Arctic warming is unequivocal, substantial and ongoing. It is manifested in the loss of sea ice, glaciers, snow and permafrost. An open water season is longer in many regions and shifts in ecosystem are observed almost everywhere in the Arctic. Since 1980, Arctic temperature rise has exceeded this of the Northern Hemisphere by a factor of two or more. The minimum extent, observed in September, has decreased 12.9 $\pm$ 2.4% per decade in the period 1979-2016. The maximum extent, observed in March, has also decreased, however only 2.7 $\pm$ 0.5% per decade. These changes have been accompanied by a decrease in mean ice thickness about 1.8 m (40%) since 1980 and a 75–80% loss in volume. This phenomenon is sometimes termed as Arctic amplification. A decade ago, in scientific literature appeared first signs that some links between the amplification of Arctic warming and extreme weather in midlatitudes of the Northern Hemisphere can exist. The hypothesis purports that this amplification of Arctic warming may increase the frequency of persistent weather patterns that can cause droughts, heat waves, cold spells, and floods. The aim of this project is checking whether and how disproportionate Arctic warming might affect extreme weather in Central Europe and Poland. The answer is of great societal and economic importance, but at the moment a consensus on whether and how Arctic amplification influences mid-latitude weather extremes is lacking.

Three groups of processes are considered as potentialy responsible for such link: weakening and shift in latitudinal position of storm tracks in the North Atlantic sector, shift in the latitudinal position of mid-latitude jet and amplification of circumglobal wave trains, with stronger meandering causing an increase in persistence of weather patterns. A few most important objectives of the project are construction of a data set consisting of indices describing the amount of heat and sea-ice characteristics of the Arctic and covering the period 1979-2019 when the satelite data are available, testing the research hypotheses that warmer Arctic corresponds to weakening and/or southward shift of storm tracks in the North Atlantic – Europe sector of the Northern Hemisphere, to southward shift of polar jet stream at all and especially in the North Atlantic – Europe sector and to stronger meandering of polar jet-stream. Next the assumption that the warmer Arctic corresponds to higher persistence of weather patterns in the Northern Atlantic – Europe sector will be tested. This task requires the choice of method of weather pattern typology and measure of their persistency. At the end set of selected extreme weather events, significant in terms of intensity or spatial coverage, will be analysed in detail, looking for amount of heat in appropriate sector in the Arctic and other characteristics of the Arctic amplification defined in the beginning of the project, location and intensity of storm tracks, jet-stream latitude position and weather patterns persistency simultanously and/or preceding the extreme weather event.

When analysing the issue on the links of the changes in Arctic to polar jet-stream, storm track and weather extremes in midlatitudes three questions are waiting for the response. Do the mechanisms responsible for these links really work? Has Arctic warming significantly influenced the midlatitude jet-stream and weather extremes in latitudes? Will these influence be significant in the future? The project is suspected to answer the first of these questions, and partially also the second. Most of tasks planned within the project concern testing the hypothesis that the Arctic warming affects jet-stream characteristics and favourse stronger persistency of weather patterns. The problem with the second question lies in the definition of “significant influence”. If it means that the effects can be distinguished from the background internal variability, the lenght of records and rareness of weather extremes prevent the positive answer. So the last task of the project has to show whether extremes in midlatitudes are accompanied by effects of Arctic amplification. If these effects preceded weather extremes then they can be used for prognostic purposes.