

Climate change effects on mycotoxins in wheat in the Netherlands

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Mycotoxins in cereal grain

- Secondary metabolites of filamentous fungi
- Chemically stable contaminants
- Toxic effects in animal and human
- Formed in the field (and during storage) under favorable environmental and agronomical conditions, e.g.
 - Warm and moist during fungal infection (grain flowering)
- Reduced grain quality and safety
- Deoxynivalenol (DON) in wheat is of high importance
- Limits in EC regulation 2006/1882

Climate change effects on mycotoxins

Climate change will lead to shifts in the occurrence of mycotoxins in cereal grains

Qualitative reports available:

- Tirado MC et al. 2010. Climate change and food safety: A review. Food Res Int. 43:1745-1765.
- Miraglia M. et al. 2009. Climate change and food safety: An emerging issue with special focus on Europe. Food Chem Tox 47:1009-2021.

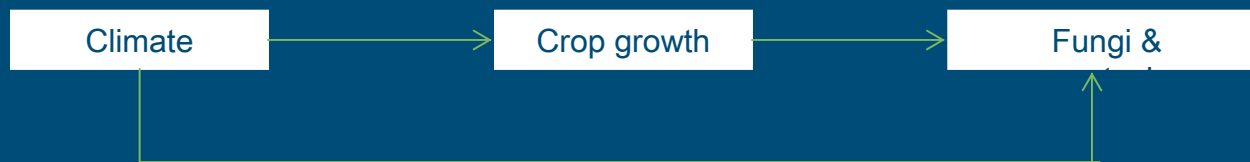
But – to date - no underpinned estimates ...

Aim of study

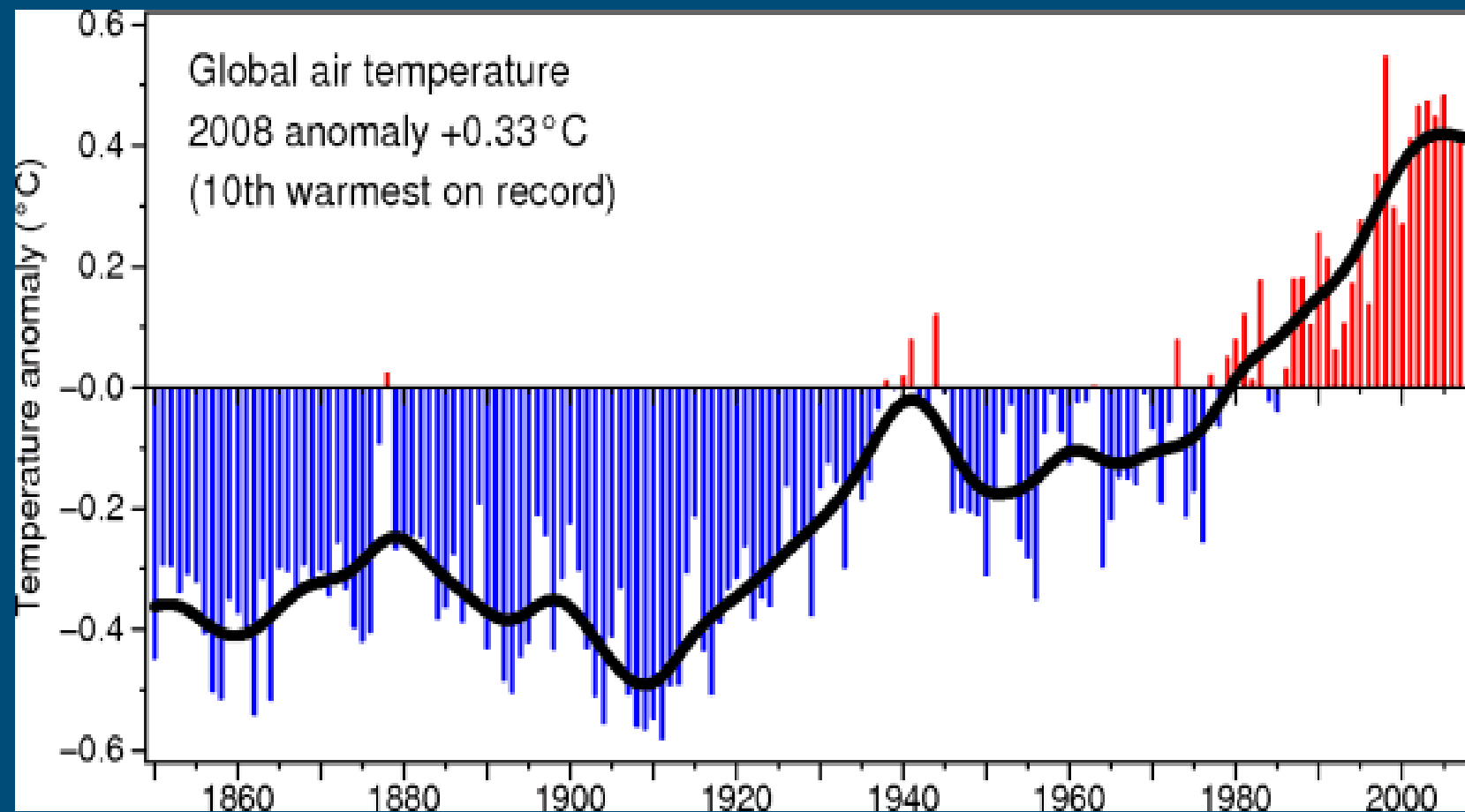
Quantify the effect of climate change on the occurrence of DON in wheat cultivated in the Netherlands

