Supporting Information for

Point-source moment tensor inversion via a Bayesian hierarchical inversion with 2D-structure uncertainty: Implications for the 2009-2017 DPRK nuclear tests

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Figures S1 to S4

Introduction

The information included Figures S1 to S4 expand the discussion briefly discussed in the main text.
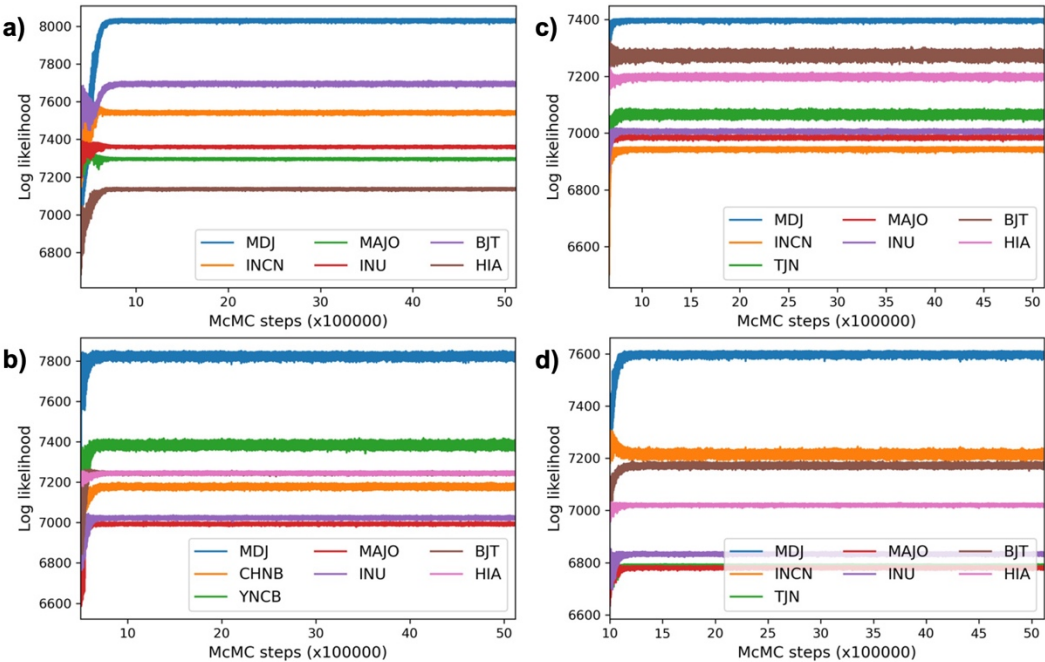
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Figure S1. Log-likelihood calculated for each station during MT inversions for the (a) DRPK2009, (b) DPRK2013, (c) DPRK2016a, and (d) DPRK2016b tests, respectively. Most burn-in steps are discarded to illustrate the likelihood function in the convergency stage.
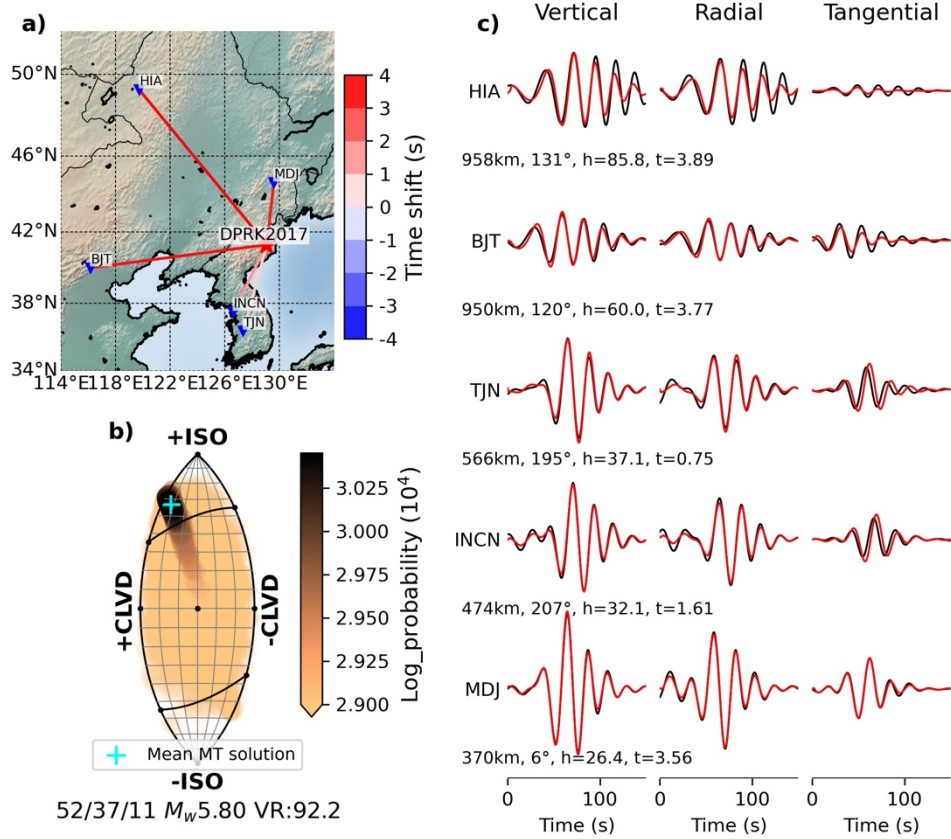
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a)

