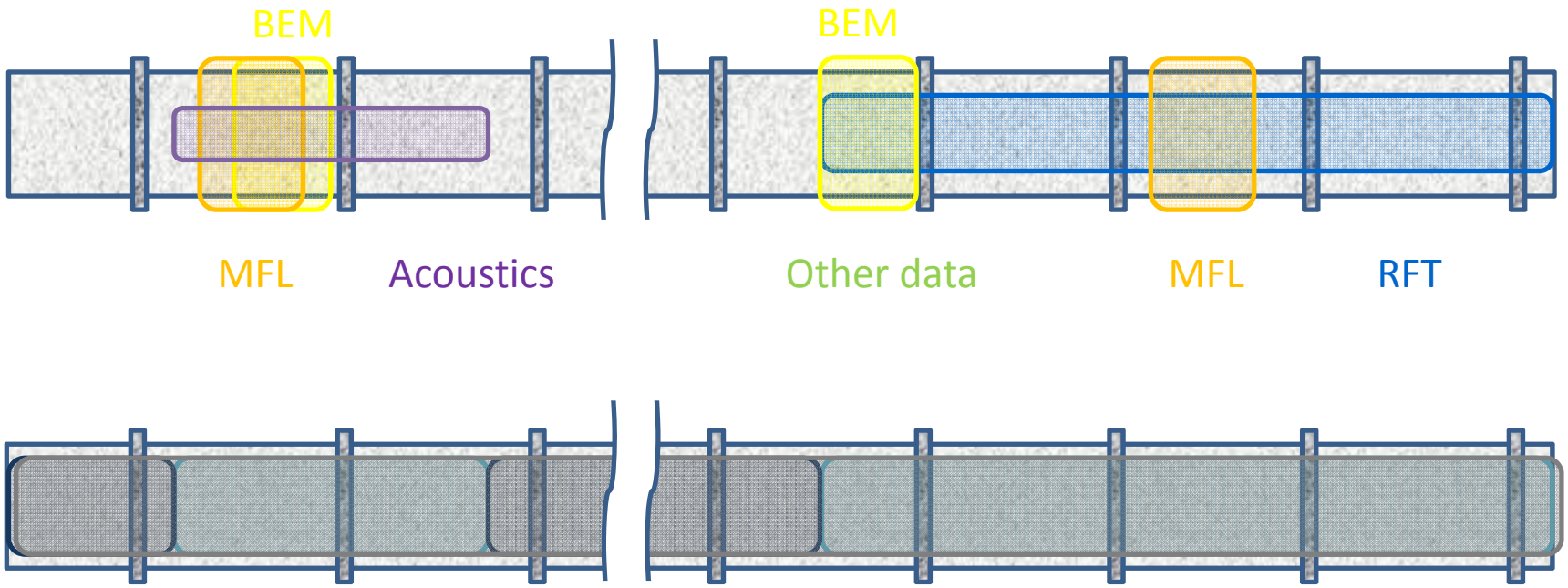
Enhanced Reliability of Condition Assessment of Buried Large Diameter Water Mains (4a)



Goal: Unified Framework

The Problem

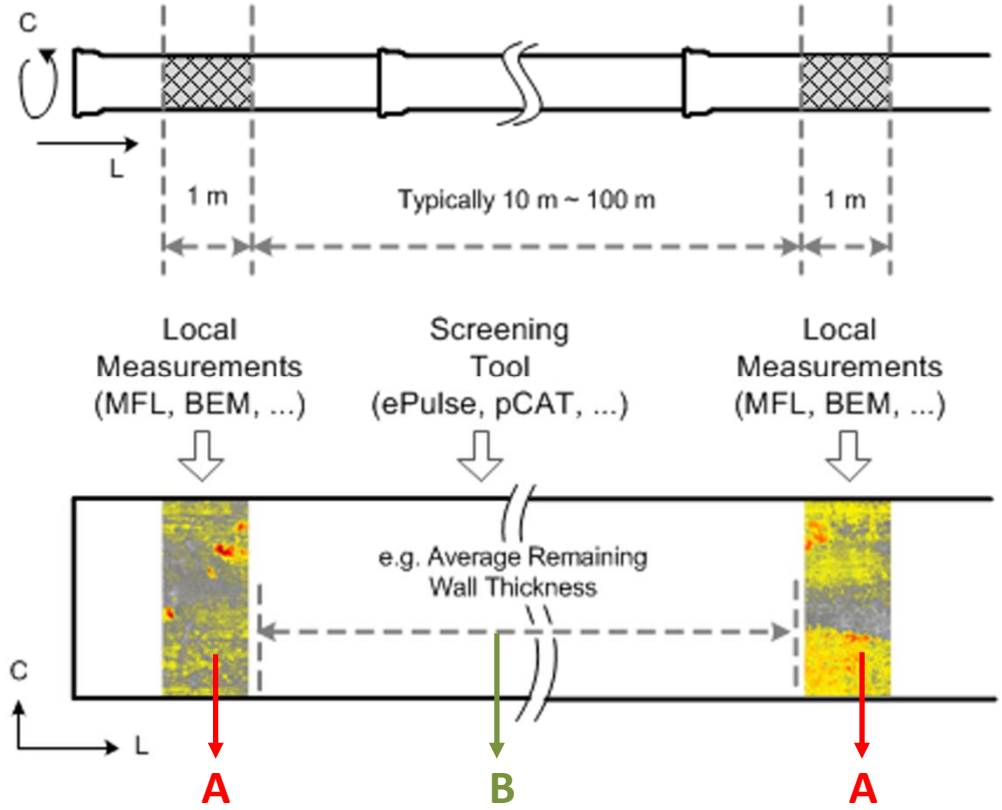
Inputs available (so far):

