1. PHD PROJECT DESCRIPTION (4000 characters max., including the aims and work plan)

Project title: Topoclimatic and bioclimatic variability in Forlandsundet region (NW Spitsbergen, Arctic) in the period 2010–15 and its causes

1.1. Project goals

The main scientific goal of the doctoral dissertation is to analyse the degree of variability in topoclimates and biometeorological/bioclimatic conditions in the western part of Oscar II Land (NW Spitsbergen) in the period 2010–15 and their determinants.

The research objective will be implemented through the following research tasks:

1) A characterisation of seasonal and annual spatial variations in temperature and air humidity in the Forlandsundet area,
2) A determination of the spatial and temporal variability of bioclimatic conditions, as well as thermal and humidity biometeorological stimuli,
3) An examination of the influence of atmospheric circulation on the formation of topoclimates and bioclimatic conditions in the Forlandsundet region,
4) An examination of the influence of cloudiness on the spatial variability of air temperature and humidity, as well as biometeorological conditions,
5) Determining the meteorological and synoptic causes of extremely low and high differences in the spatial distribution of meteorological variables and biometeorological indicators.

1.2. Outline

The study area is located in the western part of Oscar II Land (NW Spitsbergen, Arctic) and is characterised by the presence of all types of substrate that can be found in the polar regions, i.e. tundra, moraine, beach and glaciers. This diversity makes it possible to analyse several topoclimate types (tundra, glacier, mountain or fjord) and the apparent conditions (i.e. the conditions as perceived physiologically by humans) that occur on them.

The data to be used in this work have already been collected and come from observations carried out in 2010–15 at the NCU Polar Station on the west coast of Spitsbergen (Oscar II Land) and at points on the Waldemar Glacier. In the study period, 8–18 (number varied by year) temperature and air humidity measurement points were operated here on a year-round basis. For the purposes of the doctoral thesis, the most complete data series will be selected for areas including mountain peaks, a glacier, a marginal zone, a moraine, a terrace and a beach.

The first part of the doctoral dissertation will be devoted to a multifaceted analysis of the degree of spatial variation in selected meteorological variables of the western part of Oscar II Land (NW Spitsbergen) and their determinants. However, the main research effort will be aimed at determining the determinants, primarily meteorological (cloudiness and wind) and synoptic (types of atmospheric circulation according to the classification of Prof. T. Niedźwiedź), of extremely high and low differences in the spatial distribution of air temperature and humidity. This issue has so far been only fragmentarily studied in this area and is therefore insufficiently understood. In addition, the diversity of elevations among the measurement points will allow vertical air temperature and humidity gradients and their spatial variation to be calculated.

The second part of the dissertation will be a study of the diversity of bioclimatic conditions as well as thermal and humidity biometeorological stimuli. Air temperature and humidity are physical atmospheric stimuli affecting the human body. In Arctic areas, very low air temperature is unfavourable for humans, especially when accompanied by strong winds. In summer periods (when we also have measurement data on wind speed), biometeorological indicators will be calculated, e.g. Wind Chill Temperature (WCT), to assess the risk of frostbite and health consequences in given meteorological conditions. The Insulation Predicted index (Iclp) will also be applied to determine the thermal insulation of clothing that given meteorological conditions demand in order for the body's thermal balance to be maintained. Over the course of the year, the biometeorological impact of thermal and humidity conditions will also be assessed. The above-mentioned goals and research tasks will make it possible to create a general picture of long-term, year-round topoclimatic and bioclimatic changes in the western part of the Oscar II Land. This will be the first study of this type for this area.

1.3. Work plan

1) Building an electronic meteorological and biometeorological database, about 1 year,
2) Quality control of the collected data; about 0.5 years,
3) Detailed statistical analysis of topoclimatic and bioclimatic conditions; approx. 0.5–1.0 year,
4) Preparation and publication of research results in the form of articles in high-impact journals.

We anticipate about four articles, 2 years.

1.4. **Literature** *(max. 7 listed, as a suggestion for a PhD candidate preliminary study)*

1. ARAŹNY A., MIGAŁA K., SIKORA S., BUDZIK T., 2010. Meteorological and biometeorogical conditions in the Hornsund area (Spitsbergen) during the warm season. Polish Polar Research 31, 3: 217-238
2. PRZYBYLAK R., 2016, The Climate of the Arctic. Second edition, Atmospheric and Oceanographic Sciences Library 52, Springer, Heidelberg/Nework/Dordrecht/London.
3. PRZYBYLAK R., ARAŹNY A., 2006, Climatic conditions of the north-western part of Oscar II Land (Spitsbergen) in the period between 1975 and 2000. Polish Polar Research 27(2): 133-152.
4. PRZYBYLAK R., ARAŹNY A., KEJNA M., 2012. Topoclimatic diversity in Forlandsundet Region (NW Spitsbergen) in global warming conditions, Nicolaus Copernicus University, Toruń, s. 115-137.
5. PRZYBYLAK, R., A. ARAŹNY, Ø. NORDLI, R. FINKELNBURG, M. KEJNA, T. BUDZIK, K. MIGAŁA, S. SIKORA, D. PUCZKO, K. RYMER, G. RACHLEWICZ., 2014. Spatial distribution of air temperature on Svalbard during 1 year with campaign measurements, International Journal of Climatology 34, 14, 3702–3719, DOI: 10.1002/joc.3937
6. PRZYBYLAK, R., A. ARAŹNY, P. ULANDOWSKA-MONARCHA, 2018. The influence of atmospheric circulation on the spatial diversity of air temperature in the area of Forlandsundet (NW Spitsbergen) during 2010–2013, International Journal of Climatology 38, 230–251, DOI: 10.1002/joc.5172.
7. SERREZE M.C., BARRY R.G., 2014, The Arctic Climate System. 2nd ed. Cambridge, Cambridge University Press.

1.5. Required initial knowledge and skills of the PhD candidate

1. University science degree (MSc) in environmental sciences, physical geography, climatology, or related areas,
2. Good communication skills,
3. Ability to communicate in English,
4. An inquisitive mindset, accuracy, creativity and self-reliance,
5. High motivation for research work.

1.6. Expected development of the PhD candidate's knowledge and skills

Core skills:

•Increasing skills required to process large meteorological databases,

• Learning new methods, computer software, and tools used in climatology and bioclimatology,

• Expanding knowledge of climatology, bioclimatology and synoptics.

Soft skills:

• Development of analytical skills and independent problem-solving,

• Development of skills required to effectively communicate scientific research results (including the construction of oral and poster presentations),

• Acquisition of the ability to write scientific publications for high-impact scientific journals – scientific writing,

• Improving teamwork skills,

• Expanding national and international cooperation.