

# Zombie Outbreak: The Effect of Inter-State Cooperation on the Survival of Humanity

MOTTET Matthieu and WICKY Basile

# Content

- Introduction
- Goal
- Model
  - Microstate
  - Macrostate
- Implementation
- Results
- Conclusion & Outlook



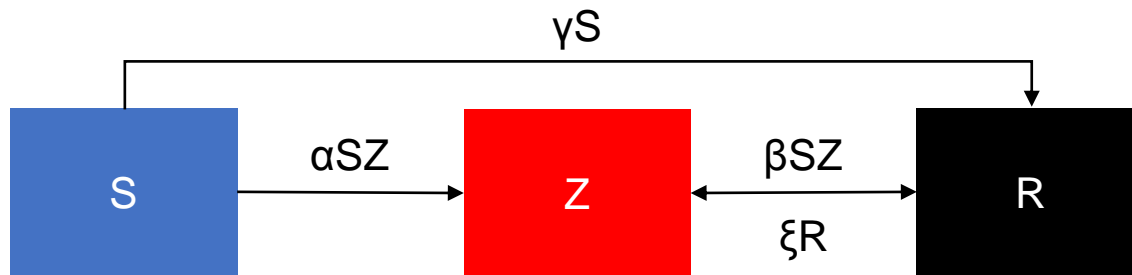
Copyright CafePress Inc.  
<http://blog.cafepress.com/>

# Introduction

- Zombies outbreak ?
  - Extremely present in modern culture.
  - Likely unlikely.
  - “*The unknown unknowns*” (Donald Rumsfeld)
- Zombies ?
  - Originate in Caribbean culture.
  - Multiple variety in modern culture.
- Previous study
  - Epidemiological treatment: SZR model.
  - Dark outcomes predicted.

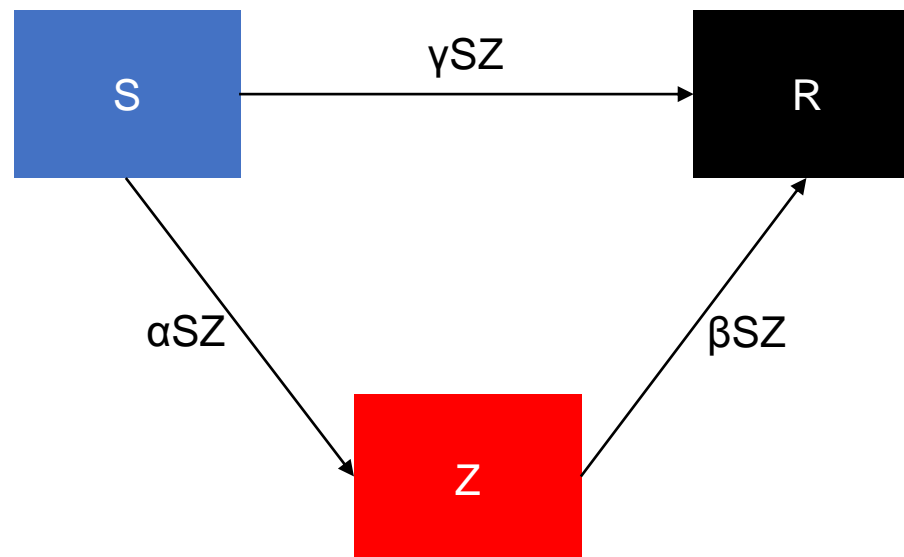
# Goal

- Previous study
  - Single population simulation
  - SZR model:

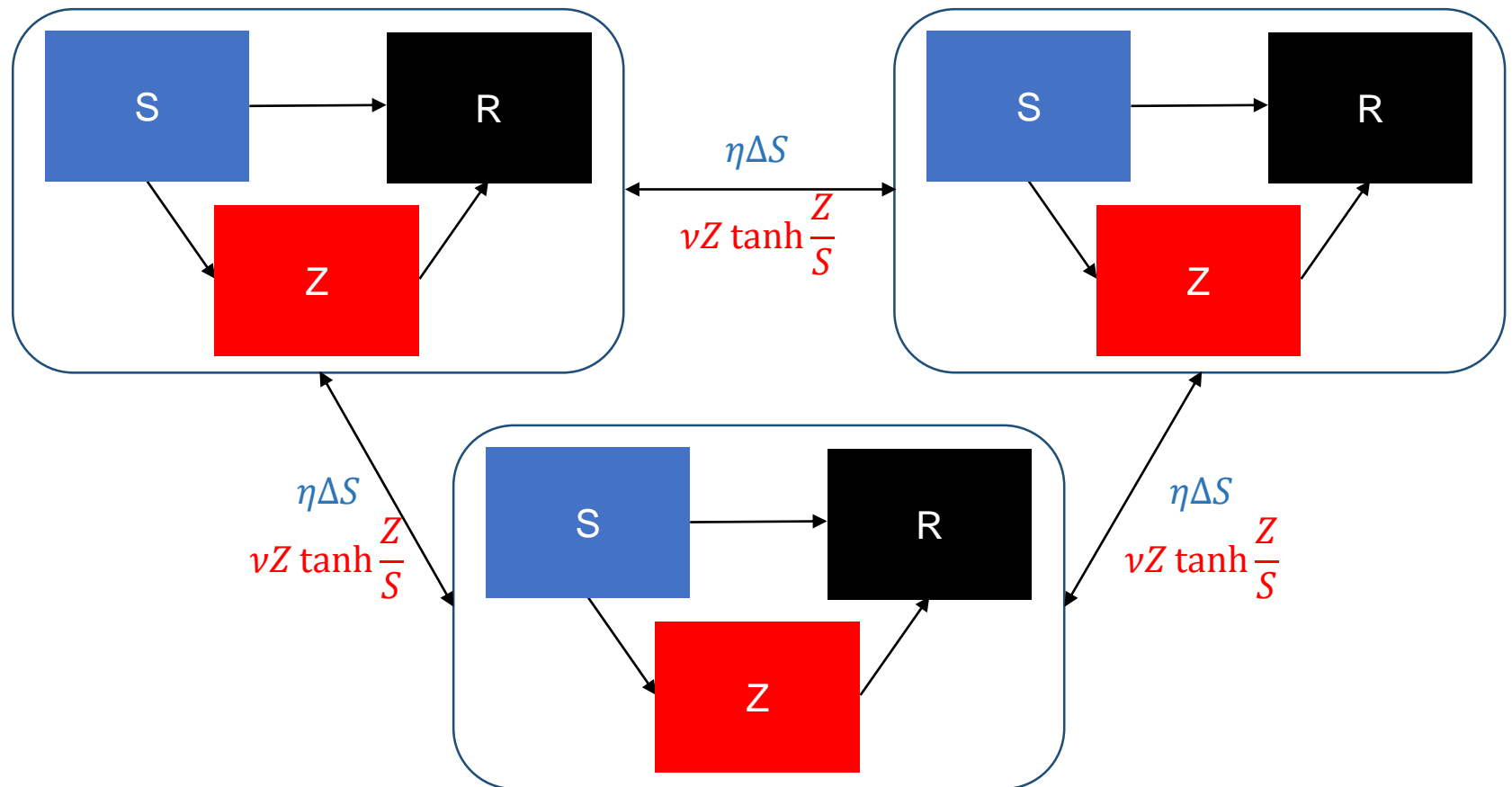


- Only dark outcomes possible.
- Different model + Multistate

# Model: Microstate



# Model: Macrostate



# Implementation: overview

*outbreak(...)*

Parameter parsing.

Variable initialization.

Loop:

*update(...)*

Variable initialization.

Computation of the variation-to-be.

Validation of the variation-to-be.

If needed

Correction of the variation.

Exit controls

Cleaning of the output data.

