Rainfall estimation, nowcasting and warnings for the Meuse basin

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Cooperation between DGO2 and RMIB

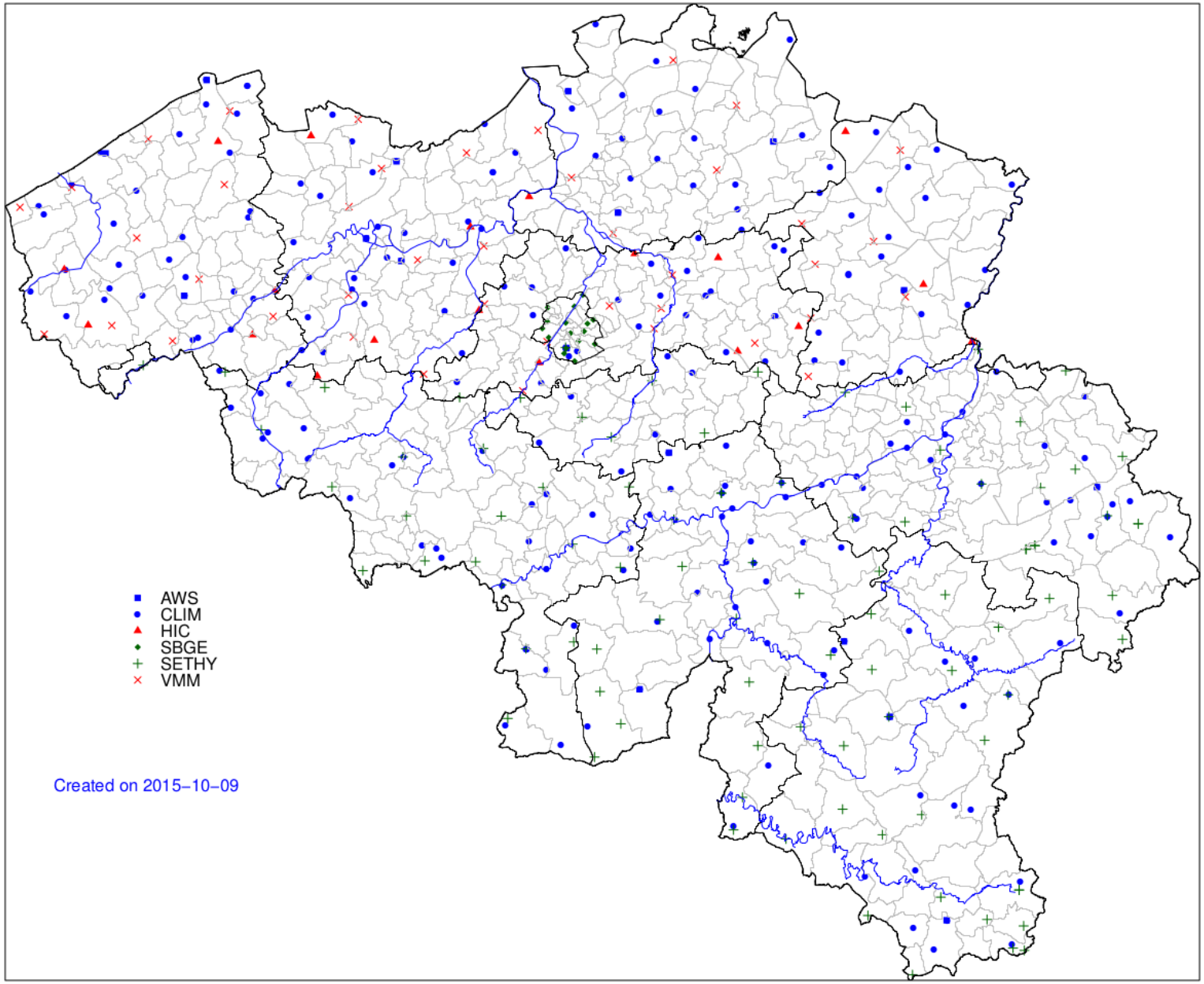
to improve hydro-meteorological observations, forecasts and warnings

- best precipitation estimation using radar and rain gauges
- new extreme precipitation statistics and warnings
- better observations and modelling of snow

started in March 2016

- steering committee meets 2 times per year
- 1 scientist (coordination, research and development) and 1.5 operators (data quality control)
- exchange of observation data and products

More than 400 rain gauges in Belgium



There is a need for quantitative precipitation estimates (QPE)

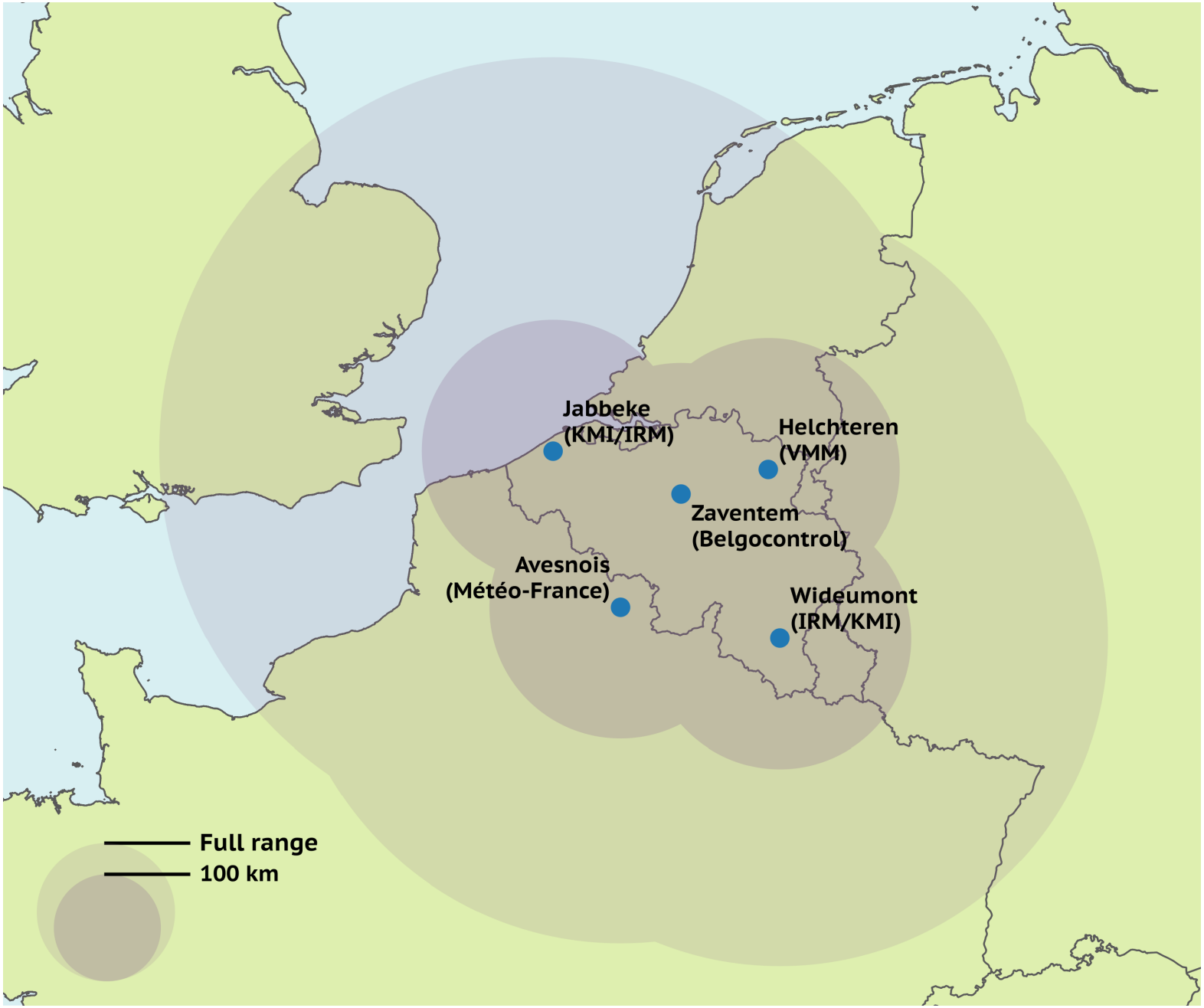
at high resolution

- as input for hydrological models
- to validate high resolution Numerical Weather Prediction (NWP) models
- regional climate model

for a long period

- to calibrate hydrological models
- to verify NWP model hindcast
- to verify regional climate model statistics

