Performance evaluation in urban drainage

Andreas Scheidegger
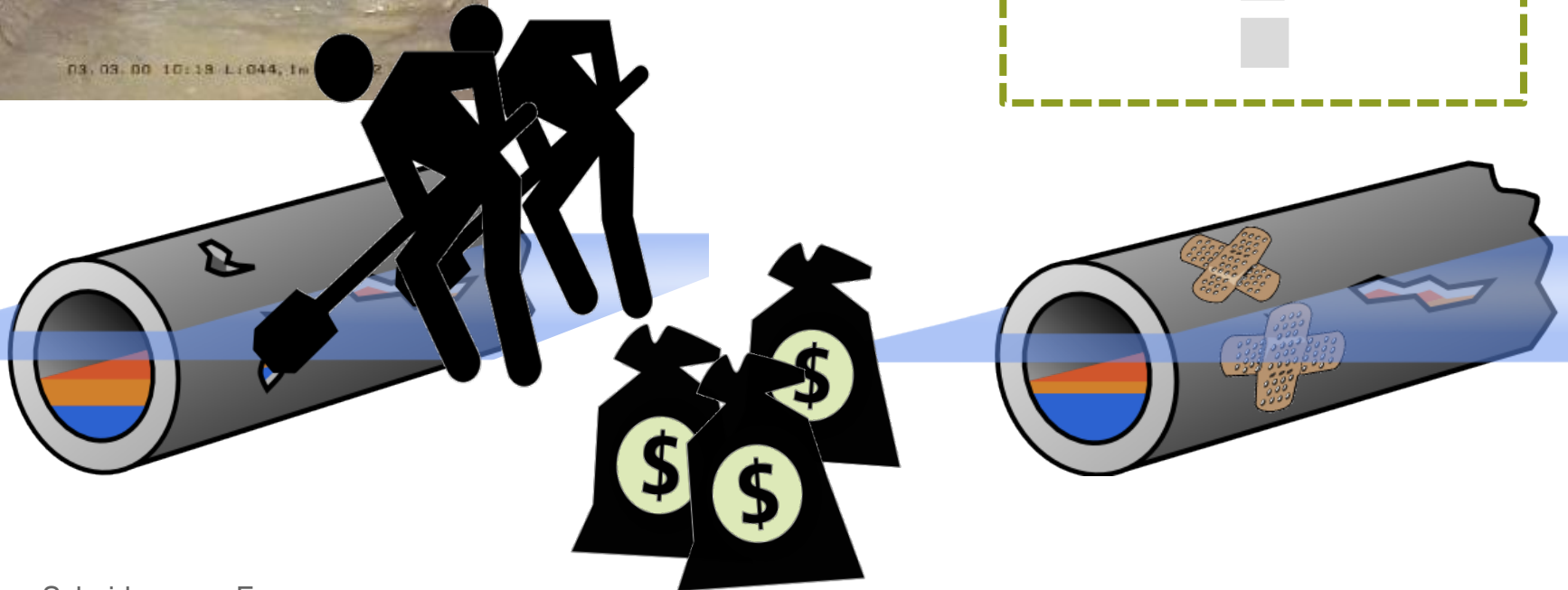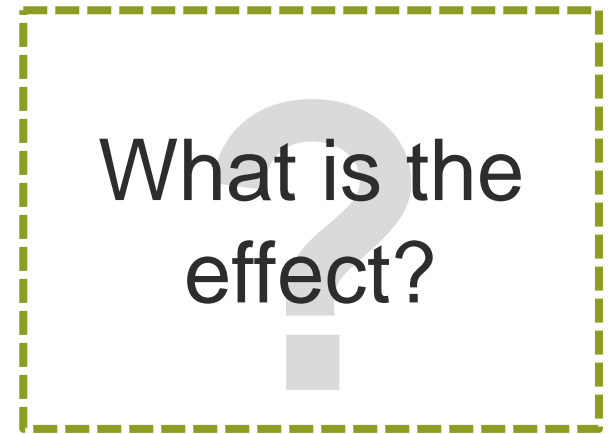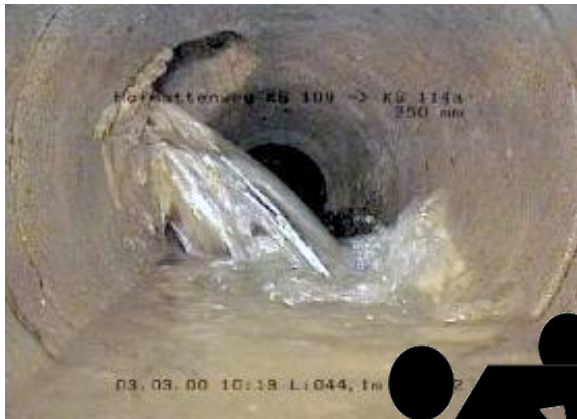