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Inverse magnetic field patches and reversals in dynamo simulations

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The discover of strong inverse magnetic field patches at the top of the Earth's core has stirred speculations whether the magnetic field might reverse within the next milleniums. These patches develop slowly and have caused the dipole component to decay by 10% in the last 150 years. Unfortunately, our knowledge of the geomagnetic field is quite limited on the relevant long time scales. I employ two different numerical dynamo models to explore the dynamics of inverse patches. Both models are selfconsistent simulations at different parameters that solve for magnetic field, flow field, and temperature differences in the Earth's outer core. Inverse field patches are regular elements of the magnetic field in dynamo simulations. They tend to be stronger at higher Rayleigh numbers. Their appearence and decay on time scales of some hundred years is part of a long time scale secular variation. Even stronger inverse patches are not necessarily precursors for reversals or excursions. However, they are more prominent during these events and cause, for example, significant differences in local reversal durations. Site dependence of paleomagnetic reversal durations may in turn offer a possibility to retrieve inverse patch dynamics, i.e. some non-dipole field characteristics, during past reversals. The appearance of inverse patches is linked to variations in the convective field. Increased convection produces more inverse field and pushed it to the core-mantle boundary. Only a sequence of several strong varations may lead to a field reversal. Such a sequence is unlikely which could explain the rarity of polarity changes.