Oasis montaj Best Practice Guide

VOXI Earth Modelling - Combined Iterative Reweighting Inversion

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Combined Iterative Reweighting Inversion

Introduction

Iterative reweighting inversion (IRI) is a powerful technique that can be used to control the type of inversion model produced by VOXI. This note describes a more advanced IRI technique and has as prerequisites the Best Practice guides, VOXI - Sharpening using Iterative Reweighting Inversion and VOXI - Exploring Inversion Solution Space. The former guide describes how to sharpen a smooth VOXI model while the latter guide describes how to produce a suite of models with different depths, all of which satisfactorily fit the geophysical data. In the following guide, we describe the process for simultaneously combining both depth control and sharpening in IRI.

The VOXI Default Model

We begin by considering a simple horizontal sheet in a half space model as shown in *Fig. 1*. We simulate the TMI response over the sheet and then invert the response with VOXI, using all defaults, to yield the result shown in *Fig. 2*. We will call this the "default" VOXI result and we can see that it is a poor approximation to the true model: the recovered target is spheroidal and lies below the true model. This is to be expected since, by default, VOXI is designed to return a compact smooth target. We now assume that we have prior information that the type of target we are looking for is a flat lying body.

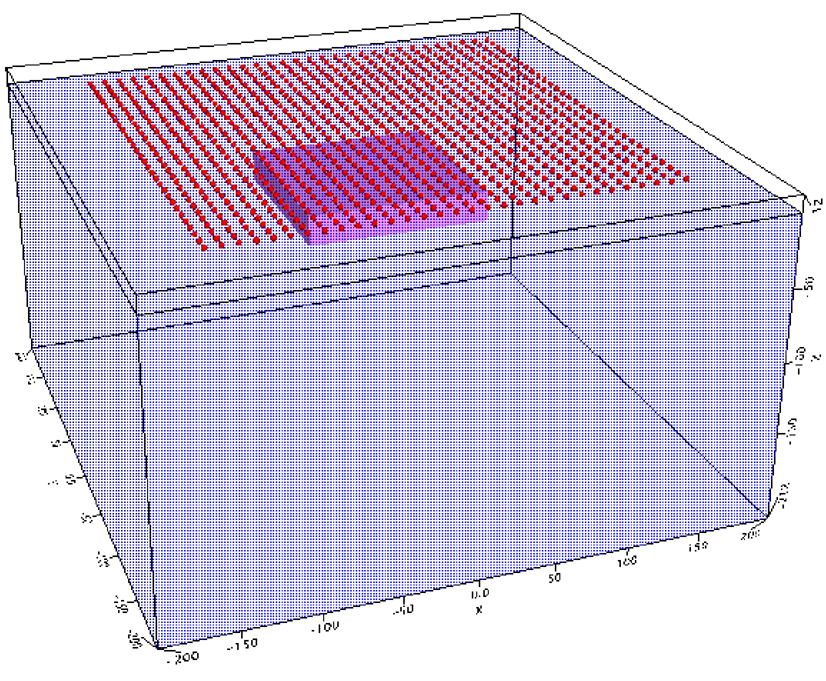

Fig. 1: The Horizontal Sheet Model

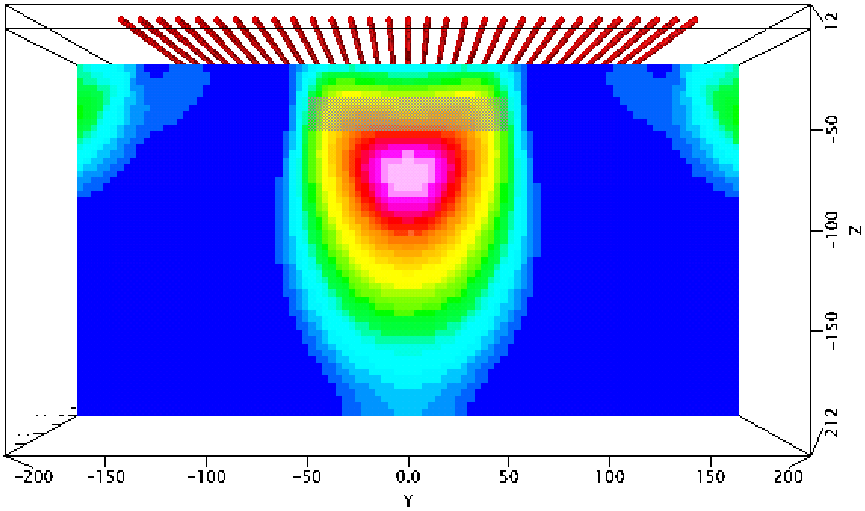

Fig. 2: The "default" VOXI inversion model for the Horizontal Sheet Model. The true model is shown overlaid in grey.

Producing a Shallow Model

The "default" inversion result shown in *Fig. 2* is compact and spheroidal, while the desired model is known to be flat lying. Using the methodology described in VOXI - Exploring Inversion Solution Space with a $(z_{max} - z)^3$ depth dependent voxel model (*Fig. 3*) as an Iterative Reweighting Inversion input yields the shallower, flat lying, model shown in *Fig. 4*. This is a much better representation of the character of the model we are trying to recover.

