Socio-ecological tipping points – Quantifying the link between environmental and climate change and conflict.

Aim:
Understand and quantify dynamics that lead from environmental and climate change to social conflict by implementing a quantitative and Agent-Based Modelling (ABM) approach, which will also allow capture of the development of crises, how they originate and interact within and between different Socio-Ecological Systems (SESs).

Background:
Research focussing on the link between climate and environmental change, and human conflict, found a significant, positive relationship between the two (Homer-Dixon 2001, Hsiang et al. 2013). However, how the effects of climate and environmental change are transmitted through the system and translate in increased conflict remains unknown. Unsustainable environmental change is chaotic and difficult to predict, often characterised by nonlinear behaviours and tipping points. When these are surpassed the system generates a shock that reverberates through the system and impacts society in complex ways, mainly through conflict and general loss of wellbeing. An example of this is the 2008 multisystem crisis which was environmentally driven and resulted in national food and fuel riots.

This project will further develop the Food and Fuel ABM (Natalini, 2016), an ABM that simulates the interconnections between scarcity of food and oil, their international prices, international trade and national political fragility, and how these dynamics lead to the occurrence of food and fuel riots (Figures 1, 2 and 3).

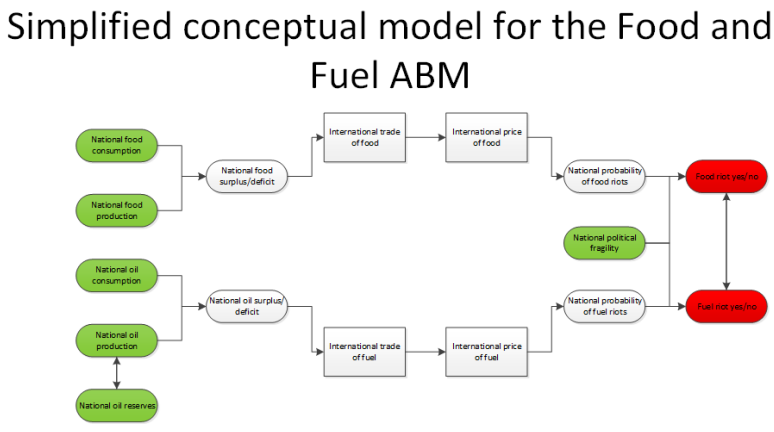

Figure 1 – Mental map of the Food and Fuel ABM (Natalini 2016).

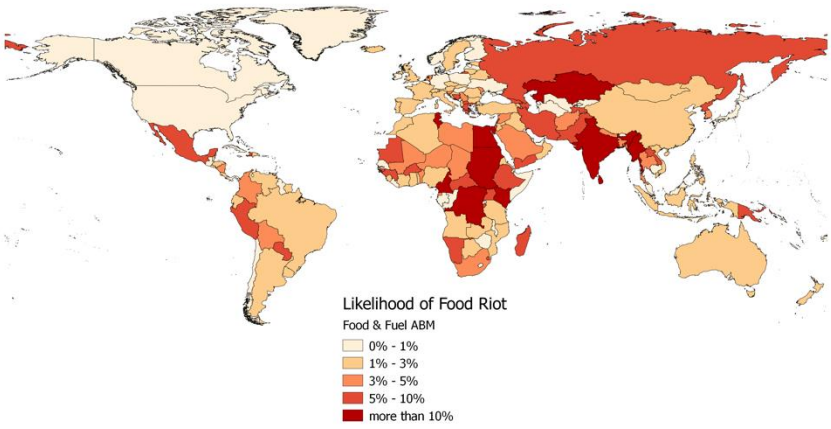

Figure 2 – Food riots predictions for the year 2017 from the Food and Fuel ABM (Natalini 2016).

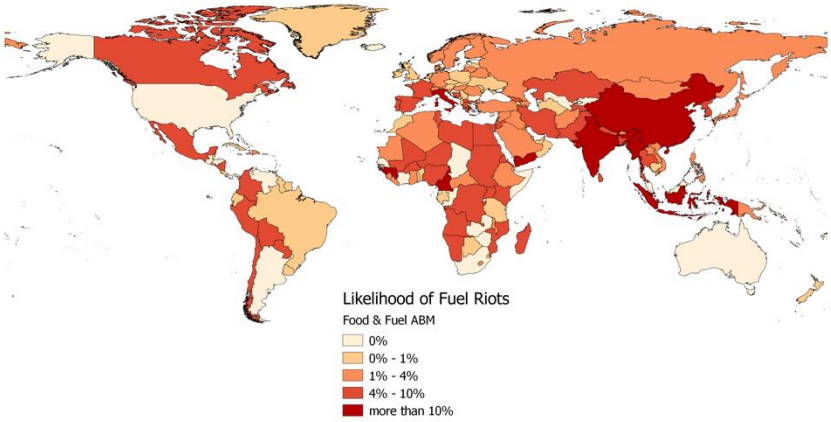

Figure 3 – Fuel riots predictions for the year 2017 from the Food and Fuel ABM (Natalini 2016).

This project will further develop the Food and Fuel ABM in different possible directions. The final option will be selected with the students that will join the project:

Option 1: Identify additional environmental variables to find a connection between environmental scarcity and food and fuel riots. This option will use FAO (food) and EIA (fuel) data. Through an econometric analysis we will identify additional environmental tipping points that can trigger riots and implement these in the ABM.

Option 2: Test the effect of other socio-economic variables at different scales on food and fuel riots, to find additional multi-scalar, socio-economic drivers of riots (e.g. volatility in international prices of natural resources). This option will use data from World Bank's World Development Indicators. Through an econometric analysis we will identify additional socio-economic tipping points that can trigger riots and implement these in the ABM.

Option 3: Extend the original quantitative analysis on drivers of food and fuel riots from Natalini (2016) to different types of environmentally-driven conflict, e.g. civil wars. This option will use large conflict datasets such as GDELT in addition to other databases. The new types of conflict and dynamics identified will be included in the ABM.

Software, tools and data: The model is currently coded in NetLogo and the original scripts for the quantitative analysis are available in R. Two key databases of food and fuel riots with data for 2005-2016 will be provided for the quantitative analyses.

References:

Homer-Dixon, T.B. 2001. *Environment, scarcity, and violence*. Princeton University Press.

Hsiang, S.M., Burke, M. and Miguel, E. 2013. Quantifying the influence of climate on human conflict. *Science*, 341(6151), p.1235367.

Natalini, D. 2016. *Estimating dynamics that lead to food and fuel riots: a quantitative and agent-based modelling approach*. PhD thesis.