**Programma Nazionale di Ricerche in Antartide (PNRA)**

# Final project report

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| *Project ID* | 2004/6.01 |
| *Title* | Studio dei processi dello strato limite planetario a Dome C (STABLEDC) |
| *Principal investigator* | Stefania Argentini |
| *Institution* | ISAC-CNR |
| *Email* | *s.argentini*@isac.cnr.it |
| *Duration* | 3 years |
| *Assigned funding* | 180,000 Euro |

## Activities and results

An atmospheric field experiment was held at the French-Italian station of Concordia (Lat 75° 06.06 S, Long 123° 20.74 E, 3250 m a.s.l.). The aim of the field experiment was to study the processes occurring in the long-lived stable, and the weak convective, atmospheric boundary layers, observed during winter and summer respectively, and to collect the relevant parameters for the atmospheric models.
Measurements were made at Dome C between November 2004 and February 2006. Turbulent fluxes of heat and momentum were measured using a Metek USA-1 thermo-anemometer installed on a mast at 3.6 m above the snow surface. Long- and shortwave radiation components were measured using Kipp & Zonen pyrgeometers and pyranometers installed at 1 m above the snow surface. Heat flux within the snowpack was measured at a depth of 50 mm using a Campbell Scientific HFP01 heat flux plate. A mini-sodar Doppler system provided a continuous record of the structure of the atmospheric boundary layer along the year. A passive Meteorological Temperature Profiler (MPT5-P) was used for the remote measurement of the air temperature profile.
The sensible heat flux on average is negative. Sometimes has positive (approximately 5 $Wm^{-2}$) values in the full summer (months of December and January) and in a few cases in correspondence of the warming events. The minimum of the sensible heat is observed at the end of June - beginning of July. The temperature behaviour is similar in summer, autumn and spring, with the peak of the temperatures 2 – 3 hours after the local noon. The amplitude of the diurnal temperature variation is ~10°C during the summer (the maximum and minimum temperatures are respectively -25°C and -35°C) and ~5°C during the spring and autumn (maximum temperature -45°C, minimum temperature -50°C ). In autumn the wind velocity is fairly constant around 4.2 $ms^{-1}$, 5 $ms^{-1}$ in winter and 4.8 $ms^{-1}$ in spring.
Strong long-lived surface inversions are observed almost all time at Dome C with the exception of the warmest hours of the summer days. These inversions contribute to create a large cold air source producing and feeding the katabatic winds observed in some zones of confluence along the East Antarctic coast. In summer the difference between the diurnal and nocturnal temperature profiles is the strongest. During the warmest hours of the day the averaged temperature profile is unstable. In spring and autumn the main differences are observed in the shape of profiles with the gradient decreasing in the first 50 m around midday and then increasing during the night. In winter, due to the complete absence of solar radiation the temperature profile are similar in absence of warming events.

## Products

**A – papers in scientific magazines**


1. D. Contini, G. Mastrantonio, A. Viola, **S. Argentini,** 2004. Mean Vertical Motions in the PBL Measured by Doppler Sodar: Accuracy, Ambiguities, *J. of Atmospheric and Oceanic Technology, vol. 21,* 1532-1544.
2. **Argentini S**., A. Viola, A. Sempreviva, I. Petenko, 2005. Summer PBL height at the plateau site of Dome C,

