

Klimaatsopwarming doet waterjuffers krimpen en maakt hen daardoor gevoeliger voor pesticiden



Julie Verheyen

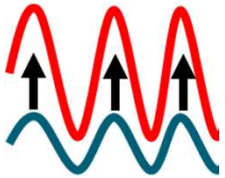
Meerdere stressoren in aquatische systemen

Klimaatsopwarming

Toenemende
temperaturen



Toenemende
DTFs



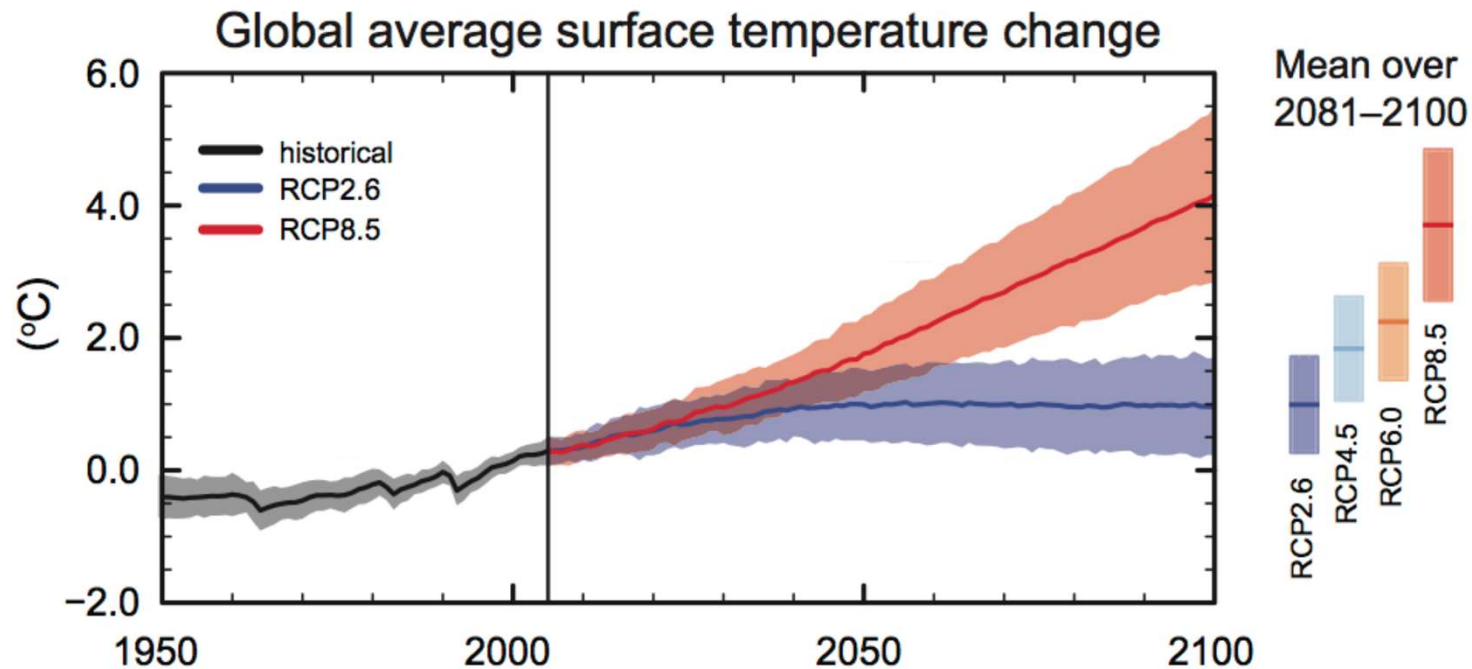
Vervuiling

Pesticiden



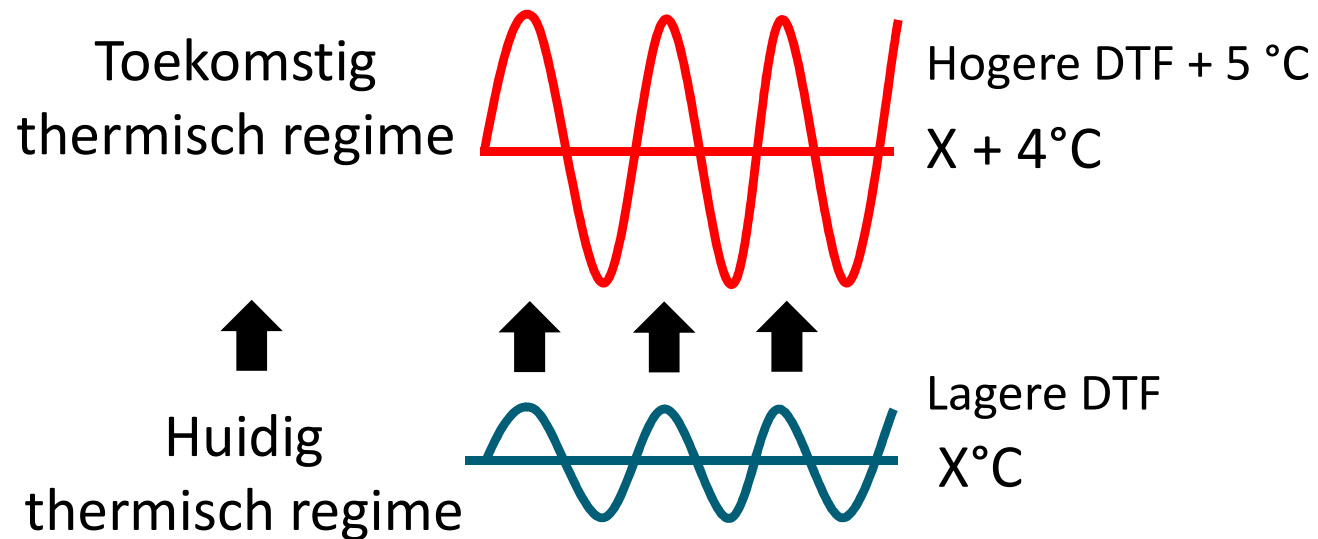
DTFs = dagelijkse temperatuursfluctuaties

