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Ensemble simulations of the ocean induced magnetic field

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The recent advent of new high-resolution datasets of electromagnetic induction allows novel combinations of observations and models. The ocean induced magnetic field provides the potential to indirectly observe the ocean general circulation and may be utilized by data assimilation techniques. The modelling of the ocean induced magnetic field is affected by various uncertainties that originate from errors in the input data and from the applied model itself. The amount of aggregated uncertainties and their effect on the modelling of electromagnetic induction in the ocean is unknown. However, the knowledge of model uncertainties is essential for many research questions. To investigate the uncertainty in the modelling of motional induction, ensemble simulations with an ocean general circulation model and an electromagnetic induction model are performed on the basis of different error scenarios. This approach allows to estimate both the spatial distribution and temporal variation of the uncertainty. The largest uncertainty in the motionally induced magnetic field occurs in the area of the Antarctic Circumpolar Current. Local maxima reach values of up to 0.7 nano Tesla (nT). The estimated global annual mean uncertainty in the motionally induced magnetic field ranges from 0.1 to 0.4 nT. The relative amount of uncertainty reaches up to 30 % of the induced magnetic signal strength with largest values in regions in the northern hemisphere. The major source of uncertainty is found to be introduced by the wind stress from the atmospheric forcing of the ocean model. In addition, the temporal evolution of the uncertainty in the motionally induced magnetic field shows distinct seasonal variations. Specific regions are identified which are robust with respect to the introduced uncertainties.