# EXPLORING THE YEAR RING GROWTH OF DOUGLAS FIR AND NORWAY SPRUCE IN RESPONSE TO THE CHANGE IN WEATHER AND CLIMATE

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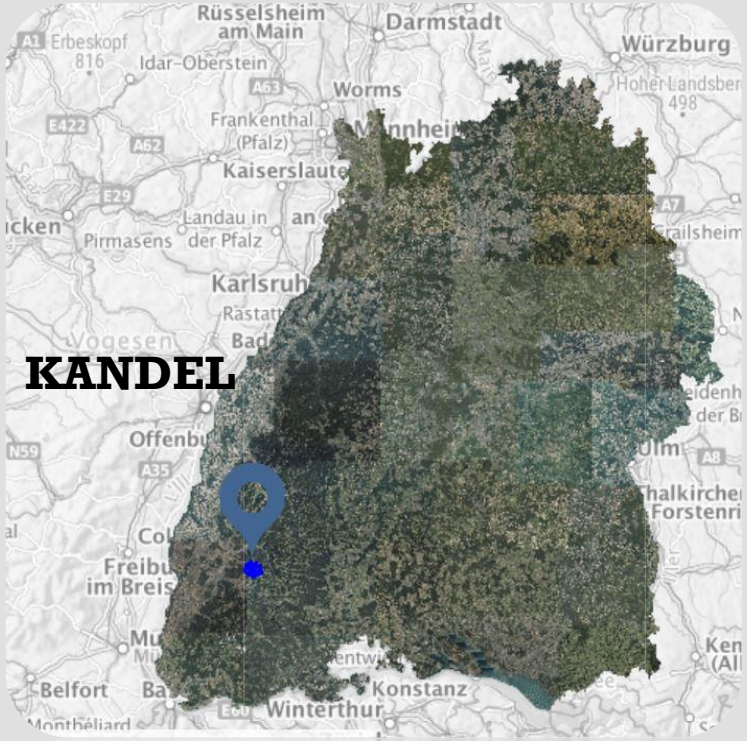
# KONKLIM

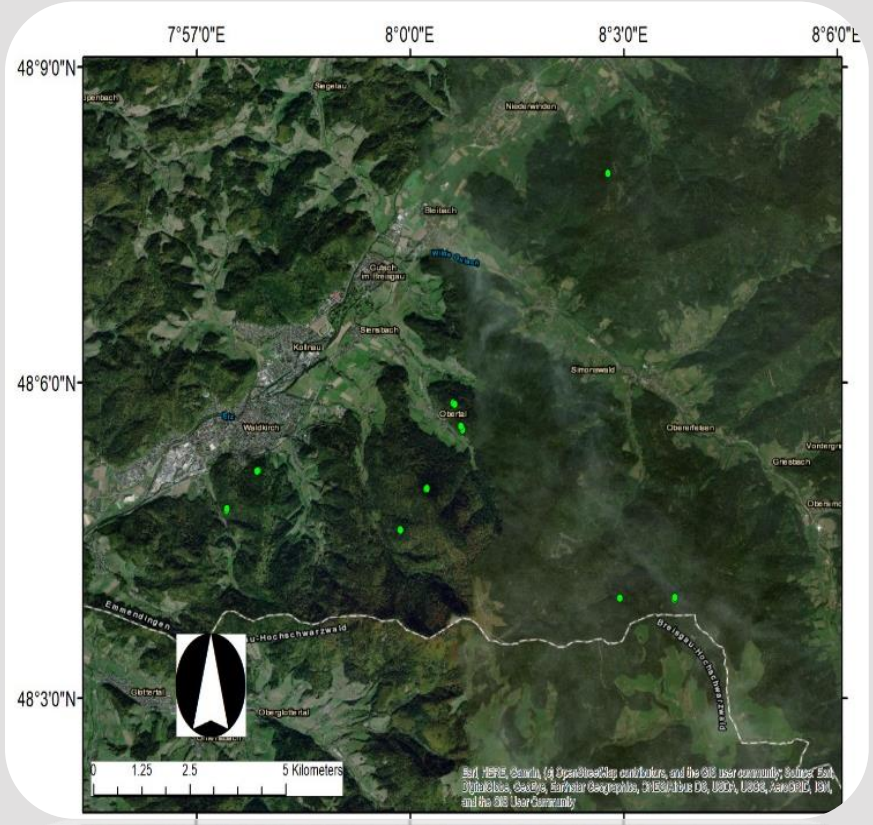
- Joint research project between Forest Research Institute Baden-Württemberg (FVA) and the Chair of Forest Growth of Albert-Ludwigs-University Freiburg (ALU).

- Aim: assess the suitability of three most economically important coniferous tree species Norway spruce, Silver fir and Douglas fir regarding their growth increments to predicted climatic changes in the Black Forest.

- Investigating quantitative wood anatomy




Source: www.Geoportal-BW.de

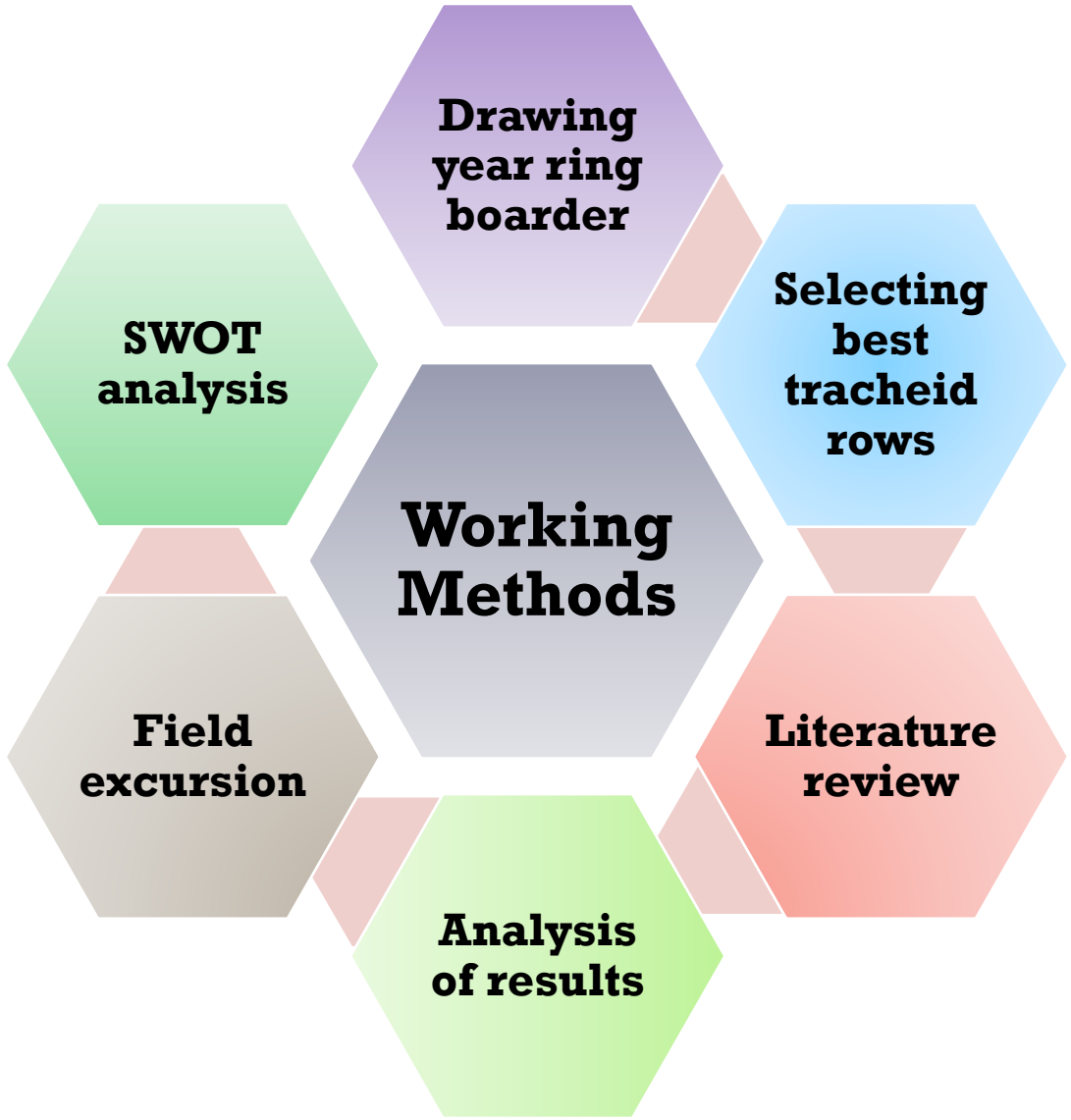



# SELECTED SAMPLE TREES FROM KANDEL

Kandel Location

- 20 selected tree individuals
- Data collected from five altitude level

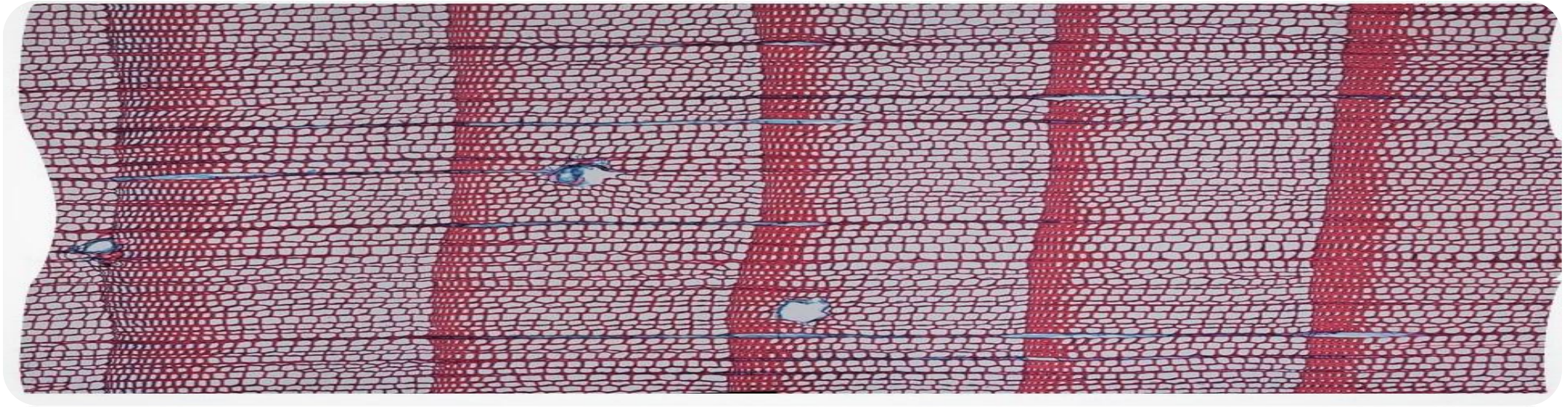
# WORKING METHODS



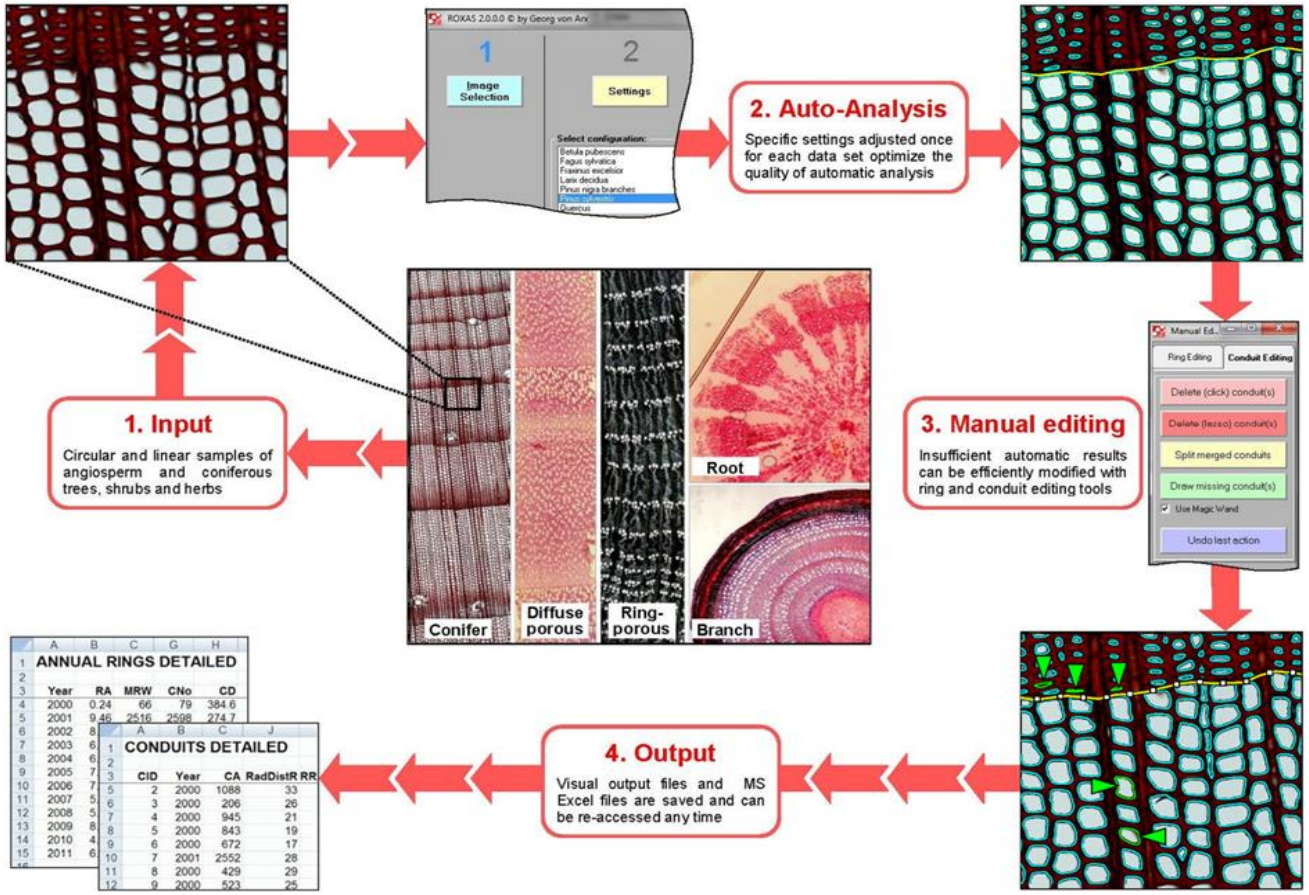

# ROXAS

## ROXAS 3.0

ROXAS is a specialized image analysis tool for quantifying xylem anatomy in circular and linear samples of angiosperms and conifers.