# Implementation: details & tricks

## Exit Policies:

$$S = 0$$

$$Z = 0$$

or

$$\langle |\Delta S| \rangle < 0.1 \ \&\& \ \langle |\Delta Z| \rangle < 0.1$$

## Update validation and correction:

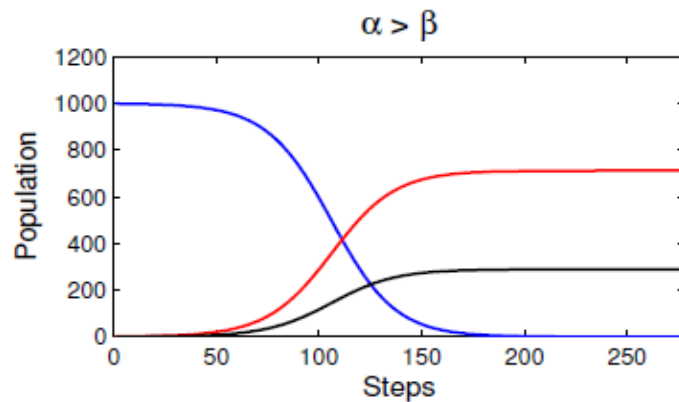
$$S_i + \Delta S_i^{tot} = S_i + \Delta S_i^+ + \Delta S_i^- \geq 0$$