Scenario's van klimaatsopwarming



➡ RCP 8.5 scenario: toename van gemiddeld 4°C wereldwijd

Toename in dagelijkse temperatuursfluctuaties (DTFs)



 Global Change Biology

Global Change Biology (2013) 19, 2373–2380, doi: 10.1111/gcb.12240

Temperature variation makes ectotherms more sensitive to climate change

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Increased temperature variation poses a greater risk to species than climate warming

David A. Vasseur¹, John P. DeLong², Benjamin Gilbert³, Hamish S. Greig^{4,5}, Christopher D. G. Harley⁶, Kevin S. McCann⁷, Van Savage^{8,9}, Tyler D. Tunney⁷ and Mary I. O'Connor⁶

Vervuiling



Organic chemicals jeopardize the health of freshwater ecosystems on the continental scale

Egina Malaj^{a,b,1}, Peter C. von der Ohe^{a,c}, Matthias Grote^d, Ralph Kühne^e, Cédric P. Mondy^f, Philippe Usseglio-Polatera^g, Werner Brack^h, and Ralf B. Schäfer^{b,1}

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Pesticides reduce regional biodiversity of stream invertebrates

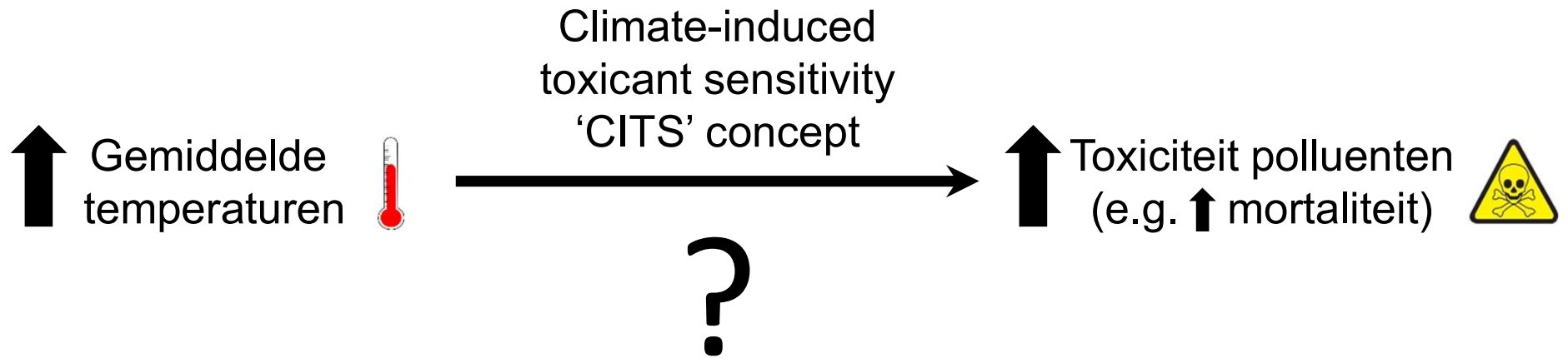
Mikhail A. Beketov^{a,1}, Ben J. Kefford^b, Ralf B. Schäfer^c, and Matthias Liess^a

^aDepartment of System Ecotoxicology, Helmholtz Centre for Environmental Research - UFZ, 04318 Leipzig, Germany; ^bCentre for Environmental Sustainability, School of the Environment, University of Technology Sydney, Sydney, NSW 2007, Australia; and ^cQuantitative Landscape Ecology, Institute for Environmental Sciences, University of Koblenz-Landau, 76829 Landau, Germany

Edited by David Pimentel, Cornell University, Ithaca, NY, and accepted by the Editorial Board May 13, 2013 (received for review March 25, 2013)

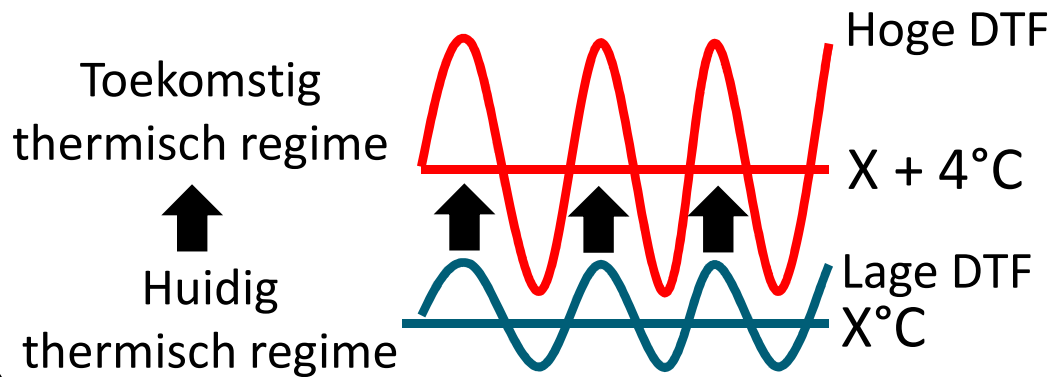
The biodiversity crisis is one of the greatest challenges facing humankind (1–15, 21), but such effects on the regional scale remained to

