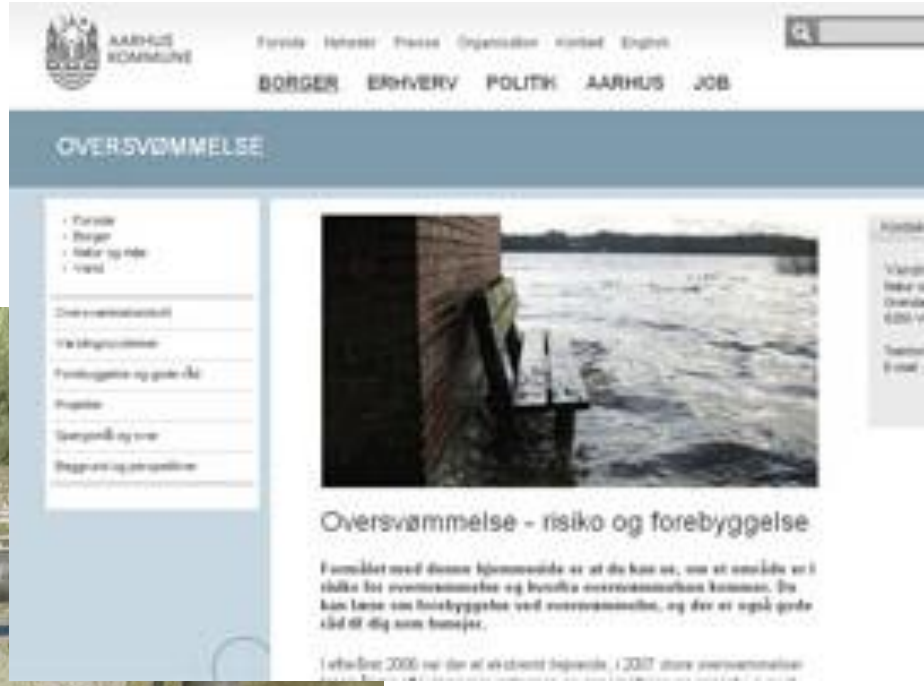
Rainfall data and insurance damage data related to sewer flooding for the case of Aarhus, Denmark

Matthieu Spekkers, Qianqian Zhou, Karsten Arnbjerg-Nielsen, Francois Clemens and Marie-claire ten Veldhuis

Rainfall – insurance damage claims: is there a relationship?

