Programma Nazionale di Ricerche in Antartide (PNRA)

Final project report

Project ID	2004/5.03
Title	Permafrost and Climate Change in Antarctica: study and monitoring of the impacts of Climate Change on permafrost and related terrestrial ecosystem and use of permafrost as paleoclimate archive
Principal investigator	Mauro Guglielmin
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Duration	3 years
Assigned funding	200.000,00 Euro

Activities and results

The activities realized on this project were mainly focussed on the active layer and permafrost monitoring, on the study of the relationships between permafrost, vegetation and climate and on the study of the rock weathering to reconstruct the geomorphological evolution of the examined areas.
The project involved 12 italian researchers and one international guest (K. Hall, CA). The activities were carried out during three research campaigns: 2004/05 at MZS (1 researcher); Signy Island (2 researchers); 2005/06 at MZS (5 italian researcher and 1 int. guest); 2008/09 at Rothera (3 researchers) and Signy (1 researcher). All the activities in the british research stations were realized with the logistic support of BAS. For what concerns the active layer and permafrost monitoring a new permafrost station (30 m deep) was installed at MZS, 2 new permafrost stations (30 m deep) were installed in cooperation with Landcare Res. and Waikato University and with the logistic support of Antarctica New Zealand at Marble Point and Wright Valley. A new permafrost station (30 m deep) was also installed at Rothera and a CALM-Grid (40x50 m) with an automatic monitoring station was realized at Signy Island. Different permafrost cores were collected at MZS and in one case close to the Strandline beach the submarine permafrost occurrence was found. The interactions between different types of vegetations and permafrost were analysed at Signy Island and Rothera where also the first measurements of CO2 fluxes were carried out. A new vegetation map was realized at Signy Island after 40 years since the previous one in order to understand ther possible changes related to the climate change and the permafrost changes.
At MZS some granite weathering features like taffoni and pits were monitored and sampled in order to understand the weathering processes and the influence of the climate elements. In Victoria Land a new station to monitor the thermal regime of ice wedges was equipped at Mt. Jackman and several ice wedges were sampled. The great spatial variability of the active layer both at Continental and Maritime Antarctica and the predominance of the local microclimate conditions on the general latitudinal effect is one of the main results achieved by the project. Moreover the demonstration of the existence of a buffering effect of the vegetation both in Continental and in Maritime Antarctica and the different amount of it between the different types of vegetation is another remarkable results. In addition, the first results of the CO2 fluxes measurements suggest the importance of the soil-permafrost characteristics on the C cycle and the complexity of the interactions between different vegetation types and the underlying soils in a climatic scenario.
Regarding the weathering processes new insights on the development of the weathering features were found, in fact our data suggest the important role of the thermal stress, salt action and biological (mainly lichen) action in the taffoni and weathering pits development while other features like the grooves seem to be inheredited relict features. New data on ice wedges and icing blisters formation and dynamic are also producted.

Products

A – papers in scientific magazines

1. CANNONE N. 2006. A network for monitoring terrestrial ecosystems along a latitudinal gradient in Continental Antarctica. Antarctic Science, 18 (4), 549–560.
2. CANNONE N., ELLIS EVANS J. C., STRACHAN R., GUGLIELMIN M. 2006. Interactions between climate, vegetation and active layer in Maritime Antarctica. Antarctic Science, 18(3), 323-333.
3. CANNONE N., WAGNER D., HUBBERTEN H. W., GUGLIELMIN M. (2008). Biotic and abiotic factors influencing soil properties across a latitudinal gradient in Victoria Land, Antarctica. Geoderma, 144: 50-65.
4. CANNONE, N., GUGLIELMIN, M. (2009). Influence of vegetation on the ground thermal regime in continental Antarctica. Geoderma, 151(3-4): 215-223.
5. CANNONE N., SEPPELT R. (2009). A preliminary floristic classification of Northern and Southern Victoria Land vegetation (Continental Antarctica). Antarctic Science, 20 (6), 553–562.
6. GUGLIELMIN M., CANNONE N., STRINI A., LEWKOWICZ A. G., 2005. Biotic and Abiotic Processes on Granite Weathering Landforms in cryotic environment, Northern Victoria Land, Antarctica. Permafrost and Periglacial Processes, 16: 69 – 85.
7. GUGLIELMIN M. 2006. Ground surface temperature (GST), active layer and permafrost monitoring in continental Antarctica *Permafrost and Periglacial Processes* vol. 17, pp. 133-143.
8. GUGLIELMIN M., ELLIS EVANS C. J., CANNONE N. (2008). Active layer thermal regime under different vegetation conditions in permafrost areas. A case study at Signy Island (Maritime Antarctica). Geoderma, 144: 73 – 85.
9. GUGLIELMIN M., LEWKOWICZ A.G., FRENCH H.M., STRINI A. 2009 Lake-ice blisters, Terra Nova Bay area, Northern Victoria Land, Antarctica. *Geografiska. Annaler.*, 91 A (2): 99–111
   HALL K., GUGLIELMIN M., STRINI A.2008a. Weathering of granite in Antarctica, II: thermal stress at the grain scale *Earth Surface Processes and Landforms*, 33,3, 475-493.
10. HALL K. , GUGLIELMIN M., STRINI A.2008b. Weathering of granite in Antarctica, I: Light penetration in to rock and implications for rock weathering and endolithic communities. *Earth Surface Processes and Landforms,* 33, 2, 295-307.
11. STRINI A., GUGLIELMIN M., HALL K. 2008. Tafoni development in a cryotic environment: an example from Northern Victoria Land, Antarctica, *Earth Surface Processes and Landforms*, 33, 1502-1519

