3D Tree

An Alternative Visualization Approach for Complex Data

WSL

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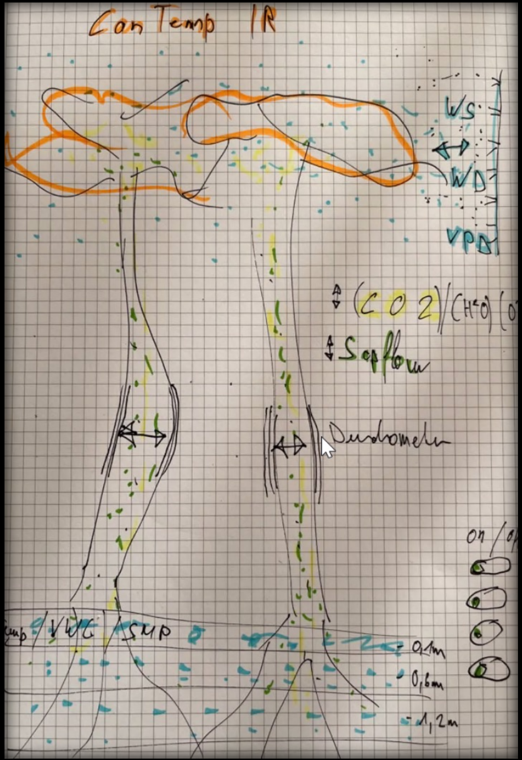
Data Visualization Pfynwald

How can we visualize the complex interaction between forest, soil, and atmosphere to the general public?

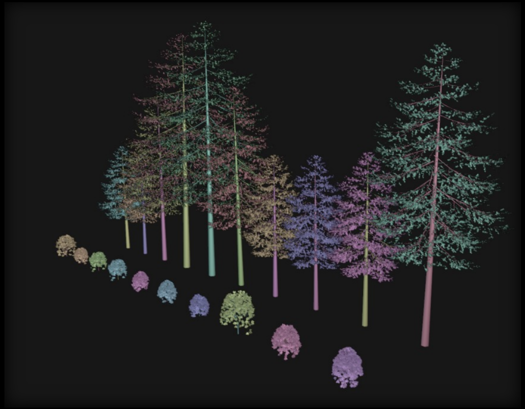
What level of detail can be implemented / what makes it get to complex?

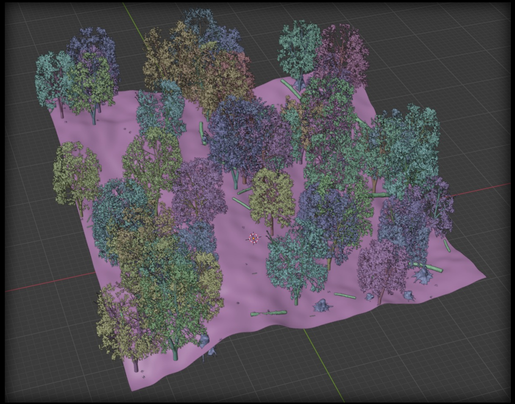
Data Visualization Pfynwald



Sketch by Jonas Gisler of the setup.

Data Visualization Pfynwald





Data Visualization Pfynwald

Step 1:
Create Tree Model

Photographs of some individual trees in Pfynwald, provided by Marcus Schaub.

