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The Alpine Swiss French Airborne Gravimetry Project (ASFAG Project)

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Abstract. An airborne gravity survey of the Western Alps was realized in February 1998, within the framework of the "GéoFrance 3D Alpes" project. We present the parameters of the survey and some results derived from the preliminary processing.

1. Introduction

This airborne gravity project is a part of the "GéoFrance 3D Alpes" project. The survey covered the western Alps, from the Rhône Valley in France to the Po-Plain in Italy. Five objectives were followed : accurate airborne measurements of the alpine gravity field, combinaison of both GPS data and that provided by a classical inertial gravitational system (INS), comparison between airborne gravity data and upward continuated ground data, mapping the Swiss-French Bouguer anomaly field by a combination of both Swiss and French airborne gravity data, 3D modeling of the alpine lithosphere using several Bouguer anomaly maps and seismic tomography models.

2. The survey

In February 1998, 18 NS lines were flown, crossed by 16 EW lines, spaced with 10 an 20 km (Fig. 1) respectively. The survey was performed with a Twin-Otter aircraft owned by the Swiss

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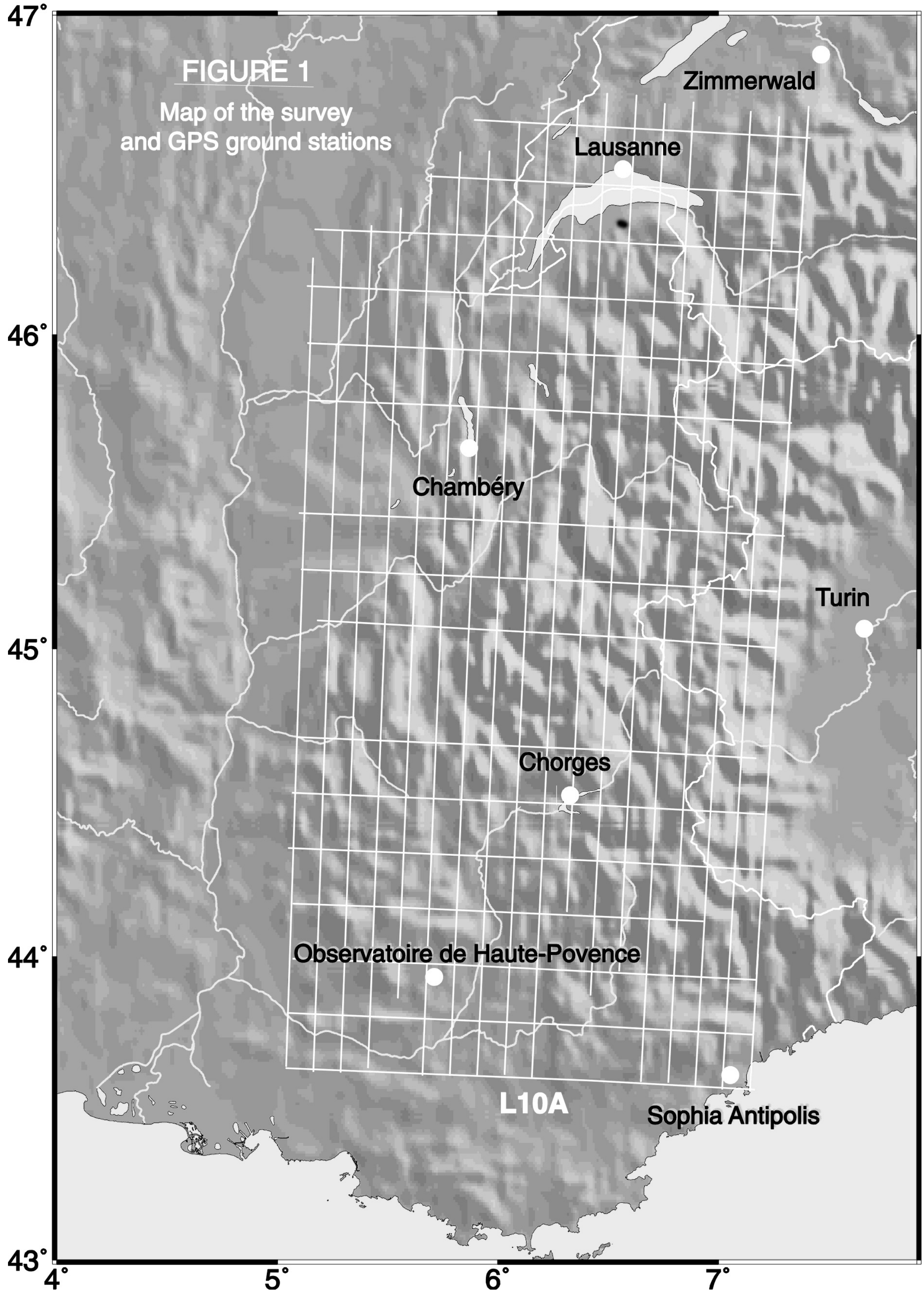

Fig. 1 - Flight lines of the airbone gravity survey.

