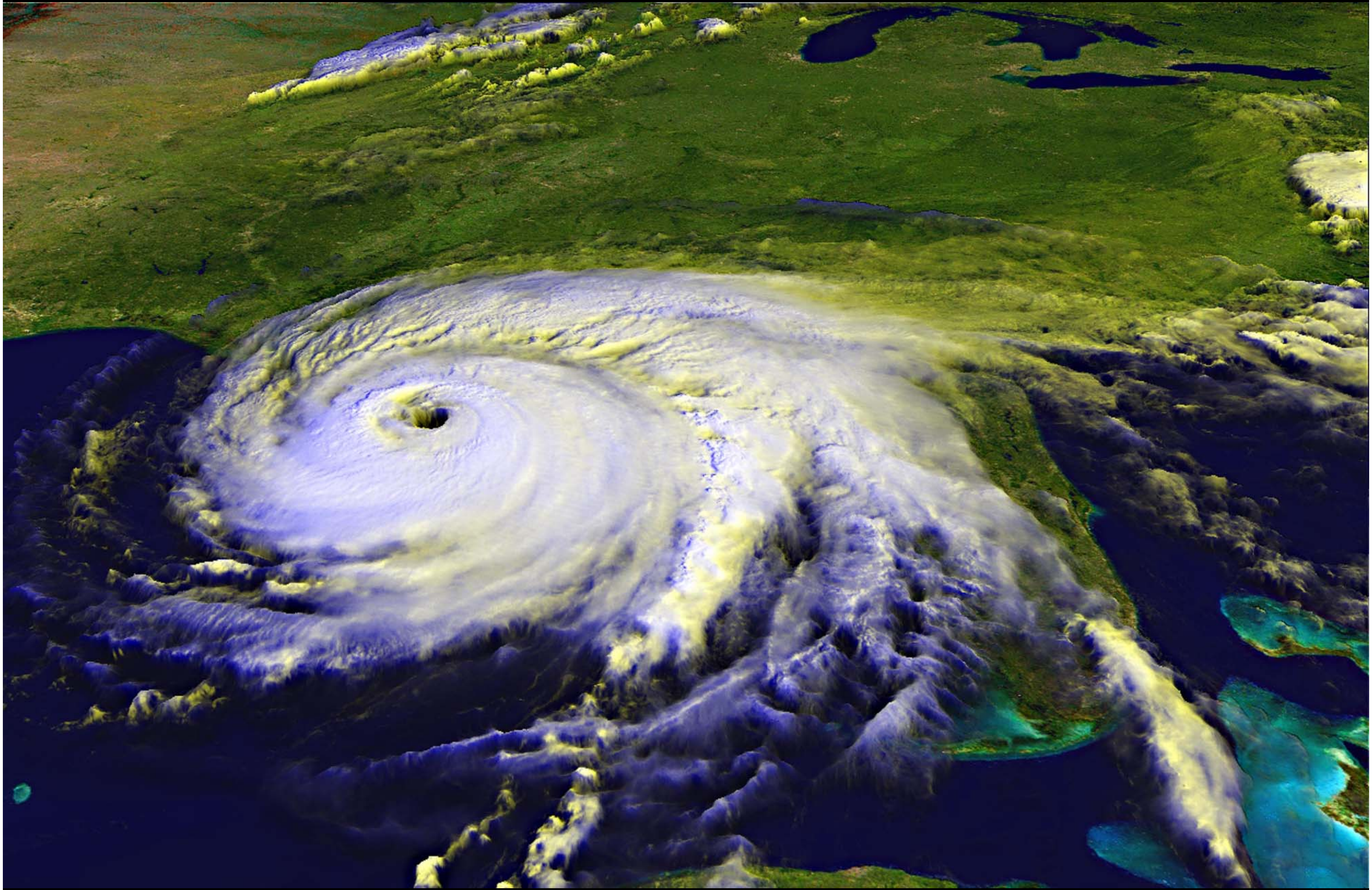
Follow The Energy

Hurricane Frances (2004) & Isabel (2003)

http://www.mthurricane.com/hurricanes.htm

Hurricane Ivan - September 16, 2004.



Hurricane Ivan

Hurricane Ivan

Hurricane Ivan - September 16, 2004.

Hurricane Ivan

http://xo.typepad.com/blog/photography/

Hurricane Katrina - August 29, 2005

Fargo Flood

http://www.ndsu.edu/fargo_geology/fldphotos2001.htm

Fargo Flood

http://www.ndsu.edu/fargo_geology/fldphotos2001.htm

Santa Clara, Utah Flood

http://www.santaclaracityutah.com/flood2005.htm

Santa Clara, Utah Flood

http://www.santaclaracityutah.com/flood2005.htm

Banda Ache Tsunami
(faked photo)

http://www.conspiration.cc/tsunami/catatrophe_made_in_us_uk.html

Banda Ache Tsunami
(faked photo)

http://www.conspiration.cc/tsunami/catatrophe_made_in_us_uk.html

Banda Ache Tsunami
(Not faked)

http://www.conspiration.cc/tsunami/catatrophe_made_in_us_uk.html

Banda Ache Tsunami

http://www.conspiration.cc/tsunami/catatrophe_made_in_us_uk.html

Tsunami victims in Indonesia

http://www.indymedia.org/images/2005/01/112691.jpg

Irrawaddy Delta, Burma

http://www.indymedia.org/images/2005/01/112691.jpg

Irrawaddy Delta, Burma

http://www.indymedia.org/images/2005/01/112691.jpg

Time in a Meandering River

Sacramento River – *a point bar and a chute cutoff*

What event is most likely to end up leaving a geologic record?

An average nice day by the river. . .

What event is most likely to end up leaving a geologic record?

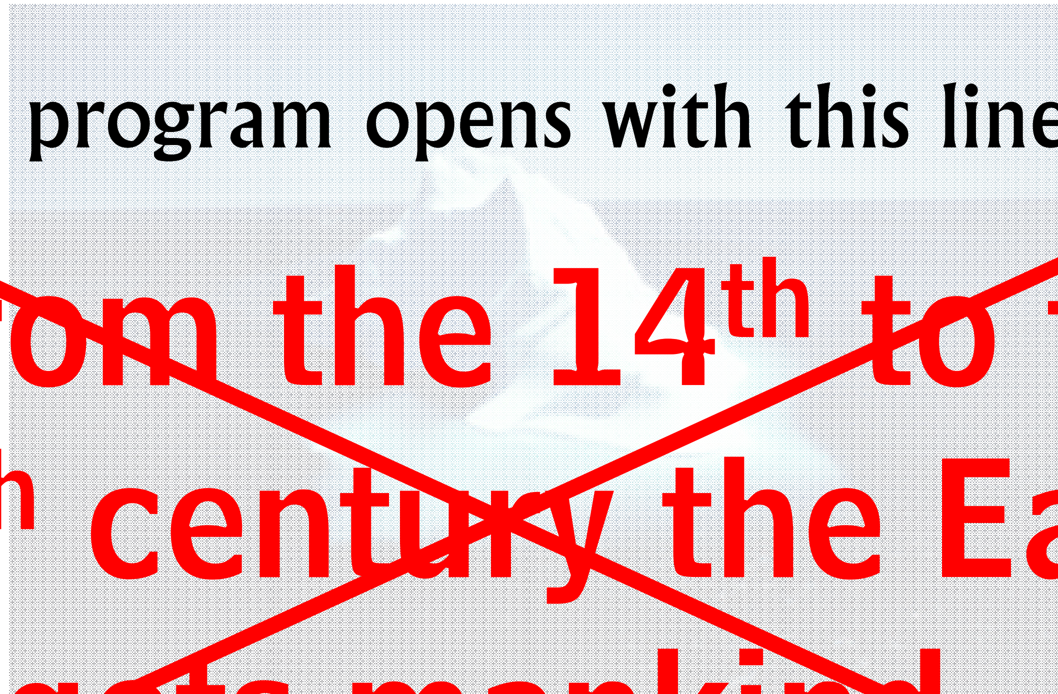
Or, a day like this . . .

http://publicworks.co.marion.or.us/administration/gis/mike11/

Which situation do humans consider right, or proper . . .

And which might the river prefer (if a river could prefer) ?

The program opens with this line . . .



"From the 14th to the 19th century the Earth targets mankind . . ."

This is part of the problem; we humans tend to think about the environment only in terms of ourselves – the Earth is doing something to us.

Traditionally, environmental approaches to the Earth fall into two categories.

1. How badly we are @#$%&* - up the Earth.

   . . . With pollution, over population, exploitation of resources, global warming, etc. etc.

2. How destructive natural Earth disasters are to humans.

   . . . – and somebody – government, scientists, somebody - better do something about it – now!

Neither approach is reasonable, balanced, accurate, or constructive.

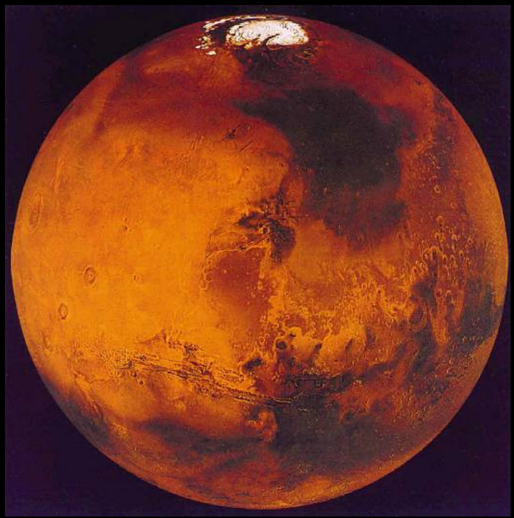
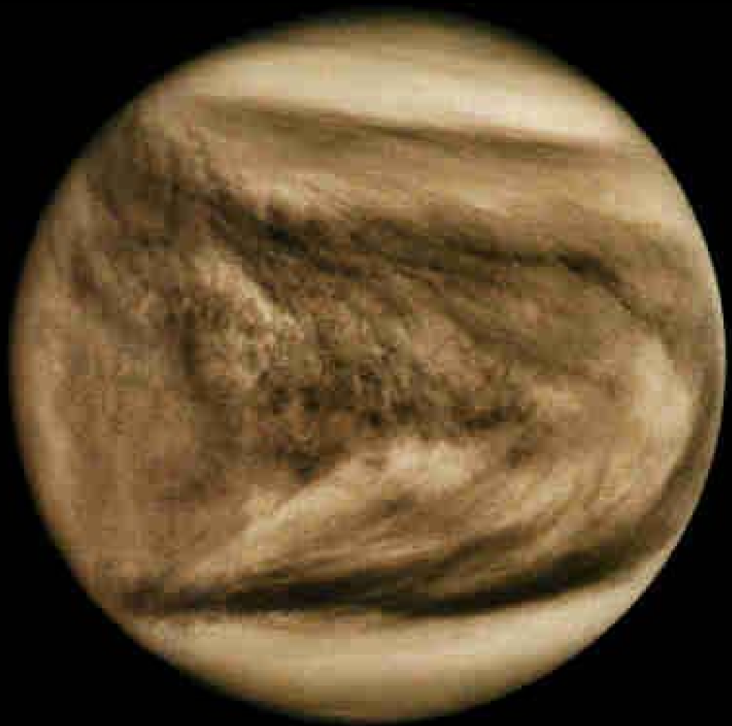
The Earth Does Not Have an Environmental Problem

We humans may have an environmental problem, . . . But not the Earth

As it has always done, the Earth just does what it does, . . .

And what it does is dissipate energy and information, . . .

The Earth is an open system, not closed like Mars . . . or Venus.

On "Acts of God" and the Earth As Natural System

"No government can be blamed for the tsunami tragedy, or cursed for not having done enough to prevent it.

We are not God.

We can recognize and work with the Earth's evolutionary design, but we cannot stop it –

Nor should we."

P.M.HJ. Atwater, L.H.D.
Echo, February 2005, page 16

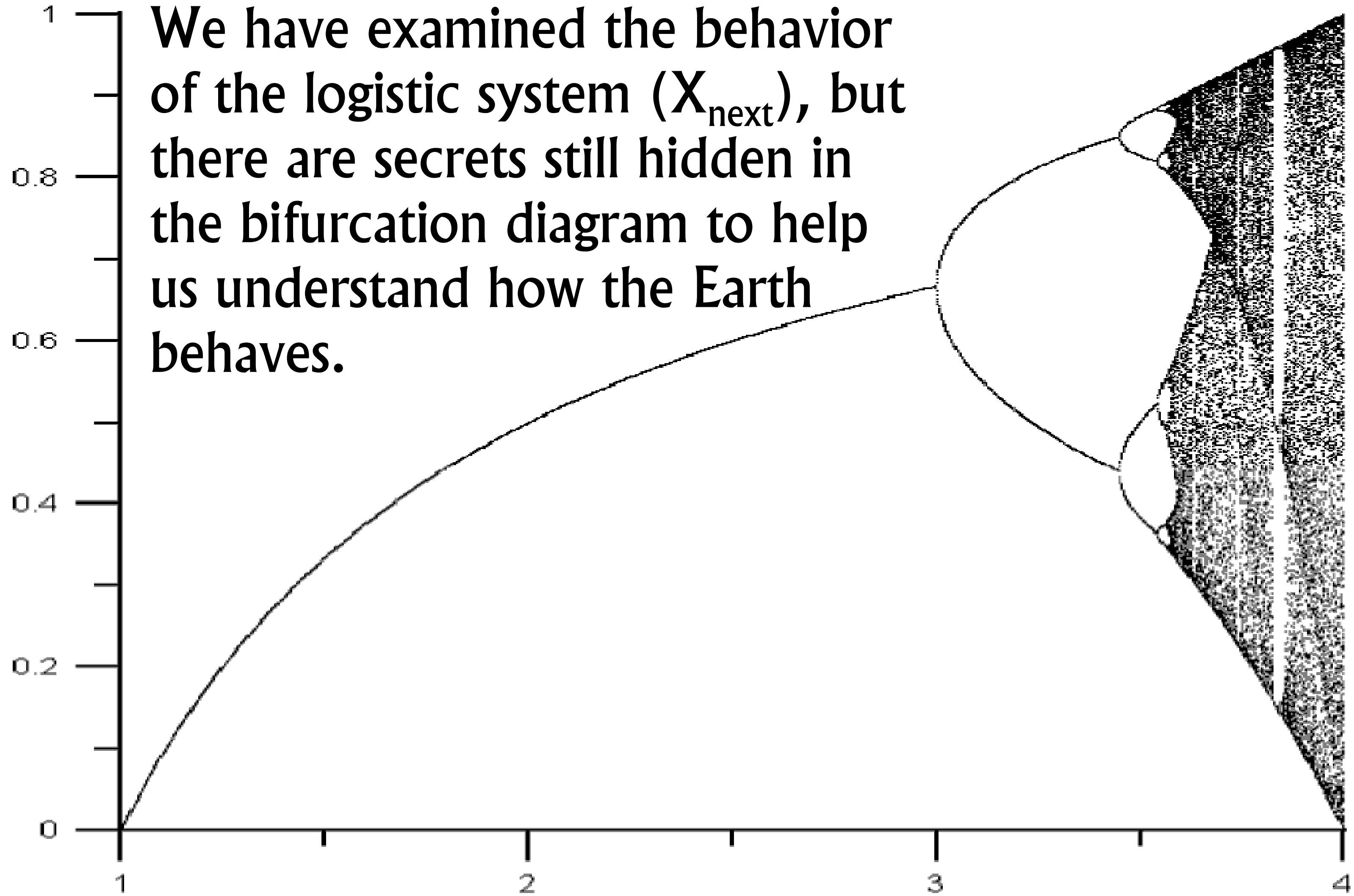
Sedimentary rocks and their environments, as well as weather events concern things that are happening at the Earth's surface, in places where we live.

