THE REALIZATION OF A NEW GEOMAGNETIC OBSERVATORY IN CENTRAL ITALY, REPLACING L'AQUILA GEOMAGNETIC OBSERVATORY

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SUMMARY

The geomagnetic Observatory of L'Aquila was founded by Istituto Nazionale di Geofisica e Vulcanologia (INGV) in 1958, on the occasion of the International Geophysical Year. It is the main Italian geomagnetic observatory and since 1999 is part of the Intermagnet network. In 2009 L'Aquila was struck by a strong earthquake; the town was seriously damaged, and since then many activities moved to the suburbs; close to the Geomagnetic Observatory new activities were planned. Then the necessity to find in the surroundings a new place, suitable for the installation of a Geomagnetic Observatory, arose. Several tests were made and a possible location was found in Castel Del Monte, 40km from L'Aquila; a preliminary analysis of the electromagnetic background noise and of the spatial magnetic field gradients has shown that the place can meet the requirements for a Geomagnetic Observatory. Meanwhile, in 2010, a new Geomagnetic Observatory was installed in Duronia, 130 km South-East from L'Aquila and since 2012 it is part of the Intermagnet network.

1. INTRODUCTION

INGV is in charge of geomagnetic field measurements in Italy, performed by means of geomagnetic observatories and repeat stations (Meloni et al., 2007); at the moment, it runs the geomagnetic observatory of L'Aquila (IAGA code AQU) and Duronia (DUR) in central Italy, Castello Tesino (CTS) in nortern Italy and Lampedusa (LMP) in southern Italy, providing a full coverage of the Italian latitudinal extension. L'Aquila geomagnetic observatory (geographic coordinates: 42°23'N; 13°19'E) has been the main italian magnetic observatory since 1958 (Meloni et al., 1984, 1989), providing long series of data (Figure 1), which have been widely used for scientific studies of the variations of the geomagnetic field (Francia et al., 1999, 2001; Lepidi et al., 1999, 2001, 2003) and for geomagnetic field modelings (Meloni et al., 1994; De Santis et al., 1997); after the April 6, 1999 earthquake, the necessity of moving the observatory to a new location arose, in order to give a continuity to the existing dataset.

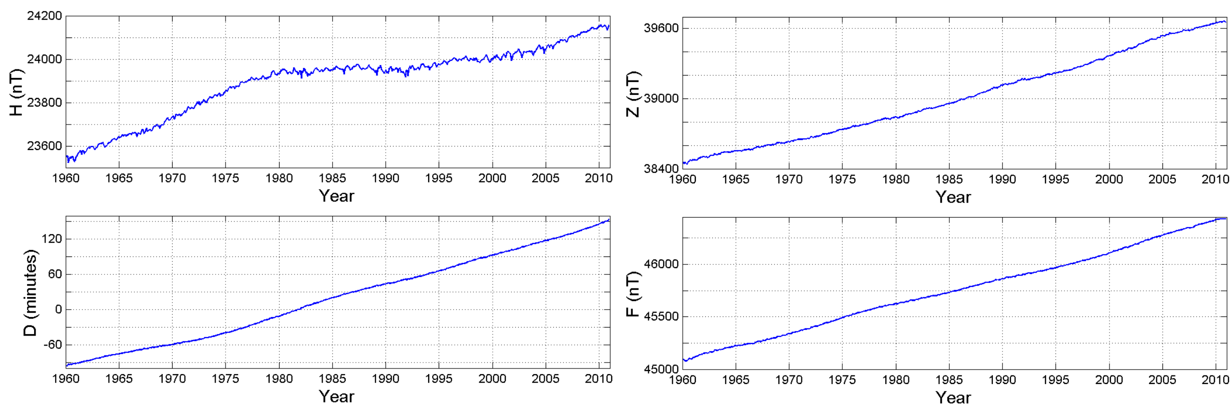

Figure 1 –Average monthly values of horizontal component H,declination D, vertical component Z and total field intensity F over 50 years.

