CONSTRAINING AN INVERSION TO FOLLOW CURVING TRENDS IN AN IMAGE

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This paper addresses the question of how to include structural information, for example from a magnetic image, into an airborne electromagnetic (AEM) inversion.
The kind of information we are interested in is the trend directions seen in the magnetic image, such as strike directions of dipping bodies, or the shape of palaeochannels.

A commonly-used technique for including prior information is to use a model covariance matrix, describing the spatial covariance between different model points. However, these covariances are usually constructed from a stationary covariance function which is dependent on the vector distance between two points, but is the same for the entire model. However, if a palaeochannel is visible in the magnetics, then we know that the AEM model is more likely to be similar along the channel than away from the channel. We therefore wish to construct a covariance matrix that can take curved and branching structure into account.

We construct an inhomogeneous covariance matrix from an image by breaking the image up into multiple windows, and then computing an elliptical distance metric in each window, such that distances in the direction of the features in that window are shorter than distances across those features. This collection of distance metrics then allows us to compute, between any two points in the image, a shortest path that curves to follow the directions of trends in the image. Using this curved-path distance allows us to generate a covariance matrix that encourages the inverted model to follow the trends in the image.