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XIX SBSR
Simpósio Brasileiro de Sensoriamento Remoto

Semi-Automatic UAV-based SfM survey of vertical surfaces

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FAPESP
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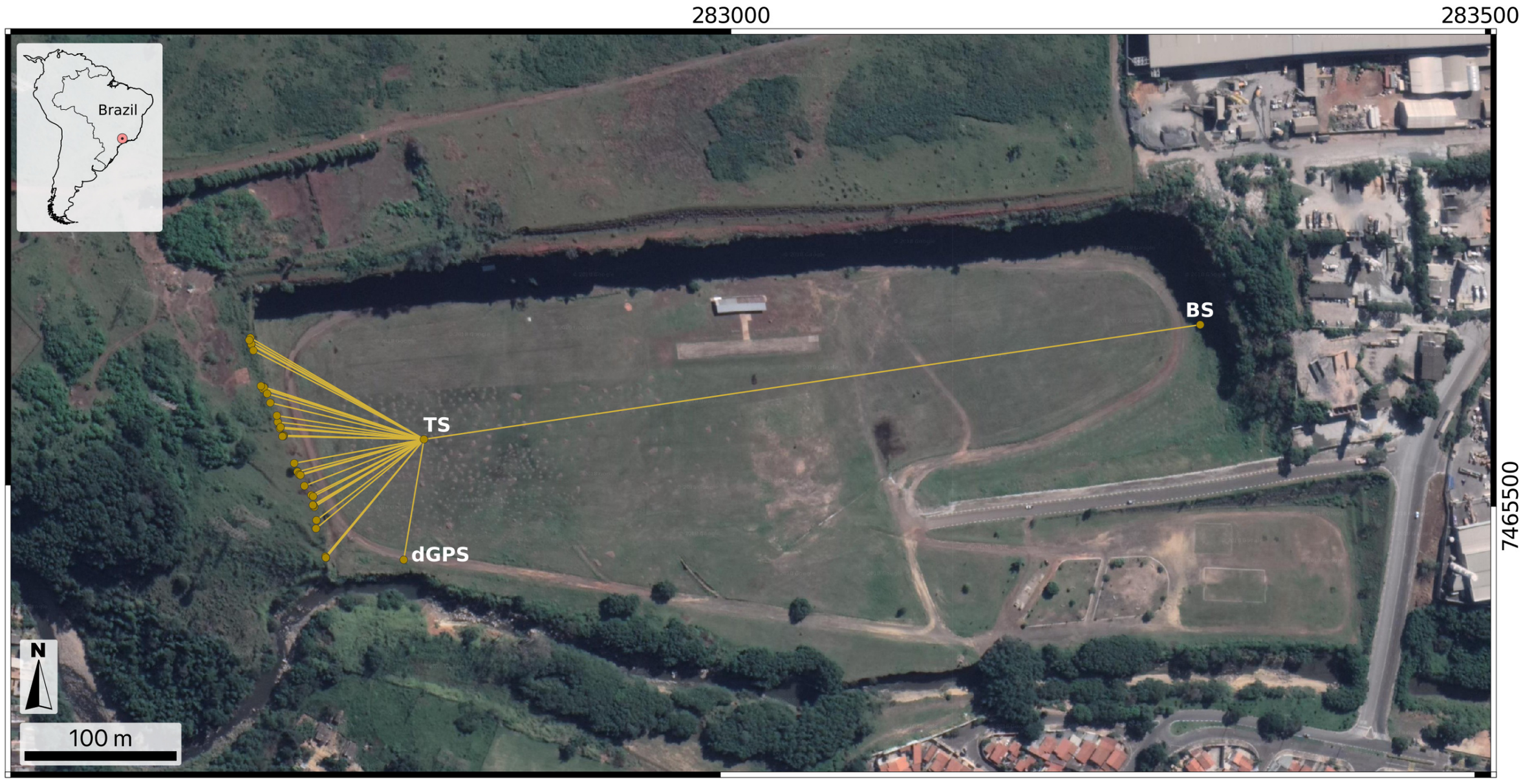
SPAMLab
Spatial Analysis and Modelling
https://spamlab.github.io

WHY?

