



My Adventures in Simplicity and Complexity at UC Davis

Carlos E. Puente

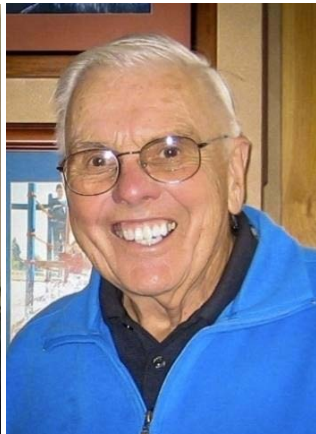
University of California, Davis



In memoriam



Jacobo Goldstein



Verne Scott



Miguel Mariño



Jorge Ramírez



Garry Willgoose



Diego Echeverry



Jim Biggar



Don Nielsen



Pete Eagleson



Fabio Castellón



Ken Tanji



Alberto Sarria



Also to



Fabian Bombardelli



Samuel Sandoval



Daniele Zaccaria



Laura Foglia



Majdi Abou Najm



Da Yang



Isaya Kisekka



Jufang Jin



Matt Igel



Adele Igel



Xiaoli Dong



Nate Chaney



The Genesis of an Idea

Landing from Uniandes & MIT



Alejandro Deeb



Jairo Uribe



Darío Valencia



Rafael Bras



Juan Valdés



I. Rodríguez-Iturbe

- 1986 after following Colombians at Tour de France
- ready to emulate giants
- set to triumph at UC Davis



Daniele Veneziano

Landing from Uniandes & MIT



Alejandro Deeb



Jairo Uribe

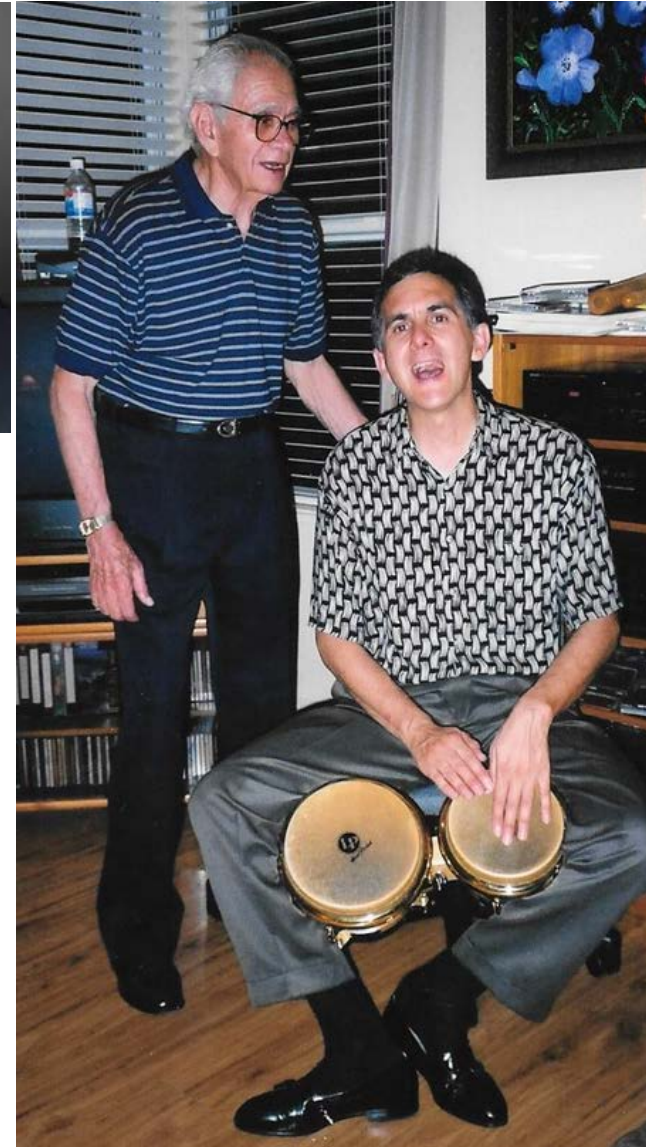


Darío Valencia



Rafael Bras

- 1986 after following Colombians at Tour
- ready to emulate giants
- set to triumph at UC Davis



My First Crop



Marc Bierkens



Germán Poveda



Enrique Ángel Sanint

- three professors
- an AGU Fellow
- a Nobel Prize winner
- **fractal geometry** and **chaos theory**

Fractals and Turbulence



Michael Barnsley



Charles Meneveau



Katepalli Sreenivasan

- fractal interpolating functions
- turbulence via multiplicative cascades
- joining the two appeared to be a good idea



Fractal Functions

via iteration of simple maps

$$w_1(x, y) = \left(\frac{x}{2}, x + d_1 \cdot y \right), \quad w_2(x, y) = \left(\frac{x}{2} + \frac{1}{2}, 1 - x + d_2 \cdot y \right)$$



Fractal Functions

via iteration of simple maps

$$w_1(x, y) = \left(\frac{x}{2}, x + d_1 \cdot y \right), \quad w_2(x, y) = \left(\frac{x}{2} + \frac{1}{2}, 1 - x + d_2 \cdot y \right)$$

- from a point in the plane to a point in the plane



Fractal Functions

via iteration of simple maps

$$w_1(x, y) = \left(\frac{x}{2}, x + d_1 \cdot y \right), \quad w_2(x, y) = \left(\frac{x}{2} + \frac{1}{2}, 1 - x + d_2 \cdot y \right)$$

- from a point in the plane to a point in the plane
- 1st component is decoupled from y
- 2nd component is a **linear** combination of x and y



Fractal Functions

via iteration of simple maps

$$w_1(x, y) = \left(\frac{x}{2}, x + d_1 \cdot y \right), \quad w_2(x, y) = \left(\frac{x}{2} + \frac{1}{2}, 1 - x + d_2 \cdot y \right)$$

- from a point in the plane to a point in the plane
- 1st component is decoupled from y
- 2nd component is a **linear** combination of x and y
- d_1 and d_2 are **parameters**, magnitudes less than 1



Fractal Functions

via iteration of simple maps

$$w_1(x, y) = \left(\frac{x}{2}, x + d_1 \cdot y \right), \quad w_2(x, y) = \left(\frac{x}{2} + \frac{1}{2}, 1 - x + d_2 \cdot y \right)$$



- from a point in the plane to a point in the plane
- 1st component is decoupled from y
- 2nd component is a **linear** combination of x and y
- d_1 and d_2 are **parameters**, magnitudes less than 1
- $x \in [0, 1]$, maps pass by $\{(0,0), (0.5,1), (1,0)\}$



Fractal Functions

via iteration of simple maps

$$w_1(x, y) = \left(\frac{x}{2}, x + d_1 \cdot y \right), \quad w_2(x, y) = \left(\frac{x}{2} + \frac{1}{2}, 1 - x + d_2 \cdot y \right)$$

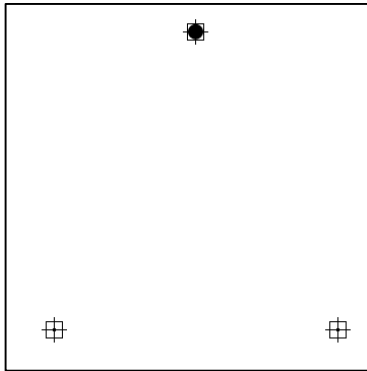
 

- from a point in the plane to a point in the plane
- 1st component is decoupled from y
- 2nd component is a **linear** combination of x and y
- d_1 and d_2 are **parameters**, magnitudes less than 1
- $x \in [0, 1]$, maps pass by $\{(0,0), (0.5,1), (1,0)\}$
- w_1 to the **left** and w_2 to the **right**



Fractal Functions

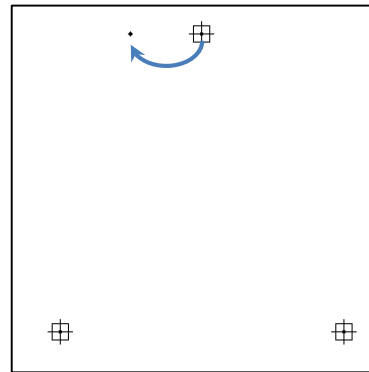
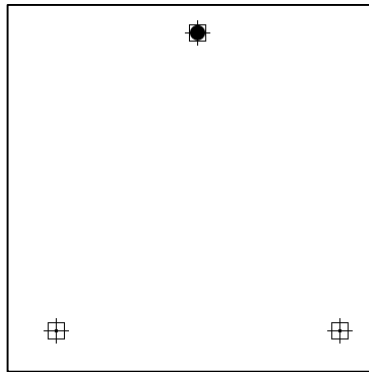
$$d_1 = -d_2 = z = 0.5$$





Fractal Functions

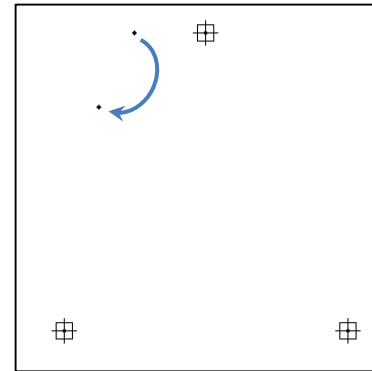
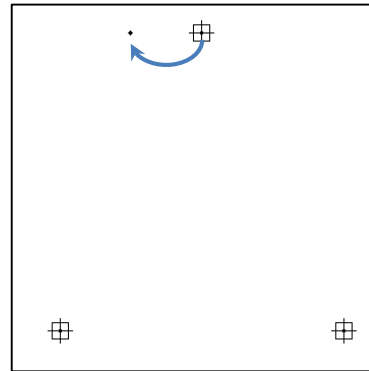
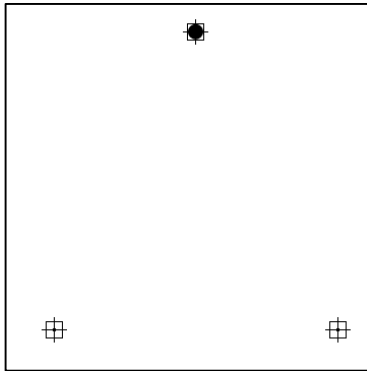
$$d_1 = -d_2 = z = 0.5$$





Fractal Functions

$$d_1 = -d_2 = z = 0.5$$

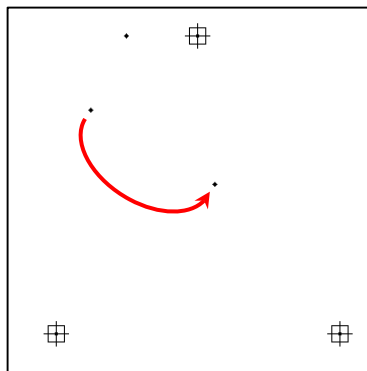
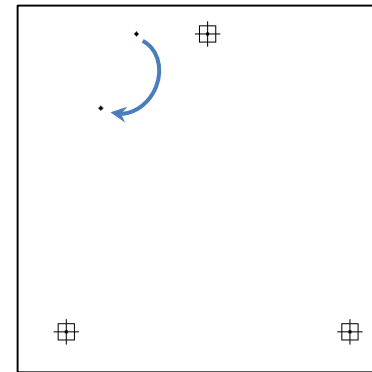
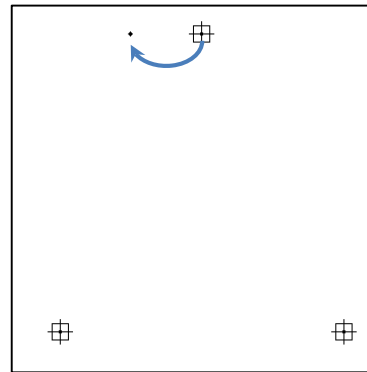
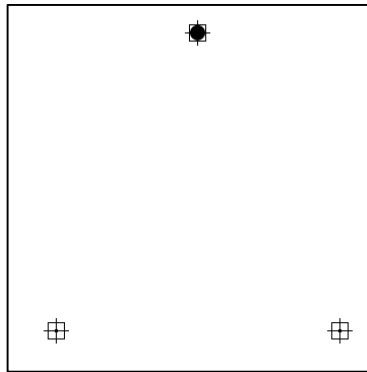




Fractal Functions

$$d_1 = -d_2 = z = 0.5$$

← w_1 w_2 →

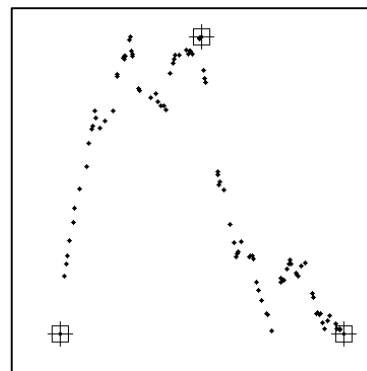
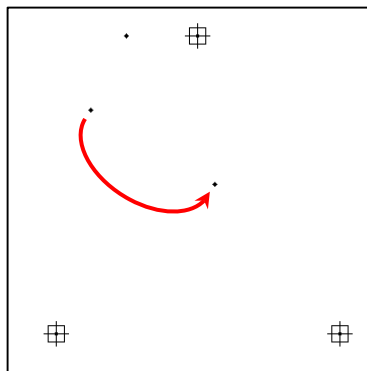
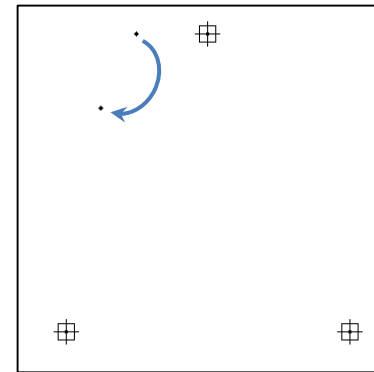
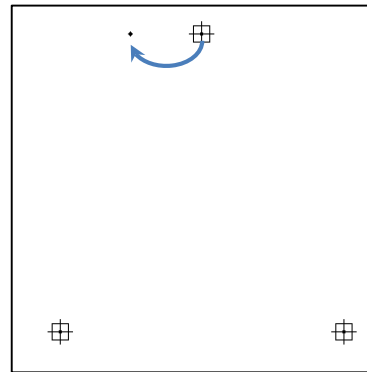
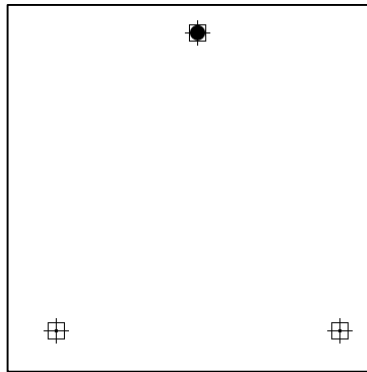




Fractal Functions

$$d_1 = -d_2 = z = 0.5$$

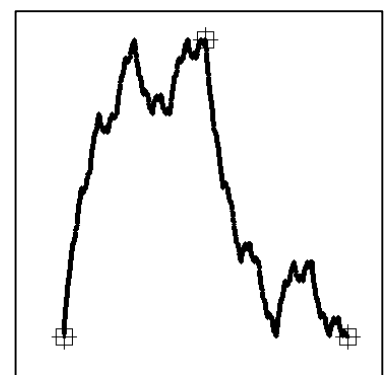
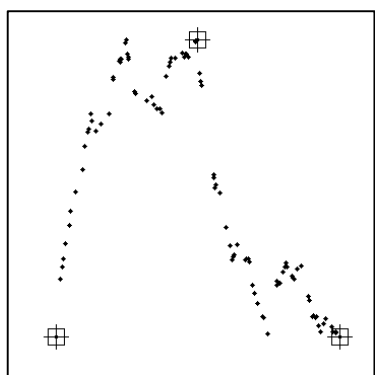
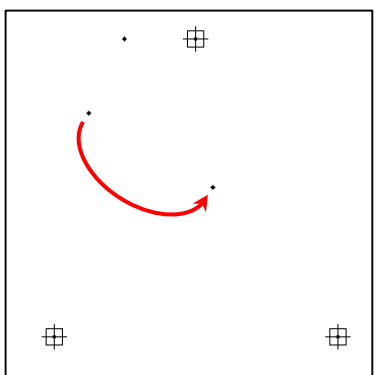
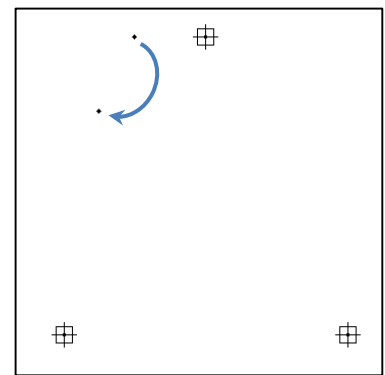
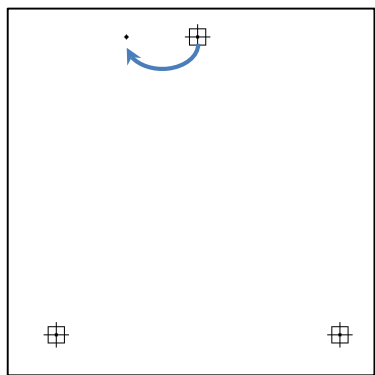
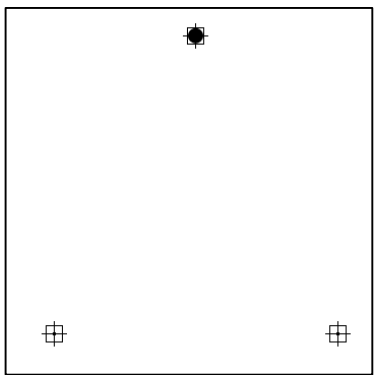
← w_1 w_2 →





Fractal Functions

$$d_1 = -d_2 = z = 0.5$$

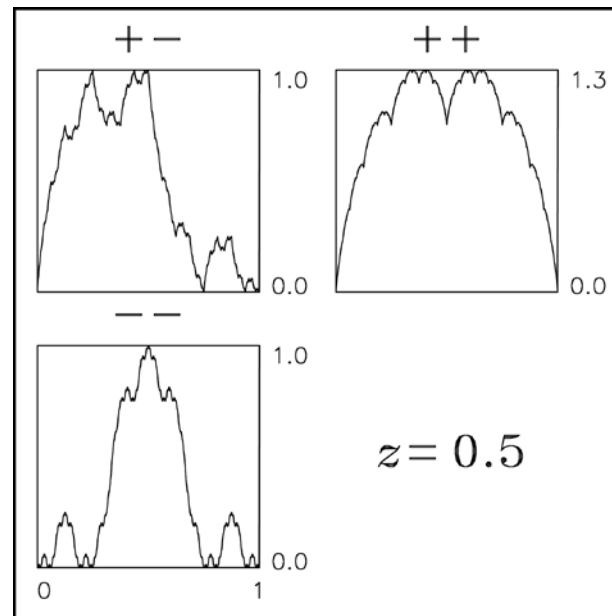


fractal
mountain

Fractal Functions

a matter of signs

$$|d_1| = |d_2| = z$$



case + - is the *mountain*

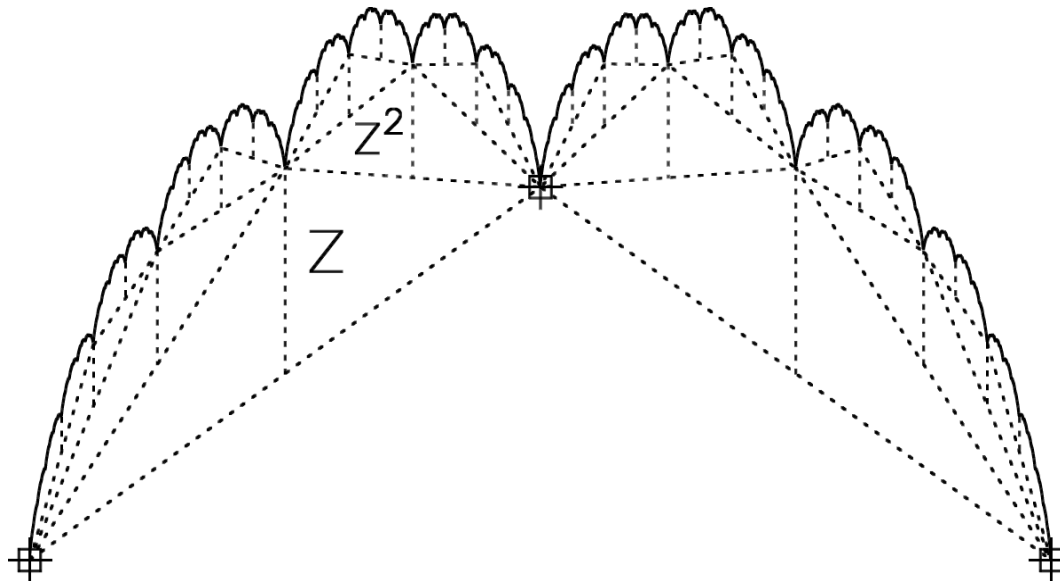
case - - yields another *mountain*

case + + defines a *cloud*

Fractal Functions

a matter of determinism

$$|d_1| = |d_2| = z$$

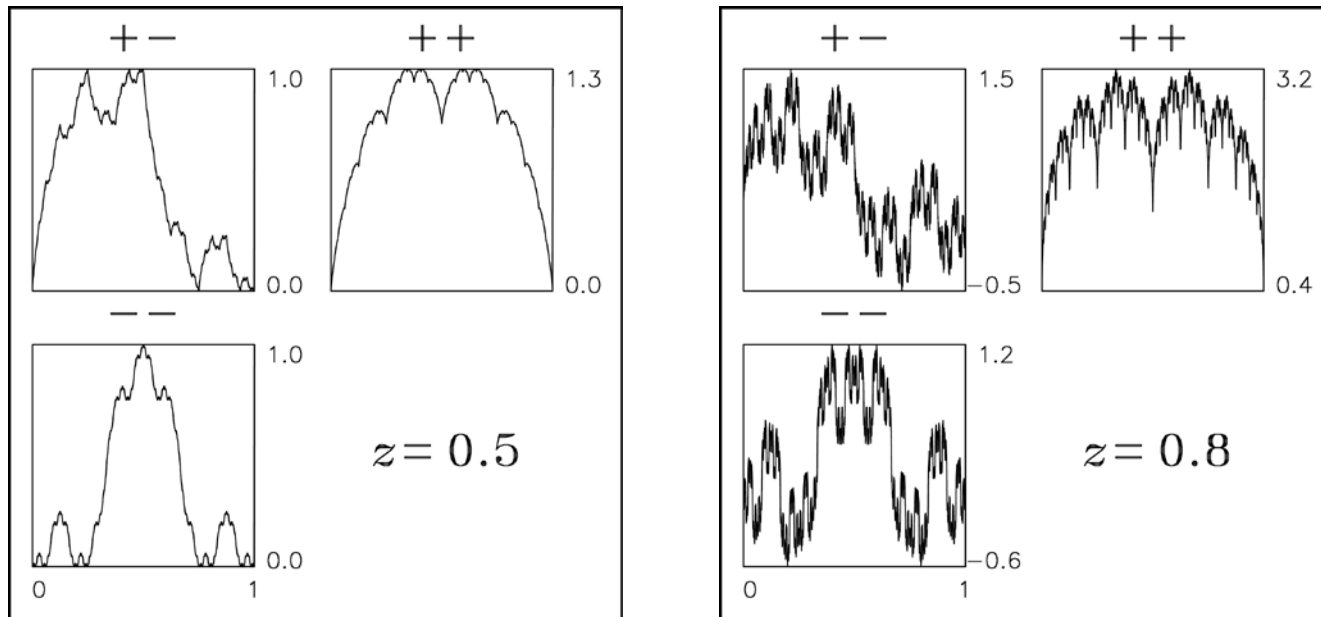


positive mid-point additions of powers of z
points always land on ***cloud***

Fractal Functions

a matter of dimension

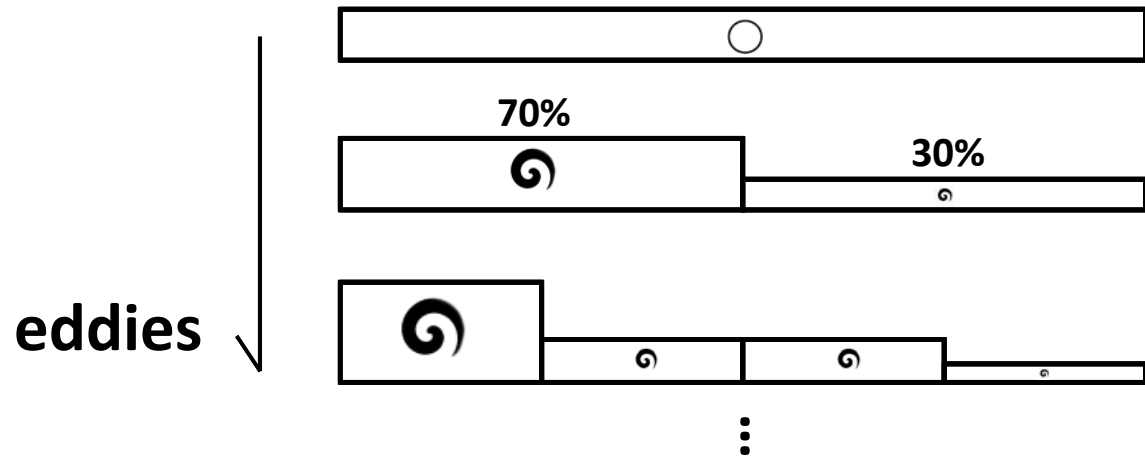
$$|d_1| = |d_2| = z$$



as $z \uparrow$, “wires” become infinite and require more ink
when $z \rightarrow 1$, **fractal** dimensions tend to 2



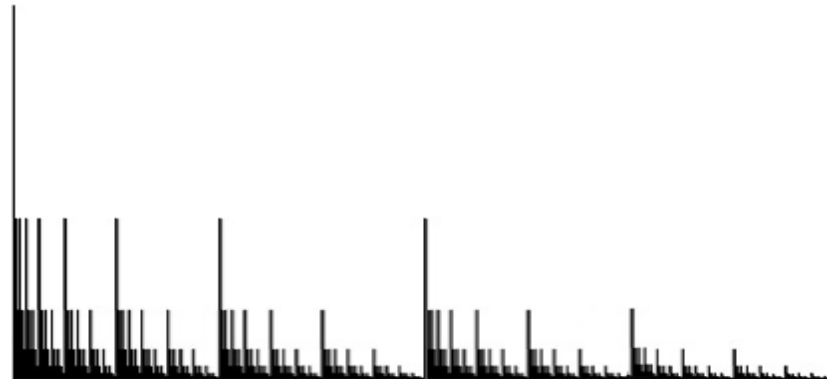
Turbulent Cascades



$$Re = \frac{\text{inertia}}{\text{viscosity}} \gg 1$$

Turbulent Cascades

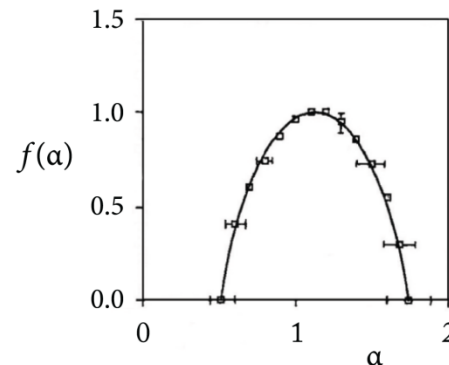
eddies



$$\text{Re} = \frac{\text{inertia}}{\text{viscosity}} \gg 1$$

layers in 1D as a simple cascade, a **multifractal**
dissipation: atmospheric, boundary layer, wake of cylinder...

