

IDENTITIES

Enlightening
Interdisciplinarity
in STEM
for Teaching

Introduction - Complexity

Climate change module – ID student block

Complexity

- Limited Predictability in Deterministic Systems
- Sensitivity in the initial conditions
- Critical States / Feedback

Limited Predictability

General Goals:

We observe the inherent limitations in predicting the evolution of a deterministic chaotic system

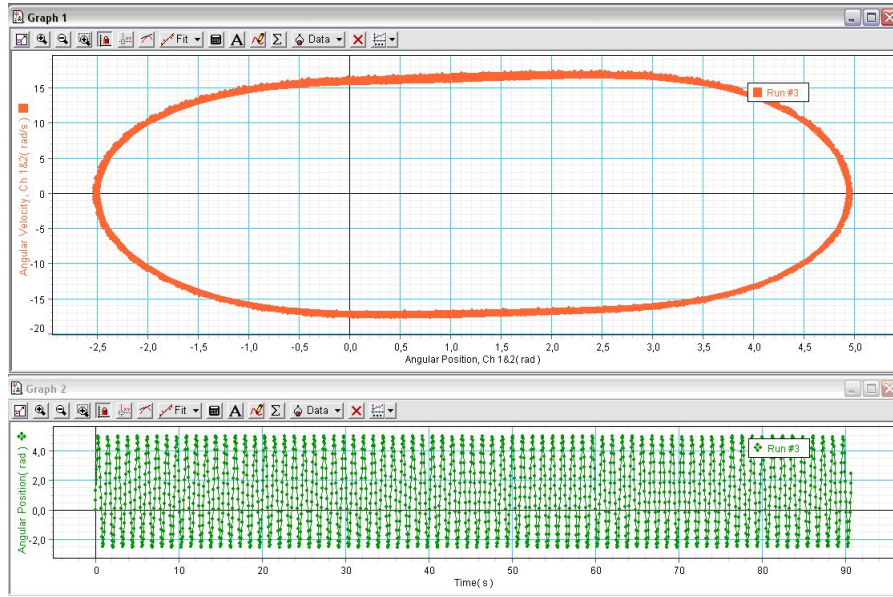
We observe that some chaotic systems even though they appear random yield a form of order.

Limited Predictability

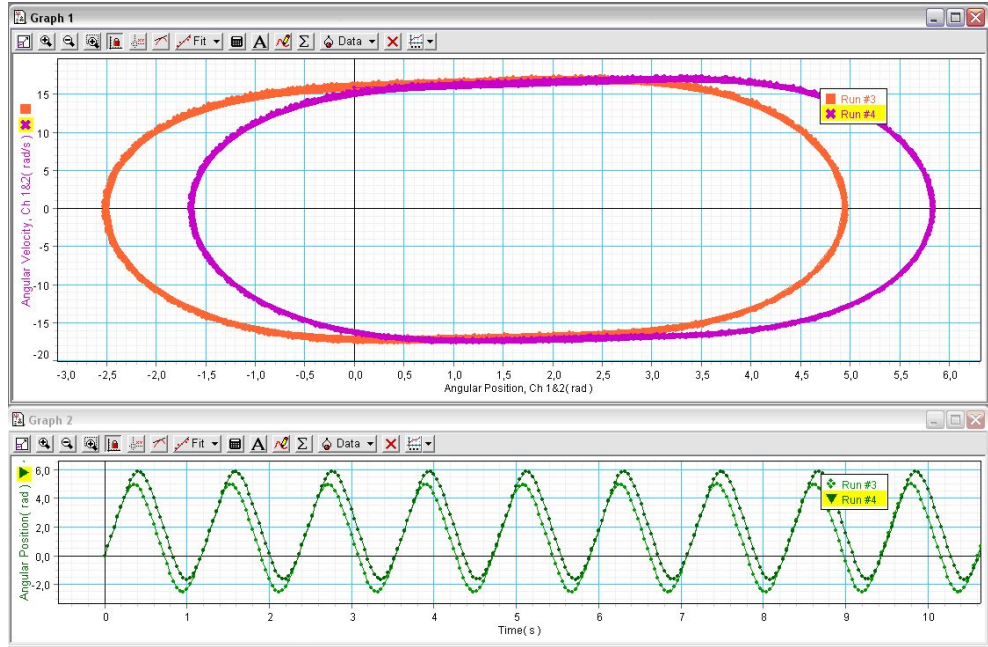
Real World Problem: Weather vs Weather prediction

