Comparing PRZM, MACRO and PEARL using field data from a case study of pesticide leaching in Norway.

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Introduction

Pesticide fate models are often used to describe pesticide fate at field, regional and country scale and can be used for reporting chemical status according to Water Framework Directive and the Ground Water Directive. PEARL (Tiktak et al., 2000), PRZM (Carsel et al., 1998) and MACRO (Jarvis, 1994) are such models aimed at the prediction of pesticides dissipation and transport in soil. One of the main objectives of this study has been to investigate the ability of these three FOCUS models to describe leaching of pesticides to groundwater under cold conditions, especially in winter periods, and to identify key variables on calibration and to validate and evaluate the performance of these models

Material and methods

A data set from a Norwegian site (fig. 1), monitored by Bioforsk (Stenrød et al. 2008) was used to compare the three leaching models PEARL, PRZM and MACRO. Data from two experimental periods on soil temperature, water contents, bromide and metribuzin in a silt loam soil (0-80 cm,) was used.

The exercise was carried out according to Good Modelling Practice (Vanclooster et al. 2000). The agreement between observed and simulated values was calculated by the following indexes: Relative root mean squared error (RRMSE), the coefficient of residual mass (CRM), the Pearson correlation (r), slope index and modelling efficiency (EF).

Results

Soil temperatures dynamics were successfully simulated by the three models except in the winter spring period (fig. 2).

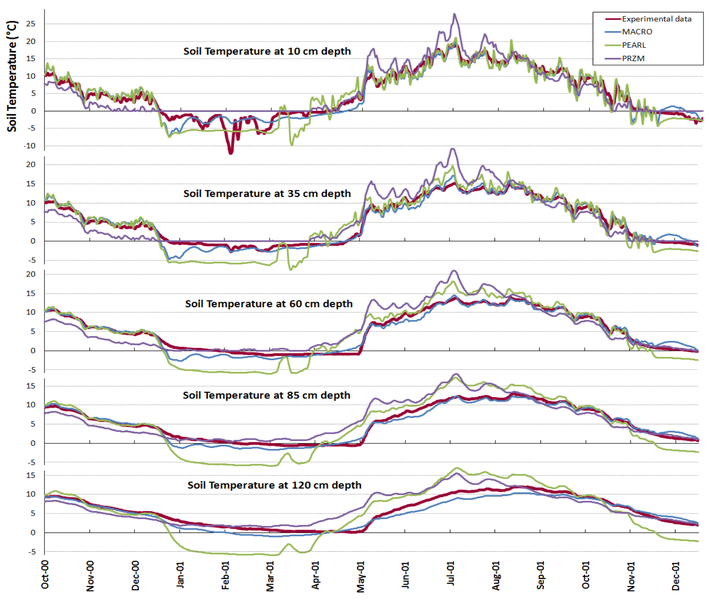

Fig.2 Soil temperature simulation profiles (1st season)

The three models simulated quite well the dynamics of bromide concentration for both experimental periods although MACRO and PRZM overestimated the bromide mass recovery compared to experimental data by an averaged factor of 1.7 ± 0.3 (Fig. 4).

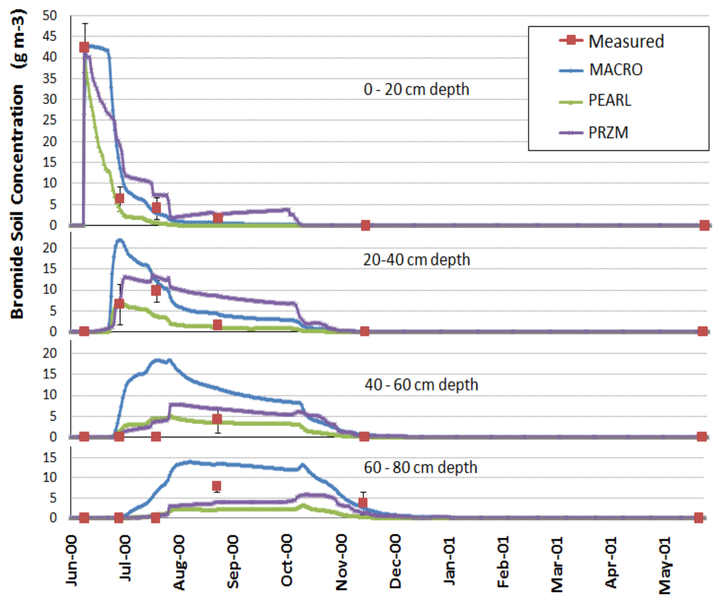

Fig.4 Bromide concentration simulation profiles (1st season)

