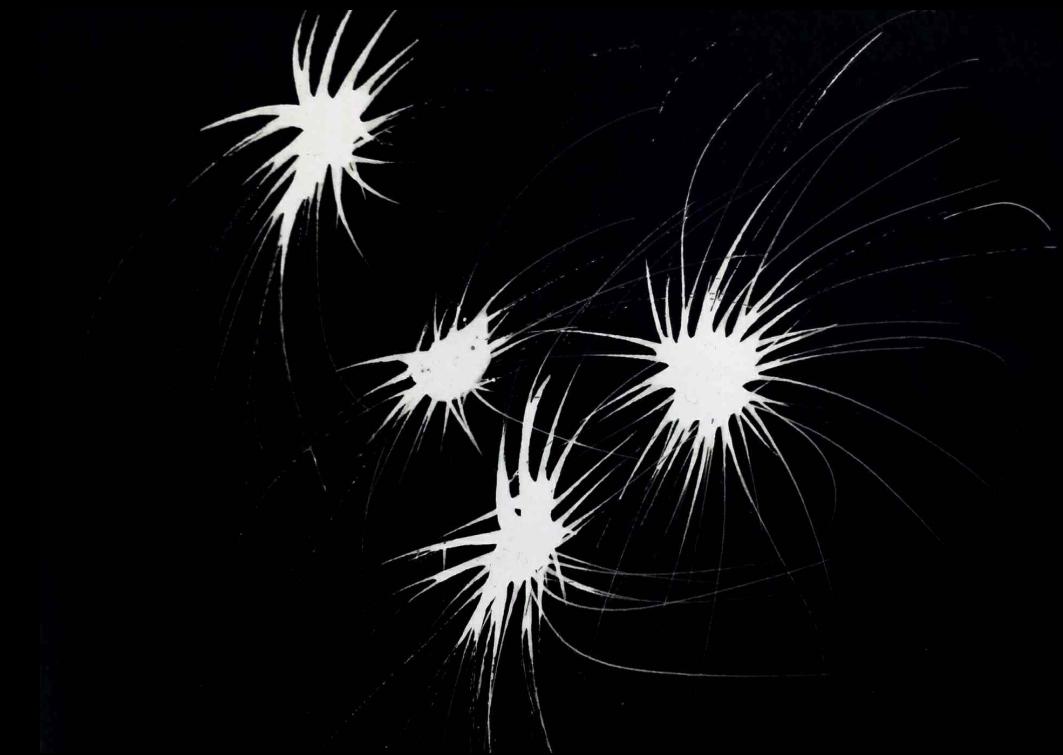
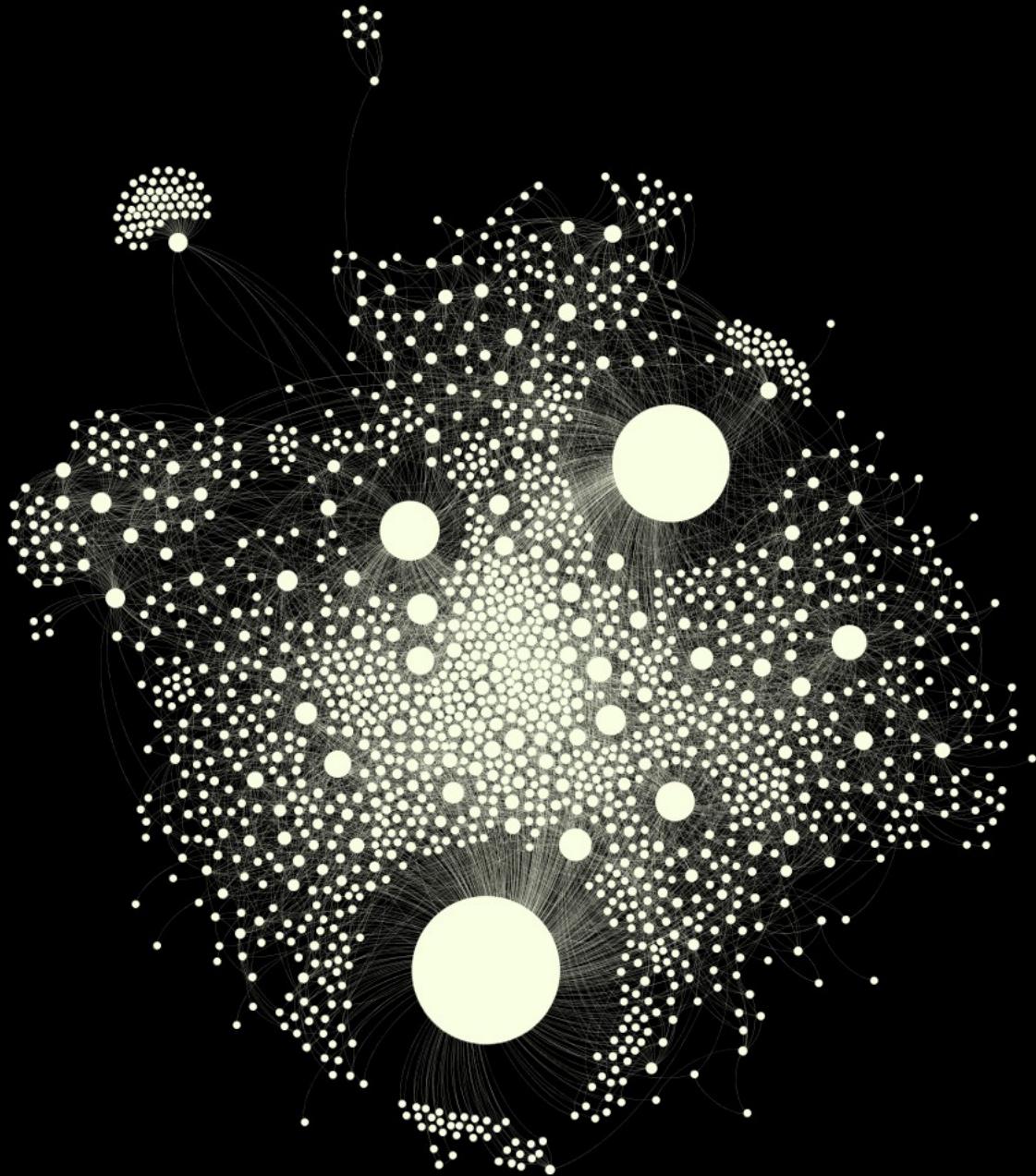


Marc Santolini, Liubov Tupikina, Marina Saburova,  
Roberto Toro, Katja Heuer, CRI  
ISCPiF ARTEX event  
October 12<sup>th</sup>, 2019