A: Localised thickness map(s)

B: Additional single CA value(s)

Challenge:

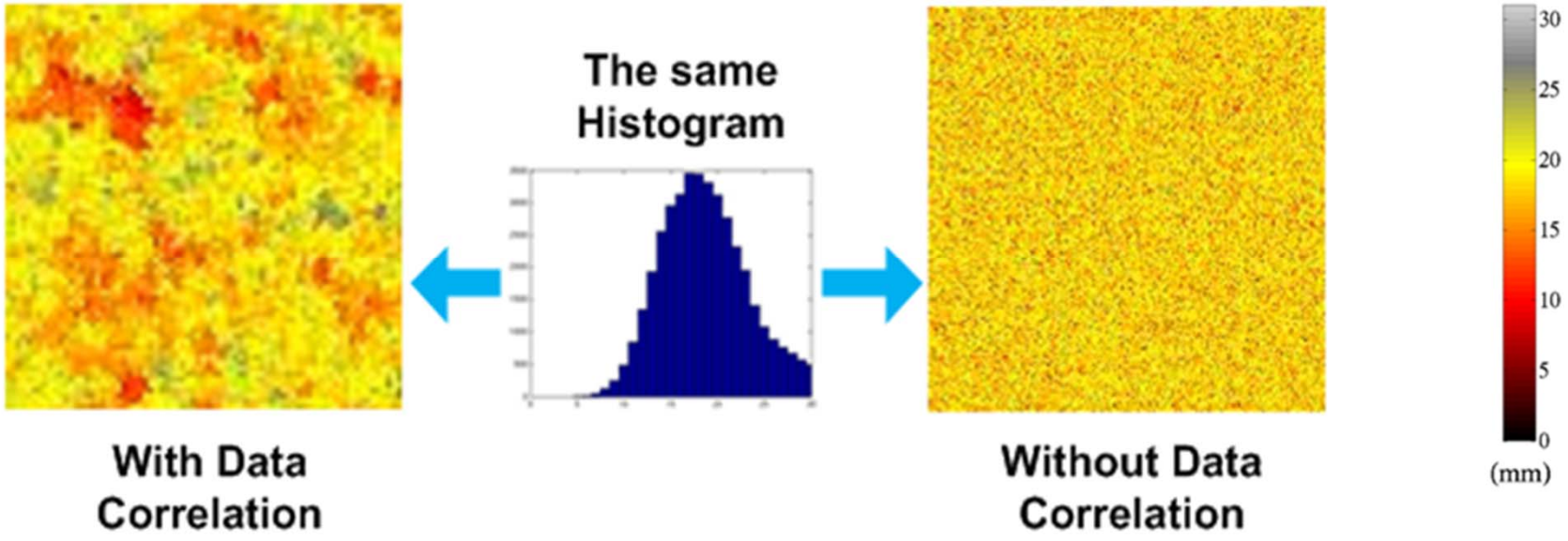
How well can we estimate the whole In-between area that B represents with the CA information available?



What Does Spatial Data Correlation Mean?

