FROM DATA TO LEARNING

A Comparative Study of UAV Photogrammetry Platforms for Educational Use in Urban Environments

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Context

Democratization of Photogrammetry

- Increased accessibility to digital cameras and drone platforms in recent decades.
- Summer 2024: research project conducted on Université Laval main campus.

Objective: assessthe data quality from various aerial drone platforms.

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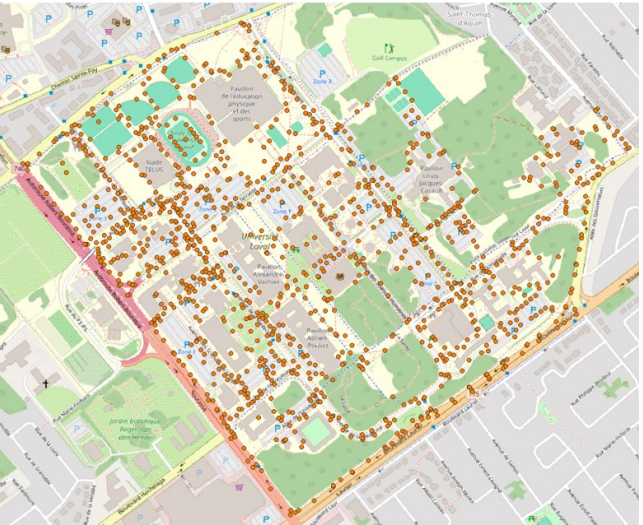

Material

Ground Control and Check Points

- A Trimble R12i GNSS receiver was used to collect 1,182 high-precision points.
- Only permanent features with strong color or texture contrast were selected to ensure visibility in aerial imagery.
- Selected points served as Ground Control Points (GCPs) togeoreference and improve model accuracy.
- A subset of points was retained as Check Points (CPs) to validate the geometric accuracy of the photogrammetric outputs.

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Material

Drones used

Three drones were used for the project:

- EVO II profrom Autel Robotics;
- Mavic 3 Enterprise from DJI ;
- mdMapper 1000 DGfrom Microdrones.

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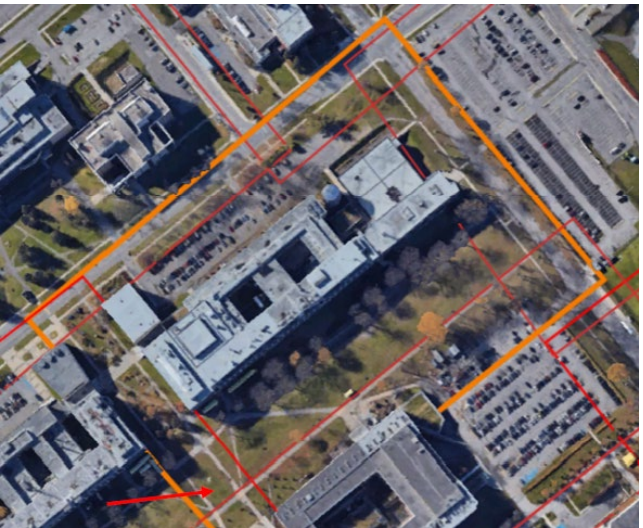

Methods

Divide the campus into different sectors and set up a network of control points

- Prior to image acquisition with the aerial drones, the campus was divided into **18 sectors**
- The division was made taking into account the **flight time of each drone platform** and the need to keep the **drone in view at all times** during field operations.
- Before acquiring photogrammetric data, it is necessary to **establish a network of points** that will serve as a basis for generating cartographic products and verifying their quality.

