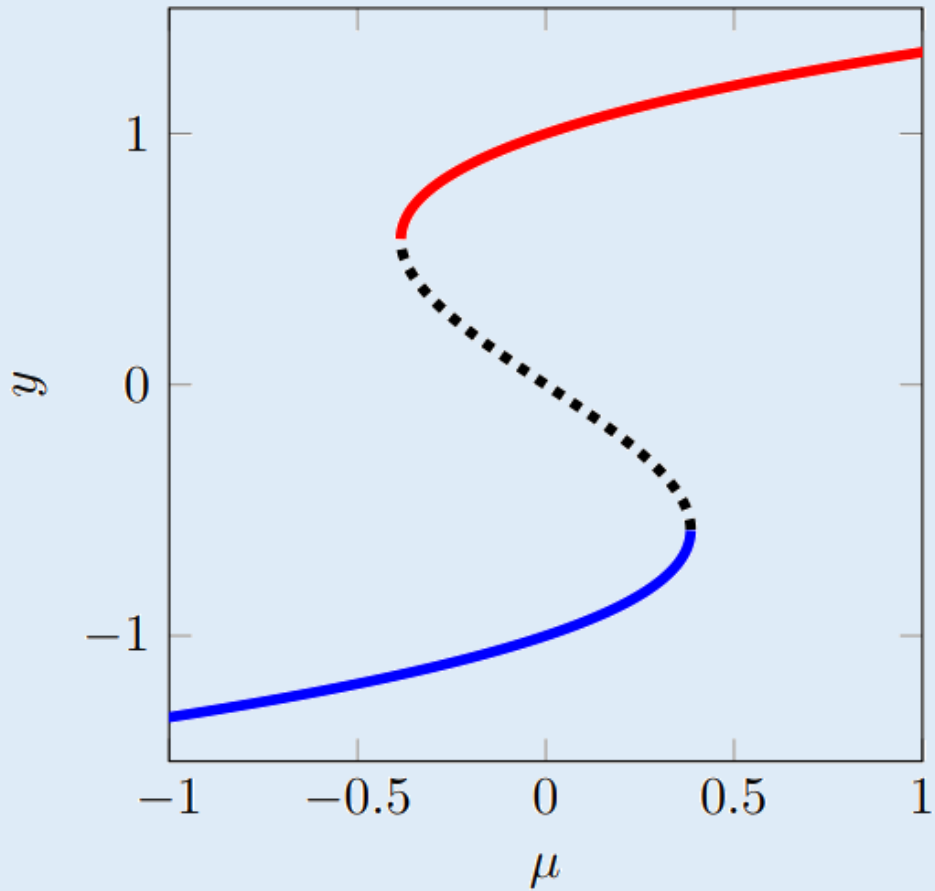


Fragmented Tipping in a spatially heterogeneous world

Robbin Bastiaansen (r.bastiaansen@uu.nl), Henk A. Dijkstra and Anna S. von der Heydt

