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Benefit of Quantum technology for future earth observation from space – gradiometry case

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A big interest exists in geoscience disciplines to know the mass variations of the Earth with high resolution and accuracy. For monitoring climate change processes at the required level, it is essential to select the appropriate sensor technology and satellite missions. Future satellite missions will strongly depend on the advancement of novel technology and dedicated observation concepts of the Earth's gravitational field.

The first objective of this study is to characterize various quantum and hybrid gradiometer concepts and to describe their respective error properties. As a result of their white noise behavior at low frequencies, Cold Atom Interferometry (CAI) accelerometers and gradiometers are perfectly suited as complementary methods to classical electrostatic concepts. Future gravity satellite missions could greatly benefit from accelerometers and gradiometers applying atom interferometry, alone or in some hybrid constellation. The comparison will demonstrate the differences in the spectral behavior as well as the mutual benefit of CAI-based and classical electrostatic gradiometers (as used in GOCE).

Using simulated atom-interferometric and hybrid gradient measurements along one or more gradiometer axes in GOCE-like orbits, we determine the gravity field in spherical harmonics coefficients for the various cases and discuss the pros and cons of the selected concepts.

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