Integration of two simple models in a geographical information system to evaluate salinization risk in irrigated land of the Valencian Community, Spain

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Abstract. Salt affected soil is one of the main problems decreasing the productivity of irrigated agriculture in the Mediterranean area. Simulation models in combination with geographical information systems (GISs) could be used to evaluate the risk of salinization at a regional scale. In this study, two logical models (Pla and Riverside) were combined in a GIS to evaluate the risk of soil salinity and sodicity in the irrigated agriculture of the Valencian Community, Spain. Simple models were chosen so that they could be used at a regional scale. Before running them in a GIS framework, a soil and irrigation water survey was conducted to validate the models with observed data. The Pla model fitted observed data better than Riverside guidelines, probably because parameters of water quality, soil and climate were considered by the Pla model. The resulting maps indicated that the soils most affected by salts are those located in the south of study area, owing to the arid climate, and those areas near the coast due to saline intrusion. Close to 42% of the irrigated area was predicted to be somewhat affected by salinization. The regional-scale soil salinity assessment presented here for the Valencian Community is the first to be made for this region and will be useful in targeting critical areas that may require special management.

Keywords: GIS, salinity model, risk evaluation, soil salinization, Spain

INTRODUCTION

The accumulation of salt in soil is a problem that affects irrigated agriculture. This process decreases crop yields, the quality of water resources, and in some cases reduces the quality of the crop. Szabolcs (1996) estimated that 50% of the world’s irrigated areas are affected to some extent by salt. In Europe, 4 million hectares are threatened by salinization (Oldeman et al. 1991). In Spain, the Ebro river basin and the arid and semiarid areas of the Mediterranean coast have a high risk of salt accumulation (Szabolcs 1996). The progressive nature of salinization hinders its early detection.

The Valencian Community is a Mediterranean region flanking the Spanish coast, where soil salinization has become a problem. This region includes more than 380 000 hectares of irrigated agriculture (Consellerı̀a d’Agricultura Peixca i Alimentacio 1999). In this region the scarcity and the poor quality of the irrigation water, restricted soil drainage and the arid to semiarid climate are the main factors causing soil salinization. The problem could be aggravated by global changes that foresee an increase in temperature and aridity in the region, which will lead to an increase in irrigated areas with poorer quality water.

There are several techniques to reclaim salt-affected soils, but they usually have a high economic cost. In some areas the lack of good quality water resources makes it difficult to reclaim the saline land, and agriculture becomes ultimately abandoned.

Prevention of salt accumulation is more advisable than soil desalinization. Simulation models that predict the effect of irrigation and drainage management on soil salinization can help in deciding the most suitable management for each combination of climate, soil and water. A decision system is absolutely necessary where there is strong competition for good quality water. This is the case for several irrigated areas of the Valencian Community.

To extend the capabilities of salinity simulation models at a regional scale, it is convenient to couple them with geographical information systems (GISs). With this combined tool it is possible to make predictive maps of salinity risk, identify problem areas and determine their extent. Several authors have modelled the risk of salinization at a regional scale using GISs (Corwin et al. 1989, 1996, 1997; Vaughan et al. 1996; Bui 1997; Bui et al. 1999; MacMillan & Marciak 2000; Utset & Borroto 2001) with the main