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## Earth's Inner Core Fine-scale Heterogeneity and Temporal Changes using IMS arrays

Understanding the structure and dynamics of the Earth's inner core is the key to understanding the history and evolution of the Earth's magnetic field. However, knowledge about the inner core remains limited. Fine-scale (1–10 km) structures within the inner core scatter high-frequency seismic waves (ICS), providing critical insights, although detecting these signals is challenging. Using the International Monitoring System (IMS) seismic array, we constructed a three-dimensional map of the inner core fine-scale structure. Our model shows substantial increases in fine-scale heterogeneity 500–800 km beneath the inner core boundary, revealing an era of rapid growth following the delayed nucleation of the inner core. The inner core is known to rotate relative to the Earth's surface or change over years to decades. However, the reported models are controversial. We analysed the ICS data from the IMS seismic array, which is sensitive to inner core changes. We found that the inner core underwent a burst of differential rotation during 2001–2003, followed by gradual eastward super-rotation from 2003–2008. Subsequently, the inner core exhibited westward sub-rotation from 2008 to 2023. Beyond differential rotation, we identified non-rotational changes near the inner core boundary between 2004 and 2008.

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