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TITLE: Using Distant Sources in Local Seismic Tomography

AUTHORS (FIRST NAME, LAST NAME): Bruce R Julian¹, Gillian R Foulger¹

INSTITUTIONS (ALL): 1. Earth Sciences, Durham University, Durham, County Durham, United Kingdom.

ABSTRACT BODY: Teleseismic tomography methods such as the "ACH" method of Aki, Christoffersson & Husebye (1976, 1977) are subject to significant biases caused by unknown wave-speed anomalies outside the study volume, whose effects are mathematically of the same order as the local-structure effects that are being studied. Computational experiments using whole-mantle wave-speed models indicate that the effects are also of similar numerical magnitude (Masson & Trampert, 1997).

These biases can be greatly reduced by solving for extra parameters defining the shapes, orientations, and arrival times of the incident wavefronts, analogously to solving for source locations in local-earthquake tomography. For planar incident wavefronts, each event adds three free parameters and the forward problem is particularly simple: The first-order change in the theoretical arrival time at observation point B resulting from perturbations in the incident-wave time t_0 and slowness vector s is $\delta t_B = \delta t_0 + \delta s \cdot r_A$, the change in the time of the plane wave at the point A where the unperturbed ray enters the study volume.

Use of this formalism enables the use of combined data from local and distant events in studies of local structure, and can significantly improve resolution of deeper structure, particularly in places such as volcanic and geothermal areas where seismicity is confined to shallow depths.

Many models in the literature that were derived using ACH and similar methods probably contain significant artifacts and are in need of re-evaluation.

KEYWORDS: 7270 SEISMOLOGY Tomography, 0520 COMPUTATIONAL GEOPHYSICS Data analysis: algorithms and implementation, 3260 MATHEMATICAL GEOPHYSICS Inverse theory, 7290 SEISMOLOGY Computational seismology.

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Contact Details

CONTACT (NAME ONLY): Bruce Julian

CONTACT (E-MAIL ONLY): bruce.r.julian@gmail.com

TITLE OF TEAM: