ahn

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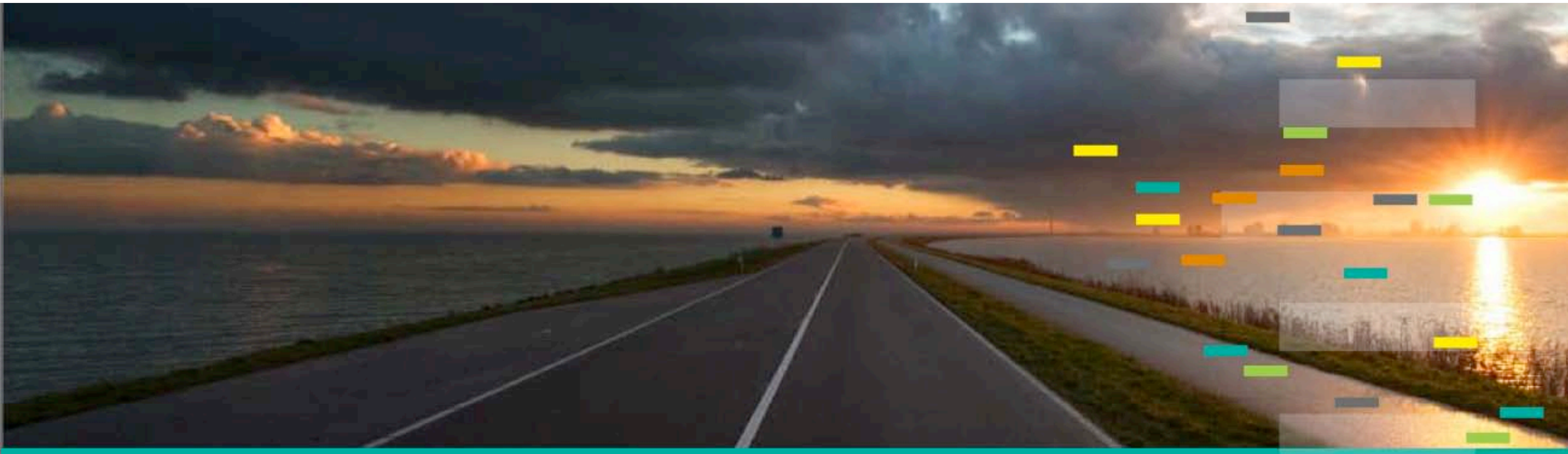
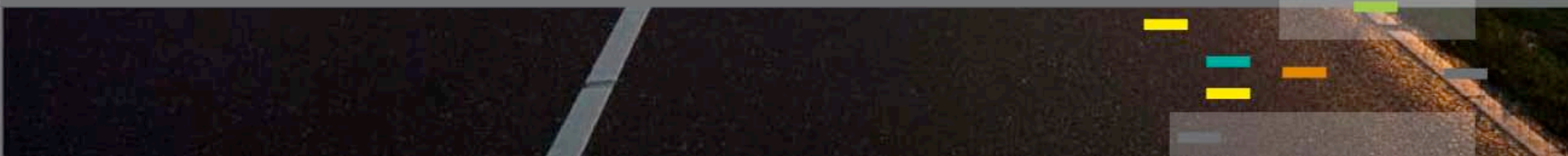


How to handle the Up-to-date Height Model of the Netherlands: detailed, precise, but so huge!

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



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Introduction

- 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.

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Introduction

- ~~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~~

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Short history of AHN

- 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^2
- Dz = 5 cm; σ_z = 15 cm
- Usefull: not too large, precise enough

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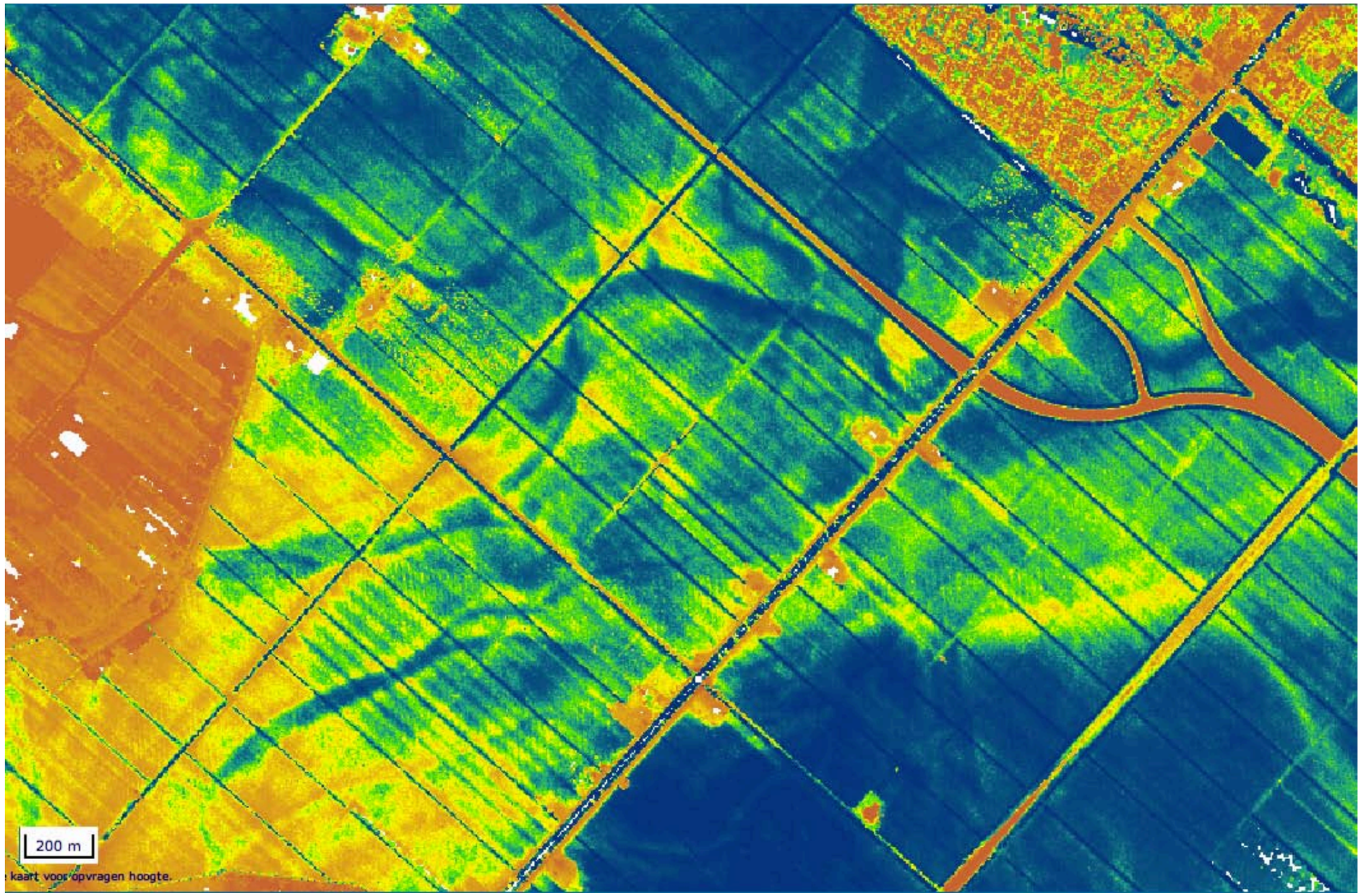
AHN viewer



AHN 1997 1pt/8m^2 Haarlemmermeer – all to your disposal at www.ahn.nl

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AHN Next Generation

- 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? …

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AHN-2 2007 pilot

- 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

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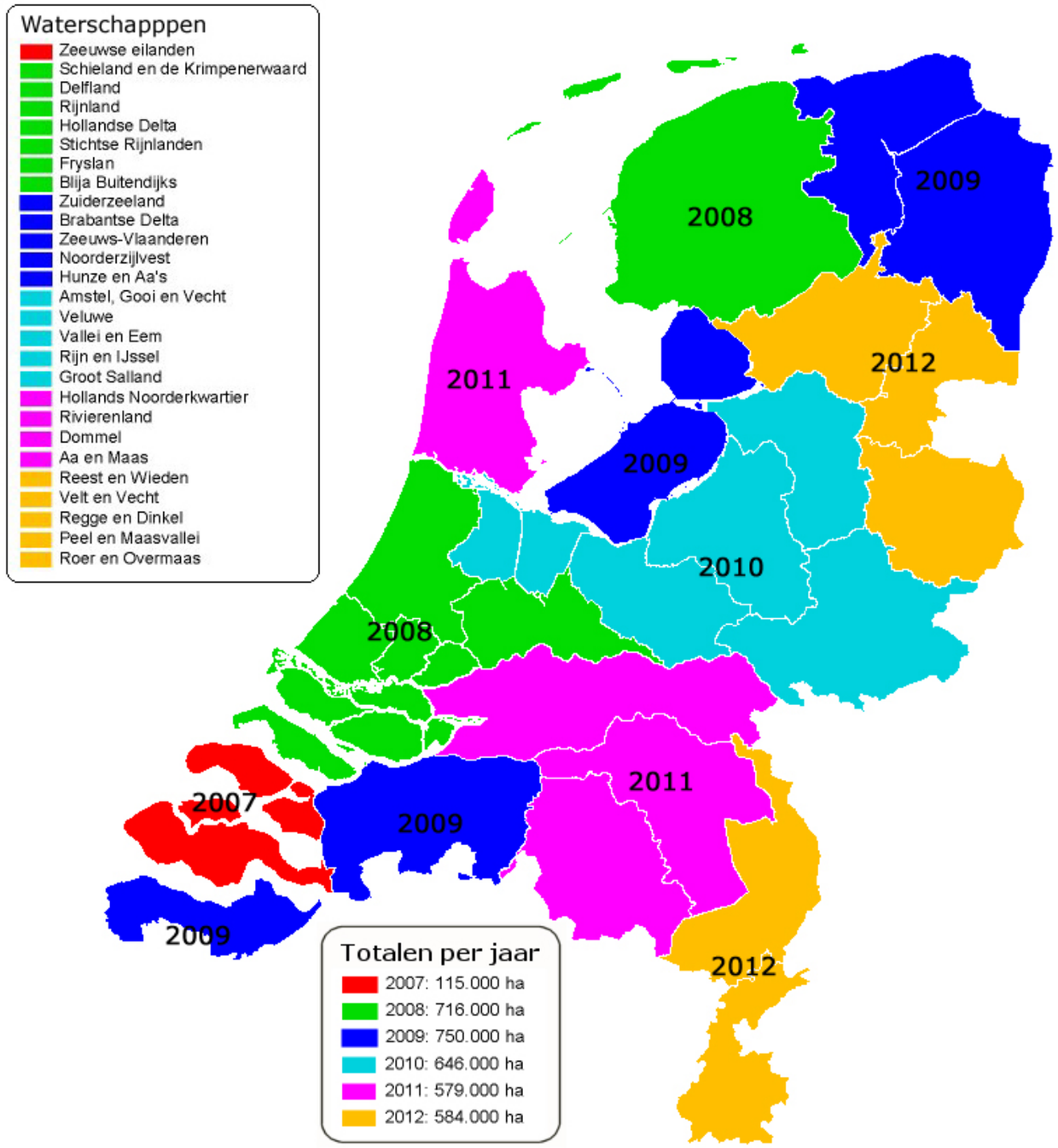
AHN-2 specifications

