kadaster

Image-based point clouds at Kadaster

Point Cloud Processing 2018

Willem van Hinsbergh

Image-based point clouds

Overview

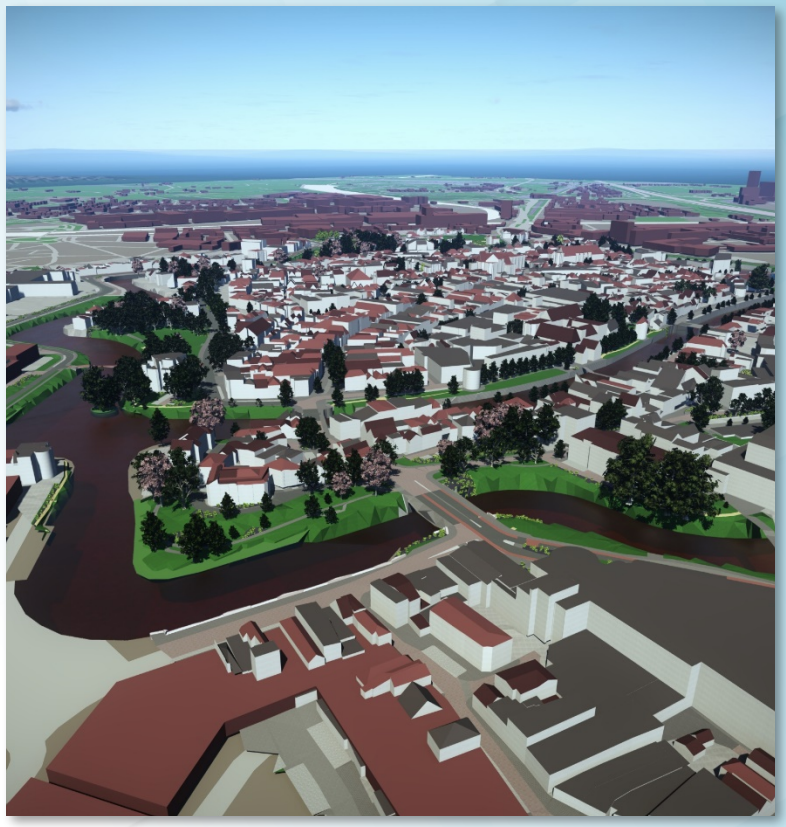
- Why image-based point clouds (apart from bonus products)
- Dense Matching
- Digital surface model
- Classification
- Bonus products

