Bern University
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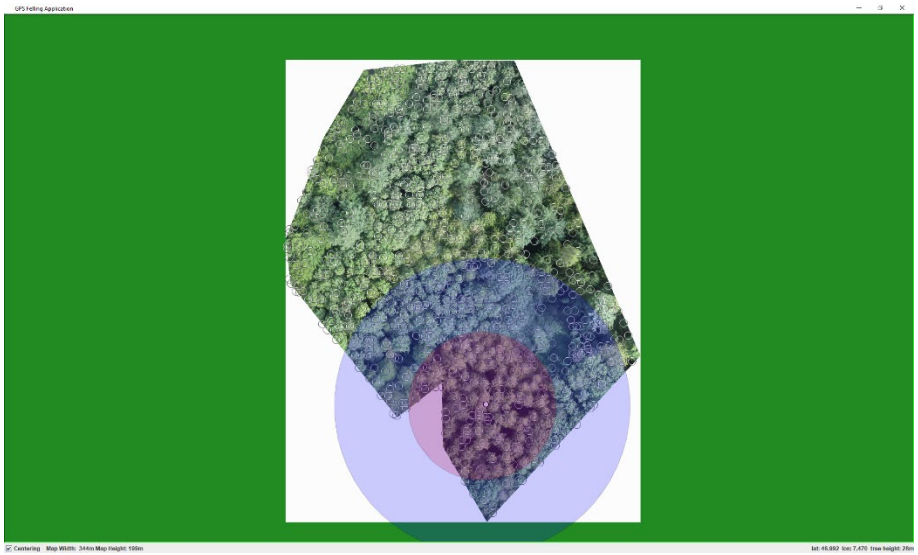


Work safety improvement for motormanual felling operations

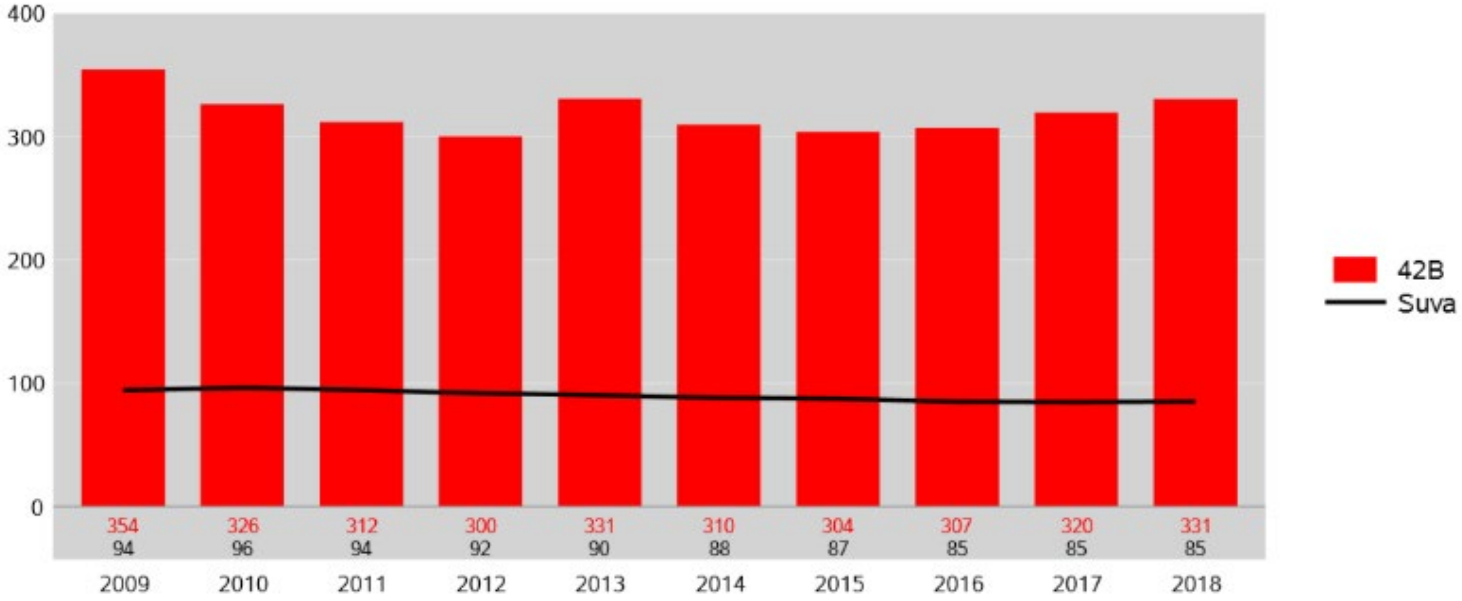
General thoughts and presentation of a prototype tool

