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STW Enabling new technology
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RiverCare Towards self-sustaining multifunctional rivers

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Monitoring vegetation phenology of grassland, herbaceous and helophyte vegetation with remote-sensing

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Problem definition

- 'Working with nature' allows for more spatial variation of floodplain vegetation
- Classification accuracy low for grassland and herbaceous vegetation in current ecotope maps
- RS obtained multi-temporal data sets may reveal new possibilities

Research aim

Monitor phenology profiles of grassland, herbaceous and helophyte vegetation in floodplains based on multi-temporal high-spatial-resolution remote-sensing data

Study area

- Breemwaard floodplain along the river Waal
- High variability of vegetation types and structures

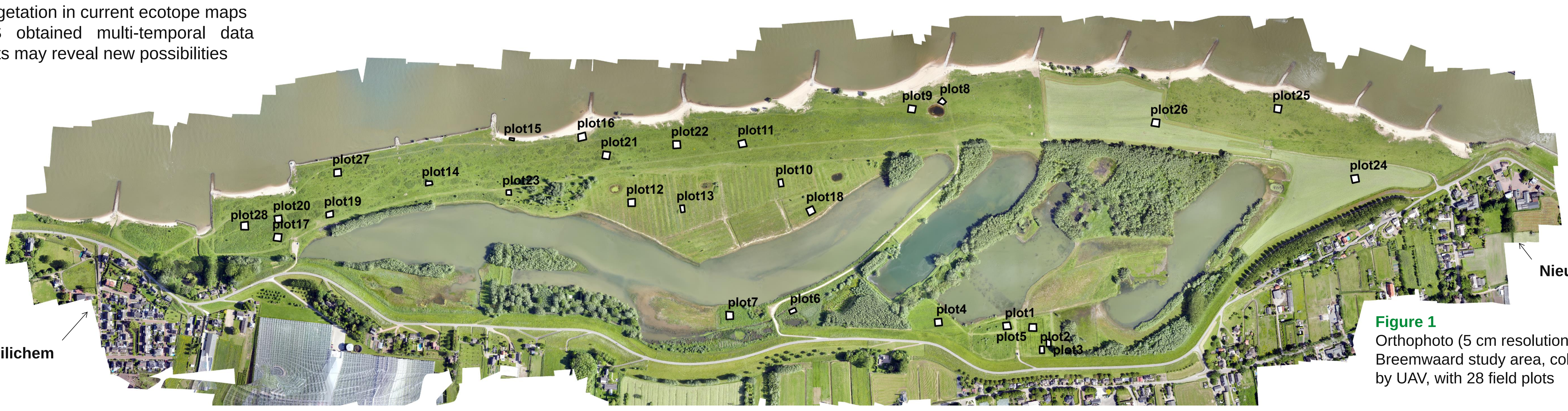

Figure 1
Orthophoto (5 cm resolution) of Breemwaard study area, collected by UAV, with 28 field plots

Materials and Methods

- Ongoing 18 months (August 2014 – January 2016) data collection
- Laser scanning data recorded from **airborne** platforms (ALS) and **terrestrial** mobile platform (MLS)
- Stereoscopic airborne imagery collected with a Unmanned Airborne Vehicle (**UAV**)
- Mean vegetation height (Hv) measured for 28 **field plots** of grassland, herbaceous and helophyte vegetation, simultaneously with the UAV campaigns
- Point clouds derived from the UAV imagery with the **Surface-from-Motion** (SfM) technique[1]
- Vegetation height from the RS data as height below which 95% of the points in the point cloud are located = 95th percentile (**P95**)
- Point clouds for true colour (**RGB**) & false colour (**NIR-GB**), with near infrared
- P95 of February used to normalize P95 of April, June and September
- Colours of the points in the SfM derived point cloud to calculate vegetation indices Normalize Difference Vegetation Index (**NDVI**) and Greenness Index (**GI**):

$$\mathrm{NDVI} = \frac{\mathrm{NIR}-\mathrm{Blue}}{\mathrm{NIR}+\mathrm{Blue}} \qquad \mathrm{GI} = \frac{\mathrm{Green}}{\mathrm{Blue}+\mathrm{Green}+\mathrm{Red}}$$

