Outdated Forecasts: Climate Drift and the Future of Pesticide Risk Models

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Figure 1. Climate trends at Okehampton over 1979–2024 from the MARS dataset, with annual rainfall (top) and temperature (bottom) exhibiting clear long-term increases as shown by trend lines.

European PPP risk assessments depend on FOCUS scenarios built from historical climate data, yet observed conditions have warmed and become wetter, as shown for Okehampton. This climatic drift may alter pesticide degradation, run-off and leaching behaviour, undermining the representativeness of current model inputs. The key problem is determining whether FOCUS weather files remain fit for purpose and how often they must be updated to maintain regulatory reliability.

KEY MODELLING ASSUMPTIONS

Simulations performed using FOCUSgw PEARL (v5.5.5), the regulatory leaching model required under EU pesticide authorisation. FOCUSgw PEARL simulates the one-dimensional vertical transport of a pesticide and its metabolites through soil to groundwater, accounting for sorption, degradation, and water flow driven by local weather. The model is run for a standardised crop and location scenario; the resulting annual average concentration is compared against the 0.1 µg/L drinking water standard to determine regulatory acceptability. In the present work, the standard FOCUS scenario for Okehampton was modeleld using two climatic datasets: the standard historical weather series currently applied in regulatory risk assessments and the most recent observed meteorological data reported for Okehampton (Toreti, 2026). Crop and soil parameters were the regulatory standard in both sets of modelling, allowing a direct comparison of leaching predictions under historical and current climatic conditions.

Crop	Application date	BBCH stage
Winter cereal (WCER)	Apr 21, 2026	BBCH 30
Maize	Jun 12, 2026	BBCH 30
Potato	Apr 15, 2026	BBCH 30
Spring cereal (SCER)	Apr 22, 2026	BBCH 30
Beans	May 5, 2026	BBCH 28

Kom (L/kg)	DT50 = 15 d	DT50 = 30 d	DT50 = 60 d
0.1	parent_1_15	parent_1_30	parent_1_60
0.2	parent_2_15	parent_2_30	parent_2_60
0.3	parent_3_15	parent_3_30	parent_3_60
0.4	parent_4_15	parent_4_30	parent_4_60
0.5	parent_5_15	parent_5_30	parent_5_60

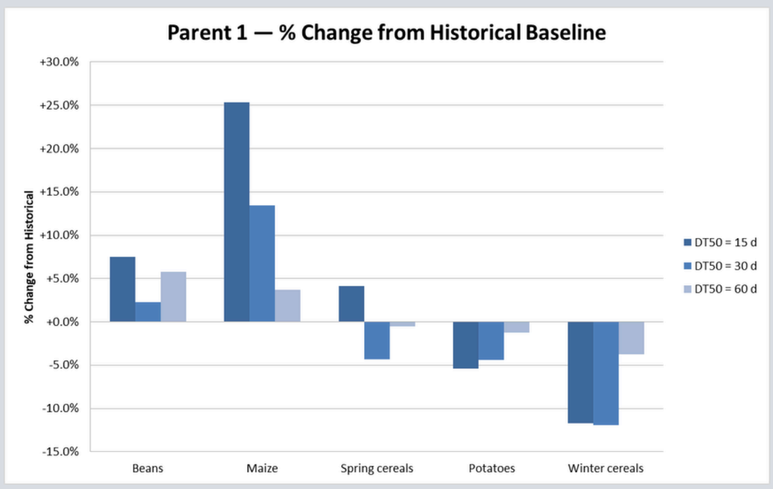
Shared physicochemical properties (all 15 Illustrative compounds):
Mol. mass: 470 g/mol Vapour pressure: 3.05×10^{-8} Pa (20°C) Water solubility: 1630 mg/L (20°C) Ea: 65.4 kJ/mol ΔHvap: 95 kJ/mol

