

EGU21-16086

<https://doi.org/10.5194/egusphere-egu21-16086>

EGU General Assembly 2021

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Forecasting Forced Migration by Coupling an Agent-based Simulation Approach with Weather Data

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There are nearly 80 million people forcibly displaced worldwide, of which 26 million are refugees and 45 million are internally displaced people (IDPs) (UNHCR, 2020). It is difficult to foresee and accurately forecast forced migration trends due to the severity and instability of conflicts or crises. However, it is possible to capture relevant aspects of this complex phenomenon and propose an approach forecasting future migration trends. Hence, we present an agent-based modelling approach, namely FLEE, that predicts the distribution of incoming refugees from a conflict origin to neighbouring countries (Suleimenova et al., 2017). Our aim is to assist governments, organisations and NGOs to efficiently allocate humanitarian resources, manage crises and save lives.

To construct a forced migration model, we obtain relevant data from three sources: the United Nations High Commissioner for Refugees (UNHCR, <https://data2.unhcr.org>) providing the number of forcibly displaced people in the conflict, the camp locations in neighbouring countries and their population capacities; the Armed Conflict Location and Event Data Project (ACLED, <https://acled-data.com>) for conflict locations and dates of battles; and the OpenStreetMaps platform (<https://openstreetmap.org>) to geospatially interconnect camp and conflict locations with other major settlements that reside en-route between these locations. Consequently, we simulate the constructed model using the FLEE code (<https://github.com/djgroen/flee-release>) and obtain the distribution of incoming forced displacement across destination camps. We were able to reproduce key trends in refugee counts found in the UNHCR data across Burundi, Central African Republic and Mali (Suleimenova et al., 2017), as well as investigated the impact of policy decisions, such as camp and border closures, in the South Sudan conflict (Suleimenova and Groen, 2020).

In our recent collaboration with Save the Children, we focus on an ongoing conflict in Ethiopia's Tigray region and forecast IDP numbers within the region and refugee arrival counts in Sudan. We found that the number of arrivals in Sudan seem to depend strongly on whether the conflict will erupt in the east or in the west of Tigray. This seems to be a larger factor than the actual intensity of the conflict.

Moreover, our modelling approach allows us to investigate possible effects of weather conditions on forcibly displaced people by coupling FLEE with precipitation data, seasonal flood and river discharge levels. The purpose of coupling with the European Centre for Medium-Range Weather Forecasts (ECMWF) data is to identify the effect of weather conditions on the behaviour and

movement speed of forced migrants.

The overall strategy is the static coupling of weather data where we have analysed 40 years of precipitation data for South Sudan to identify the precipitation range (minimum and maximum levels) as triggers which by the agents' movement speed changes accordingly. Besides, we have used daily river discharge data from Global flood forecasting system (GloFAS) to explore the threshold for closing the link considering values of river discharge for return periods of 2, 5 and 20 years. Currently, we only use a simple rule with one threshold to define the river distance for a given link, which we aim to investigate further.

References

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