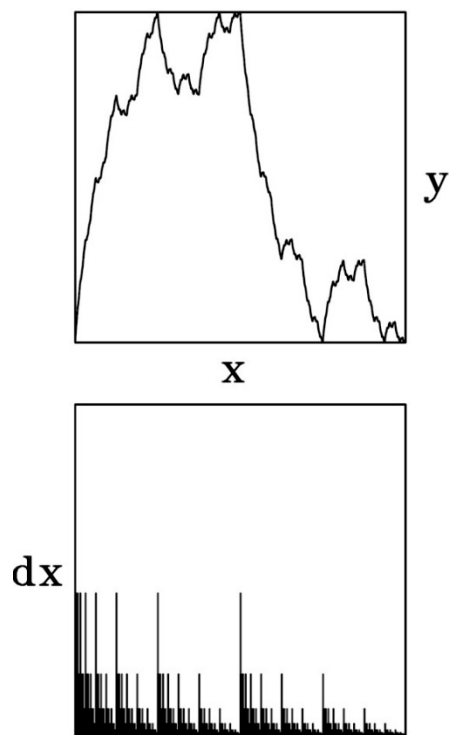
$$p = 0.7$$



power of the air



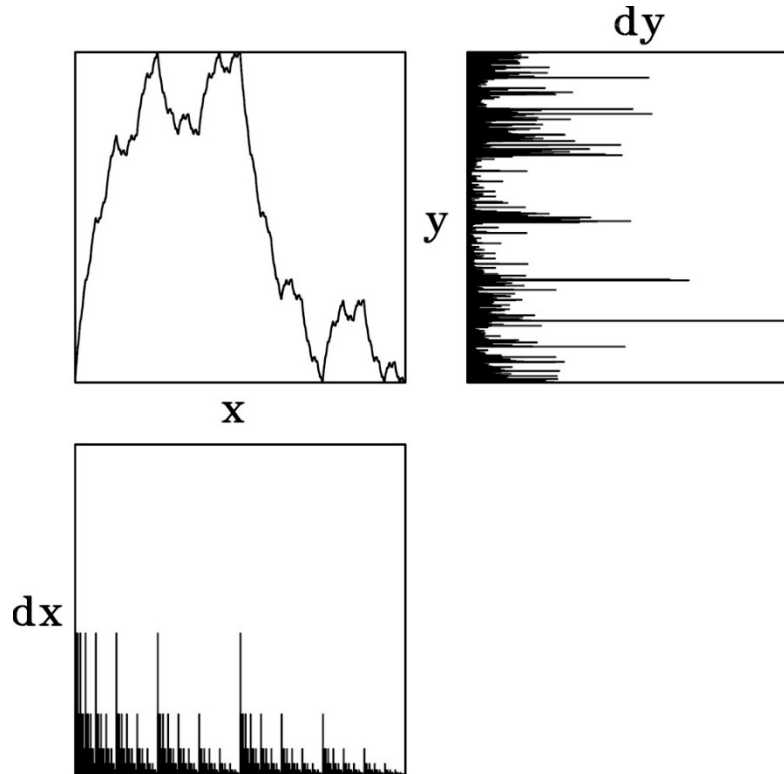
A Bridging Idea



70-30 iterations yield encyclopedia of **turbulence** dx over x



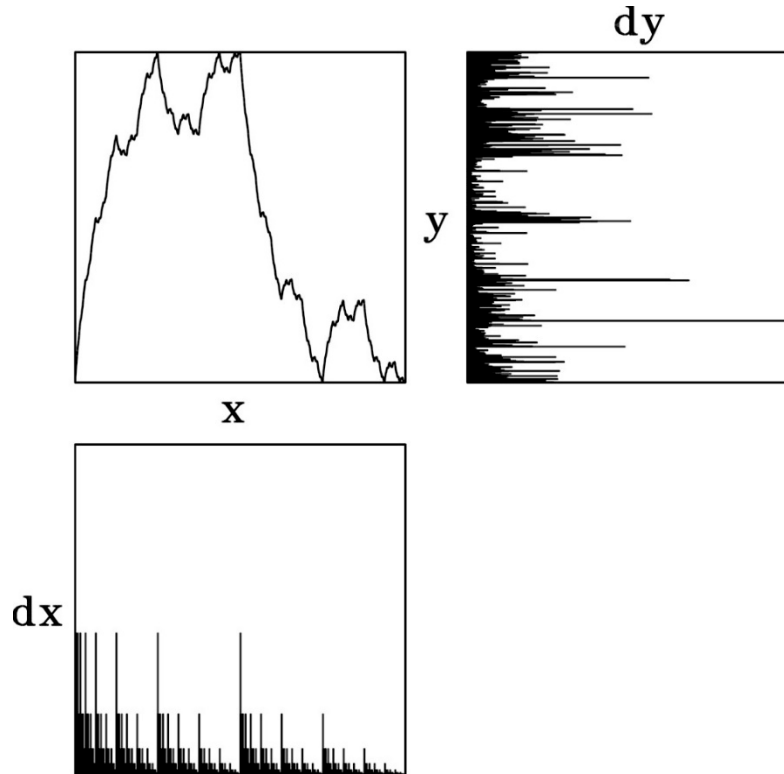
A Bridging Idea



70-30 iterations yield encyclopedia of **turbulence** dx over x
derived histogram dy over y is **transformation** of turbulence



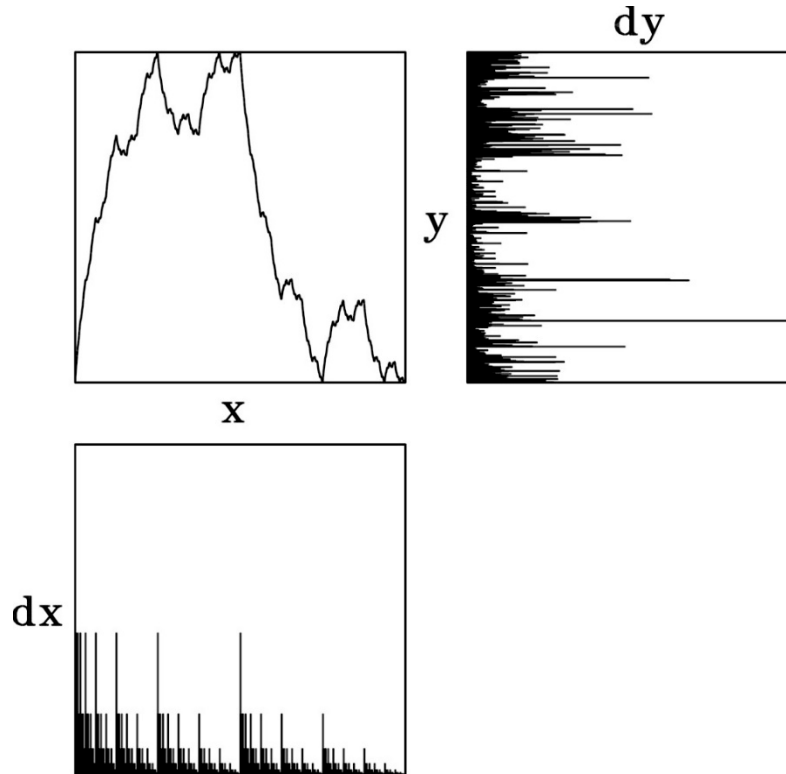
A Bridging Idea



70-30 iterations yield encyclopedia of **turbulence** dx over x
derived histogram dy over y is **transformation** of turbulence
real data sets? **hydrology?** **geophysics?**



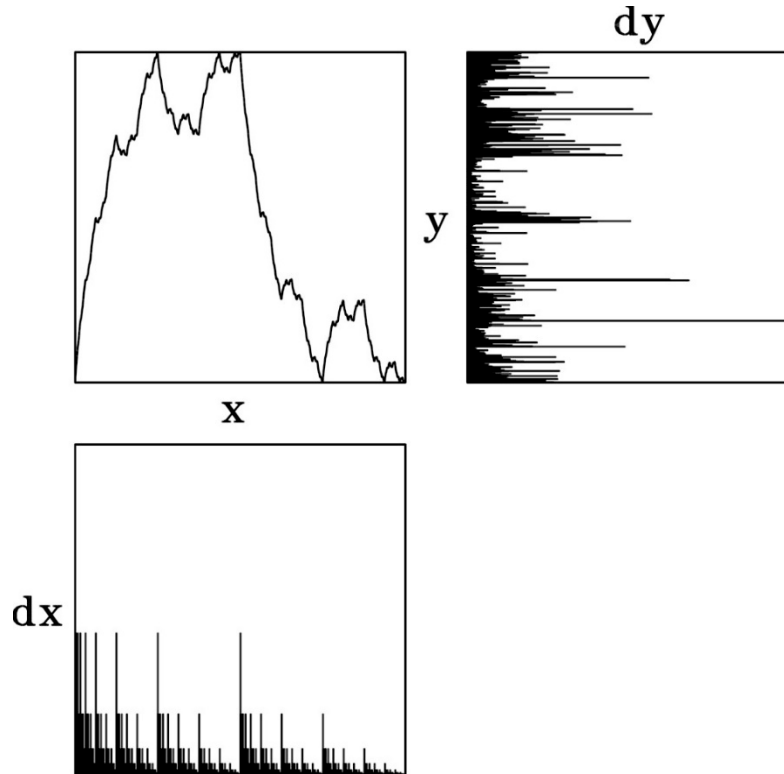
A Bridging Idea



Plato is right: dy is “*shadow*” of wire “*illuminated*” by dx



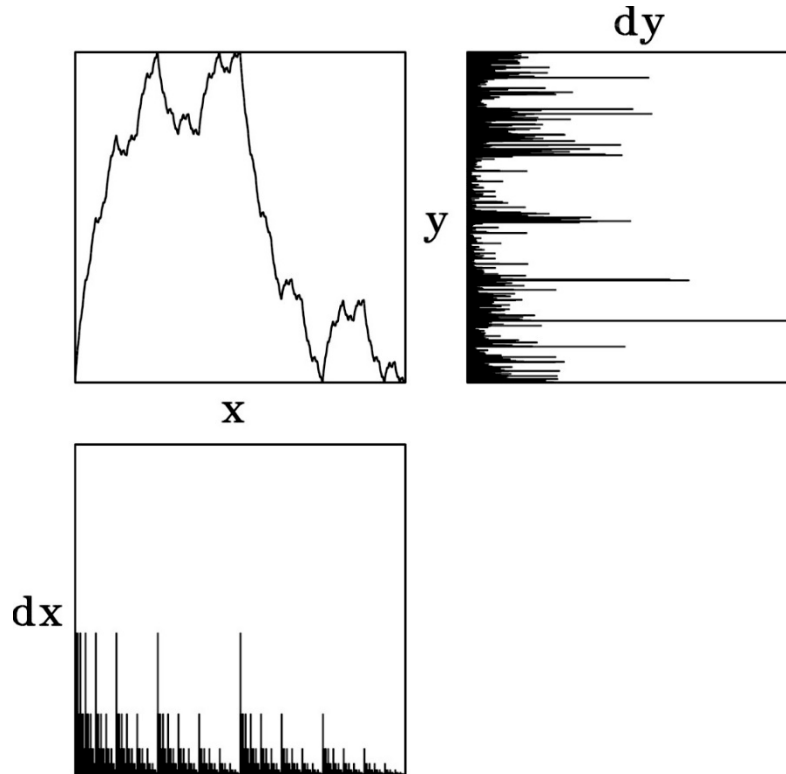
A Bridging Idea



Plato is right: dy is “*shadow*” of wire “*illuminated*” by dx
 dy appears **random**, but it is not, it is **deterministic**