- ***Magnetic Pendulum / Magnetic Pendulum Simulation:***
Studying the sensitivity of a chaotic system in its initial conditions and other
- Studying the possibility of a long term predictability

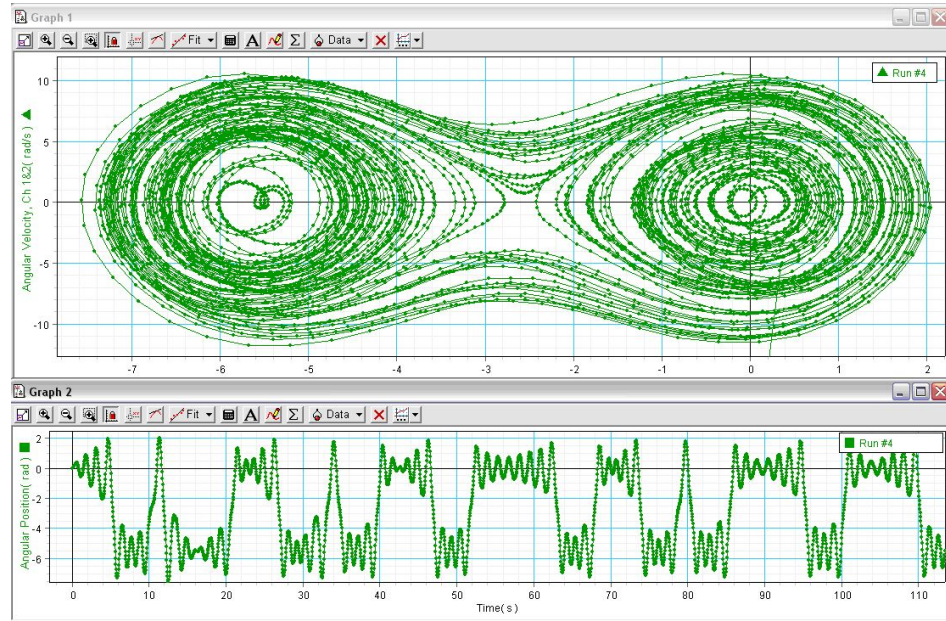
Harmonic Oscillation



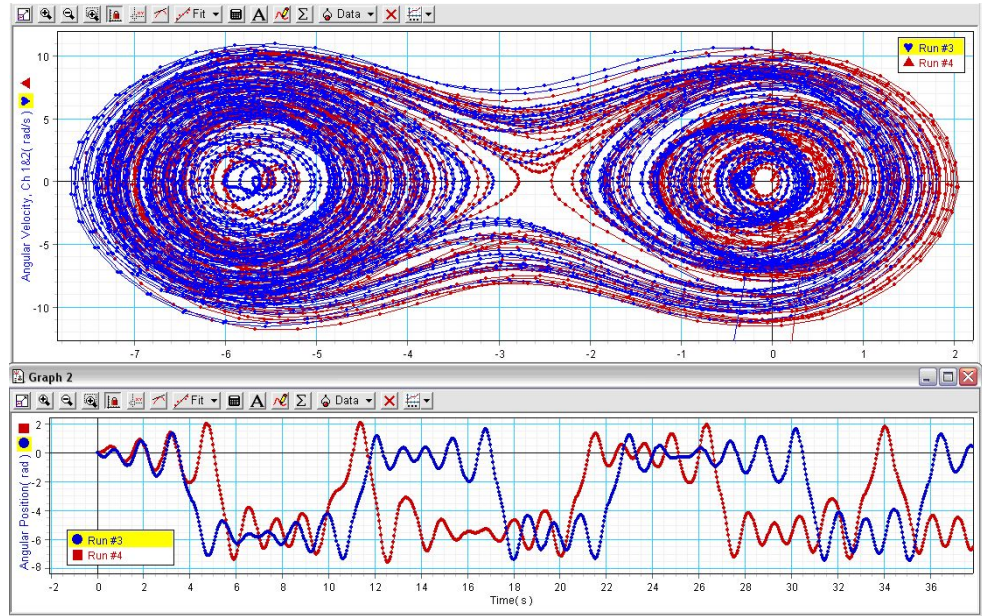
Harmonic Oscillation



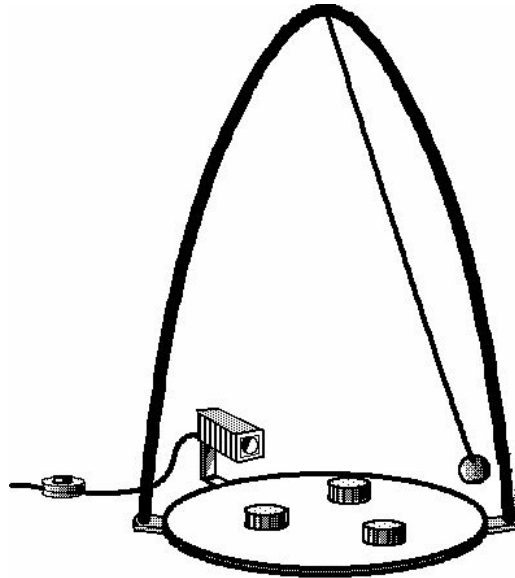
Deterministic Chaos



Deterministic Chaos



Limited Predictability



Critical States

General Goal:

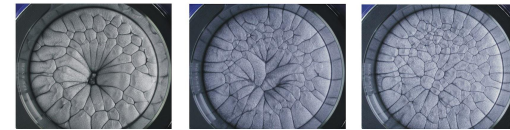
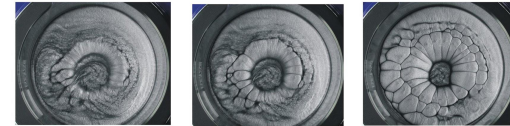
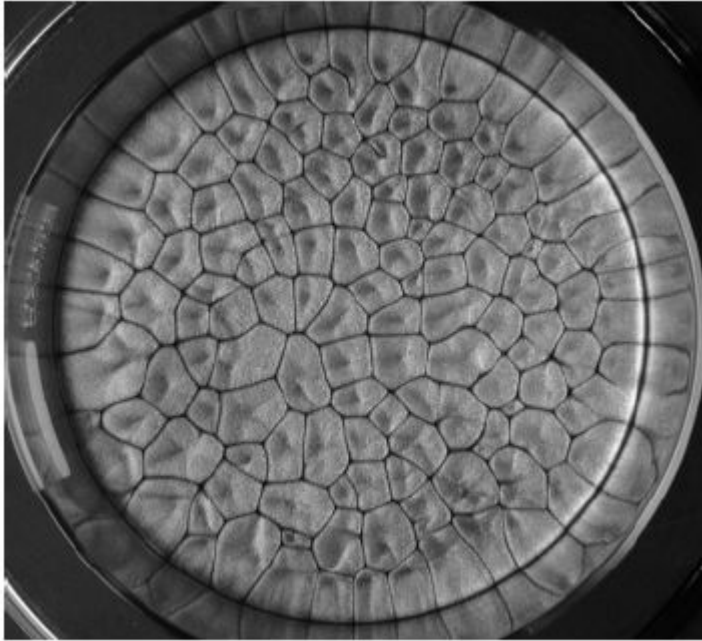
We observe that as a system evolves it passes through critical states that dictates its final “form” (self-reinforcement)

Critical States - Feedback

Real World Problem: Self-organization

Bernárd Cells: Studying that the evolution of a system is dictated by specific critical “states” (bifurcating equilibrium states)

