



**The Abdus Salam  
International Centre for Theoretical Physics**



**1968-7**

**Conference on Teleconnections in the Atmosphere and Oceans**

*17 - 20 November 2008*

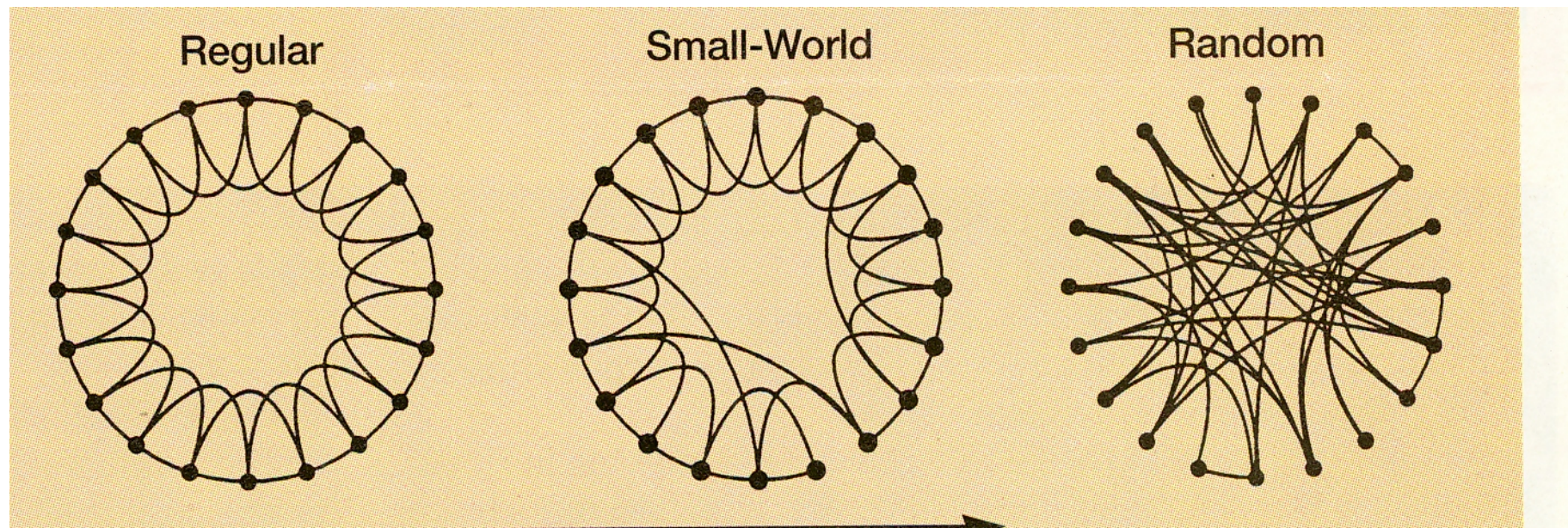
**On the role of atmospheric teleconnections in climate.**

