

**Pollution of alpine ponds and groundwater by de-icing chemicals (Serra da Estrela,  
Central Portugal)  
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The ecological and socioeconomic importance of mountains is being increasingly recognised. Such regions provide key ecosystem services, namely, water supply which benefits local as well as lowland human populations. Besides mountain aquifers and rivers, alpine lakes and ponds are crucial for water resources management but are also important in hydroecological and wildlife conservation terms. This study aims at comparing the pollution of surface and underground water bodies by de-icing chemicals in a mountain environment. The influence of geological, geomorphological, pedological, climatic and anthropic conditions is taken into account. The study region is the highest part of the Serra da Estrela, a Mediterranean mountain located in Central Portugal. In this area there is a hydrological system which encompasses water-table aquifers and number of alpine ponds of glacial origin situated between 1500 m a.s.l. and the summit (1993 m a.s.l.). In the study area, the alpine ponds and springs were inventoried. Water sampling campaigns were carried out for hydrogeochemical characterisation of alpine ponds. These results were compared with hydrogeochemical data from water springs obtained in previous studies. Concentration of the following analytes were determined- total organic carbon (TOC), metals (Pb, Zn, Fe, Cu, Ni, Cd, Cr, As, Mn), cations ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ), anions ( $\text{F}^-$ ,  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ), silica ( $\text{SiO}_2$ ) and nutrients (N, P). Additionally, parameters such as pH, conductivity, turbidity and alkalinity were also measured. The hydrogeochemistry of ponds and water table aquifers affected by de-icing chemicals is clearly different from the one showed by non-polluted water bodies, due to the influence of different physical settings as well as to the spatial distribution of the anthropic influence. The pond and aquifer contamination affects water quality but may also disturb the local highly sensitive aquatic ecosystems.

