UNIVERSITY OF TWENTE.

# IMAGING THE UNSEEN

GEOPHYSICS
FOR IMAGING AND MONITORING THE SUBSURFACE

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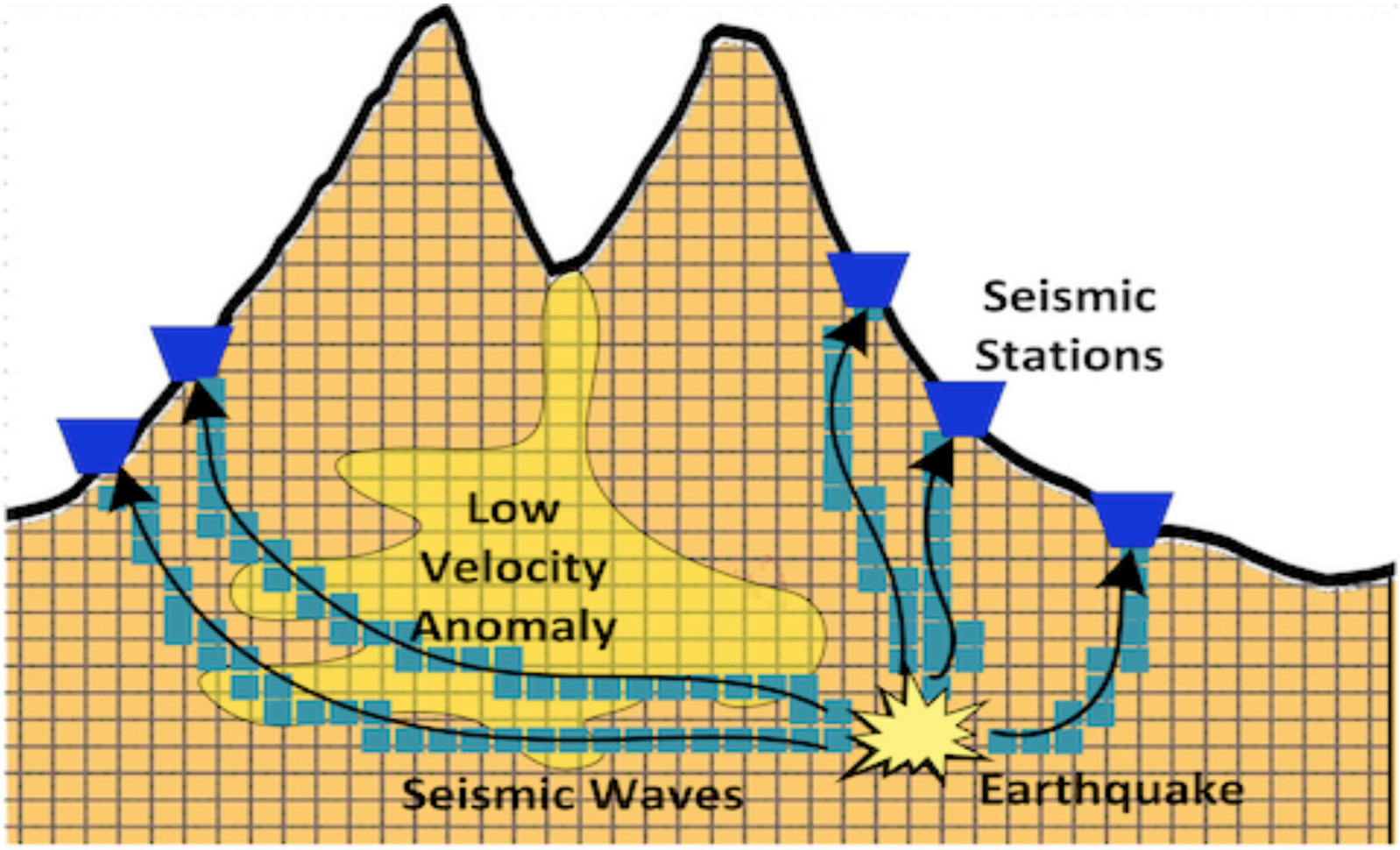
ITC FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

