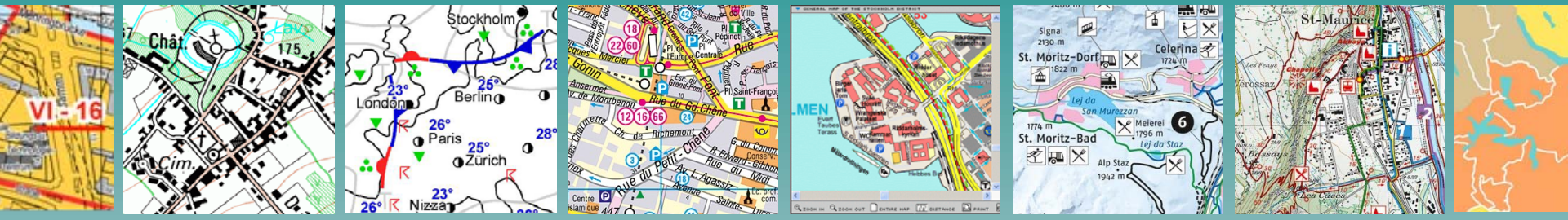

Integrating LiDAR data into the workflow of cartographic representation.

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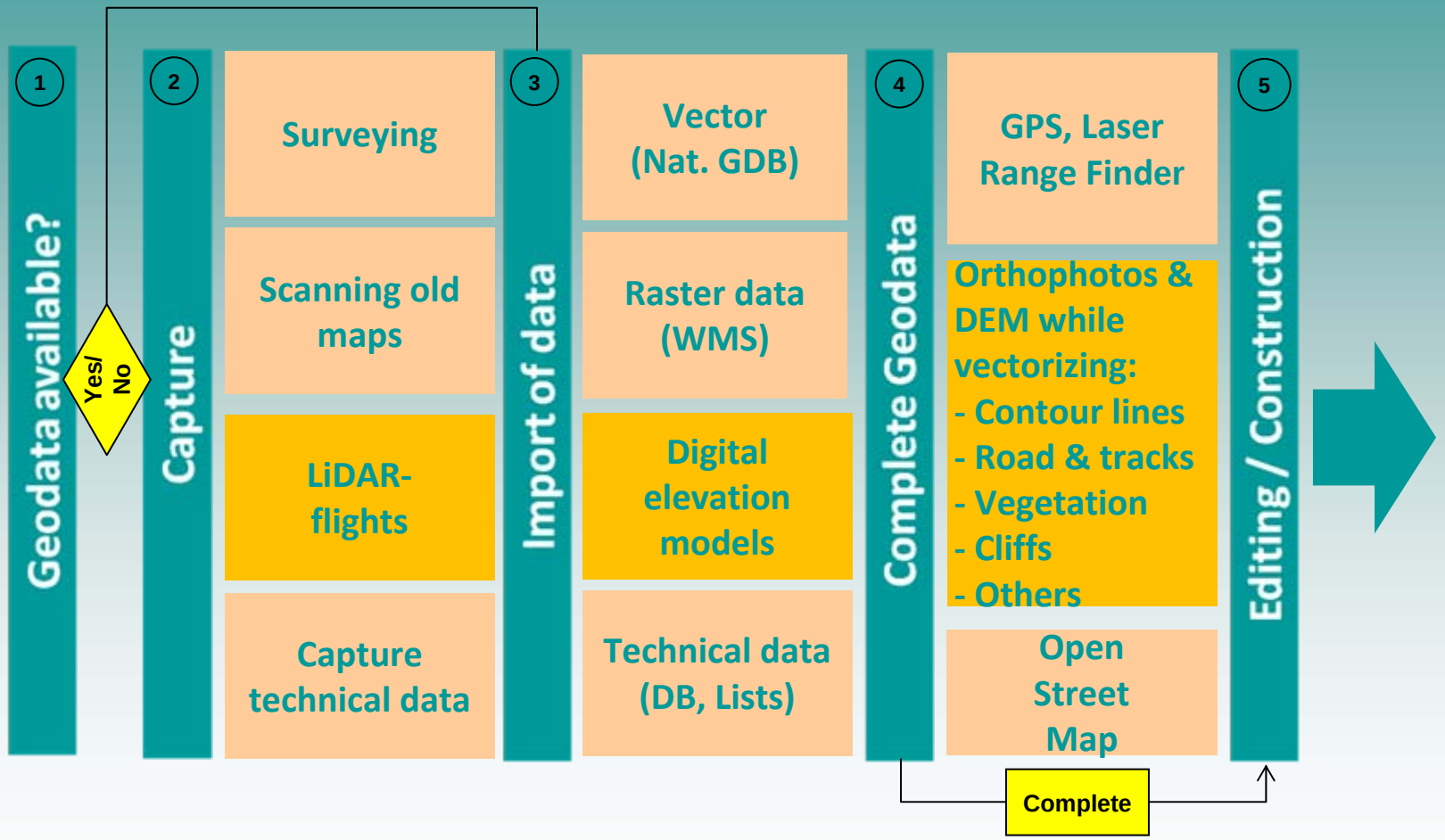
Cartographic Workflow I.



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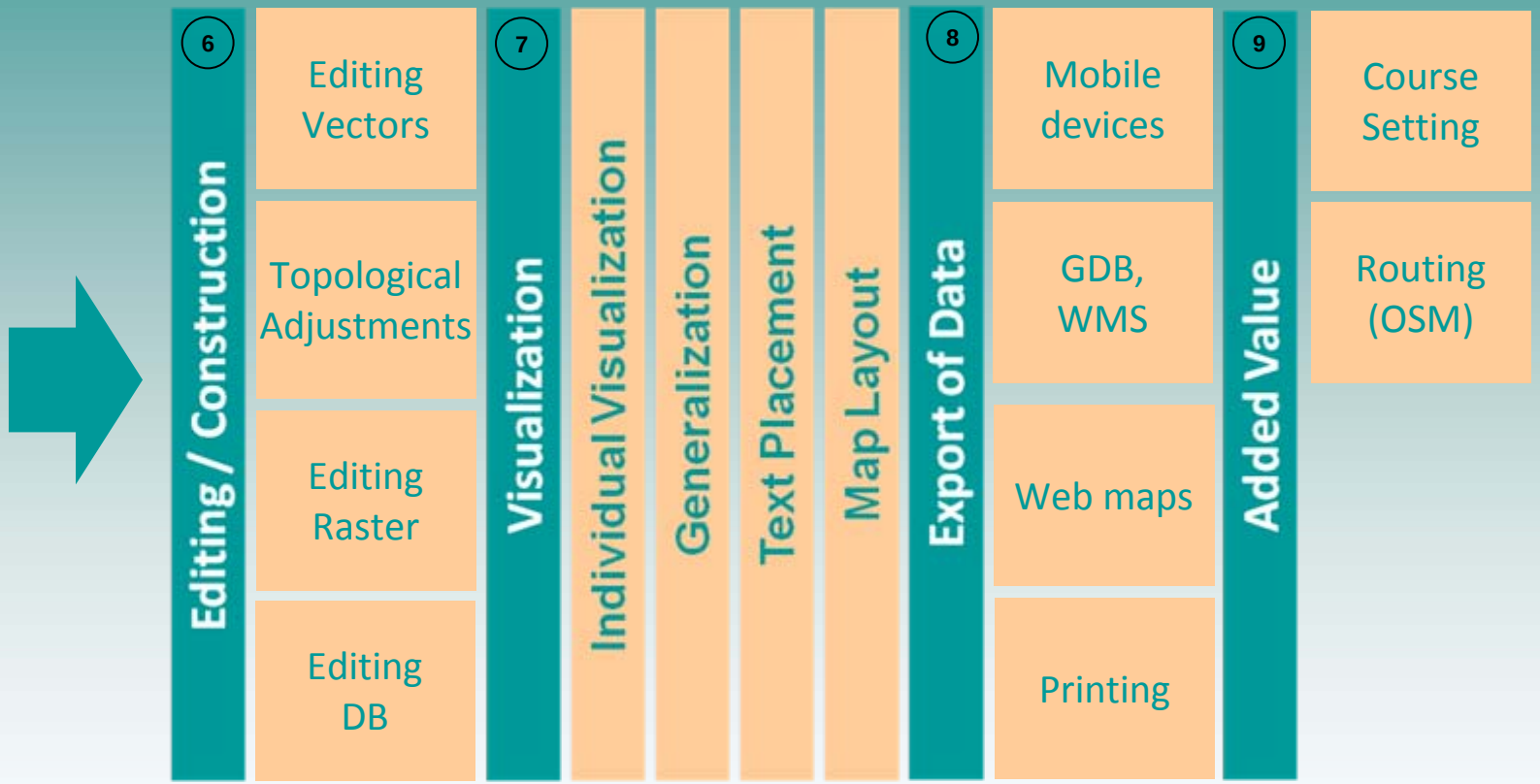
Cartographic Workflow II.