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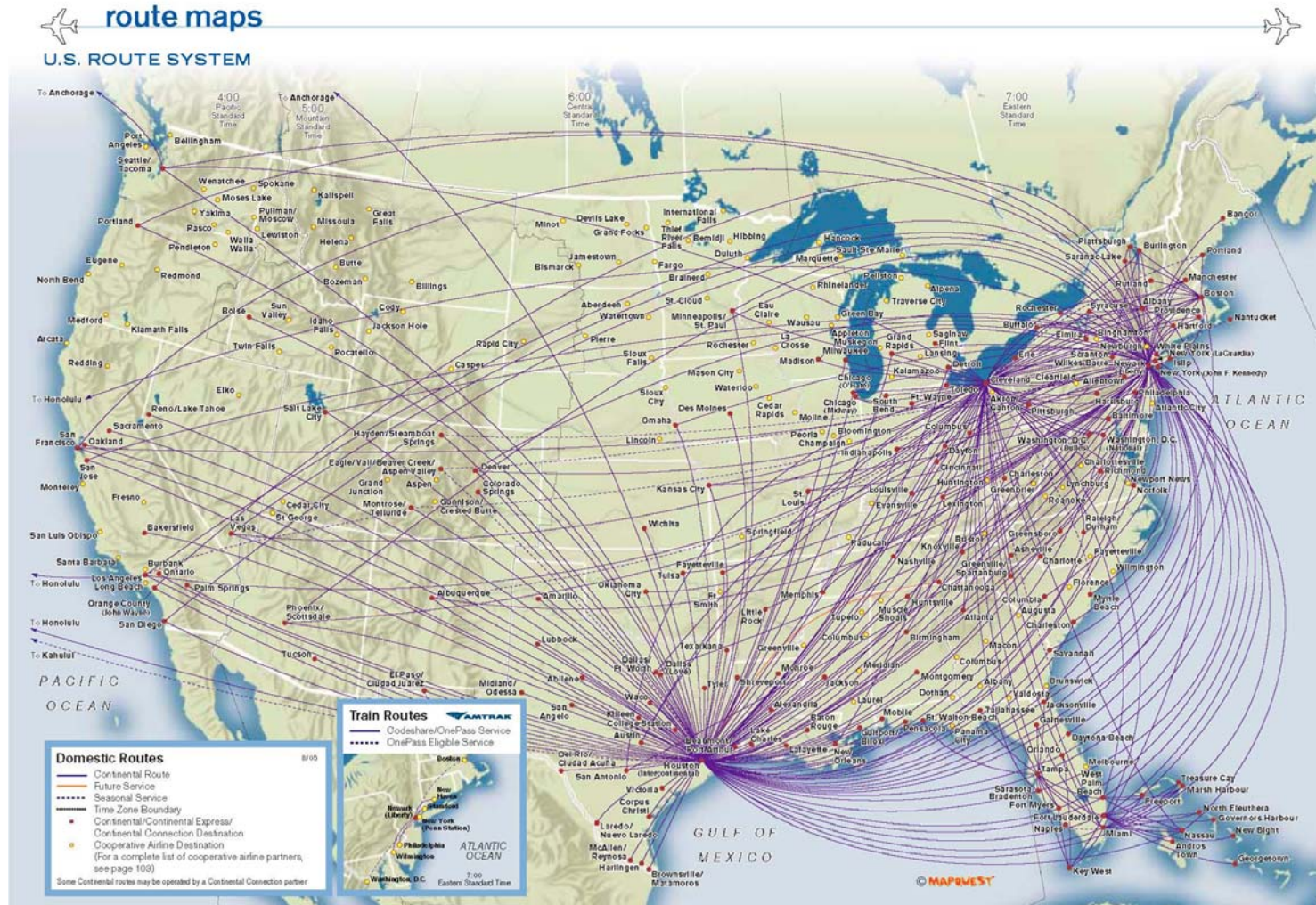
# On the role of atmospheric teleconnections in climate

Anastasios A. Tsonis  
University of Wisconsin-  
Milwaukee

# Types of networks



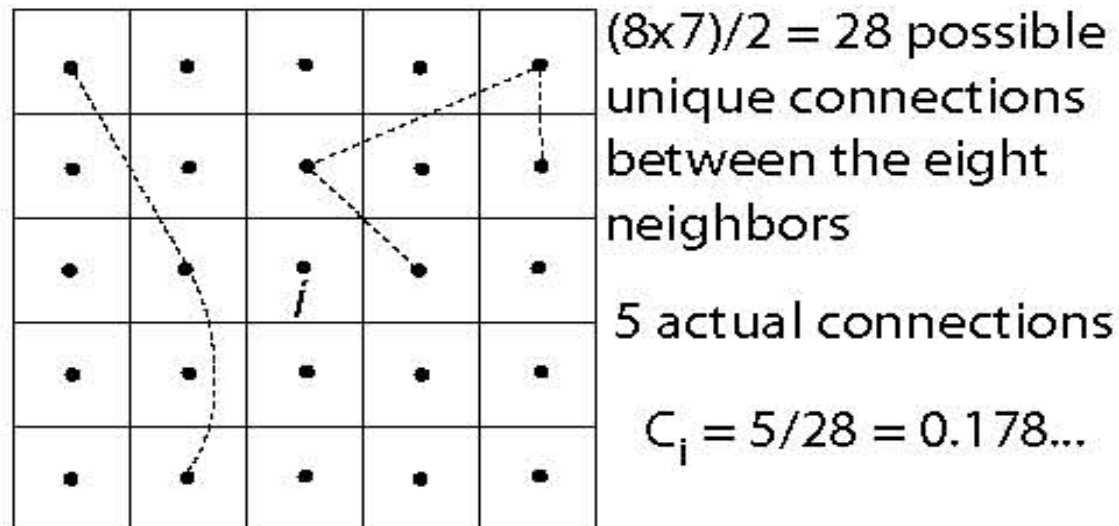
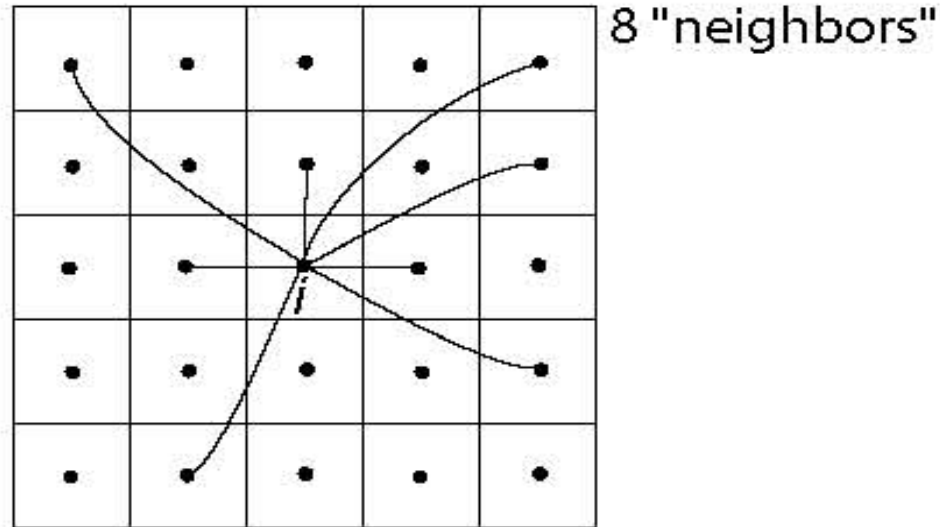
# An example of a scale-free network



