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Time lapse ERT Inversion Incorporating Structural Information

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The interpretation of time-lapse ERT data is complicated by both the presence of noise in the data and the influence of low sensitivity in parts of the model. A uniform space and time constrain is not able to address this problem. In this work, we propose a new approach to distinguish noise-related artefacts to true changes in resistivity, while at the same time addressing the problem of the lack of sensitivity of electrical resistivity tomography with depth. We propose transforming the space and time constrains to be active. We mean that the regularization parameters are distributed rather than being uniform for the entire model. This way, both time-related noise (assumed to be random) in the data and the lack of sensitivity are addressed and we can incorporate prior information in a natural way into the inversion scheme. Moreover, we propose the use of image guided inversion in a time-lapse scheme, where the structural information is used directly from high resolution geophysical methods (e.g. ground penetrating radar or seismic reflexion) or from geological cross-sections. This information then is introduced into the inverse problem through a weighted smoothens matrix, where it correlates and favours formations that belong to a structural feature and not just uniformly to the whole model. Using this strategy, the inversion scheme is able to favour areas where the expected changes are likely to occur while filtering out areas where no changes should occur. The favoured areas can be either selected from a preliminary analysis of the data, or by incorporating other type of prior information into the system based on the process that is monitored.