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Orienteering Maps.

8 Years ago: LiDAR data / DEM / Tablets (OCAD 10/11)

- Base map: Digital Survey Maps / **WMS** /
  LiDAR data
  → Contour lines
  → Relief shading
  → Slope map
  → Density Maps
  → Intensity Maps

- Surveying: GPS Receiver → Tracks
  Laser Range Finder
  Tablet PC

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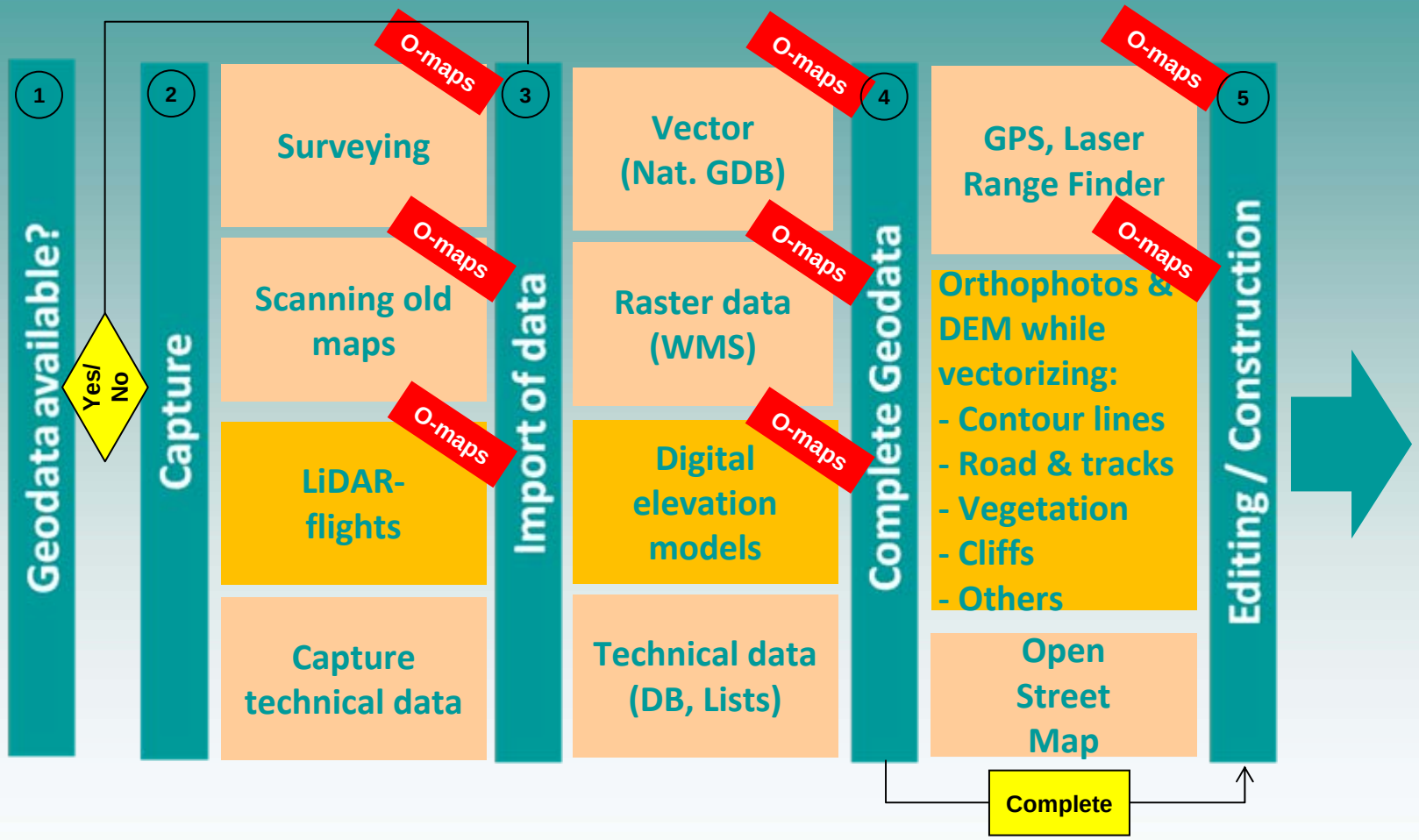
Cartographic Workflow I.



