National Report of Slovenia
to the EUREF 2014 Symposium in Vilnius

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1 Introduction

This paper is a review of activities regarding national geodetic reference frames, active GNSS network and activities related to EUREF in Slovenia for the period 2013–2014. The highlights of the paper are:

- adoption of the Act on Georeference System,
- start of the project called Modernization of Spatial Data Infrastructure to Reduce Risks and Impacts of Floods,
- densification of the SIGNAL permanent GNSS network – the new station in Idrija, and
- works on horizontal/terrestrial, height, and gravimetric reference frames and plans for the future.

2 Act on Georeference System

A new geodesy-related act was adopted in Slovenia in April this year [Act on Georeference System, 2014]. This act introduces:

- a new, modern national spatial reference system, which is based on the European Spatial Reference System (ESRS), and
- a new national topographic system together with the new map-grid system.

The scope of the new act is regulation of competences and tasks of the Surveying and Mapping Authority of the Republic of Slovenia (hereinafter: SMA) related to the realization and maintenance of the national spatial reference system in long term and providing up-to-date spatial datasets and data products.

The maintenance period, accuracy, and spatial resolution of the national spatial datasets, and scales of the resulted national topographic maps are specified. Deadlines of transformation into the new national coordinate reference system for the national spatial datasets and datasets owned by private companies are also determined.

Some detailed specification about the geodetic datum of horizontal/terrestrial, height and gravimetric components of the spatial reference system, as well as map projection parameters and coordinate transformation model will be published within the implementing regulations, which are in the process of adoption.

3 Project of Modernization of Spatial Data Infrastructure to Reduce Risks and Impacts of Floods

The above-named new project started in Slovenia in November 2013. It is supported through the EEA Financial Mechanism Programme 2009–2014 for Slovenia. The project is carried out by SMA and will be realized in co-operation with the Ministry of Infrastructure and Spatial Planning and the Ministry of Agriculture and the Environment. The project partners are the Norwegian Mapping Authority (Kartverket) and the National Land Survey of Iceland (Landmælingar Íslands); see also the project website: www.gurs-egp.si/eng/.

The long-term goal of the project is facilitating water management and reduce the risks and impacts of floods and at the same time increase the consistency of the data and their related services to the requirements of the INSPIRE directive [Režek, 2014]. The project is divided into four sub-projects covering:

- Geodetic Reference Framework,
- Topographic Database,
- INSPIRE Directive, and
- Hydrography.

The first sub-project is directly involved in the activities regarding the national geodetic reference frames. Its objective will be achieved by establishing a modern vertical component of the national spatial reference system and the combined horizontal/vertical geodetic network. This network will allow the high-quality realization of the new national height reference system, as well as the new (quasi)geoid model. The same network will be used for the new realization of the ETRS89-based national horizontal/terrestrial coordinate reference system. Due to the 18-year period since the EUREF GPS campaigns were conducted in Slovenia (1995.55 was the mean epoch), the existing coordinate reference system has already become out of date [Caporali et al., 2011].

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The activities on establishing the so called zero order combined geodetic network of Slovenia have started. The preliminary study providing the concepts of the network has already been presented [Medved et al., 2013a and 2013b]. Much effort has been devoted to find the optimal micro locations for the six network stations, which are planned to be built. The main criteria for this search were:

- public ownership of the land,
- accessibility by car and closeness to an office of the SMA to allow fast interventions,
- access to basic infrastructure (electricity and telephone network),
- appropriate geological and hydrogeological conditions, and
- possibility to perform various types of high-quality geodetic measurements (e.g. open horizon etc.).

The last point refers to the EUREF Guidelines for EPN Stations and ECGN Standards. At the moment (May 2014) two micro locations were already chosen – for the south-eastern (Prilozje) and the most eastern (Kog) network station.

The latter is placed next to the station of the seismic network of Slovenia (international code: KOGS), which is maintained by the Slovenian Environmental Agency. Both sites will be monumented by the concrete pillars. The pillar for the Prilozje station in shown in Figure 1 [Popović and Popović, 2013].

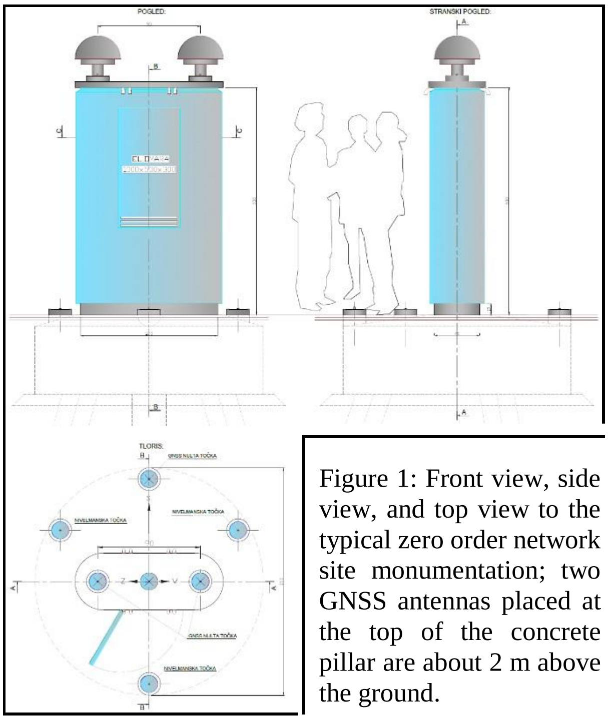

Figure 1: Front view, side view, and top view to the typical zero order network site monumentation; two GNSS antennas placed at the top of the concrete pillar are about 2 m above the ground.

