

Very High Resolution imagery for forest condition monitoring in Wallon Region

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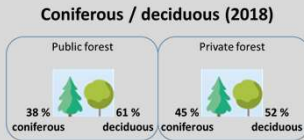
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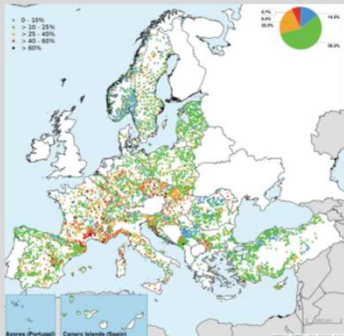
Wallon forests, as mostly worldwide forest, are impacted by climate changes

Wallonia: 16901 km²
~33 % of forest (~5540 km²)
49% public
51 % private



Source SPW - http://stat.environnement.wallonie.be/files/Infographic_2021/PDF/10.Fur%ac3%aats.pdf

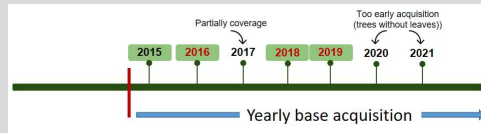
Crown condition, soil condition and foliar nutrient status are main indicators for forest health, collected in a standardised way by the ICP Forest monitoring network.



Mean defoliation of trees at monitoring plots (all tree species), 2018
State of Europe's Forests 2020, Forest Europe.

Remote Sensed VHR images

Orthophotos
(R.G.B.I.R - 25 cm)



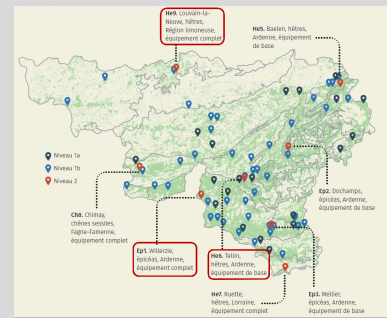
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Ground data

(level 2 plots: 8 in Wallonia since 1999, **1, 6 and 9** included in this study)

| Survey | Frequency |
|--------------------------------|---------------------------------|
| Crown condition | annually |
| Foliar chemistry | every 2 years |
| Soil chemistry | every 10 years |
| Tree growth | every 5 years |
| Ground vegetation | every 5 years |
| Stand structure incl. deadwood | test phase ongoing |
| Epiphytic lichens | test phase ongoing |
| Soil solution chemistry | continuously |
| Atmospheric deposition | continuously |
| Ambient air quality | continuously |
| Meteorology | continuously |
| Phenology | several times per year |
| Litterfall | continuously |
| Remote sensing | preferably at plot installation |

Data available at tree level



Localisation of ICP-forests monitoring network (level 1 and 2) in Wallonia

The main objective of this study is to evaluate the potential of aerial ortho-imagery available in Wallonia as complementary source of data for forest monitoring at tree level in framework of ICP Forest network

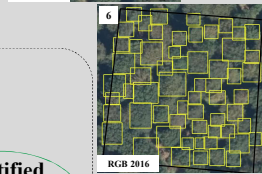
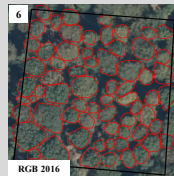
METHODOLOGY

Semi-supervised deep learning work-flow: **DEEFOREST** (Weinstein et al., 2020b, c)

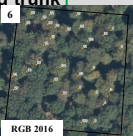
Tree Crown Delineation

TRAINING – 2016 (manual delineation of crowns)

RUN – 2016, 2018, 2019



Tree identification (crown and ground trunk position)

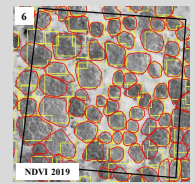
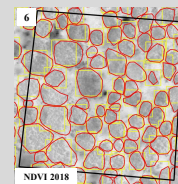
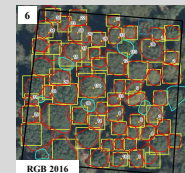


dGNSS measurement + laser system

Ground position of trunks

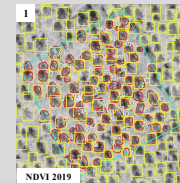
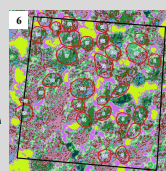
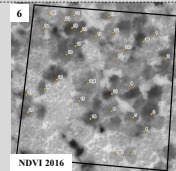
Identified crowns on orthoimagery

PRELIMINARY RESULTS

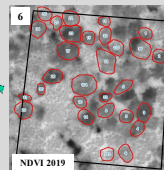
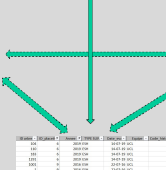
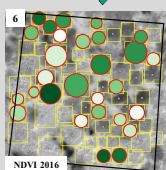
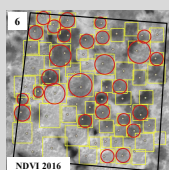


Normalized Difference Vegetation Index (NDVI) calculation

$$NDVI = \frac{(NIR - R)}{(NIR + R)}$$



Comparison between ground measurement (defoliation, etc ...) and NDVI extracted for each identified tree



PERSPECTIVES

- Comparison with ground data
- Testing impact of acquisition date of RS

Weinstein, B.G.; Marconi, S.; Bohman, S.; Zare, A.; White, E. Individual Tree-Crown Detection in RGB Imagery Using Semi-Supervised Deep Learning Neural Networks. Remote Sens. 2019, 11, 1309

The work was done in the framework of CARTOFOR research project :

