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Optimizing time lapse ERT measurements using the Jacobian matrix approach

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In this work we present an algorithm for optimizing time-lapse ERT measurements. Single time-step measurement optimization is being carried out by selecting optimum measurements on the basis of their sensitivity matrix value in relation to the subsurface parameters. The optimized data-set is being selected form a comprehensive data set which involves all independent combinations of several widely used surface 4-electrode arrays (i.e. dipole-dipole, multiple-gradient, etc.). The number of the maximum number of measurements is being predefined by the user. The performance of the optimized arrays which is produced is being tested with synthetic data and benchmarked against standard electrode arrays.
Further optimization for time-lapse data was achieved by assigning higher optimization weights to the parameters which belong to regions in which changes are taking place. In particular very fast approximate data inversion is used to define areas that resistivity changes are more likely (or expected) to take place and then measurement optimization process is focused into to them in order to obtain customized data sets for each time step. The applicability of this procedure is demonstrated again with synthetic data examples. The presented optimization method proved effective having the advantage of being extremely fast as it is solely based on the calculation of the Jacobian matrix for homogeneous earth.