National Report of Italy

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1 Introduction

National geodetic activities performed by the Italian Geographic Military Institute (IGMI) in the past year have included the development of the following geodetic networks:

- the GPS dynamic permanent network (RDN)
- the GPS static network IGM95
- the high precision levelling network

2 National Dynamic Network (RDN)

The italian RDN, established in 2009, consists of a network of 99 GPS permanent stations (Figure 1), with stable materializations, that continuously record satellite signals and trasmit them telematically to a Data Processing Centre situated in the Geodetic Service of IGM. The permanent stations belong mainly to public agencies and are homogeneously distributed (mean distance about 100-150 km) across the country. The network includes 13 IGS fiducial stations, belonging to the ITRF2005 solutions, necessary for the alignment of the Datum.

The main purpose of this project is the materialization and monitoring of the Global Reference System on the Italian territory. With RDN, Italy has adopted since the 1st January 2009 the most recent official ETRS89 frame, that is ETRF2000, at epoch 2008.0. RDN was submitted to Firenze 2009 Symposium for the official endorsement (resolution 1).

The computation of the network was performed by the Data Processing Centre of the Geodetic Service of IGM, using BERNESE software (version 5.0). To test the results, the same computation was performed independently by the University of Padova (prof. Caporali) and by the G3 group in Milano (prof. Sansò).

Monitoring computations are performed every six months; up to the present, comparisons among the original and the monitoring computations show good consistency with the expected crustal movements.

3 IGM95 network

From 1992 to 1996 the Geodetic Service of IGMI completed the realization of a static GPS fundamental geodetic network, homogeneously distributed on the national territory as the classical trigonometric one and called IGM95.

This network is entirely determined through differential GPS techniques. Firstly it represented the italian ETRF89 realization of the European System ETRS89. Afterwards, in 2008, it was recalculated in the new ETRF2000 realization through the National Dynamic Network (RDN): due to small local deformations it was not possible to transform the coordinates from ETRF89 to ETRF2000 simply through roto-translations. So 45 RDN stations were connected through GPS measurements to those IGM95 points that, established from 1992 to 1996, were part of the fundamental network adjustment, and all the IGM95 network was recalculated using the GEOLAB software.

The original IGM95 network was formed by ~ 1230 points, at a mean distance of 20 km, and ~ 450 of these points (called GEOTRAV) were coincident with or connected to leveling benchmarks of the High precision leveling network.

At present, the network is formed by ~ 5000 points, and ~ 1100 of these points are GEOTRAV. It is in progress a densification project, in cooperation with the Regional Governments, that will lead to a mean distance of about 7 km among points. In Figure 2 the already densified zones are clearly visible.

4 High-precision levelling network

The modern high-precision levelling network was realized from 1950 to 1971, and at the beginning it was formed by about 13.000 benchmarks located along the national routes at a mean distance of about 1 km.

It is in progress a remeasurement and densification project that, thanks to the institution of new levelling lines, will lead to a total number of

about 20.000 benchmarks. Lines remeasured in 2010 are shown in Figure 3.

This densification project is an essential part of a project, started by the Geodetic Service in cooperation with the Polytechnic of Milano, finalized to the improvement of the National Geoid.

Fig. 1 National Dynamic Network (RDN)

5 Software

IGMI provides also software applications, the Verto suite, that perform transformations of coordinates among different planimetric (Roma40, ED50, ETRF89, ETRF2000) and altimetric reference systems (ellipsoid GRS80, national geoid).

The method is based on regular grids, covering all the national territory, made up of difference values between geographic coordinates ($\Delta\varphi$ and $\Delta\lambda$) in the various reference systems. The user can transform coordinates among the reference systems by mean of a bilinear interpolation among the grid values. Inside the applications there are only the

algorithms necessary for the transformations; the data are distributed separately, as portions of grids, in files *.gk1 and *.gk2.