Data Visualization Pfynwald

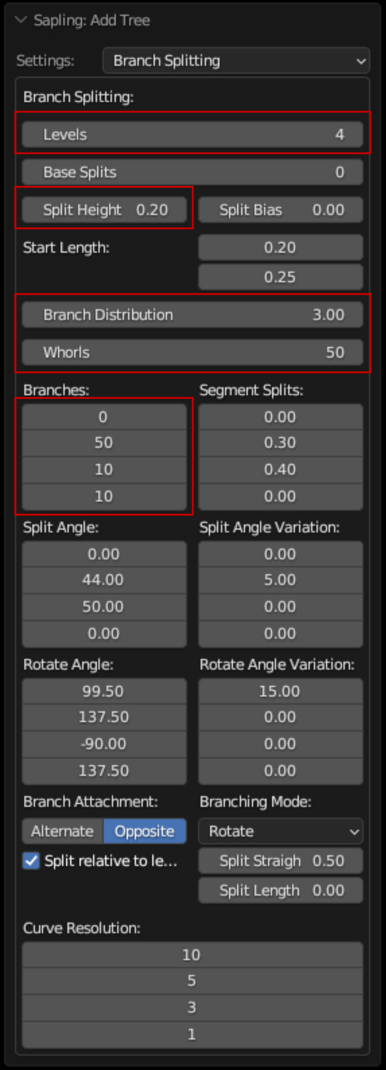
Step 1:
Create Tree Model

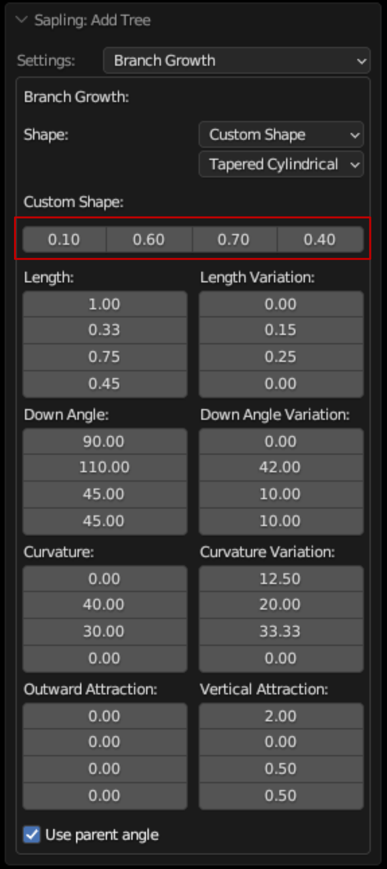
[1]: Andrew Hale et al. [Blender Documentation]

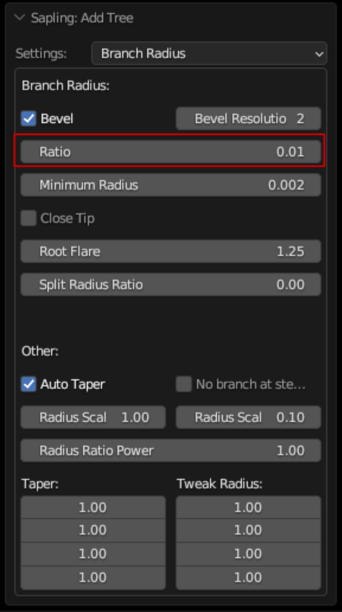
Data Visualization Pfynwald

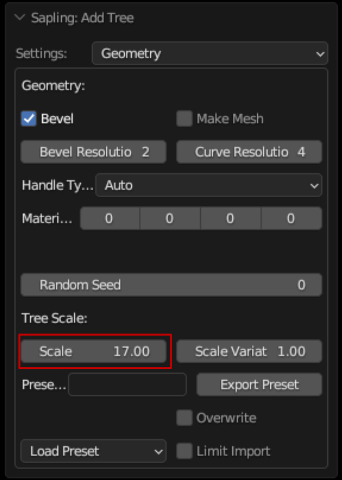
Step 1:
Create Tree Model

Blender – "Sapling Tree Gen" Tool [1]









[1]: Andrew Hale et al. Blender Documentation

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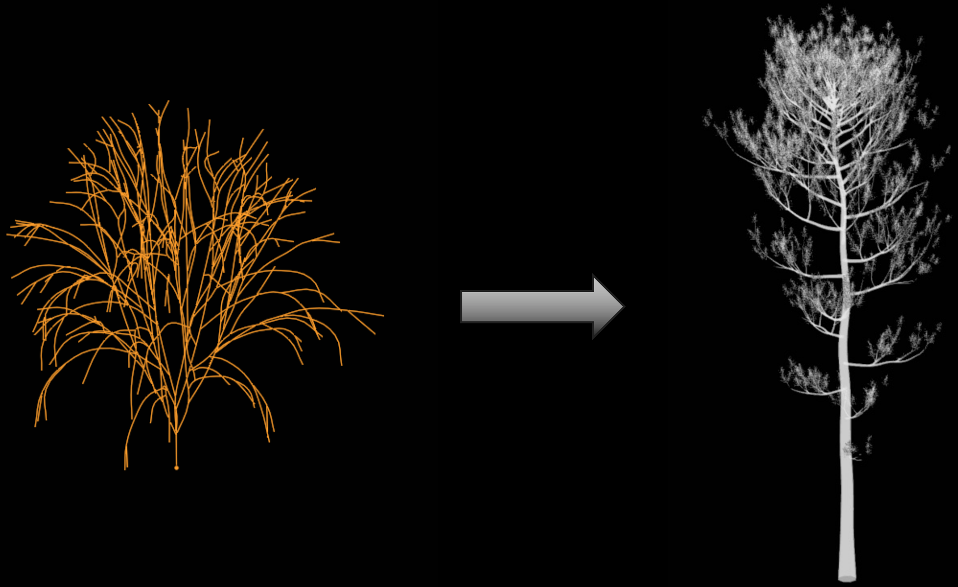

