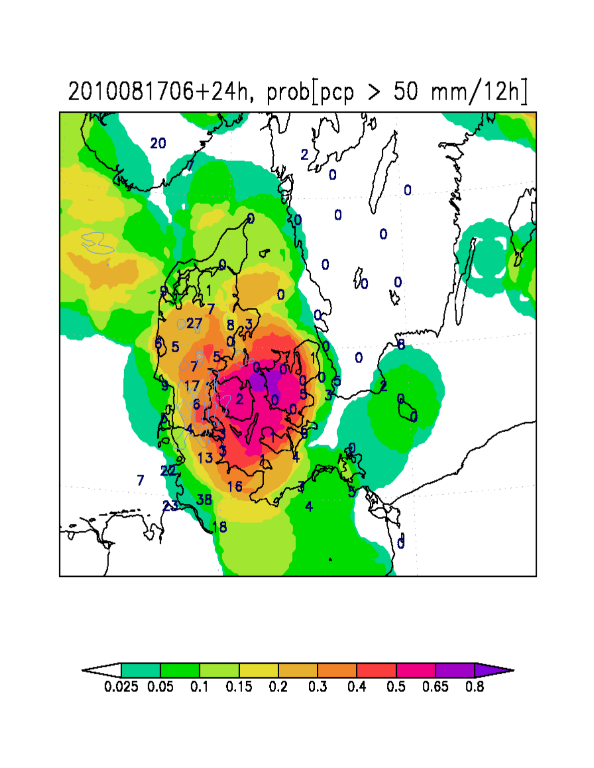
No upscaling



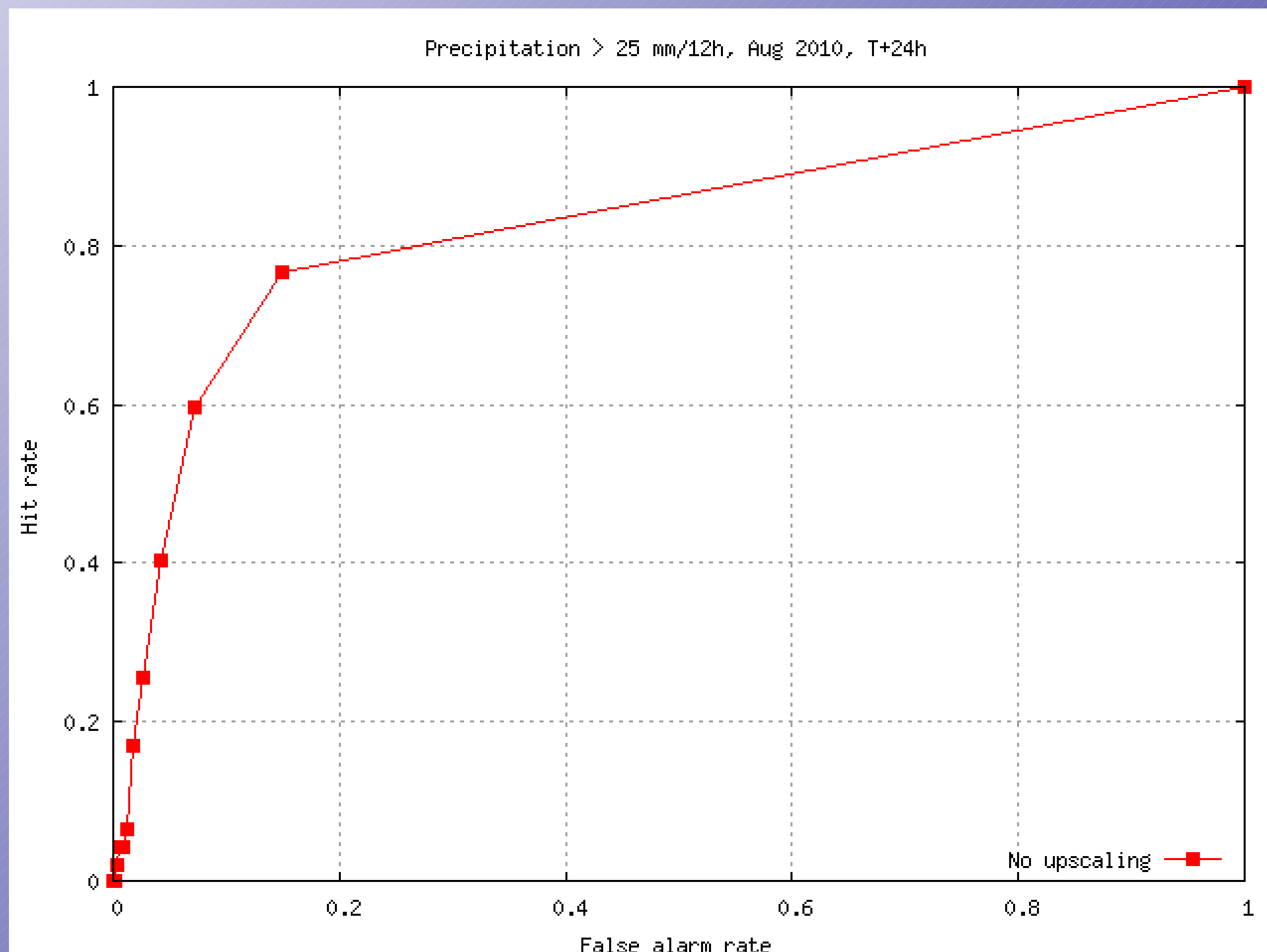
Upscaling diameter ≈ 60 km



Upscalerings-diameter ≈ 115 km

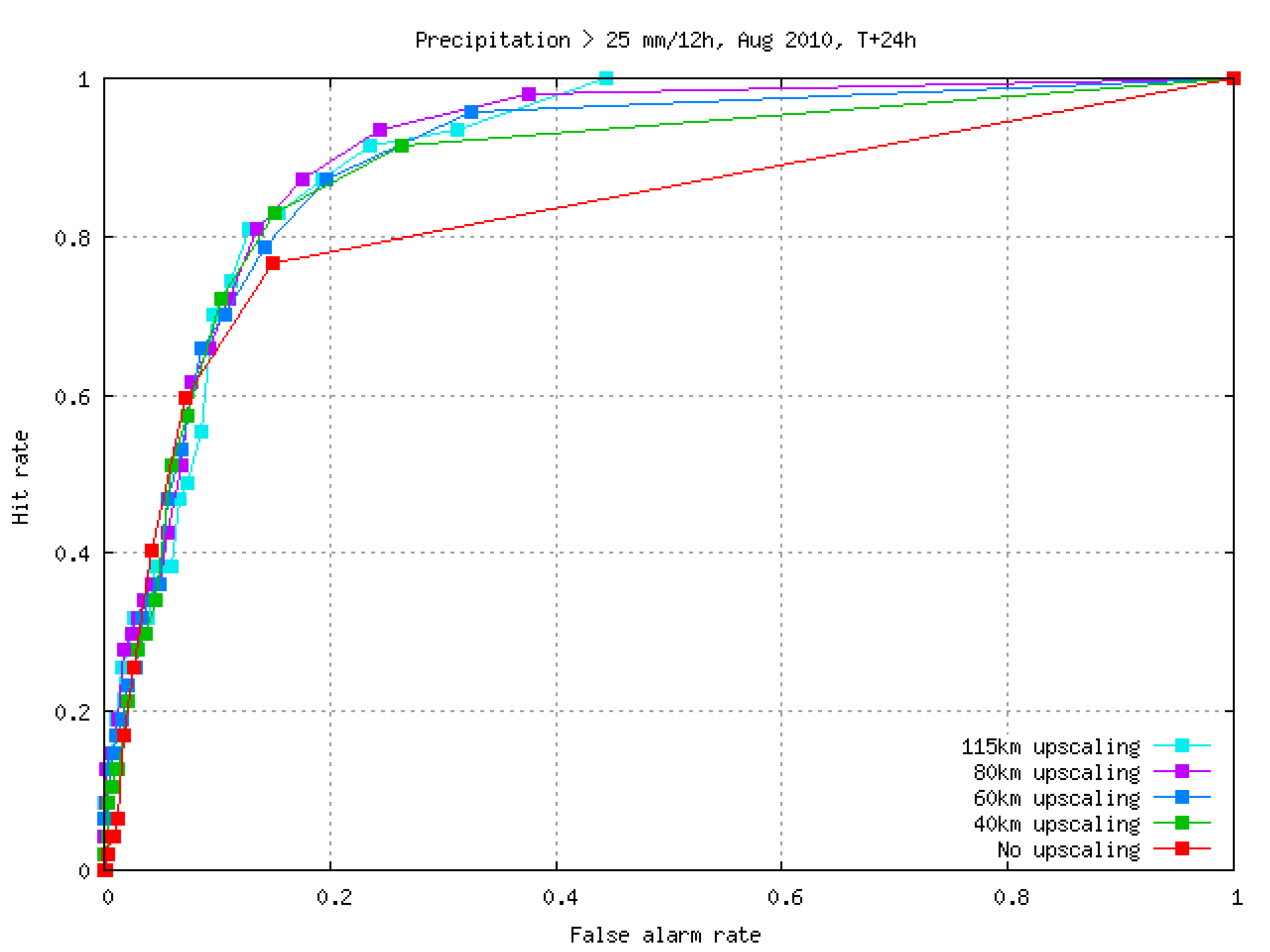


Verification, Aug 2010
