EO AFRICA EXPLORERS

PRISMA 4 AFRICA

PocketLAI: theory and practice

Raffaele Casa
University of Tuscia
rcasa@unitus.it

Poisson model for randomly distributed leaves

$Po(\theta_v)=exp^{-k(\theta_v)*LAI}$

Po = gap fraction

θ_v= probe angle

LAI= leaf area index

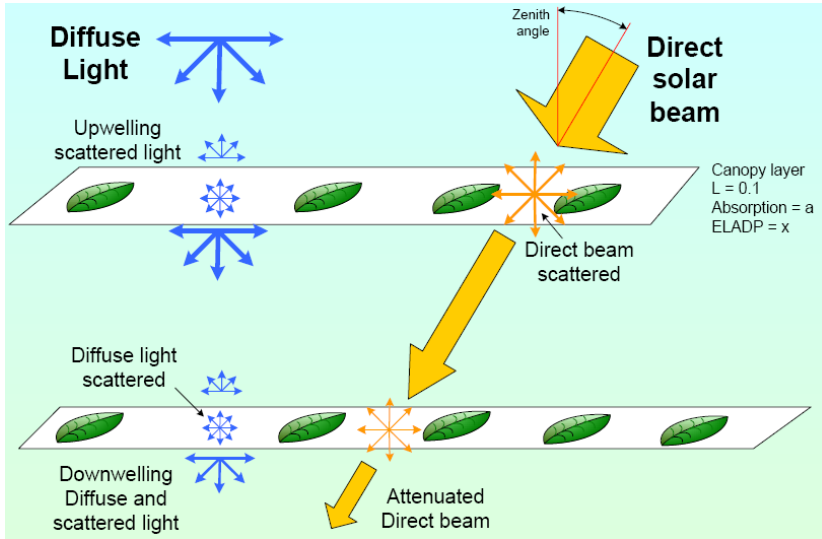
k = extinction coefficient (function of θ and x =Campbell's ellipsoidal leaf angle distribution)

$$K(x,\theta) := \frac{\sqrt{x^2 + \tan(\theta)^2}}{x + 1.702\cdot(x + 1.12)^{-0.708}}$$

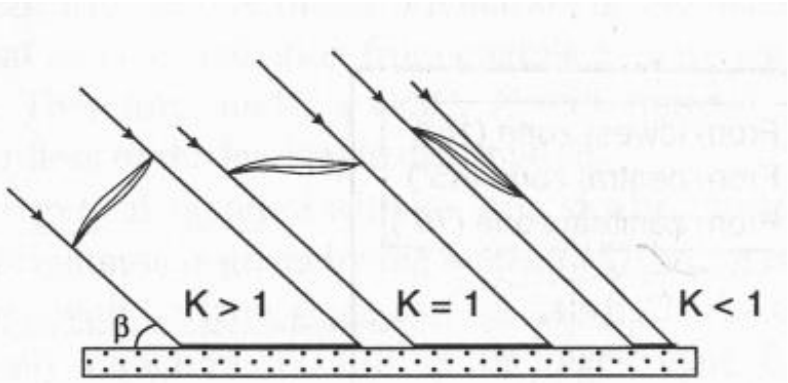
…for clumped leaves

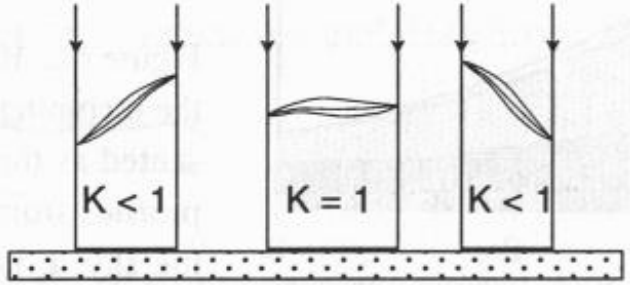
$Po(\theta_v)=exp^{-\lambda k(\theta v)LAI}$

λ = clumping parameter (<1)

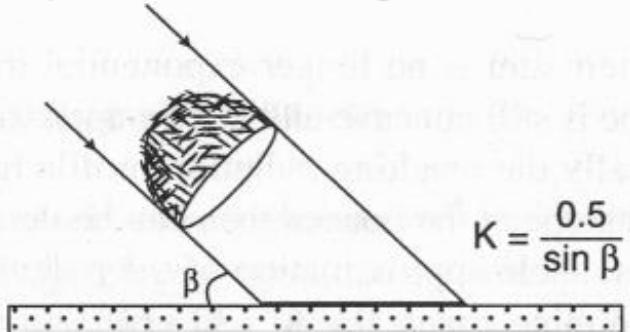


K and leaf angle distribution: Campbell's ellissoidal model





Spherical leaf angle distribution

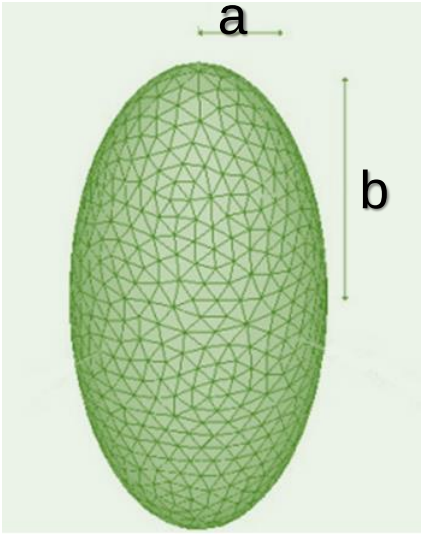


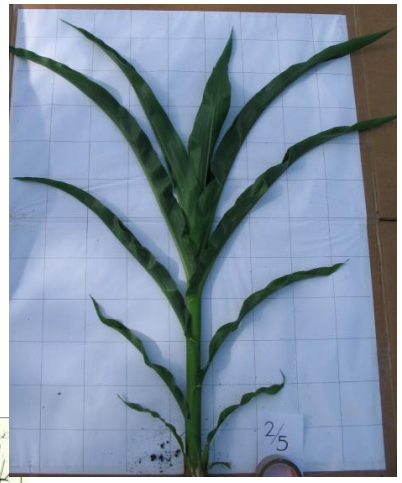
Ellissoid can be elongated or flattened

$$K(x,\theta) := \frac{\sqrt{x^2 + \tan(\theta)^2}}{x + 1.702\cdot(x + 1.12)^{-0.708}}$$

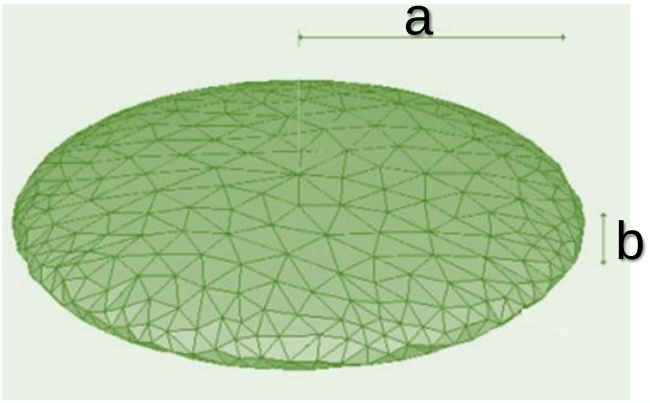
X =a/b

X <1





X >1



The “magic” angle of 57°

At 57° the extinction coefficient k does not change with leaf angle distribution

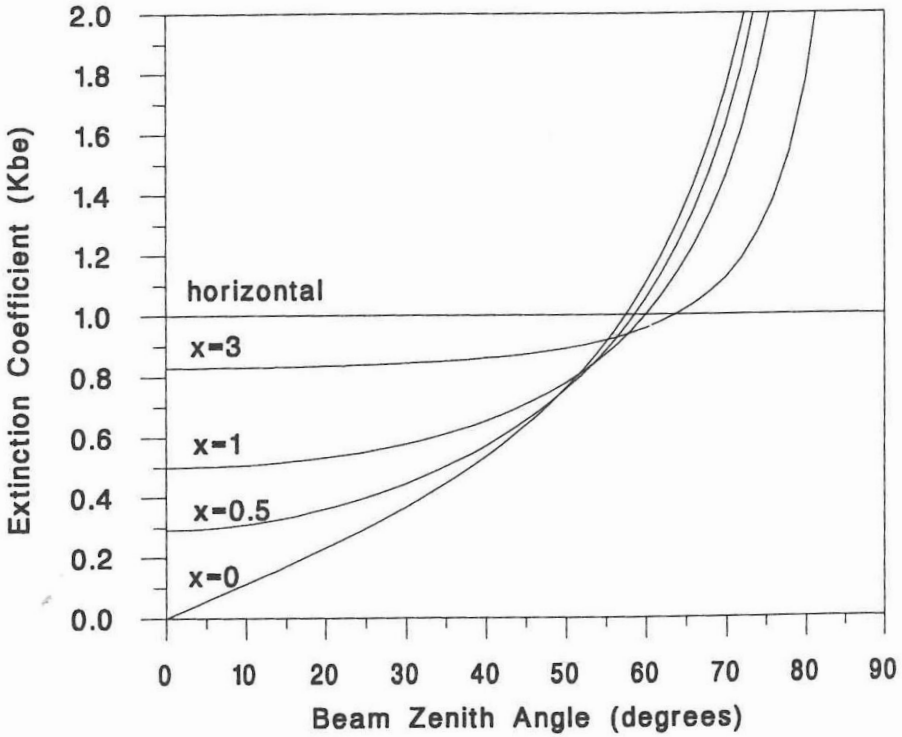
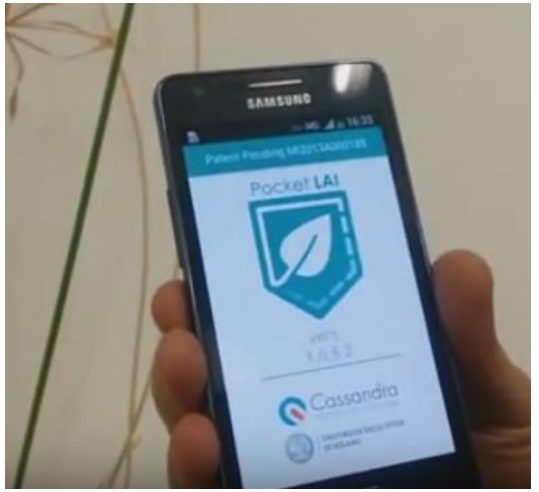


FIGURE 15.2. The extinction coefficient $K_{be}(\psi)$ as a function of zenith angle for x values representing various leaf angle distributions.

If we measure the gap fraction at 57° we can calculate LAI without knowing leaf angle distribution

$$Po(57.5°) = e^{0.5 \cdot LAI / \cos 57.5°} \Leftrightarrow LAI = -\frac{\cos 57.5°}{0.5} \log(Po(57.5°))$$



Smartphone App PocketLAI functioning

$$P_0(57.5°) = e^{\left(-0.5\frac{LAI}{\cos(57.5°)}\right)}$$

1) segmentation

2) Luminance (L, candela m^{-2}) … using device "exposimeter"

