Statistical Ecotoxicology - Improving the utilization of data for ecological risk assessment

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Landau, 22.09.2016

My field of research is somewhere between...

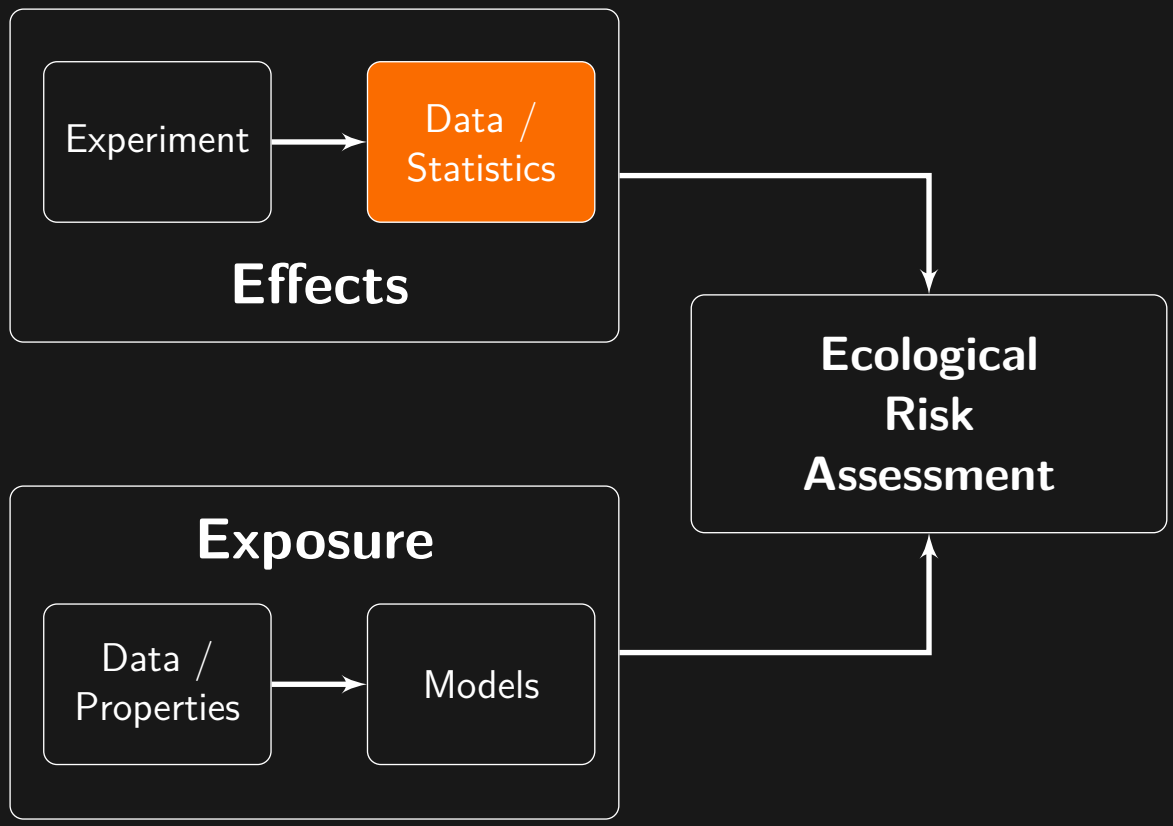
... Eco(-toxico)logy, Data Analysis & Programming

Statistical Ecotoxicology

Current use in ecotoxicology

- Ecological risk assessment heavily relies on statistics

- Usually analysed using Linear Models of transformed data
- Null Hypothesis Significance Testing (=> NOEC)