# Measures in networks

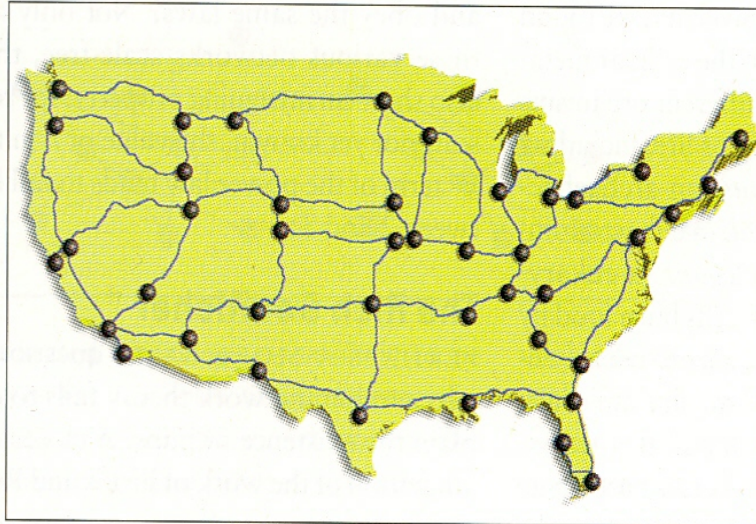
- Clustering coefficient
- Diameter
- Distance
- Betweenness
- Degree distributions
- Modularity
- Communities, etc.