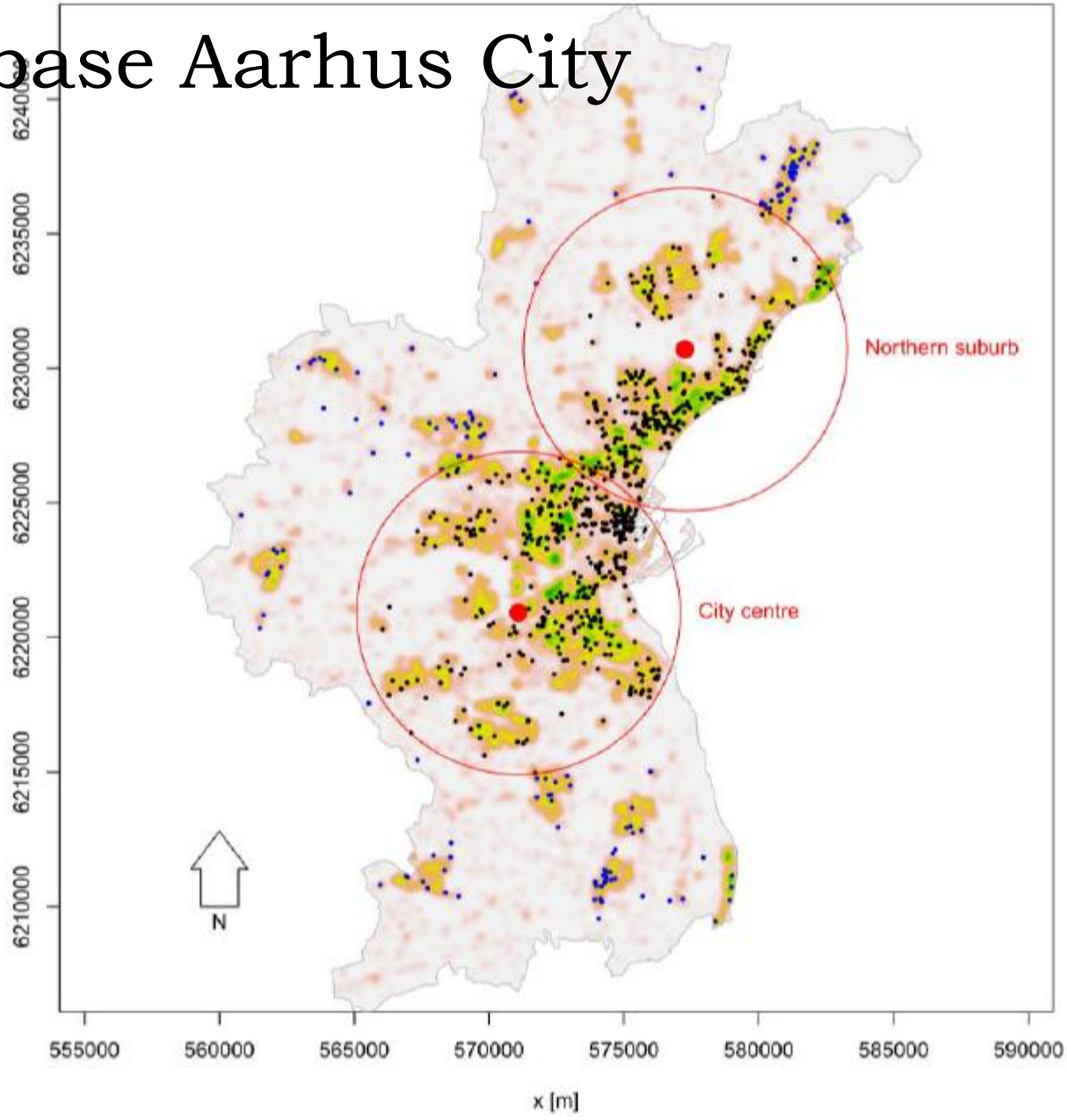
CITY OF AARHUS



Claim database Aarhus City

Aarhus City:

- 315,000 inhabitants
- 47,000 hectares
- Elevation: 0-107m+MSL

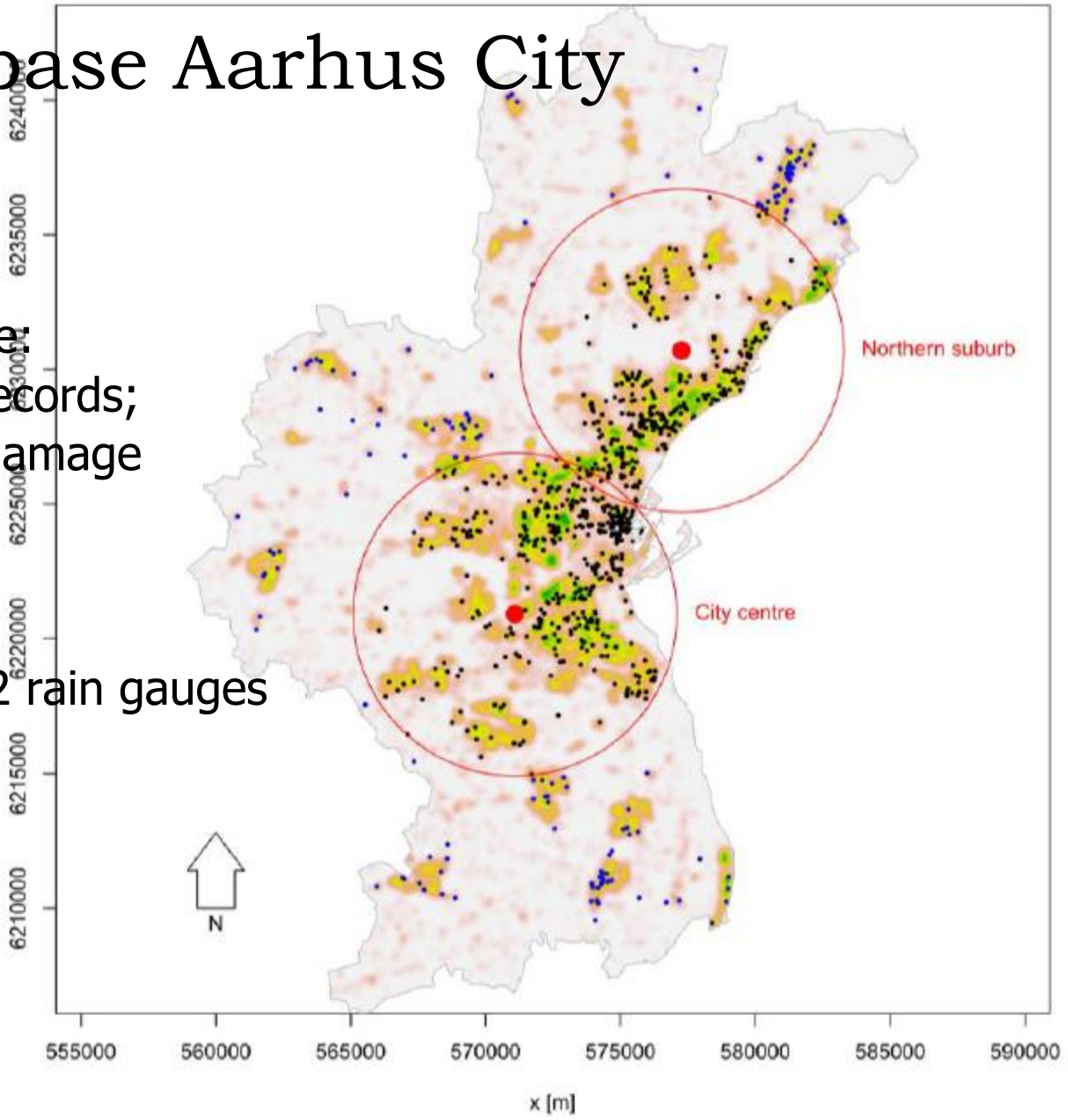


Claim database Aarhus City

Insurance claim database:

- 1044 geo-referenced records; property and content damage
- 24/7 service

- 813 records used
- within 6 km range of 2 rain gauges
- period 2005-2009



Relationship rainfall – insurance damage claims?

Problem:
Lagged response of damage claim to time of rainfall event causing damage

Relationship rainfall – insurance damage claims?

Problem:
Lagged response of damage claim to time of rainfall event causing damage