Current use in ecotoxicology

- Ecological risk assessment heavily relies on statistics
- Experiments with low replication
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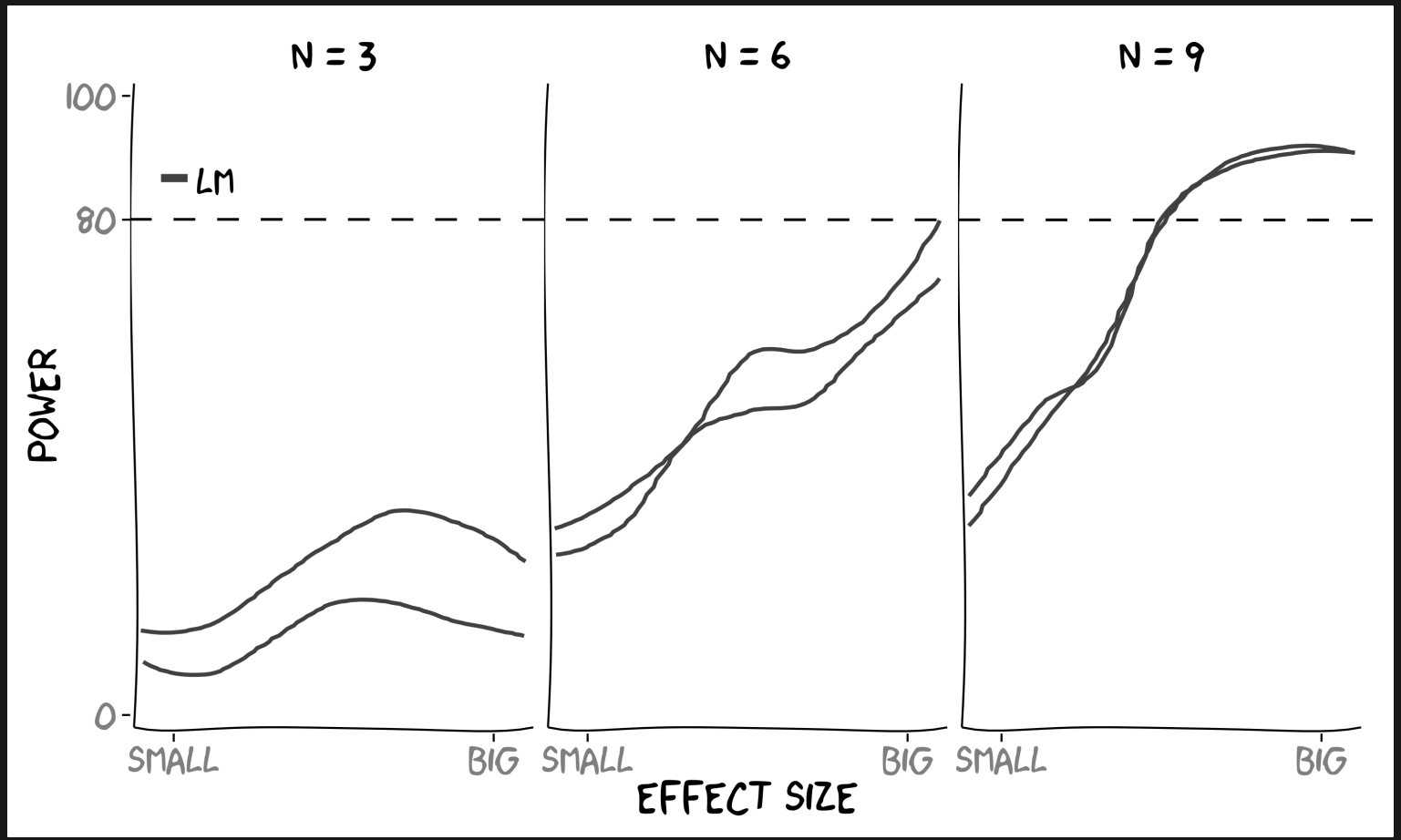
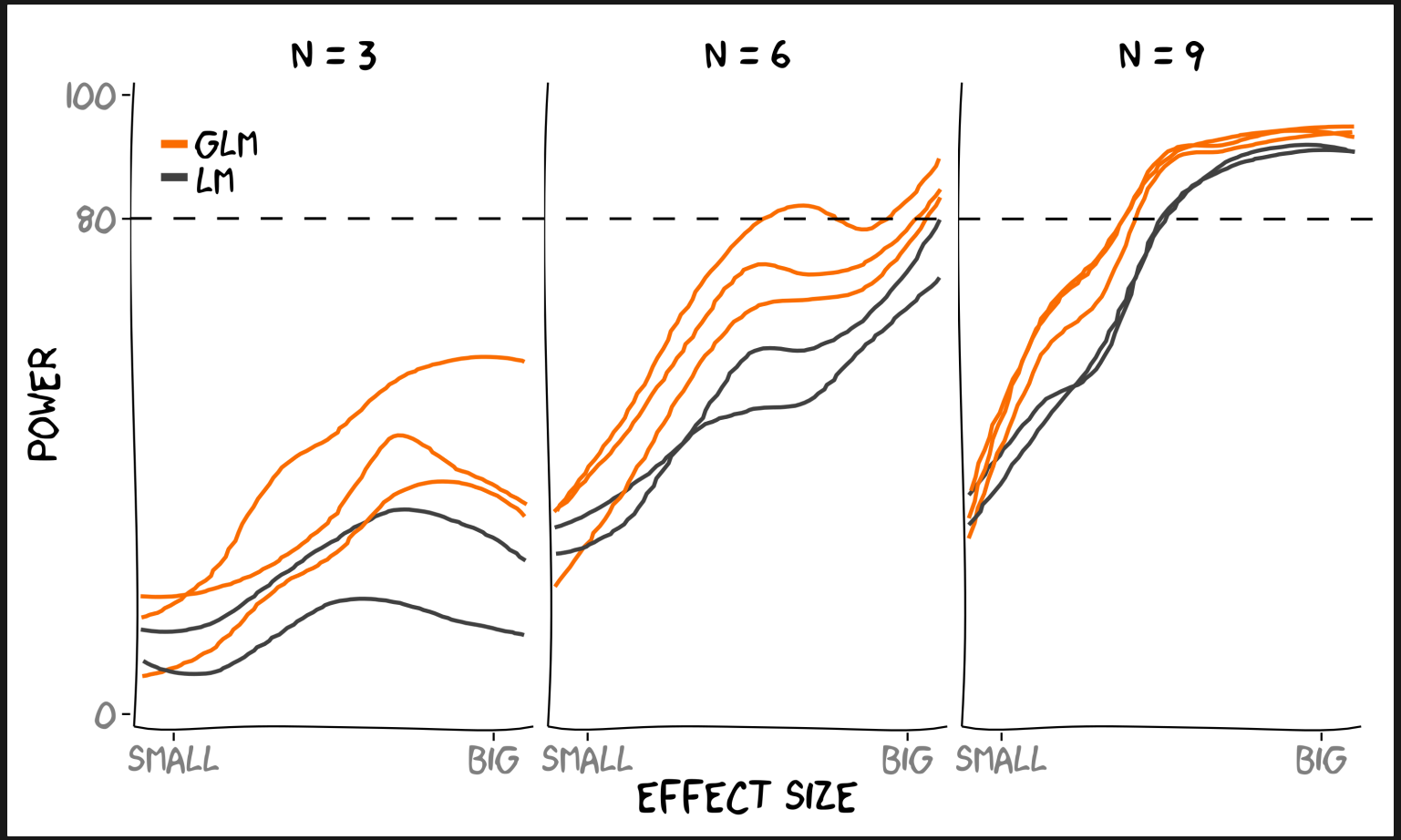
Statistical Power in current experimental designs in ecotoxicology is unacceptably low