c) Vertical Radial Tangential

HIA 958km, 131°, h=85.8, t=3.89

BJT 950km, 120°, h=60.0, t=3.77

TJN 566km, 195°, h=37.1, t=0.75

INCN 474km, 207°, h=32.1, t=1.61

MDJ 370km, 6°, h=26.4, t=3.56

b)

+ISO

+CLVD -CLVD

Log_probability (10^4)

+ Mean MT solution

-ISO

52/37/11 M_w5.80 VR:92.2

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Figure S2. MT Solutions were obtained by hierarchical Bayesian inversion considering uncorrelated noise and 2D structural error when removing two stations in Japan. (a) Map of region showing five stations and the recovered station-based time shift. (b) The source-type lune diagram shows MT solutions' evolution during the inversion. The cyan cross marks the source type of the mean MT solution. The color bar is used for log- probability. All log-probability under 2.7×10^4 is set to be black to visualize the later stage of the inversion better. The numbers beneath are percent ISO, CLVD, DC, moment magnitude of the mean MT, and the waveform fit variance reduction for the mean MT. (c) Waveform fit between the observed (black) and predicted waveforms (red) from mean MT plot in (b). The numbers below each row are source-station distance, azimuth, recovered station-specific noise parameters, and time shifts, respectively.
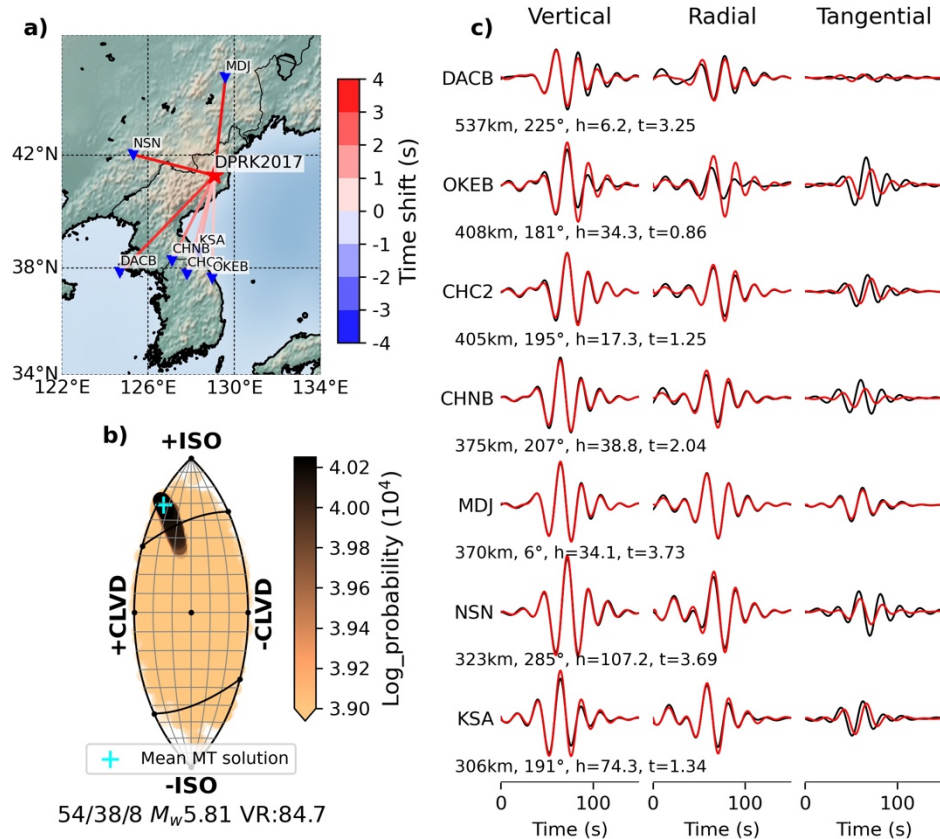
Figure S3. MT solutions were obtained by hierarchical Bayesian inversion considering uncorrelated noise and 2D structural error using another dataset. (a) Map of region showing seven stations and the recovered station-based time shifts. (b) The source-type lune diagram shows MT solutions' evolution during the inversion. (c) Waveform fit between observed and predicted waveforms from mean MT plot in (b). See caption of Figure S2 for more details.
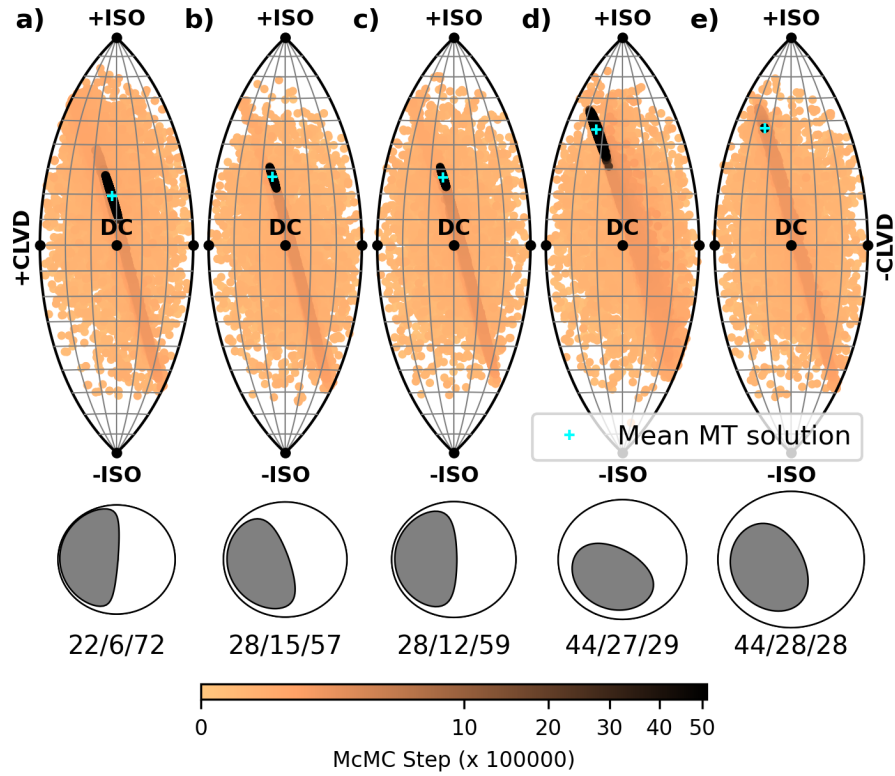
Figure S4. Lune diagram of source type of MT solutions when fixing the noise strength to the same as pre-event ambient noise for five DPRK tests from 2009 to 2017 with panels (a)-(e), respectively. See caption of Figure 9 for details.