Use of along-track magnetic field differences in lithospheric field modelling

We demonstrate that first differences of polar orbiting satellite magnetic data in the along-track direction can be used to obtain high resolution models of the lithospheric field. Along-track differences approximate the north–south magnetic field gradients for non-polar latitudes. In a test case, using 2 yr of low altitude data from the CHAMP satellite, we show that use of along-track differences of vector field data results in an enhanced recovery of the small scale lithospheric field, compared to the use of the vector field data themselves. We show that the along-track technique performs especially well in the estimation of near zonal spherical harmonic coefficients. Moreover, lithospheric field models determined using along-track differences are found to be less sensitive to the presence of unmodelled external field contributions and problems associated with the polar gap are ameliorated. Experiments in modelling the Earth's lithospheric magnetic field with along-track differences are presented here as a proof of concept. We anticipate that use of such along-track differences in combination with east–west field differences, as are now provided by the Swarm satellite constellation, will be important in building the next generation of lithospheric field models.

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