Integrating LiDAR data into the workflow of cartographic representation.
Cartographic Workflow I.

1. Geodata available?
2. Capture
   - Surveying
   - Scanning old maps
   - LiDAR-flights
   - Capture technical data
3. Import of data
   - Vector (Nat. GDB)
   - Raster data (WMS)
   - Digital elevation models
4. Complete Geodata
   - GPS, Laser Range Finder
   - Orthophotos & DEM while vectorizing:
     - Contour lines
     - Road & tracks
     - Vegetation
     - Cliffs
     - Others
   - Open Street Map
5. Editing / Construction

Yes/No

Complete

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Integrating LiDAR data into a cartographic workflow, ICC Dresden 2013
Cartographic Workflow II.

1. Editing / Construction
   - Editing Vectors
   - Topological Adjustments
   - Editing Raster
   - Editing DB

2. Visualization
   - Individual Visualization
   - Generalization
   - Text Placement

3. Map Layout
4. Export of Data
   - Mobile devices
   - GDB, WMS
   - Web maps
   - Printing

5. Added Value
   - Course Setting
   - Routing (OSM)

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Integrating LiDAR data into a cartographic workflow, ICC Dresden 2013
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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Integrating LiDAR data into a cartographic workflow, ICC Dresden 2013
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Contour Lines.

- Individual contour interval.
- Problem: Large file of Danish Land Survey with 36 km\(^2\) → several days
- Solution: Split into tiles of 1km km\(^2\) → 6 minutes and merge contour lines afterwards!
Contour Lines.

- Problem: jagged contour lines
- Solution: 
  1\textsuperscript{st} use Douglas-Peucker Algorithm and 
  2\textsuperscript{nd} change into Bèzier Curve.
Contour Lines.

- **Problem:** differentiate depressions from hills
- **Solution:** Combine with hill shading picture
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.
Contour Line vs. Hill Shading
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
Vegetation Height Maps.

Orthophotos vs. Vegetations Heights Maps (DSM minus DTM)
Vegetation Height Maps.

Orthophotos vs. Vegetation Heights Maps (DSM minus DTM)

Illustration: B. Imhof, U. Steiner
Cliffs

- Calculate slope map → Classify all slopes (pixels) more than 45°
Is this workflow useful only for orienteering maps?
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

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Integrating LiDAR data into a cartographic workflow, ICC Dresden 2013
Survey Map 1:10’000.

Raw data (DXF)  Individual visualization  With relief shading and toilets for dogs

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- Routing (OSM)
- Course Setting
- O-maps

Integrating LiDAR data into a cartographic workflow, ICC Dresden 2013
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.
Thank you for your attention!