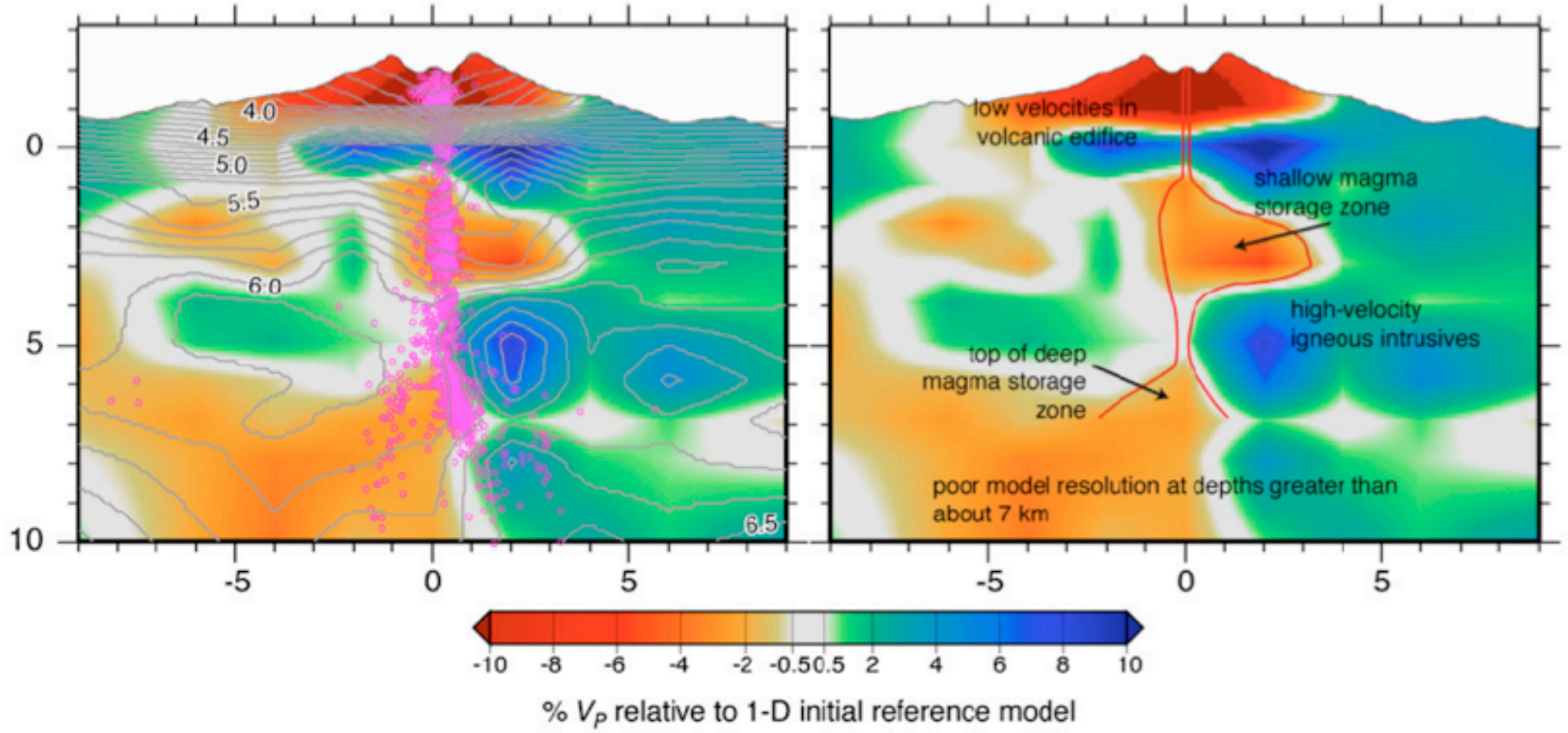
# SURFACE EXPRESSIONS

# MODEL OF BELOW




Sensor Sampling and Timing → Event Detection → Event Hypocenter Determination → Compute Velocity Model (Tomography) → Visualization

# ACTUAL SITUATION



# MARK VAN DER MEIJDE

- Gepphysicist
- MSc Utrecht, PhD ETH Zurich
- Worked at seismological service NL, Geological survey NL, seismological service Brazil
- Now at dept Earth Systems Analysis at Utwente

- Chair in Earth Structure and Dynamics
- Head of geophysical lab

- Near-surface geophysics (pipes, archeological, environmental)
- Seismology (FEM of subsurface-surface interaction, site effects, impact on structures)

# IMAGING THE UNSEEN?

Geophysics = physics of the Earth

Used to retrieve properties of Earth material without destructive investigation

Can visualize Earth structure and composition (and any objects within the Earth) by using characteristics of physical phenomena

Anything with a contrast in geophysical property can be potentially detected

# SOME EXAMPLES

- Flow of water in the subsurface
- Pipeline leakage
- Water reservoir pollution detection and monitoring
- Sewage system failure early detection systems

# FLOODCONTROL2015 - CONSTRUCTION OF TWO TEST DIKES

A Dutch initiative to:

- develop sensor technology for dike monitoring
- understanding processes behind dike failures
- merge science and industry for societal problems