Generalized Linear Models can do better



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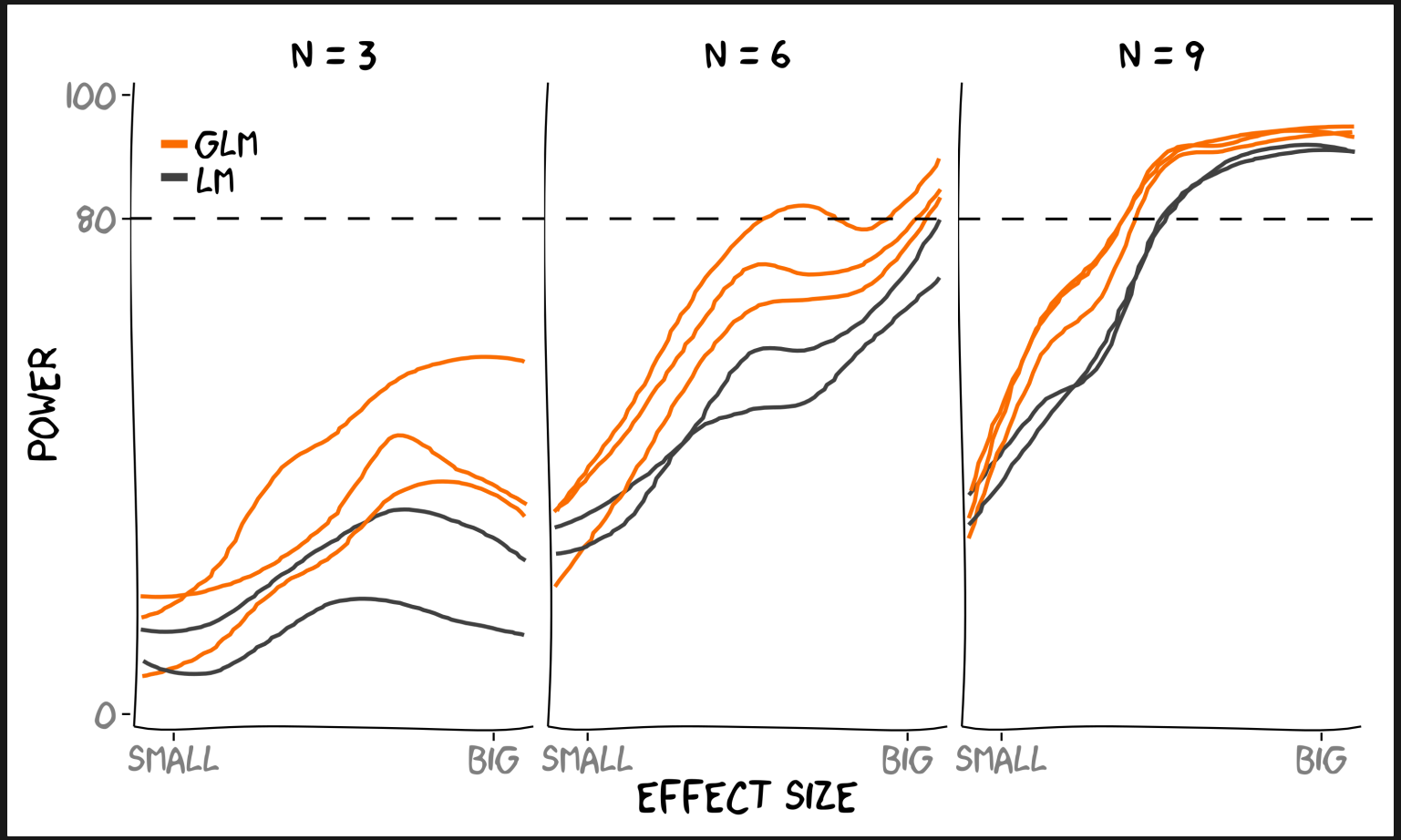

Better abandon NOEC and use a regression design [1]...

[1] debated since 30 years.

Monitoring Data

aaa

Software

Biologists and Chemists face similar problems...

Names

Osmia rufa, *Osmia bicornis*,
Osmia ruffa, *Osmia unilandauis*,
Osmia spec.

Chlorpyrifos, Chlorpyriphos,
Chlorphyrifos, Chlorpyrifos-ethyl,
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Hymenoptera/ Apoidea/ Megachilidae/ Osmia/ rufa

organophospate, ester, insecticide

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2921-88-2, Clc1c(OP(=S)[...], InChI=1S/C9H11C[...], SBPBAQFW[...], CSID,...

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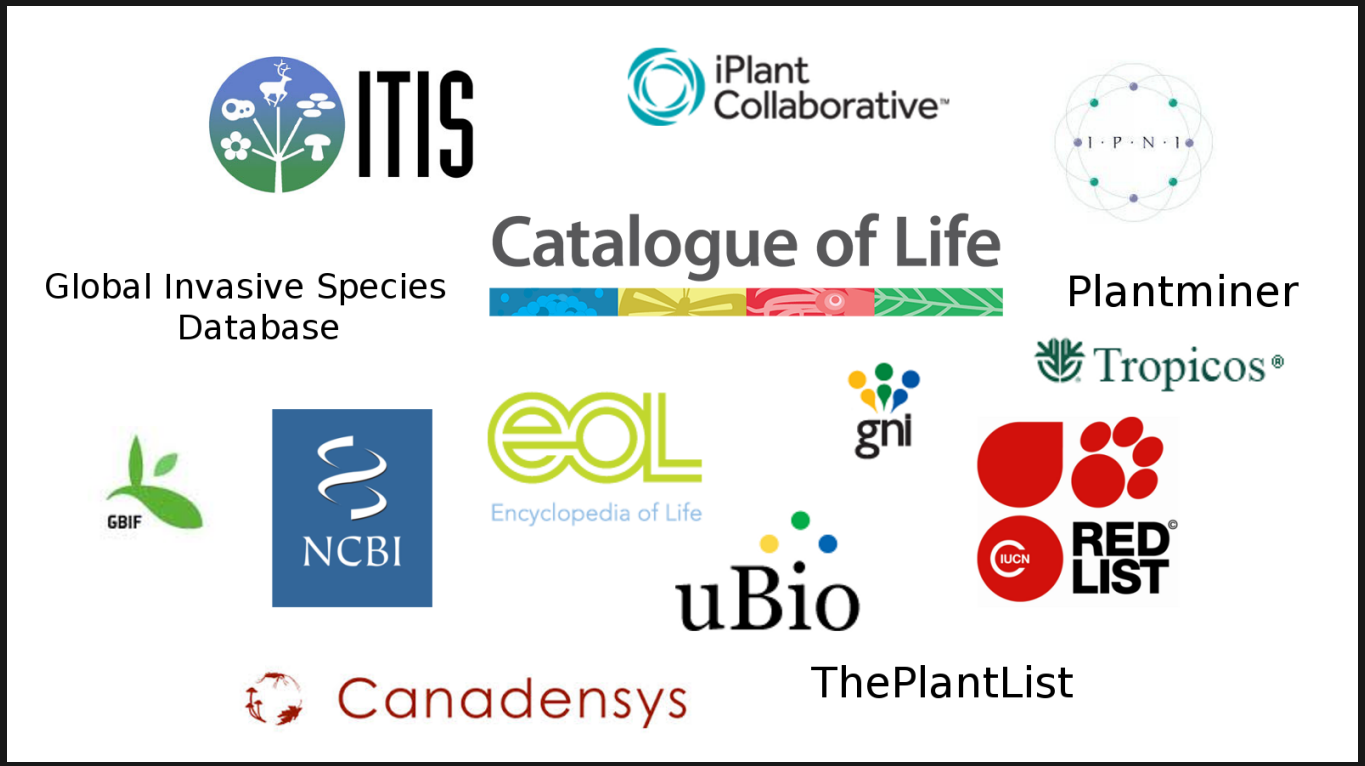
Amount of data

2993 taxa

489 pesticides
(+ 590 other organics)

Instead of wasting time...