- Height precision ≤ 5 cm systematic and 5 cm standard deviation stochastic
- Planimetric precision: objects 2 × 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^2
- STOWA-workgroup large-scale lidar (WGL, Rens): assessment suitability for dike management: OK
- One product for water & dike management

AHN-2 planning

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



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AHN-2 product levels

- Quality control acquisition
- Target water board
- Other water boards and Rijkswaterstaat (owners)
- Rest of the world

- Product levels have different availability and price

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AHN-2 Rest of World products

- 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

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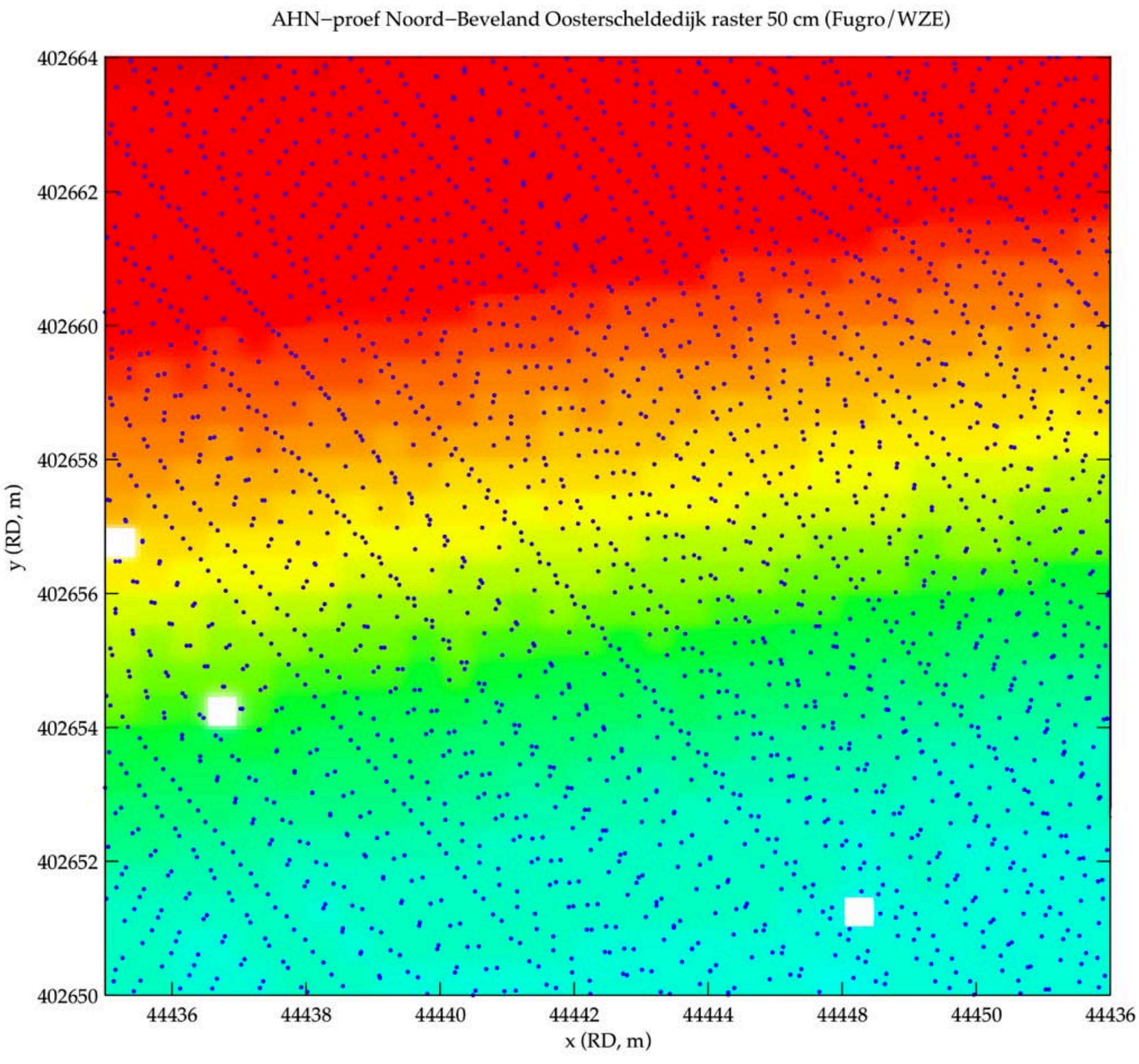
AHN-2 filled-in gaps

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 …



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AHN-2 water board products

- 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
- ¼-½ TB per water board
- Not available to non-target water board and rest of world

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AHN-2 quality control products

- 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

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Distribution to water boards