If not, then:

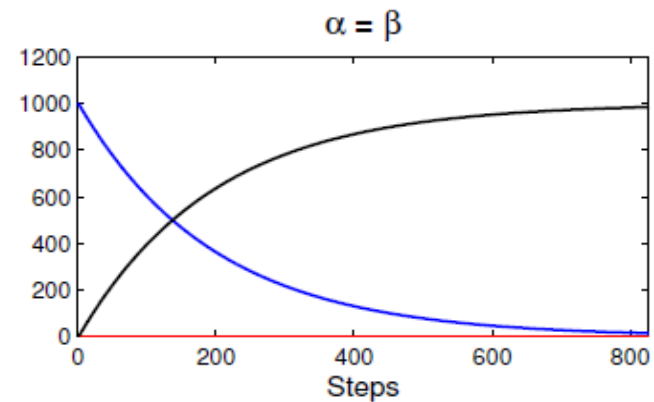
$$\Delta S_{X \rightarrow Y, 1} = \frac{\Delta S_{X \rightarrow Y, 1}}{\Delta S_i^-} \max(S_i + \Delta S_i^+, 0)$$



# Results: Isolated state

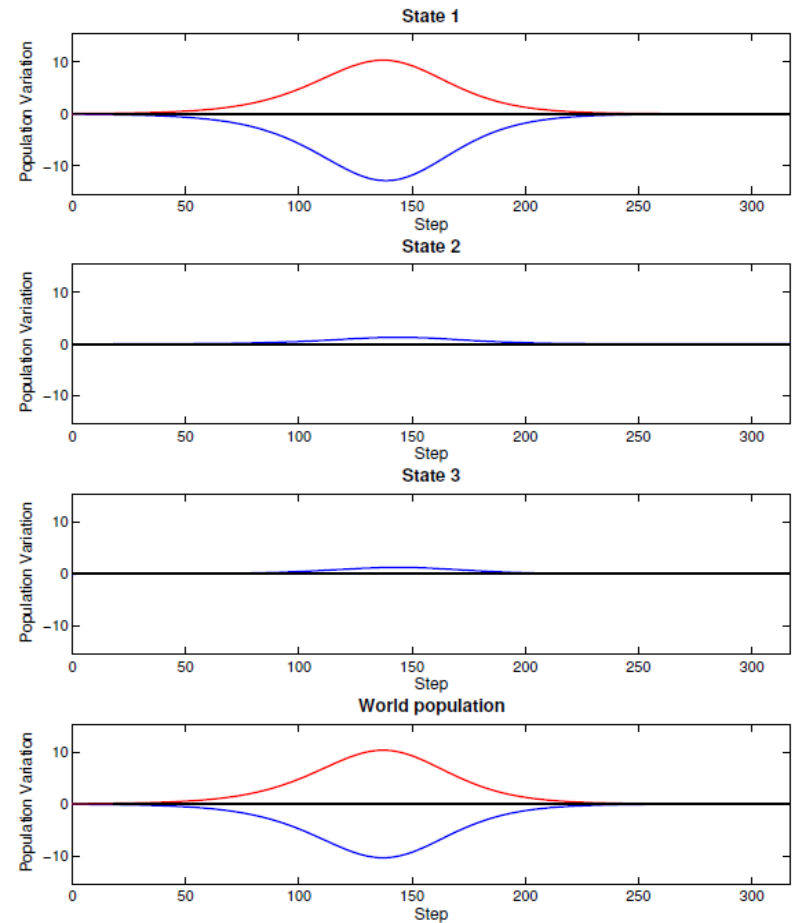
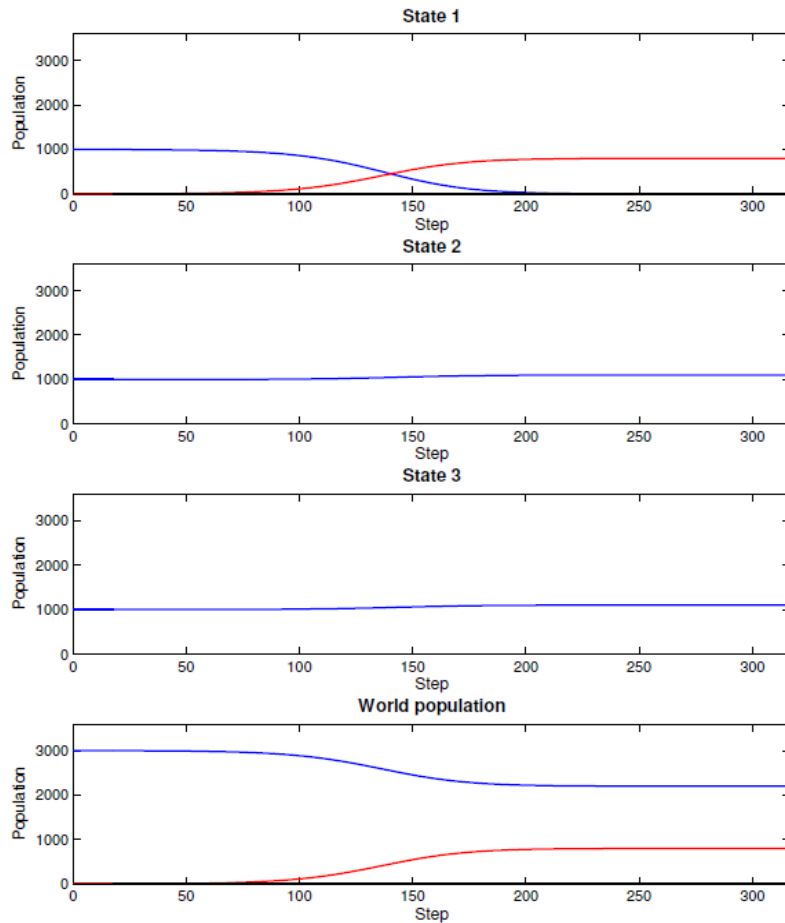


