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Magnetic mapping mission for the decades to come

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The last 20 years of nearly continuous high quality magnetic field measurements has led to the great advances in our understanding of Earth's geomagnetism and its interaction with the Solar Wind. However, at this time we still have limited understanding of the secular variation, the variability of the space environment and uniqueness of the models.

The Ørsted and CHAMP missions provided global coverage from single space-time measurements while the Swarm constellation delivers measurements at about 500 km altitude with varying distances between the high and the two lower spacecraft of about 100km. Although the scientific results of these missions are excellent, there is still a need to resolve the short wavelength signatures that contain both spatial and temporal effects at all latitudes. This would allow full separation and therefore characterization of the various sources that contribute to the magnetic signatures and it will enable production of further and yet more accurate products in forecasting the space weather. Further, more unique (less ambiguous) geomagnetic maps are achieved with better space-time sampling.

The demonstrated precision of the Swarm magnetic vector products of 25pT derived from the Vector Field Magnetometer (VFM) would allow a design of future missions capable of measuring the magnetic gradient in space with the required accuracy. Using this instrument in a formation flight configuration of a number of spacecraft would enable to maintain a constant distance, to give the desire wavelength (e.g. 5km), between the satellites. Components of the magnetic gradient tensor will be then resolved to detect density currents above tens of nA/m̓2.

We present a mission concept offering accuracy and coverage sufficient to enable further unambiguous mapping of the magnetic field, its time variation and space weather forecasting. Employing the heritage instrumentation from Swarm, further miniaturization and a simple formation flight system, the proposed mission cost is kept well below that of its predecessors, thus offering true, affordable, global magnetic mapping quality for the decades to come.

The proposed mission based on measurements of the magnetic field vector, will also support the 2017 IAGA resolution No.1 about Magnetic satellite mission constellation, stating 'the need for permanent long-term measurement of the magnetic field for understanding its generation, forecasting its evolution, and for space weather applications'.

The versatility of the proposed mission makes it also attractive for the research of other solar system bodies including Martian moons and asteroids.