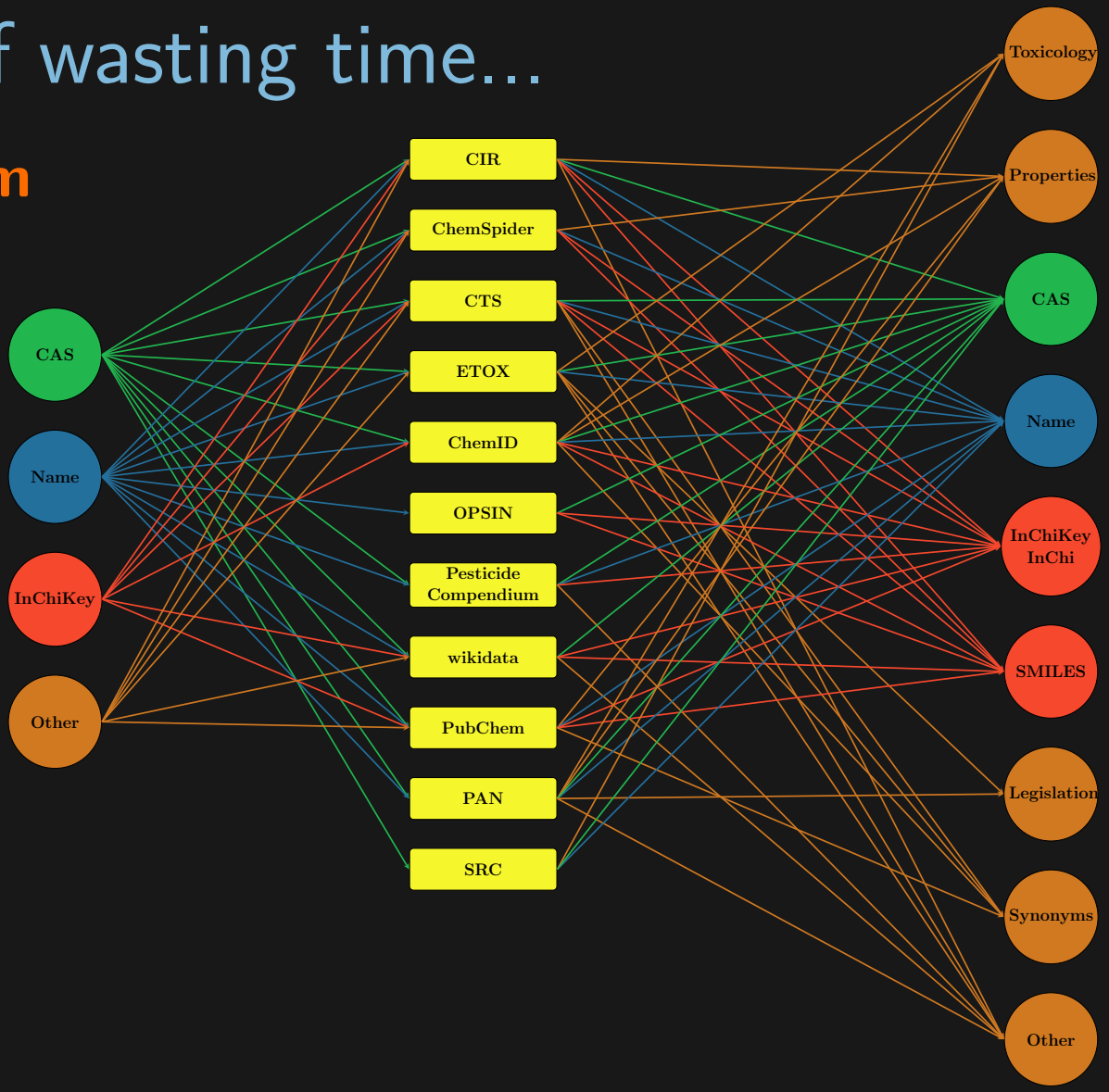
taxize - taxonomic search and retrieval in R



ROpenSci

Instead of wasting time...

webchem



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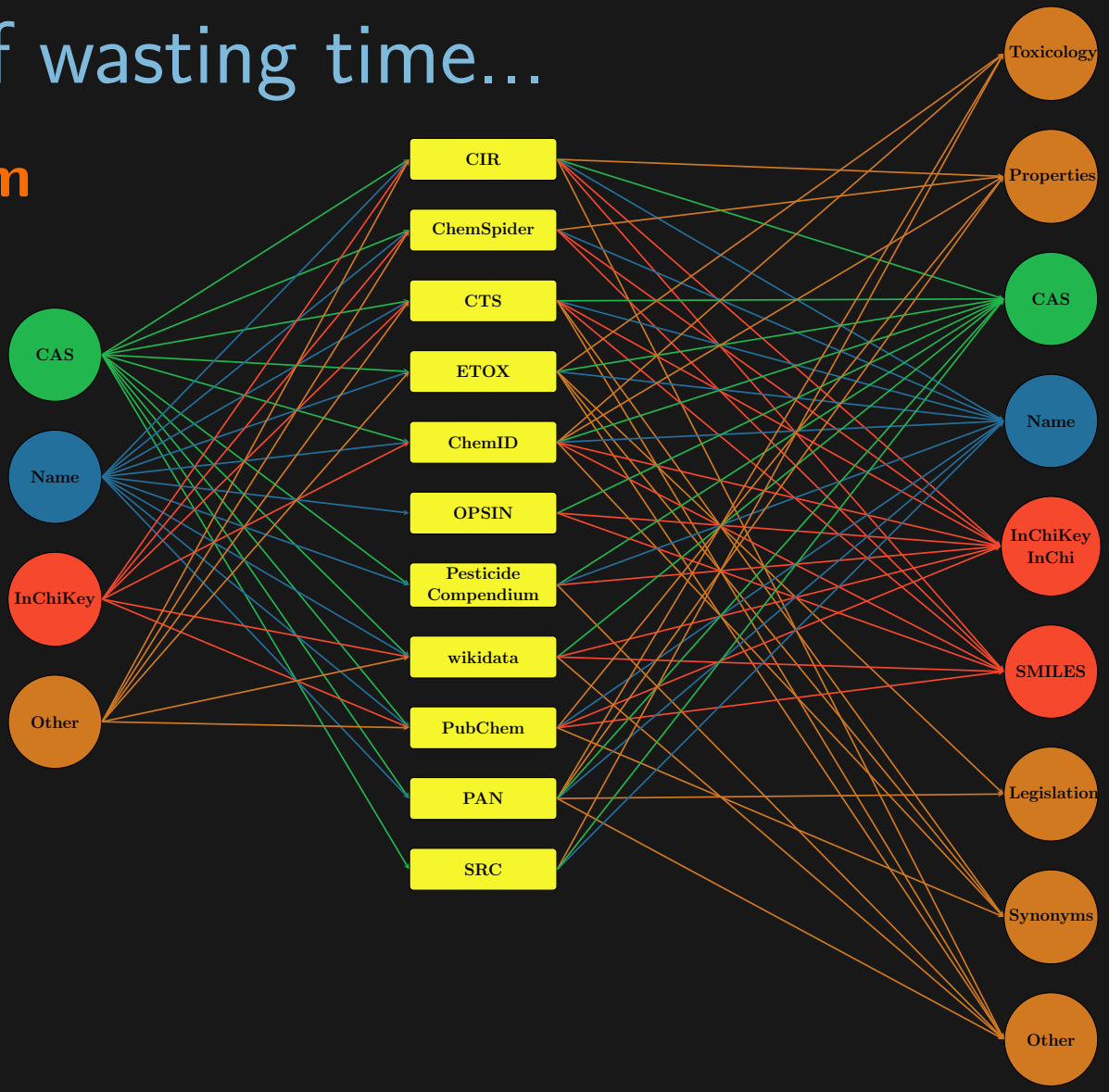