- Automatic mission planning creates grid of flight lines
- Vertical features (cliffs, etc) aren’t mapped with constant sensor geometry about the ‘wall’
- manual flight can help but it will take more time and can be dangerous (for the aircraft)

Case study: Jardim Garcia Quarry, Campinas (SP)



Grohmann et al., XIX SBSR, 2019

step-by-step

1) Create first flight line in Google Earth and save as KML;

2) Import KML into Mission Hub and edit actions for first waypoint;

3) Export mission as CSV and open in text editor;

4) In text editor, adjust flight height and duplicate actions for all waypoints;

5) Save one mission for each required flight height as CSV;

6) Import CSV into Mission Hub and save into user account;

7) Fly each mission via Litchi mobile App.

step 1 - Create first flight line in Google Earth and save as KML

step 2 - Import KML into Mission Hub and edit actions for <u>first waypoint</u>

Important!!!

step 3 - Export mission as CSV and open in text editor

```
 latitude,longitude,altitude(m),heading(deg),curvesize(m),rotationdir,gimbalmode,gimbalpitchangle,
 actiontype1,actionparam1,actiontype2,actionparam2,actiontype3,actionparam3,actiontype4,actionparam4,actiontype5,actionparam5,
 actiontype6,actionparam6,actiontype7,actionparam7,actiontype8,actionparam8,actiontype9,actionparam9,actiontype10,actionparam10,
 actiontype11,actionparam11,actiontype12,actionparam12,actiontype13,actionparam13,actiontype14,actionparam14,actiontype15,actionparam15,
 altitudemode,speed(m/s),poi_latitude,poi_longitude,poi_altitude(m),poi_altitudemode
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```

flight height

actions and parameters for first waypoint

copy/paste for all waypoints

step 4 - Adjust flight height and duplicate actions for all waypoints