2. TESTS FOR A NEW INSTALLATION IN CASTEL DEL MONTE

Castel Del Monte (CDM) is a small village (about 500 inhabitants) on the Apennine mountains, about 40 Km East of L'Aquila. A suitable location for a new observatory was found 3Km outside the village, at almost 1600 m altitude, where there is a quite flat piece of land of about 2 hectares, with an underlying stable bedrock. Preliminary tests have been performed to analyze the background noise level; in particluar, 1-sec variation measurements of the geomagnetic field components were recorded with a fluxgate magnetometer for a few days and were compared with simultaneous AQU data (Figure 2, left panel); it can be seen that the variations at the two stations are very similar and that the background noise level at CDM is very low. Also higher frequency variations, with a sampling rate of 125 Hz, were measured (Figure 2, right panel); the Schumann resonance at 7.8 Hz is well evident, and also in this case the background noise level is very low.

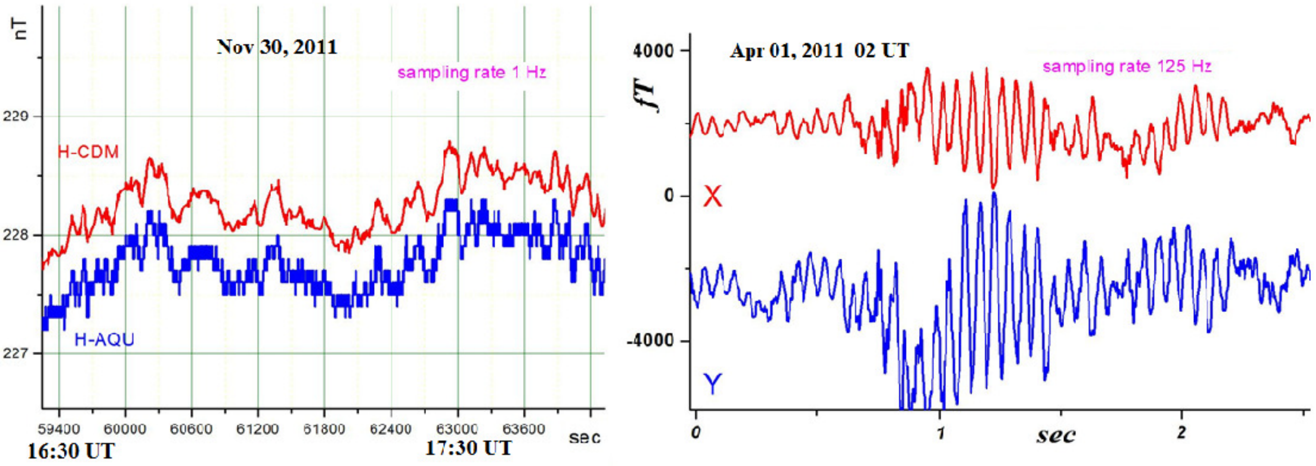

Figure 2 – left panel: Simultaneous 1 Hz measurements of the total horizontal geomagneti field component at AQU and CDM; right panel: 125 Hz measurements of the two horizontal components at CDM.

Simultaneous absolute measurements of the declination D, the inclination I and the total magnetic field F were performed at the two sites in order to check if the differences are constant and if the values at CDM can be considered representative (Table 1).

Table 1- Simultaneous absolute measurements (Declination, Inclination, F in nT) at CDM and AQU.
Delta is the difference CDM-AQU

D(CDM)	D(AQU)	I(CDM)	I(AQU)	F(CDM)	F(AQU)	Delta D	Delta I	DeltaF
2°57'03"	2°47'35"	58°45'12"	58°42'16"	46535.20	46466.75	0°09'28"	0°02'56"	68.45
2°56'43"	2°47'16"	58°45'56"	58°42'13"	46532.85	46464.57	0°09'27"	0°03'43"	68.28
2°56'50"	2°47'20"	58°46'00"	58°42'22"	46532.73	46463.36	0°09'30"	0°03'38"	69.37
2°56'38"	2°47'00"	58°46'01"	58°42'13"	46531.89	46462.78	0°09'38"	0°03'48"	69.11

