alert solutions

A practical implementation of a sensor network for geotechnical monitoring

Sensing a Changing World

Drs Erik Peters

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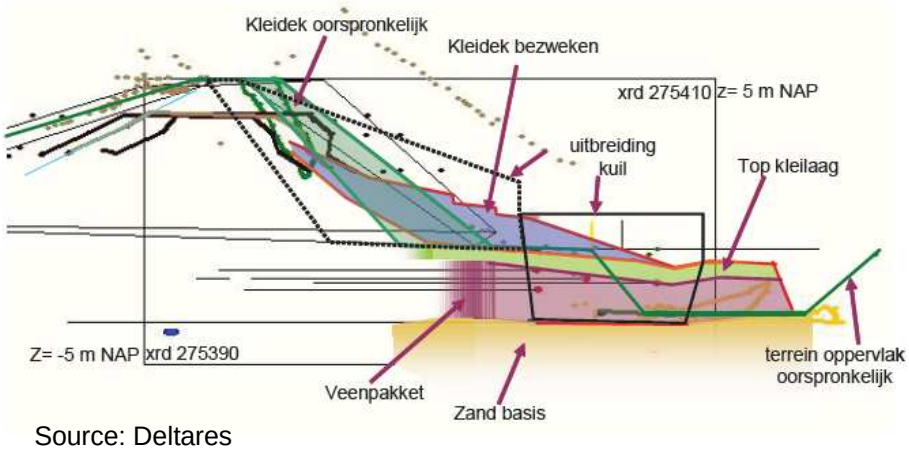
Introduction Alert Solutions BV

- Alert Solutions is a technostarter located at the incubator of the TU Delft
- Alert Solutions develops GeoBeads™, an innovative monitoring system for measuring ground stability
- Alert Solutions was awarded with an assignment by the Dutch Ministry of Transportation (Min. V en W)
- A large scale prototype network of GeoBeads was tested in life-size circumstances at the 'smart dike' facility (IJkdijk)

Project ‘Smart Dike’ (IJkdijk)

- Unique test facility in the province Groningen to develop smart dikes and test innovative dike monitoring systems

- First life size experiment in September 2008
  - Study mechanisms that lead to macrostability failure
  - Evaluate ability to design early warning systems

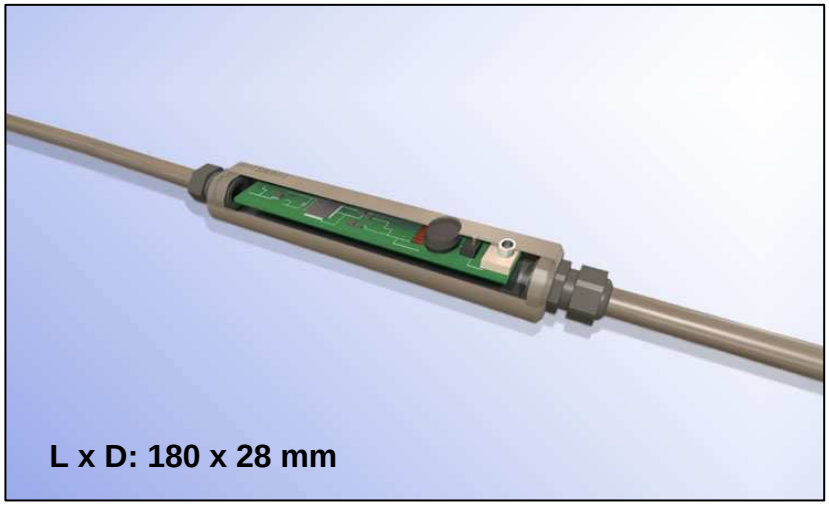


Source: Deltares

- Alert Solutions is one of the participating sensor technology companies in this initiative

Sensor Network GeoBeads™
‘A Chain of Beads in the dike’

- Based on chipsensors
- Multiple parameters
- Focussed on ground stability monitoring
- Real time data gathering
- Modular and scalable network
- ‘Plug and measure’
- Remote visualisation & interpretation