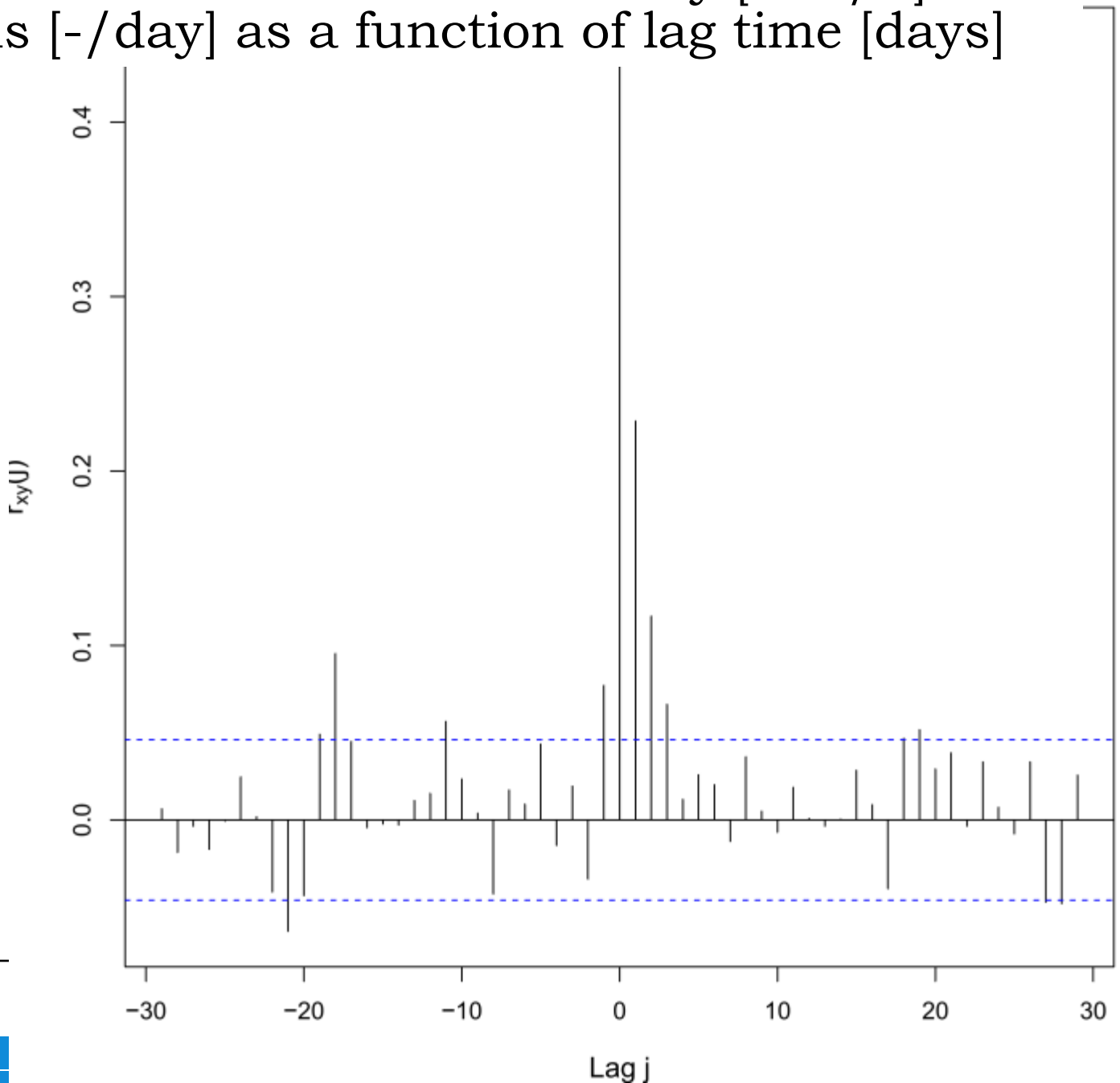
Solution:

- impulse-response function (lagged regression) – from signal processing (cf. electric pulse)

- Precondition: impulse is short compared to response; impulse is immediate (infinitely short).

➢ Here: impulse = rainfall (min-hours); response = claims (days)