Classic Tipping

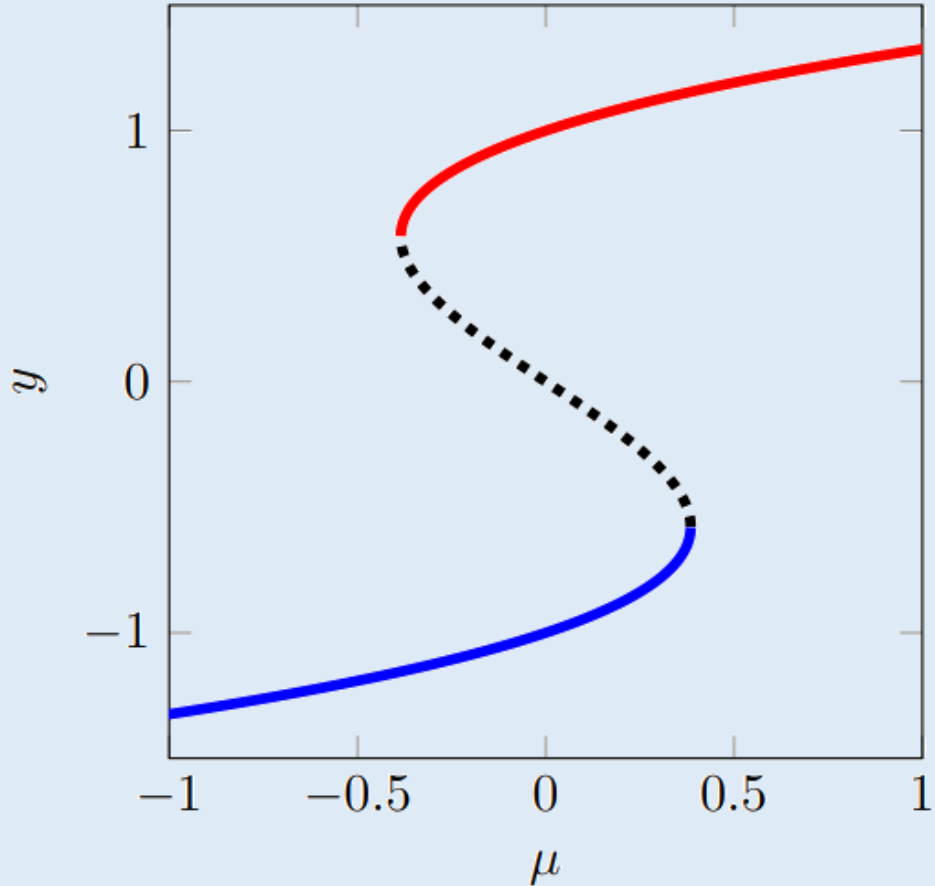


Example:
$$\frac{dy}{dt} = y(1 - y^2) + \mu$$

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Example: $\frac{dy}{dt} = y(1 - y^2) + \mu$

Assumes spatial well-mixedness!



Reality is not always spatially-uniform!

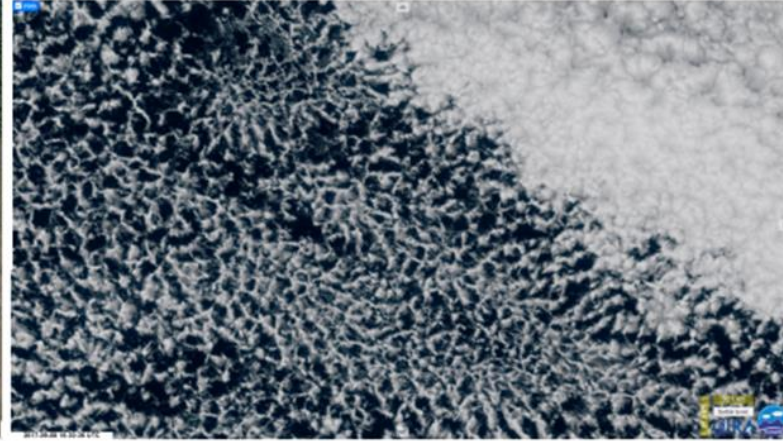
tropical forest
& savanna
ecosystems

[Google Earth]