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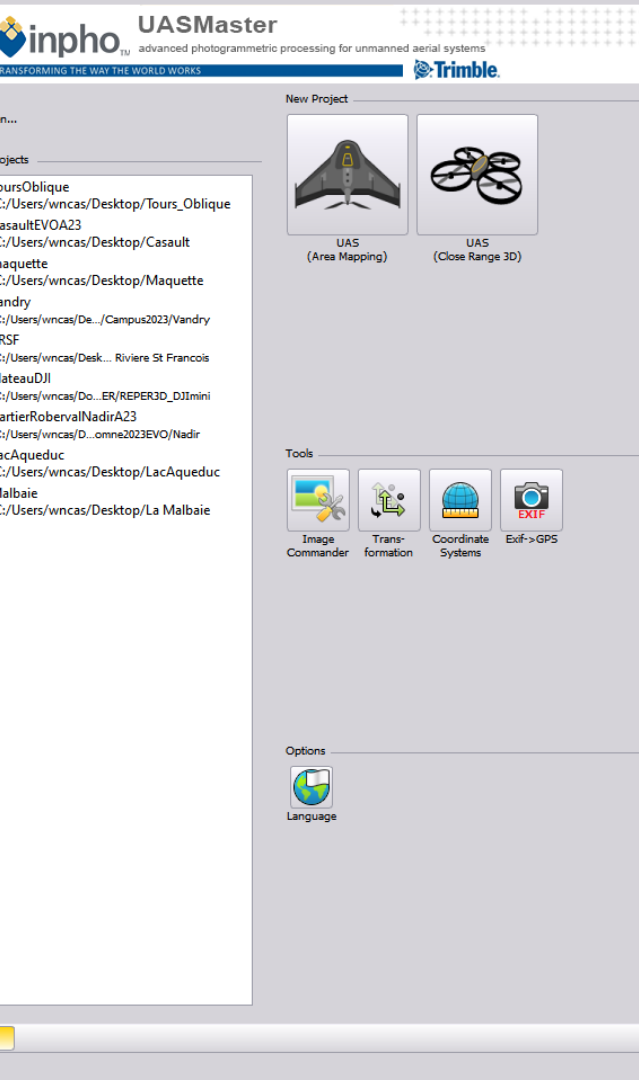

Data processing

Software used

- Trimble Inpho's UASMaster was used to process the photogrammetric data.
- Trimble Applanix PosPACsoftware was used to process the trajectory of the mdMapper 1000 DG.

Cansel
Improving field to finish productivity

Trimble

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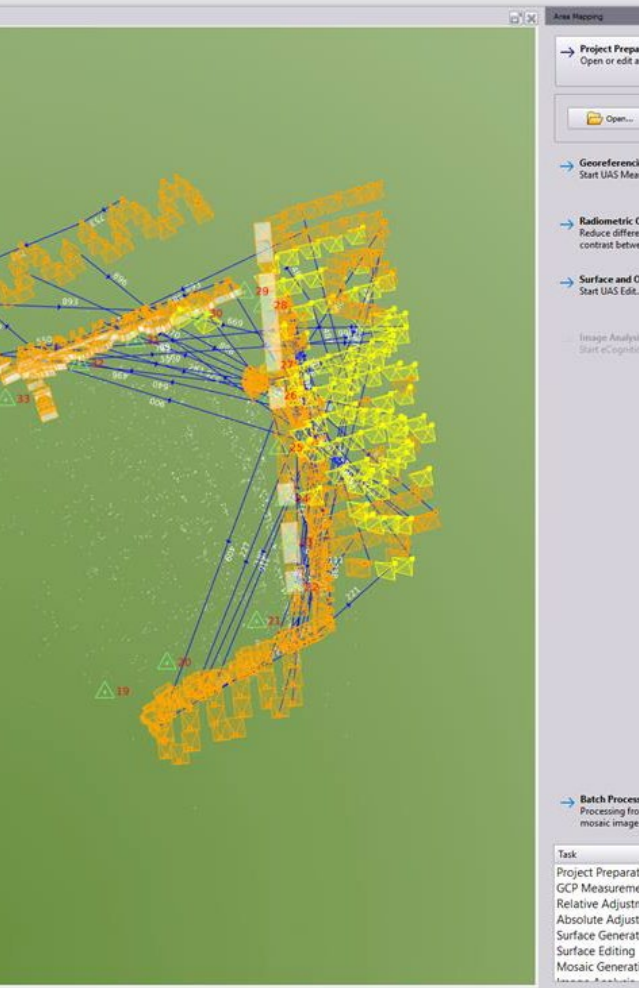

Data processing

Point cloud and orthoimage generation

- The georeferencing of the images for each sector considered an average of 15 control points with a good spatial distribution with the points clearly visible on the images.
- Then, a minimum of 30 points were used for quality control according to ASPRS standards (2024, p.30). Each point was measured in at least 20 images per sector.

