

## **Protocol for data collection and processing from UAVs imagery using OpenDroneMap**

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Previously, we developed a protocol for workflow for acquisition of images taken from Unmanned aerial systems (UAS)

<http://bit.ly/37AIUAs>

The following aims to complement the aforementioned and to further provide a simple guide on the use of OpenDroneMap for the analyses of UAS derived imagery.

### **Rationale**

Currently there is worldwide concern about the state of productivity and degradation of pastures. This is mainly due to a number of factors including: unsuitable forage and fodder species, overgrazing and poor agronomic practices. There is a demand to determine the productivity and general condition of pastures at different spatio-temporal scales is necessary for their monitoring, management and restoration. Technology with its high flexibility and low costs provide an appropriate sampling method for pasture monitoring at a high spatio-temporal scale. Consumer UAS (e.g., DJI Phantom) are highly portable and light weighted which make them ideal for travel over remote areas and for hilly/mountainous environments.

Among techniques used in drone mapping is that of orthomosaics. Orthomosaics mostly refers to the creation of a single representation of an area, created out of many photos. To build up an orthomosaic, individual images are collected from cameras carried up by drones, and then stitched them together, while being geometrically corrected, as to create an accurate map.

Nowadays there is a plethora of orthomosaic software. These include:

- 3DF Zephyr photogrammetry software.
- Agisoft Metashape 3D software.
- Agisoft PhotoScan photogrammetry software.
- Arcadis Photogrammetry and 3D Modelling.
- Autodesk ReCap photogrammetry software.
- DroneDeploy 3D mapping.
- DroneDeploy Enterprise 3D Map software.
- ESRI Drone2Map for ArcGIS.
- Maps Made Easy orthophoto and 3D models software.
- OpenDroneMap photogrammetry software.
- Pix4D Mapper photogrammetry software.
- PrecisionHawk 3D map software.

- SenseFly Aerial Mapping Solutions.
- SimActive Correlator3D™ software.
- WingtraOne Surveying Mapping Solution.

Among the list above, only OpenDroneMap photogrammetry software is the only one free of charge.

The main purpose of this work was therefore to compare only two of the abovementioned software:

- Agisoft Metashape 3D software (widely used in the drone mapping community) and;
- OpenDroneMap photogrammetry software.

The work is therefore organized as:

- 1) Description of a simplified workflow for each software;
- 2) Description of the learning curve for each software;
- 3) Accuracy of cover area estimated from the resulting orthomosaic of each software

## 1. Simplified workflow for software use

The following was with the aim to provide a simplified workflow, one that can be easily followed and without detours, with the output being an orthomosaic.

However, there is extensive documentation for each software. We recommend to explore the following (information within these links were by far the easiest to follow among a large number) openly available in the web:

### Agisoft Metashape 3D software:

- <https://www.agisoft.com/support/tutorials/beginner-level/>
- [https://www.agisoft.com/pdf/PS\\_1.3%20-Tutorial%20\(BL\)%20-%20Orthophoto,%20DEM%20\(without%20GCPs\).pdf](https://www.agisoft.com/pdf/PS_1.3%20-Tutorial%20(BL)%20-%20Orthophoto,%20DEM%20(without%20GCPs).pdf)
- [https://www.agisoft.com/pdf/PS\\_1.3%20-Tutorial%20\(BL\)%20-%20Orthophoto,%20DEM%20\(GCPs\).pdf](https://www.agisoft.com/pdf/PS_1.3%20-Tutorial%20(BL)%20-%20Orthophoto,%20DEM%20(GCPs).pdf)
- <https://www.youtube.com/watch?v=EZfahR49IxA>  
<https://www.youtube.com/watch?v=O--J8JrAB7M>

### OpenDroneMap photogrammetry software:

- <https://docs.opendronemap.org/>
- <https://www.youtube.com/watch?v=5B6G9RSuZVU>
- <https://www.youtube.com/watch?v=kJQegRQUhWU>
- [https://www.youtube.com/watch?v=H\\_bH02FcSX8](https://www.youtube.com/watch?v=H_bH02FcSX8)

## 1.1. Agisoft Metashape 3D software:

To generate an orthomosaic, first download and pay a license for Agisoft Metashape (<https://www.agisoft.com/buy/licensing-options/>) that fit your requirements.