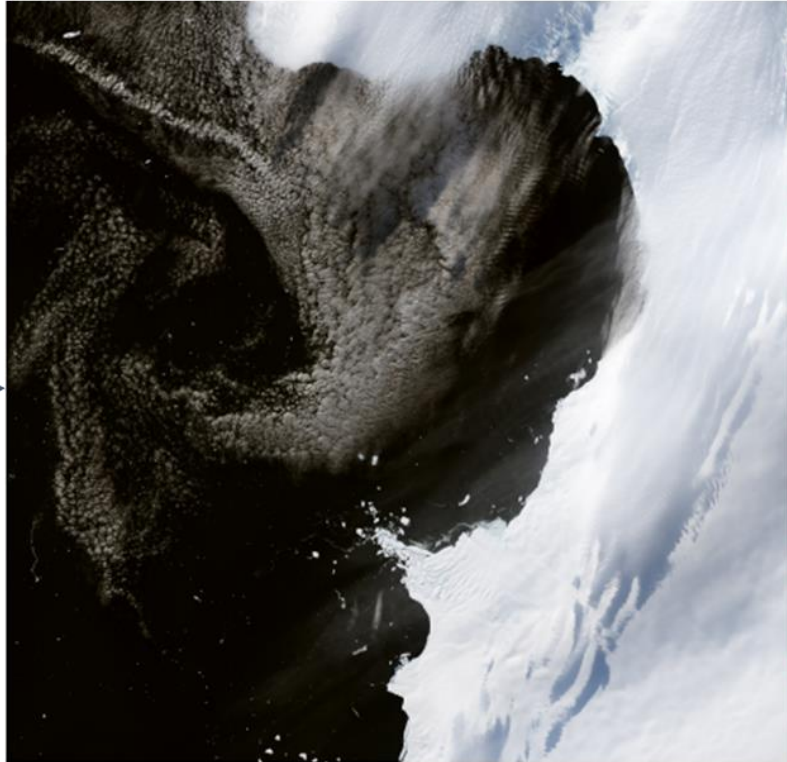
types of
stratocumulus
clouds

[RAMMB/CIRA SLIDER]



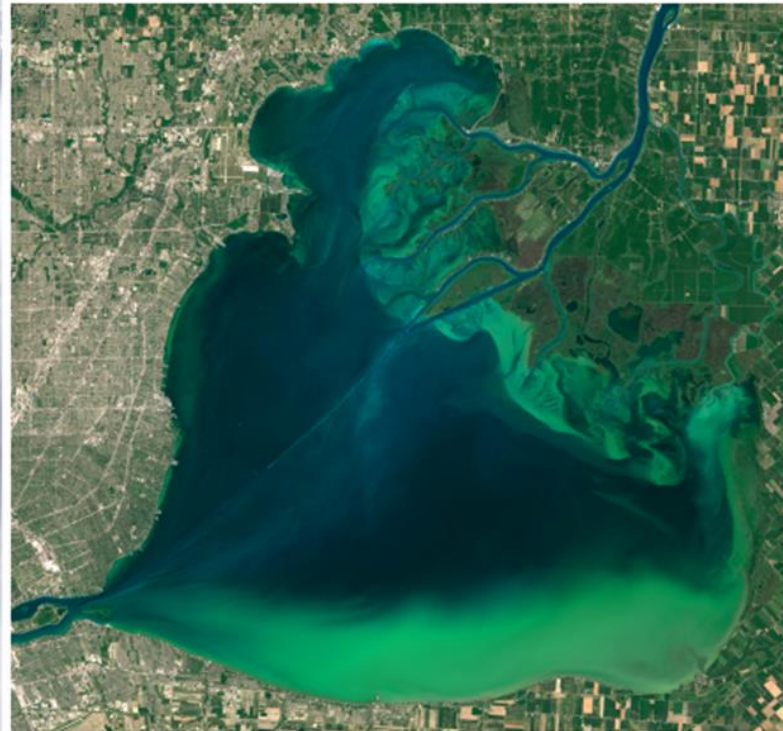
sea-ice & water
at Eltanin Bay

[NASA's Earth observatory]



algae bloom
in Lake St. Clair

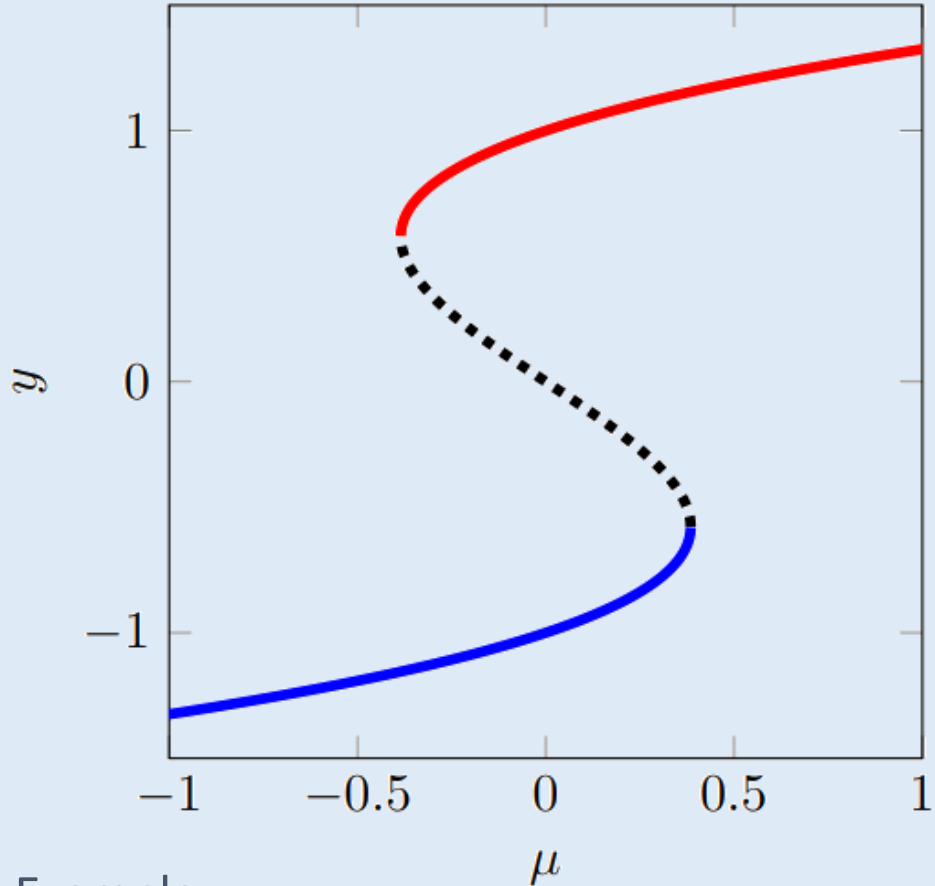
[NASA's Earth observatory]



Fragmented Tipping in a spatially heterogeneous world

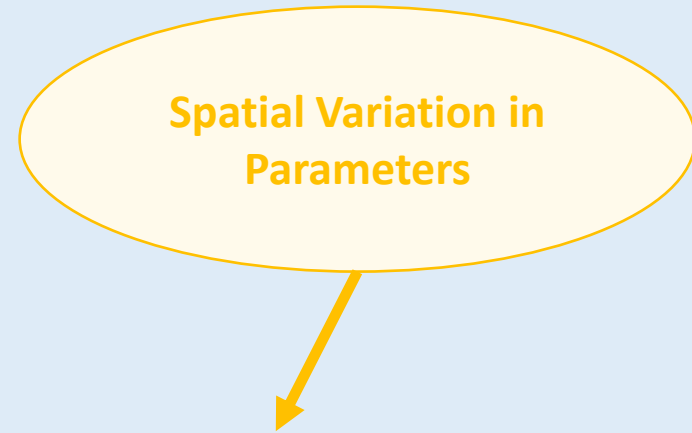
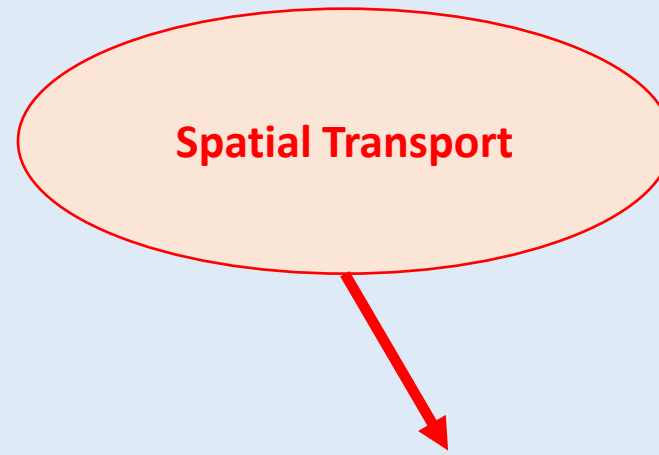
Robbin Bastiaansen (r.bastiaansen@uu.nl), Henk A. Dijkstra and Anna S. von der Heydt