Relative operating characteristic

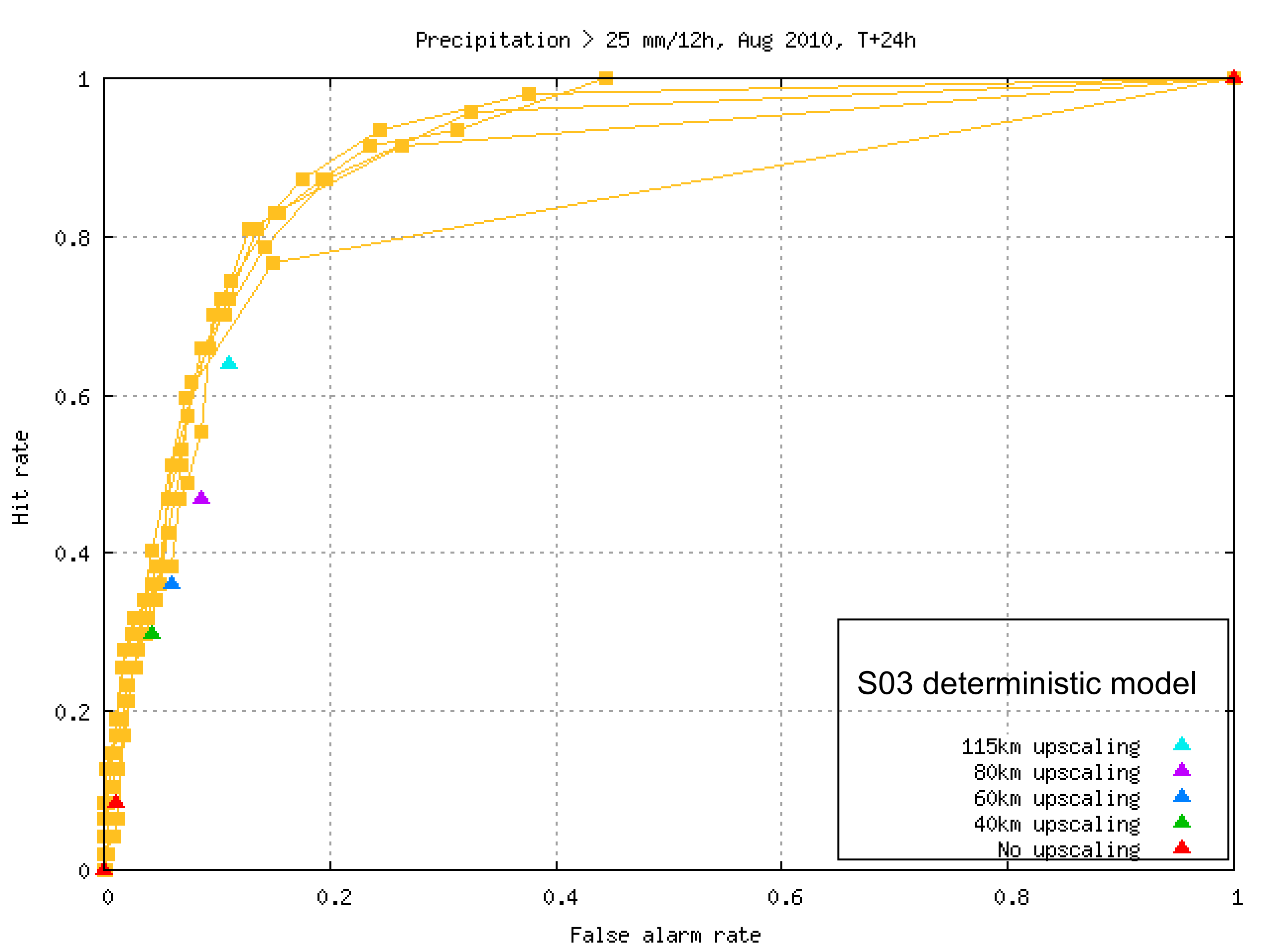


False alarm rate = events falsely forecast / events non-occurred

