Supporting Information for "Automatic seismic waveform identification using a Convolutional Neural Network"

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Introduction

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This document contains examples of precursors picks for different CNN quality values (Fig. S1), and plots of S410S-SS and S660S-SS relative travel times for stacked data in all bin sizes, comparing autopicked to handpicked results (Figs. S2-S10). We also present plots of S410S-SS and S660S-SS relative travel times generated by autopicked results for individual seismograms (Fig. S11-S13).

Movies S1 to S4 show visually how the autopicker iteratively scans stacked data or seismograms to identify signals, and determines the polarity of the signals by calculating quality values.
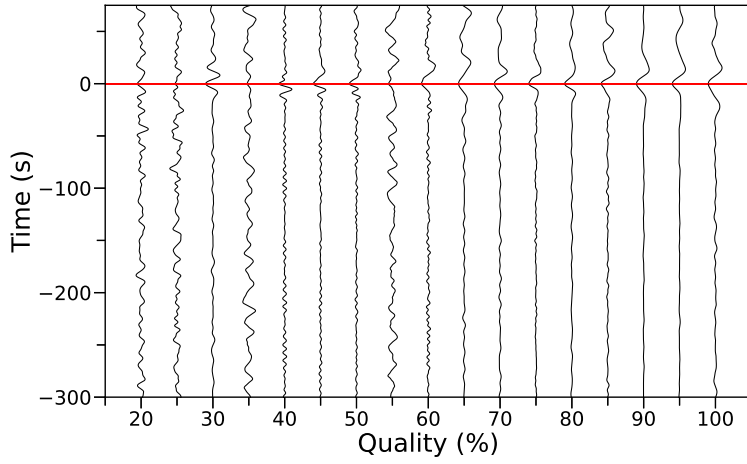
Table S1 lists average pick quality for stacked data, comparing handpicked and autopicked. Table S2 is the average CNN pick quality for handpicked data, separated by handpicked quality. Table S3 shows the minimum CNN quality pick values required to retain the same number of bins as the handpicking quality check procedure.

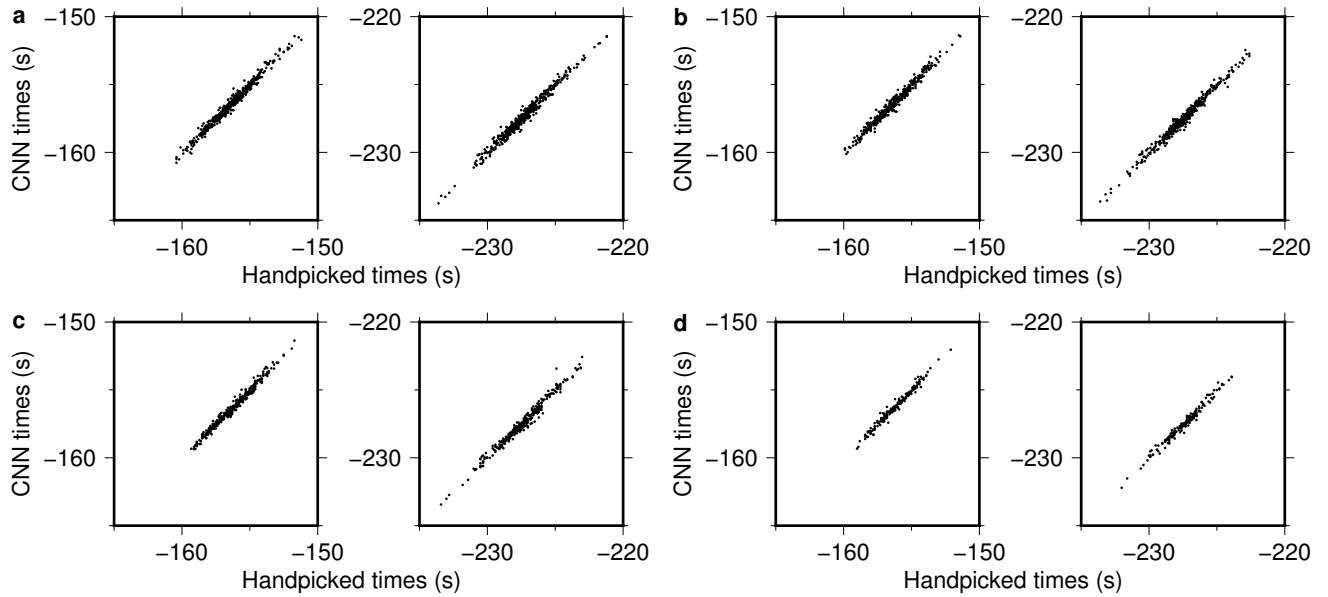**Movie S1.** Example of the CNN model scanning for and identifying an SS phase signal.

Movie S2. Determining phase polarity by scanning on the positive and negative polarity versions of a seismogram.

Movie S3. Identifying SS precursors in a stack.

