ON THE CONSISTENCY BETWEEN LOCAL TIES AND SPACE GEODESY ESTIMATES IN THE SIMEIZ–KATZIVELY CO-LOCATION SITE

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ABSTRACT. The agreement between local ties of measuring points of the stations in the Simeiz–Katzively co-location site and space geodesy estimates of coordinates of these stations was quantified. There are large discrepancies (up to 120 mm) between these data, the reason for which needs a further study.

1. INTRODUCTION

The ITRF2014 construction depends on the availability of co-location sites where several instruments of different space geodesy techniques are operated and local surveys between instrument measuring points are available (Altamimi et al., 2017).

One of those co-locations sites is the Simeiz–Katzively site (Figure 1) that is situated on the south coast of the Crimea, Ukraine (Yatskiv et al., 2014). There are five stations of space geodesy techniques located on the site: RT–22 radio telescope (IVS name: CRIMEA, IVS code: Sm, CDP number 7332), two SLR stations — Simeiz (ILRS code: SIML, CDP Number 1873) and Katzively (ILRS code: KTZL, CDP number 1893), two GNSS stations — CRAO (IGS station) and KTVL (EPN station). On early 1990s observations with a mobile SLR station was carried out on the ground marker SIME (CDP number 7561) that is situated not far from the Simeiz SLR station. At present, coordinates and velocities of these stations are available in the ITRF2014 reference frame (Altamimi et al., 2016) at epoch 2010.0.

The Main Astronomical Observatory of the National Academy of Sciences of Ukraine (MAO NASU) performed on the Simeiz–Katzively site local survey geodetic campaigns in 1994 (Samoilenko, 1996), 2004 (Samoilenko et al., 2007), 2008 and 2011 (Odynets et al., 2013) as well as GNSS campaigns in 1994 (Bolotin et al., 1995), 2001 (Khoda, 2004), 2004 (Khoda, 2006), 2009 (Khoda, 2011). As the results corresponding local ties for measurement points of SLR and GNSS stations with respect to the position of the VLBI station (RT–22) at the epoch 2004.6 were estimated (Odynets et al., 2013) and has been provided the IERS Central Bureau.

2. PRELIMINARY ANALYSIS OF DATA

The ITRF2014 coordinates of the space geodesy stations on the Simeiz–Katzively site were propagated to the epoch 2004.6. Differences between coordinates of the SLR and GNSS stations with respect to the coordinates of the VLBI station (RT–22 radio telescope) will set the so-called "catalogue values" of local ties on the site.

Variations of the distances ΔR, defined as $(\Delta R)^2 = (\Delta X)^2 + (\Delta Y)^2 + (\Delta Z)^2$, where ΔX, ΔY and ΔZ are survey geodetic local-tie values, are shown in Figure 2 as differences between values ΔR and their mean values. The types of lines are the same for the stations or markers located on the same areas of the site (the first is around the RT–22 radio telescope, the second is around the Katzively SLR station and the third is around the Simeiz SLR station).

The maximum variation of distances for markers around the RT–22 radio telescope (KTRT,

