Derivation of Forest Parameters from Stereographic UAV Data – A Comparison with Airborne LiDAR

seit 1558

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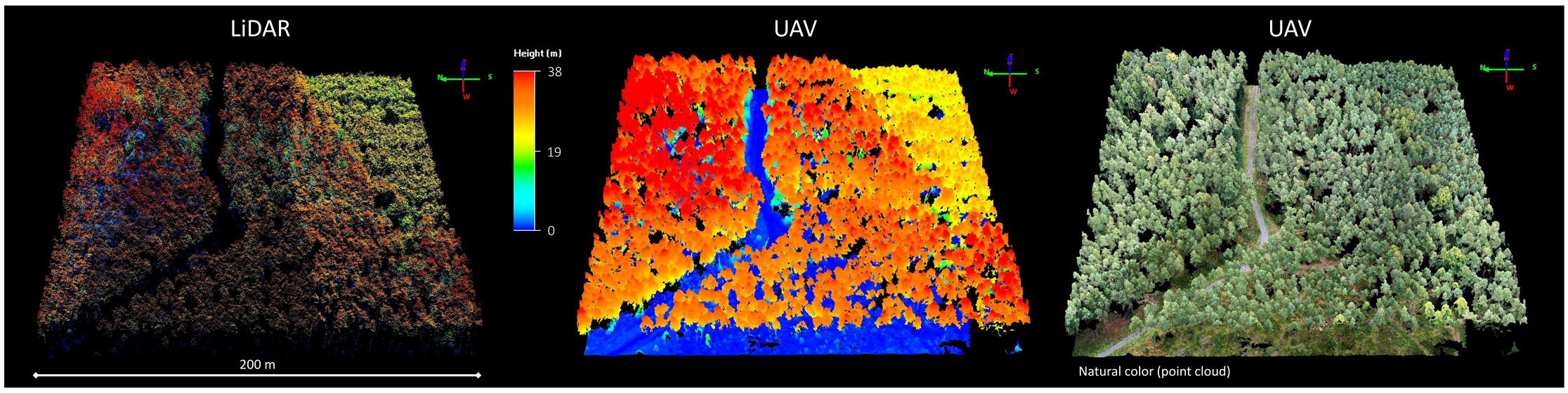
Data



LIDAR DATA

- Acquisition date: 15th February 2014
- Instrument: Optech ALTM Gemini
- Point density: 4-8 points/m²
- Footprint diameter: 0.15 – 0.25 m
- Height RMS: < 0.08 m
- Points classes: ground & non-ground, each subdivided into first, last, only
- Supplied by Thuringian land surveying office

UAV IMAGE DATA

- Acquisition date: 09th September 2014
- Instruments: Sony NEX-7/Tetracam mini MCA
- Platform: Logo-Team Geocopter X8000
- Flight altitude: 100 m over treetops
- Total area covered: 175 ha* (7 flights per camera)
- Overlap: 80% in flight direction, 60% between parallel tracks
- Number of images: 1750 (NEX-7 RGB), 5200 (miniMCA MS)
- Ground resolution NEX-7: 2 cm, miniMCA: 8 cm

UAV POINT DATA

- Delineated from overlapping images using structure from motion (SfM) as implemented in Agisoft Photoscan 1.2.4.
- Point density: 310 points/m²
- Georeferencing: DGPS

Site: Roda forest (managed), Germany (spruce, pine, larch, birch)

* For this study a 4 ha subset was used, mean tree height: 24.5 m.