Platform for application of multiple sensors
Cause & effect oriented

	Range	Accuracy
Pore water pressure	0 – 2500 mbar	3 mbar
Temperature	-40 tot +120˚C	0.2˚C
Humidity	0 tot 100%	2.0%
Inclination	0 tot 360˚	0.02˚
Shift	shock detection	tbd
Vibration	0 – 100 Hz	tbd

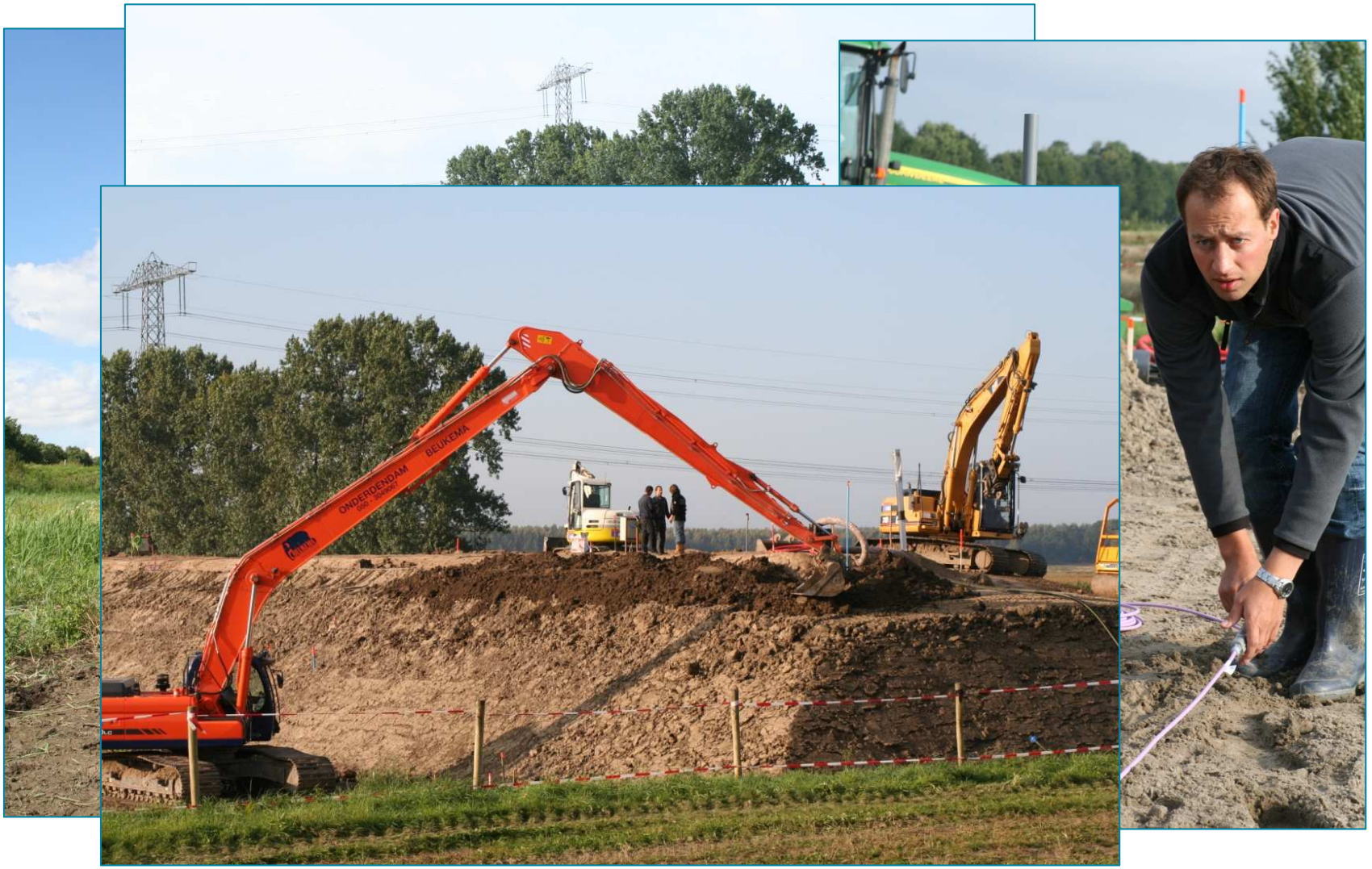
Cause: **hydraulics**

Effect: **movement**

- Load cells
- Waterflow
- Chemical substances
- Sound
- Vision
- …

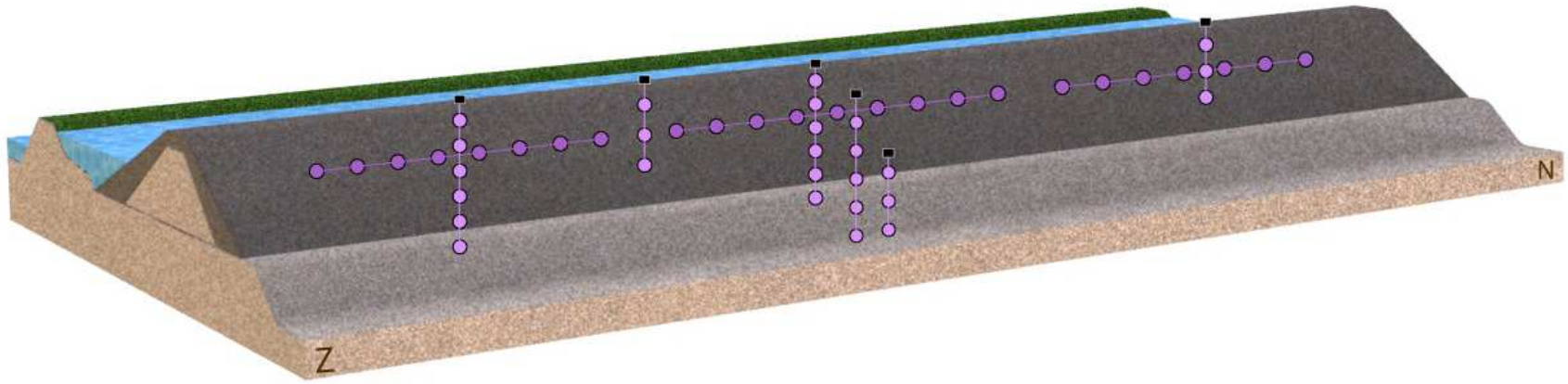
Other sensors can be added

Installing GeoBeads™ & Building the Dike



The ‘Smart Dike’