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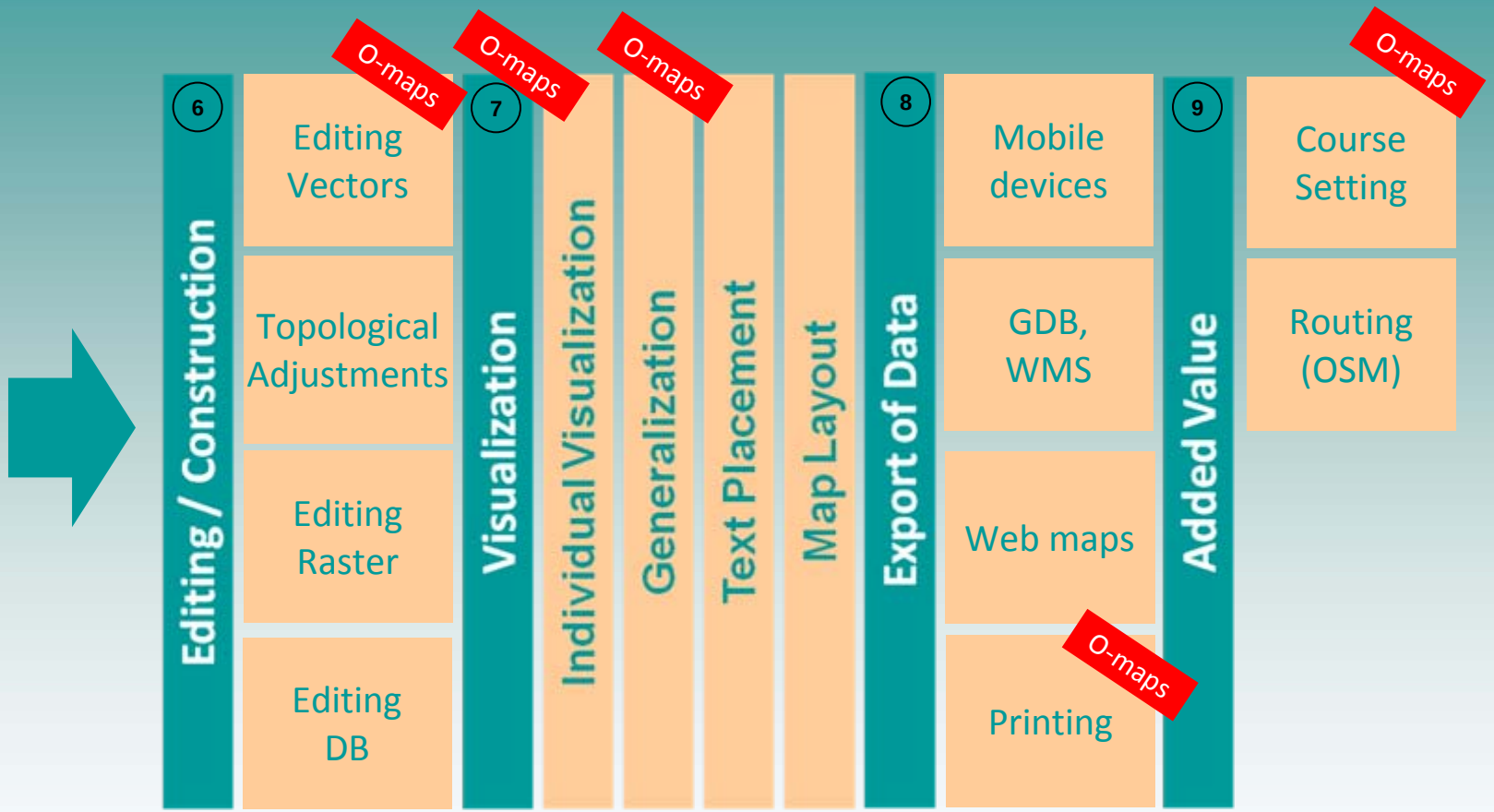
Cartographic Workflow II.



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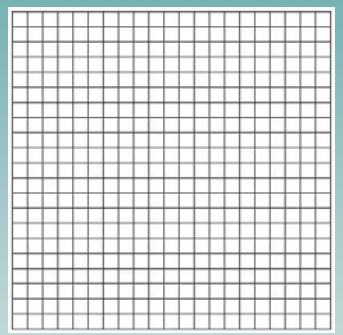
LiDAR Data.

Laser Raw Data

551001.630	168916.990	520.900
551007.280	168921.990	522.940
551047.900	168946.030	521.690
551002.070	168975.660	525.700
551038.280	168922.590	520.100
551037.470	168923.490	520.170
551035.490	168924.130	520.300
551034.420	168925.330	520.250
551074.600	168912.830	518.160
551093.410	168943.010	520.420
551094.720	168943.490	520.500
551091.810	168947.240	520.550
551092.780	168945.960	520.420
551052.440	168900.370	518.300
551055.890	168942.290	520.760
551054.910	168943.710	521.440
551058.210	168967.050	521.910
551080.930	168916.260	518.290
551039.580	168906.470	519.050
551036.320	168908.590	519.130
551050.930	168903.580	519.190
551050.130	168901.360	518.490
551049.530	168903.360	518.910
551034.950	168921.310	519.480
551035.380	168922.850	519.610
551036.350	168921.550	519.480
551087.450	168944.330	520.530
551074.270	168911.130	518.360
551075.590	168911.590	518.320
551052.210	168961.030	521.950

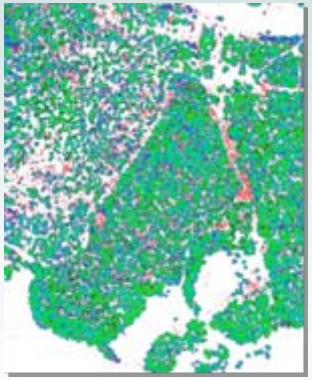
GRID



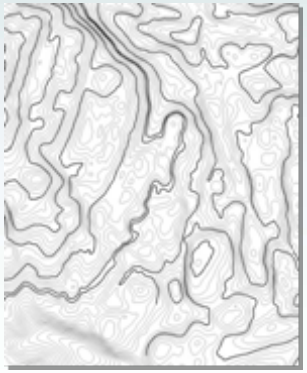
RGB Photo

Hill Shading

DSM - DTM



Contour Lines



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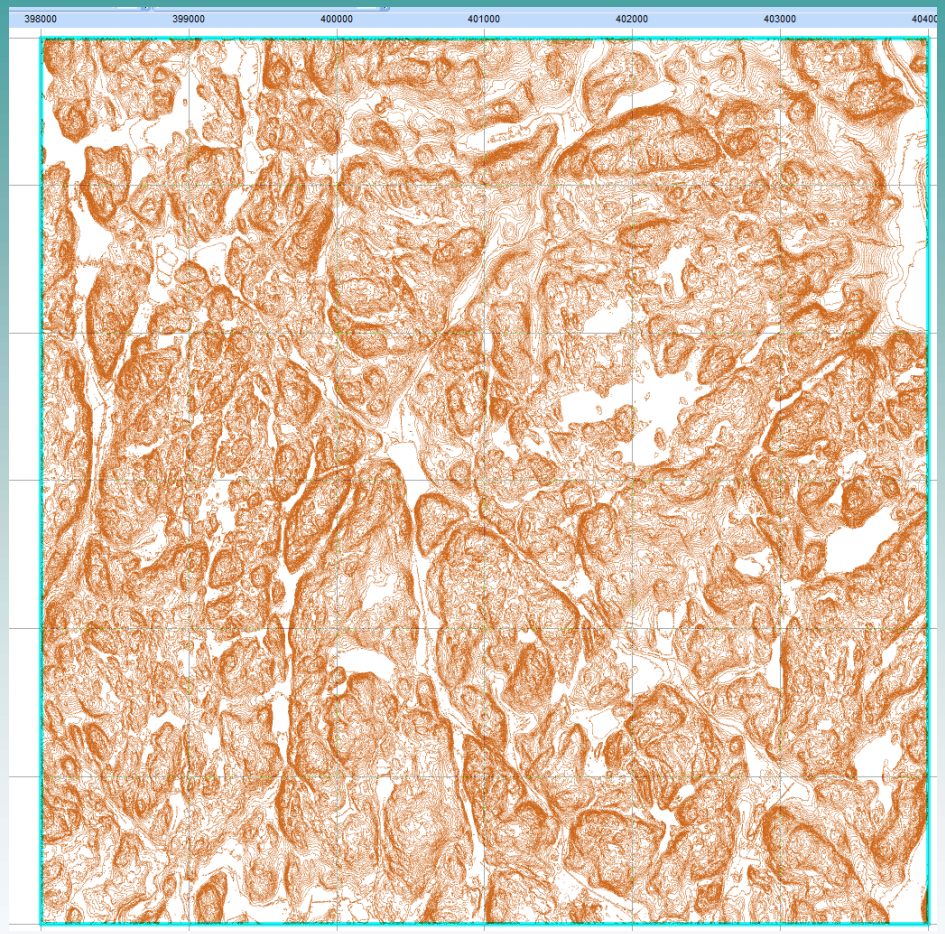
Contour Lines.