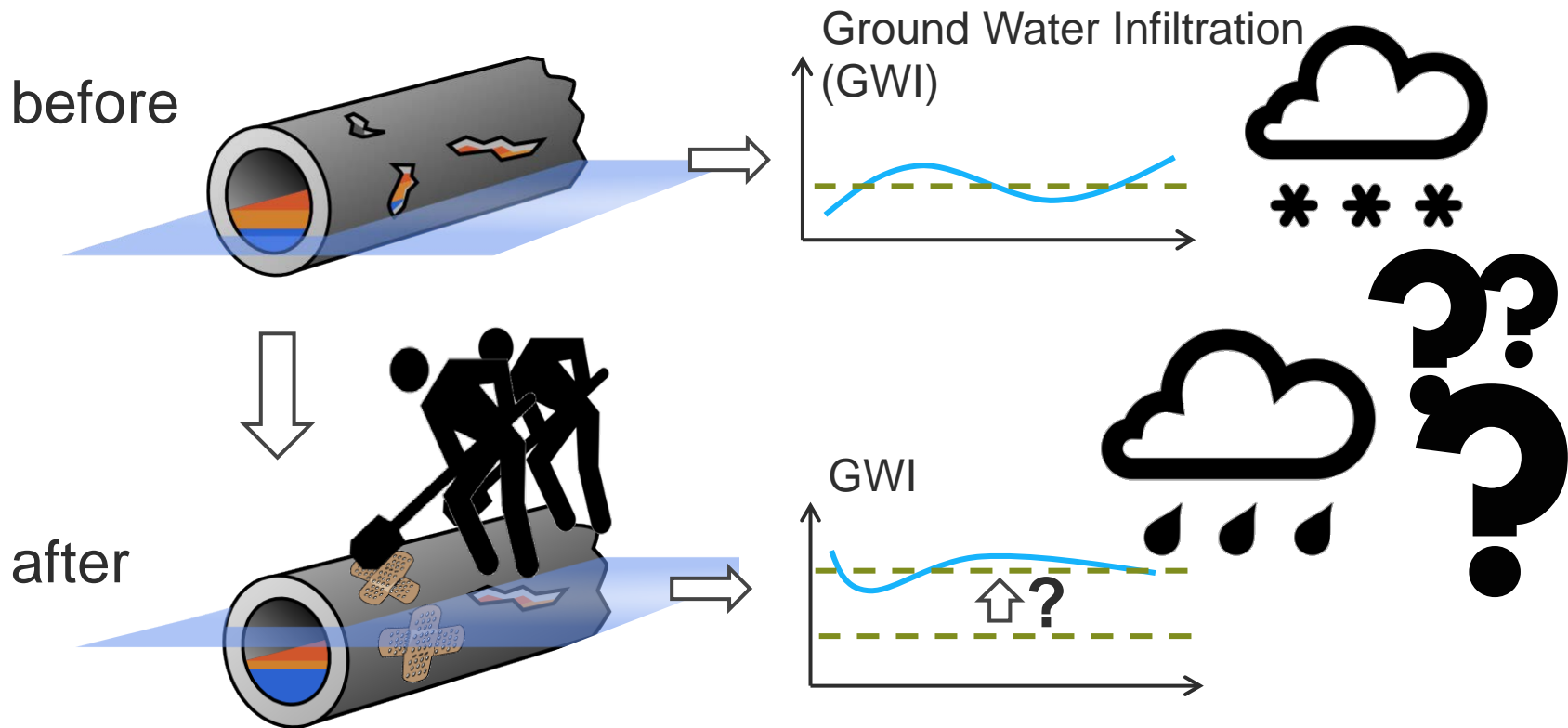
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Reduction of groundwater infiltration and surface water inflow (I/I)

