Development of interface for GNSS and GIS integration by using free open source software

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Motivation – Surveying and geodetic practice nowadays

The standard tasks in geodetic practice that are performed every day:
- Survey Control Networks – accuracy of 2-5 cm
- Surveys – accuracy of 5-10 cm
- Tracing – accuracy of 5-10 cm
- Geospatial data collection (incl. real time tracking) – accuracy of submeter or decimeter level

What is important for the practice:
- Time for obtaining the solution
- Accuracy
- Cost
GNSS and GIS – common use

Application of RTK/NRTK, DGPS and PPP methods for real time data collection:
- Survey Control Networks – accuracy of 2-5 cm – RTK/NRTK
- Surveys – accuracy of 5-10 cm – RTK/NRTK
- Tracing – accuracy of 5-10 cm – RTK/NRTK
- Geospatial data collection – accuracy of submeter or decimeter level – DGPS and PPP

What are the basic advantages of GIS:
- Data collection, maintenance, management, classification and analysis
- Data layers from many sources
- Works with databases
- Wide variety of coordinate systems and projections
- Wide variety of coordinate transformation methods
The use of open source software

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GPL V2, GPL V3
Integration of GNSS and GIS by using RTKLIB and QGIS open source software
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Integration of GNSS and GIS by using RTKLIB and QGIS open source software

Why Standard Functionality is not enough?

1. QGIS only uses NMEA as data input
2. The tool makes points with geometry characteristics only, but further information about the solution is not available
3. There are many others things that matter, so if we want to compare the results we should keep in mind:
   - Positioning mode
   - Solution type
   - Satellite systems
   - Frequency type
   - Elevation mask
   - Ionosphere correction
   - Troposphere correction
   - Ephemeris
   - Clocks
4. The use of coordinate systems and projections – the results must be in the same system and frame
Development of Interface for real time GNSS measurements in GIS environment

International Association of Geodesy (IAG), Commission 4 Symposium, Positioning and Applications, September 04-07, 2016, Wroclaw, Poland
Development of Interface for real-time GNSS measurements in GIS environment
Development of Interface for real-time GNSS measurements in GIS environment
Spatial database – PostgreSQL with extension PostGIS, EPSG coordinate systems

Usually, we don’t use only GNSS data but make combinations with other types of data.

*Even if we perform GNSS measurements only => Coordinate conversion and transformations are to be applied*

Every GNSS measurement, ever taken, is related to current measurement epoch and if the obtained coordinates must be compared with previously obtained ones, where the time between the two epochs is more than a few months, an epoch-conversion model must be used. The static measurements for example, due to the post processing, the coordinates obtained for the newly determined points are related to the coordinates of the known ones. Similar is the situation with the Real time Kinematic measurements, but this is not the case for the stand alone positioning, especially for precise point positioning. It is necessary such conversion to be applied when using global reference frames, because of the velocities of the points.

If the time period between the two measurements is few years or even more the transformation most probably will include and change of the realization of the system – change of the reference frame. In addition, for analysis or other purposes the X,Y,Z coordinates of the points could be used, but also B,L,H, or projected coordinates, related to some specific type of projection, so coordinate conversion is commonly used for such case.

This is possible with the use of spatial database with applying transformations with predefined parameters.
Working with Spatial database – PostgreSQL with extension PostGIS, EPSG coordinate systems

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Geodetic CRS (geocentric) [ITRF2008]

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Operations:
- [ ] show intermediate steps

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Further works

Making modifications of the output of RTKLIB software
Making modifications of the solutions
Making modifications
Analyzing the different types of solutions and make comparison in order to be obtained the most efficient ones
Applying the coordinate conversion and transformations as a part of the interface
References

3. http://postgis.net/
5. https://www.epsg-registry.org
8. https://igs.bkg.bund.de/
Thank You for Your Attention!