Classic Tipping



Example: $\frac{dy}{dt} = y(1 - y^2) + \mu$

Tipping in Spatially Heterogeneous Systems

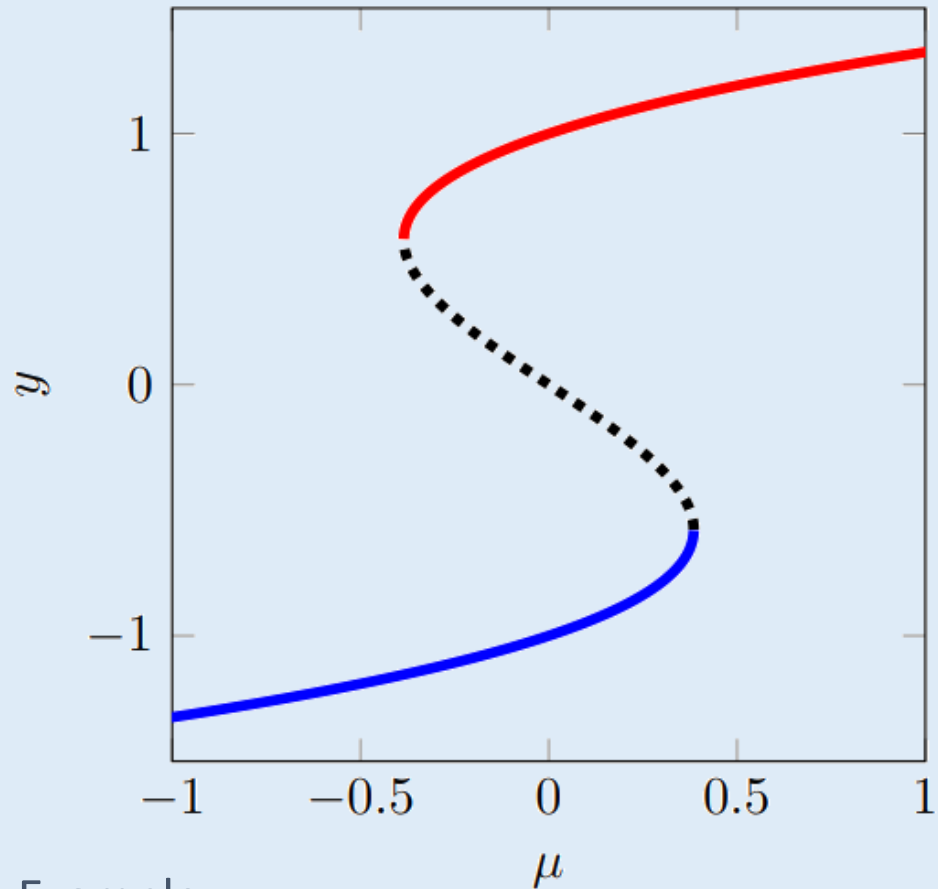


Example: $\frac{\partial y}{\partial t} = D \frac{\partial^2 y}{\partial x^2} + y(1 - y^2) + \mu + \frac{1}{2} \cos(\pi x)$

Fragmented Tipping in a spatially heterogeneous world

Robbin Bastiaansen (r.bastiaansen@uu.nl), Henk A. Dijkstra and Anna S. von der Heydt