B – book chapters

1. GUGLIELMIN M. (2009) Changes in Antarctic permafrost and active layer over the last 50 years In: Turner J., Convey P. di Prisco G. Mayewski P.,c Hodgson D. Fahrbach E. Bindschadler B. Antarctic Climate Change and the Environment. Published by the Scientific Committee on Antarctic Research Scott Polar Research Institute, Lensfield Road, Cambridge, UK 261-262.

C - proceedings of international conferences

1. BOCKHEIM J.G., CAMPBELL I.B., GUGLIELMIN M., LÓPEZ-MARTÍNEZ J. 2008 Distribution of Permafrost and Ground Ice in the Antarctic Region In: D.L. Kane and K.M.Hinkel (Eds), Proceedings of 9th International Conference on Permafrost, University of Alaska Fairbanks, 29 June-3July 2008, Alaska, USA, Inst. of Northern Engineering. Vol. 1, 125-130.
2. CANNONE N., 2005. Moss and Lichen flora of Victoria Land (Continental Antarctica) along a Latitudinal Transect. Terra Antarctica Reports, N. 11, 1-9.
   CANNONE N., GUGLIELMIN M. 2008. Patterned ground features and vegetation. Examples from Continental and Maritime Antarctica. Proceedings of the Ninth International Conference on Permafrost, Fairbanks (Alaska, USA), 29 June-3 July 2008, edited by Douglas L. Kane and Kenneth M. Hinkel. Published by the Institute of Northern Engineering, University of Alaska Fairbanks, Vol. 1, pp. 227-231.
3. GUGLIELMIN M., BOSCHI D., D'AGATA C., ELLIS-EVANS C., WORLAND M.R. 2008. Periglacial and Permafrost Map of Signy Island, South Orkneys Islands, Maritime Antartica. In: D.L. Kane and K.M.Hinkel (Eds), Proceedings of 9th International Conference on Permafrost, University of Alaska Fairbanks, 29 June-3July 2008, Alaska, USA, Inst. of Northern Engineering. Vol. 1, 569-574.
4. GUGLIELMIN M., ELLIS EVANS J. C., CANNONE N., 2005. Interactions between climate, vegetation and active layer in Maritime and Continental Antarctica for Climate Change monitoring. Terra Antarctica Report, N. 11, 15 – 27
5. HUISKES A.H.L., BOSCHKER H.T.S., LUD D., MOERDIJK – POORTVLIET T.C.W., CANNONE N., 2005. Stable isotope ratios as a tool for assessing the marine influence on Antarctic terrestrial ecosystems. Terra Antarctica Report, N. 11, 33 – 37.

6. RAFFI, R., S. SEGA (2008). Ice-wedge thermal regime in northern Victoria Land, Antarctica. *Ninth International Conference on Permafrost, Fairbanks June 29 – July 3, 2008. Extended abstracts Volume,* Eds. D.L. Kane and K.M. Hinkel, pp 249-259
7. RAFFI, R., B. STENNI, O., GENONI, O. FLORA, S. SEGA. 2007. Thermal regime, isotopic and morphological characteristics of ice wedges in Northern Victoria Land, Antarctica. *10th International Symposium on Antarctic Earth Sciences, Santa Barbara, California, 26 August to September1, 2007. Session : The State of Permafrost in a Changing Environment.* Oral presentation, USGS OFR- 2007-1047, Extended abstract 204 (http://pubs.usgs.gov/of/2007/1047/ea/of2007-1047ea204.pdf).

D – proceedings of national meetings and conferences

1. DE PONTE S., MALAVASI S., STRINI A. E GUGLIELMIN M. (2008). Possible wind effects of the wind on weathering pits in some coastal test sites in Victoria Land. Terra Antartica Reports, 14: 223-227.
2. RAFFI, R., B. STENNI, O. FLORA, U. GENTILI (2008). Thermal and geochemical investigations of ice wedges in northern Victoria Land (Antarctica). *Terra Antartica Reports*, **14**, 6 pp. ISBN 978-88-88395-10-4.
3. STRINI, A. CANNONE N. E GUGLIELMIN M. (2008). Weathering features in granite outcrops of Victoria Land, Continental Antarctica. Terra Antartica Reports, 14: 235-240.

E – thematic maps

1. FREZZOTTI M., R. RAFFI, M. GUARRACINO AND M. MANCINI. (2005). Matusevich Glacier area, Oates Coasts, East Antarctica 1:250,000 (Glaciological Map). *In IUGG (CCS) – UNEP – UNESCO (2005). Fluctuations of Glaciers 1995-2000,* **Vol. VIII**. World Glacier Monitoring Service, Zurich, p 54.

F – patents, prototypes and data bases

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G – exhibits, organization of conferences, editing and similar

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

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Research units

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Dr. Adriano Ribolini
Dr. Davide Boschi
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Notes