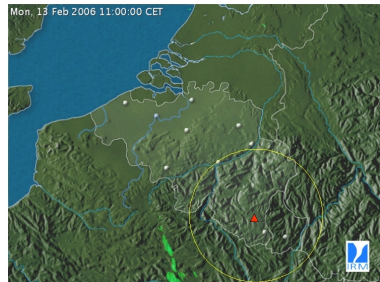


## Areal rainfall statistics based on radar observations

Edouard Goudenhoofdt and Laurent Delobbe  
Royal Meteorological Institute of Belgium (RMIB)

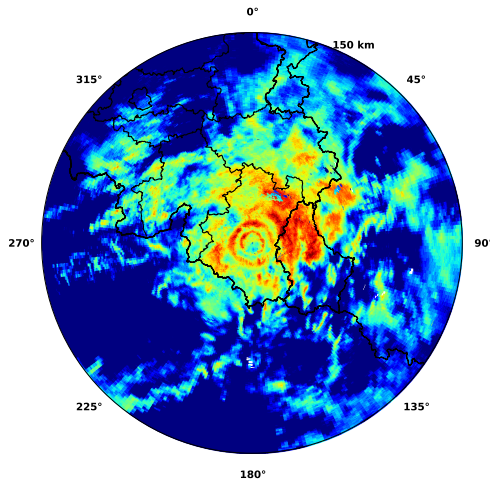
June 3, 2013, European Conference on Severe Storms

# RMIB operates a C-band radar since 2001



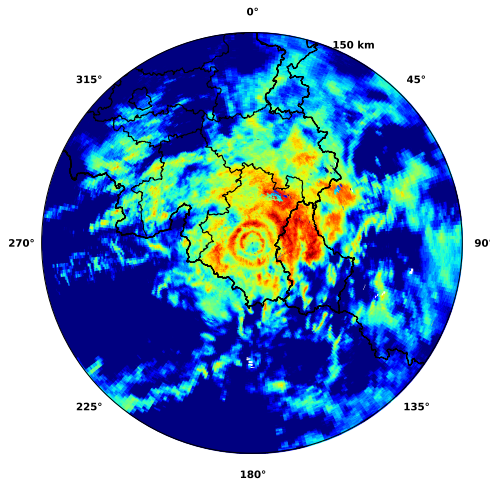
- ▶ Single-polarisation
- ▶ Doppler filtering (clutter)
- ▶ Located 600 m asl, range of 240 km
- ▶ 5-elevation every 5 min (during 2 min)
- ▶ Resolution :  $1^\circ$  in azimuth, 250 m in range

# Quantitative precipitation estimates



- ▶ PCAPPI 800 m above radar level
- ▶  $Z = 200 R^{1.6}$
- ▶ Hail:  
 $Z > 53 \text{ dBZ} \rightarrow 53 \text{ dBZ}$   
(75 mm/h)
- ▶ Cartesian grid 500 m resolution.
- ▶ Accumulation by linear interpolation.

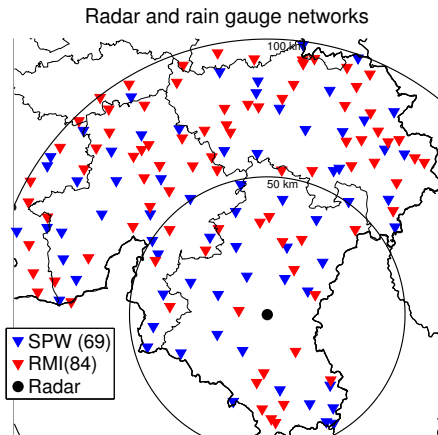
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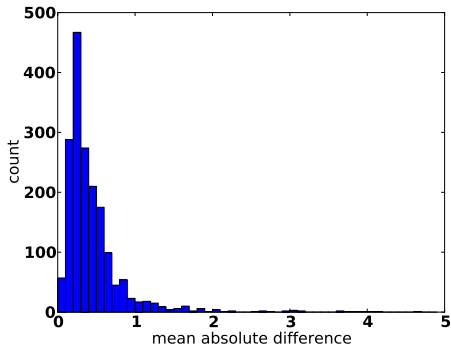
To be validated : clutter mitigation and profile correction.

