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Estimation of the magnetic field gradient tensor using the Swarm constellation

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Estimation of the magnetic

field gradient tensor using the Swarm constellation

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For the first time, part of the magnetic field gradient tensor is estimated in space by the Swarm mission. We investigate the possibility of a more complete estimation of the gradient tensor exploiting the Swarm constellation. The East-West gradients can be approximated by observations from the lower pair of Swarm satellites, whereas the North-South gradients can be approximated by the first differences in the along-track direction. As a preliminary test, here we will present an analysis of along track differences of CHAMP vector observations. These show considerably smaller standard deviations compared to conventional vector observations at almost all latitudes. Analytical and numerical analysis of the spectral properties of the gradient tensor shows that specific combinations of the East-West and North-South gradients have almost identical signal content to the radial gradient. Gradient data are less contaminated by large scale fields produced in the magnetosphere and ionosphere and specific gradient combinations can lead to an improved determination of both the lithospheric field and the high degree secular variation.