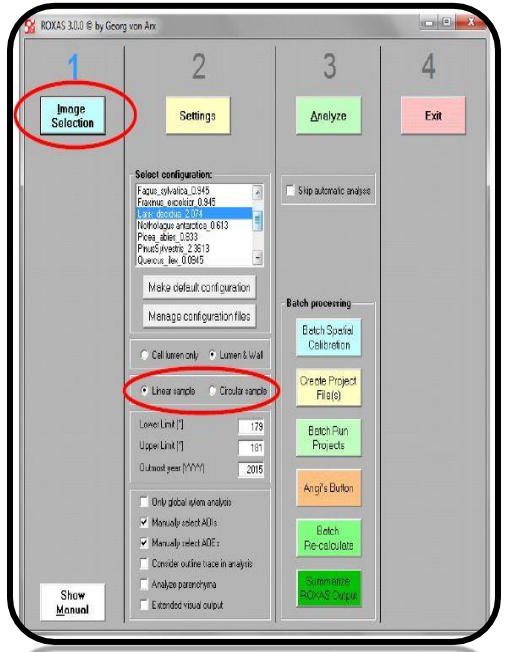


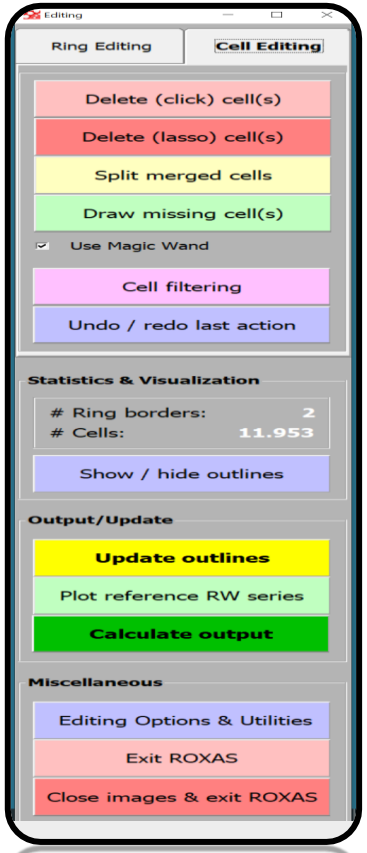
# ROXAS ANALYSIS CYCLE

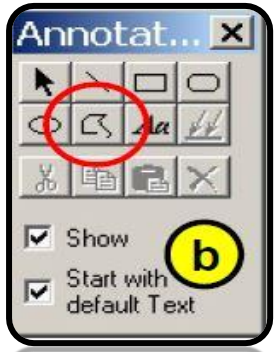


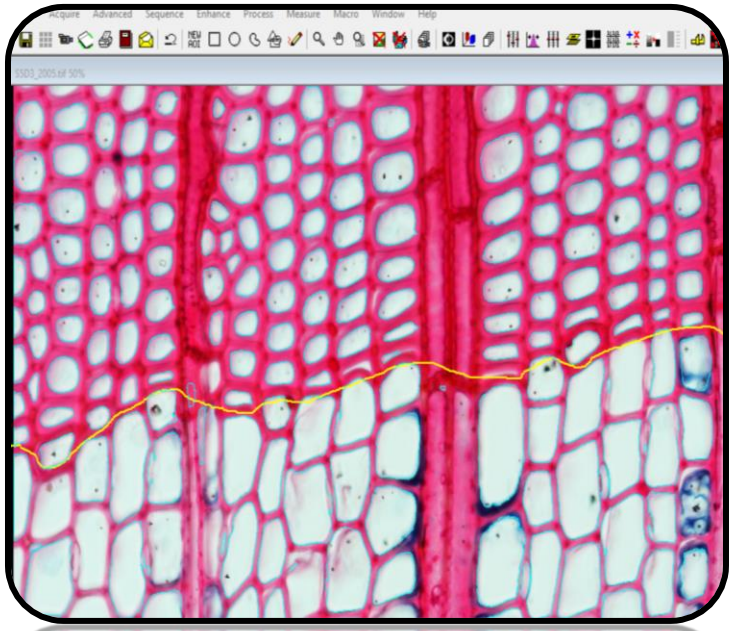

Von Arx, 2016

# TASK 1: DRAWING ANNUAL CELL RING BORDERS



Von Arx, 2016

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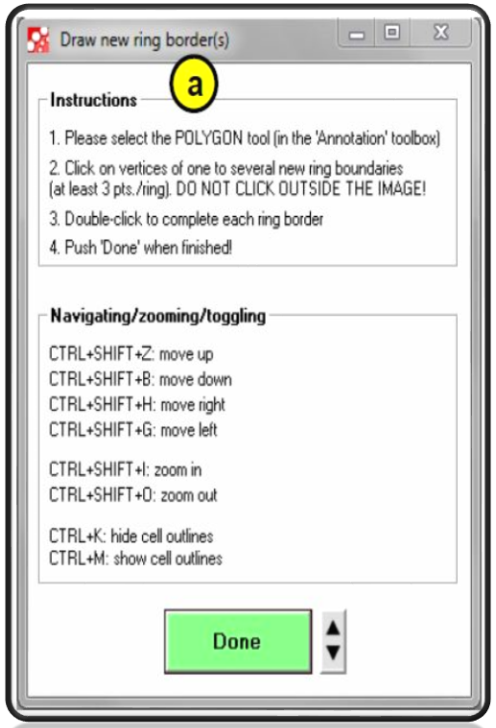
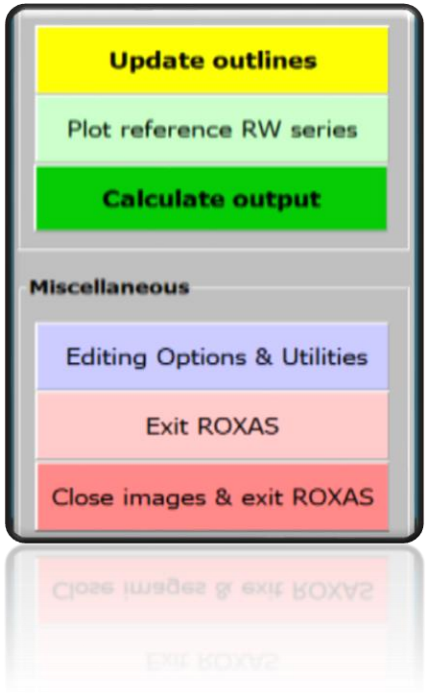
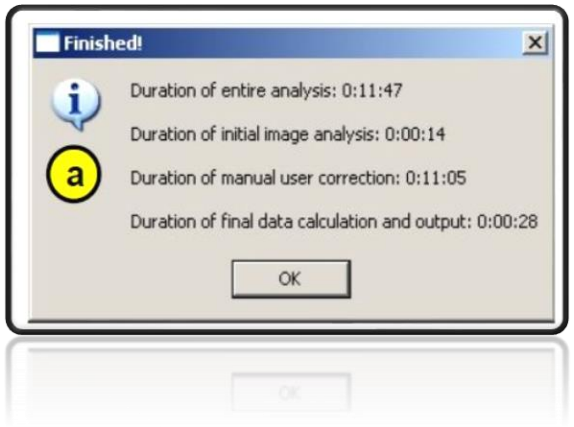
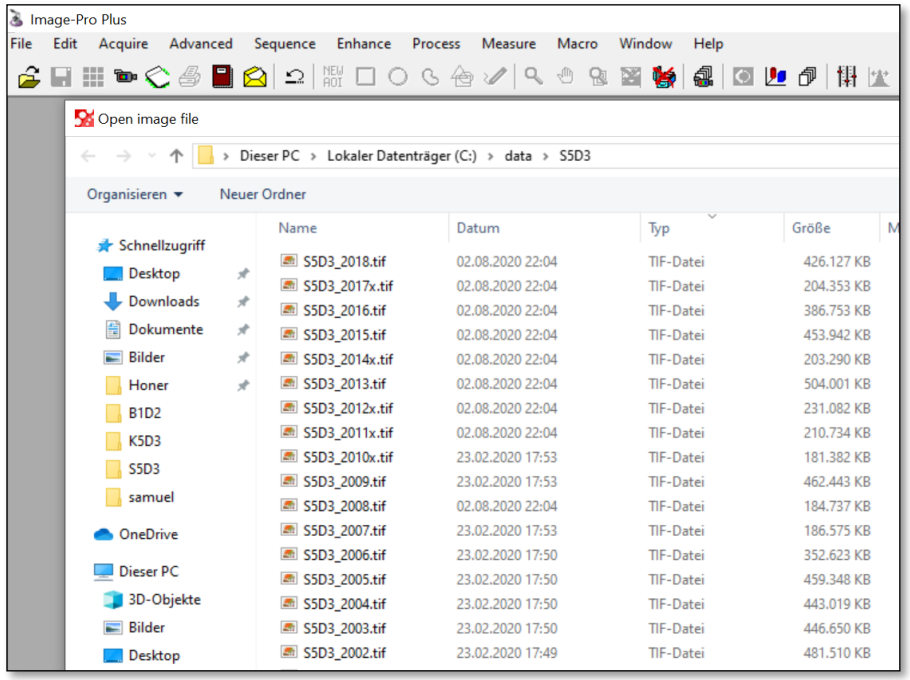