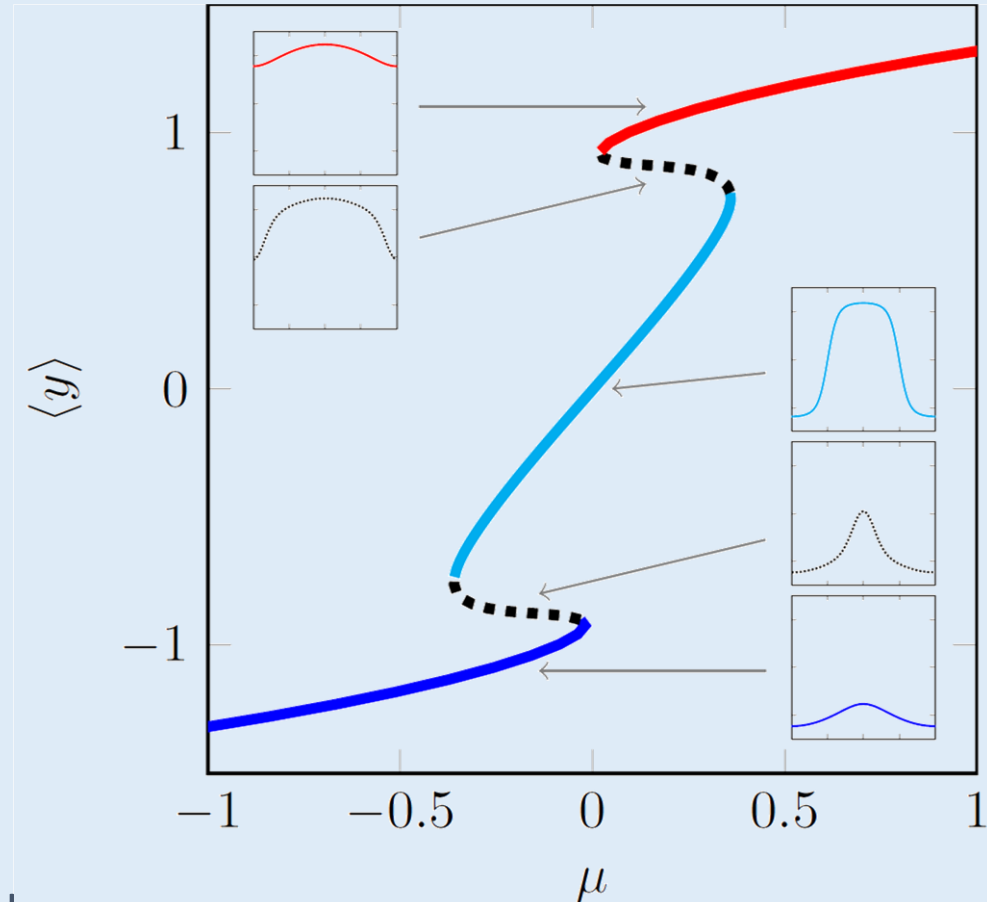
Classic Tipping



Example:

$$\frac{dy}{dt} = y(1 - y^2) + \mu$$

Tipping in Spatially Heterogeneous Systems

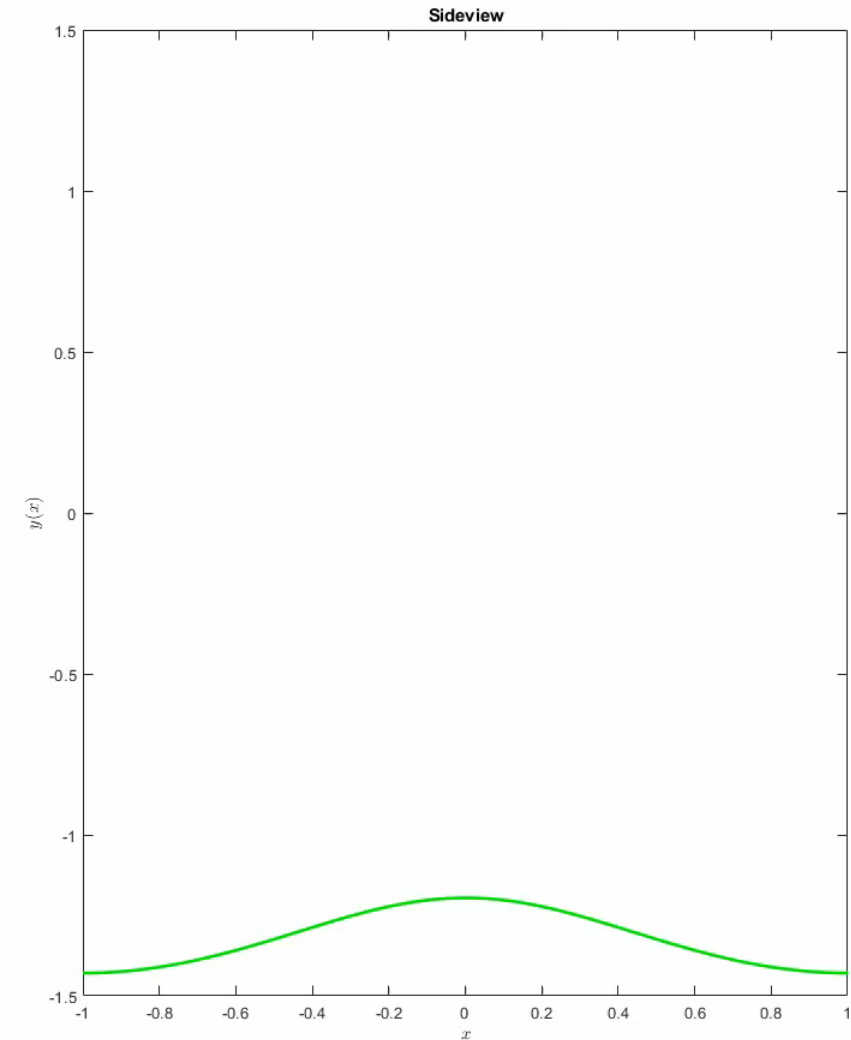
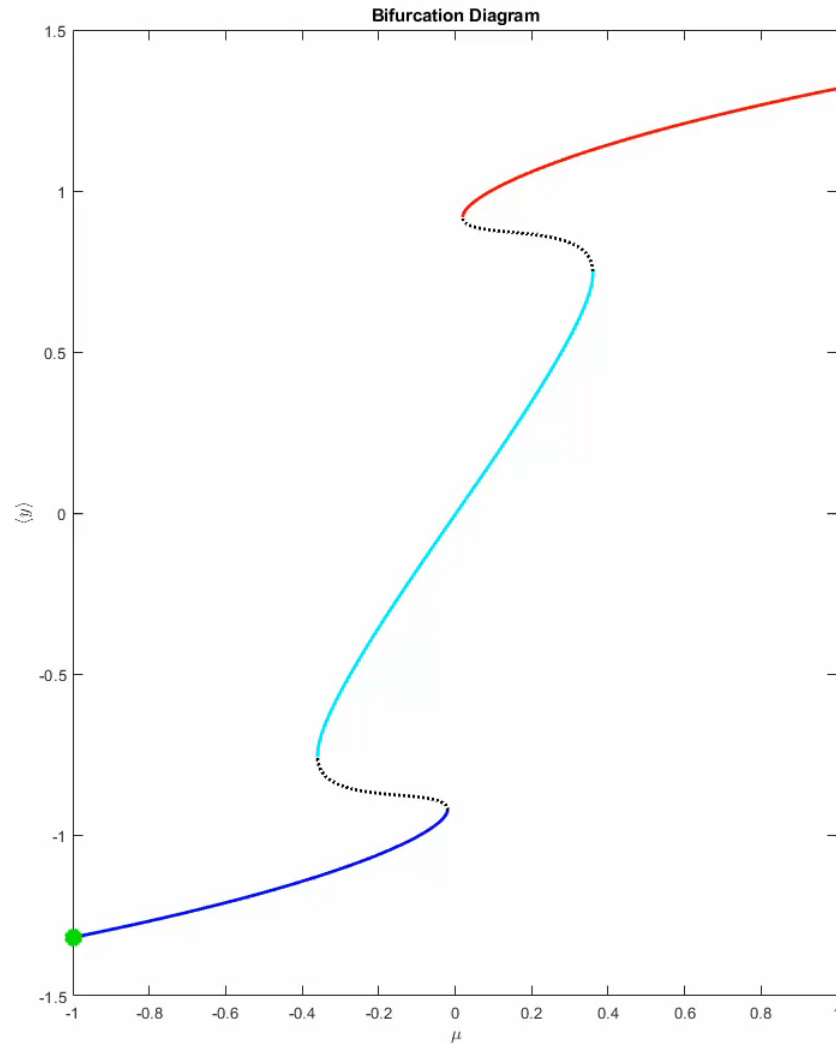


Example:

$$\frac{\partial y}{\partial t} = D \frac{\partial^2 y}{\partial x^2} + y(1 - y^2) + \mu + \frac{1}{2} \cos(\pi x)$$