Simulating dike breach
Used to test/validate simple efficient technologies

# CONTINUING MEASURING

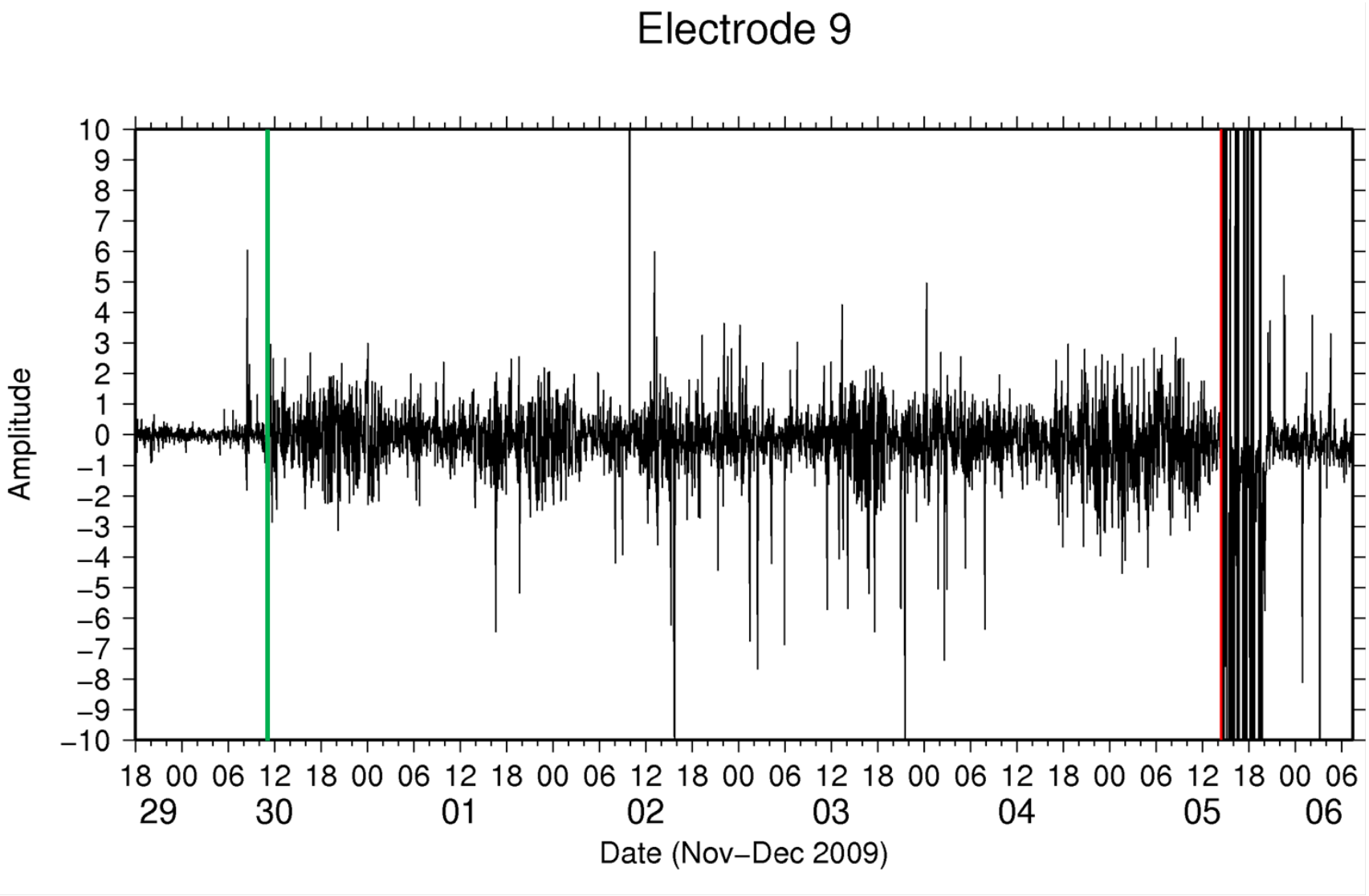
- The 15 parties involved in this test have recorded over 30 million measurements till the dike finally broke after 5 days of increasing water pressure in the basin.

- In total 4 tests have been done with different sandbeds, different dams, different waterlevels

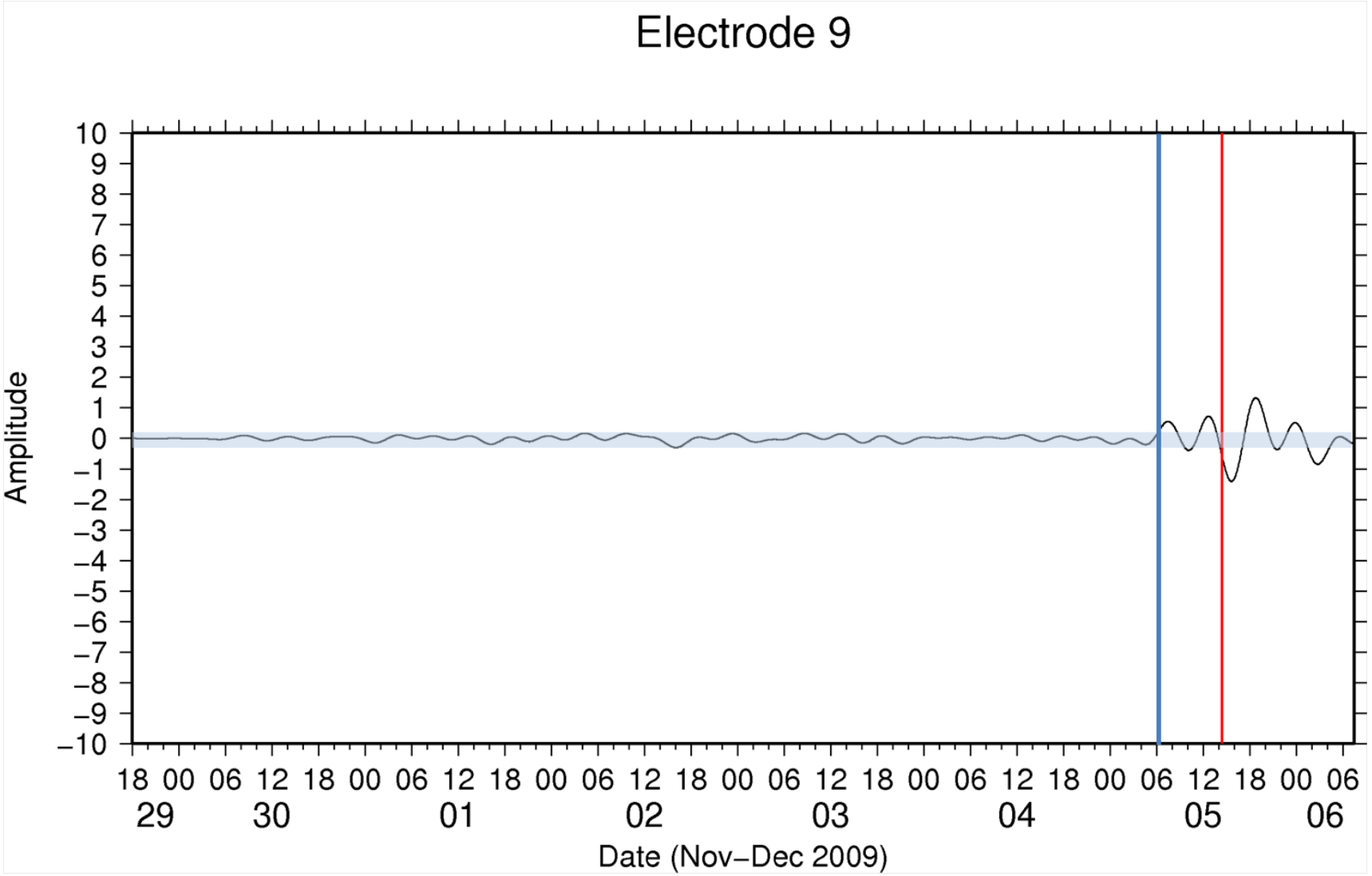
# THE TEST DIKE

# SIMULATED DIKE BREACH! BASIN NOW ALMOST EMPTY

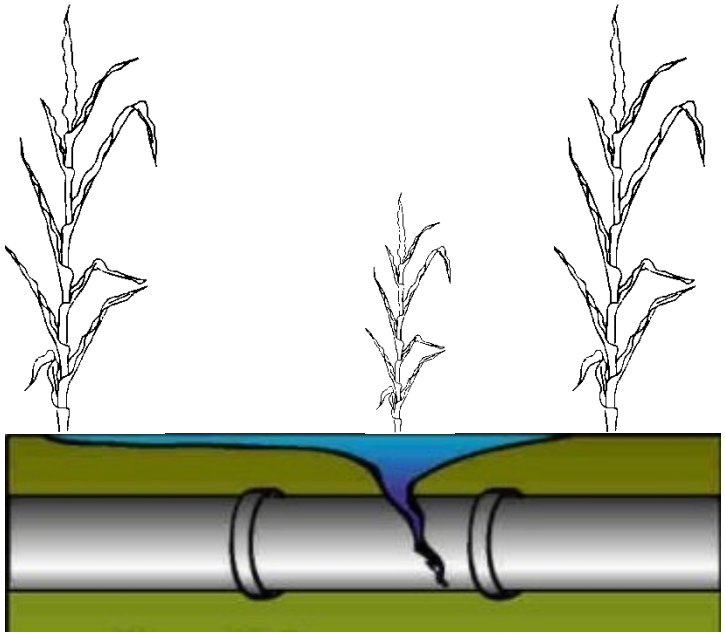
# RAW DATA AT LOCATION AT CENTER OF DIKE