```
 latitude,longitude,altitude(m),heading(deg),curvesize(m),rotationdir,gimbalmode,gimbalpitchangle,
 actiontype1,actionparam1,actiontype2,actionparam2,actiontype3,actionparam3,actiontype4,actionparam4,actiontype5,actionparam5,
 actiontype6,actionparam6,actiontype7,actionparam7,actiontype8,actionparam8,actiontype9,actionparam9,actiontype10,actionparam10,
 actiontype11,actionparam11,actiontype12,actionparam12,actiontype13,actionparam13,actiontype14,actionparam14,actiontype15,actionparam15,
 altitudemode,speed(m/s),poi_latitude,poi_longitude,poi_altitude(m),poi_altitudemode
-22.9035544946994,-47.1184402458146,4,280,0,0,0,0,0,1000,1,0,4,265,1,0,4,250,1,0,5,-15,1,0,4,265,1,0,4,280,1,0,0,1000,5,0,-1,0,0,0,0,0,0,0
-22.9036275426808,-47.1184118144023,4,280,0,0,0,0,0,1000,1,0,4,265,1,0,4,250,1,0,5,-15,1,0,4,265,1,0,4,280,1,0,0,1000,5,0,-1,0,0,0,0,0,0,0
-22.9037005906621,-47.1183833829901,4,280,0,0,0,0,0,1000,1,0,4,265,1,0,4,250,1,0,5,-15,1,0,4,265,1,0,4,280,1,0,0,1000,5,0,-1,0,0,0,0,0,0,0
-22.9037736386434,-47.1183549515778,4,280,0,0,0,0,0,1000,1,0,4,265,1,0,4,250,1,0,5,-15,1,0,4,265,1,0,4,280,1,0,0,1000,5,0,-1,0,0,0,0,0,0,0
-22.9038466866247,-47.1183265201655,4,280,0,0,0,0,0,1000,1,0,4,265,1,0,4,250,1,0,5,-15,1,0,4,265,1,0,4,280,1,0,0,1000,5,0,-1,0,0,0,0,0,0,0
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-22.9046502144193,-47.1180137746306,5,280,0,0,0,0,0,1000,1,0,4,265,1,0,4,250,1,0,5,-15,1,0,4,265,1,0,4,280,1,0,0,1000,5,0,-1,0,0,0,0,0,0,0
```

`actiontype1: 0` *(stay hovering)*

`actionparam1: 1000` *(miliseconds)*

`actiontype2: 1` *(take photo)*

`actionparam2: 0` *(no associated parameter)*

`actiontype3: 4` *(rotate aircraft)*