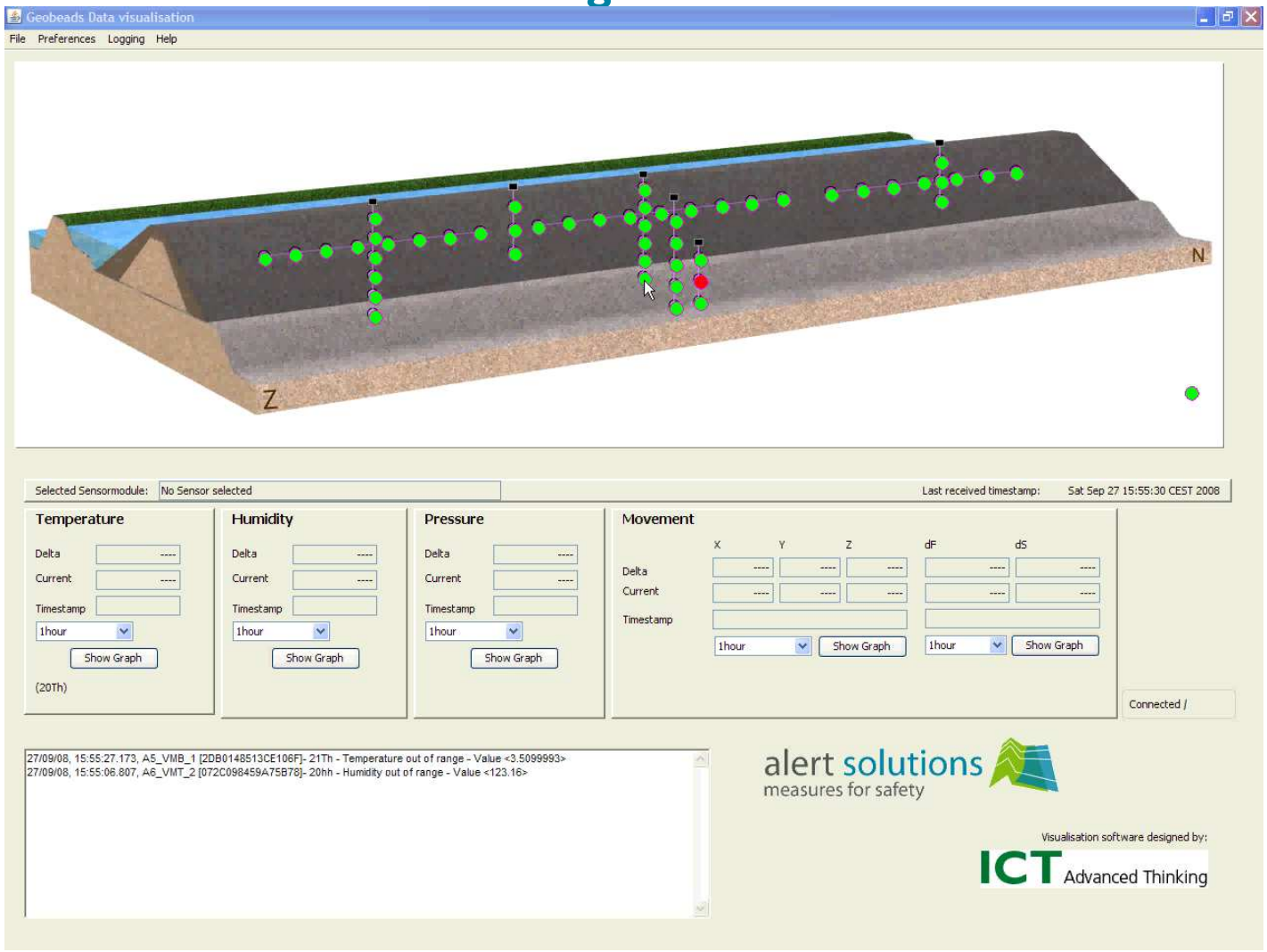
Alert Solutions installed a high density GeoBeads network



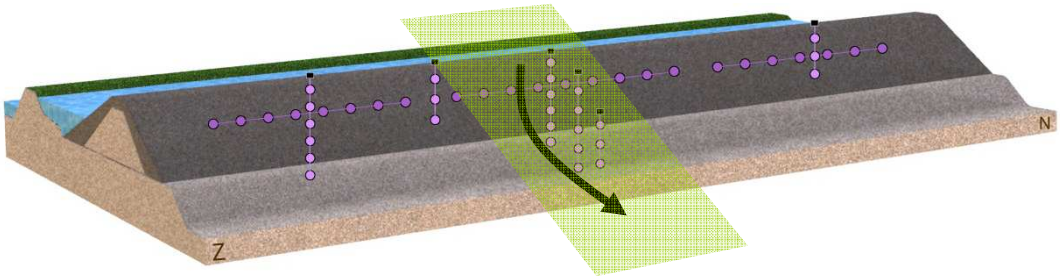
- Levee dimensions: 100m wide, 6m high embankment, 3m deep ditch
- 51 sensormodules with 255 sensors in total
- Installed in sand core, clay, peat and pleistocene (+5m to -3m N.A.P)
- One data point per minute for each sensor
- Experiment over the course of three days
- 1,2 million data points gathered

