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Hunting for seamounts using neural networks: learning algorithms for geomorphic studies

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Many geophysical studies rely on finding and analysing particular topographic features: the various landforms associated with glaciation, for example, or those that characterise regional tectonics. Typically, these can readily be identified from visual inspection of datasets, but this is a tedious and time-consuming process. However, the development of techniques to perform this assessment automatically is often difficult, since a mathematical description of the feature of interest is required. To identify characteristics of a feature, such as its spatial extent, each characteristic must also have a mathematical description. Where features exhibit significant natural variations, or where their signature in data is marred by noise, performance of conventional algorithms may be poor.

One potential avenue lies in the use of neural networks, or other learning algorithms, ideal for complex pattern recognition tasks. Rather than formulating a description of the feature, the user simply provides the algorithm with a training set of hand-classified examples: the problem then becomes one of assessing whether some new example shares the characteristics of this training data. In seismology, this approach is being developed for the identification of high-quality seismic waveforms amidst noisy datasets (e.g. Valentine & Woodhouse, 2010; Valentine & Trampert, *in review*): can it also be applied to topographic data?

To explore this, we attempt to identify the locations of seamounts from gridded bathymetric data (e.g. Smith & Sandwell, 1997). Our approach involves assessing small 'patches' of ocean floor to determine whether they might plausibly contain a seamount, and if so, its location. Since seamounts have been extensively studied, this problem provides an ideal testing ground: in particular, various catalogues exist, compiled using 'traditional' approaches (e.g. Kim & Wessel, 2011). This allows us to straightforwardly generate training datasets, and compare algorithmic performance. In future, we hope to extend the approach to identifying the seamount's 'footprint' and, by isolating it from the underlying seafloor, extracting parameters of interest such as height, radius and volume.

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