Canopy image treatment

Data acquisition

Three photos were taken for each plot along the central 20 m long string: a photo at 0 m upstream (beginning of the plot), at 10 m (middle of the plot), and at 20 m downstream (end of the plot). To obtain these photos, a camera is held 2 m above the ground, in a vertical position, with the camera lens facing up.

With ImageJ software, the images were binarized and adjusted to transform the obstacles (foliage, branches, cliffs...) between the daylight and the observer in black pixels and the free sky in white pixels. The threshold is first manually estimated, then the same threshold is applied to all the images. In a few cases, we had to correct manually the threshold image, for example if a trunk in the foreground was treated as white. In this case, we manually painted the trunk in black.

Then, using ImageJ "Measurements" menu, we get the number of black and white pixels; the ratio Rcanopy is an estimation of the canopy closure for one image. Finally, the canopy opening $C_{opening}$ is the mean of R_{canopy} for the three images.

R_{canopy} = *number of black pixels / number of white pixels*

For one plot

$$C_{opening} = \sum_{i=1}^{n} \frac{R_{i\ canopy}}{3}$$

Software needed

IMAGEJ https://imagej.net/Fiji/Downloads

Image Treatment

- ✓ Open a canopy image (fig. 1)

Figure 1

✓ Binarization

Image → Type→ 8 bits (fig. 2)

Figure 2

✓ Adjust Threshold

Image→ Adjust→ Threshold (fig.3)

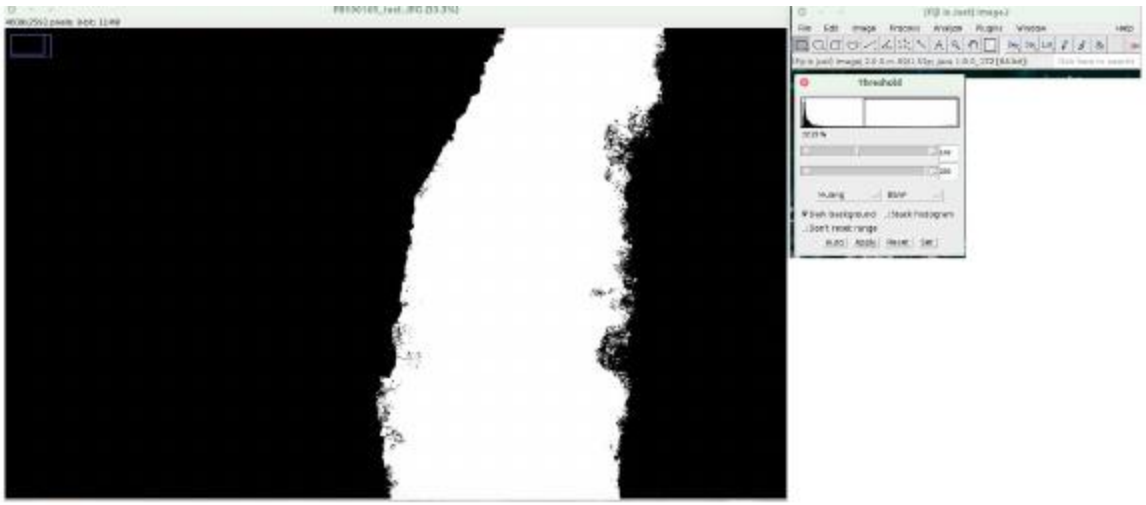

Figure 3

✓ Adjust in order to be close to the original image.

→ **Apply**

(color may be inverted if the option « dark back ground » is on, white pixels are counted)

✓ Analyze of black and white pixels (fig. 4)

- **Analyse** → **SetMeasurement** choose : **Area**, **Min&Max gray value** (you must have 0 et 255); **Area Fraction** (white pixel count); **Display label**

