

# ILEE meets CMK

Online



Institute of Life, Earth and Environment

**CMK**

CENTRE FOR  
ENVIRONMENTAL SCIENCES



**UHASSELT**

# Introduction CMK colleagues



Influences of the environment  
& climate change on...



HUMAN HEALTH



ECOSYSTEM FUNCTIONING



Sustainable,  
clean technologies



BIOBASED TREATMENTS



BIOBASED & ENVIRONMENTALLY  
SAFE PRODUCTS



Biodiversity &  
science-policy interface



BIODIVERSITY MONITORING &  
MANAGEMENT



SUPPORTING ORGANIZATIONAL,  
EDUCATIONAL  
& POLICY TRANSITION



1. Phytoremediation: organic and inorganic pollutants in water and soil
  - Use of plants to clean up contaminated soils (heavy metals, organic chemicals like PFAS and TNT...) with or without the support of...
    - microorganisms (e.g. metal-immobilizing bacteria, PFAS-degrading fungi)
    - soil additives (e.g. silicon, biochar)
2. Plant/crop-bacteria interactions
  - Microbiome studies in plants, rhizosphere and soil
  - Focus on phytoremediation, biodegradability, sustainable agriculture
  - Microbiome sequencing in house
3. Study the influence of nutrition on mice/human microbiome

Spin-off on remediation of soil and groundwater: [‘Bio2Clean’](#)

Relevant projects:

- EU REA project: [‘MIBIREM’](#) (2022-2027)
- LIFE project: [‘NARMENA’](#) (2019-2025)
- ICON project: [‘Popeye’](#) (2019-2023)
- Interreg Flanders-Netherlands project: [‘RESANAT’](#) (2019-2022)
- Running citizen science projects: [‘Stiemerlab’](#) and [‘Bodemleven’](#)



postdoc  
dr. Sofie Thijs





dr. Sophie  
Hendrix

dr. Michiel  
Huybrechts

1. Fundamental research line:

effects of abiotic stressors on plants with a focus on antioxidative defence

Using biochemical & molecular tools to unravel pathways in plants under stress

- type of stressors: heavy metals, drought, heat
- type of plants: model plant *Arabidopsis thaliana*, model crop *Phaseolus vulgaris*, other crops including tomatoes, strawberries, alfalfa, miscanthus, grapes...

2. Applied research line:

support plant growth in lands that are under pressure with a focus on plant quantity and quality

Using soil amendments or sustainable alternatives for sustainable agriculture

- type of stressors and plants are the same as above
- specific research on valorisation of plant waste streams; biochar as soil amendment; sustainable alternatives to grow microgreens

Relevant projects:

- SBO project: '[BASTA](#)' (2019-2023)
- ICON project: '[SpaceBakery](#)' (2018-2022)
- Interreg Flanders-Netherlands project: '[Circular farming and chemistry](#)' (2022-2025)





### Fundamental research on fungi

- general: fungi als inoculant to promote plant growth
- specific research topics (fundamental):
  - Zn transporters and their role in Zn homeostasis and tolerance mechanisms in the ectomycorrhizal fungus *Suillus luteus*
  - Functional characterisation of heavy metal transporting P-type ATPases and metallothioneins of the ectomycorrhizal fungus *Suillus luteus*
- specific applications:
  - Adaptation of the rhizosphere microbiome to ionizing radiation: using the Fukushima nuclear disaster as a case study



dr. Rik Verdonck





## 1. Microbial interactions in the soil

- Microbial communities and enzyme activities in soil
- Impacts of climate change (heat waves, drought) on
  - soil microbial stability
  - soil carbon sequestration
- Expertise in
  - heathlands
  - modeling food web dynamics
  - soil additives (e.g. silicon, biochar)
  - fungi with degrading capacity (e.g. PFAS)

