SEISMICA

Supplement to A repeating earthquake catalog for Northern Chile

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Description

This supplement file contains **a description of the associated text files: `nc_repeater_list.txt`, `nc_mining_cluster.txt`, `nc_event_pairs.txt`** as well as **additional figures** with examples and descriptions to support the main article.

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Catalog Files

nc_repeater_list.txt

This file contains the repeating earthquake table, where events are grouped into repeater families already. Below the header, there occur two different types of lines. The type, starting with #, contains information on the properties of the repeater family. The other line-type holds information on the single events.
Header entries are:

time	:	event origin time
cID	:	cluster ID
lat	:	event latitude or median of the sequence
lon	:	event longitude or median of the sequence
dep	:	event depth in km or median of the sequence
mag	:	magnitude or average magnitude for the sequence
stdmag	:	standard deviation of magnitudes in the sequence
numel	:	number of events in the sequence
td	:	total duration between first and last event in days
tr	:	average inter-event time
cvr	:	coefficient of variation
slip	:	slip in cm or cumulative slip in cm for the whole series, where each first event is neglected
sr	:	average slip rate in cm/yr, note that sr may be artificially high if td or tr are very small.
tccls	:	tectonic location identifier from Sippl et. al, 2023
type	:	recurrence pattern type for sequences with n>3

nc_mining_cluster.txt

This file contains a list of earthquakes that fulfill the repeater criteria but bear the tectonic label Mi, which stands for mining events. They were removed from the repeater lists as they do not reflect natural seismicity. The events are grouped into clusters similar to the repeaters. Below the header, there occur two different types of lines. The type, starting with #, contains information on the properties of the repeater family. The other line-type holds information on the single events.
Header entries are:

time	:	event origin time
cID	:	cluster ID
lat	:	event latitude or median of the sequence
lon	:	event longitude or median of the sequence
dep	:	event depth in km or median of the sequence
mag	:	magnitude or average magnitude for the sequence
numel	:	number of events in the sequence
tccls	:	tectonic location identifier from Sippl et. al, 2023

nc_event_pairs.txt

This file contains the pairs of matches and templates from which the repeater families were constructed.
Header entries are:

time	:	event origin time of the match
time_t	:	event origin time of the template
cc	:	list of cross correlation values at the closest available stations - sorting refers to stat column
lat	:	latitude of template event
lon	:	longitude of template event
dep	:	depth of template event in km
stat	:	stations on which the cc was computed - sorting refers to the cc column
cID	:	cluster ID
mag	:	magnitude of match
mag_t	:	event origin time

Additional Figures

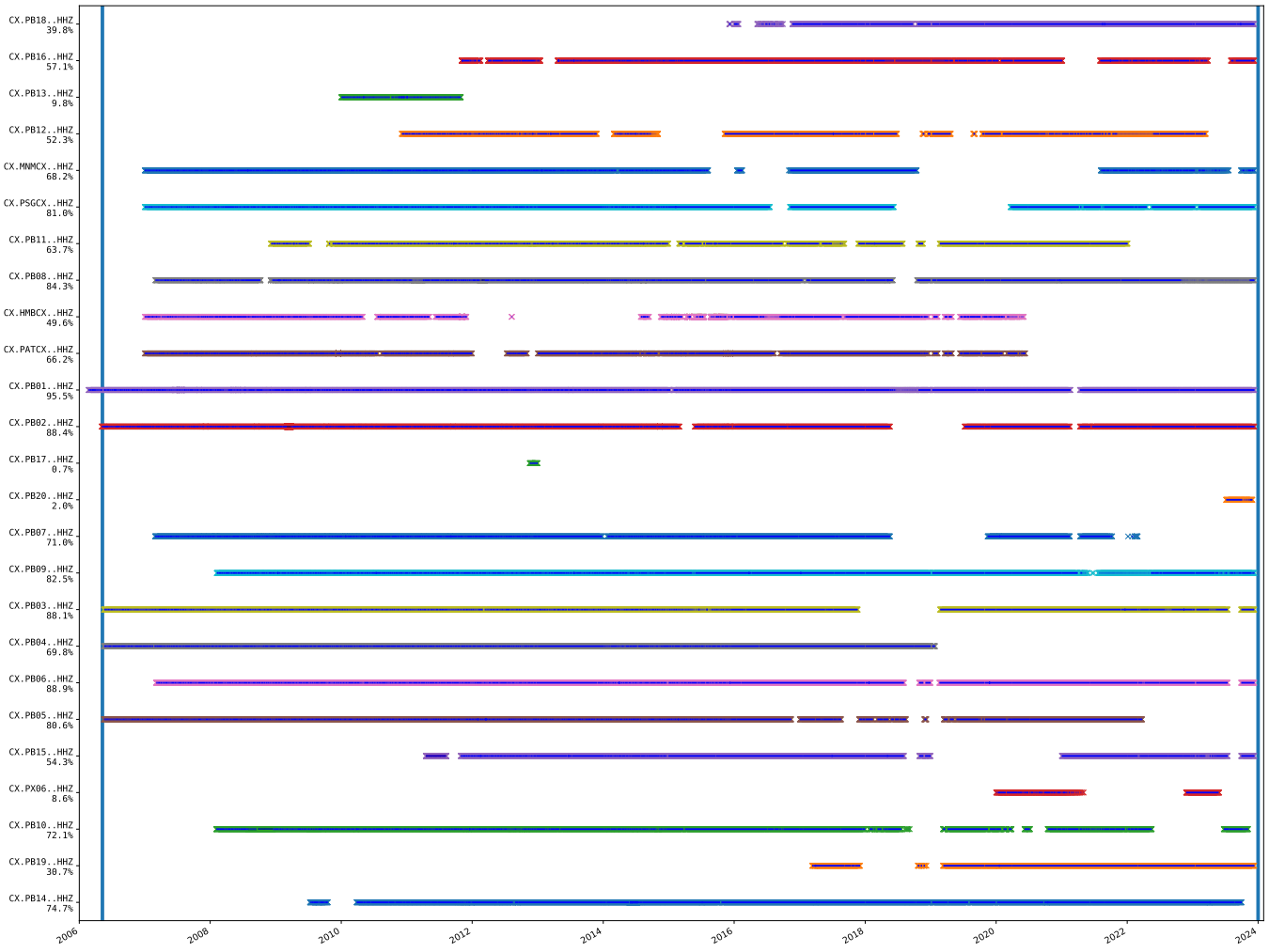

Figure S 1 Station availability of the IPOC (2006) seismic network, with stations sorted from north to south. Blue vertical lines denote the time interval of this catalog. Stations 1-10 have very continuous data availability with few gaps. Station locations are shown in Figure S2 and in the main manuscript, Figure 1. Note, that stations PB13 and PB16 have similar locations, i.e., the latter one is the replacement of the former.

References

IPOC. IPOC Seismic Network. Integrated Plate boundary Observatory Chile - IPOC, GFZ German Research Centre for Geosciences; Institut des Sciences de l'Univers-Centre National de la Recherche CNRS-INSU, Seismic Network, 2006. doi: 10.14470/PK615318.