Belgium is well covered by radars



Radars emit electromagnetic pulses with a typical resolution of 500 m and 1°

Belgian radars perform scans in 5 min

Relation between reflectivity and rainfall rate

Radar equations

$$Z_e = \int_0^{Dmax} |K|^2 N_0 e^{-\Lambda D} D^6 dD$$

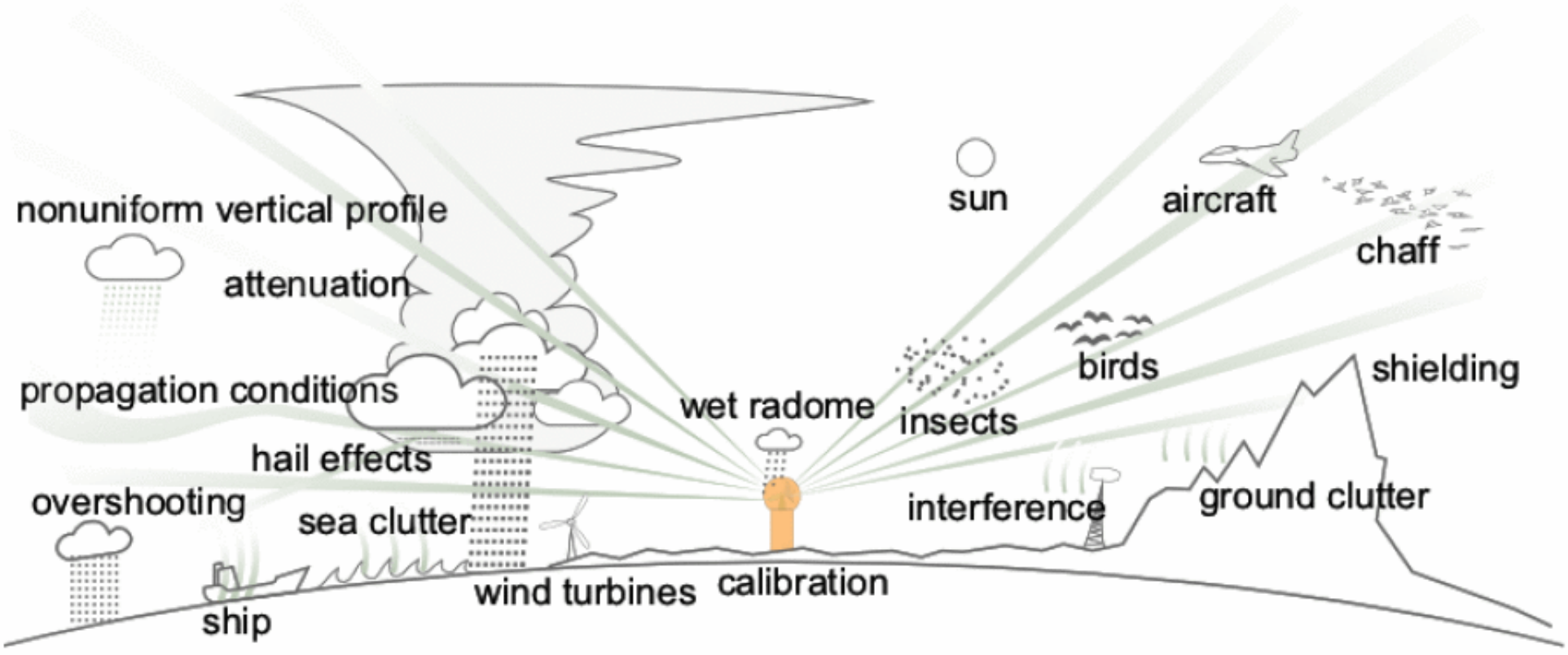
$$R = \int_0^{Dmax} N_0 e^{-\Lambda D} \frac{\pi D^3}{6} v(D) dD$$

but unknown distribution of rain droplets' diameter (D)

Empirical relation

$$Z_e = a\, R^b$$

Estimating rainfall from radar measurements is a chalenge



because of the many sources of error and uncertainty

Surface rainfall estimation algorithms

basic (CAP)

- Doppler filtering & PCAPPI 800 m & $Z = 200R^{1.6}$

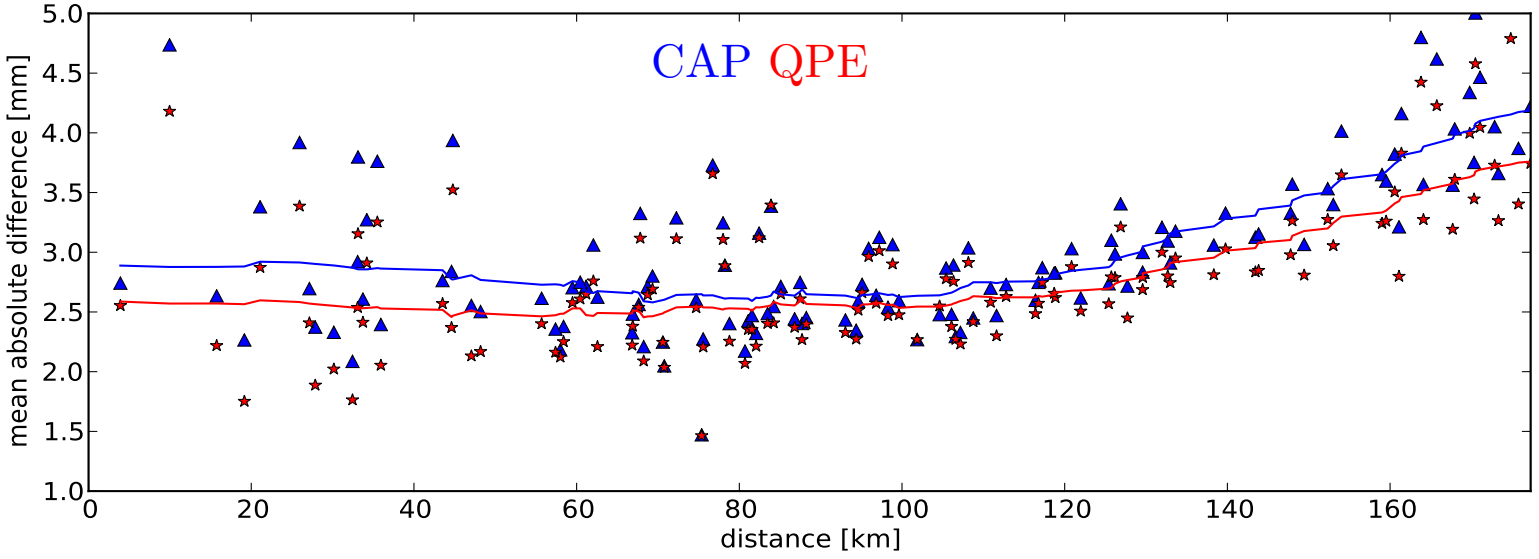
complex (QPE)