School of Agricultural, Forest and Food Sciences HAFL Patrick Dietsch, Michael Starke, Martin Ziesak 07.10.2019

Introduction – accident statistics

Case risk

Newly registred, accepted cases per 1’000 full-time employees

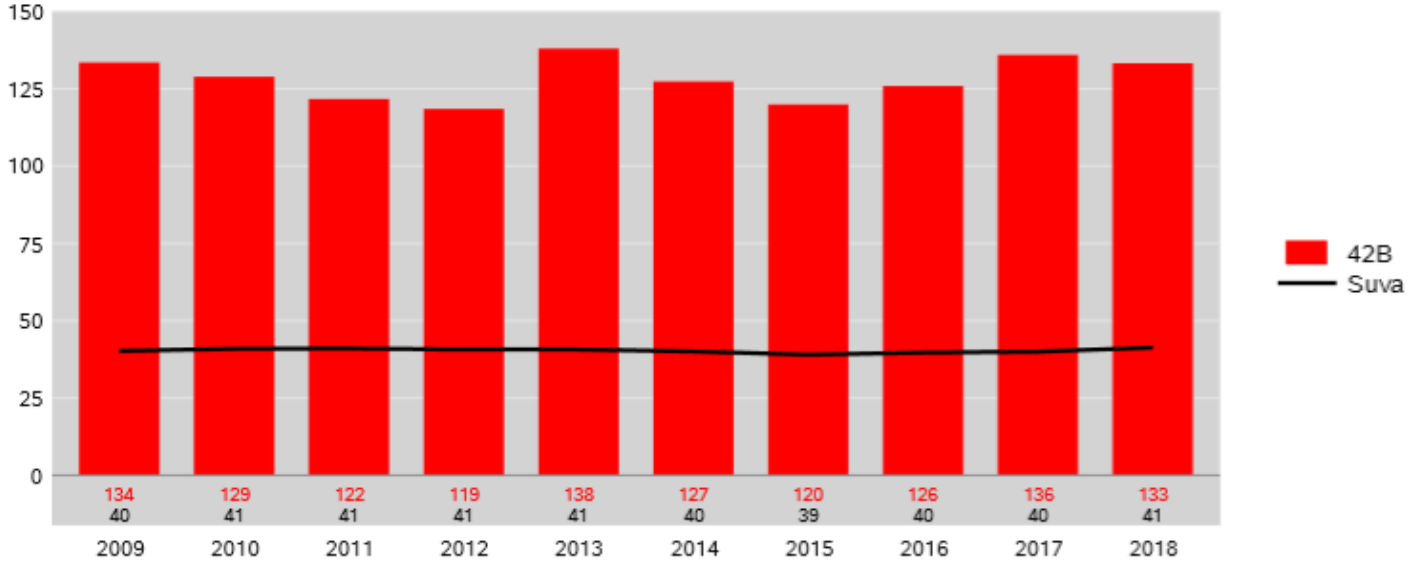


Number of accidents – forestry (Suva 2018a)

