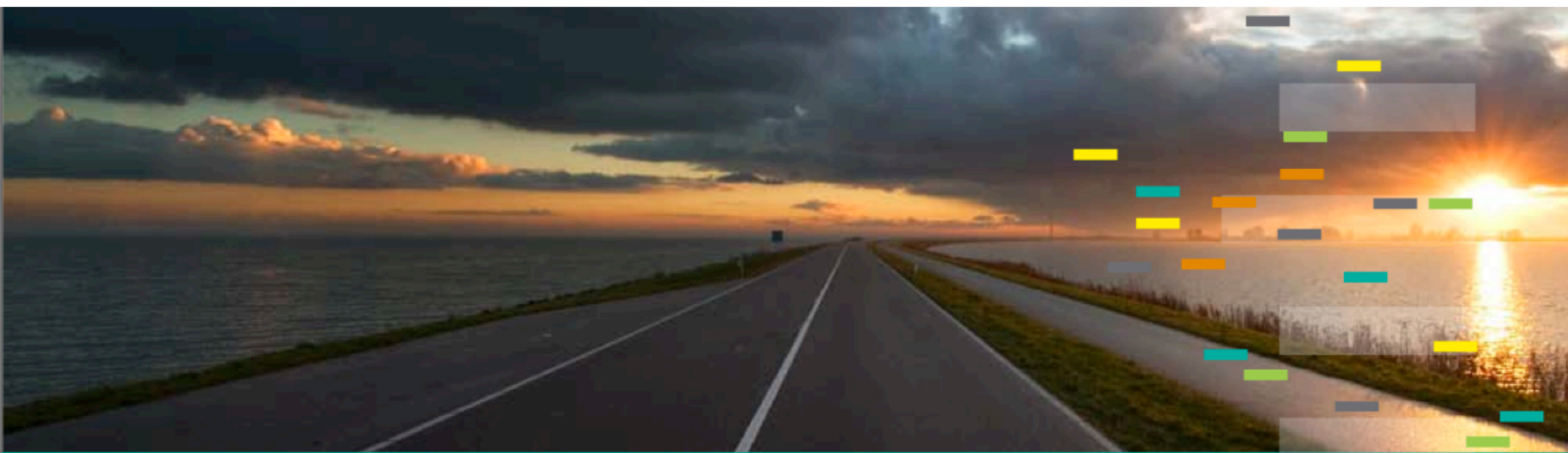




ahn

Actueel Hoogtebestand Nederland



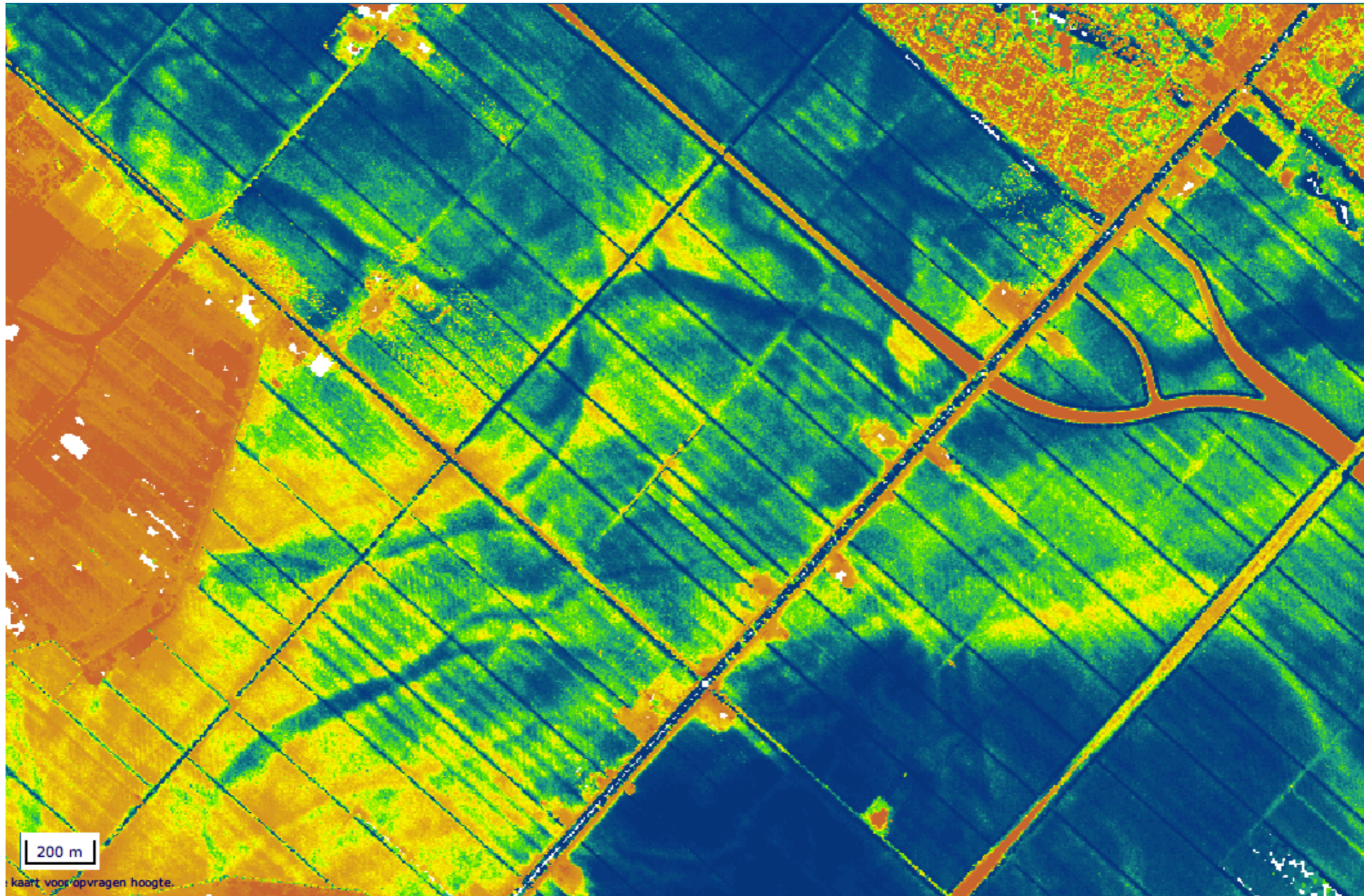
# How to handle the Up-to-date Height Model of the Netherlands: detailed, precise, but so huge!