- 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

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Usage: grids

- 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

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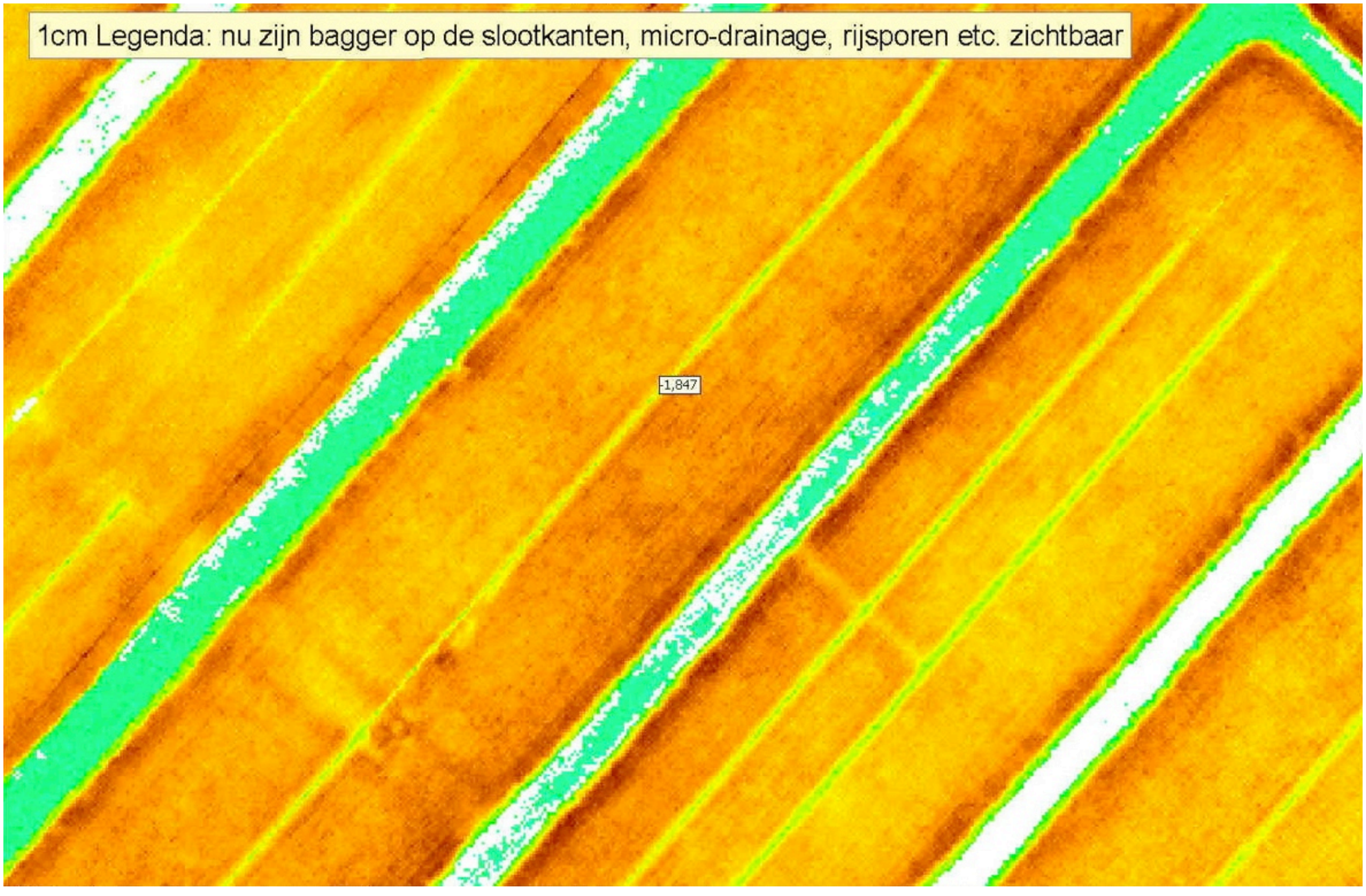
Usage: grids



AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

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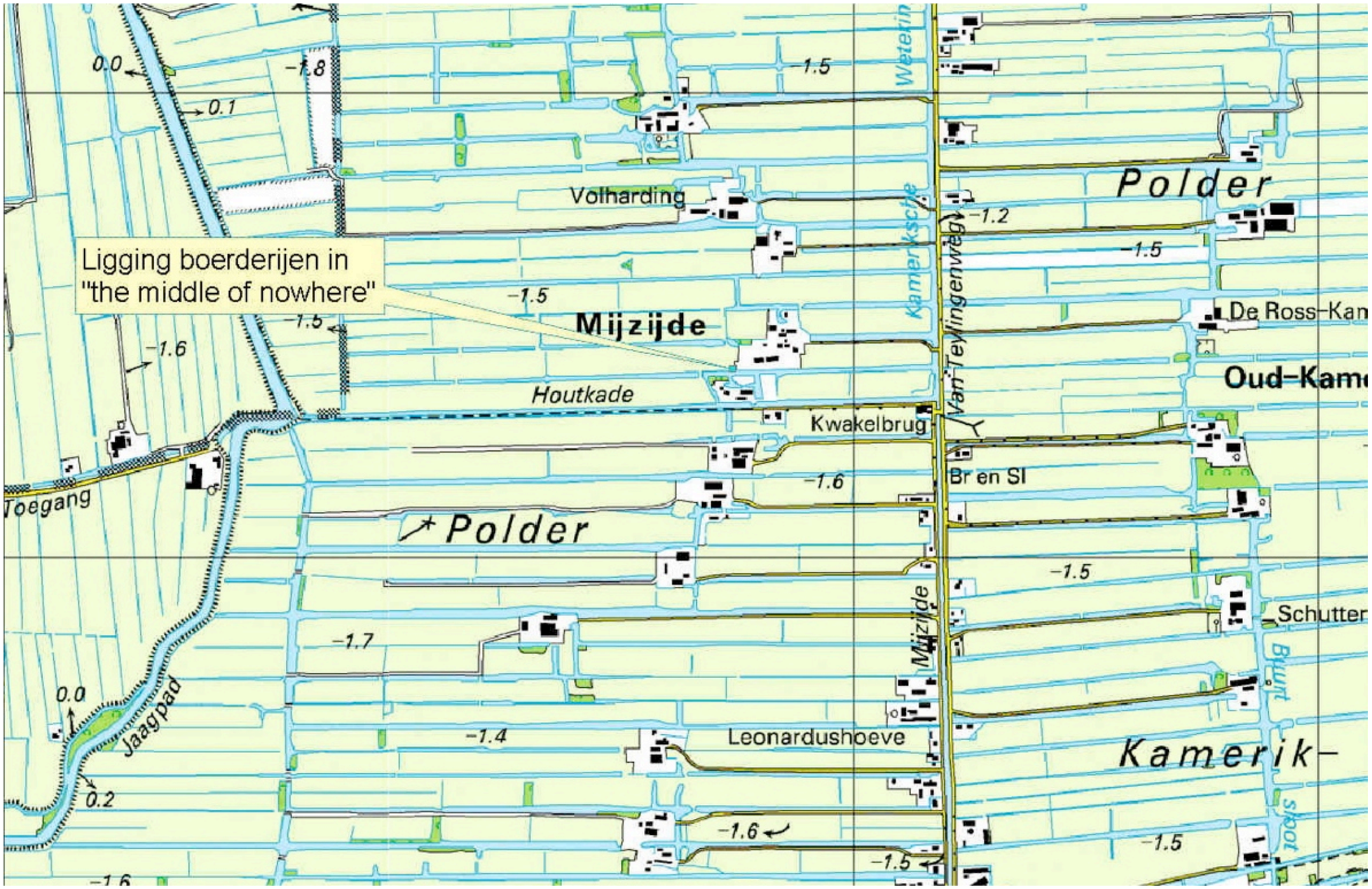
Usage: grids



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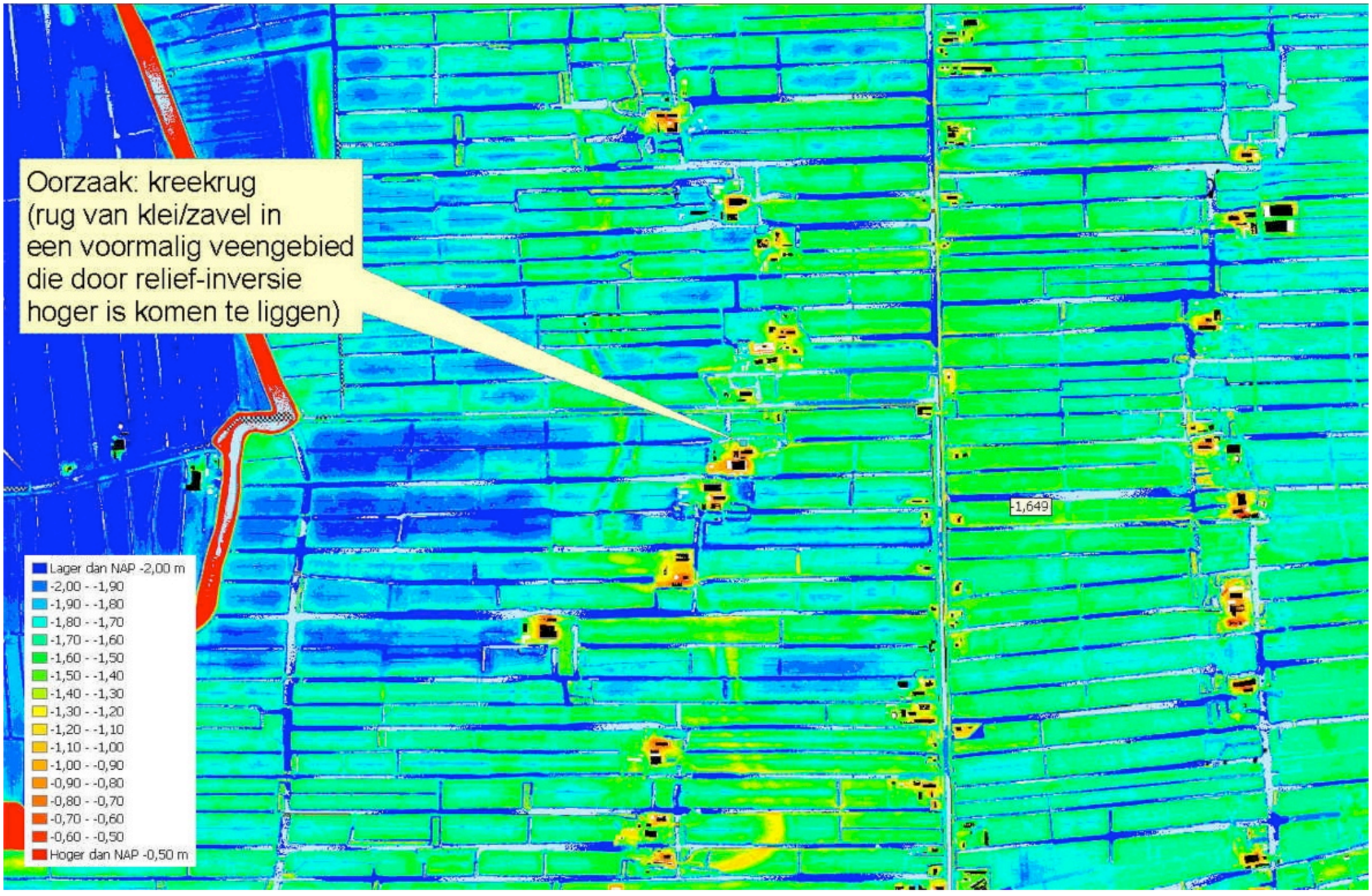

