Generalized Minimum Support Norm for time-lapse inversion

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Often in geophysical monitoring experiments time-lapse inversion models vary too smoothly with time, owing to the strong imprint of regularization. Several methods have been proposed for focusing the spatiotemporal changes of the model parameters. In this study, we present and apply a generalization of the minimum support norm, namely the asymmetric generalized minimum support norm, which favour compact time-lapse changes. Inversion results from synthetic direct current resistivity models that mimic developing plumes show that the focusing scheme significantly improves size, shape and magnitude estimates of the time-lapse changes. Inversions of the synthetic data also illustrate that the focusing settings are easily chosen. Inversions of full-decay time-domain induced polarization (IP) field data, both from surface and cross-hole monitoring acquisitions, show that the focusing scheme performs well for field data and multiparameter inversions. Our tests show that the asymmetric generalized minimum support norm reacts in an intuitive and predictable way to the norm settings, implying that they can be used in time-lapse experiments for obtaining reliable and robust results.

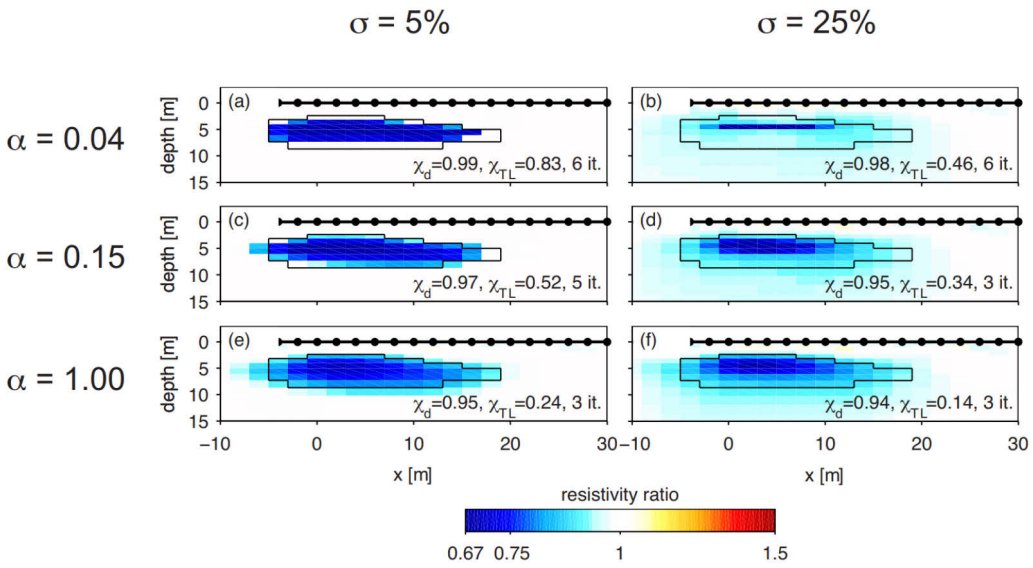

Figure caption: comparison of asymmetric minimum support inversion results when varying the σ and α norm settings (which control the size and the sharpness of the time-lapse changes, respectively). The synthetic data were created using an input model with a resistivity ratio of 0.75 within the outlined plume (black line) and 1 outside, and adding 2 per cent Gaussian noise. The left and right columns show inversions with an a-priori σ of 5 per cent and 25 per cent, respectively