We need to understand how this energy is dissipated.

Assumption # 3

Science tells us that change is linear: slow, gradual, and stately

We have examined the behavior of the logistic system (X_{next}), but there are secrets still hidden in the bifurcation diagram to help us understand how the Earth behaves.



X – Next
Zoom-Zoom

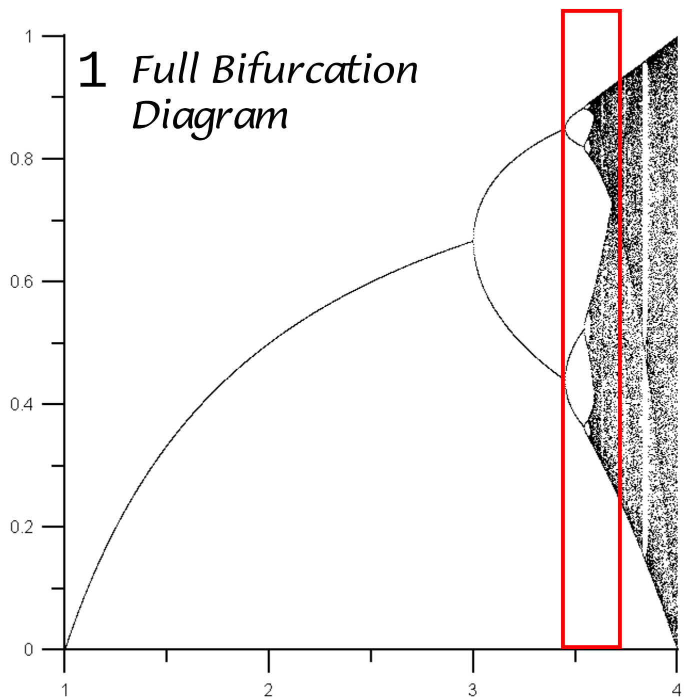
FRACTALS

Patterns, within patterns, within patterns, within patterns

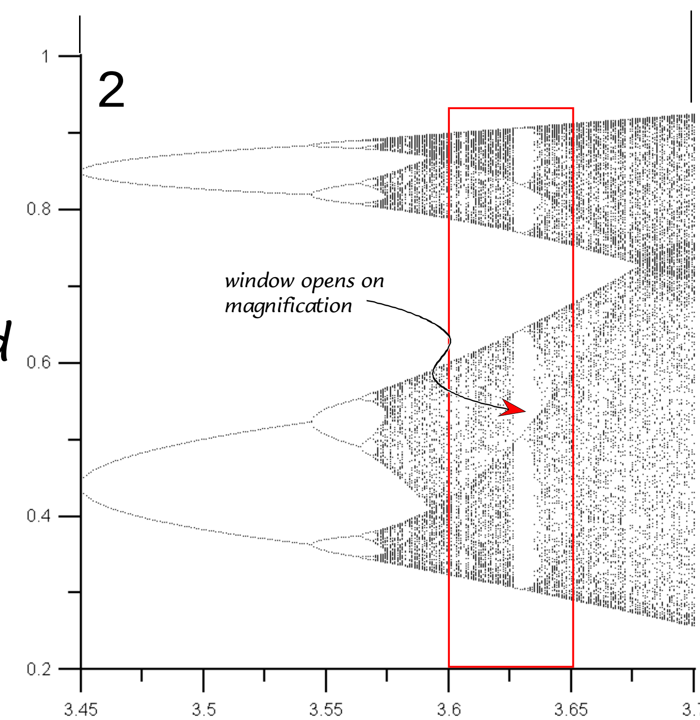
Properties of Complex Evolutionary Systems

Fractal Organization - X_{next}

patterns, within patterns, within patterns



Red box in 1 Stretched and Enlarged in 2

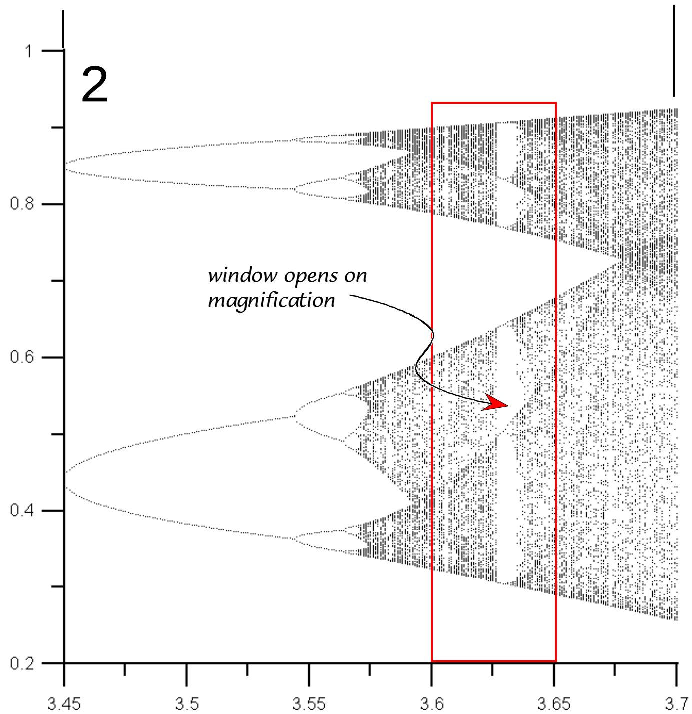


Universality

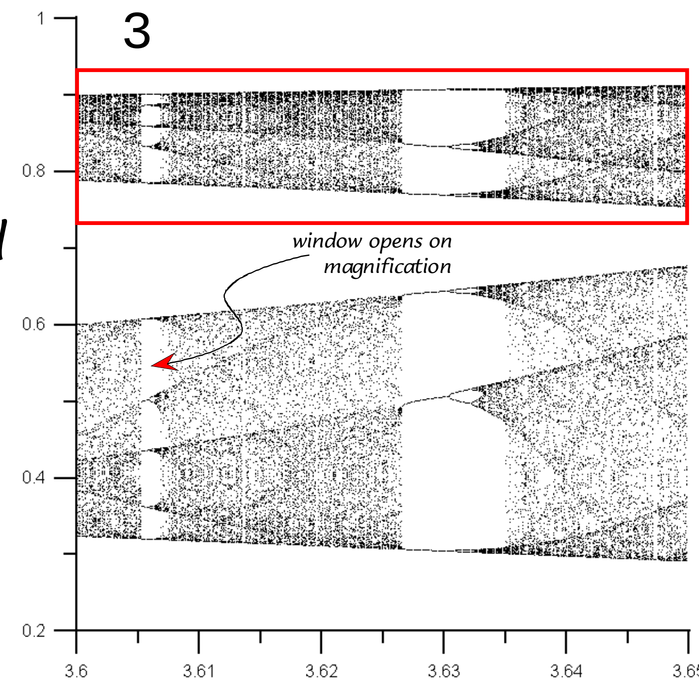
Properties of Complex Evolutionary Systems

Fractal Organization - X_{next}

patterns, within patterns, within patterns

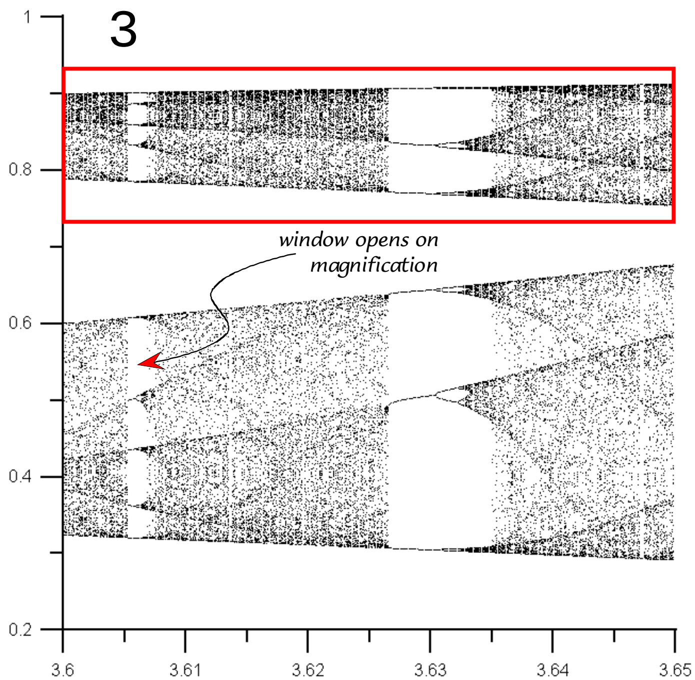


Red box in 2 Stretched and Enlarged in 3

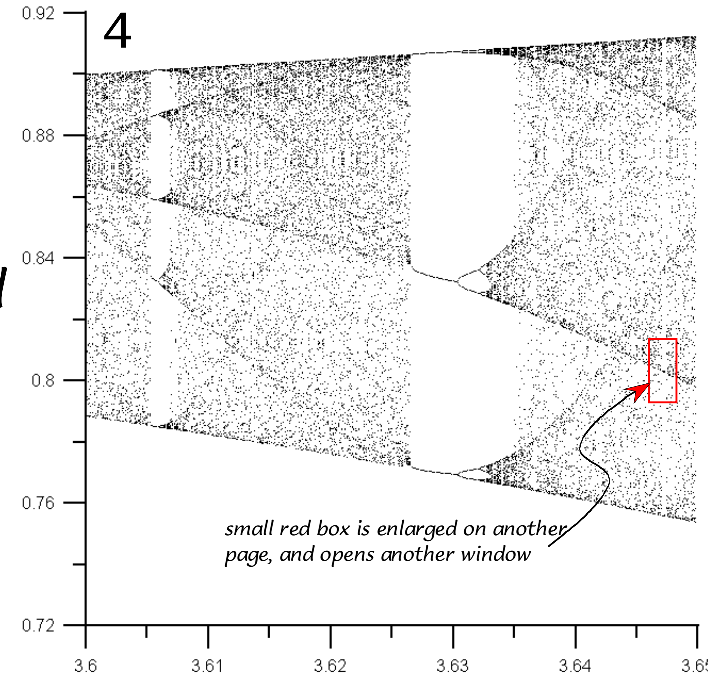


Fractal Organization - X_{next}

patterns, within patterns, within patterns



Red box in 3 Stretched and Enlarged in 4



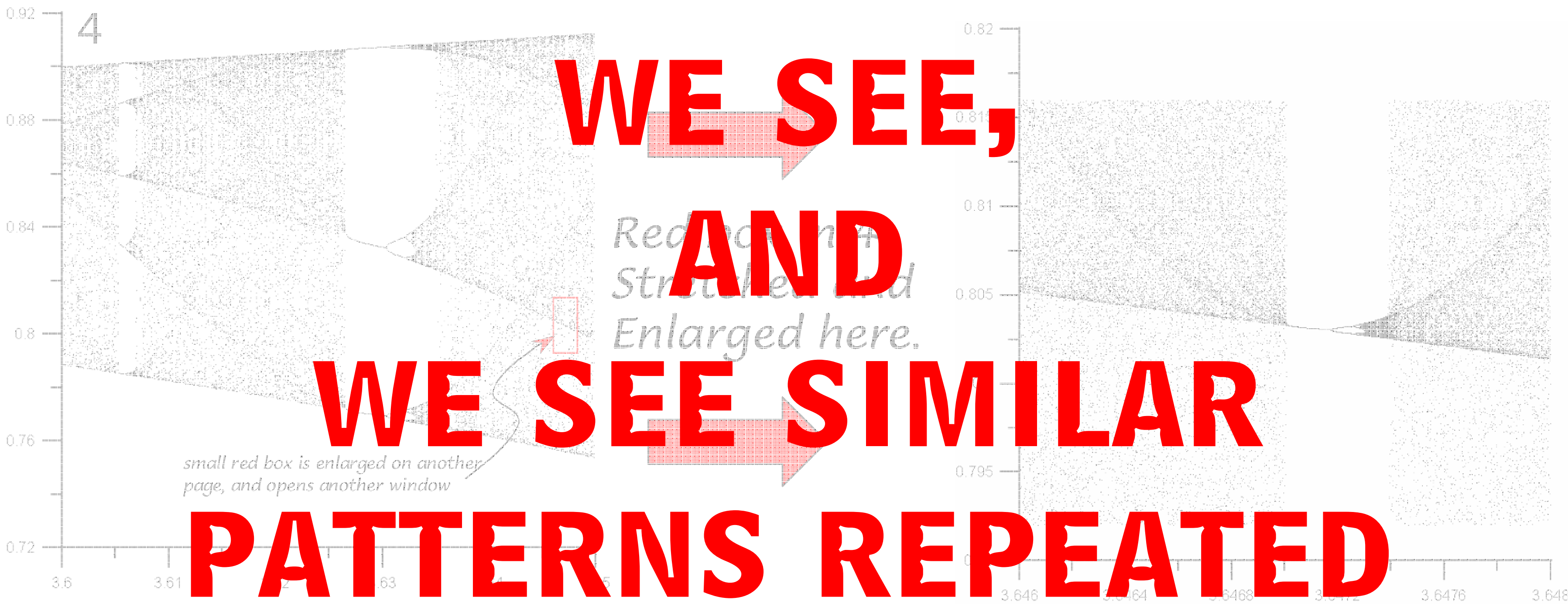
Universality

Properties of Complex Evolutionary Systems

Fractal Organization - X next

patterns, within patterns, within patterns

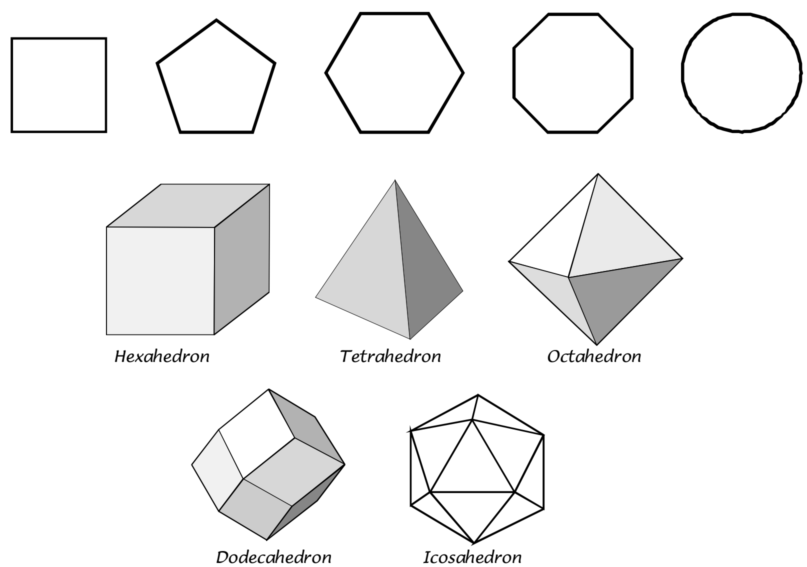
THE CLOSER WE ZOOM IN THE MORE DETAIL WE SEE, AND WE SEE SIMILAR PATTERNS REPEATED AGAIN AND AGAIN.



