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The along-track spectral-spatial approach for estimating the ocean-induced magnetic field from Swarm vector magnetic data

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This study deals with the analysis of Swarm vector magnetic field measurements for estimating the poloidal part of the ocean-induced magnetic field. For a single Swarm satellite, the magnetic measurements from magnetically quiet nights are processed by the along-track spectral-spatial approach on track-by-track basis with careful treatment of four unwanted magnetic fields, the main magnetic field, the magnetospheric magnetic field, the polar electrojet and field-aligned current magnetic fields. The respective magnetic fields are modelled by the CHAOS-5 field model, the spectral approach and simplified spatial representations of electric currents flowing in the polar regions. One by one the modelled magnetic fields are subtracted from the along-track Swarm magnetic measurements. The remaining residual magnetic field is expected to contain the magnetic field induced by ocean currents. The X and Z components of the residual magnetic field are spectrally analyzed and tested whether the field has an internal origin only and whether the components are physically consistent. If the test is positive, the modelled residual magnetic field is interpreted as the magnetic field induced by ocean currents. A few examples of the along-track, spectral-spatial analysis of Swarm vector magnetic data are presented. The Swarm-based estimates of the ocean-induced magnetic field are then compared with the simulated magnetic signals. The simulations are done for the global barotropic ocean circulation under lunisolar tidal forcing by the data-assimilated DEBOT model. The Swarm-based estimates and the simulations of the ocean-induced magnetic field are in satisfactory agreement along chosen Swarm tracks.