

Habilitation thesis reviewer's report

Masaryk University	
Faculty	Faculty of Science
Field of study	Physical geography...
Applicant	<i>Mgr. Kamil Láska, Ph.D.</i>
Unit	Department of Geography
Habilitation thesis (title)	<i>Response of biotic and abiotic environments on climate variability in the region of the Antarctic Peninsula and Svalbard Archipelago</i>
Reviewer	dr. hab. Grzegorz Rachlewicz, prof. of Adam Mickiewicz University in Poznań
Unit	Instytut Geoekologii i Geoinformacji, Wydział Nauk Geograficznych i Geologicznych, Uniwersytet im. Adama Mickiewicza, Poznan, Polsko

Reviewer's report (extent of text up to the reviewer)

Abstract:

The value of the work undertaken by dr. Kamil Láska in his habilitation thesis is dealing with the description and attempt to the explanation of climate variability in the surroundings of Antarctic Peninsula and in central part of Spitsbergen (Svalbard) with its impact on abiotic and biotic milieus. It is a deeply over thought scientific composition, discussing results presented by the Author in 10 research papers, 9 of which are published in well positioned journals and another one is submitted also in a top publishers edition. The input of the Candidate into the presented papers set is very significant. In nine out of ten cases he was responsible for acquisition of data in fieldworks and took part in their extensive elaboration. The thematic scope of investigations covers novel approaches to solar radiation modelling, glaciers covers, permafrost regime, meteorological conditions and their modelling as well as the impact of climate and broader environmental setting on living organisms. From dr. Láska scientific development a broad potential for independent activity in the future is visible, leading to the development of his own team within meteorological/climatological background of environmental changes assessment. He is an outstanding scientist whose works are grounded in the context of environmental reactions due to climatic changes, and looking to find and expose generally driving natural regularities. In my opinion, research work presented in the evaluated thesis is a sufficient basis for the promotion of dr. Kamil Láska to the habilitation degree in the field of Earth sciences in the scope of physical geography. High level of thesis professionalism allows me also to move for award a scientific prize for the presented achievement, if the procedure is accepting such a proposal.

Full text of the review is provided as an attachment

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

- 1. How the weather dynamics in the region of Antarctic Peninsula is affecting specific components of the natural environment?**
- 2. Describe examples of vertical and horizontal atmospheric gradients over Spitsbergen and their consequences for cryosphere.**

Conclusion

The habilitation thesis submitted by dr. Kamil Láška entitled "*Response of biotic and abiotic environments on climate variability in the region of the Antarctic Peninsula and Svalbard Archipelago*" *meets* the requirements applicable to habilitation theses in the field of physical geography

In Poznań on 24th of June 2016

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Review of habilitation thesis

by dr. Kamil Láska

Masaryk University, Faculty of Science, Department of Geography

**Response of biotic and abiotic environments on climate variability in the region of the
Antarctic Peninsula and Svalbard Archipelago**

Most of environmental processes both in abiotic and biotic realms on the surface of the Earth are climate controlled. Some properties of the atmosphere may lead to the so called “polar forcing” of climate, inducing as well warmings as coolings, with a much higher amplitude than those observed in lower latitudes. The effect combined with relative simplicity of polar geoecosystems is giving a perfect opportunity to isolate particular factors influencing changes of the environment, to show their impact on the rate of geological, geomorphological or biological processes, as the effect of past variability, in terms of retrodiction and proposed predicted scenarios, knowing the range of possible fluctuations. On millennial and centennial scale the chance to approximate trends in environment evolution arise from proxy data analyses, error burdened even if collected with highest possible temporal resolution (i.e. annual or even seasonal). Thus the real value to assess environmental conditions, their development and possible future behaviour is possible in decadal time-span based on direct measurements and their relations to observed effects contemporarily recorded in ambient archives, consisting of sediments, cryosphere elements, plants or their remnants or even life symptoms at its lowest level, like bacterial communities. Researches in polar regions are giving also a unique opportunity, especially on isolated and protected vast areas of Antarctica, to separate the effects of natural changes in local and regional scale from inconsiderable in intensity human influences. All those arguments make remote polar regions very attractive for research and in many cases still unexplored because of difficulties in access as well as in

logistic support of investigations. All above arguments are emphasizing the value of the work undertaken by dr. Kamil Láska in his habilitation thesis, dealing with the description and attempt to the explanation of climate variability in the surroundings of Antarctic Peninsula and in central part of Spitsbergen (Svalbard) with its impact on abiotic and biotic milieus. In the reviewers opinion such an order (abiotic-biotic) is more proper than used by the author (in the opposite order), as all biological processes and their life-based consequences have the background in non-organic form of the Universe.

