

# Bathing in urban rivers

Predicting water quality for early warning at bathing sides

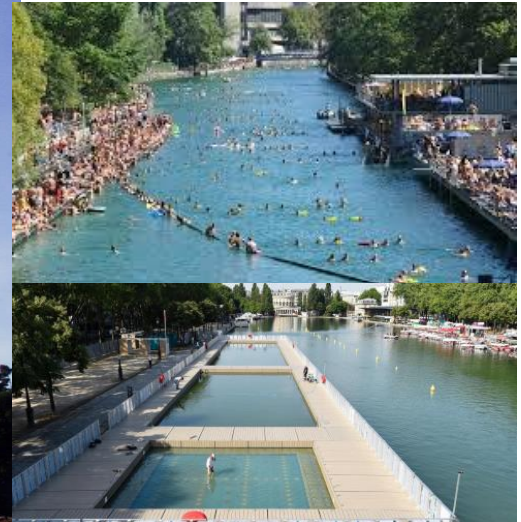


Quelle: Wolf Raber, Insel der Jugend



# Bathing in urban rivers is smart

Quelle: Berliner Wasserbetriebe



Limmat Zürich

Marne in Paris

Quelle: AFP/Getty

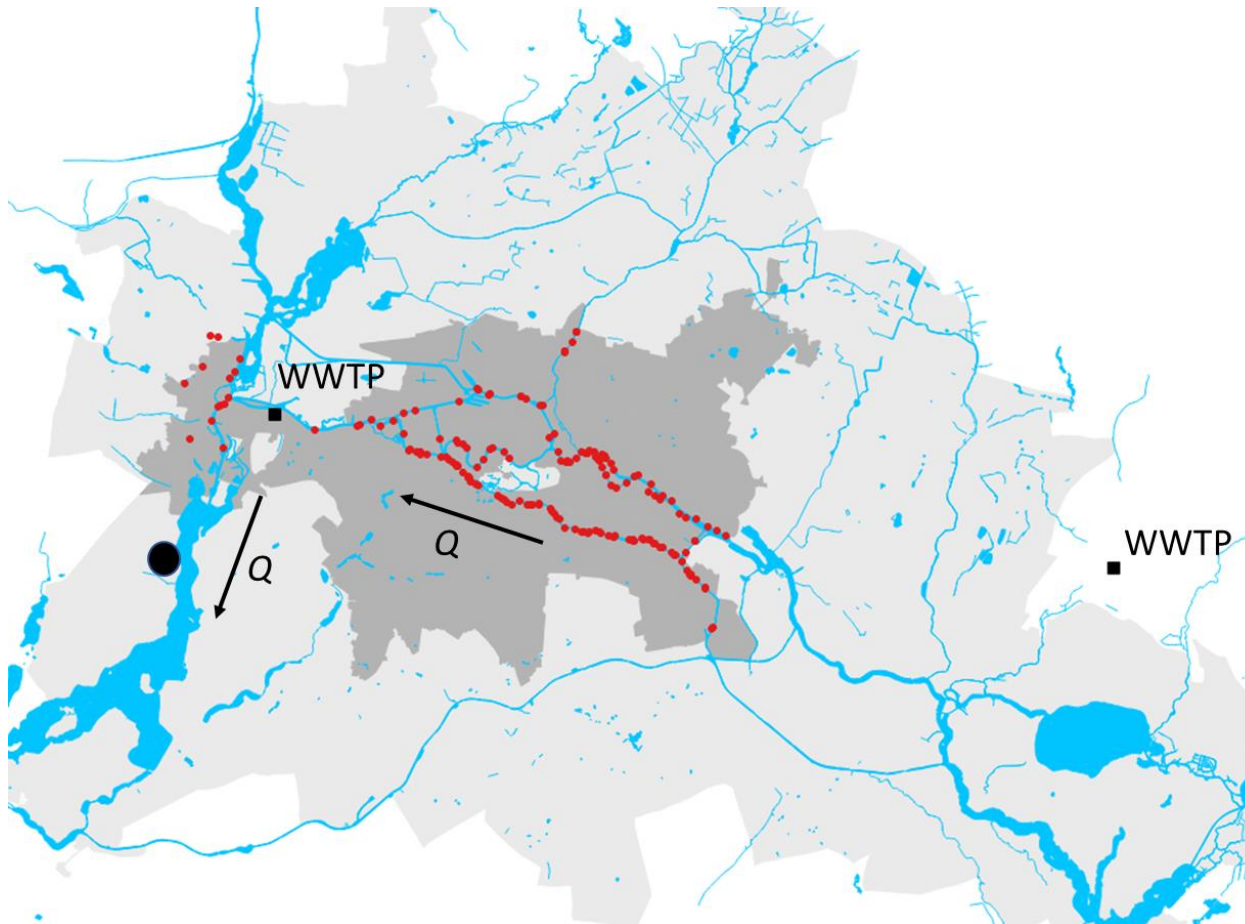
Images



Flaucher Isar

(Foto: Margit Schade)

## Bathing in urban rivers means risks from urban drainage



### Berlin combined sewer system

- 53 km<sup>2</sup> impervious surface
- 1,5 Mio Inhabitants
- 179 CSO discharge points
- 30 -40 events per year
- CSO Volume: 7 Mio m<sup>3</sup>/a