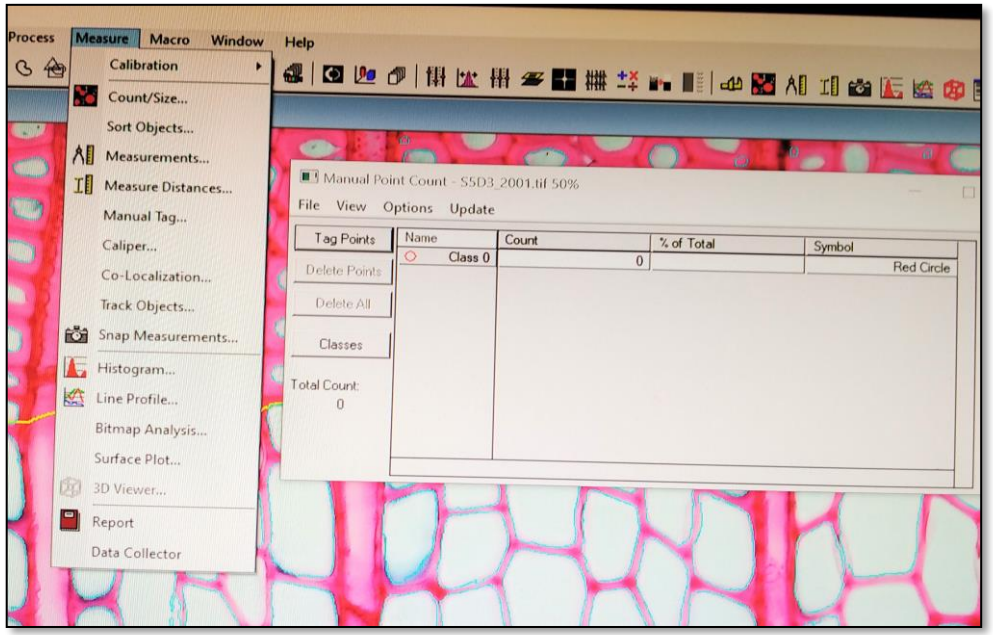




Von Arx, 2016

# TASK 2: SELECTION OF BEST FIVE TRACHEID ROWS



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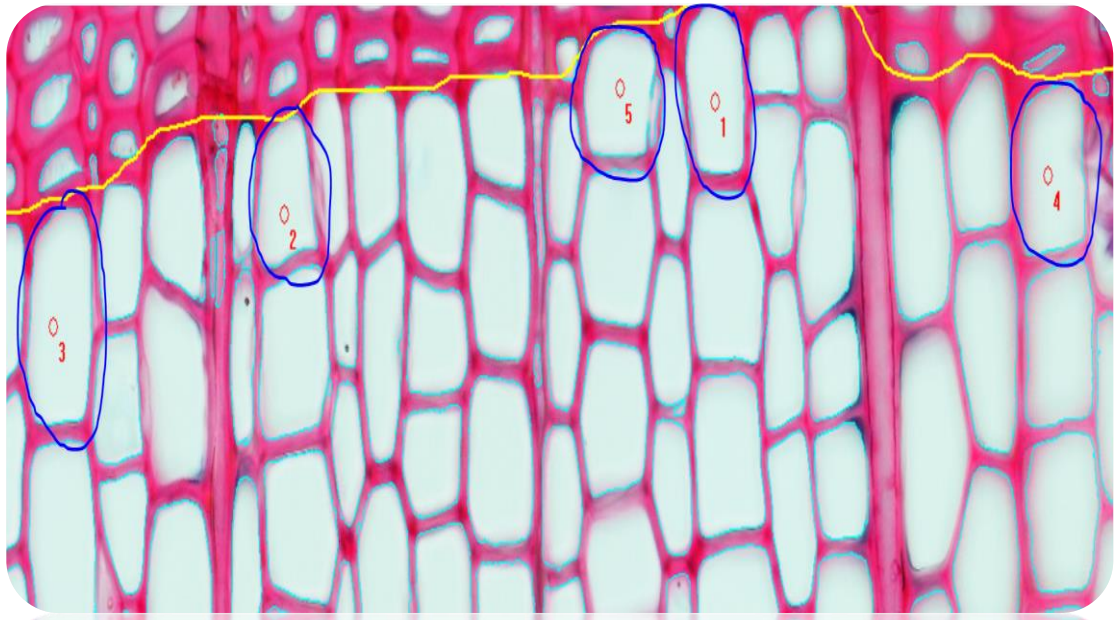
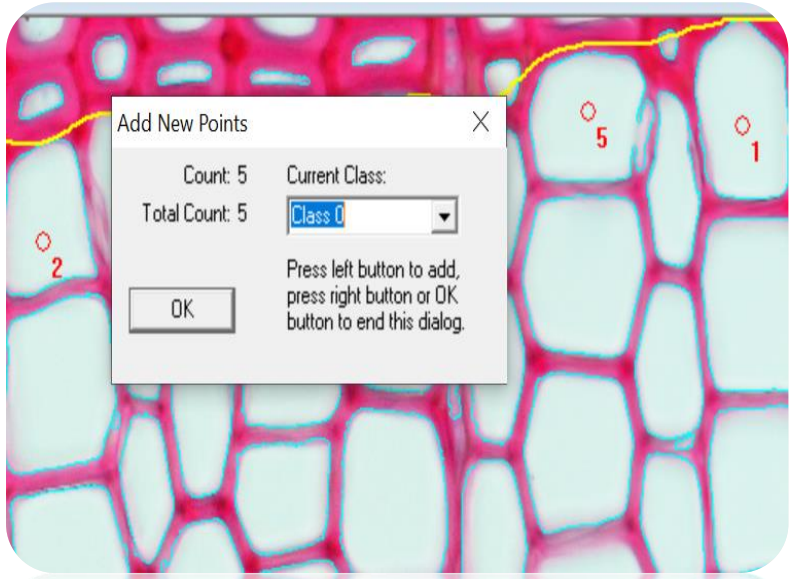