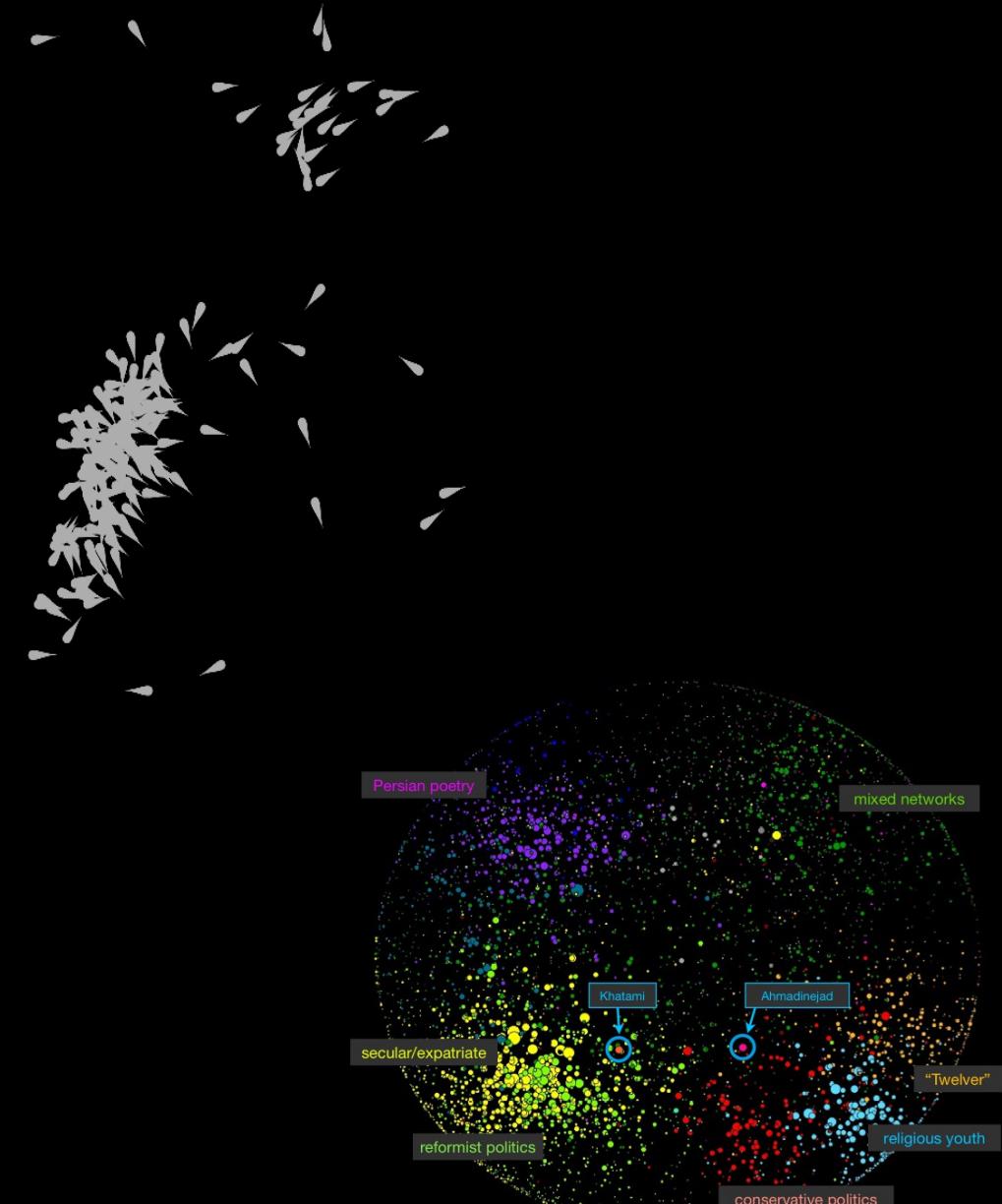


**"I think the next century will be the century of complexity."**  
**Stephen Hawking, 2000**

# Workshops:

## I Collective phenomena

## II Random networks



<https://journals.sagepub.com/doi/full/10.1177/2056305117691545>

# Collective phenomena:



# Collective phenomena:



In physics:

“In order to understand dynamics of a physical system we need to focus on the macro level and not on its parts: we look at flocking birds as one organism to understand its dynamics.”

Japanese art:

“In order to draw flocking birds or schools of fishes, one should not concentrate on each small part but instead to concentrate on the movement and depiction of one element which can express the whole”

# Collective phenomena:



Examples of numerical simulations:

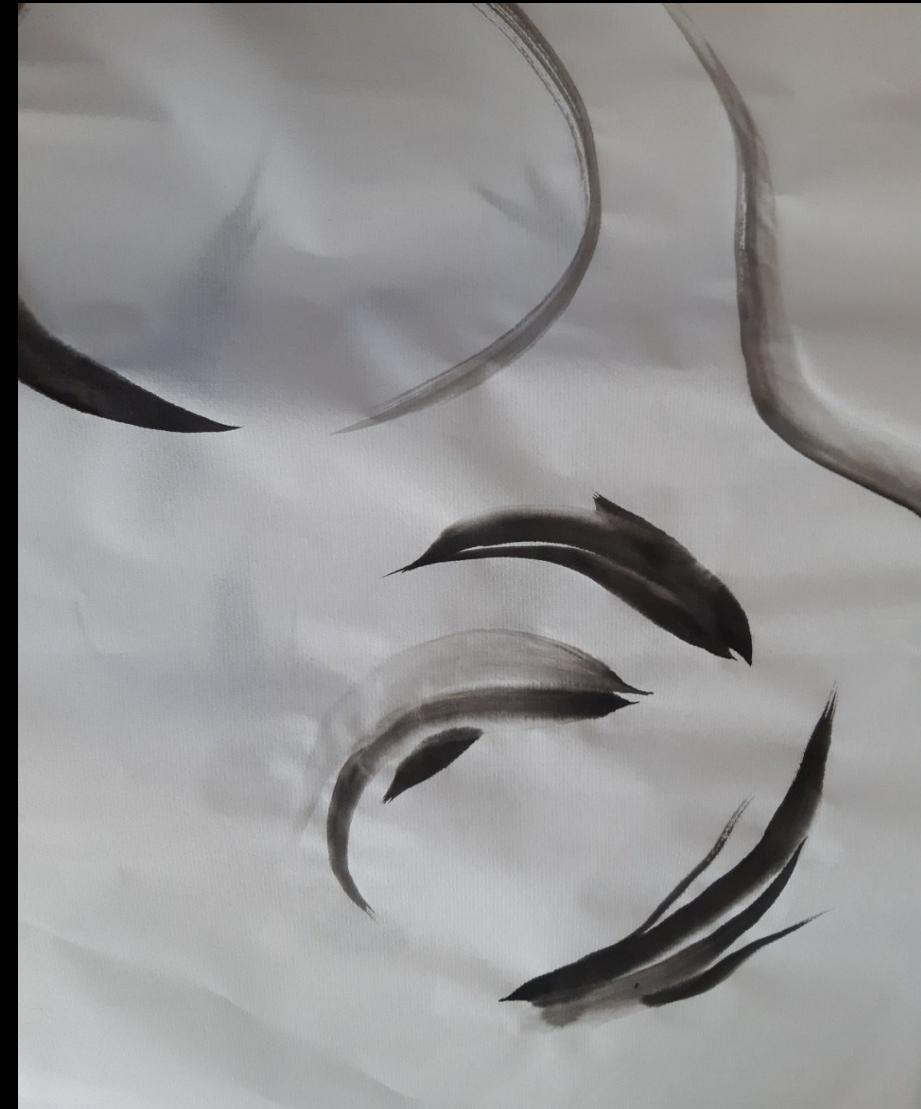
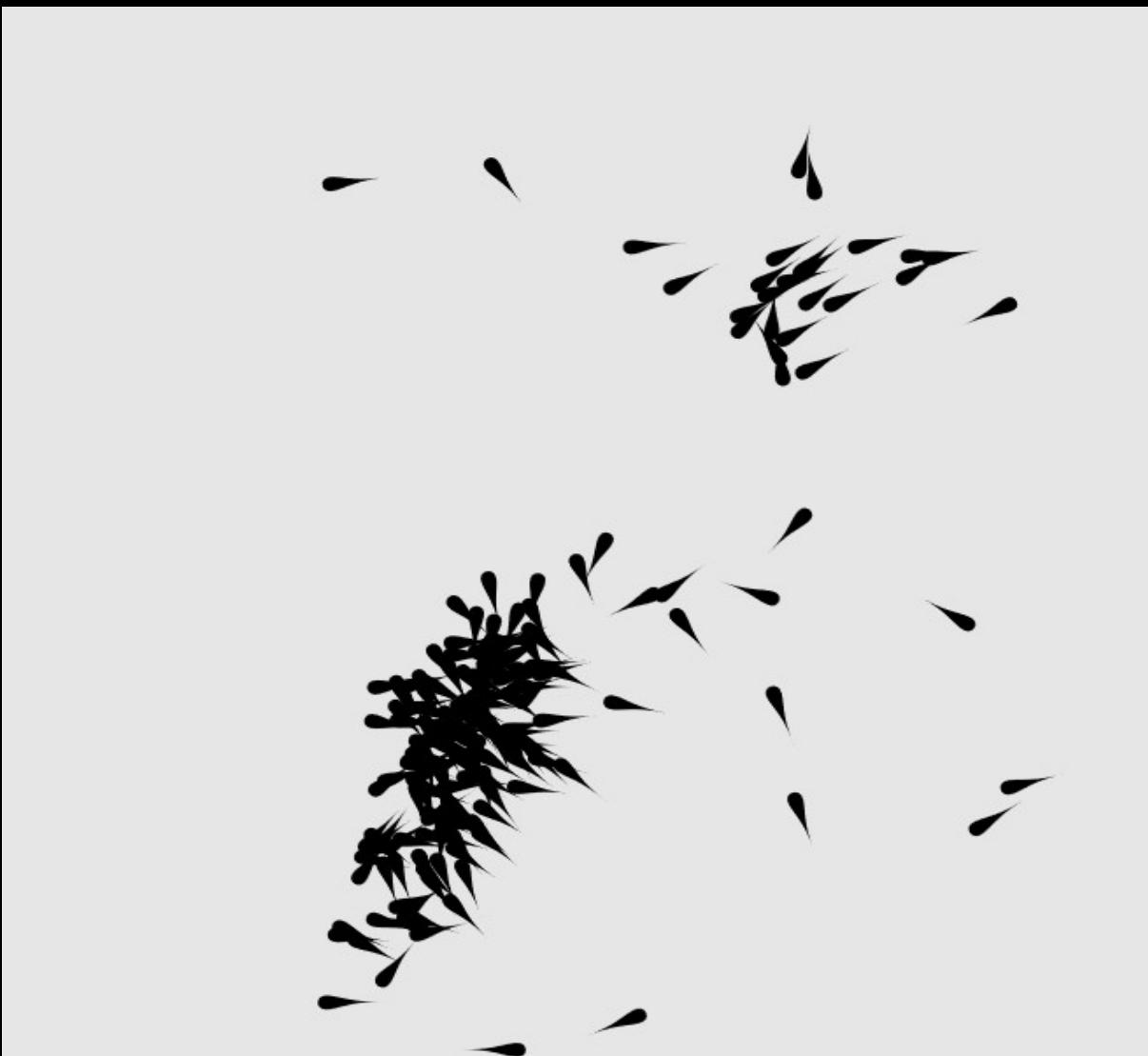
Complexity explorer from Pr.Brockman group <http://rocs.hu-berlin.de/>

