Groundwater flow and Nitrate content in the shallow and unconfined aquifer of the upper plain of the Province of Modena.

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INTRODUCTION

Due to the widespread of intense agricultural activities, nitrate pollution is one of the main causes of groundwater quality deterioration. In Emilia Romagna Region, high amount of nitrates are commonly detected along the upper part of the Po plain, where infiltration processes from the ground-surface could become more active through the coarse deposits of the alluvial fans. In the case of the Taro, Enza, Tiepido, Sillaro shallow aquifers, this phenomenon is so severe that NO$_3$ content can exceed the maximum limit for safe drinking water law (50 mg/l) up to reach 140 mg/l (Marcaccio 2008).

The aim of this work is to improve the knowledge on the groundwater flow and quality characterising the shallower and phreatic aquifers. Field activities has been done between autumn 2010 and summer 2011 (2 campaigns) and they focused on 53 wells spread over the Tiepido alluvial fan (Province of Modena).

They consisted of groundwater levels monitoring and physical analyses (temperature, pH, electrical conductivity), while waters were sampled for chemical in-lab characterization (major ions and NO$_3$).

RESULTS

Wells placed in municipality of Maranello and Formigine were completely dried. In the other ones, the groundwater table depth ranged between 0.50 and 15 meters.

No substantial difference was detected between the two campaigns if we exclude few wells where the water table decreased of some
meters. This phenomenon seems related to the intense crop irrigation.

The interpolation of water table levels (Fig. 1) shows as the shallow aquifer is connected and recharged by the Tiepido river. Moreover, local intense pumping were highlighted in Formigine and Maranello municipality.

For the chemical point of view, groundwater is Ca-HCO$_3$ while pH is between 6.60 and 8.20. The electrical conductivity varies from 590 (foothills area) up to 2190 µS/cm (distant part of the alluvial fan). Cases of agricultural or human pollution have been detected; some samples were characterized by high NO$_3$ contents (4 wells exceeded 50 mg/l, max. value 146 mg/l; Fig.1) and in some samples, NO$_3$ was associated to remarkable level of Na (max. 151 mg/l), K (max. 10 mg/l), Mg (max. 60 mg/l), Cl (max. 368 mg/l), SO$_4$ (max. 191 mg/l) (Fig. 2).

In the local rivers, the electrical conductivity of the water is in the range 378 and 2020 µS/cm, instead the pH is in the range of 7.75 - 8.94. In the Tiepido the amount of NO$_3$ is in the range 1 – 20 mg/l. The direct recharge from the river to groundwater, together with the low concentration in NO$_3$, favours a dilution in the amount of NO$_3$ in the A0 aquifer.

CONCLUSION

The work has permitted to elaborate a first groundwater level map of the shallowest aquifer hosted inside the alluvial fan of the Tiepido river. The interpolation showed an important recharging process from the Tiepido river while, north-westward the interpolation shows an important recharging process of the groundwater by Tiepido river. At north-westward of the map, instead, it shows as the groundwater level was lowered by the agricultural and industrial water supplies and/or by the drainage action caused by the near Secchia river's alluvial fan (which is characterized by high hydraulic conductivity and by high thickness of gravelly sediments). The physical and chemical measures highlighted cases of pollution by human activities, probably agricultural. In some wells, the nitrates content exceeded 100 mg/l and high concentration of K, Mg, Cl was found.

REFERENCES
