Every year, floods kill thousands of people, especially in less developed countries and cause immense damage to property, in almost all countries, with a global loss reaching tens of billions of dollars. Despite high expenditures on structural flood defenses, dramatic floods do occur in Europe and Poland. In our country, particularly destructive deluges were recorded in 1997 and 2010. One can state that nowhere in the world people cope satisfactorily with floods. The flood risk is increasing with time in all spatial scales, mainly due to increasing exposure and vulnerability of people and property, but also due to changes in drainage basins and river beds as well as climatic changes (increases of frequency and amplitude of intense precipitation that accompany the warming). However, understanding of changes in flood hazard and flood risk is rather weak. No general, ubiquitous, and statistically significant trend in the observed maximum river flows has been found yet and model-based projections of changes in flood risk are highly uncertain. The thematic area of the project is very important, both scientifically and societally, but poorly understood. One can ask a rhetorical question whether flood science is ready for "the prime time"?

The aim of the “Interpretation of Change in Flood-related Indices based on Climate Variability” (FloVar) project is to improve understanding of an important mechanism affecting the variability of likelihood of flooding. In particular, changes in the variability of characteristics related to floods will be examined and relationships between them and the indices of climate variability will be sought. Research hypothesis, tested in this project, will seek the existence of a spatially-varying connection between indices of climate oscillations and the variability of likelihood of destructive abundance of water. The spatial scope of this work includes the Globe (all continents), but without a hopeless attempt of covering the entire map of the world’s rivers, because in many areas hydrological data are scarce.

The variables related to floods include characteristics of heavy rain, high river flow, flood severity and magnitude and flood losses (material damage and number of casualties), while the indices of climate variability describe the characteristics of solar activity and volcanic eruptions as well as various oscillations in the atmosphere-ocean system (such as ENSO, i.e. El Niño – Southern Oscillation). Time series of climatic oscillations and variables associated with floods manifest strong variations in different time scales, between years and decades, some of which may be random. However, a thorough analysis of the variability of characteristics related to floods and their links with climate variability seems to be a promising path to a better interpretation of changes in flood hazard and flood risk.

The starting point for the FloVar project is a systematic study of published material indicating existence of probabilistic associations between indices of climate oscillations and variability of renewable water resources (rain, river flow) in some regions of the world. The current project will extend far beyond the previously published results, using more flood-related variables and multiple indices of oscillation in the atmosphere-ocean system.

Several data-based methods will be used, including tools of time series analysis and statistics, methods of multi-variate correlation and regression, harmonic analysis, detection of changes, as well as evolutionary algorithms.

It is expected that the results of the project will prove to be important for the development of science, and will reduce significant gaps that exist in the understanding. Scientific results of the project will definitely extend beyond the current state of knowledge, and it can be expected that numerous (at least nine) articles will be published in prestigious, peer-reviewed, high-impact, scientific journals.

Interdisciplinary research will be carried out in the project, primarily in the domain of earth sciences (hydrology, but also links with the atmosphere and the oceans, and thus the areas of climatology and oceanology) and engineering sciences (water management, flood protection),with application of mathematics with statistics and IT. The project will benefit of a unique combination of data that are already available in various repositories, but so far have never been used together in a similar way.

The expected results of the project are: building a rich information base and creation of a data repository; improvement of understanding of the structure of spatial-temporal variables related to flooding and the temporal structure of indices of climate variability; as well as building innovative and comprehensive interpretation of the links between climate oscillation indices and variability of characteristics associated with floods. Possible additional effects include potential discovery of new teleconnections, i.e. links between variables in remote areas. It is expected that the project may lead to significant and measurable progress in understanding the changes to the flood hazard and flood risk in different scales.