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Constraints on the Rheology of the Earth's Deep Mantle from Decadal Observations of the Earth's Figure Axis and Rotation Pole

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The over four decades long record of Satellite Laser Ranging (SLR) observations to a variety of historical geodetic spherical satellites makes it possible to directly observe the long-term (seasonal to decadal time scales) displacement of the Earth’s mean axis of maximum inertia, namely its principal figure axis, with respect to the crust, through the determination of the degree-2 order-1 geopotential coefficients over the 34-year period 1984—2017.

On the other hand, the pole coordinate time series (mainly from GPS and VLBI data), yield the motion of the rotation pole with even a greater accuracy.

The time-dependent nature of the response of the Earth’s mantle to external forces, where it behaves either elastically on short time scales (seconds) or like a viscous fluid over geological time scales (millions of years), is poorly constrained at decadal periods. Here we propose to relate oscillations of the figure axis to those of the Earth’s rotation pole (through the Euler-Liouville equations) to study the mass-related excitation of polar motion and provide global constraints on the rheological properties of the deep Earth.