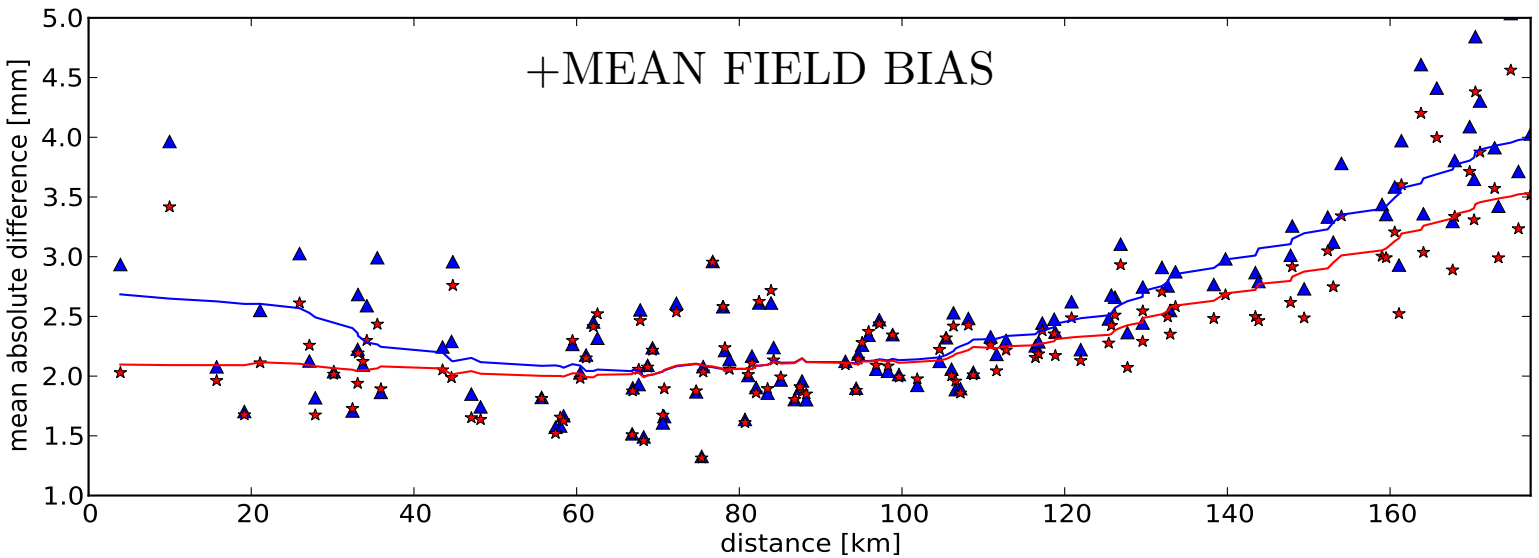
1. non-meteo echoes removal & beam blocking correction
2. average VPR & extrapolation towards ground
3. convective($Z = 77R^{1.9}$), stratiform ($Z = 200R^{1.6}$), hail (max 55 dBZ)

merging radar and raingauges (1 h accum)

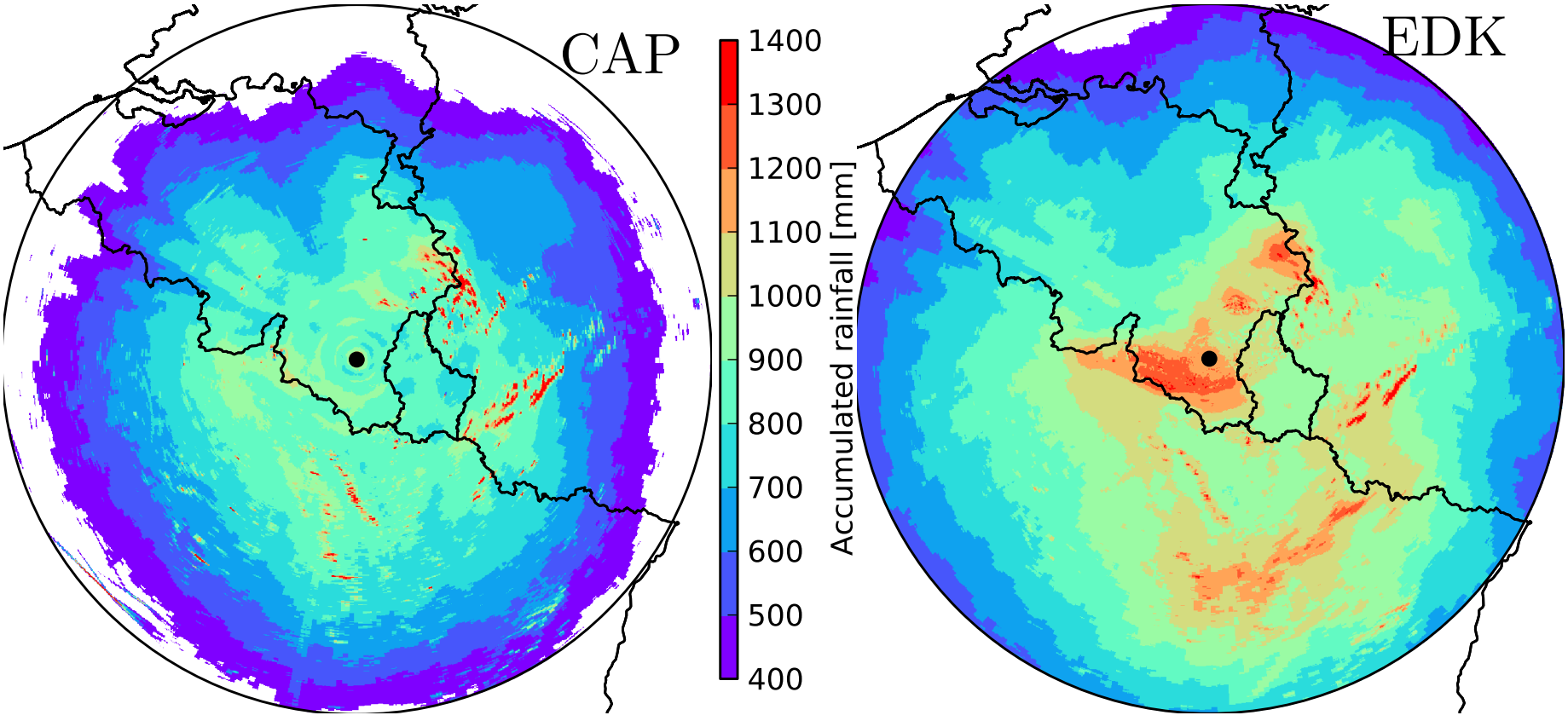
- MFB : single correction by the median of their ratios
- EDK : spatial merging by Kriging of the gauges with the radar as external drift

2005-2014 verification against daily gauge measurements above 1 mm





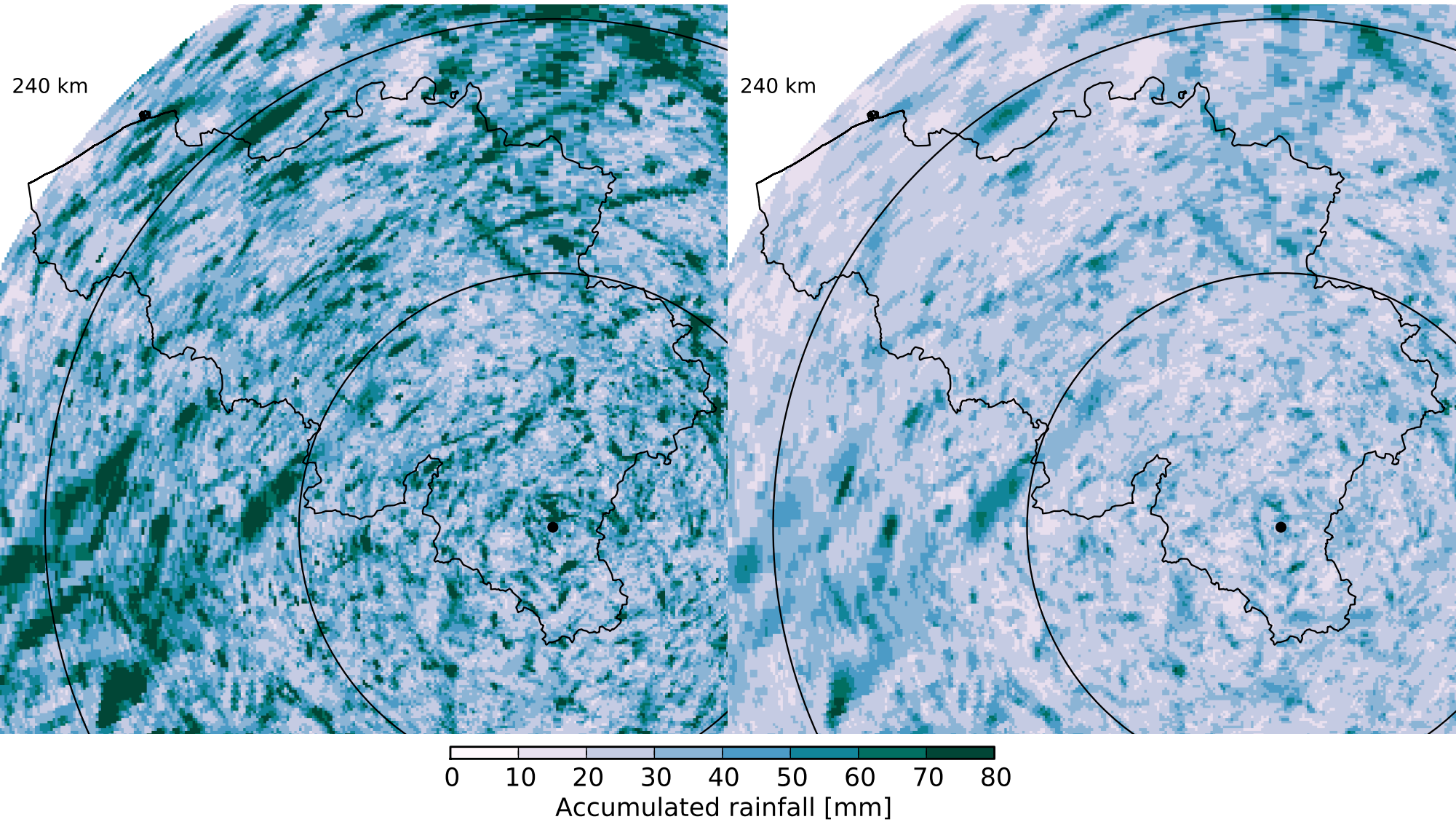
2005-2014 MEAN ANNUAL TOTALS



- most radar artifacts are mitigated
- correlation with gauges increases from 0.54 to 0.80

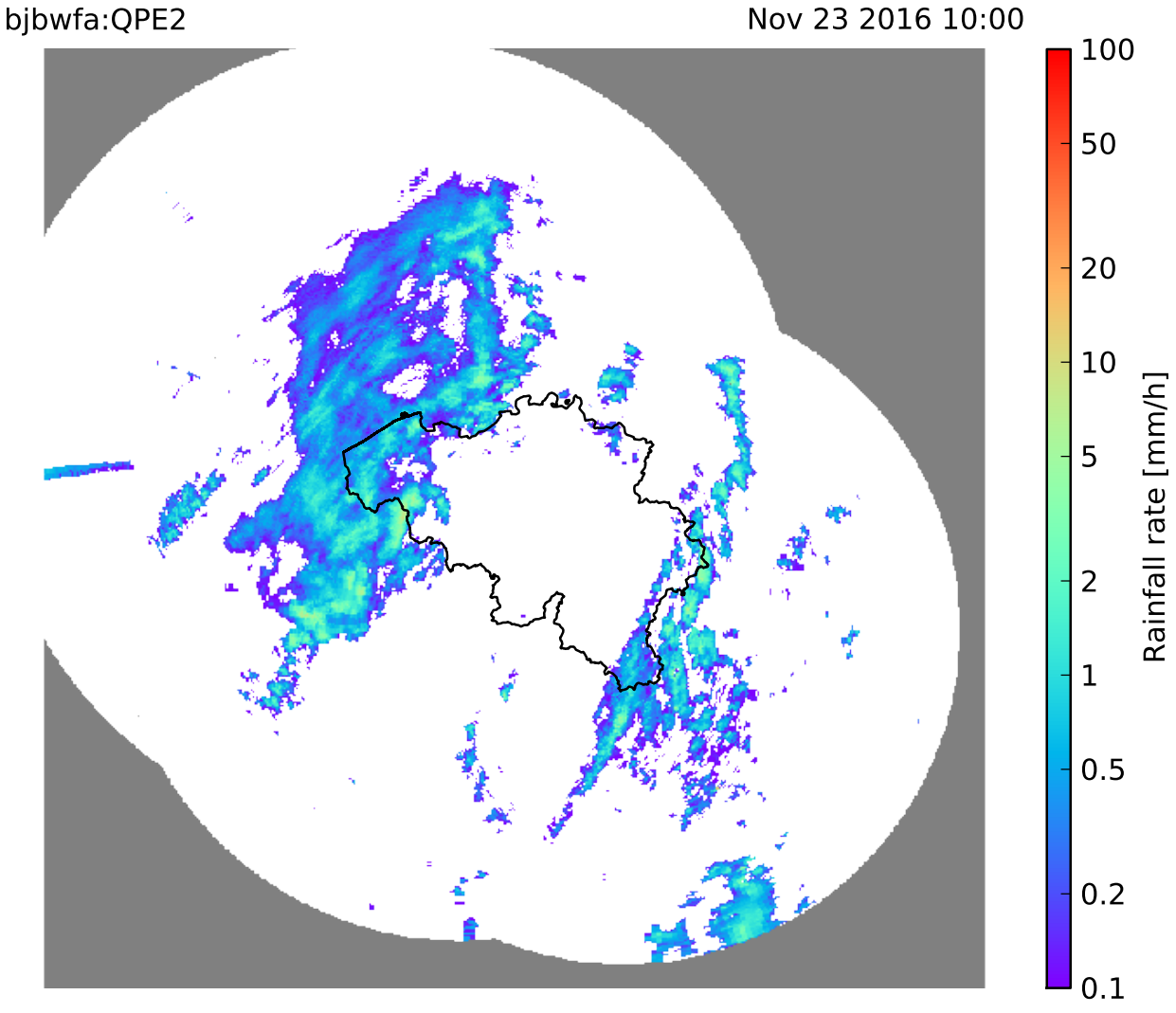
more verification results in Goudenhoofdt and Delobbe (2016)

1-hour maximum 2005-2016



- mainly due to hail threshold and non-meteo echoes removal

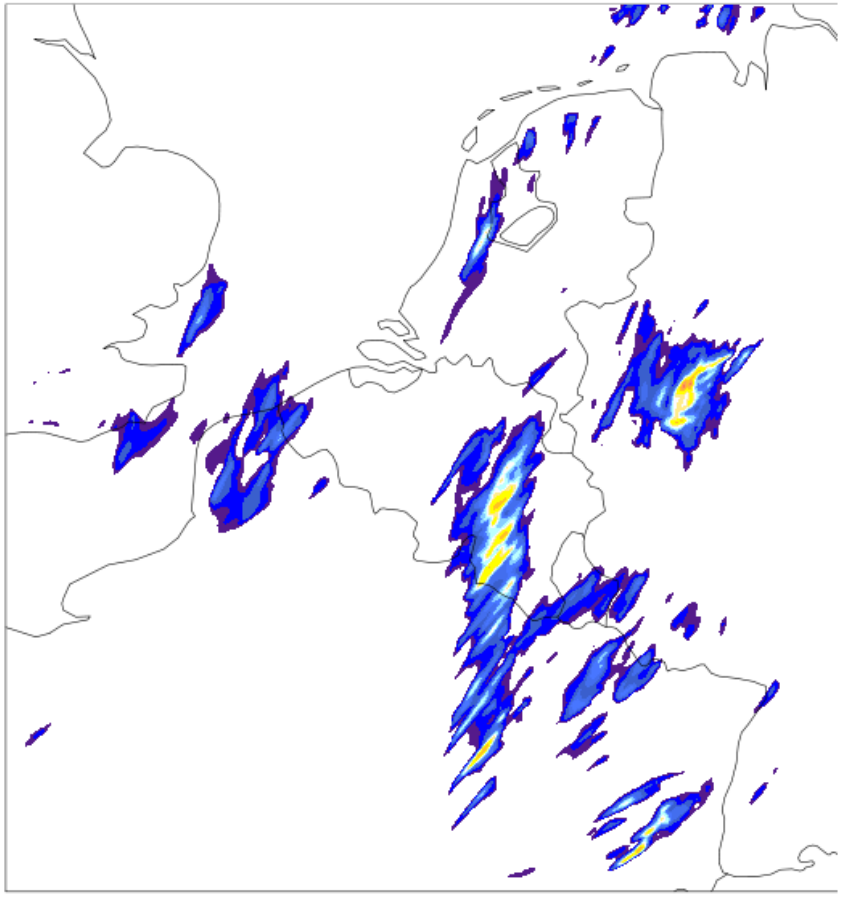
Realtime QPE composite since Sep 2016



- merging with DGO2 gauges
- available within 5 minutes
- rainfall accumulation
- manual quality control

