One of the most convincing evidence for differential inner core rotation has been the temporal change of differential PKP BC-DF times from earthquakes in the South Sandwich Islands recorded at stations in Alaska (Song and Richards, 1996). Song and Li (2000) provided an independent support for a differential inner core rotation from a new ray path from earthquakes in southern Alaska to the South Pole station (SPA). The pathway has several characteristics that help us study the inner core rotation. (1) It is a north-south path with small ray angles from the spin axis, which was previously identified to have large BC-DF anomalies (Song and Helmberger, 1993). The largest anomalies and lateral variations from the inner core have all been identified with north-south paths; thus a north-south path is a good start to detect travel time changes. Furthermore, if the axis of the inner core rotation is the same or close to the spin axis, the effect of rotation on travel times is expected to be most easily observable along north-south ray paths. (2) The SPA station has a long history of continuous operation. (3) The great circle paths from anywhere in the globe to SPA are along the corresponding longitudes of the sources, making it easy to sample a sweep of inner core longitudes needed to determine the lateral variation of the patch sampled.

We found that the differential PKP BC-DF travel times along the pathway have increased by about 0.85 s over 37 years with standard error of 0.27 s (Fig. 1). Fig. 2 plots the observed travel time residuals (normalized by the travel times in the inner core) as a function of longitude and time. Plotted also are equi-residual contours of the residuals and bilinear fits (dashed lines) on longitude and time to the residuals. The temporal trend and the longitudinal gradient are observable directly from both the observed residuals and the equi-residual contours. The temporal gradient (along horizontal direction) and the longitudinal gradient (along vertical direction) from the bilinear fits are 0.01849%/yr and -0.02192%/deg, respectively, giving a rough estimate of the rotation rate of 0.84 deg/yr, if we assume such travel time changes are caused by shifts of a laterally-varying inner core structure due to an inner core rotation around the spin axis (Creager, 1997). Applying a technique to invert simultaneously for the inner core structure and the rotation rate (Song, 2000). The rotation rate determined from the new pathway is about 0.6 deg/yr faster than the mantle.