# Merging and verification with dense raingauge networks.



- ▶ hourly automatic raingauge network (blue)
- ▶  $1E^6$  scale difference !
- ▶ mean field bias : simple and robust
  - ▶ max range 120 km
  - ▶ min value 0.1 mm
  - ▶ min 10 valid pairs

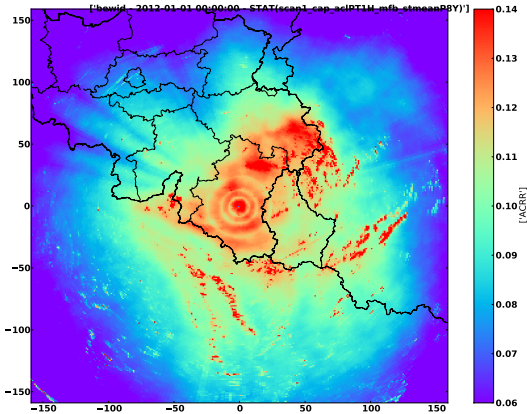
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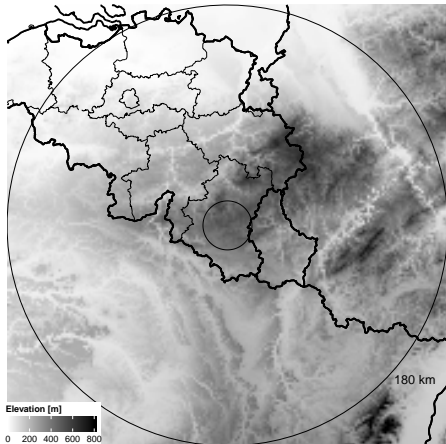
A 8-year verification reveals relatively good accuracy.

# Mean hourly rainfall depth 2005-2012



- ▶ unconditional mean (dry periods are included)
- ▶ minimum 0.07 mm (600 mm/year) in the plains
- ▶ maximum 0.14 mm (1200 mm/year) in the hills

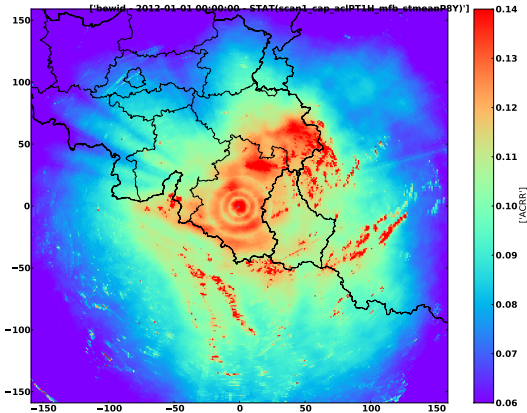
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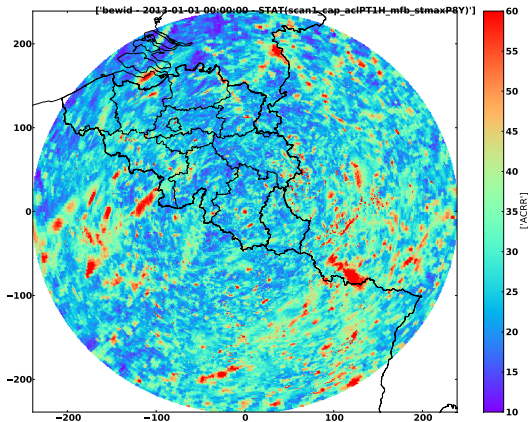
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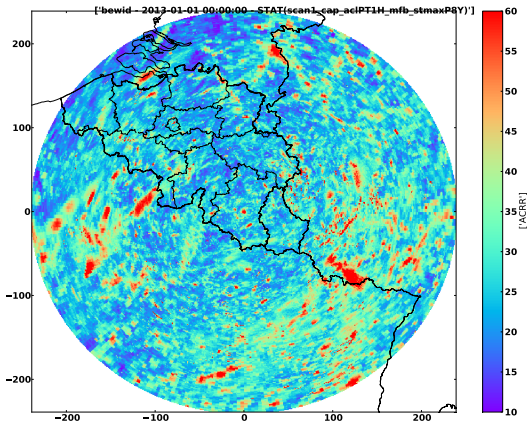
Those results are consistent with raingauge climatology.

