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Publication date:
2014

Citation (APA):

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Parameterisation of LCI/LCIA models of agricultural systems emissions under future pressures

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**The problem (I)**

**Marine eutrophication** (nitrogen emitted from fertilisers application)

- Excessive increase of primary production and organic matter accumulation
- Ecosystem response to an excessive input of nutrients
- Results in excessive oxygen depletion and impacts on biota, ecosystem and (socio)economy

**Influence of Temp. in the marine eutrophication model**

Temperature is not modelled directly, but other parameters do vary with T:
- Metabolic rates (increased productivity, respiration, remineralisation) and organic matter
- Increased species sensitivity to stress and poleward species distribution
- Climate zones aggregated by SST

**Examples of modelled/estimated impacts of marine eutrophication**

- 4°C increase and 20% more N emissions result in 63% larger bottom-hypoxic area in the Gulf of Mexico
- By 2050, 10 ha of natural ecosystems changed to agriculture land, globally, and 2.4-fold increase in N-driven marine eutrophication
- 4°C increase and -0.96 mgO/L (solubility) hypoxic areas will double, up to 38% of total bottom area in the Danish Straits (worst case scenario)
- Algal blooms in 80% of fertiliser applications in Gulf of California, and 27-59% of N fertiliser will be applied upstream of N-deficient marine ecosystems by 2050
- Overall, increased occurrence, frequency, intensity, and duration of eutrophication and hypoxia

**The problem (II)**

**Ecotoxicity** (chemicals emitted from pesticides application)

- Additional pesticide applications result in additional pesticide emissions
- Pesticides are toxic by design: pesticides reaching non-target organisms may in toxic impacts to other organisms, including humans
- Climate change affects type and nature of pests

**How is Temp. included in the LCI model PestLCI**

- Temperature is, along with rainfall, an input to the model’s database, affecting a number of processes in the field:
  - Higher volatilization from leaves and soil with increasing temperature: higher air emissions
  - Higher dissipation of pesticides in soil with increasing temperature: less emissions to freshwater and groundwater

**Pesticide emissions in Danish agriculture in a future climate?**

Emissions of pesticides in the production of wheat and barley were compared for different climates:
- Current Danish climate (2010) and climate forecasted for Denmark in 2050 ([CO2]: 400-550 ppm, T: +2°C)
- Emissions to air increased 1% (barley) and 10% (wheat), to groundwater increased 103% and 13%, to surface water fell 66% and 50%
- Not accounted: increased dosage of some chemicals and the addition of new pesticides.
- Overall, increased emissions of pesticide to air and groundwater, decrease in emission to surface water.