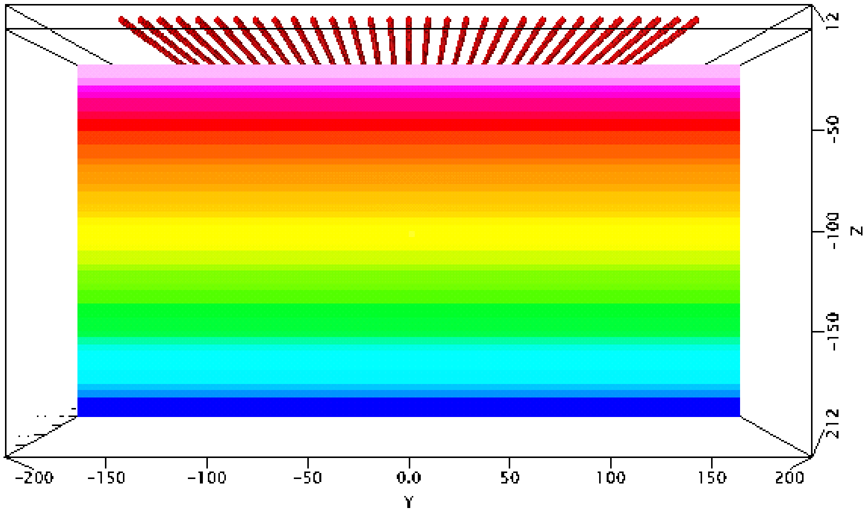

Fig. 3: A section view through the shallow depth weighting IRI constraint.

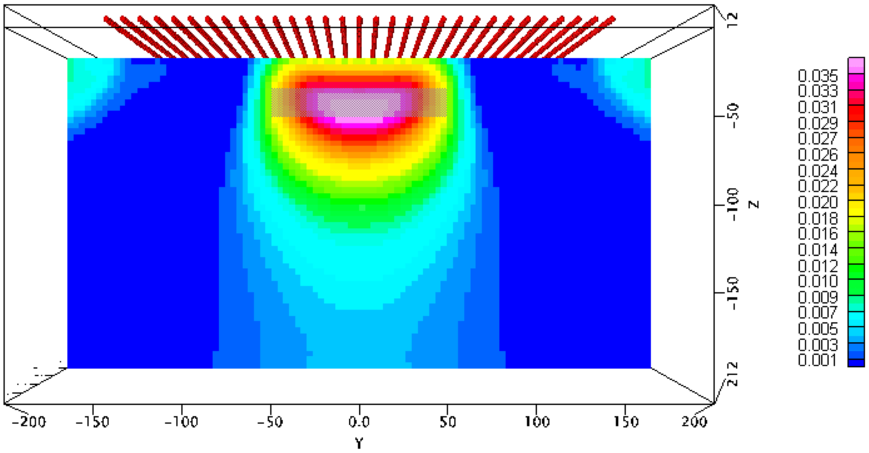

Fig. 4: A section view through the recovered model using the IRI shallow depth weighting shown in Fig. 3. The true horizontal sheet is shown overlaid in grey.

Producing a Sharpened Shallow Model

The shallow model shown in *Fig. 4* is a good representation of the true model, however, we may improve the result by sharpening the model using an IRI iteration. To construct the sharpening-shallow-depth-weighted IRI input, take the model in *Fig. 4* and multiply by the depth weighting (*Fig. 3*) using voxel math and use the rest as the IRI input and invert again. This will yield the model shown in *Fig. 5*, which is an excellent representation of the true model.

⚠ *Note that amplitude of the recovered susceptibility is approximately twice that of the smoother model.*

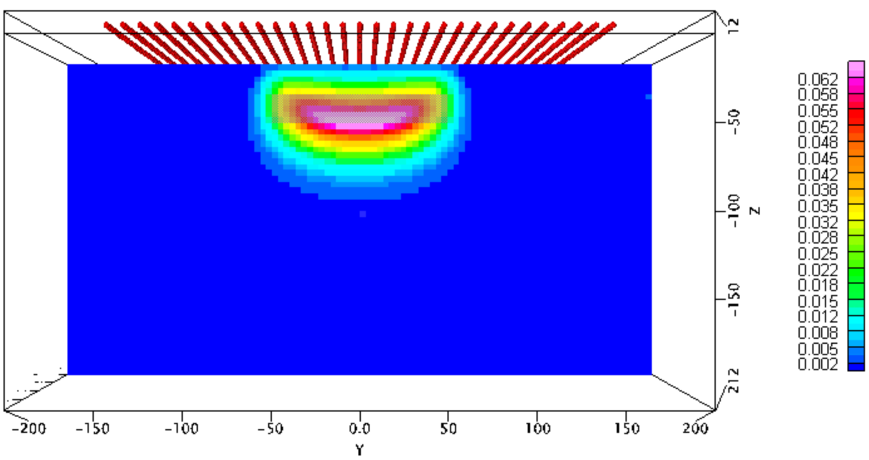

Fig. 5: A section view through the recovered models from 0, 1, and 2 IRI iterations. The true horizontal sheet is shown overlaid in grey.

Conclusion

Iterative reweighting inversion (IRI) in VOXI is a powerful technique that can be used to constrain inversion results to better agree with known geology or geophysics. In this note we have seen how IRI can be used to simultaneously sharpen smooth inversion results and to control the depth of the recovered targets. The simplest way to combine different simultaneous constraints is to multiply the IRI representations of the individual constraints to form a combined constraint.