# Estimating the clustering coefficient

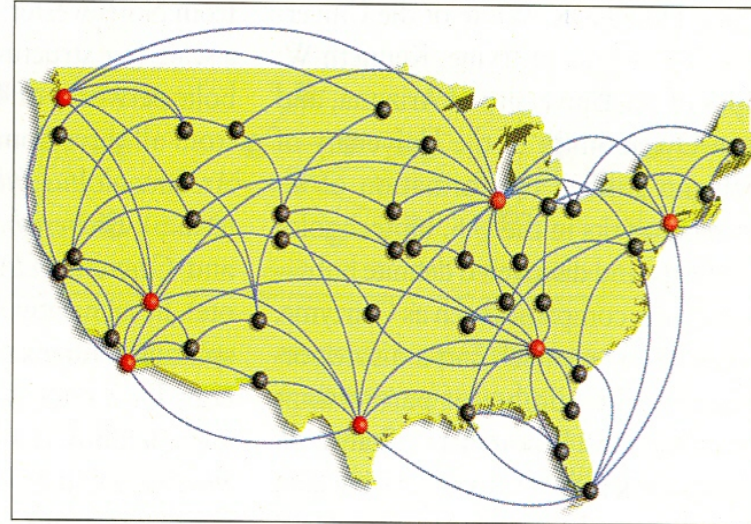


# Random versus scale-free networks

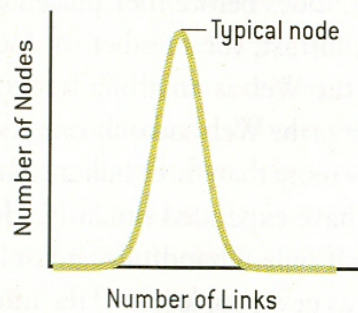
Random Network



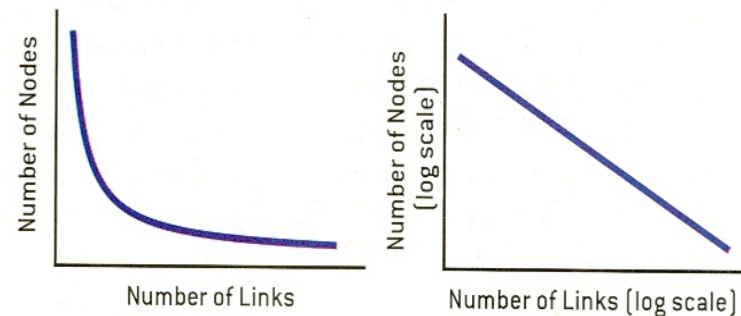
