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A multiscale model of Earth's inner-core anisotropy

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The Earth's solid inner-core exhibits a global seismic anisotropy of several percents. It results from a coherent alignment of anisotropic Fe-alloy crystals through the inner-core history that can be sampled by present-day seismic observations. By combining self-consistent polycrystal plasticity, inner-core formation models, Monte-Carlo search for elastic moduli, and simulations of seismic measurements, we introduce a multiscale model that can reproduce a global seismic anisotropy of several percents aligned with the Earth's rotation axis. Cubic-structured Fe-alloy fail at producing significant global scale anisotropy. Conditions for a successful model are an hexagonal-close-packed structure for the inner-core Fe-alloy, plastic deformation by pyramidal $\langle c + a \rangle$ slip, and large-scale flow induced by a low-degree inner-core formation model. For global anisotropies ranging between 1 and 3%, the elastic anisotropy in the single crystal ranges from 5 to 20% with larger velocities along the c-axis.