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Spatio-temporal analysis of PECs in edge-of-field watercourses exposed to spray drift in fruit growing in NL

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Background

Recently, a model for spray drift deposits next to pome fruit orchards has been developed. The model is implemented in a countrywide exposure assessment model to estimate the risk of exposure to pesticides for aquatic organisms in edge-of-field watercourses next to pome fruit orchards in the Netherlands.

Objective

To define and parameterise representative scenarios as countrywide monitoring situations using spatio-temporal analysis.

Introduction

A set of representative scenarios was defined to cover spray application schemes in practice (Fig.1, Table 1). Spray drift deposits and predicted environmental concentrations (PECs) were computed for these scenarios in a probabilistic exposure assessment study, for edge-of-field watercourses next to apple tree orchards.

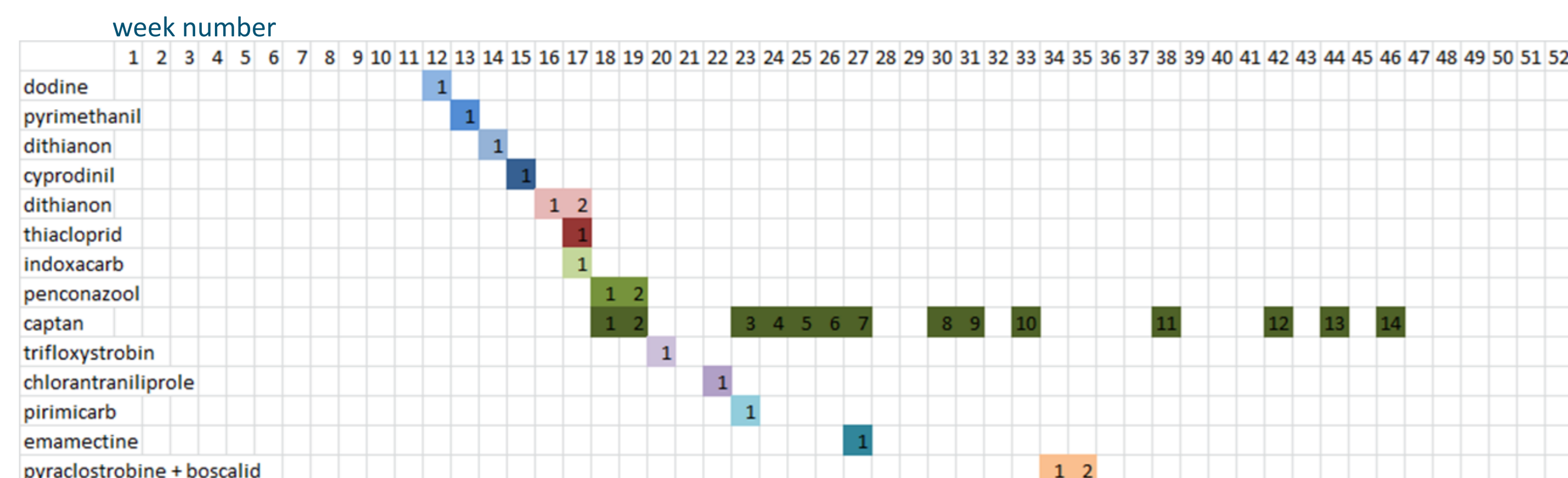**Figure 1.** Typical spray application plan for apple tree orchards in NL.

Table 1. Definition of basic scenarios in countrywide simulations

scenario index	E1	L1	E3f	L3f	S15f
# spray applications	1	1	3	3	15
application month	May	Aug	May	Sep	Jun-Sep
pesticide dissipation	n/a	n/a	fast	fast	fast

Methods

The countrywide simulations involved all possible combinations of spatial variables (in discrete steps) and many repetitions in time (selecting temporal variables from continuous probability functions). Spatial variables are listed in Table 2, temporal variables in Table 3.