## 2. Mycomaterials: expertise in mycelium production & use in mycomaterials

### Relevant projects:

- Bilateral PhDs with other universities
- ERA-NET FACCE SURPLUS project: '[BioFoodOnMars](#)' (2020-2023)



## Fundamental research on biodiversity - nature conservation

- Study biodiversity in natural protected areas
  - We investigate the space use and behavior of medium-sized mammals using a long-term camera trap design
    - The focus is on changes in their ecology caused by the interactions between humans and wildlife. We use and optimize existing spatial distribution models.
    - We study mammalian population dynamics in the National Park Hoge Kempen (Belgium) and formulate conservation strategies. We extend existing methodology into less assumption-driven models.
    - This will yield improved guidelines for data collectors and analysts, as well as a better understanding of mammalian abundances with the potential for direct implementation in conservation policies.
    - Intense collaboration with the fauna division of INBO and DSI-UHasselt.
  - We study ways to translate knowledge on species in natural protected areas into policy advice
    - Detailed analysis of space and habitat use; evaluate the breeding success and survival; investigate the food availability; and analyze the body condition of individuals through blood analyses.





## Fundamental research on biodiversity - nature conservation

- expert in animal ecology
  - focus on invasive species (e.g. frogs and fishes)
  - develop alternative methods to control invasive species (e.g. sterilisation)
  - policy advice





## Fundamental research on climate change

- Optimize agricultural production under climate change - using simulations in the Ecotron
  - We perform state of the art climate change simulation in our ECOTRON facility for future proof agriculture
    - There is land that is left aside from agricultural use, because it is too poor, too polluted, or too dry to be profitable. Can we make this marginal land attractive again for food or feed production? If yes, how? And can we do that with a minimal C footprint? We study how we can produce biofortified and climate-resilient food and fodder.
  - We simulate the effect of future climate on the functioning of natural ecosystems, and the consequences for society.
    - Climate change will favor dominance of fast-growing, resilient species.
  - Long term experiments
    - [BioFoodonmars](#) - We evaluate the benefits of using amendments on crops growing on marginal land, under future climate conditions
    - [Drought impact on heathland](#) - Stimulate the effect of future climate on the functioning of the heathland ecosystem, and the consequences for society
    - [Q-Pear](#) - We assess how growth of pear trees, pear quality and functioning of the pear orchard agri-ecosystems will be affected by future climate
    - [Ecotron infrastructure](#)





### Fundamental research on biodiversity

- expert in (flatworm) taxonomy
  - biology of invertebrates, meiofauna, and aquatic parasites in particular, with a main emphasis on taxonomy, phylogeny and biogeography.
  - "classical" taxonomical studies, and in-depth molecular phylogenetic, phylogenomic, population genomic and phylogeographical analyses, in order to elucidate important evolutionary events (e.g. habitat shifts, origin of parasitic/symbiotic life styles) and to disentangle cryptic diversity



CMK participates in worldwide projects such as the Freshwater Animal Diversity Assessment (FADA) which offers up-to-date information on biodiversity to all types of end users.





### Fundamental research on biodiversity

- expert in (flatworm) taxonomy
  - applied philosophical research focussing on the role of values in species descriptions, which can have major impact on policy making regarding nature conservation issues
- translate biodiversity information into capacity building and sustainable development in developing countries
  - long-term institutional partnerships (Institutional University Cooperations - VLIR) with the University of Moulay Ismail in Morocco on sustainability and energy; and with the Universidad de Oriente in Cuba on biodiversity, the environment and food production
  - numerous smaller-scale collaborations with universities and research institutes throughout sub-Saharan Africa, mainly on the monitoring and management of aquatic ecosystems

CMK participates in worldwide projects such as the World Register of Marine Species (WoRMS), which offers up-to-date information on biodiversity to all types of end users.