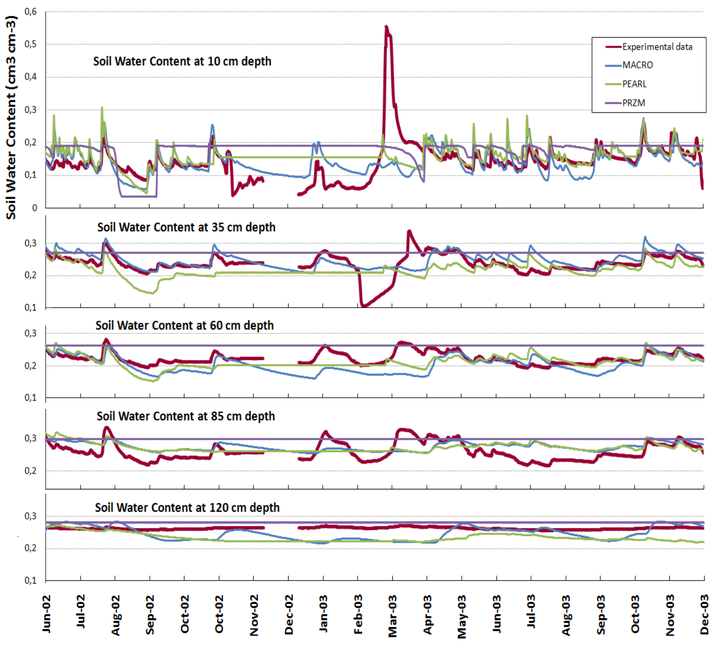

Fig. 3 Soil water content simulation profiles (2nd season)

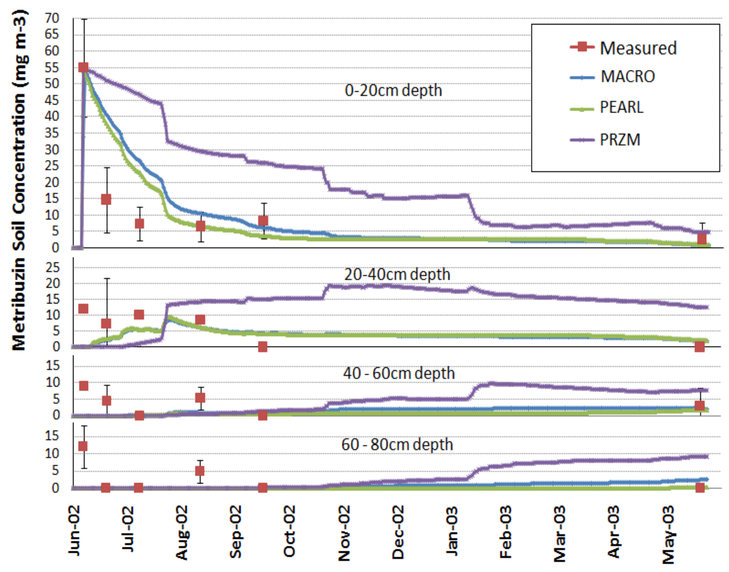

Fig.5 Metribuzin concentration simulation profiles (2nd season)

For metribuzin, PEARL and MACRO models simulated herbicide concentration with the same dynamics at each depth in both periods. PRZM had a tendency to over-predict the mean concentrations of metribuzin in the soil). profile (fig.5)

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CONCLUSIONS

- ✓ Although calibration of hydrodynamic parameters were performed for the three models, the particular cold climatic conditions of Norway were poorly simulated (soil temperature and water content dynamics during winter spring period).
- ✓ PRZM simulation of pesticide transfer differed largely from MACRO and PEARL

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