Scale-Free Network



Bell Curve Distribution of Node Linkages

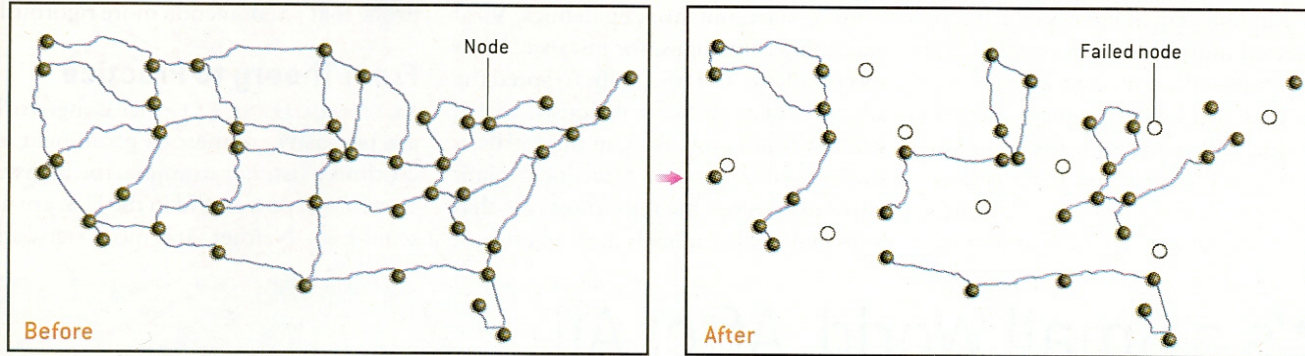


Power Law Distribution of Node Linkages

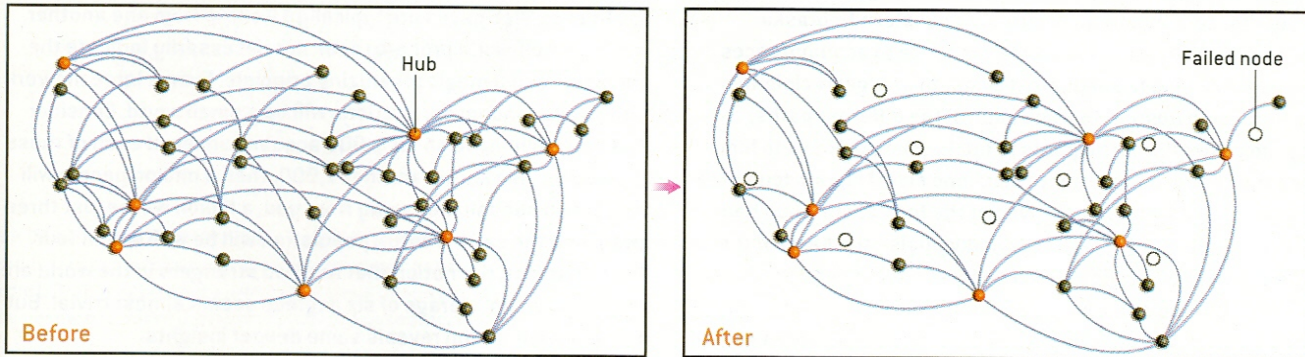


# Stability of random and scale-free