What is the effect?

Performance evaluation
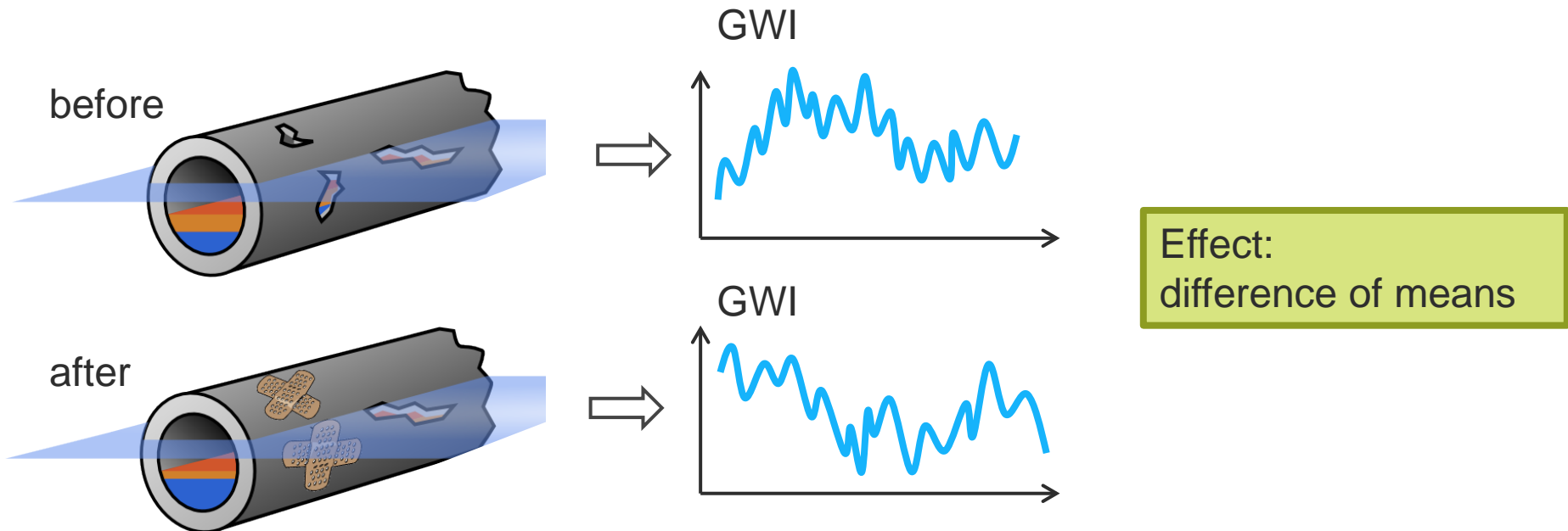
Why is it difficult?

Is an effect due to the measure or due to changing conditions?

Approach i)