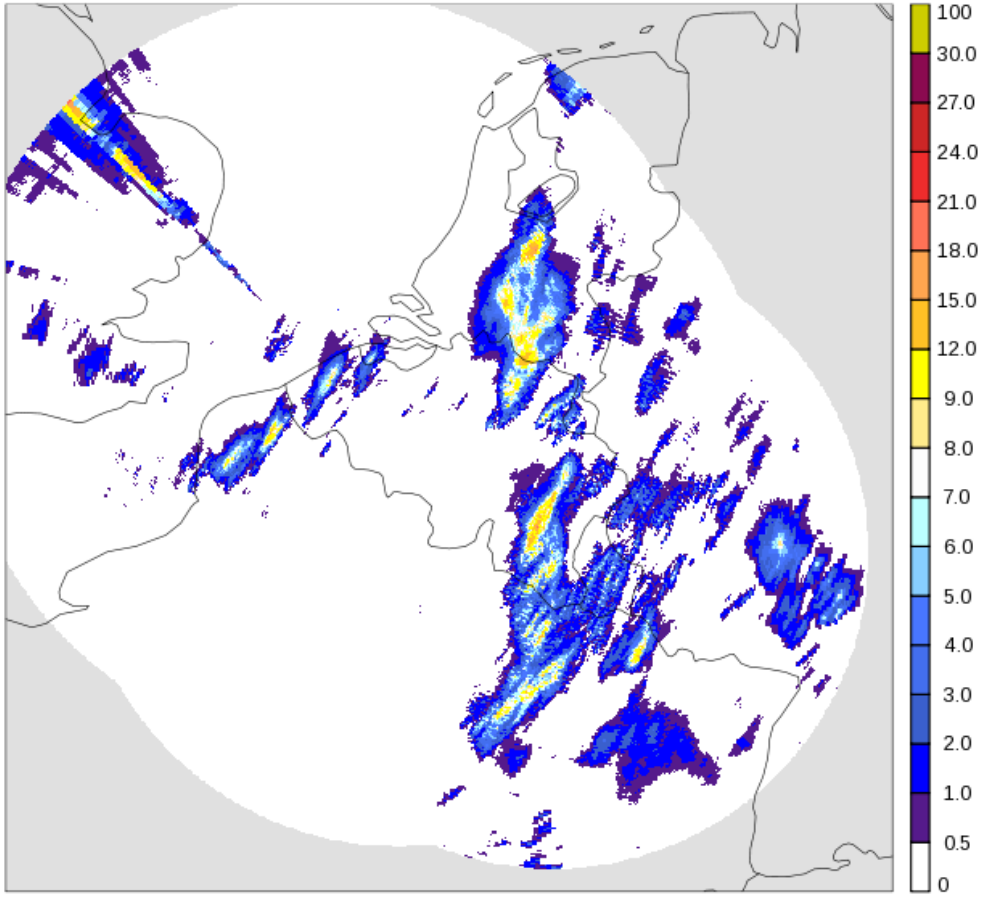
Realtime QPE used for NWP monitoring

1h Precipitation
2017-07-19:18 +8h



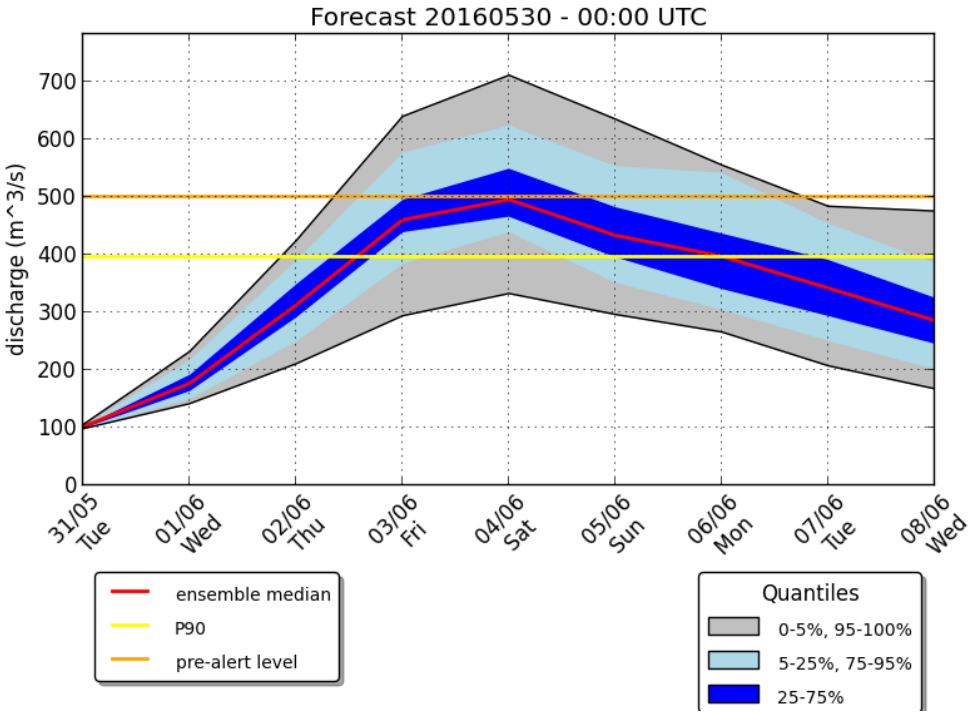
Alaro 1.3km

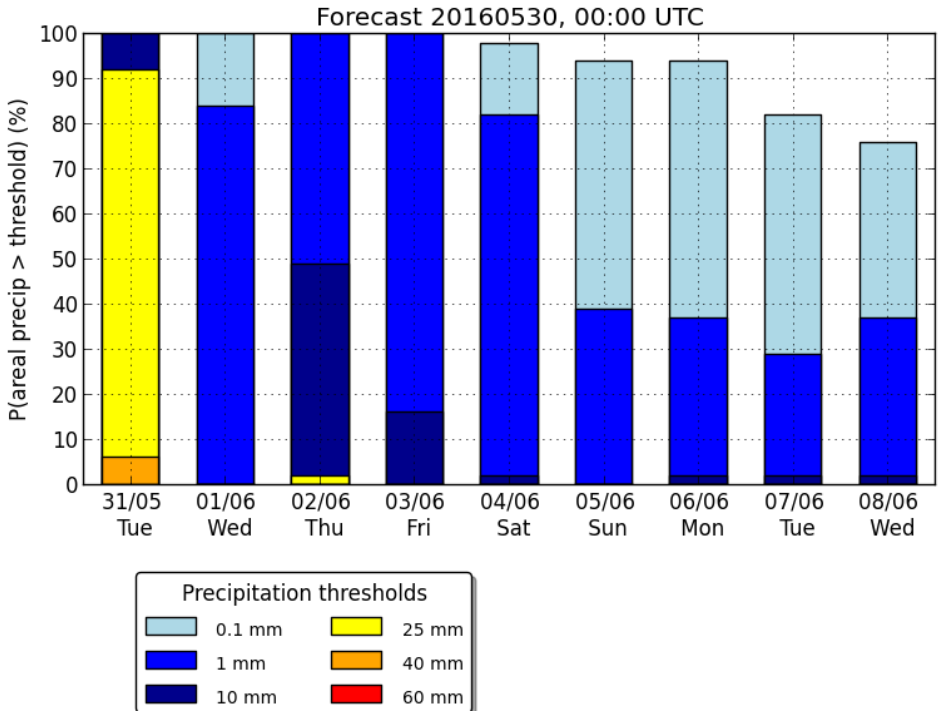
1h precipitation
2017-07-20:02h



radar composite

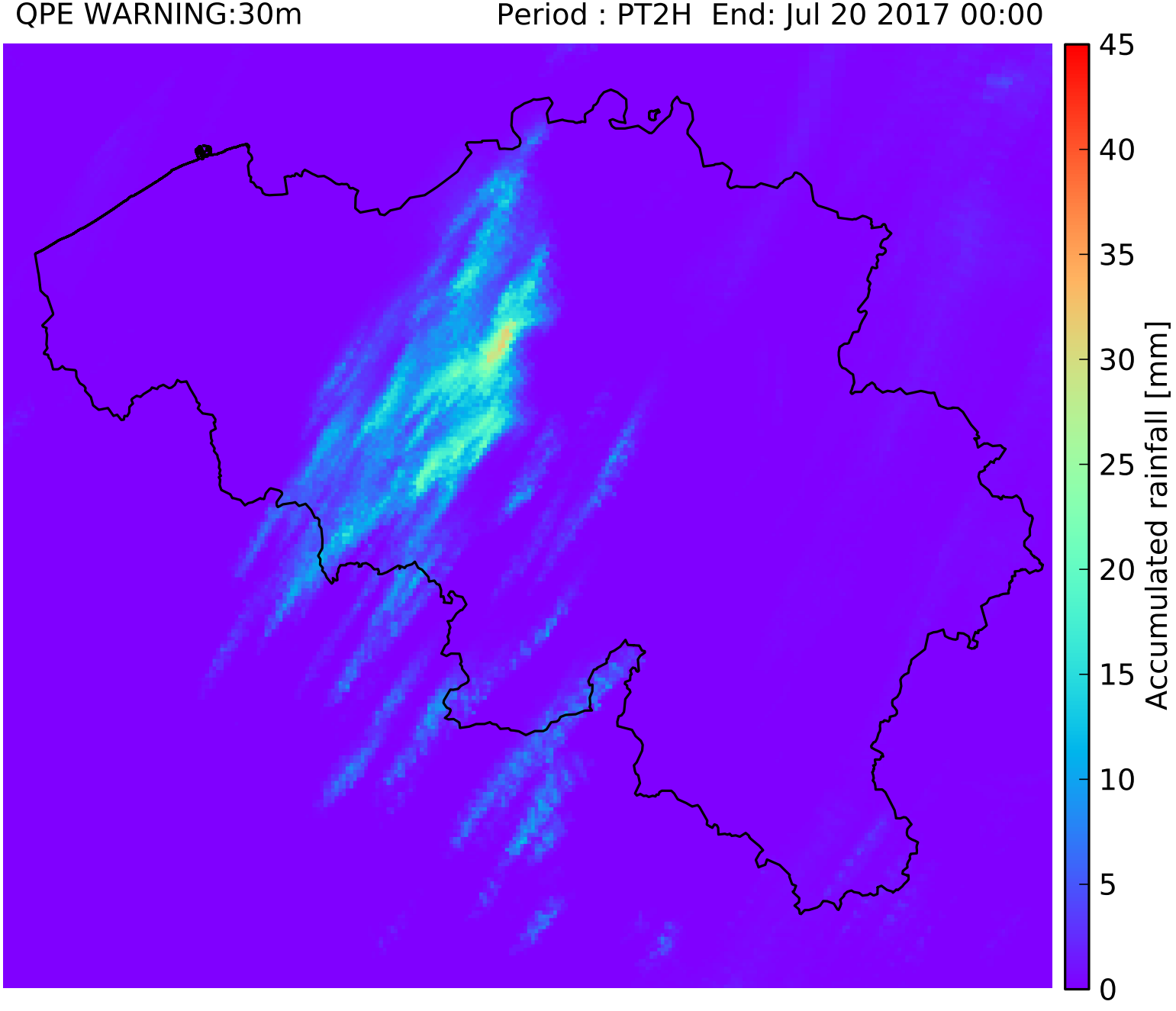
RMIB hydrological ensemble forecasts (HEPDO) : Meuse/Chooz





based on realtime QPE and ECMWF ensemble forecasts

MAX 30 MIN ACCUM FOR THE PAST 2 HOURS



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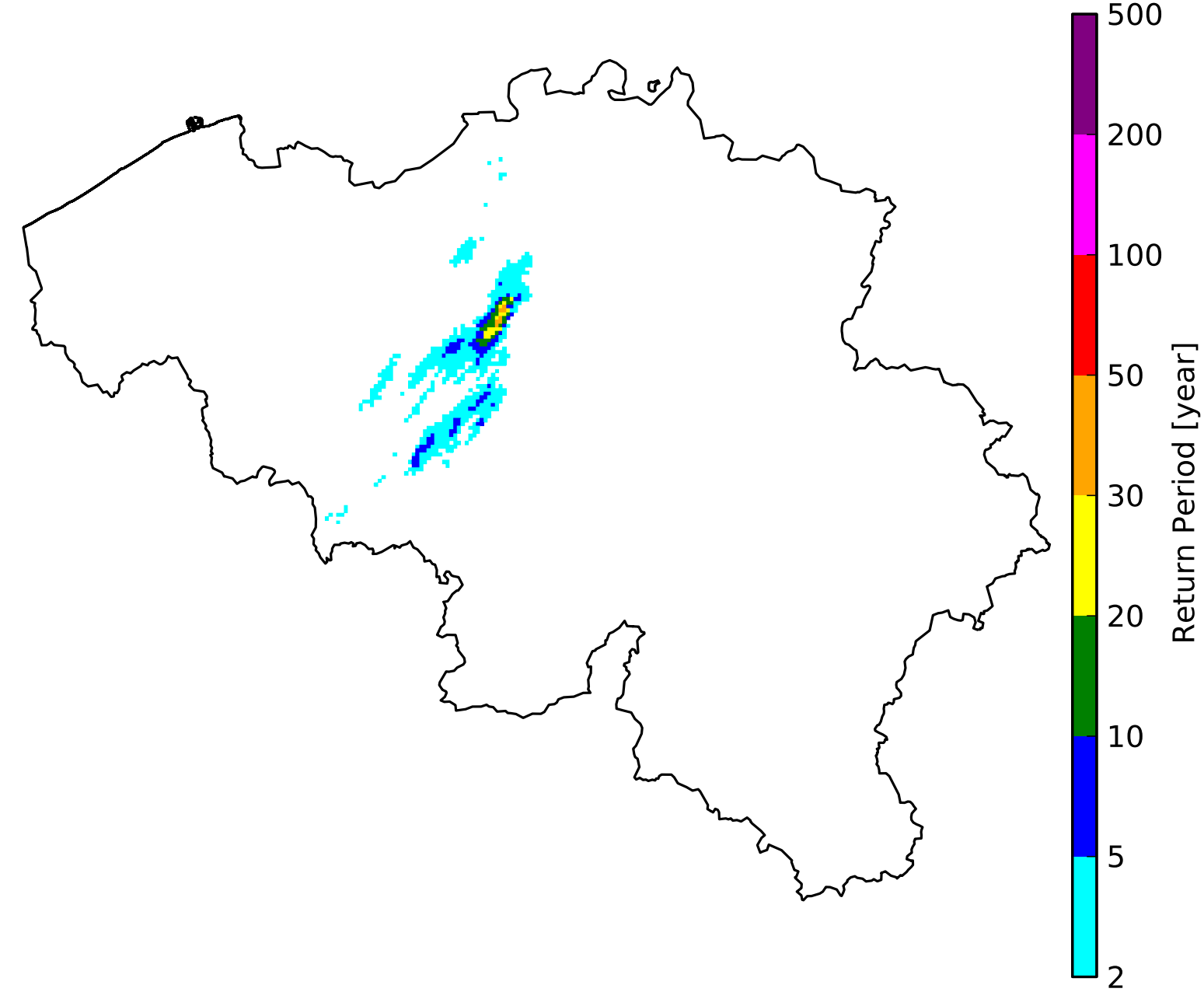
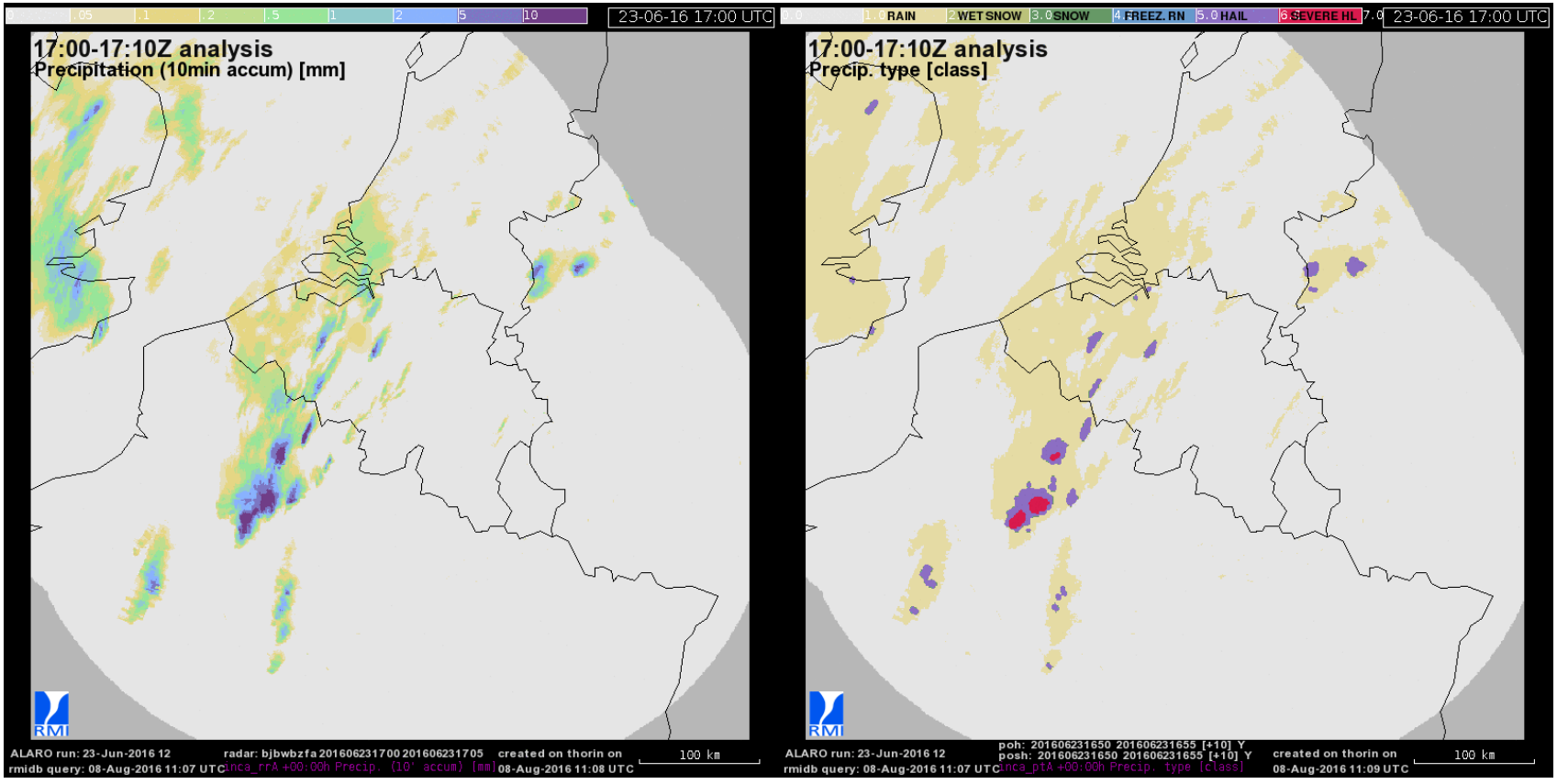


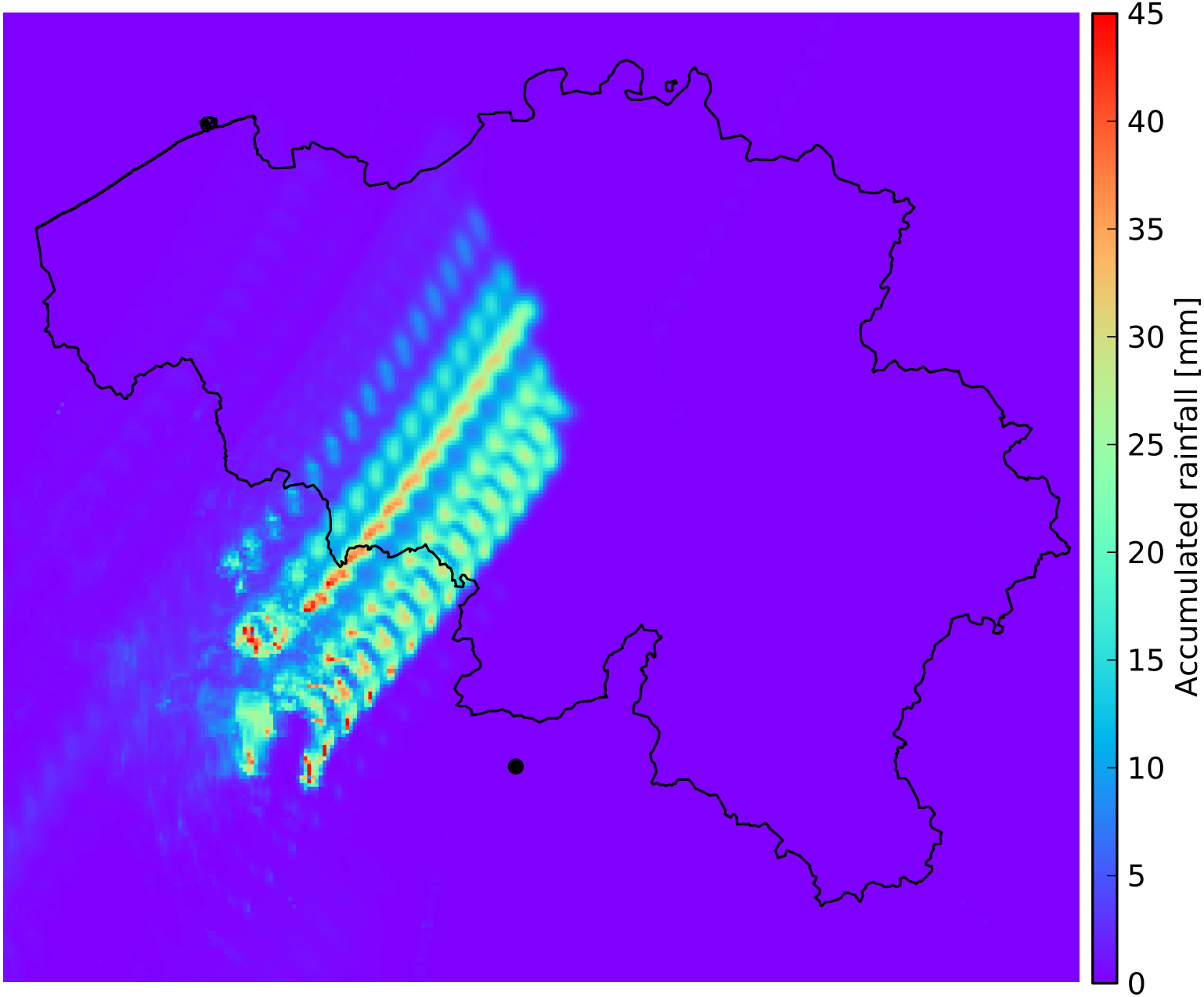
RMIB operational nowcasting system INCA-BE (smartphone application)



- extrapolation based on area tracking of radar observations
- nowcast up to +4h every 10 min
- blending with NWP from +2h