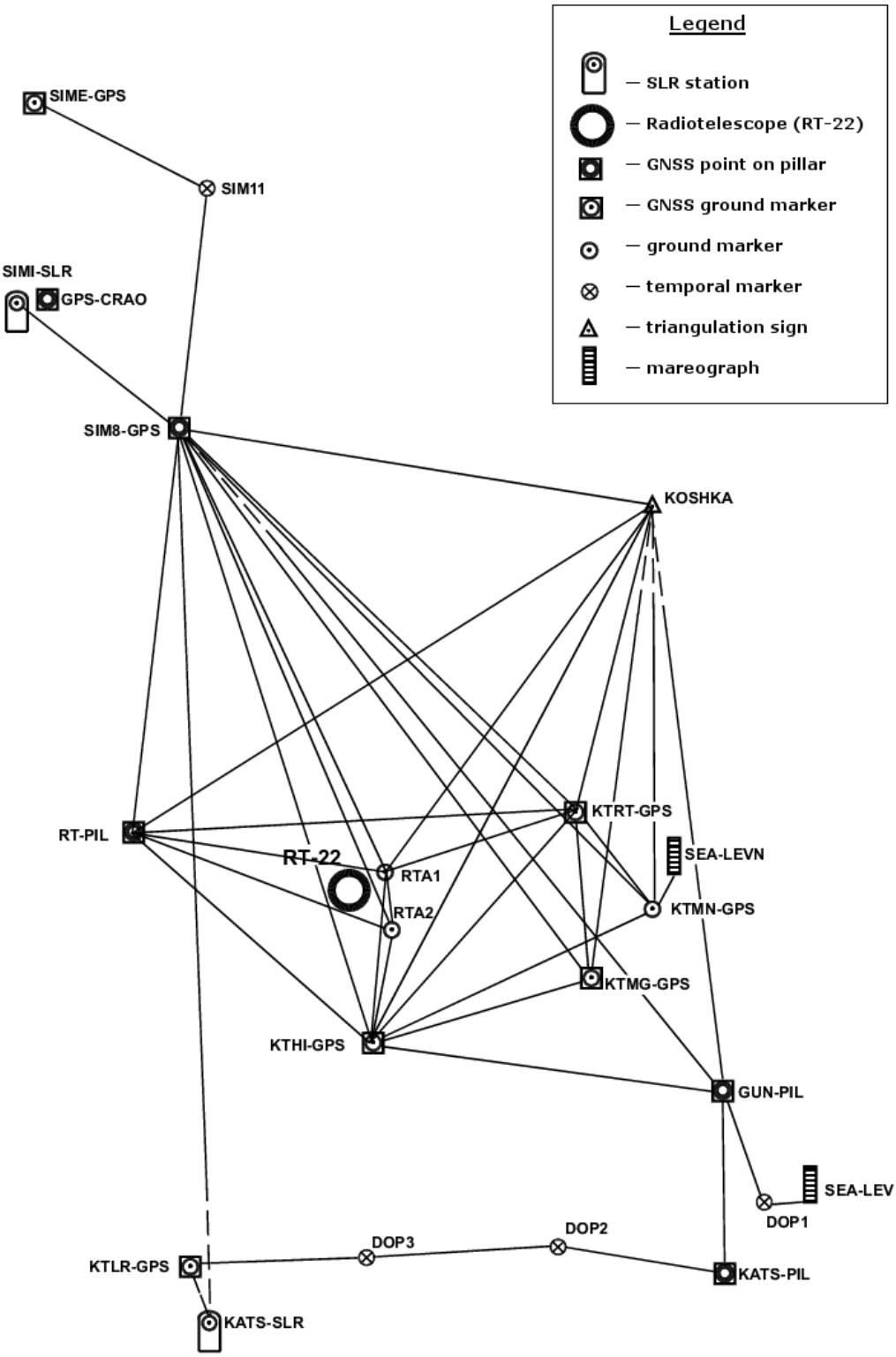

Figure 1: The Simeiz–Katzively site

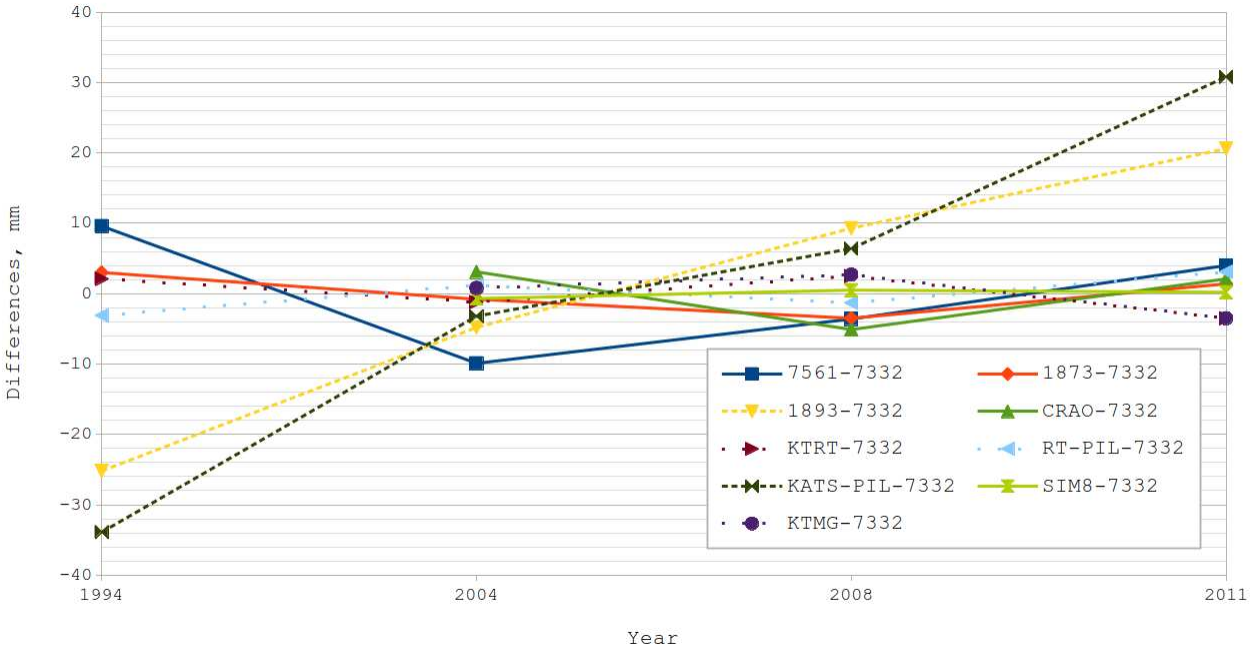

Figure 2: Differences between estimated distances ΔR on the Simeiz–Katzively site and their mean values

KTMG, RT–PIL) is 3.5 mm. Approximately the same values are for both stations and the SIM8 marker located around the Simeiz SLR station: from 0.7 mm for SIM8 to 3.5 mm for 1873 and 5.1 mm for CRAO. The differences between the distances for the mobile SLR station (7561) and their mean value are in the range from -9.9 mm to 9.6 mm. Before campaigns in 1994 the centre of the marker 7561 was destroyed that may be one of a cause of possible errors of centring and determining the heights of the devices above the marker during measurements. Another possible source of this large variation is excavation works around the 7561 marker between campaigns.