Rens Swart – Swartvast/Het Waterschapshuis – NCG 26 november 2009

- Rens Swart
  - geodesy
  - TU Delft deformation analysis radar interferometry
  - consultant remote sensing Rijkswaterstaat MD/AGI/DID/...
  - 2006 Swartvast: bridging the gap between supply of technology and application in government and society – remote sensing – RWS & water boards
- Het Waterschapshuis
  - Management and execution of ICT for water boards
  - Houses AHN as of 2008
  - René van der Velden, Maartje Zwaneveld, projectl.

- ~~How to handle the AHN data set~~
- Development of AHN to a large data set
- Products and availability levels
- Usage of the products
- ~~Future products~~

- Rijkswaterstaat & water boards & provinces:  
use laser altimetry instead of TOPhoogteMD
- Up-to-date Height Model of The Netherlands  
UtdHMoTN or AHN
- 1996–2004
- 1–16 pts/16 m<sup>2</sup>
- $Dz = 5 \text{ cm}$ ;  $\sigma_z = 15 \text{ cm}$
- Usefull: not too large, precise enough



AHN 1997 1pt/8m<sup>2</sup> Haarlemmermeer – all to your disposal at [www.ahn.nl](http://www.ahn.nl)

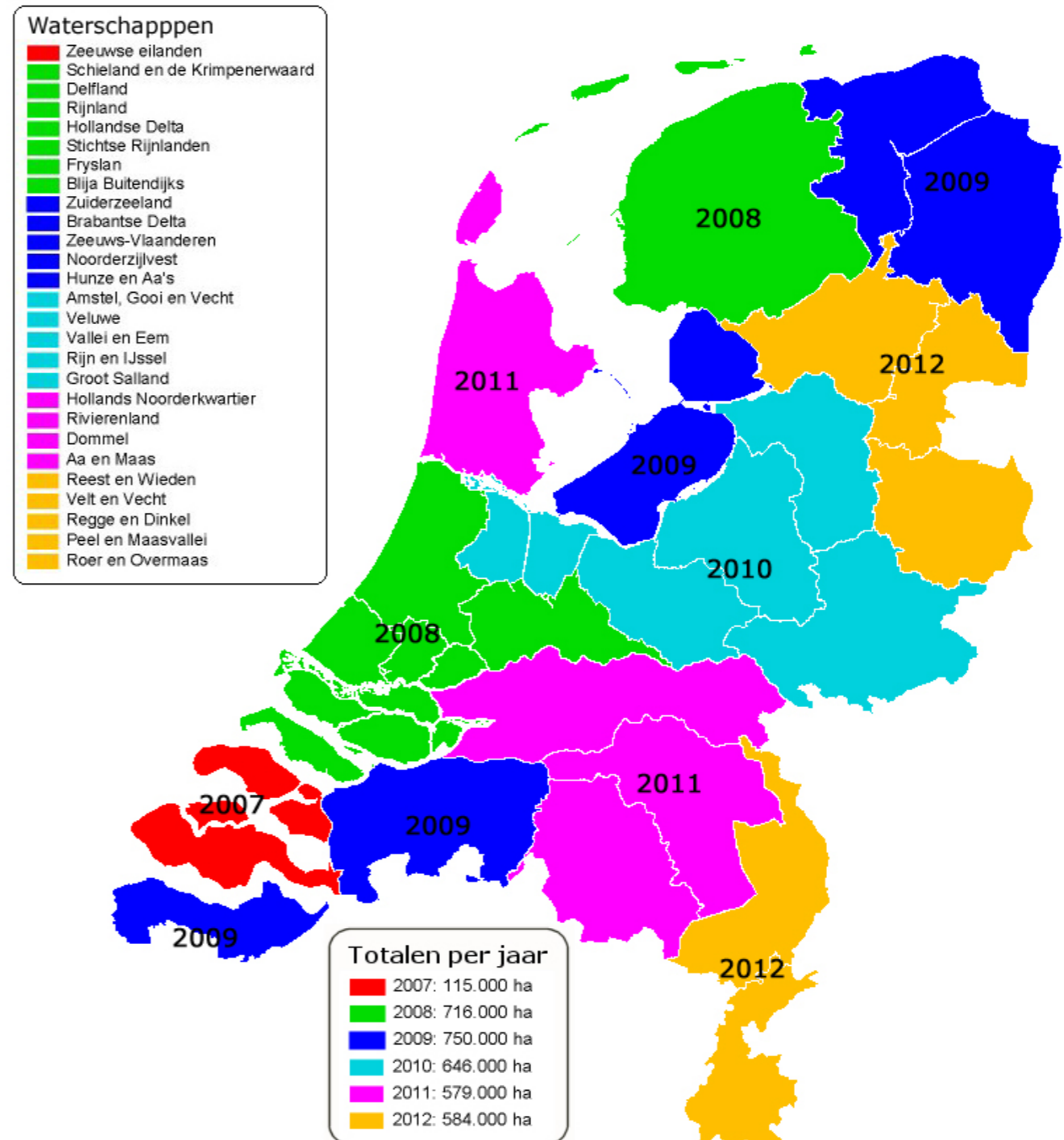
- Technological development:  
higher point density, higher precision
- Demand from water boards:  
high-density data for dike assessment and  
setting up dike register (legal obligations)
- Proposals from commercial party:  
country-wide lidar DEM would make AHN  
superfluous
- Organisational issues: Rijkswaterstaat (expert,  
expensive quality control) vs water boards  
(speed, need, not experts), funding? contracting?  
core spatial data? free availability? ...

