THE FAST HARTLEY TRANSFORM APPLIED TO THE IBERIAN GEOID CALCULATION

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ABSTRACT

For the Iberian Peninsula ($-10.5<\lambda<5.5$, $35<\phi<45$) a quasigeoid solution has been computed using a global geopotential model, a digital terrain model and point gravity anomalies. The Fast Hartley Transform (FHT) technique has been used in the computations. The effect of topographic masses is taken into account by a residual terrain model (RTM) reduction using a 1000x1000 m DTM in the area. The region was divided into two sub-areas with a common part. Some experiments were performed in order to test the results obtained in each individual sub-area and also in a global calculation for all of the region. Then one solution was calculated at 80692 points in a regular grid covering the region and referred to the GRS80. Results are presented in a contour map.

1. INTRODUCTION

The first determination of a gravimetric geoid in the Iberian Peninsula area was made last year (Sevilla, 1994). The geoid (quasigeoid) solution was computed based on the following data types: a) a geopotential model, namely the OSU91A spherical harmonic coefficients set, b) a set of 110948 point free-air gravity anomalies covering the Iberian Peninsula and the surrounding regions and c) a 1000x1000 meters digital terrain model for Spain and the ETOPO5U for the rest of the area.

The method used in the computations was Stokes' integral in convolution form. The input data were gridded gravity anomalies. To evaluate the integral, the Fast Hartley Transform (FHT) technique was applied (Bracewell, 1986; Li and Sideris 1992; Tziavos, 1993a,b). To compute height anomalies, discrete spectra of the kernel function is used. 100 % zero-padding was appended around the signal matrix in order to avoid circular convolution effects. The main advantages of the FHT are that the FHT is faster than the FFT (Fast Fourier Transform) and it only needs the half of the computer memory with respect to the FFT (see, e.g., Tziavos, 1993a).

The following tasks were of special interest in this study. The first was to compute absolute geoidal heights in a dense grid (2.4'x3') in the area . The second was to investigate the differences obtained using the FHT procedure in the overlapping zones, where different data sets have been used.

F. Sansò (ed.), *Geodetic Theory Today*

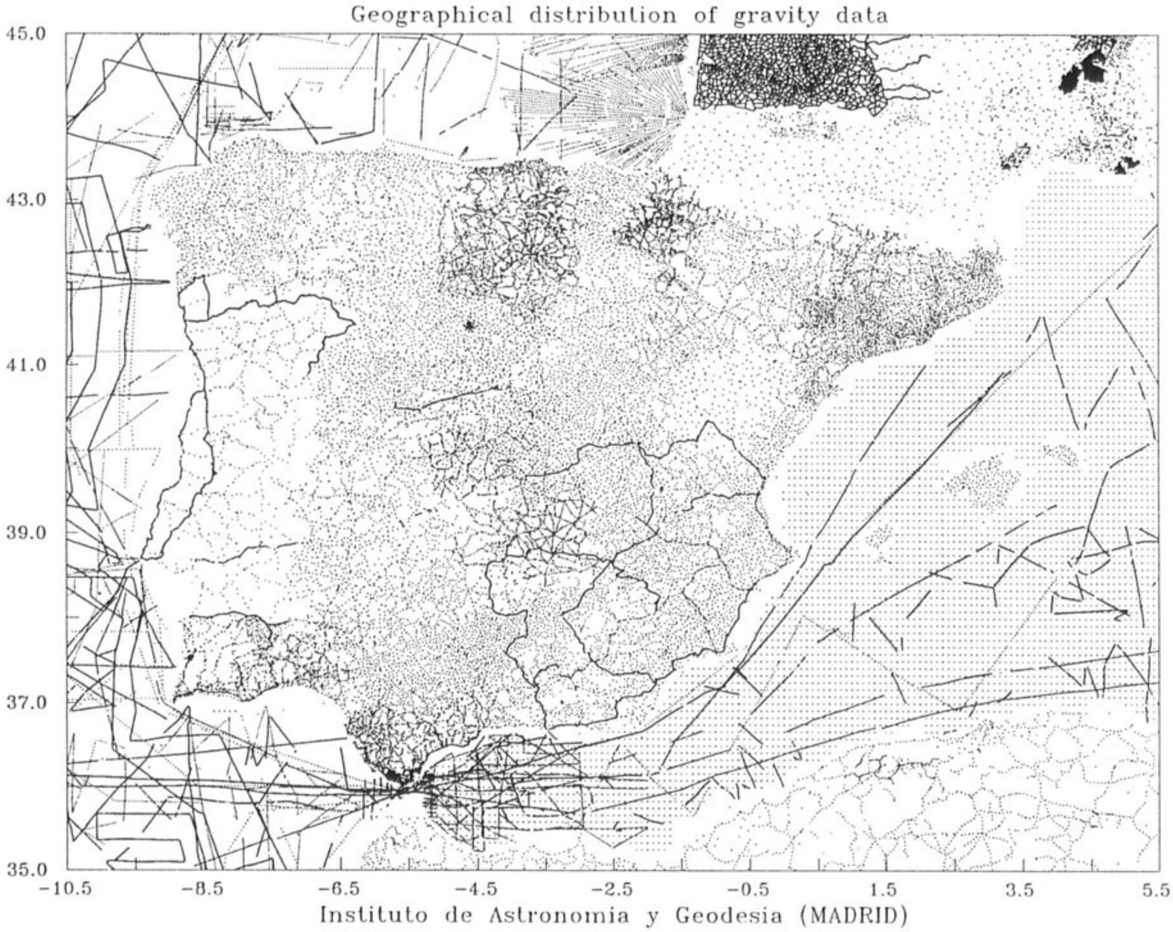

Fig.1. Geographical distribution of data points

2. DATA TYPES AND PREPROCESSING

Gravity anomalies

A number of 110948 point free-air gravity anomalies in the area ($-10.5<\lambda<5.5$, $35<\phi<45$) were used in the geoid computation and transformed to the GRS80 reference system. This data came from different sources. All data sets have been checked carefully and validated for gross errors by applying different procedures (Sevilla et al., 1991).

Figure 1 shows the geographical distribution of the available gravity data. Figure 2a shows an histogram of free-air gravity anomalies.

Geopotential Model

The geopotential model OSU91A (Rapp et al, 1991) complete to degree and order 360 has been used to obtain the reduced free-air gravity anomalies. Thus, the long wavelength part of the Earth's gravity field is removed from the gravity anomalies. This model fits well to the anomalous gravity field of the area (Sevilla, 1994)(see Table 1).