"webchem ...likely saved hundreds of working hours"

Münch (2016)

Outlook

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- continuous distribution in $\mathbb{R}_0^+$
- censoring (x $<$LOQ)3

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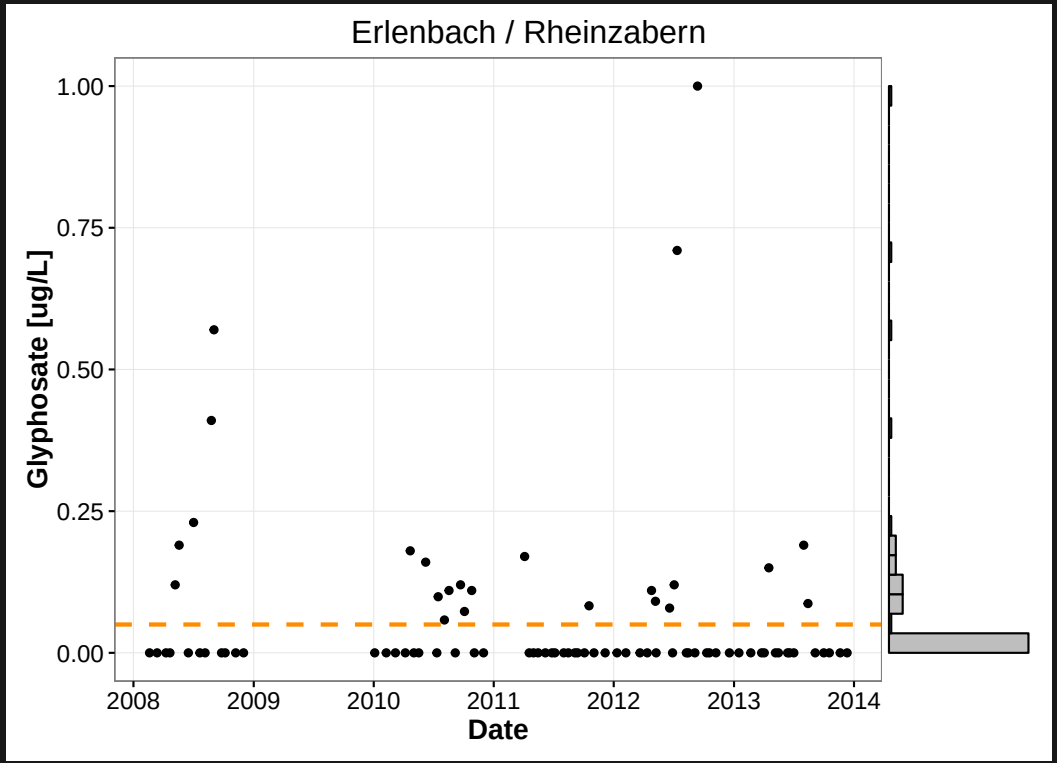
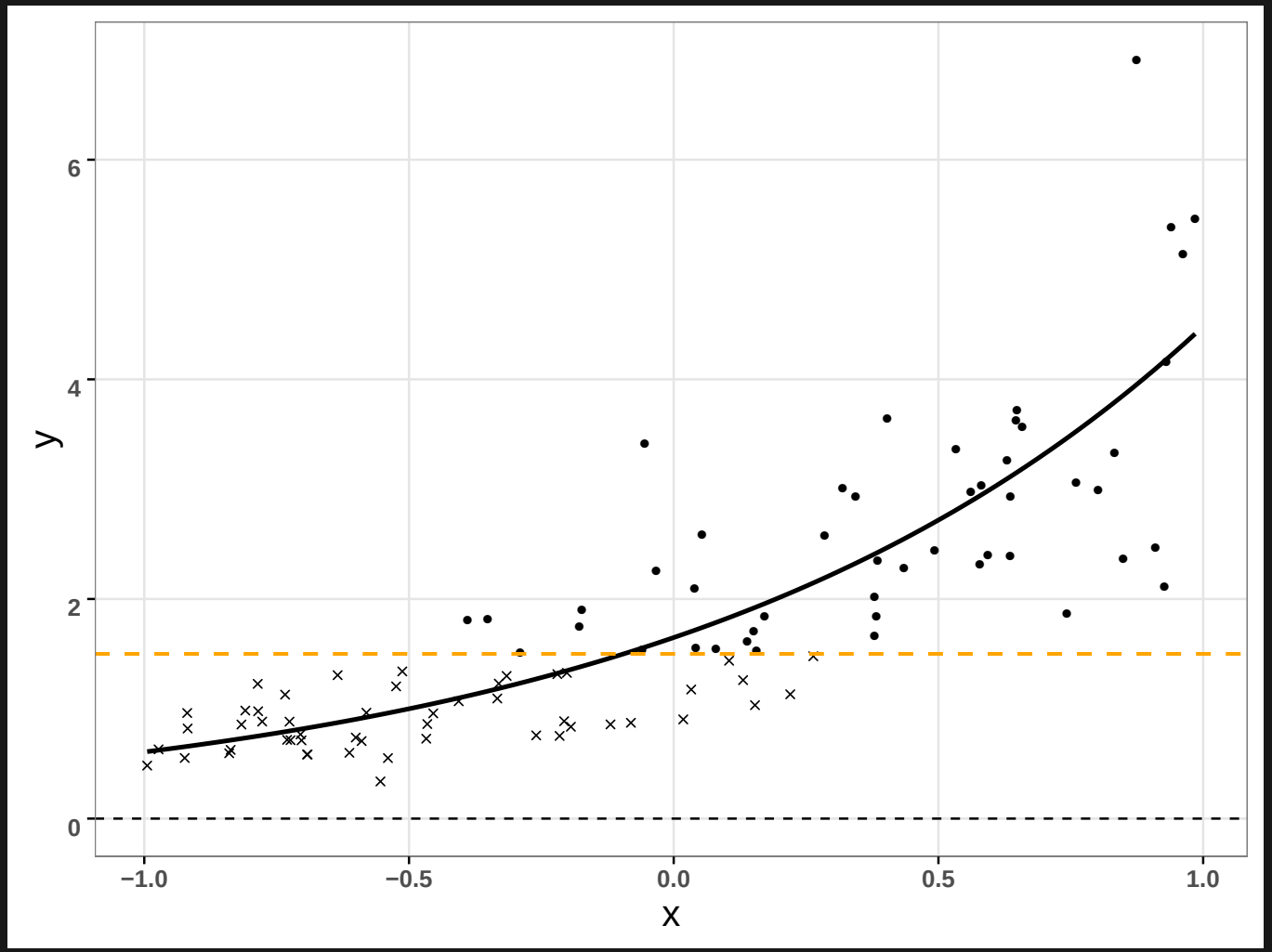
- continuous distribution in $\mathbb{R}_0^+$
- censoring (x <LOQ)3
- non-linearity (season, trends)
- dependency (spatial, temporal)