- Specifications in terms of final qualifications
  - user requirements leading (mapping and height accuracy)
  - contractors have freedom in process & specifications (point density, point distribution, height & planimetric precision)
  - contractors should prove quality
- Both data acquisition and quality control were tendered – 2 specifications should fit flawlessly
- Project management: Het Waterschapshuis
- Contracting party: Rijkswaterstaat
- Pilot Waterschap Zeeuwse Eilanden 2007

- Height precision  $\leq 5$  cm systematic and 5 cm standard deviation stochastic
- Planimetric precision: objects  $2 \times 2$  m must be mapped within 50 cm
- Vegetation, objects, buildings etc. filtered out to obtain real terrain height ('maaiveld')
- Resulting point density? 8–20 pt/m<sup>2</sup>
- STOWA–workgroup large–scale lidar (WGL, Rens): assessment suitability for dike management: OK
- One product for water & dike management

- Water boards pay annual fee
- One acquisition in 5 year
- Rijkswaterstaat funds 50%
- AHN-2 2007-2012

Planning AHN-2 per juli 2009  
actualisatieschema 2007-2012



- Quality control acquisition
  - Target water board
  - Other water boards and Rijkswaterstaat (owners)
  - Rest of the world
- 
- Product levels have different availability and price

- Laser points

- points representing terrain (maaiveld)
- all other points (filtered out)

ASCII xyz – blocks 1000×1250m – ½ TB / water board

- Grids

- terrain-filtered data, resampled to 50×50 cm grid
- terrain-filtered data, resampled to 50×50 cm grid with gaps caused by irregular point distribution filled in
- non-filtered data, resampled to 50×50 cm grid
- terrain-filtered data, resampled to 5×5 m grid

ASCII grid – blocks – 200 GB per water board

# AHN-2 filled-in gaps

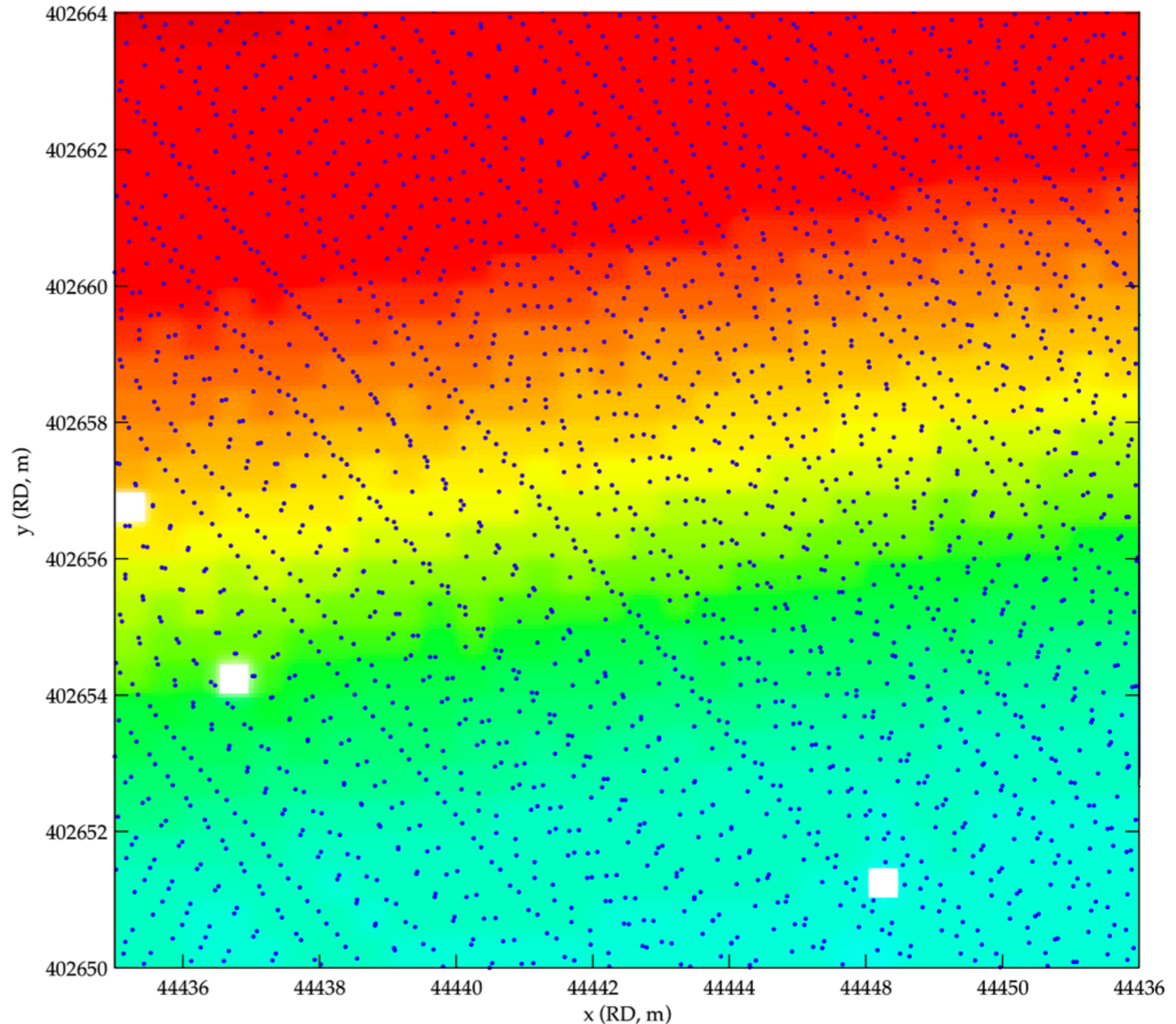
AHN-proef Noord-Beveland Oosterscheldedijk raster 50 cm (Fugro/WZE)

Specification mentions:  
“herbemonsterde gefilterde data waarbij ‘no-data’ cellen ten gevolge van een incidentele ongunstige puntverdeling en puntdichtheid wél zijn opgevuld”

≈

resampled filtered data with gaps caused by irregular point distribution filled in

my discovery causes a lot of data ...