Measure long time series

IDEA: If we measure *long* enough we have a chance to capture all variabilities
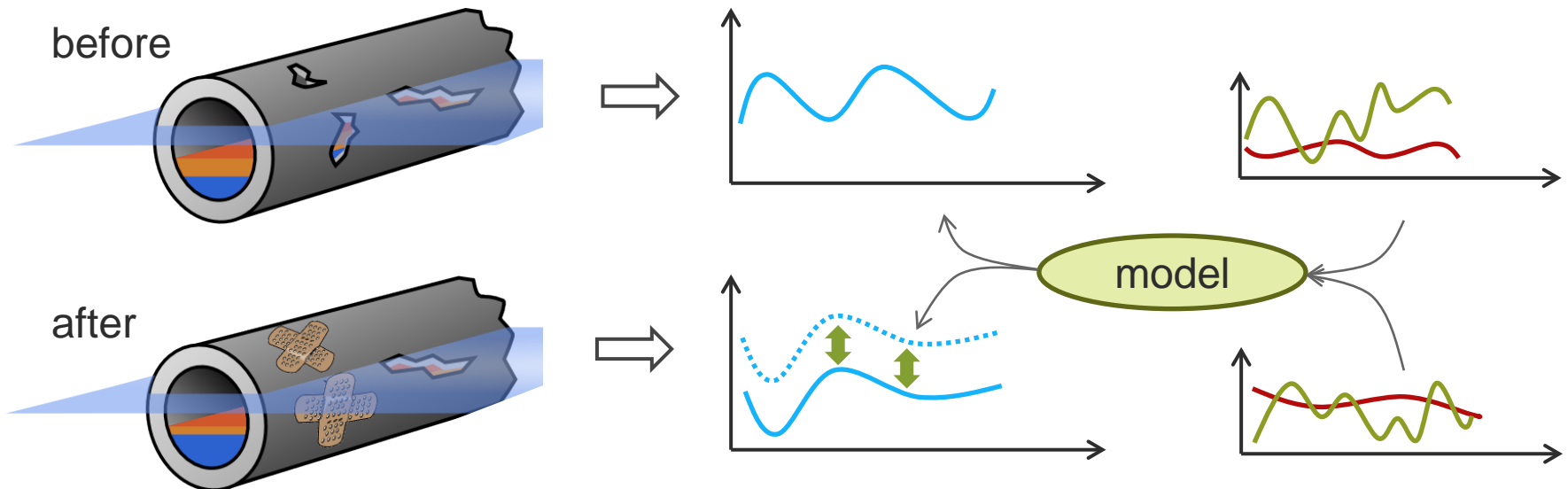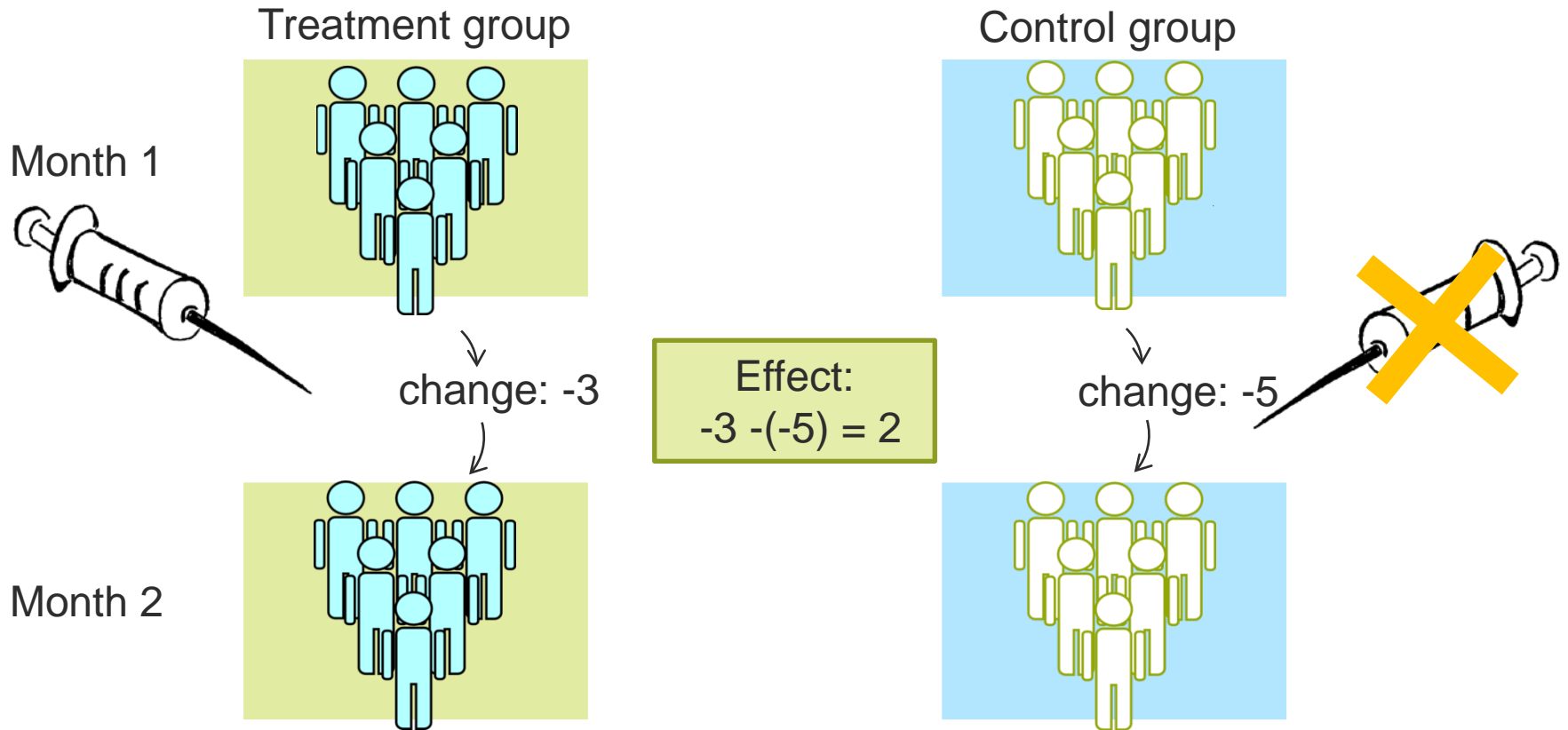
Approach ii)