<http://www.complexity-explorables.org/explorables/thrilling-milling-schelling-herings/>

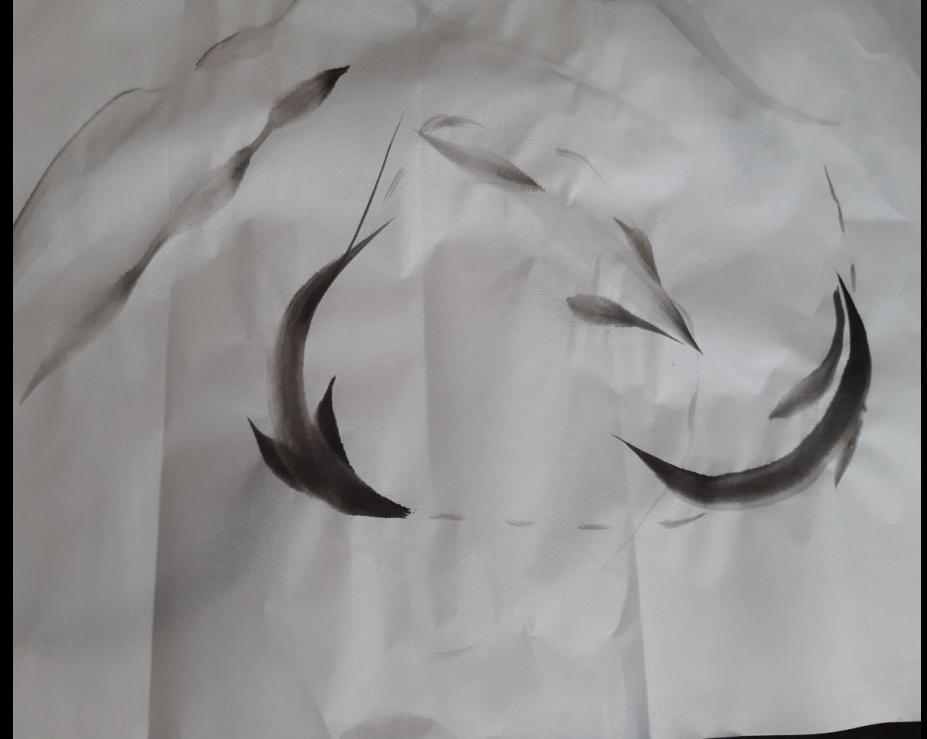
<https://www.sciencedirect.com/science/article/pii/S0022519302930651?via%3Dihub>

Flocking birds behaviour <http://www.xavibou.com/index.php/project/ornitographies/>

# Collective phenomena:



# Collective phenomena:

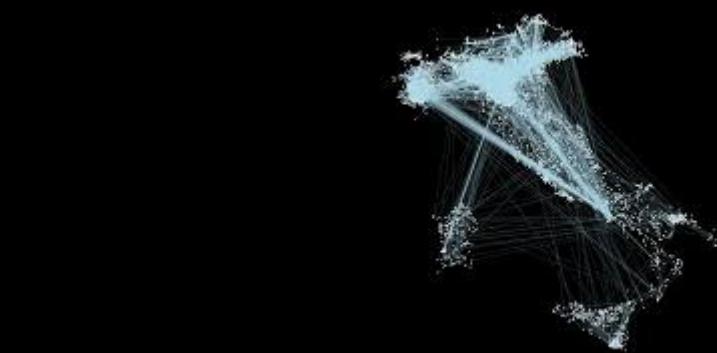
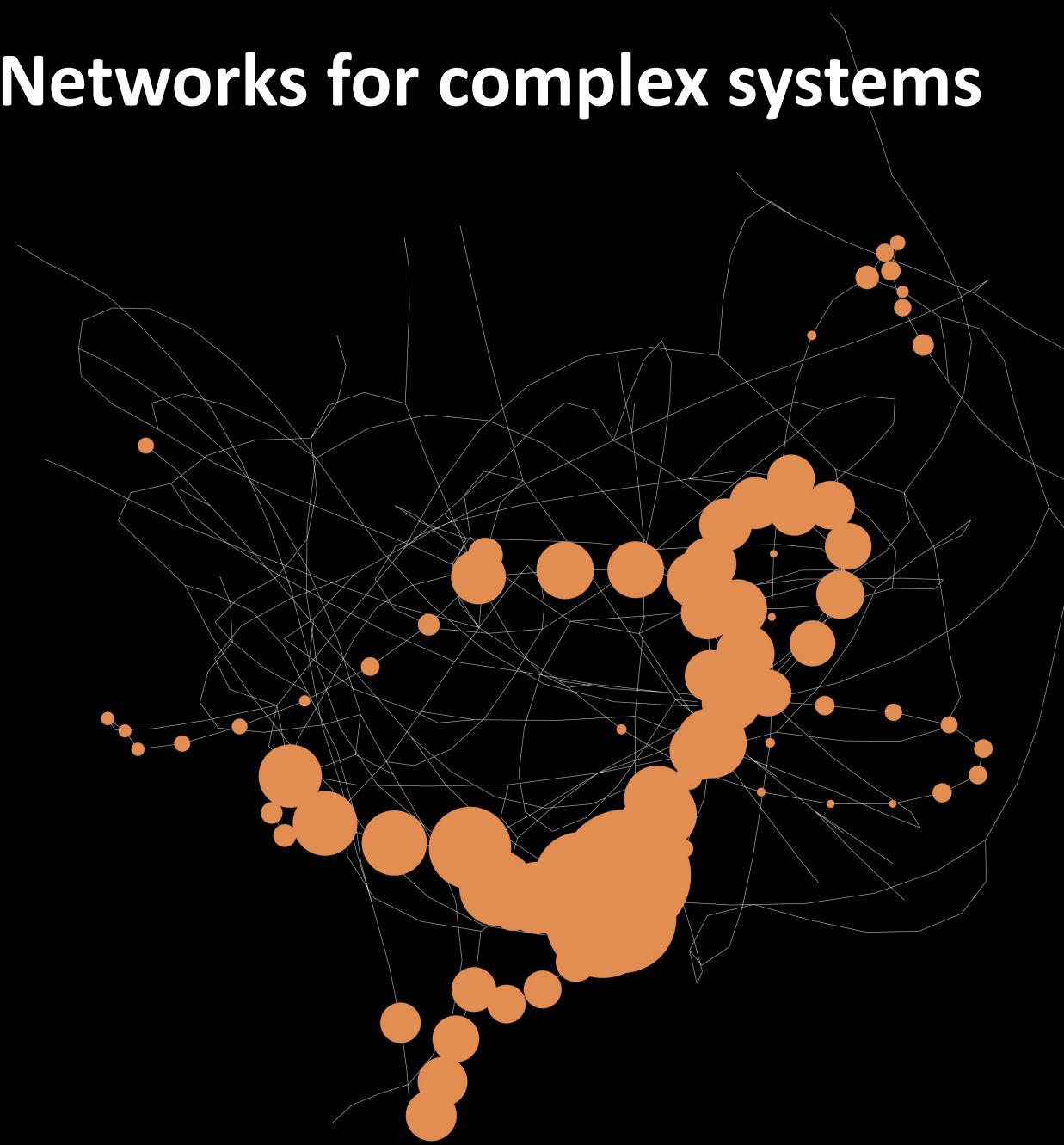