A Bridging Idea



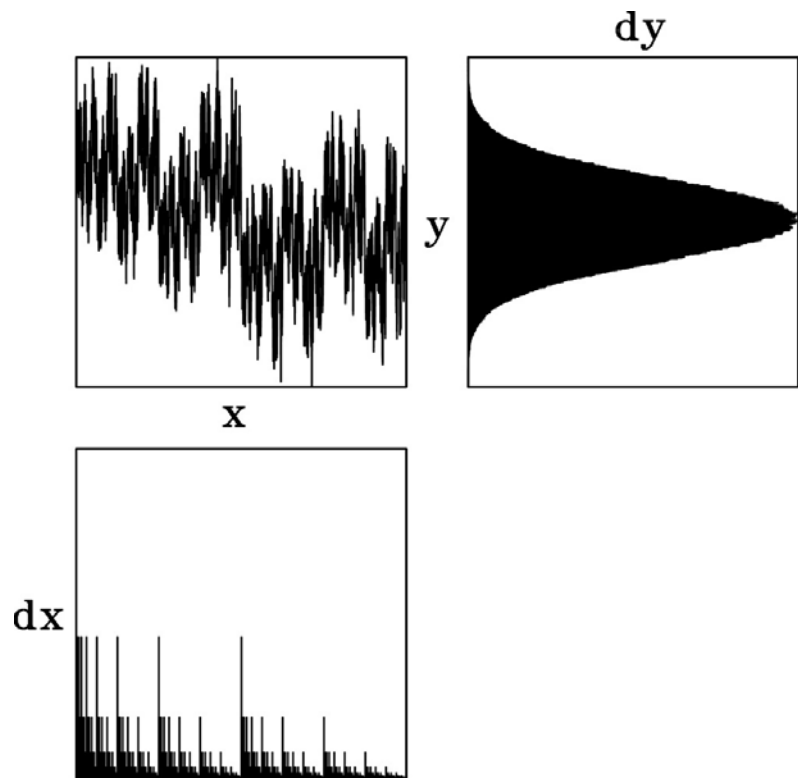
Plato is right: dy is “*shadow*” of wire “*illuminated*” by dx

dy appears **random**, but it is not, it is **deterministic**

the notions define the **Fractal-Multifractal, FM**, method



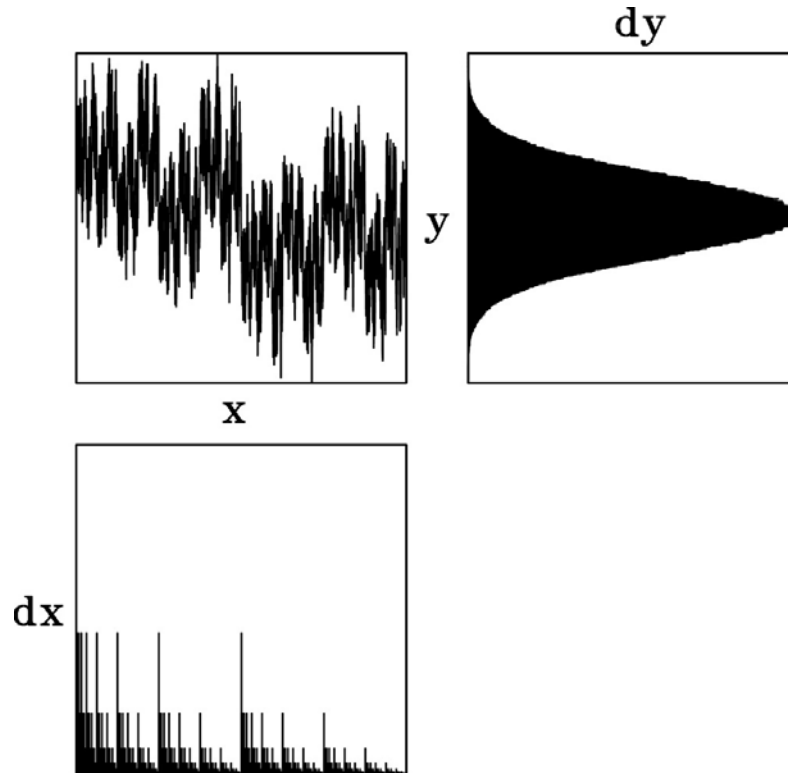
A Bridging Idea



dy is a ***Gaussian bell*** for **any** non-discrete dx



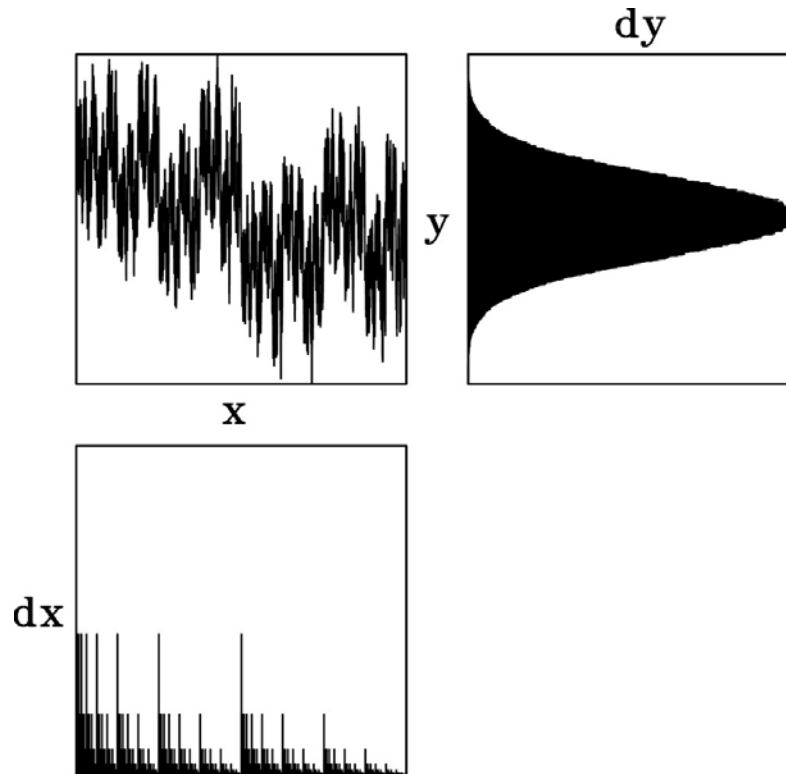
A Bridging Idea



dy is a *Gaussian bell* for **any** non-discrete dx
a surprising *PUENTE* from **dissipation** to **conduction**



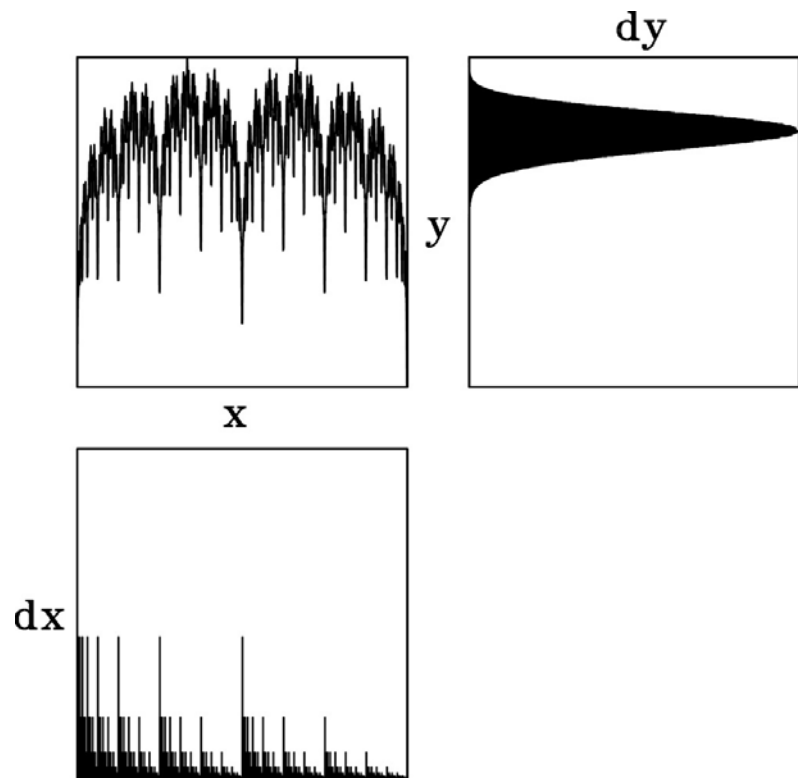
A Bridging Idea



dy is a ***Gaussian bell*** for **any** non-discrete dx
a surprising ***PUENTE*** from **dissipation** to **conduction**
case - - yields **oscillations** between two bells



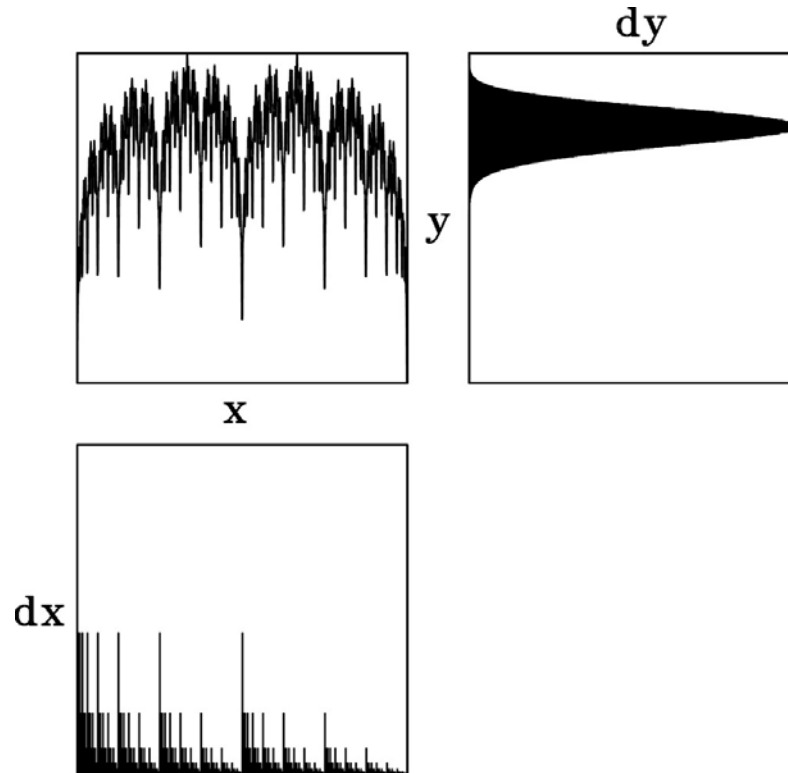
A Bridging Idea



a luminous and singular bell concentrated at **infinity!**



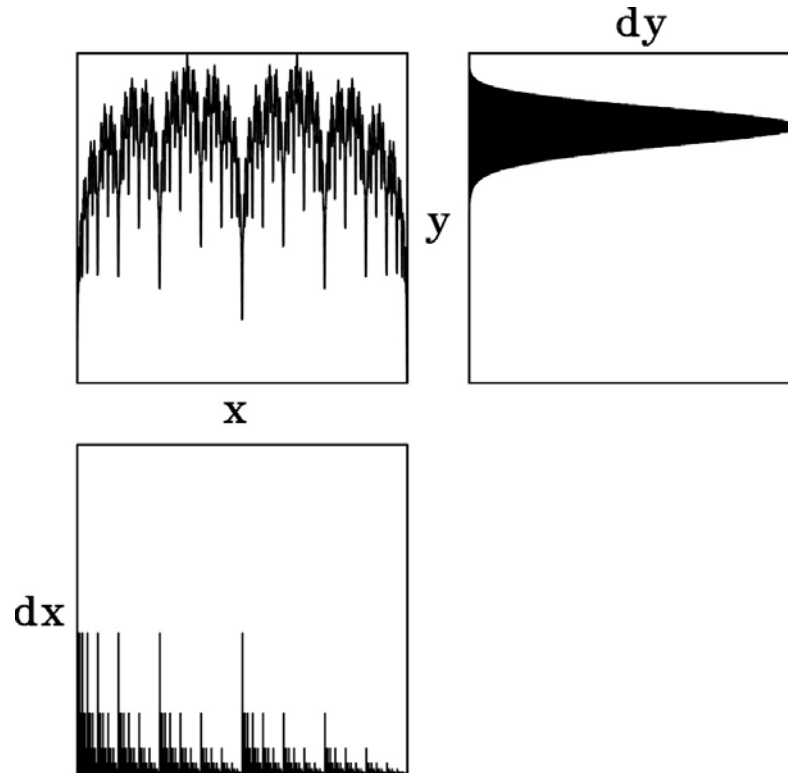
A Bridging Idea



a luminous and singular bell concentrated at **infinity!**
the **maximally positive** wire filters up almost any disorder



A Bridging Idea

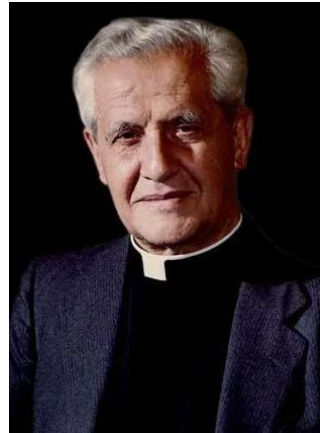


a luminous and singular bell concentrated at **infinity!**
the **maximally positive** wire filters up almost any disorder
what is the transformation? *LOVE?* I had an **epiphany...**

Appointed Inspiration



Álvaro Aldama



St. Rafael García Herreros



Fr. Diego Jaramillo



Fr. Camilo Bernal

- a classmate who explained “being born from above”
- a saint who encouraged me to dream
- two dear priests that guided my growth

Friends to the Rescue



Akin Orhun



Daniel Fessler



Marta Juliao

- carlito, why hydrology?, try the economy
- a benefactor helping Vatican Observatory?
- ultimately, a donation from **Pacific Bell**