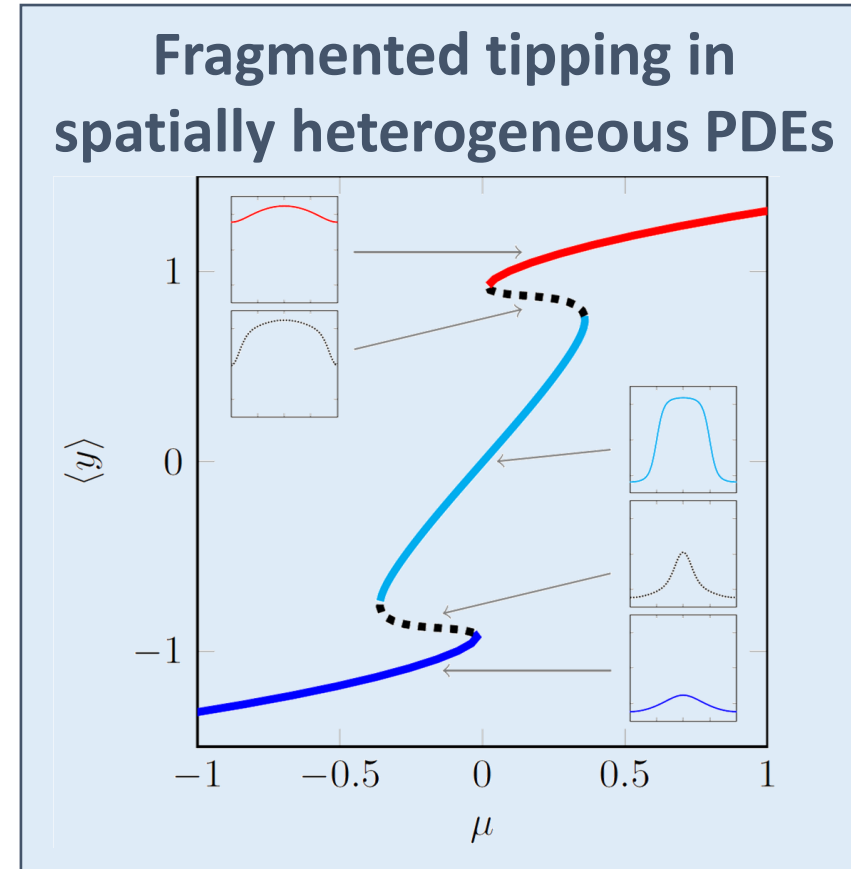
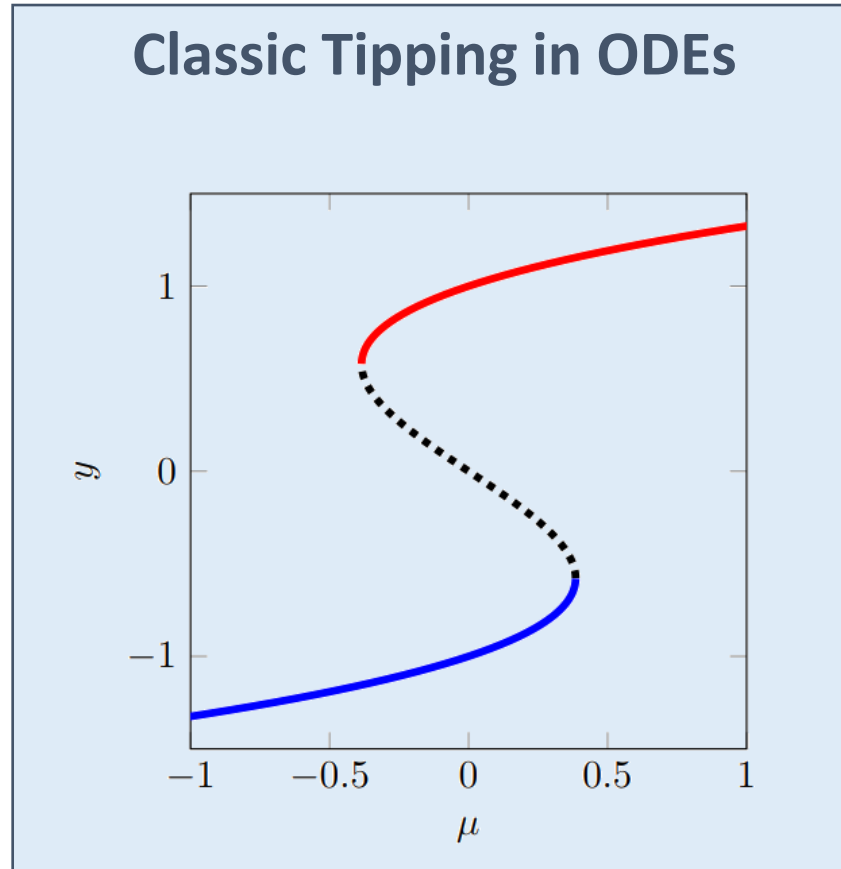
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Bastiaansen, R., Dijkstra, H. A., & von der Heydt, A. S. (2022).
 Fragmented tipping in a spatially heterogeneous
 world. *Environmental Research Letters*, 17, 045006

