

Final project report

<i>Project ID</i>	2004/7.04
<i>Title</i>	Operation and scientific exploitation of the ionospheric HF radar in Kerguelen
<i>Principal investigator</i>	Maria Federica Marcucci
<i>Institution</i>	IAPS-INAF, Rome (formerly IFSI-INAF)
<i>Email</i>	<i>federica.marcucci@iaps.inaf.it</i>
<i>Duration</i>	3 years
<i>Assigned funding</i>	40.000,00 Euro

Activities and results

The Super Dual Auroral Radar Network (SuperDARN) is an international project devoted to the study of the high latitude ionosphere in the framework of Solar-Terrestrial Relations. SuperDARN consists of two longitudinal chains, in the Northern and Southern hemispheres. The 2004/7.4 PNRA project had the goal to pursue the management and scientific exploitation of the SuperDARN Kerguelen radar.

That radar, located in the Kerguelen Sub-Antarctic region, was installed at the end of 1999 near the Port-aux-Français base in Kerguelen (French Antarctic Territory), after a two year development by a consortium lead by Dr. J.P. Villain (LPCE, Orléans, France) with the participation of IFSI-CNR, Italy.

The activities carried out in Italy in the framework of project 2004/7.04 focused on the maintenance of the radar on one side and on the data storage and their scientific analysis on the other.

As for the maintenance, several power transmitters were repaired and sent back to Kerguelen. As for data storage, a local area network (protected from intruders, but accessible via the Internet by its users) was realised at IFSI.

The scientific work performed on the data at IFSI concerned:

- SuperDARN radar response to pressure pulses of solar wind;
 - Modelling of the transpolar potential in the southern hemisphere;
 - Modelling of the global system of currents aligned with the geomagnetic field;
 - Studying time delay in the reconfiguration of the north-south auroral ionospheric convection and polar-induced rotations of the interplanetary magnetic field;
 - MHD oscillations at frequencies in the ULF magnetosphere;
 - Coincidence of SuperDARN echoes with GPS scintillation;
 - Effects of the dual lobe reconnection on the high latitude ionosphere;
 - Measuring the amount of solar wind plasma injected into Earth's magnetosphere during dual lobe reconnection;
 - Study of the dynamical changes of the Polar Cap Potential in the framework of Information Theory.
-

Products

A – papers in scientific magazines

1. Coco, I., E. Amata, M. F. Marcucci, M. De Laurentis, J.-P. Villain, C. Hanuise, and M. Candidi, Effects on SuperDARN HF Radar Echoes of Sudden Impulses of Solar Wind Dynamic Pressure, *Ann. Geophys.*, 23, 1771 – 1783, 2005.
2. Marcucci, M. F., I. Coco, D. Ambrosino, E. Amata, S. E. Milan, M. B. Bavassano Cattaneo, and A. Retinò, Extended SuperDARN and IMAGE observations for northward IMF: evidence for dual lobe reconnection, *J. Geophys. Res.*, 113 (A2), A02204, doi:10.1029/2007JA012466, 2008.

Programma Nazionale di Ricerche in Antartide (PNRA)

3. Coco, I., E. Amata, M. F. Marcucci, D. Ambrosino, J.-P. Villain, and C. Hanuise, The effects of an interplanetary shock on the high-latitude ionospheric convection during an IMF By-dominated period, *Ann. Geophys.*, 26, 2937 – 2951, 2008.
4. Amata, E., D. Ambrosino, M. F. Marcucci and I. Coco, Multi-instrument study of high latitude ionospheric convection during a positive By period, *Il Nuovo Cim.*, in press, 2008.
5. Alfonsi, L., et al. including Amata, E., Probing the high latitude ionosphere from ground-based observations: The state of current knowledge and capabilities during IPY (2007-2009), *Journal of Atmospheric and Solar-Terrestrial Physics*, Volume 70, Issue 18, p. 2293-2308.
6. Ambrosino, D., E. Amata, M. F. Marcucci, I. Coco, W. Bristow, and P. Dyson, Different responses of northern and southern high latitude ionospheric convection to IMF rotations: a case study based on SuperDARN observations, *Ann. Geophys.*, 27, 2423 – 2438, 2009.
7. Coco, I., E. Amata, M. F. Marcucci, D. Ambrosino, and S. G. Shepherd, Effects of Abrupt Variations of Solar Wind Dynamic Pressure on the High-Latitude Ionosphere, *International Journal of Geophysics*, Vol. 2011, doi:10.1155/2011/207514, 2011.
8. Coco, I., G. Consolini, E. Amata, M. F. Marcucci, and D. Ambrosino, Dynamical Changes of the Polar Cap Potential Structure: an Information Theory Approach, *Nonlin. Processes Geophys.*, 18, 697 – 707, 2011.