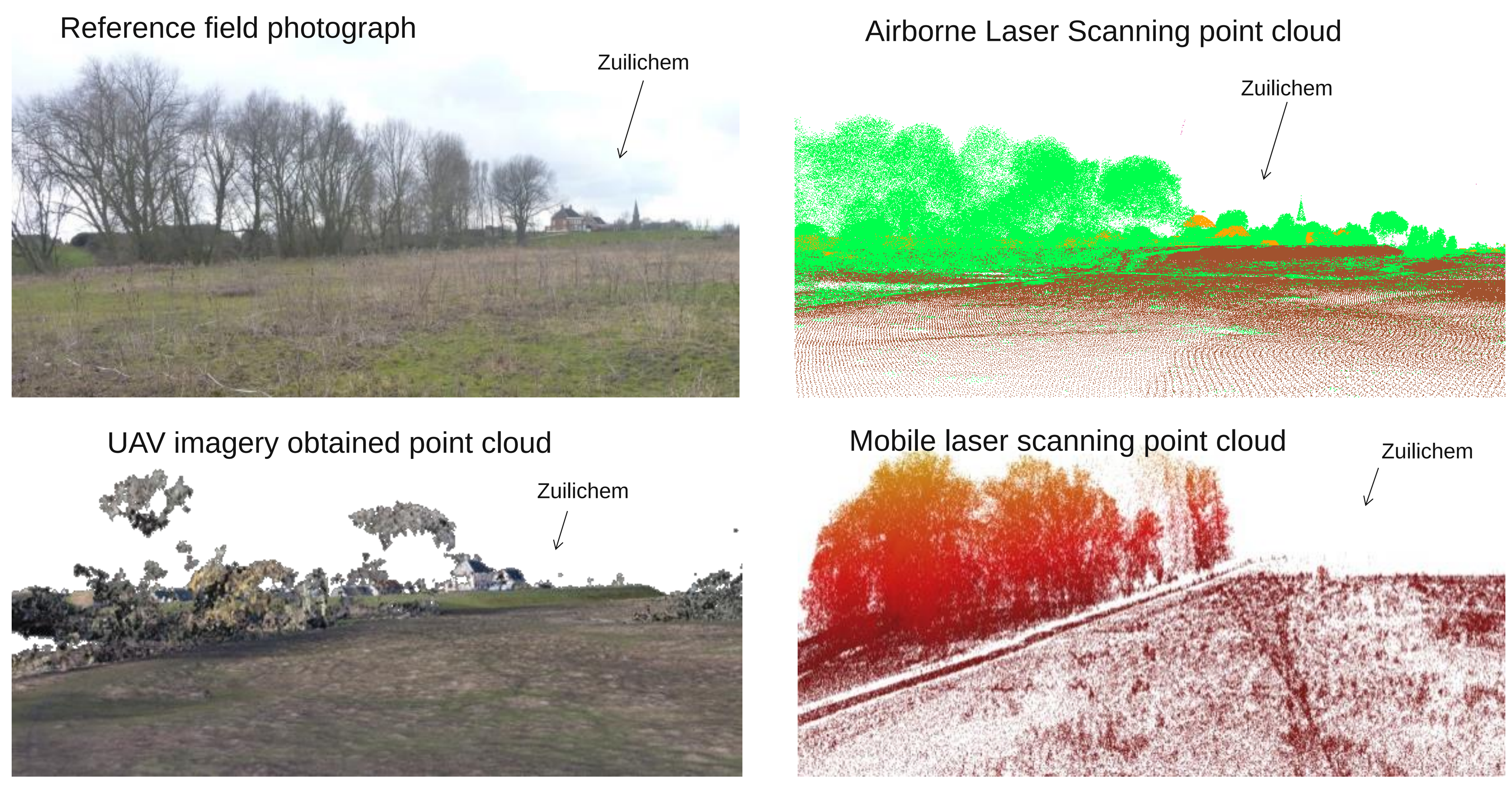

Figure 2 Examples of the height models collected with different techniques: ALS, MLS and UAV.

Preliminary results

- So far, four field campaigns: February April, June and September 2015

NDVI and Greenness

- Increase for both NDVI and GI, but higher correlation between NDVI and Hv than GI and Hv
- Increase of NDVI and GI precedes increase in Hv during growing season
- Decrease of GI between Jun and Sep, indicates the start of senescence of vegetation
- Decrease of NDVI between Jun and Sep only for plot 9

