Adaptive Semi-Strong Ecosystem Dynamics

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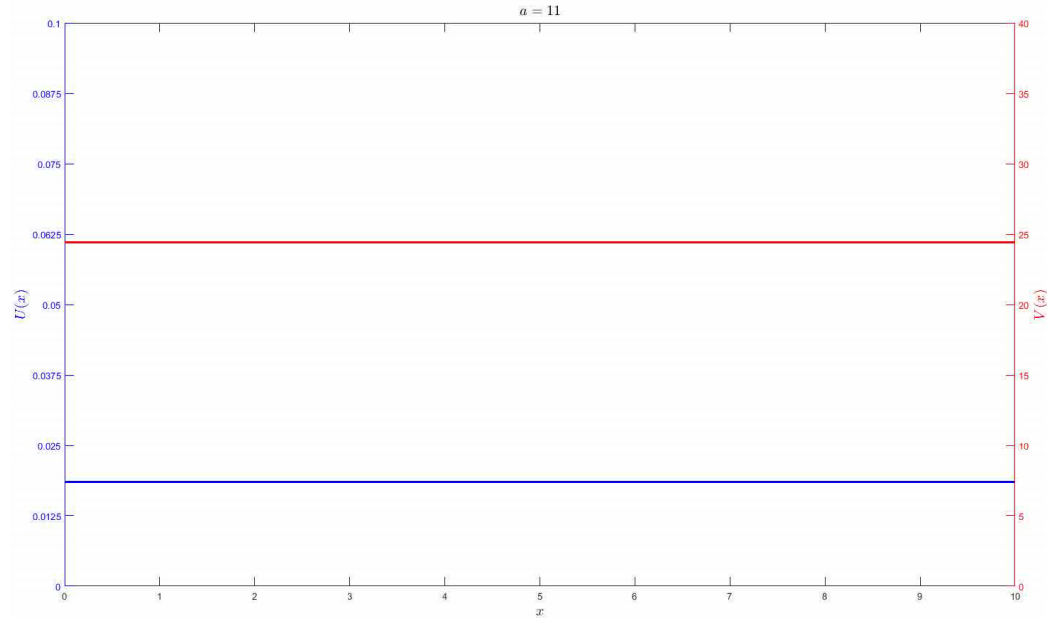
Bij ons leer je de wereld kennen

Motivation: desertification

How do we go from uniform vegetation to a bare soil?

Desertification – a simulation

Mathematical Model

Extended Klausmeier model

$$U_t = U_{xx} + a - U - UV^2$$

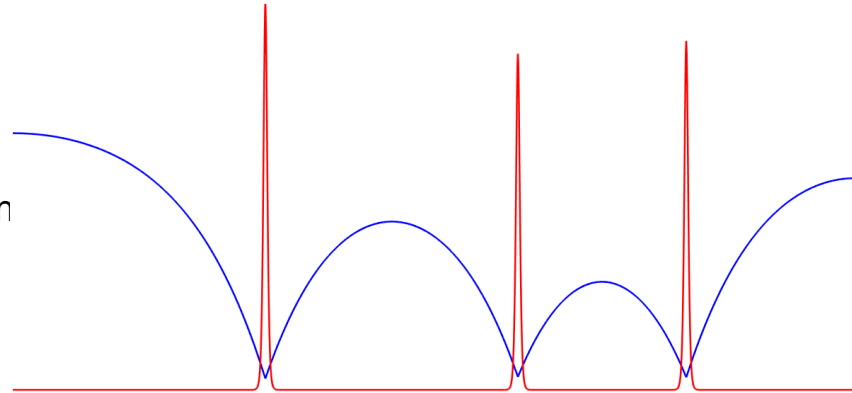$$V_t = \varepsilon^2 V_{xx} - mV + UV^2$$

Variables:

U water

V vegetation

Parameters:

a rainfall

m mortality of vegetation
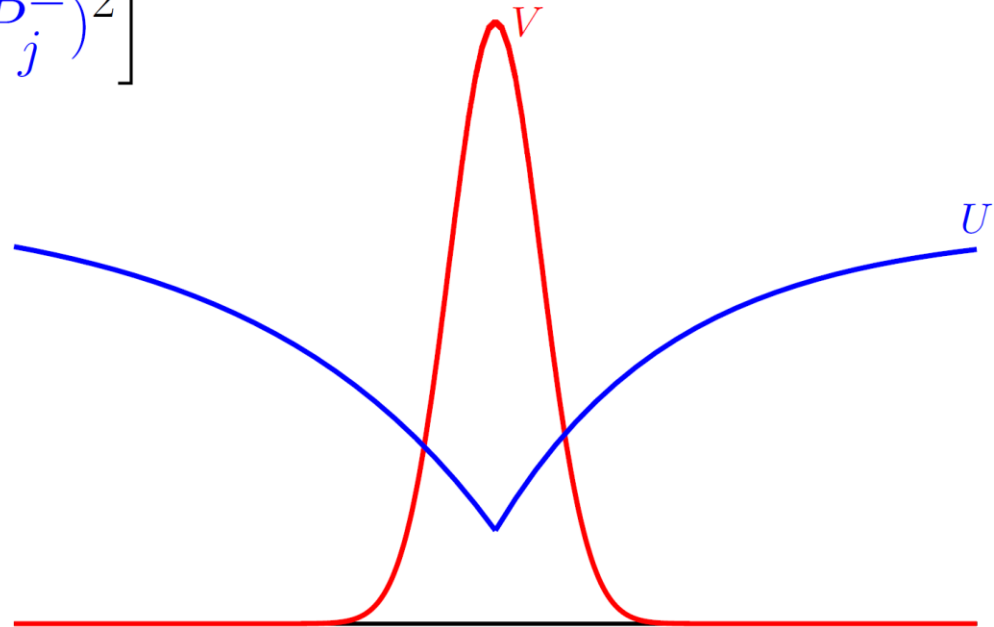
ε small parameter

Movement of Pulses

- Reduce full PDE to an ODE

$$\frac{dP_j}{dt} = \frac{\varepsilon}{m\sqrt{m}} \frac{1}{6} \left[U_x(P_j^+)^2 - U_x(P_j^-)^2 \right]$$
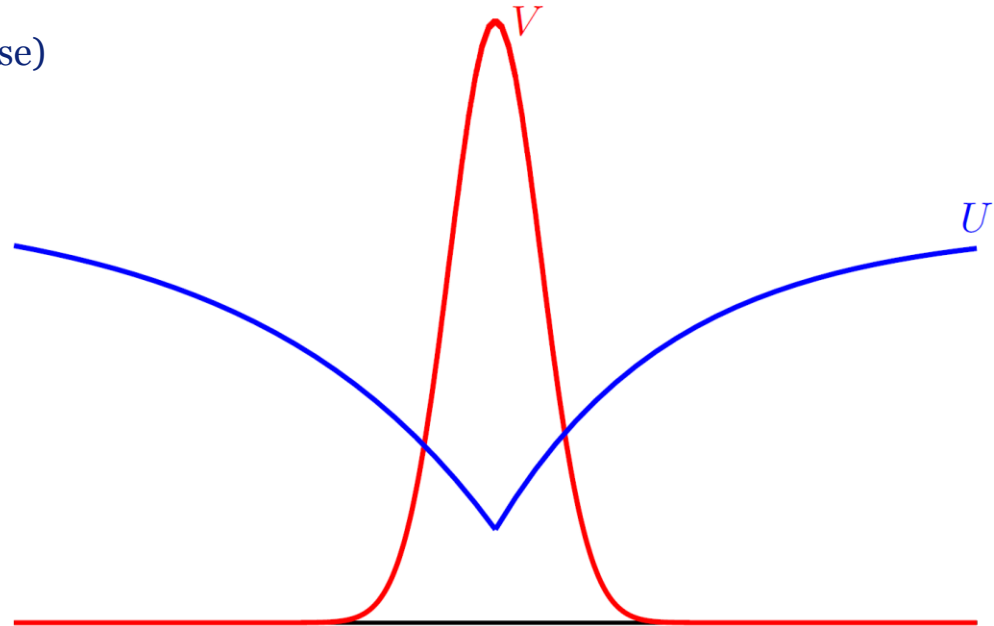
- ODE describes movement of the Pulses

