

Italy INAF Analysis Center Report

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Abstract

This report summarizes the activity of the Italian INAF VLBI Analysis Center. Our Analysis Center is located in Bologna, Italy and belongs to the Institute of Radioastronomy, which is part of the National Institute of Astrophysics. IRA runs the observatories of Medicina and Noto, where two 32-m VLBI AZ-EL telescopes are situated. This report contains the AC's VLBI data analysis activities and shortly outlines the investigations into the co-locations of space geodetic instruments.

1. Current Status and Activity

A thorough investigation into the local stability of the geodetic monuments at the Medicina site and the determination of local, intra-site motions was completed in 2012. The data sets used in the investigation were those acquired during the terrestrial surveys of the GPS-VLBI tie vector during the period 2001-2010. These precise terrestrial observations allowed us to determine the local stability of the local ground control network over a decade. The intra-site motions are remarkable, with rates of 1.7 mm/yr over baselines not exceeding a few tens of meters. The variation of the VLBI-GPS tie vector was also determined and is 0.4 ± 0.4 mm/yr. The results derived by the analysis of the terrestrial data were cross-checked against those obtained by the analysis of the GPS data acquired by the two permanent EUREF [1] stations MEDI and MSEL over the period 2004-2010. The GPS results show a non-negligible, statistically significant relative motion of the two permanent stations, especially in the horizontal component. GPS and terrestrial results are consistent over the common time span. A thorough description of the analysis and a discussion of the results can be found in [2], (<http://gji.oxfordjournals.org/content/early/2013/01/07/gji.ggs092.full>). In 2012 we published a paper ([3]) where VLBI was used in order to study the Etna volcano's activity by means of the crustal deformations between Noto and Matera (located on the African and the Eurasian Plates, respectively). By analyzing European VLBI experiments, we obtained the behavior of the baseline that crosses the Etnean area. VLBI data are very sparse even if the time series is quite long; therefore, to fill gaps in the information, we analyzed GPS continuous observations at the two sites, and we were able to highlight both extensions and compressions in detail. Comparisons between the trend of Noto-Matera baseline length variations, volcanic activity, and seismicity in the Mt. Etna area show the complexity of the development over time and space of these phenomena, which are caused deep in the earth by a catalyst that can be traced, in our opinion, to the interaction between the asthenospheric mantle, deep crust, and surface crust.

2. Data Analysis and Results

The IRA started to analyze VLBI geodetic databases in 1989, using a CALC/SOLVE package on the HP1000 at the Medicina station. In subsequent years, the same software was installed first on an HP360 workstation and later on an HP715/50 workstation. In more recent years, two HP785/B2600 workstations and an HP282 workstation were used. In 2007, a new Linux workstation was set up for the migration of all the VLBI data analysis, and Mark 5 Calc/Solve was installed. During 2012, we stored all the 1999-2012 databases available on the IVS data centers. All the databases were processed and saved with the best selection of parameters for the

final arc solutions. The most recent IRA solution for crustal deformation comprises all the Europe sessions analyzed at IRA from 1987 to 2009, and the estimated horizontal and vertical velocities are presented in [4].

Our Analysis Center has participated in the IVS TROP Project on Tropospheric Parameters since the beginning of the activities. Tropospheric parameters (wet and total zenith delay and horizontal gradients) of all IVS-R1 and IVS-R4 24-hour VLBI sessions were regularly submitted. In 2012 we submitted our results to IVS.

3. Outlook

We will continue with the regular submission of INAF tropospheric parameters to the IVS data centers, also studying the impact of the Vienna Mapping Function on the geodetic results. We will submit a long time series of troposphere parameters using all VLBI sessions available in our catalog in order to estimate the variations over time of the content of water vapor in the atmosphere.

References

- [1] Bruyninx, C (2004). The EUREF Permanent Network; a Multidisciplinary Network Serving Surveyors as well as Scientists. *GEOInformatics* 7(5), 32-35.
- [2] Sarti, P., C. Abbondanza, J. Legrand, C. Bruyninx, L. Vittuari, J. Ray. (2013) Intrasite motions and monument instabilities at Medicina ITRF co-location site. *Geophys J Int*, doi: 10.1093/gji/ggs092,
- [3] La Delfa, S., M. Negusini, S. Di Martino, G. Patané. (2012) Improved geodetic European very-long-baseline interferometry solution using models of antenna gravitational deformation. *Int J Earth Sci* 101 (4), 1065-1075
- [4] Sarti, P., M. Negusini, C. Abbondanza. (2010) Improved geodetic European very-long-baseline interferometry solution using models of antenna gravitational deformation. *Ann Geophys* 53(5-6) doi 10.4401/ag-4739.