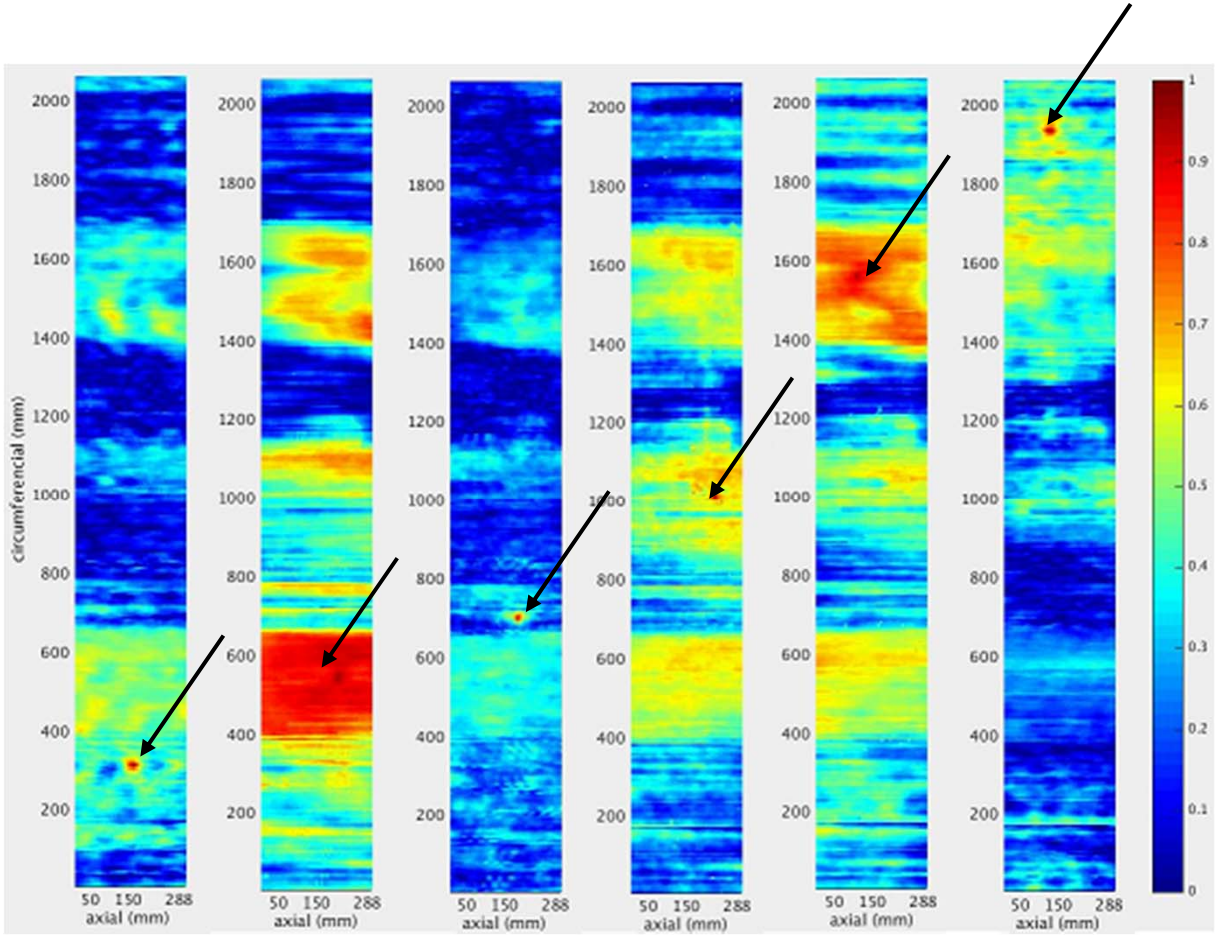
Pipe Wall Thickness Map

Pipe Wall Thickness Map



Observation from Test-Bed Data: Spatial Data Correlation

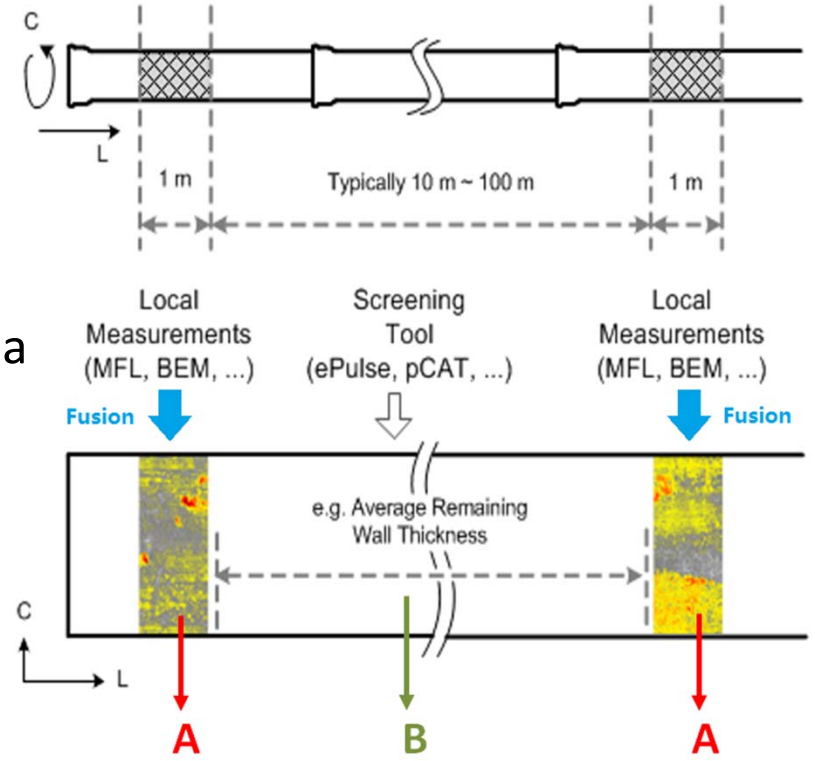
Condition of a pipe at certain locations has stronger dependencies on other locations' condition (remaining wall thickness) (video)



In-Between Framework

Option 1: Spatial Statistics

- Learn spatial correlation from A first
- Apply B to get picture of in-between area