# FILTERED DATA – PREDICTION 10 HRS BEFORE



# Hydrocarbon pollution

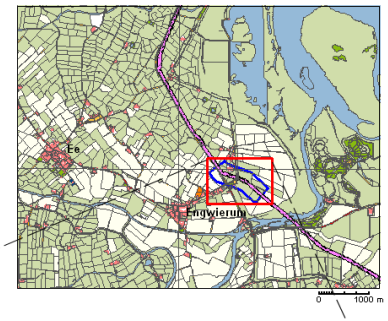


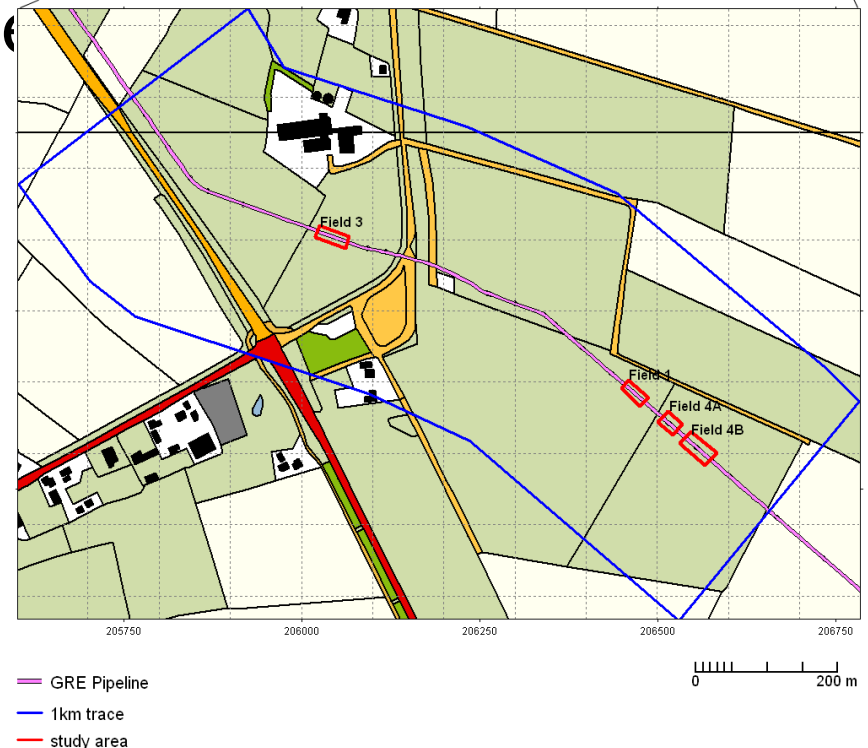
Leakage of hydrocarbons in the environment has a negative influence on vegetation. In some cases this influence is directly visible at the surface, in other cases only through vegetation → **indirect detection**

# Problem

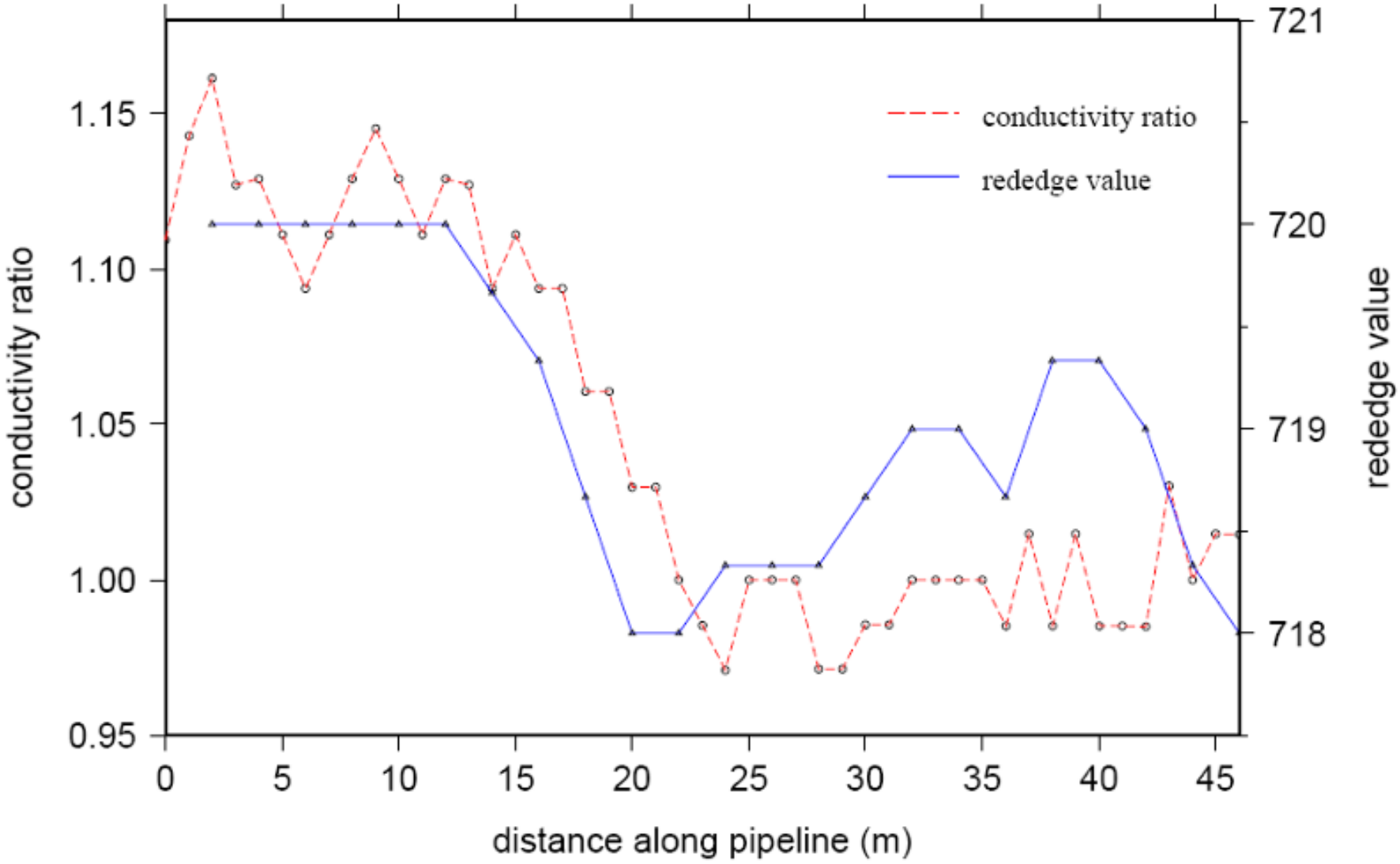
- 21 km long pipeline, 1 k
  test area, 4 fields
  covered with (long) gras
- Connectors every 9 mete
- Approx. 50% of the
  connectors ‘sweats’

