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Essential Biodiversity Variables (EBVs) and Earth Observation—An Invitation to Participate

Addressing the Biodiversity Crisis

Biodiversity loss and degradation, with its impacts on the sustainability of resources used by society, is developing as a major global concern for companies, government, NGOs and the public.

In response, the scientific community developed the concept of Essential Biodiversity Variables (EBVs) (Pereira et al., 2013) which provides a structure to harmonise key aspects of biodiversity from genes to landscape. EBVs are a comprehensive set of standardised observations that indicate how key aspects of biodiversity are changing over the short (1-5 years) or medium-term (10-50 years).

The definition of EBV's encompasses six variable classes: genetic composition, species population, species traits, community composition, ecosystem structure and ecosystem function. Within each class there are a wide range of candidate EBV's which include, for example, many well-known remote sensing products such as morphology of species, land cover, fractions of live cover, primary productivity, fire disturbance of ecosystems, phenology and species distributions (Skidmore et al. 2021). These different EBV candidates, and their associated remote sensing biodiversity products, can be observed and monitored across the range of spatial and temporal scales (Figure 1).

The Role of Earth Observation

Earth Observation data offer insights into both the spatial and temporal patterns of many EBV's as well as their change in time and space using a range of platforms including satellite systems, aircraft and remote piloted systems as well as terrestrial sensors.[1] The role of spatial sciences in general, and remote sensing in particular, are key elements in many of the EBV's as most biodiversity observations are collected in the field by in situ observations based at a point in time. With remote sensing we can interpolate and model in space and time many key biodiversity variables. A recent paper details and prioritizes the 30 top biodiversity remote sensing products which can be retrieved now or in the next decade from remote sensing (Skidmore et al., 2021). They conclude current and emerging next-generation satellite remote sensing technologies are an ideal tool for the continuous detection of changes in biodiversity from local to global levels, thereby filling data gaps in the spatial and temporal coverage of in situ observations.

When observed from spacecraft, specific EBV's can be monitored at near global scales, thereby providing significant benefit to the biodiversity community through remote sensing biodiversity products that can be integrated into global, national and regional biodiversity monitoring programs. A number of key technologies with unique capacity to predict some EBV's are only able to be flown (currently) on aircraft systems, for example small footprint lidar and hyperspectral data. In these cases, data sets are more limited in spatial coverage, and temporal resolution, and whilst these data sets still have critical roles to play in biodiversity monitoring programs, they are more likely to be relevant at local and regional levels, rather than in a global context.

Since the definition of the EBV concept over a decade ago.[2] there has been research and documentation on which of these EBV's are best suited to observation by remote sensing technologies. This attention has focused on how to best apply Earth Observation technologies (for example proof of concepts and best practice guides). More recently there has been a push towards working more collaboratively with space agencies to develop new sensor technologies such as image spectroscopy as well as LiDAR that are able to provide insights into EBVs currently not well detected using existing technologies. The availability of space-based LIDAR lidar and image processing systems designed for vegetation structure and ecosystem function (e.g., stress) are providing near global estimates of attributes likely to be highly relevant to the estimation and monitoring of biodiversity.

Invitation to Contribute

A key organisation for biodiversity monitoring is the UN Group on Earth Observation Biodiversity Observation Network or GEOBON. GEOBON is a global network of hundreds of biodiversity scientists, users, companies and governments,

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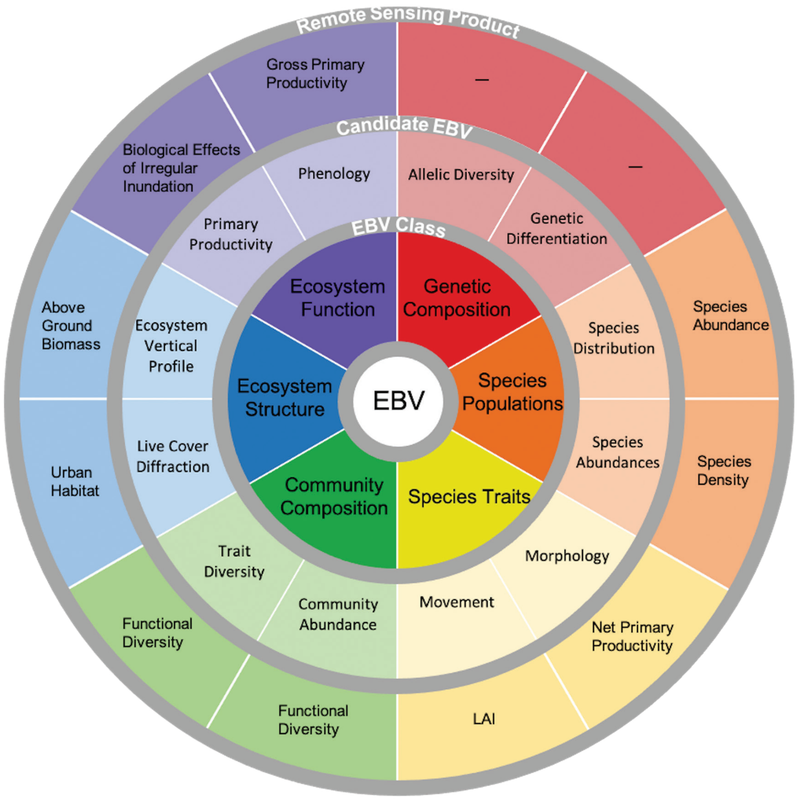

Figure 1: Central to the EBV concept are EBV classes which allow definition of multiple candidate EBV's many of which can be observed and monitored using remote sensing technologies. The 6 EBV classes, example candidate EBV's and examples of remote sensing products which can either measure or be correlated to candidate EBV's above.

and has been examining through a working group structure each of the EBV classes, producing a number of peer reviewed papers on each EBV class. In addition, GEOBON has overseen the establishment of a number of biodiversity observation networks at the national and international level as well as across biomes for example SOILBON and MARINEBON. Each working group has been tasked with examining each EBV class to focus on which EBV's are the most suitable for measurement, detection, and sensitive to change. They are working closely with taskforces focused on data management and remote sensing to ensure that the proposed observation networks can be applied across time and space. Remote Sensing is a key area of science filling the gaps between field based biological observations and allowing upscaling from local to global levels.

As the EBV concept matures, so too will the approaches of GEOBON to developing future observation networks and metrics for biodiversity as well as informing the most applicable use of remote sensing technologies for biodiversity assessment. GEOBON has strong links to National Aeronautics and Space Administration (NASA), European Space Agency (ESA) and Committee on Earth Observation Satellites (CEOS), and is active in key biodiversity networks including the UN Convention on Biodiversity as well as the Biodiversity and Ecosystem Services (IPBES) Satellites.

As we move forward in the continuing development and demonstration of EBV's, key directions will focus on exploration of how to bridge the work of ecologists (who address the efficacy of using EBVs for biodiversity monitoring) and remote sensing specialists (who address technologies deriving remote sensing products related to EBVs). In particular a focus of discussion includes the technical requirements needed to ensure that EBVs are operationally realistic from a remote sensing perspective. We need your help and welcome your involvement in the GEOBON Remote Sensing activities. To do so, please reach out to the co-authors.

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2. Skidmore, A. K. et al.,(2021), Priority list of biodiversity metrics to observe from space. Nat. Ecol. Evol., doi:10.1038/s41559-021-01451-x.

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