Dealing with censored, non-normal data



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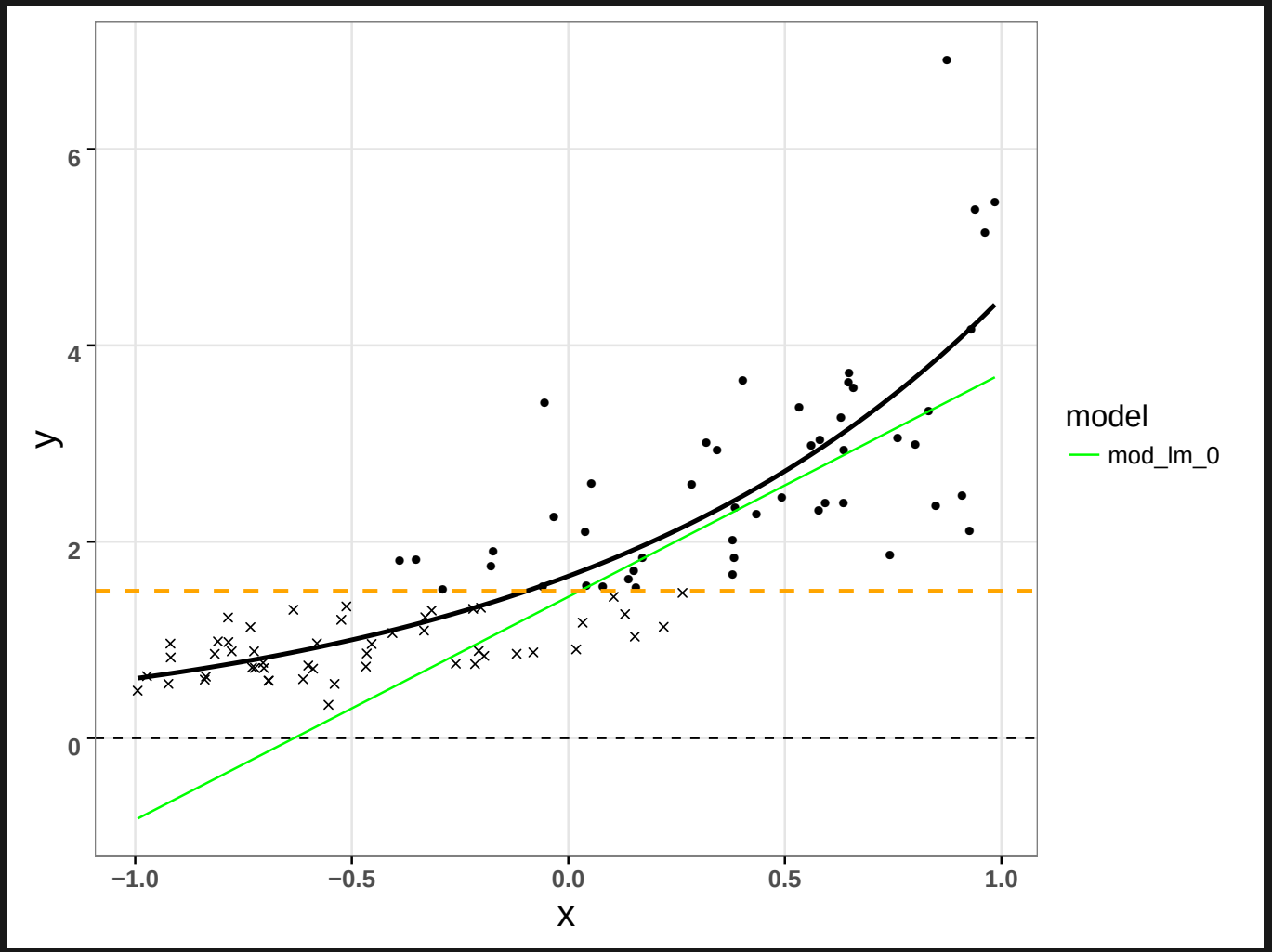