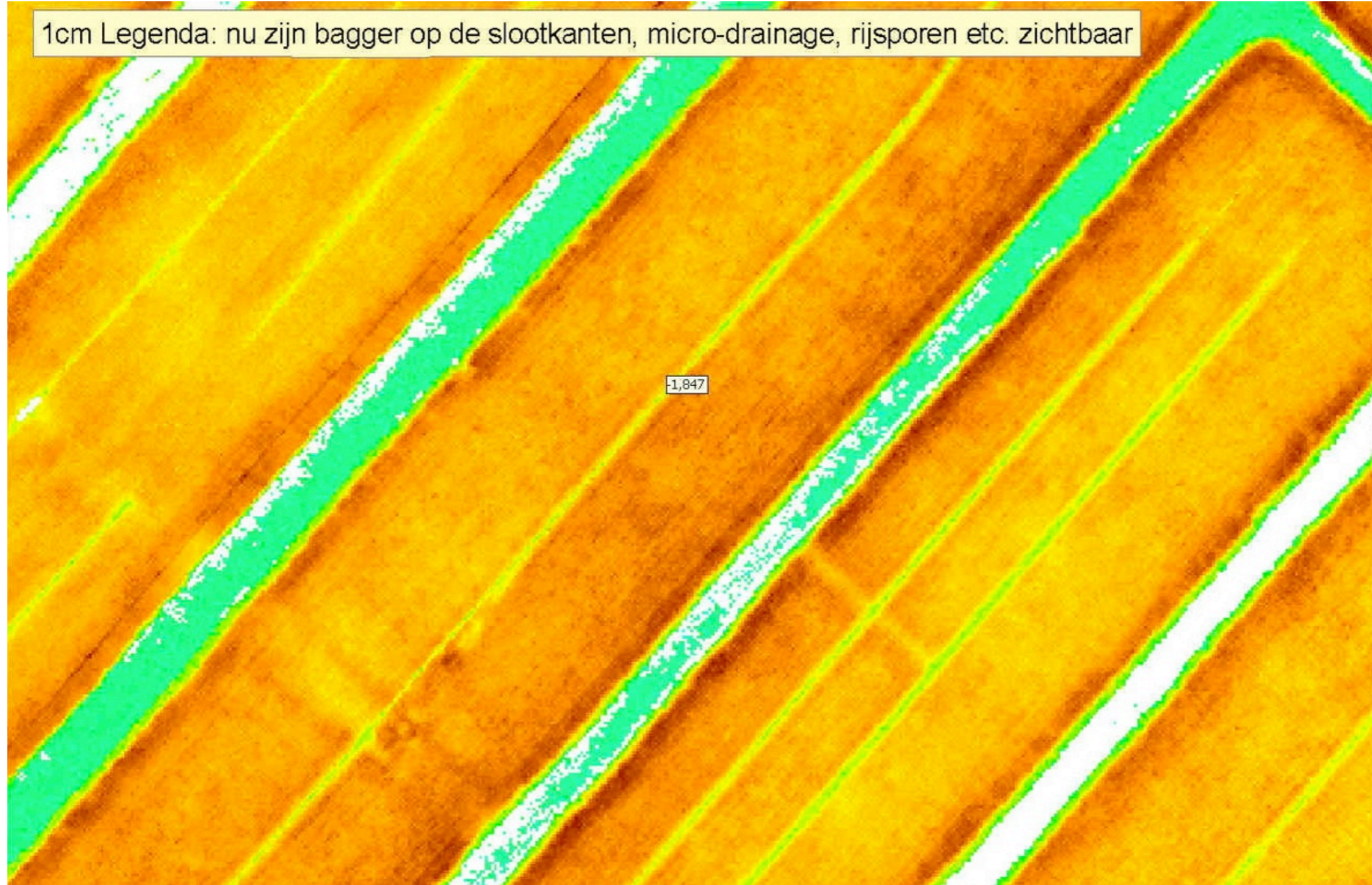
- Aerial photography
  - acquired within a week from laser acquisition
  - must be suitable to assess laser data:  
for identification and interpretation of potential objects or artefacts
  - geo-referenced
  - but not mosaiced nor colour-corrected nor smoothed
- 1/4–1/2 TB per water board
- Not available to non-target water board and rest of world

- Laser points
  - all points (raw data minus outliers)
  - points representing terrain, in flight strips
  - all other points (filtered out), in flight strips
- Grids
  - strip height data for strip overlaps
  - strip height difference data for strip overlaps
  - point density
  - hill shades for control filtering
- Total about 1 Terabyte per water board
- Data not available to water boards and RoW

- Data is supplied via hard disks
- Each water board devises its own way to load the data onto a server
- Struggles & discussions on format conversion, database, pyramids, network load, workstations
- Not all data is loaded
- Not all data is made available to anyone