Concerning altimetry, a specific grid of difference values between the national geoid and GRS80 ellipsoid has been calculated. This allows to transform ellipsoidic heights in geoidic heights and vice versa. At the moment two geoidic models are available, created in cooperation with the Polytechnic of Milano: ITALGEO99 and ITALGEO2005, respectively implemented in *.gk1 and *.gk2 grids, with a mean deviation from levelling lines of 0.16 and 0.04 m.

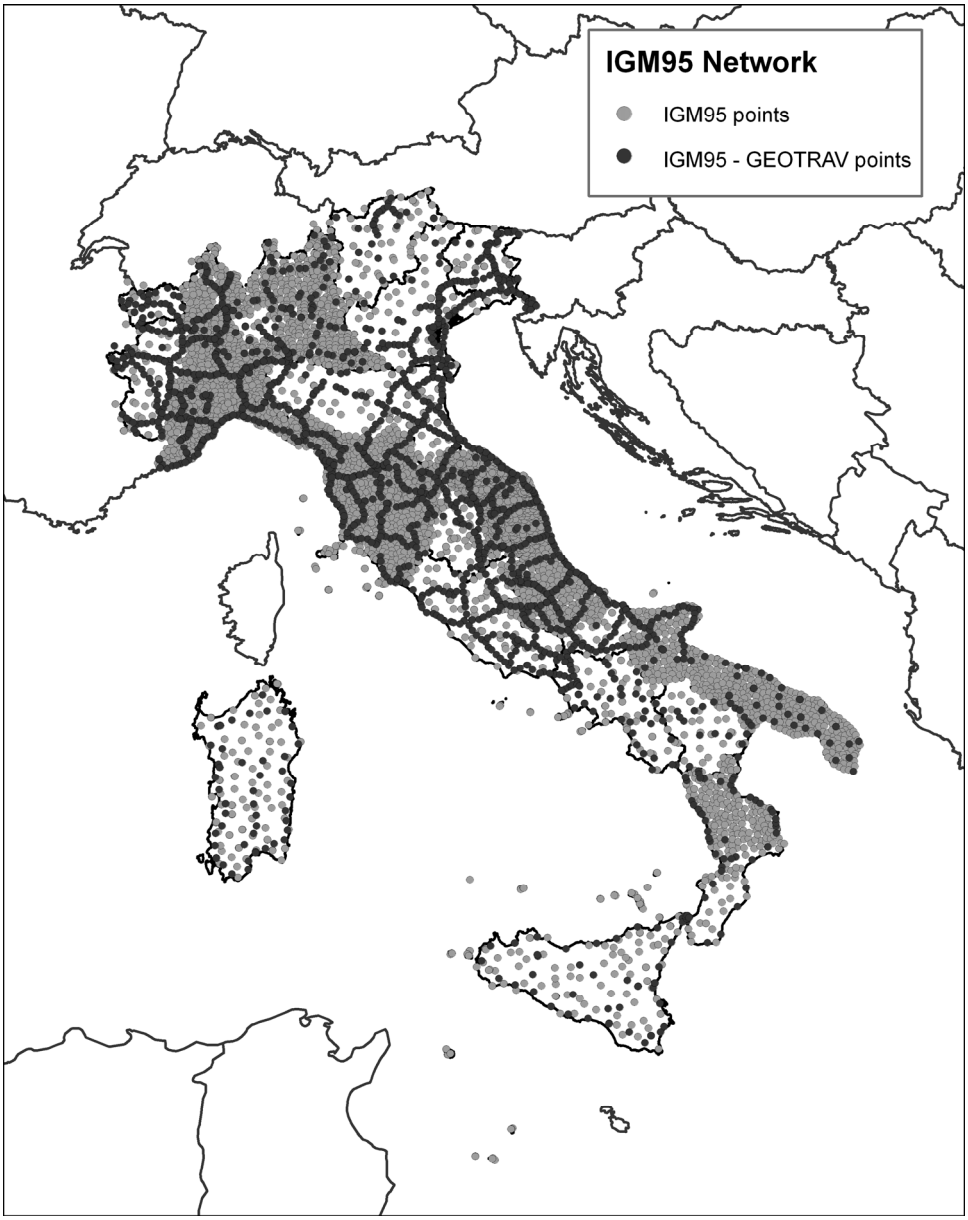

Fig. 2 IGM95 network

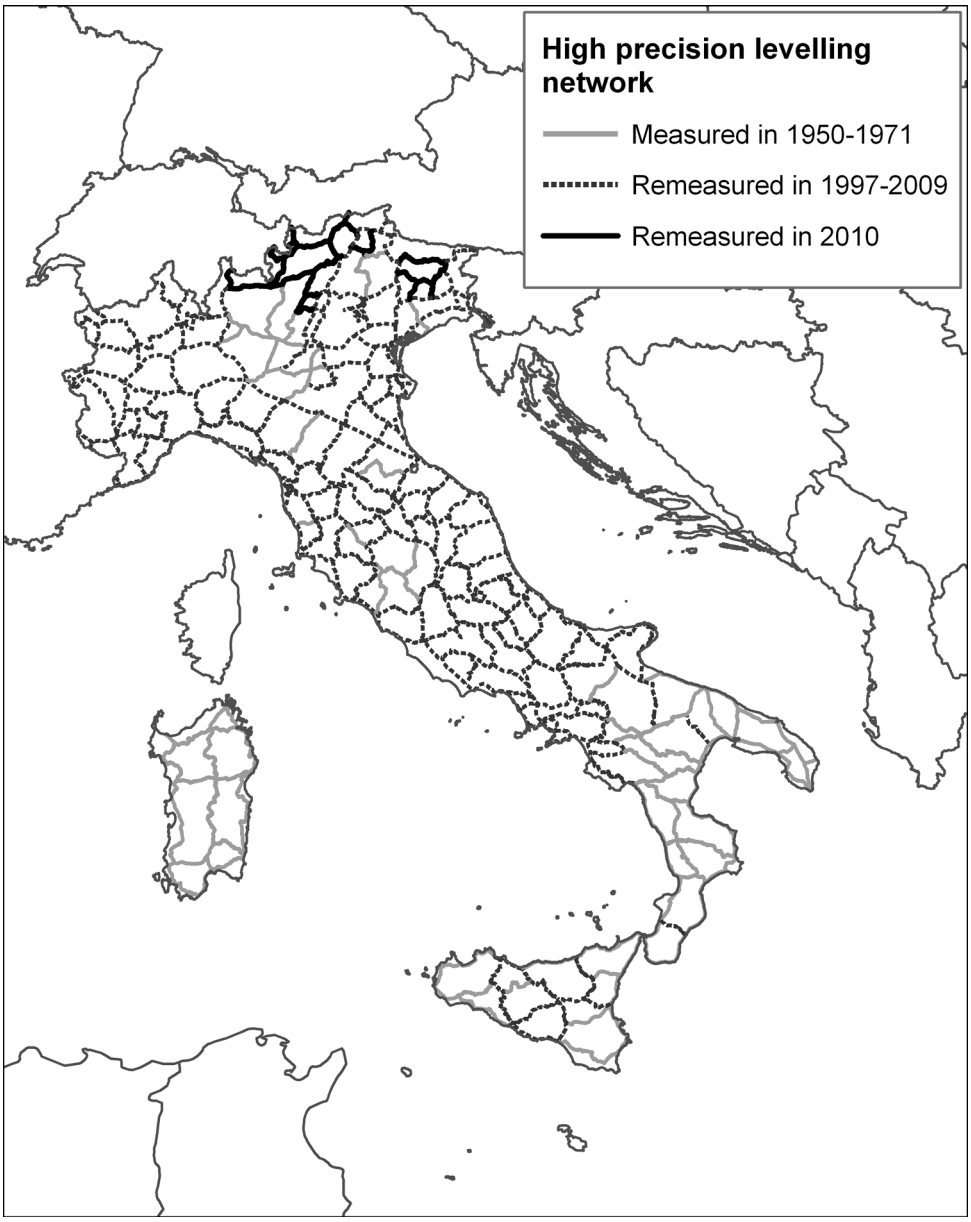

Fig. 3 High precision levelling network

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