The application of geographic information techniques for data synthesis and evaluation of remote high mountain lakes in the lake district Tyrol (Austria & Italy)

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Abstract

The interest in high mountain lakes is based on their remoteness and the absence of direct anthropogenic impacts. These lakes are good indicators for regional and global changes because of their sensitivity to regional climate change, to atmospheric depositions and global warming. Information about environmental changes is stored for shorter periods in the water column and aquatic biota as well as for long term in the lake sediments. More than 3000 remote high mountain lakes are studies by 26 institutes in 15 European countries joined together in the EU project EMERGE (**E**uropean **M**ountain lake **E**cosystems: **R**egionalisation, dia**G**nostics & socio-economic **E**valuation). The analysis of these lakes is carried out through a comprehensive evaluation of the ecological and chemical status of remote mountain lake ecosystems within these 13 lake districts using harmonised methods. The work is divided into two main parts: the up-scaling of knowledge from individual sites to regions and the evaluation of regional data in order to enable the formulation of effective policies for the sustainable management of mountain lake ecosystems.

The lake district Tyrol comprises 466 lakes situated in North-Tyrol (Austria) and South-Tyrol (Italy). Due to the remoteness of high mountain lakes, it is impossible to sample and survey all 466 high mountain lakes of this lake district during a short ice-free period in summer. To assess the morphological, chemical and biological properties of the total lake population we develop a methodology that allows the up-scaling from 31 survey lakes to all 466 lakes of the Tyrol lake district, whereby results from previous lake surveys are included. The combination of geographic information techniques (GIS) and the appropriate extrapolation and up-scaling procedures allow an ecological and environmental evaluation over large areas. The geographic information techniques are implemented by combining raster-GIS and vector-GIS. For extrapolation and up-scaling

we apply multivariate statistical methods (e.g. cluster analysis, PCA, CCA). So far, all sampled lakes have been classified as lying above the timber line, within an altitudinal range from 1840 to 2796 m a.s.l.. The majority of these lake lie on crystalline rocks, which results in waters of very low conductivity. All lakes belong to the class of clear-water lakes with an extremely low content of dissolved organic carbon. The content of chlorophyll *a*, as an estimate of algal biomass, is quite variable between the sampled lakes depending on site-specific morphological and chemical features. In most lakes the biodiversity of phytoplankton, benthic diatoms and macrozoobenthos is particularly high.