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Paleo Structure of the Earth's mantle derived from Fluid Dynamic Inverse Theory

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Fluid dynamic conservation equations, akin to those that govern the evolution of the atmosphere and oceans describe the motion of the mantle. While powerful computer models exist to simulate the circulation of the mantle, sophisticated fluid dynamic inverse theory is now at hand that makes it possible to track mantle motion back into the recent geologic past. A major opportunity exists in applying this theory to our understanding of the paleo-circulation of Earth's mantle and constructing a quantitative model of past Earth structure (PaleoEarth). Important in its own right, such model would provide vital information on the history of plate driving forces, the temporal evolution of the core mantle boundary and its associated impact upon the geodynamo, time variability of Earth's geoid, as well as a deeper understanding into the development of sedimentary basins. We will explore some early applications of the approach, focusing on uncertainty in particular on the choice of residuals that drive the inverse problem.