Text S2. Model comparison metrics

Three metrics are developed to test and evaluate the mobility models. These metrics are designed to measure the moving distance, closeness between pastoralists, and the spatial extent of the route, respectively.

First, we calculate the mean distance pastoralists make between two consecutive days as \(D_t = \frac{1}{N} \sum_{i=1}^{N} d(x_{it}, x_{i(t-1)})\), where \(N\) is the number of pastoralists, \(x_{it}\) is the location of the \(i\)-th pastoralist at time \(t\), and \(d\) is a function returning the Euclidean distance between two locations. The difference between the simulations and the data is calculated using the standardized root mean squared deviation of \(D_t\) between the simulated paths and that of the reported paths in the data for the entire year as \(\sqrt{T \sum_{t=1}^{T} (D_t - D^*_t)^2 / \sum_t D^*_t}\), where \(D^*_t\) is the mean moving distance at time \(t\) from the survey data, and \(T\) is the total time (354 days in this case).

Second, we measure the closeness of pastoralists at time \(t\) by computing the mean distance between them at that time as \(C_t = \frac{1}{N(N-1)} \sum_{i=1}^{N} \sum_{j=i+1}^{N} d(x_{i,t}, x_{j,t})\). We then calculate the difference between the simulated routes and the data using the standardized root mean square deviation of \(C_t\) between the simulated paths and the reported in the data for the year as \(\sqrt{T \sum_{t=1}^{T} (C_t - C^*_t)^2 / \sum_t C^*_t}\), where \(C^*_t\) is the mean closeness at time \(t\) from the survey path data, and \(T\) is total time (365 days).

Lastly, we use the convex hull that encloses all the locations of the pastoralists in a group for the entire year as an indication of the overall spatial extent of the annual transhumance cycle. We measure the overlapped area ratio between the simulated routes and the data as \(2a_o/(a + a')\), where \(a\) is the area of the convex hull of the locations in the data, \(a'\) is area of the convex hull from the simulated data, and \(a_o\) is the overlapped area between the two hulls. This measure is 1 if the two convex hulls are exactly the same, and is 0 if the two hulls do not intersect.