The Katzively SLR station (1893) and the KATS–PIL marker have significant offsets relative to the RT–22 radio telescope. They are situated on the area that moves towards the sea in the south direction with non-negligible velocity.

3. CONSISTENCY BETWEEN LOCAL TIES AND SPACE GEODESY ESTIMATES

As pointed out by Altamimi et al. (2017), quantifying the level of agreement between survey geodetic local ties and space geodesy estimates of relative positions of the stations is very critical for further investigation of the ITRF. Therefore the station position residuals (or tie discrepancies) for the Simeiz–Katzively co-location site were computed. The obtained differences $d(\Delta R)$ between survey geodetic local tie distances and space geodesy catalogue distances on the site are shown in Figure 3.

It is easy to see that line for 1893–7332 differences (for distances between the Katzively SLR station and the RT–22 radio telescope) exhibits peculiar behaviour. We know that the velocities for both the SLR stations on the Simeiz–Katzively site have the same values in the ITRF2014 catalogue. But as mentioned above the area around the Katzively SLR station has significant local movements. One can compare velocities values in the catalogue for the Katzively SLR station

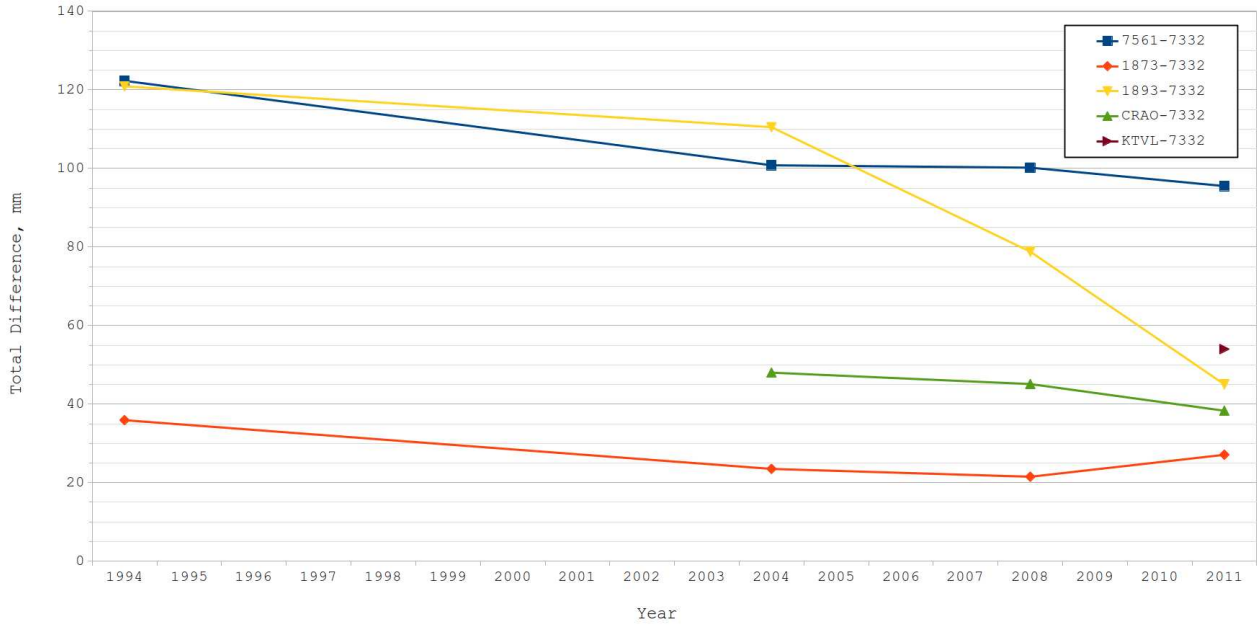

Figure 3: Differences $d(\Delta R)$ between estimated and catalogue distances on the Simeiz–Katzively site

(1893) and the GNSS station KTVL that located near it, especially for Z component.

$$V_X(1893) = -.01742\ m/y, \quad V_X(KTVL) = -0.01967\ m/y,$$
$$V_Y(1893) = 0.01914\ m/y, \quad V_Y(KTVL) = 0.01766\ m/y,$$
$$V_Z(1893) = 0.00819\ m/y, \quad V_Z(KTVL) = -0.00106\ m/y.$$

The residuals which are shown in Figure 3 are very large (up to 120 mm). Reasons for these discrepancies could be both namely due to errors in survey geodetic local ties and in the ITRF2014 estimates of space geodesy coordinates for the Simeiz–Katzively site. Identifying the error sources needs further study.

At first glance, it is obvious that during the construction of the ITRF2014 local tie vectors between reference points on the Simeiz–Katzively site were not taking into account. Velocities of the SLR stations 1873 and 1893 in the ITRF2014 are the same that contradicts the data shown in Figure 2. Taking into account the significant local movements of the area around the Katzively SLR station, for future ITRS realizations this area should be considered as a separate site.

4. REFERENCES

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