Friends to the Rescue



Akin Orhun



- carlito, why
- a benefactor
- ultimately, a donation from **Pacific Bell**



Some Results in Hydrology & Beyond

Other Collaborators



Sivakumar Bellie



Jason Huang



Andrea Cortis



Mahesh Maskey



Jorge Pinzón



Jason Emmons



Martha Díaz



René Lobato



José Angulo



Aldo Romero

Yet Other Collaborators



Nelson Obregón



Víctor Peñaranda



David Serrano



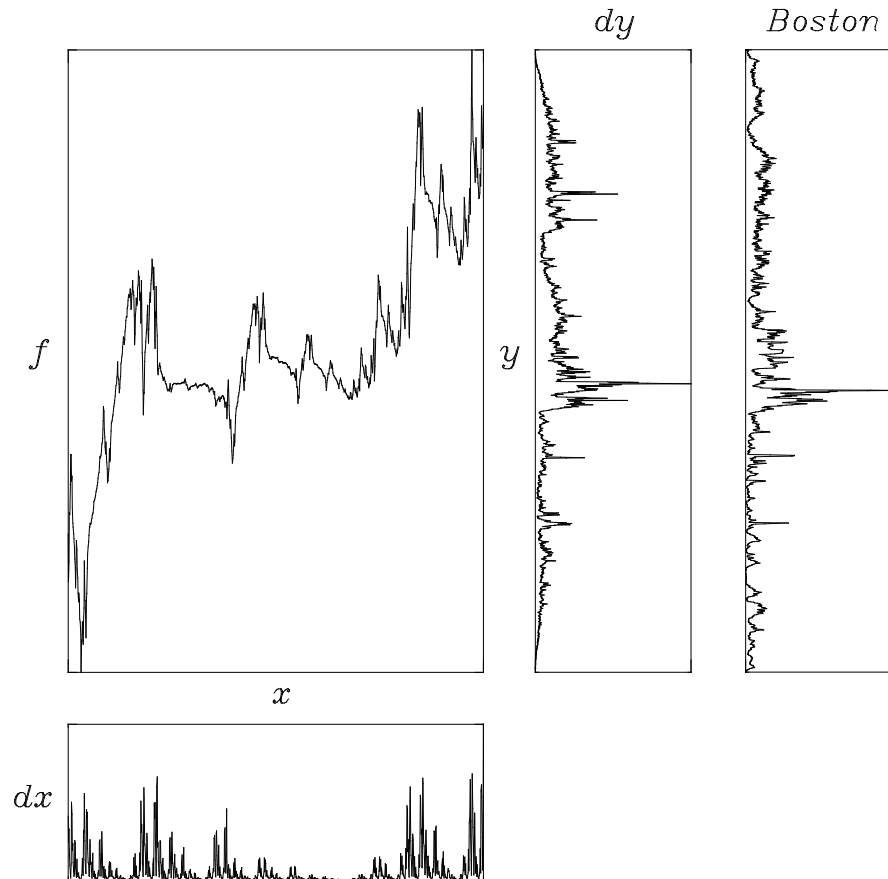
Fernando Torres



María Paula Sanabria

- the longest genealogy

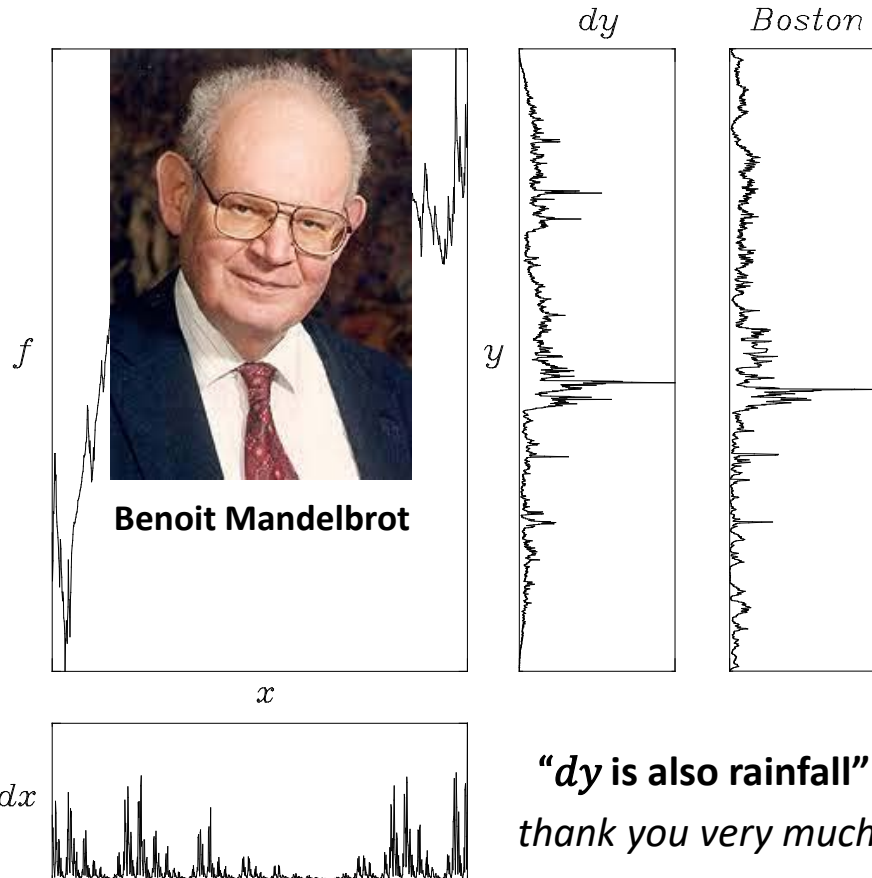
A Rainfall Event



an FM representation from a wire passing by 5 points
preserves statistical and chaotic properties



A Rainfall Event



an FM representation from a wire passing by 5 points
preserves statistical and chaotic properties

Daily Rainfall

iterating $N = 2$ maps

$$w_n \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a_n & 0 \\ c_n & d_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \end{pmatrix} \quad n = 1, 2$$

subject to:

$$w_n \begin{pmatrix} x_0 \\ y_0 \end{pmatrix} = \begin{pmatrix} x_{2n-2} \\ y_{2n-2} \end{pmatrix}, w_n \begin{pmatrix} x_{2N-1} \\ y_{2N-1} \end{pmatrix} = \begin{pmatrix} x_{2n-1} \\ y_{2n-1} \end{pmatrix}$$

with ranges in x : $[0, x_1]$ and $[x_2, 1]$

giving a Cantor set over x and holes over y if $x_1 < x_2$

Daily Rainfall

iterating $N = 2$ maps

$$W_n \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a_n & 0 \\ c_n & d_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \end{pmatrix} \quad n = 1, 2$$

subject to:

$$W_n \begin{pmatrix} x_0 \\ y_0 \end{pmatrix} = \begin{pmatrix} x_{2n-2} \\ y_{2n-2} \end{pmatrix}, \quad W_n \begin{pmatrix} x_{2N-1} \\ y_{2N-1} \end{pmatrix} = \begin{pmatrix} x_{2n-1} \\ y_{2n-1} \end{pmatrix}$$

with ranges in x : $[0, x_1]$ and $[x_2, 1]$

giving a Cantor set over x and holes over y if $x_1 < x_2$

FM parameters: $(0, 0), (x_1, y_1), (x_2, y_2), (1, y_3), d_1, d_2, p, \varphi_v$

Daily Rainfall

iterating $N = 2$ maps

$$W_n \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a_n & 0 \\ c_n & d_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \end{pmatrix} \quad n = 1, 2$$

subject to:

$$W_n \begin{pmatrix} x_0 \\ y_0 \end{pmatrix} = \begin{pmatrix} x_{2n-2} \\ y_{2n-2} \end{pmatrix}, \quad W_n \begin{pmatrix} x_{2N-1} \\ y_{2N-1} \end{pmatrix} = \begin{pmatrix} x_{2n-1} \\ y_{2n-1} \end{pmatrix}$$

with ranges in x : $[0, x_1]$ and $[x_2, 1]$

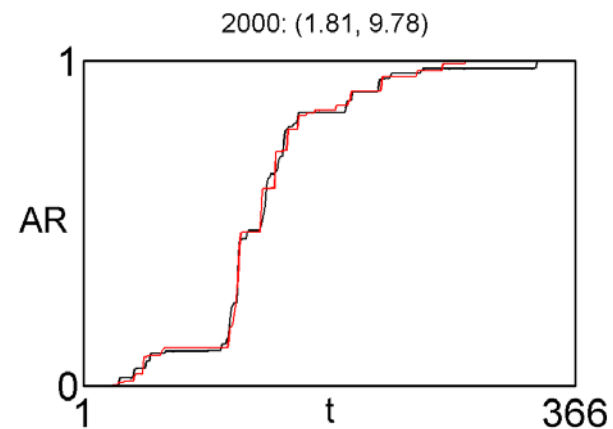
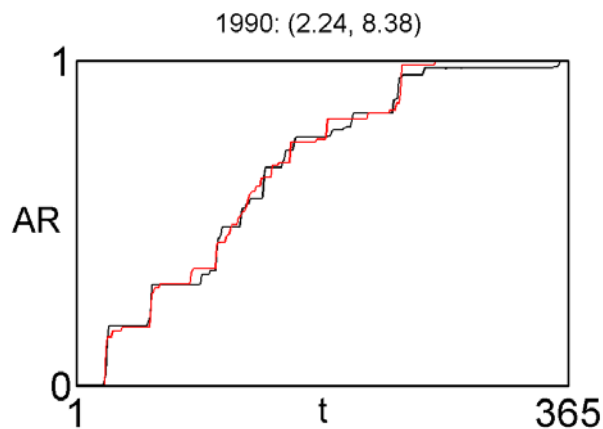
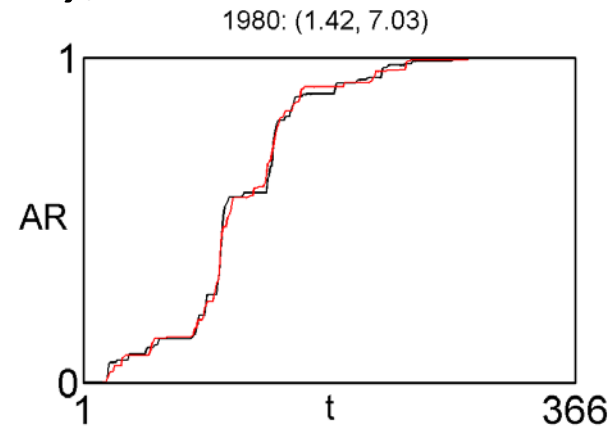
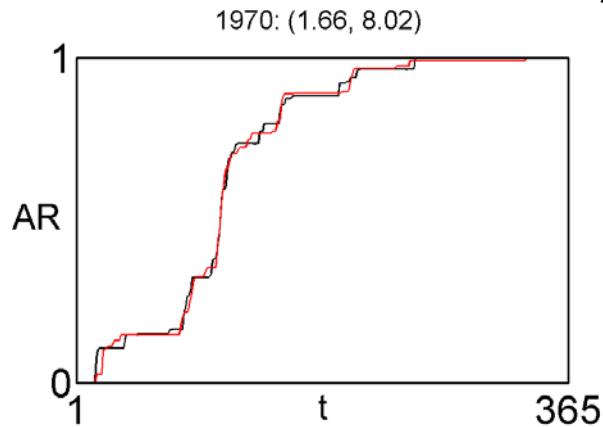
giving a Cantor set over x and holes over y if $x_1 < x_2$

FM parameters: $(0, 0), (x_1, y_1), (x_2, y_2), (1, y_3), d_1, d_2, p, \varphi_v$

inverse problem: minimizing root mean square error of accumulated records using a “particle swarm” algorithm

Daily Rainfall

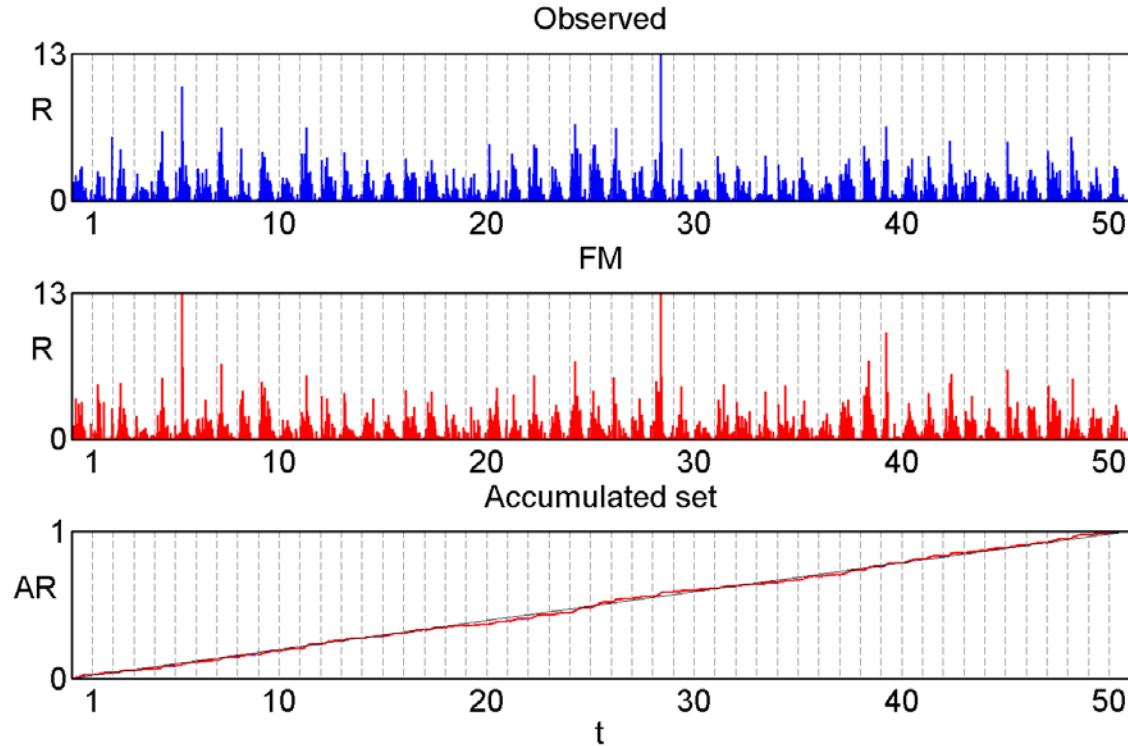
Cherry Valley, CA



sample years gathered daily, (RMSEAR, MAXEAR)