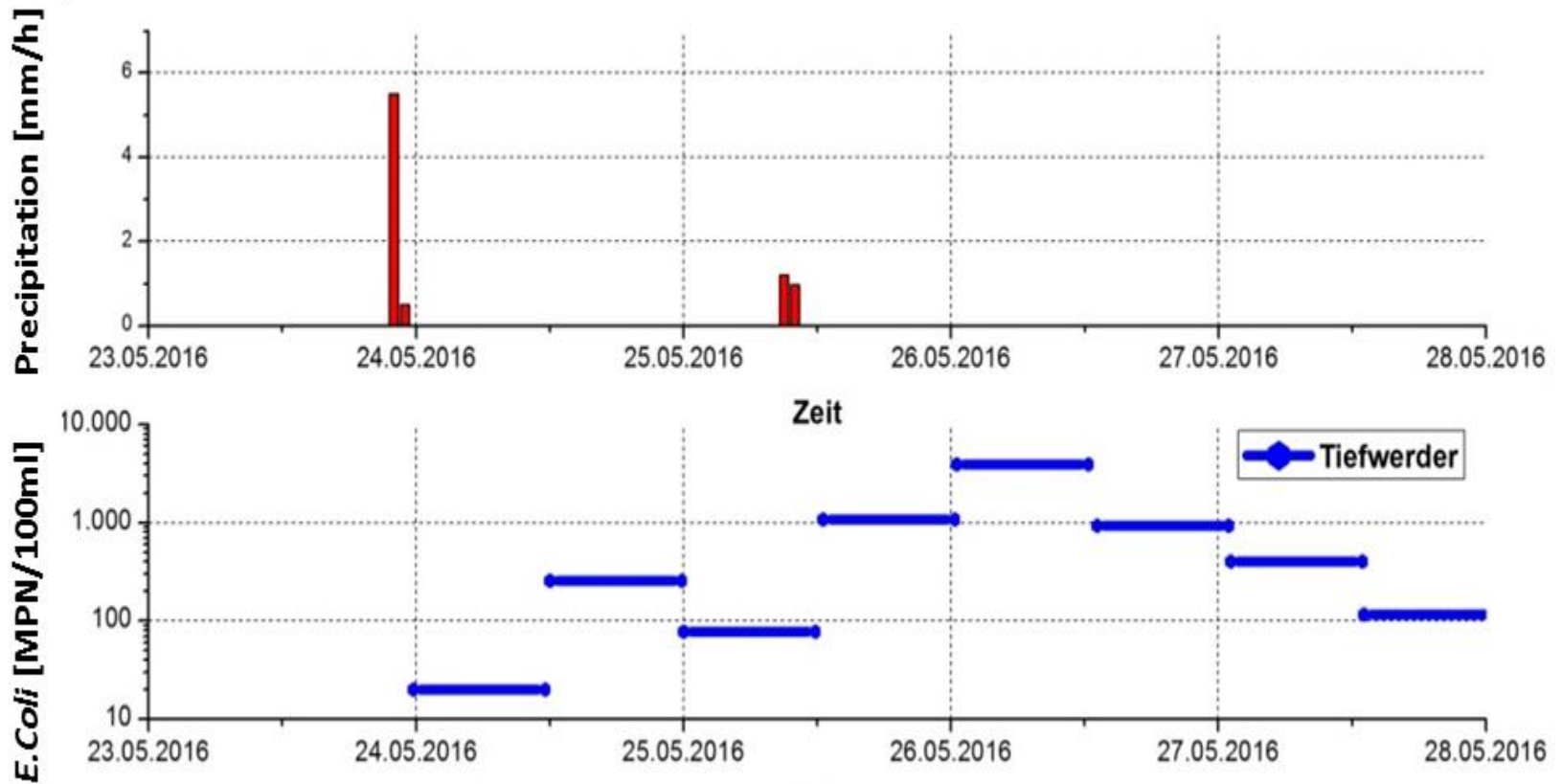
### Berlin separate sewer system

- 53 km<sup>2</sup> impervious surface
- 2 Mio Inhabitants
- 47.6 Mio m<sup>3</sup>/a
- **100-120** events a year

### WWTP

- 234 Mio m<sup>3</sup>/a
- UV disinfection dry weather
- Bypass stormwater

# E-Coli pollution after rain event at river bathing sites



# Statistical models can be used for early-warning

## Main effects:

- **Precipitation (P) [mm] (5min)**