Movie S4. Scanning for SS precursors in an individual seismogram.
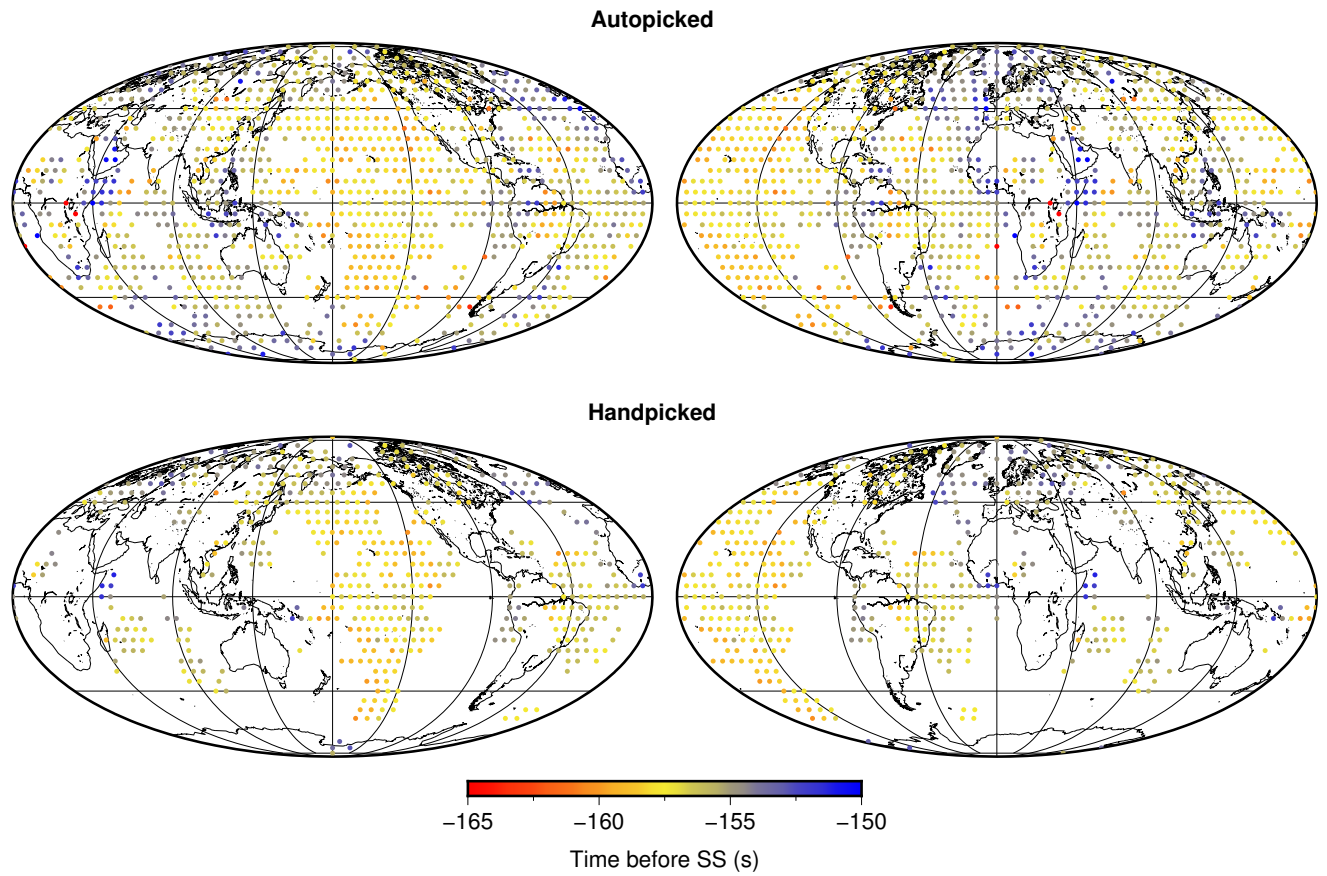
November 16, 2020, 5:46pm
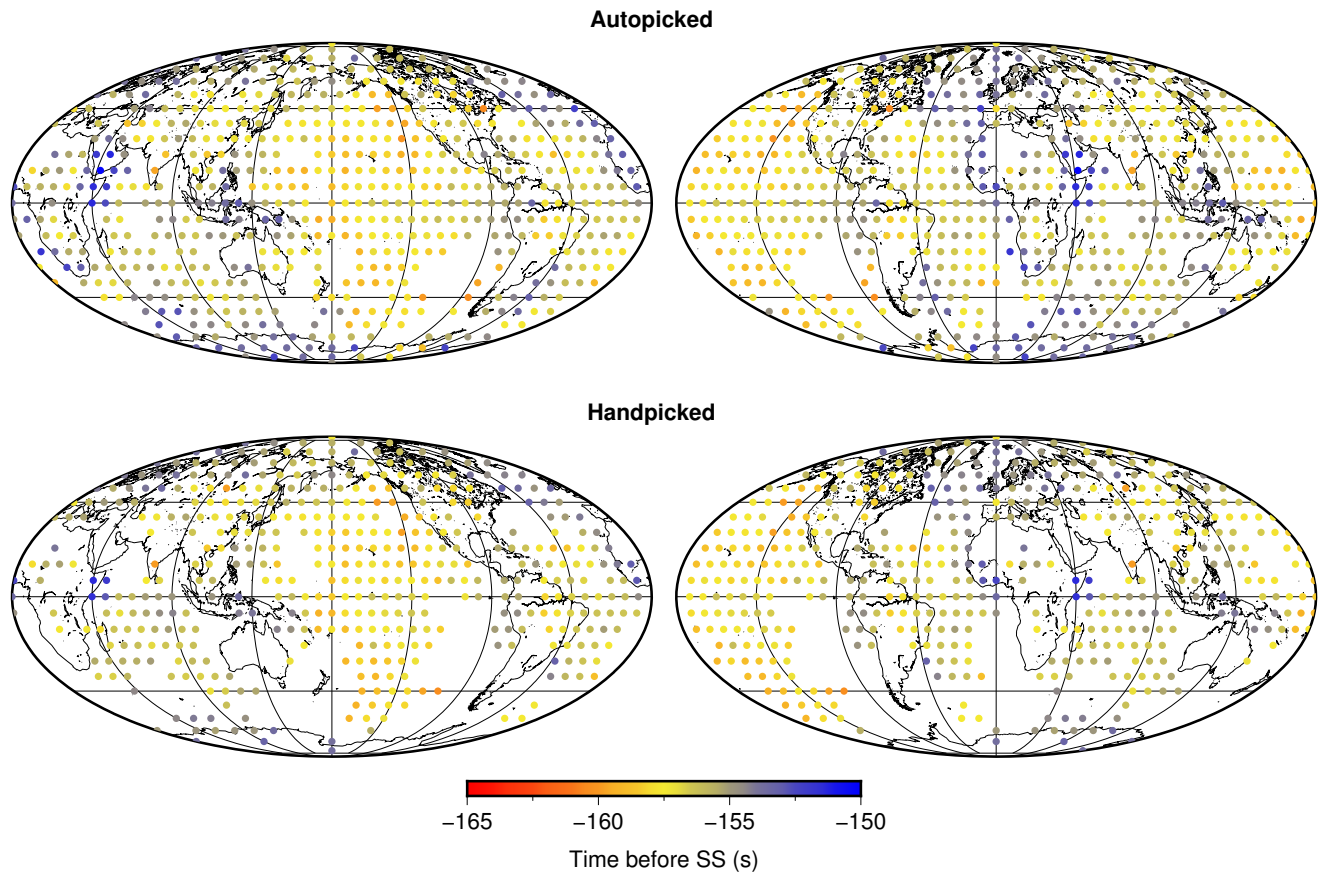
Figure S1. Examples of SS picks of various qualities.