Introduction – accident statistics

Risk of daily allowance cases

Cases with daily allowance per 1'000 full-time employees



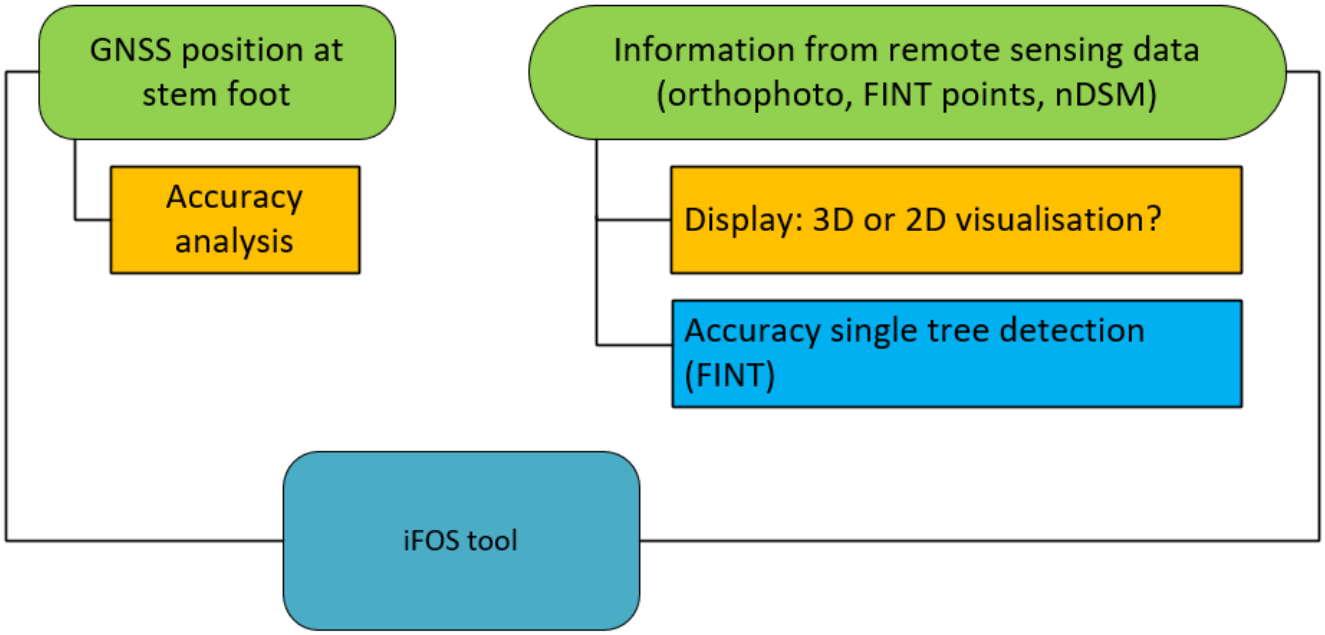
Number of accidents with daily allowance – forestry (Suva 2018a)

- Forest accident statistics still worrying
- Many accidents in motor manual felling:
  insufficient or missing tree and environmental evaluation (Suva 2018b)