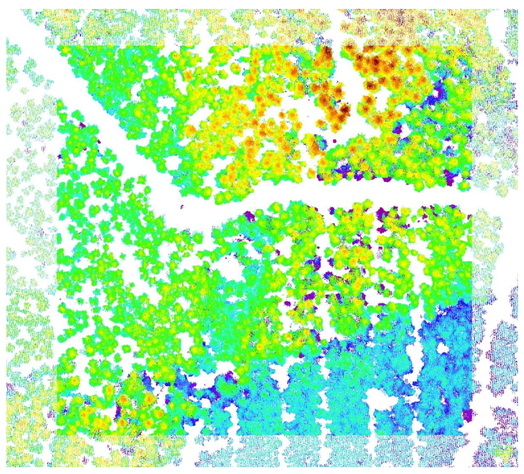
Point-like

COMPARISON OF LiDAR AND UAV RASTERS

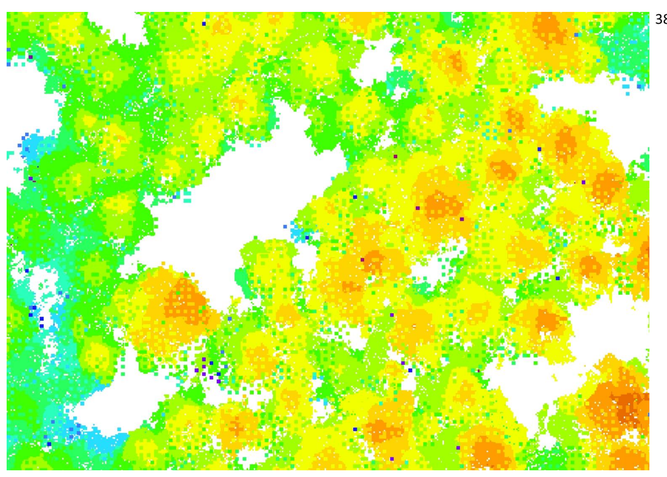
- Normalization of LiDAR and UAV point clouds for terrain using LiDAR ground returns (last & only)
- Delineation of raster from point data using highest point within raster cell
- Cell size LiDAR: 0.25 m
- Cell size UAV: 0.10 m

Images to the right:

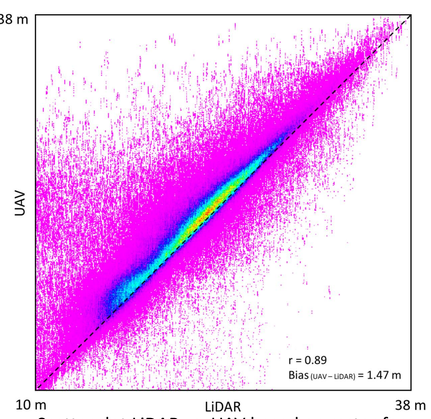
- Upper layer LiDAR raster
- Lower layer UAV raster
- No data: transparent



Entire 4 ha subset. Mind the "frame" were only the LiDAR data is shown.



Subset of investigated area. Coarse LiDAR pixels are visible when they feature a different height than UAV pixels.



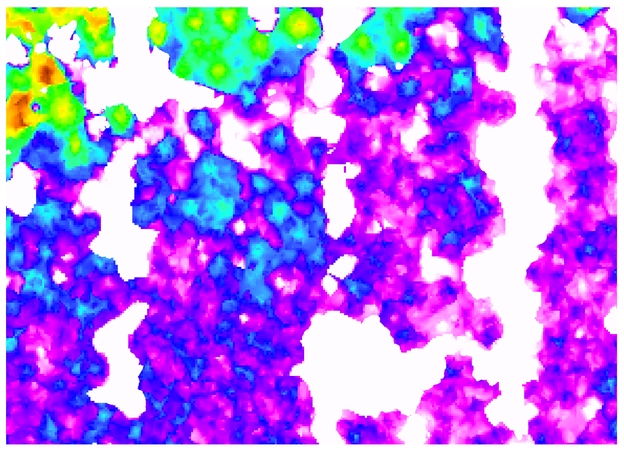
Scatterplot LiDAR vs. UAV based on raster for entire 4 ha subset

Surface

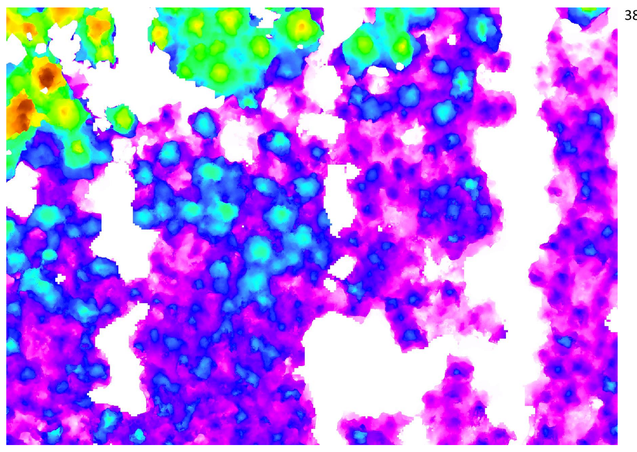
COMPARISON OF LiDAR AND UAV CHM

- Generation of pit-free canopy height model (CHM) from UAV and LiDAR data (Khosravipour et al. 2014)
- No interpolation for TIN generation over distances > 1 m
- Cell size LiDAR: 0.25 m
- Cell size UAV: 0.05 m