Euclidean and Fractal Geometry

Things that are fractal are characterized by two distinctive characteristics:

1. Non-whole Dimensions



• Dimension 0	Dimension 1
Dimension 2	Dimension 3

$$\text{Fractal Dimension} = \frac{\text{Log N (number of similar pieces)}}{\text{Log M (magnification factor)}}$$

$$N = M^{D}$$

N = # of new pieces

M = magnification

D = dimension

Fractal dimensions are never whole numbers.

Euclidean and Fractal Geometry

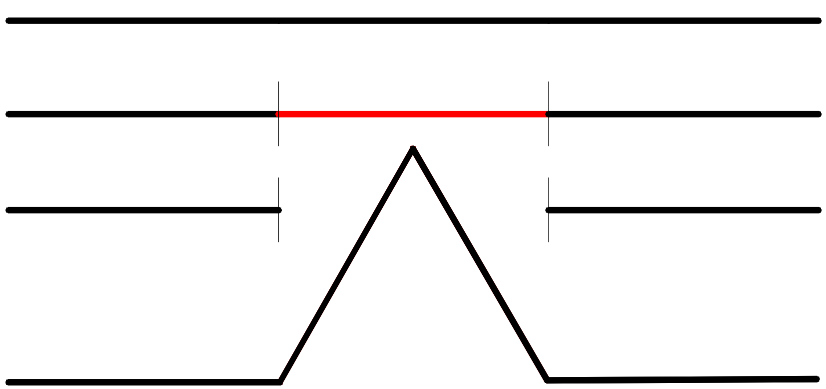
Things that are fractal are characterized by two distinctive characteristics:

2. Generated by iteration

Fractal objects are generated by iteration of an algorithm, or formula. The Koch Curve is an example, generated by 4 steps, which are then repeated-iterated -over and over indefinitely, or as long as you want.

Koch Curve

First Iteration

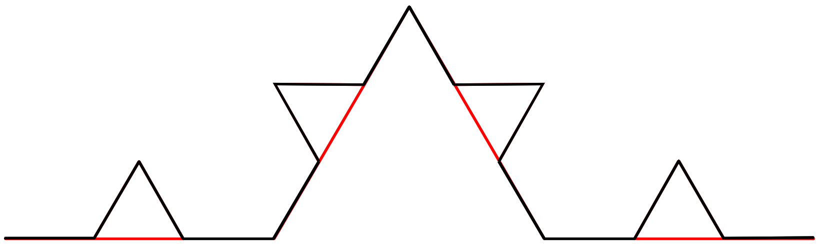


1. Begin with a line
2. Divide line into thirds
3. Remove middle portion
4. Add two lines to form a triangle in middle third of original line

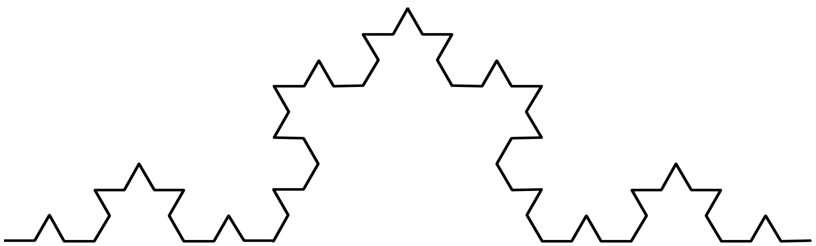
Repeat Steps 1 - 4

Universality

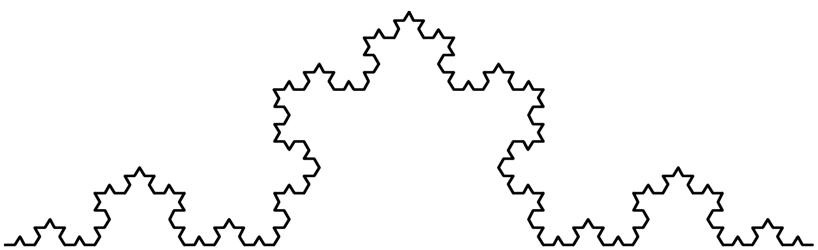
Fractal Geometry
Koch Curve



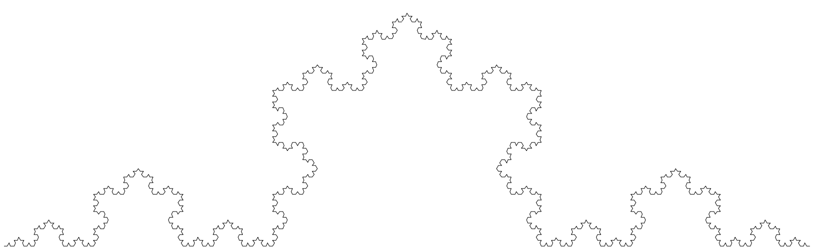
2nd Iteration



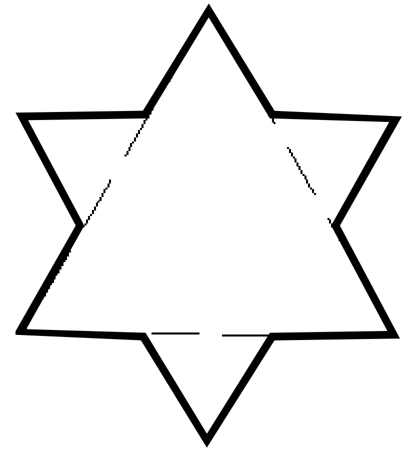
3rd Iteration

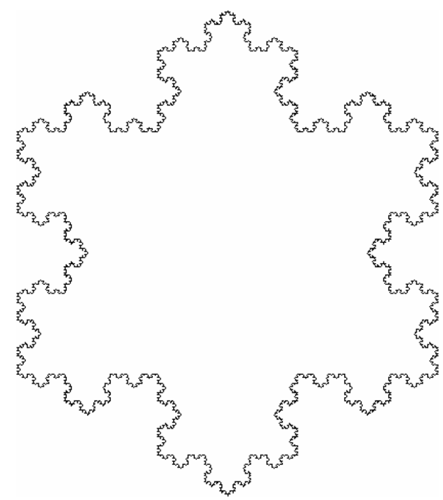


4th Iteration

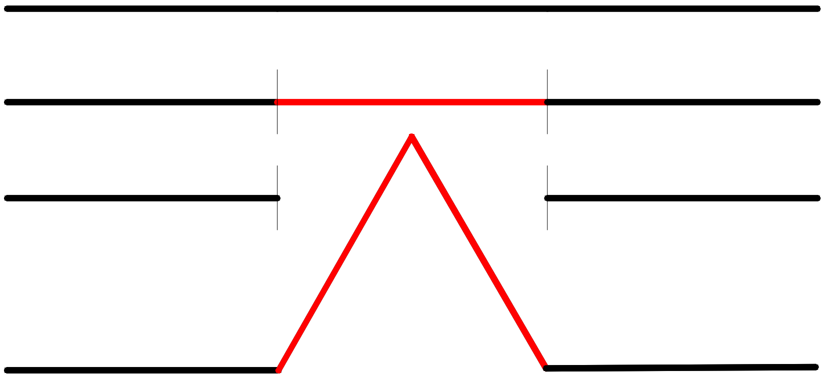


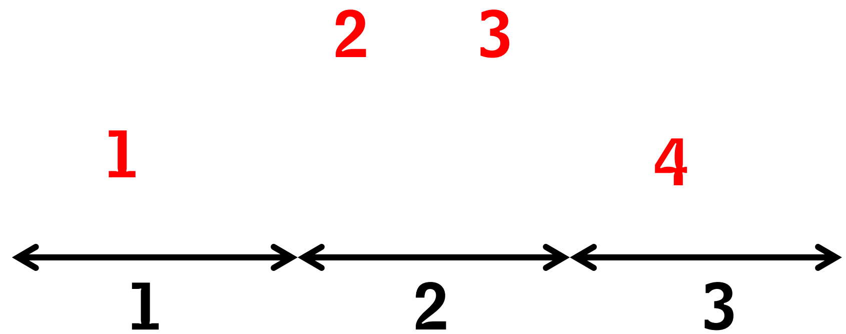
5th Iteration



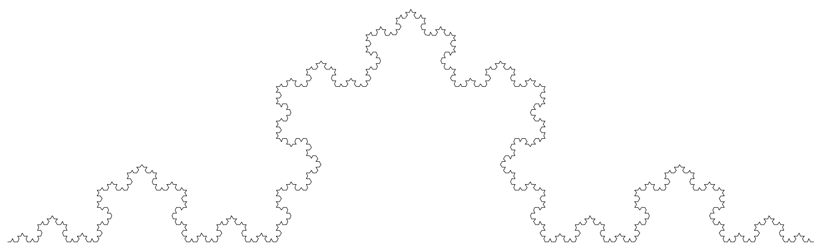


Koch Curve Fractal Dimensions





$$D = \frac{\text{Log N (number of new pieces)}}{\text{Log M (Magnification: factor of finer resolution)}} \quad \frac{\text{Log } 4}{\text{Log } 3} \quad \frac{.602}{.477}$$



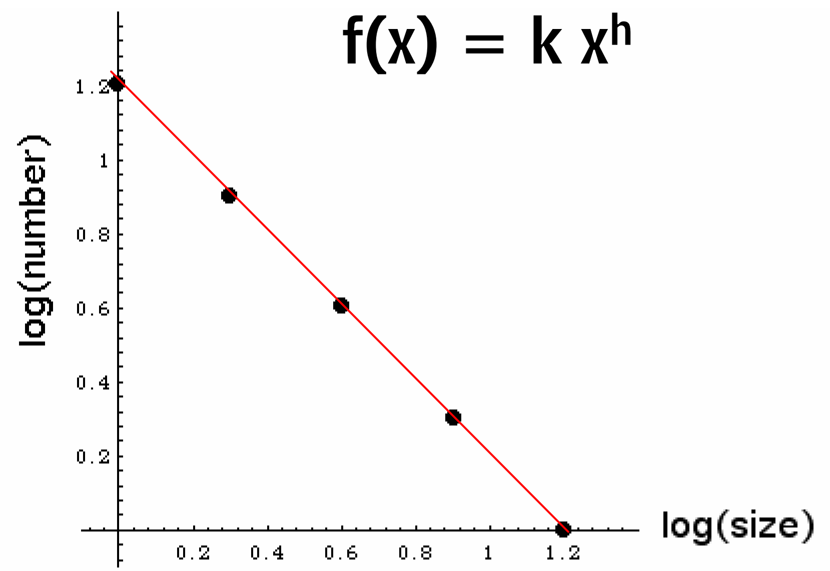
Koch's Curve has a dimension of 1.2618595071429

Euclidean and Fractal Geometry

Things that are fractal are characterized by two distinctive characteristics:

1. Non-whole Dimensions

$$\text{Fractal Dimension} = \frac{\text{Log (number of similar pieces)}}{\text{Log (magnification factor)}}$$



Fractal Dimension =

~ 2.5

$$N = M^D$$

N = # of new pieces

M = magnification

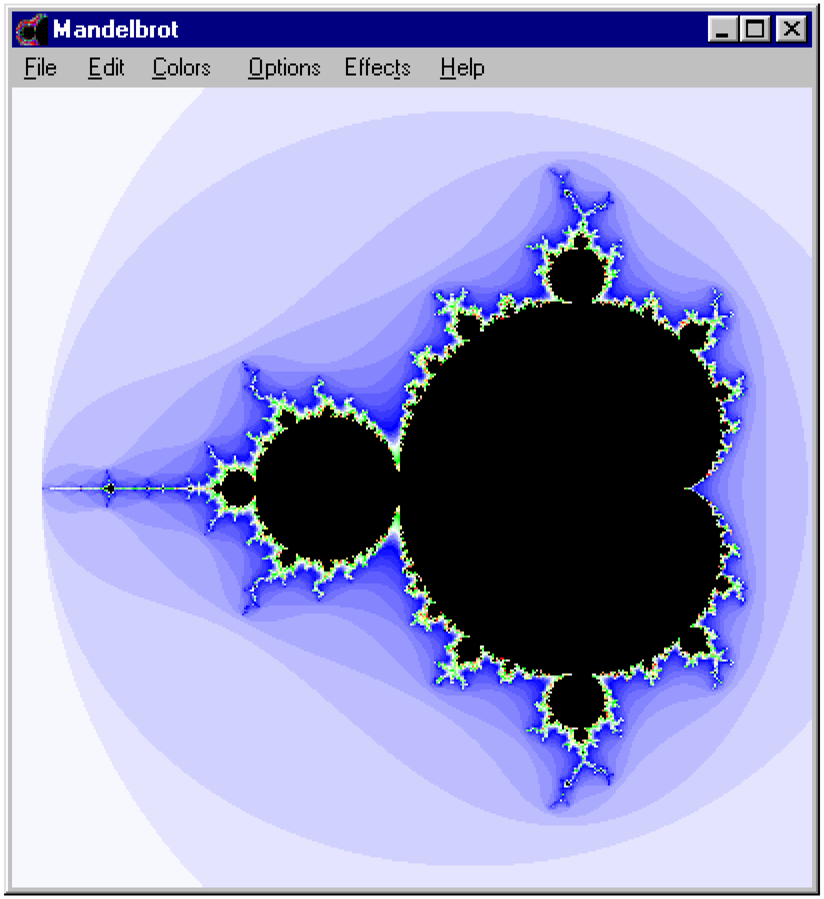
D = dimension

Crumpling the paper introduces spaces of a range of sizes. There is a hierarchy of space sizes, a few large, many small.

