Programma Nazionale di Ricerche in Antartide (PNRA)

Final project report

Project ID	2004/7.07
Title	Aspetti dinamici della magnetosfera terrestre
Principal investigator	Umberto Villante
Institution	Dipartimento di Fisica - Università dell'Aquila
Email	umberto.villante@aquila.infn.it
Duration	3 years, 2004-2007
Assigned funding	50.000,00 Euro

Activities and results

The present project concerns the measurements, analysis and interpretation of ULF (1 mHz-1 Hz) geomagnetic field fluctuations recorded in Antarctica at Terra Nova Bay (TNB, since 1992) and at Dome C (DMC, since 2005). At both stations the instruments consist in almost identical, high sensitivity triaxial induction coil magnetometers, and automatic acquisition systems, with timing provided by GPS and a final sample rate at 1 Hz. These very high latitude measurements are important in that these regions are magnetically connected to the outer magnetosphere, where several mechanisms of energy transfer from the solar wind are active.

The characteristics of ULF pulsations were studied using the data recorded at TNB and DMC, at other Antarctic stations (cooperation with the Bell Laboratories, NJ), at low latitude (station of L'Aquila) and from interplanetary spacecraft. The main results are the following:

- By means of a polarization analysis of the ULF signals (1-100 mHz) recorded at TNB, it has been proposed a new model of the diurnal and latitudinal variation of the resonance region, characterized by a shift toward lower latitudes of this region with increasing frequencies. At frequencies greater than 20 mHz the experimental observations suggest additional contributions from waves propagating along the magnetotail lobes (Villante et al., 2009).

- An analysis of the ULF (1-100 mHz) power during 2003-2006 at DMC and TNB, indicates a more significant solar wind speed control at DMC, less influenced by cusp related phenomena. At TNB the power maximizes around local magnetic noon, in correspondence to the cusp proximity, while at DMC the power is almost uniform through the day, with a small enhancement in the post-midnight sector. At TNB the characteristics of the daytime pulsations are connected to the fundamental and higher harmonics of the field line resonances of the neighboring lower latitude regions, and the characteristics of nighttime Pc3 pulsations indicate a penetration of upstream waves through the magnetotail lobes (De Lauretis et al., 2009; Francia et al., 2009).

The results of such scientific activity have also been discussed in some review papers (Villante et al., 2006; Cafarella et al., 2007).

Products

A – papers in scientific magazines

1. Villante U., M. De Lauretis, P. Francia, M. Vellante, and A. Piancatelli, Experimental aspects of mid-frequency pulsations (f ≈ 10-100 mHz) in the southern polar cap, *Space Science Rev.*, **122**, 107-117, 10.1007/s11214-006-7015-7, 2006.
2. De Lauretis M., P. Francia, A. Piancatelli, M. Vellante, and U. Villante, Low and mid-frequency pulsations in the polar cap: polarization pattern and MLT dependence of the spectral power during the descending phase of the solar cycle, *Annals of Geophys.*, **52**, 27–34, 2009.
3. Villante U., P. Francia, M. Vellante, and M. De Lauretis, Polarization pattern of low and mid-frequency magnetic pulsations in the polar cap: A comprehensive analysis at Terra Nova Bay (Antarctica), *Advances in Space Research*, **43**, 1135–1142, doi:10.1016/j.asr.2008.10.009, 2009.
4. Francia P., M. De Lauretis, M. Vellante, U. Villante, and A. Piancatelli. ULF geomagnetic pulsations at different latitudes in Antarctica, *Annales Geophysicae*, **27**, 3621–3629, 2009.

B – book chapters

--

C - proceedings of international conferences

1. Amata E., et al., SINERGIES, the Italian Network for Ground-Based Observations of Sun-Earth Phenomena, *Proceedings of the XLIX Congresso della Società Astronomica Italiana*, Catania, 2-7 May, 2005, *Mem. S.A.It. Suppl.*, **9**, 79-81, 2006a.
2. Amata E., et al., SINERGIES (Sun, INterplanetary, EaRth Ground-based InstrumEntS) or the potential of the Italian Network for Ground-Based Observations of Sun-Earth Phenomena, *Proceedings of the XLIX Congresso della Società Astronomica Italiana*, Catania, 2-7 May, 2005, *Mem. S.A.It. Suppl.*, **9**, 82-84, 2006b.
3. Cafarella L., M. De Lauretis, D. Di Mauro, P. Francia, S. Lepidi, A. Meloni, P. Palangio, A. Piancatelli, L. Santarelli, M. Vellante, and U. Villante, ULF geomagnetic pulsations at high latitudes: the Italian contribution, *Proceedings of XIIth IAGA Workshop on Geomagnetic Observatory Instruments, Data Acquisition, and Processing*, Belsk, Poland, 19-24 June, 2006, *Publs. Inst. Geophys. Pol. Acad. Sc.*, vol. C-99, p. 398, 2007.

D – proceedings of national meetings and conferences

--

E – thematic maps

--

F – patents, prototypes and data bases

G – exhibits, organization of conferences, editing and similar

--

H - formation (PhD thesis, research fellowships, etc.)

1. Borsa di studio "Pulsazioni geomagnetiche nella calotta polare: studio dei meccanismi di generazione e delle caratteristiche delle pulsazioni osservate a Dome C", titolare Mauro Regi, dal 24.02.2009 al 24.05.2009, euro 5000,00.
2. Borsa di studio "Analisi dati antartici", titolare Davide Di Memmo, dal 06.02.2006 al 05.08.2006, euro 4352,51.
3. Borsa di studio "Analisi dati antartici", titolare Alfredo Del Corpo, dal 20.02.2007 al 20.05.2007, euro 4481,51.
4. Borsa di studio "Analisi dati antartici", titolare Chiara De Paulis, dal 20.02.2007 al 20.05.2007, euro 4481,51.

Research units

Composizione dell'Unità operativa:

Umberto Villante (Università dell'Aquila)
Marcello De Lauretis (Università dell'Aquila)
Patrizia Francia (Università dell'Aquila)
Andrea Piancatelli (Università dell'Aquila)
Massimo Vellante (Università dell'Aquila)
Mauro Regi (Borsista Università dell'Aquila)
Davide Di Memmo (Contrattista Università dell'Aquila)
Alfredo Del Corpo (Contrattista Università dell'Aquila)
Chiara De Paulis (Contrattista Università dell'Aquila)
Mirko Piersanti (Assegnista Università dell'Aquila)

Date:

Notes