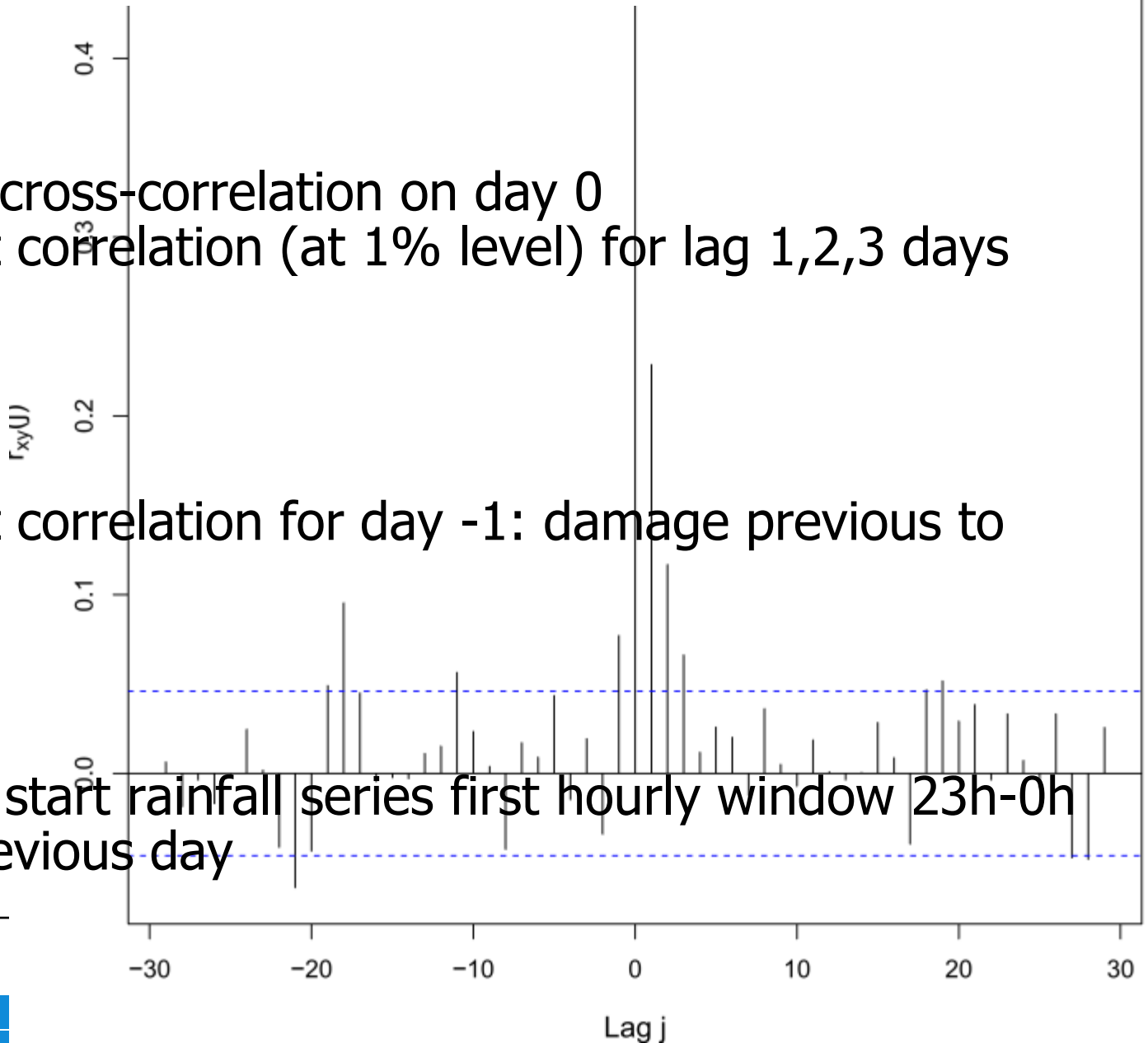
Cross correlation max rainfall intensity [mm/h] vs nr of claims [-/day] as a function of lag time [days]



Cross correlation max rainfall intensity [mm/h] vs nr of claims [-/day] as a function of lag time [days]