Go to Workflow menu and follow these basic steps:

- 1) Load photos
- 2) Align photos (Accuracy: medium to ultrahigh; pair preselection: generic)

Product is a sparse-cloud. Once the sparse cloud is built:

- 3) Build mesh (surface type: height field; polygon count: medium)
- 4) Build texture (mapping mode: orthophoto; blending mode: mosaic (default); texture size: 4096 X 1)

Go to file menu and

- 5) Export texture (either jpg or tiff)

The orthomosaic is complete and can be exported for further analyses in GIS software such as QGIS or ArcGIS, or image analyses software

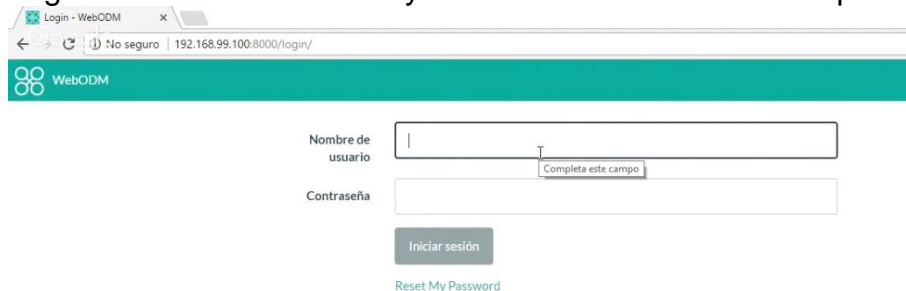
## 1.2. OpenDroneMap software

To generate an orthomosaic, first download OpenDroneMap. OpendroneMap can be used either as WebODM (User Interface) or ODM (Command Line). It is recommended for people used to COTS (commercial off the shelf software) to carefully read the following, and use WebODM:

- <https://docs.opendronemap.org/installation.html>

Once installed, the process is very smooth and as follows:

1. Login in: Once downloaded you will have a username and password



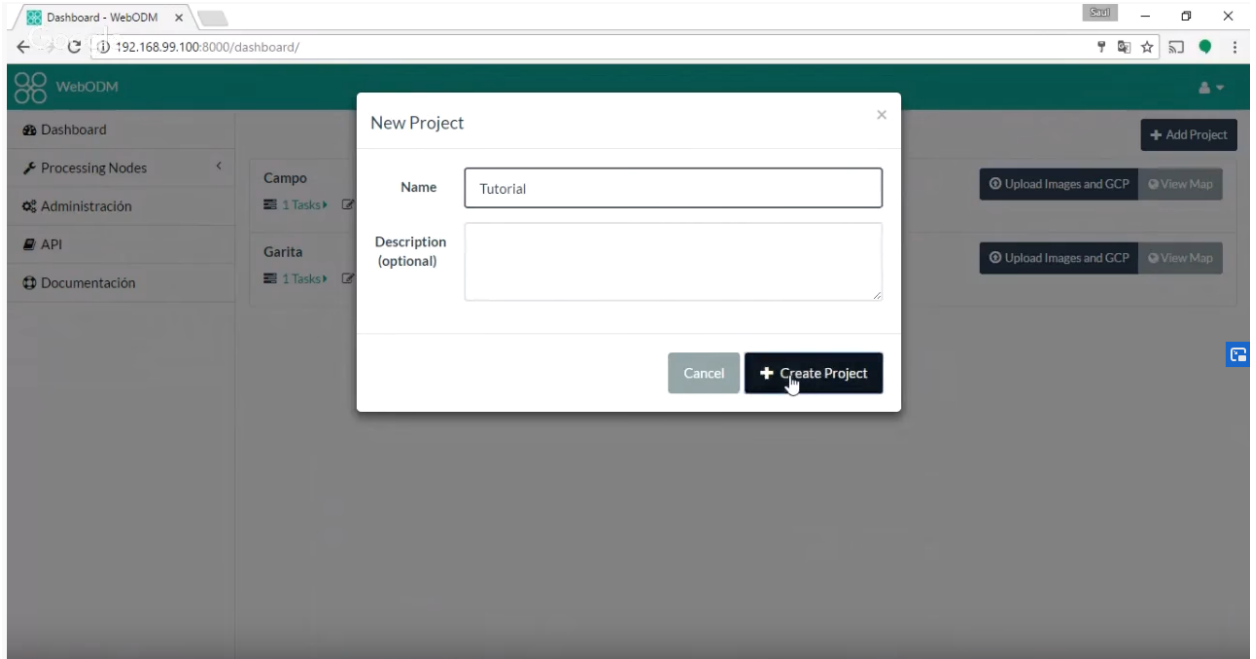
Nombre de usuario

Contraseña

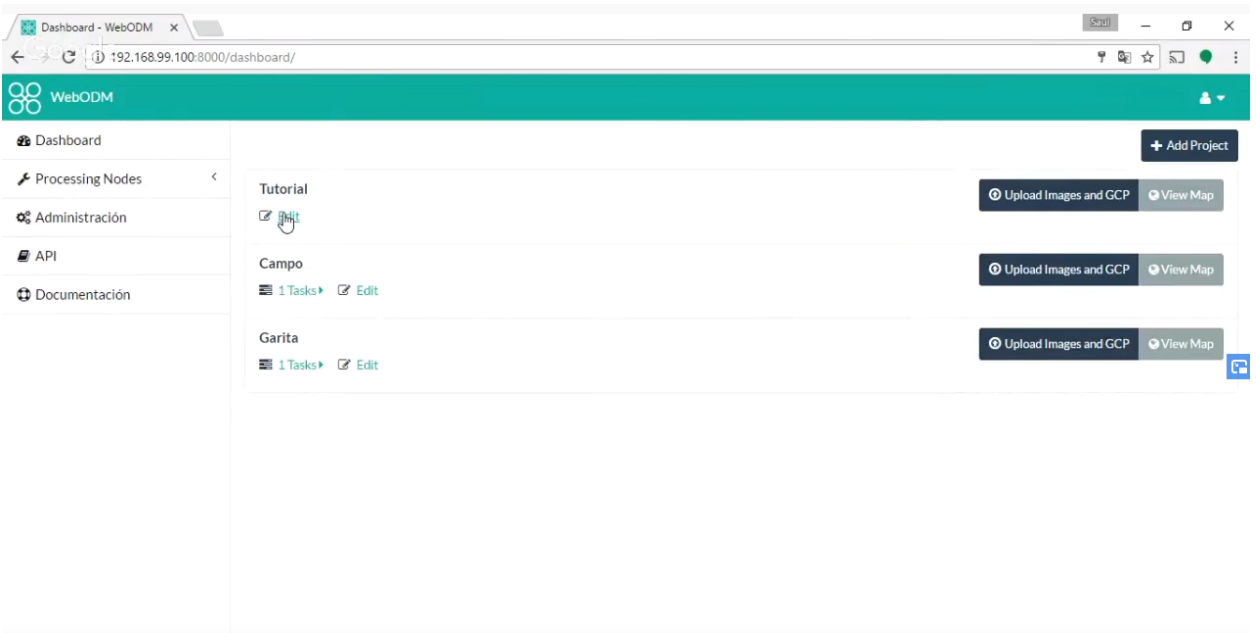
Iniciar sesión

[Reset My Password](#)