# **Networks science**

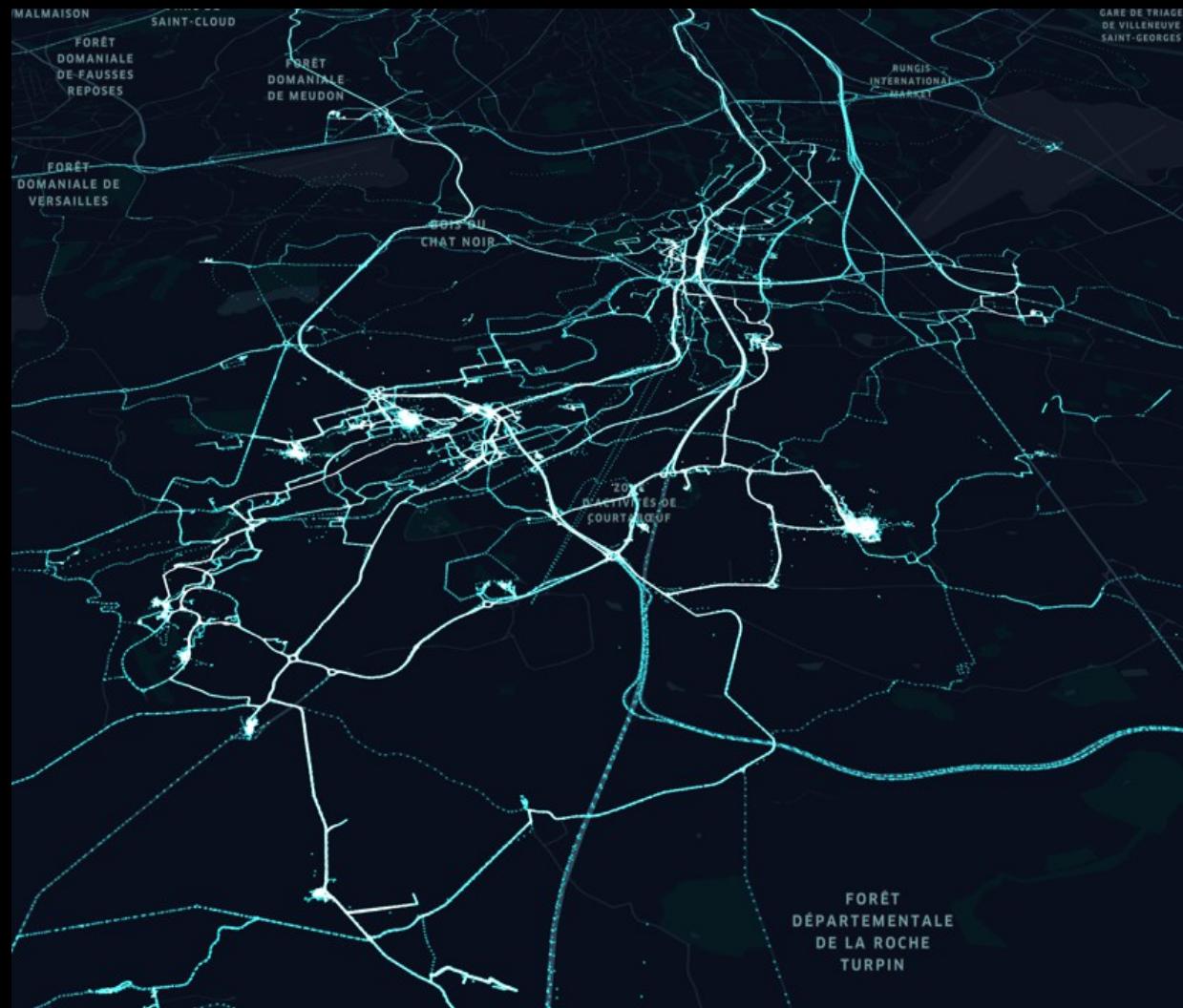
# Complex networks in nature



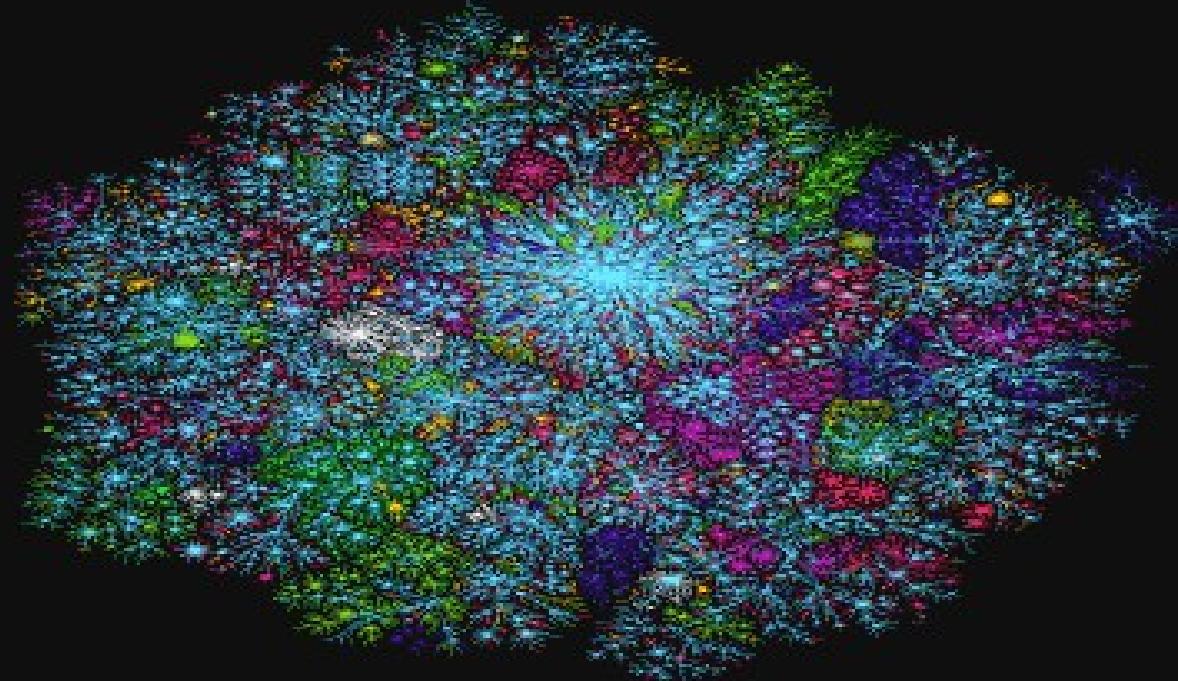
# Networks for complex systems



# Networks for complex systems

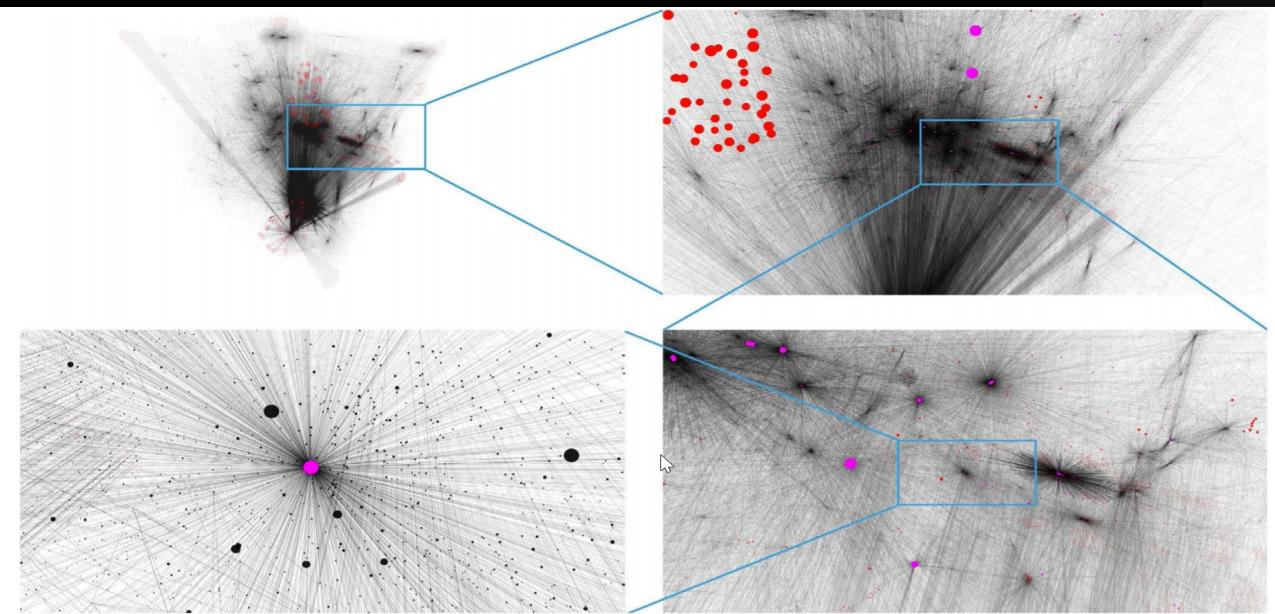
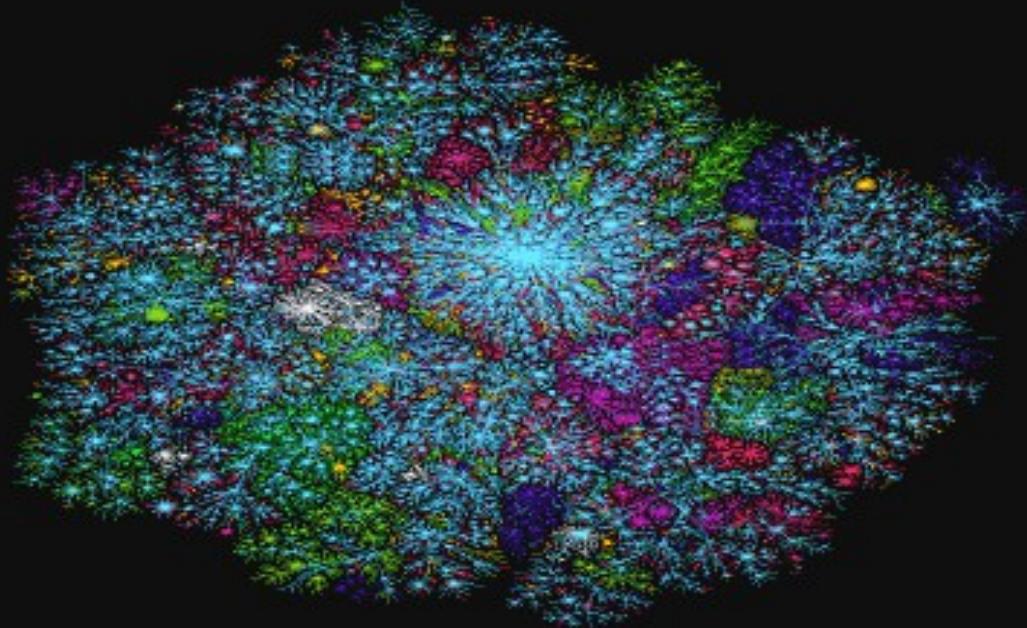