Selected best tracheid rows



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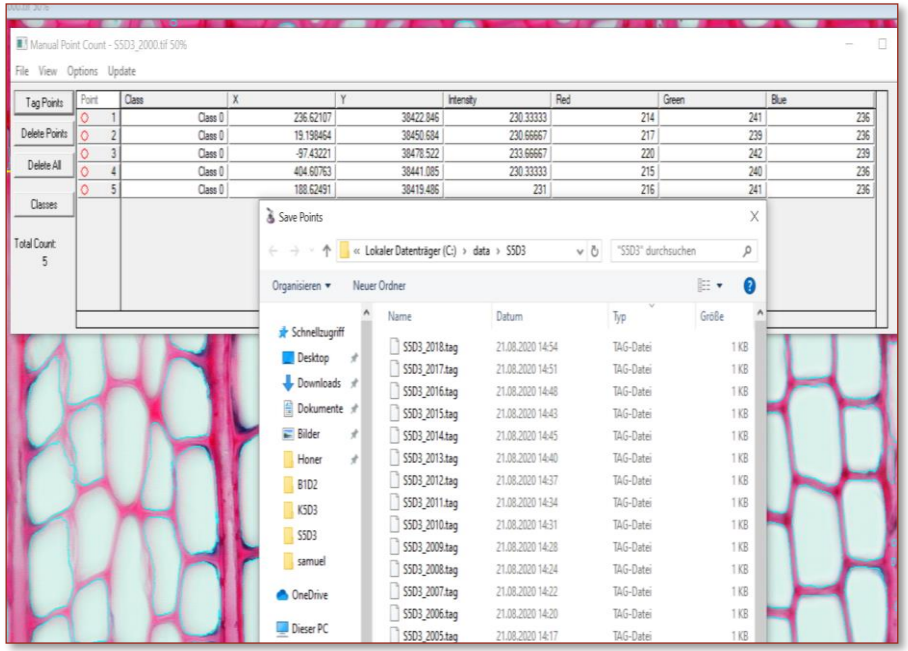
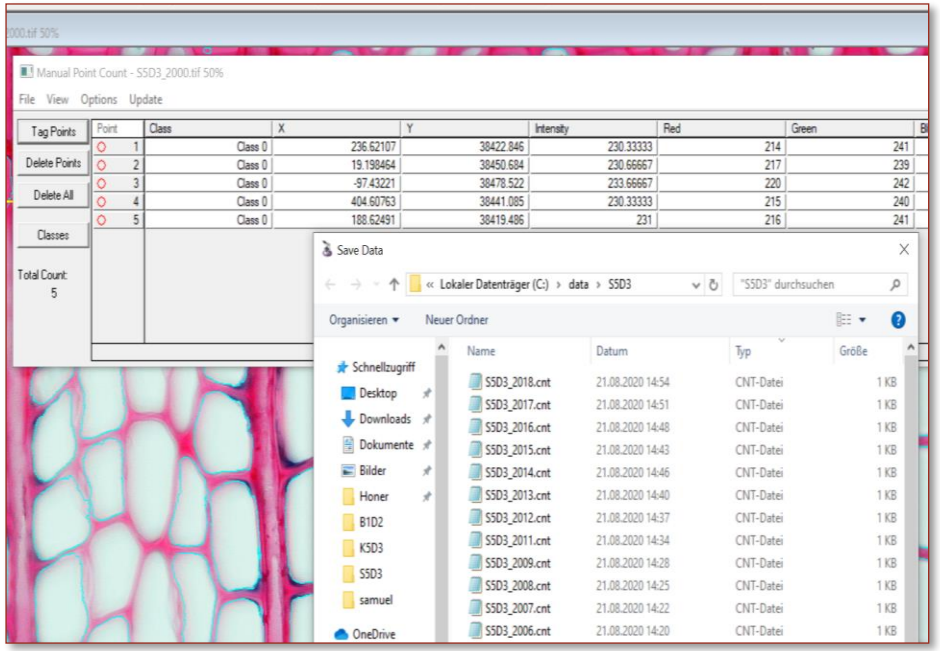
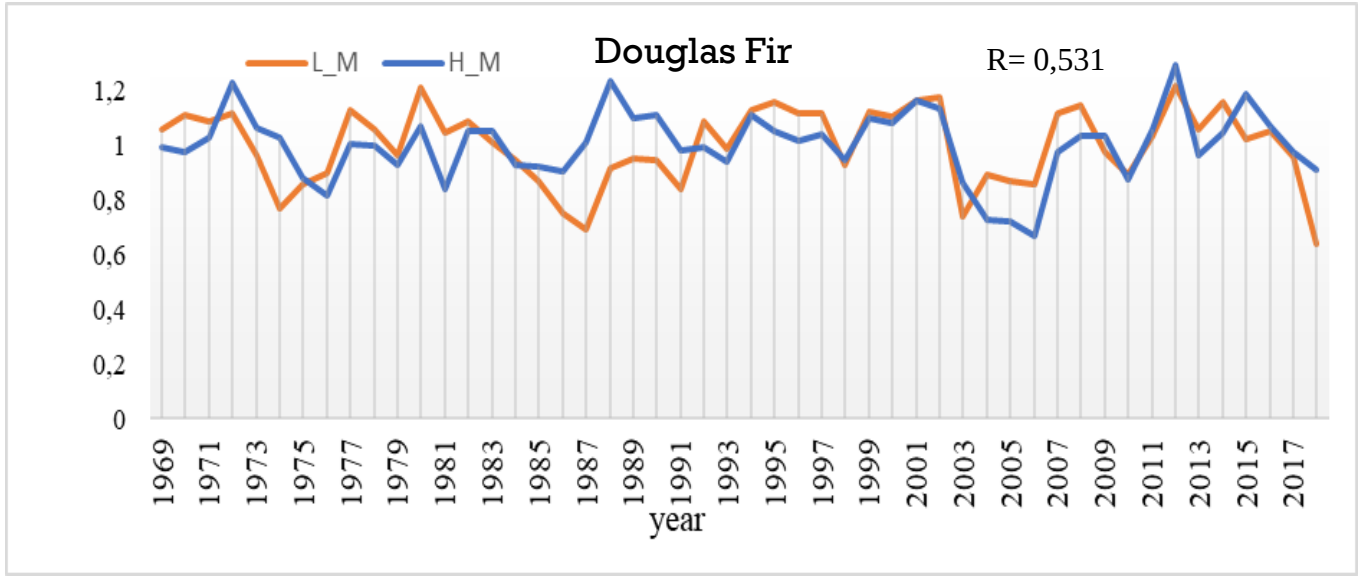


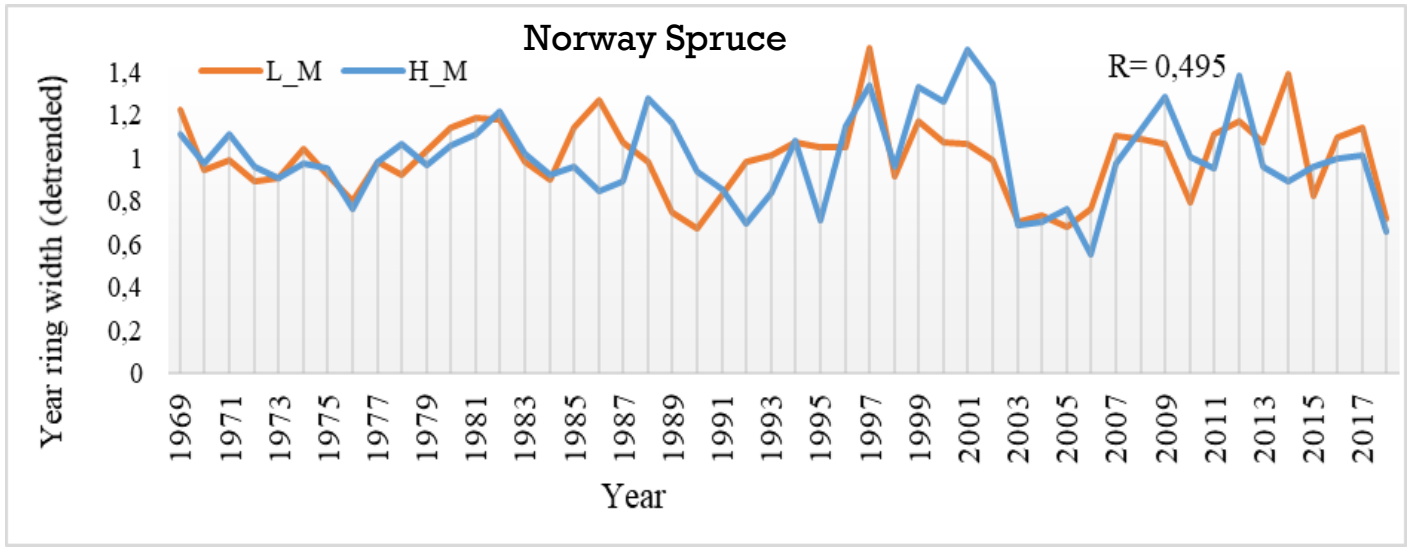

Saving tag files




Saving cnt files


# RESULT ANALYSIS

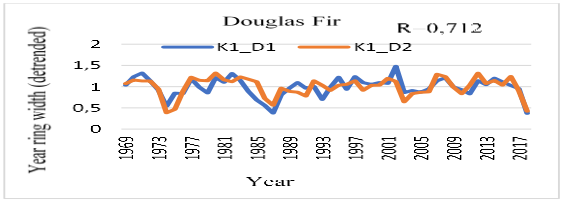


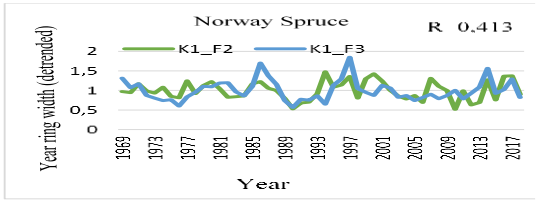



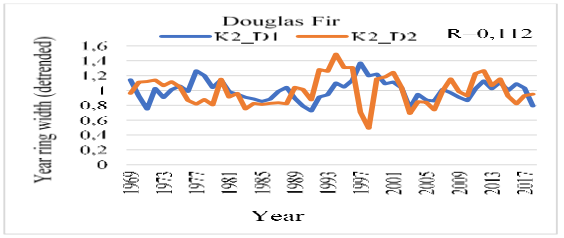

Here, L_M= Lower altitudinal range (350 -650m) and H_M=Higher altitudinal range (650-1100m) of Kandle