- ODE may have fixed points

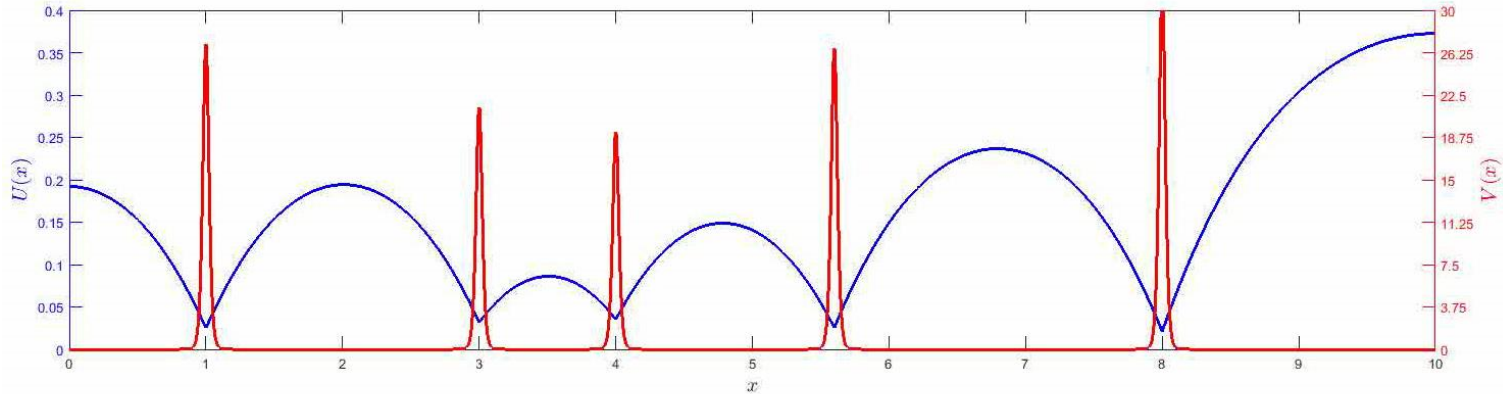V

U

Modelling a climate change

- Decrease rainfall parameter a

- When a decreases, the N-pulse solution becomes unstable

  ➤ One or more pulses disappear

  ➤ We find a stability condition (per vegetation pulse)

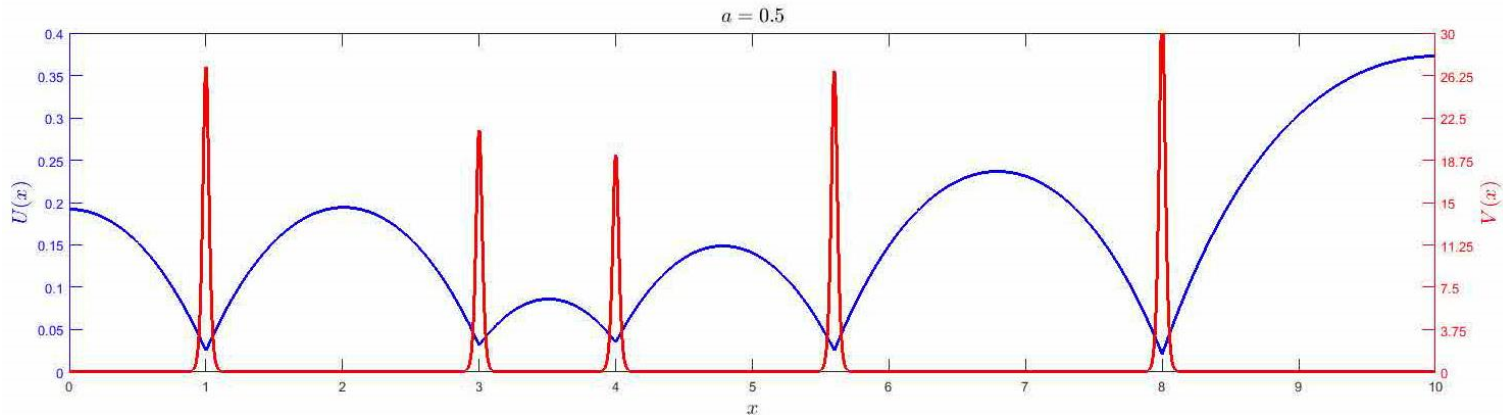$$2\varepsilon m^2 \left(\frac{u_j^2}{a^2} \right) < C(\varepsilon, m)$$

Simulations

Slow decreasing rainfall a

Fast decreasing rainfall a

Conclusions + Outlook

• The speed of the climate change plays an important factor in the desertification process

To Do:

• Understand period doubling

• Take topography into account

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