Using an integrated modelling approach:

- Climate change models
- Crop growth models
- Prediction model for DON in wheat in the Netherlands



Observed global temperature change



CRU, UEA

Climate change scenario

IPCC climate change scenarios:

- Generally increasing temperatures
- Increasing rainfall intensity
- More frequent droughts
- More variable climate (in many areas)

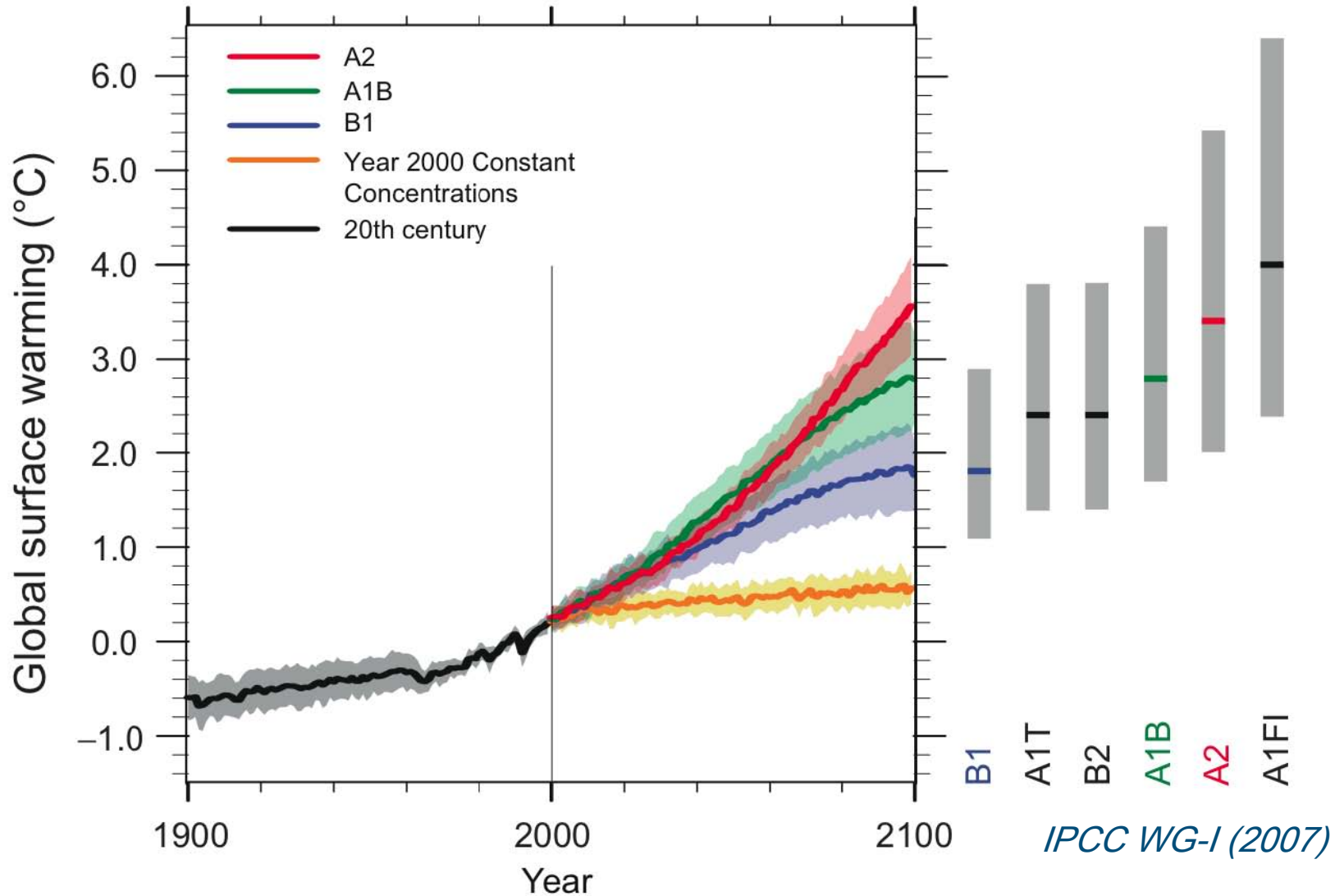


Climate change scenario:

- IPCC scenario A1B (“middle scenario”)
- Climate for 2031 – 2050 (2040, with 20 years of variation)
