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Inner core super-rotation investigated by earthquake doublets in the Tonga-Fiji-Region recorded at seismic stations in Germany

Barbara Heuer, Thomas Plenefisch, and Klaus Stammler
BGR, B4.3, Hannover, Germany (Thomas.Plenefisch@bgr.de)

First seismic evidence for a possible super-rotation of the Earth's inner core was found in 1996. Since then, there has been a controversial debate about the actual existence and detectability of such a phenomenon. The effect seems to be very small and has been mostly detected by seismic phases passing the inner core on N-S paths. Furthermore, the structure of the inner core has turned out to be rather complex regarding its distribution of seismic velocities and anisotropy, including different structures in the eastern and western hemispheres of the inner core.

In our study we present results of an investigation of earthquake waveform doublets of events from two distinct areas in the Tonga-Fiji region recorded at German permanent seismic stations since 1980. We chose events in the epicentral distance range 145°-155° in order to record the three core phase branches PKP(DF), PKP(BC) and PKP(AB). In case of a super-rotation of the inner core, the differential travel time of PKP(BC)-PKP(DF) should change slightly (order of tenths of a second over several years or decades) with increasing time span, while PKP(AB)-PKP(BC) should remain unchanged.

First we determined earthquake doublets by waveform cross correlation. With the resulting doublet events we performed again a waveform cross correlation of the individual phases PKP(DF), PKP(BC) and PKP(AB). By determining the relative time differences of each phase of the two corresponding events and calculating the relative time differences between the different core phases, we get very accurate measurements without the need to pick phases or making absolute time measurements. However, up to now we could not see any time dependency in the resulting values of travel time differences. On one hand this could be due to insufficient time resolution as a result of the sample rate, on the other hand this might be due to the direction of the wave-path, which is not N-S directed, or to the absence of velocity/anisotropy structures in the inner core on the sampled path that can be used as markers. With the aid of oversampling and array techniques we aim to distinguish between these two options.