Geophysical Research Abstracts
Vol. 18, EGU2016-8346, 2016
EGU General Assembly 2016

2D Pn Velocity-Gradient and Attenuation Models for Eurasia

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Pn is one of the most important phases in nuclear-explosion monitoring. Pn velocity-gradient and attenuation play important roles in shaping the Pn propagation both in terms of its travel time, which is used to locate events, and in terms of its amplitude, which is used for discrimination. Accurately mapping the lateral variation of Pn velocity gradient and attenuation will improve the monitoring of nuclear explosions through better predictions of Pn travel times and amplitudes. In this study, we develop 2D Pn velocity-gradient and attenuation models for Eurasia using observed Pn travel times and amplitudes. Eurasia is one of the few places on the Earth with extensive Pn coverage. We first calculate path-specific Pn velocity gradients from observed Pn travel times incorporating predictions from a 3D Earth model. We assume that these path-specific gradients are the mathematical mean of laterally varying velocity gradients along the paths. The assumption is validated through a Monte Carlo simulation. Using a tomographic inversion, we construct a 2D Pn velocity-gradient map for Eurasia from path-specific velocity-gradient measurements. To construct the 2D Pn attenuation model, we correct observed Pn amplitudes for geometric spreading using predictions from the 2D Pn velocity-gradient model we developed. The Pn velocity-gradient model from observed data allows us to make realistic Pn geometric-spreading corrections, which in turn results in a more accurate Pn attenuation model.