Antarctica. *Boundary Layer Meteorology. Vol. 115 Number 3, 409-422.*

3. King J.C., **S. Argentini,** P. Anderson, 2006**.** Contrasts between the summertime surface energy balance and boundary layer structure at Dome C and Halley stations, Antarctica. *J. of Geophysical Research Vol. 3 D02105(13 pagine)*.
4. **Argentini S**., I.Pietroni, C. C. Gariazzo , A. Amicarelli , G. Mastrantonio , A. Pelliccioni , I. Petenko , A. Viola, 2009. Boundary Layer Temperature Profiles by a RASS and a Radiometer: differences, limits and advantages. *Nuovo Cimento B Vol. 124 N°5 p. 549-564.*
5. Genthon C. , D. Six, V. Favier, **S. Argentini.** A. Pellegrini, 2009. Meteorological Atmospheric Boundary Layer Meteorological Measurements and ECMWF annales during summer at Dome C, Antarctica . J. Geophys. Res., doi:10.1029/2009JD012741, in press.
6. Le Moigne P., J. Noilhan E. Masciadri, F. Lascaux, **I. Pietroni,** 2009. Adaptation and validation of the surface schemes of Meso-NH and Arome meso-scale models for polar conditions. Submitted to *Journal of Geophysical Research*.

**B – book chapters**

1. Argentini S. and G. Mastrantonio.2007 Atmosfera: Lo strato limite. Enciclopedia Scienza e Tecnica. Pp. 425-436. Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.

**C - proceedings of international conferences**

1. Contini D., G. Mastrantonio, A. Viola, **S. Argentini**, 2004: Experimental accuracy on vertical wind velocity measured with a Doppler Sodar. Proceedings of the 11th International Symposium on Acoustic Remote sensing and Associated Tecniques of the Atmosphere and Oceans, p. 104-108, Cambridge, England, (11-16 luglio).
2. Petenko I., **S. Argentini**, A. Bolignano,G. Mastrantonio, A. Viola, 2004. Time and horizontal scales of convective plumes at mid-latitudes and in Antarctica Proceedings of the 11th International Symposium on Acoustic Remote sensing and Associated Tecniques of the Atmosphere and Oceans, p. 23-26, Cambridge, England (11-16 luglio).
3. **Argentini S**., G. Dargaud, I. Pietroni, A. Viola,G. Mastrantonio, A. Conidi, I. Petenko, A. Pellegrini . Behaviour of the temperature and inversion layer depth and strength at Dome C Antartica during the 2004-2006 field experiment . *Proceedings of the 13th International Symposium for the advancement of Boundary Layer Remote Sensing. , p. 137-139, Garmish, Germania, 18-20 July, 2006.*
4. Neff B., **S. Argentini**, P. Anderson. An Overview and Highlights from a Special Session at the 2006 EGU on Boundary Layers in the High Latitudes. *Proceedings of the 13th International Symposium for the advancement of Boundary Layer Remote Sensing. , p. 99-102, Garmish, Germania, 18-20 July, 2006.*
5. **Argentini S.**, I. Pietroni,G. Mastrantonio, A. Viola, S. Zilitinchevich. Characteristics of the night and day time atmospheric boundary layer at Dome C, Antarctica . Proceedings of the ARENA, Antarctic Research a European Network for Astrophysics. Roscoff , France 16-19 Ottobre, 2006 pp. 49-55.
6. Petenko I, **S. Argentini**, I. Pietroni, A. Viola, 2007 Temperature behaviour during winter in Antarctica. Proceedings of the. 2nd Antarctic Meteorological Observation, Modeling, and Forecasting Workshop. Rome 26-28 Giugno. 6 pagine
7. **Argentini S**., I. Pietroni, *G. Mastrantonio, A. Viola, I. Petenko, 2007* Atmospheric Boundary layer observations at Dome C Antarctica. Proceedings of the. 2nd Antarctic Meteorological Observation, Modeling, and Forecasting Workshop. Rome 26-28 Giugno. 6 pagine .
8. Ghenton C., D. Six, V. Favier, **S. Argentini**, A. Pellegrini, 2009, Observation and analyzes of the summer diurnal cycle in the lower atmospheric boundary layer at Dome C, Antarctic plateau. MOCA09: IAMAS IAPSO IACS 2009 Joint Assembly, Montreal – Canada, 19-29 Luglio, 2009.
9. Pietroni I.**, S. Argentini,** 2009**.** Behaviour of boundary layer height at Dome C, Antarctica. EMS annual Meeting & European Conference on Applications of Meteorology, 28 settembre – 2 ottobre, 2009 Tolosa, Francia.