Compare with GWI model

IDEA: - Measure GWI *and* all relevant
         external factors
       - Model GWI

Effect:
difference of model
and measurement

Similar problems occur in clinical trials

Treatment group

Control group

Month 1

change: -3

Effect:
-3 -(-5) = 2

change: -5

Month 2

IDEA: "measure" the effects of all (potentially unknown) factors with a control group.

Approach iii)

Use of a control catchment
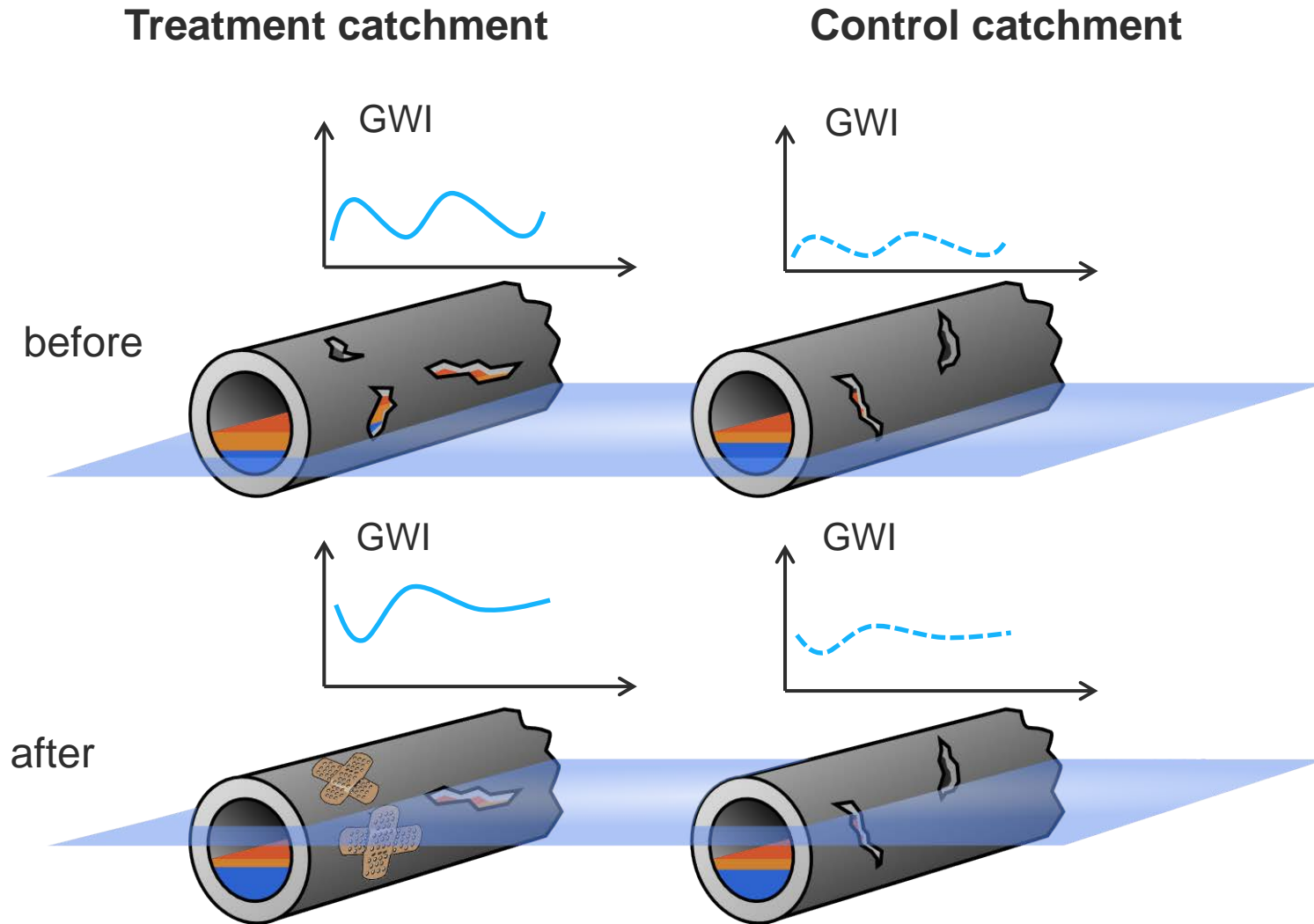
Approach iii)

How to calculate the effect?