Figure S2. Comparison of measured travel times in handpicked versus autopicked stacked data, for all bin sizes. a. 5°. b. 7.5°. c. 10°. d. 15°.

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Autopicked

Handpicked

−165   −160   −155   −150

Time before SS (s)
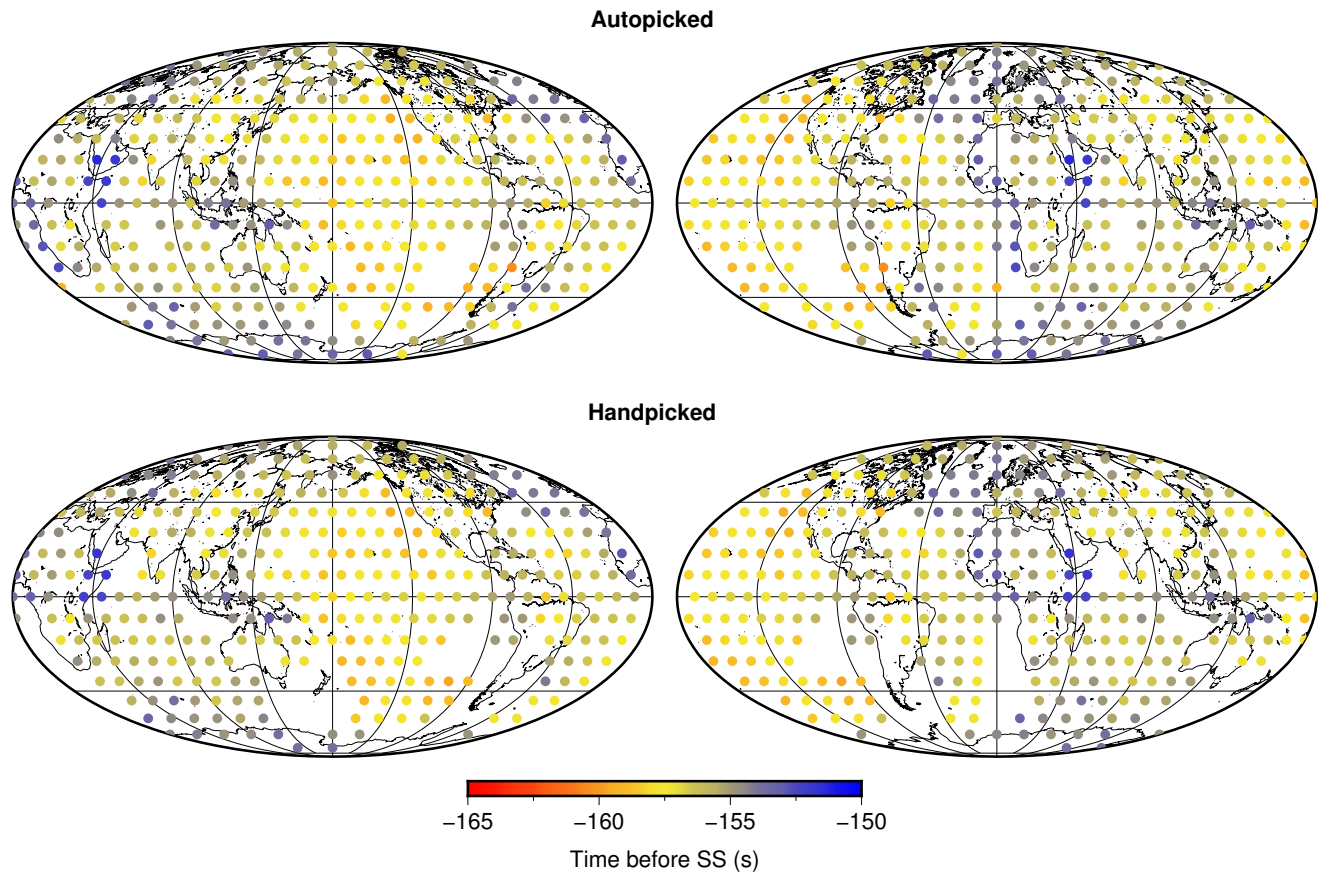
Figure S3.   Maps of autopicked (top) and handpicked (bottom) S410S-SS travel time measurements in stacked data, 5° radius caps.

Autopicked

Handpicked

−165　　−160　　−155　　−150

Time before SS (s)

Figure S4. Maps of autopicked (top) and handpicked (bottom) S410S-SS travel time measurements in stacked data, 7.5° radius caps.