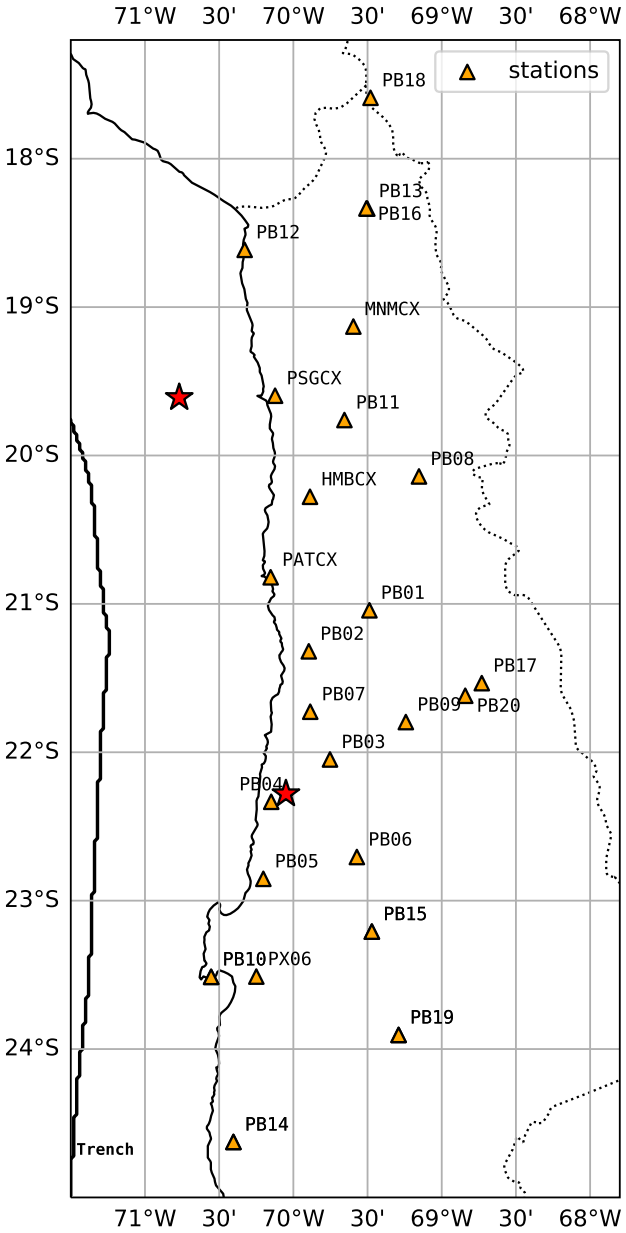

Figure S 2 IPOC (2006) station network. Orange triangles are IPOC stations. The upper red star is the 2014 MW8.1 Iquique event, the lower star is the 2007 MW7.7 Tocopilla event.

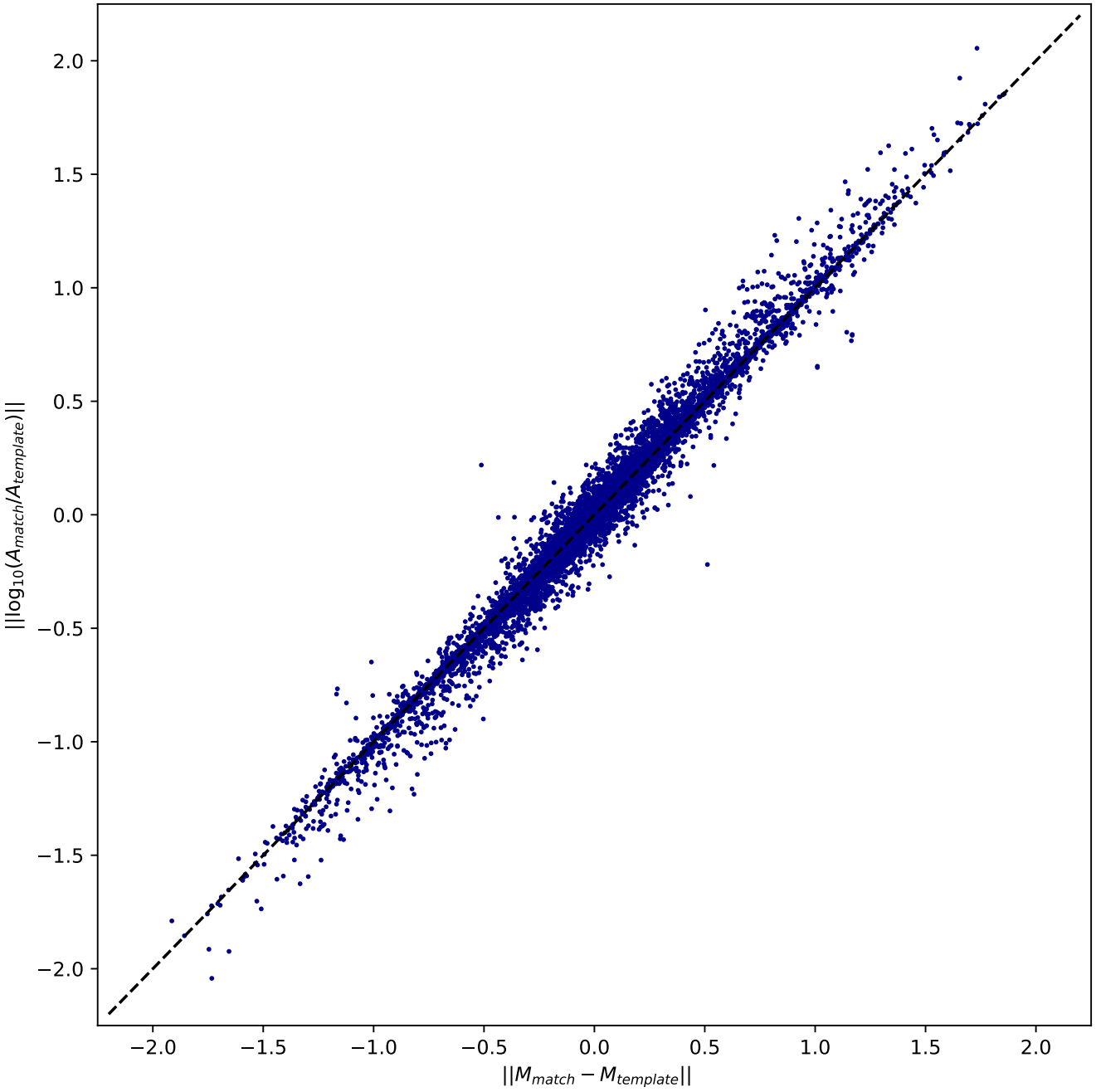

Figure S 3 Logarithmic amplitude ratio versus magnitude difference for all 15167 event pairs, where both events are contained in the IPOC catalog. Black dashed line is the bisecting (1:1) line. Here, both $M_{template}$ and M_{match} are the catalog magnitudes, while the amplitude ratio is independently measured (averaged over 2-3 stations, 1-4Hz filtered velocity waveforms). The great majority of points lie very close to the 1:1 line, meaning that Equation (2) in the paper provides consistent values with the catalog magnitudes. We can therefore apply it to compute the magnitudes of the newly detected events which were not in the original catalog. Note that this relative simple approach works especially well here, because it is applied to pairs of highly similar seismic waveforms.