Table 2. Spatial variables and their number of values

Spatial parameters	Number
districts	14
watercourse types	44
water levels	9
orchard orientations	18
orchard side with watercourse	4

Table 3. Temporal variables

Temporal parameters
canopy density
wind speed
wind direction
ambient temperature

Acknowledgements

Results

- *Countrywide* simulations were carried out for different scenarios, crop-free zones and drift-reducing application techniques (DRTs).
- Different scenarios yield different overall PEC_{90} values.
- Spatio-temporal analysis shows which configurations are close to overall-PEC_{90}.
- A *single spatial configuration* could be selected to represent the 90th percentile exposures risk for all scenarios.
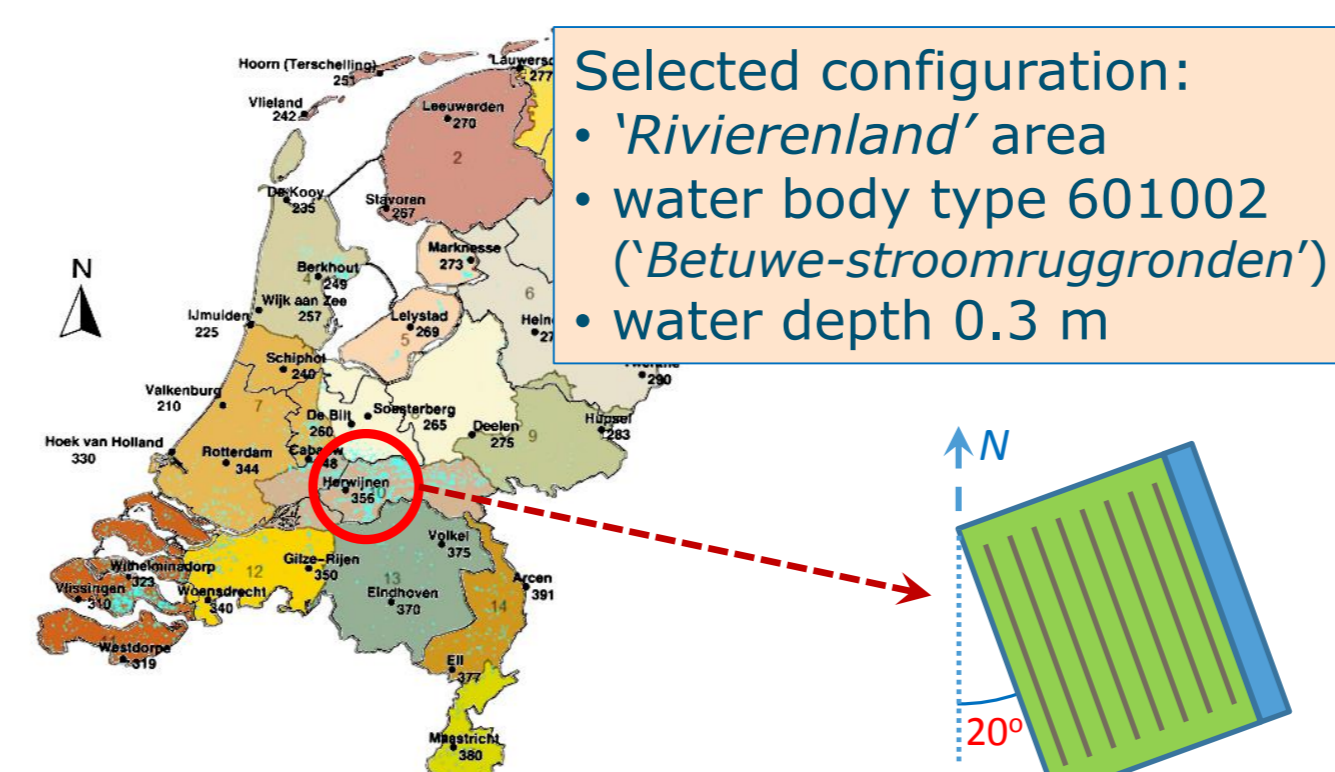