- Reference situation (baseline) 1975-1994
- Two GCM x RCM combinations, ENSEMBLES database
- LARS-WG for daily data (temperature and precipitation)

Projections of global mean temperatures

Multi-model Averages and Assessed Ranges for Surface Warming



Predictive model DON in wheat in NL

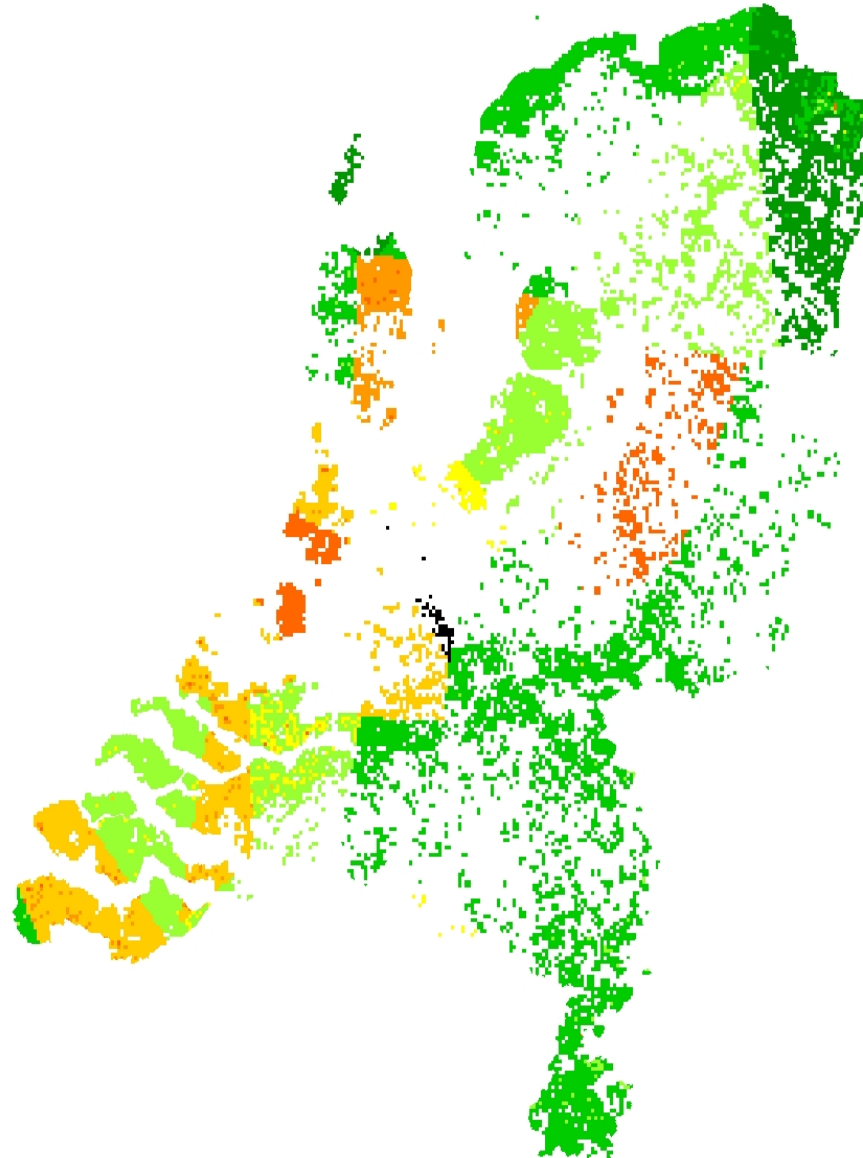
■ Empirical model based on field data 2001-2008¹

¹Van der Fels-Klerx HJ et al. 2010. Descriptive modeling to predict deoxynivalenol in winter wheat in The Netherlands. *Food Addit Contam A* 27(5):636-643.