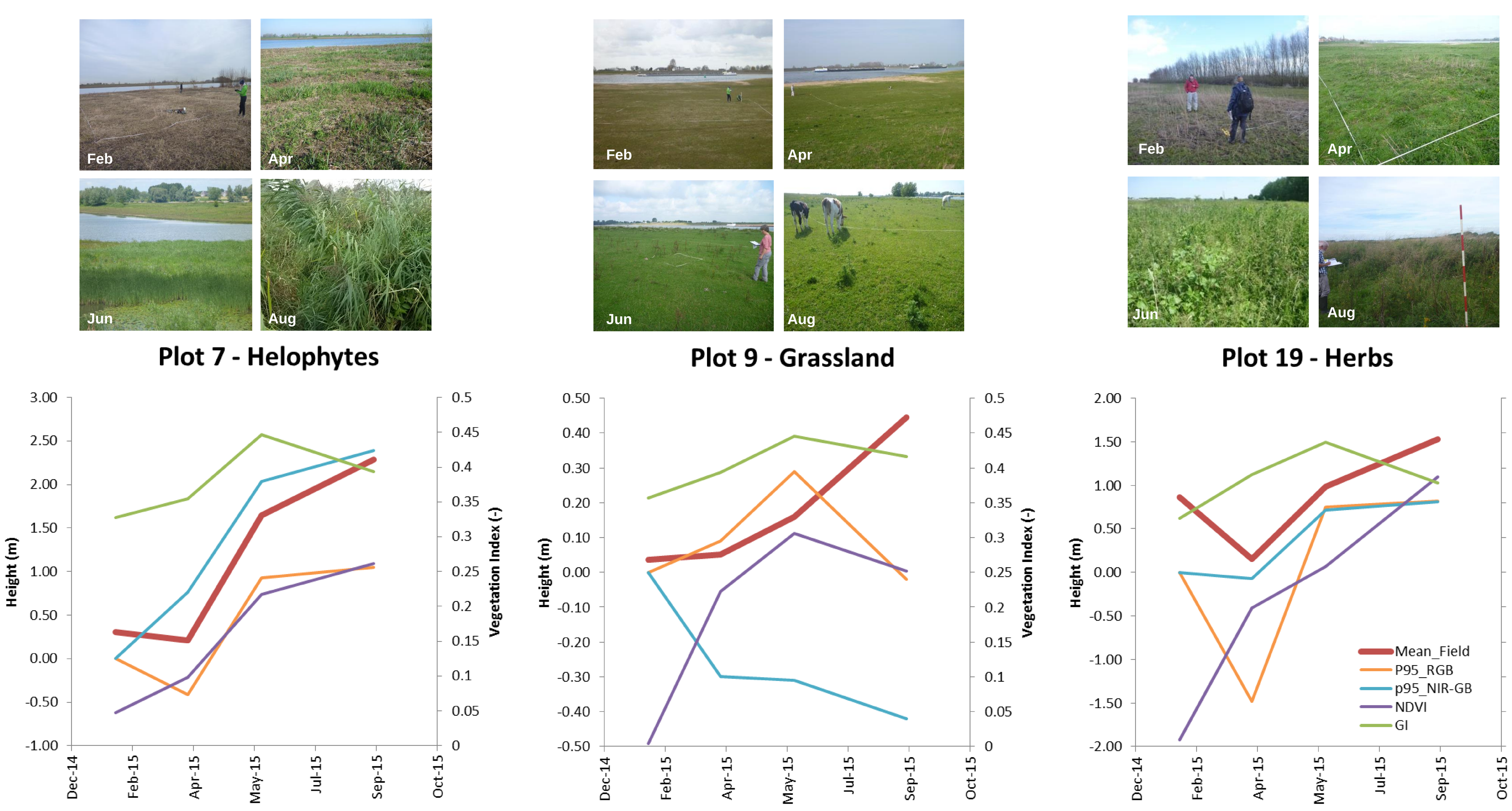

Figure 3 Comparison field vegetation height and SfM derived phenology of true and false colour imagery

Vegetation height

- P95 height from the RGB point clouds correlates with Hv of plot 7 and 19
- P95 height from the NIR-GB images only correlates with Hv for plot 19
- Relatively high Hv in February for plots 7 and 19 due to presence of senescent vegetation of 2014 growing season > Normalization with the February point cloud is therefore arguable

Preliminary conclusions

- Increase in NDVI and GI precedes vegetation height increase during growing season
- Correlation between NDVI and Hv is higher than between GI and Hv
- Some correlation between P95_RGB vs. Hv and between P95_NIR-GB vs. Hv, but also outliers

  > Further refinement of the method is needed

Outlook

- UAV and/or LiDAR remotely sensed vegetation height may be used as additional information during the classification of vegetation at floodplain scale
- Monitoring vegetation height over time in this study may be indicative for the best time to collect the remote-sensing data for mapping purposes

References
[1] Lucieer, A., De Jong, S. M., & Turner, D. (2014). Mapping landslide displacements using Structure from Motion (SfM) and image correlation of multi-temporal UAV photography. Progress in Physical Geography, 38: 97–116

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