Polluenten onder klimaatsopwarming



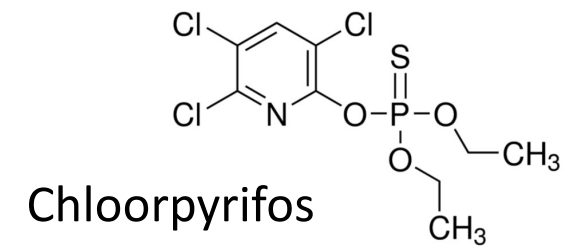
Polluenten onder klimaatsopwarming

Klimaatsopwarming



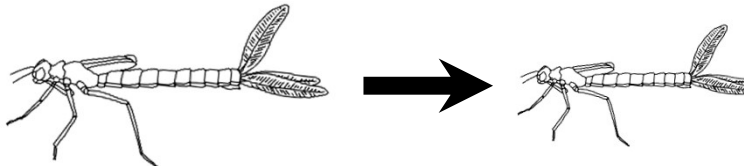
CITS

↑ Pesticide toxiciteit



Temperatuur-grootte regel

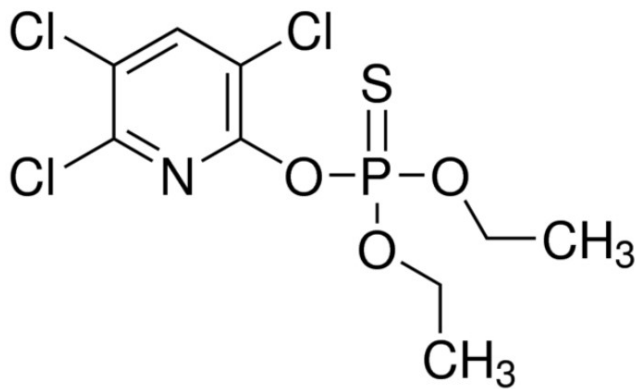
Organismen worden kleiner



Hogere oppervlakte t.o.v. volume ratio (opname)

Typisch organofosfaat pesticide

Chloorpyrifos
(CPF)



Wereldwijd gebruikt



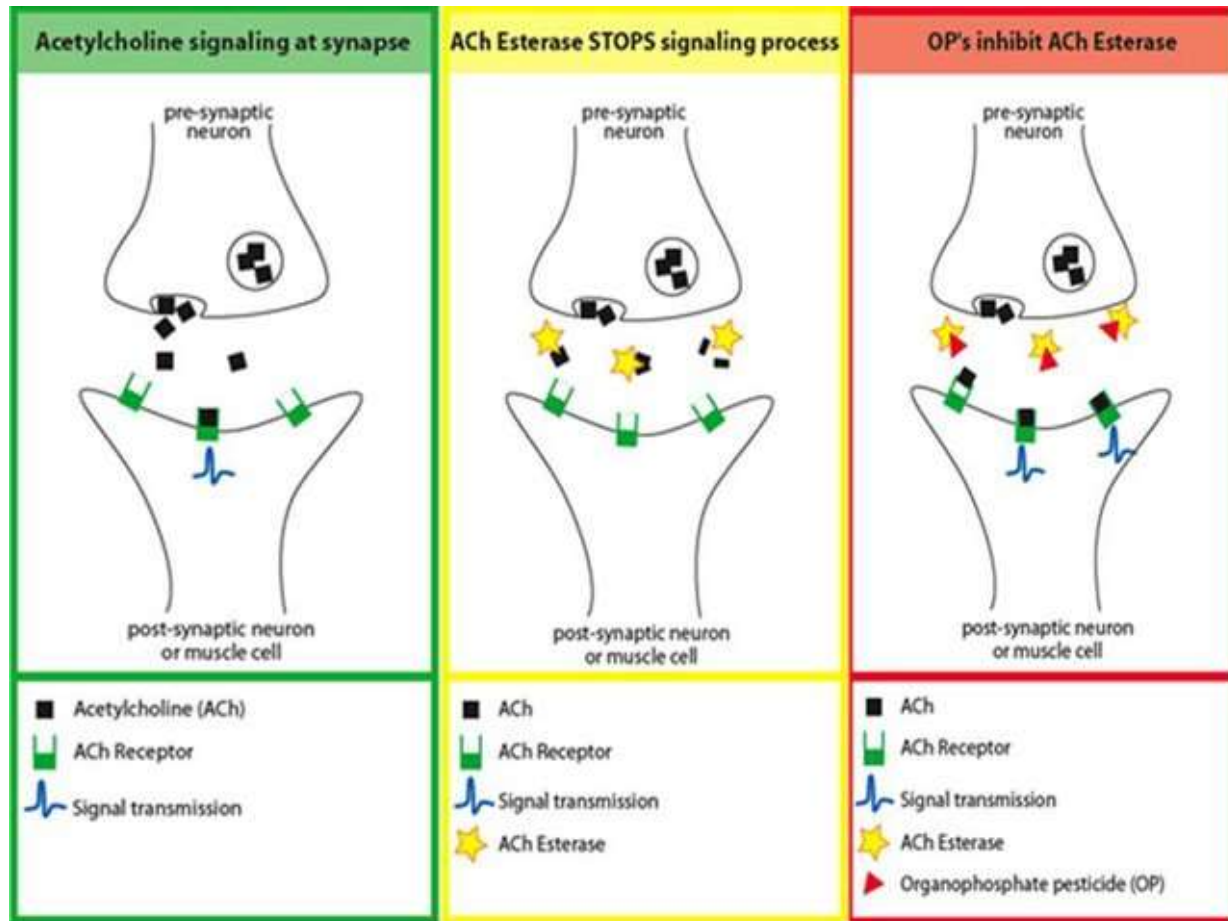
Top tien hoogste risico



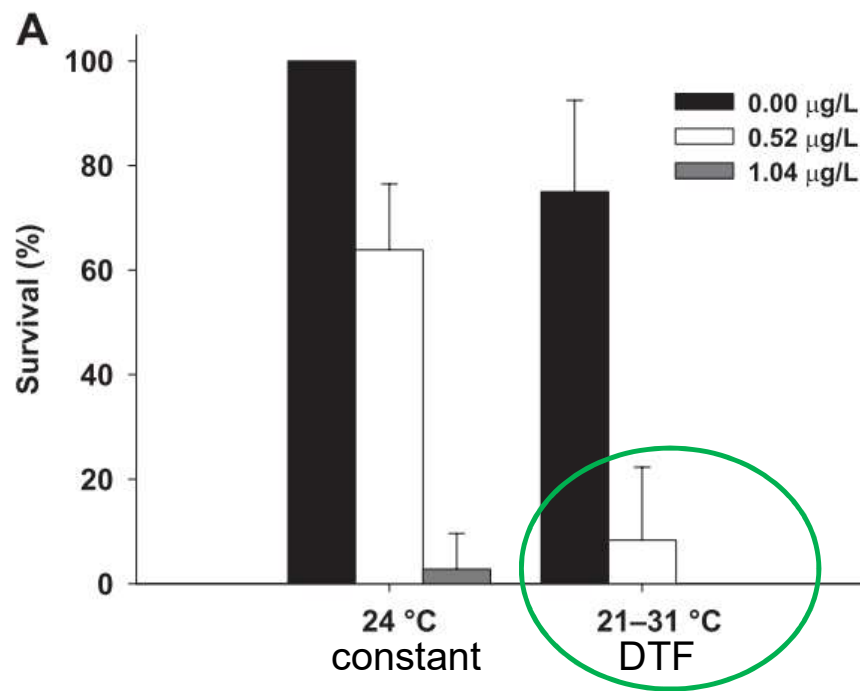
Prioriteit pollutant (European Water Framework Directive)



Inhibeert acetylcholinesterase



Pesticiden onder DTFs

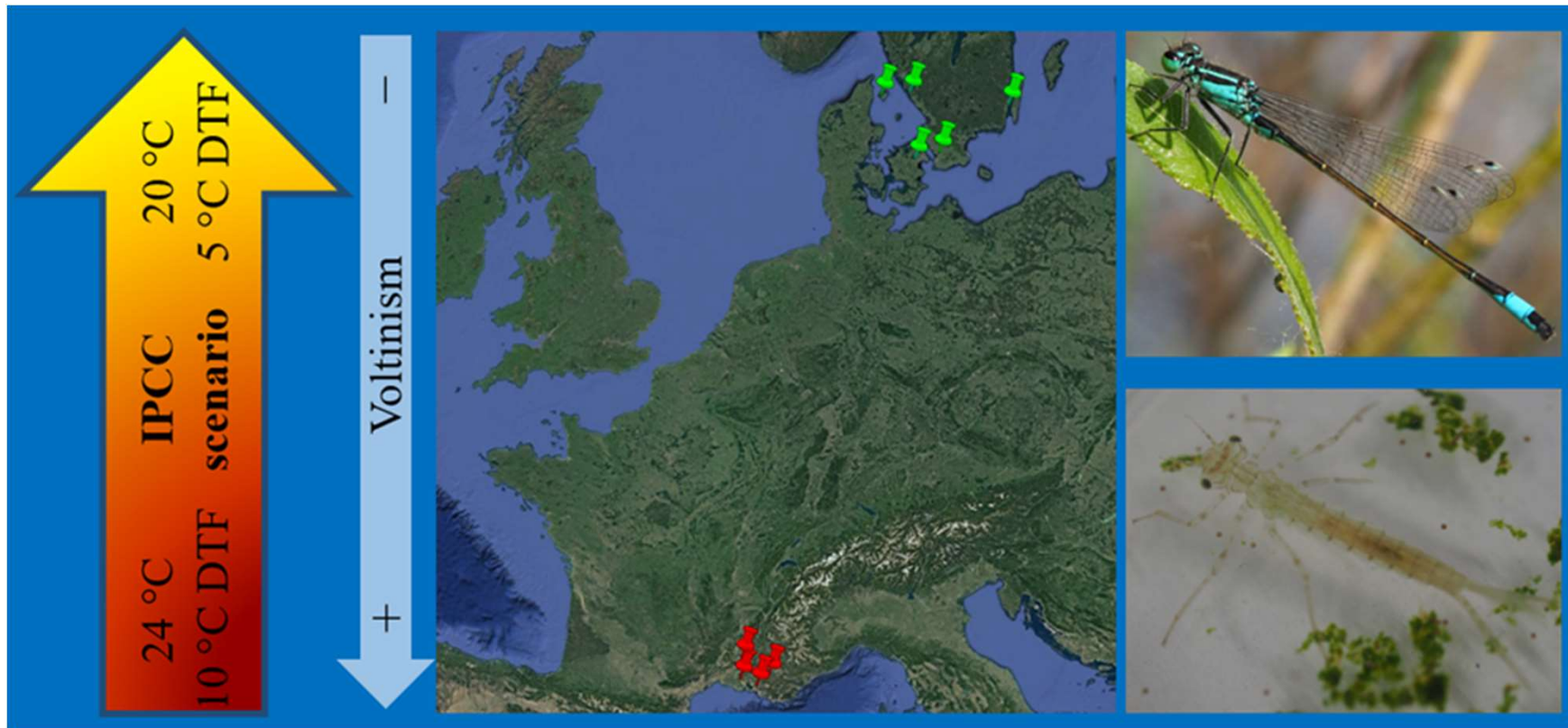


Bifenthrine meer toxisch
(lagere overleving) onder DTF

Studiesoort



Lantaarntje, *Ischnura elegans*



Onderzoeksvragen

-  Is het pesticide toxischer als de gemiddelde temperatuur en DTF stijgen? (CITS)
-  Worden larven kleiner onder klimaatsopwarming?
-  Zijn pesticiden meer dodelijk onder klimaatsopwarming omdat organismen kleiner worden?
-  Wat zijn de onderliggende fysiologische mechanismen voor een hogere pesticide toxiciteit bij hogere temperaturen?