- Individual contour interval.
- Problem: Large file of Danish Land Survey with 36 km² → several days
- Solution: Split into tiles of 1km km² → 6 minutes and merge contour lines afterwards!

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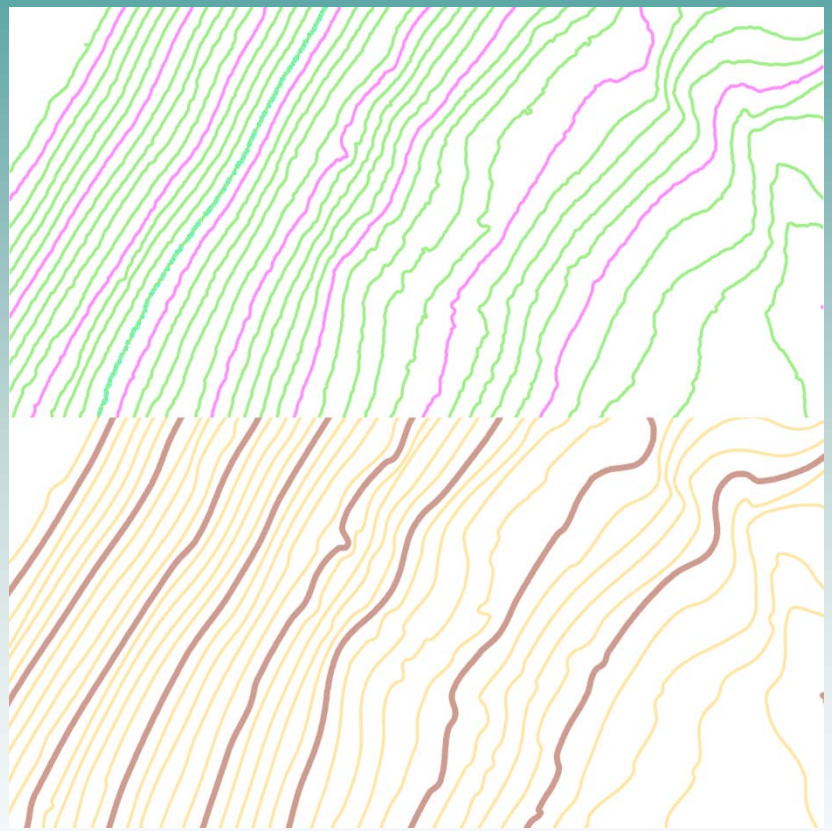
Contour Lines.



- Problem: jagged contour lines
- Solution:
  1st use Douglas-Peucker Algorithm
  and
  2nd change into Bèzier Curve.

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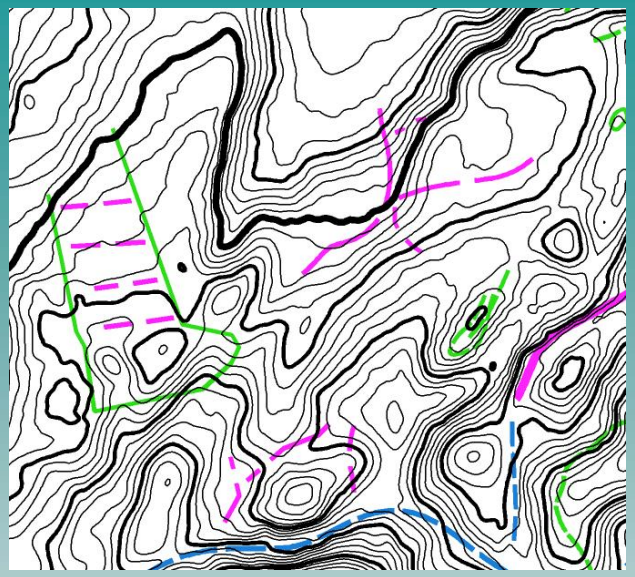
Contour Lines.



- Problem: differentiate depressions from hills
- Solution:
  Combine with hill shading picture

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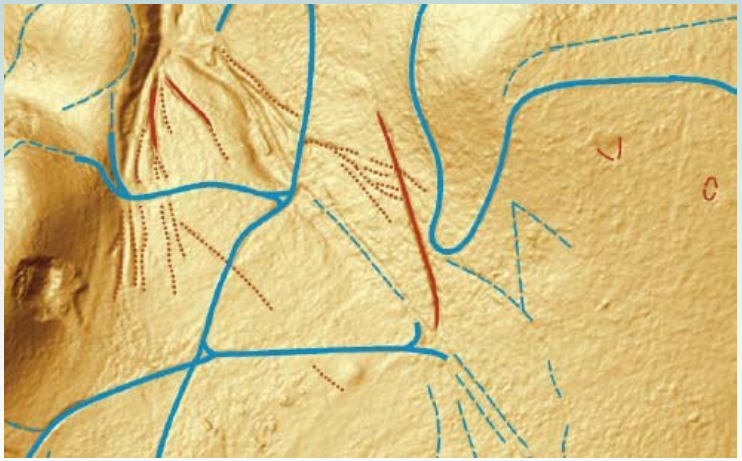
Hill Shading.

- Open hill shading as background map and vectorize the shape of terrain, like
  - trail and track network
  - ditches and depressions
  - hills
- The quality of the hill shading can differ due to the quality of the resolution.
- Experienced user can detect vegetation boundaries as well.