Project objectives

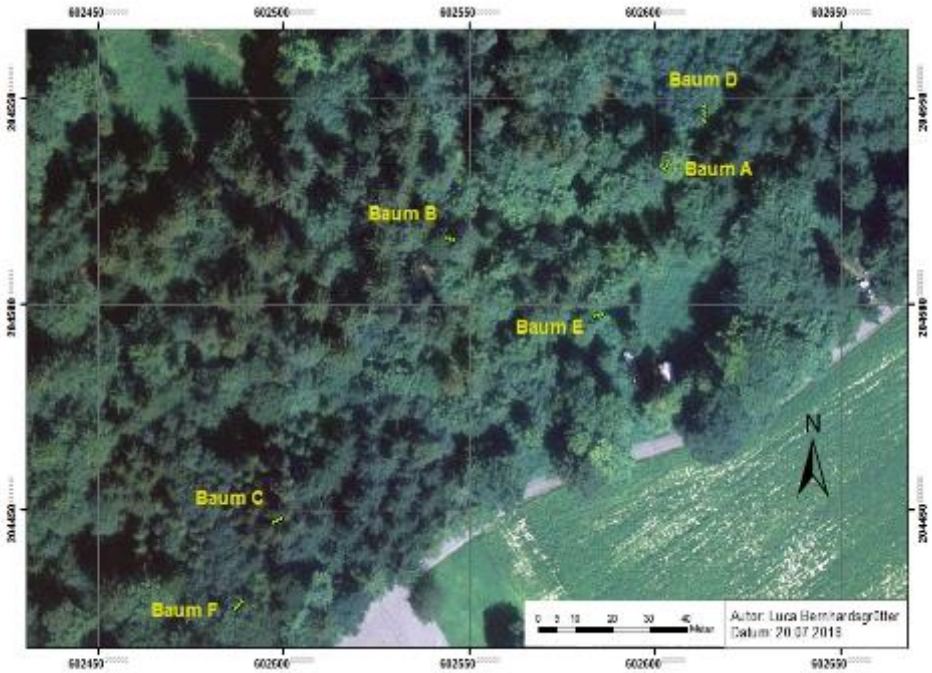
- Reduce the number of accidents in motor manual felling
- Support forest workers in the evaluation of felling and danger area with modern technologies
  - bird's eye perspective
  - Remote sensing (drone and LiDAR) and GNSS data
- Development of a prototype
  - Programming for iFOS
  - Visualisation of potential felling and danger area based on remote sensing and GNSS data

Material and methods - Overview scheme



- Development with data from Switzerland
- Application tested with data from Germany

Material and methods - GNSS accuracy analysis



Measuring points for the accuracy analysis with GNSS sensors (Source: Bernhardsgrütter 2018)

- Geodetic survey
- Recording concept:
  - Factors: degree of coverage & lateral shading
  - Sensor dependent (App / datalogger)
  - 2D position accuracy

Material and methods - GNSS sensors

M8N sensor (Source: u-blox AG 2015)

- Single-frequency receiver
- GPS and GLONASS signals
- Patch antenna
- ca. 160 euro

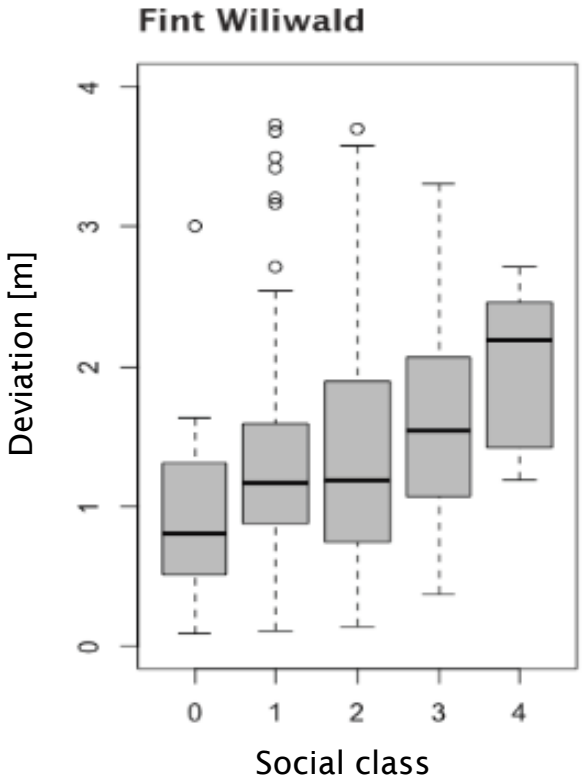
10xx sensor (Source: PPM GmbH 2017)

- Dual-frequency receiver
- GPS and GLONASS signals
- Helix antenna
- Ca. 2’200 euro

Material and methods - Remote sensing data

- Drone eBee RTK: sensefly, 18.2 megapixel camera, high precision GNSS
- Used in previous research projects