Option 2: Growth Model

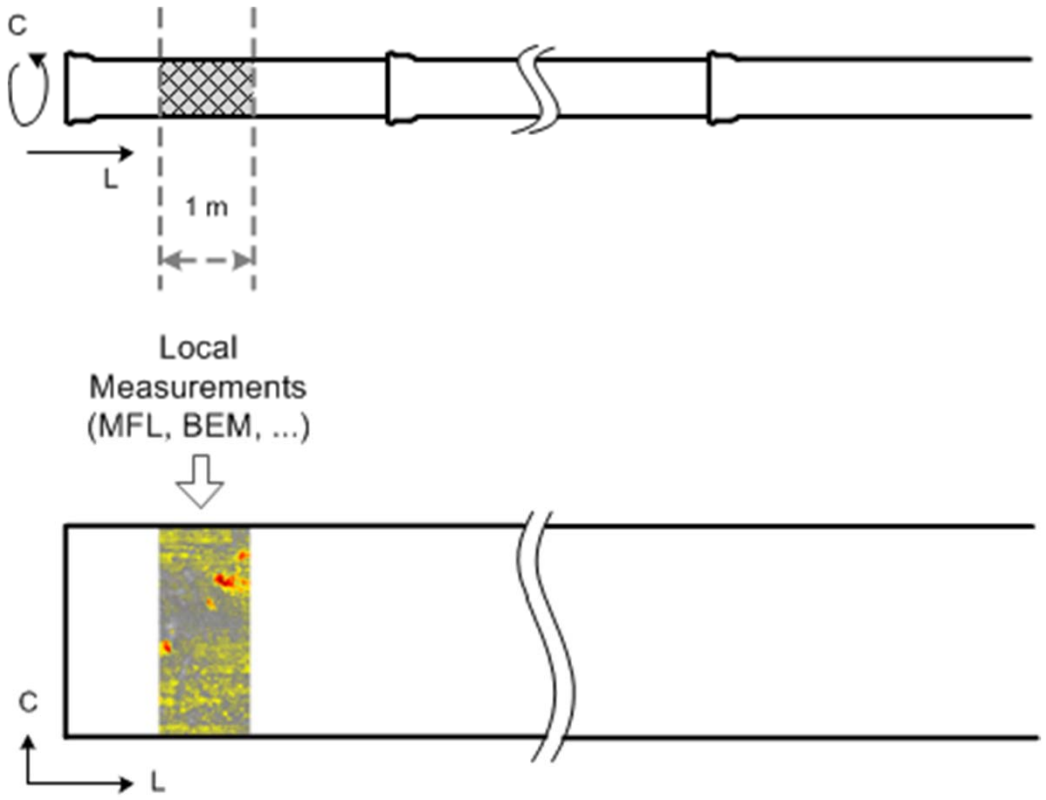
- Use B to get a reasonable* picture of B from a 'realistic' growth model
- Learn spatial correlation from A
- Refine the "reasonable" picture of the B area

* reasonable here means e.g. similar distribution/histogram

Building Knowledge from Data: Data Fusion

Measurements from different types of sensor (e.g. MFL, BEM)

How can we integrate them to build a “better”, more informative thickness map?