We selected an area of 80mx130m and, to check if there are any magnetic anomalies, we measured the geomagnetic field intensity F and its vertical gradient at the nodes of a square grid at distances of 10m. The results are shown in Figure 3. White squares indicate missing measurements in correspondence of a building. This building produces an evident magnetic disturbance, with vertical F gradients greater than 10 nT/m. Areas with low values of the F gradient are localized in the lower-right zone and in the upper corners. Using simultaneous AQU measurements as a reference, we computed the difference with F measured at each point of the grid (Figure 4, left panel). We then used these differences to compute their horizontal gradient, as the difference at each node of the grid with the four nearest nodes (Figure 4, right panel). It is evident that the areas in which the F difference with AQU is constant, and consequently its horizontal gradient is lower, are localized in the lower-right and upper zones of the selected area.

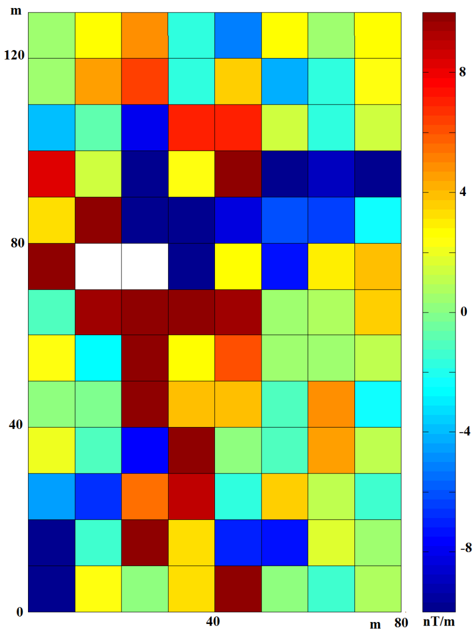

Figure 3 – Vertical gradient of F measured at each point of the grid.

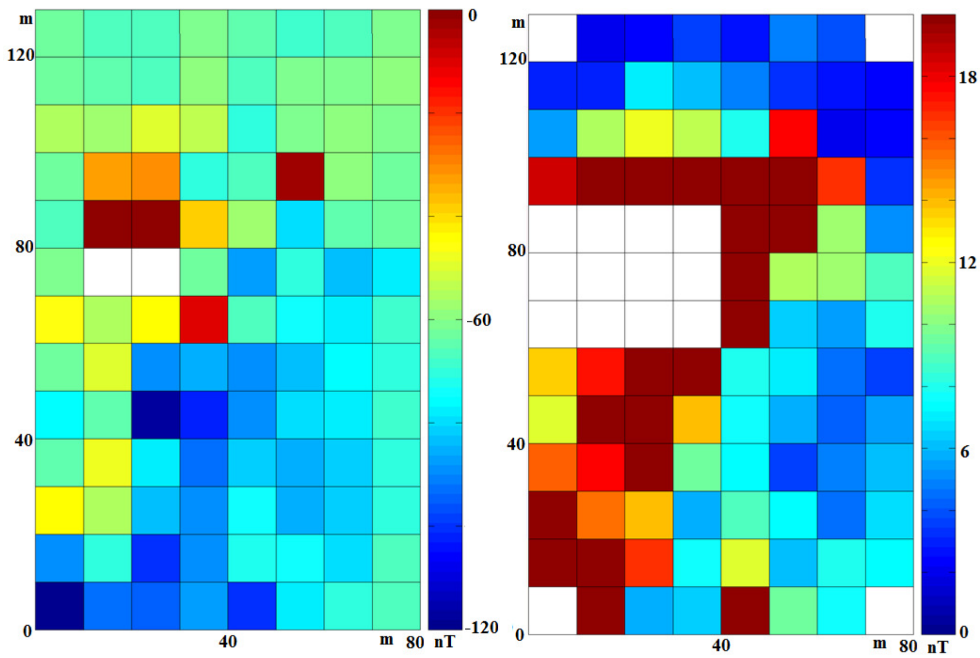

Figure 4 – Left panel: Difference between F measured at each point of the grid and the simultaneous value at AQU observatory; right panel: Horizontal gradient of the difference between F at each point of the grid and the simultaneous value at AQU.