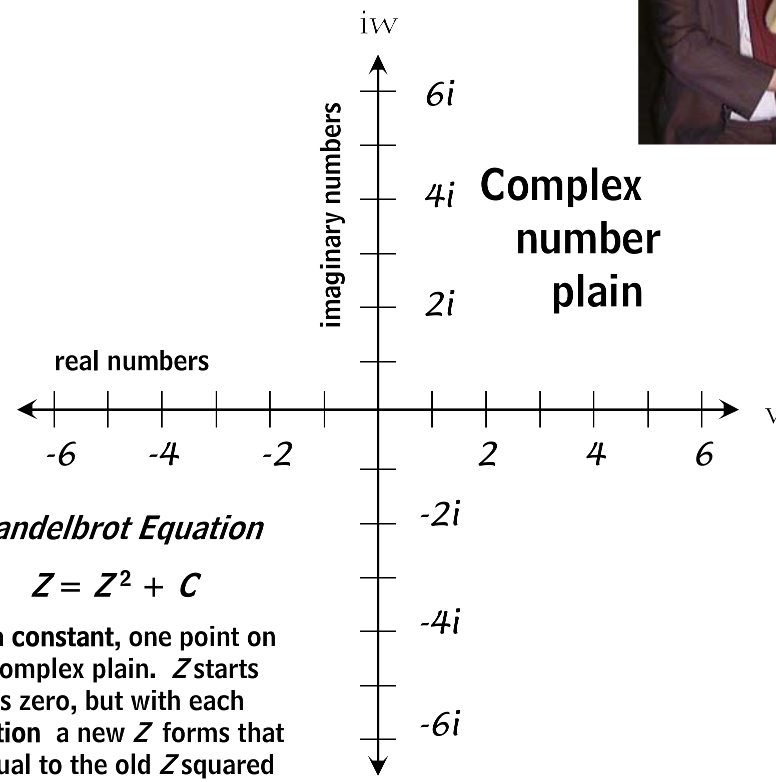
http://classes.yale.edu/fractals/FracAndDim/BoxDim/PowerLaw/PowerLaw.html

Universality

Fractal Geometry in the The Mandelbrot Set



Geometrical Self Similarity



Complex number plain

Mandelbrot Equation

$$Z = Z^2 + C$$

C is a **constant,** one point on the complex plain. *Z* starts out as zero, but with each **iteration** a new *Z* forms that is equal to the old *Z* squared plus the constant *C*.

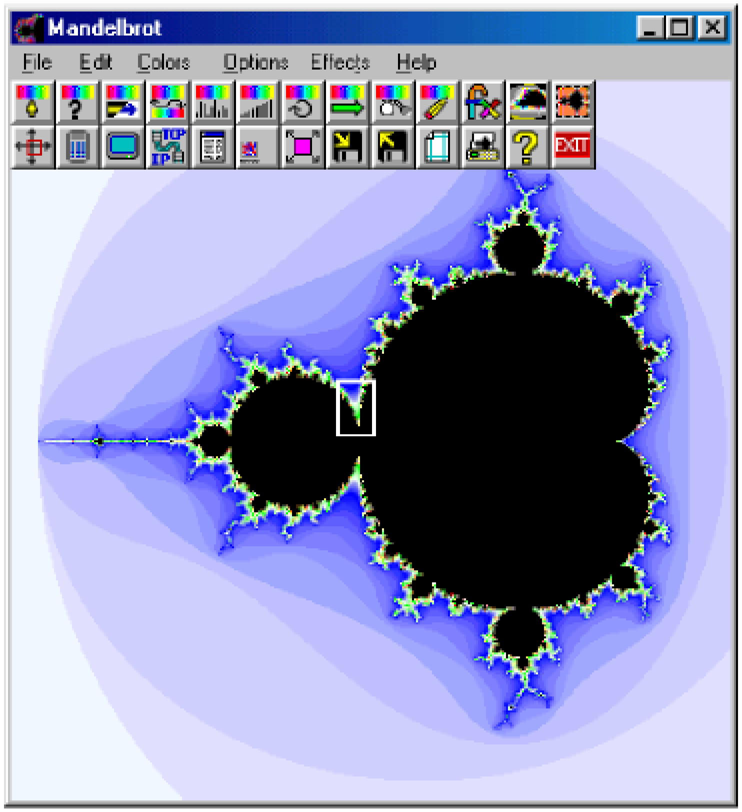
Take a point on the complex number plain, place its value into the Mandelbrot equation and iterate it 1000 times. If the number resulting from the equation settles down to one value, color the pixel black. If the number enlarges towards infinity then color it something else, say fast expanding numbers red, slightly slower ones magenta, very slow ones blue, and so on. Thus, if you have a sequence of pixels side by side, of different colors, that means that each of those values expanded toward infinity at a different rate in the iterated equation. The discs, swirls, bramble-like bushes, sprouts and tendrils spiraling away from a central disc you see are the results of calculating the Mandelbrot set.

Run Mandelbrot

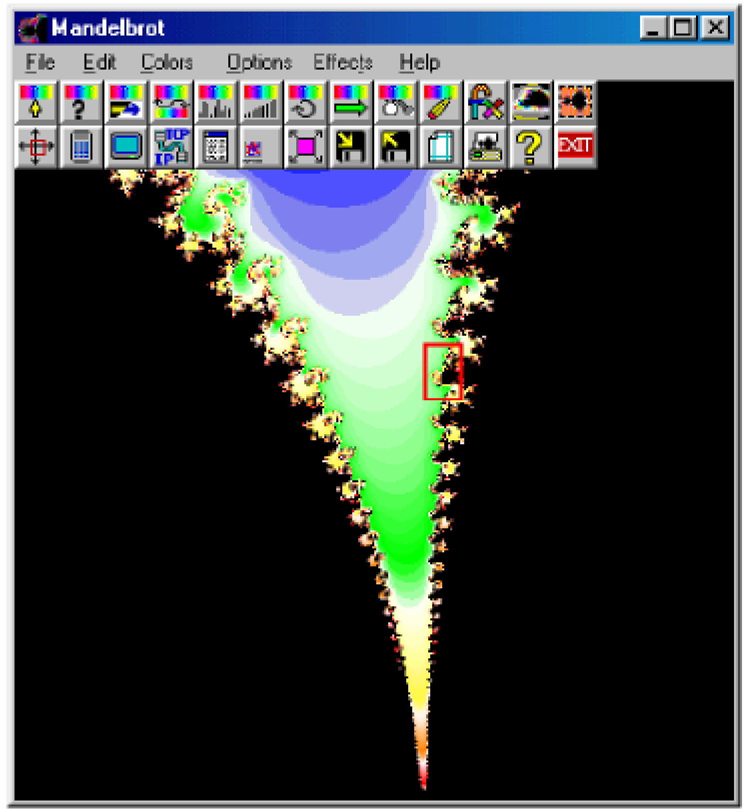
[Google Search]