■ Model variables

- Region: M, N, W, S
- Wheat resistance level against *Fusarium* spp.: 1-10
- Wheat flowering date (FD)
- Length FD and harvest date (HD)
- Weather variables in critical time periods of wheat growing
 - Temperature: avg hourly temp (°C)
 - Rain: total rainfall (in mm)
 - Relative Humidity : # hours RH is 80 or higher
- Late *Fusarium* spray (Zadoks 61-69): 0-2 times

GIS application Dutch DON – wheat model



Model calculations

■ Climate

- Climate change scenario IPCC A1B with 2 GCM/RCM
 - MPI/KNMI and METEOHC/METEOHC
- LARS-WG & additional daily weather parameters calculated
 - DON levels: 31 grids in NL, related to weather stations

■ Flowering and harvest date not changed

■ Processing results

- Per GCM / RCM: 20 years with DON levels * 31 grids
- Means of 20 years calculated, per grid

Results KNMI model

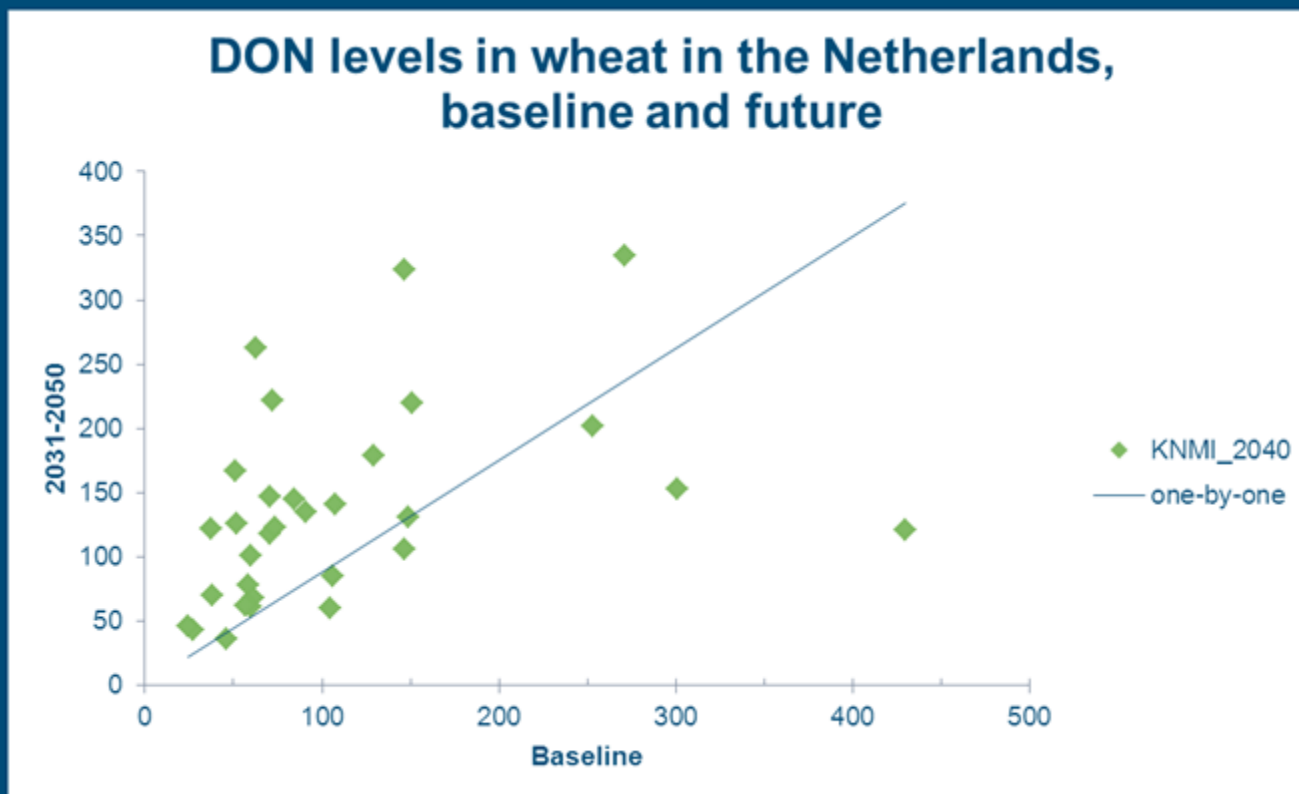


Fig 1. Mean DON levels (in ppb) in the Netherlands (31 grids) in 2031-2050 versus baseline, using IPCC A1B and MPI / KNMI models