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Autopicked

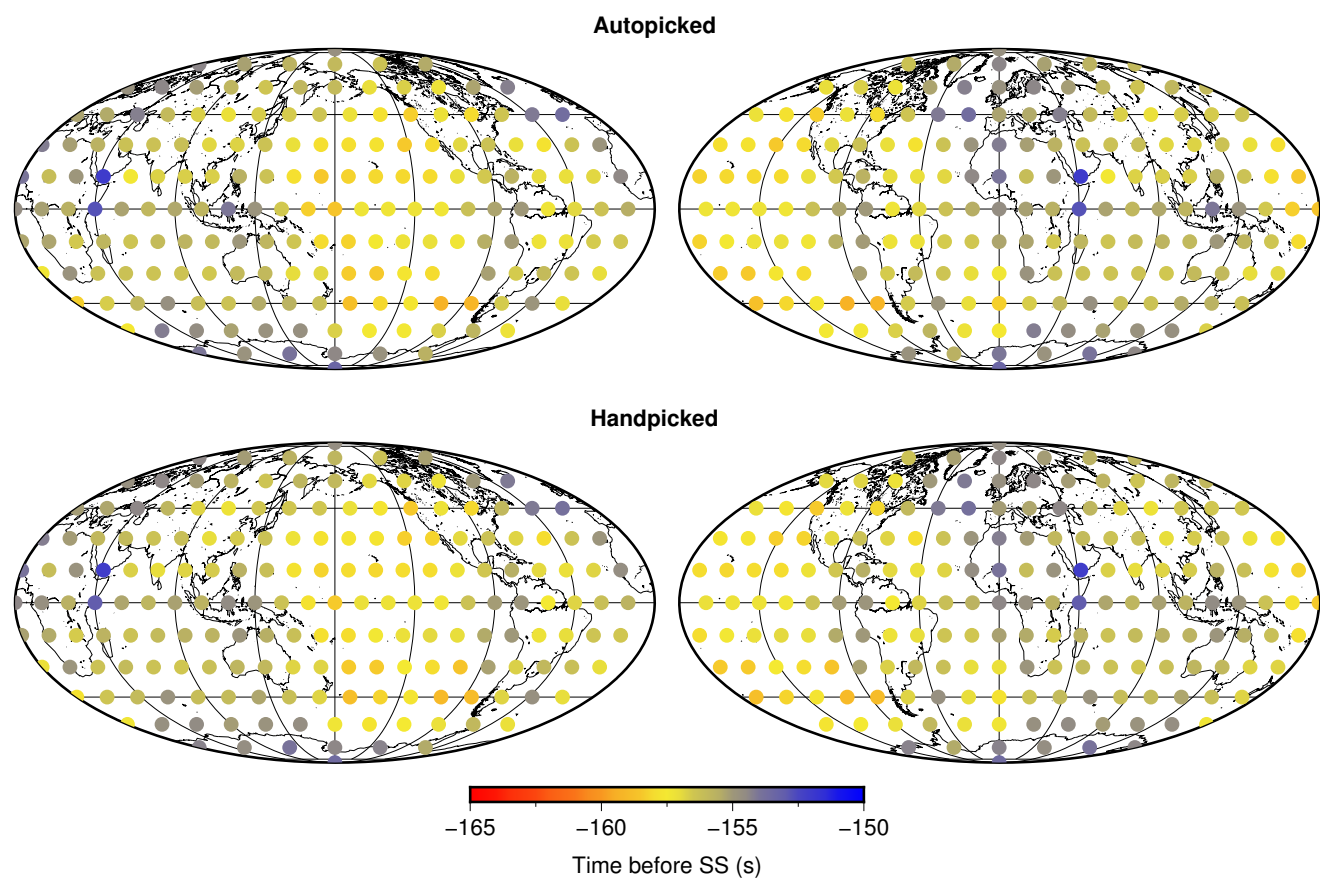**Handpicked**

−165   −160   −155   −150

Time before SS (s)

Figure S5.   Maps of autopicked (top) and handpicked (bottom) S410S-SS travel time measurements in stacked data, 10° radius caps.