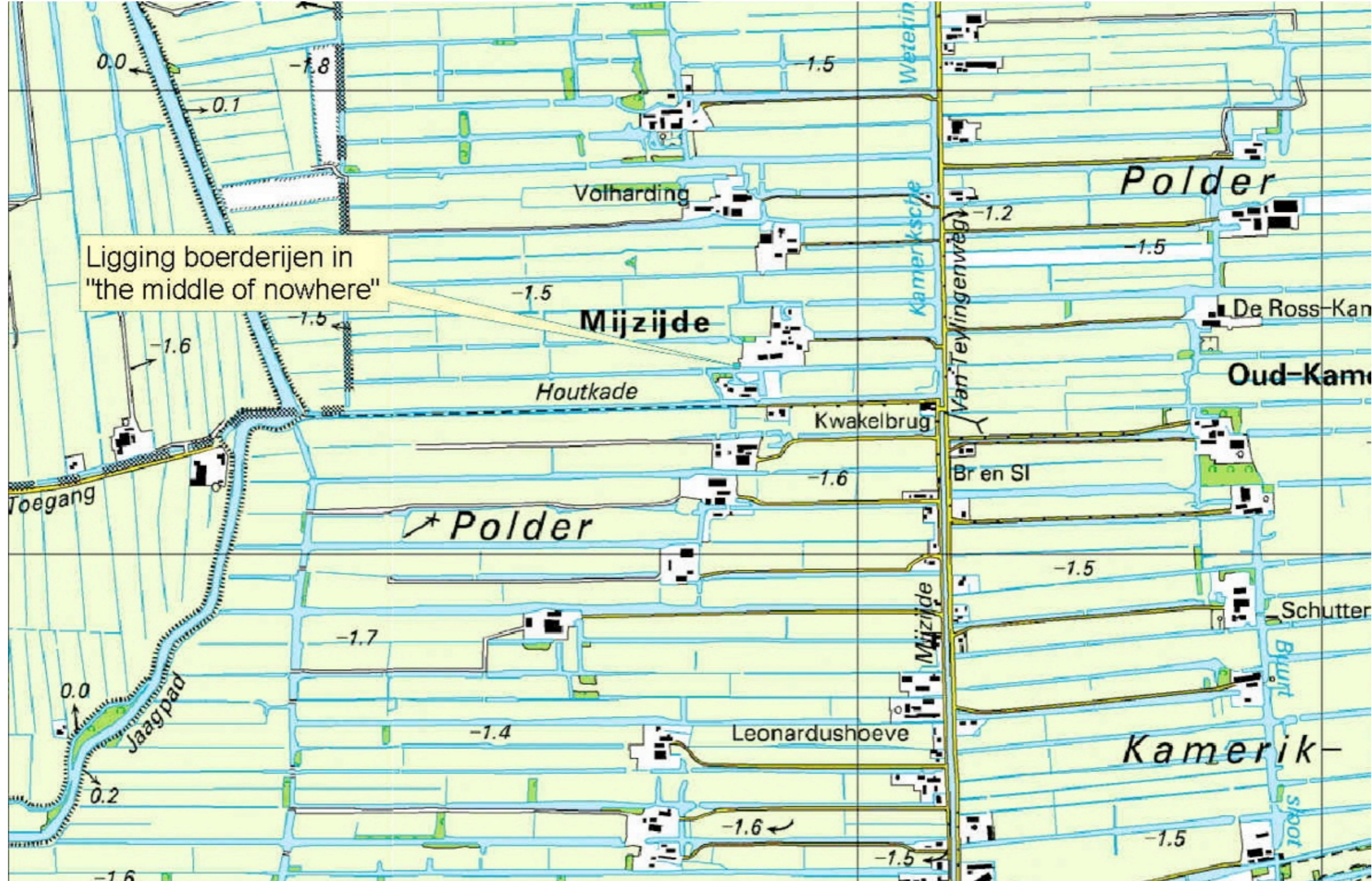
- Hydrologic modelling
  - full resolution welcome
  - terrain representation and filtering ('classification') crucial
  - no gaps, no non-existing walls
- Water area plans
  - prefer lack of detail, also to prevent detailed questions
- Polder water level decisions
  - removal of all water ways and grid cells on non-maaiveld slopes, to get a real mean terrain height

# Usage: grids



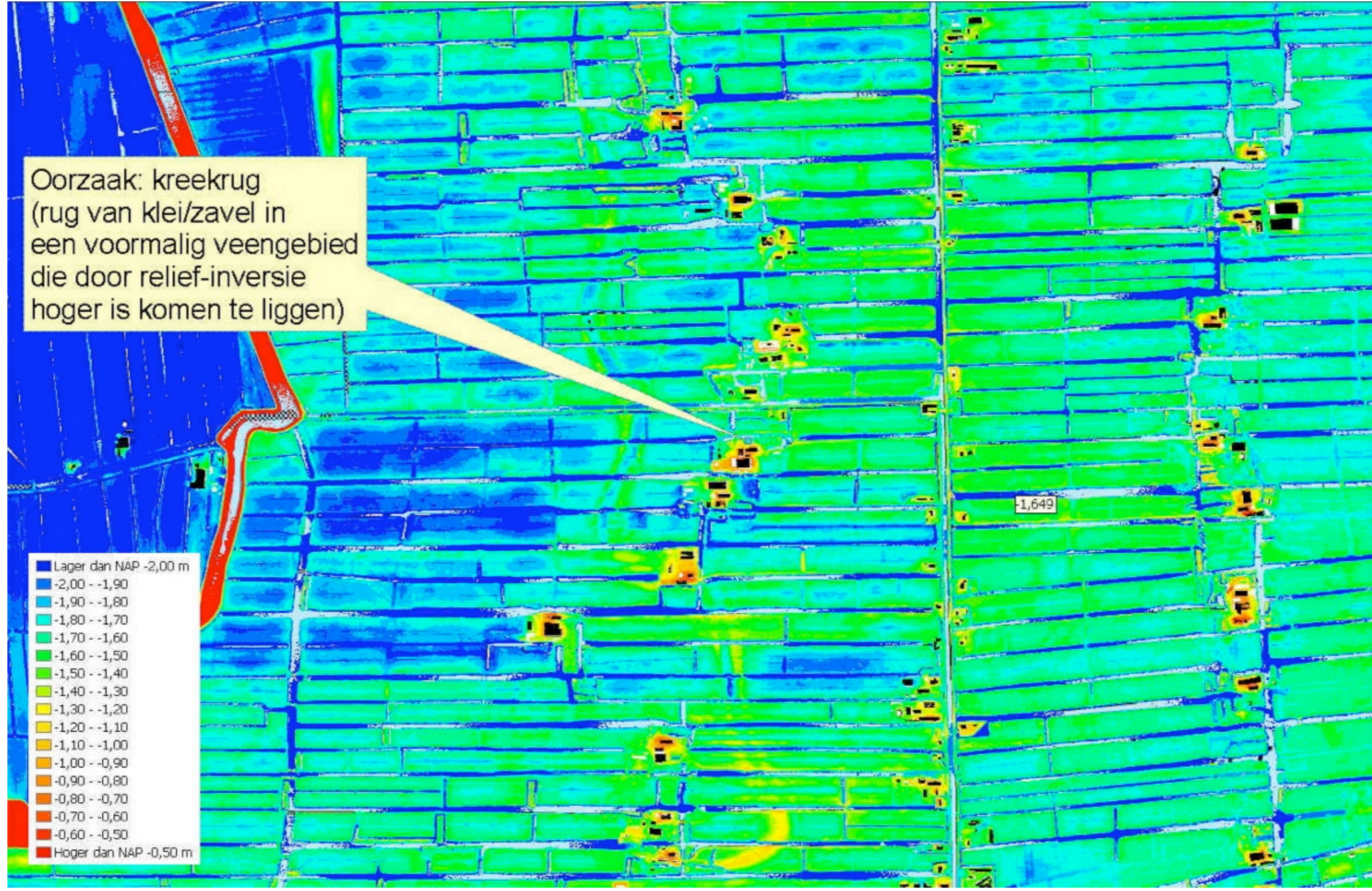
AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