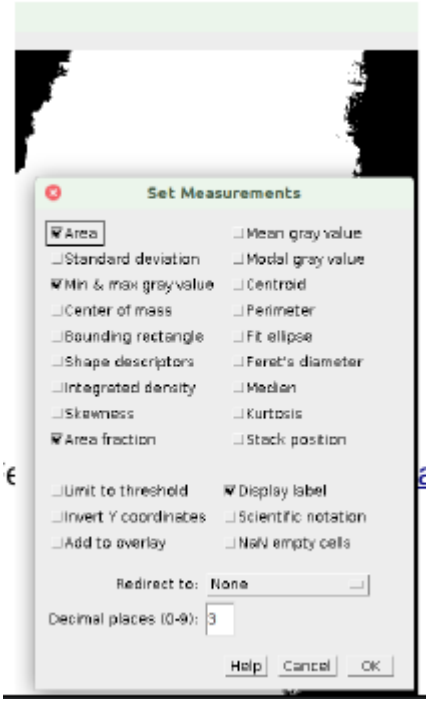

Figure 4

- *Area Fraction* - The percentage of pixels in the image or selection that have been highlighted in red using Image>Adjust>Threshold. For non-threshold images, the percentage of non-zero pixels.
- *Display Label* - If checked, the image name and slice number (for stacks) are coded in the first column of the results table.
- *Min & Max Gray Level* - Minimum and maximum gray values within the selection.

✓ If the threshold does not trat all the zones in an image

- example T1_cano_8061377.JPG : the trunk is still white ‘fig.5) → **tool Brush**

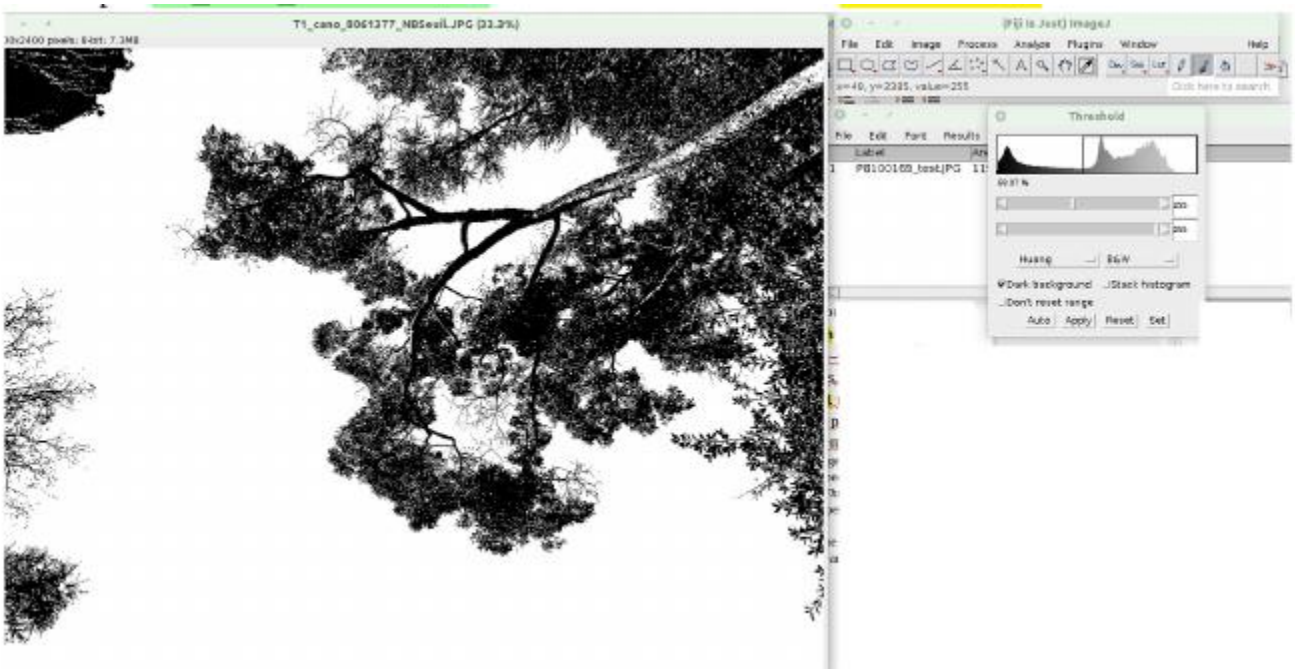

Figure 5

- **Adjust the diameter and color** of the brush, then paint the trunk. (fig.6)