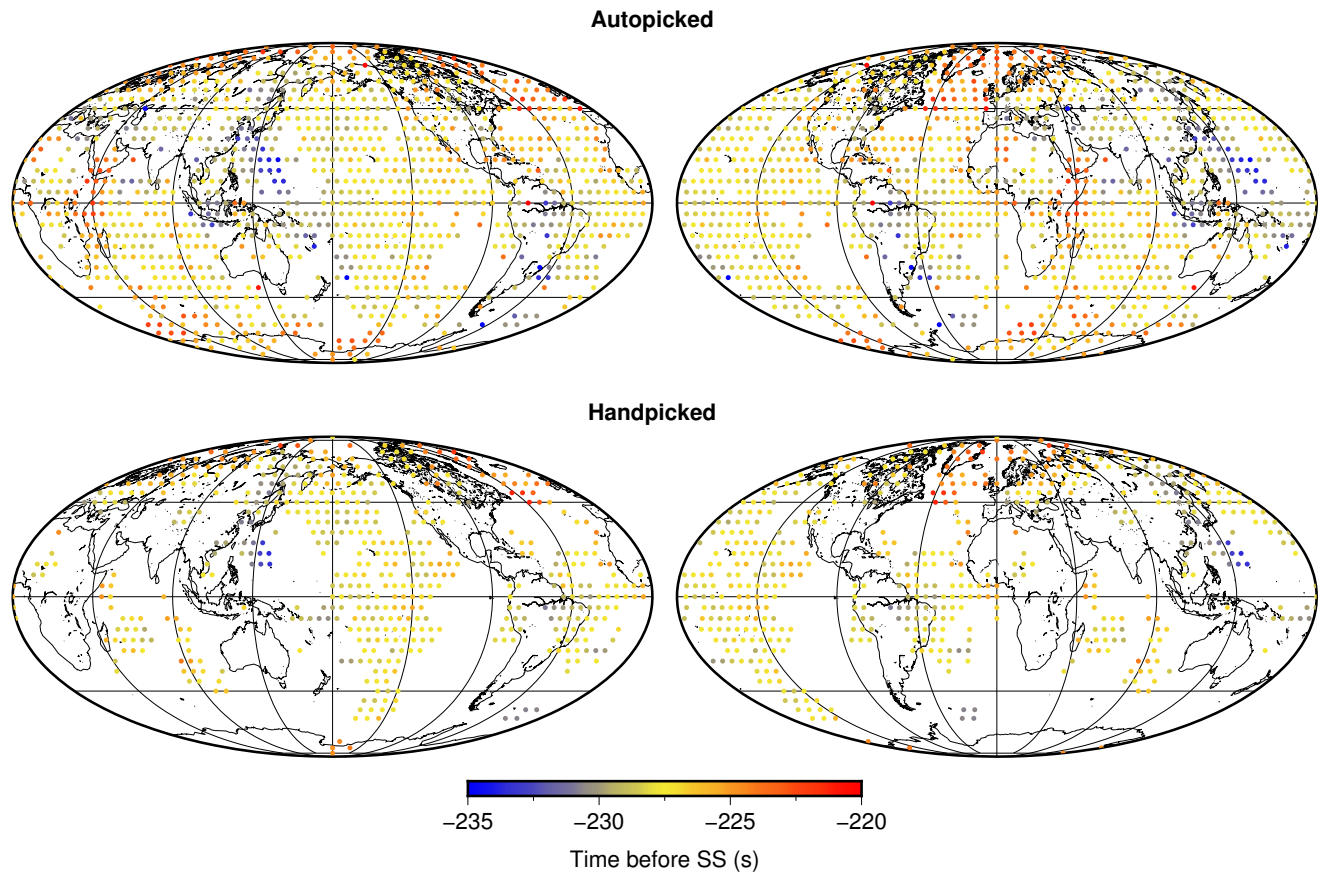November 16, 2020, 5:46pm

Autopicked

Handpicked

Time before SS (s)
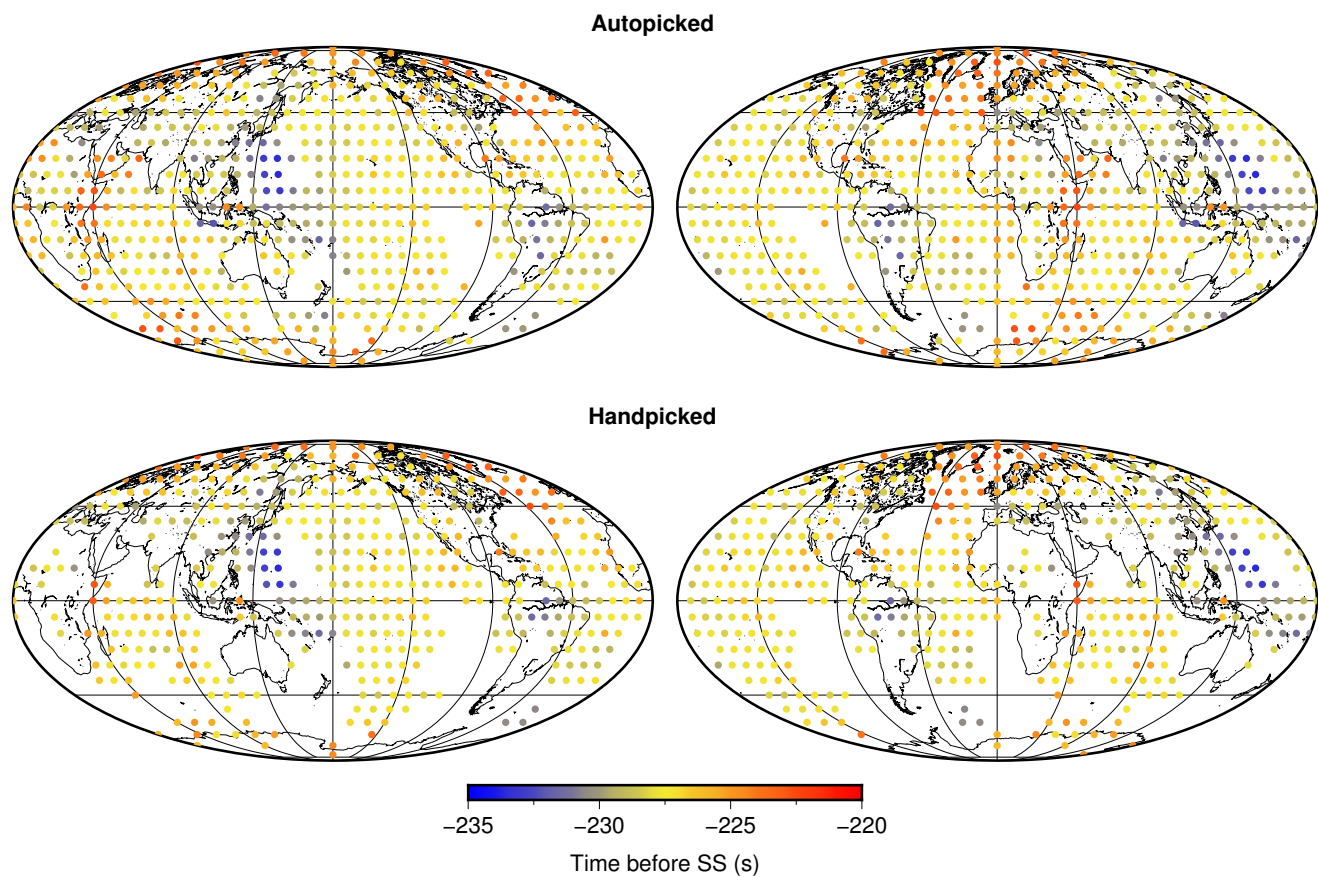
Figure S6.   Maps of autopicked (top) and handpicked (bottom) S410S-SS travel time measurements in stacked data, 15° radius caps.