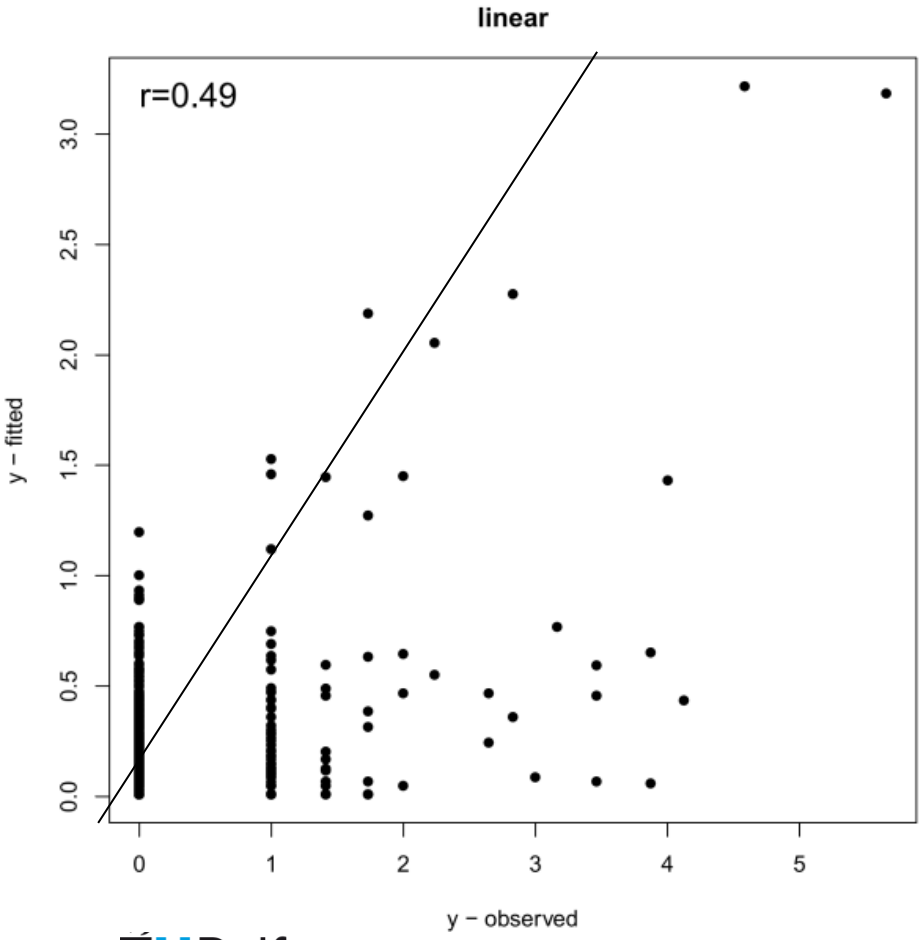
- Strongest cross-correlation on day 0
- Significant correlation (at 1% level) for lag 1,2,3 days
- Significant correlation for day -1: damage previous to rainfall?

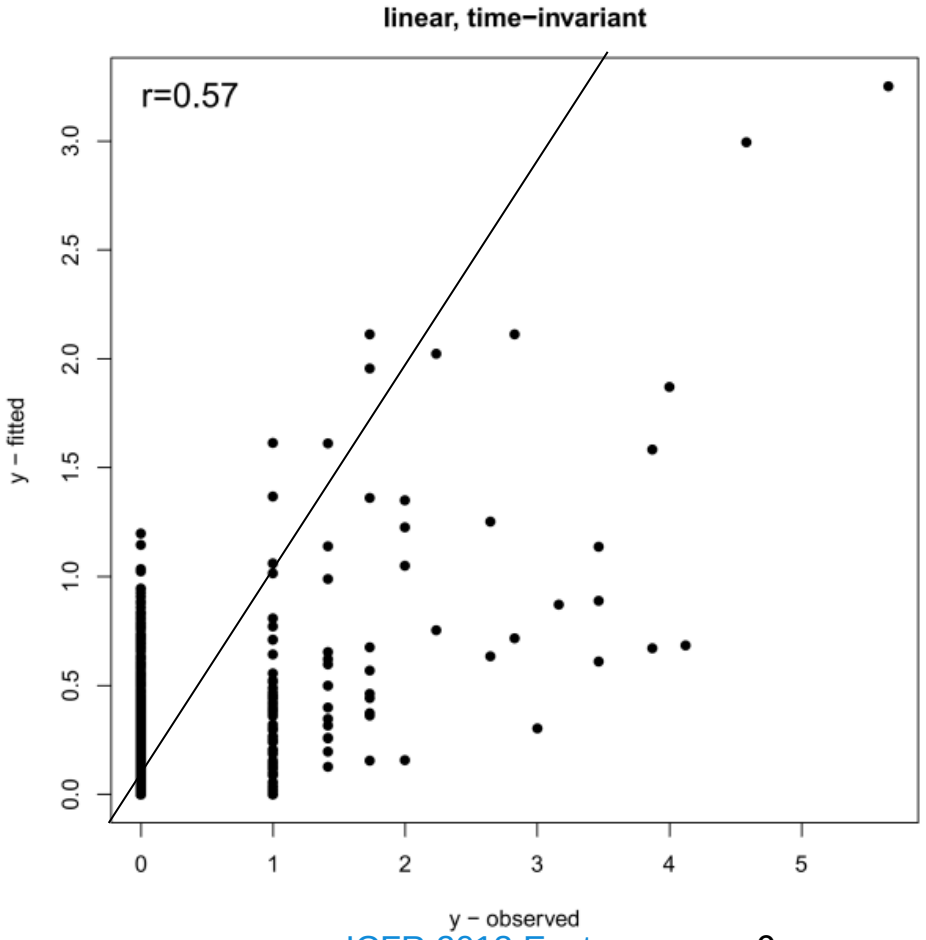
➢ Probably: start rainfall series first hourly window 23h-0h is from previous day



