# Nexus approach for a sustainable environment: from individual modeling approaches to digital twins

Prof. Anthony Lehmann

Institute for Environmental Sciences, University of Geneva

Switzerland

**Short Biography**
Prof. Anthony Lehmann specialized in Species Distribution Modeling (SDM) and pioneered the development of GRASP, the first package enabling spatial predictions based on point observations of plant and animal distributions.

More recently, Prof. Lehmann has focused on leveraging hydrological modeling to inform decision-making processes. He initiated and coordinated the FP7 enviroGRIDS project that aimed at bridging the gap between scientific data and decision-making in the Black Sea catchment. This project advanced Earth Observation capacity building, data-sharing practices, and the calibration of a large, complex hydrological model for the region.

Prof. Lehmann's recent research emphasizes spatially explicit assessments of ecosystem services. He coordinated the H2020 ERA-PLANET/GEOEssential project (2017–2021), which developed geoprocessing workflows to link Earth Observation data with environmental policy indicators using Essential Variables. Building on this expertise, he led the Swiss National Fund project SWATCH (2017–2020), focusing on eco-hydrological modeling of Swiss rivers, and is currently involved in the ValPar.CH project (2020–2023), exploring ecosystem services, biodiversity, and ecological infrastructures in and around Swiss regional parks.

**Abstract**Effective environmental management requires high-quality geospatial data, yet data access remains hindered by technical, political, and economic barriers. The Essential Variables (EVs) framework, initially developed for climate data, now extends to biodiversity and socio-ecological systems, emphasizing the need for robust Spatial Data Infrastructures (SDIs). However, SDI implementation remains costly and complex, limiting seamless data sharing.

Recent advances in geospatial workflows, driven by open-source tools like Python and R, have improved reproducibility and scalability. We illustrate this with two Swiss case studies: (1) prioritizing conservation areas through species distribution and ecosystem service assessments, and (2) using SWAT modeling to analyze river water quality.

These examples highlight the potential for further integration within a Nexus framework, connecting Climate-Food-Water-Energy-Ecosystem domains. The ultimate goal is to embed these methodologies into Digital Twins, transforming essential variables into actionable environmental insights.