Experimentele opzet



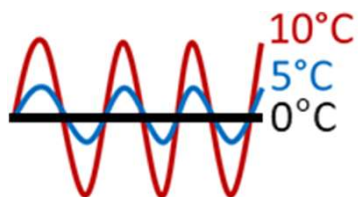
6 Thermische regimes

2 gemiddelde temperaturen

24°C

20°C

x 3 DTF

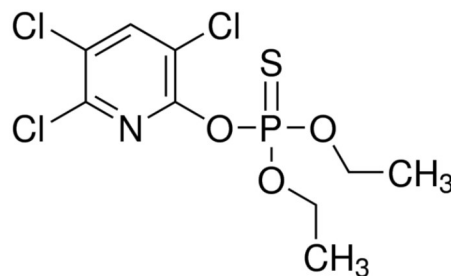


X

4 Pesticide conc

Chloorpyrifos

0, 0.75, 1.50 en 2.25 µg/L



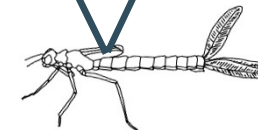
X

2 Latitudes

Hoge- vs Lage-latitude

Denemarken

Frankrijk



Ischnura elegans
waterjuffer larven

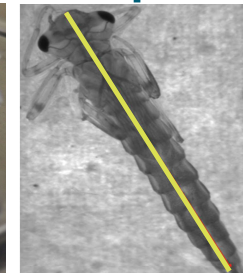
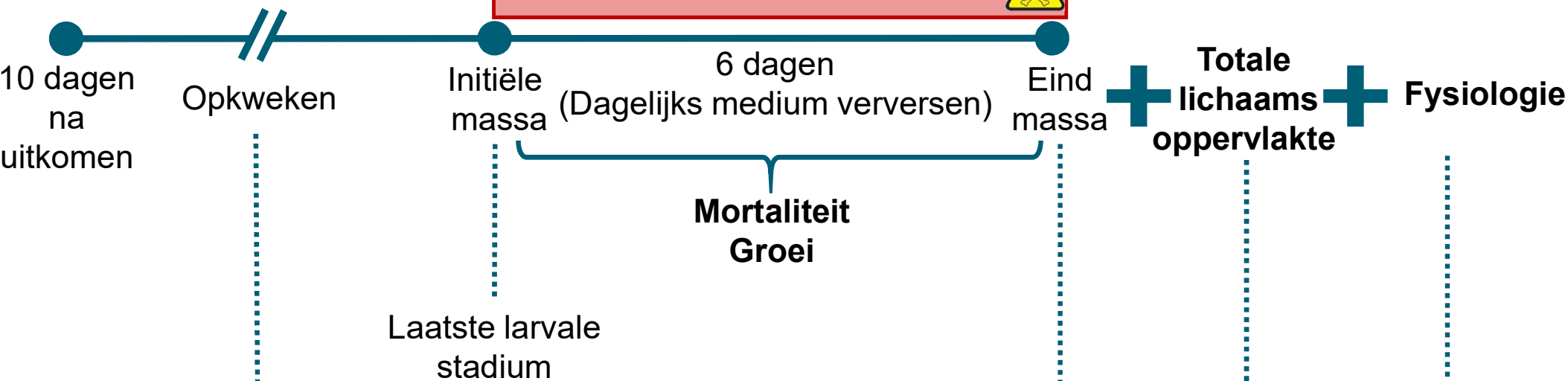
Experimentele opzet



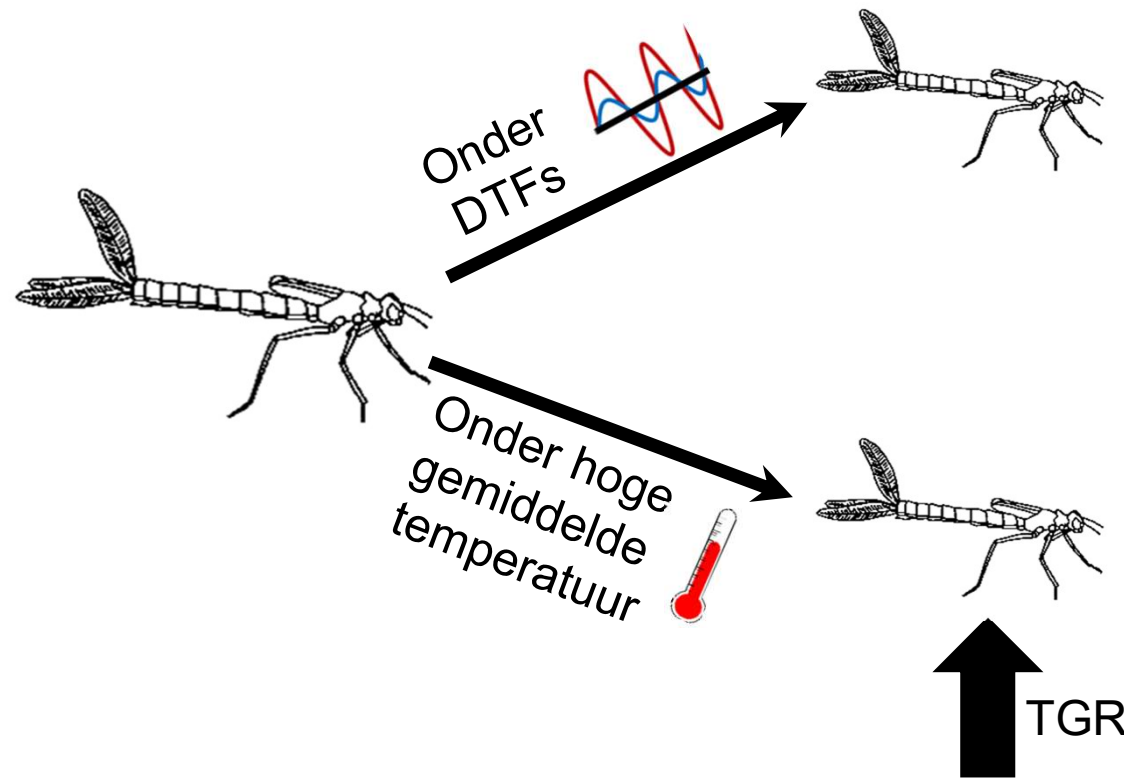
6 Thermische regimes



Solvent controle - Chloorpyrifos

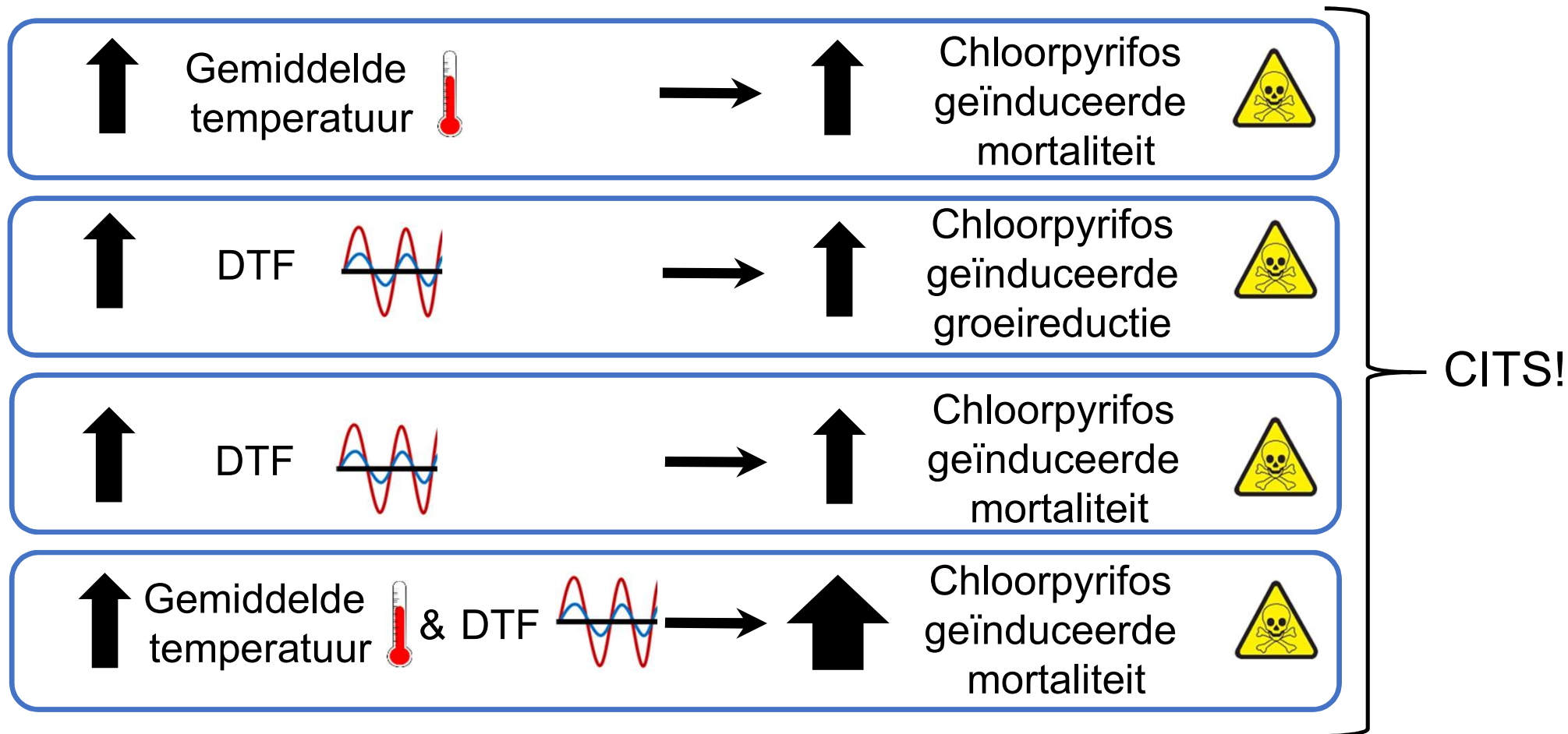


Resultaten: Temperatuur-grootte regel (TGR)