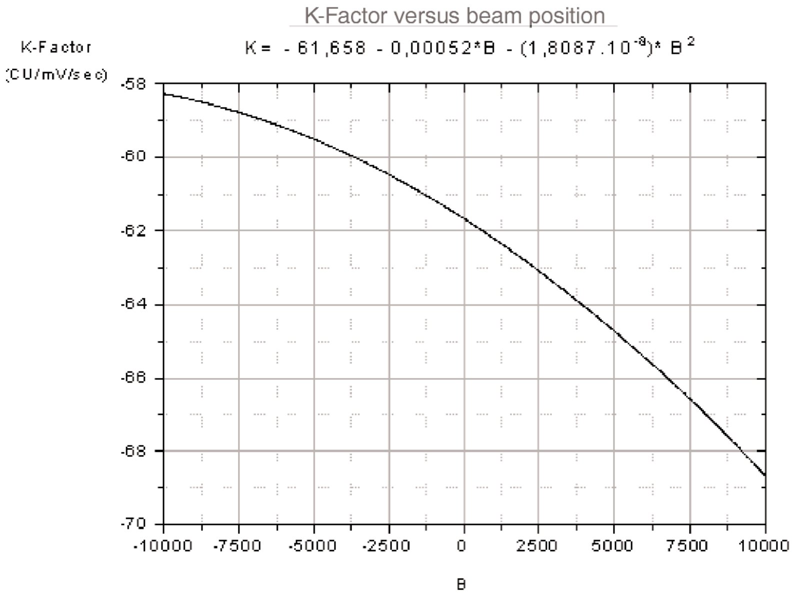

Fig. 2 - $K_{FACT.}$ versus beam position of the L&R gravimeter, SA type, number 110.

Federal Directorate of Cadastral Surveying at a barometric altitude of 5100 m above sea level. The aircraft was equipped with 5 GPS receivers (with working frequencies from 1 to 8 Hz) for relative positioning to 7 ground-fixed GPS stations and for monitoring aircraft velocities and accelerations. The gravity field was measured with an L&R airborne gravimeter, SA type, mounted on a laser gyro-stabilized platform (working frequencies: 1 Hz for the spring tension, 10 Hz for the beam position). The INS collected x, y, z accelerations and pitch, roll and yaw angular velocities at 50 to 100 Hz frequencies.

3. Preliminary processing

The observed gravity at point M is derived from gravimeter measurements following the equation :

$$g^*(M)=G_{FACT}*(S+K_{FACT}*B'+CC) \quad (1)$$

where :

S is the spring tension of the gravimeter measured in counter unit (CU);
B' is the beam velocity in (mV/CU/s);
CC is the correction of the cross-coupling effect (CU);
G_{FACT} and K_{FACT} are calibration coefficients.

The calibration coefficients were determined experimentally and we noticed that K_{FACT} depends on the beam position (Fig. 2).

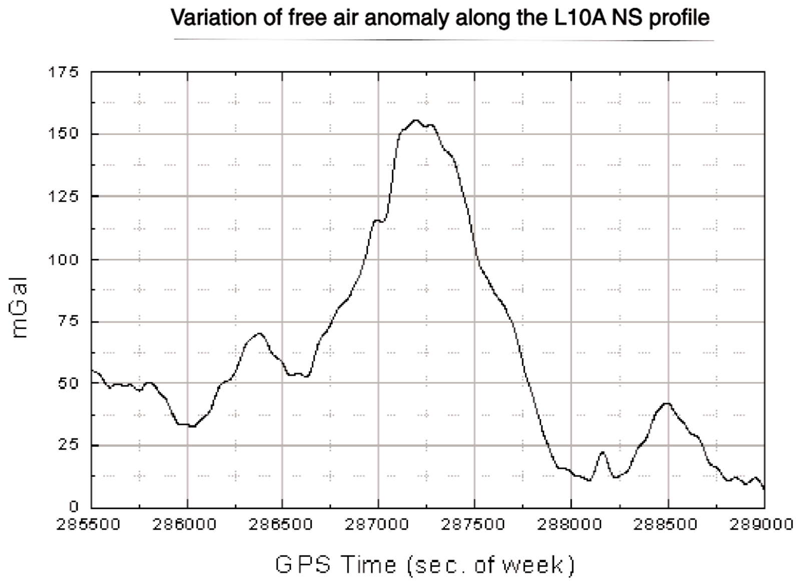

Fig. 3 - An example of the long wavelength free-air anomaly of the NS L10 line.

The gravity field is derived from the following formula :

$$g(M)=g^*(M)+\delta g_{E\ddot{o}t}(M)+ \delta a_v(M) \tag{2}$$

where :
$g^*(M)$ is the quantity measured by the gravimeter;
$\delta g_{E\ddot{o}t}(M)$ is the Eötvos correction of the Coriolis and centripetal accelerations;
$\delta a_v(M)$ is the correction of the vertical acceleration of the aircraft relative to the Earth.

GPS measurements were used to compute both the geodetic position of the gravimeter and acceleration corrections (Eötvos and vertical acceleration). Data were first processed using only one " GPS couple" (antenna "rear" on the aircraft, fixed ground station: Zimmerwald). At each step of the computation, filtering procedures may be applied by means of a cascade of filters. We used successively mean, median an recursive filters on both gravimetric an geodetic data.

Figure 3 shows an example of long wavelenth free-air anomaly computed along NS L10 line. A more complete processing is now in progress using all positioning information and GPS/gravity measurement transfer function in order to estimate the gravity field.

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