B – book chapters

1. Amata, E., C. Hanuise, M. Lester, and M. F. Marcucci, Recent results on ionospheric convection based on SuperDARN, in *Developing the scientific basis for monitoring, modelling and predicting Space Weather*, EC-EUR 23348, ISBN 978-92-898-0044-0, 2008.

C - proceedings of international conferences

--

D – proceedings of national meetings and conferences

1. Amata, E., Berrilli, F., Candidi, M., Cantarano, S., Centrone, M., Consolini, G., Contarino, L., Criscuoli, S., De Lauretis, M., Del Moro, D., et al., SINERGIES (Sun, INterplanetary, EaRth Ground-based InstrumEntS) or the potential of the Italian Network for Ground-Based Observations of Sun-Earth Phenomena, *Memorie della Società Astronomica Italiana Supplement*, vol. 9, p. 82, 2006.
2. Bertello, I., Amata, E., Marcucci, M. F., Coco, I., Towards a statistical model of the Southern ionospheric polar convection maps, *Memorie della Società Astronomica Italiana Supplement*, vol. 9, p. 88. 2006.
3. Coco, I., Amata, E., Marcucci, M. F., Villain, J.-P., Hanuise, C., Cerisier, J.-C., St. Maurice, J.-P., Sato, N., Night-side effects on the polar ionospheric convection due to a solar wind pressure impulse, *Memorie della Società Astronomica Italiana Supplement*, vol. 9, p. 91, 2006.
4. Marcucci, M. F., Amata, E., Ambrosino, D., Coco, I., Bavassano Cattaneo, M. B., Retinò, A., Ionospheric convection observed by SuperDARN during ongoing lobe reconnection revealed by Cluster, *Memorie della Società Astronomica Italiana Supplement*, vol. 9, p. 114, 2006.
5. Ambrosino, D., E. Amata, M. F. Marcucci, I. Coco, Evolution of the magnetopause X line during variable IMF orientation, *Memorie della Società Astronomica Italiana*, v.80, p.272 (2009)

E – thematic maps

--

F – patents, prototypes and data bases

1. È stato creato presso l'IFSI un database dei dati di SuperDARN (Coco, I.; Eraclito: Rules of the road. Utilizzo della macchina e descrizione dei principali programmi attualmente operativi. Nota Interna INAF/IFSI-2008-2, 2008)

G – exhibits, organization of conferences, editing and similar

1. E. Amata, Seminario: La rete di radar SuperDARN per lo studio della ionosfera di alta latitudine, 9 Gennaio 2009, Università dell'Aquila, Dipartimento di Fisica

Programma Nazionale di Ricerche in Antartide (PNRA)

2. E. Amata, Seminario: Effetti della riconnessione alla magnetopausa sulla convezione ionosferica di alta latitudine, 16 Gennaio 2009, Università dell'Aquila, Dipartimento di Fisica.

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

1. Igino Coco, PhD in polar sciences, University of Siena, 2001-2004. Title of thesis: "Study of the Effects of Sudden Impulses of Solar Wind Dynamic Pressure on the Polar Ionosphere with SuperDARN HF Radars". Supervisor: Dr. E. Amata.
2. Igor Bertello, PhD in polar sciences, University of Siena, 2002-2004 (not completed).
3. Danila Ambrosino, PhD in polar sciences, University of Siena, 2005-2007. Title of thesis: "Study convection in the austral auroral and polar ionosphere in relation with transient phenomena in the terrestrial magnetosphere." Supervisor: Dr. E. Amata.
4. Danila Ambrosino - Research Contract, Title: "Polar and Auroral Ionospheric Convection in relation to transient magnetospheric phenomena."

Research units

The original project comprised of a research unit, base at IFSI-INAF, Rome, which included the following participants:

Maria Federica Marcucci (Responsible)

Ermanno Amata

Maurizio Candidi

Igino Coco, Assegno di ricerca 2004-2007.

Danila Ambrosino (PhD fellowship: 2005, 2006, 2007)

Igor Bertello (Assegno di ricerca 2004-2006)

Mr. Maurizio Maggi, Electronic engineer, IFSI-INAF

Mr. Nello Vertolli, Electronic engineer, IFSI-INAF

Date: 30 January 2012

Notes.