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Investigations of deep quakes on the lunar far side

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Following the Apollo landings, four seismic stations operated on the Lunar surface (1969-77) and recorded over 12000 events. More than 7000 were identified as deep moonquakes, some of which are located on the moon's far side (Nakamura, 2005). The Lunar deep quakes have been subject of ongoing studies and location attempts. One of their most puzzling properties is their apparent concentration on the lunar near side. However, it is difficult to assess the accuracy of currently available location estimates, since the errors of the arrival time readings are often poorly known or unknown at all. Also, the classical location methods may be biased by the starting solutions.
To improve the accuracy of the locations, a new processing is applied to several clusters, for which far side locations are compatible with existing arrival time readings. We look for additional arrivals and try to establish reliable arrival time uncertainties. The LOCSMITH package (Knapmeyer, submitted to GJI), a MatLab based, deterministic, nonlinear method on an adaptive search grid, is used to locate the nests with respect to those uncertainties. This method results in 3D uncertainty volumes in which the true moonquake location is contained.
Depending on phase availability across the triangular seismometer array, several types of uncertainty can be distinguished by the geometrical shape of the error contours: "small balls" when shear waves (S) arrive at all three corners of the triangle and a compressional wave (P) at least at a single station is available, "bananas" (2 S-arrivals and at least 1 P-arrival), "cones" (only 3 S-arrivals, no P-recording) and "discs" (2 S-arrivals). Based on these distinctions, we try to identify those clusters for which a search for new arrivals, or a better definition of arrival times is most promising in order to reduce the overall volume of the uncertainty, and to transform "bananas" and "cones" into "balls". This way we hope to identify deep quakes which are definitely

located on the moon’s far side.