Results – Accuracy single tree detection

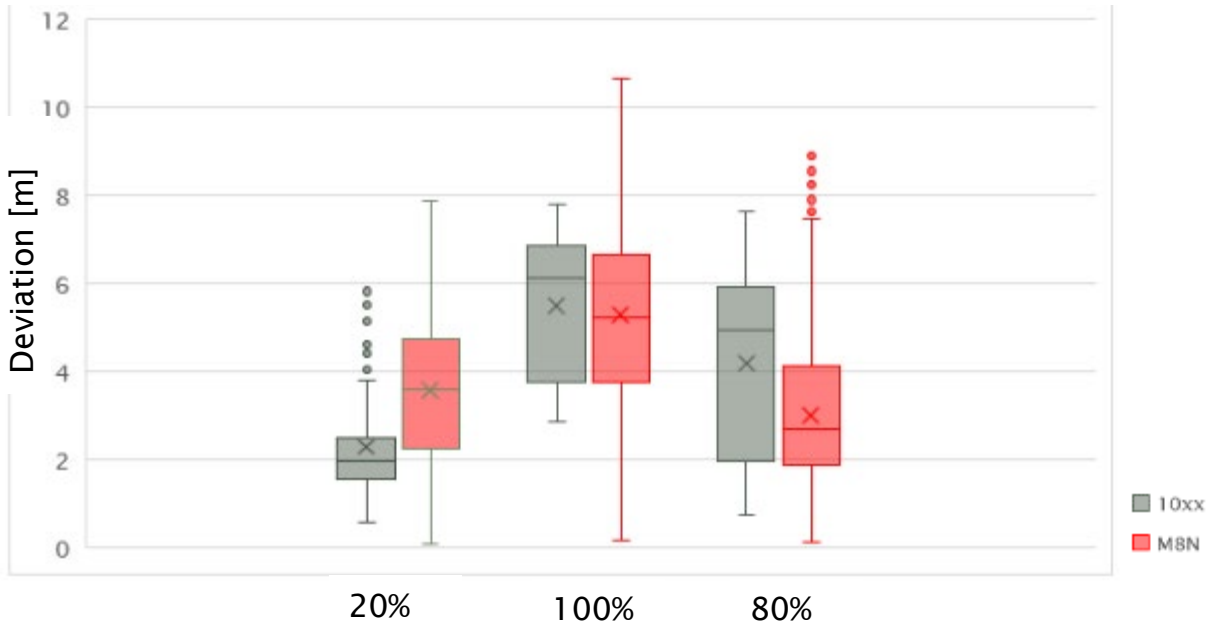


Deviation of stem foot coordinates according to «Kraft's tree classes» for FINT (n=25 (0), 85 (1), 58 (2), 26 (3), 5 (4)) in marteloscope Wiliwald (Condrau 2017, modified)

- Accuracy for tall trees better than 2m
- Flat terrain, hard- and softwood

Results - Accuracy analysis GNSS sensors

Degrees of coverage



Sensor deviation (M8N & 10xx) for different degrees of coverage (n = 93 for 10xx; n = 903 for M8N)

- higher coverage = lower accuracy

Results - Accuracy analysis GNSS sensors

Distance to tree	10xx sensor	M8N sensor
1m	2.82m	4.44m
3m	2.79m	4.41m
All measurements	2.87m	4.83m

Sensor accuracy over the first 5 minutes of all measurements at 1-3m distance to the tree (n=186 each for 10xx; n =1806 each for M8N) and accuracy over all measurements (n = 890 for 10xx; n = 8720 for M8N)

