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Old map series and their georeferencing for environmental GIS applications

Old maps are very important source of information about historical landscape. At the Czech Technical University in Prague (CTU) several projects focused on analysis and georeferencing of old maps have been solved during last 10 years. Since 2012 we are working on the project “Landscape reconstruction and database of vanished municipalities in the Usti region for preserving the culture heritage” funded by Ministry of Culture of the Czech Republic. Old maps can provide valuable information about vanished municipalities, cultural and natural monuments. These were lost during industrial revolution in 19th century and massive coal mining activity in 20th century.

The aim of the project is to collect maps, photographs and other material to reconstruct original landscape of the Usti region. Data are collected into geodatabases and will be presented by the web map application. Geodata will be also distributed via web map services.

Area of the Czech Republic was for a long period part of the Habsburg Empire. Therefore, old maps suitable for our project are part of Military Mapping Surveys of Habsburg Empire or Habsburg Cadastral maps. First Military Mapping Survey (in the Czech Lands 1763–1768) did not use any base geodetic network and maps are not very accurate. Despite, it could be interesting to create seamless map showing the region before industrial revolution in his complexity. Second Military Mapping Survey (in the Czech Lands 1836–1852) is closely linked to Stable Cadastre (in the Czech Lands 1824–1843) of Habsburg Empire. These maps are very accurate (compared to current maps). Their georeferencing is much easier and can be done using corner points. Third Military Mapping Survey (in the Czech Lands 1874–1880) shows landscape changes during industrial boom in 19th century.

Other map material contains original maps of the Czechoslovak army made after World War II (1953–1957). First airborne photographs made in 30’s and 40’s can be used also. All these maps can be compared to the 1980’s maps when the Czech Republic was highly damaged by coal mining activity. Current topographic maps show restoration of landscape and establishment of new natural elements (lakes, forests ...).

As old maps are very important part of the project, their georeferencing is crucial. There exist several methods how to georeference old maps, but usually without edge matching condition for map series. If the map series are accurate enough, corner coordinates of map sheets can be used for georeferencing. But, if there is no information about corner coordinates, or the map is not accurate enough, ground control points should be used for georeferencing.

In this project we proposed the new method of georeferencing old maps based on the overall adjustment of transformation parameters with edge matching constraints. After ground control points collecting these points are used for least squares adjustment with constraints. Usage of adjusted parameters for map sheets results in seamless map, which can be used in GIS application for later analyses. These maps are usually very interesting background layers in environmental GIS applications and can serve for broad public as well.

First testing area of 16 map sheets of First Military Mapping Survey has been georeferenced and results are promising. Map sheets fit together and can be used as seamless layer. Accuracy is not so well but global landscape characteristics can be identified easily.