1. Abstract

On April 17th, 2018, the Instituto Geográfico Nacional de Costa Rica (IGNOR), through Executive Decree D-40962-MIP, formalized the new national geodetic reference known as CR-SIRGAS. The new geodetic reference frame is officially linked to SIRGAS.

The Executive Decree represents a huge advance in national geodesy, since for the first time the country is directly linked to the International Terrestrial Reference Frame (ITRF) through the weekly scientific solutions of the GNSS stations of the SIRGAS-CON network in Costa Rica, whose administration is the responsibility of the IGNOR.

Additionally, in the establishment of CR-SIRGAS, a series of passive points were contemplated, which will serve as a base for the transforming process from geodetic old references to CR-SIRGAS (figure 1).

Together with the officialization of CR-SIRGAS and its mandatory compliance, the coordinates (X, Y, Z) and velocities (VX, VY, VZ) of the stations defining the frame were made available to users.

CR-SIRGAS has been aligned to ITRF2008 (IGS2008) and reduced 2014.59 epoch, week 1803 and it is the base of national cartographic projection called Costa Rica’s Transverse Mercator (CRTM).

The results of a kinematic analysis regarding these values and the final weekly positions given by the SIRGAS CP’s provide an ideal behavior of the general behavior of the new national geodetic frame, emphasizing the obvious need to always have linked coordinates at the observation epoch.

In addition, estimates of the velocity of the national geodetic frame made with the VelMIC tool (Moya and Bastos, 2014) and its validation regarding the final weekly solutions of SIRGAS are presented (figures 2 to 7).

2. Methodology

The geocentric coordinates and velocity values associated to the CR-SIRGAS and that are valid for the epoch 2014.59 (week 1803), an extrapolation was made of the geocentric positions of 6 of the 8 stations continuous operation GNSS (LIBE, LIMN, NEIL, PUNT, RICC and SAGE) until week 1833, which is the week before the adoption of the ITRF2014 frame. Working with 130 weeks, the geocentric positions were calculated for the 6 stations following three criteria:

1. The final SIRGAS coordinates at the observation epoch, that is one every week.
2. The product coordinates of the components of geodetic position reported by the IGNOR.
3. The product coordinates of the velocity values geocentric calculated using VelMIC.

Table 1 shows the results of a preliminary comparison of the VelMIC geocentric velocities given to the 2014.59 epoch, ITRF2008, with those reported by SIRGAS in its latest multiyear solution (SIR17P01) ITRF14 epoch 2015.0 (Sánchez, 2017). Maximum differences of 0.2 mm are observed in Vx, 1.8 mm in Vy and 3.5 mm in VZ considering that they are not in the same frame of reference or time. VelMIC velocities must be recalculated to ITRF14 to be consistent with SIRGAS.

3. Time Series of CR-SIRGAS stations

4. Velocities comparison

Table 1 shows the results of a preliminary comparison of the VelMIC geocentric velocities given to the 2014.59 epoch, ITRF2008, with those reported by SIRGAS in its latest multiyear solution (SIR17P01) ITRF14 epoch 2015.0 (Sánchez, 2017). Maximum differences of 0.2 mm are observed in Vx, 1.8 mm in Vy and 3.5 mm in VZ considering that they are not in the same frame of reference or time. VelMIC velocities must be recalculated to ITRF14 to be consistent with SIRGAS.

4. Conclusions

• The figures first show a consistency between the velocities determined by VelMIC and the actual dispersion of the stations given by the final weekly solutions of SIRGAS.
• There is no match between extrapolated values according to CR-SIRGAS velocities and its actual positions. However, special care should be taken with the interpretation, since CR-SIRGAS velocities were considered acceptable in the period covered by their determination, but it is found that they do not represent the best values to be used in the coordinate update. It is necessary a kinematic model that incorporates in addition to the linear component, other factors that allow a better description of the stations contemplating the jumps and effects in the series.

Reference:
• Moya, J. y S. Bastos (2014). Cálculo, mediante la aplicación del algoritmo de ajuste por mínimos cuadrados, de las componentes… Unicen, vol 38, No. 11, Vol 38, No. 12-14