Results UK model

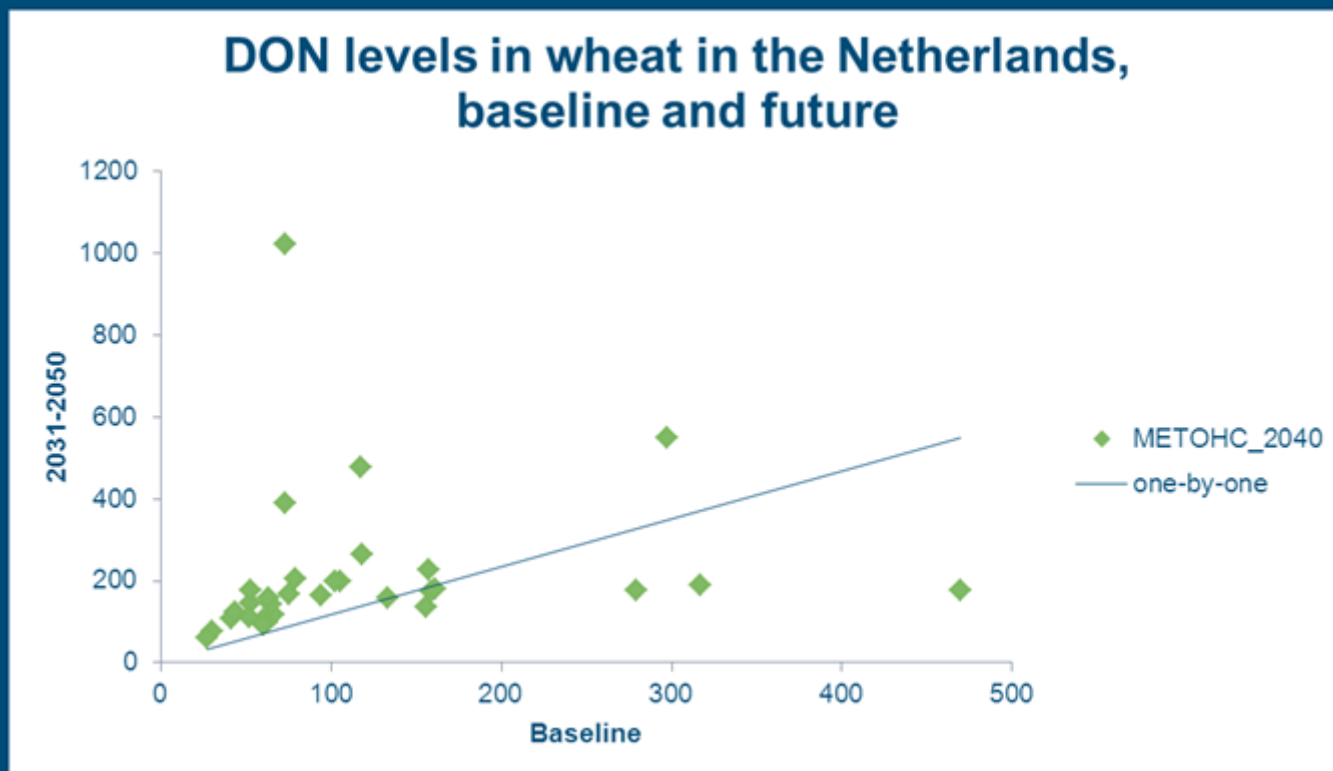


Fig 2. Mean DON levels (in ppb) in the Netherlands (31 grids) in 2031-2050 versus baseline, using IPCC A1B and METEOHC / METHEOHC models

Conclusions & Future outlook

- With climate change, DON contamination in wheat will generally increase in the Netherlands
- Increase higher with METEOHC RCM as compared to KNMI RCM
- But, only incidentally above EC limit
- However, effects of shifts in growing conditions for wheat need to (and will) be incorporated
 - Changes in Temperature Sums needed to achieve flowering and harvest dates, and daylength period

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