Daily Rainfall

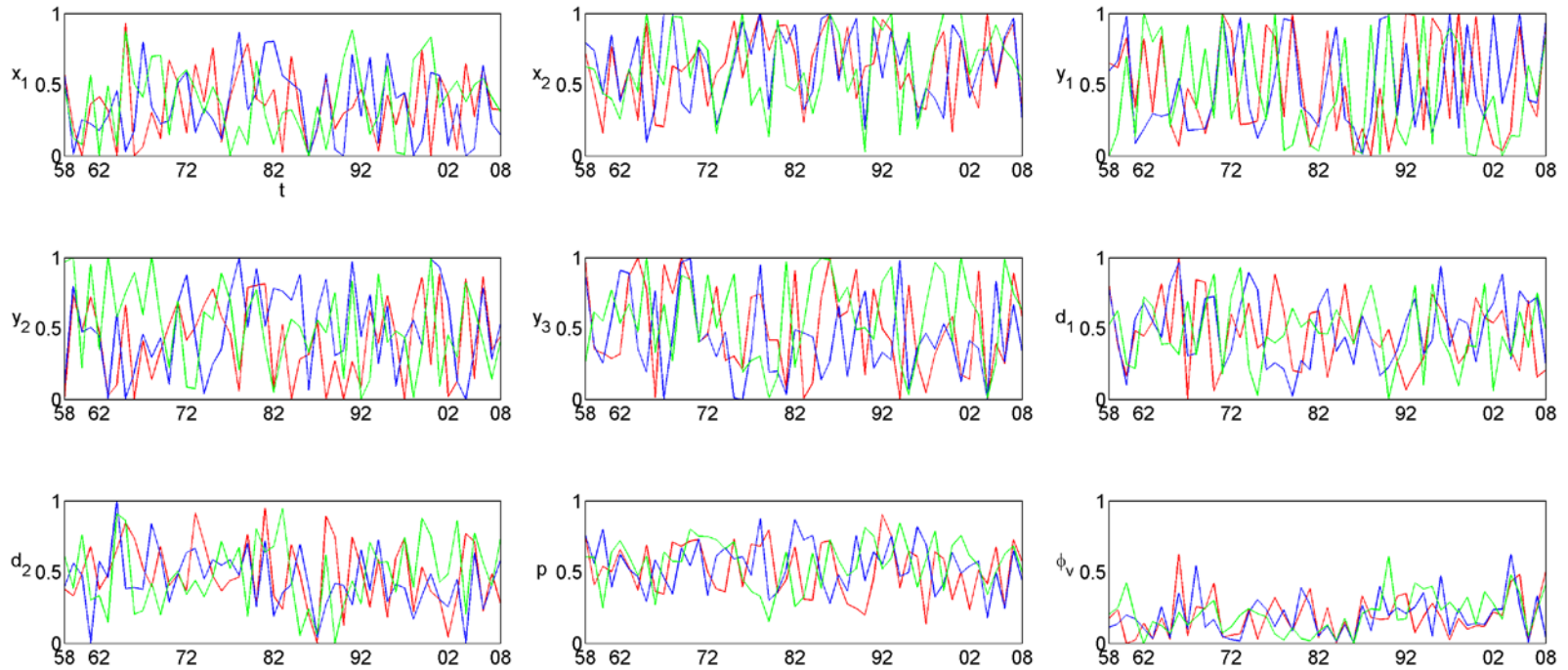
Cherry Valley, CA, 1958-2008



RMSEAR, MAXEAR: $1.6 \pm 0.3\%$, $7.1 \pm 1.5\%$ (yearly encoding)
 0.03% , 0.27% (accumulated sets)

Daily Rainfall

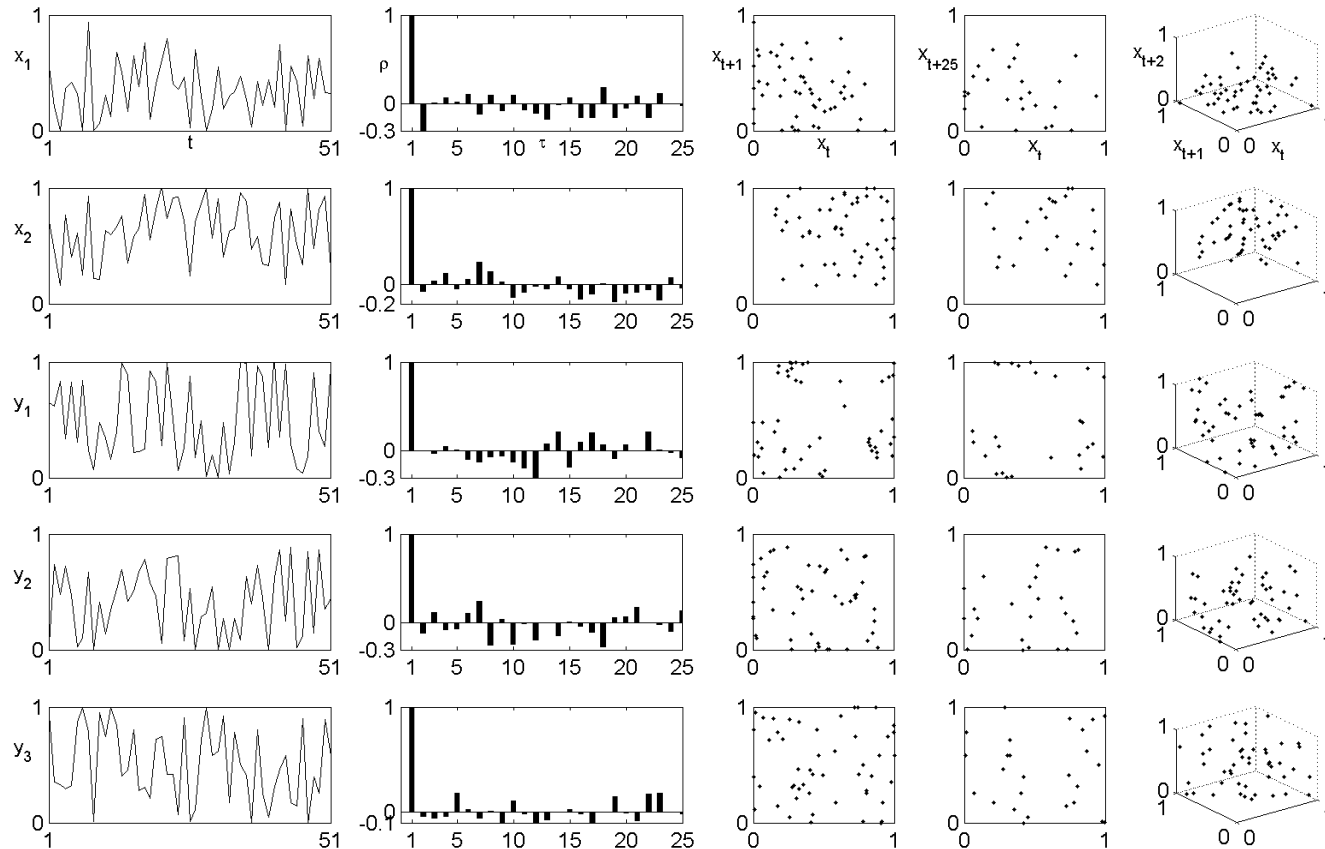
Cherry Valley, CA, three best parameters



best in **red**, second best in **blue**, and third best in **green**
no obvious climate change

Daily Rainfall

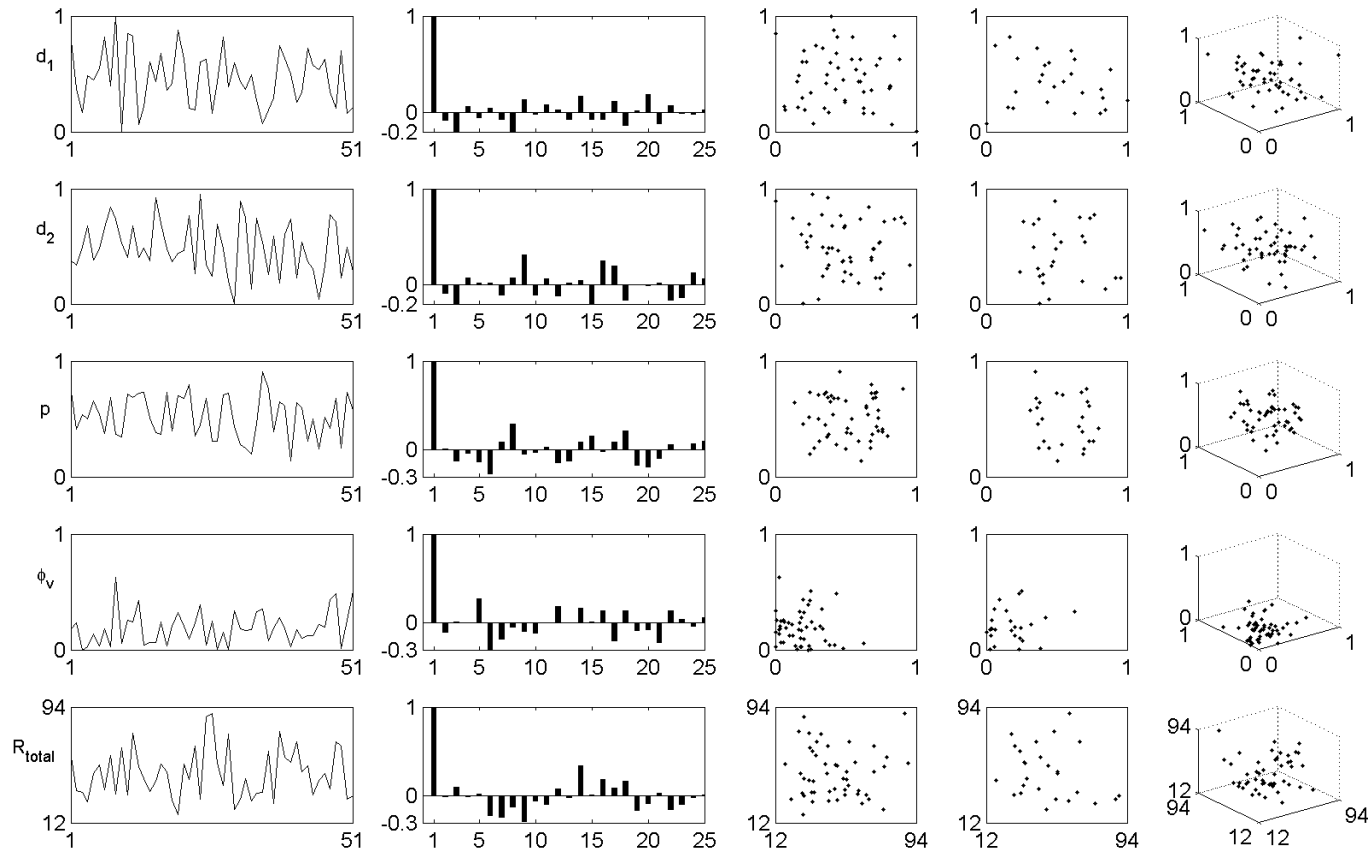
Cherry Valley, CA, evolutions, autocorrelations & phase diagrams



interpolating points exhibit clear complexity

Daily Rainfall

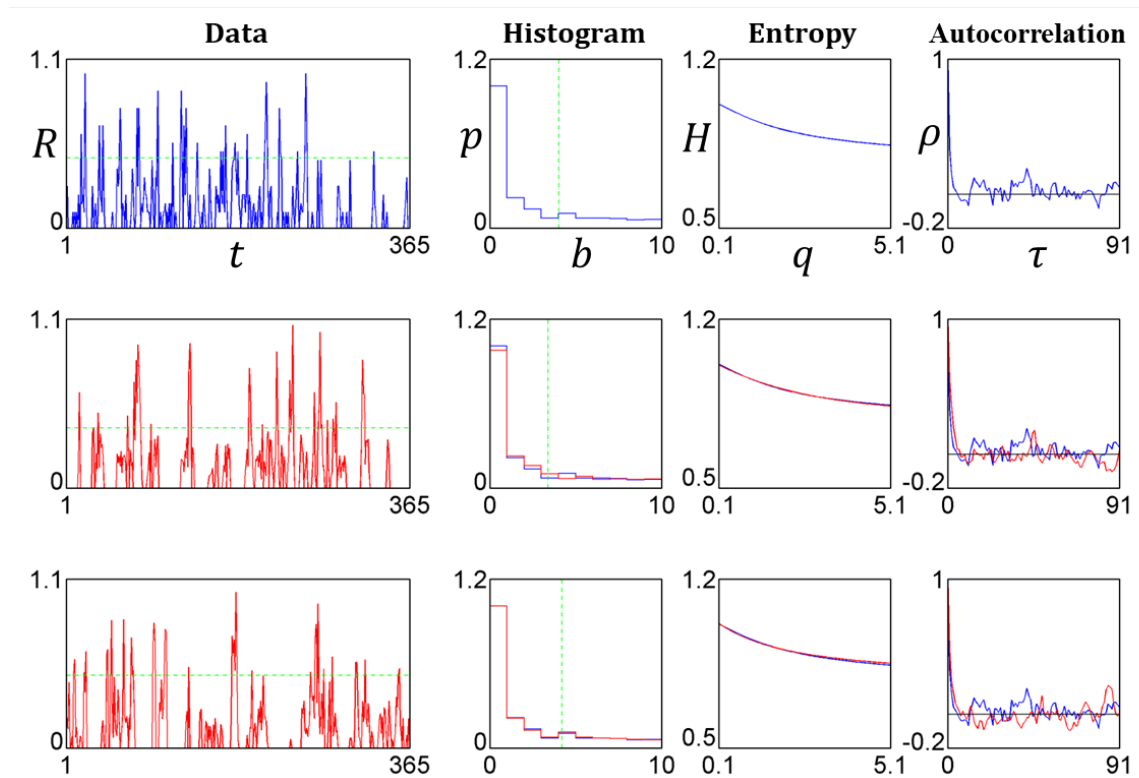
Cherry Valley, CA, evolutions, autocorrelations & phase diagrams