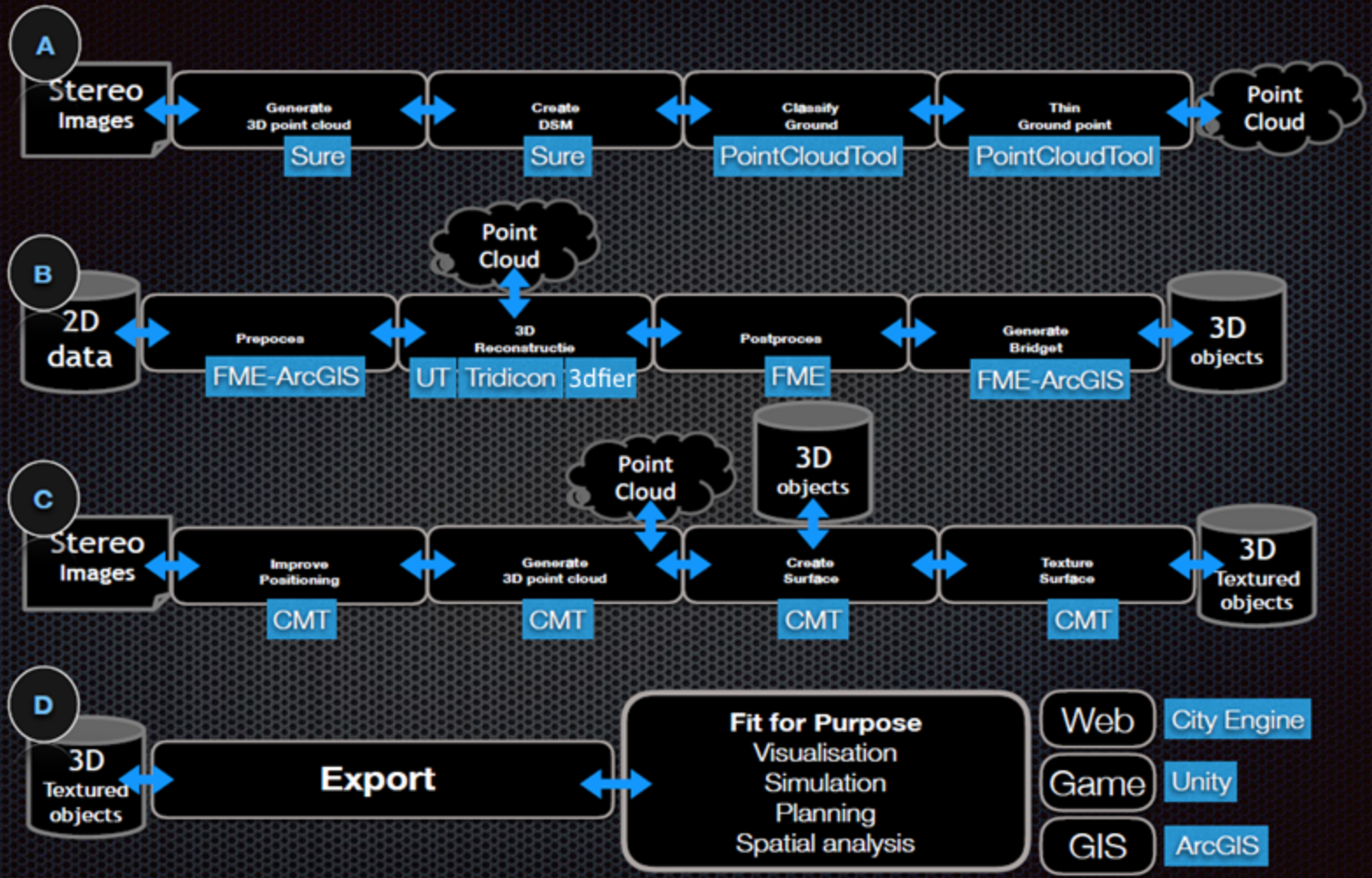
Why image-based point clouds: Project 3D

AHN is the national lidar based height model, but:

Project 3D goals are:

- Create a 3D dataset based on existing 2D geometry (BGT/BAG)
- Suitable for….(e.g. Omgevingswet)
- Nationwide
- Fully automated
- **Yearly updated** (≠ AHN)





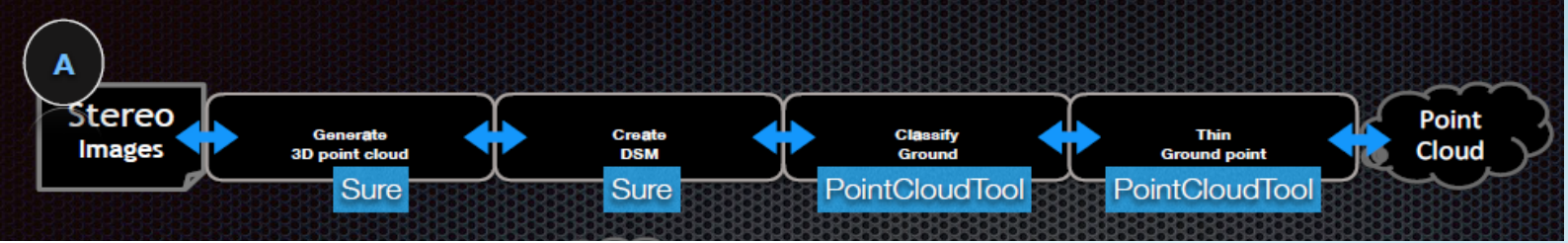
Dense matching

3D reconstruction

Texturing

Serving

kadaster

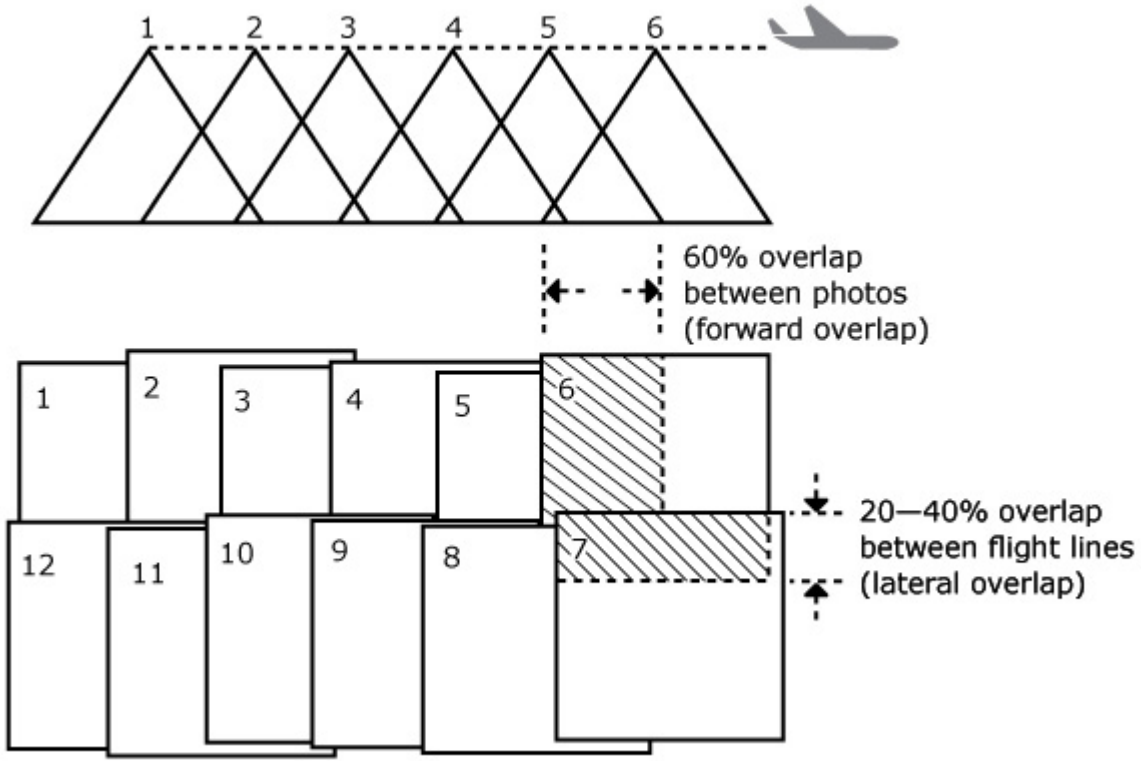


Dense matching

- Input: Yearly acquired aerial images with 60% or 80% forward overlap

- Output: Classified dense surface model (DSM) (ground, water, vegetation, building, other)

