Coupling ecosystems exposure to nitrogen and species sensitivity to hypoxia: modelling marine eutrophication in LCIA - DTU Orbit (31/12/2018)

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Characterisation modelling in Life Cycle Impact Assessment (LCIA) quantifies impacts of anthropogenic emissions by applying substance-specific impact potentials, or Characterisation Factors (CF), to the amount of substances emitted. Nitrogen (N) emissions from human activities enrich coastal marine ecosystems and promote planktonic growth that may lead to marine eutrophication impacts. Excessive algal biomass and dissolved oxygen (DO) depletion typify the ecosystem response to the nutrient input. The present novel method couples a mechanistic model of coastal biological processes that determines the ecosystem response (exposure) to anthropogenic N enrichment \( (\text{eXposure Factor}, \text{XF} \ [\text{kgO}_2\cdot\text{kgN}^{-1}]) \) with the sensitivity of species exposed to oxygen-depleted waters (Effect Factor, \( \text{EF} \ [(\text{PAF})\cdot\text{m}^3\cdot\text{kgO}_2\cdot\text{kgN}^{-1}] \)), expressed as a Potentially Affected Fraction (PAF) of species. Thus, the coupled indicator \( (\text{XF} \times \text{EF}, [(\text{PAF})\cdot\text{m}^3\cdot\text{kgN}^{-1}]) \) represents the potential impact on benthic and demersal marine species caused by N inputs. Preliminary results range from 2 \( (\text{PAF})\cdot\text{m}^3\cdot\text{kgN}^{-1} \) (Central Arctic Ocean) to 94 \( (\text{PAF})\cdot\text{m}^3\cdot\text{kgN}^{-1} \) (Baltic Sea). Comparative contributions per country or watersheds can also be obtained. Further adding environmental fate modelling of N emissions completes the CF for eutrophying emissions making it a useful contribution for sustainability assessment of human activities, as applied in Life Cycle Assessment (LCA).

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