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Data Visualization Pfynwald

Step 1:
Create Tree Model

Step 2:
Extract Curves from Tree Object

>> Hierarchically structured bezeir curves

>> Extract points alonge the curve

>> Connect start point of branch to closest point in parent

>> Generate a graph network by connecting the neighbouring points

Data Visualization Pfynwald

Step 1:
Create Tree Model

Step 2:
Extract Curves from Tree Object

Step 3:
Find Endpoints of Curves

>> List all points at the end of a branch

>> Mark the point that connects the tree to the ground

>> Looping through the graph from endpoint to groundpoint or otherwise

Data Visualization Pfynwald

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Step 1:
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Step 4:
Connect to Real World Data

>> VPD values on three level with 4 - 5 sensors each

>> Interpolate between 3 nearest neighbours for each endpoint

Data Visualization Pfynwald

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Connect to Real World Data

Step 5:
Simulation of Photosynthesis, Respiration and Transpiration

>> Simulation for the **visualization** of stomatal gas exchange

>> **Not** to get numerical accurate consumtion or production values

Data Visualization Pfynwald

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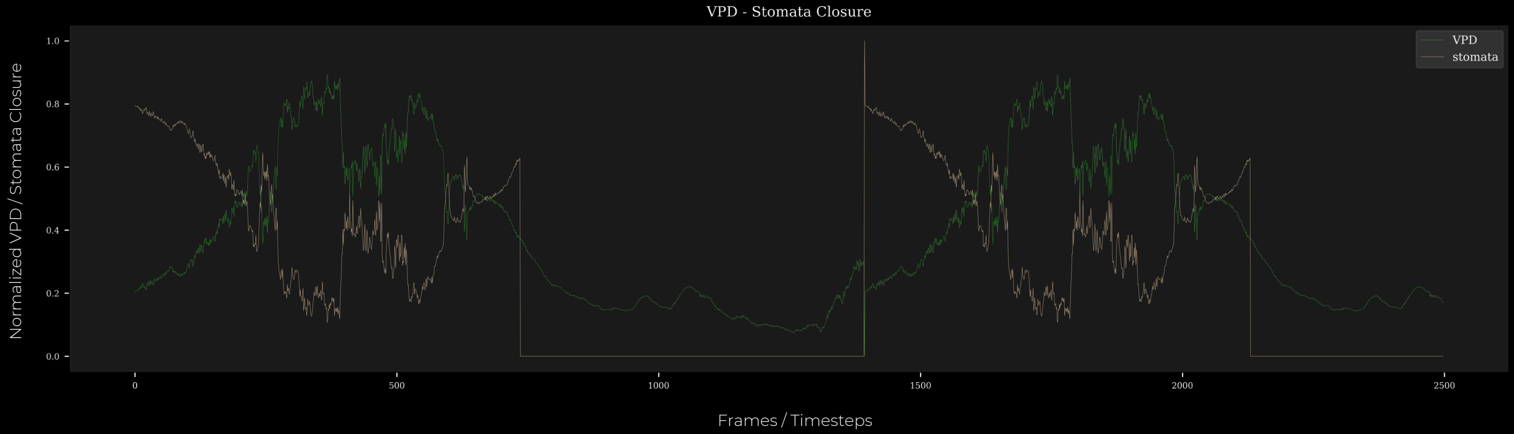
Real World Data

>> VPD – Vapour Pressure Deficit

> Temperatur (air & canopy), relative humidity

> VPD = saturated_vapour_pressure * (1-relative_humidity/100)