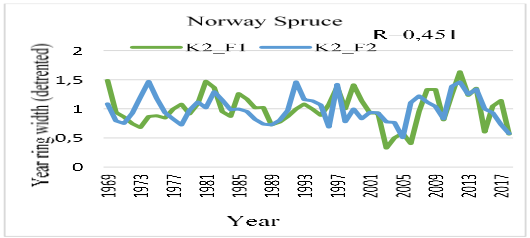
# ANALYSIS OF YEAR RING INCREMENT IN DIFFERENT ALTITUDINAL LEVEL OF KANDLE

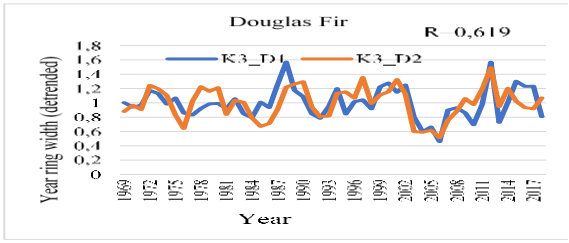
- 20 tree individuals of Norway Spruce and Douglas Fir
- The interseries correlation for both species showed significant differences ($p<0.05$) from each other
- Used dplR package (Bunn 2008)

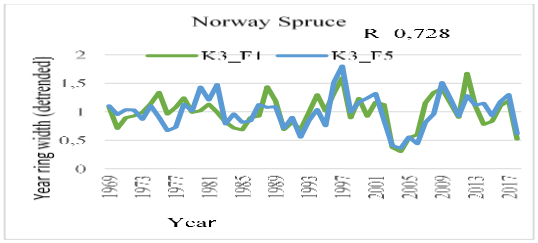


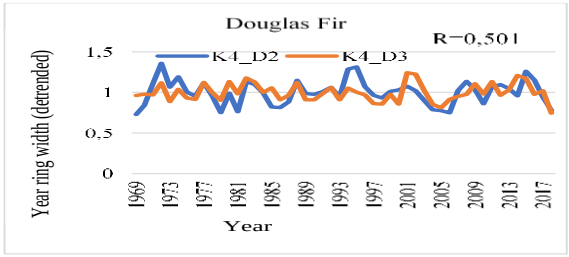



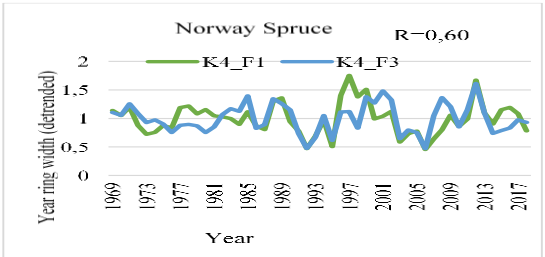



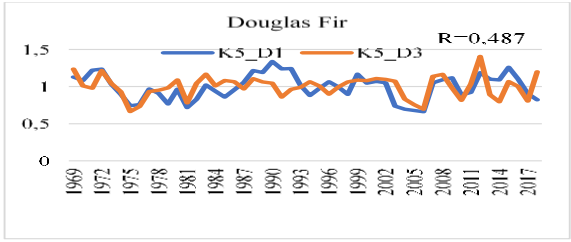



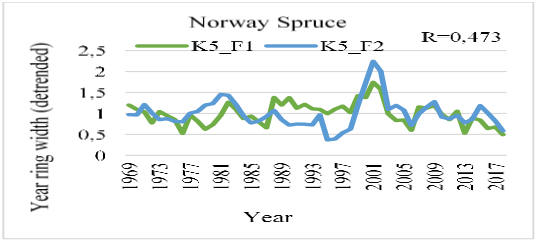



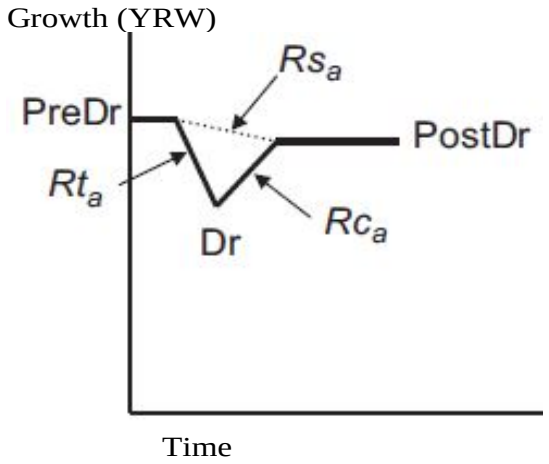

Here, D1= Douglas Fir first, D2= Douglas Fir second, D3= Douglas Fir third tree individual, F1= Norway Spruce first, F2= Norway Spruce second, F3= Norway spruce third, F5= Norway spruce fifth tree individual ; K1= 350-500m, K2= 500-650m, K3= 650-800m, K4= 800-950m, and K5= 950- 1100m range of altitude

# CORELATIONS BETWEEN THE TWO INDIVIDUALS IN FIVE ELEVATION LEVEL

- good corelation is observed in almost every case

# TREES RESPONSE TO DROUGHT EVENT AND THE EFFECT OF GROWING ELEVATION

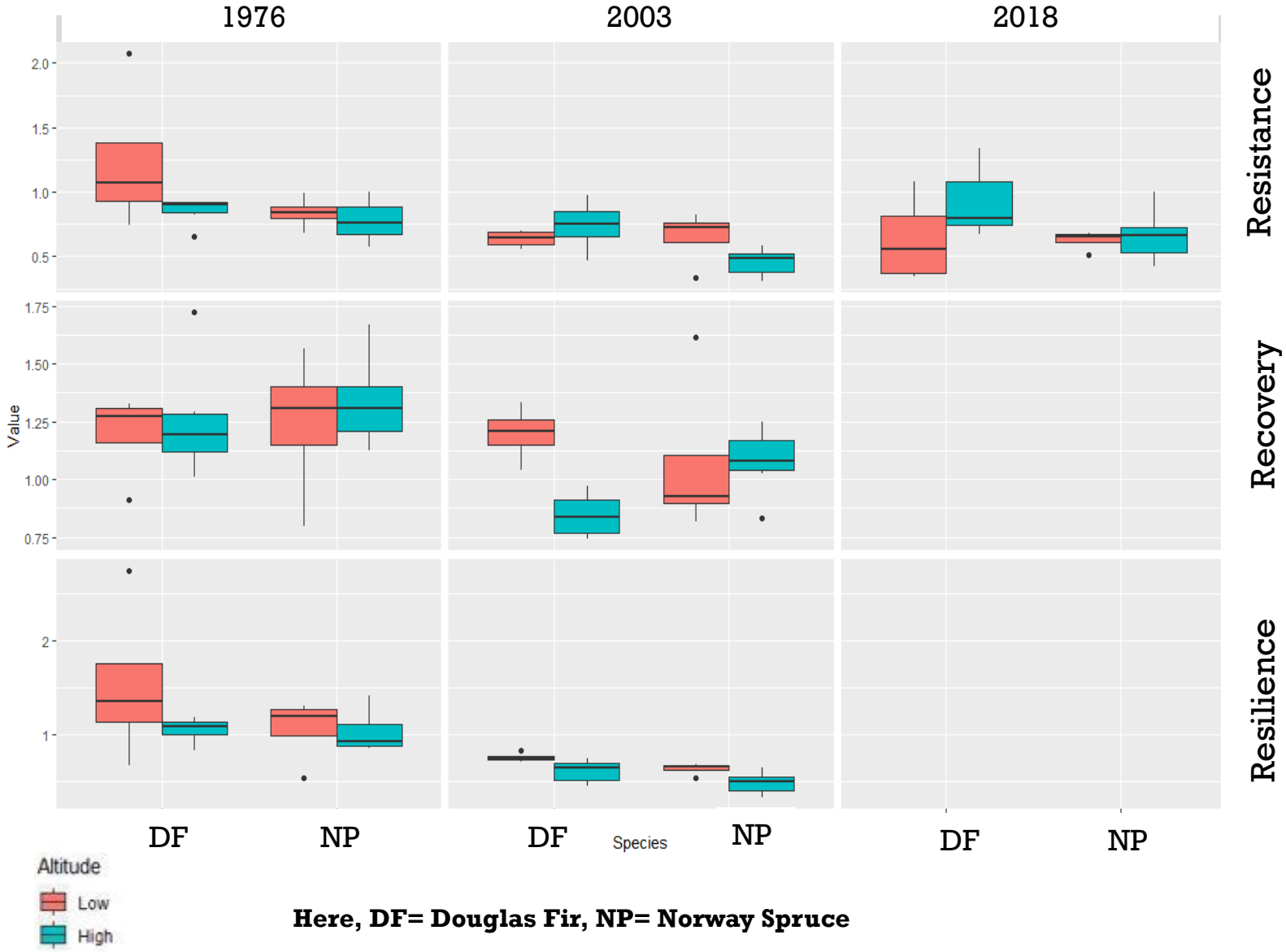
| **Resistance (Rt)**$= \frac{Dr}{PreDr}$ | **Recovery (Rc)** $= \frac{PostDr}{Dr}$ | **Resilience (Rs)** $= \frac{PostDr}{PreDr}$ |
|---|---|---|