Definition: Overlap



kadaster

Dense Matching

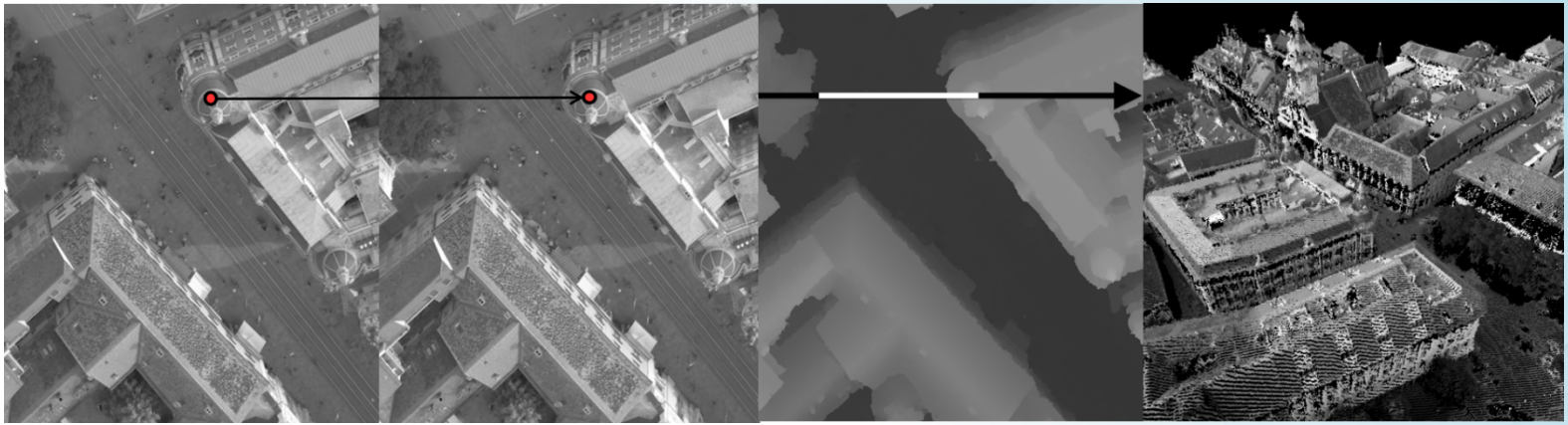


Image from Konrad Wenzel, nFrames

- At 60% overlap an object is visible in 2 images, at 80% in 4-5, but there will allways be some occluded areas
- % mismatch and noise improve dramatically using 80% overlap

Dense Matching: 3D point cloud

Create Digital Surface Model (DSM)