Autopicked

Handpicked

Time before SS (s)

Figure S7.   Maps of autopicked (top) and handpicked (bottom) S660S-SS travel time measurements in stacked data, 5° radius caps.

Autopicked

Handpicked

−235   −230   −225   −220

Time before SS (s)
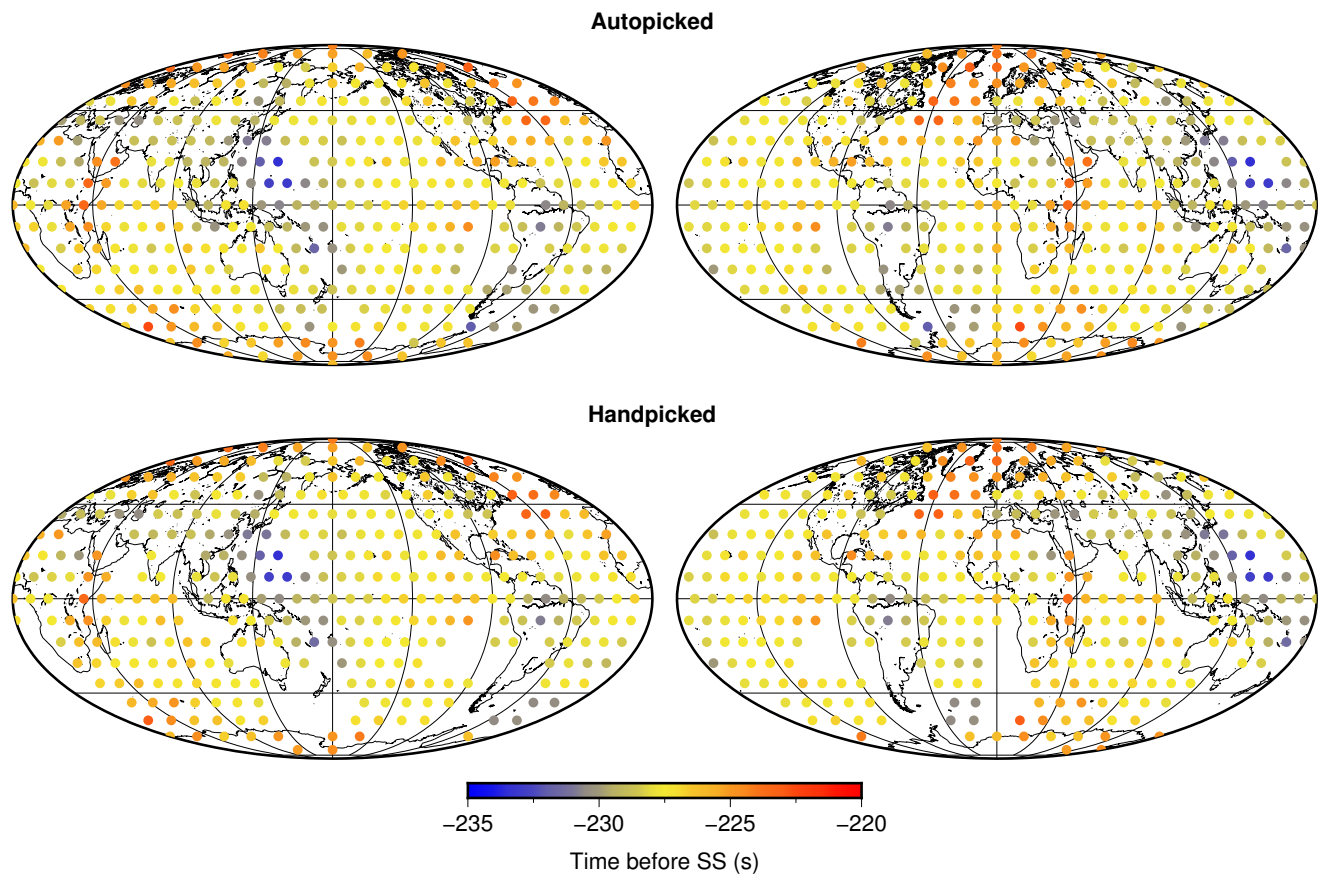
Figure S8.   Maps of autopicked (top) and handpicked (bottom) S660S-SS travel time measurements in stacked data, 7.5° radius caps.