Multiplicative regression model:

indicator functions:
either '1' or '0'

stochastic
error term

$$\mathrm{GWI}_i = \beta_1 \beta_2^{I(\mathrm{rehab})} \beta_3^{I(\mathrm{control})} \epsilon_i$$

base level

effect of
rehabilitation

difference between
catchments

Formal framework to deal with uncertainties, but:

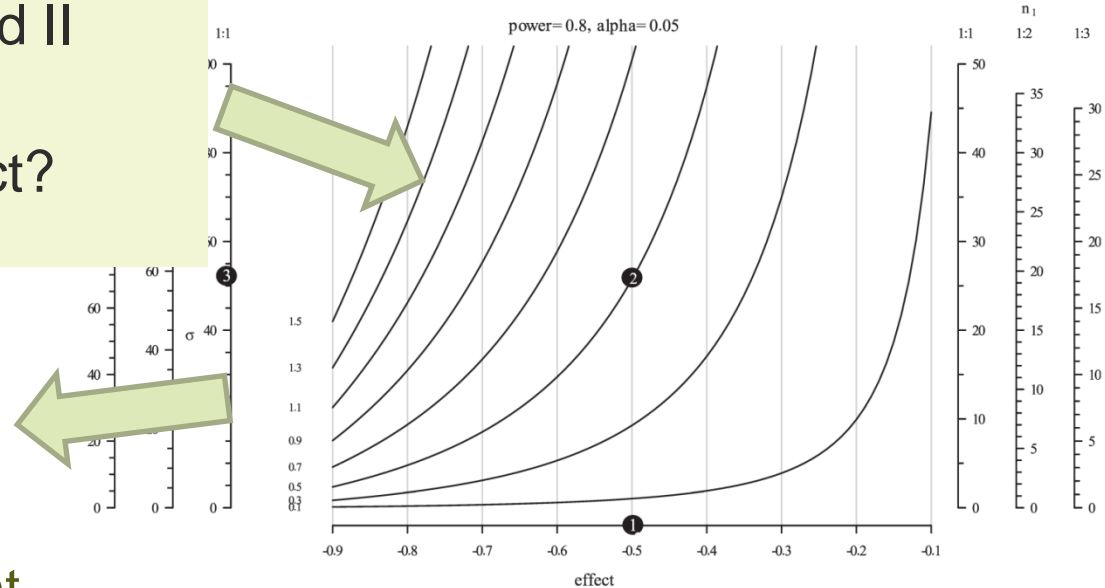⚠ Autocorrelation must be considered!

How long do we have to measure?

Experimental design

Factors that influence the require sample size:

- What effects size is of interest?
- What chance of type I and II error do I accept?
- What variation do I expect?

n_{before}

n_{after}
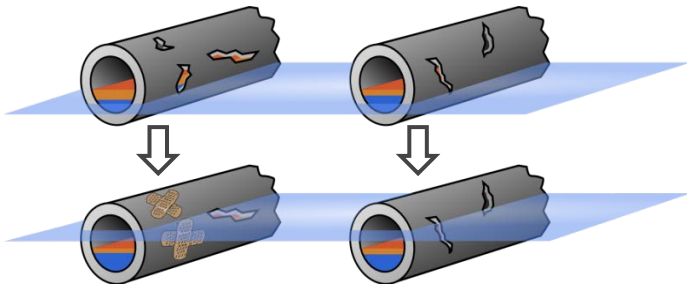
Ideally sample same amount of data before and after.

Staufer, P., Scheidegger, A., and Rieckermann, J. (2012) Assessing the performance of sewer rehabilitation on the reduction of infiltration and inflow. Water Research.

Conclusions

Performance evaluation is important.

Naïve comparison leads to over- or underestimation of the effect.

$$\mathrm{GWI}_i = \beta_1 \beta_2^{I(\mathrm{rehab})} \beta_3^{I(\mathrm{control})} \epsilon_i$$

The presented approach:
- is based on a simple model.
- enables statistical testing.
- enables to estimate the sample size.
- is applicable on different metrics.