Figure 2. Cumulative probabilities leading to different PEC_{90}s for different scenarios; countrywide.
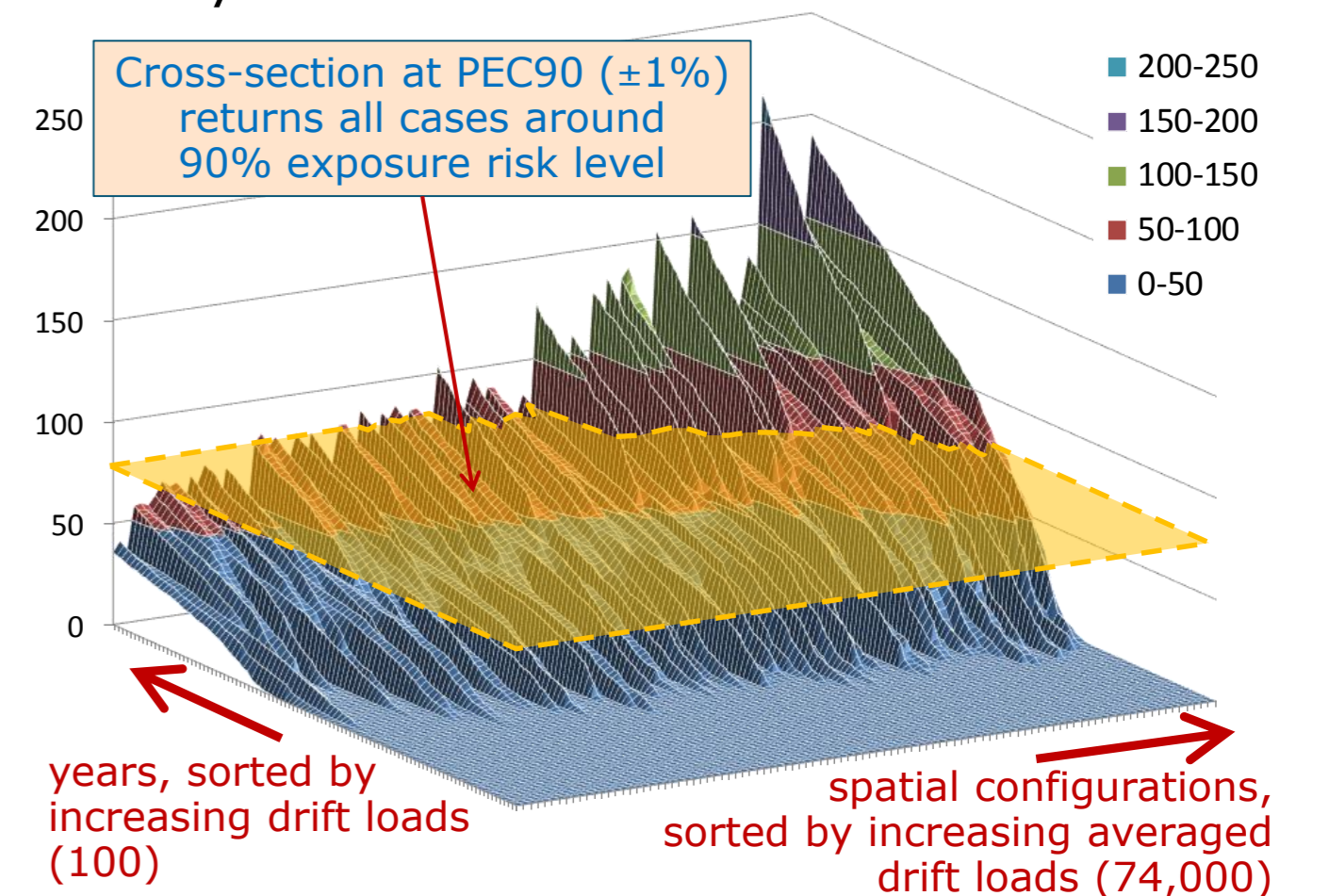
Figure 3. Spatio-temporal plot of PECs with cross-section at overall 90%, E1 scenario.

Figure 4. Spatio-temporal plot of PECs with cross-section at overall 90%, S15f scenario.

Selected configuration:
- 'Rivierenland' area
- water body type 601002 ('Betuwe-stroomruggronden')
- water depth 0.3 m

Figure 5. Selected spatial configuration.