# Max hourly rainfall depth 2005-2012



- ▶ High small scale variations.
- ▶ No significant large scale trend.
- ▶ Slightly more max in South-East.

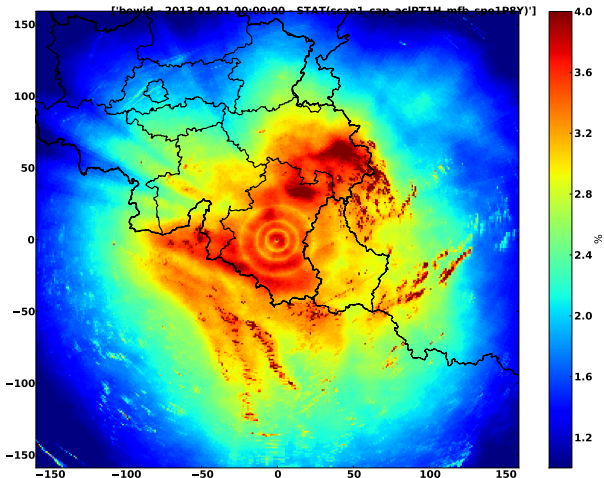
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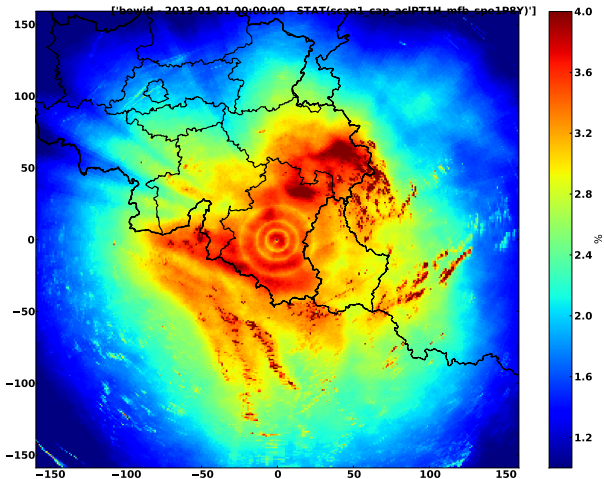
Highest values are due to stationary cells and/or hail.

# Probability of hourly rainfall (1 mm).



- ▶ ranges from 2% to 4%
- ▶ positive effect of topography

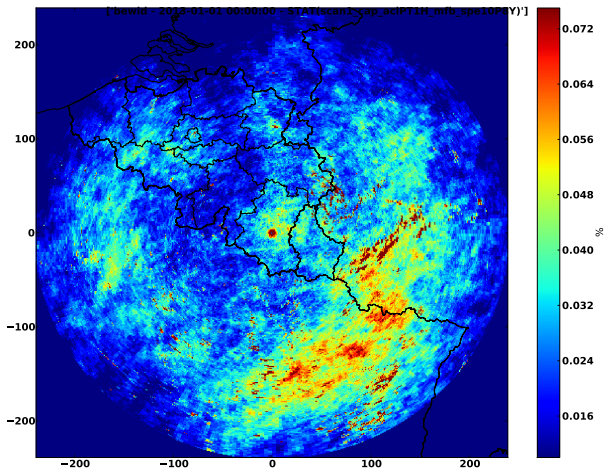
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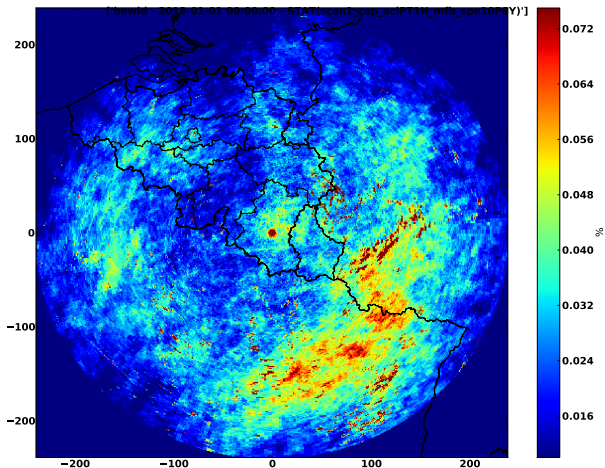
Highly correlated with mean hourly rainfall