## Fundamental research on toxicology

- Study the impact of emerging pollutants
  - wide portfolio of toxicity tests
    - aim to provide alternative models and model systems to assess different types of toxicity (carcinogenicity, neurotoxicity, developmental toxicity)
    - Neomodels is an assay based on changes in stem cell dynamics and has the potential to detect non-genotoxic carcinogens
    - special attention is given to stem cells as promising tools in the evaluation of potential toxic effects
    - impact of nanoparticles, microplastics and heavy metals on human health and aquatic organisms





## Fundamental research on epidemiology - air pollution

- Long term data on the interaction between the environment and children's health
- World expert on monitoring health impact of air pollution
- Expert in telomere length and non-invasive carbon black/black carbon measurements
- ENVIRONAGE birth cohort
  - Environmental factors, such as air pollution and nutrition, can affect the fetal health during the prenatal period.
  - ENVIRONAGE investigates the underlying mechanisms of age-related disorders, such as cardiovascular diseases, dementia and diabetes. By studying newborns and children, we aim to find predictive markers of ageing, which are linked to environmental exposures.
  - ENVIRONAGE is a longitudinal study that aims to investigate the influence of environmental exposures during pregnancy and early life on the health of children.
- Projects
  - The [ENVIRONAGE](#) birth cohort study
  - [ATHLETE](#) (Advancing Tools for Human Early Lifecourse Exposome Research and Translation) is a European-funded project that aims to better understand and prevent health effects of numerous environmental hazards and their mixtures, starting from the earliest stages of life





## Fundamental research on epidemiology - effect of nature

- Study the impact of green for better living, working and learning conditions
  - Exposure to nature, including green spaces, has been associated with improved physical and mental health as well as well-being. We use Epigenetics as a sensitive and early measure which can represent sensors of external stimuli, interfacing between exposure and health outcome.
  - We perform intervention studies to analyze how stress can lower and cognition can improve when employees perform activities in nature during the work hours, and to analyse the impact of exposure to nature on the health, cognitive performance and well-being of schoolchildren.
  - We integrate subjective (well-being, life satisfaction) and objective (epigenetics, cognition) outcomes with the ultimate goal of providing a solid and practical scientific evidence-base for policy-makers, enabling them to devise and implement informed and cost-effective interventions, to improve mental health and well-being.
- Projects
  - [GREENBRAIN](#) - The physiological and economic impact of nearby green space on stress, cognitive and behavioral development and mental well-being of children
  - [Green healthy secondary schools](#)
  - [Nature based prevention for burnout](#) - pilot study







Expertise in developing and applying medical dosimetry, in particular for radiotherapy

- focus on the exposure to radiation from a radioprotection point of view (negative aspects) or for medical use (positive aspects)
- collaborate with the Belgian government in developing dosimetry audits in the domain of radiotherapy
- dosimetry knowledge has also been applied in the context of biological studies and can be put in service to anybody who needs a more precise determination of the dose in their experiments (such as hospitals)

Projects: [Microdosimetry](#) - Develop a method based on the use of a physical dosimeter, a microdosimeter, that can be deployed for routine use in a clinical setting



### Applied research in nuclear technology

- optimize nuclear detection techniques
- NORM experts
  - Treatment and reuse of NORM in e.g. construction materials
  - [RADONORM](#) project
- nuclear waste management
  - nuclear waste reuse during nuclear decommissioning and immobilisation of nuclear waste
  - [Archer](#) project
- educate in nuclear dismantling using VR trainings



## Green chemistry

- Production of biochar using different pyrolysis methods
- Analyse adsorption capacity of activated carbon (AC)
  - in collaboration with SCK CEN and JRC
  - expertise to perform and compare adsorption and desorption studies of water soluble and gaseous contaminants on different kinds of adsorbents (AC, biochar, zeolites, embedded nanoparticles, ...)
  - execute leaching studies of new developed matrices
  - ACs are produced from various industrial and agricultural rest streams using pyrolysis and activation. Production facilities for ACs (lab-scale to pilot-scale) are available in house.
  - We also investigate the efficiency of regeneration of these dedicated adsorbents, and assess their performance for special applications in nuclear emergency monitoring, environmental protection and waste treatment.
  - We collaborate closely with SCK CEN, JRC Karlsruhe, and Act & Sorb.
- Develop innovative green extraction methods
  - e.g. for nutraceutical extraction from plants/plant waste