The Mandelbrot Set Cascade

Zoom One

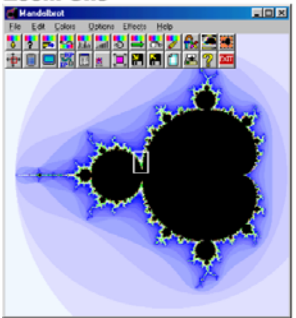


Zoom Two

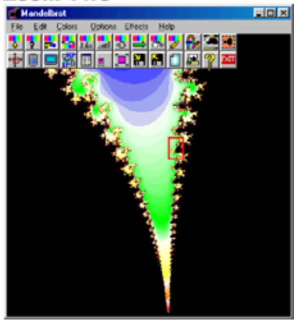


The Mandelbrot Set Cascade

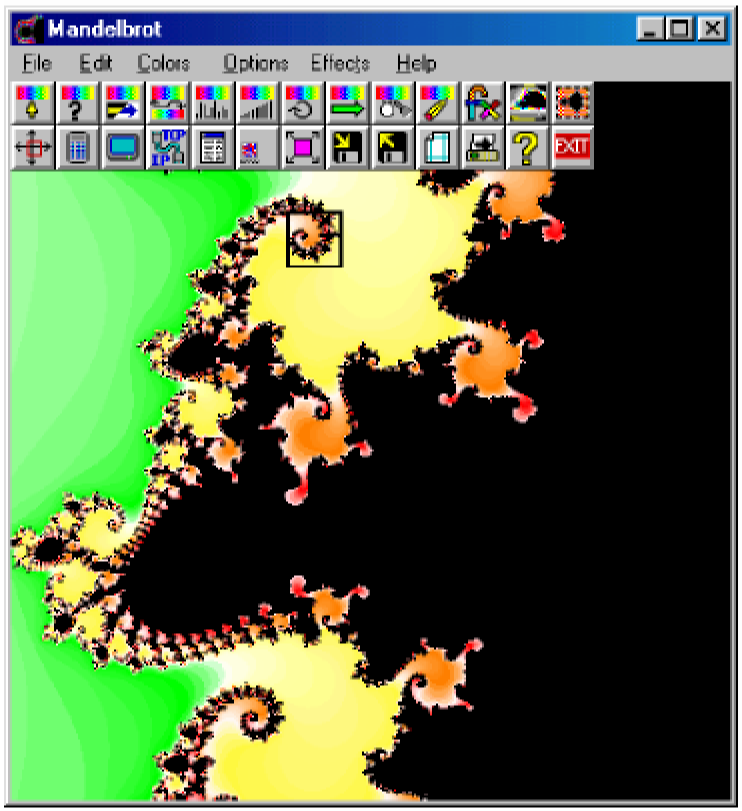
Zoom One



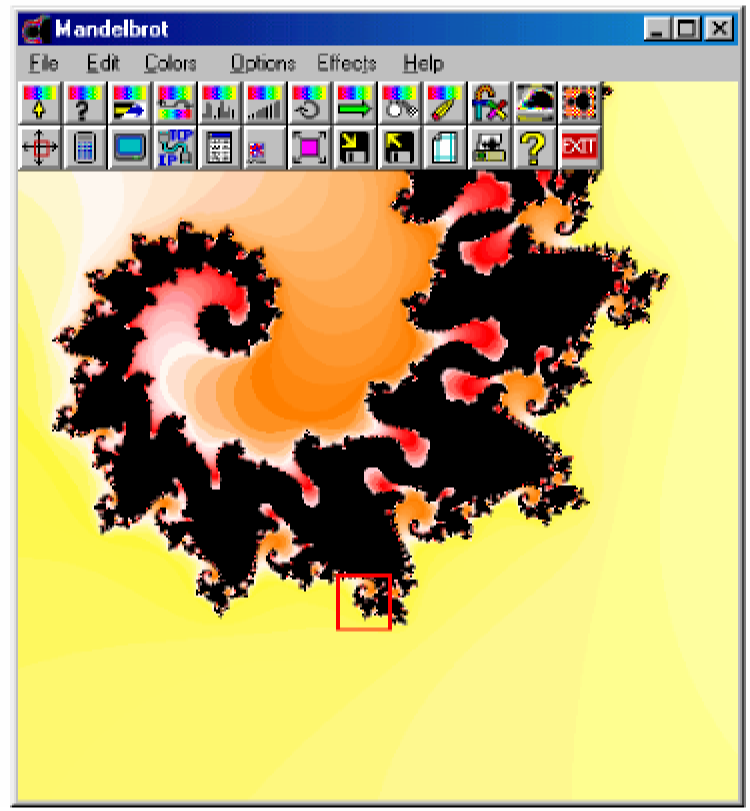
Zoom Two



Zoom Three

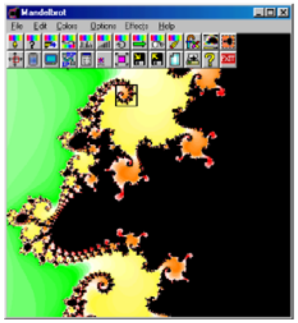


Zoom Four



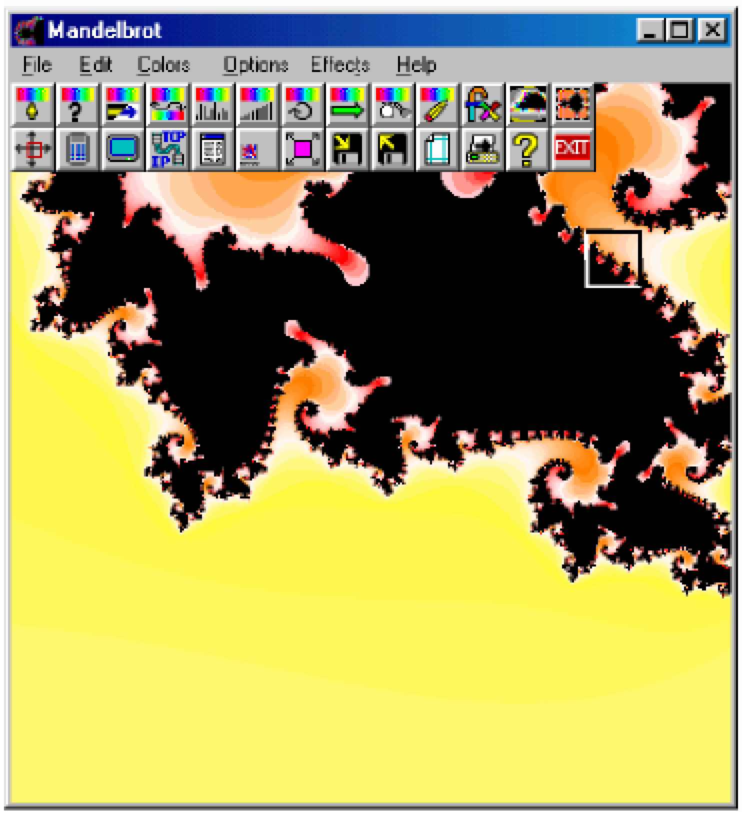
The Mandelbrot Set Cascade

Zoom Three

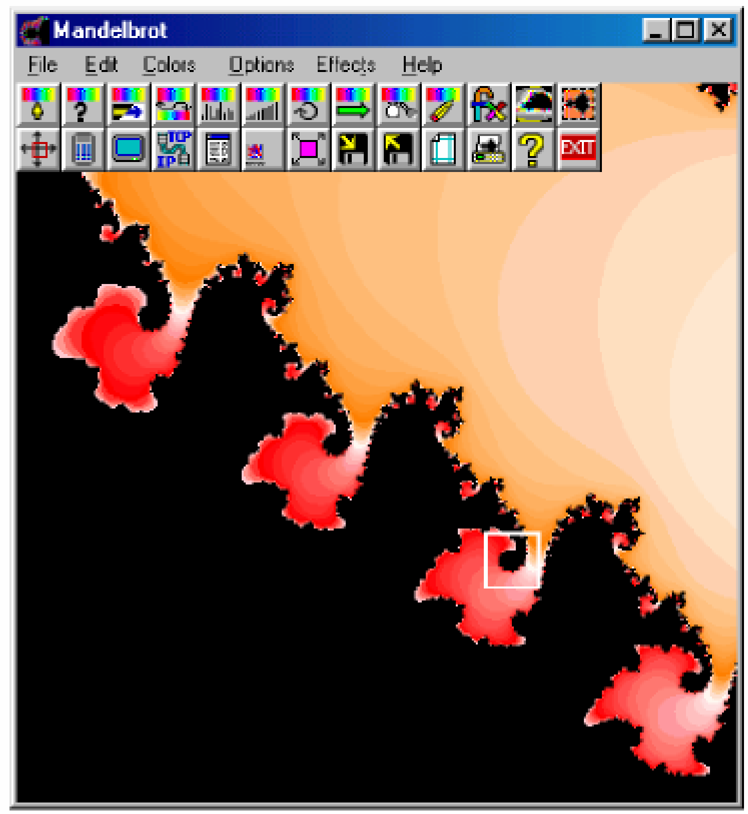


Zoom Four

Zoom Five

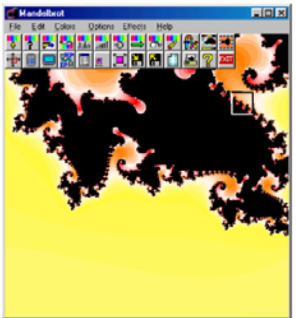


Zoom Six

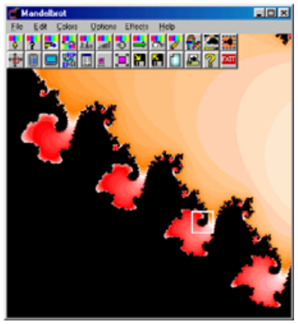


The Mandelbrot Set Cascade

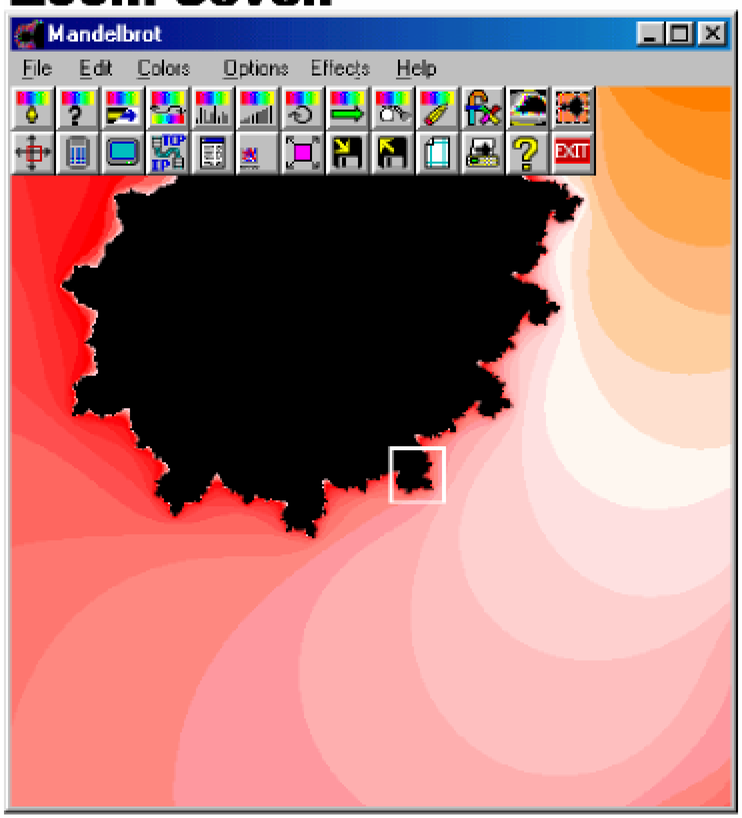
Zoom Five



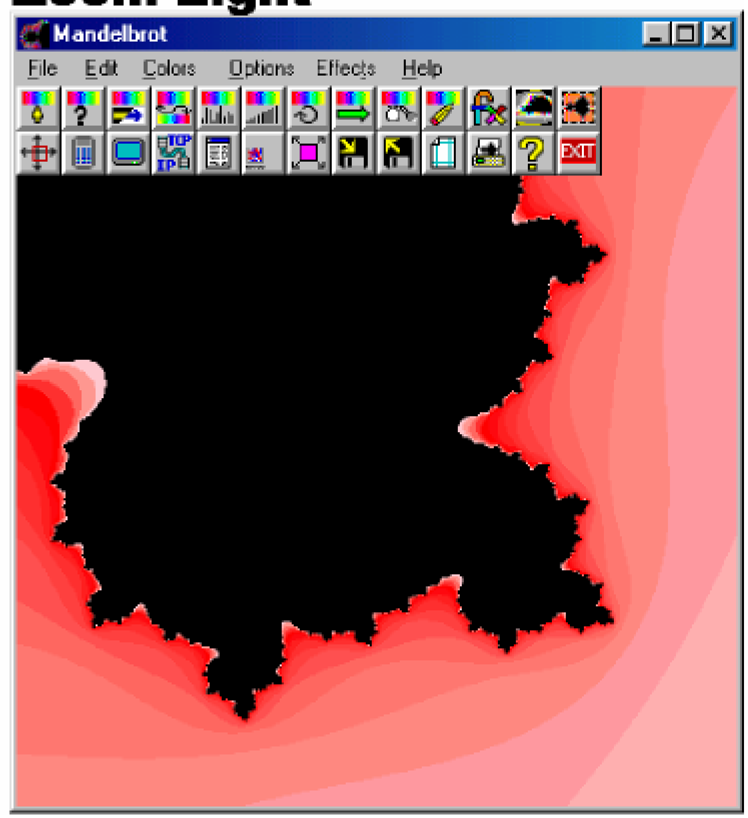
Zoom Six



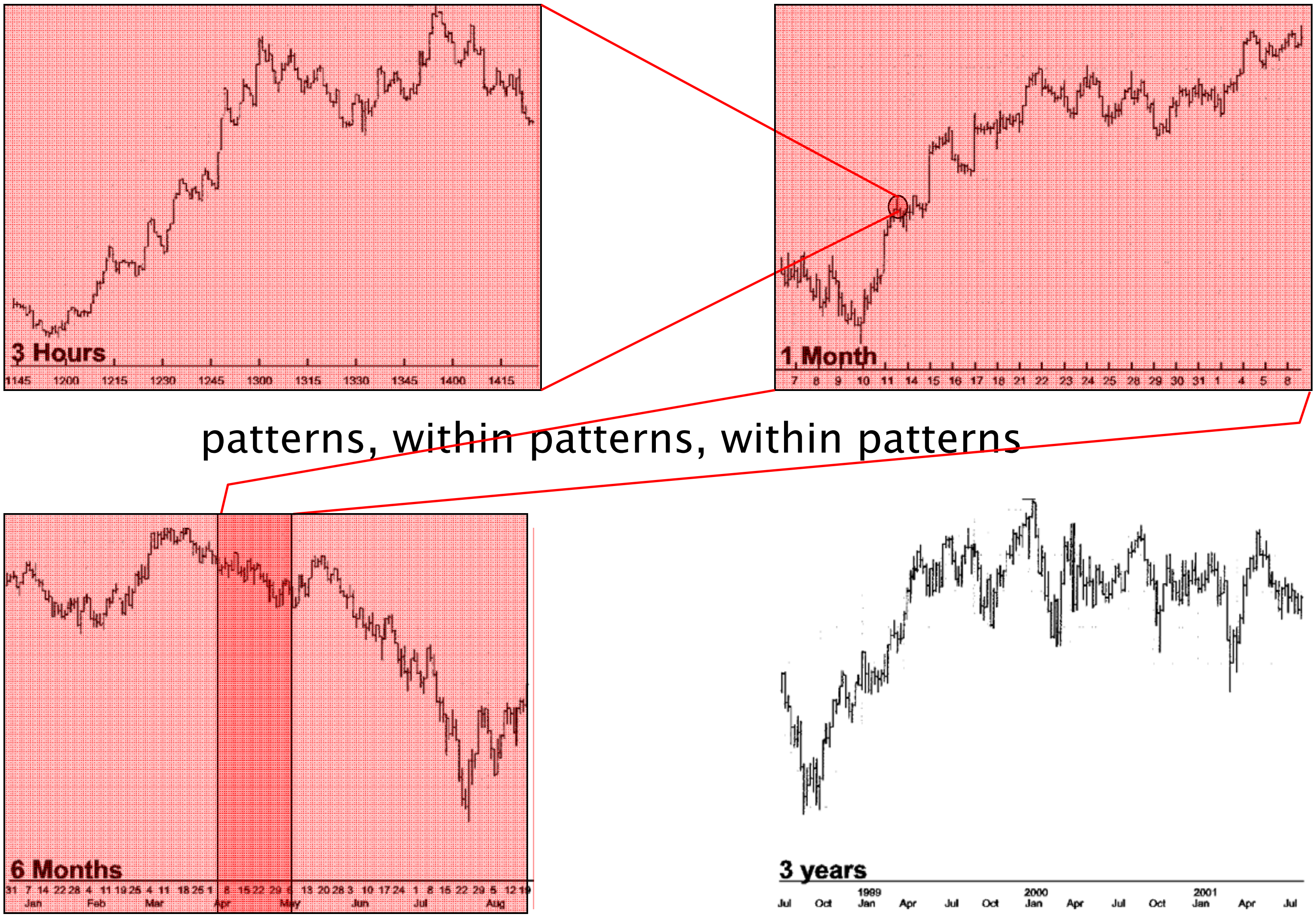
Zoom Seven



Zoom Eight



Fractal Organization – Dow Jones Average



What you can see and understand . . .

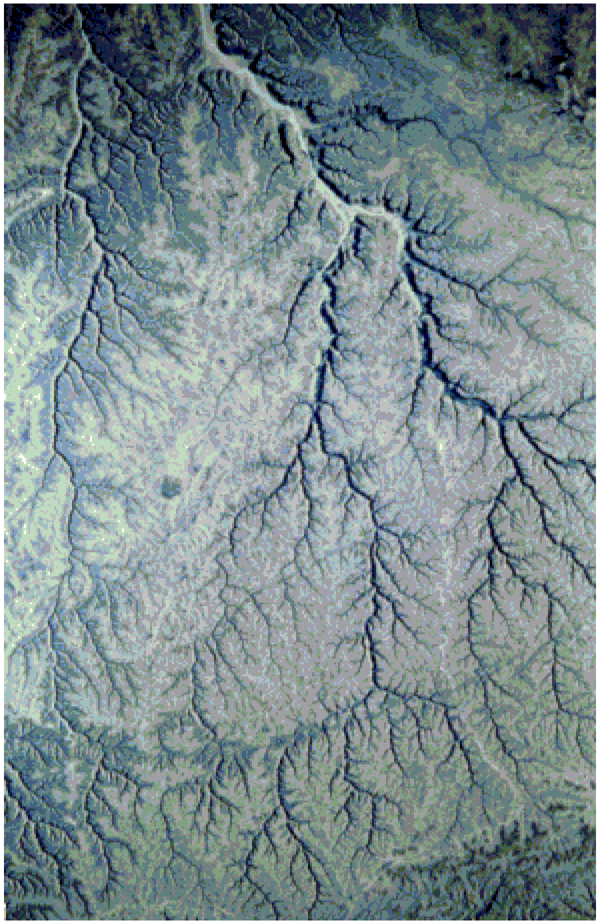
Depends on Your Scale of Observation

Universality
Properties of Complex Evolutionary Systems

Fractal Organization – Drainage Patterns

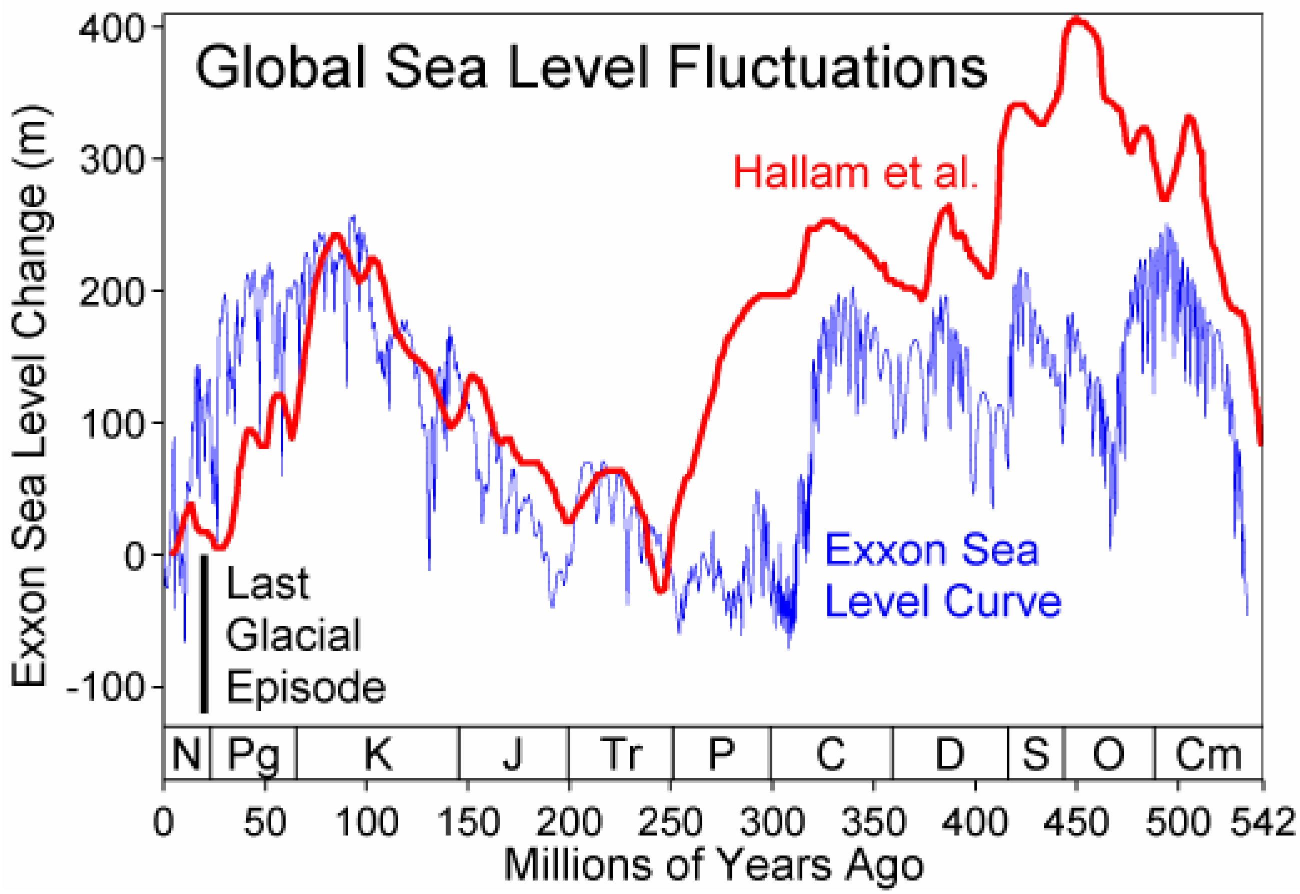
patterns, within patterns, within patterns

Careful geologists always include a scale or scale reference (a coin, a hammer, a camera lens cap or a human) when taking a picture of geologic interest. The reason is that if they didn't, the actual size of the object pictured could not be determined. This is because many natural forms, such as coastlines, fault and joint systems, folds, layering, topographic features, turbulent water flows, drainage patterns, clouds, trees, etc. look alike on many scales.