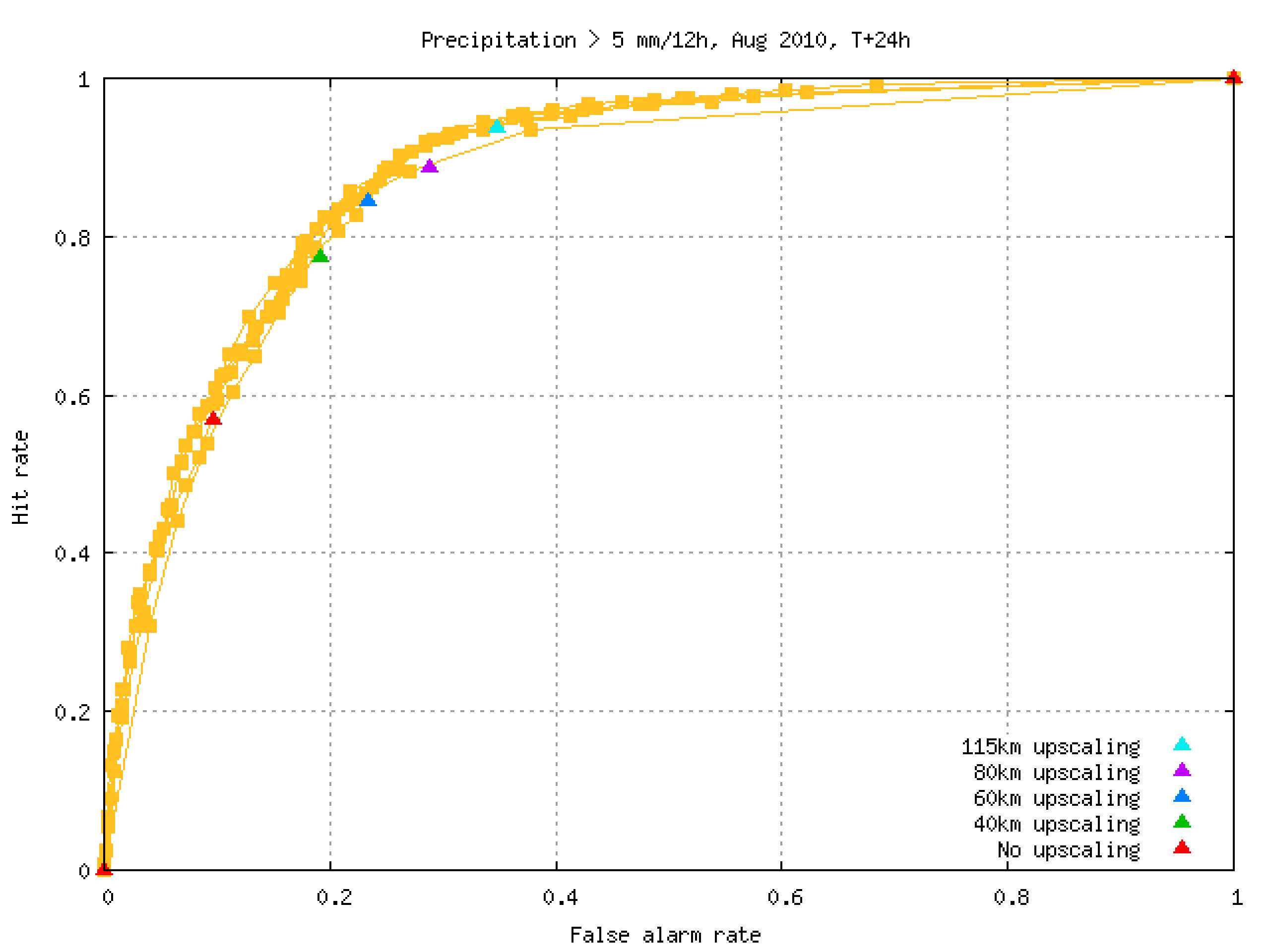
Verification, Aug 2010
Relative operating characteristic