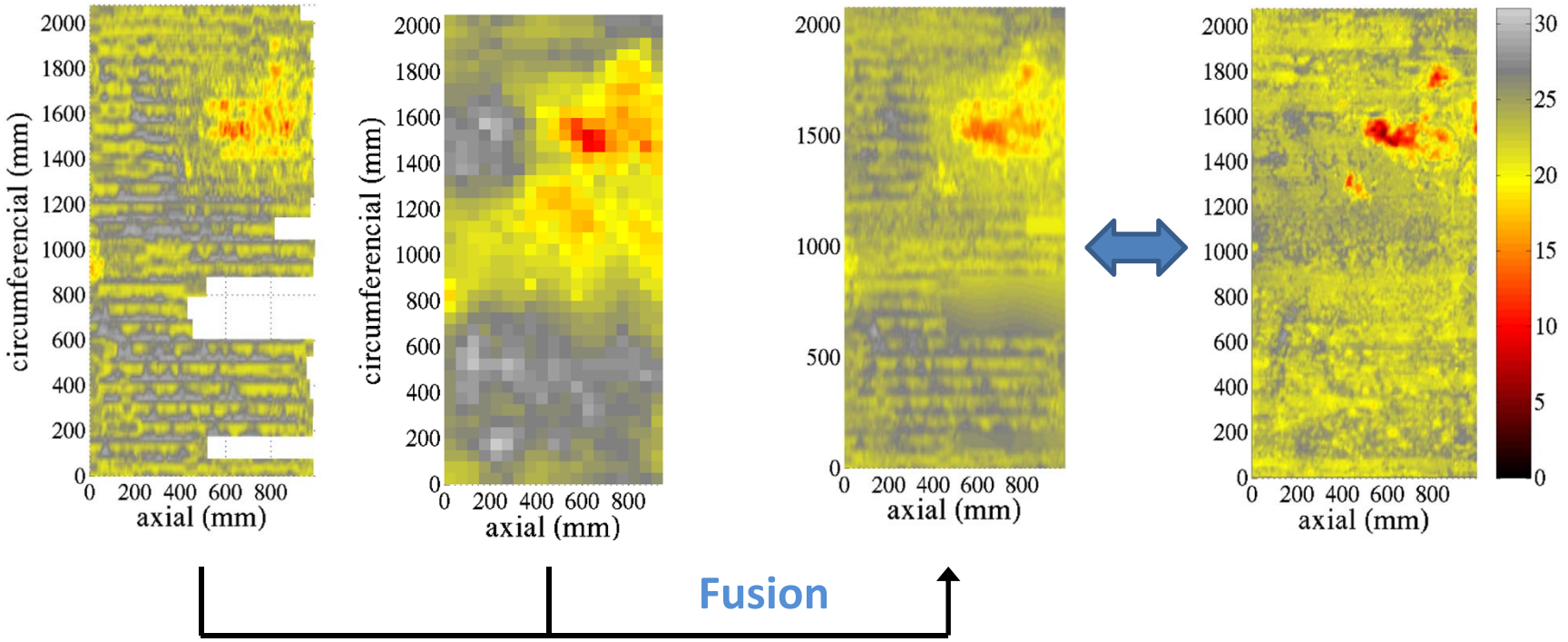
Proposition: **Data Fusion**

Data Fusion: A (Real) Example

MFL:
High Resolution*

BEM:
Low Resolution

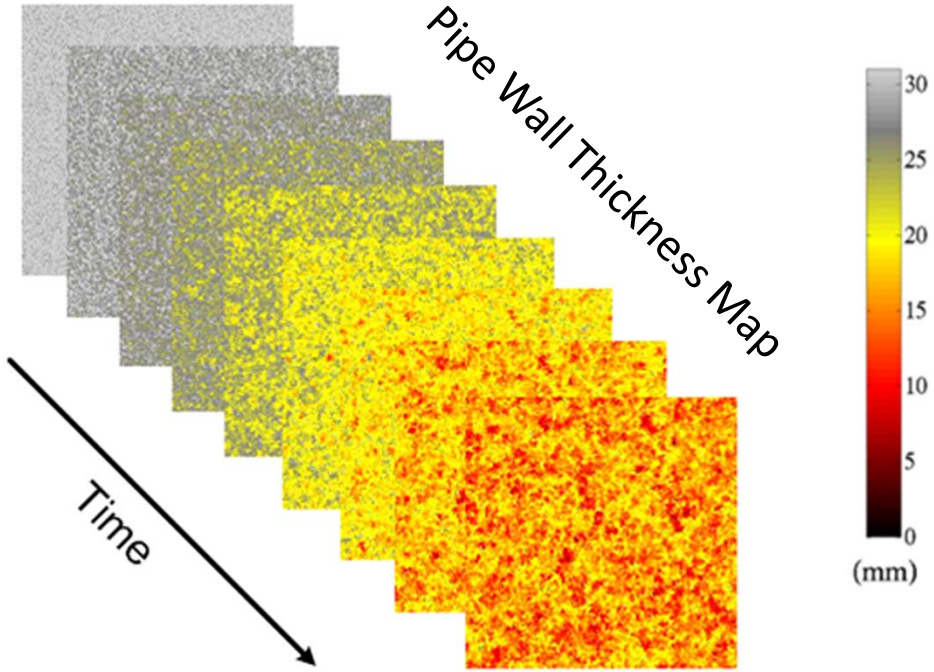
Reference
(GT from the
Laser Scanner)



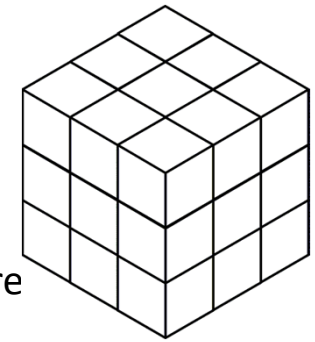
- Inference of thickness in unknown positions
- Learning the underlying correlation of sensor data

A Model for Corrosion Deterioration