networks

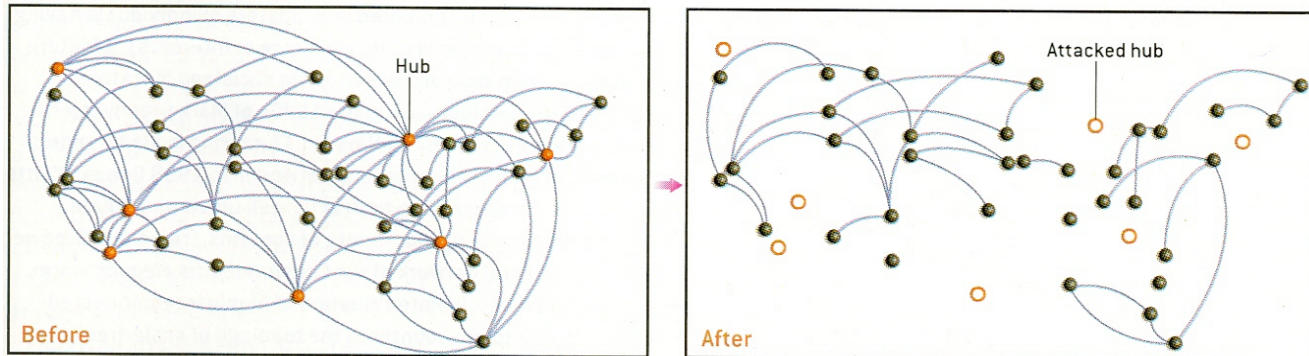
Random Network, Accidental Node Failure



Scale-Free Network, Accidental Node Failure

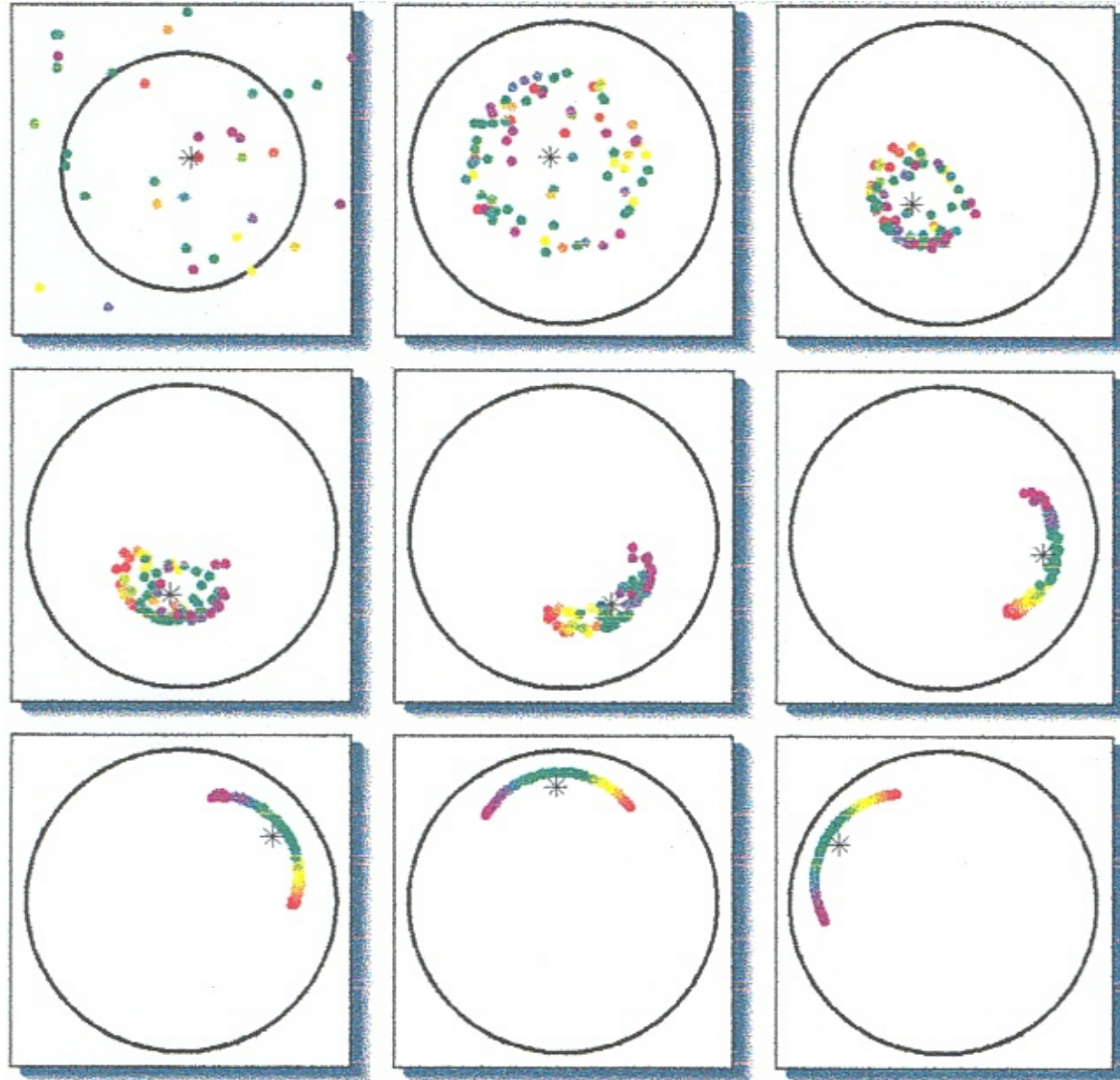


Scale-Free Network, Attack on Hubs

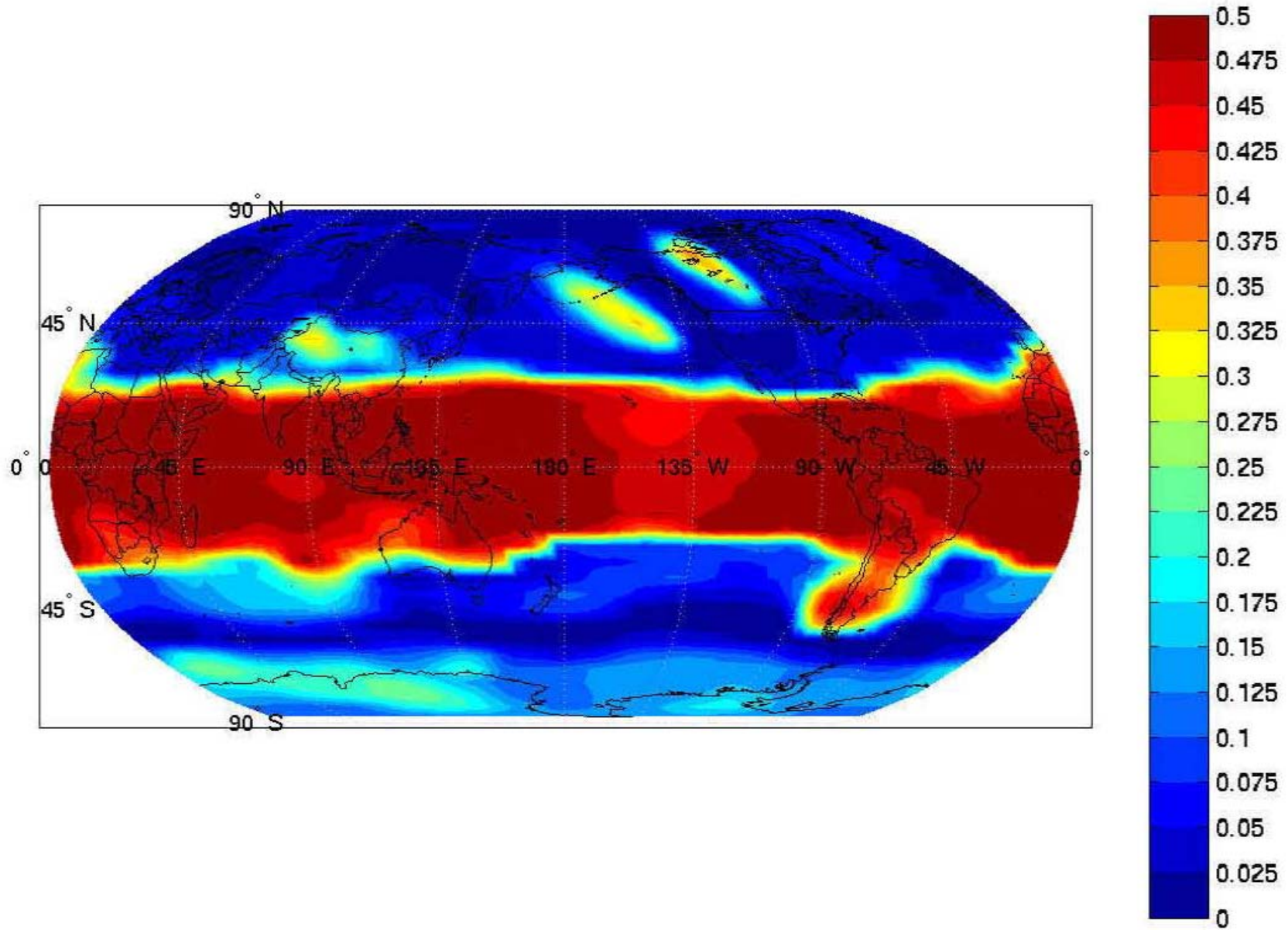




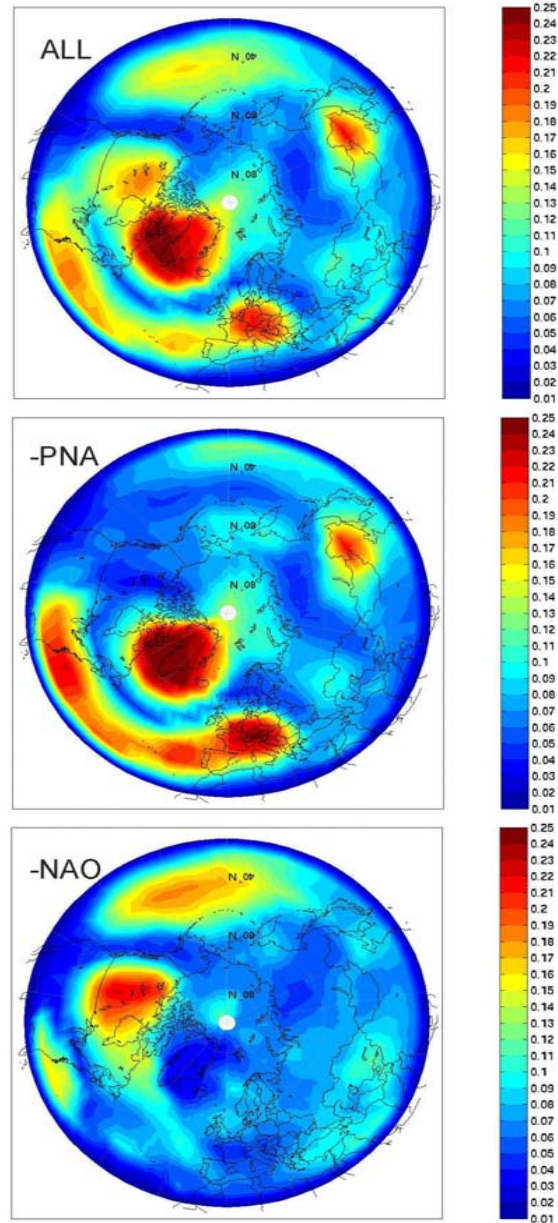
# How a network of oscillators synchronizes



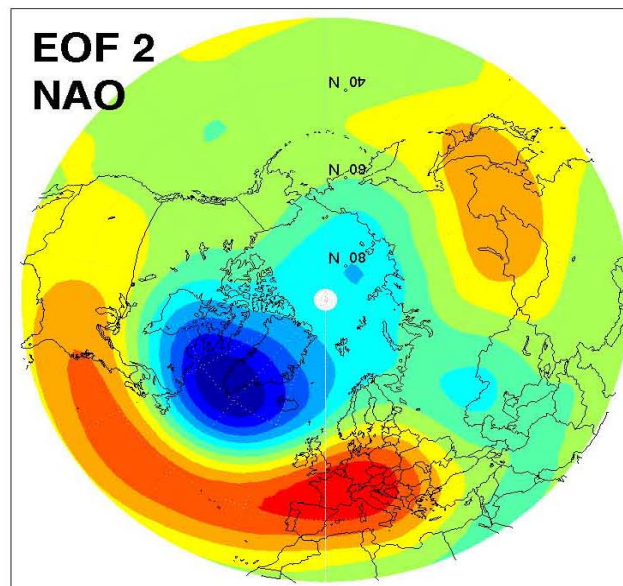
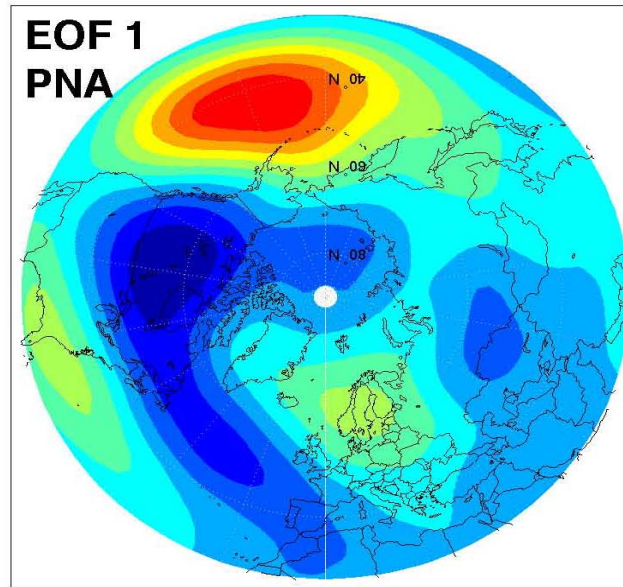
# The 500 mb network



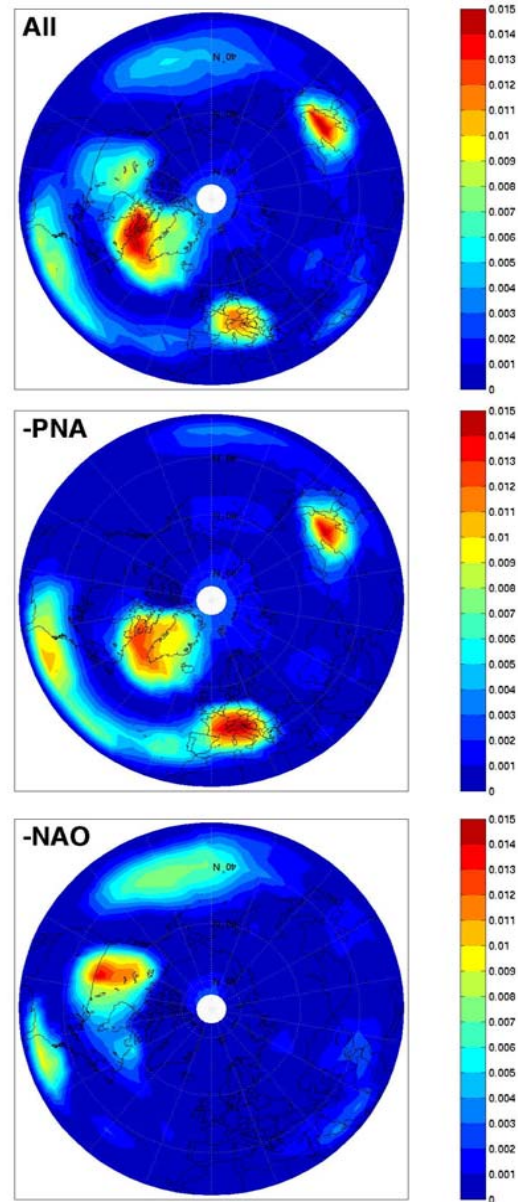
# The networks with and without supernodes



# EOFs 1&2 of the 500 hPa field



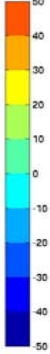
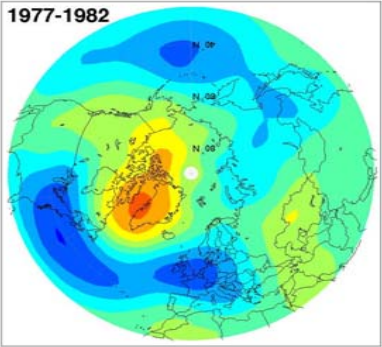
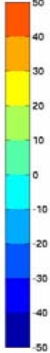
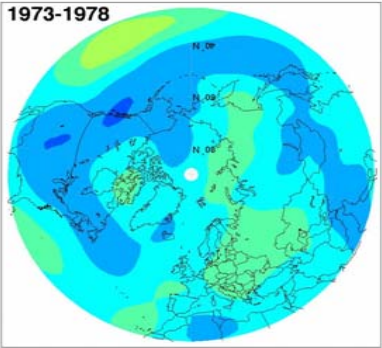
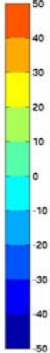
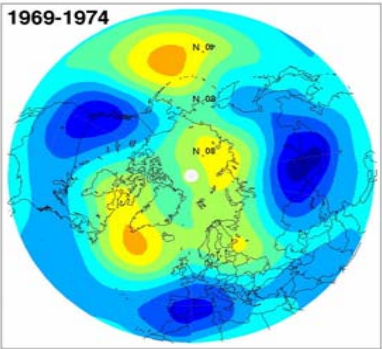
# Distance with and without supernodes



# Network statistics

	Modified clustering coefficient	Distance
Complete network	0.34	0.0025
Network without PNA	0.33	0.0023
Network without NAO	0.27	0.0016

# Observed 500 hPa anomaly composites



# Main points so far

- Climate has properties of small-world and scale-free networks.
- Teleconnection patterns can be viewed as supernodes in the network
- Teleconnections key to climate stability
- NAO a major force in the extratropics whereas PNA is a linear response to tropical forcing