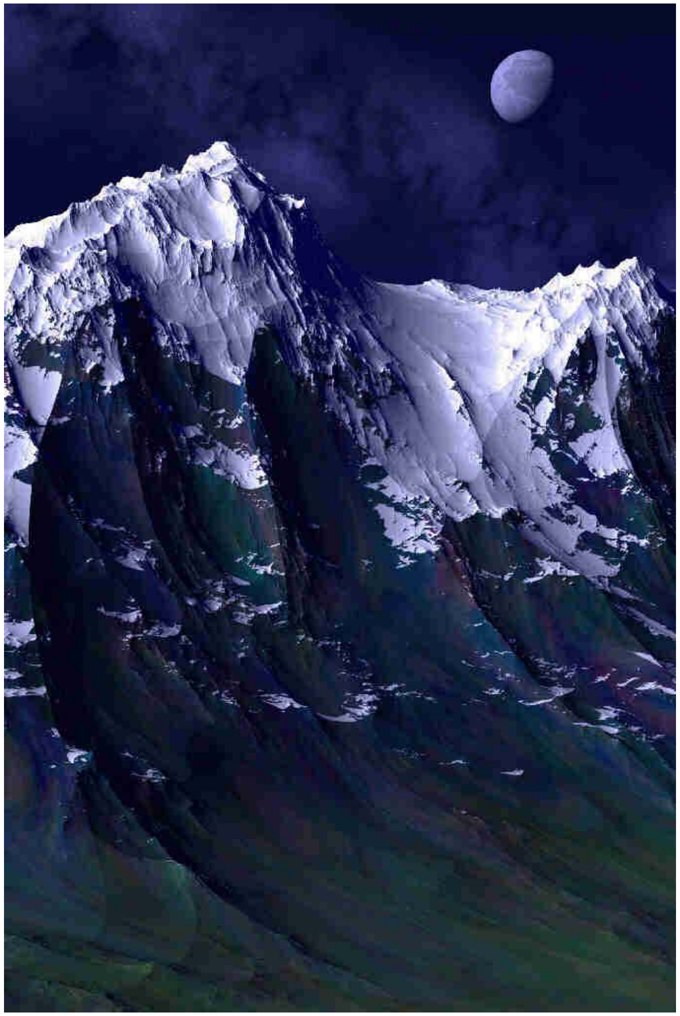
http://www.earthscape.org/t1/ems01/link03Txt-03.html

Fractal Organization – Sea Level Changes



Fractal Organization – Landscapes

patterns, within patterns, within patterns



Scale and Observation

What you can measure depends on the scale of your ruler.

The time you can resolve depends on the accuracy of your clock.

The size of what you can see depends on the power of your measuring instrument; microscopes for small things, eyes, for intermediate things, telescopes for very distant things.

The Earth events you can witness, or even the human species can witness, depends on how long you live.

There is no typical or average size for events.

Scale and Observation

What you can measure depends on the scale of your ruler.

The time-scales you can detect depend on the accuracy of your clock.

There is no typical or average size for events.

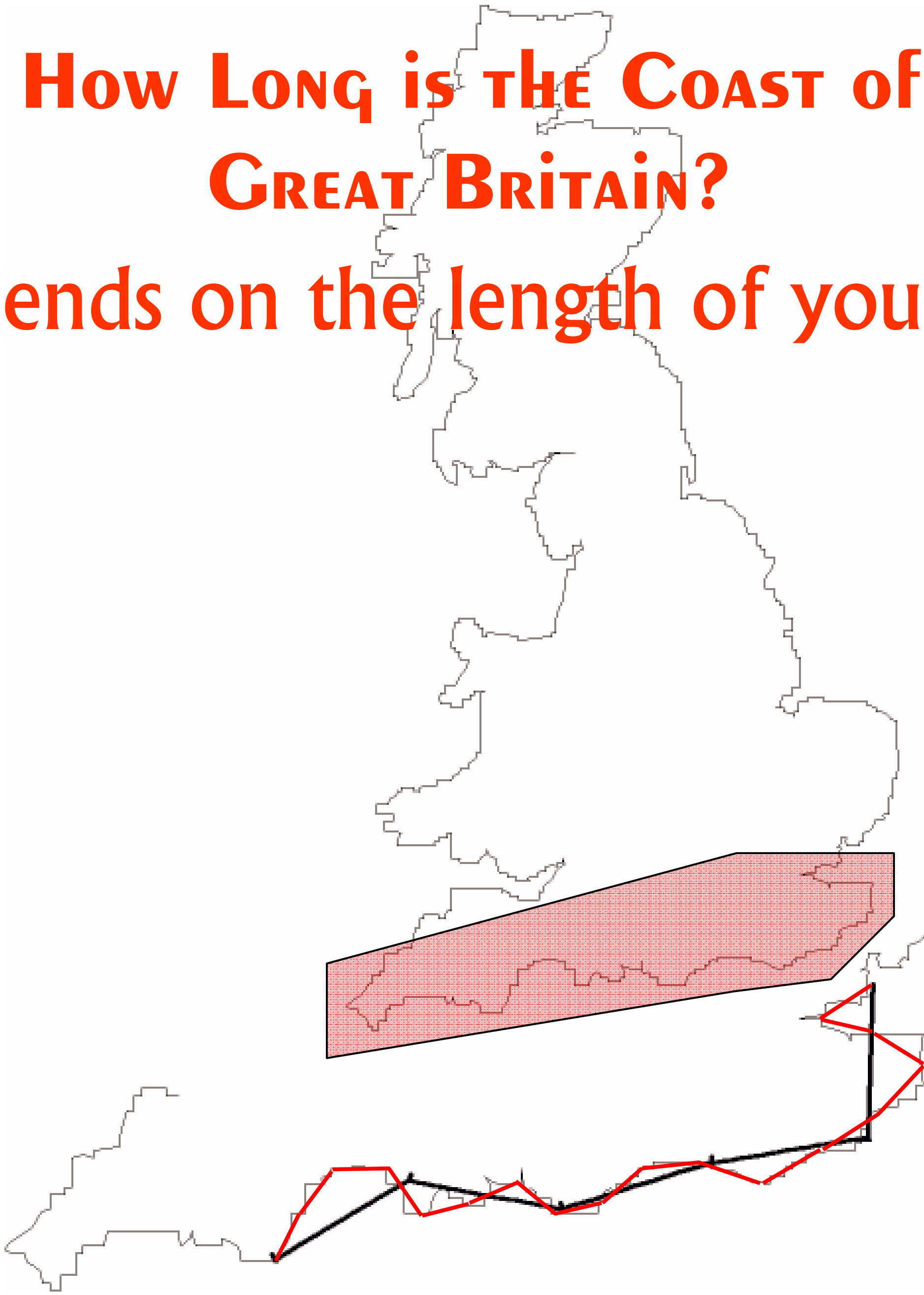
The [illegible] you can see depends on the power of your measuring instrument; microscopes for small things, eyes for intermediate things, telescopes for very distant things.

The Earth events you can witness, or even the human species can witness, depends on how long you live.

There is no typical or average size for events.

How Long is the Coast of Great Britain?

It depends on the length of your ruler



http://en.wikipedia.org/wiki/List_of_fractals_by_Hausdorff_dimension

How Long is the Coast of Great Britain?

It depends on the length of your ruler

The coast line is actually infinitely long

Fractal Dimension = 1.24

http://en.wikipedia.org/wiki/List_of_fractals_by_Hausdorff_dimension

X – Next and Chaos Theory

Power Law Relationships

Anything that is fractal follows a power law relationship, and everything that evolves by the dissipation of energy is fractal.

Comparing Linear, Exponential and Non-Linear Changes

$$Y = mx + b$$

Linear, if we graph it we get a straight line

In general, if the right hand side is all pluses, minuses, multiplication, and/or division.

$$Y = X^2$$

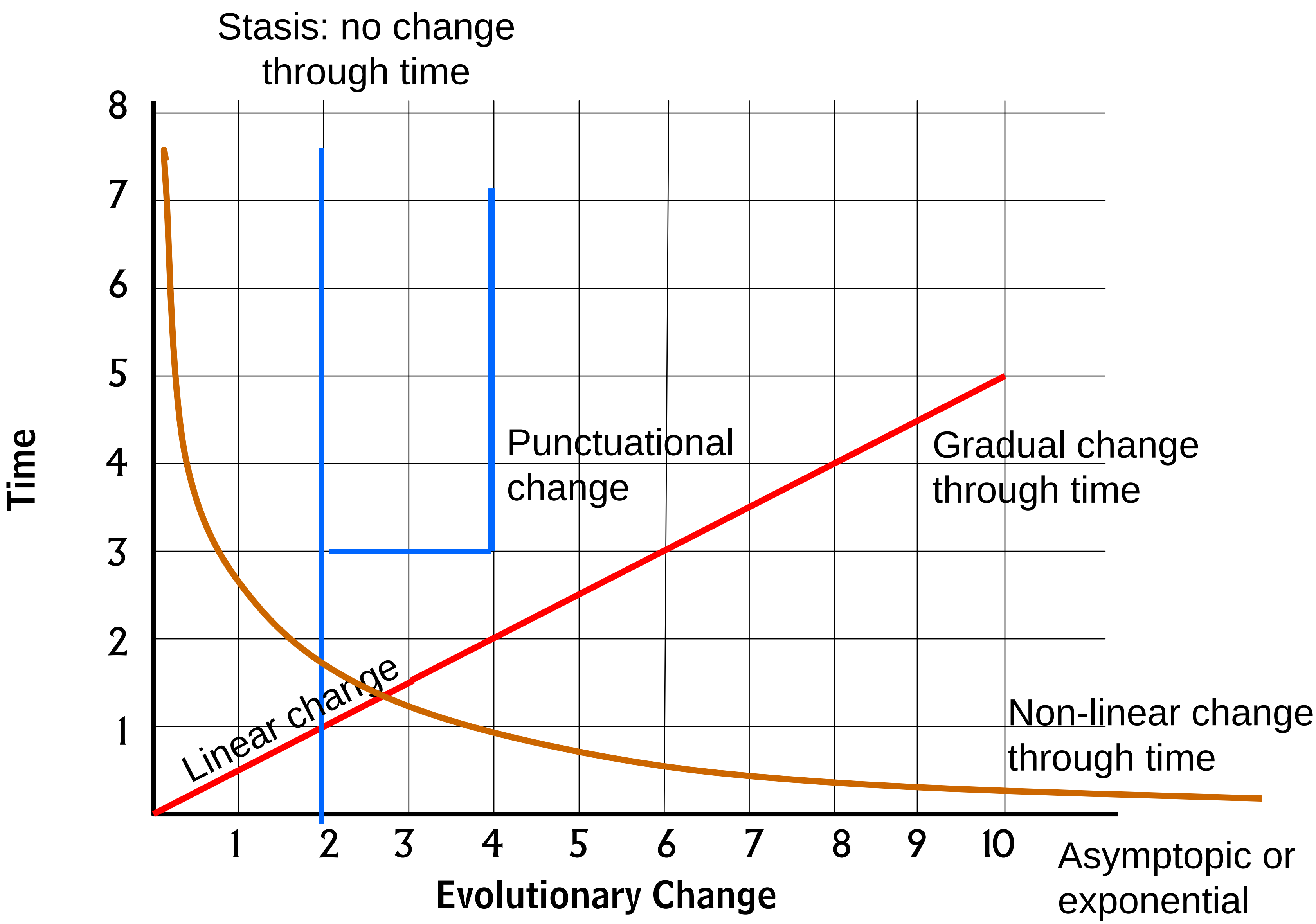
$$Y = \sin X$$

Non-Linear, if we graph it we get an exponential curve.

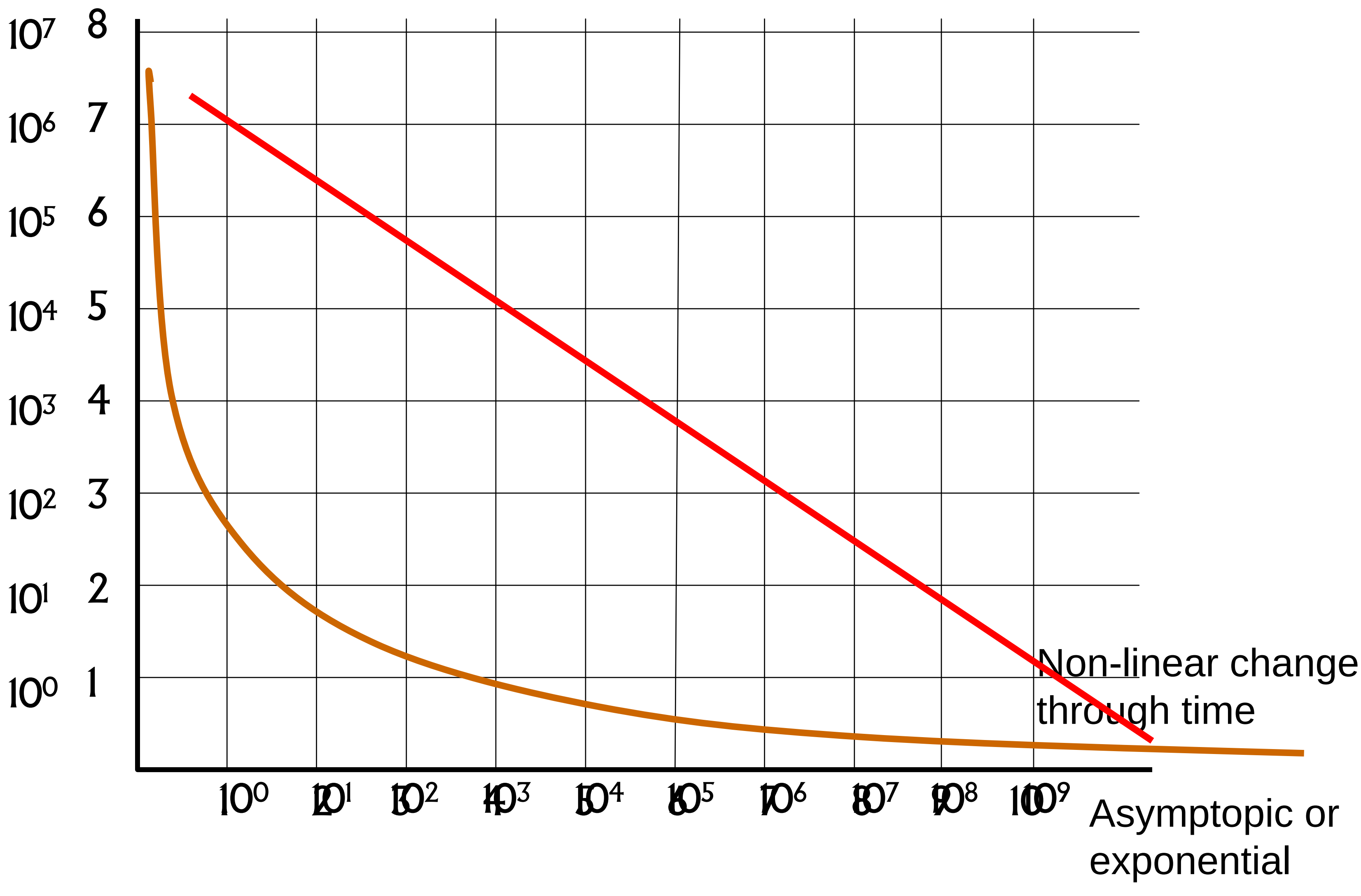
In general, if the right hand side has powers, sines, cosines, or other fancy stuff it is non-linear