Assume there exists a corrosion "growth" model that could mimic the progress of corrosion (video)



Resolution:
< 1 mm



Assumptions:

a) The pipe wall can be decomposed into small cubes of arbitrary size

b) Breakdown of any face leads to the cube's deterioration

c) A face starts to breakdown when exposed to the environment

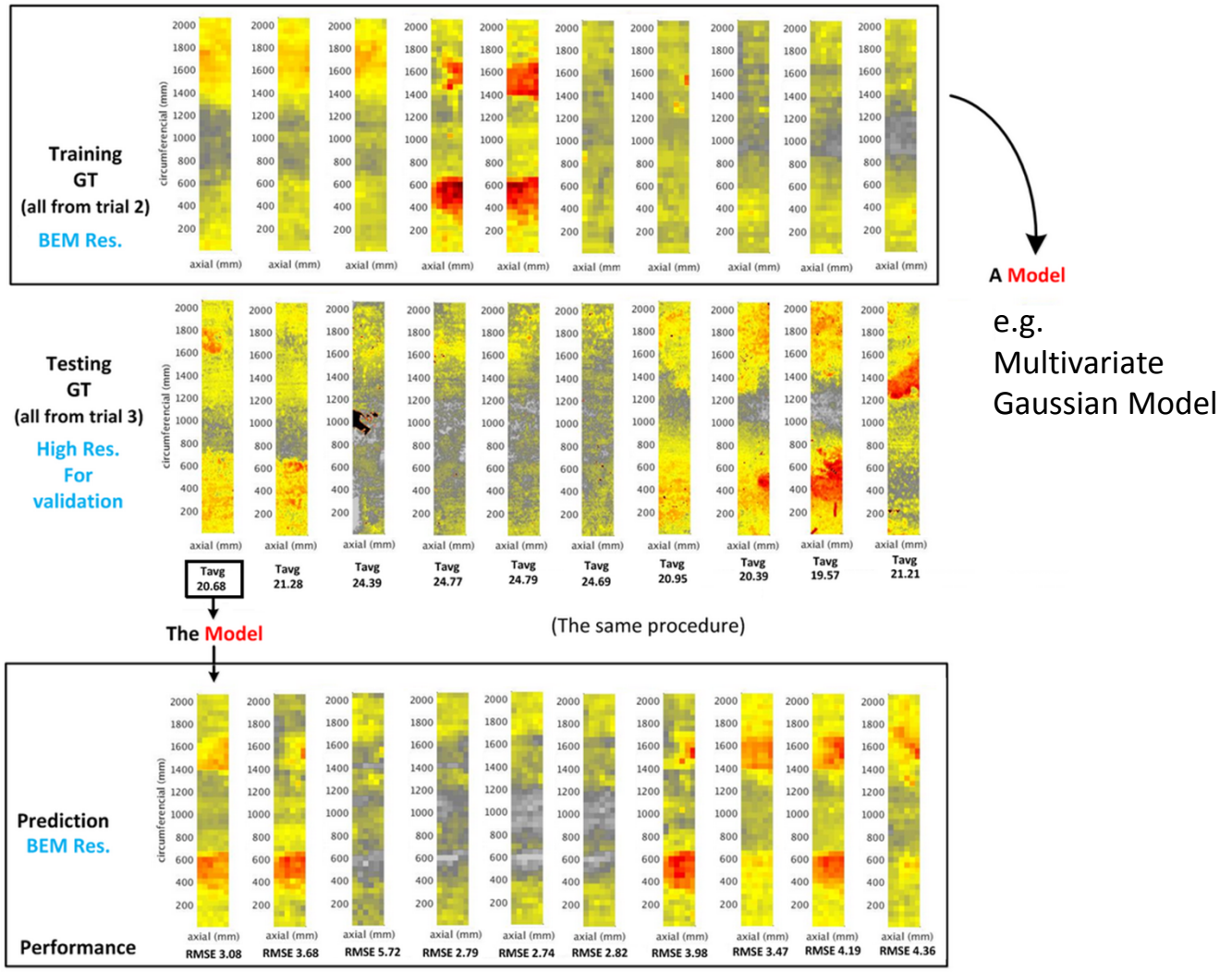
d) The probability of an exposed face breakdown is a function of its exposure

