Probabilistic Pathway Projection to Counter Foreign Fighters

OVERVIEW

START Geographic Information Scientists assessed the possible transportation corridors used by foreign fighters when travelling to and from territories controlled by the Islamic State of Iraq and the Levant (ISIL), specifically focusing on transportation networks in Europe, North Africa, and the Levant. The growing migrant/refugee traffic was explored as a means for foreign fighters to blend in with noncombatant flows. Our findings show that the advanced, multimodal network designed by START GIS can successfully forecast large flows of persons/materials and it shows how potential deterrence/mitigation activities can manipulate those flows.

PROJECT BACKGROUND

The project examines multiple potential scenarios under which people may ingress/egress between Europe and the Levant. In an unweighted model, assessing the likelihood of a chosen route requires a consideration of the interaction between time, speed, and choice of transportation modality. Scenarios move from unweighted and general in character (e.g., a scenario where people may travel without regard for cost), to more specific scenarios focused on how movement alters when air travel is not available or various human terrain factors (illicit routes, corruption levels, built infrastructure) impede shortest pathways. The scenarios focus on transit between various European, Iraqi, and Syrian cities, but random points were also used to increase the robustness of the analysis to allow for uncertainty in origination.

FINDINGS

- As more variables and constraints are incorporated, the model solidifies to include fewer discrete routes. The relative lack of unevenness in these routes consistently models how flows of migrants/refugees changed throughout 2015.
- Specifically, as variables are included, the algorithm chooses routes very similar to popular routes through Greece, Macedonia, and Hungary.
- Once border stations and barriers went up, the algorithm routes around them, and the least-cost path becomes very similar to the Balkan Route, which is also a common pathway for drug trafficking as well as a corridor for refugees and migrants.
- Despite the overall size of the model, chokepoints consistently appear in the Aegean Sea, suggesting that the least-cost path is through various Greek islands in most cases (fig. 1).

Figure 1: A visualization of multiple ground-based least-cost paths between Syria and Iraq and Europe. Chokepoints are identified as red dots of varying sizes based on how many modeled routes traversed those points.

- Traffic through the Adriatic into Italy and into Odessa and through Ukraine were unexpected results, but they are significant (fig. 2).

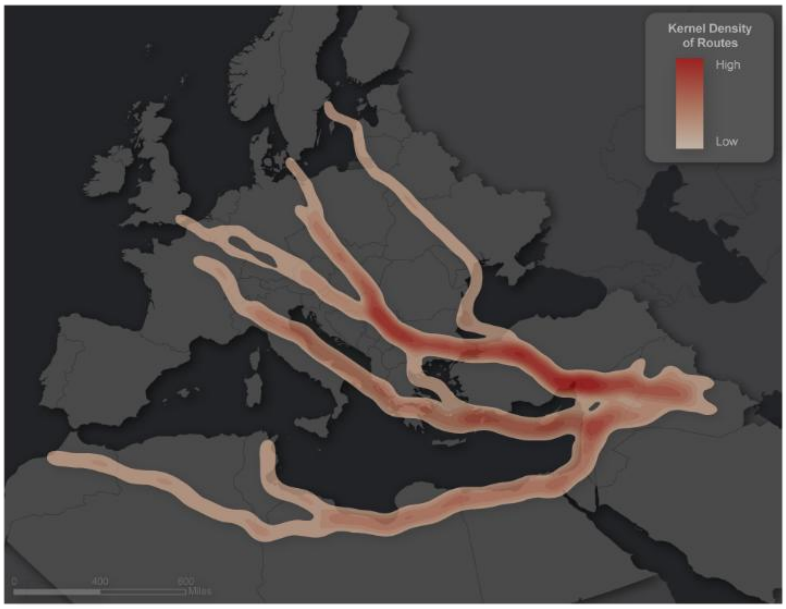

Figure 2: A visualization of the edge bundling. This visualization shows which routes were used most often during a specific run of the model. This particular visual mimics migrant/refugee flows prior to the introduction of border checkpoints and other barriers in Europe.

POLICY RECOMMENDATIONS

- If migrant/refugee flows are to continue, this model can be used to inform decision makers by testing and/or forecasting outcomes of potential policy decisions.
- Decision makers interested in discovering potential returning foreign fighters will be interested in START's chokepoint findings and in how these chokepoints can be modeled to show alternative pathways if these chokepoints become unavailable. Chokepoints are synthesized by examining all routes run for each scenario and calculating which nodes are traversed most often by each individual route.
- Closing forecasted chokepoints or pathways will open new ones. START's methodology can assist in determining both an ethics-based solution to the wider humanitarian crisis and the cost/benefit analysis necessary to manage assets to thwart returning ISIL operatives.

METHOD

In order to analyze probable routes for foreign fighters entering ISIL-controlled territory, researchers used an algorithm originally developed by Dijkstra with custom parameters. This algorithm is applied to a multi-modal transportation network to generate probable routes to and from ISIL-controlled territory. The integrated multi-modal transportation network across the study region is a bidirectional graph that consists of a set of vertices and edges. If foreign fighters want to minimize risk when traveling to or from ISIL-controlled areas, the baseline assumption of this model is that they will choose the least cost path from an origin point in Europe to an ISIL-controlled destination (or vice versa). The unweighted cost variable, speed, is applied to the edges in order to weight the graph. The weighted cost variable is a function of time (derived from distance and speed) and risk. A potential foreign fighter will prefer to take the shortest pathway with the lowest amount of risk. To this end, the model is a simple function of distance (measured in time to traverse a segment) weighted by the costs and incentives discussed above.

RESEARCHERS AND CONTACT INFORMATION

Marcus A. Boyd, GIS Senior Researcher at the National Consortium for the Study of Terrorism and Responses to Terrorism (START); **Joshua M. House**, GIS Analyst at START; **Brady L. Woods**, GIS Analyst at START; **Douglas I. Zietz**, GIS Researcher Assistant at START; and **Rhys A. Young**, GIS Researcher Assistant at START. Questions about this report should be directed to Marcus A. Boyd at boydma@umd.edu.
The full report on this topic can be found on START's website at http://go.umd.edu/w4h

START

The National Consortium for the Study of Terrorism and Responses to Terrorism (START) is supported in part by the Science and Technology Directorate of the U.S. Department of Homeland Security through a Center of Excellence program based at the University of Maryland. START uses state-of-the-art theories, methods and data from the social and behavioral sciences to improve understanding of the origins, dynamics and social and psychological impacts of terrorism. For more information, contact START at infostart@start.umd.edu or visit www.start.umd.edu. This research was supported by the National Geospatial Intelligence Agency through awards made to the START and the first author. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the National Geospatial Intelligence Agency or START.