The rate of change changes

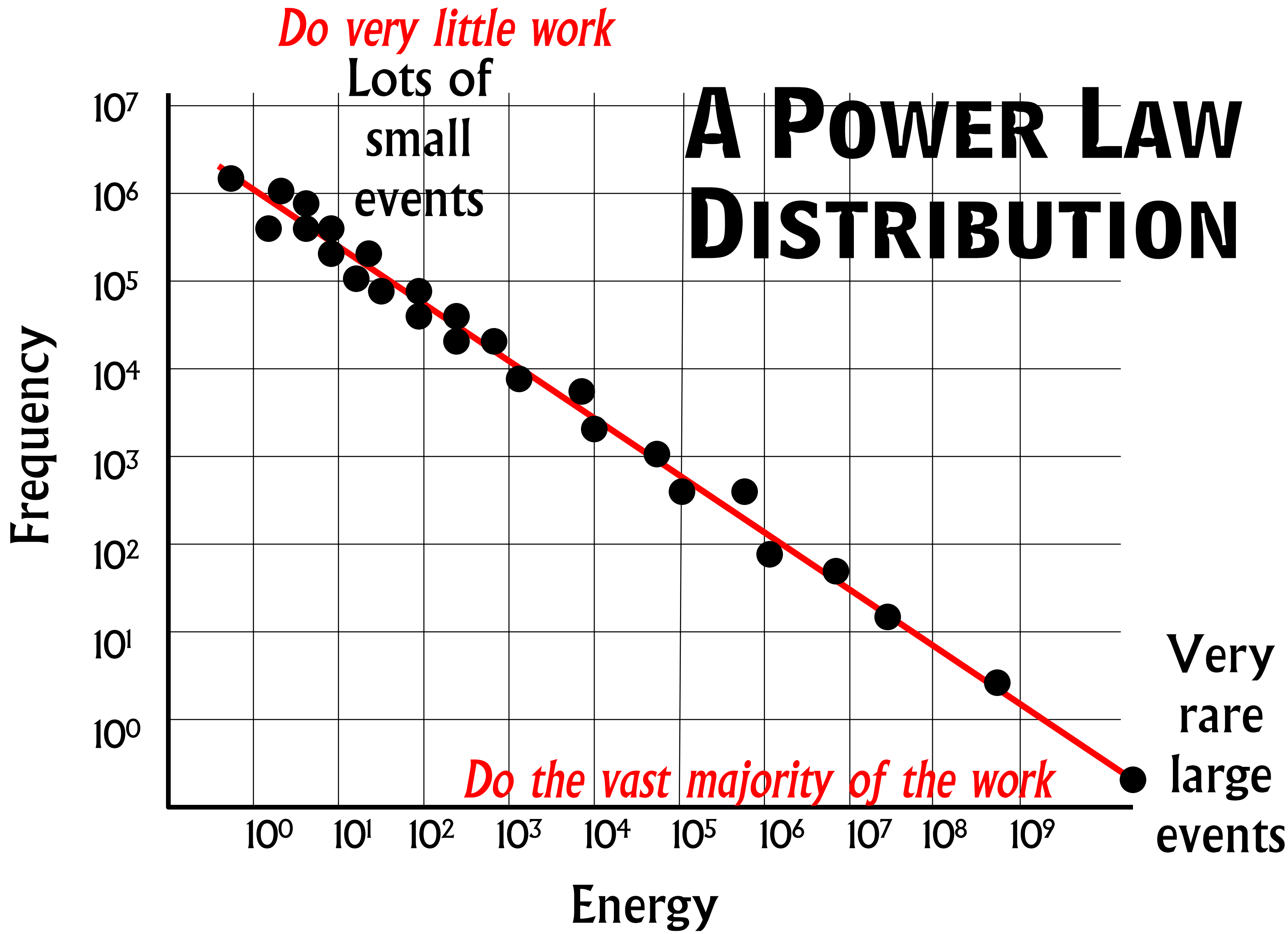
Comparing Linear and Non-Linear Changes



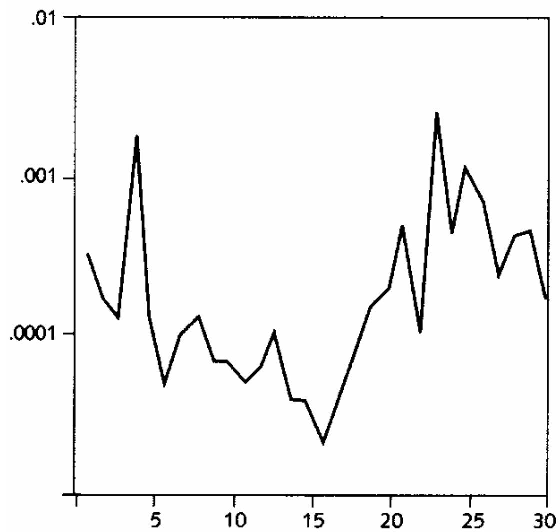
Comparing Linear and Non-Linear Changes

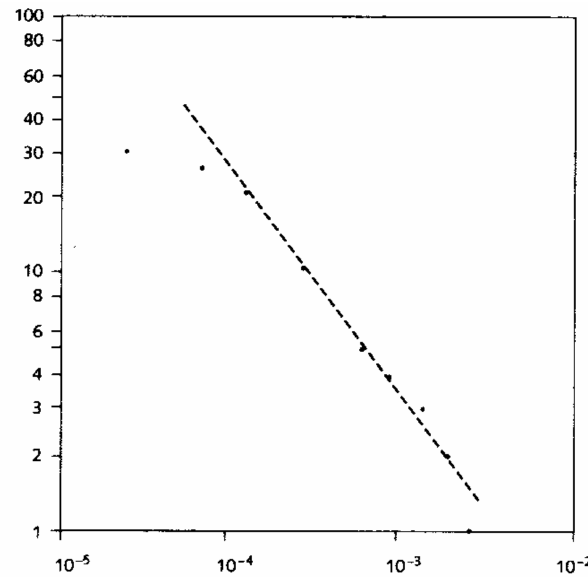


Comparing Linear and Non-Linear Changes



Power Law Relationships – Cotton Prices





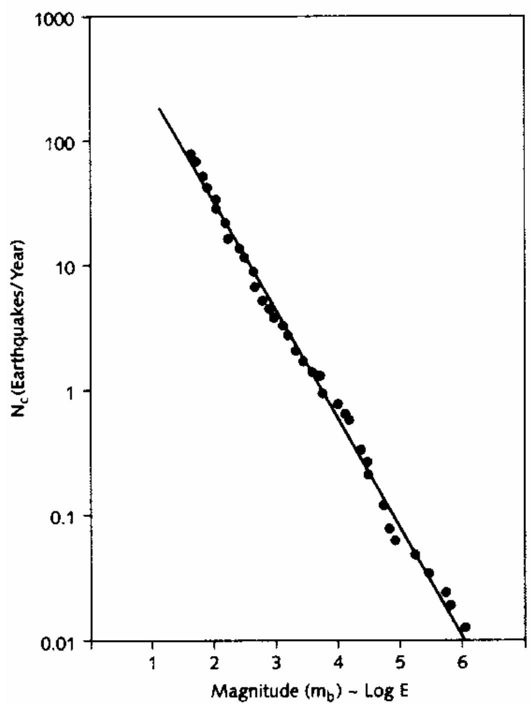
Mandelbrot's (1963) analysis of monthly variations in cotton prices during a 30 month period. The left plot shows the month by month changes. Note how they vary; lots of small changes, and fewer large changes. The right logarithmic graph shows the same data is a power-law distribution, indicating the cotton commodities market is at the critical level (SOC). Other commodities follow a similar pattern.

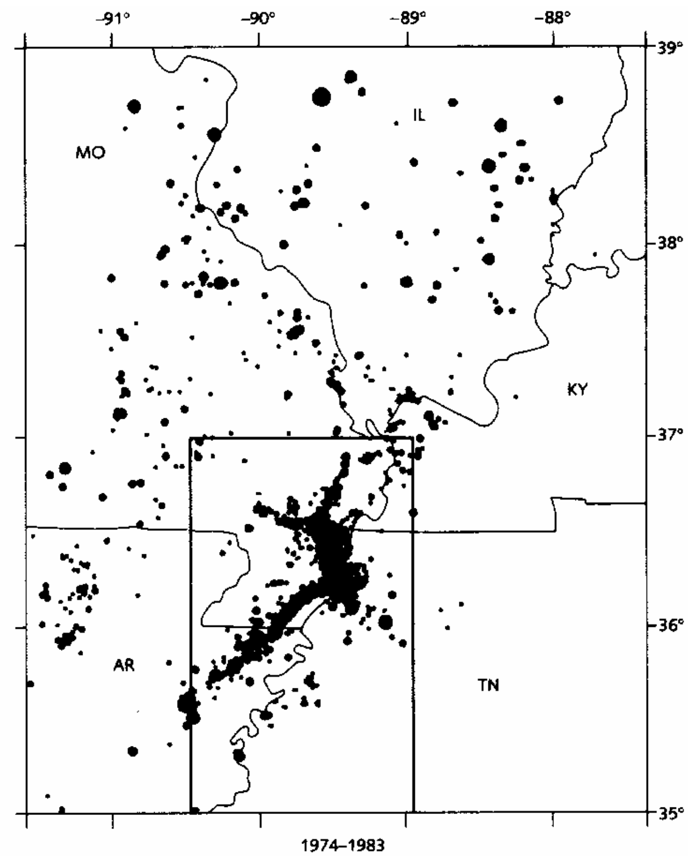
Universality

Properties of Complex Evolutionary Systems

Power Law Relationships - Earthquakes

New Madrid, Missouri Earthquakes





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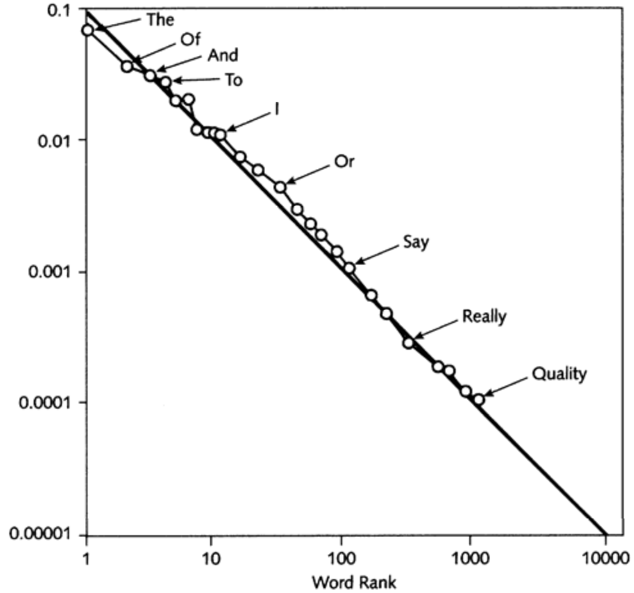
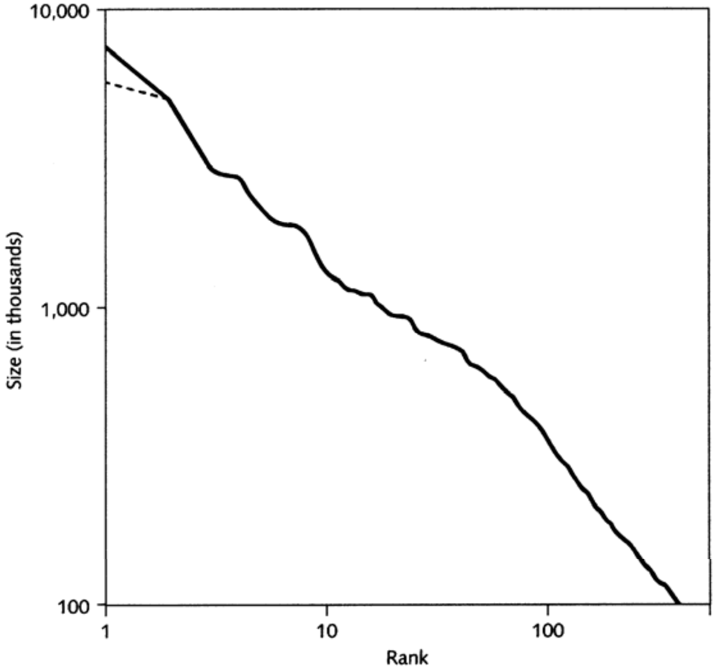
Power Law Relationships – Zipf's Law

Formulated by George Kingsley Zipf who observed a number of striking observations about patterns in human systems. Two prime examples, word usage in the English (and other) languages, and distribution of city population sizes. Both follow a power-law distribution. Both of these examples imply these systems are evolving at the critical level.



Zipf's Law for the English language.