$$P_0 = \frac{L_{below}}{L_{above}} \cdot \beta$$

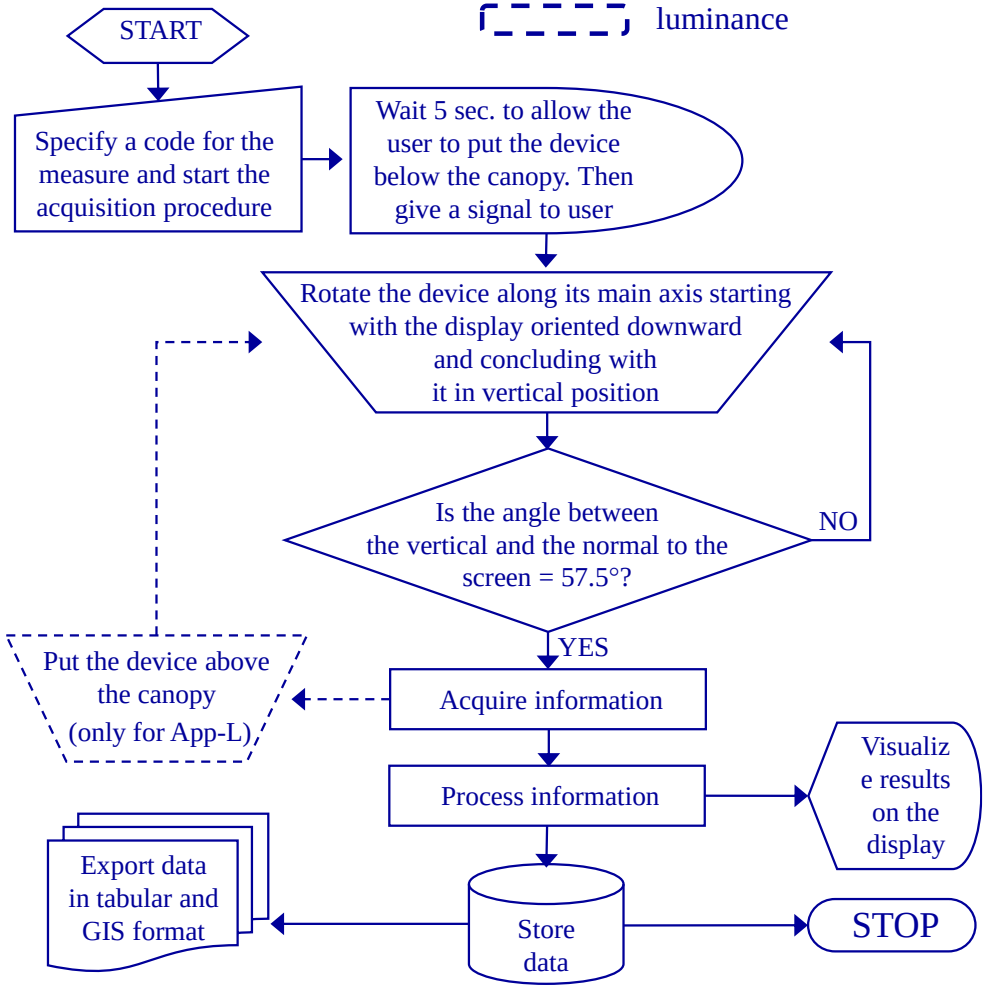
$$L = \frac{N^2 \cdot k}{t \cdot S}$$

- N is the f-number or focal ratio
- t (sec) is the exposure time
- S is the ISO sensitivity
- k is the reflected-light constant
- β correction factor for scattered radiation below the canopy

Two methods:

segmentation

luminance

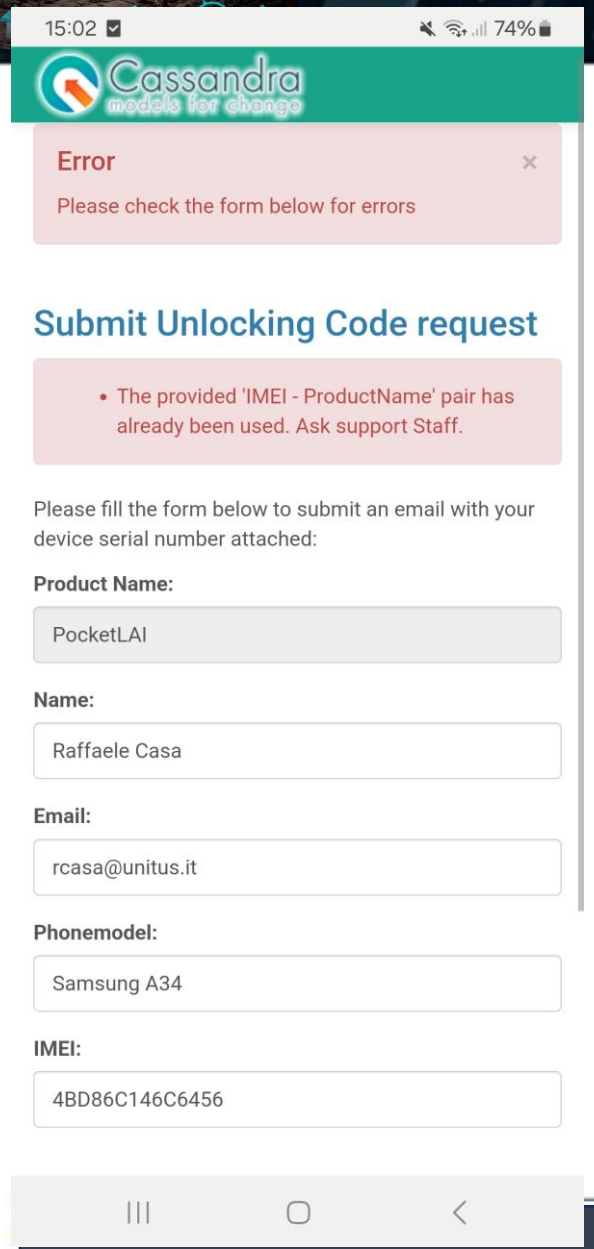


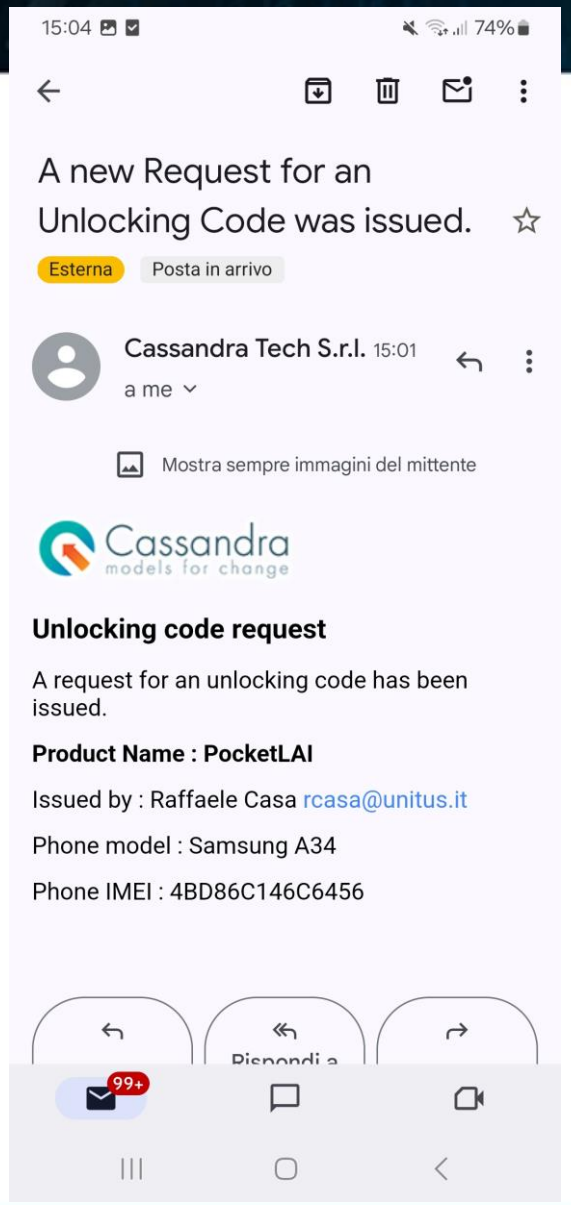
PocketLAI installation

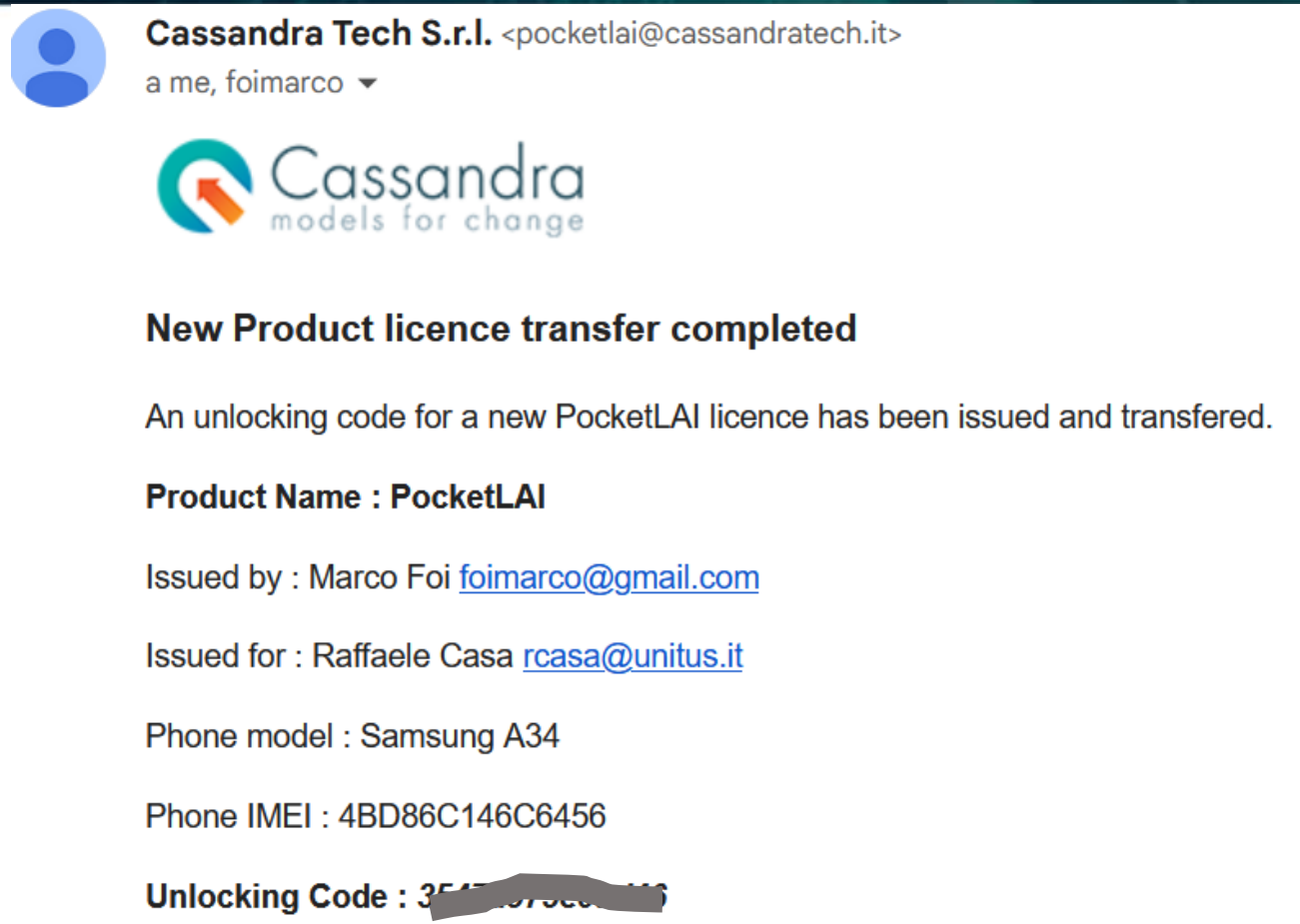
Dear All,
You are now ready to download and install your PocketLAI applications on your android smartphones/tablets that will be used to collect validation data on the selected sugarcane fields.
To do so, please follow the following instructions:

Link to download the app: https://pocketlai.cassandratech.it/PocketLAI_v5.1.60_release.apk
It is easier to use it directly from the phone on which the app will be installed because it makes the process more intuitive.