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Orthoimages generated

- For each sector acquired,true orthophoto were generated using UASMaster software.
- The mosaics were generated at their optimum spatial resolution, which varied between 1.2cm and 3.5cm.
- The spatial resolution of these mosaics was reduced to 10 cm for online display in order to optimize ArcGIS Online cloud storage space.

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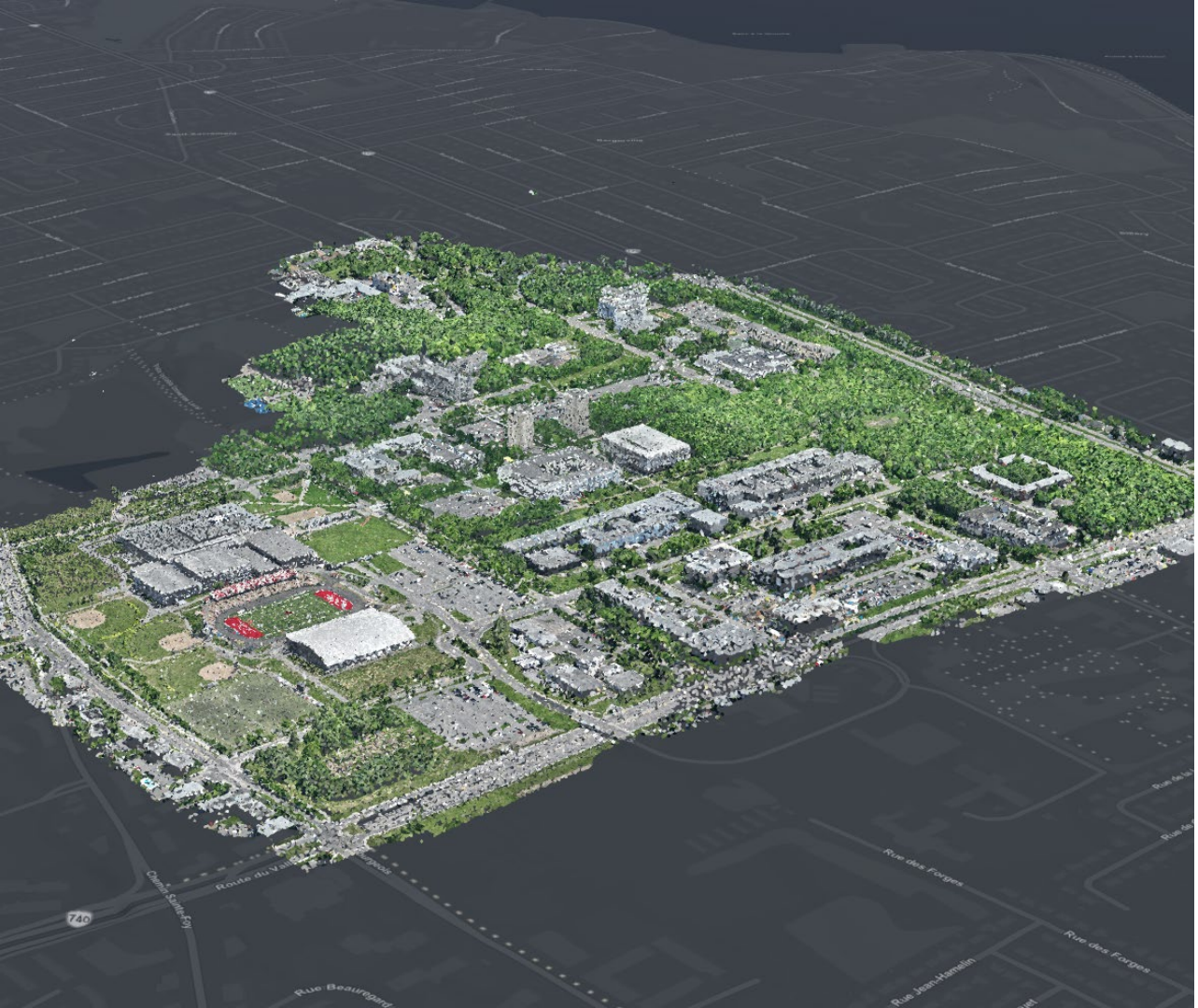