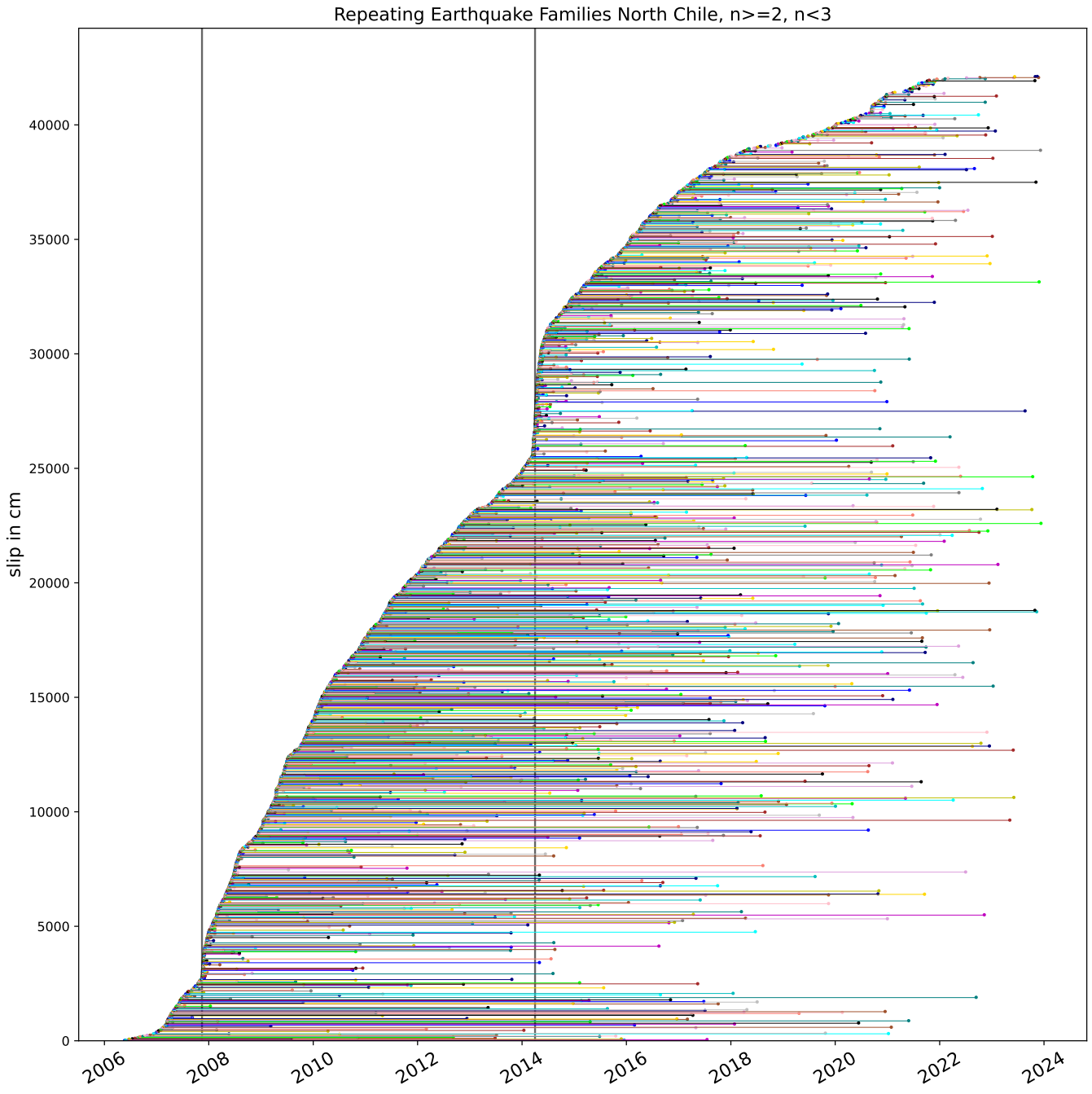

Figure S 4 Slip vs. time for repeater families that only have 2 members (doublets). Vertical lines denote the occurrence time of (1) the 2007 Tocopilla event and (2) the 2014 Iquique event. Note their big influence on repeater occurrence rates. For reasons of better graphical representation, the lines are gradually offset by a value of 20cm slip on the vertical axis. Also note that the original earthquake catalog of template events ends in 2022, and thereafter no new sequences can emerge.

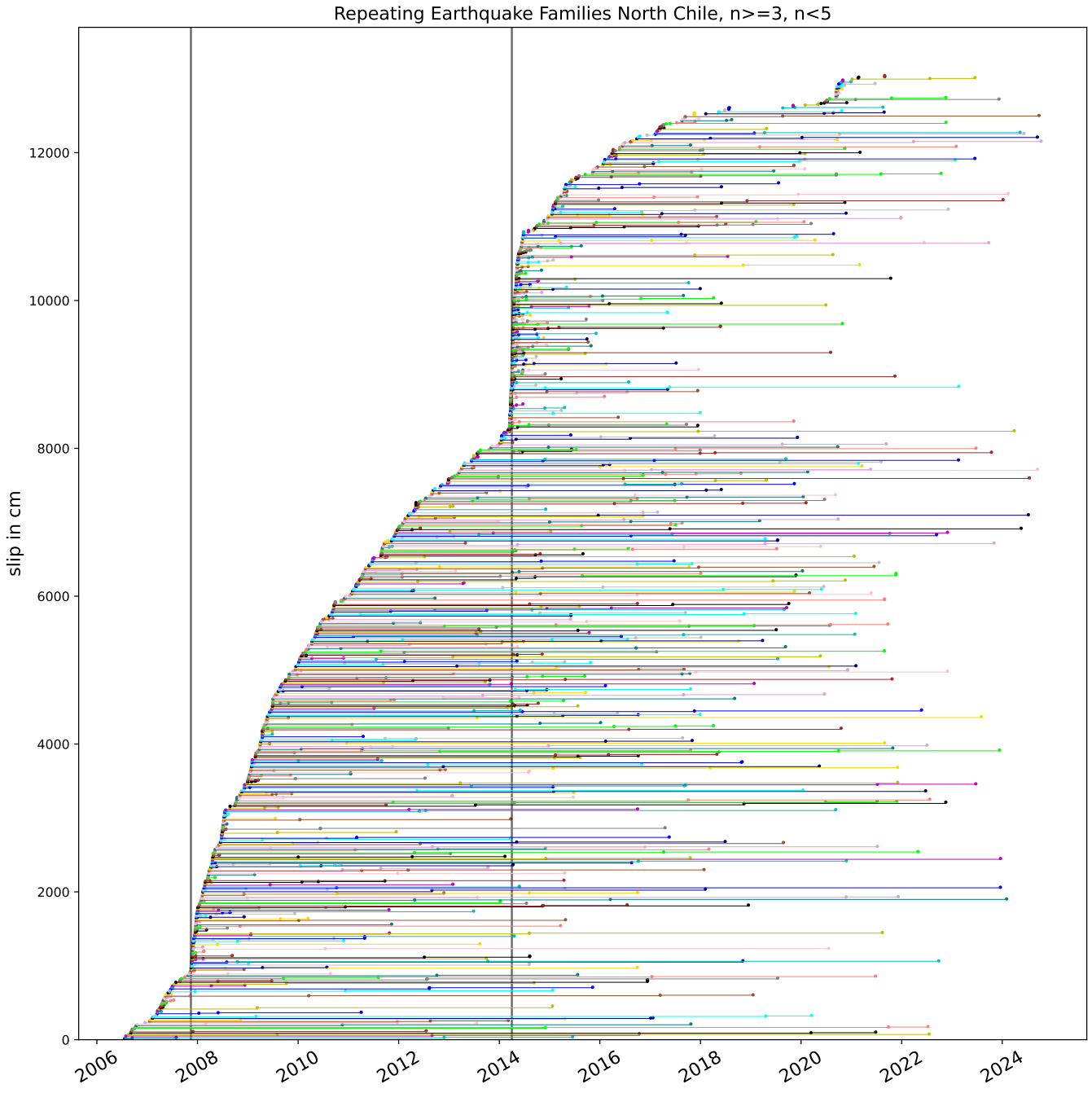

Figure S 5 Slip vs. time for repeater families that have 3–4 members (triplets/quadruplets). Vertical lines denote the occurrence time of (1) the 2007 Tocopilla event and (2) the 2014 Iquique event.