The habilitation thesis presented by dr. Kamil Láska, entitled “Response of biotic and abiotic environments on climate variability in the region of the Antarctic Peninsula and Svalbard Archipelago”, is a deeply over thought scientific composition, discussing results presented by the Author in 10 research papers, 9 of which are published in well positioned journals and another one is submitted also in a top publishers edition. From bibliometric point of view, the total impact factor of presented papers (including the submitted one) is equal 22,801 and the citation sum (after Web of Science) reaches 44.

There is also a significant authorship input of the Candidate into the presented papers set. In nine out of ten cases he was responsible for acquisition of data in fieldworks and it is also a premise to suppose of his participation in the design of the observational system, crucial but difficult to be realized in harsh polar conditions.

The habilitation thesis introductory part consist of commonly placed “Acknowledgements” (page 2), “Abstract” (page 3), “Contents” (page 4) and “List of Papers” presented for appraisal (page 6). On two following pages the Author provides the “Introduction” which is a presentation of the research scope, describing the importance of polar atmospheric research to examine global geo- and ecosystems functioning. He is pointing at very differentiated course of climate variability and climate changes connected with other environmental aspects. Polar regions play a crucial role in these interactions, first because of their complexity, but on the other hand due to the fragility of components, mostly referring to wide extent of cryosphere and specifically biosphere developing on the edge of its vital chances, reacting dynamically to any impulse and representing constant instability of the system. The areas of investigations under study are located in the regions especially exposed to climate warming and its effects on abiotic and biotic realms. As in the case of the Arctic the problem is well known and widely spread around all the circumpolar territory and Svalbard case can be treated as model one, the special attention is paid to the Antarctic Peninsula region suffering

exceptional impact of environmental reactivity, contrasting to other high latitude parts of Southern Hemisphere. In the associated system of sea-land-atmosphere, in relation to cryo- and bio-elements, it is a great opportunity to have the observation system established in such a key place, as the Czech Antarctic Johan Georg Mendel Station is located, not only to observe local environmental variability, with all the consequences for the nature, but also to find broader, regional interrelationships all over Antarctica or at least its Atlantic sector, whereas the variability and high gradients of environment's elements are observed.

On the next 28 pages (from page 9 to page 36), in the chapter "Results" main achievements of the work are presented, divided into three main parts: "2.1 – Solar radiation in high-latitude locations", "2.2 – Impacts of climate variability on glacial, periglacial and aquatic environments of northern James Ross Island, Antarctic Peninsula", "2.3 – Climate variability and its impact on terrestrial ecosystems in the Arctic Svalbard archipelago". In the chapter 2.1 four of out of ten papers taken into evaluation are characterized and consequently in the chapter 2.2 – three papers, in the chapter 2.3 – three others. The descriptive part is ended by "Summary and Outlook" chapter (pages 37-39) and "References" (pages 40-48). The rest of thesis publication fill in the *in extenso* printed list of under evaluation publications, preceded, what is very useful, with the list of other important publications of the Author (26 positions), showing his broad scope of research interests in polar regions. Results in every described paper are placed in following sub-chapters of chapter 2, that needs broader comments in relation to supplemented papers. In the introductory part of the "Results" Author provides main tasks of the undertaken projects that lead to the elaboration of all presented papers. It is worth to underline that he can see the team work engagement to solve problems in polar research in conditions of long-term monitoring of particular environmental components, with well-organized system of data acquisition, elaboration and management, as well as their disclosure, not only by scientific publications, but also in public domains, available for political and economic stakeholders, that is also important from social point of view and in terms of further efforts in rising research finance. The meteorological monitoring, Authors speciality, that is the bracket binding together all scientific issues in selected papers, was spread into different time scales, from decades to seasons, but is having a tradition going back to early 90ies of the past century, in particular meteorological elements measurements undertaken by dr. Láška, not only traditionally done at observatory points, but as important for the polar environment state like UV radiation and other components of energy budget. We can then ascertain with strongest conviction his professionalism in this type of research

activity as also, on that background, in the application of the results in environmental analyses, shown in many examples, not only emblazoned in the presented set of publications.