Once the app has been installed, you need to access the Data panel and fill out the form **without modifying the pre-filled IMEI**.
The agreed email must be entered in the form and, upon sending, you must wait for the confirmation in the Form itself.
The code to unlock the license will be sent to the agreed e-mail address. **The code must then be entered in the same Data panel, in the dedicated white field**.

PocketLAI installation







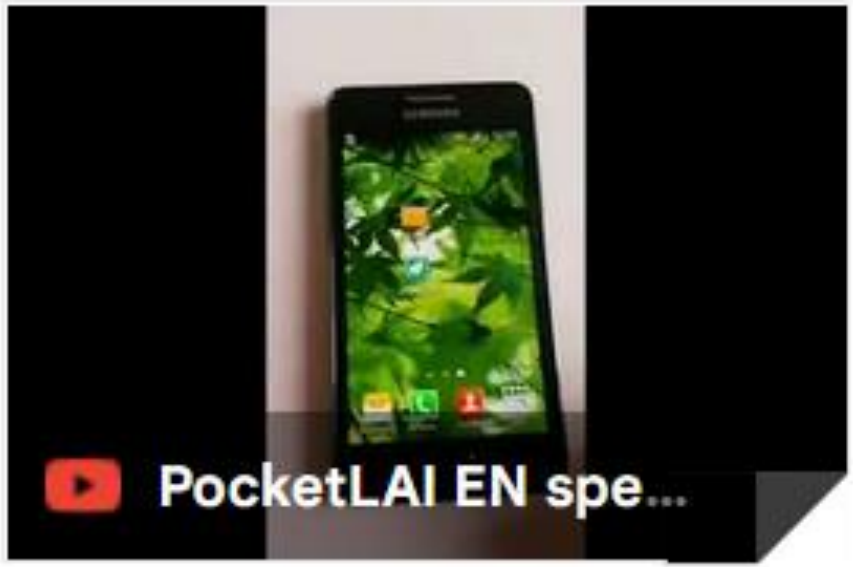
You get the activation code by mail. Once you get it, enter the App and copy it inside the field named 'Insert unlocking code', available in the **'Data'** page of PocketLAI.
Restart the app to unlock all features.

