

Global Migration Modelling with MIDAS: Call for Experts, BIGSSS Migration 2019 @ Cagliari

Short description of motivation

This project aims at using the 2 weeks of summer school to build a global model of migration based on the MIDAS (Migration, Intensification, and Diversification as Adaptive Strategies) framework (Bell, 2019). This framework draws on the 'push-pull-mooring' (PPM) theory of migration to integrate the influences of social networks, climatic shifts, and opportunities for livelihoods diversification on migration in a single framework. So far MIDAS has been applied to Bangladesh and to the US-Mexico Corridor, and employs a data structure that perfectly matches the UN Population Division's estimates of international Total Migrant Stock, adaptable to a global model during the two weeks of the summer school. We think that such a global model could help us better investigate the components of utility that can adequately explain international migration flows. A global migration framework built on freely available data for pushes, pulls, and moorings (such as censuses and integrated household surveys) would be an invaluable tool in directing future research (and potentially policy focus) in migration, by highlighting i) the common bases across which migration in different regions and states can be compared, ii) the degree to which existing datasets help explain variation in global migration flows, and iii) the key missing pieces for targeted data collection. Through this work we will be able to generate further knowledge on the environment-migration-conflict nexus and improve global estimates of migration under future climate change, for example, improving on other global efforts that have focused on particular impacts (e.g. sea level rise; Rigaud et al. 2018).

This is a shared application of Stefano Balbi (Basque Centre for Climate Change), Helen Adams (King's College London) and Andrew Bell (New York University). Adams and Balbi are available to come to Cagliari from June 10, 2019, while Bell will support in remote due to family reasons.

Description of data and methods

[MIDAS](#) is a novel agent-based model of livelihoods and migration, which represents locations as nodes with place-specific opportunities for agents to derive utility—from regular sources of income, as well as from assets and local social and cultural amenities. Some opportunities are common to many places (e.g. teaching jobs, food marketing, etc.) while others are location-specific (e.g. access to mountains or lakes, etc.). Accessing opportunities may carry costs, which may give the agent access to the same opportunity in many places, or only in some (e.g. purchasing a home in a specific place). Agents occupy nodes, accessing a portfolio of different utility sources (described by the cost of access, time commitment, and per-time period utility), and are embedded in a social network. Agents share both income and information across their social network, with the likelihood and cost of sharing varying both with the strength of the link (i.e. closeness of the relationship) and the distance across which the relationship is enacted. At each time step, with agent-specific likelihoods, agents participate in social interactions across their networks, and (again, with agent-specific likelihoods) re-evaluate the appropriate portfolio of utility sources for them to pursue. In this decision process, agents compare possible portfolios both within their current location and in alternate locations about whose opportunities they may have learned through their social networks or otherwise. Comparisons are made with a boundedly-rational (small number of possible portfolios, including past options as well as randomly selected options), future-discounting expected utility framework, with the utility that agent would derive for a particular portfolio of opportunities in a particular place. Net values are summed across all opportunities in the portfolio, as are the net shared resources across the social network, for each agent as well as (optionally) additional members of their social network, allowing agents to be optimizing welfare of their extended network, rather than only themselves. The incorporation of risk preferences allows preferences for smoother income streams, and the emergence of strategies (like diversification) to reduce variability in utility from period to period.

MIDAS has been used for regional application, and its data input structure perfectly matches the UN Population Division's estimates for [Total Migrant Stock](#). We think this allows *the adaptation of the framework, in a reasonable amount of time, to a global model where the MIDAS units represent individual countries*. Fitting the model behavior to the statistical international flows would shed some light on the country specific "utility layers" that can explain such flows. **Implementation note:** The global data are given as spreadsheets by UN DESA. The MIDAS framework is implemented in Matlab so we'd appreciate to be supported by Matlab trained participants.

Profiles of the applicants and link to personal websites

[Helen Adams](#) is an expert in migration and livelihoods, and has made major theoretical and empirical contributions to our understanding of different aspects of place under environmental change and livelihoods in driving migration, including ecosystem services and other dimensions of well-being. She's among the experts consulted by the authors of [The Atlas of Environmental Migration](#) and is a Lead Author on the IPCC Sixth Assessment Report. [Andrew Bell](#) is a well established agent-based modeller of social systems. His research focuses on rural livelihoods decision-making, using experimental and behavioral data collection to inform agent-based models of forest use, agricultural systems, and irrigation. Bell is the architect of the MIDAS modeling framework for this work. [Stefano Balbi](#) is a well established agent-based modeller now focusing on data driven methods and models integration. He's interested in integrating the [MIDAS](#) framework into the simulation platform developed by his research team: ARTificial Intelligence for Ecosystem Services ([ARIES](#)).

Potential lectures or hands-on workshops that can be offered

Helen Adams:

- Place attachment and immobility under environmental change
- Forced migration and resettlement under rapid onset climate change
- Ecosystem services and behaviour migration theories to link climate change and migration

Stefano Balbi:

- From Netlogo to [k.LAB](#): a new generation of integrated ABM tools on the making
- Integrated modelling: creating unprecedented model-data integration through semantics
- Ecosystem services and human migration modelling

Applicants' Representative Publications

(1) "Migration as a human affair: Integrating individual stress thresholds into quantitative models of climate migration." *Environmental Science & Policy* (2018) In Press. (2) "Redefining community based on place attachment in a connected world." *Proceedings of the National Academy of Sciences* 114.38 (2017): 10077-10082 (3) "Why populations persist: mobility, place attachment and climate change." *Population and Environment* 37.4 (2016): 429-448. (4) "The contribution of ecosystem services to place utility as a determinant of migration decision-making." *Environmental Research Letters* 8.1 (2013): 015006. (5) "Agent-based modelling to assess community food security and sustainable livelihoods." *Journal of Artificial Societies and Social Simulation* 21.1 (2018): 1-23. (6) "Machine learning for ecosystem services." *Ecosystem Services* (2018). "Machine learning for ecosystem services." *Ecosystem Services* (2018). (7) "Semantics for interoperability of distributed data and models: Foundations for better-connected information." *F1000Research* 6 (2017). (8) "Informing decisions in agent-based models—A mobile update." *Environmental Modelling & Software* 93 (2017): 310-321.

References

(1) Bell, et al. 2019. Migration, Intensification, and Diversification as Adaptive Strategies, [SESMO](#), upcoming. (2) MIDAS online repository <https://github.com/andrew-nyu/migration> / MIDAS [video presentation](#) (3) Rigaud, K., Kanta, de Sherbinin, A., Jones, B., Bergmann, J., Clement, V., Ober, K., Schewe, J., Adamo, S., Cusker, B., Heuser, S., Midgley, A. (2018) Groundswell: Preparing for Internal Climate Migration. Washington, DC: The World Bank. (4) UN Population Division's estimates for Total Migrant Stock provided as [Spreadsheets](#).