Geophysical Research Abstracts
Vol. 17, EGU2015-10887, 2015
EGU General Assembly 2015

Maximising returns from large datasets with sparse and variable resolution: A seamount case study

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Marine geomorphology studies at even a basic topographical level suffer from a duality of simultaneous data wealth — the oceans are immense, and the resulting datasets large — and data poverty — resolution in many areas is very low (km scale), and rarely approaches standards taken for granted in terrestrial areas. A compounding factor is the nonuniform nature of the data. Some areas have 25–100 m scale coverage of bathymetry data measured directly by ship; others have only data that is inferred from gravity or sea surface altimetry data. This data is not only thus indirect, but also has resolution that is 1–2 orders of magnitude lower.

Here we look at how these challenges affect what should be a basic, but fundamental task: identifying seamounts, submarine mountains that are the products of excess volcanism. Worldwide, 10,000–20,000 seamounts over 1 km in height have been identified, depending on the study, but it is estimated that up to 60% of seamounts in this height range remain unmapped. We explore how differing coverage in bathymetry versus gravity-based data affects our perception of the same feature, increasing the difficulty of making reliable identifications from partial information. To try to optimise results given these complexities, we analyse a range of data types at variable resolution using a new technique based on neural networks, a type of learning algorithm designed to have sophisticated pattern recognition capabilities. Potentially valuable directions for future developments include simultaneous analysis of multiple data types and algorithms specifically trained to work a finer resolutions, where available.