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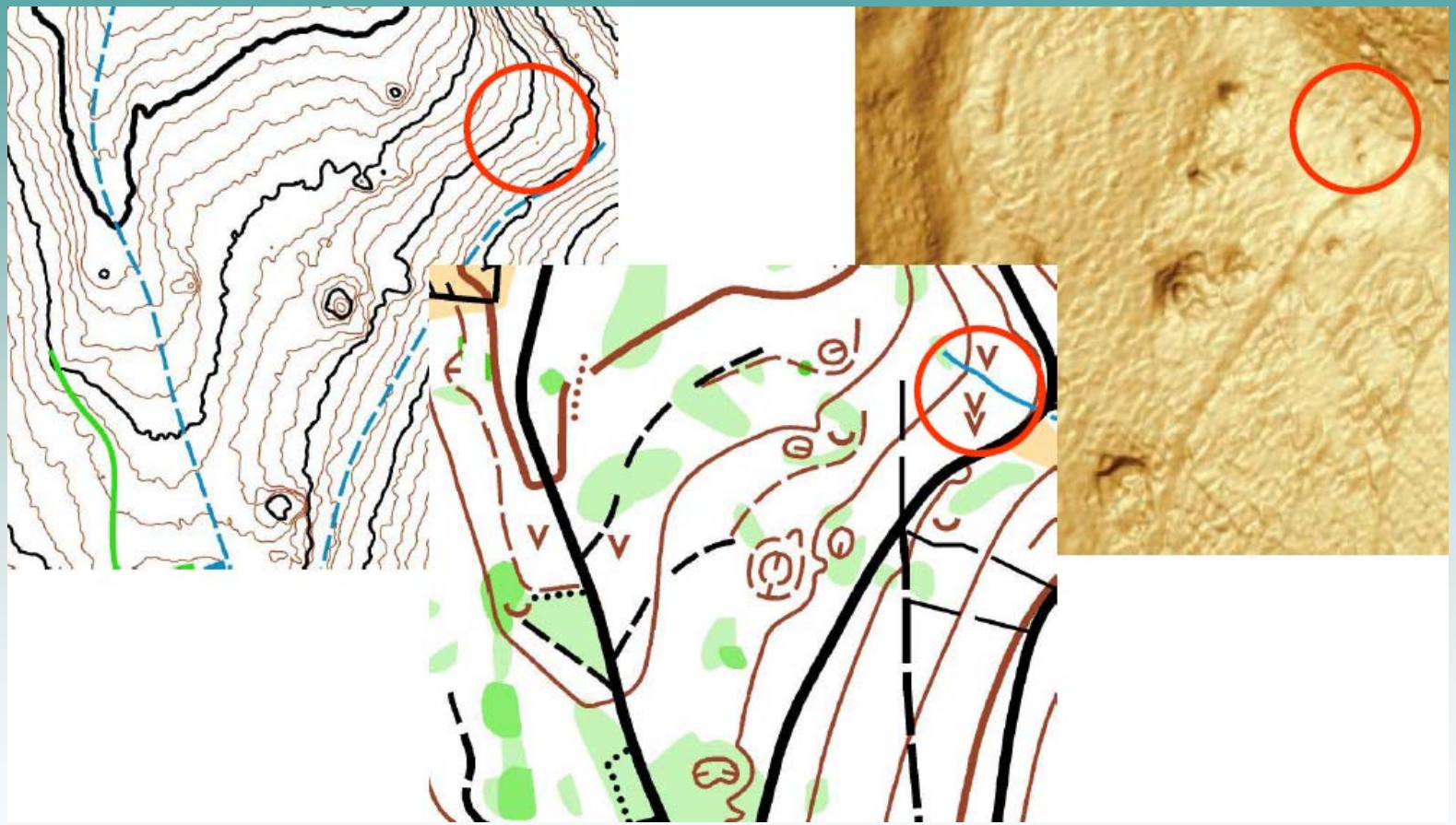
Contour Line vs. Hill Shading



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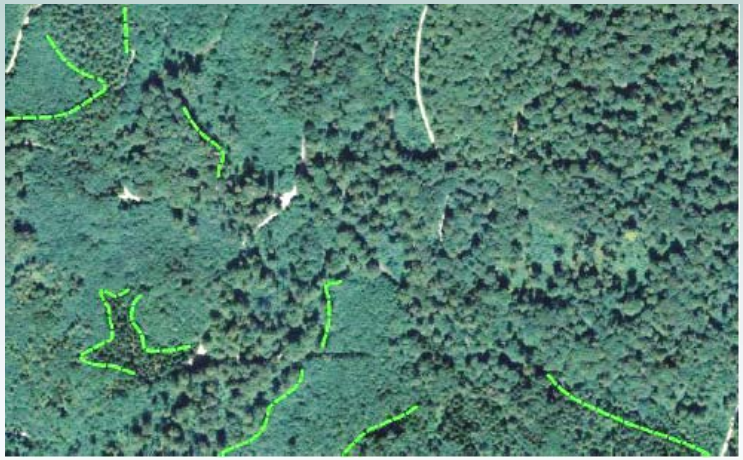
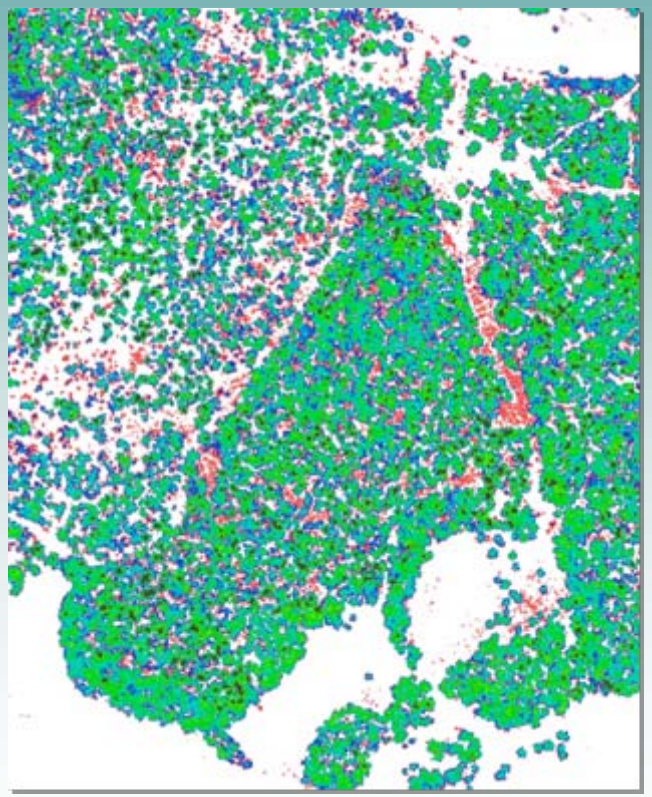
Orthophoto.



- Open georeferenced orthophotos as a background map and vectorize vegetation edges.
- Quality can differ a lot, due to the date of the shot.
- Restriction due to shadow and stage of vegetation

Vegetation Height Maps.

- Calculate difference from Digital Surface Model (DSM) and Digital Terrain Model (DTM) → Classify the differences.
- More distinct than orthophotos



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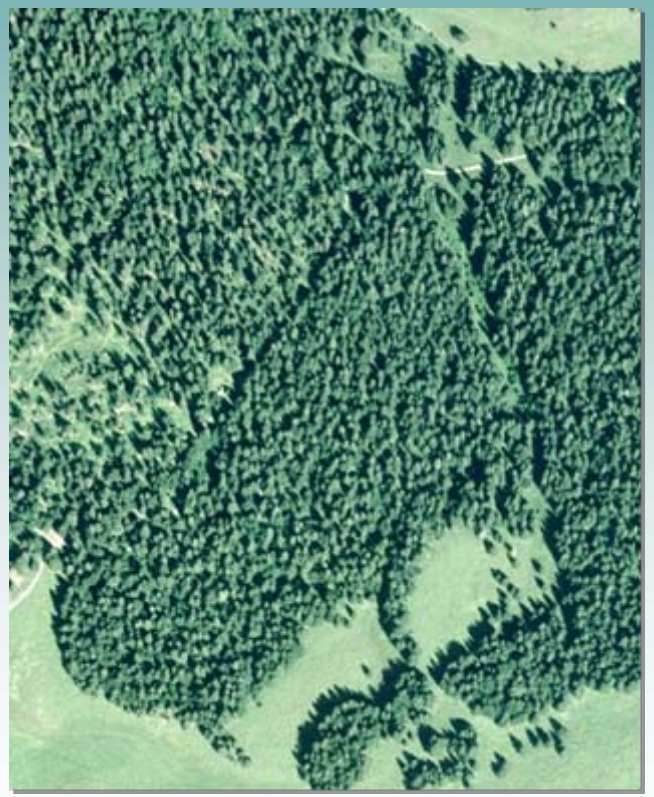
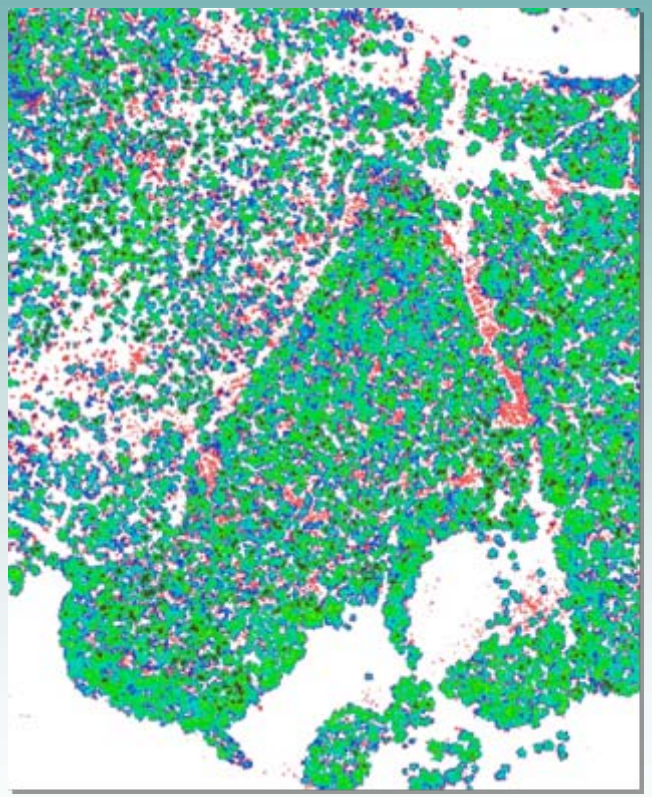
Vegetation Height Maps.

Orthophotos vs. Vegetations Heights Maps (DSM minus DTM)





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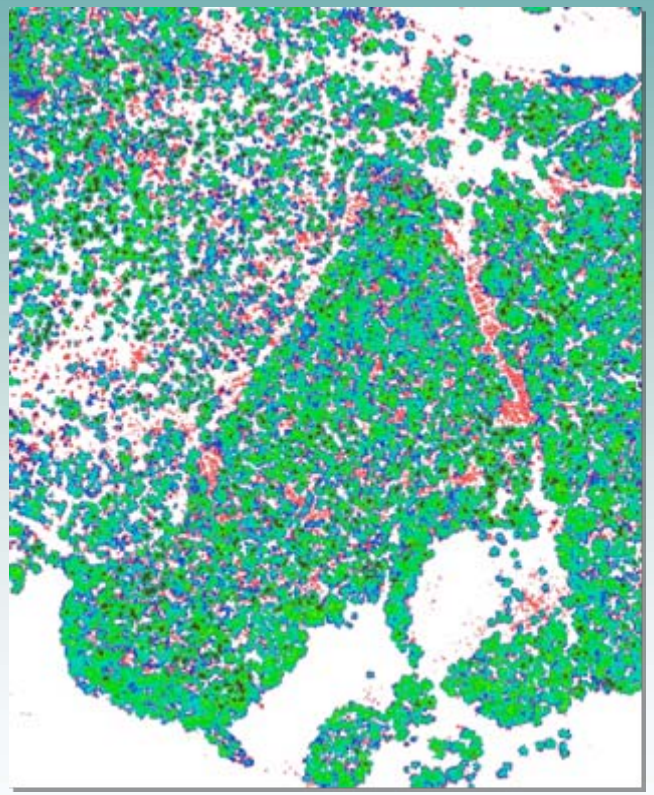
Vegetation Height Maps.

Orthophotos vs. Vegetation Heights Maps (DSM minus DTM)



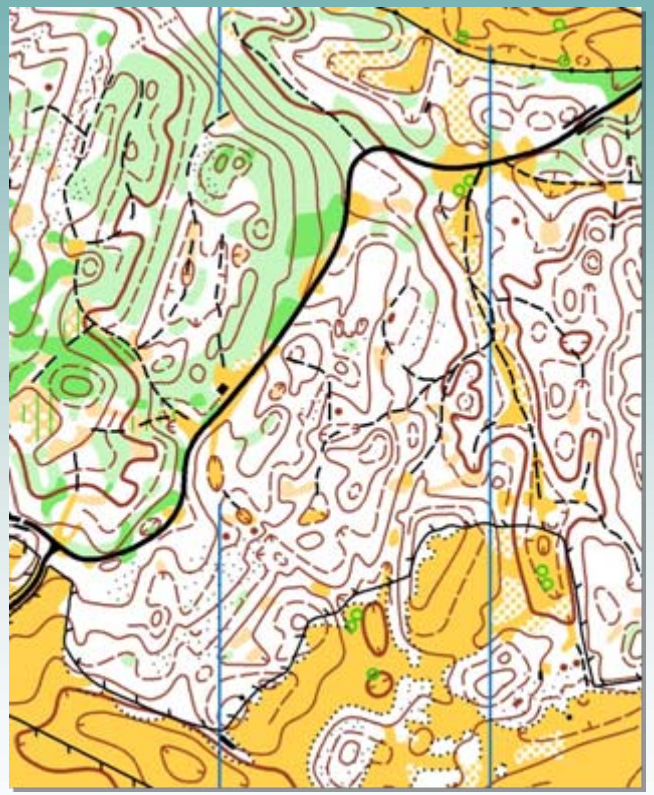


Illustration: B. Imhof, U. Steiner

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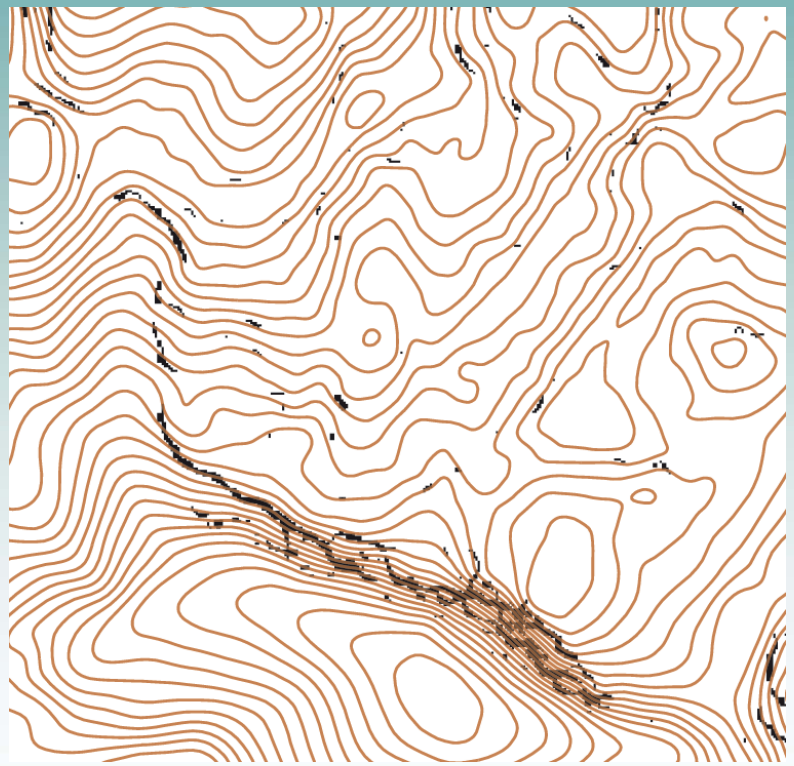
Cliffs