- **River flow (Q) [m<sup>3</sup>/s] (15min)**
- **non-disinfected WWTP discharges (WWTP) [m<sup>3</sup>/s] (30 min)**

## Transformations:

- Log<sub>10</sub> transformation of *E.coli* concentrations
- Log transformation of precipitation data

## Interactions:

- Flow and WWTP + flow and precipitation

## Software:

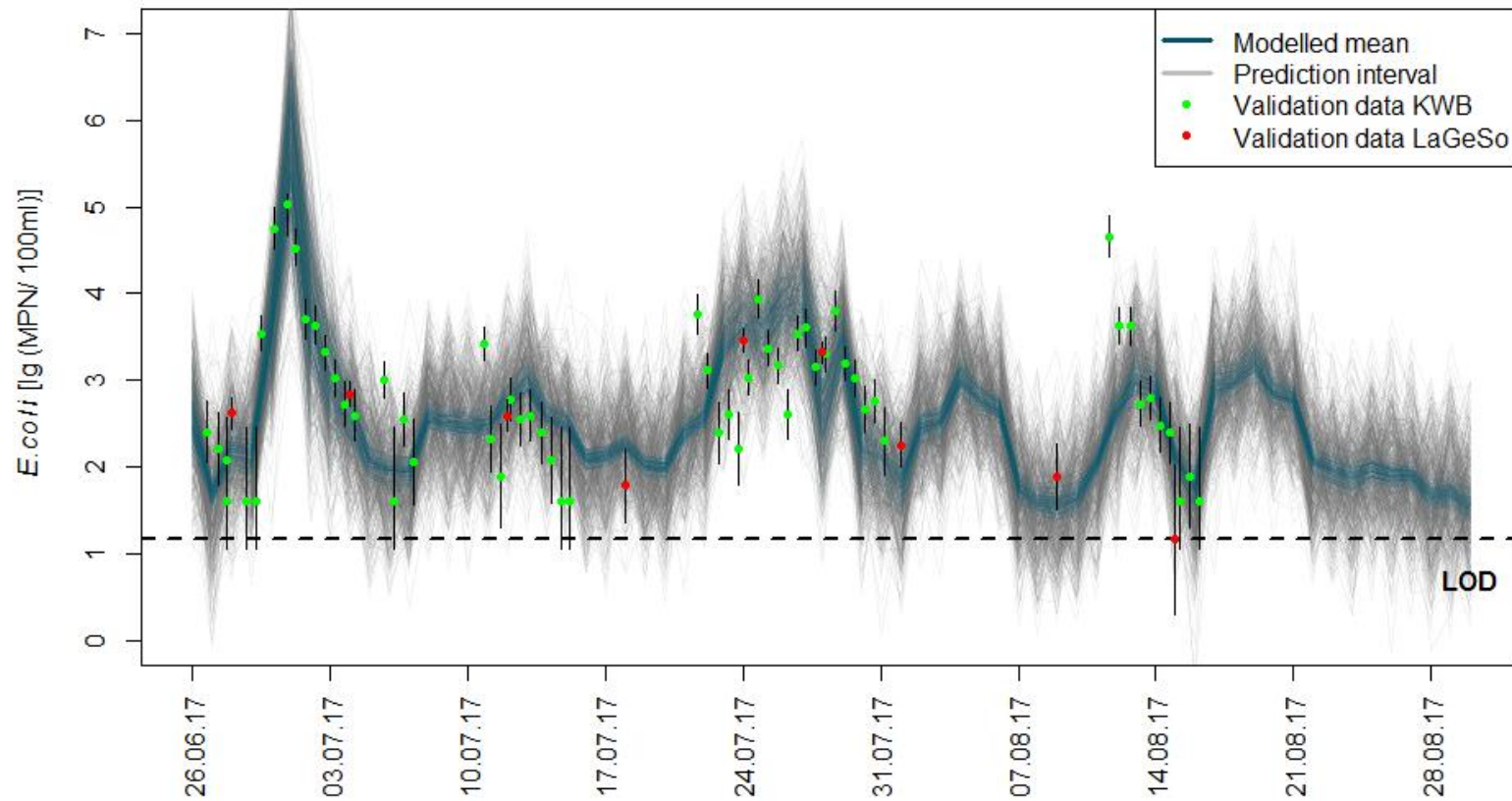
- R, rstanarm-package for applied Bayesian regression modelling



