6.3.1 Detecting displacements and temporal relocations

In calculating displacement and disaster statistics, detecting residential location is a key as it is used as the origin and destination of transition matrices for relocation. For instance, in Bangladesh, changes in the number of active SIMs were used as proxy for population transitions after Cyclone Mahasen in 2013; this highlights the benefit of CDR data, which enables us to measure small movements across vast areas—these are extremely difficult to measure using traditional survey-based approaches (Lu et al., 2016) because such populations spread easily across large areas (Fussell et al. 2014). In Nepal, home locations were used to build transition matrices (origin-destination matrix), describing the countrywide mobility between two points in time. Individual home locations were determined by calculating the modal daily location over a certain period at the district level—a user was counted as displaced if they had spent at least seven consecutive days away from their pre-earthquake home location in a two-week period after the 2015 earthquake. This case demonstrates how cellular network data can be used to detect displacements, including returning residents, based on changes in home locations (Wilson et al. 2016).

For these indicators, it should be noted that the number of people proxied by active SIMs is a function of phone use and the number of active subscriptions. The estimated results can reflect changes in cell phone use instead of those in population numbers. In addition, the value presented in a transition matrix is the number of people moving between two regions, which highly depends on the spatial and time scales used for computation (Kishore et al. 2020) as well as the definition of locations used as the origin and destination. For capturing long-distance travel, larger time windows are useful as it typically takes longer to move from an origin region to the destination one. When only overnight locations are used and other trips such as commuting are excluded from the matrix, it enables the identification of long-term relocation. On the other hand, to understand short-term mobility fluctuations, such as those within a day, smaller time windows are useful.

In general, one can consider the following steps and process in using CDR data for detecting displacement in the context of disaster.

**Step 1. Establishing the baseline.**

In this process, time windows for the baseline and detecting displacement need to be specified. Data quality assurance should be performed for both time windows to ensure that the baseline data reflect the usual pattern with respect to the purpose of the analysis.

**Step 2. Filtering and pre-processing.**

When a methodology employed for computing statistics requires specific input-data conditions, filtering and pre-processing need be performed. For example, some statistics may require minimum number of records per week and/or a certain active period of subscriptions with a certain number of records as input data. It is suggested to examining if there are any potential biases associated with the process as they could affect the characteristics of statistical outputs.

**Step 3. Detecting home location before the event.**

Home location before the event or external shock is used for indicating the usual living place under the normal time. It is estimated using the data of the baseline period and regarded as the origin of displacement/relocation.

**Step 4. Detecting home location after the event.**

Home location after the event or external shock is used for indicating the living place after the event, which can remain unchanged for some people. It is estimated using the data after the event. Home location after the event can be computed at the different time scale, such as weekly, and monthly basis, depending on the purpose of the analysis. It is regarded as the destination of displacement/relocation.

**Step 5. Detecting displacements and computing transition matrices.**

Definition of the displacement may be subject to the context of events inducing relocations. For example, a time period used for measuring displacement may vary depending on the type of the events. Usually, home locations before and after the event are used for detecting displacements and constructing transition matrices.

<table>
<thead>
<tr>
<th>Country</th>
<th>Partnership</th>
<th>How CDR data are used for detecting displacement</th>
</tr>
</thead>
</table>

Table 2.1 summarizes country cases which use CDR data for detecting displacement. More information for each country case is provided in Annex 2.1.a (Indonesia) and Annex 2.1.b (Nepal).
<table>
<thead>
<tr>
<th>Location</th>
<th>Data Sources</th>
<th>Methods and Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia (earthquake and tsunami)</td>
<td>MNOs, Pulse Lab Jakarta, IOM</td>
<td>• The number of subscribers (weekly aggregates) used to identify displacement</td>
</tr>
</tbody>
</table>
| Nepal (earthquake, 2015)  | MNOs, Flowminder                      | • Changes in home locations, estimated as the modal location of every individual, used for analyzing origin, destination, and relocation size  
• Scaled estimates of total inflows per district compared with the census population data for the baseline period, with the result showing a close match |