At the top of the pillar are two reference points for GNSS measurements. Near the pillar – at the same platform – are primary reference point and reference benchmarks for levelling and gravity measurements. Four additional marks will be set up close to the main pillar (up to a few 10 m away) to form combined terrestrial/horizontal and levelling micro networks.

Geological field report was prepared [Vrabec, 2013] to be able to evaluate geological conditions and find an appropriate solution for the station foundation. The platform with the pillar will be fixed by the three 20-meter long precast concrete piles, installed obliquely [Logar, 2013]. Test GNSS measurements were conducted to check the eventual signal disturbance and to get the precise station horizon mask, see Figure 2.

Figure 2: GNSS measurements at the location of the future Prilozje zero order network station.

The micro locations for the remaining stations are currently in the process of final verification. The building of the network stations shall be started in autumn this year.

4 SIGNAL Positioning Service

Regular activities of the SIGNAL Positioning Service are:

- maintenance and further development of the network (hardware/software upgrades etc.),
- integrity monitoring and quality control,
- transmission of real-time data,
- archiving and distribution of RINEX data, and
- support to the users of location based services.

In May 2014 a new permanent GNSS station in Idrija (IDRI) was launched. In this way, the network configuration was improved at the area of the lowest density. The new station has Leica GRX1200+GNSS receiver and Leica AR10 antenna installed. The method of determining the stations coordinates was the following:

- the daily network solutions were stacked to compute ITRS positions at the mean epoch of observations, by tying the network to EPN_A_Igb08 using minimal constraints on the set of EPN Class A stations, and finally
- ETRS89 position of IDRI station were computed by fitting the combined weekly network solution to the closest SIGNAL stations (GSR1, RADO and NOVG).

The current network consists of 16 permanent GNSS stations. Additionally, 5 Austrian stations (APOS network), 6+1 Croatian stations (CROPOS network), and one Hungarian station (GNSSnet.hu) are included, see Figure 3.

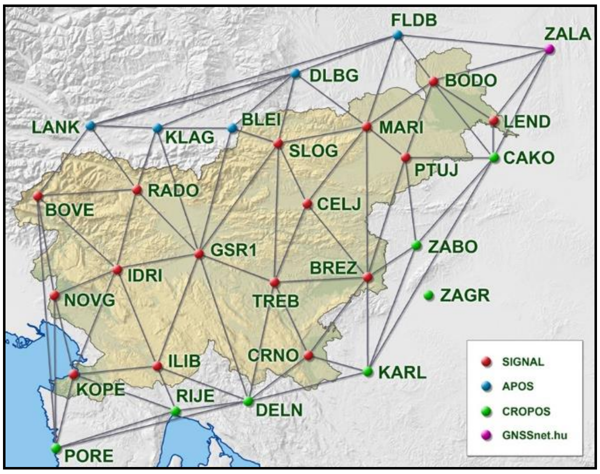

Figure 3: National permanent GNSS network of Slovenia – the SIGNAL network (www.gu-signal.si).

As an equipment upgrade, a new GNSS antenna was installed at the Ilirska Bistrica (ILIB) station at the end of 2013.

5 Horizontal/Terrestrial and Height Reference, and Gravity Field

Some pillars of the classical 1st order triangulation network have been physically restored with intention of their preservation. An example can be seen in Figure 4.

Figure 4: Network point no. 515 (Košuta) before and after restoration.

The measurement of the new levelling network has continued. About 120 km of new levelling lines were measured in 2013, see Figure 5.

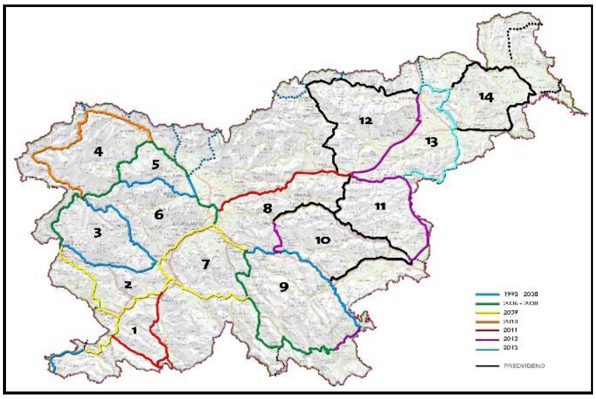

Figure 5: Epochs of the 1st order levelling lines (years of their last re-levelling).

In recent years, already 65% of the planned 1900 km of levelling lines were measured. We expect that the new levelling network will be measured and computed until the end of 2016. This will be the basis for implementation of the new height reference system in Slovenia.

Parallel to the levelling, gravimetric measurements on the levelling benchmarks were also conducted. Over 1500 benchmarks have already been measured.

For the purpose of improvement of the height reference surface model, GNSS measurements were carried out on homogeneously distributed points covering the whole territory of Slovenia.

6 Other Activities

As already reported at the last EUREF symposium [Medved et al., 2013b], a countrywide aerial laser scanning project re-started in 2013. This project is pretty much correlated with the new project presented in Section 3 of this report. High quality georeferencing of airborne laser scanning data is essential to provide appropriate data for water resource management [Bric et al., 2013], including flood management and drainage strategy. (Quasi)geoid model, which is one of the project outputs, will be used subsequently to improve transformation of ellipsoidal heights of the lidar point cloud data into the new national height reference system.

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