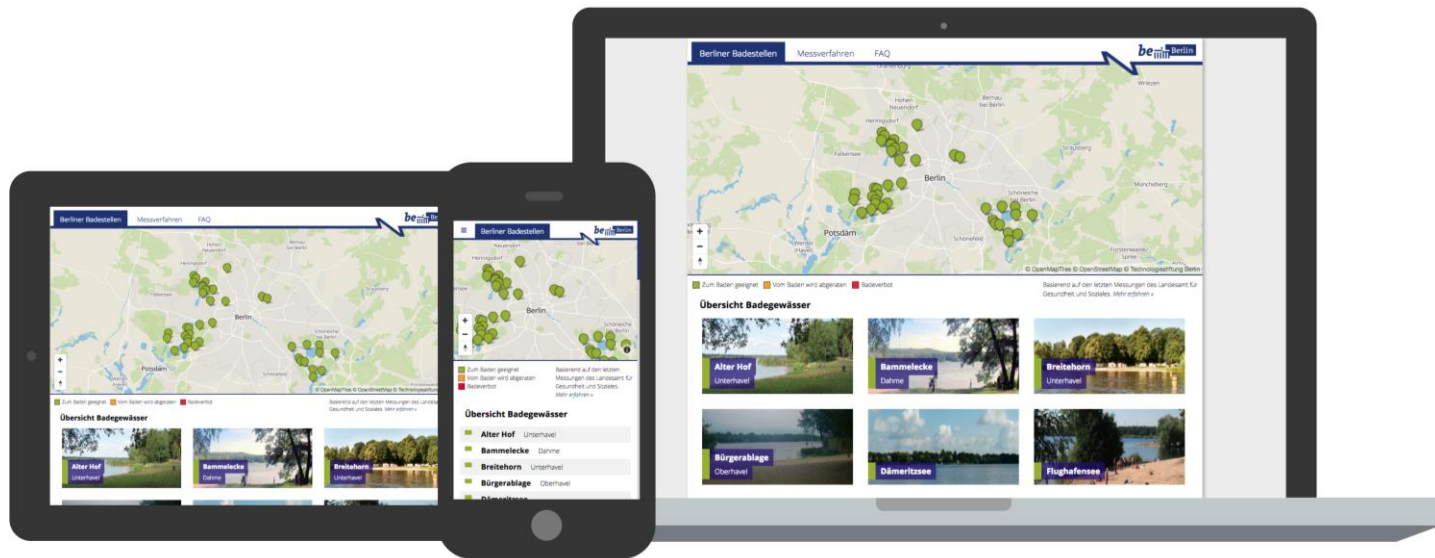
## General form of the used regression models

$$\text{Log}_{10}(E.coli) \sim N ( Q ( \log(P) + WWTP ), \sigma^2 )$$

# Regression model can be validated



# Early-warning system is only based on available data and is now communicated!



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- Use city data makes life in urban areas smarter!
- City data means cooperation between city partners....
- Statistical models can be used instead of complex ones
- Risk communication to citizen is important!