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## ***Interactive comment on “Impact of variable sea-water conductivity on motional induction simulated with an OGCM” by C. Irrgang et al.***

### **Anonymous Referee #2**

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The paper discusses the effect of variable electrical conductivity of the sea water on the magnetic signals induced by large-scale ocean circulation. It is a recent topic addressed by several research groups, and also related to the launch of the Swarm satellite mission. I find it suitable for publication subject to a moderate revision.

My main issue with the presented approach is that while the authors introduce a detailed, three-dimensional model of the electrical conductivity, based on the temperature and salinity distributions provided by the ocean circulation model, they still use the static, thin-layer simplification of the EM induction equation. For example, the self-induction term ( $d\mathbf{B}/dt$ ) cannot be neglected for tidally induced ocean flows (cf. the different methods used in Tyler et al., J. Geoph. Res. 1997 vs. Tyler, Geophys. Res. Lett. 2005), casting a doubt on the last paragraph of conclusions (p. 1880, l.20-26). Although this

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is probably not critical in the slowly evolving global circulation model, one could still imagine the effects of large vertical conductivity gradients not described by Eq. (1), e.g. the electric currents bypassing a resistive area above or below it, giving rise to vertical currents. Also, using an insulating Earth's mantle might be a good first-order approach, but wouldn't a conductive mantle affect the generated magnetic signals to a similar degree, as variable seawater conductivity does? I think these topics deserve some discussion in the paper.

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Interactive comment on Ocean Sci. Discuss., 12, 1869, 2015.

**OSD**

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