Harmonization of the database of peaks in Slovenia

Dušan Petrovič, Marija Brnot, Andrej Stritar, Primož Kete

University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia,
Surveying and Mapping Authority of the Republic of Slovenia, Slovenia, Alpine Association of Slovenia, Geodetic Institute of Slovenia, Ljubljana, Slovenia
Background

- mountaineering as very popular activity (10,000 km of marked mountain trails)
- information for mountaineers – maps, guide books, panoramas, web maps, blogs...
- data is (of course) different in different sources

main users problem: which altitude is correct?
Redefining altitudes of mountain interesting peaks and other characteristic points in Slovenia

Dušan Petrovič, Blaž Kovačič, Primož Kete
University of Ljubljana, Faculty of Civil and Geodetic Engineering, Ljubljana, Slovenia,
Geodetic Institute of Slovenia, Ljubljana, Slovenia
Mountain Geographic Information System (PlanGIS)

- database of Mountaineering Association of Slovenia (started in 2019),
- contains all mountain related spatial data (huts, tracks, characteristic points such as peaks, saddles and starting points),
- reference source for mountain maps, guides...

- altitudes in PlanGIS:
  - from the most reliable available source
  - from the DEM data

**geodetic issue?**
Project 1

- determine the „correct“ altitude of the selected points using the most suitable method (field measurement for selected number),
- analyze differences between the altitudes in different sources,
- find (propose) the most suitable source for defining „correct“ altitude.

- GNSS field measurements give ellipsoidal heights,
- the official vertical altitude system in Slovenia SVS2010 is based on the system of normal altitudes, uses the height reference plate SLO_VRP2016/Koper.
Selection of case studies and field work

- 1721 height points in PlanGIS / 19 analyzed
- Criteria: the difference between the two altitudes in PlanGIS and accessibility (pandemic time 2021, winter and early spring)
- 5 groups:
  - Peaks with geodetic points,
  - Peaks that are not overgrown and do not have a geodetic point,
  - Overgrown peaks (without geodetic point),
  - Saddles,
  - Parking/starting points.
- Static GNSS measurement to get reference altitude (Javad Triumph LS, additionally level instrument to help determine the highest point), conversion to SVS2010.
- Detecting the altitude from LiDAR point cloud (class ground).
## Sinchronised altitudes:

<table>
<thead>
<tr>
<th>Name</th>
<th>Altitude PlanGIS [m]</th>
<th>DEM altitude PlanGIS [m]</th>
<th>Altitude LPC [m]</th>
<th>Measured altitude [m]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gladki vrh</td>
<td>1667</td>
<td>1665</td>
<td>1667.0</td>
<td>1667.0</td>
</tr>
<tr>
<td>Škabrijel</td>
<td>646</td>
<td>645</td>
<td>646.1</td>
<td>646.1</td>
</tr>
<tr>
<td>Šmarnogorska Grmada</td>
<td>676</td>
<td>674</td>
<td>675.7</td>
<td>675.7</td>
</tr>
<tr>
<td>Vošca</td>
<td>1737</td>
<td>/</td>
<td>1737.1</td>
<td>1737.2</td>
</tr>
<tr>
<td>Krim</td>
<td>1107</td>
<td>/</td>
<td>1107.5</td>
<td>1107.5</td>
</tr>
</tbody>
</table>
Results

- none of two altitudes in PlanGIS can be taken as correct,
- (old) topographic maps are suitable data source, when geodetic point is on top, but....
- DEM altitude can vary for max. 2 – 3 m, except...
- LiDAR ground point cloud (LPC) proved to be the most reliable source in the selected study cases, but... (1721 heights)
Project 2

- automatic determination of all peaks (maximum values in LPC), horizontal and vertical, latter also other extreme points (depressions),
- comparation with MAS and SMA data,
- systematical analyses of all differences (horizontal, vertical, interpretation, names...).
883 conflicts, where the data from different sources differed markedly

- for different groups of users the peak can be defined and named differently,
- different records and names of peaks were created over time,
- differences in the display of peaks appeared on different maps, both national topographic and thematic, as are, for example, mountainous,
- on national topographic maps, geodetic points were often marked as summit points, but they are not always at the highest point of the summit,
- mountain maps supported by mountain guides generally showed the point of the summit that provides access, often also offers an adequate view, and is also not necessarily at the highest point,
- the surrounding inhabitants often named the part of the elevated surface that they saw as exposed from the valley...
Solving conflicts

- regular meeting of four persons:
  - Mountaineering Association of Slovenia (MAS) - Mountain Geographic Information System (PlanGIS),
  - Surveying and Mapping Authority (SMA) - Register of Geographical Names,
  - Geodetic institute – map and other SMA datasets control,
  - Faculty of Civil and Geodetic engineering.

- weekly 3 – 4 hours, 50 – 80 conflicts / meeting
- comparing different sources, consulting locals
Rules

- summit at the highest point, but declared only if relative height is at least 10 m,
- name of the mountain can be repeated as the name of summit,
- named according linguistic rules, no local dialects,
- can be named by (religious) object on the top,
- named on major local use,
- some names indicates parts of the mountains (ridges, saddles...),...
Conclusions

- Project 2 should give “correct altitude” at “correct locations” with “correct names” for all peaks → unified source data for maps, guides...

- users want to have “unified” world,

- locals are sensitive on their used names

- lot of discussions, cases outside of the “rules”...

- any similar experiences?