Overview of study area

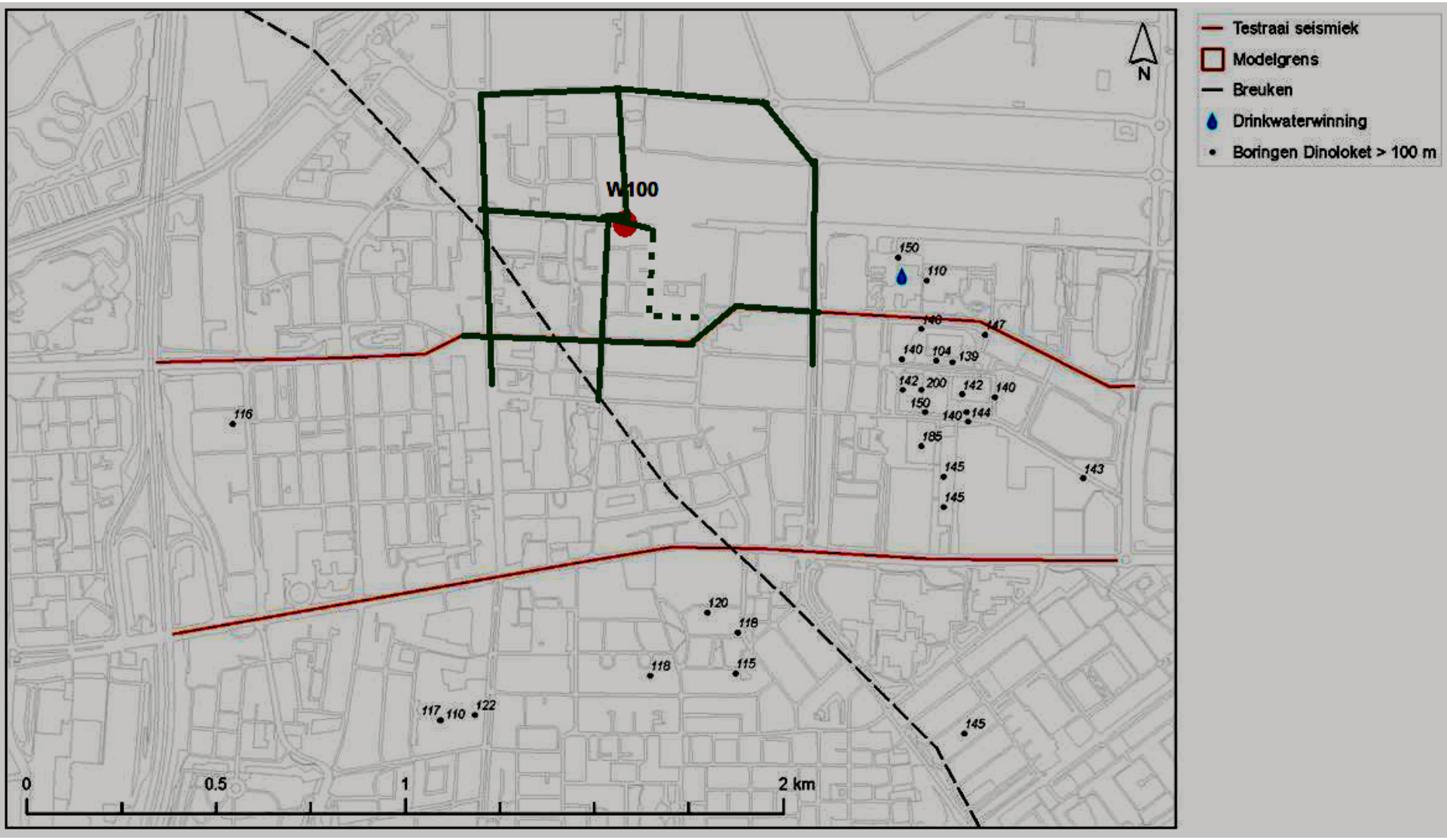


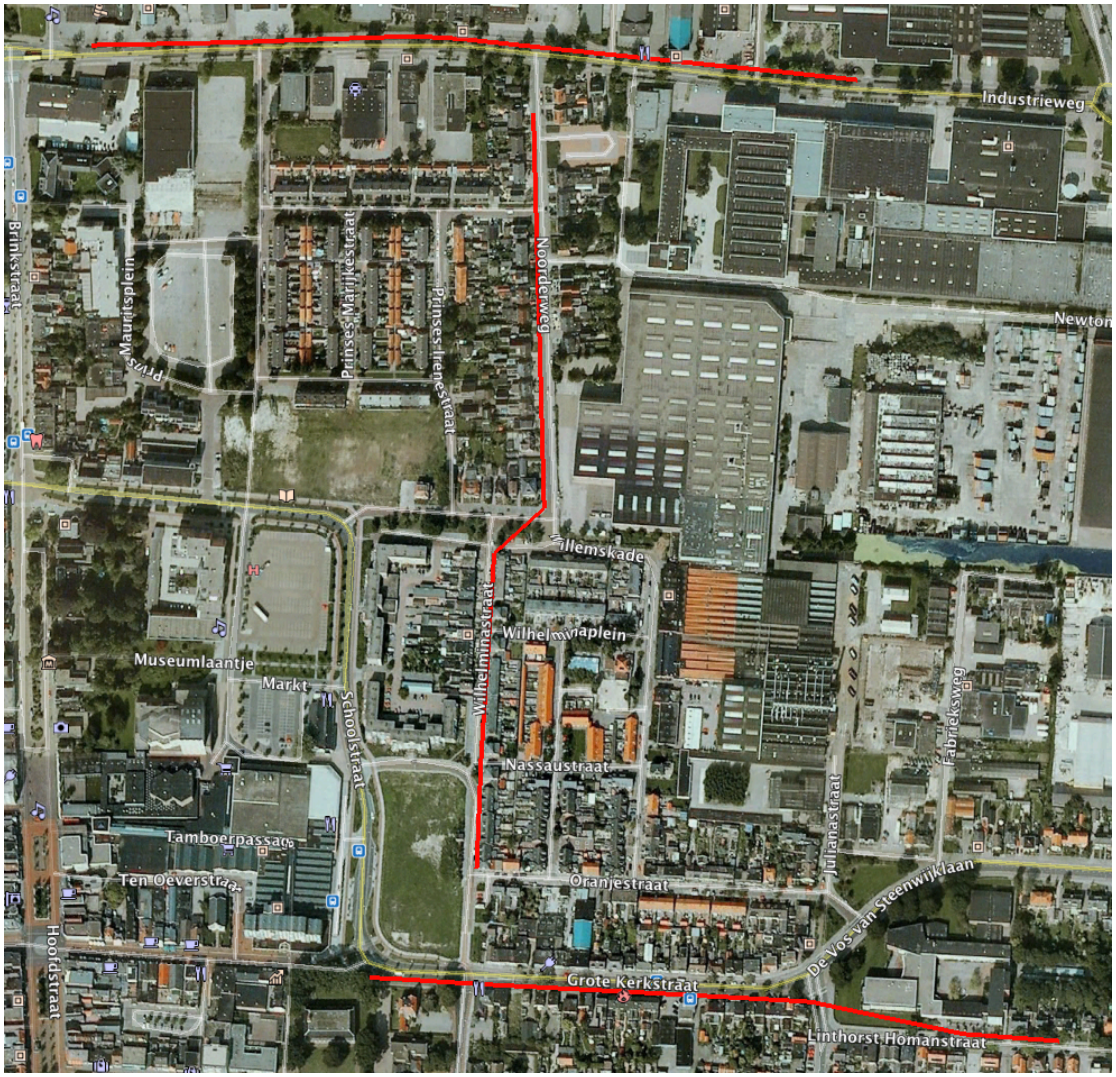
# Validation with geophysics



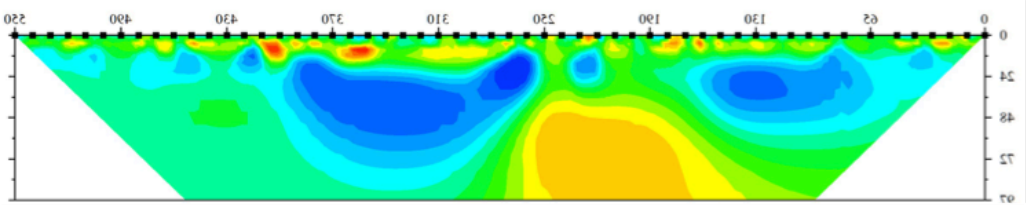
# WATER RESERVOIR POLLUTION UNDER A CITY