**D – proceedings of national meetings and conferences**

1. Argentini S., Conidi A. A. Viola, G. Mastrantonio, N. Ferrara, I. Petenko, Kadygrov, E.N., Koldaev, A.V., Viazankin, A.S., 2005: Temperature measurements at Dome C using a new microwave temperature profiler. *X Workshop sull'atmosfera antartica*, Roma (22-24 ottobre, 2003), pp.215-228.
2. Petenko I., S. Argentini, A. Bolignano, G. Mastrantonio, A. Viola, 2004: Temporal and spatial variation of the summer convective boundary layer at the Antarctic plateau station of Dome C. *X Workshop sull'atmosfera antartica*, Roma (22-24 ottobre, 2003) pp. 199-213.
3. Argentini S., I. Pietroni, G. Mastrantonio, A.Viola, A. Conidi, 2007. One year of high resolution temperature profiles at Dome C, Antartica. XI Workshop Fisica e Chimica dell' Atmosfera Antartica. Roma 10-12 aprile.
4. Petenko I., S. Argentini, I. Pietroni, A. Viola, 2007 Warming events during winter in Antartica. XI Workshop

Fisisca e Chimica dell' Atmosfera Antartica. Roma 10-12 aprile.

5. Pietroni I, S. Argentini, The surface radiation budget at Dome C, Antartica during the STABLEDC field experiment. XI Workshop Fisica e Chimica dell' Atmosfera Antartica. Roma 10-12 aprile, 2007.

**E – thematic maps**

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**F – patents, prototypes and data bases**

1. Records misure di radiazione solare ad onda corta ed onda lunga e della turbolenza atmosferica.
2. Records misure della temperatura e della velocità del vento a due quote provenienti dalla torre meteorlogica
3. Struttura termica atmosferica
4. Profili di temperatura

**G – exhibits, organization of conferences, editing and similar**

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

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| 2005-2008 | PhD thesis in Polar Sciences Dr. Ilaria Pietroni. |
| 2008-2012 | PhD thesis to improve polar radiometer MTP5-P. |
| 2004-2009 | Co-Convener EGU session "Boundary Layers in High Latitudes: Observations and Modeling"held in Vienna, Austria. |
| 2007 | Member of the ARENA working group objective NA2 (site testing). |
| 2007 | Argentini S. Seminario per la scuola di dottorato in Scienze Polari (terzo ciclo) presso il dipartimento di Scienze della Terra dell' Università di Siena, 4 Ottobre 2007, Siena. |
| 2008 | Argentini S, 2008, An Observing System for Boundary Layer Monitoring at Concordia Station, Antarctica, seminario per la scuola internazionale ISSAOS. |

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## Research units

*Unità operativa 1 Responsabile S. Argentini*

- Alessandro Conidi Tecnico ISAC-CNR Roma
- Giangiuseppe Mastrantonio Dirigente di Ricerca ISAC-CNR Roma
- Ilaria Pietroni Dott.Scienze Polari,Università Siena - CNRRoma
- Igor Petenko Ricercatore RAS e ISAC-CNR Roma
- Angelo Viola Primo Ricercatore ISAC-CNR Roma

*Unità operativa 2 Responsabile M. Nardino*

- Silvia Rossi Dottoranda IBIMET - CNR Bologna
- Teodoro Georgiadis Primo Ricercatore IBIMET - CNR Bologna
- Osvaldo Facini Ricercatore IBIMET - CNR Bologna
- Federica Rossi Primo Ricercatore IBIMET - CNR Bologna

*Unità operativa 3 Responsabile G. Didonfrancesco*

- Francesco Cairo Ricercatore ISAC/CNR Roma
- SNELS MARCEL Primo Ricercatore ISAC-CNR Roma

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**Date:**

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*Notes*