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Usage: grids for dike management

- 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 maintainance and mowing
  - permits
  - vindication

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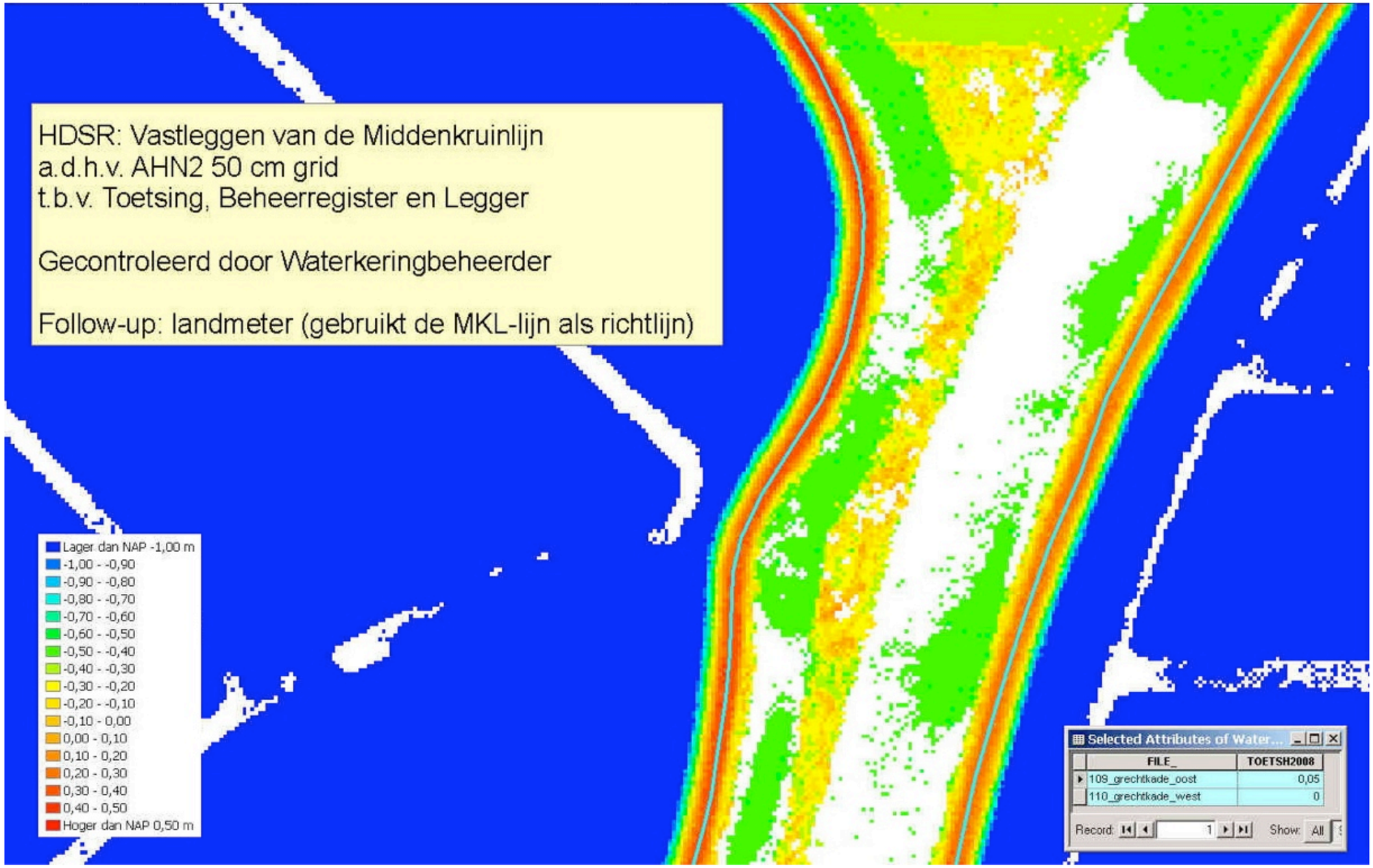
Usage: grids for dike management