Paper 1 (Láska *et al.* 2009), described as “Modelling of solar ultraviolet radiation in the Antarctic Peninsula region (chapter 2.1.1) was at the time of publication a novel approach, broadening the knowledge on UV radiation modelling and possibilities of its prediction. It benefitted from the experiences of earlier measurements in the Antarctic Peninsula region as well as was possible to be verified on the base of collaboration with the Ukrainian Vernadsky Station and acquired data. The model shown very high adjustment level and gave the impulse to further studies, concerning more variabilities changes influencing UV radiation in high latitudes of Southern Hemisphere.

Therefore the paper 2 (Láska *et al.* 2010) is undertaking the problem of clouds cover influence in the computation of solar ultraviolet radiation to obtain higher level of model adjustment, referring to broader environmental changeability, as dynamically it is observed in polar areas. Again the data of solar radiation, ozone content, but also cloudiness were taken from the Antarctic Peninsula region (northern part of western coast), but for the much longer period and the nonlinear regression model with a hyperbolic transmissivity function was very well adjusted, especially in higher cloudiness ranges, constituting, however, a considerable majority of cases.

In the following paper (# 3 – Láska *et al.* 2011) the developed new version (a continuation of deliberations presented in previous two papers) of nonlinear regression model with an improved algorithm for estimating erythemally effective UV radiation was tested with the use of data from first three years of observations at Johan Georg Mendel Czech Antarctic Station on James Ross Island. Moreover it was supported with the analysis of the total ozone content and effective surface reflectivity gained from a satellite survey. It is seen that the every following model and every particular approach was treated with highest possible reliability to improve its accuracy and the attempt to obtain as more as possible data either direct or remotely sensed. I am deeply convinced it is the only way to develop observation/prediction system of acquisition of environmental parameters so much useful not only as a monitoring tool, but also to be implemented into other investigation fields.

Despite all above, concerning three preceding articles, having own station in Antarctica and gathering data on solar radiation, the authors attempted to compare the course of their values between two sites differing considerably in conditions, however, located on one continent

(#4 – Petkov *et al.* 2016). The opposite site to the Czech Antarctic Station is selected the French-Italian Concordia Research Station at Dome C, Eastern Antarctica, far distant from the coast and not exposed to all the weather changeability connected to maritime conditions, seasonal and year to year variability. We can find out that the attentive material processing showed differences in both location as environmental influences on results record. It is also worth to underline, as Kamil Láska is not the first author in this case, he gave a significant input by elaborating data from James Ross Island and one can feel in this work the echoes of previously described experiences.

The following three papers from the set are referring to environmental changes on James Ross Island connected with climate variability in this very fragile to any interactions region. And it is how such a processes should be treated, as interrelationships covering land-ocean-atmosphere-biosphere system, where the changes in one factor involves another and *vice versa*. As the whole system functioning is driven by energy flow, the relation to previously discussed issues is basic. Paper 5 (Engel *et al.* 2012) is showing quite a novel approach to the presentation of reactions of ice masses to climate changes. The possibility to combine results from radar sounding, elevation and extent changes of two glaciers on Ulu Peninsula (James Ross Island) allowed to calculate the deglaciation dynamics in 3D, for this region of Antarctica, as it was previously stated, very dynamic in terms of climate warming, resulting in dramatic decay of ice masses.

The debate on climate forcing on environment is also expanded on other components of the cryosphere. In paper 6, Hrbáček *et al.* (2016) have shown the relation between atmospheric conditions (especially rising up the role of snow cover) and permafrost active layer thickness and thermal regime. It is very often noticed that weather monitoring system is separated from other environmental components observations, due to what several gaps in understanding the geo-ecosystem functioning appears. In the discussed paper, although methods are standard for such a project, it was unique at such a remote positions in Antarctica and what is important is treated as common in the observational system of Czech Station, used also in another elaborations. I find here a significant contribution of dr. Kamil Láska. The findings of the paper are driving the attention to atmospheric circulation but also to the relationships between ground thermal dynamics and snow cover, vegetation cover, freezing factor, especially positioning the studied site within other Antarctic Peninsula surrounding locations.

It is very important to understand how to interpret biotic response in relation to abiotic environmental factors variability. One of such examples is shown in the presented paper 7 (Elster *et al.* 2016). The article is bringing the attempt to solve a problem of the appearance of organic calcareous covers on the bottom of lakes on James Ross Island. The problem solution required the engagement of specialists in the field of biology/ecology, geology and meteorology, that is especially interesting for us in terms of the Habilitant skills, who was responsible for description of contemporary conditions, including meteorology to describe the environmental conditions of organisms evolution and CaCO₃ production. It was stated that carbonates precipitation in selected lakes of James Ross Island is the effect of *Hazenia* algae activity in endhoreic conditions. Water characteristics was also shown on the background of air temperature and radiation with the analysis of basic ions composition. The chemical and physical (environmental) conditions, recognized by our Author, seems to be here of great importance.