MAX 30 MIN ACCUM FOR THE NEXT 2 HOURS

INCA WARNING:30m Period : PT2H End: Jul 19 2017 10:00



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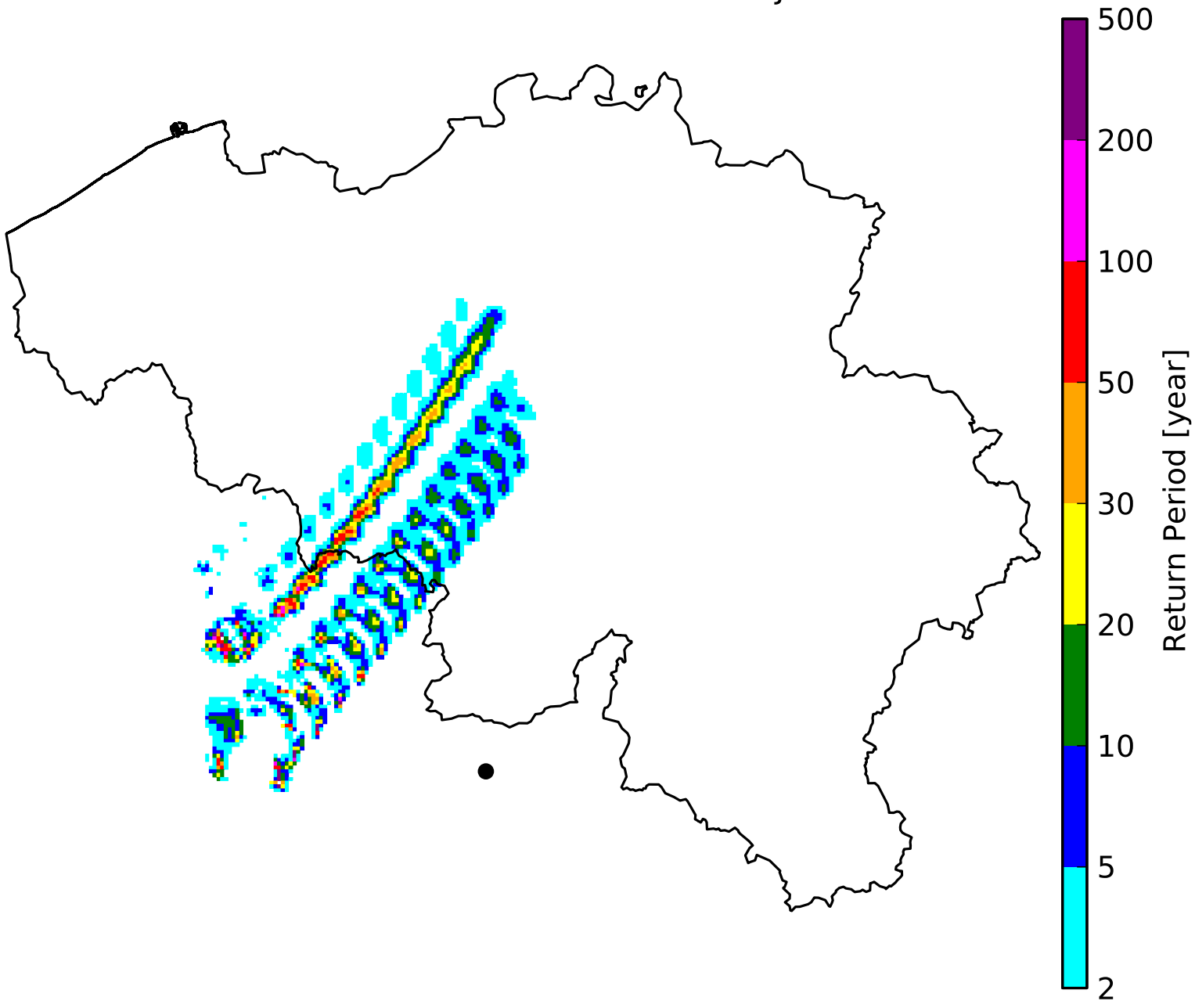
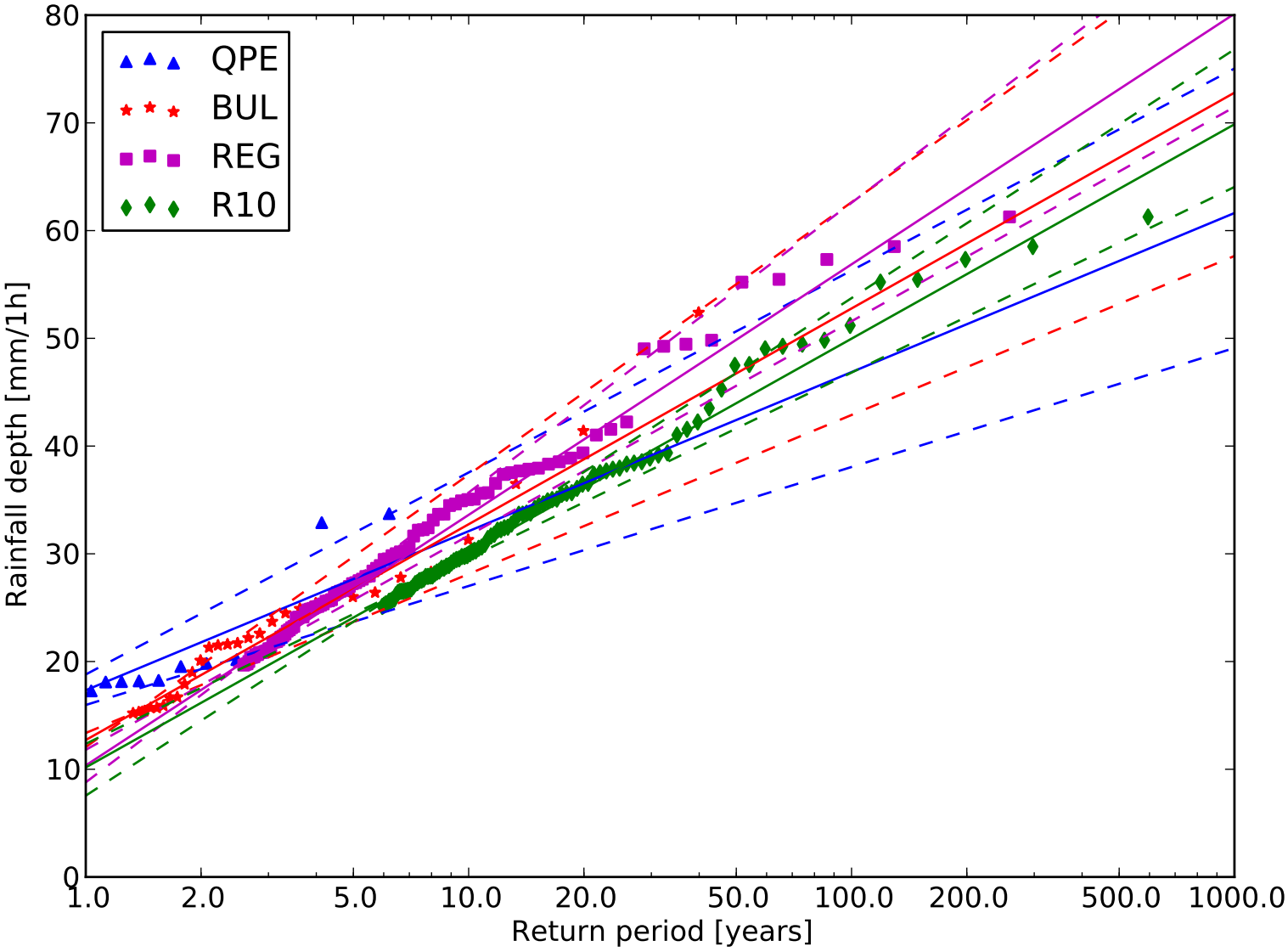


Radar extreme rainfall statistics



more results in Goudenhoofdt, Delobbe, and Willems (2017)

NEXT STEPS

PRECIPITATION OBSERVATIONS

- correction for QPE time sampling errors
- automatic QPE quality control
- QPE in INCA-BE (RMIB nowcasting system)
- QPE in HYDROMAX (DGO2 hydrological model)

PRECIPITATION NOWCASTS

- probabilistic nowcasts (STEPS-BE)
- improved radar-NWP blending

PRECIPITATION WARNINGS

- use radar extreme statistics
- areal precipitation warnings