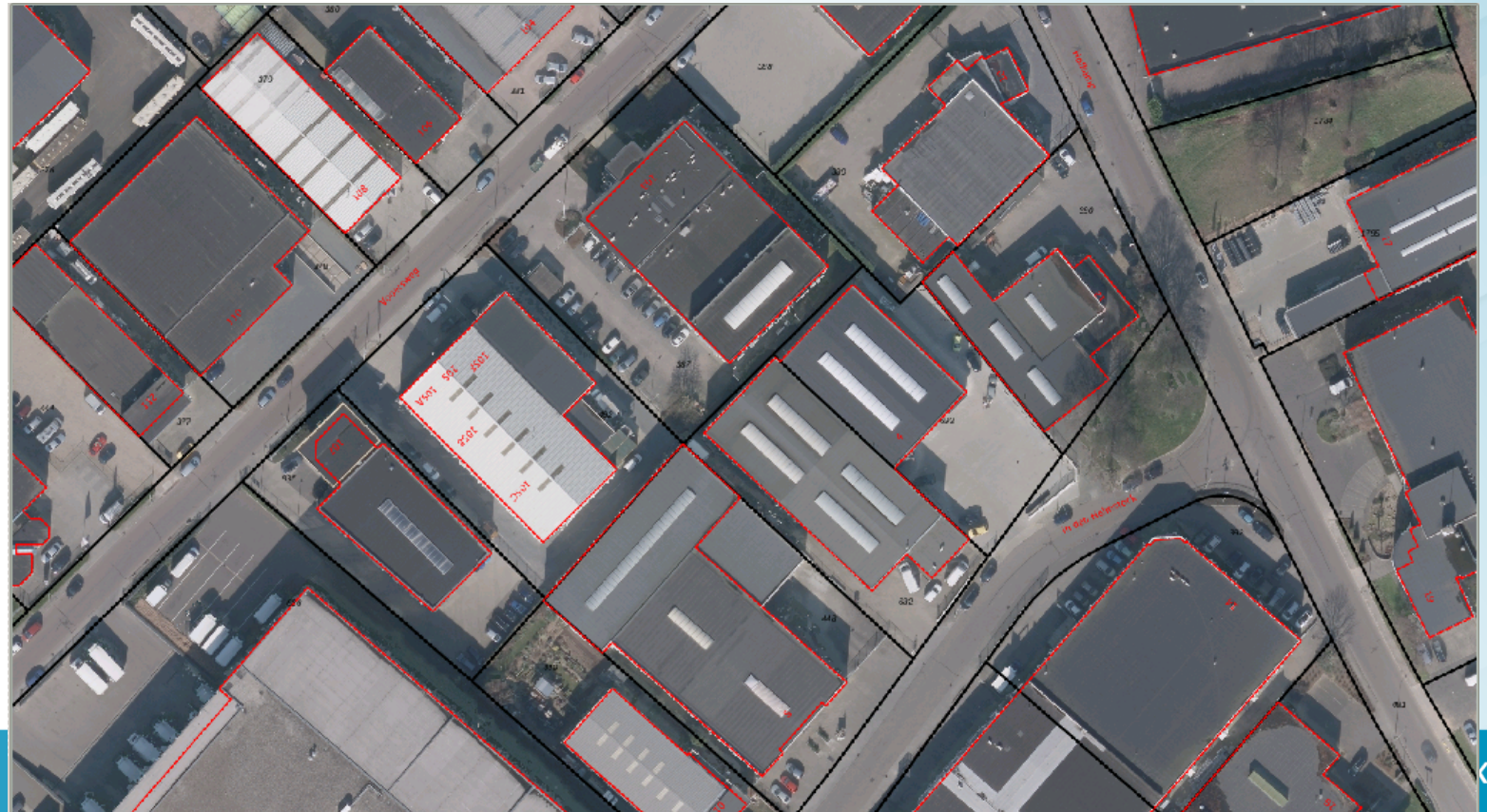
- 3D points are ‘gridded’ to a 10cm or 20cm raster, depending on overlap and purpose. For the 3D project a 20cm raster is used
- The heighest ‘valid’ point within a gridcell is selected
- At 60% overlap 84% of all cells get a value, at 80% overlap 94%
- 80% overlap improves height quality by a factor of 3