# Probability of rainfall exceeding 10 mm.



- ▶ ranges from 0.02 % to 0.06 %
- ▶ less effect of topography
- ▶ higher probability South-East of radar

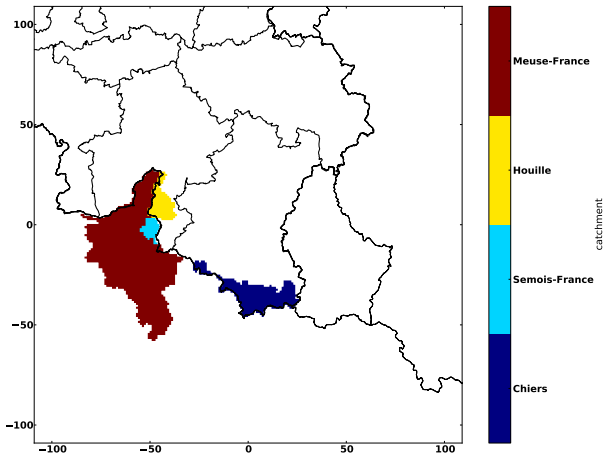
# Probability of rainfall exceeding 10 mm.



- ▶ ranges from 0.02 % to 0.06 %
- ▶ less effect of topography
- ▶ higher probability South-East of radar

Partially correlated with max hourly rainfall

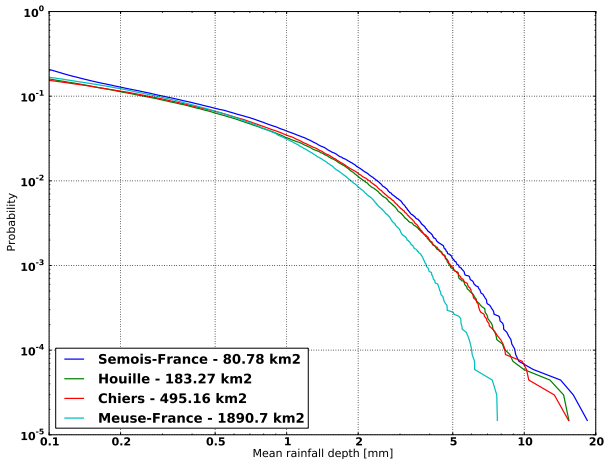
# Exceedance probability of four different river catchment.



► catchment of different size

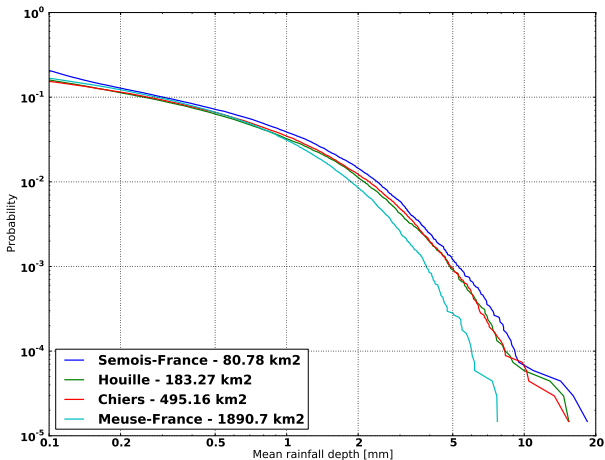


# Exceedance probability of four different river catchment.



- ▶ catchment of different size
- ▶ smooth and logarithmic behavior
- ▶ smallest catchment : max 20 mm
- ▶ largest catchment : max 8 mm