PocketLAI operation

Measurement

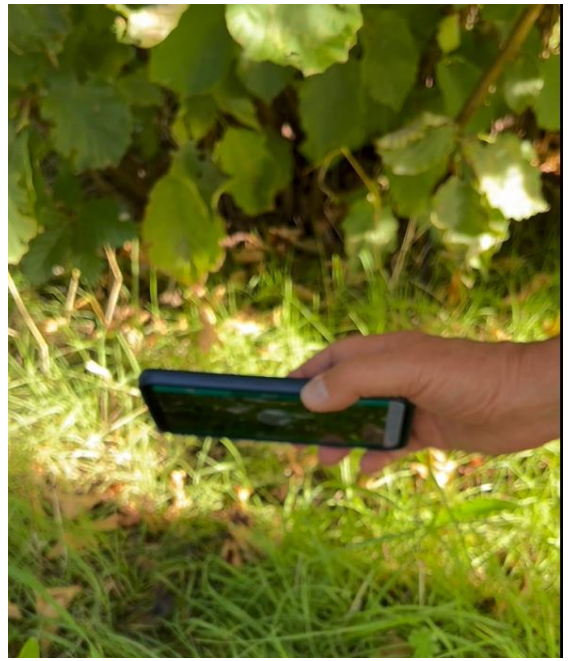
https://youtu.be/ejGIyGIsxaY

Data management



https://youtu.be/qWVW_hed-_E

Measurement in the field



PocketLAI Tips

TAKING THE PICTURES

The camera should be held horizontally at the level of soil.
The distance between the plants and the phone lens should be **10 cm** but for very thick canopy this distance can be lowered to a few centimeters. The less the portrayed canopy is disturbed by the action of taking the picture, the better is for the result. While opening the canopy the suggestion is to gently bend some plants to one side using the free hand, then take the picture of the other undisturbed plants with the phone. One of the key points to good measurements is including in the pictures just the plants and the sky. So beware of plants, building and colleagues.
Also avoid including the sun in the pictures.

WEATHER AND TIMING

PocketLAI has no restrictions on operation timings in the day provided the sky is already/still blue.
PocketLAI cannot be used with pink/orange/red sunsets/dawns.
Also clouds do not cause any problems unless they are very dark thunderstorm clouds. Translucent cirrus clouds or dense white/gray clouds are handled by the processing algorithm.

PocketLAI Tips

AVERAGING

PocketLAI offers the chance of performing averaging over a number of pictures: we strongly suggest to use this feature (should be enabled by default). For research purposes **do not take less than 4 (four) repetitions for each measure** as such repeated measure are the key to best accuracy. One single measure could be accidentally taken with a leaf right in front of the lens resulting in a large overestimation of LAI. PocketLAI also embeds **Grubb's Test** that assesses the measure and ignores ONE eventual outlier in computing the average. **Enable this feature if you plan to take 7 or more pictures per measure**.
Pictures included in a single measurement set should be taken around one physical location in the field, by moving around the selected "center" of not more than 1 meter in radius. While doing this, we suggest also changing the azimuth of the picture: the direction towards which the camera is pointed. While the first picture can be taken keeping the sun right behind one's shoulders, the other pictures should explore the directions around the first one. Do not extend the explored angle more than 90° to the left and to the right of the first picture otherwise there will be a risk of including the sun in the pictures.

EXPLORING VARIABILITY

To achieve a good understanding of field variability, more than one set of measurement should be taken. NDVI or NDRE free satellite maps (10x10m pixel size) dating no more than 4-6 days can be a good source of hints about where to take further measurement sets (see e.g. https://browser.dataspace.copernicus.eu)

Getting operational

Now it'you turn to try it!
Good luck!!!