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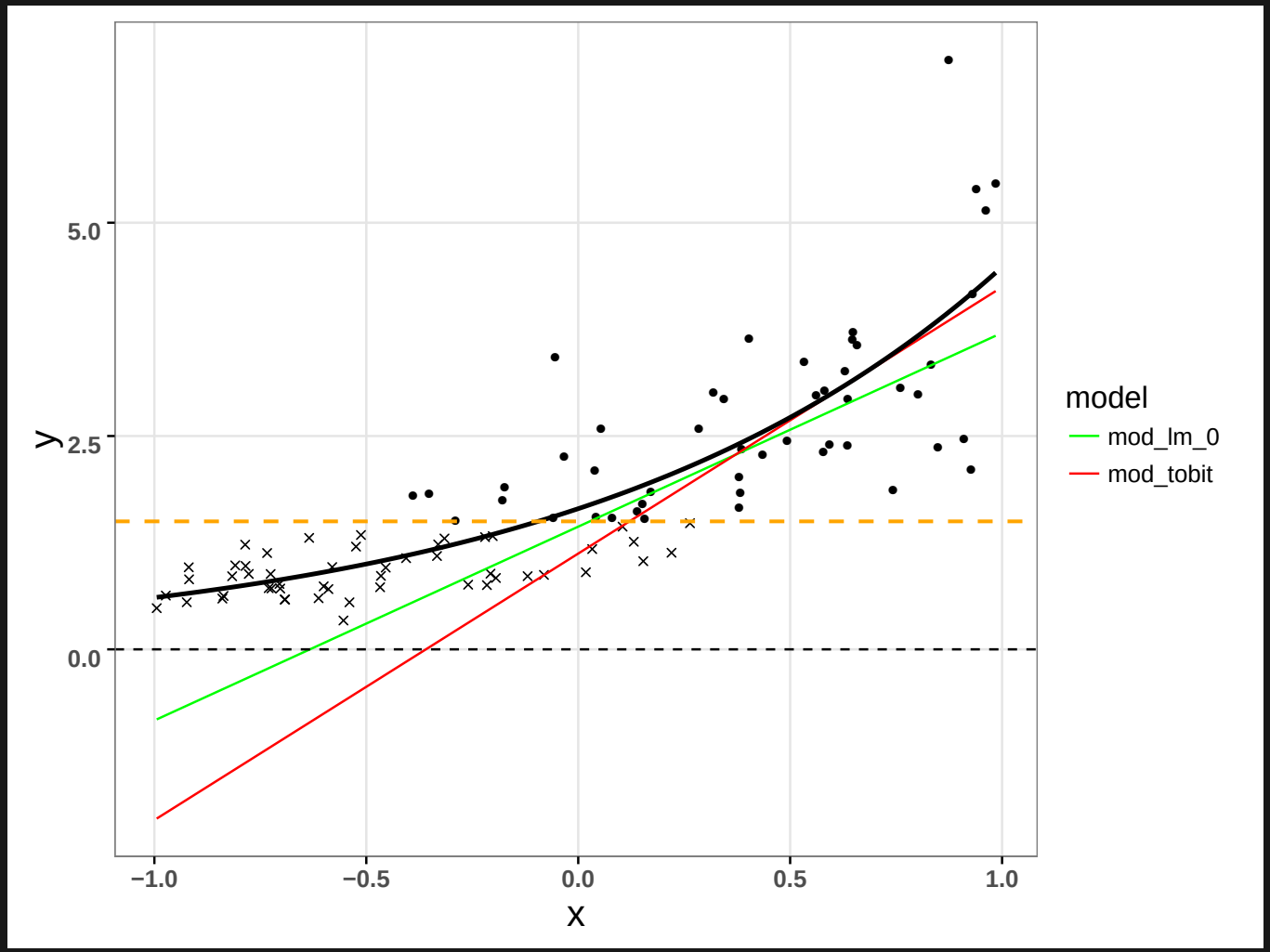

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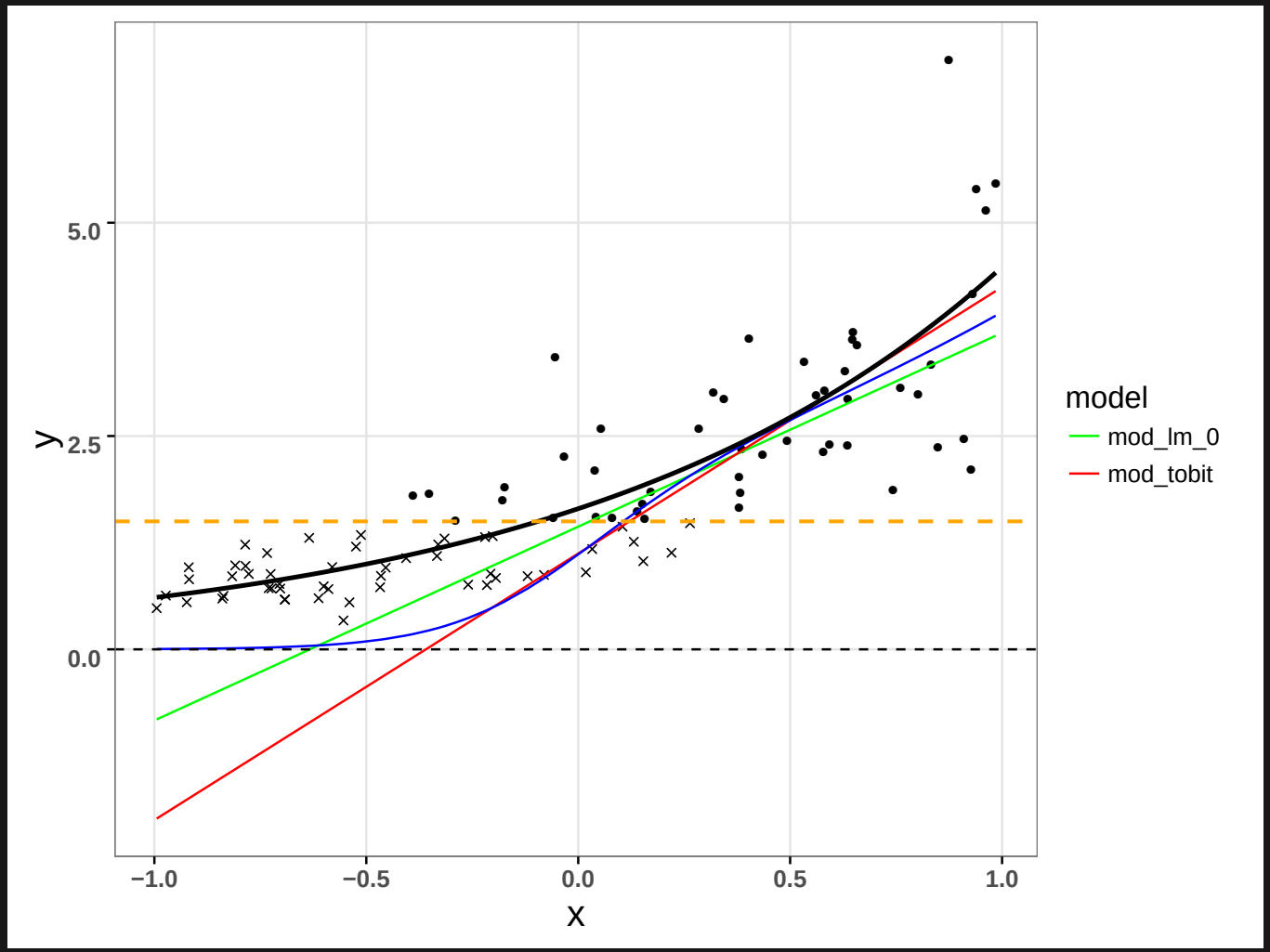