GeoBeads Dashboard showed live status

Absolute values & delta's through time

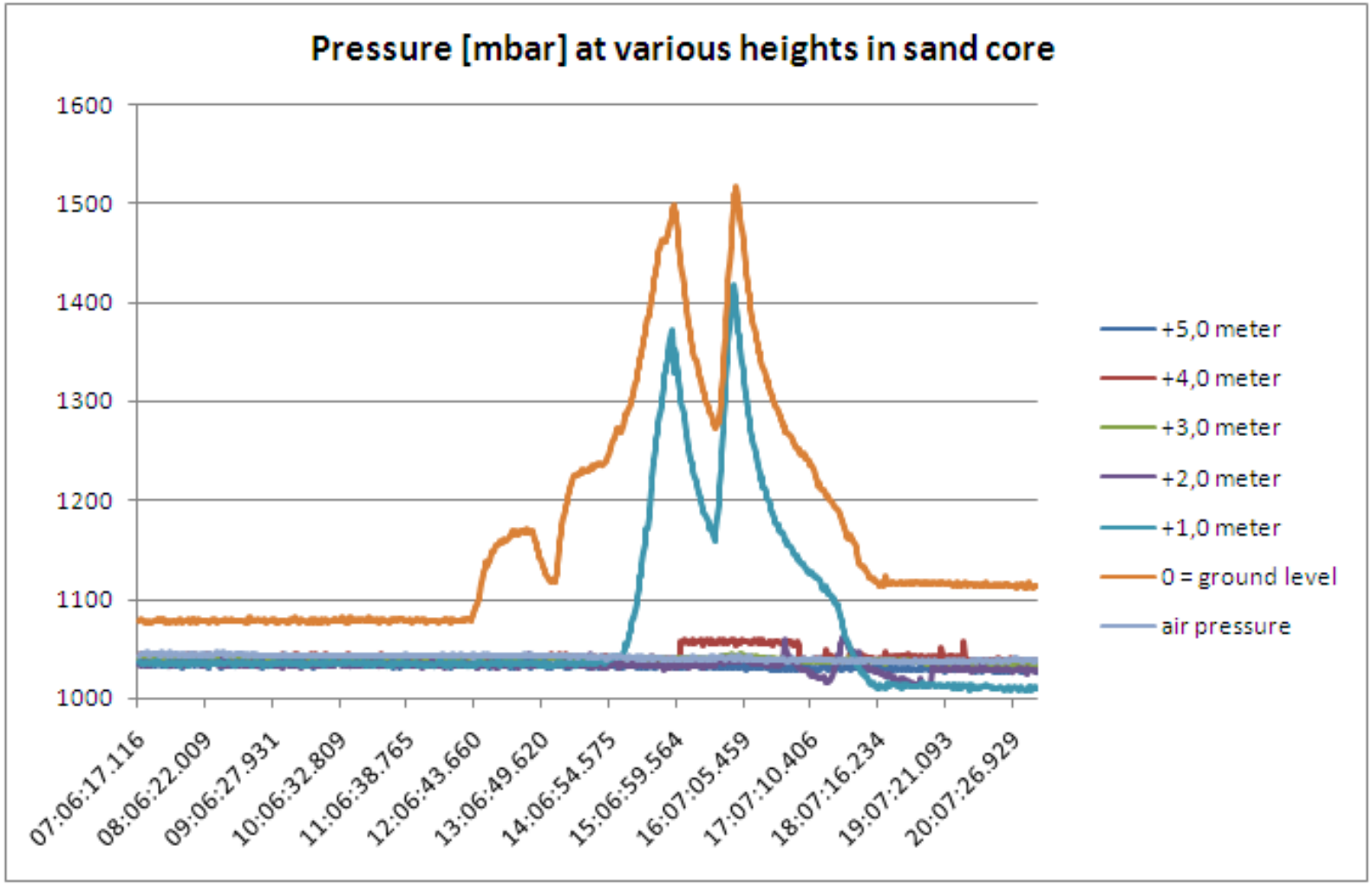


Macro stability experiment succeeded

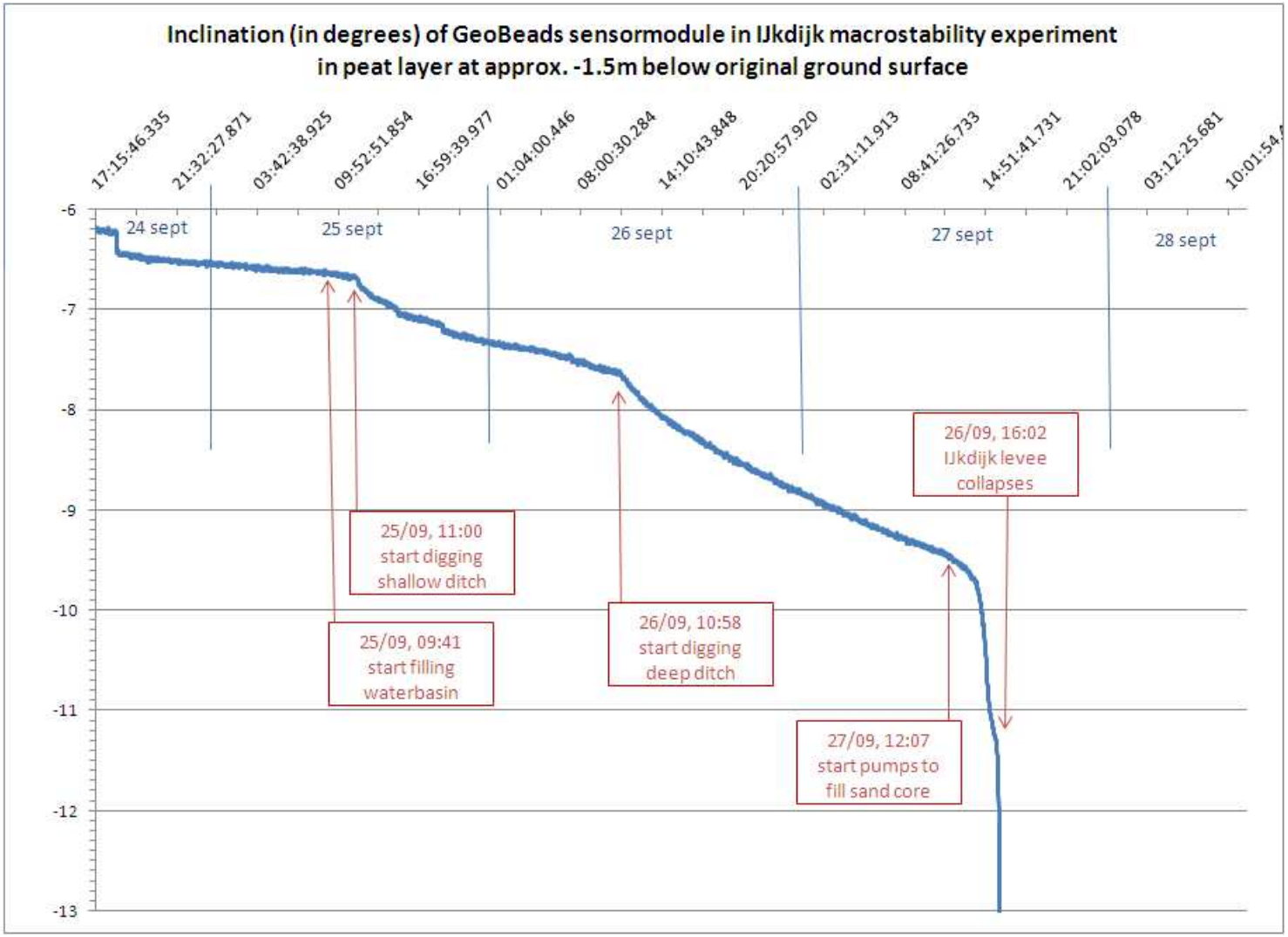


The levee was subjected to natural forces by several activities under controlled circumstances and collapsed on Saturday the 27th of September at 16.02 PM.

Pore Pressure measurement



Movement detection (inclination)



Challenges at hand

- We gathered a spatial and temporal data set containing multiple parameters
- How to best analyze and validate
  - Relevant effects and trends
  - Correlations and interdependencies
- And relate to geotechnical processes
  - Mechanical models, hydraulics and soil characteristics
- Or describe with statistical models
- In order to move from observation to prediction of critical situations

Invitation to contribute to interpretation

- GeoBeads data set collected at the IJkdijk will be made available to those interested in carrying out analysis and interpretation for scientific purposes.
- A web portal for download and sharing insights will be launched in the coming weeks
- Or… contact us directly:
  - Alert Solutions BV, Rotterdamseweg 145, 2628AL Delft
  - e.peters@alertsolutions.nl
  - 015-2568551 / 06-28839709