T H E   W H O L E   I N T E R N E T



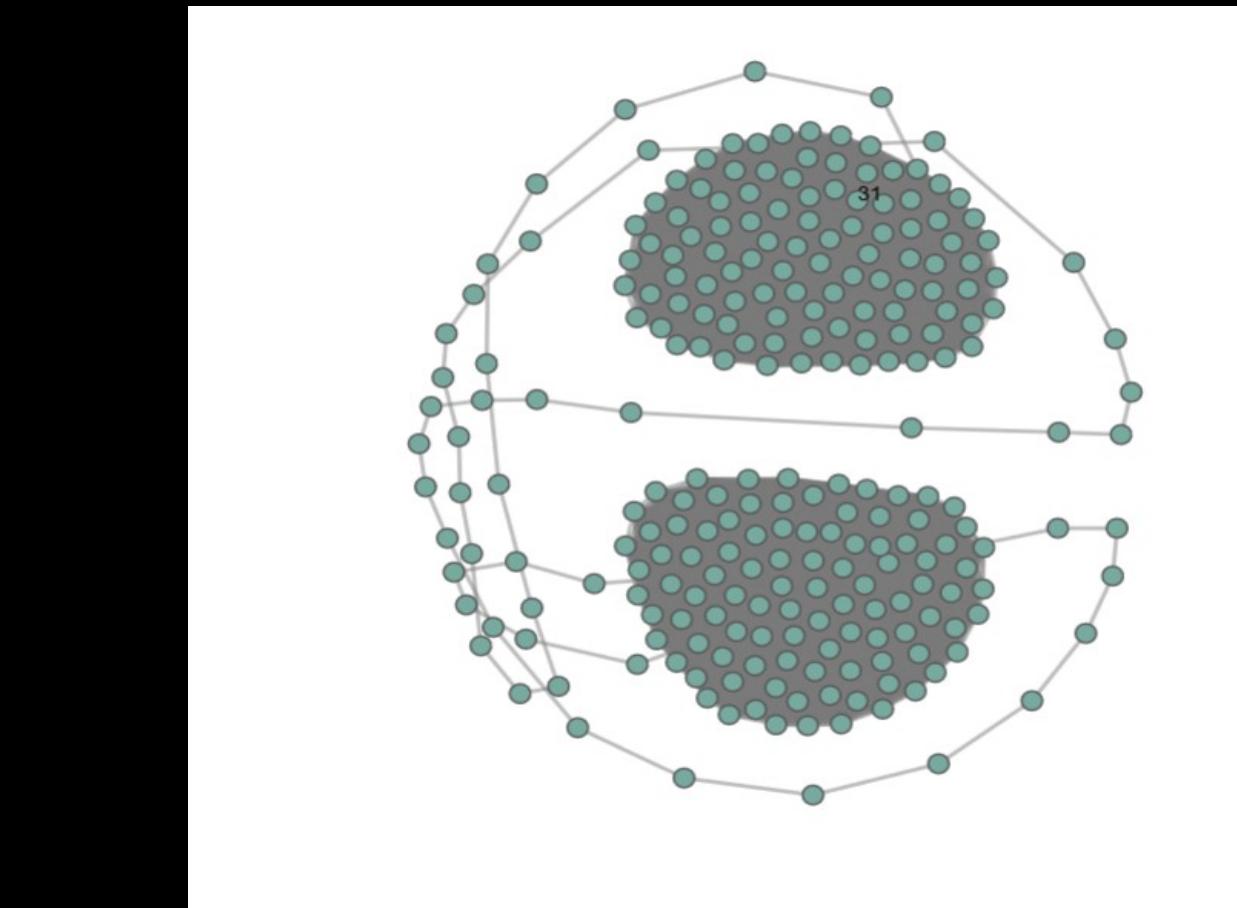
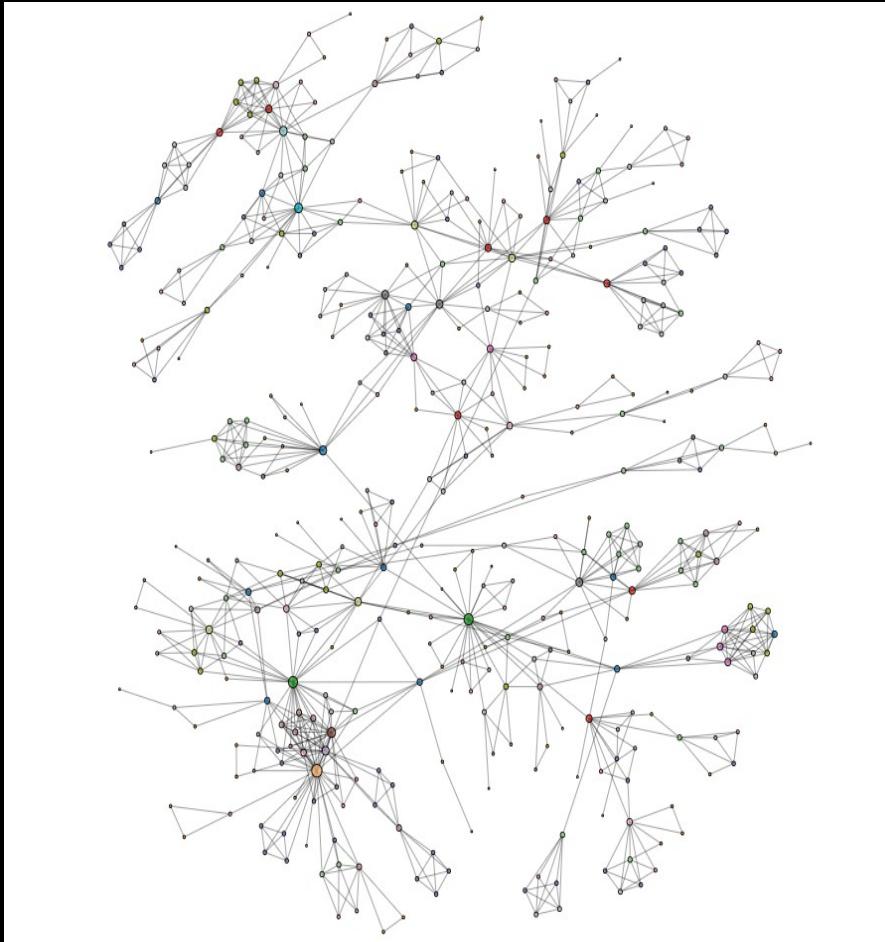
# Network resources