# Usage: grids



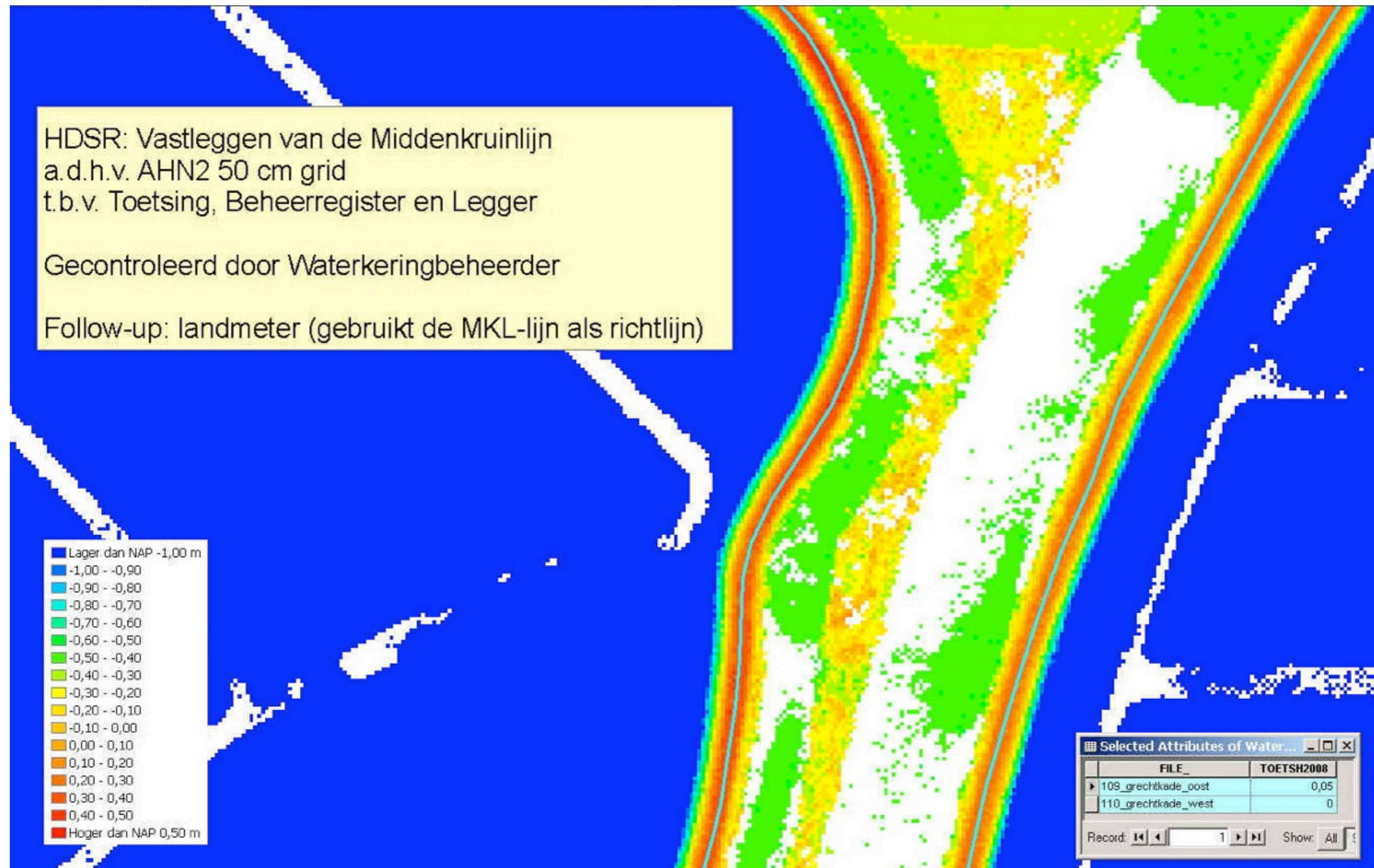
AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

