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A genetic algorithm approach to estimate glacier mass variations from GRACE data

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The application of a genetic algorithm (GA) to the inference of glacier mass variations with a point-mass modeling method is described. GRACE K-band ranging data (available since April 2002) processed at the Graz University of Technology serve as input for this study. The reformulation of the point-mass inversion method in terms of an optimization problem is motivated by two reasons: first, an improved choice of the positions of the modeled point-masses (with a particular focus on the depth parameter) is expected to increase the signal-to-noise ratio. Considering these coordinates as additional unknown parameters (besides from the mass change magnitudes) results in a highly non-linear optimization problem. The second reason is that the mass inversion from satellite tracking data is an ill-posed problem, and hence regularization becomes necessary. The main task in this context is the determination of the regularization parameter, which is typically done by means of heuristic selection rules like, e.g., the L-curve criterion. In this study, however, the challenge of selecting a suitable balancing parameter (or even a matrix) is tackled by introducing regularization to the overall optimization problem.
Based on this novel approach, estimations of ice-mass changes in various alpine glacier systems (e.g. Svalbard) are presented and compared to existing results and alternative inversion methods.