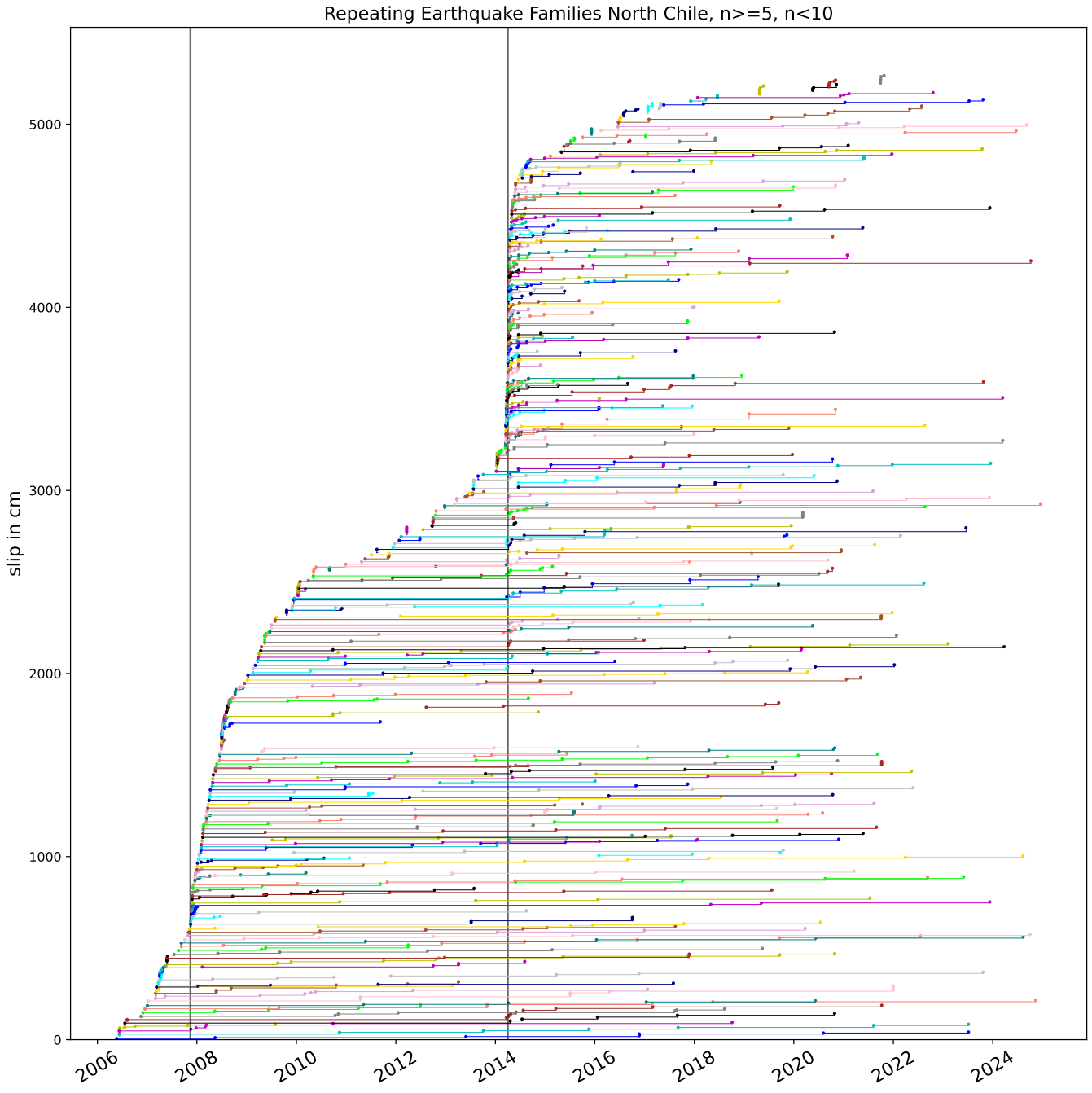

Figure S 6 Slip vs. time for repeater families that have 5–9 members. Vertical lines denote the occurrence time of (1) the 2007 Tocopilla event and (2) the 2014 Iquique event.

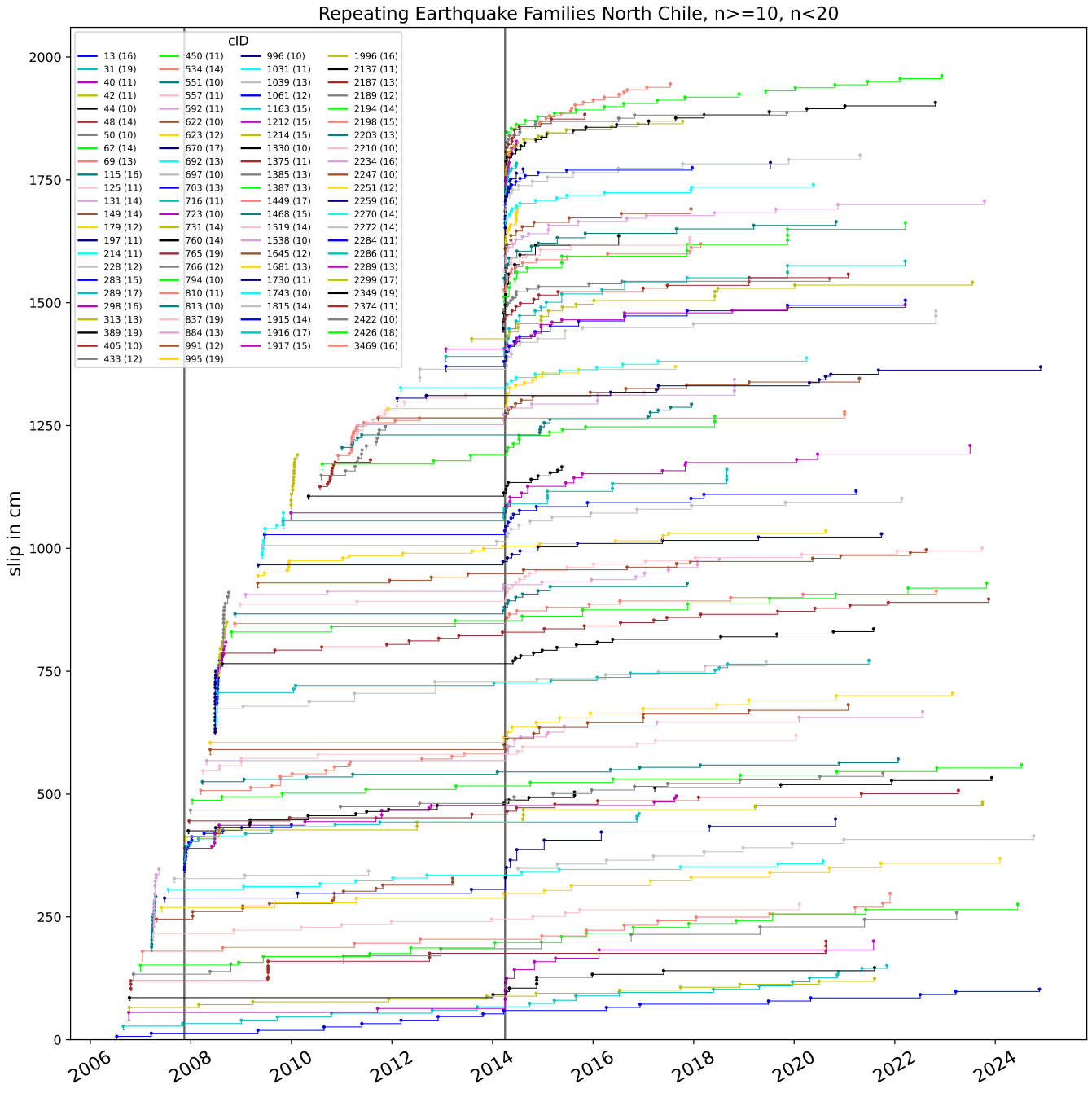

Figure S 7 Slip vs. time for repeater families that have 10–19 members. Vertical lines denote the occurrence time of (1) the 2007 Tocopilla event and (2) the 2014 Iquique event.