Autopicked

Handpicked

Figure S9. Maps of autopicked (top) and handpicked (bottom) S660S-SS travel time measurements in stacked data, 10° radius caps.
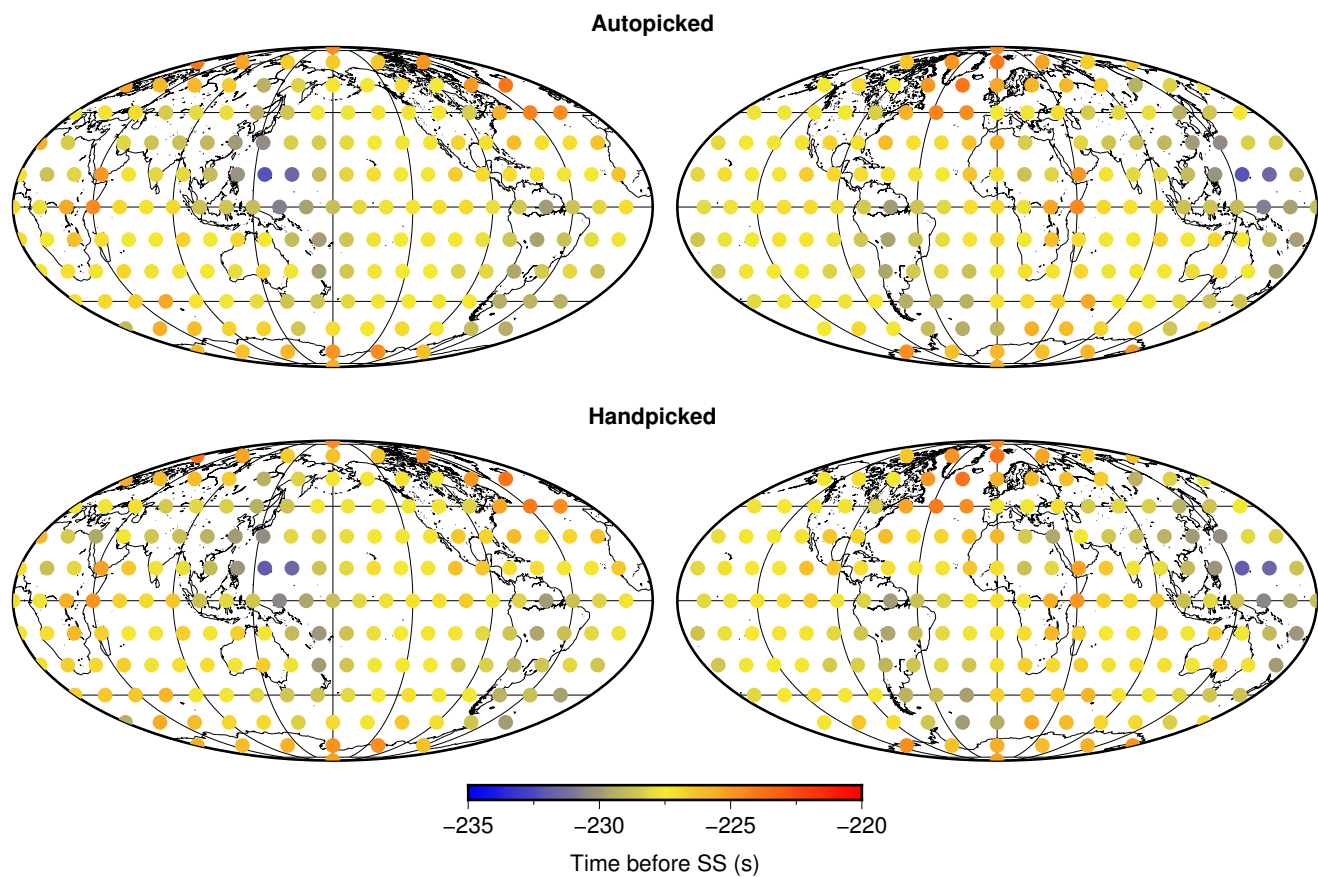
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Autopicked

Handpicked
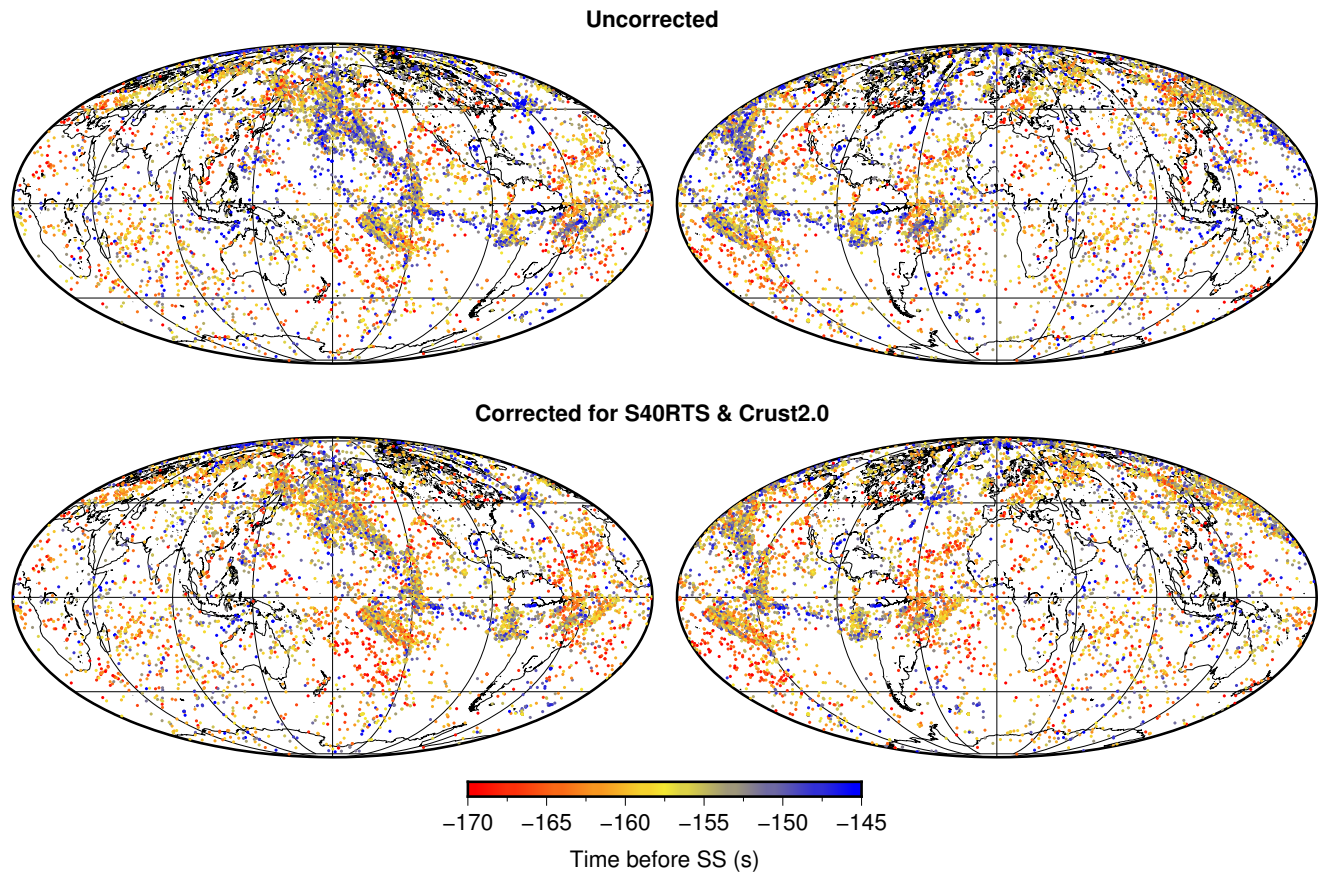
Figure S10. Maps of autopicked (top) and handpicked (bottom) S660S-SS travel time measurements in stacked data, 15° radius caps.

