A case study of SYNOPS-WEB application and evaluation using pesticide concentrations from a Norwegian catchment

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SYNOPS-WEB

- A field-based, online tool to assist farmers and advisors in environmental risk assessment and selection of appropriate mitigation measures at field-level under realistic conditions.
- Uses **PRZM5** (Suárez, LA, 2006, *EPA/600/R-05/111. USEPA*) to calculate loads from surface runoff and erosion.
- http://synops.julius-kuehn.de/ - includes a Norwegian version with registered pesticides products and crops appropriate for Norway.

Monitoring data 2007-2011 for evaluation

- The Skuterud catchment, south of Oslo, roughly 450ha, discharges its contents into the Østensjøvann lake (*Fig.1*).
- Long-term pesticide monitoring is carried out by the **Norwegian Institute of Bioeconomy Research (NIBIO) (JOVA; www.nibio.no/jova)**
  - The monitoring from 2007 to 2011 via flow proportional sampling included 116 pesticides. Average sampling period was 18.2 days.
  - 41 different pesticides were applied on the fields, of which 10 were detected in the stream. 7 were used for validation as the other 3 were found only once.

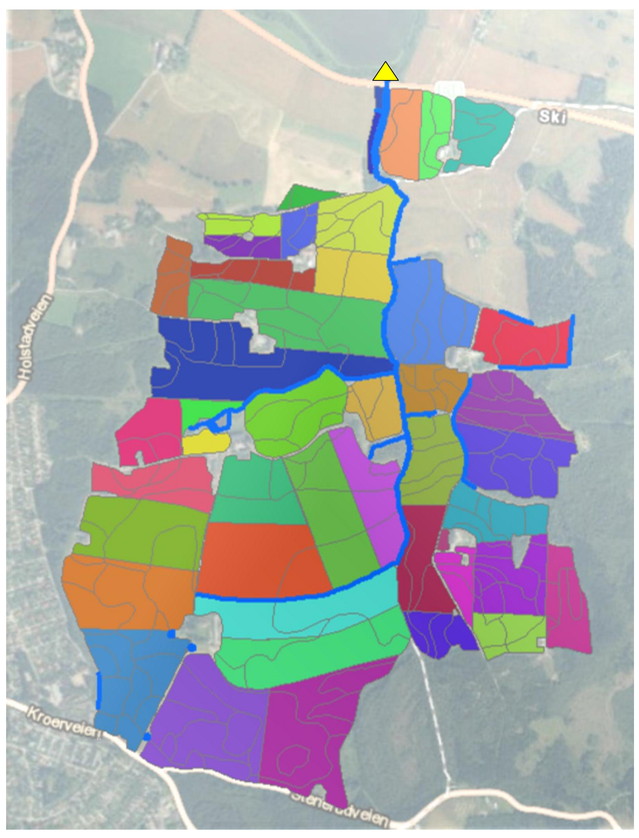


Fig.1 (Left) Skuterud catchment showing the field shapes (*unique colours*) and the surface water (*blue*). The lake into which the stream drains is to the North of the catchment. The monitoring location is marked by the *yellow* triangle (just before the stream drains into the lake).

The *grey* polygons are soil polygons, of which the soil type with the maximum coverage for a given field was used for SYNOPS-WEB simulations.

Application patterns were simulated for 46 fields . The stream dimensions were fixed at 6000*1*0.3 m (l*b*d).

SYNOPS-WEB: input data and simulations

- Soil data was derived from the digital soil map of Norway and weather data from Ås (Agrometeorology Norway).
- Physical and chemical parameters for the pesticide active ingredients are from the Pesticides Property Database (PPDB) (Lewis et. al. *Human & Eco Risk Assess: An Intl J. 2016, 22, 4).*
- Default values from the EU-FOCUS Jokioinen SW scenarios were used as PRZM5 input values where necessary.
- Pesticide application data 2007-2011 for each field in the catchment was supplied from the pesticide monitoring.
- Pesticide loadings of the surface water caused by drift , run-off and erosion were modelled on a daily basis. The latter two were calculated with PRZM5 while drift was based on a distance function.

Validation

- Pesticide loads and concentration are calculated, by default, for a fixed volume of water and the risk for a given site scenario and application pattern is assessed.
- For this study, the loads were deposited in an estimated daily flow volume in the stream that is more realistic.
  - Assuming a stream velocity of 0.18m/s and a stream volume of 1.8 million L, a constant daily flow volume of 4.6 million L down the stream was estimated.
  - Being a flowing body of water, pesticide concentrations are set to zero at the start of each day.
- Modeled loads that were in the order of *1E-3 to 1E-15* were reduced to 0, for validation purposes.
- 3 of the 7 chemicals considered showed reasonably good correlations with measured concentrations (*Fig2a & 2b*).