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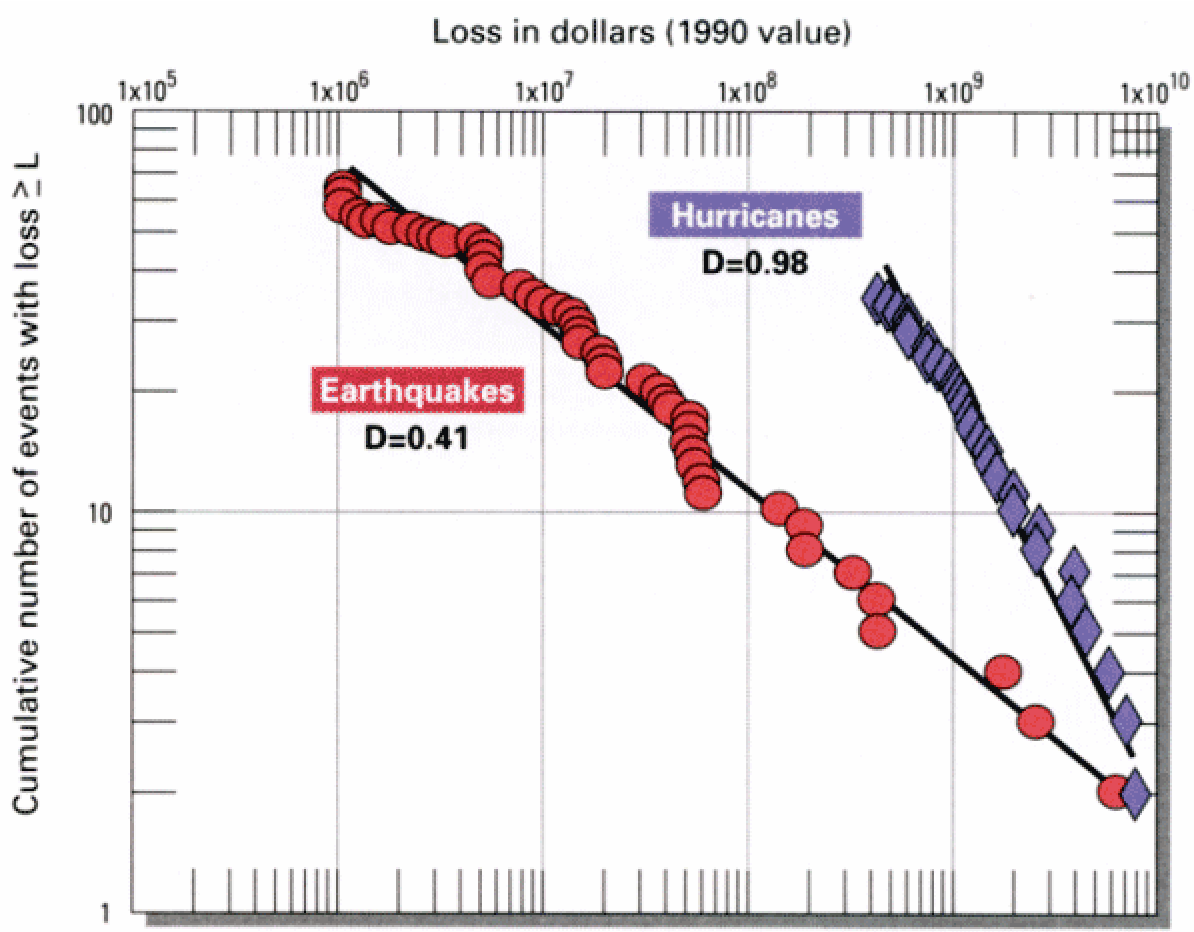
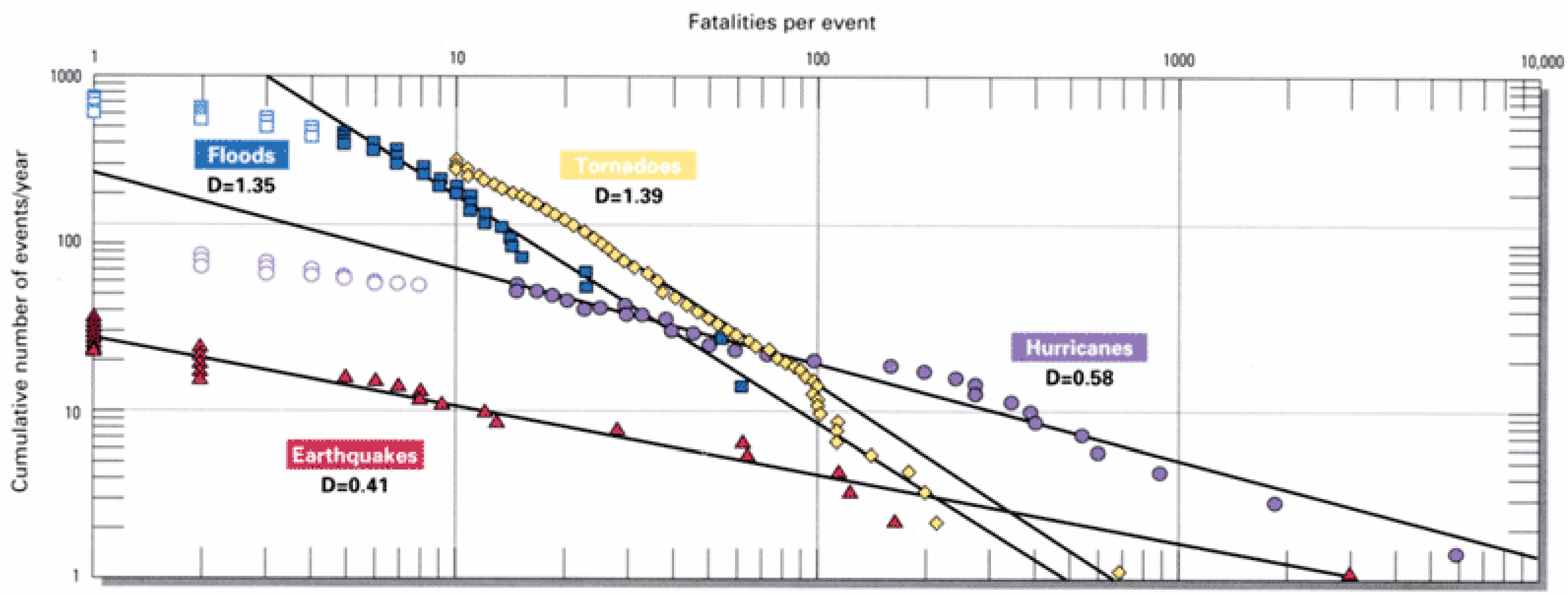
Power Law Relationships – Natural Disasters



Plot of cumulative frequency of dollar loss due to earthquakes and hurricanes in the U.S. between 1900 and 1989. Data presented in this manner reveal linear trends which provide the basis for forecasting the probability of future dollar loss.

http://pubs.usgs.gov/fs/natural-disasters/figures/fig3.html

Power Law Relationships – Natural Disasters



Comparison of natural disaster fatalities in the United States. Cumulative size-frequency distributions for annual earthquake, flood, hurricane, and tornado fatalities. In addition to demonstrating linear behavior over 2 to 3 orders of magnitude in loss, these data group into two families. Earthquakes and tornadoes are associated with relatively flat slopes (D=0.4 - 0.6); while floods and tornadoes have steeper slopes (D=1.3 - 1.4). Open symbols were not used to calculate slope of lines.

http://pubs.usgs.gov/fs/natural-disasters/figures/fig3.html

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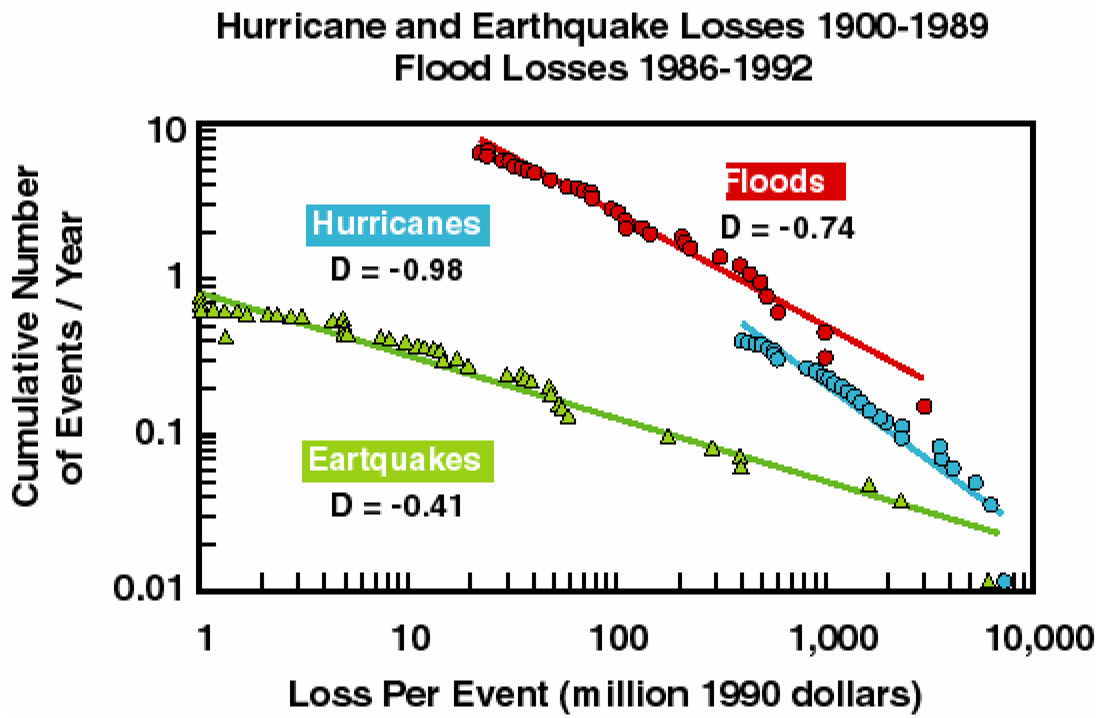
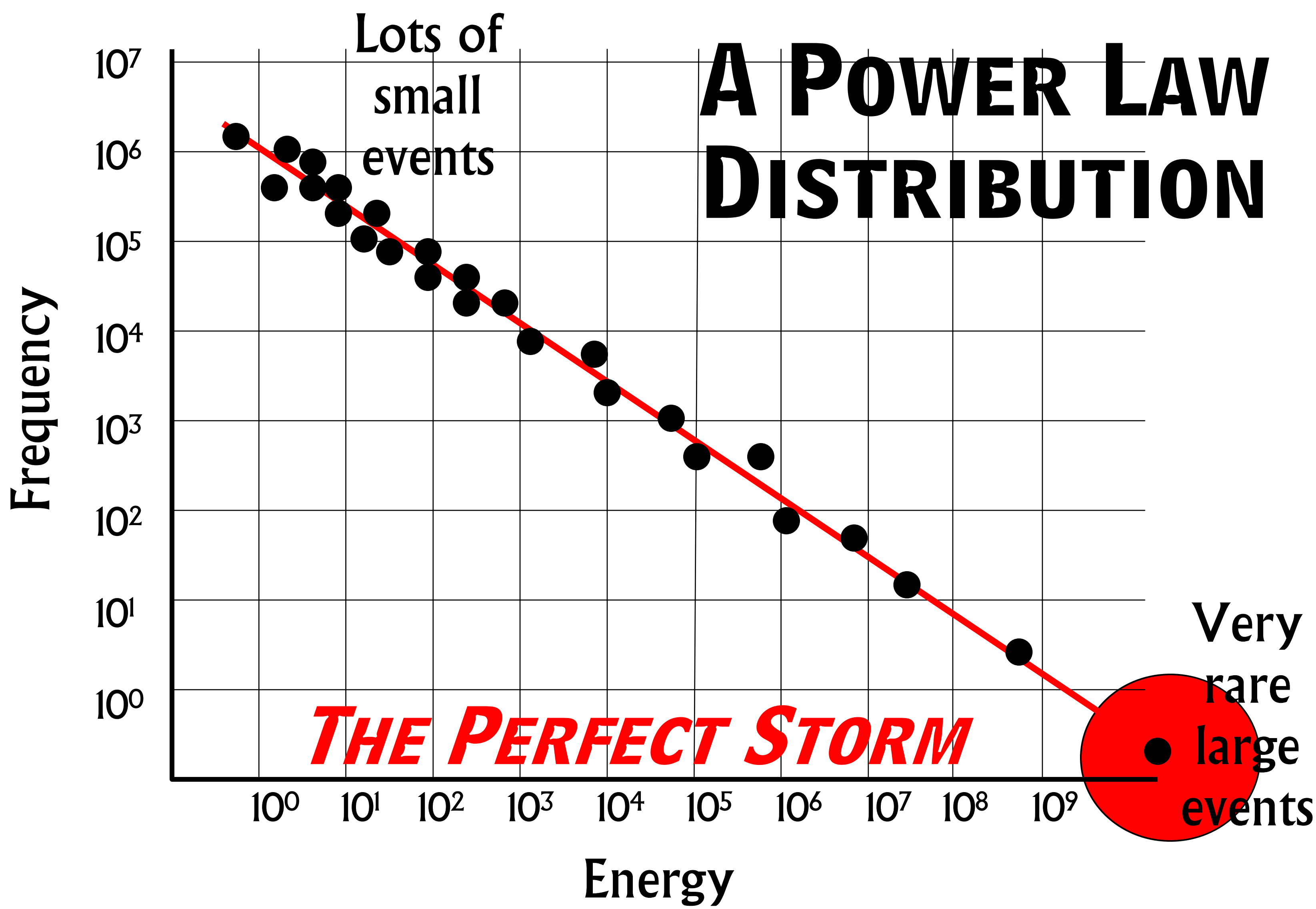
Power Law Relationships – Natural Disasters



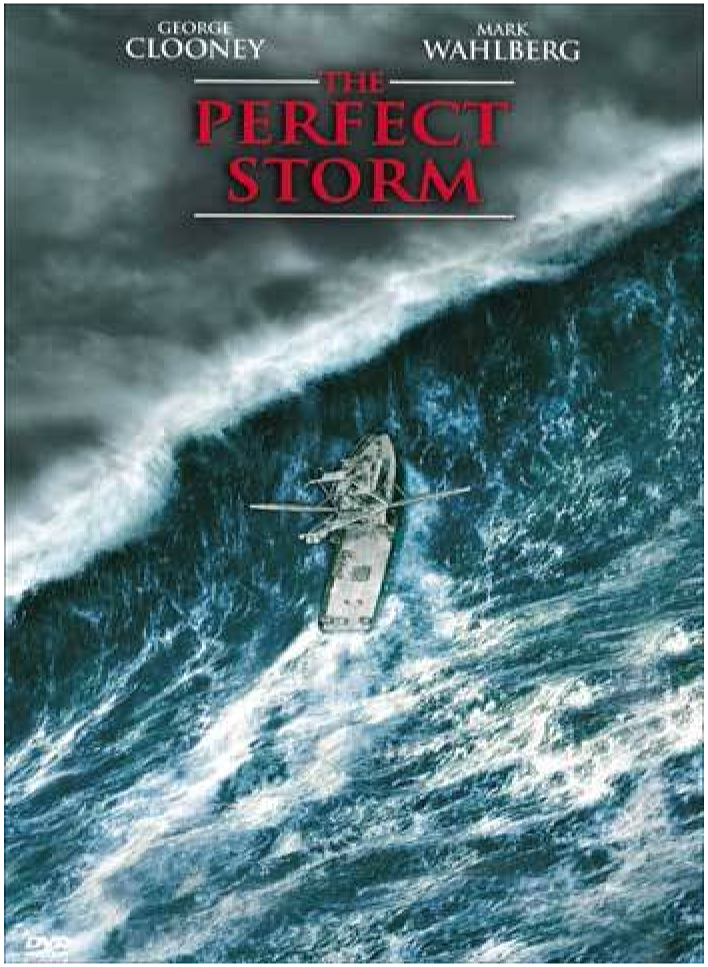
Plot of cumulative frequency of dollar loss due to hurricanes, earthquakes, and floods in the U.S. Data presented in this manner reveal linear trends which provide the basis for forecasting the probability of future dollar loss.

http://coastal.er.usgs.gov/hurricane_forecast/hurr_losses.html

Comparing Linear and Non-Linear Changes



THE PERFECT STORM



The phrase perfect storm refers to the simultaneous occurrence of events which, taken individually, would be far less powerful than the result of their chance combination.

The book/movie is about the Halloween Nor'easter that hit North America in October 1991.

Such occurrences are rare by their very nature, so that even a slight change in any one event contributing to the perfect storm would lessen its overall impact.

CONCLUSIONS

Natural events follow a power law distribution.

That is most events are small and uneventful.

Big events are rare, but they release huge amounts of energy, and do and have done most of the work of creating the world we live in.

The world is as it is because of these large events, and it is not going to stop happening because it is inconvenient to us.

There is nothing special or unusual about this; it is just the way the Earth system works. And, there is nothing we can do to change it.

We might, though, think about changing ourselves.

On "Acts of God" and the Earth As Natural System

"No government can be blamed for the tsunami tragedy, or cursed for not having done enough to prevent it.

We are not God.

We can recognize and work with the Earth's evolutionary design, but we cannot stop it –

Nor should we."

P.M.H.J. Atwater, L.H.D.
Echo, February 2005, page 16