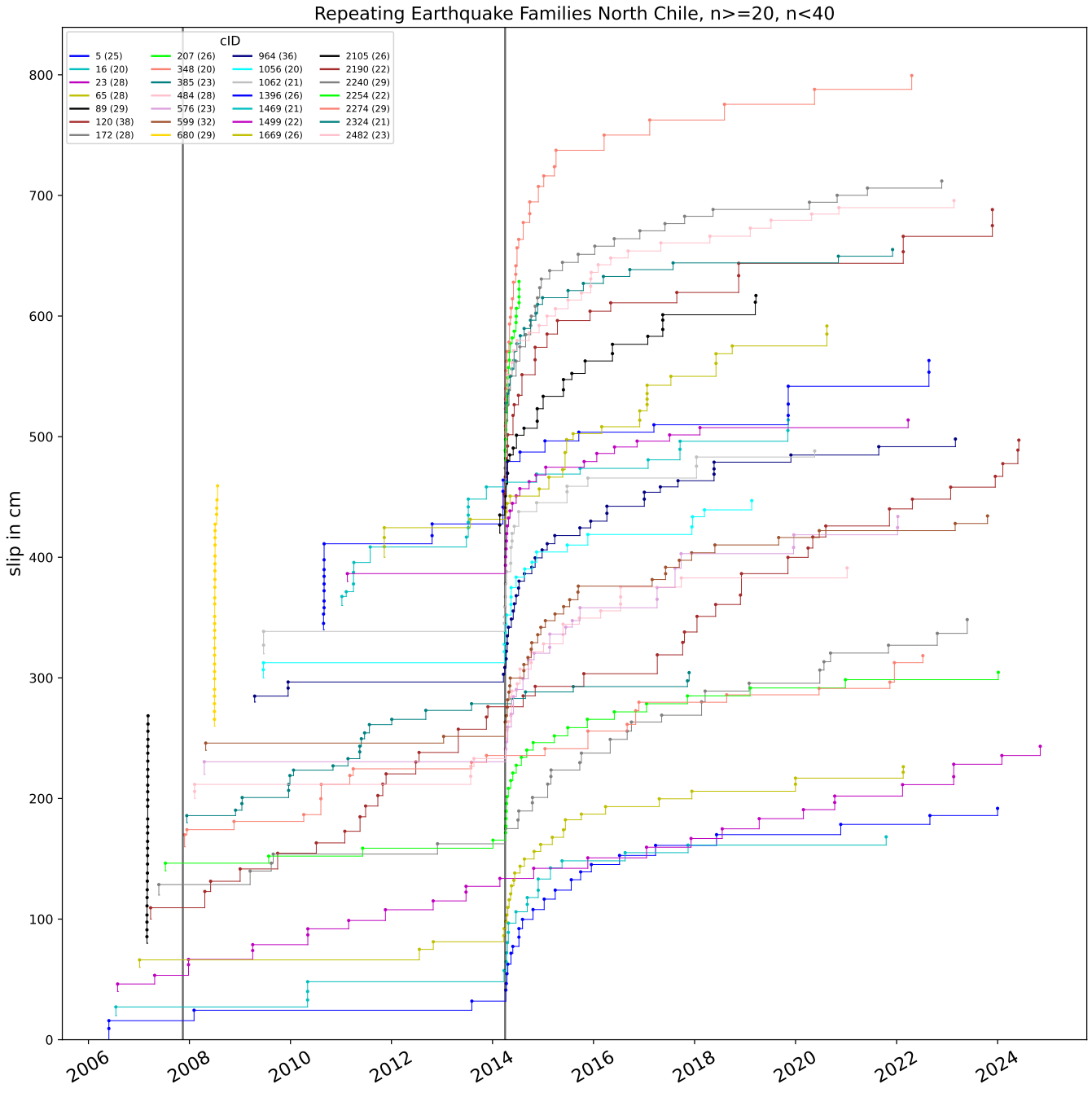

Figure S 8 Slip vs. time for repeater families that have 20–39 members. Vertical lines denote the occurrence time of (1) the 2007 Tocopilla event and (2) the 2014 Iquique event.

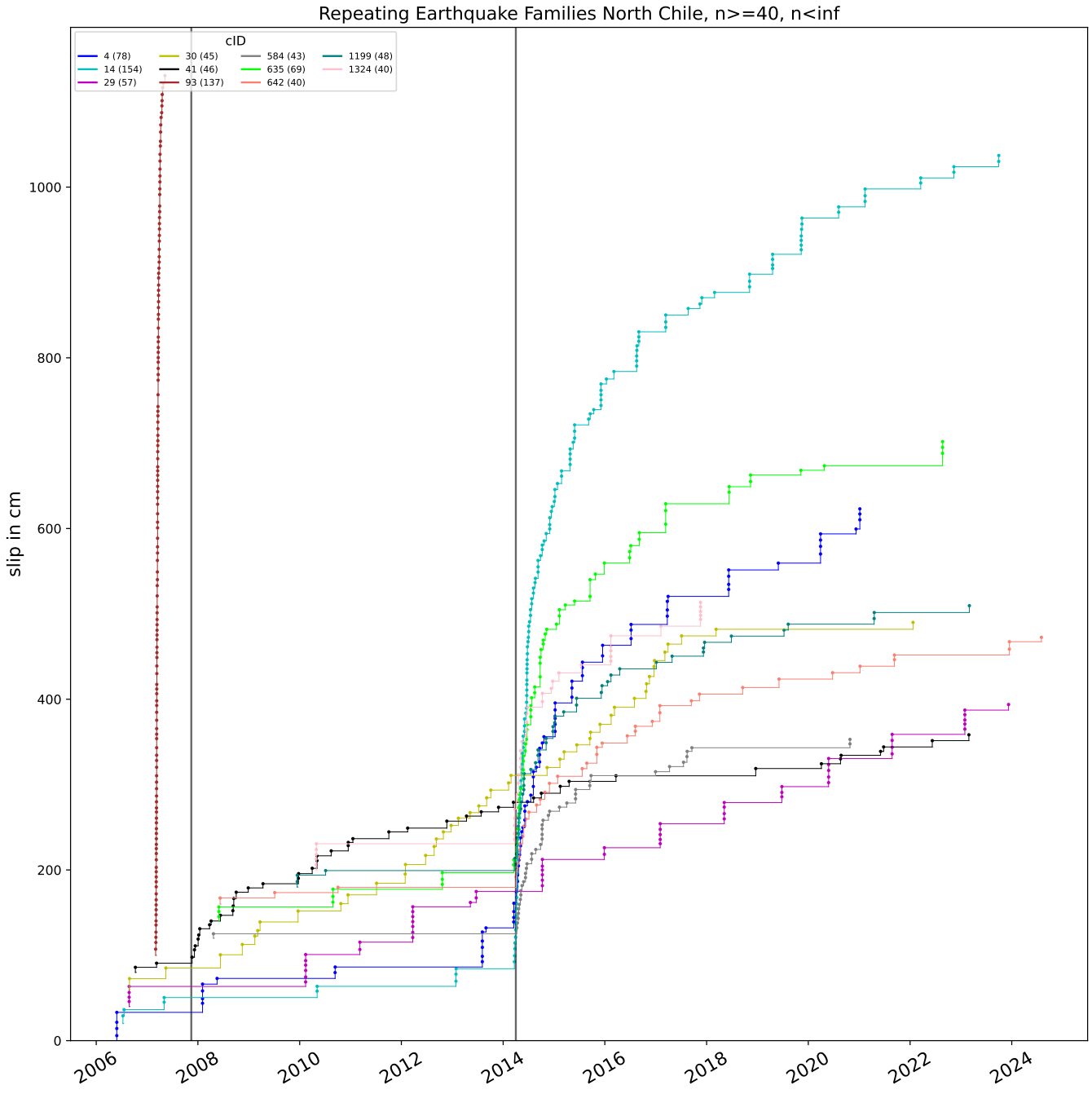

Figure S 9 Slip vs. time for repeater families that have 40 or more members. Vertical lines denote the occurrence time of (1) the 2007 Tocopilla event and (2) the 2014 Iquique event.