Challenge:

1. Find the parameters that describe this corrosion process
2. Can be substituted/complemented with any other available corrosion model

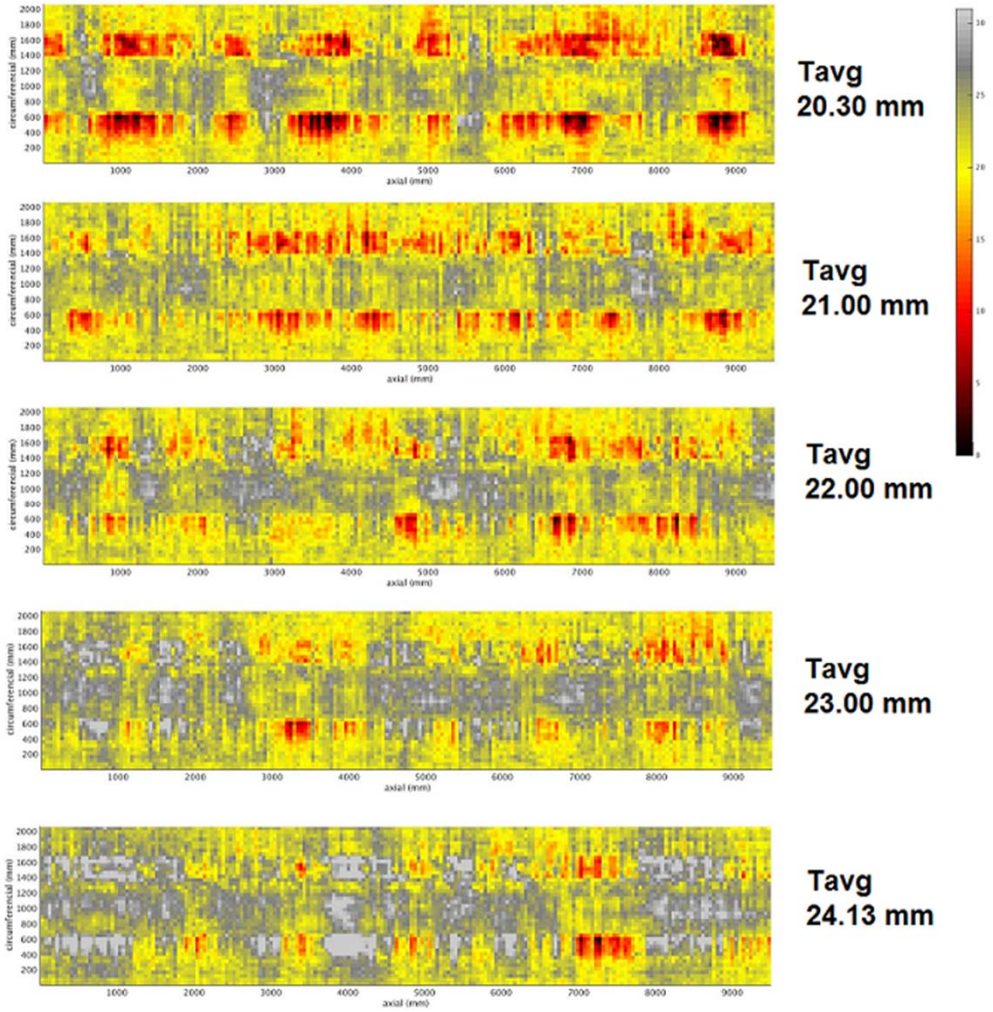
In-Between Methodology: Spatial Statistics