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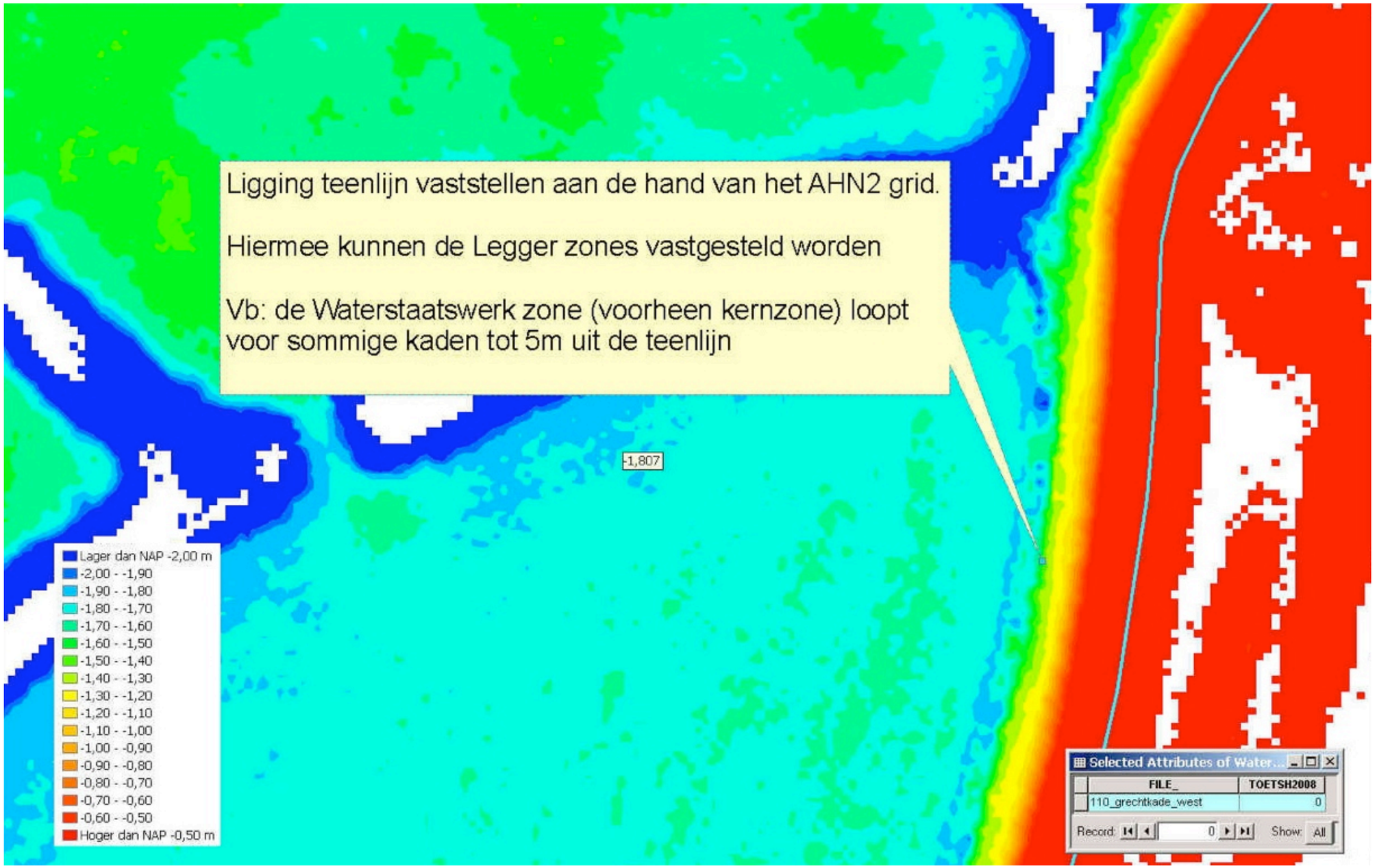

AHN 2008 Stichtse Rijnlanden (met dank aan Marten Westerink)

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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

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Usage: aerial photography

- 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)

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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 terrestric 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 ++

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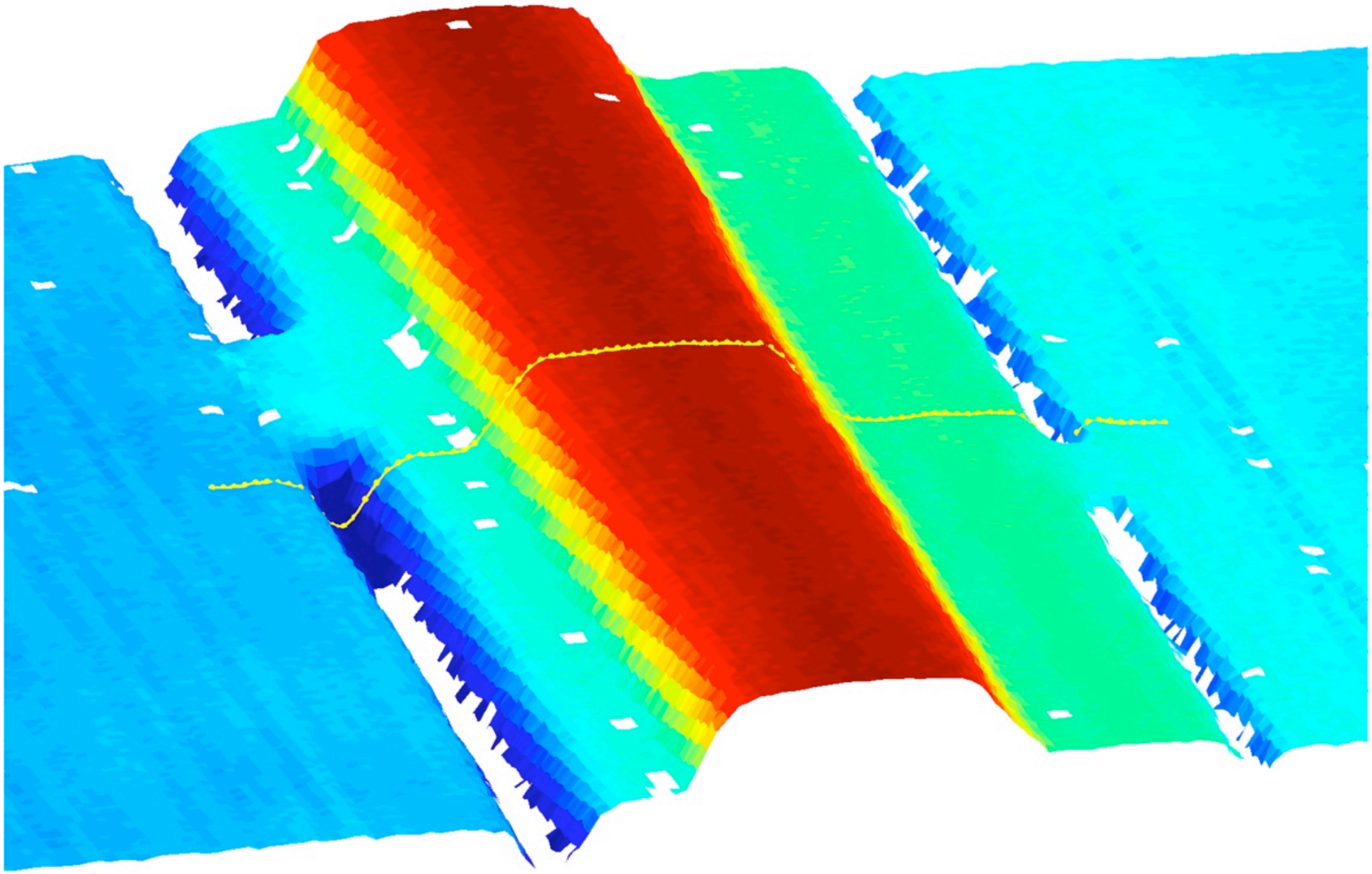
WGL: AHN for dike management



