



## **Accuracy of 1908-1912 high to medium scale cartography of Rome and its surroundings and related georeferencing problems**

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The first attempts to georeference maps of early twentieth century produced by Istituto Geografico Militare (IGM, the Italian geodetic agency) for the city of Rome and its surroundings, reported residual errors bigger than errors observed on similar maps, while previous studies performed on maps one or two century older of the same area, showed similar or smaller errors.

Possible explanations for errors of this entity can be the different systems of geodetic projection and geodetic datum or the derivation of some details from maps at smaller scale.

In particular, the map of “Roma e Suburbio” of 1908 and the map of “Roma e l’Agro Romano” (representing a wider area) of 1912, both in scale 1:5000, have been studied. Parameters useful to perform the transformation of the geodetic system applied to these historical maps in more modern systems are not known. For such reason, until now the various attempts to georeference them were based on the collimation of points recognizable on modern cartographies such as corners of historical buildings. This approach often has offered unsatisfactory results.

The historical geodetic system used the ellipsoid of Bessel oriented locally in the geodetic observatory in Genoa, while for the projection was used conformal Flamsteed one. In order to exclude that the deformations are due to the different projection (while comparing the original one to the transverse of Mercatore used both for the UTM and for the national system Gauss-Boaga used after 1940 and based on the Datum Roma40), we decided to study a transformation able to re-project the coordinates of points with known coordinates. This kind of transformation has also been performed by the IGM while transforming the existing cartographies of the whole Italian territory into the cartographic system Gauss-Boaga; for maps in scale 1:25000 with extension of around 10 km\*10 km, the IGM estimated that the differences due to the different projection were irrelevant, therefore the represented details were copied from one map to the other without changing their shape. In the case of the maps in our study, the greater scale requires the re-projection. In this context, the use of complex algorithms is needed to resample the raster images, implying a careful selection of the software package to perform the georeferencing process. The residual errors have been studied in detail, performing different checks for buildings, contour lines and spot heights. This was necessary since preliminary studies on different test areas have shown great incompatibilities, making us think that features such as buildings, roads, etc., could have been copied from cartographies at smaller scale through simple procedures of projection, while the characteristics of the ground could have been drawn by a special relief with characteristics of precision and accuracy proper of the 1:5000 scale. If we succeed in assessing surely that these maps have been drawn in this way we can use the obtainable height information with greater reliability. The maps georeferenced using the cartographic reprojection can furnish a valid tool to study different phenomenon, such as the geomorphologic variations due to natural and human causes within one century.