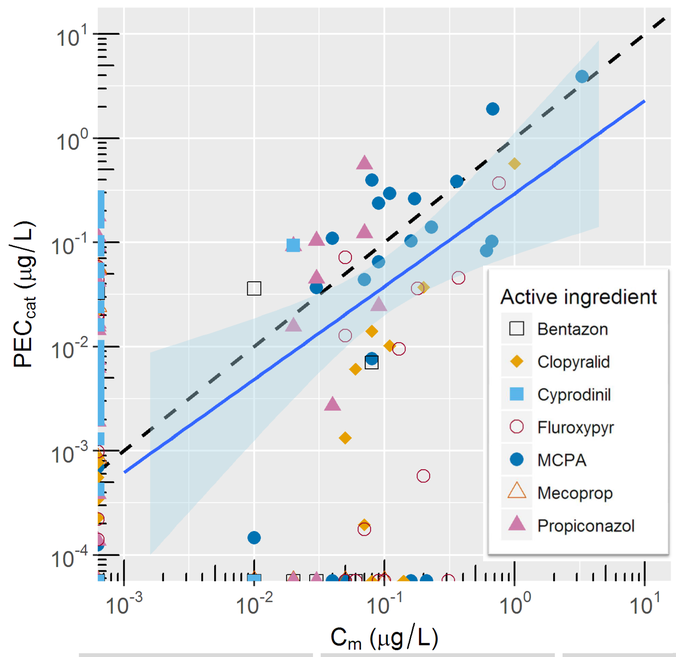
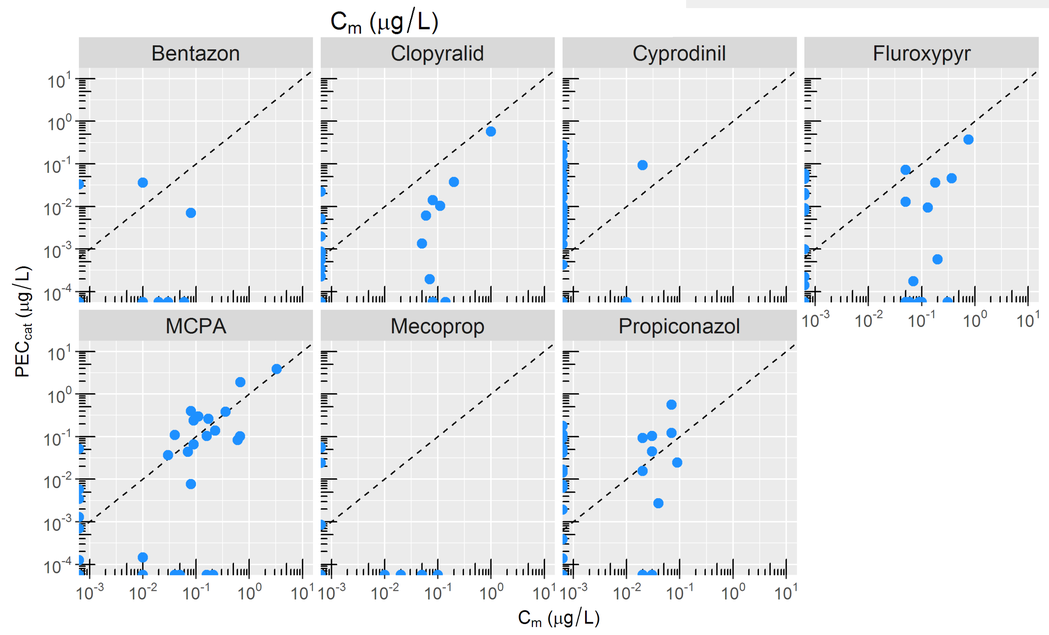


Fig.2a (Left) Plot of measured concentration, C_m (µg/L) against predicted environmental concentration, PEC_{cat} (µg/L) showing all 7 chemicals used for validation. The axes are log-scaled. The black dotted line is the 1:1 line and the solid blue line, the regression line.

Fig.2b (Below) Plot of the same data as *Fig. 2a*, with each ingredient in a separate panel. The zero values lie on the axes due to the log-scaling.



Summary

- We have evaluated the performance of SYNOPS-WEB for use in Norway using 5-year monitored data from a closed catchment.
- Strong correlations were found between modelled and monitored concentrations.
- Long-term monitoring of water bodies is crucial to assess trends in risk to water quality from pesticide use.
- SYNOPS-WEB enables retrospective risk assessment of an application pattern based on realistic field conditions.
- It allows the end user to adjust site-specific input parameters to better reflect field conditions and to assess risk under different mitigation measures to choose the most optimal strategy.