100 m dike Zeeland – height 2–2.5m × 2 – 50 cm grid & GPS-profile location

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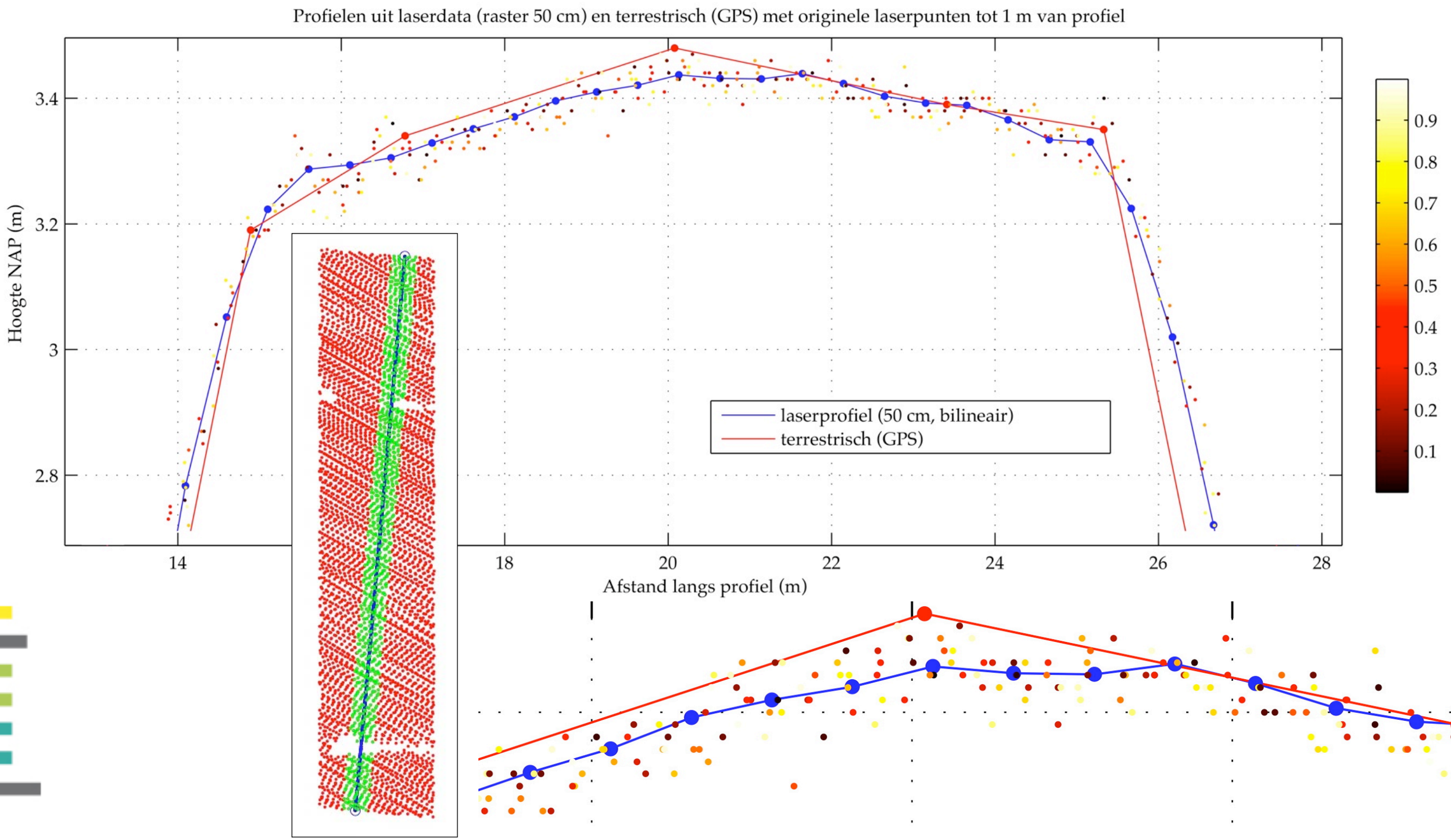
WGL: AHN for dike management



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WGL: AHN for dike management