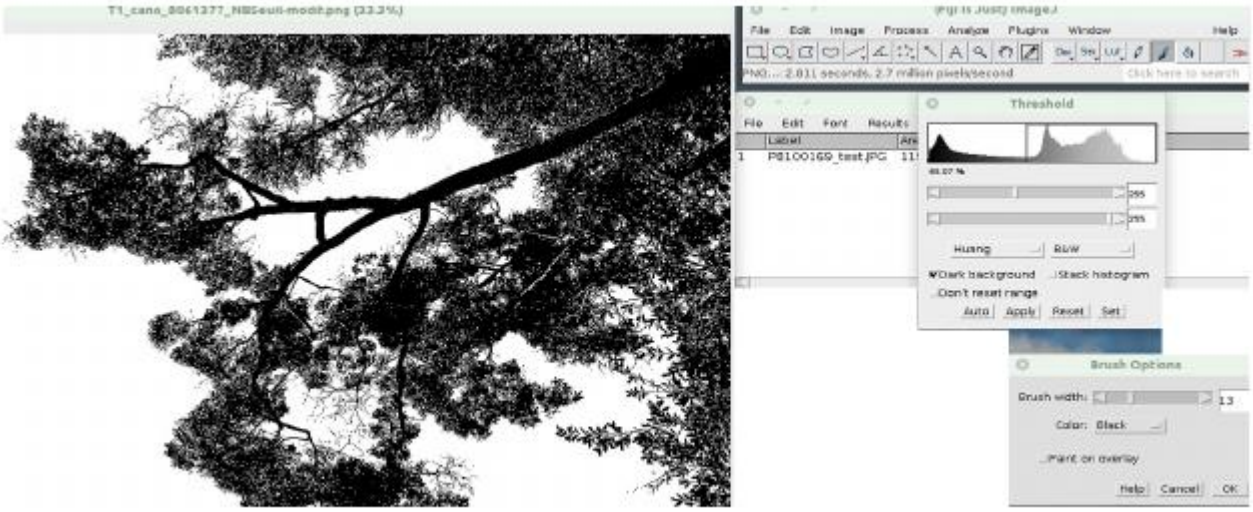

Figure 6

- ✓ Measurements: click on **"m"** or go to **Analyze→ Measure**
  - A window with the result appears (fig. 7). Each time you measure, a line is added at the end. Lines can be modified, deleted etc.
  - ◦ Min 0 are the black pixels, Max 255 are the white pixels, % area is the percentage of white pixels.
  - If you do **Results→ Clear Results ATTENTION** every results are lost if not saved before.
- ✓ Save the results: export with **Results → File → Save as → Results**_xxx .csv

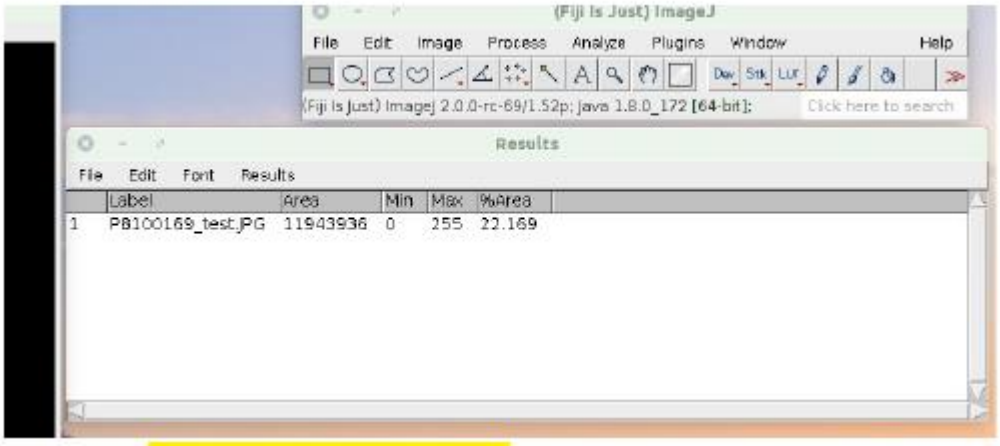

Figure 7

Reference.

Brown N, Jennings S, Wheeler P, Nabe-Nielsen J (2000) An improved method for the rapid assessment of forest understorey light environments. Journal of Applied Ecology 37: 1044–1053. https://doi.org/10.1046/j.1365-2664.2000.00573.x