Antarctic Research

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As part of the National ItaliAntartide Project, a geomagnetism program has been undertaken in order to contribute to solid Earth sciences as well as to upper atmosphere and magnetospheric studies. As a first step during the austral summer 1986-1987 a magnetic observatory was set up in Terra Nova Bay, in the Italian Base area. This observatory has been working since then and has also been upgraded.

The Terra Nova Bay Geomagnetic Observatory is equipped with instruments able to monitor the Earth's magnetic field time variations in the elements H, D and Z and with absolute instruments, which allow calibration measurements. The instruments used at the Observatory include two proton precession magnetometers for the recording of total field F, two flux-gate magnetometers for recording the elements H, D and Z, and a DIM theodolite for absolute measurements.

Since the Italian Base has up to now been limited to summer access, an automatic wintering-over installation has been employed to ensure continuous data acquisition. While the sampling rate has been averaged to 1 minute for all summer operations, wintering over automatic data acquisition has been averaged to 2 minutes.

The amplitude of the daily variation shows at Terra Nova Bay an evident increase in all elements related probably to the solar activity variation. The effect in the daily amplitude ranges for all elements can be clearly seen in fig. 12 (a, b, c, d) where each box refers to a single magnetic element. In each panel the minimum (triangle) and maximum (square) reached levels are shown vs time; the daily range (peak to peak) of the equivalent harmonic wave can be seen, for every year (from 1987 to 1993), by the vertical bar between square and triangle.

Starting with 1991/92 expedition a program of aeromagnetic surveying has been undertaken in North Victoria Land. In this area an integrated program of geology and geophysics is in progress as a coordinated effort of several national programs under the name LIRA (Lithospheric Investigations in the Ross Sea Area).

Three aeromagnetic helicopter-borne campaigns (1991/92-1992/93-1993/94) have been performed in Victoria Land as part of the GITARA programme (German Italian Aeromagnetic Research in Antarctica) between Terra Nova Bay and Granite Harbour from the coast to approximately 200 km inland (about 50.000 km^2). Flight altitude was about 2700 m and line spacing 4.4 km for profile lines and 22 km for tie lines. An optically pumped caesium magnetometer was used with a sampling rate of one second; magnetic time variations were monitored with proton precession magnetometer base stations. The accuracy of positioning, which is particularly stringent for high resolution aeromagnetic mapping in these areas, was significatively improved, by employing a ground-based Trident system for GITARA 1, a merged Trident and GPS sys-

tem for GITARA 2 and a differential GPS system for the GITARA 3 campaign. Standard processing steps (recovery of flight paths, removal of magnetic time variations, IGRF correction, levelling) were optimized with microlevelling procedures. Data sets were merged and gridded to produce aeromagnetic anomaly maps; digital enhancement techniques and filtering were applied as an aid to interpretation. These maps are a contribution to the geophysical mapping of East Antarctica and are being used in investigations of major tectonic structures and crustal units of this sector of the Transantarctic Mountains, as part of the LIRA project. The aeromagnetic program is still in progress.

The Earth's electromagnetic enviroment in the ULF/ELF bands (Ultra Low Frequency and Extremely Low Frequency) exhibits a rich variety of naturally occurring electromagnetic phenomena, in particular geomagnetic field pulsations and the extremely low frequency band in which the propagation of electromagnetic waves has some unusual properties because their wavelength is comparable with the Earth's radius. Global electromagnetic resonances may then appear when the frequency is equal to the natural frequency of the resonator formed by the spherical cavity between the Earth and the ionosphere. This resonator is excitated by terrestrial and cosmic sources. In the polar zone electromagnetic radiation arriving from space through the ionosphere may act as a source of e.m. waves in the Earth-ionosphere cavity. Signals produced by cosmic sources can be measured in Antarctica. In polar areas, in fact, far from artificial and other natural sources, the interaction of the solar wind with the magnetosphere can be imagined to act like a large MHD generator. The solar wind kinetic energy is converted into electric currents that, driven to the polar upper atmosphere, can generate Earth-ionosphere cavity oscillations. These measurements have recently been undertaken at the Geomagnetic Observatory at Terra Nova Bay; we hope, with this additional information at our station, to improve the knowledge of the space-time distribution of ULF/ELF signals.

