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Annex No. 10 to the MU Directive on Habilitation Procedures and Professor Appointment Procedures

# HABILITATION THESIS REVIEWER'S REPORT

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| **Masaryk University** | |
| **Applicant** | Mgr. Filip Hrbáček, Ph.D. |
| **Habilitation thesis** | Active layer thermal regime and thickness in Antarctica |
| **Reviewer** | Professor Julian Murton, PhD, BSc |
| **Reviewer's home unit, institution** | Department of Geography, University of Sussex, UK |

The thesis comprises a 36-page introduction and summary of the research, followed by 16 papers, mostly research articles, and a few reviews. The thesis is structured clearly around three objectives (site-specific, modelling, spatiotemporal variability) and presented effectively. It provides the reader with an excellent description and analysis of the active layer in Antarctica, clearly distinguishing between what is known scientifically and what future research priorities remain.

In terms of strengths, the thesis shows a strong focus over about 10 years on collection of primary data on environmental conditions in the Antarctic Peninsula region, together with a good ability to analyse the data statistically and model it using simple analytical solutions. It also shows skills in synthesising the data and placing the research within the context of related research on active layer and permafrost across the whole Antarctic region. Primary data collection and reporting are a clear strength of the research, and have been carried out systematically and well. There is an appropriate development of the research from monitoring to modelling with the Stefan, Kudryavtsev, and TTOP models, which enables expansion of the research in spatial and/or temporal scales. My clear impression is that much of the research has been designed and led by Dr Hrbáček. Overall, the research provides valuable new data (and analysis) from a region (notably James Ross Island) that is little studied by permafrost scientists.

In terms of weaknesses, some of the papers, when read successively from #1 to #16, are rather repetitive (e.g. mention of short-term ground cooling on James Ross Island in early part of 21$^{st}$ Century). This is inevitable concerning site description and methods, but there does seem to be a heavy reliance on data from just a few sites, and repeat descriptions of relationships and trends. A greater variety of sites (e.g. including bedrock or ice-cored moraines, both of which are mentioned frequently in passing) would be interesting to include and broaden the scope. Some additional points are raised below (#3 and #4)

In conclusion, the thesis is an excellent and novel piece of research, nicely contrasting with the better known study of active layers in the Northern Hemisphere.

**Reviewer's questions for the habilitation thesis defence** (number of questions up to the reviewer)

1. What attributes make an **ideal active-layer monitoring site** to record changes in atmospheric climate? Where might such a site(s) be found in the Antarctic?
2. How might the **ground thermal effects of lichens** compare with those of moss?
3. Please clarify how you **distinguish between soil containing variable amounts of liquid water and soil containing variable amounts of ice**. As I'm sure you know, Campbell Scientific CS655 probes (used in your 2024 Catena paper) measure volumetric liquid water content, based on time domain reflectometry. This principle applies the order-of-magnitude different dielectric constants of solid water (ice) and liquid water: ~3.15 and 78.4, respectively. If you used the TDR probes during summer thaw seasons only for your 2024 paper, did you report data on volumetric water content for only the thawed ground only or, as I suspect, for a combination of thawed ground above some partially frozen ground? I suppose from Fig. 5 that the probe at 5 cm depth early in the thaw season recorded liquid VWC in thawed soil while the probe at 30 cm depth (with much lower values of VWC) recorded liquid VWC in partially frozen ground beneath the thaw front (but could not record ice content). A similar question applies to the paper you cite by Clayton et al. (2021; https://doi.org/10.1088/1748-9326/abfa4c) in which I do not understand how a conclusion about latent heat during thaw was derived when no measurements of ice content were given for active-layer sites in Alaska. Overall, I think any correlations drawn between thermal conductivity and VWC (e.g. Fig. 8 in your 2024 paper) should specify that the water content is liquid, otherwise one may be combining the effects of water (ice) with a relatively high thermal conductivity with liquid water with a lower thermal conductivity, which is likely to affect values of $r^2$. There may be implications, too, to the relationship between soil moisture and ALT, which I believe are unsubstantiated to some degree in Clayton et al. (2022).
4. What is "**subglacial permafrost, in … non-cryotic…form**…" (2023, Earth Science Reviews p. 2)? Non-cryotic, by definition, denotes a temperature above 0°C, which excludes permafrost.

**Conclusion**

I am delighted to recommend that, in my view, the habilitation thesis entitled "Active layer thermal regime and thickness in Antarctica" by Dr Filip Hrbáček **fulfils** the requirements expected of a habilitation thesis in the field of physical geography.

Date: 27th August 2025 Signature: