Comment on "Regulatory FOCUS Surface Water Models Fail to Predict Insecticide Concentrations in the Field", Knäbel et al., EST, 2012.

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Comment on "Regulatory FOCUS Surface Water Models Fail to Predict Insecticide Concentrations in the Field"

Knäbel et al.[1] extracted 122 measured field concentrations (MFCs) of insecticides in surface waters and sediment from 22 field studies and compared the MFC with predicted environmental concentrations (PEC_{sw}, PEC_{sed}) modeled by FOCUS steps 1−4. The authors interpret the frequency and magnitude of MFC underestimation by FOCUS PECs and conclude that "the FOCUS modeling approach is not protective for insecticide concentrations in the field".

A critical review of the 22 field studies in detail suggests that a substantial number of these studies are not qualified to provide suitable MFCs. In the studies (1), (2), (5), (8), (14), and (22) (reference numbers in brackets refer to the list given in the Supporting Information for ref 1) the insecticide river input was not only caused by runoff, drainage and/or spray drift deposition, but other main sources of insecticide input into the sampled rivers are mentioned in the publications such as farmyard runoff, irrigation return water, wash-off from roads along the fields or structural pest control. River bed sediments of (4), (8), (11), and (17) are sampled from 0 to 3 cm depth or less, while the model TOXSWA averages the PEC_{sed} over 0−5 cm. While the substance concentration regularly decreases with sediment depth a shallower sampling leads to a higher MFC. Ref (13) contributes 22 of the 122 MFCs in total, but the publication presents only poor information on water and sediment sampling. The relevance and the suitability of the 22 MFC cannot be judged seriously. In (20), MFCs for chlorpyrifos and Tau-fluvalinate are not given in the publication, and MFC for bifenthrin is reported for suspended sediments, but not for stream bed sediment. (21) monitored the fruit growing region ″Altes Land″ (Germany) which is explicitly not covered by the FOCUS spray drift scenarios due to its particular landscape structure. Moreover, in the Altes Land there are special derogation rules from the national pesticide application regulations (e.g., narrower no-spray zones).

Additionally the MFC selection strategy "only the peak concentrations that originated from different entry events were classified a separate events"[1] leads to a distinct bias in the data collection. Neglecting events with measured concentrations below the overall peak concentration and especially all concentrations below the detection limit, the comparison between MFCs and PECs do not fulfill the recommendations for an independent model test. Model validation should be based on a data set (here: on a set of runoff events from different fields, crops, weather situations, application dates, river sites etc) which is collected stochastically and spreads over the entire range of monitored concentrations including concentrations <DL. Only by such a kind of population of sampled events including measured results <DL the degree of over- or underestimation of MFCs by modeled PECs can be judged statistically. This problem of data exclusion concerns nine studies, for example, in (3) 18 streams were sampled at one runoff event thereof only the three concentrations >DL are selected as MFC, 15 results "n.d." were not listed as MFCs and do not count for the over- or underestimation of FOCUS PEC_{sw}. However, since these are independent data points they must be considered. Another noticeable case of selectivity gives study (18) where 12 results (2 substances × 2 sites × 3 events) with three values >DL are reported, but only one MFC is used for the FOCUS comparison.

Furthermore only 8 of the 22 studies are in fact from the EU, the monitoring data include 14 studies that are from the U.S., Canada, Argentina, or South Africa. The environmental conditions here can be very different from those in Europe and, while it is possible to correlate soil and environmental characteristics to those of Europe, it is not straightforward and much more information would be needed to check that the studies used are actually relevant and correlate well to the FOCUS scenario used. Ignoring all above specified studies only three studies (no. 3, 12, 19) remain with 17 MFCs in water for two insecticides and none for sediment.

Knäbel et al.[1] describe the parametrization of their FOCUS step 1−4 model calculations not in detail, especially not for the step 3 realistic modeling. Thus it is not possible for the reader to check the evidence of the FOCUS modeling adopted to the agro-environmental situation and water body characteristics of the respective field study, and to reproduce the calculated PECs. Even in the additional data of Table S4 (Supporting Information for ref 1), the vital information is omitted as to which FOCUS scenario each study has been assigned. The data in Table S4 shows that for studies (5), (6), (15), (17), (18), (19), and (21) the base flow has been changed, presumably to "fit" the local data. When developing the FOCUS water body scenarios, the base flow component of each water body was derived using the FOCUS soil type HOST coefficients[2] relating to Base Flow Index (BFI) and Mean Annual Minimum 7-day flow (MAM7). If these do not fit the local data well, it suggests that the FOCUS scenario used is incorrect (mainly from the soil point of view) or that it cannot be well correlated with the FOCUS scenarios. The lack of any mention of the soil types associated with any of the field studies or, indeed, related to the FOCUS scenarios seems a big omission.

We agree with the statement by Knäbel et al.[1] "that the FOCUS modeling approach is not reliable in predicting insecticide concentrations when compared to real world surface water situations", but for other reasons. Several weakness of the FOCUS approach are described in literature, for example, (i) the Curve Number method is not appropriate for calculating edge-of-field surface runoff volumes;[3] (ii) erosion inputs are underestimated by the FOCUS model concept; and (iii) FOCUS does not use the entire simulation period of MACRO (7.3 yr) and PRZM (20 yr), respectively, for PEC_{sw} calculation in TOXSWA, but only a period of 16 months (MACRO) and 12 months (PRZM). Klein[4] points out that this period does not cover the total variance of the yearly concentration maxima

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over 20 years and thus may underestimate the PEC_{sw} significantly.

In summary, the majority of field studies used by Knäbel et al.[4] and the methodology they employed are not suitable to evaluate the validity or protectiveness of the FOCUS surface water approach. The conclusions drawn by the authors can therefore not be considered as valid.

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Notes

The author declare no competing financial interest.

REFERENCES

(1) Knäbel, A.; Stehle, S.; Schäfer, R. B.; Schulz, R. Regulatory FOCUS surface water models fail to predict insecticide concentrations in the field. *Environ. Sci. Technol.* **2012**, *46*, 8397−8404.

(2) Boorman, D. B.; Hollis, J. M.; Lilly, A. *Hydrology of Soil Types: A hydrologically-based classification of the soils or the United Kingdom*, Report No. 126; Institute of Hydrology: Wallingford, UK, 1995, 137 pp.

(3) Garen, D. C.; Moore, D. S. Curve number hydrology in water quality modeling uses, abuses, and future directions. *J. Am. Water Res. Assoc.* **2005**, *41*, 377−88.

(4) Klein, M. Long term surface water simulations with STEPS-1-2-3-4. In *Environmental Fate and Ecological Effects of Pesticides*; DelRe, A. A. M., Capri, E., Fragoulis, G.; Trevisan, M.; 13th Symposium Pesticide Chemistry, Piacenza, Italy, 3−6 September 2007. **2007**, 950-957.