Point cloud

- Point clouds were created for each sector of the campus.
- Their density is of the same order of magnitude as the resolution of the orthoimages, ranging from 1.2cm to 3.5cm.

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Point cloud

mdMapper 1000 DG

DJI Mavic 3E

Autel EVO II

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Processed data quality

Here is a brief summary of the processed data quality for each drone used in the experiment :

RMSEh/ RMSEv (cm)	Avg	Max	Min	Standard deviation
mdMapper 1000 DG	3.70/5.23	6.40/7.49	2.23/3.59	1.02/1.15
Mavic 3E	3.20/4.20	3.84/6.97	2.78/2.79	0.29/0.97
EVO II pro	5.26/11.60	6.92/23.97	4.23/5.37	0.66/5.18

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Data quality analysis

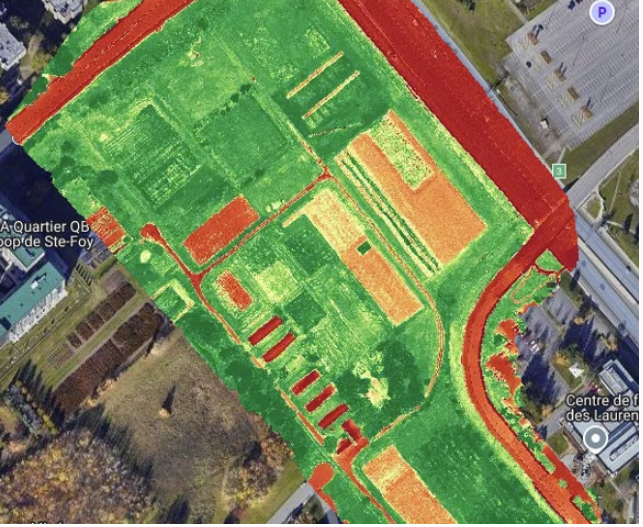
Quantitatif

- An exhaustive analysis of the quality of the photogrammetric data generated was published in an article in the Geomatics magazine of the Ordre des Arpenteurs-Géomètres du Québec (OAGQ) in Autumn 2024.
- Here is a summary of the results:

	GSD (cm)	RMSE (CP) (cm)	Ratio (RMSE/GSD)
mdMapper 1000 DG	1.52	3.87	2.55
Mavic 3E	3.27	2.78	0.85
EVO II pro	2.65	5.35	2.02

Conclusion

Drone	Advantages	Disadvantages
mdMapper 1000 DG	High performance; Less noise in the point cloud; High resolution; Raw data acquired.	More complex and time-consuming processing; Reduced autonomy; Complex deployment; Higher system cost.
DJI Mavic 3E	Ease of use; RTK option for acquisition; Simple deployment; Battery autonomy; Affordable price.	Coarser resolution; Limited mission planning application.
Autel EVO II pro	Ease of use; Simple deployment; Affordable price.	Repeatability of results after processing; Autonomy of joystick and drone in flight is limited.



Perspectives

The data acquired from the campus can be used as a basis for:

- Laboratories;
- Exercices;
- Research;
- Time comparison;
- Campus management;
- ETC.

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CENTRE DE RECHERCHE
EN DONNÉES ET INTELLIGENCE GÉOSPATIALES

Fonds de recherche Québec

CRSNG NSERC

Guy Montreuil
Jonathan Gagnon
Cliford Vilpique
Marie-Claude Boulet
Élizabeth Dione

Thank you!

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Questions?

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