THE WHOLE INTERNET



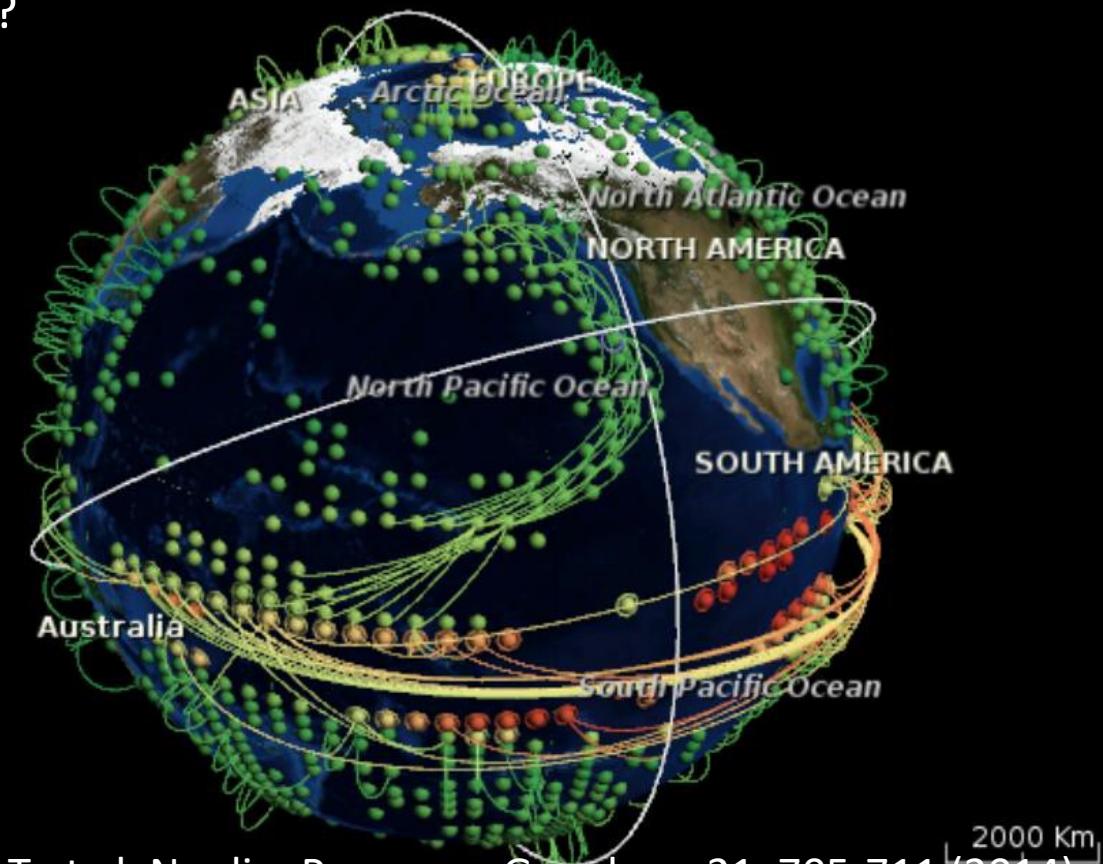
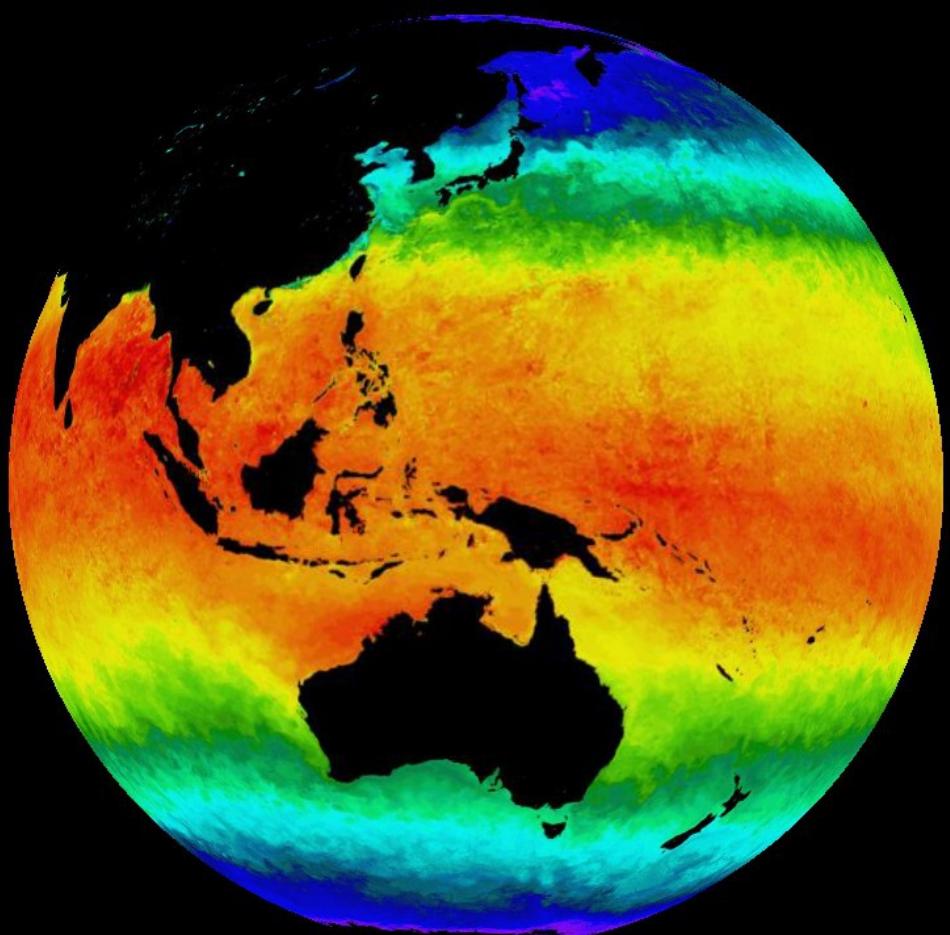
# Network visualisations platforms

<http://networkrepository.com/graph-vis.php>



Questions from physics and climatology:

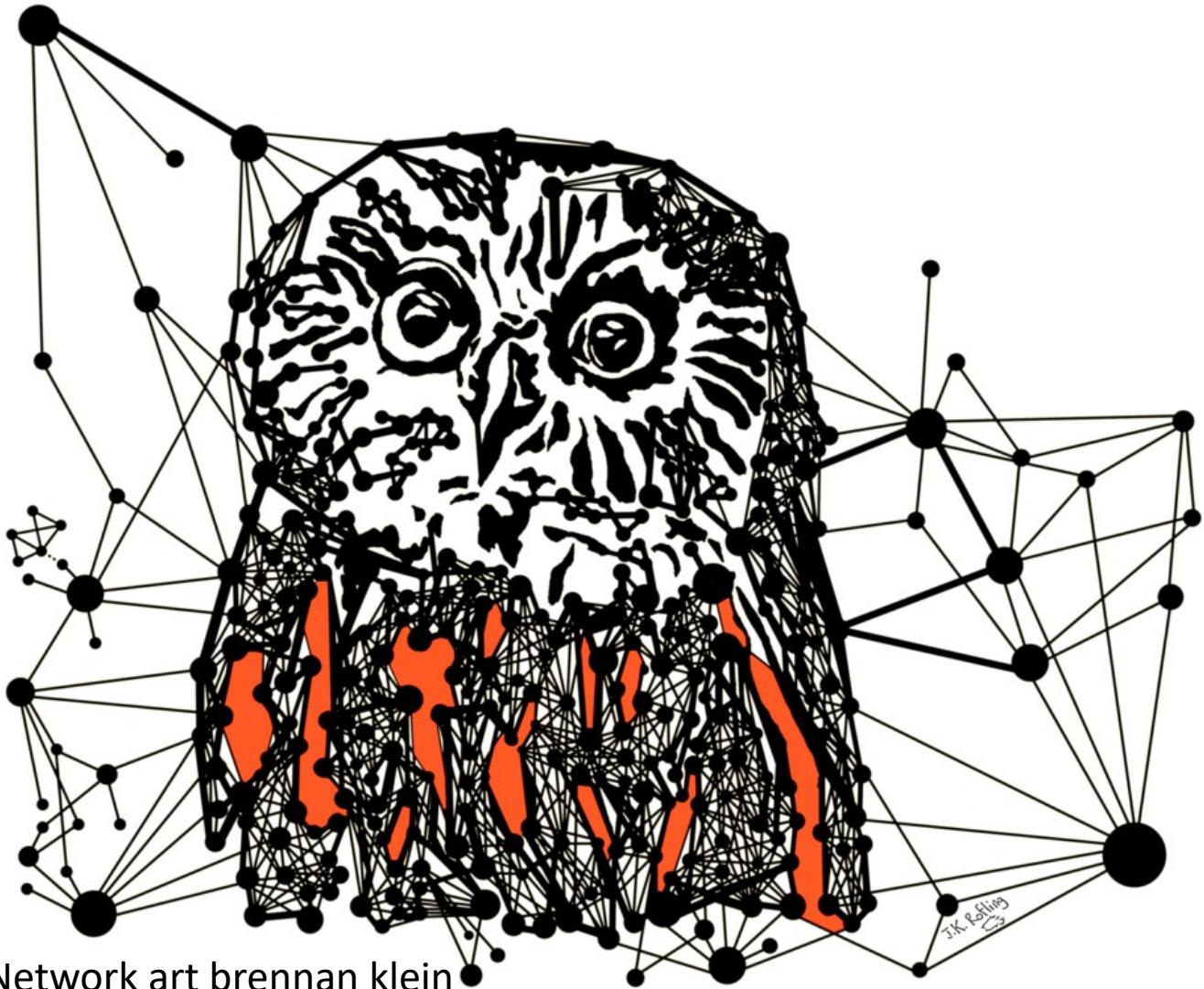
What is the meaning of correlations patterns in data structures?