Measurements of the cosmic noise with a radiometric receiver called a RIOMETER (Relative IOnosphere Opacity METER) tuned to the appropriate frequency (typically 30-40 MHz), can be useful for inferring the wave absorption relative to the known ionospheric layers. Riometers have recently been installed at Terra Nova Bay and can detect absorption events related to ionospheric-magnetospheric coupling instabilities.

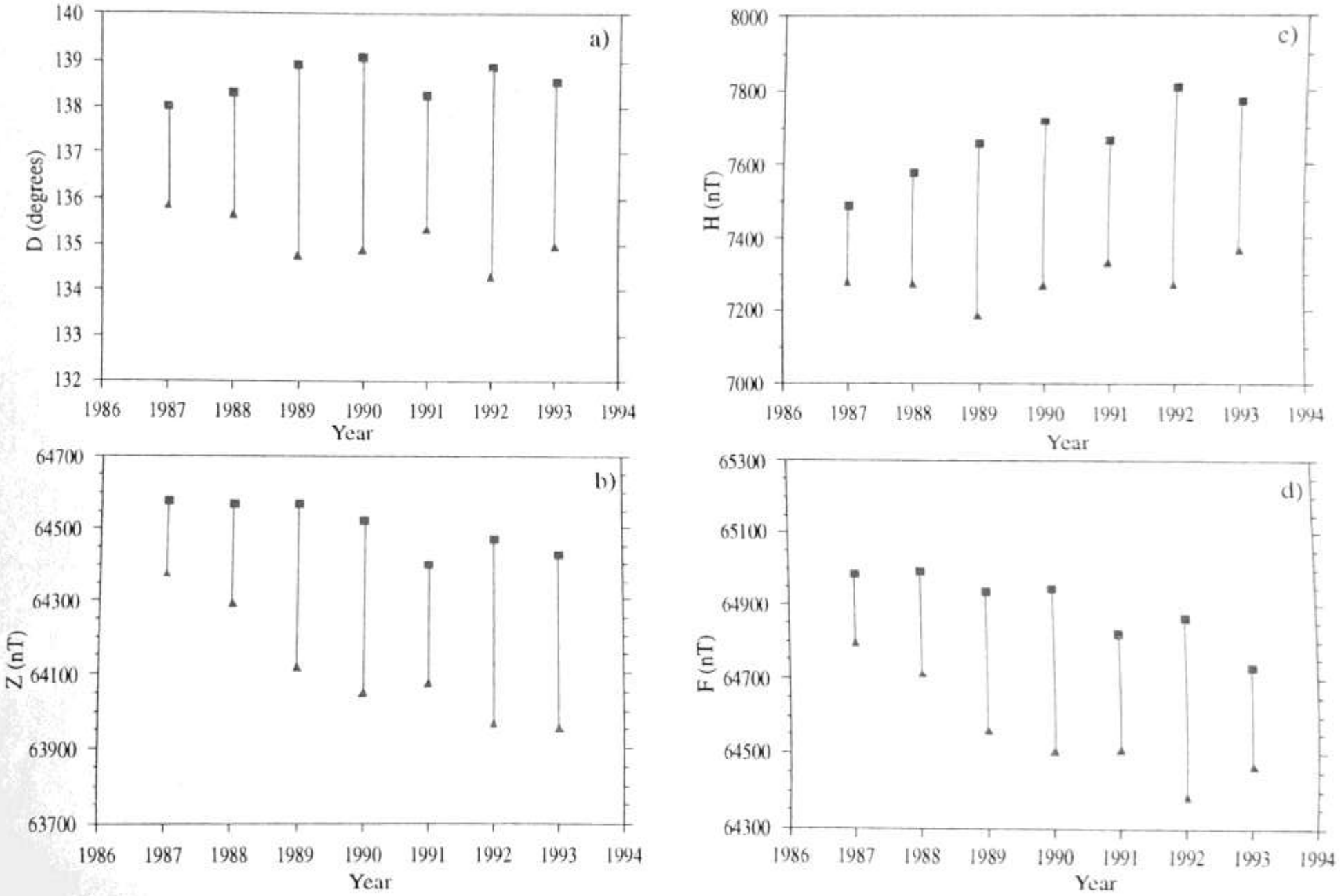

Fig. 12. Declination (a), vertical (b), horizontal (c) and total field (d) daily ranges as recorded from 1987 to 1993 at Terra Nova Bay observatory (Antarctica).