$$\alpha = 1.6 \cdot 10^{-4}, \beta = 1.0 \cdot 10^{-4}, \gamma = 8.0 \cdot 10^{-5}$$



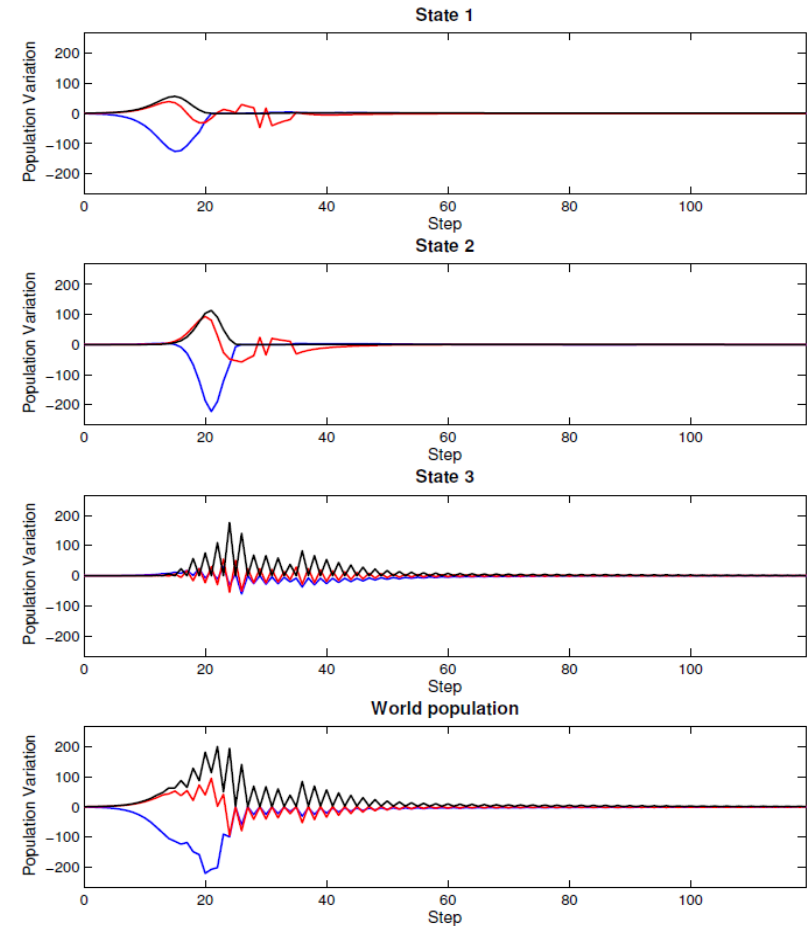
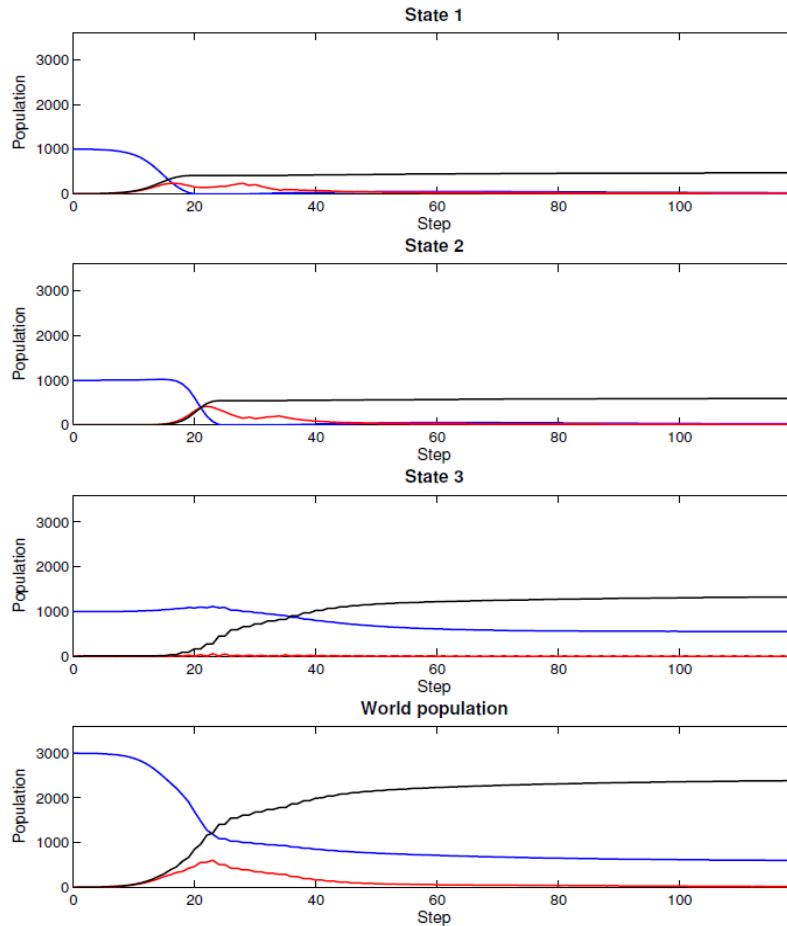
$$\alpha = 5.0 \cdot 10^{-3}, \beta = 5.0 \cdot 10^{-3}, \gamma = 8.0 \cdot 10^{-5}$$

# Results: Interconnected states



$$\alpha = 5.0 \cdot 10^{-5}, \beta = 5.0 \cdot 10^{-10}, \gamma = 5.0 \cdot 10^{-10}, \eta = 0.1, \nu = 0$$

# Results: Asymmetric systems



$$\alpha = 1.0 \cdot 10^{-3}, \beta_{1,2} = 5.0 \cdot 10^{-4}, \beta_3 = 5.0 \cdot 10^{-3}, \gamma = 1.0 \cdot 10^{-4}, \eta = 0.25, \nu = 0.1$$

# Conclusion & Outlook

- Working model.
- Positive outcomes possible.
- High dependency on domestic parameters.
- To go further:
  - Implementation of a GT framework for time evolving parameters.

# Thank you for your attention

## Any questions ?