- Calculate slope map → Classify all slopes (pixels) more than 45°

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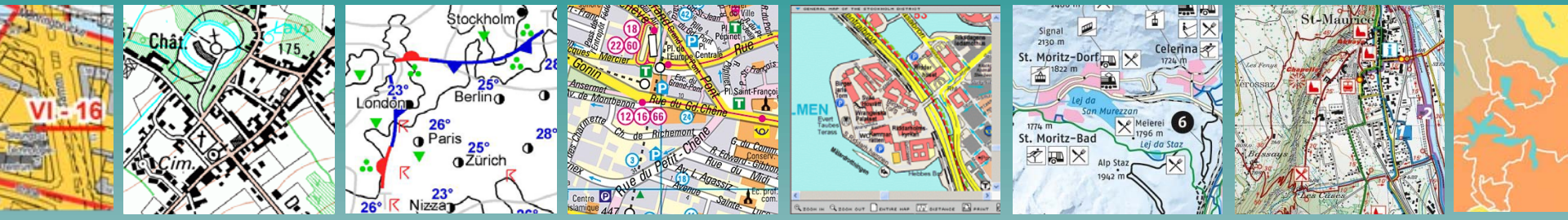

Is this workflow useful only for orienteering maps?

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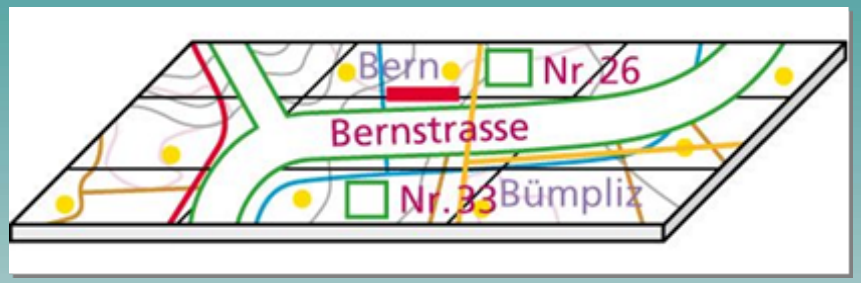
Data of Official Survey in Switzerland.



11 Thematic Layers

Survey marks
Ground cover
Single objects
Heights (DEM)
Nomenclature
Properties
Piping
Boundaries
Permanent erosion and mudflow
Address of houses
Administrative boundaries

Contour lines and hill shading are missing!

Source : www.cadastre.ch

Toilets for dogs

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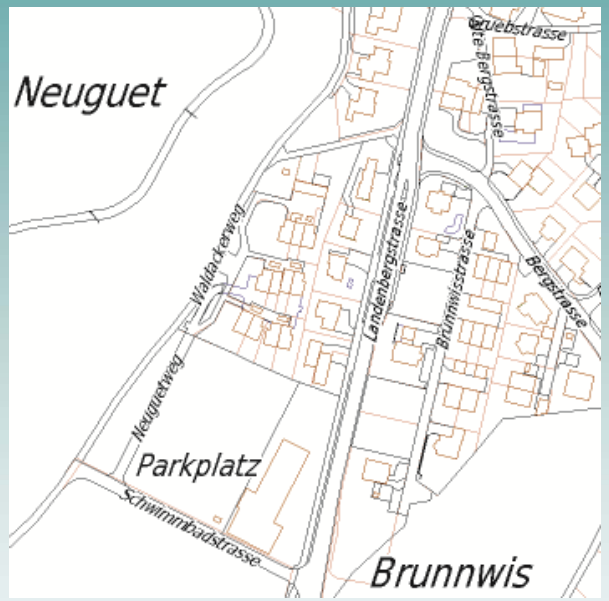
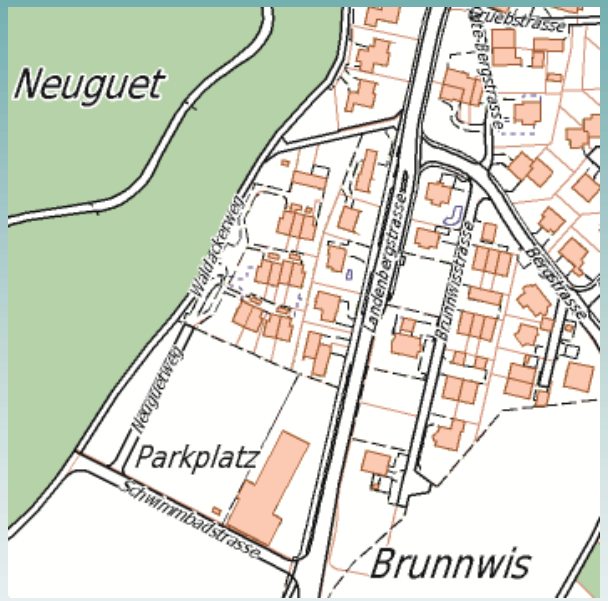
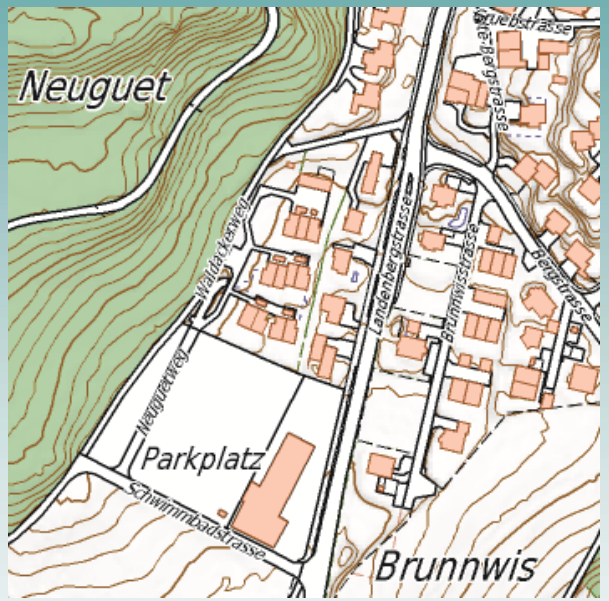
Survey Map 1:10’000.