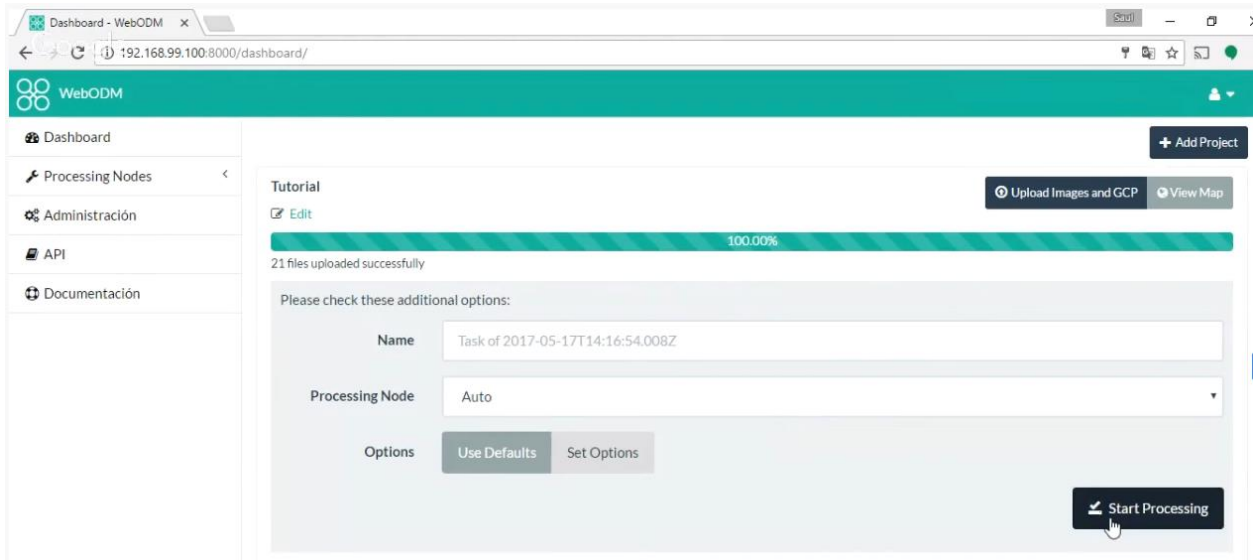
## 2. Name and add project



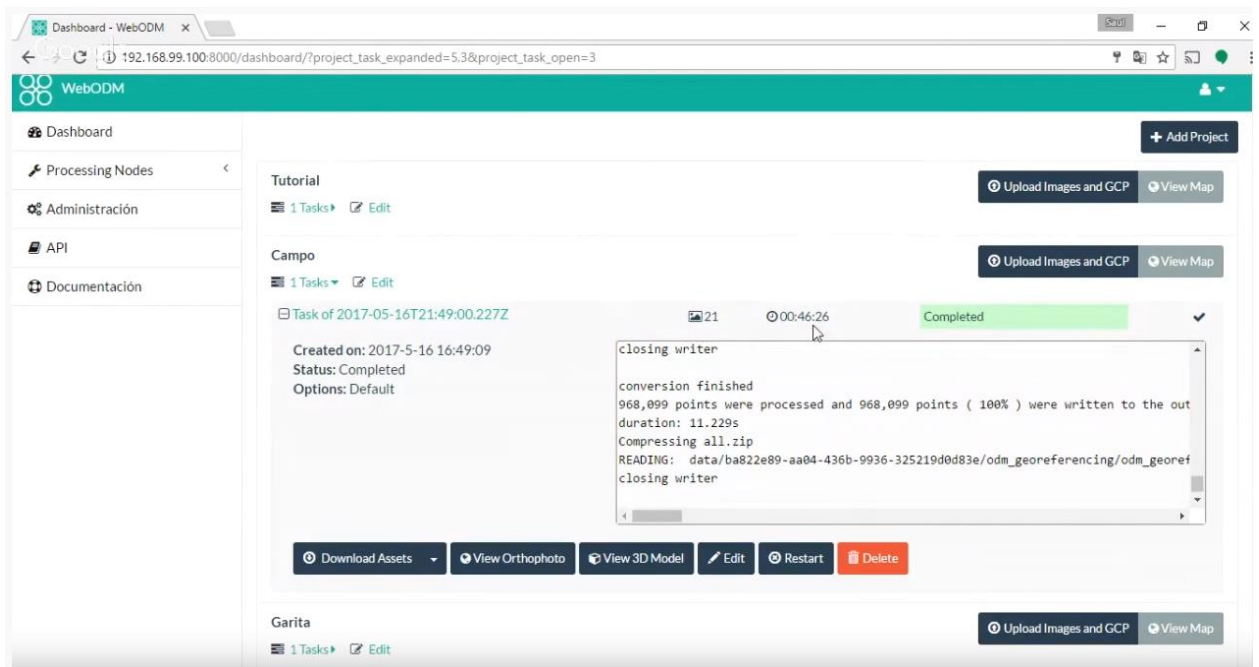
## 3. Upload images



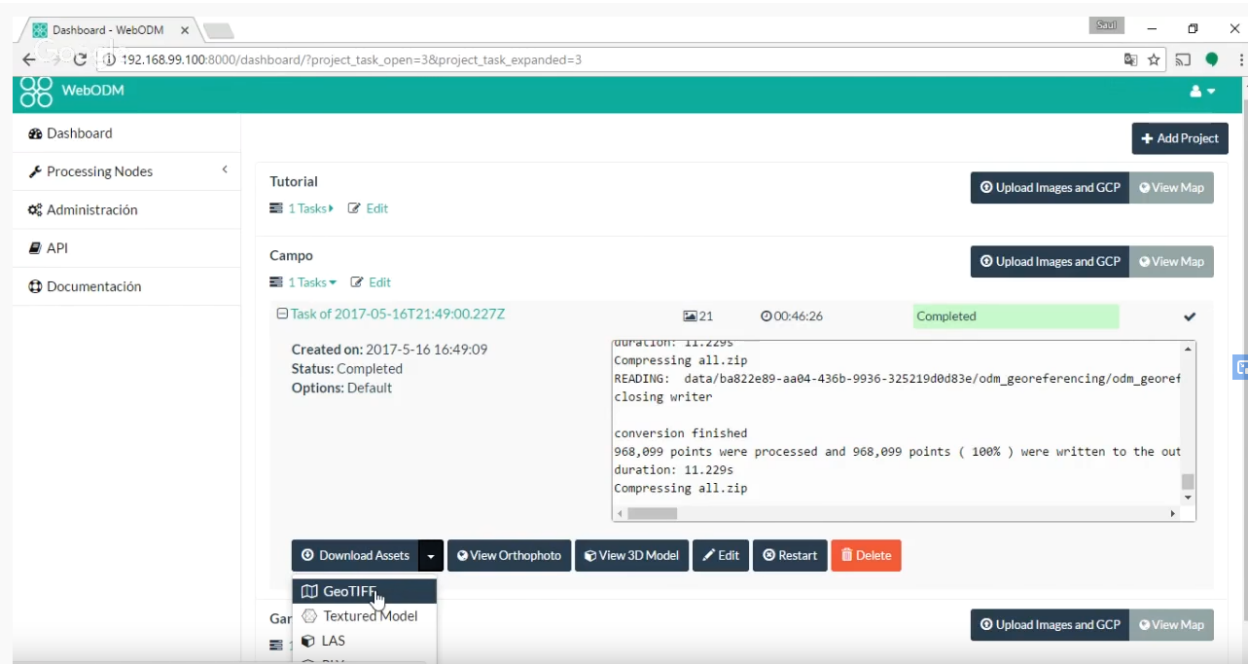
#### 4. Start processing



#### 5. Go to tasks



## 6. View orthophoto/download GeoTIFF



The orthomosaic is complete and can be exported for further analyses in GIS software such as QGIS or ArcGIS, or image analyses software

## 2. Learning curve for each software

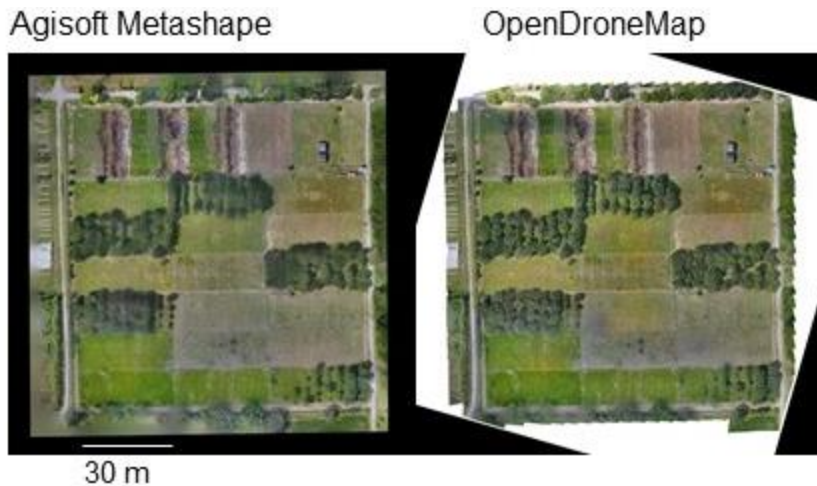
For each software we recorded the amount of time needed to follow instructions and tutorials, from installation till stitching of images to create an orthomosaic. The time needed to properly install OpenDroneMap took about a working week. Whereas the installation of Agisoft Metashape was straightforward. The “expertise” required to install OpenDroneMap likely limit its use over a wider community. However, once installed, the workflow was smooth and easy to follow. One of the advantages of Agisoft Metashape is the number of options provided in the menu, to move from an orthomosaic to a different level of analyses or product (e.g., Digital Elevation Model). Within OpenDroneMap, different products are also available; however, these are less conspicuous to the novice user. It is worth to mention that once the initial drawback of installation in OpenDroneMap the workflow was smooth and easy to follow.