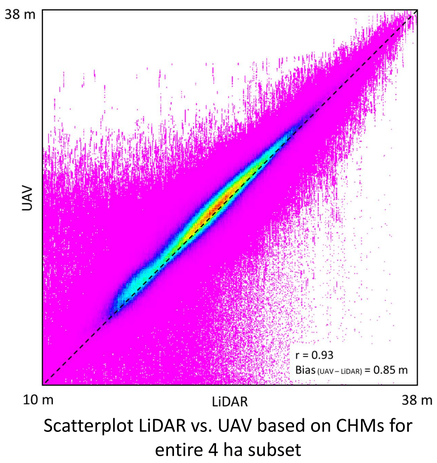
- The difference image LiDAR–UAV (not shown) primarily reveals differences in areas with small trees, also the treetops are slightly higher in the UAV data



LiDAR CHM Subset. Small trees can be hardly discriminated.



UAV CHM Subset. Better resolution and more details.



Scatterplot LiDAR vs. UAV based on CHMs for entire 4 ha subset

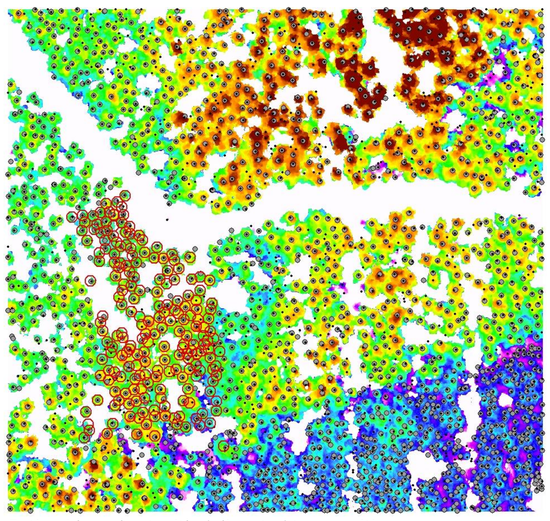
Tree detection

COMPARISON OF LiDAR AND UAV BASED TREE DETECTION

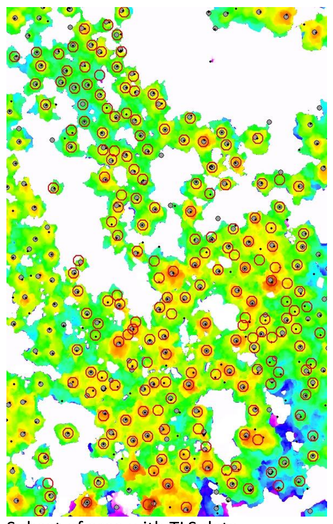
- Tree detection based on local maximum algorithm using an adaptive search window size (Popescu & Wynn 2004)
- Window size is based on relation between tree height and crown diameter, which was estimated for the study site
- Reference data: TLS point cloud (Riegl VZ 1000) (position of 205 trees was manually determined)

LiDAR	
Detection rate:	78,0% (45 trees)
Commission:	9,8% (20 trees)
UAV	
Detection rate:	93,2% (14 trees)
Commission:	10,7% (22 trees)

UAV-based tree
LiDAR-based tree
TLS-based tree (reference)



Entire 4 ha subset with delineated tree positions.



Subset of area with TLS data.

SUMMARY – CONCLUSIONS – OUTLOOK

- In general good agreement between LiDAR and UAV based data/products with a slight advantage of UAV
- In some cases LiDAR penetrates deeper into the canopy (mind differing season of acquisition)
- UAV data exhibits more details which is useful to detect small trees
- UAV data can be an alternative for areas where no LiDAR data is available or frequent acquisitions are required
- Study will be extended to larger area including broad leafed trees

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