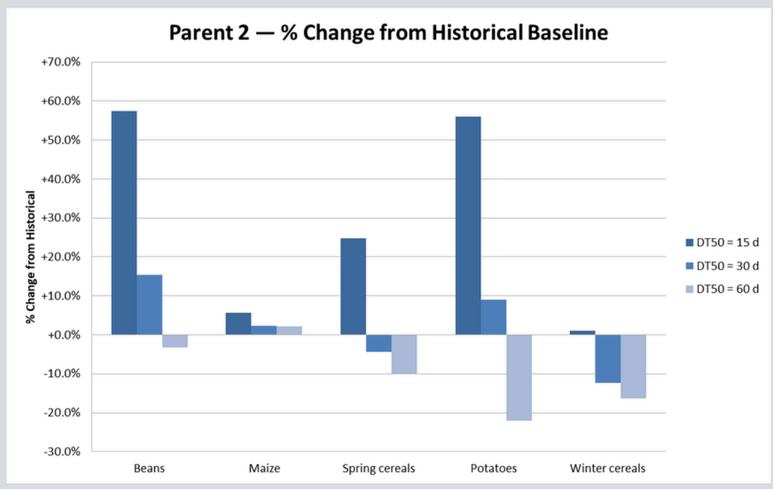
- Linear sorption isotherm (Freundlich exponent = 1.0); equilibrium assumed
- Degradation temperature correction: Arrhenius (Ea = 65.4 kJ/mol; ref. temp. 20°C)
- Standard FOCUS foliar dissipation and wash-off parameters applied
- 80th-percentile annual average concentration ($AANC_{80}$) extracted at 1 m depth
- Historical data modelled alongside the latest data reported for Oakehampton

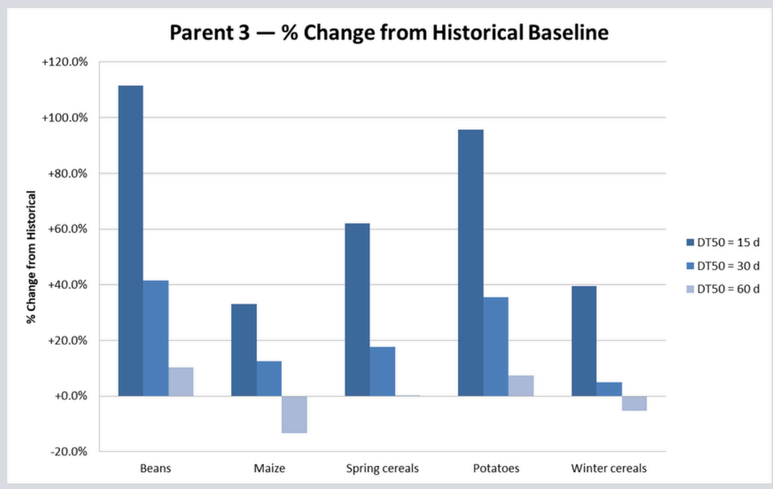
FINDINGS

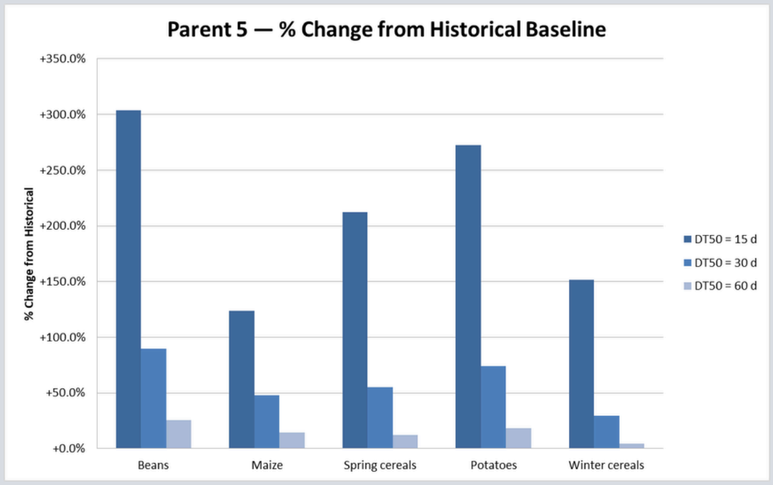
The values presented below reflect the 80th-percentile annual average concentration at 1 m soil depth, the regulatory endpoint extracted from FOCUSgw PEARL output. Percentage changes compare the values predicted under the recent Oakehampton climate to the historical baseline value, which is treated as 100%. A positive change indicates that current climate conditions drive higher predicted concentrations at 1 m depth than the historical standard; a negative change indicates the historical scenario is conservative relative to current conditions.