The subsequent subject concerning climate variability and its impact on terrestrial ecosystems in the Arctic Svalbard archipelago, covered by issues elaborated in next three papers, is an aftermath of Czech scientific activities undertaken in the Petuniabukta region, central Spitsbergen. Field campaigns covered several research tasks, one of which, as a background for other investigations, but also of great importance itself in describing environmental conditions of the region, was led from the very beginning in 2008 by dr. Kamil Láška, organizing and broadening the scope of meteorological observations, not only in a classic way of standard meteorological observatory, but also as a network of topoclimatic stations and attempt to modelling weather and climate processes. First results of these investigations were presented in paper 8 (Láška *et al.* 2012) concerning climate conditions and weather patterns in central Spitsbergen. In the observations during the period 2008-2010, with use of automatic registration, becoming a standard in polar meteorological investigations, several advancements were made in understanding weather patterns of central part of Spitsbergen, differing much from other neighbouring areas. The paper contains references to the atmospheric circulation, solar radiation, wind field, air temperature and humidity, ground temperature as snow conditions, some of information broadening essentially our knowledge of this poorly yet explored, however important due to proximity of other research places area, showing big gradients in the regional scale.

As the consequence of meteorological studies undertaken in central Spitsbergen appears the paper 9 (Láška *et al.* in press), dealing with high-resolution numerical simulation of summer

wind field over complex topography of Svalbard archipelago. The undertaken problem is basic not only for meteorology and atmosphere physics study but also for those working with aeolian processes and other geomorphological issues as well as biosphere environmental relations such as surface drying, snow cover development or primary succession. The findings of the paper like wind-topography dependence, northern winds directions generation, general circulation influences and the generally good agreement between the model and observations is a great prognostic for other researchers working in the area and a base for further development.

As it was stated above, meteorological conditions are very important to assess habitats conditions, especially in an unstable state of changing environment. Such a conclusion comes from the presented paper 10 (Elster et al. 2012) dealing with Cyanobacteria colonies development in conditions of warming affecting Arctic wetlands. Dr. Láska provided meteorological data to this paper and analysed them in terms of experimental time-series of air and ground temperatures in open top chambers, where investigated *Nostoc* colonies were controlled. Distinct changes were observed both in environmental conditions of the wetland area under the experimental setting as regarding the ecophysiology of bacterial colonies. It is very important to simulate changes in longer periods to predict further changes. This types of standardized observations have a great scientific value, however, they are conducted in extreme field conditions of the Arctic.

The presented thesis, as it was mentioned at the beginning, has a high scientific value, gathering a broad amount of factographic material. Meteorology of polar areas is developing now in a modern style, not only with a use of new instruments and remote sensing approach, but also elaborating enormous amount of data with very sophisticated statistical methods, finally leading to establish more and more accurate models, also in terms of prediction of the changes in Earth natural system functioning. However, at the moment it is also very important to validate the model approach with the use of direct observations. All above premises are present in the works of dr. Kamil Láska, who is both prepared to field works and realize it with success for over two decades in Antarctica and in the Arctic, as well as he is also an efficient data analyst and more and more experienced modeller. From his scientific development one can see a broad potential for independent activity in the future, leading to the development of his own team within meteorological/climatological background of environmental changes assessment. Finally it is worth to underline that both the reviewer as Habilitant himself do not forget about his background and teachers, leading him to now-a-

days scientific successes, I would call the “Brno School of Polar Meteorology and Climatology”, with such eminent authorities as prof Rudolf Brázdil and prof. Pavel Prošek.

Summarizing the review of presented publications series, that is unquestionably a scientific achievement of the habilitation Candidate, together with all additional materials and personal knowledge of the reviewer, it is necessary to pay attention that problems undertaken, methods used as well as results obtained, are characterized by high level of originality, proving both dr. Láska’s independence in approaching research problems and substantial input in the development of the research discipline he represents. He is an outstanding scientist whose works are grounded in the context of environmental reactions due to climatic changes, and looking to find and expose generally driving natural regularities.

In my opinion, research work presented in the evaluated thesis is a sufficient basis for the promotion of dr. Kamil Láska to the habilitation degree in the field of Earth sciences in the scope of physical geography. High level of thesis professionalism allows me also to move for award a scientific prize for the presented achievement, if the procedure is accepting such a proposal.

Poznań, 2016-06-24