

Groundwater constitutes a major part of drinking water resources in Poland and Europe. Sustainable management of water resources and their protection from contamination require protective measures to be undertaken by administration bodies. Such measures include among others: delineating wellhead protection zones, evaluation of susceptibility of groundwater bodies to contamination or development of water balances for specific areas. In all these applications computer models are routinely used to describe groundwater flow and contaminant transport. Numerical models are also used for groundwater protection and remediation studies.

In the subsurface we can distinguish two main zones, with distinct forms of water occurrence. Directly below the ground surface we have the unsaturated (or vadose) zone, which typically has the thickness of a few to few tens of meters. In this zone the void spaces in soils and rocks are filled partly with water and partly with air. Below there is the saturation zone (or groundwater zone), where the voids are filled completely with water. Groundwater is extracted from permeable rocks and soils in the saturated zone. However, the flow processes in the vadose zone are critical for quality and quantity of the groundwater resources. Due to evaporation and uptake by plant roots in the uppermost part of the vadose zone, only a minor part of precipitation falling on the Earth surface recharges the saturated groundwater zone. In Poland the average groundwater recharge corresponds to about 18% of average precipitation. However, this value may vary significantly depending on factors such as the type of soil, thickness of the vadose zone, type of vegetation and terrain form. The role of these factors has not yet been fully investigated, there is also a lack of efficient methods to represent recharge variability in large-scale numerical models.

The main aim of the project is to investigate spatial and temporal variability of recharge on a selected outwash plain area. Outwash plains are one of the most common forms of fluvio-glacial sediments, deposited during Pleistocene period. They cover large areas of northern Poland and other European countries, as well as USA and Canada. Outwash plains are large sandy plains, abundant with ground water. Infiltration recharge plays a key role on these areas. We plan to install on the chosen experimental site a weather station, collecting meteorological data, in particular precipitation. In four points, differing in vegetation cover and depth to groundwater table, we plan to install measuring devices collecting soil water content in the vadose zone and groundwater level. The velocity of infiltration will be estimated using infiltrometer experiments and tracer experiments (observations of the movement of salt solution injected into soil in non-harmful quantity). Additional laboratory experiments for characterizing the soils are also planned. We intend to develop a computer model of the chosen area, including water flow in both saturated and unsaturated zones.

The novelty of its project lies in its combination of field and laboratory experiments and numerical analysis applied for the first time to outwash plain area in northern Poland. It is expected that the project will bring significant advancements in the research on groundwater recharge, since new methods will be applied to characterize soils in the vadose zone and to solve numerically the unsaturated flow equation. Collaboration with leading experts from USA and France will bring an international dimension to the project and ensure broad dissemination of the results.