Analysis of GPS data from the Balearic geodetic network (XGAIB)

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In this document, we report processing and results of all available data from XGAIB network and two additional sites (MALL and IBIZ) located in the Balearic Islands. Continuous measurements at 10 permanent GNSS stations in the Balearic Islands show that horizontal velocities aligned to the ITRF2008 reference frame are stable within the current estimated uncertainties. These results indicates that all XGAIB network stations in its current configuration are suitable for regional and global geodynamics studies.

Data acquired by continuous GNSS sites belonging to the Balearic geodetic network (Fig. 1) were processed by using the GAMIT/GLOBK software which is a comprehensive GPS analysis package developed at MIT, the Harvard-Smithsonian Center for Astrophysics, and the Scripps Institution of Oceanography (Herring et al., 2010). GAMIT is composed of distinct programs which can be run with a single command by using the shell script "sh_gamit" or run individually. GAMIT incorporates a weighted least-squares algorithm to estimate the relative positions of a set of stations, orbital and Earth-rotation parameters, zenith delays, and phase ambiguities by fitting to doubly differenced phase observations.

To improve the overall configuration of the network and to tie the regional measurements to an external global reference frame, data coming from 10 continuously operating IGS stations (SFER, MAS1, MADR, RABT, TETN, IFRN, VILL, EBRE, YEBE, GRAS) were also introduced into the processing. Data were processed by using IGS (International GNSS Service - http://igscb.jpl.nasa.gov) precise ephemerides and Earth orientation parameters from the International Earth Rotation Service (http://www.iers.org) Bulletin B. Since we estimated for each station the zenith delays of the atmosphere at 2-hour intervals also, we introduced into the processing the mapping function described in Niell (2000). It must be considered that for geodynamic studies, this general configuration is more than adequate. For more detailed work, the use of the "global mapping function" developed by Boehm et al. (2006) from fitting numerical weather model data over 20 years could result more accurate than the one described in Niell (2000).

By using the GLOBK software we combined, on a daily basis, our solutions (and their covariance matrices) with global solutions (IGS1, IGS2, IGS3, IGS4, IGS5, IGS6 and EURA) provided by the SOPAC (http://sopac.ucsd.edu) in order to generate sites time series. To obtain clean time-series, we allowed an offset to be estimated for any discontinuities caused by antenna changes and we removed any position estimate whose uncertainty was greater than 20 mm or whose value differed by more than 10 mm from the best-fitting linear trend. Then, we aggregated the daily estimates over periods of 1 month to reduce the computational burden and to better assess the long-term statistics of the observations (Palano et al., 2013). As final step, by using the GLORG module of GLOBK we combined these monthly-averaged solutions and their full covariance matrices to estimated a consistent set of positions and velocities in the ITRF2008 reference frame (Altamimi et al. 2012) by minimizing the horizontal velocity of the 13 continuously operating IGS stations mentioned above. To account for correlated noise, we applied the "realistic sigma" algorithm of Herring et al. (2003) to each of our time-series, after removing the best-fitting annual and semi-annual signals and then included the estimated random walk component for each component of each station in our velocity solution. Velocities referred to the ITRF2008 reference frame are reported in Table 1.

SITE	Long	Lat	Heigth (m)	V*east*	V*north*	σVeast	σVnorth	RHO	Vup	σVup
IBIZ	1.44896622	38.91124871	59.9639	20.9	16.21	0.15	0.15	0.007	-1.00	0.23
FORM	1.42879152	38.70528124	99.6090	20.97	16.54	0.66	0.67	0.004	-0.11	1.27
EIVI	1.40687534	38.95119404	132.1468	20.23	16.71	0.66	0.67	0.004	-1.64	1.28
ALOR	4.14015507	39.93436094	189.5383	21.34	16.29	0.65	0.66	0.002	-0.19	1.2
MENC	3.83123602	40.00061829	66.6458	22.46	16.24	0.67	0.67	0.004	-1.56	1.32
BONA	3.39227664	39.61369677	57.3449	20.72	17.06	0.66	0.66	0.003	-1.92	1.23
SINE	3.01535047	39.64590544	188.0650	20.9	16.45	0.66	0.66	0.003	-0.61	1.27
JORD	2.99817373	39.31494230	57.5077	21.23	16.7	0.65	0.66	0.003	-0.74	1.21
TRAM	2.89161594	39.81844226	606.1023	20.95	16.19	0.88	0.89	0.003	-0.78	1.56
MALL	2.62455586	39.55262765	62.0412	19.13	16.74	0.15	0.15	0.002	0.30	0.22

Table 1. Site code, geodetic coordinates, east, north and up velocity components (mm/yr) referred to the ITRF2008 reference frame. For each site, associated errors (1-sigma), the correlation between the east and north components of velocity (RHO) are also reported.