DSM: result 60% overlap

DSM: result 80% overlap

DSM: accuracy in xy direction

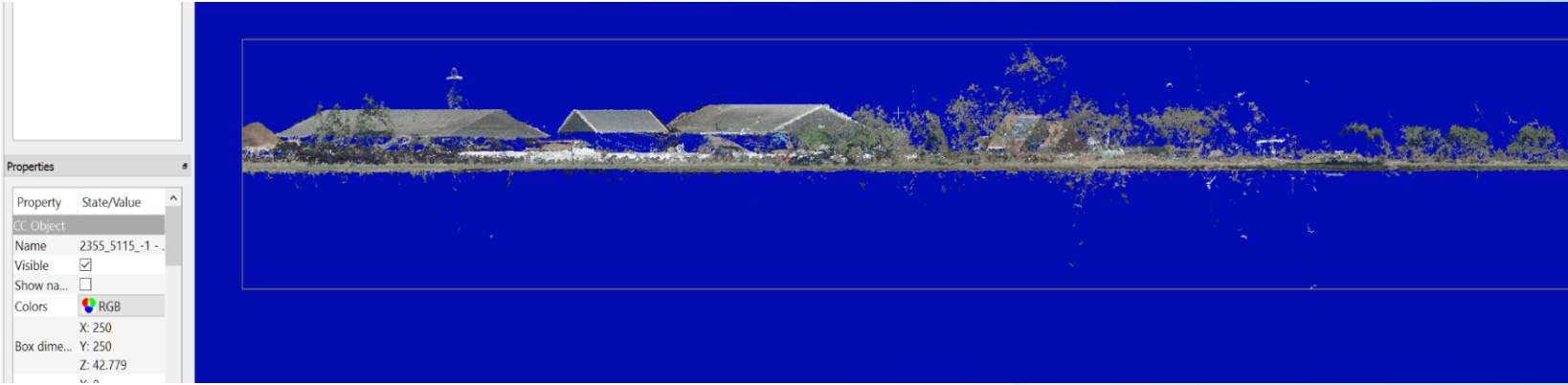
DSM: accuracy in xy direction



DSM: accuracy in z direction

Box: 42.8 m in height

60%

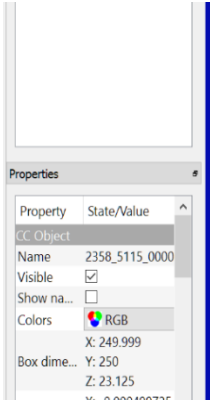


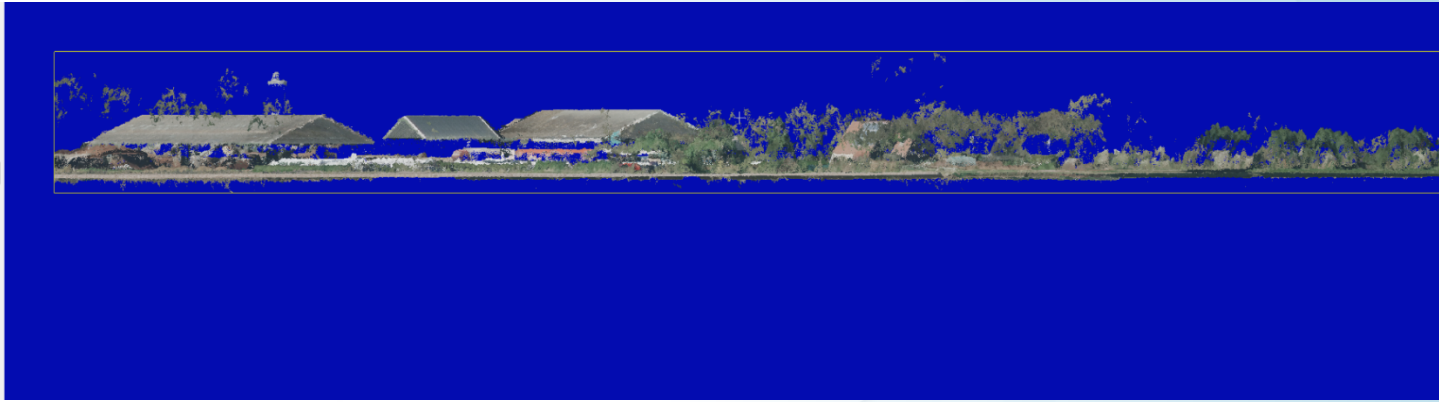
kadaster

DSM: accuracy in z direction

Box: 23.1 m in height

80%





kadaster

Classification

The DSM points need to be classified for further usage

- Ground, Water, Vegetation, Building, Other

Extra datasets used:

- CIR-images for vegetation detection
- Water-, building- and forest polygons to aid the classification process
- AHN

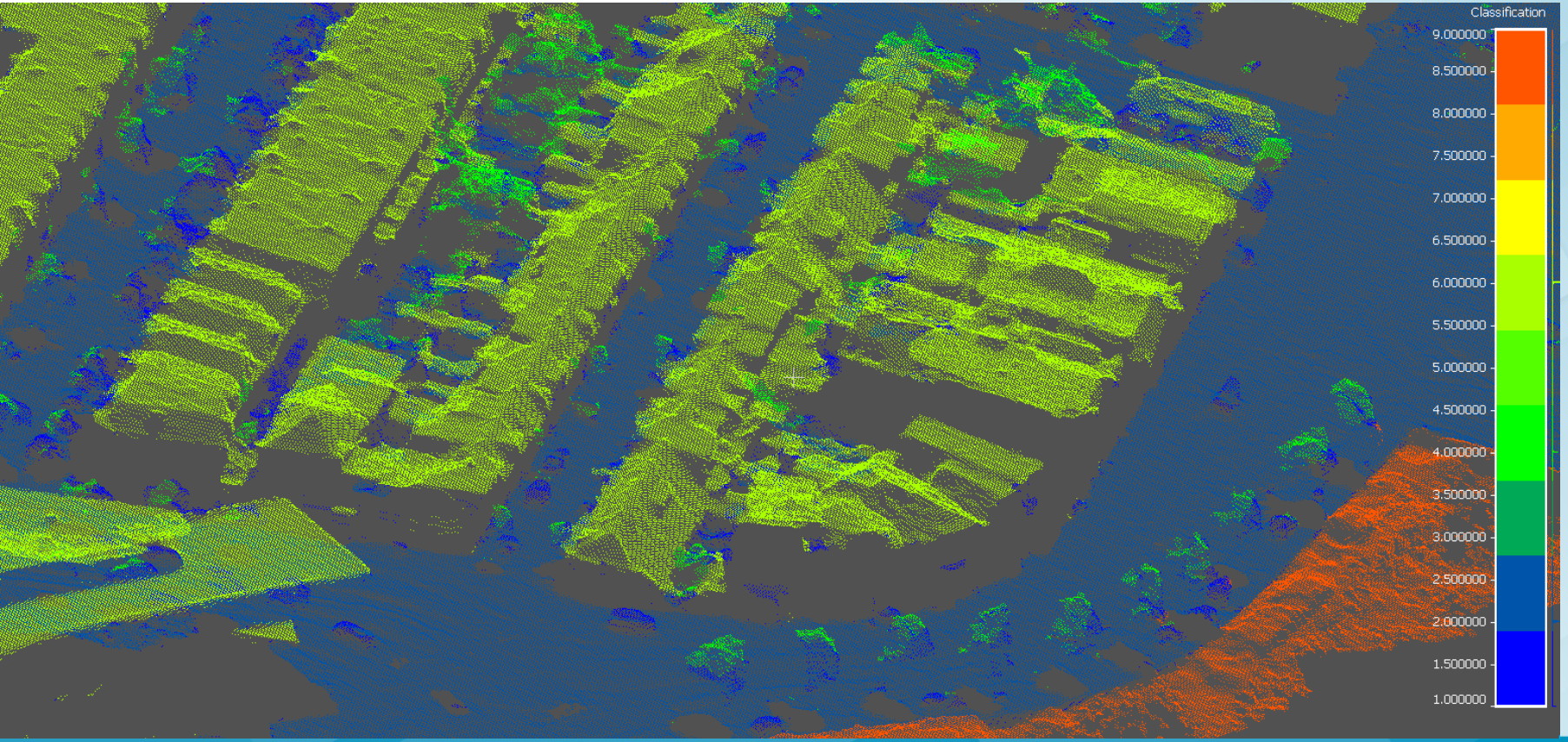
Classification

Problem areas:

- Water height cannot be detected correctly:
  - Exclude water areas from classification
  - Assign height to water
  - Select water areas based on existing 2D polygons

- Ground detection fails in forest areas:
  - Ground level in forest is stable over many years, so
  - Assign ground height based on AHN
  - Select forest areas based on existing 2D polygons

Classification: Result



kadaster

Results

- Result is a lot of data every year

Overlap	Totaal input	3D Cloud	Aantal punten	DSM10 product	Aantal punten	DSM20 product	Aantal punten	Totaal output
60/30	60 TB	44 TB	$8 * 10^{12}$	nvt	nvt	16 TB	$1 * 10^{12}$	60 TB
80/30	120 TB	170 TB	$30 * 10^{12}$	64 TB	$4 * 10^{12}$	16 TB	$1 * 10^{12}$	250 TB

- Result is used to create 3D model based on 2D geometries from large-scale topography (BGT/BAG)