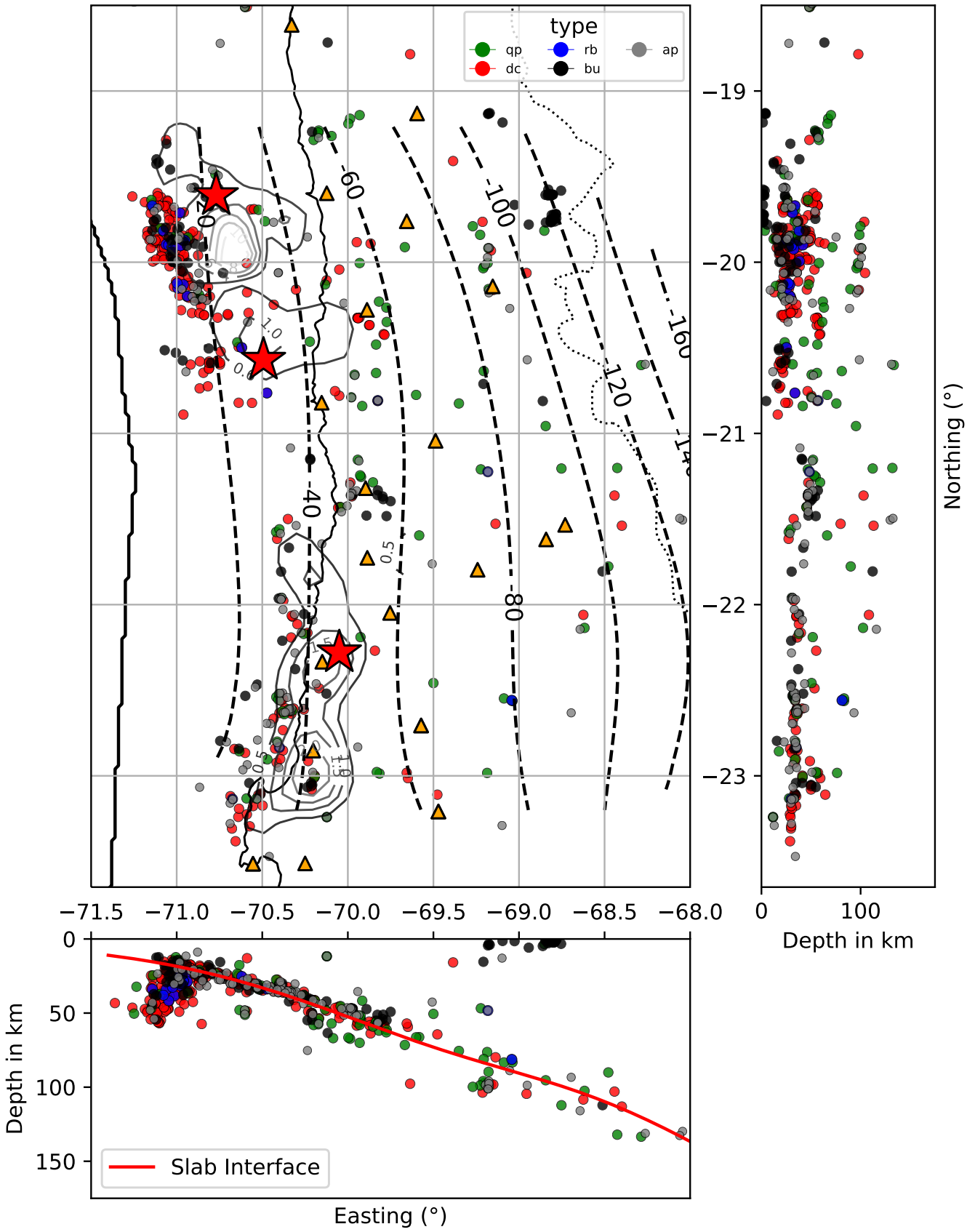

Figure S 10 Repeating earthquake sequence recurrence type distribution. qp: quasi periodic, rb: repeated burst, ap: aperiodic, dc: decay, bu: burst. For the description of the typification see the main manuscript. Dashed black lines are the depth contours of the plate interface as estimated by Sippl et al. 2018.

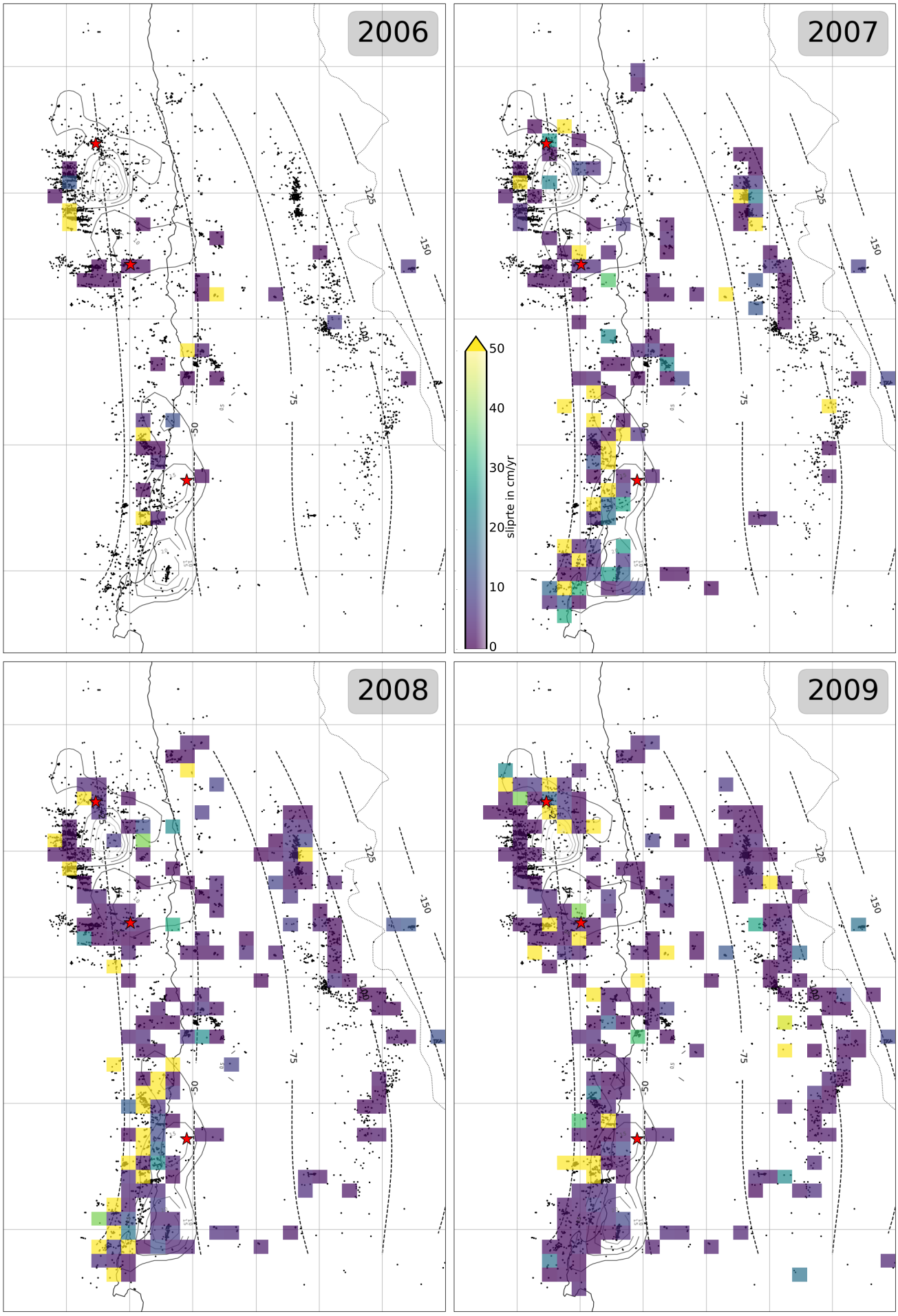

Figure S 11 Slip maps for the years 2006 to 2009. Increased-size reprints of Figure 6 from the main manuscript with the same color scheme. Dashed black lines are the depth contours of the plate interface as estimated by Sippl et al. 2018.

