ARPHA Conference Abstracts 8: e151516
doi: 10.3897/aca.8.e151516

OPEN ACCESS

Conference Abstract

Using big data to address global environmental challenges

W. Daniel Kissling ‡

‡ University of Amsterdam, Amsterdam, Netherlands

Corresponding author: W. Daniel Kissling (w.d.kissling@uva.nl)

Received: 26 Feb 2025 | Published: 28 May 2025

Citation: Kissling WD (2025) Using big data to address global environmental challenges. ARPHA Conference Abstracts 8: e151516. https://doi.org/10.3897/aca.8.e151516

Abstract

Global policy frameworks such as the UN Sustainable Development Goals (SDGs) or the Kunming-Montreal Global Biodiversity Framework (KMGBF) as well as numerous EU policies related to species and habitat conservation (e.g. Nature Restoration Law, Birds Directive, Habitats Directive, Water Framework Directive, Marine Strategy Framework Directive), ecosystem services (e.g. Pollinators Initiative, Land Use Land Use Cover and Forestry Regulation, proposed Forest Monitoring Regulation) and the sustainable management of natural resources (e.g. Common Fisheries Policy, Common Agricultural Policy) highlight the urgent need to monitor changes in biodiversity, ecosystems and the natural environment. However, tracking progress towards the ambitious policy goals is challenging and requires a minimum set of measurements that are consistent across scales and regions for deriving indicators that capture the major dimensions of change. Delivering such information is supported by the development of essential variables for climate (ECVs), oceans (EOVs), biodiversity (EBVs) and geodiversity (EGVs) which can be used to characterize and monitor changes on our planet. This can advance science and inform policy.

Our knowledge, management and governance of the Earth system ultimately depends on diverse measuring tools and multiple data types, including remote sensing and in-situ data collection with field samples and experiments. For monitoring of biodiversity and ecosystems, EBVs can provide consistent knowledge about multiple dimensions of biodiversity change across space and time. For such variables, diverse data types are

© Kissling W. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

required, including structured in-situ observations, citizen science data, and time-series data collected through cutting-edge methods. These cutting-edge methods span DNA-based techniques like eDNA metabarcoding; digital sensors such as cameras, acoustic devices, and GPS tags; and remote sensing technologies, including satellites, drones, airplanes, and weather radars. In the era of “big data”, the vast and often unstructured datasets cannot easily be downloaded or analyzed without advanced, high-throughput processing pipelines. Transforming such data into actionable insights therefore involves applying FAIR (Findable, Accessible, Interoperable, Reusable) principles, integrating heterogeneous data from multiple sensors, testing the robustness and transferability of models and metric calculations, developing automated and transparent processing workflows, leveraging parallel or distributed computing, and employing cloud-based virtual research environments to streamline the analyses.

These processed and standardized biodiversity data can be utilized for a variety of applications, including the construction of data cubes for spatiotemporal analysis, the building of models and tools for biodiversity and ecosystem change analysis, and simulations and scenarios using Digital Twins and other forecasting tools. Additionally, artificial intelligence (AI), particularly deep learning, has emerged as a powerful tool for analyzing big and complex datasets, such as imagery from satellites and unmanned aerial vehicles (UAVs), wildlife and insect camera images, acoustic recordings, and LiDAR point clouds. The integration of remote sensing and in situ observations, harmonized data and models, and the use of automatic recorders with AI algorithms will substantially advance biodiversity and ecosystem monitoring. This can provide improved support for species and habitat conservation policies and land use management, and enable science-driven strategies to address global environmental challenges.

Keywords

Biodiversity indicators, data streams, environmental policy, essential variables, interoperability, modelling, monitoring, observation network, sustainable stewardship

Presenting author

W. Daniel Kissling

Presented at

KEYNOTE

Conflicts of interest

The authors have declared that no competing interests exist.