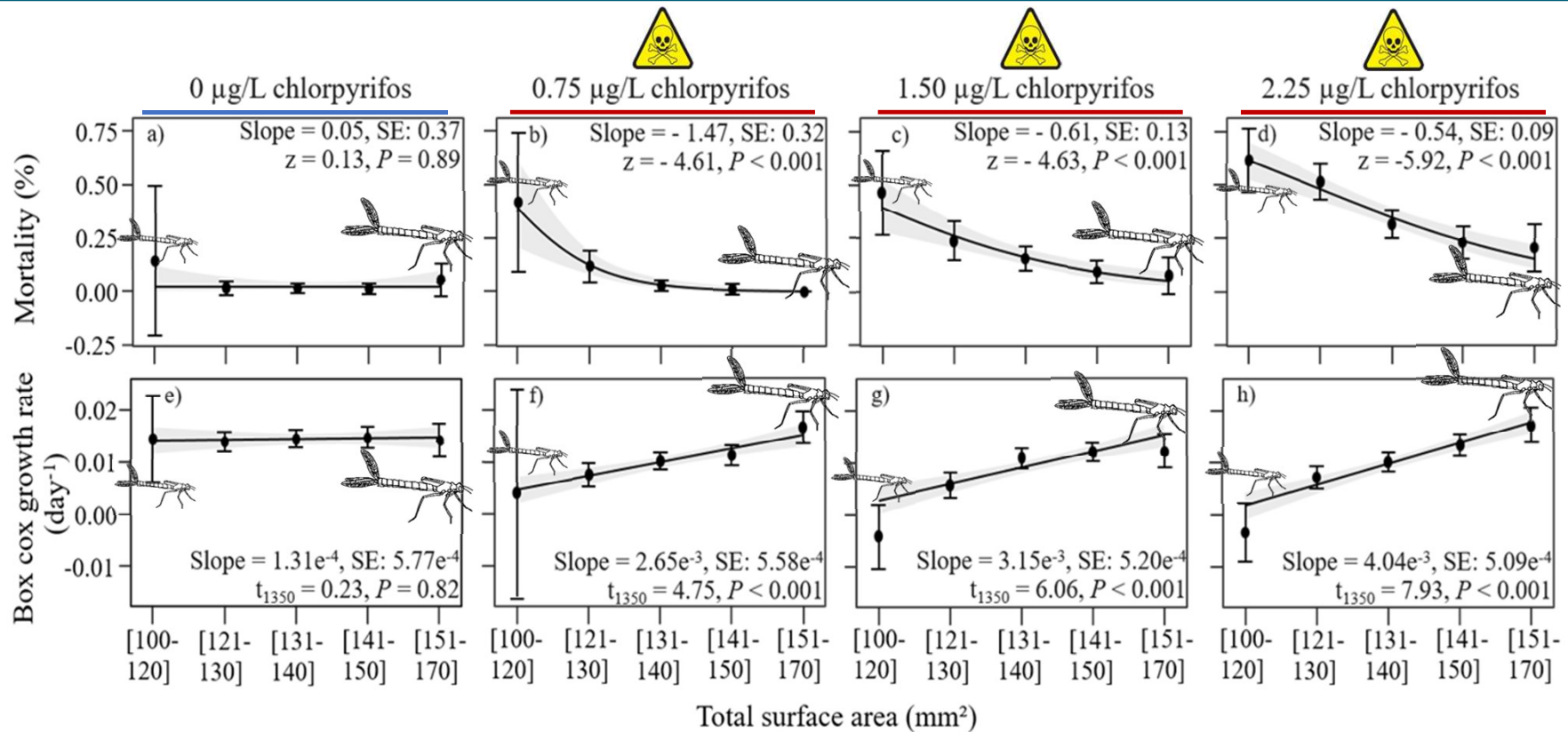


↑ Ontwikkelingssnelheid > ↑ Groeisnelheid
↓ Grootte op een bepaalde leeftijd

Resultaten: CITS

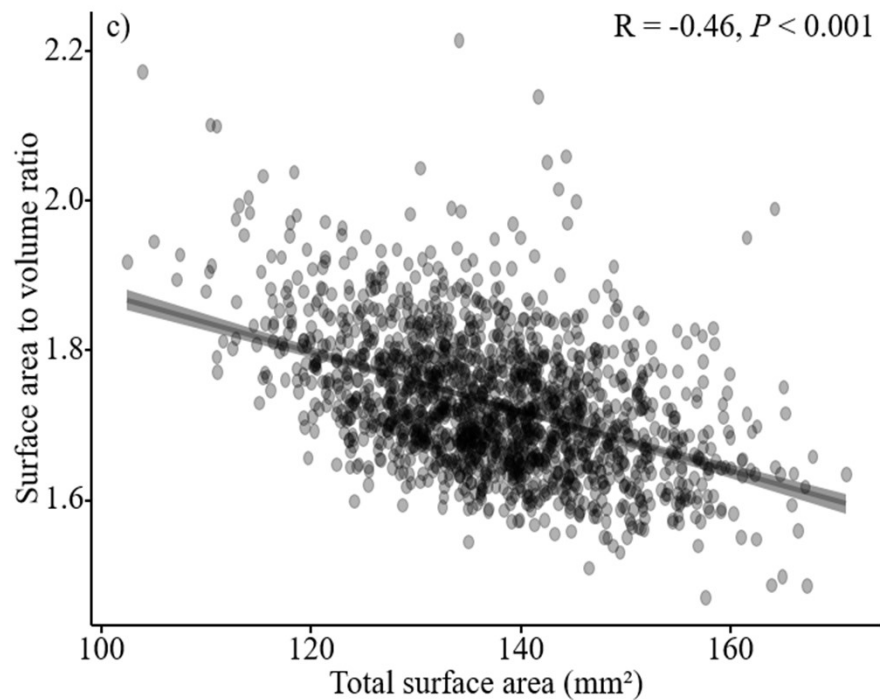


Koppeling toxische effecten en lichaamsgrootte

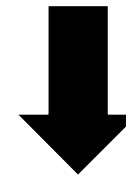


Chloorpyrifos is toxischer voor kleinere larven

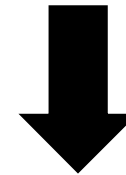
Correlatie lichaamsoppervlakte – OV ratio



Kleinere larven
(lagere lichaamsoppervlakte)



Hogere oppervlakte t.o.v.
volume ratio (OV ratio)



Hogere opname van
pesticiden

Buchwalter et al. 2004, Aq. Toxicol.

Energie budget (CEA)

Energie budget (CEA) = Energie beschikbaar / Energieverbruik

20°C - Constant



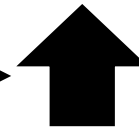
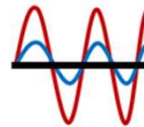
Weinig effect van chloorpyrifos
op het energie budget