Raw data (DXF)



Individual visualization



With relief shading and toilets for dogs

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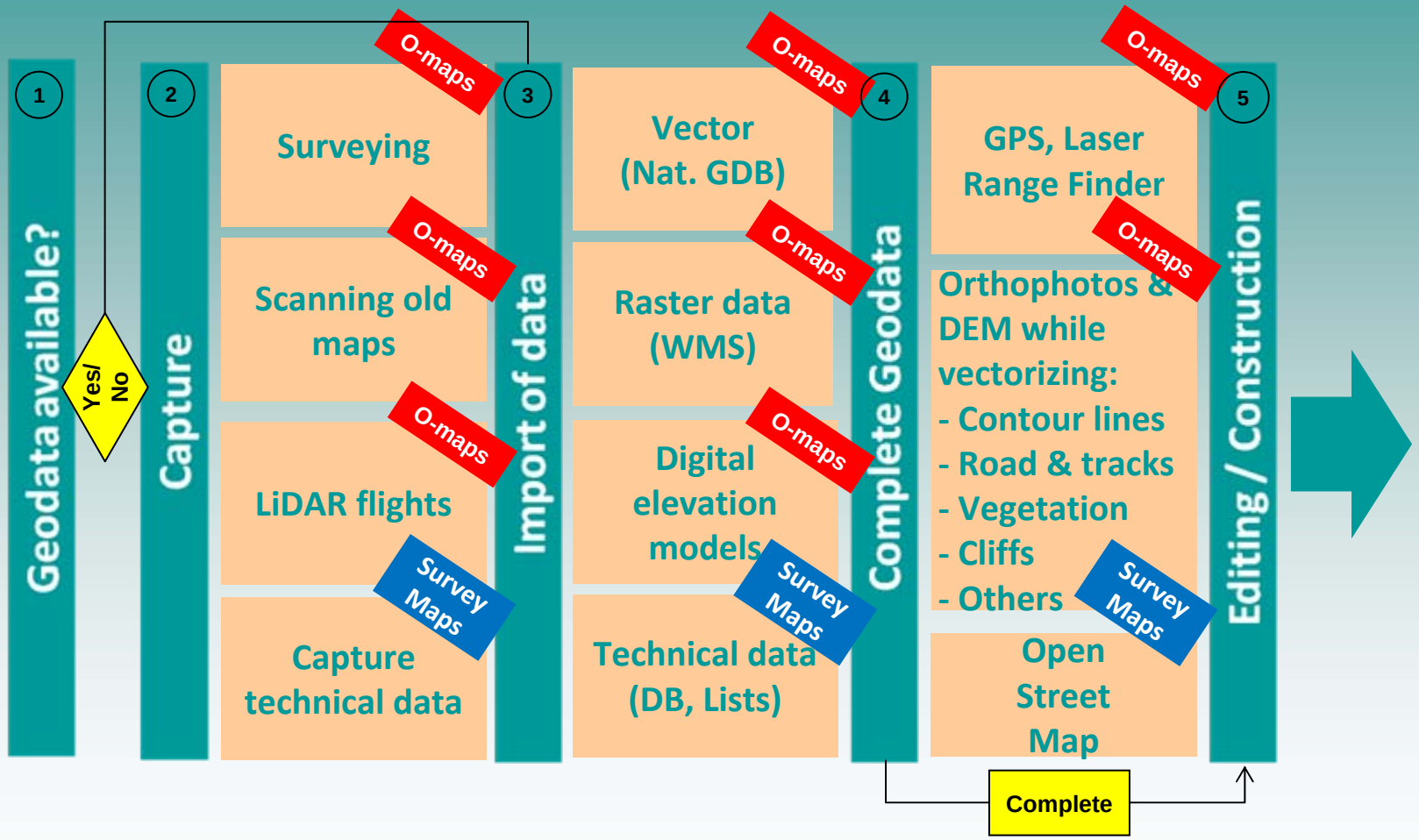
Cartographic Workflow I.



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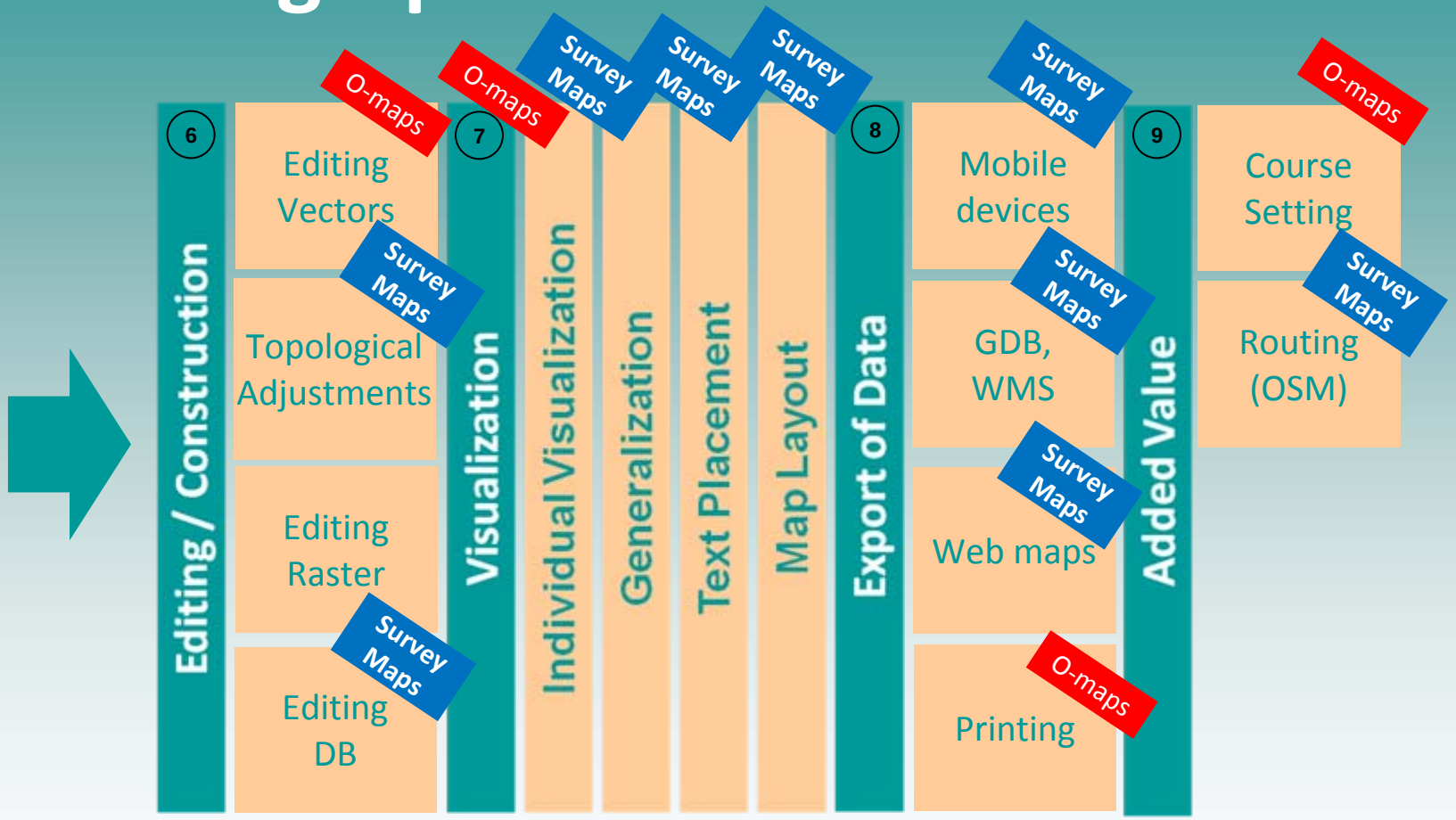
Cartographic Workflow II.



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Conclusion.

Laser Airborne Scanning has revolutionized orienteering maps very much:

Products:
- Contour lines
- Hill shading
- Cliffs
- Vegetation Height Maps

This manner to complete maps is not only practicable for orienteering maps, it is suitable also for other topographic maps.

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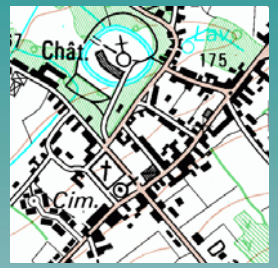

Thank you for your attention!

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