>> Day/Night



Data Visualization Pfynwald

Step 5:
Simulation of Photosynthesis, Respiration and Transpiration

>> Simulation for the **visualization** of stomatal gas exchange

>> **Not** to get numerical accurate consumtion or production values

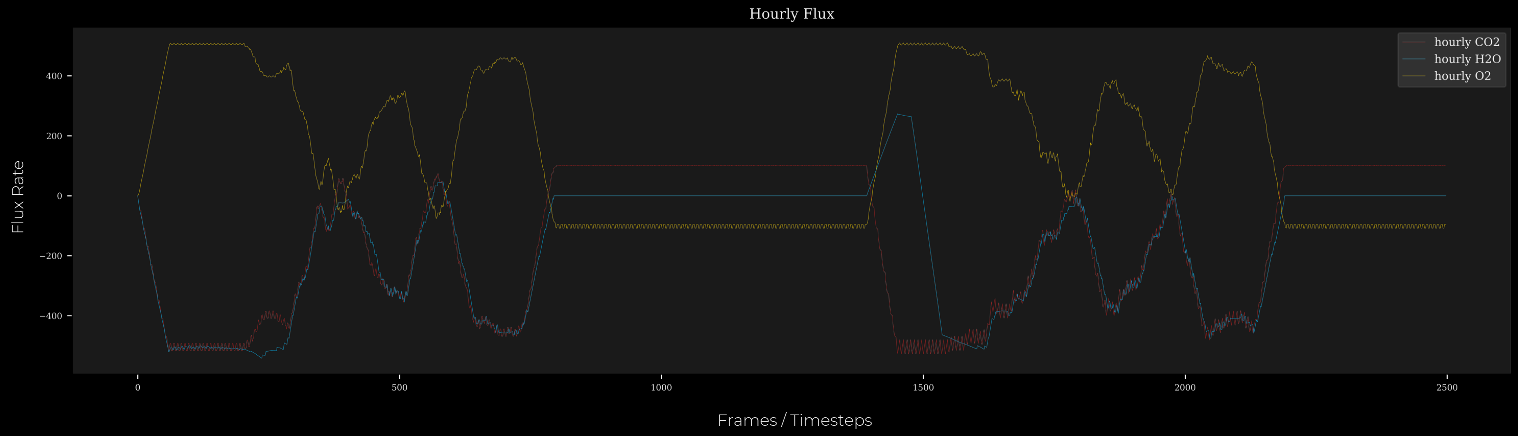
Simulated Data

>> Internal storage (CO_2, O_2, H_2O, Glucose)

>> Stomata Closure & Calvin cycle approximated based on VPD-readings and light

>> Stomata Closure

> To what extend is gas exchange possible



Data Visualization Pfynwald

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Photosynthesis or Photorespiration?

>> Each endnode gets assigned n – cores

> 10 „cores" for Photosynthesis or Photorespiration during the day

> 2 „cores" for Respiration during the night

--> Approximately 10‘000 „decisions" each frame

>> „Speed" currently constant

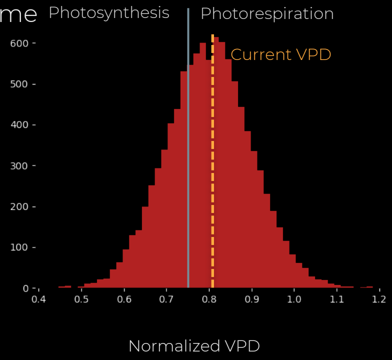

Fig 1: n (10000) normal distributed values (mean = 0.8, std = 0.2)

Data Visualization Pfynwald

Step 5:
Simulation of Photosynthesis, Respiration and Transpiration

>> Simulation for the **visualization** of stomatal gas exchange

>> **Not** to get numerical accurate consumtion or production values

>> Transpiration while the stomata is open

>> O_2 & CO_2 exchange rate based on opening level of stomate

>> surplus & shortage

>> H_2O atm not limited
--> Soil moisture values should be integrated in the future

08-18
03:19
Control
Treatment
Molecule Exchange Leaf to Atmosphere
O2
H2O
CO2
Treatment
VPD Sensor Readings
VPD_uc_4
VPD_uc_3
VPD_uc_2
VPD_uc_1
VPD_oc_4
VPD_oc_3
VPD_oc_2
VPD_oc_1
VPD_ic_5
VPD_ic_4
VPD_ic_3
VPD_ic_2
VPD_ic_1
ic = in crown | oc = over crown | uc = under crown
0
1
2
3
4
VPD Values
Control
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VPD_uc_4
VPD_uc_3
VPD_uc_2
VPD_uc_1
VPD_oc_4
VPD_oc_3
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VPD Values

Outlook

Integrate Soil Moisture - Additional Internal Flux Visualization

Refine Cycles - Make the Simulation adjust Parameters on the go

Close to Real Time Update on the Website