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Locally adapted resolutions for potential field modelling and inversion

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Some of the major challenges of the modelling and analysis/inversion of potential field data from satellite missions are as follows:

1. Huge amounts of data have to be handled.
2. The data are available in an unprecedented precision which should be reflected by the obtained model.
3. The downward continuation of the data is exponentially ill-posed.

In case of the inversion of gravitational data, further challenges occur due to the non-uniqueness of the solution and the three dimensions of the domain. New basis systems, such as splines, wavelets, and Slepian functions, have already yielded essential progress. We will show that mathematical tools called matching pursuit, greedy algorithm, compressed sensing, or sparse regularization, can be adapted to geophysical and geodetic problems. The novel approach provides us with essential algorithmic improvements for the use of such bases. In regions with a high detail structure, the resolution of the result is increased. In comparison to previous methods, this local resolution is automatically adapted and it reaches resolution scales which could not be achieved before. Moreover, we can add a (Tikhonov-)regularizing component to the algorithm in case of ill-posed problems.