# Exceedance probability of four different river catchment.

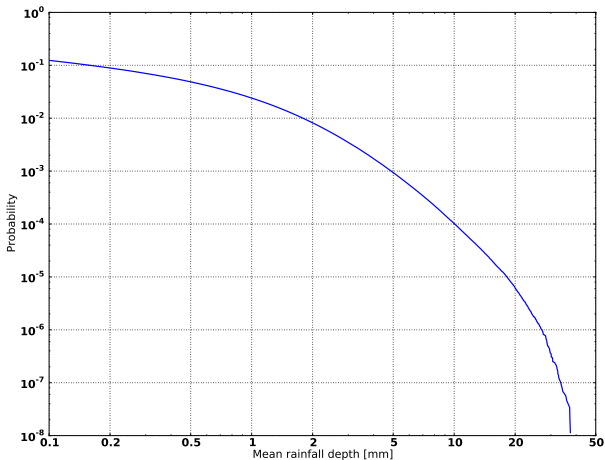


- ▶ catchment of different size
- ▶ smooth and logarithmic behavior
- ▶ smallest catchment : max 20 mm
- ▶ largest catchment : max 8 mm

Computation of return periods is limited (8 years).

# Exceedance probability of adjacent equal-area squares.

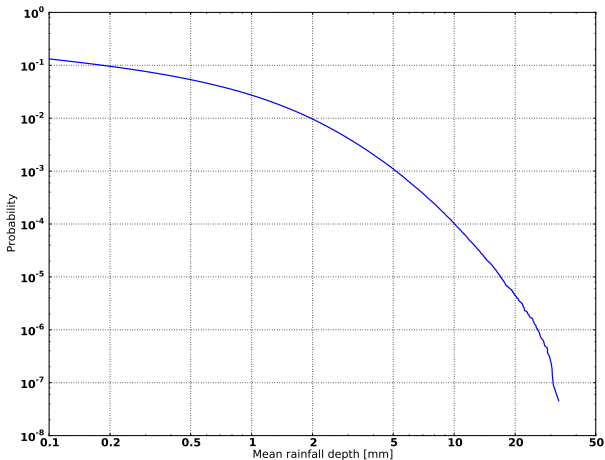
Area = 25 km<sup>2</sup>



- ▶ simple approximation of a catchment
- ▶ distance less than 100 km for best accuracy
- ▶ space and time stationarity
- ▶ independence between windows?

# Exceedance probability of adjacent equal-area squares.

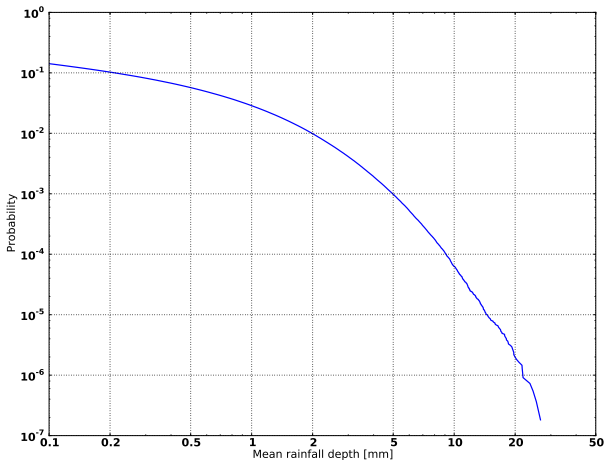
Area = 100 km<sup>2</sup>



- ▶ simple approximation of a catchment
- ▶ distance less than 100 km for best accuracy
- ▶ space and time stationarity
- ▶ independence between windows?

# Exceedance probability of adjacent equal-area squares.

Area = 400 km<sup>2</sup>



- ▶ simple approximation of a catchment
- ▶ distance less than 100 km for best accuracy
- ▶ space and time stationarity
- ▶ independence between windows?

Possibility to compute longer return periods?  
(theoretically 8 years x number of windows)

## Conclusions

- ▶ Weather radar provide **good** areal rainfall estimates.
- ▶ Areal rainfall exceedance **probability** can be computed.
- ▶ Important application to river **catchment**.
- ▶ **Longer** return periods could be computed using a larger domain.

## Outlook

- ▶ **Best** single radar QPE reanalysis (almost ready)
- ▶ Radar **composite** to mitigate attenuation and beam broadening
- ▶ Effect of rainfall depth **duration**
- ▶ Proof using a proper **theoretical** framework