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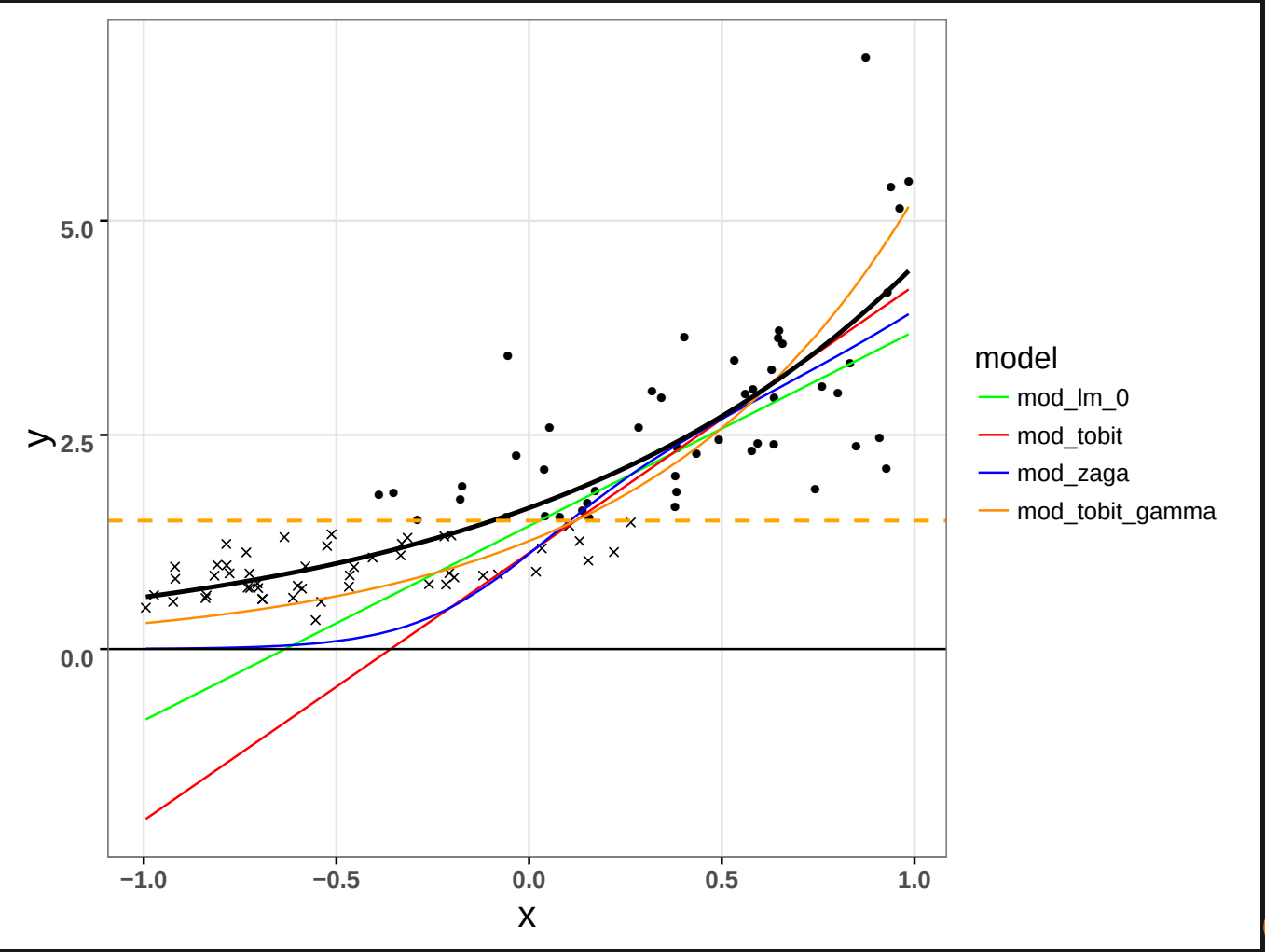

Currently, guidance how to model environmental concentrations ís missing

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- Pesticides show compound specific dynamics
- Mixture dynamics? - Multivariate response.

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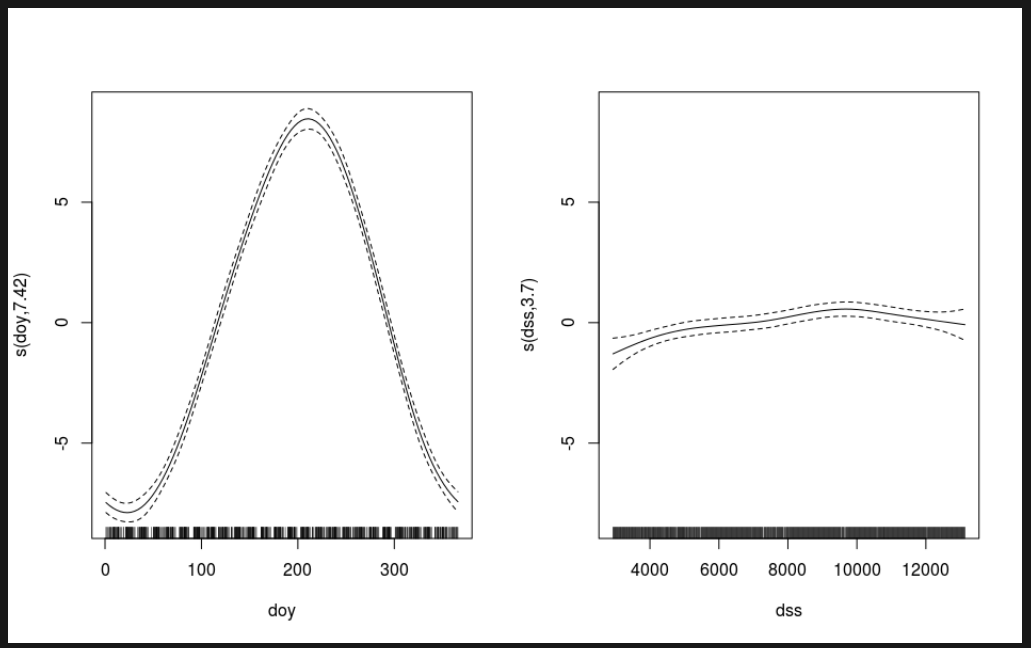
- Additional layer of model complexity...



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https://github.com/edild/talk_work2