



## **The Ecological Marine Units Project as a Framework for Collaborative Data Exploration, Distribution, and Knowledge Building**

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A data-derived, ecological stratification-based ecosystem mapping approach was recently demonstrated by Sayre et al. for terrestrial ecosystems, resulting in a standardized map of nearly 4000 global ecological land units (ELUs) at a base spatial resolution of 250 m. The map was commissioned by the Group on Earth Observations for eventual use by the Global Earth Observation System of Systems (GEOSS), and was also a contribution to the Climate Data Initiative of US President Barack Obama. We now present a similar environmental stratification approach for extending a global ecosystems map into the oceans through the delineation of analog global ecological marine units (EMUs). EMUs are comprised of a global point mesh framework, created from over 52 million points from NOAA's World Ocean Atlas with a spatial resolution of  $\frac{1}{4}$  by  $\frac{1}{4}$  degree ( $\sim 27 \times 27$  km at the equator) at varying depths and a temporal resolution that is currently decadal. Each point carries attributes of chemical and physical oceanographic structure (temperature, salinity, dissolved oxygen, nitrate, silicate, phosphate) that are likely drivers of many marine ecosystem responses. We used a k-means statistical clustering algorithm to identify physically distinct, relatively homogenous, volumetric regions within the water column (the EMUs). Backwards stepwise discriminant analysis determined if all of six variables contributed significantly to the clustering, and a pseudo F-statistic gave us an optimum number of clusters worldwide at 37. Canonical discriminant analysis verified that all 37 clusters were significantly different from one another. A major intent of the EMUs is to support marine biodiversity conservation assessments, economic valuation studies of marine ecosystem goods and services, and studies of ocean acidification and other impacts (e.g., pollution, resource exploitation, etc.). As such, they represent a rich geospatial accounting framework for these types of studies, as well as for scientific research on species distributions and their relationships to the marine physical environment. To further benefit the community and facilitate collaborate knowledge building, data products are shared openly and interoperably via [www.esri.com/ecological-marine-units](http://www.esri.com/ecological-marine-units). This includes provision of 3D point mesh and EMU clusters at the surface, bottom, and within the water column in varying formats via download, web services or web apps, as well as generic algorithms and GIS workflows that scale from global to regional and local. A major aim is for the community members to may move the research forward with higher-resolution data from their own field studies or areas of interest, with the original EMU project team assisting with GIS implementation (especially via a new online discussion forum), or hosting of additional data products as needed.