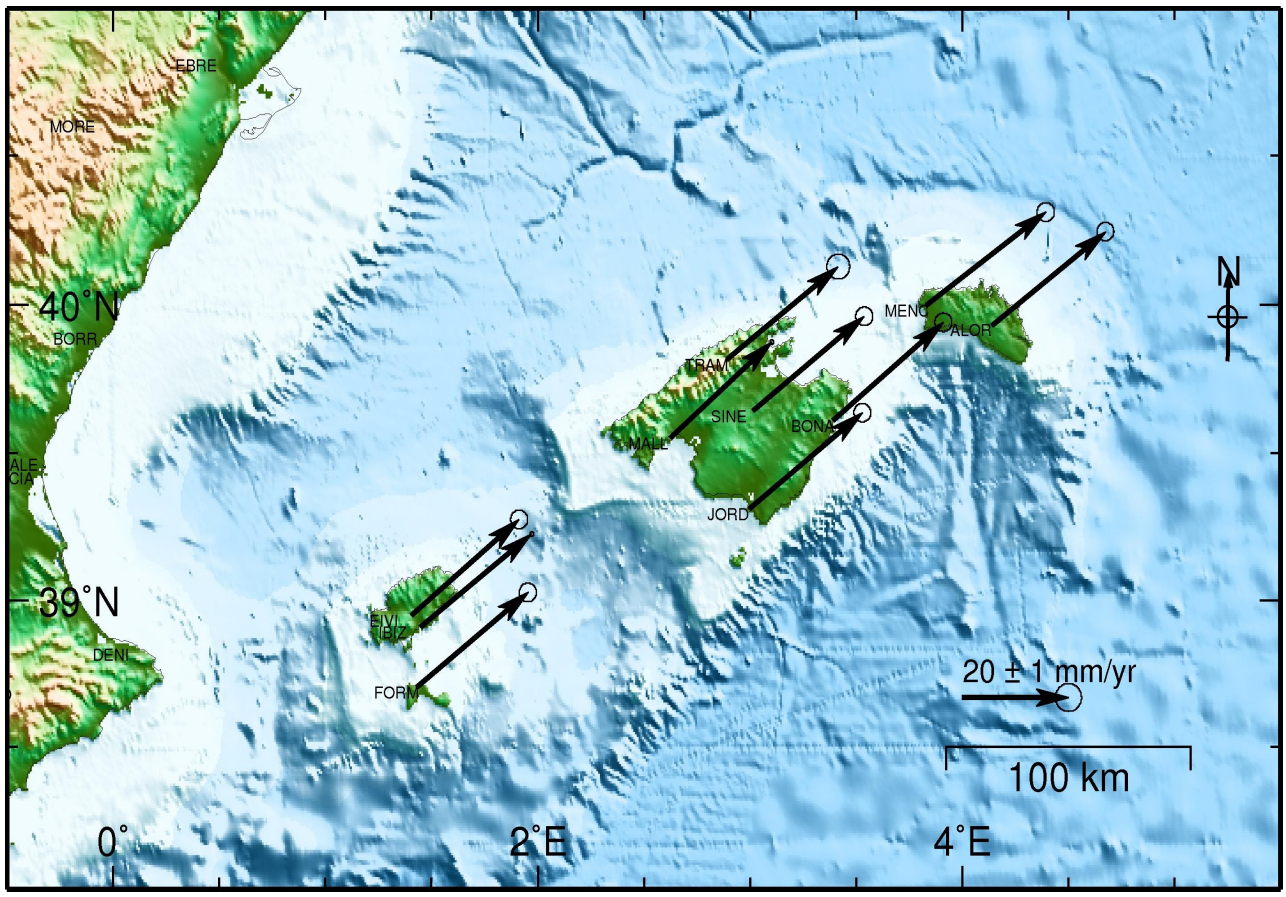

Figure 1. Location map of the processed XGAIB GNSS network with site codes (http://xarxagnss.caib.es/spiderweb/frmIndex.aspx) plus two additional sites. Arrows represent the horizontal station velocities in mm/yr referred to the ITRF2008 reference frame. Error ellipses were calculated to the 95% confidence interval.

References

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Auxiliary table. Site code, Cartesian coordinates and velocities at the 2011.400 epoch. Associated errors are also reported. Data are in the specific GAMIT/GLOBK apr-file format (see the reference manual for details).

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IBIZ 4967979.4860 125663.2308 3984692.9413 -0.01145 0.02061 0.01202 2011.400 0.0005 0.0003 0.0005
FORM 4982379.8148 124271.9466 3966900.1814 -0.01090 0.02070 0.01287 2011.400 0.0009 0.0005 0.0007
EIVI 4965340.8435 121946.5018 3988187.9184 -0.01223 0.01993 0.01200 2011.400 0.0008 0.0005 0.0007
ALOR 4884754.0187 353584.7079 4072521.4968 -0.01208 0.02052 0.01240 2011.400 0.0008 0.0005 0.0007
MENC 4881780.2334 326920.7310 4078081.0025 -0.01307 0.02163 0.01148 2011.400 0.0009 0.0005 0.0008
BONA 4911589.8675 291137.8015 4045072.5681 -0.01352 0.01996 0.01196 2011.400 0.0008 0.0005 0.0007
SINE 4911221.6125 258705.6478 4047910.2050 -0.01201 0.02030 0.01231 2011.400 0.0008 0.0005 0.0007
JORD 4934529.8085 258450.0322 4019465.3032 -0.01221 0.02062 0.01249 2011.400 0.0008 0.0005 0.0007
TRAM 4899859.8245 247497.3578 4062910.5889 -0.01197 0.02037 0.01197 2011.400 0.0009 0.0006 0.0008
MALL 4919369.3982 225499.9737 4039849.9191 -0.01125 0.01863 0.01313 2011.400 0.0007 0.0004 0.0006
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