



SCAR Fellowship Report

Effect of vegetation cover on active layer thermal regime in climatically contrasted environments of Antarctica.



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Introduction

Active layer and permafrost research in Antarctica was significantly extended after the International Polar year in 2007-2009. During the last 10 years the overall knowledge about the thermal state and thickness of active layer was strongly improved. However, the more complex studies analyzing the role of climate, geology or vegetation are still sparse and the majority of studies were carried out on one site and considering only some driving factors. Therefore, the topic of the effect of climate and vegetation on ground thermal regime and active layer thickness is of high interest.

Project Objectives

The selected study sites covered different environments from the moist maritime on Signy Island (60°S; -3.5 °C), across transient maritime/continental on James Ross Island (63°S; -7.0 °C) to continental on Victoria Land (74°S; -16.5°C). The main aims were

- a) the identification of the role of climate factors (air and solar irradiance) on near-surface ground thermal regime
- b) the effect of different moss species on the near-surface ground thermal regime and active layer thickness.

Methods, Execution and Results

The work was based on the statistical analysis of climate and geoscientific data obtained in the study areas by the Czech and Italian research teams from three areas in Antarctica. We used the data from the ground temperature measurement undertaken in bare-ground and vegetation-covered profiles. In the first step, the instruments and sensors were evaluated. The data was homogenized and its suitability for comparison was verified. Despite different measuring techniques, the data was found to be of a very good quality for all three study areas. It allowed us to use data of air temperature, incoming radiation, near-surface ground temperature and interpolated active layer thickness for further statistical analysis. The data treatment is based on standardly used parameters (averages, freezing/thawing indices) allowing the comparison with already published works from Antarctica.

The results showed remarkable differences between the sites. The effect of incoming radiation on near-surface ground temperature was reduced with decreasing latitude, while the effect of air temperature was amplified. The most pronounced effect of moss cover, as well as the highest differences between vegetated and bare-ground sites was found on Signy Island, where the active layer is about 3 times thinner beneath mosses than bare ground. The results from James Ross Island and Victoria Land showed a rather similar moss effect and active layer about 1.2-1.5 times thinner beneath mosses.

Project Outcomes

The topic of the connection between climate, vegetation and ground belongs to the near-future research directions defined by SCAR in 2014. Therefore, the scientific results (publication) have great potential to attract the community of scientists focused on permafrost as well as vegetation in Antarctica.

We identified the differences in the role of vegetation and climate on ground surface temperature and active layer thickness. Large differences were found mostly in summer temperatures, which were very intensively affected by the incoming radiation

in the southernmost site, while the air temperature is a more important climate factor in the northern areas. The role of mosses was most pronounced on Signy Island (northern site), where the mosses are thicker and therefore form a stronger insulation layer for heat transfer from air to ground. Beside the project, I had also possibility to discuss with Prof. Guglielmin other topics related to the active layer and permafrost research in Antarctica including the measurement approaches or suitability of different methods for different areas.

Publications, Presentations and Products

The data processed during the fellowship was prepared for publication in the form of a scientific paper. The manuscript titled "The effect of climate and moss vegetation on ground surface temperature and the active layer along a latitudinal coastal transect in Antarctica" has been submitted to the journal "Environmental Research Letters" and was under review in the time of the project evaluation submission.

Conferences:

Preliminary results were published as a poster on Polar2018 conference in Davos.

The results are also considered for presentation on the upcoming conferences:

Students in Polar and Alpine Research Conference 2019, Brno, Czech Republic, April 2019

South Conference on Permafrost 2019, Queenstown, New Zealand, December 2019

Capacity Building, Education and Outreach Activities

I worked together with the young researchers (PhD and Postdoc) of Prof. Guglielmin and Prof. Cannone. We shared our working experience from different areas (Arctic/Antarctic/Alpine) which I believe was beneficial for all of us. I did not have a public lecture during my stay in Varese.

The fellowship was promoted [in an article](#) published on the website of Masaryk University. Thanks to the fellowship and its promotion on the university website I was asked for an interview in the leading [newspaper in the Czech Republic](#) and I was invited to a live interview in the national broadcast "[Český rozhlas](#)" where I spoke about our work in Antarctica in general.

Future Plans and Follow-ups

I am staying in contact with Prof. Guglielmin within the frame of ANTPAS research group, and also within the project NUNANTAR led by our colleague Dr. Marc Oliva. We have also discussed the possibility of joint Czech-Italian project focused on the periglacial environment research on James Ross Island, which is dependent on the funding possibilities on both sides. I would like to continue with this research topic and focus more on soil properties in the areas covered by vegetation.

Personal Impact

The SCAR fellowship means an important step in my scientific career. The whole progress including the planning of the proposal, the work with the data and setting the hypothesis and the final paper writing was a new experience for me. The fellowship allowed me to work with one of the most recognized experts in the field of permafrost research and learn a lot of theoretical as well as practical things related to the Antarctic research and gain more insight into the possible topics and hypotheses of the research. It was also a very interesting experience to stay in a different

working environment and find out more about the differences in the education and university system between the Czech Republic and Italy.

Financial Statement

The SCAR Fellowship was used to cover the travel expenses to Varese (3 times), as well as accommodation and living costs in Varese (6 weeks in total). Furthermore, the funding was used to cover the expenses of Polar2018 conference (travel, accommodation and living costs for one week, registration and abstract fee). The fellowship was further used to cover work material (laptop, software Surfer).

Acknowledgements and References:

I am grateful to Prof. Guglielmin, Prof. Cannone and dr. Ponti for hosting me during my stay in Varese. I am thankful to Prof. Nývlt for the support of my application from my home institution and Czech Antarctic Research Program. Finally, I thank the Scientific Committee of Antarctic Research for providing the fellowship.

Feedback for the SCAR Secretariat:

This section will not be published with final report, it is for internal use.

What could be done to improve the guidance and application process?

The process and the structure of the project is clear on my opinion.

We often like to use quotes from these reports in advertising the programme. Do you have a specific quote you would like us to use?

Probably “The fellowship allowed me to work with one of the most recognized experts in the field of permafrost research and learn a lot of theoretical as well as practical things related to the Antarctic research.”

We are always looking to improve SCAR’s activities. Are there suggestions you have that we could do to help make this programme more effective?

I do not have any suggestion. I think there is lot of information about any kind of the SCAR’s activities easily available for everybody.

Other comments:

I appreciate it was allowed to me to extend the duration of the fellowship in sense the finalizing of the main work. Unfortunately our work was interrupted in the period November 2017 to April 2018 due to participation of me and Prof. Guglielmin on the Czech and Italian expedition, respectively. In Czech case, moreover, the expedition took a months longer than is usual, which I cannot know during project planning.