Bonus Products

- True ortho model without lean
  - E.g. quick check of data quality

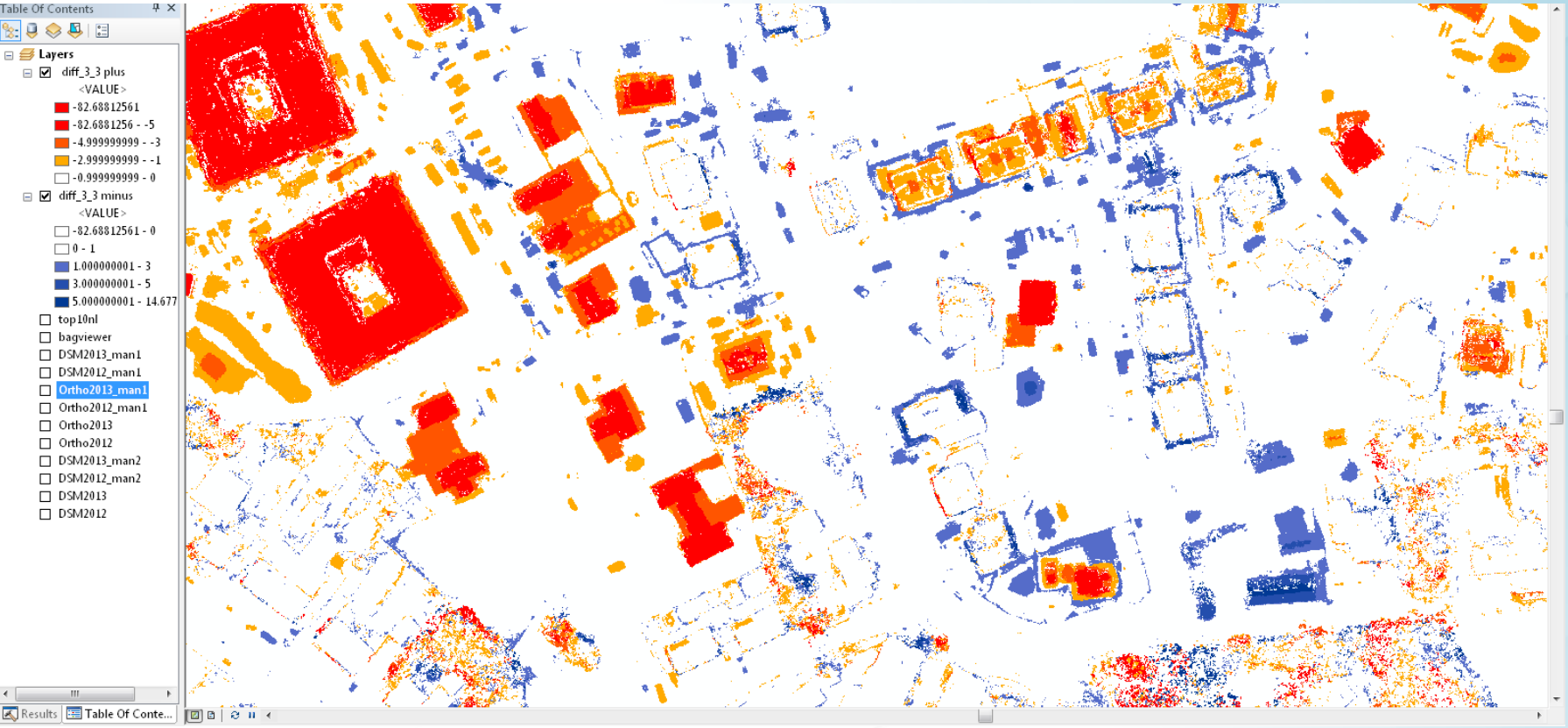
- Yearly updated height model
  - E.g. input for change detection

Ortho <------> True Ortho

Diff DSM of two consecutive years

Diff DSM of two consecutive years

Diff DSM of two consecutive years



kadaster

Questions?

willem.vanhinsbergh@kadaster.nl

Cijfers

- Kwaliteit(Haala/Vosselman) op 1600m vlieghoogte (no-TMA)

Resolution and overlap	10 cm 6030	10 cm 8030	Lidar (AHN2)
2)Vertical accuracy	1σ = 9,7 cm	1σ = 2,9 cm	1σ < 5,0 cm
% mismatch	9% > 29,1 cm (3σ)	11% > 8,7 cm (3σ)	0,3% > 15 cm (3σ)

- TMA wordt op 4000 m gevlogen ipv op 1600 m. Ook de resolutie is wat lager (10.8 cm ipv < 10 cm)
  - Kleinere snijdingshoeken, dus vertical accuracy is een factor 2.5 – 3 slechter
  - Horizontal (xy) accuracy heeft veel minder last van deze vlieghoogte (note: true ortho)

Cijfers

- Omvang data voor geheel Nederland

Overlap	Totaal input	3D Cloud	Aantal punten	DSM10 product	Aantal punten	DSM20 product	Aantal punten	Totaal output
60/30	60 TB	44 TB	$8 * 10^{12}$	nvt	nvt	16 TB	$1 * 10^{12}$	60 TB
80/30	120 TB	170 TB	$30 * 10^{12}$	64 TB	$4 * 10^{12}$	16 TB	$1 * 10^{12}$	250 TB