Example (from test-bed): Predict fixed length area (e.g. 30 cm)



In-between methodology: Spatial Statistics

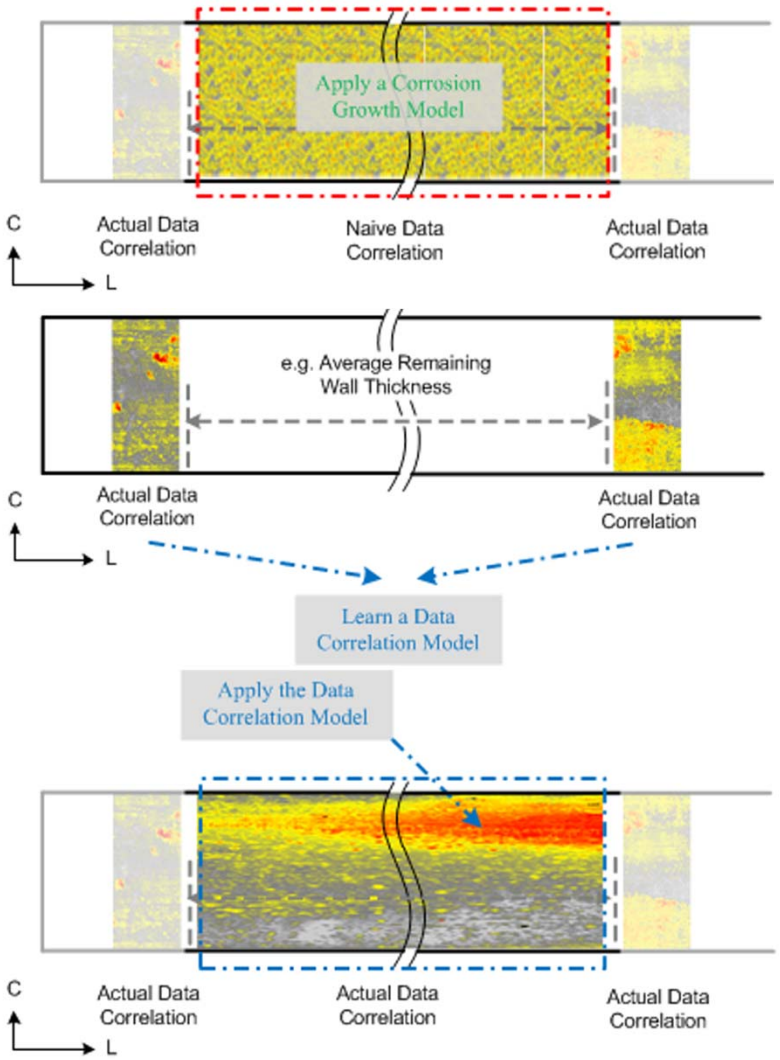
Example (from test-bed): Predict arbitrary length area (e.g. 10 meters)



Ten meters pipe sample with different Tavg

In-between methodology: Growth-model

Conceptual Results



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Looking into the Future: Remaining Life Prediction

- Beauty of statistics is that samples can be drawn and stress analysis carried out for best/worst case scenarios

- A number of predictions from the “In-Between” CA framework that ‘match’ observed data can be drawn, and incorporated into the ‘Remaining Life Prediction’ calculations

Progress and Goals

Goal	Status
Continue evaluation of the fusion framework with real-data sets from test-bed	In progress
Preliminary evaluation with tes-bed data from MFL, BEM and ePulse	In progress
Expand current spatial statistical model for in-between approach to predict arbitrary lengths of pipes	In progress
Continue work on in-between approach to assess value of incorporating further advances from corrosion modelling to an otherwise statistics-only model.	In progress