Pesticide field concentrations exceed FOCUS surface water predictions

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The application of pesticides to agricultural areas can result in transport to adjacent nontarget environments. In particular surface water systems are likely to receive agricultural pesticide input (Schwarzenbach 2006). When pesticides enter aquatic environments, they may pose a substantial threat to the ecological integrity of surface water systems. To minimize the risk to nontarget ecosystems the European Union prescribes an ecotoxicological risk assessment within the registration procedure of pesticides, which consists of an effect and an exposure assessment. The FOCUS surface water modeling approach is used in regulatory risk assessment to predict the frequency and magnitude of individual pesticide surface water concentrations (FOCUS 2001) and consists of four different tiers (step 1 - 4). To evaluate the quality and protectiveness of the FOCUS surface water modeling approach, we compared datasets of measured field concentrations of agricultural insecticides (Knäbel et al. in prep.; n = 466) and fungicides (Knäbel et al. 2014; n = 417) in surface water and sediments to respective predicted environmental concentrations calculated with FOCUS step 1-4. Measured field concentrations (MFC) were extracted from the scientific literature and were measured in field studies conducted primary in Europe. While FOCUS step 1 and step 2 predicted environmental concentrations (PEC) generally overpredicted the measured concentrations, 9% of the step 2 PEC surface water underestimated the respective insecticide field data. In step 3 and step 4, up to one third of the measured field concentrations were underpredicted by the model calculations, which questions the protectiveness of the model results. Furthermore, using realistic input data a higher amount of step 3 simulations underpredicted MFCs of insecticides in surface water and sediment compared to the standard calculations. This indicates that a higher degree of realism even reduces the protectiveness of model results. While no significant differences in the ratio of PEC and MFC in surface water between different substance classes were found for fungicides, pyrethroids had significant lower PEC/MFC-ratios than all other insecticide substance classes. In addition, no relationship between predicted and measured concentrations were found for insecticides and fungicides for all FOCUS steps. In conclusion, the study results show that the FOCUS modeling approach is neither protective nor appropriate for predicting fungicide and insecticide concentrations in the field in the context of the European regulatory risk assessment.