

55.3: Polar Motion

In addition to a change in the direction of the Earth's rotation axis described so far, there is also a small movement of the location of the intersection of the rotation axis with the Earth's surface; this movement is called polar motion. It consists of three major components:

An annual oscillation with a period of 365 days, due to small changes in the gravitational attraction of the Sun caused by the eccentricity of the Earth's orbit.

An oscillation with a period of 435 days, called the Chandler wobble. This is attributed to factors such as ocean floor pressure variation and wind.

Superimposed on these two oscillations is a long-term drift, so that the north pole moves in the general direction of 80° west longitude.

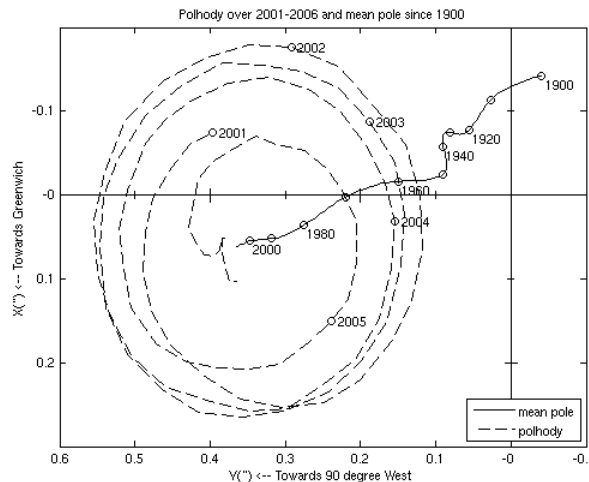


Figure 55.3.1: Polar motion. The dashed line shows the polar motion for the period 2001-2006. The solid line shows the drift in the mean pole position over the period 1900-2006. The axes are in units of seconds of arc subtended from the center of the Earth (0.1 arcsec = 3 meters). (Credit: International Earth Rotation Service.)

The two oscillations "beat" together, so that the pole moves in a circle that expands and contracts in diameter with a frequency equal to the beat frequency (the difference in frequencies of the two motions); therefore the period of the change in diameter is

$$\left(\frac{1}{365 \text{ d}} - \frac{1}{435 \text{ d}} \right)^{-1} = 6 \text{ years.} \quad (55.3.1)$$

The rate of long-term drift is irregular, but over the last 100 years has averaged about 12 cm per year.

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