3. DURONIA GEOMAGNETIC OBSERVATORY

Duronia observatory consists of seven little wooden buildings inside a forest: variometer, absolute measurements, automatic absolute measurements, ULF search coil, ELF search coil , VLF search coil and a wide band (1 Hz - 5 GHz) electrometers (Palangio et al., 2009). It is located in a very low noise area: the background noise level is less than 20 fT/√Hz in the frequency band 10 Hz -25 kHz. These characteristics allow to plan research activities in the field of geomagnetic sciences such as Schumann resonance (Figure 5) and Alfvén resonance. The new observatory became fully operational in June 2010, with continuous measurements of the geomagnetic field, including variation recordings and absolute measurements. In Figure 6 the difference between scalar and vectorial F and the baselines for six months are shown. The results show that the new observatory is well within the IAGA 2002 standards, with a 5 nT peak to peak baseline amplitude. In 2012 DUR was included in the Intermagnet network.

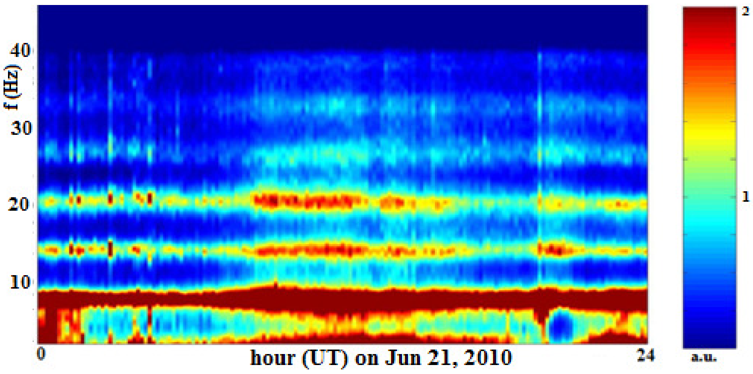

Figure 5 - Spectrogram for 1 day showing the Schumann resonance at 7.8 Hz and its harmonics

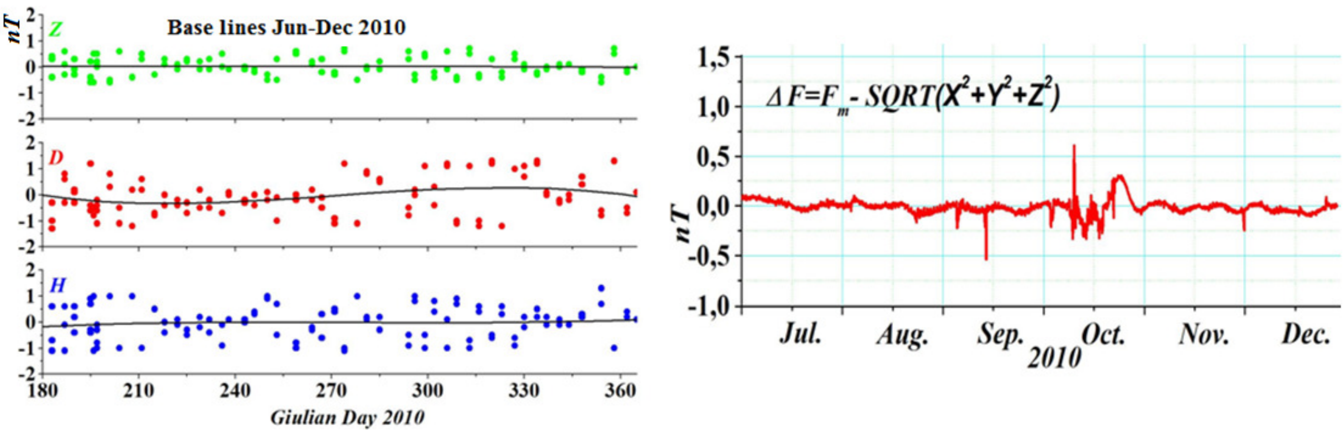

Figure 5 – Left: Baselines; right: Difference between scalar and vectorial F

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