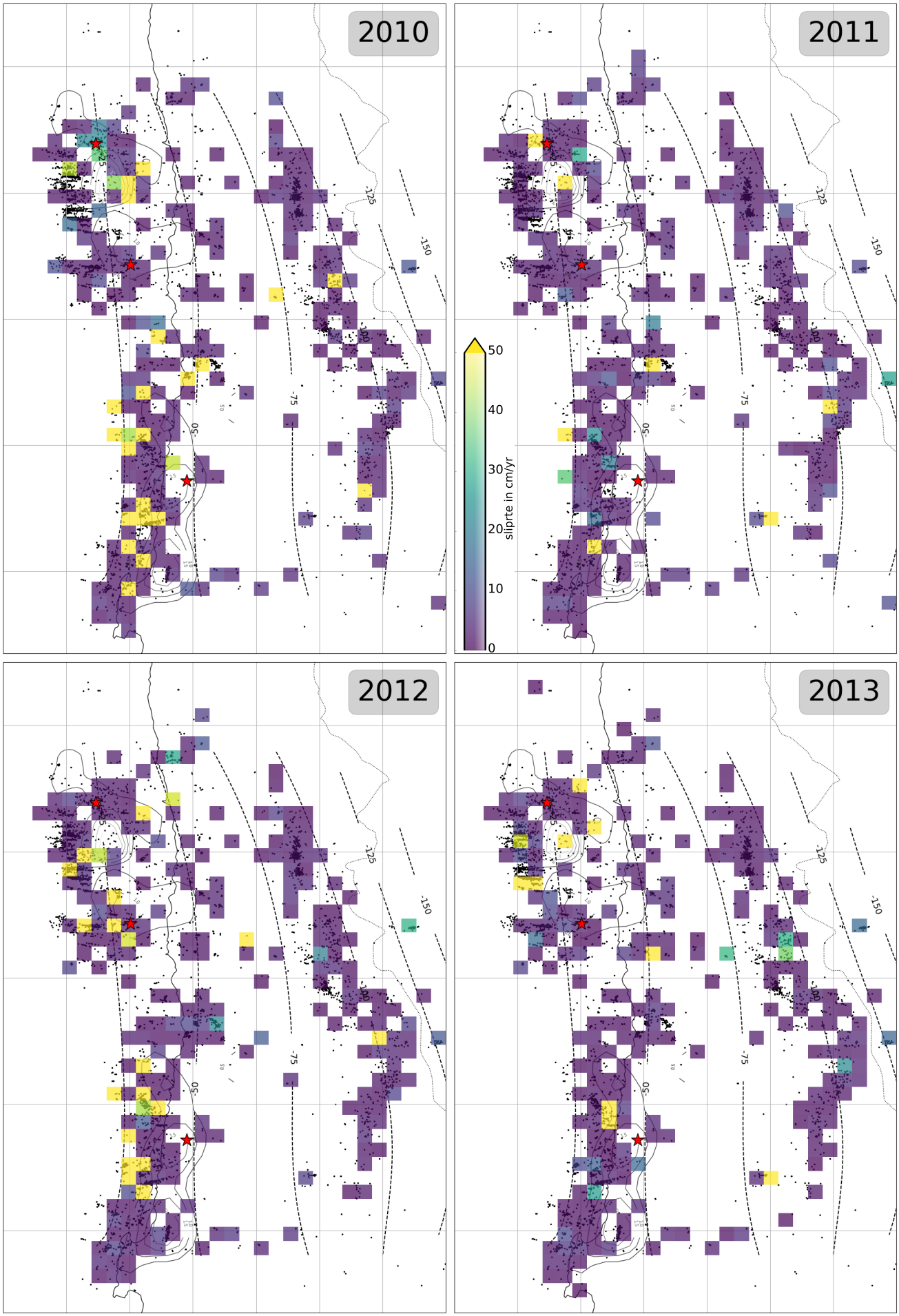

Figure S 12 Slip maps for the years 2010 to 2013. Increased-size reprints of Figure 6 from the main manuscript with the same color scheme. Yellow to dark-violet colors reflect high to low averaged slip values.

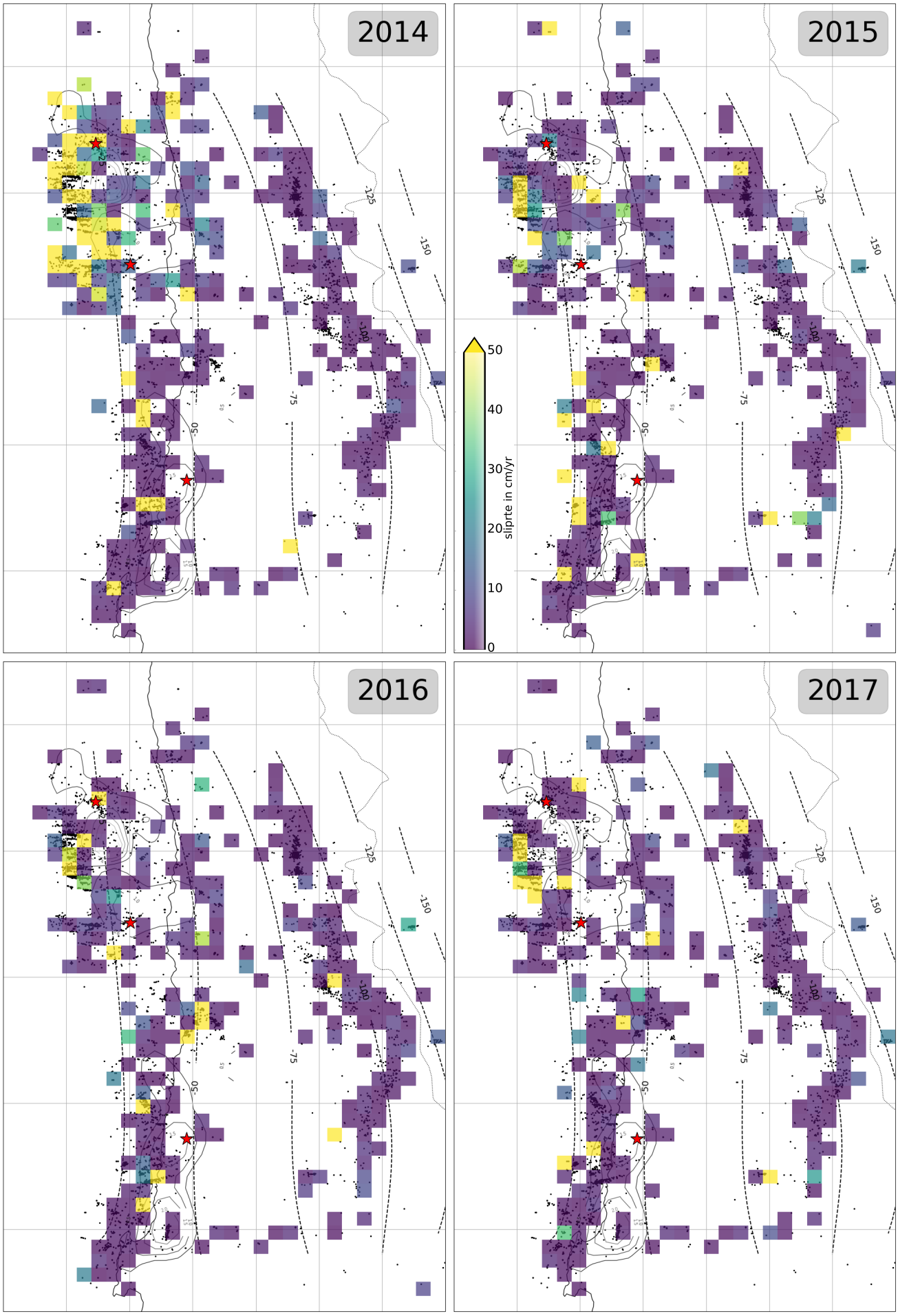

Figure S 13 Slip maps for the years 2014 to 2017. Increased-size reprints of Figure 6 from the main manuscript with the same color scheme. Yellow to dark-violet colors reflect high to low averaged slip values.