`actionparam3: 265` *(azimuth)*

Actions defined for this example

1) Hover for 1s (to stabilise the UAV);
2) Take photo (aircraft is oriented at initial 'heading' setting of N280º);
3) Rotate aircraft to N265º;
4) Take photo;
5) Rotate aircraft to N250º;
6) Take photo;
7) Tilt camera gimbal -15º;
8) Take photo;
9) Rotate aircraft to N265º;
10) Take photo;
11) Rotate aircraft to N280º;
12) Take photo;
13) Hover for 1s;
14) Tilt camera gimbal back to 0º.

step-by-step

1) Create first flight line in Google Earth and save as KML;

2) Import KML into Mission Hub and edit actions for first waypoint;

3) Export mission as CSV and open in text editor;

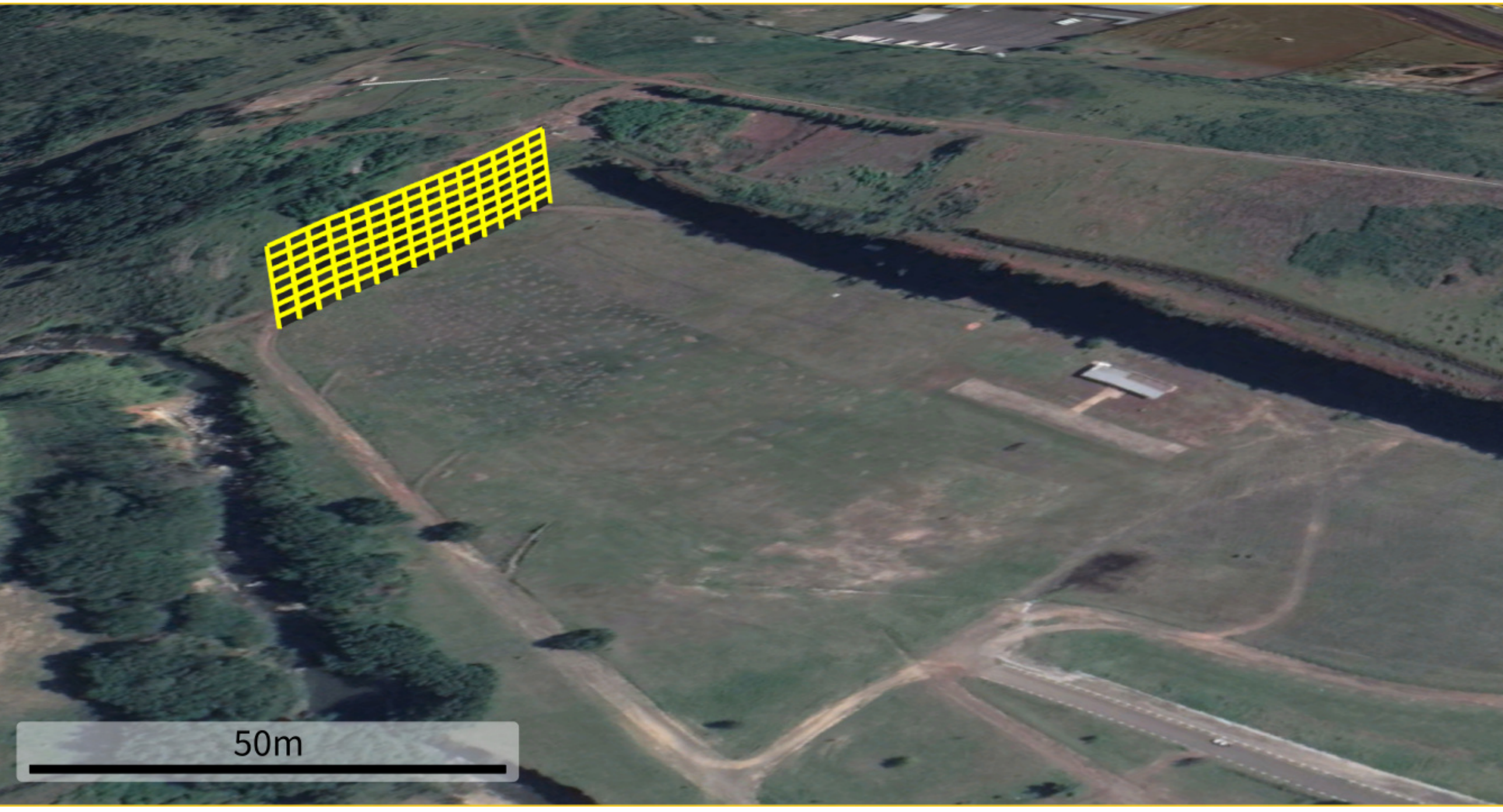
4) In text editor, adjust flight height and duplicate actions for all waypoints;

5) Save one mission for each required flight height as CSV;

6) Import CSVs into Mission Hub and save into user account;

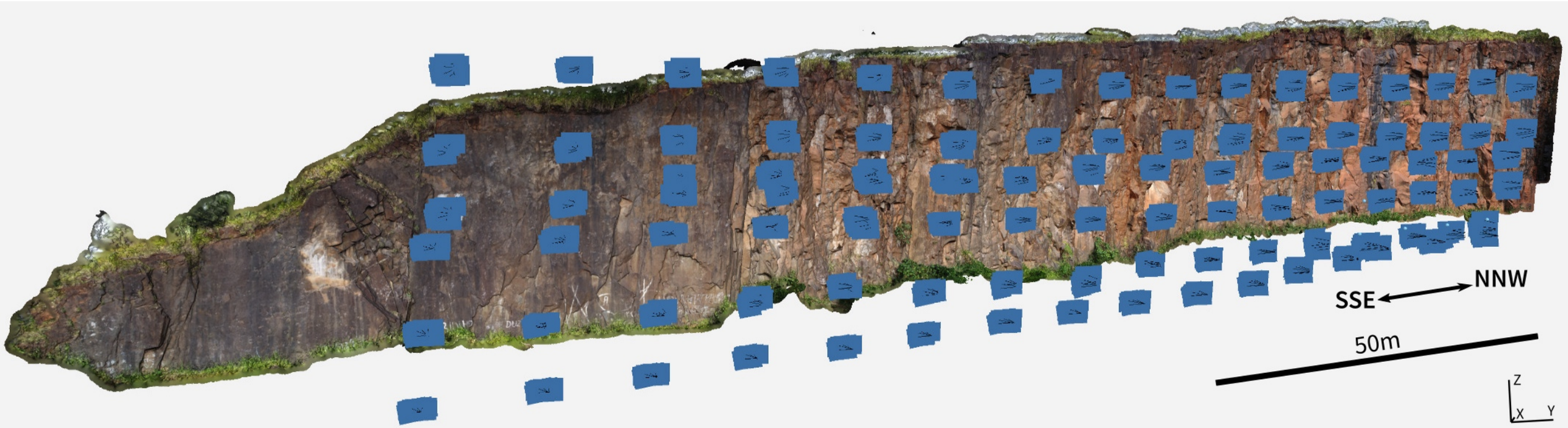
7) Fly each mission via Litchi mobile App.

KMLs of missions visualised in GoogleEarth

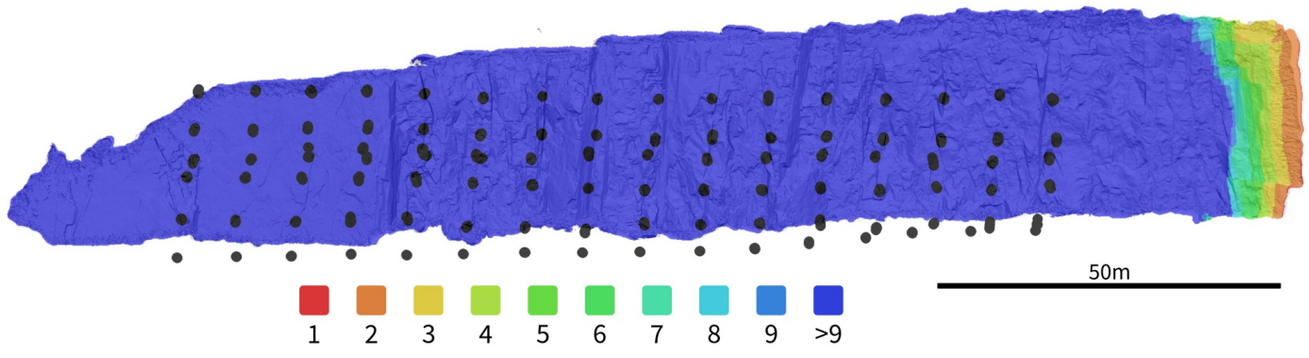


Grohmann et al., XIX SBSR, 2019

Results - flight lines, cameras positions and image overlap



- 6 flight lines (16 waypoints each)
- each flight line - about 8 minutes
- total time - around 1:15
- overlap >9 images
- 3D model - 534 images
    - sparse cloud (SfM) - 129,806 tie points
    - dense cloud (MVS) - 39,599,660 points
    - mesh - 7,919,932 faces



Results - final 3D model

Take-home message

method is flexible, adaptable to user needs

ensures safety (user and aircraft)

ensures constant distance and geometry

reproducible (data collection and fair science)