# Usage: grids



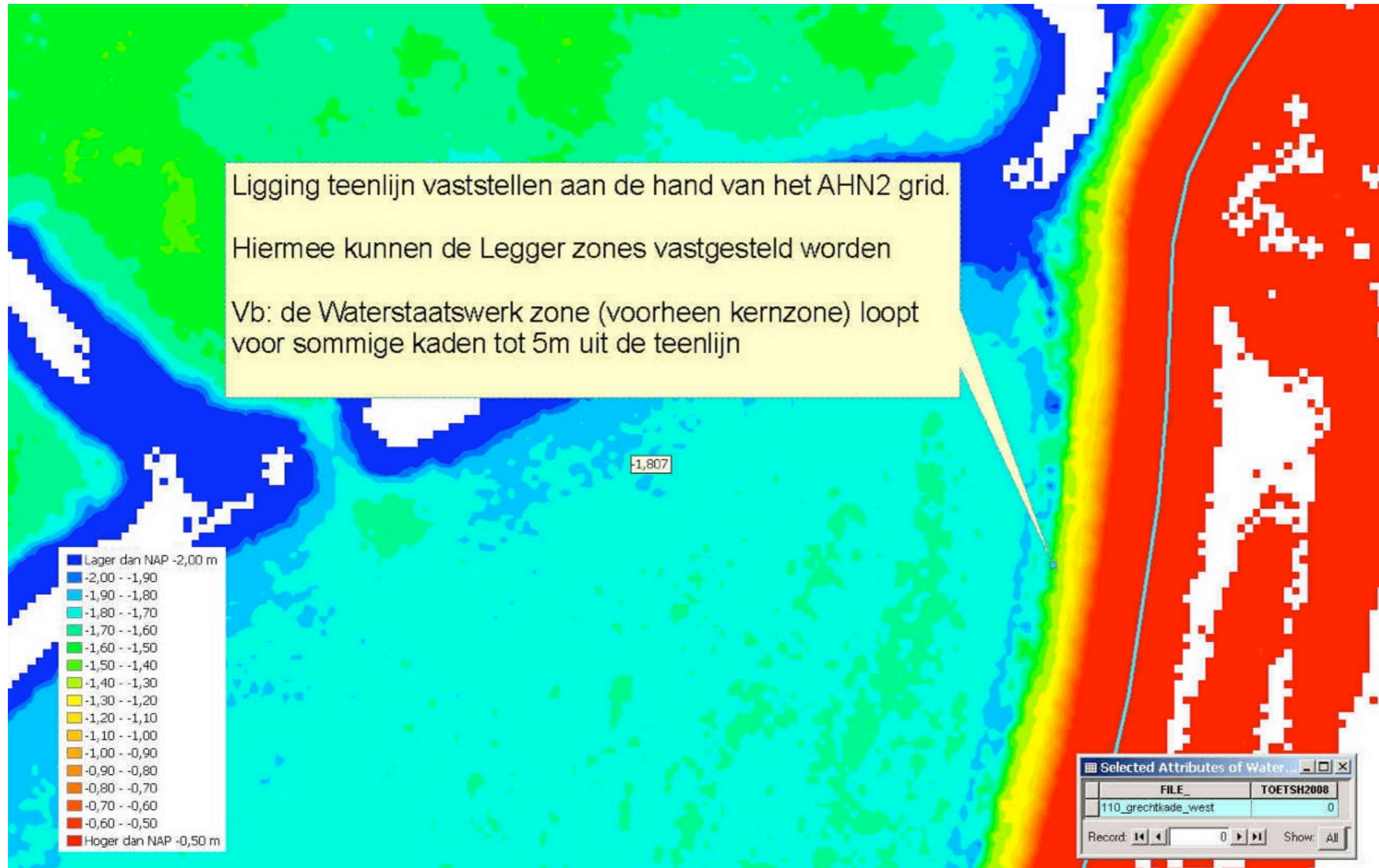
AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

- Dike management
  - determination of dike top height for five-year legal assessment (VTV, Wet op de waterkering)
  - determination of dike strength (resistance against sliding) on representative profiles (legal: VTV, WoW)
  - mapping of primary and regional dikes and embankments (legger en beheerregister)
    - middle top line (middenkruinlijn)
    - inner and outer toe lines (teenlijnen)
    - jurisdictional zone of water board (keurzone)
  - tenders for large maintenance and mowing
  - permits
  - vindication



AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

# Usage: grids for dike management



AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

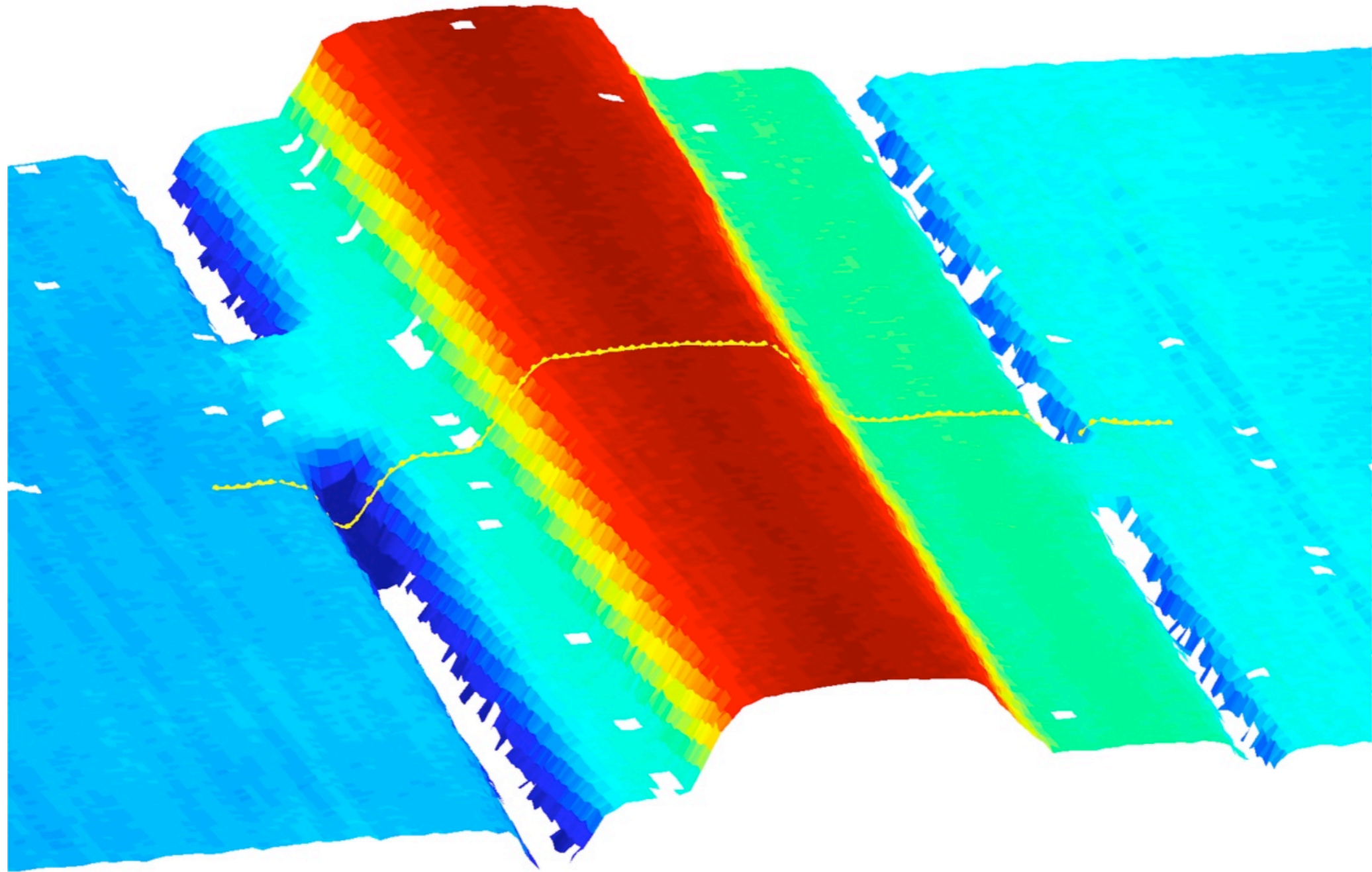
# Usage: points

- Points are barely used
  - dike management: height and profiles are determined on grids (I did to assess AHN-2 for WGL)
  - mapping of primary and regional dikes and embankments (legger en beheerregister)
- Points are sometimes used
  - for mapping: mostly outsourced
- Why are points barely used?
  - grid is good enough
  - software and hardware not optimal
  - software not suitable to map or profile
  - just kept in the safe-deposit

- Aerial photography is not always used
  - if not mosaics: more difficult to use
  - Zeeland with province and municipalities: contract for a yearly mosaic, much higher quality than AHN (Rens: but not the best suitable to assess laser data)
  - just kept in the safe-deposit
  - highest demand for dike management (still have to figure out the eventual use)

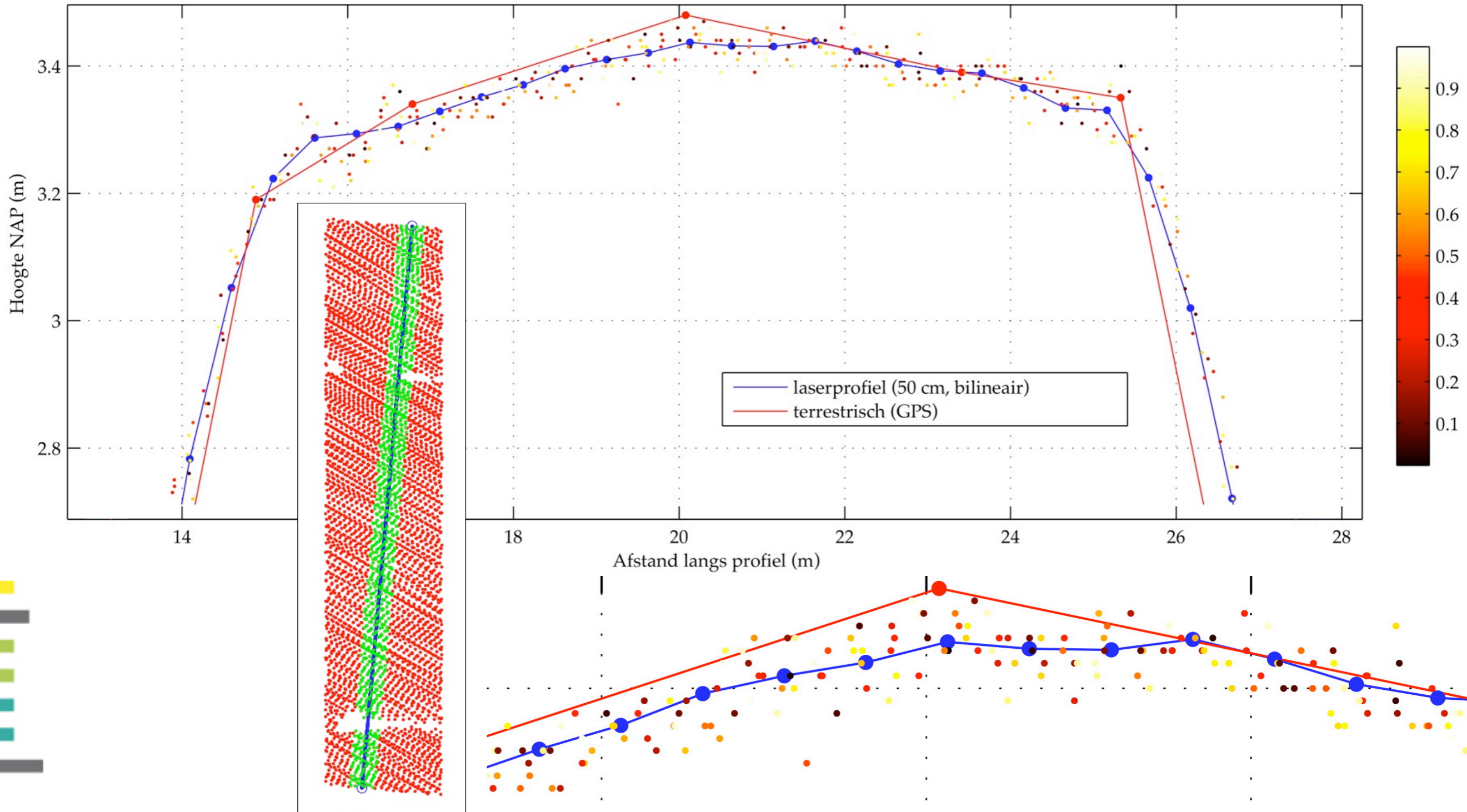
# Points compared to grid

- STOWA–Werkgroep Grootschalige Laseraltimetrie: determination of requirements for dike management (2007, after Wilnis 2004)
- Assessment of data pilot AHN–2
  - comparison with GPS–profiles
  - comparison of dike stability calculations
- Dike managers use terrestrial profiles as reference
- 50 cm–grid represents terrain better than GPS
- Water line and ditch depth cannot be determined
- Use points for mapping: bend line accuracy ++



100 m dike Zeeland - height 2-2.5m  $\times$  2 - 50 cm grid & GPS-profile location

Profielen uit laserdata (raster 50 cm) en terrestrisch (GPS) met originele laserpunten tot 1 m van profiel



Profielen uit laserdata (raster 50 cm) en terrestrisch (GPS) met originele laserpunten tot 1 m van profiel