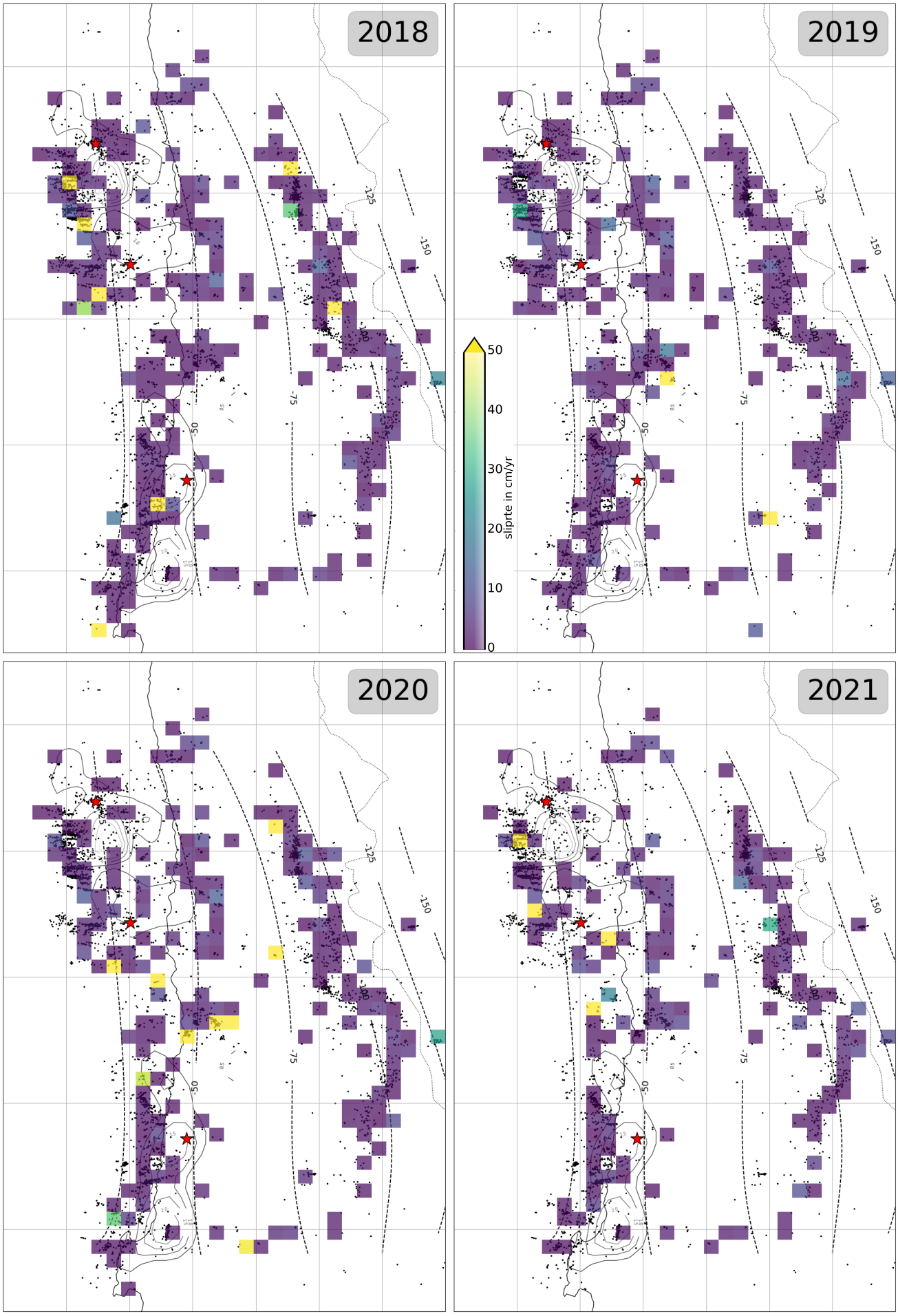

Figure S 14 Slip maps for the years 2018 to 2021. Increased-size reprints of Figure 6 from the main manuscript with the same color scheme. Yellow to dark-violet colors reflect high to low averaged slip values.

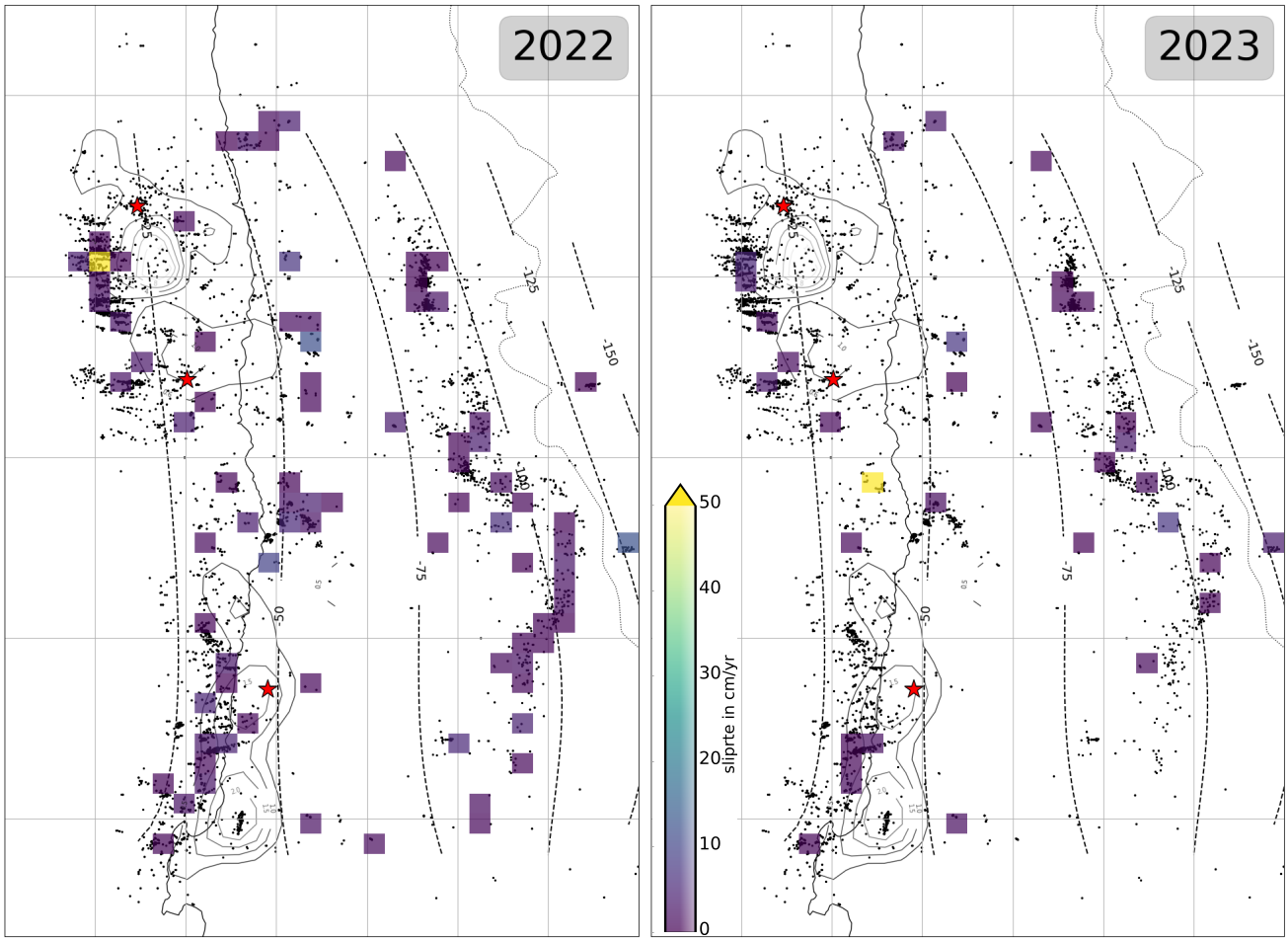

Figure S 15 Slip maps for the years 2022 to 2023. Increased-size reprints of Figure 6 from the main manuscript with the same color scheme. Yellow to dark-violet colors reflect high to low averaged slip values.