↑ Gemiddelde
temperatuur 

&

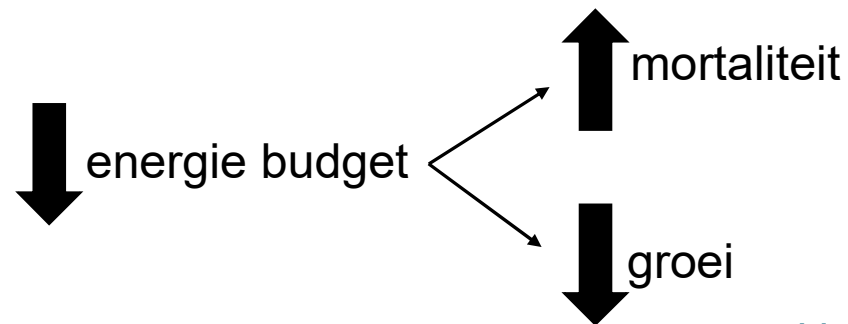
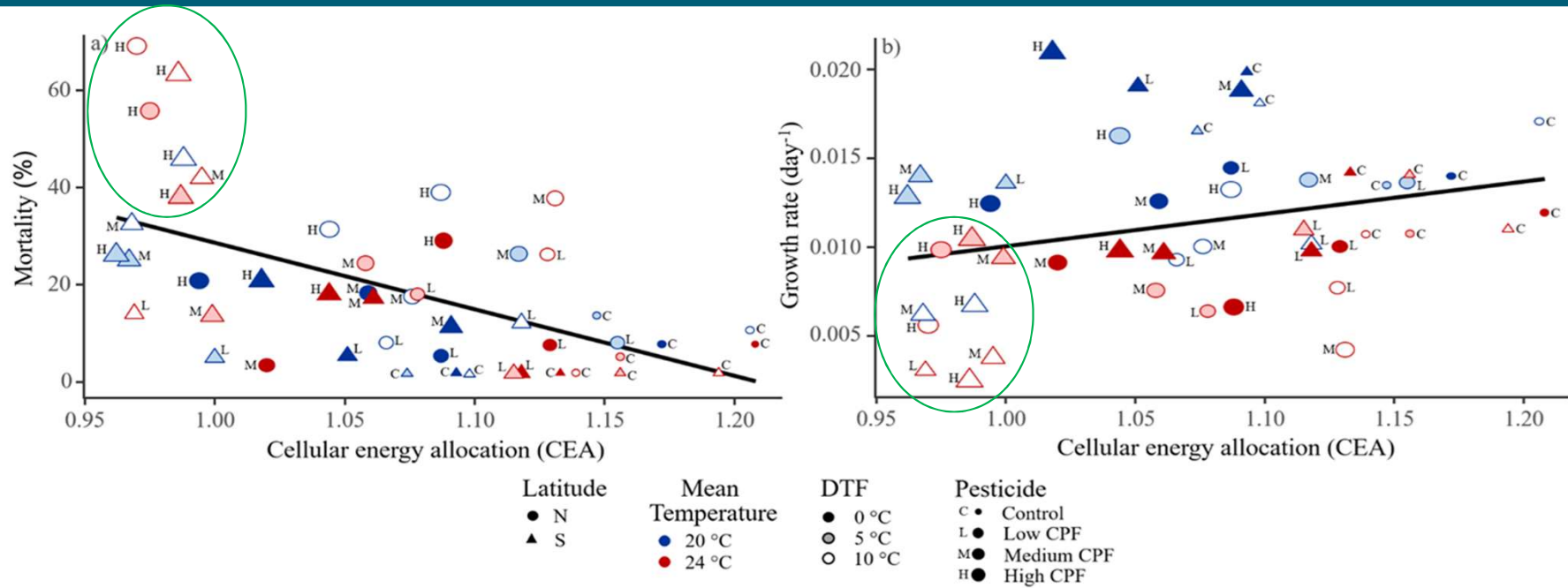
DTF



Chloorpyrifos geïnduceerde
reductie in energie budget

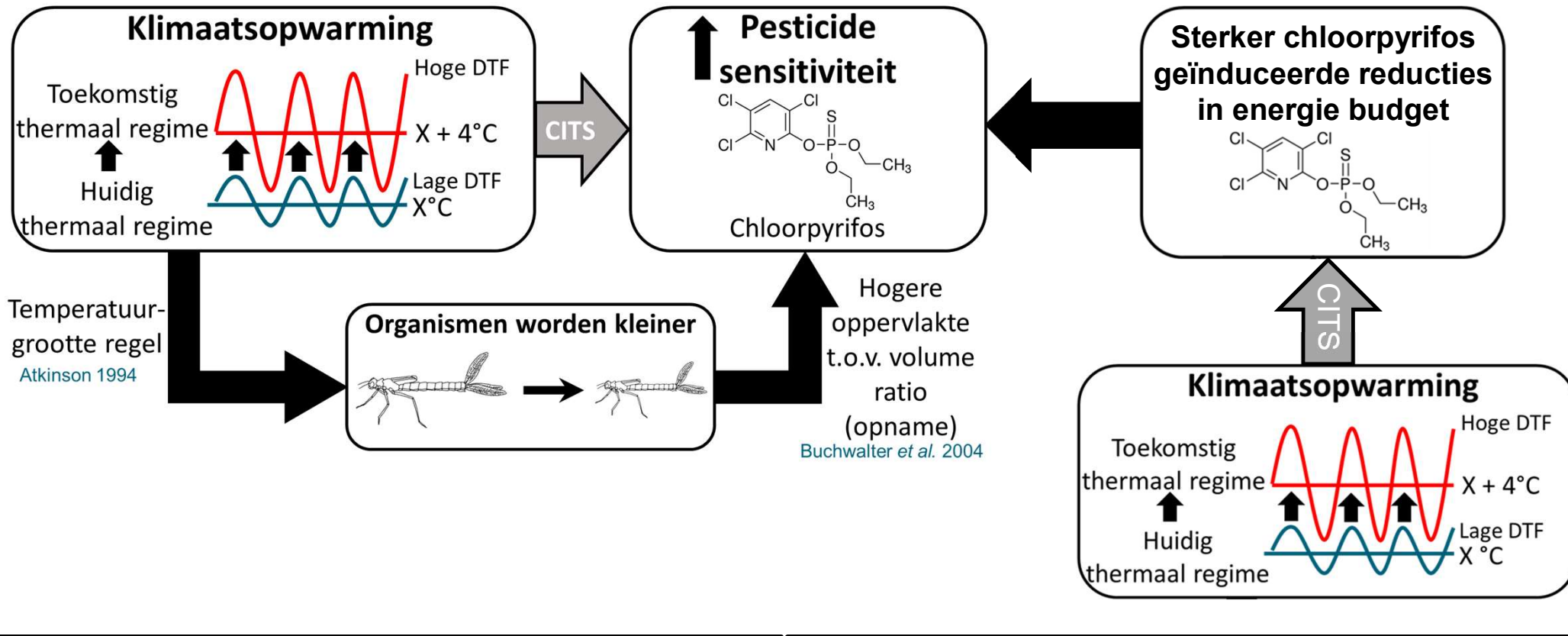


Energie budget (CEA)



Verheyen and Stoks 2020, Chemosphere

Conclusies



Integreren in de huidige en toekomstige ecologische risico-evaluatie
voor pesticiden onder klimaatopwarming



Dankwoord

Evolutionary Stress Ecology and Ecotoxicology

KU LEUVEN