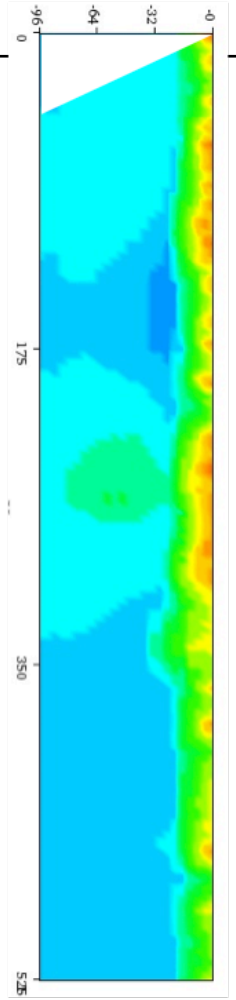


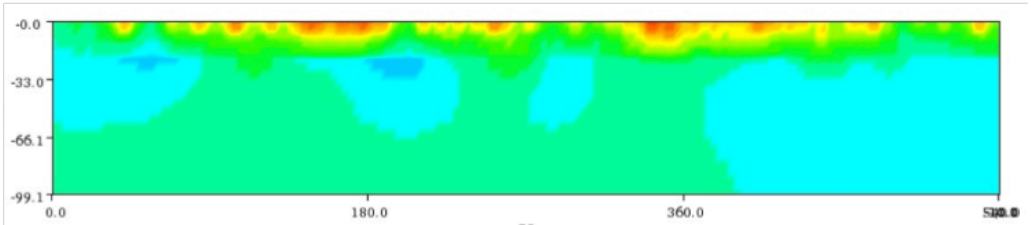
# NEED TO WORK DOWNTOWN, BUT DEPTH REQUIRED



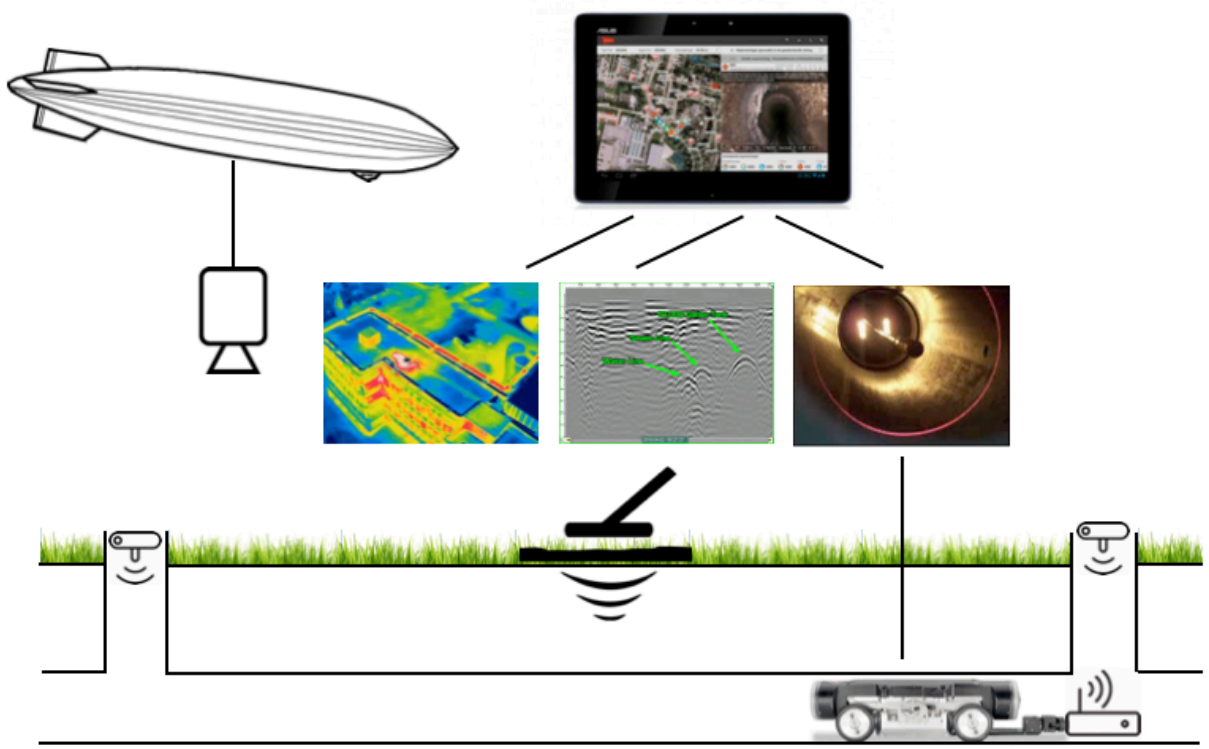
# NOT THE MOST EASY ENVIRONMENT


0
65
130
190
250
310
370
430
490
550
0
24
48
72
97


-96
-64
-32
-0
0
175
350
525


-0.0
-33.0
-66.1
-99.1
0.0
180.0
360.0

# TISCALI project



**Technology Innovation for Sewer Condition Assessment – Long-distance Information-system (TISCALI)**