- *Local* simulations for the *selected* configuration yield temporal percentiles (T_{90}) to represent the overall PEC_{90} levels.
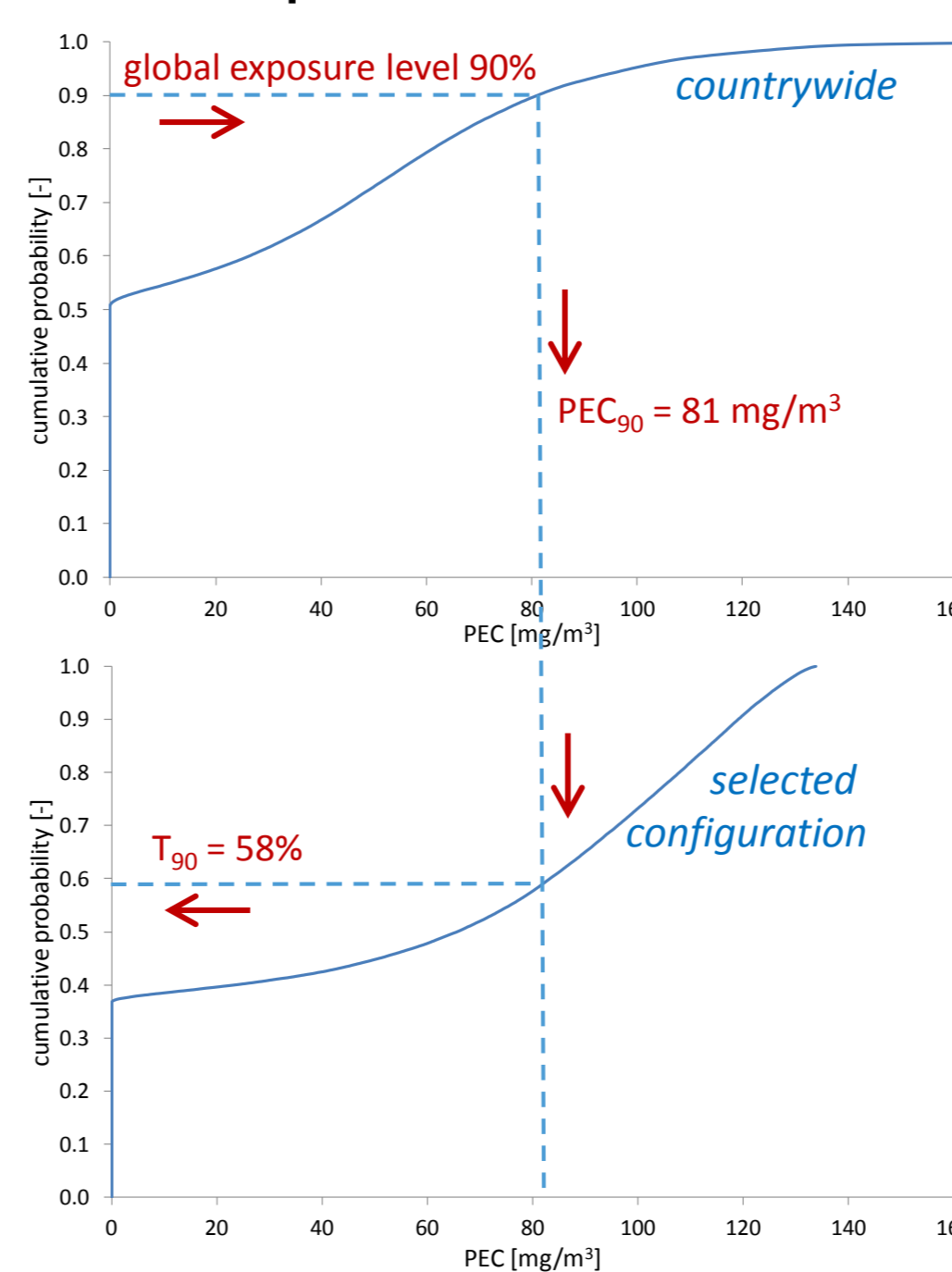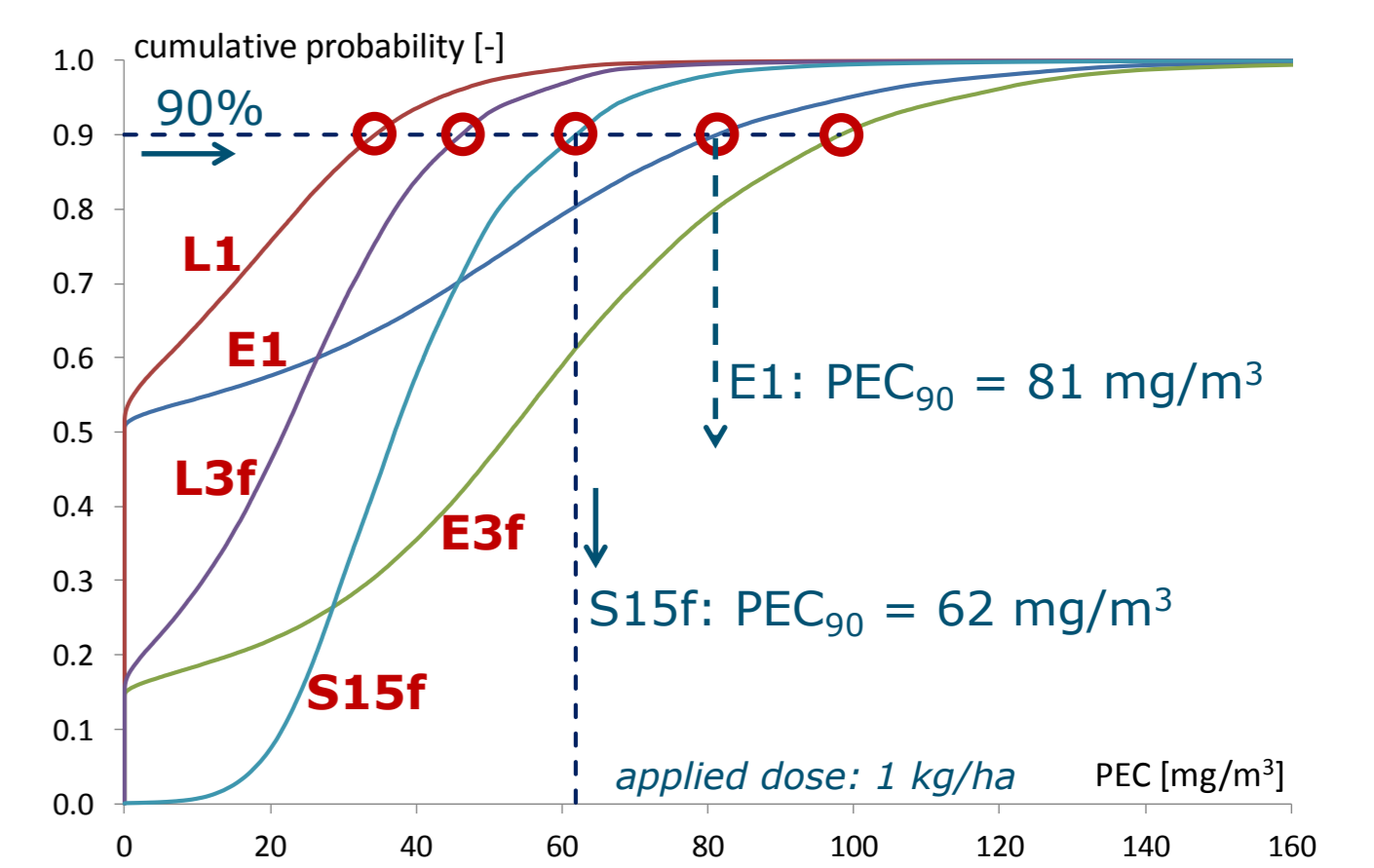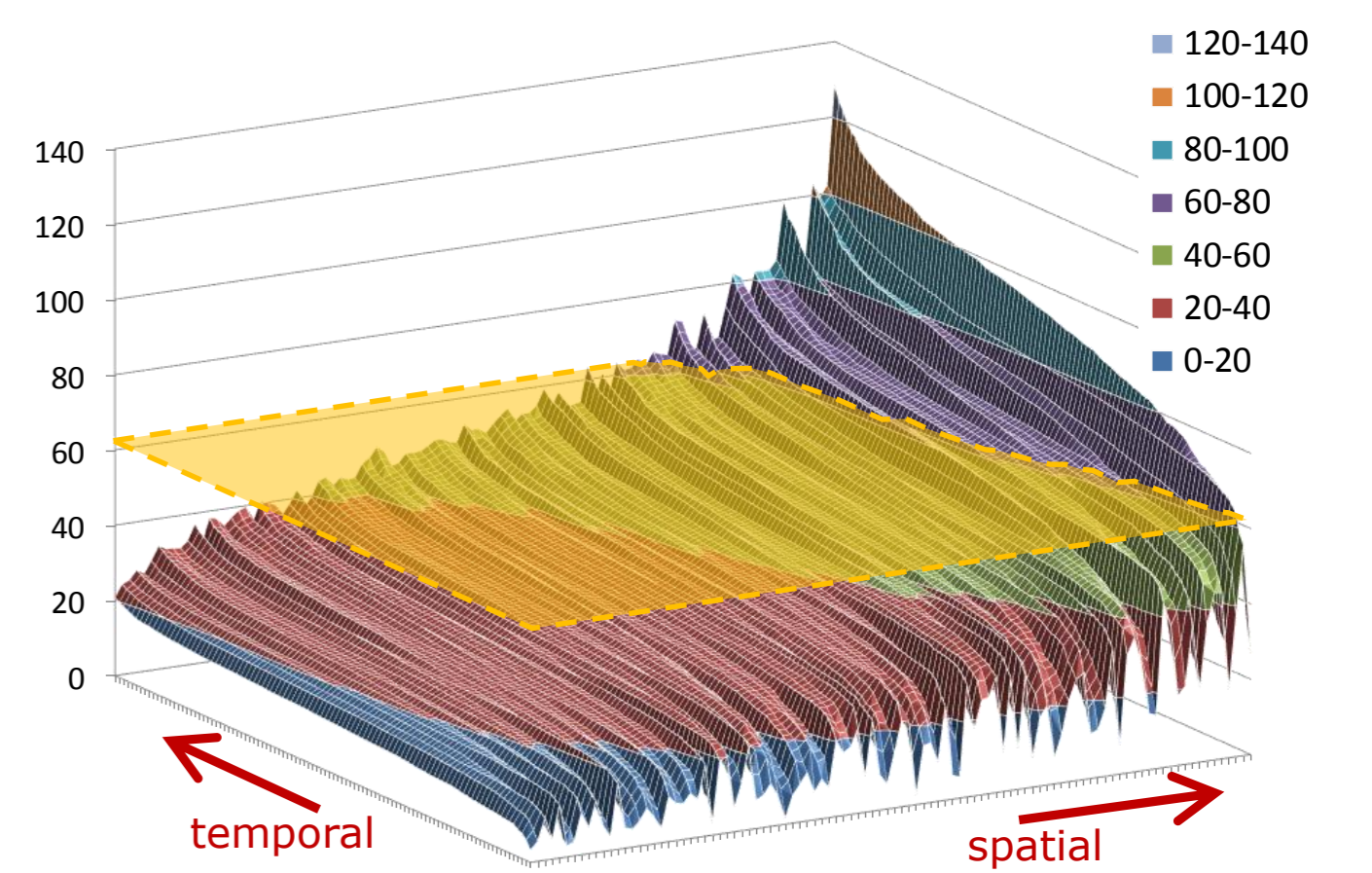