Grid Interpolation in dbSEABED using 3D IDW

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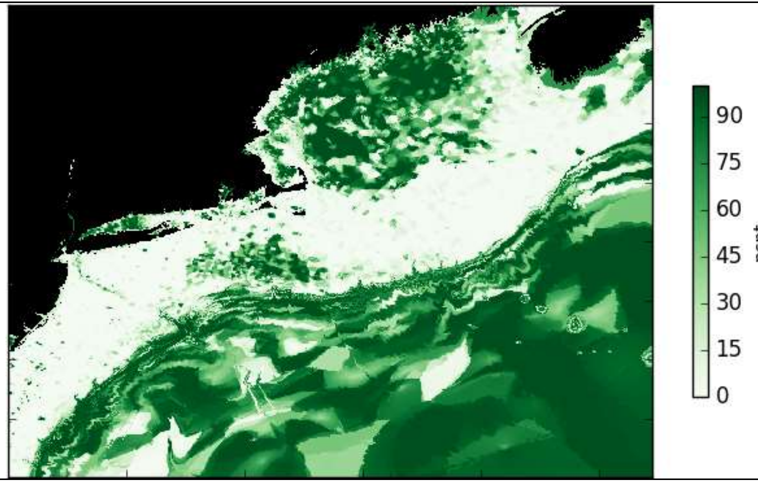

Problem. Any number of mathematical methods are available for grid interpolation of point data – IDW, Natural Neighbour, Kriging, Spline, Machine Learning (ML) suite, etc. Choice of method for the wide-area mappings of dbSEABED hinges on several factors: (statistical reliability, (ii) environmental reasonableness, (iii) faithfulness to local data, (iv) not a 'black-box' method.

The IDW method, though one of the simplest, is still widely acknowledged as effective for many tasks. However, it is very dependent on the spatial distribution of the data. The present method – 3d IDW – lessens that problem by using a guiding layer, in this case bathymetry. The method has similarities to a k-NN ML method that uses 3 coordinates of distance – x,y,z - as predictive feature layers.

Method. The distance weighting on each input value (i) is: $D_i = \sum\left(dX_i{}^2 + dY_i{}^2 + dZ_i{}^2\right)^p$ where p is the IDW power (usually -2), dX,dY are easting and northing distances in km, and dZ is water depth difference in 10*metres (decametres). The 1:100 scale difference between X,Y and then Z ensures that the distances are equally sensitive to the sediment variabilities. A filter excludes data points >2x different from the mapcell (but with special measures close inshore).

The training data are cell-wise values of the observed data, each cell holding a mean and variance for each parameter. The amount of input for common parameters for a map region anywhere in the world for dbSEABED is typically ~300-3000 cells. Processing is carried out in reference to each cell of the map area, selection of data and application of weights, to compute the result. So the process is highly local.

A mask is provided for the mapping, distinguishing "mapped" and "predicted" grades of uncertainty on the results, with a boundary at 50% uncertainty on the parameter FSD. A "predicted" label indicates that renewed effort in better sampling is required.

Outputs. The interpolations (e.g., Fig. 1) are a great improvement on the CIDW results (see that briefing). They also out-perform the ML-generated products that have been produced. Two sharp tests are whether the griddings – for example of mud – sensibly follow terrain such as submarine canyons, the seamounts (true, see Fig. 1). Otherwise the method causes many facies patches to follow for some distance along-contour. Considering the control of density on lateral ocean current pathways, this is a reasonable outcome.

The method does depend on the quality of the underlying bathymetry data layer (usually SRTM30+), but not always critically because of the need for nearby data. In areas of very scattered data on flat areas - such as abyssal plains - the method produces results akin to nearest neighbor.