### Develop innovative methods for evidence-based policy making

- assess people's preferences and willingness to pay for policies and solutions targeted at the mitigation of and adaptation to environmental problems
- stated and revealed preference methods are used
- our research contributes to identifying and shaping best practices in stated choice modelling
- we apply methods that allow explaining and stimulating pro-environmental behavior such as structural equations modelling and survey experiments

### Sustainable aviation fuels: Economics, environmental performance and regulation

- world expert on the economics & environmental performance of sustainable aviation fuels
- research to help make aviation greener
- core area of research is sustainable aviation fuels, in particular with regard to assessments on their economic and environmental viability (using e.g. TEA and LCA) and with regard to designing methods to appropriately account for those fuels in international climate regulation
- Projects
- [ASCENT 1](#) - [ALTERNATE](#) - [STARGATE](#)





- education: Teaching methodology at the School of Educational Studies of our university (UHasselt) and the Multidisciplinary Institute of Teacher Education (MILO) at Vrije Universiteit Brussel (VUB)
  - topics: training and education for a sustainable and circular society
- economics: environmental economics with a focus on techno-economic analyses
  - topics: biochar; circular economy

He combines both expertises in creating transformative learning environments for sustainable development

- e.g. Sustainability management control in Belgian local governments: speeding up the European Green Deal towards a circular economy
- Projects:
  - [Active8-Planet](#): research and experiment with unconventional approaches towards teaching and learning that would empower and mobilize students towards future-oriented climate and sustainability actions
  - [CIRCLESPEED](#) - Take the highway to circular enterprise

He is one of three co-presidents of the COPERNICUS Alliance, the European Network of Higher Education for Sustainable Development.



## Perform economic assessments of clean technologies



- We have developed a methodological framework for techno-sustainability analysis (TSA) for cleantech in function of its TRL, in which techno-economic, environmental and social LCA are integrated.
- Whenever trade-offs exist, it becomes difficult to choose among alternative clean production pathways. Societal techno-economic assessment then is a way to integrate the environmental aspects with economics in order to make optimal investment and/or policy decisions regarding cleantech. Recently, efforts are directed more towards the integration of environmental aspects with (private) economic aspects by means of shadow prices. The latter is what we call a societal TEA that reflects both the societal value of environmental impacts and the private costs and benefits associated with cleantech. If appropriate and properly measured, those shadow prices help to determine optimal (societal) strategies for the transition towards more sustainable production and consumption as environmental and economic aspects can be expressed in one single monetary indicator.

## Develop innovative methods for evidence-based policy making

- assess people's preferences and willingness to pay for policies and solutions targeted at the mitigation of and adaptation to environmental problems







## Meta-research in environmental science and economics

- Meta-research is research-on-research with the aim to improve the credibility and reliability of published research. Researchers are incentivized to publish and some results can be easier published than others. As a result, researchers may consciously or unconsciously search for results that can be more easily published, distorting the evidence that is available to the public. Such a selection of results is known as p-hacking or publication bias. y
- As an affiliate at the Meta-Research Innovation Center at Stanford (METRICS), Stephan pursues his passion about improving the evidence base with the ultimate goal to foster evidence-based environmental and climate policy.
- Goal: Develop innovative methods for evidence-based policy making



### Fundamental research on environmental law

- European expert on studying the prosecution & sanctioning of environmental crime in EU
  - We offer a substantiated answer to questions that concern the core of the subject, such as: What administrative sanctions exist in our environmental law? What is their law enforcement potential? What about the sanctioning practice?