Growth indices in hypothetical case

Dr= width of tree year ring in a drought year
PreDr= mean tree ring width 2 years before the disturbance
PostDr= mean tree ring width 2 years after the disturbance

Lloret et al. 2011; Vitali 2017




**Here, DF= Douglas Fir, NP= Norway Spruce**

# THE EFFECT OF GROWING ALTITUDE AND SPECIES RESPONSES TO DROUGHT EVENTS

- Better resistance found for Norway spruce in higher altitude level
- Resilience recorded better for both species in lower altitudinal level

# LABORATORY DEMONSTRATION

TP1020 machine

Histocore Arcadia H machine

Rotary Microtome Machine

Cresyl Violet Acelate solutions

Sample slide with their ID No.

- TP1020- Paraffin (Wax) to stabilize sample
- Histocore Arcadia H - prevent the sample to become solid
- Rotary Microtome- accurate slides of sample
- Cresyl Violet Acelate - differentiate the state of cells

# FIELD EXCURSION IN SCHAUINSLAND

Schauinsland study area

Microcores collection

- Microcores collection
- 45 sample trees
- Instruments used

-Trephor

- Eppendorf tube filled with 50% Ethanol

# Field Excursion in SFB Research Area

- Has stabilized voltage and induction sensors
- Radial growth and shrinkage of the tree

- Saved data on flash memory card
- Data can be downloaded via cell phone modem

- Point dendrometer and data logger observation

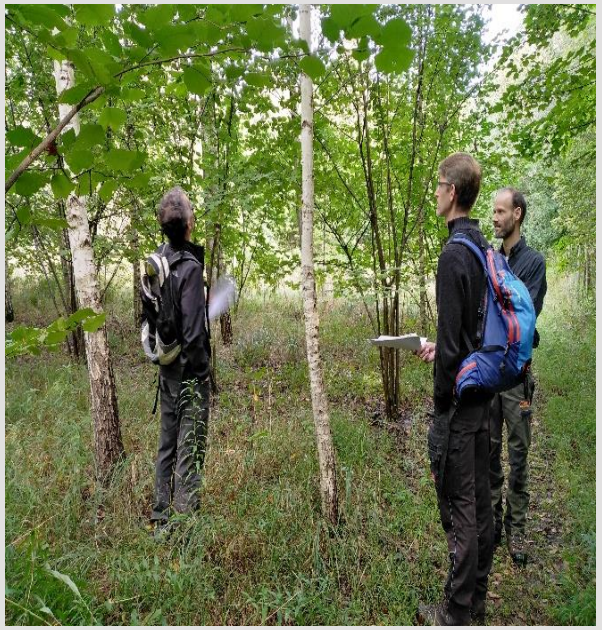
# Field Excursion to Blauen Mountain

- **Measure radial growth and water stress condition**

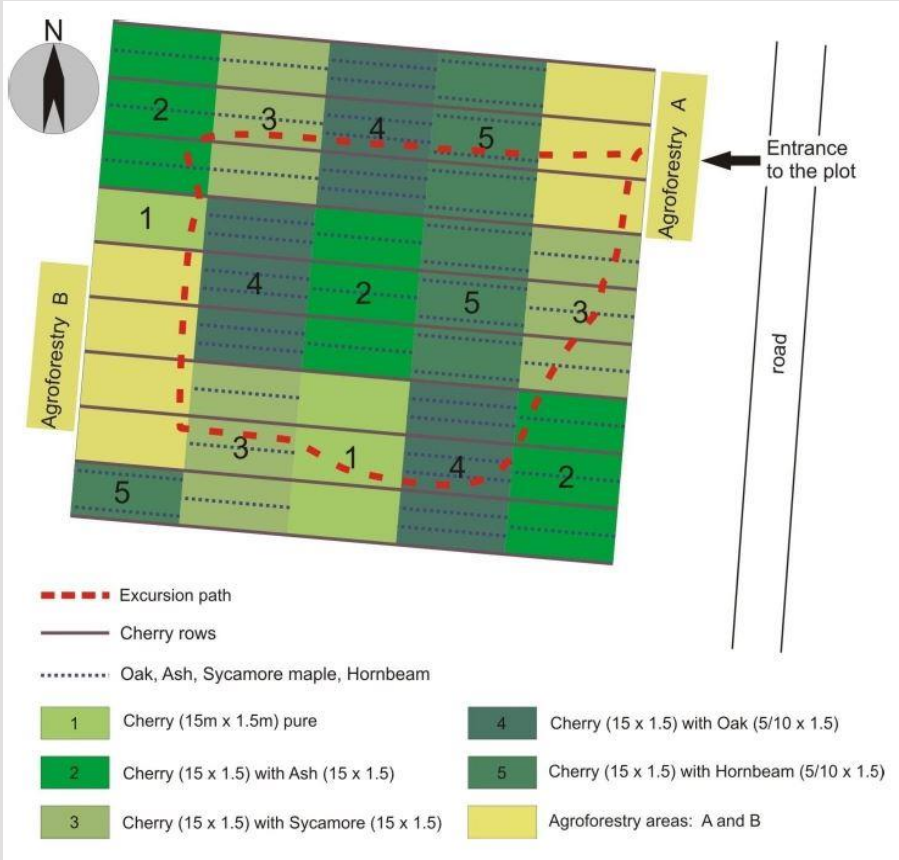
- **USB/IrDA cable used**
- **Mini32 software required**

- **Band Dendrometer measurements**
- **Microcores Collection**
- **DBH measurements**
- **Exposition measurement**

