CLIMATE CHANGE IMPACTS ON ENVIRONMENTAL RISK ASSESSMENTS – A SYNTHESIS

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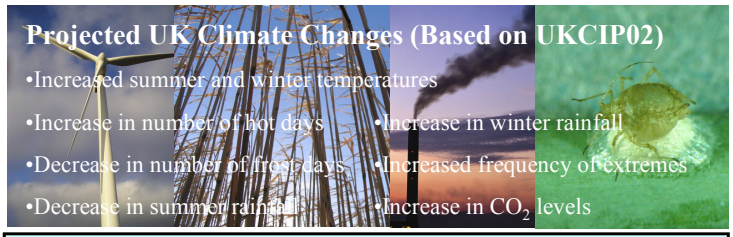
•IPCC AR4 (2007) – CO_2, CH_4 and N_2O have increased owing to anthropogenic activities leading to global warming

•Stern report (2006) – Climate change threatens to be the greatest and widest ranging market failure ever witnessed

•Are current environmental risk assessment approaches "climate change proofed"?



Climate changes, summarised above for the UK, will have both negative and positive impacts on the agricultural industry. Key impacts that may lead to changes that would affect pesticides and veterinary medicines are summarised below:

Increase in:
- •Insect infestations
- •Weed growth
- •Disease outbreaks
- •Pest and disease problems
- •Soil erosion
- •Grazing opportunities in winter
- •Drainage systems
- •Wet weather animal health problems
- •Irrigation requirement
- •Growing season
- •Pest/weed resistance
- •Pesticide/Herbicide/VetMed usage
- •Pesticide/Herbicide volatilisation
- •Pesticide/Herbicide/VetMed degradation

Decrease in:
- •Crop resistance to products
- •Spray days
- •Pesticide/Herbicide Efficacy

Change in:
- •Soil water balance
- •Flow path importance
- •Cropping practices
- •Crop ranges
- •Crop types (incl. novel crops)
- •Crop/Animal husbandry
- •NTA/NTP prevalence and timing
- •Dilution potential

Climate change will impact on environmental risk assessments both directly and indirectly as illustrated in Figure 1. The direct impacts will affect all steps of the assessment process primarily as a result of changing climate. The indirect impacts relate to the agricultural industry undergoing both autonomous (optimisation) as well as long term structural change. Both the direct/indirect impacts will affect inputs, parameters, processes, models and exposure represented within these risk assessment processes as illustrated within Figure 2.

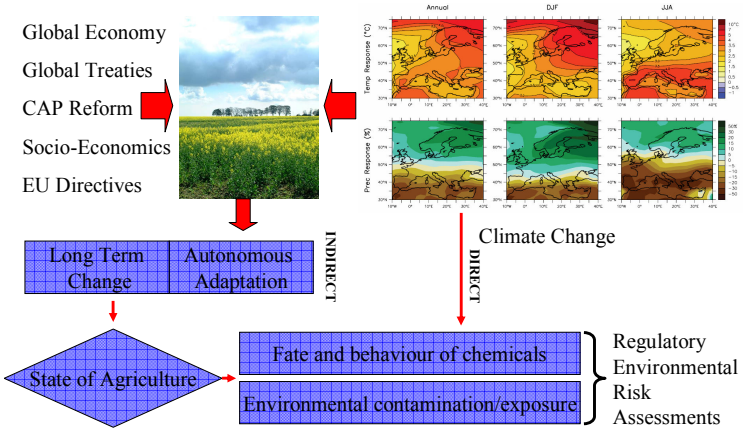


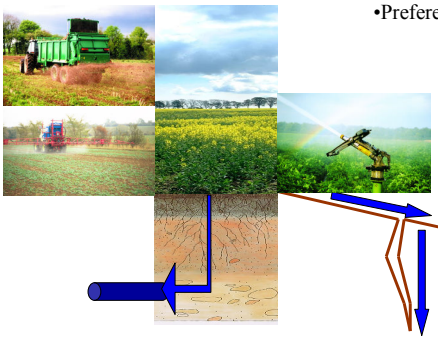
Figure 1: Summary of the types of pressures, including climate change, on the agricultural industry and their direct and indirect impacts on environmental risk assessments

Changes in inputs
- •Climate
- •CO_2 and O_3
- •Herbicide/pesticide/Vetmed
- •Irrigation

Changes in parameters
- •Crop specific
- •Husbandry

Changes in model
- •Crop models
- •Preferential flow

Changes in processes
- •Pathway importance
  - •Preferential flow
  - •Overland flow
  - •Under drainage
- •Degradation



Changes in exposure
- •Vapour/sediment/aqueous phase
- •Dilution
- •Waterbody presence
- •Concommitant ecosystem change

Figure 2: Climate change affects environmental risk assessments through impacts on inputs, parameters, processes, (sub-) models and exposure.

In general the modelling methodologies employed in Europe to assess the exposure of pesticides/VetMeds in the environment are scenario driven (e.g. FOCUS) and are generally robust and able to accommodate these climate change induced impacts. The ability of the current models to deal with new challenges e.g. crop physiological changes in response to elevated CO_2 / O_3 and preferential flow are a key area of weakness. Example impacts are provided below:
- •Inputs e.g. Types (some new) and amount of product used
- •Parameters e.g. Sowing dates; timing of applications of product
- •Processes e.g. Increased runoff and soil erosion
- •Models e.g. Crop models need to account for elevated CO_2/O_3
- •Exposure e.g. Change in temporal nature of ditches

Take Home Messages

- •Modelled climate change patterns will vary spatially
- •Future Regional Climate Model (RCM) projections will be probabilistic e.g. UKCIP08
- •Daily RCM datasets will be more readily available e.g. UKCIP08
- •Uncertain/varying climate change impacts on different parts of the hydrological cycle and on the fate and behaviour/exposure of/to chemicals in the environment
- •Climate change will impact on the inputs to, the parameters within, the (sub-)models within and the processes represented by regulatory environmental risk assessment models
- •Agricultural planning horizons are short and therefore the 2020 projections are most appropriate when considering climate change impacts/adaptation
- •Agriculture is more likely to respond to other shorter term stressors than climate change, although autonomous adaptation to climate change will/is taking place
- **•The product registration renewal cycle (±10 years) should capture the key elements of climate change impacts provided recent climate is considered and approaches/inputs reflect the current state of the agricultural industry**

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