Uncorrected

Corrected for S40RTS & Crust2.0

−170 −165 −160 −155 −150 −145
Time before SS (s)

Figure S11.   Maps of autopicked S410S-SS travel time measurements in individual seismo-

grams, uncorrected and corrected for S40RTS and Crust2.0.

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Uncorrected

Corrected for S40RTS & Crust2.0

−245 −240 −235 −230 −225 −220 −215
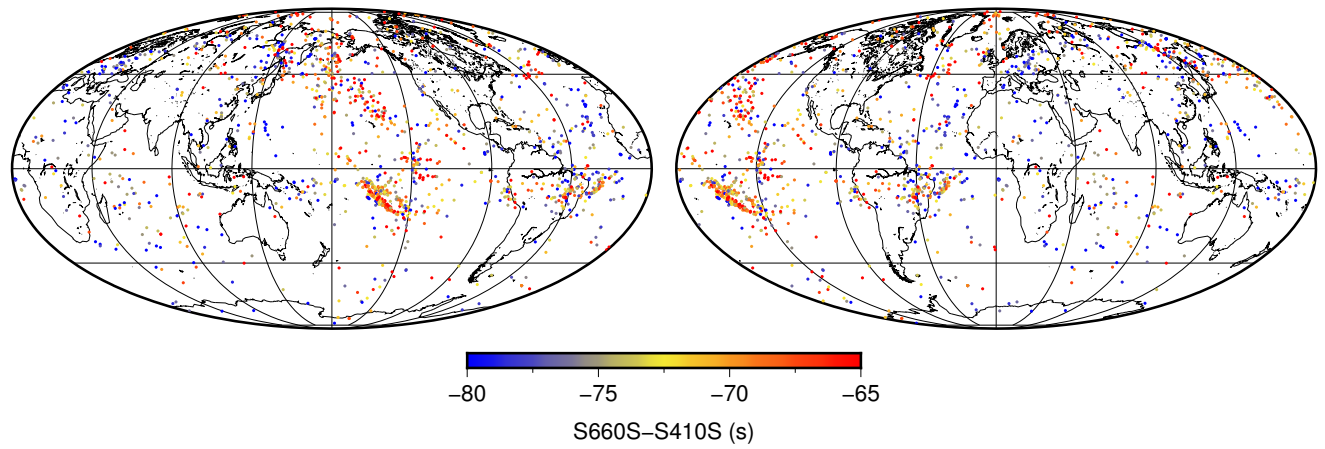
Time before SS (s)

Figure S12.   Maps of autopicked S660S-SS travel time measurements in individual seismo-

grams, uncorrected and corrected for S40RTS and Crust2.0.

−80   −75   −70   −65

S660S−S410S (s)

Figure S13.   Maps of autopicked S660S-S410S travel time measurements in individual seismo-

grams, corrected for S40RTS and Crust2.0.

Table S1.   Average pick quality for stacked data.

Data	Handpicked	Autopicked (all)	Autopicked only
S410S, 5°	0.816	0.773	0.740
S410S, 7.5°	0.816	0.800	0.765
S410S, 10°	0.839	0.829	0.762
S410S, 15°	0.856	0.856	N/A
S660S, 5°	0.881	0.822	0.772
S660S, 7.5°	0.886	0.854	0.771
S660S, 10°	0.895	0.881	0.778
S660S, 15°	0.911	0.911	N/A

Table S2.   Average pick quality for stacked data, separated by handpicked quality.

Data	a	b	c	d
S410S, 5°	0.859	0.837	0.803	0.762
S410S, 7.5°	0.878	0.799	0.803	0.773
S410S, 10°	0.874	0.838	0.813	0.787
S410S, 15°	0.885	0.820	0.808	0.730
S660S, 5°	0.919	0.887	0.866	0.863
S660S, 7.5°	0.918	0.900	0.870	0.838
S660S, 10°	0.913	0.906	0.881	0.845
S660S, 15°	0.919	0.908	0.889	0.839

Table S3.   Minimum pick quality for stacked autopicked data to achieve the same quantity of picks as handpicked.

Data	S410S quality	S660S quality
5°	0.798	0.860
7.5°	0.698	0.825
10°	0.660	0.773
15°	0.613	0.693