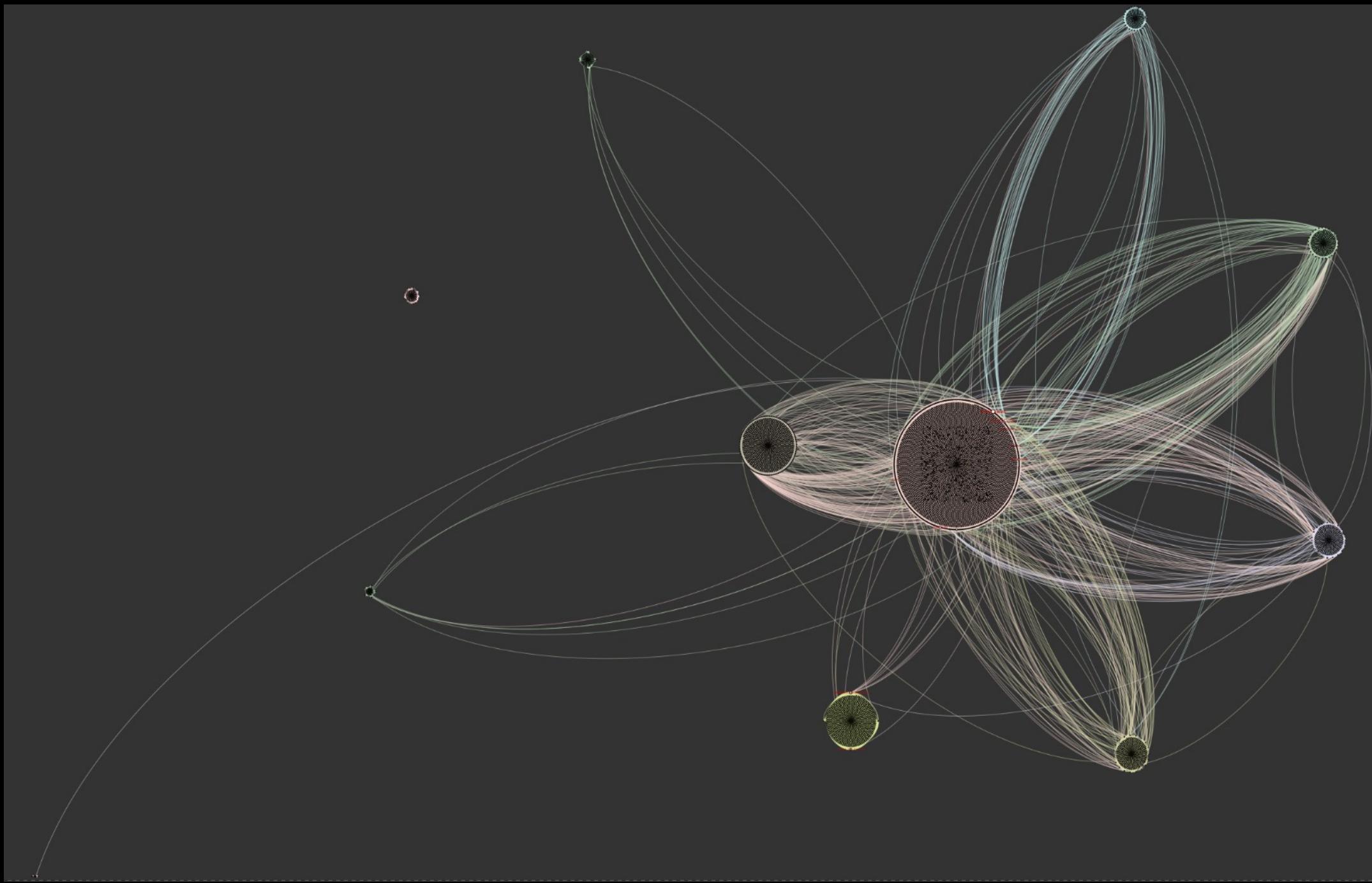


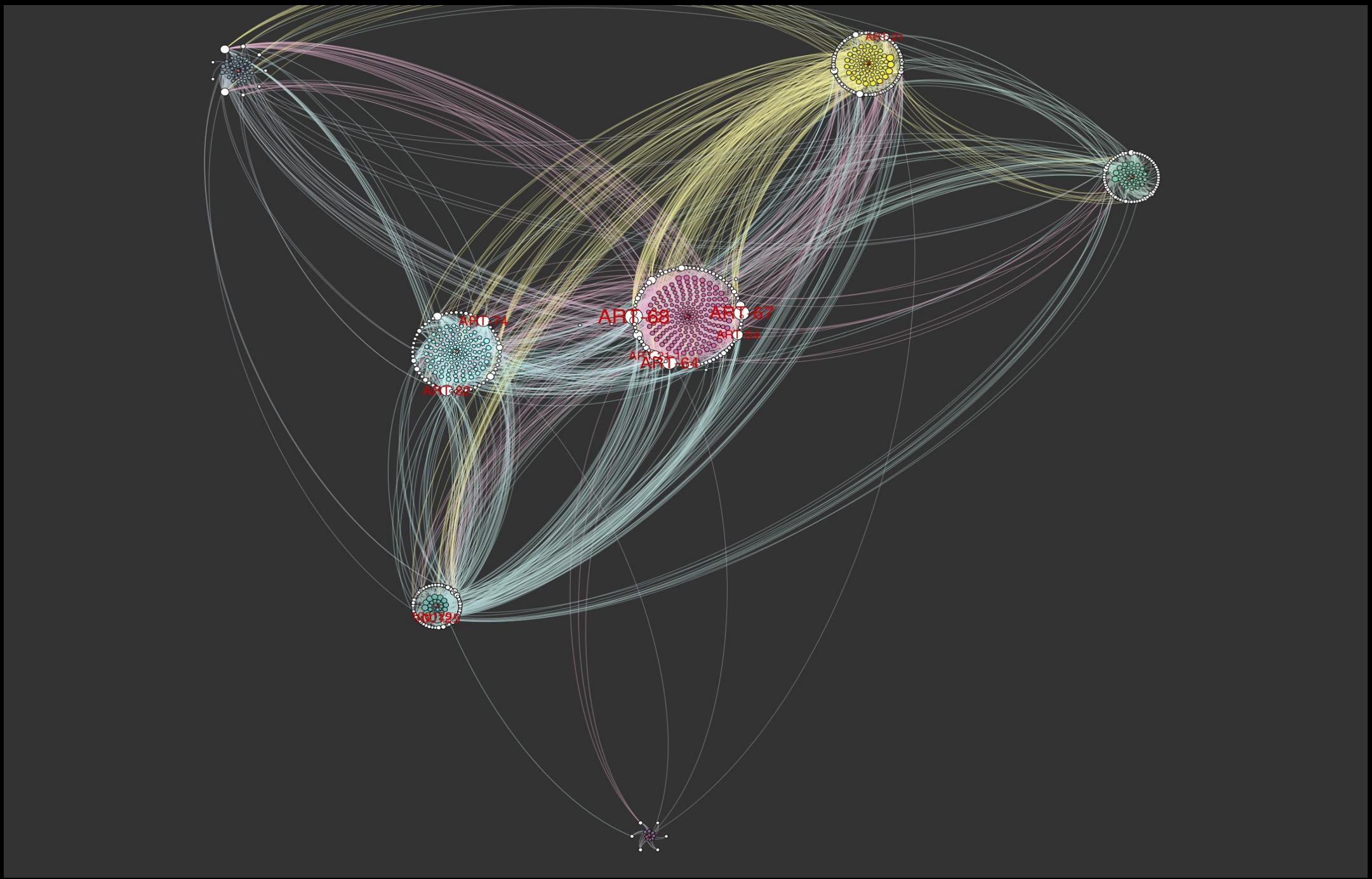
LT et al. Nonlin. Processes Geophys., 21, 705-711 (2014)

J.F. Donges et al. Chaos 25, 113101-1-25 (2015)