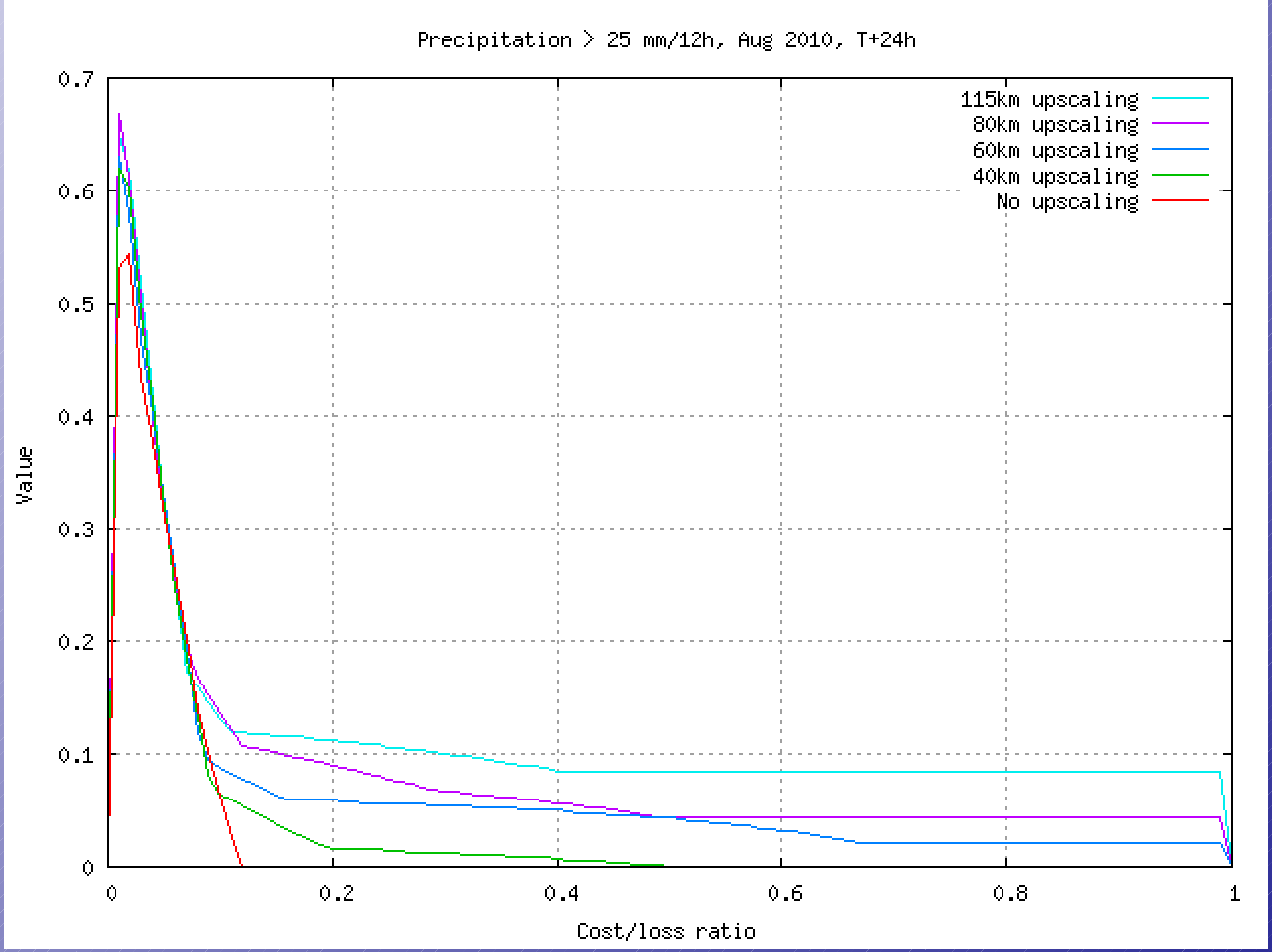
Verification, Aug 2010
Relative operating characteristic



Verification, Aug 2010
Relative operating characteristic



Verification, Aug 2010
Relative economic value



Conclusions

- Upscaling improves probabilistic forecast skill for intense precipitation
- Upscaled probability forecasts can provide improved guidance to forecasters
- Forecasters at DMI will consult upscaled probability forecasts in prediction of intense precipitation this summer