FM parameters are as variable as rainfall totals
same behavior at three other locations in California

Daily Rainfall

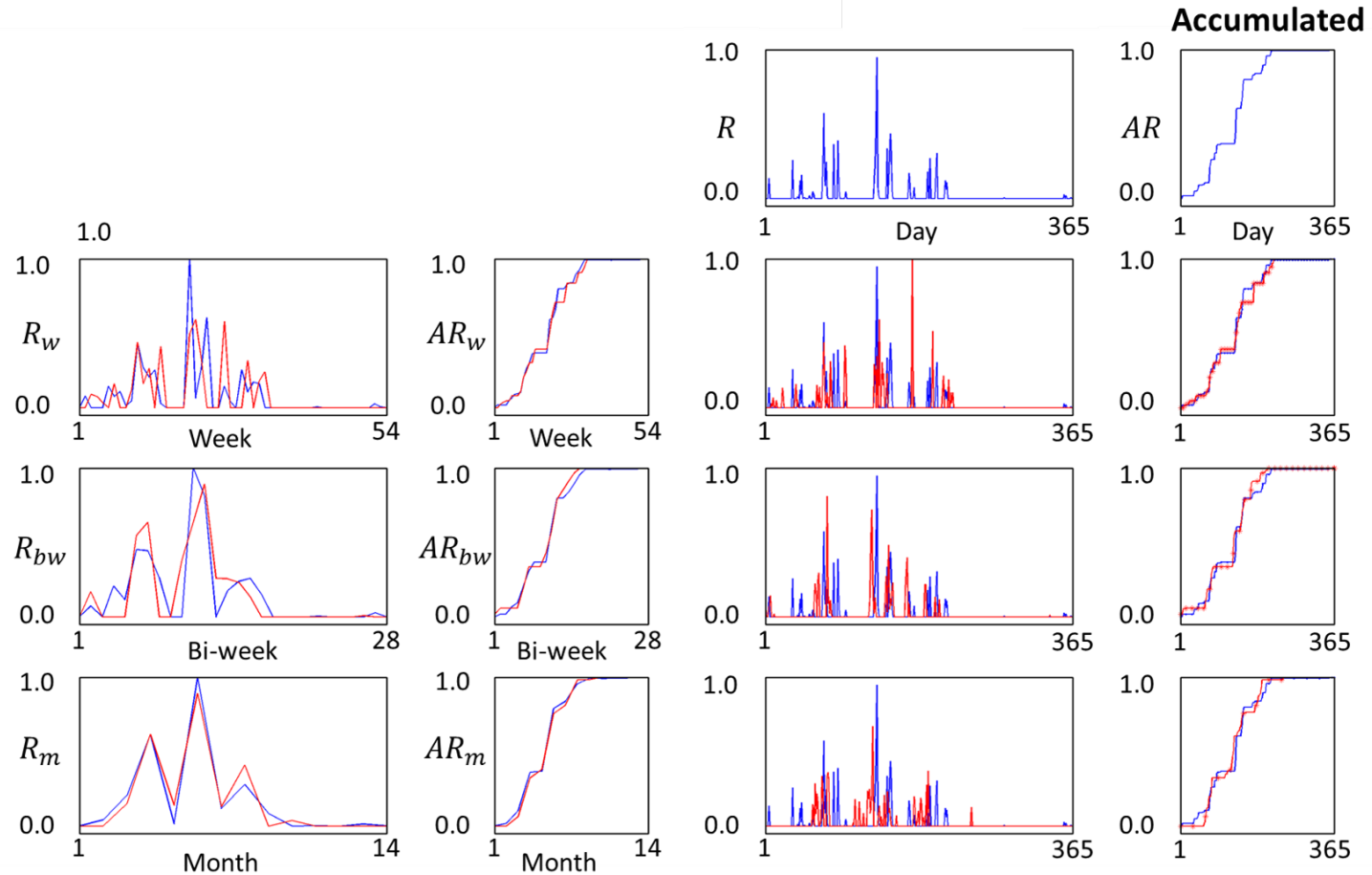
Tinkham Creek, WA, simulations based on entropy and histogram



sets with similar textures

Daily Rainfall

Sacramento, CA, weekly, bi-weekly and monthly disaggregations



once again, adequate textures



Daily Streamflow

iterating $N = 3$ maps

$$w_n \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a_n & 0 \\ c_n & d_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \end{pmatrix} \quad n = 1, 3$$

subject to:

$$w_n \begin{pmatrix} x_0 \\ y_0 \end{pmatrix} = \begin{pmatrix} x_{n-1} \\ y_{n-1} \end{pmatrix}, w_n \begin{pmatrix} x_N \\ y_N \end{pmatrix} = \begin{pmatrix} x_n \\ y_n \end{pmatrix}$$

with ranges in x : $[0, x_1]$, $[x_1, x_2]$ and $[x_2, 1]$



Daily Streamflow

iterating $N = 3$ maps

$$w_n \begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} a_n & 0 \\ c_n & d_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \end{pmatrix} \quad n = 1, 3$$

subject to:

$$w_n \begin{pmatrix} x_0 \\ y_0 \end{pmatrix} = \begin{pmatrix} x_{n-1} \\ y_{n-1} \end{pmatrix}, w_n \begin{pmatrix} x_N \\ y_N \end{pmatrix} = \begin{pmatrix} x_n \\ y_n \end{pmatrix}$$

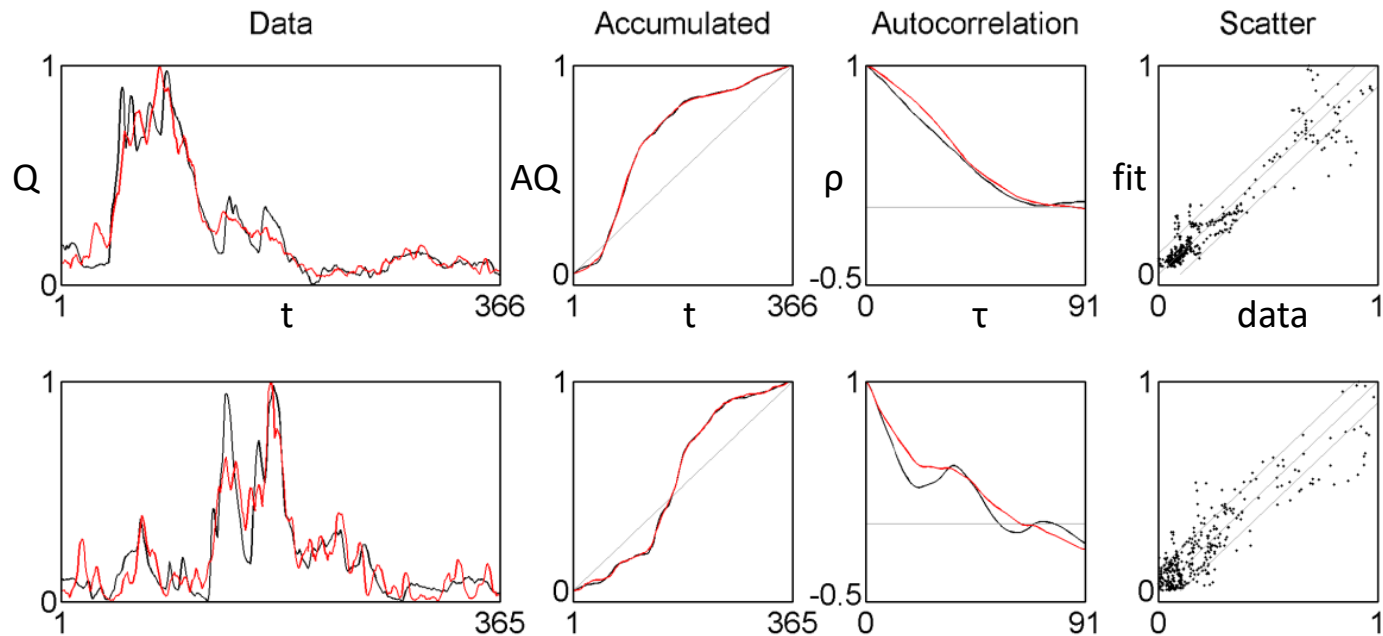
with ranges in x : $[0, x_1]$, $[x_1, x_2]$ and $[x_2, 1]$

FM parameters: $(0, 0)$, (x_1, y_1) , (x_2, y_2) , $(1, 0)$, d_1, d_2, d_3, p_1, p_2

inverse problem: minimizing root mean square error of accumulated records using a “particle swarm” algorithm

