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EXTENDED ABSTRACT ONLY

Biodiversity modelling for all

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Abstract: We are entering the sixth mass extinction event in Earth's history, making it ever more important that we understand the spatial distribution of Earth's biodiversity. Such an understanding is crucial to determine the allocation of scarce conservation resources. It is also integral to efforts to comprehend the evolutionary and environmental processes that shape past, current and future biodiversity distributions.

Online and freely accessible databases now make available enormous and ever increasing amounts of data describing and documenting species occurrences and related attributes. Spatial data can be obtained from sources such as the Atlas of Living Australia (http://www.ala.org.au; >70,000,000 observation records) and the Global Biodiversity Information Facility (http://www.gbif.org; >700,000,000 observation records). Other non-spatial data such as phylogenetic trees and genetic data can be obtained from sources such as Treebase (www.treebase.org) and Genbank (www.ncbi.nlm.nih.gov/genbank/). There is also an increasing wealth of environmental layers at regional to global extents, representing for example climate, edaphic and terrain variables.

There is a clear need for modelling and analytical tools to enable the easy integration of these considerable resources. This is especially the case for the many researchers who have a deep understanding of their specialist areas (e.g. organisms or ecosystems), but who lack the technical know-how and sufficiently powerful hardware to implement potentially complex modelling processes for large data sets.

The Biodiversity and Climate Change Virtual Laboratory (BCCVL; http://bccvl.org.au) has been developed for this purpose. The BCCVL provides a "one-stop modelling shop" to simplify biodiversity and climate change modelling.

The BCCVL provides tools to generate distribution models for any number of species using any or all of 17 different SDM algorithms. While use of such models is standard practice in many fields, typically no more than two such algorithms are run using a researcher's own systems, and then commonly with little to no experimentation with parameter settings. The further advantage and novelty of the BCCVL is in the "value adding" — model outputs can be used in subsequent experiments to (1) identify potential impacts of climate change under nine different potential emissions scenarios, (2) aggregate indices to identify hotspots of endemic species, and (3) use ensemble analyses to combine SDM results from different algorithms.

More recent developments in the BCCVL have expanded the nature of the data sets that can be used by researchers. (1) Users can move beyond the grid cell and develop SDMs of freshwater aquatic systems, leveraging the stream segments and catchments provided by the Bureau of Meteorology's Geofabric data set. (2) There is support for migratory species SDMs, enabling the analysis of distributions that can change rapidly over time. Migratory species can often have part of their distribution in highly threatened environments, so gaining an understanding of where these occur is of vital importance. (3) The response of species traits, a current hot topic in ecology, can be modelled in relation to the environment. This allows the prediction of how the spatial distribution of traits such as leaf size, or potentially CO_2 uptake, will change under future climate projections.

The BCCVL is a major collaborative project between researchers across multiple universities, with funding from NECTAR, ANDS and RDS. The code base is free and open source, and accessible through GitHub (https://github.com/BCCVL/). The web interface is freely accessible to any researcher, with access for Australian researchers enabled through the Australian Access Federation.

An aspiration of many modellers is to get their models into practical use beyond the academy. The BCCVL provides a clear example of how this can be done, a process relevant across the modelling spectrum.

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