# Field excursion in Breisach



Study area demonstration




Plot orientation of valuable broadleaved trees

Excursion guide, 2020

Established: 1997

- Area: 2.5 ha

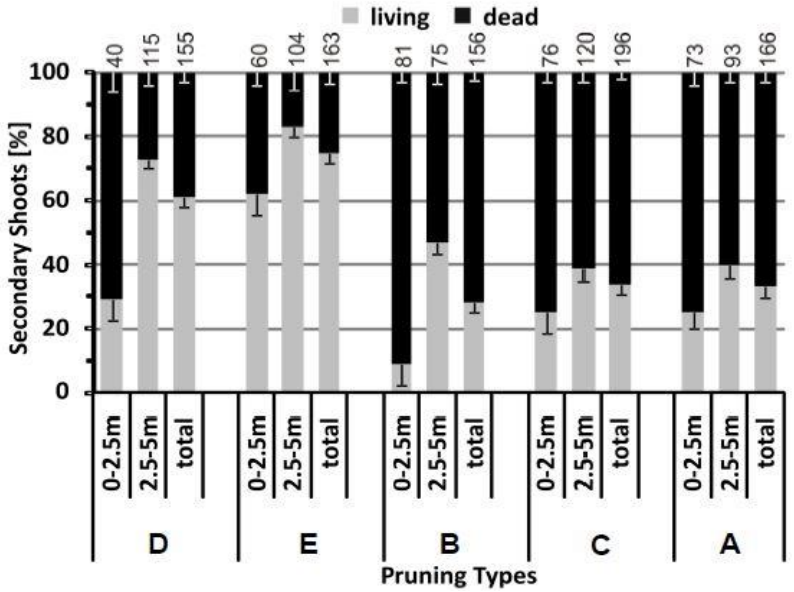
-15 plots (RBD used)

- Objectives: Growing valuable timber with broadleaved trees

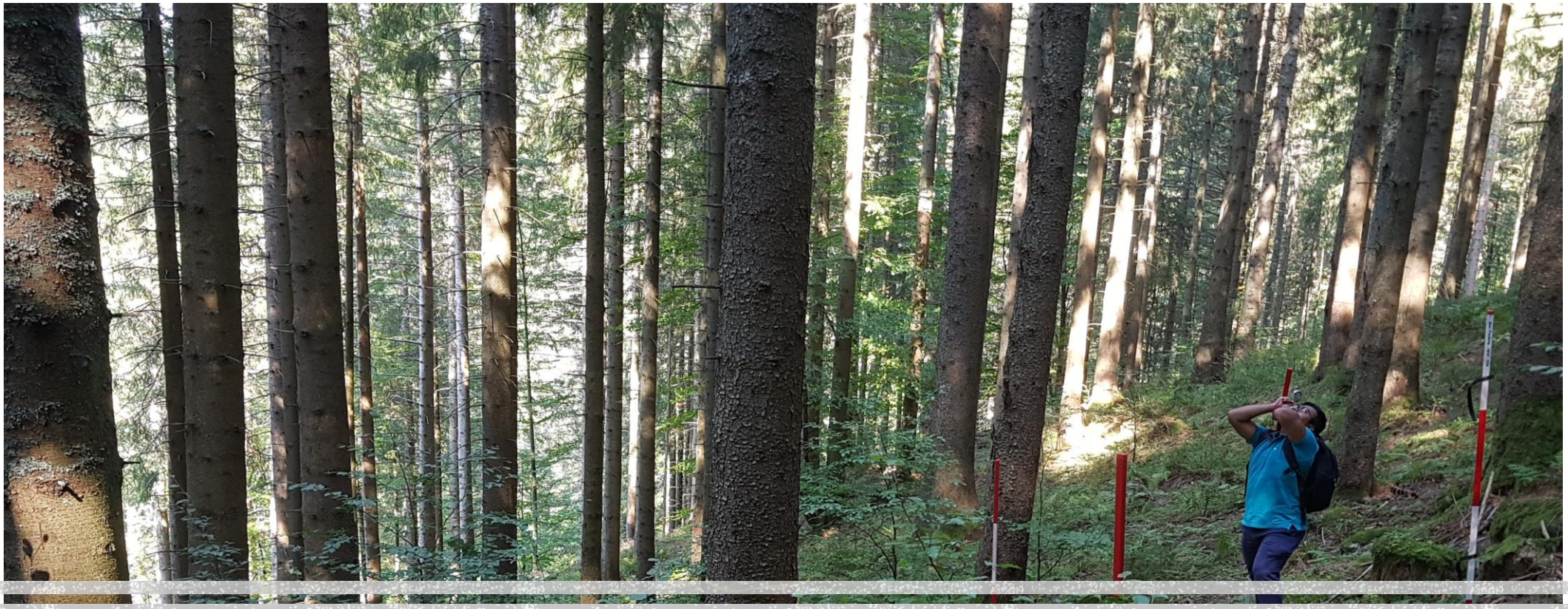
# Field excursion in Breisach

## Observations from experiment area

- The number of dead shoots increases by application of pruning type B and C (Anticipatory pruning approach)
- Sixty Cherry trees has been sun burned
- Dying back of Ash tree




(Springmann et al. 2011)



# FIELD EXCURSION IN MENZENSCHWAND

- **Responsibilities**

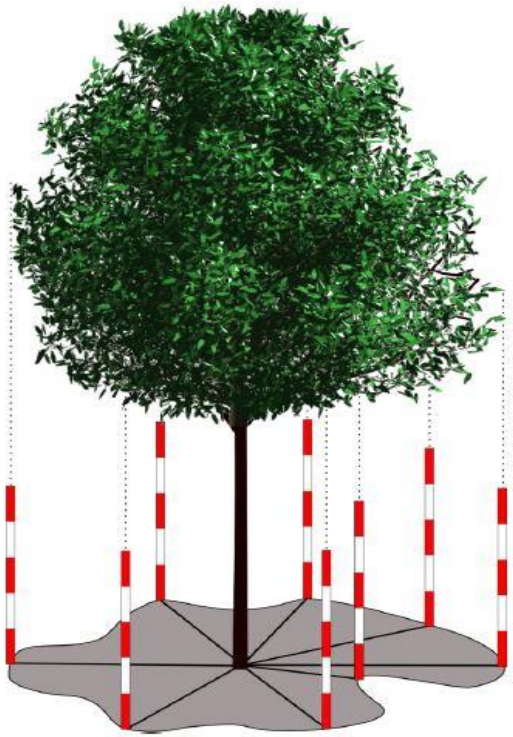
**-Diameter at breast height,**

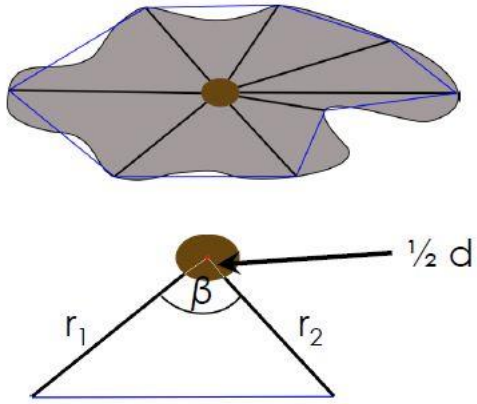
**-Crown projection area measurement,**

**-Competitor trees**

**-Fixing band dendrometer**

# CROWN PROJECTION AREA MEASUREMENT






$Area_{\Delta} = a \times b \times \sin\beta \times ½$

$Area_{\Delta 1} = (r_1 + ½\ d) \times (r_2 + ½\ d) \times \sin\beta \times ½$

Crown projection area = $\Sigma\ Area_{\Delta}$

Spiecker, 1991

## STRENGTHS

- Collaborative process
- Strong background, skills of researchers
- Well equipped lab
- ROXAS analytical tool

## OPPORTUNITIES

- Comprehensive research
- Noble research; create a good portfolio for the selected conifers
- Funding for new research
- Enhanced forest management strategy with changing climate


## WEAKNESSES

- Planned very ambitiously
- Limited meetings to share the current activities
- Financial limitations
- Limited cooperation among all the working packages

## THREATS

- Current COVID-19 situation
- Uncertainties due to climate change
- Delays will increase ultimate cost of projects
- To get continuous collaboration of future projects

# TAKE AWAY MESSAGES

- ROXAS- quantitative analysis of year rings
- Ideas about dendrochronological research
- From field excursion

  Microcores collection

  Data saving from band dendrometer

  Crown projection area measurement

- Professionalism, official rules and norms

# REFERENCES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Lloret F, Keeling EG, Sala A. 2011. Components of tree resilience: effects of successive low-growth episodes in old ponderosa pine forests. Oikos, 120: 1909–1920. doi: 10.1111/j.1600-0706.2011.19372.x

# THANK YOU

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