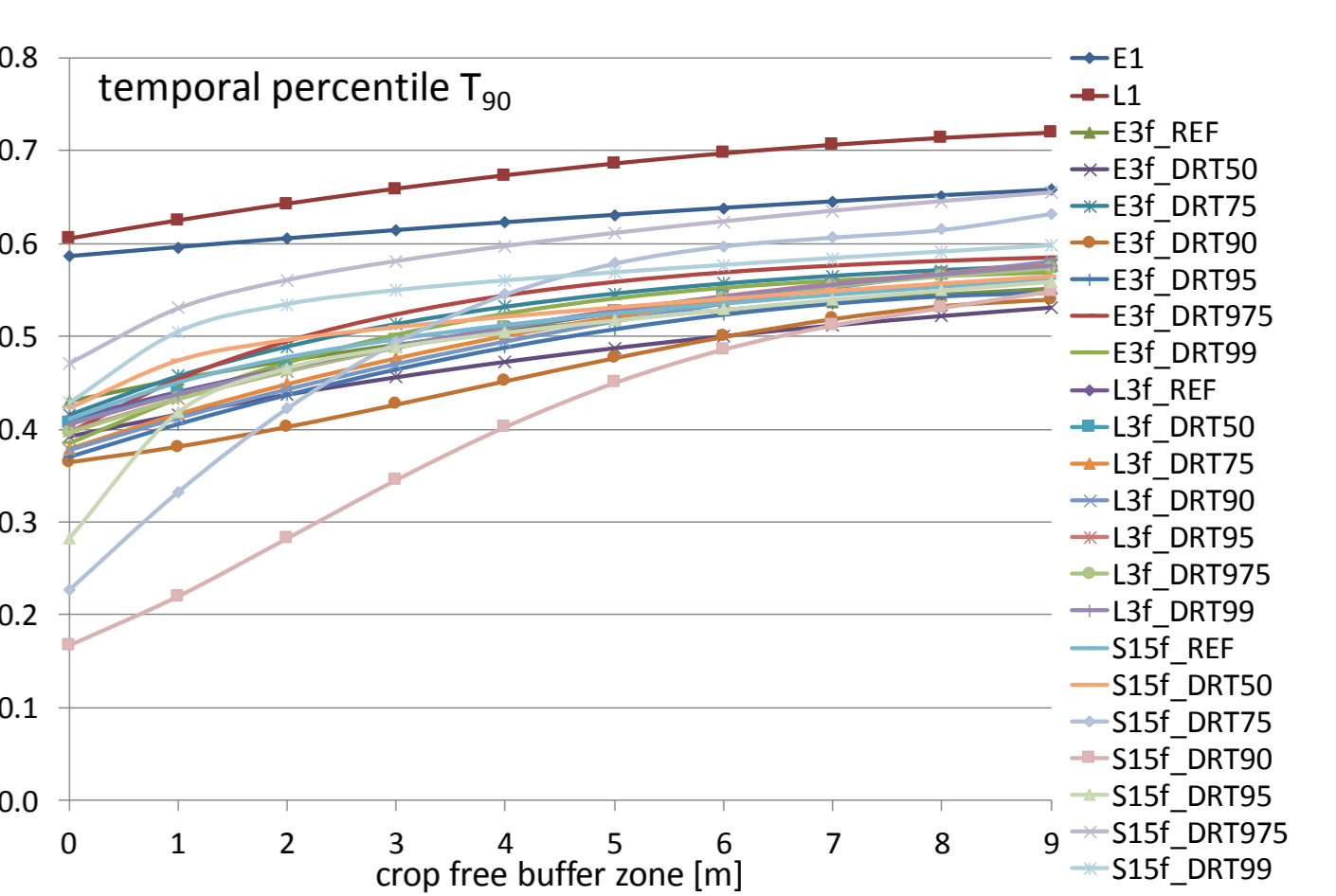- T_{90} depends on scenario type, DRT and crop-free buffer zone.

Figure 6. Deriving local T_{90} to represent countrywide PEC_{90} level; scenario E1.

Figure 7. Temporal percentiles for selected spatial configuration, representing 90% countrywide risk levels.

Conclusions

- Using spatio-temporal analysis, a single spatial configuration could be found to represent the 90th percentile exposures risk for all basic scenarios in pesticide spraying in pome fruit orchards in NL.
- Different temporal percentiles have been derived for the selected configuration, for all scenarios, DRTs and crop-free buffer zones.
- Results have been implemented in a countrywide exposure assessment model for edge-of-field watercourses.