Critical States / Feedback



Reflection

Biodiesel

Literature

- Stavrou, D. & Duit, R. (2014). Teaching and Learning the Interplay Between Chance and Determinism in Nonlinear Systems. *International Journal of Science Education*, 36, 3, 506-530
- Stavrou, D., Assimopoulos, S. & Skordoulis, C. (2013). A unit on deterministic chaos for student teachers. *Physics Education*, 48, 3, 355-359
- Stavrou, D, Duit, R. & Komorek, M. (2008) A teaching and learning sequence about the interplay of chance and determinism in nonlinear systems. *Physics Education*, 43(4), 417-422
- Komorek, M., Stavrou, D., & Duit, R. (2003). *Non-linear physics in upper physics classes: Educational Reconstruction as a frame for development and research in a study of teaching and learning basic ideas of nonlinearity*. In: D. Psillos, P. Kariotoglou, V. Tselfes, E. Hatzikraniotis, G. Fassoulopoulos, & M. Kallery (Eds.), *Science Education Research in the Knowledge Based Society*, 269-276. Dordrecht: Kluwer.
- Duit, R. & Komorek, M. (1997) Understanding the basic ideas of chaos-theory in a study of limited predictability. *International Journal of Science Education*, 19(3), 247-264

IDENTITIES

Enlightening
Interdisciplinarity
in STEM
for Teaching

www.identitiesproject.eu

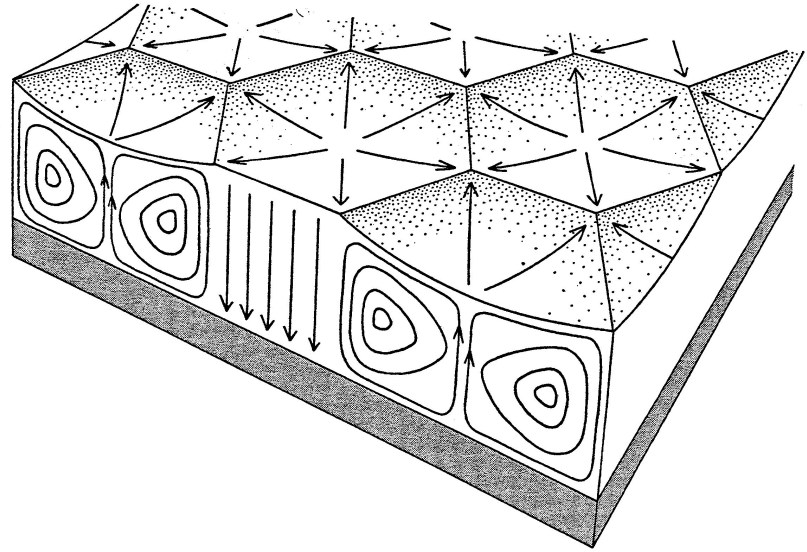
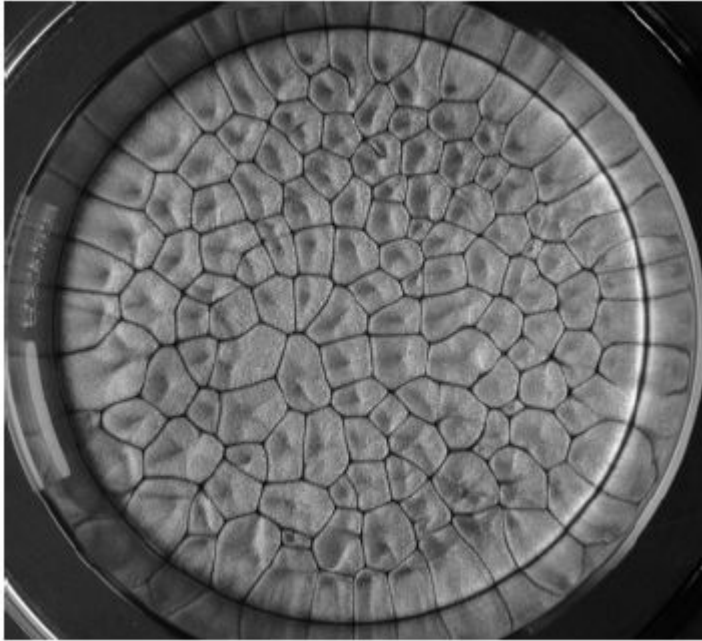


Co-funded by the
Erasmus+ Programme
of the European Union



Grant Agreement n°2019-1-IT02-KA203-063184

Critical States - Feedback



Critical States - Feedback