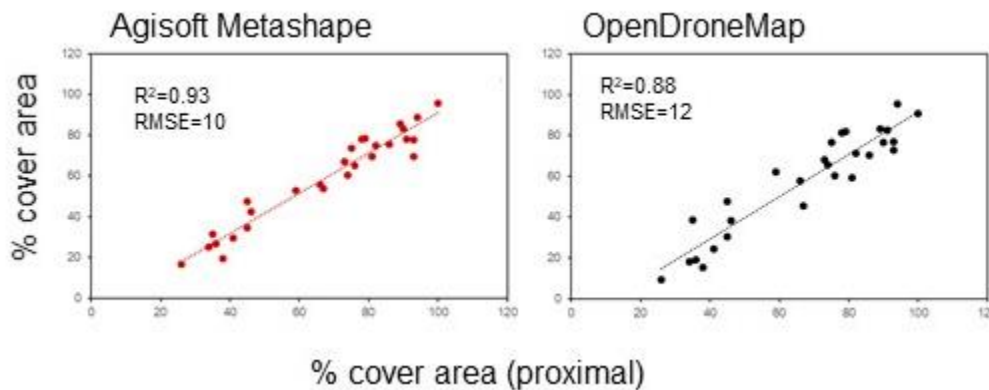
**Figure 1.** Learning curve for each software. Note the inflection point of OpenDroneMap (arrow). Once the OpenDroneMap software was installed and running, the usability became almost instantaneous

### 3. Accuracy of cover area estimated from the resulting orthomosaic of each software

A comparison of ground cover using a plot estimate technique (2500 cm<sup>2</sup>, proximal pictures at nadir angle) as described in Jimenez & Cardoso, et al, 2017. A total of 28 frames were placed across a silvopastoral trial at CIAT HQ (3°30'07.25" N 76°20'45.17" W). Those frames were geopositioned using an Emild Reach RTK GNSS receiver). Previous to the collection of proximal pictures, a UAS (Phantom IV) was used to collect images at 80% overlap and around midday, previously modifying the exposure triangle (ISO Speed, Shutter Speed, Aperture) to avoid overexposure or underexposure of images. Ground sampling distance of images was 0.96cm/px. The images were not subjected to any pre-processing (vignette or fish eye distortion corrections) as one of the aims of this work was to develop a simplified workflow that can be up taken easily by a newcomer. The images were then uploaded to both Agisoft Metashape and OpenDroneMap as described before. Orthomosaics were produced (Figure 2), downloaded, and cover areas of each georeferenced frame were analyzed using a color segmentation approach as described in Jimenez & Cardoso, et al (2017). Overall, there was good agreement between methods (Figure 3) ( $R^2 > 0.8$ , and RMSE ~ 11). There were not significant differences in cover areas estimated either by Agisoft Metashape or OpenDroneMap. Overall image quality of the orthomosaic seemed to be better in OpenDroneMap (less blurriness than in Agisoft Metashape)



**Figure 2.** Resulting Orthomosaics produced by Agisoft Metashape or OpenDroneMap



**Figure 3.** Comparison of cover areas estimated by proximal imaging, and from orthomosaics produced by Agisoft Metashape or OpenDroneMap

## Conclusions

OpenDroneMap seems to be a viable solution for those interested in generating orthomosaics on a budget. Probably the greatest limitations of its wider use, is the first impression of how difficult it is to install for an unexperienced user of Ubuntu and Docker.

## References

Jiménez JC & Cardoso JA, Leiva L, Gil J, Forero MG, Worthington ML, Miles JW, Rao IM. 2017. Non-destructive phenotyping to identify *Brachiaria* hybrids tolerant to waterlogging stress under field conditions. *Frontiers in Plant Science*. 8:167.