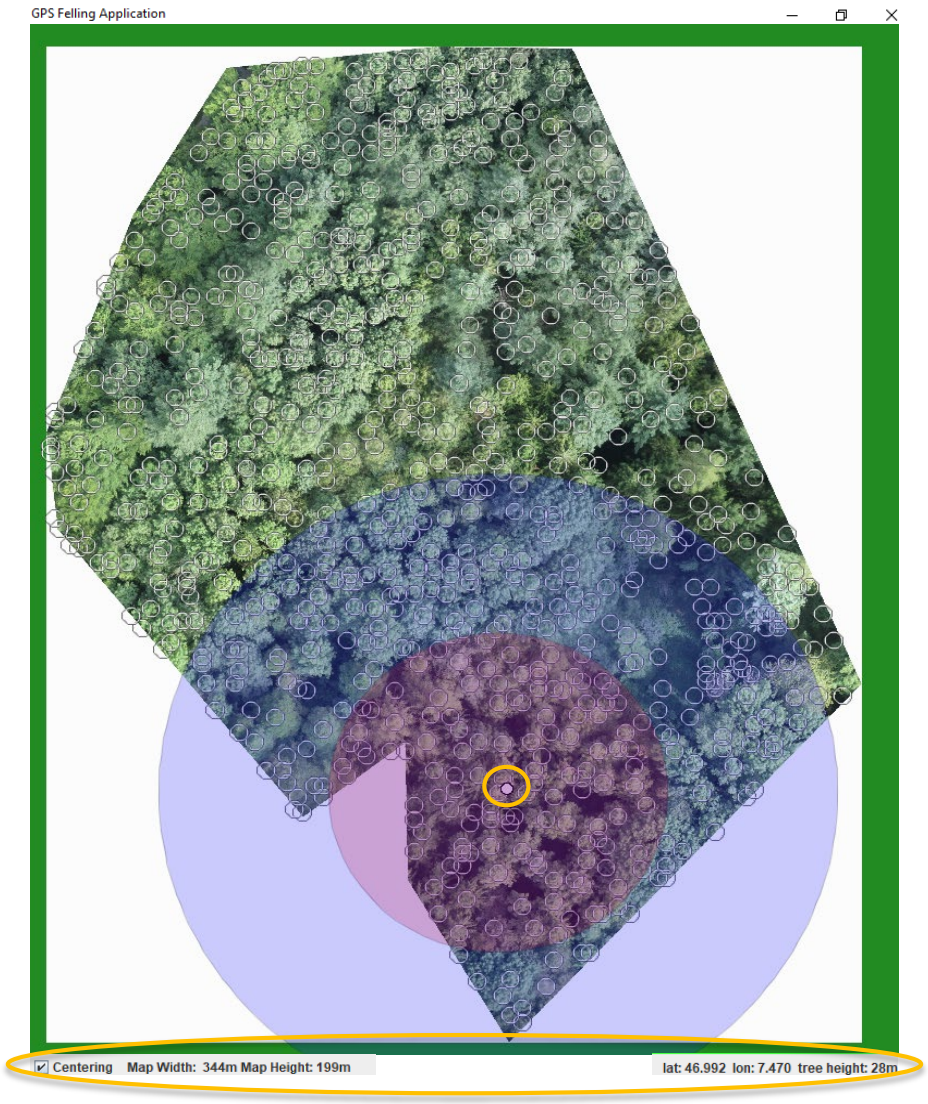
- Distance to the tree: no significant influence on the accuracy or overlapped by other factors

Results - 3D view of drone data

3D PDF Wiliwald with enlarged image section

- Insufficient detailing
- High required computing power: image disappears when rotating
  → 3D visualization rejected

Results – Prototype: 2D visualisation in iFOS



Discussion & conclusion

- Additional information: size of potential felling and danger area
  - 2D visualisation works -> 3D visualisation?
  - GNSS position 3 to 5m -> needs verification
  - Modular system
    - GNSS sensors / GIS layer
- Possibilities of using:
  - Education and training (sensitisation)
  - Trees near infrastructure
- Further development
  - Improvement of GNSS accuracy
  - Automatisation (visualisation without clicking)
  - Display other forest workers / warning if necessary

Sources

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- PPM (Precise Positioning Management) GmbH 2017. Produktbeschreibung 10xx GNSS Sensor, abgerufen am 11.07.2018, http://www.ppmgmbh.com/ppm_design/ppm-design-pdf/10xx.pdf
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Thank you for the attention!

Questions?