Nr of damage claims predicted vs observed

(SQRT(nr claims))



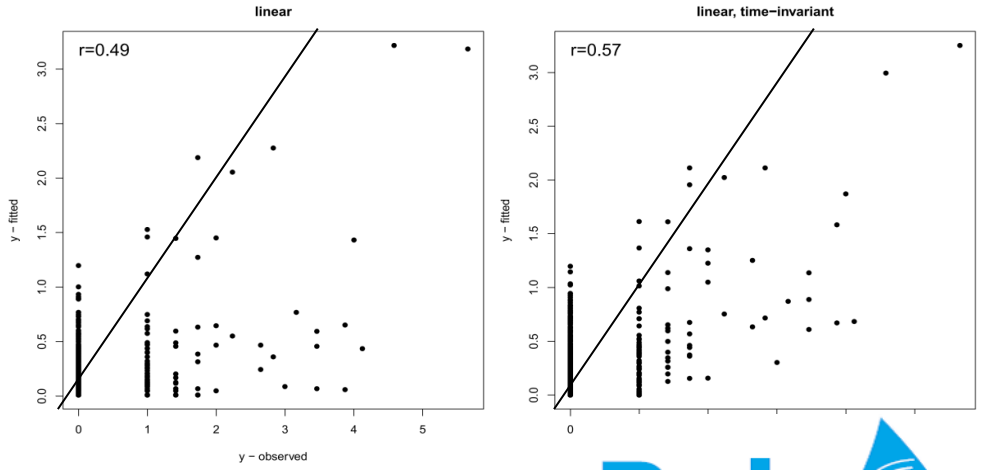


Correlation coefficients (Pearson)

		Northern suburb		City centre	
	Model	dcounts	dtot	dcounts	dtot
rmax	Linear	0.49	0.45	0.40	0.37
	Linear, time-invariant	0.57	0.53	0.47	0.43
rvol	Linear	0.45	0.40	0.38	0.34
	Linear, time-invariant	0.54	0.48	0.44	0.38
Avg. distance claim-rain gauge		3.1 km		4.0 km	
Total number of claims		363		450	

D_counts: nr of damage claims/day
D_tot: total damage volume/day

Prediction of rainfall-related damage



Needs for improvement:

- accurate insurance data: in time and space
- accurate rainfall data: especially in space (rainfall radar)
- additional data sources: topography, local drainage, socioeconomic data

Acknowledgments:
Forsikring and Pension
DTU
FP7 SMARTeST

SMARTeST