

The uptake and meridional transport of heat by the global ocean circulation is a key driving mechanism of our climate system. The connected mass transports cover timescales from days to thousands of years. The estimated precision of 0.1 nT of the SWARM mission and the close connection of magnetic induction and ocean currents result in the opportunity of an unprecedented view below the sea surface and may enable us to study the dynamics, i.e., the ocean current system, of the world oceans directly.

This project improves, quantifies, characterizes and assimilates contributions to the Earth's magnetic field which arise from the ocean circulation. We combine an ensemble approach with an advanced global ocean circulation model to derive realistic characteristics, e.g., values, ranges, pattern, frequencies, errors and correlations, of the ocean induced electric currents and the resulting magnetic signals. Furthermore, investigate the sensitivity of the magnetic field operator to different approximations: salinity and temperature dependent conductivity versus ocean wide constant conductivity, thin-shell approximation versus full three dimensional implementation and steady state versus time dependent assumptions. With regard to ocean model data assimilation applications of magnetometer data, the project will quantify which oceanic signals and frequencies can in principle be measured and separated by recent or future magnetometer satellite missions. With the ocean model ensemble, robust signals will be identified, i.e., signals that proved to be insensitive to uncertain assumptions in the magnetic field operator (e.g., uncertainties in the background conductivity distributions) and the ocean model (e.g., uncertainties in the initial conditions and model-forcing).