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THE 2004 GEOMAGNETIC REPEAT STATION SURVEY OF CROATIA

– A National Report –

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Abstract. Croatian Geomagnetic Repeat Stations Network is described. Equipment and procedures used in the 2004 repeat station survey are presented. The geomagnetic declination, inclination and total intensity data reduced in reference to observatories of Fuerstenfeldbruck, Tihany, and L'Aquila, and the epoch of the 2004.5, are given and discussed. Future survey plans are addressed.

Croatian Geomagnetic Repeat Stations Network

A new national repeat stations network was setup in the year of 2004 (Brkić et al. 2006). The maintenance of the network is held by the Faculty of Geodesy for the State Geodetic Administration. The network consists of eight primary repeat stations (along with one secondary station at PONP established in the 2005) with the average distance of approx. 178 km. All the primary repeat stations have permanent marks made of hard limestone block. In addition, three azimuth reference marks were setup more than a few hundreds meters from the repeat station, and the auxiliary point was setup roughly 7 m away from the repeat station. Repeat stations as well as reference marks coordinates were determined by GPS relative static positioning with Trimble 4000 SSI receiver to the accuracy better then two cm, enabling reliable calculation of the true north azimuths. The resulting repeat stations positions are presented as φ and λ coordinates on Bessel's ellipsoid (see Table 1, and Figure 2).

Repeat station survey of the year of 2004

The geomagnetic declination D, inclination I and total intensity F survey was completed within the time and financial framework of national network setup. The absolute instruments used were Bartington D/I MAG01H fluxgate with MAG Probe A and Zeiss 010B theodolite with nonmagnetic tripod, along with GEMSys GSM-19G Overhauser PPM. The comparison check of the instruments before and after the survey proved their reliability.

For each repeat station roughly three sets of declination and inclination observations were performed in the early morning and in the evening, usually during two days. Each D and I set of observations employed the null method. The azimuths to the reference points were checked before and after each D and I set of observations. Total intensity was continuously recorded at the auxiliary point at the same time. All the observations were stored on PC, and documented on the paper form. The space weather was regularly checked for geomagnetic activity during the campaign.

Fig. 1: Gradiometry (left). Besides investigating the condition of low total intensity gradients in repeat station setup, gradiometry is important in site maintainence as an indication of possible site's contamination. Orientation of the theodolite in reference to the azimuth reference mark (middle). The azimuth reference mark with a signal rod (right) was usually placed near the road, within the distance of a few hundred meters.

Reduction to the epoch of 2004.5

The survey was reduced to the epoch of 2004.5 using data of Fuerstenfeldbruck (FUR), Tihany (THY) and L'Aquila (AQU) reference observatories. The reduced value of the geomagnetic element at the repeat station was calculated from

$$E_{rs}^{2004.5} = E_{obs}^{2004.5} + \left(E_{rs}^{t} - E_{obs}^{t}\right) \quad (1)$$

where $E_{obs}^{2004.5}$ refers to the observatory annual mean value of the geomagnetic element, E_{rs}^{t} the element observed at the repeat station at time t, and E_{obs}^{t} the element observed at the observatory at the same instant (see e.g. Rasson and Delipetrov 2006).

All the observational sets at the particular repeat station were reduced to each observatory, and averaged; the final values of the geomagnetic elements as well as their scatter refer to all three observatories, and the epoch of 2004.5 (Table 1, and Figure 2). The scatter of each repeat station shows acceptable measurements' quality, as well as suitability of the reduction model (1). The overall error of the whole network estimated as the average scatter amounts to 0.5′ in D, 0.2′ in I, and 2.7 nT in F.

Table 1. Reduced data to FUR, THY and AQU, and the epoch of 2004.5.

St. Name	Lat. [deg.]	Lon. [deg.]	h [m]	D [deg.]	Scatter D [deg.]	I [deg.]	Scatter I [deg.]	F [nT]	Scatter F [nT]
POKU	45.4733	15.9833	105	2.485	0.012	62.013	0.003	47434.8	5.0
MEDJ	46.4839	16.3317	199	2.403	0.001	62.931	0.003	47755.2	2.3
BARA	45.8364	18.7869	86	3.046	0.007	62.521	0.001	47738.8	1.8
RACI	44.8564	18.9694	81	2.959	0.013	61.536	0.005	47454.2	5.2
KONA	42.5322	18.3403	47	2.716	0.009	59.259	0.003	46770.0	1.7
SINP	43.6494	16.6886	296	2.302	0.014	60.479	0.002	46922.9	2.8
KRBP	44.6697	15.6300	648	2.270	0.004	61.240	0.001	47039.7	2.0
PONP	45.3561	13.7347	5	1.924	0.006	61.773	0.002	47221.5	0.7

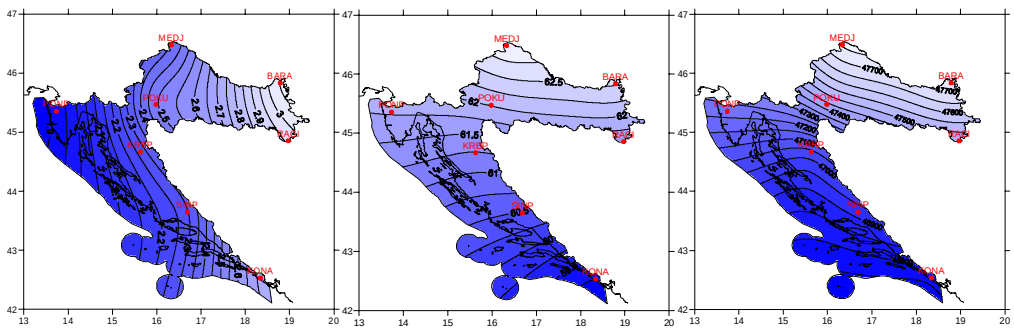

Fig. 2: Reduced declination, inclination, and total intensity 2004.5.

Similar results were obtained in (Brkić et al. 2007), where the survey was reduced only to FUR observatory, and were the normal fields, represented by 2nd degree polynomials, showed a significant differences to DGRF (up to 200 nT in F). A general conclusion was that a more regular and frequent repeat stations surveys, as well as setup of a denser geomagnetic network are a must in the years to come.

The Future?

A considerable resources still need to be devoted to fundamental work of networks setup, as well as establishment of a regular periodic survey. Hopefully a repeat stations survey of a complete national network is planned in the year of 2007; in addition, a few new repeat stations are planned to be setup on the Adriatic sea, and within the Bosnia and Herzegovina. However, setup and survey of a much denser network is envisaged to follow in the next several years.

Acknowledgements. The authors gratefully acknowledge the INTERMAGNET, as well as the geomagnetic observatories Tihany, L'Aquila and Fuerstenfeldbruck for providing the observatory data.

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