<http://www.pik-potsdam.de/~donges/pyunicorn/>



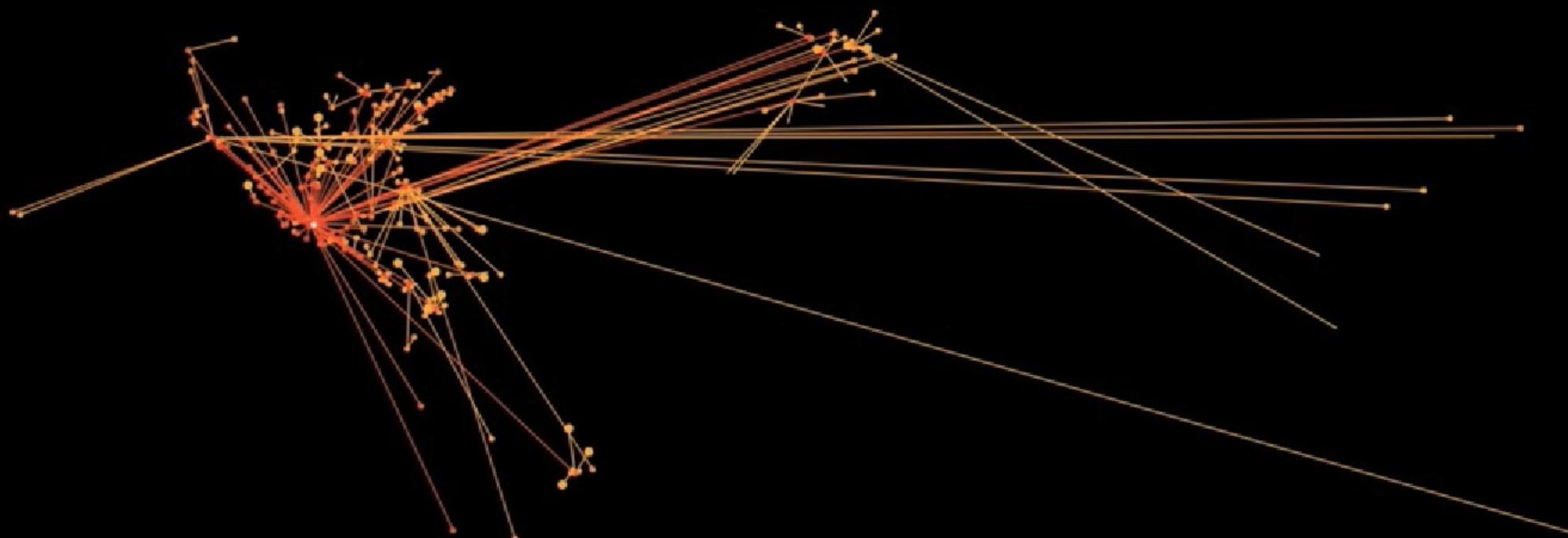




# Network visualisations platforms

<http://www.bleamviz.org> Vespignani GLEAM group

Jun 10 2009



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# Network visualisations platforms

<http://www.gleamviz.org>

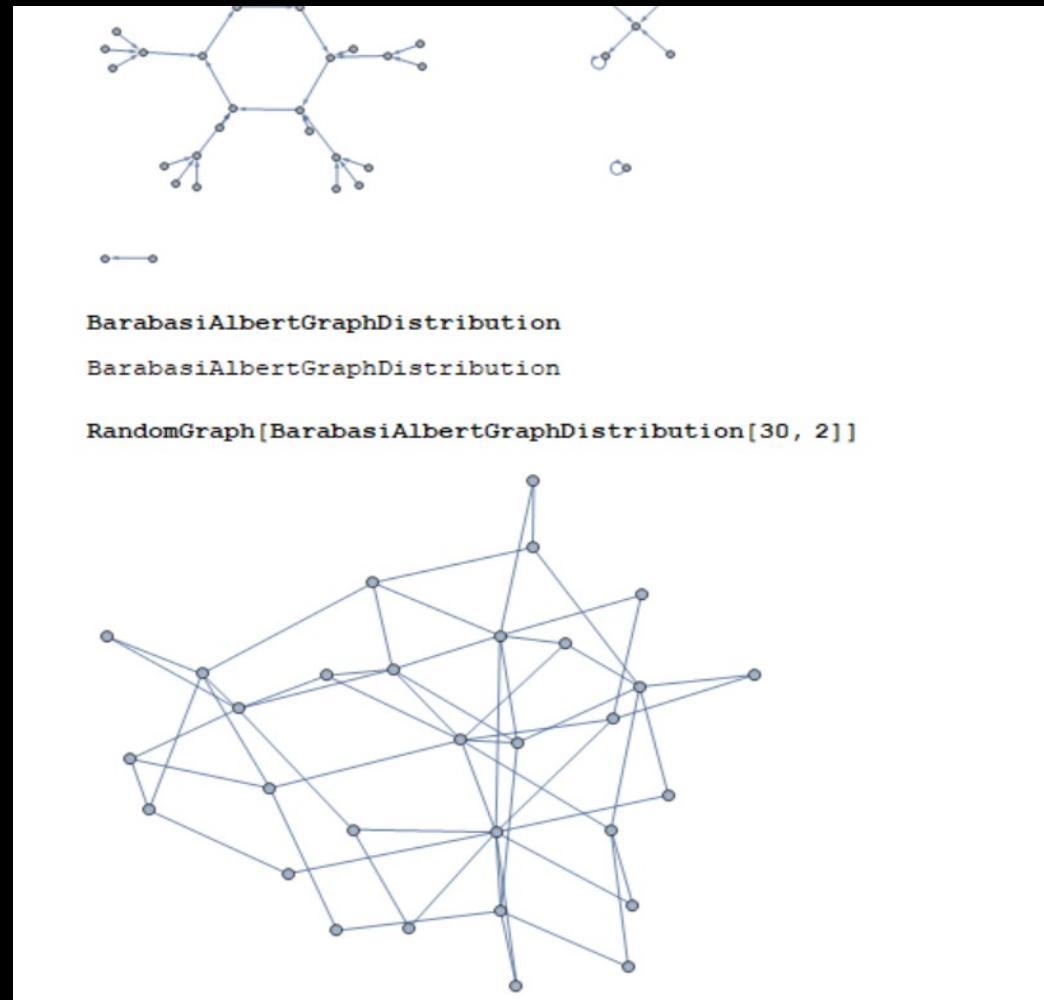
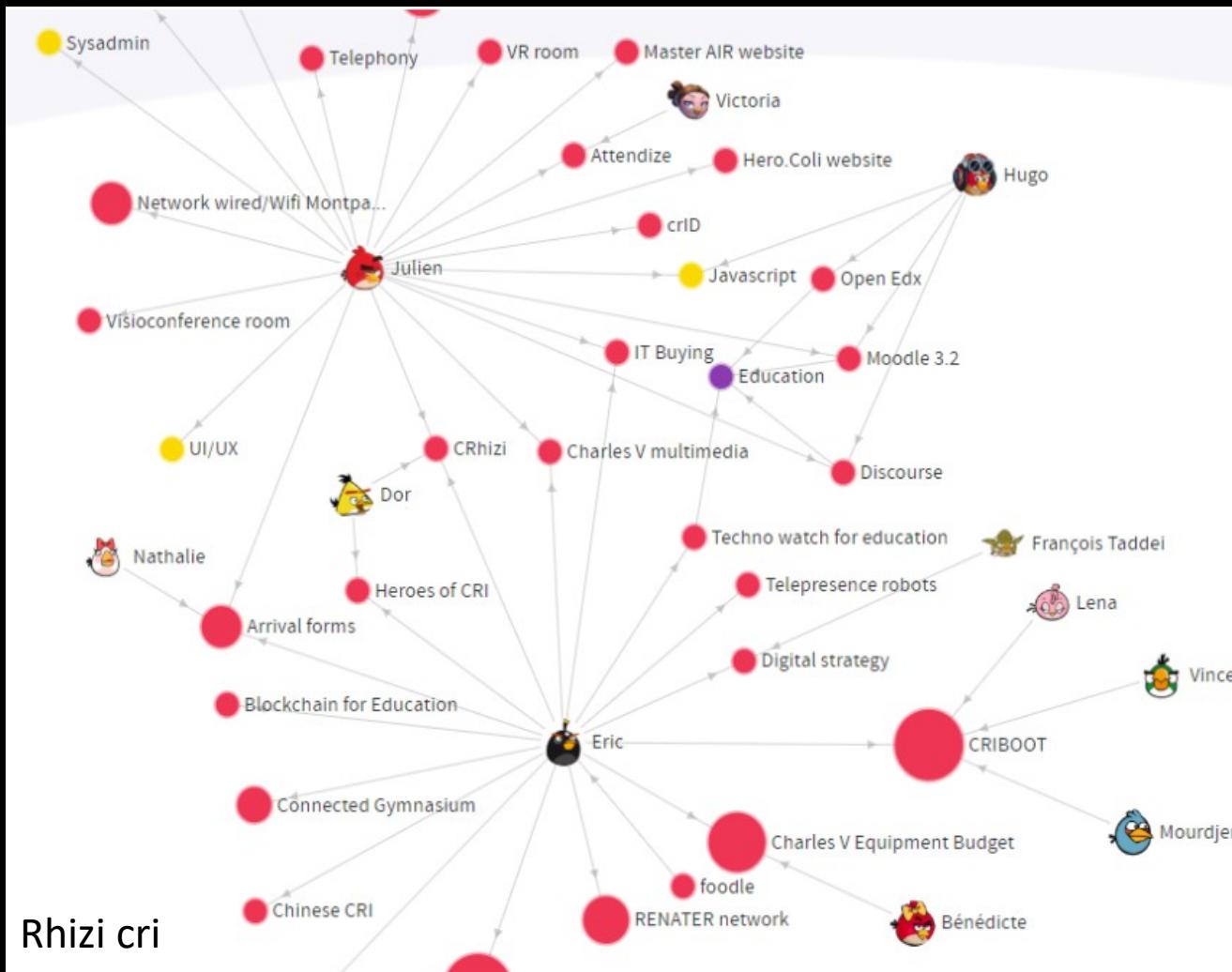
Aug 08 2009



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Try it yourself

