Model ALAKE

Software ALAKE was developed as a tool for estimating the influence of a water area (lake) on the air temperature. The impetuses for its development were hydric reclamations of the brown coal mines in the northern Bohemia. Hydric reclamations are processes of flooding the mineshafts after finishing mining activities. This way of regenerating the destroyed country after coal mining and is recently used and it is planned to be used in the future. The origination of a new water area changes thermal characteristics of the surface including albedo and surface roughness which leads to the changes in the atmosphere.

The ALAKE model was developed using data concerning flooding of Ležáky open mine and the formation of Most lake. For this area data from the Kopisty meteorological observatory located approximately 1 km from the lake bank and data from a lake station measuring the water temperature were utilized.

We used the non-hydrostatic numerical model COSMO to simulate the impact of the water area on the air temperature. The model was applied with a horizontal resolution of 333 m and with 70 unequally distributed vertical levels. We supposed a flat terrain and geographical parameters like surface roughness, soil type and vegetation we set to constant values prevailing in the studied area. In addition we supposed that the lake has a rectangle shape.

We performed hundreds of model integrations for various initial conditions. We supposed that initial conditions that were calculated using meteorological observations at the Kopisty station and vertical profiles obtained from ECMWF analysis, corresponded to the equilibrium state between the ground surface and the atmosphere. When the model started integration with the included lake, the equilibrium was disrupted. During the integration, the structure of the boundary layer was modified, and the imbalances were gradually dropped. The model integration continued until a new approximate equilibrium was reached, and the resultant state was considered to be caused by the existence of the lake. To approach the equilibrium state, the radiation parameterization was switched off in the model to remove diurnal variation and the Coriolis force was also switched off to ensure that the initial conditions were consistent with the physical model. The effects of the lake were calculated as the differences between the state of the atmosphere upstream from the lake and the state after the integration. Tests showed that the approximate equilibrium was reached after 3 or 4 hours of integration.

The ALAKE model is a simple physical model with empirical parameters whose values were determined so that the outputs of the ALAKE and COSMO models were similar. The outputs of COSMO were treated as the true values. ALAKE approximates the relationships between a predictand, which is the change in temperature at a given location caused by the creation of the lake and calculated by the COSMO model, and predictors, which are the parameters of the lake and selected variables describing the current weather situation.

The ALAKE software estimates the changes in 2m temperature evoked by the lake existence. There are 6 input parameters: width of the lake, lake water temperature, surface temperature, air temperature and relative humidity at 2 m and wind speed at 10 m above the ground.
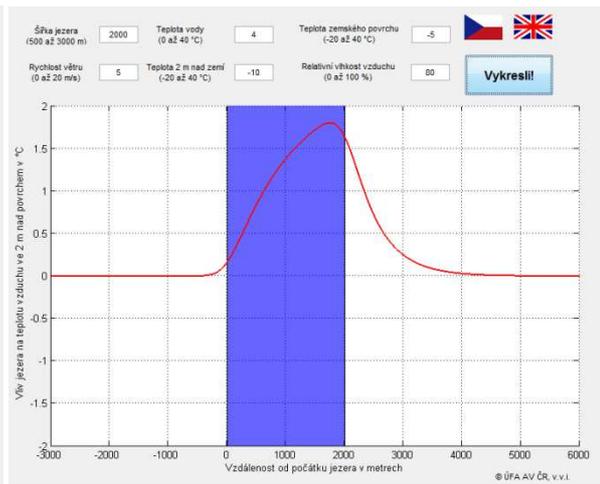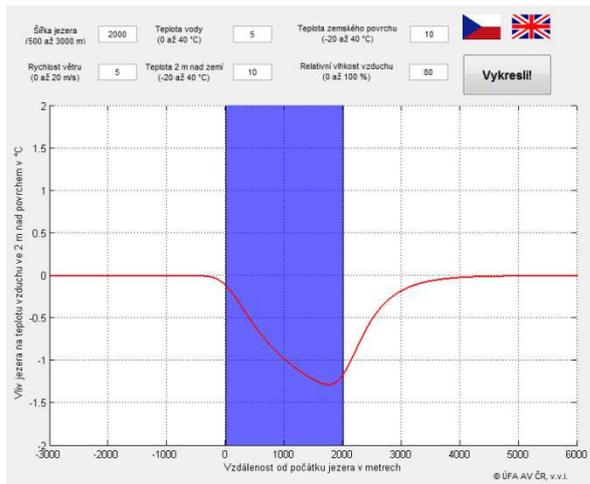
Figure 1. Examples of ALAKE outputs