CARIOQA RESEARCH SPOTLIGHT #2:

Translating scientific publications into accessible knowledge

CARIOQA Quantum Pathfinder Mission for Space Weather Research. *Schilling, M., Biskupek, L., Bremer, S., Weigelt, M. (2026). In: International Association of Geodesy Symposia. Springer, Berlin, Heidelberg.*

Abstract

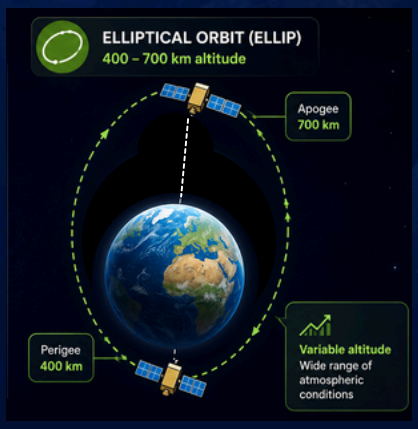
Current satellite gravimetry missions such as GRACE and GRACE-FO are partly constrained by the performance of classical electrostatic accelerometers, particularly their low-frequency noise. This limits the accuracy of gravity field recovery and atmospheric drag measurements. The study investigates whether a quantum atom-interferometry accelerometer developed within the framework of the CARIOQA Pathfinder Mission can overcome these limitations while providing improved observations of the Earth's thermosphere, including its density and crosswinds.

Methodology

To demonstrate how the CARIOQA Pathfinder Mission can overcome these current limitations, the researchers perform computer simulations of two possible orbits :

- a 500 km circular orbit;
- an elliptical orbit ranging from 400 km to 700 km.

These simulations estimate the forces acting on the satellite, such as atmospheric drag and solar radiation pressure, to verify that the instrument will operate reliably in space and that the sensor will provide sufficient sensitivity to measure the non-gravitational accelerations acting on the satellite.



Graphical representation of the two orbit scenarios tested within the scope of the study

Key Results

The simulations show that both orbital configurations meet the mission objectives. The circular orbit provides conditions similar to those of the GRACE and GRACE-FO missions, while the elliptical orbit offers a wider range of atmospheric drag conditions for evaluating the quantum accelerometer. Overall, the study demonstrates the benefit of operating a quantum accelerometer in space and highlights the potential of the CARIOQA Pathfinder Mission to improve gravity measurements, thermospheric density retrieval, atmospheric crosswind estimation in future satellite gravimetry missions. The CARIOQA Pathfinder Mission instruments sensitivity enables already data collection for density data products.

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