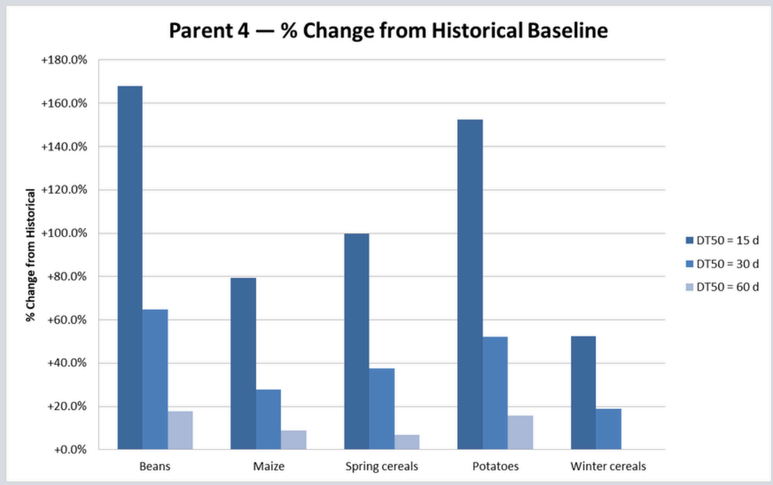
Under EU Regulation 1107/2009, a predicted concentration exceeding 0.1 µg/L at a depth of 1 m is the trigger for regulatory concern. A shift in predicted concentration driven purely by climate change, with no change to the compound or use pattern, therefore has direct implications for whether an authorisation granted under historical FOCUS climate would remain valid under current conditions.











The climate sensitivity of FOCUS PEARL leaching predictions varies systematically with Koc.

- At low Koc (0.1 - 0.2), recent climate reduces predicted leaching. For high-pressure crops like potatoes and winter cereals, this means the historical standard is over-conservative: it blocks products that would pose no real risk under today's climate.
- At moderate-to-high Koc (0.3 - 0.5), the pattern reverses sharply. Recent climate increases predicted leaching by up to 300%, with the largest shifts at short DT50 (15 d) mechanistically coherent, as fast-degrading moderately-sorbing compounds are most sensitive to episodic rainfall timing.
- The regulatory implication is not model failure but baseline obsolescence: FOCUS historical climate is simultaneously over-conservative for mobile compounds and under-conservative for moderately sorbing ones. Products near the 0.1 µg/L threshold in either direction may be misclassified under current assessment conditions.

CONCLUSION

As the regulatory landscape shifts toward refined models and contextualised risk assessment, it is critical to recognise that conservative FOCUS assumptions lack not only spatial precision but are increasingly based on climatic conditions that no longer reflect reality.

While tiered screening tools remain essential, even modest updates to input conditions, such as substituting historical climate records with recent observations, can substantially alter predicted outcomes and, by extension, regulatory decisions.

This has consequences in both directions: compounds blocked under outdated conservative assumptions may pose no real-world risk, while others passing current screens may present underestimated exposure under present-day conditions.

As modelling frameworks evolve, periodic re-evaluation of foundational scenario parameters is a regulatory necessity.

Toreti, Andrea (2026): Gridded Agro-Meteorological Data in Europe. European Commission, Joint Research Centre [Dataset] doi: 10.2905/JRC.WG6925R PID: http://data.europa.eu/89h/jrc-marsop4-7-weather_obs_grid_2019