Daily Streamflow

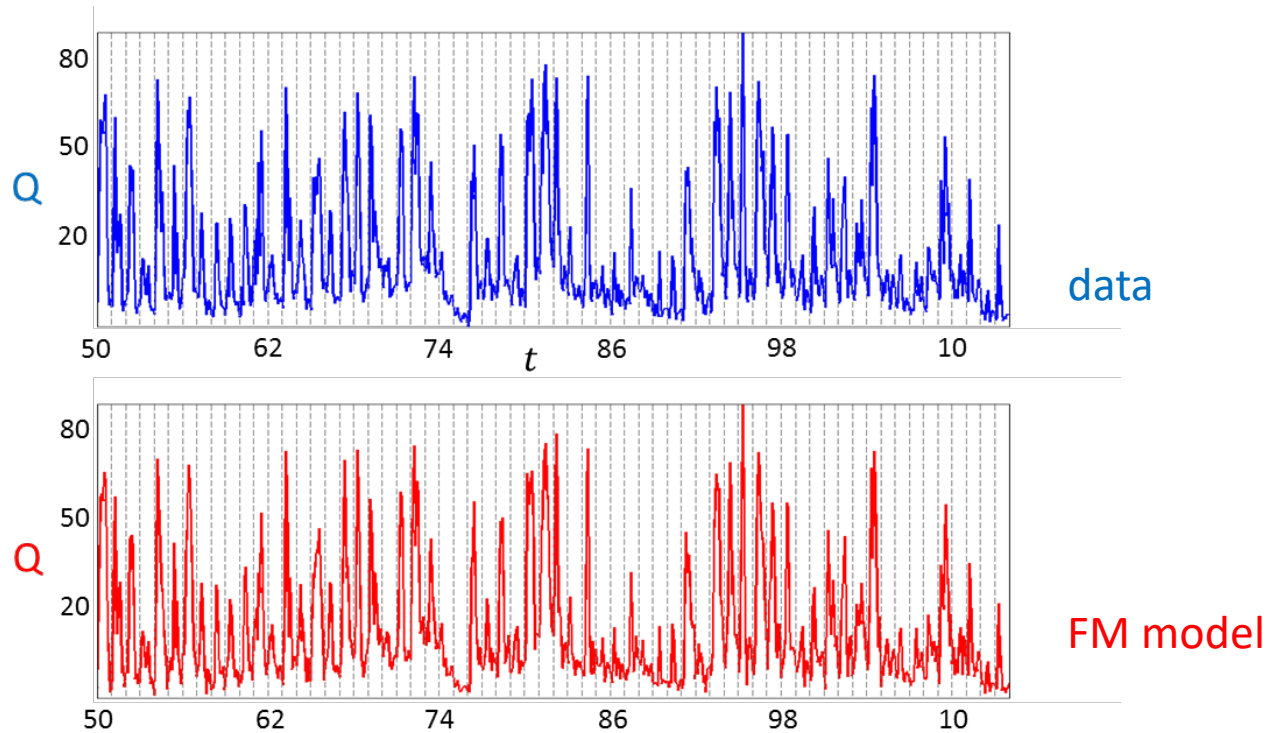
Sacramento, CA, 1975 and 1984



the **accumulated** records and data are adjusted accurately

Daily Streamflow

Sacramento, CA, 1950-2015

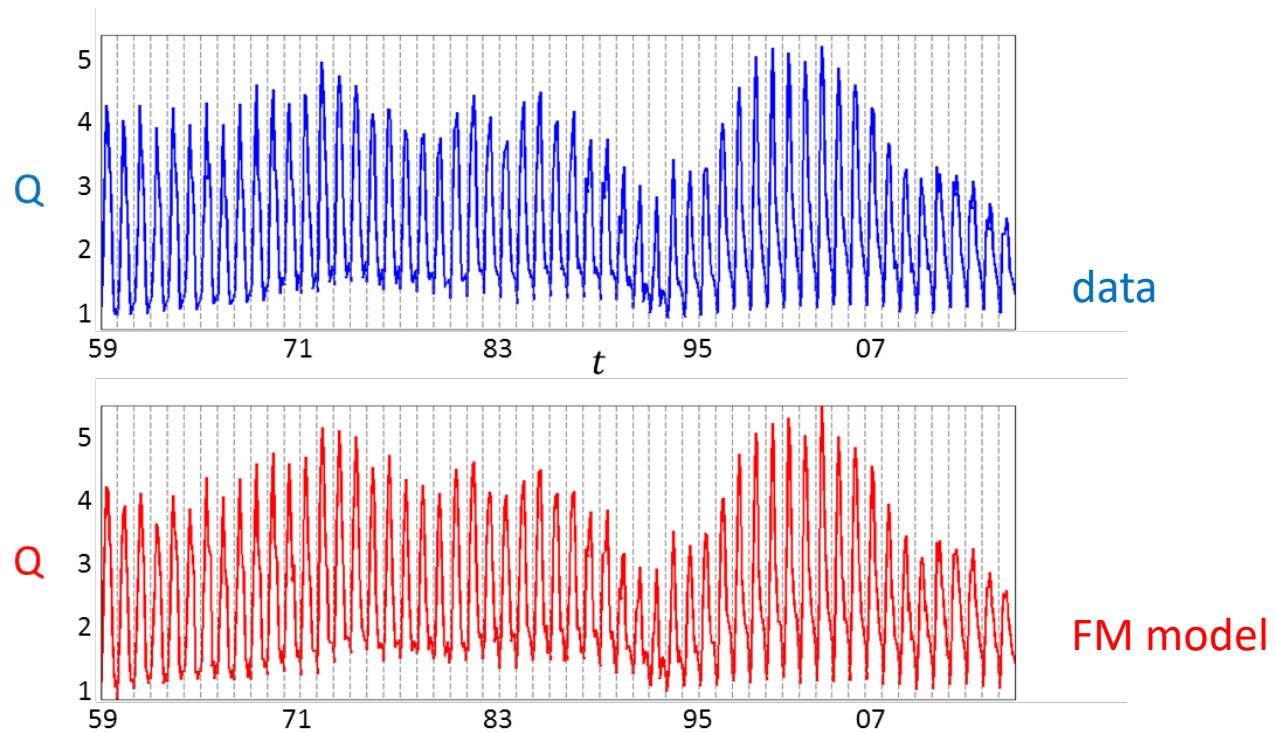


scale in 10^3 x cfs

RMSEAR $0.8 \pm 0.3\%$; MAXEAR $1.8 \pm 0.5\%$; NSD $63.9 \pm 19.0\%$

Daily Streamflow

Sacramento, CA, averaged decades 1959-2015

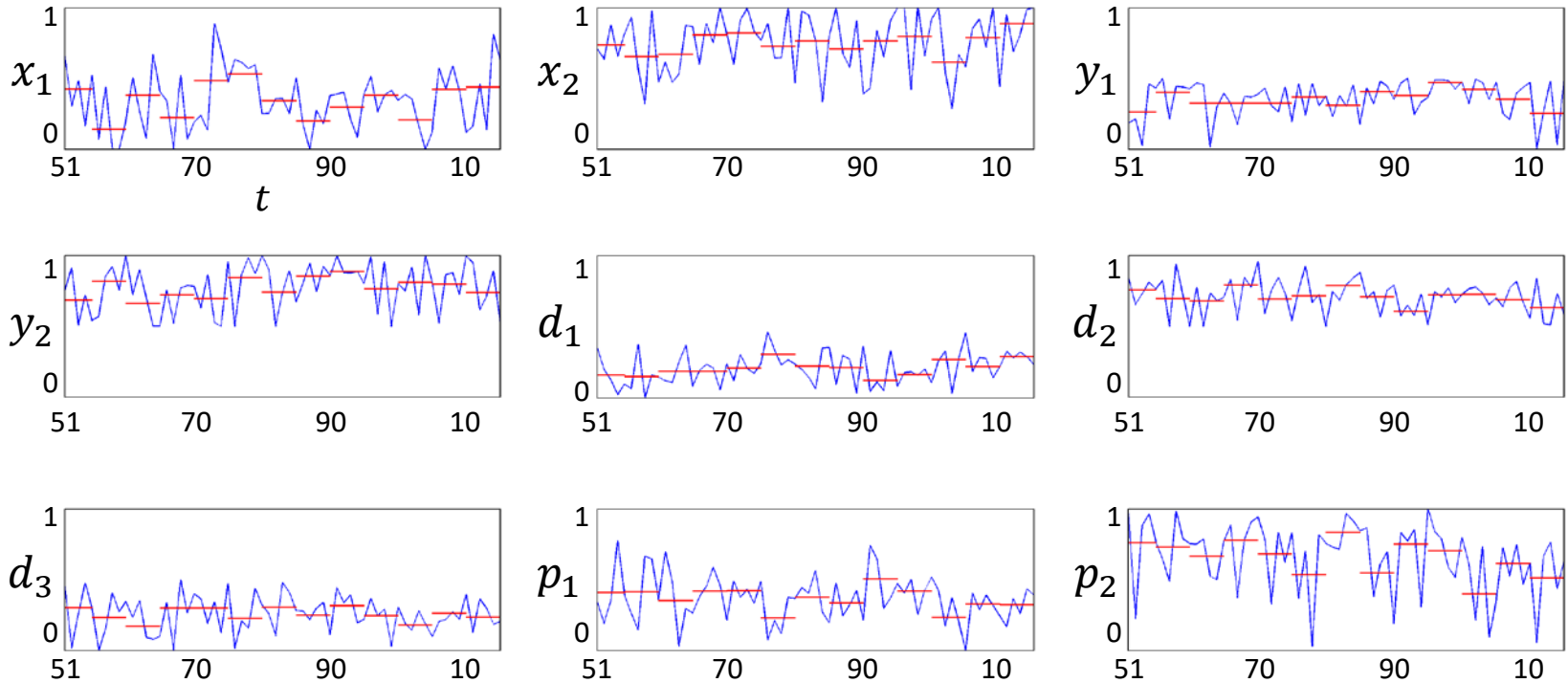


scale in 10^3 x cfs

RMSEAR $1.8 \pm 0.4\%$; MAXEAR $3.6 \pm 0.7\%$; NSD $92.2 \pm 12.5\%$

Daily Streamflow

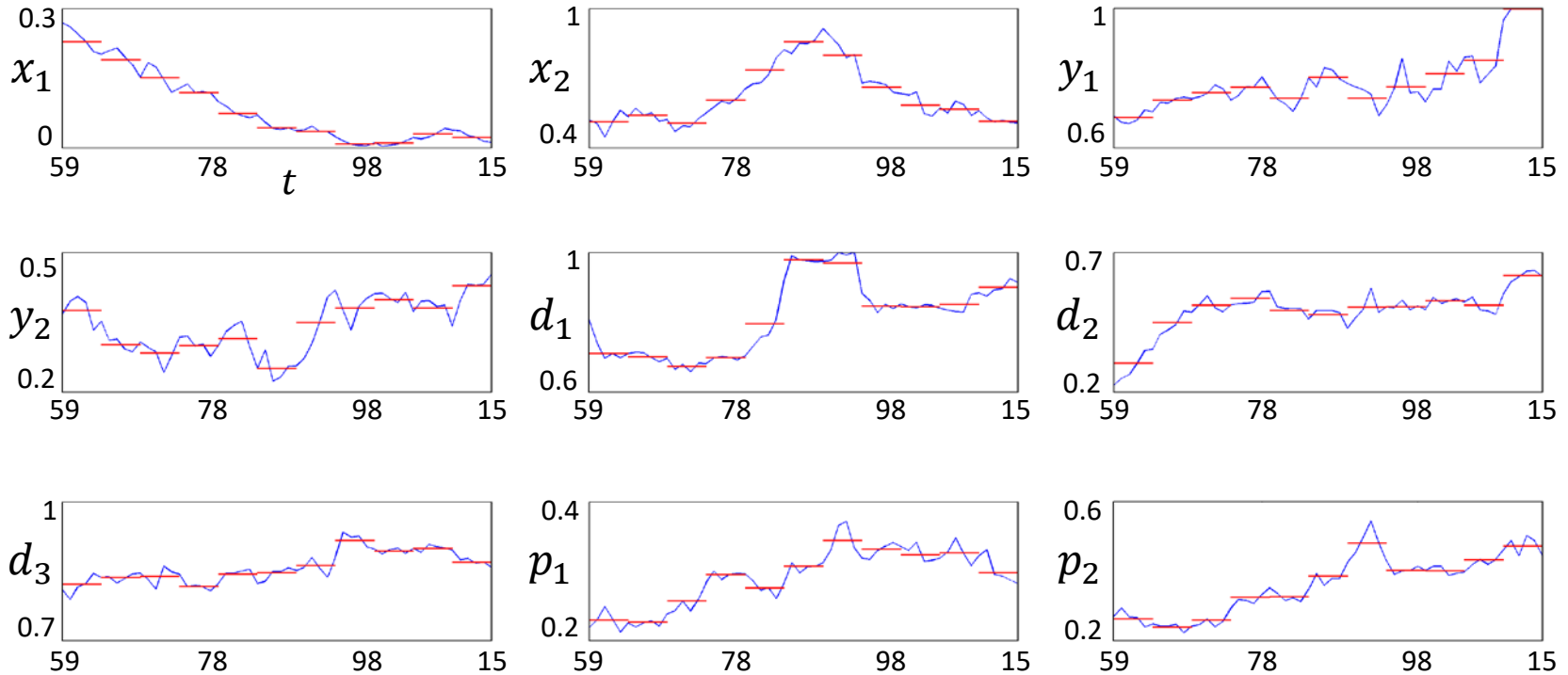
Sacramento, CA, best parameters



some trends but clear natural variability

Daily Streamflow

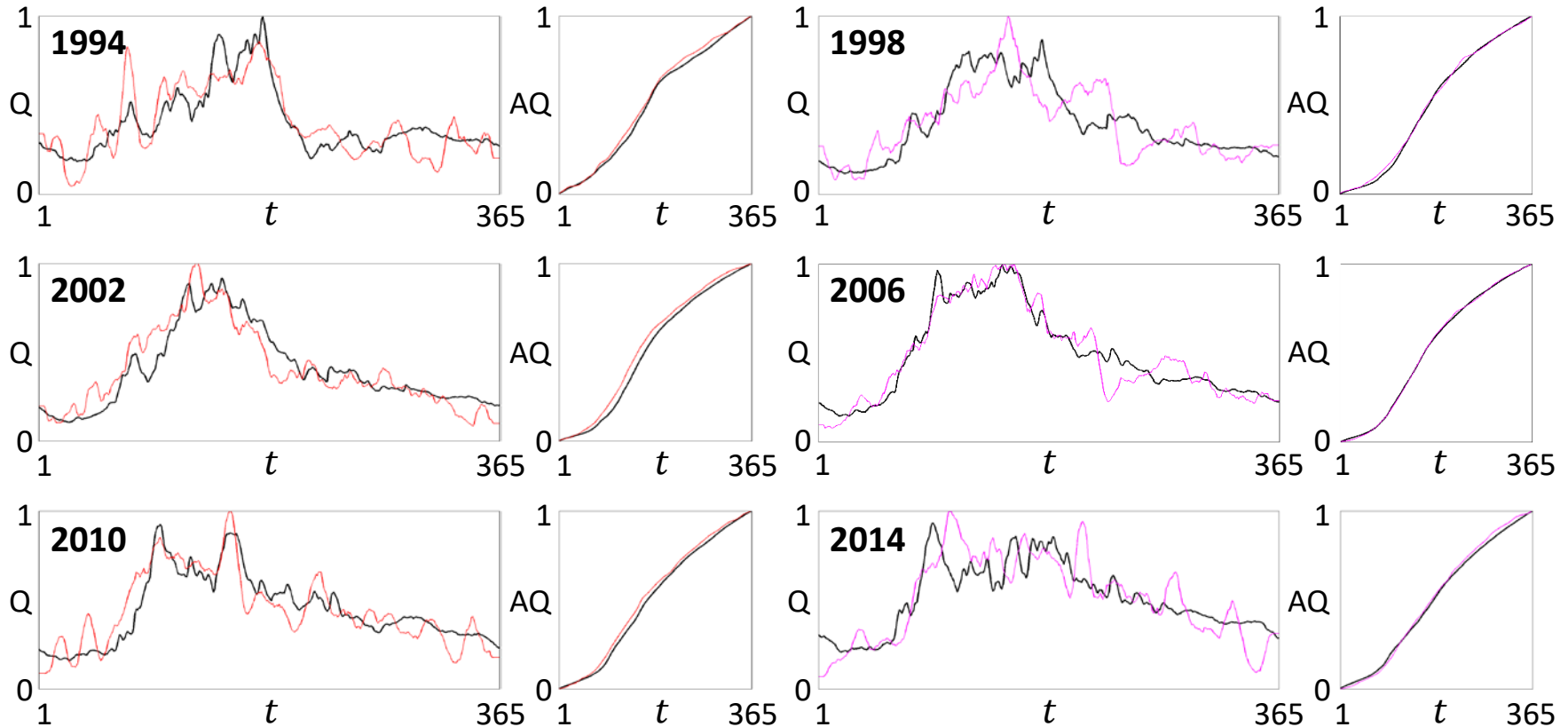
Sacramento, CA, best parameters averaged decades



more stable trends
useful for climate change studies?

Daily Streamflow

Sacramento, CA, predictions averaged decades: TS & NN



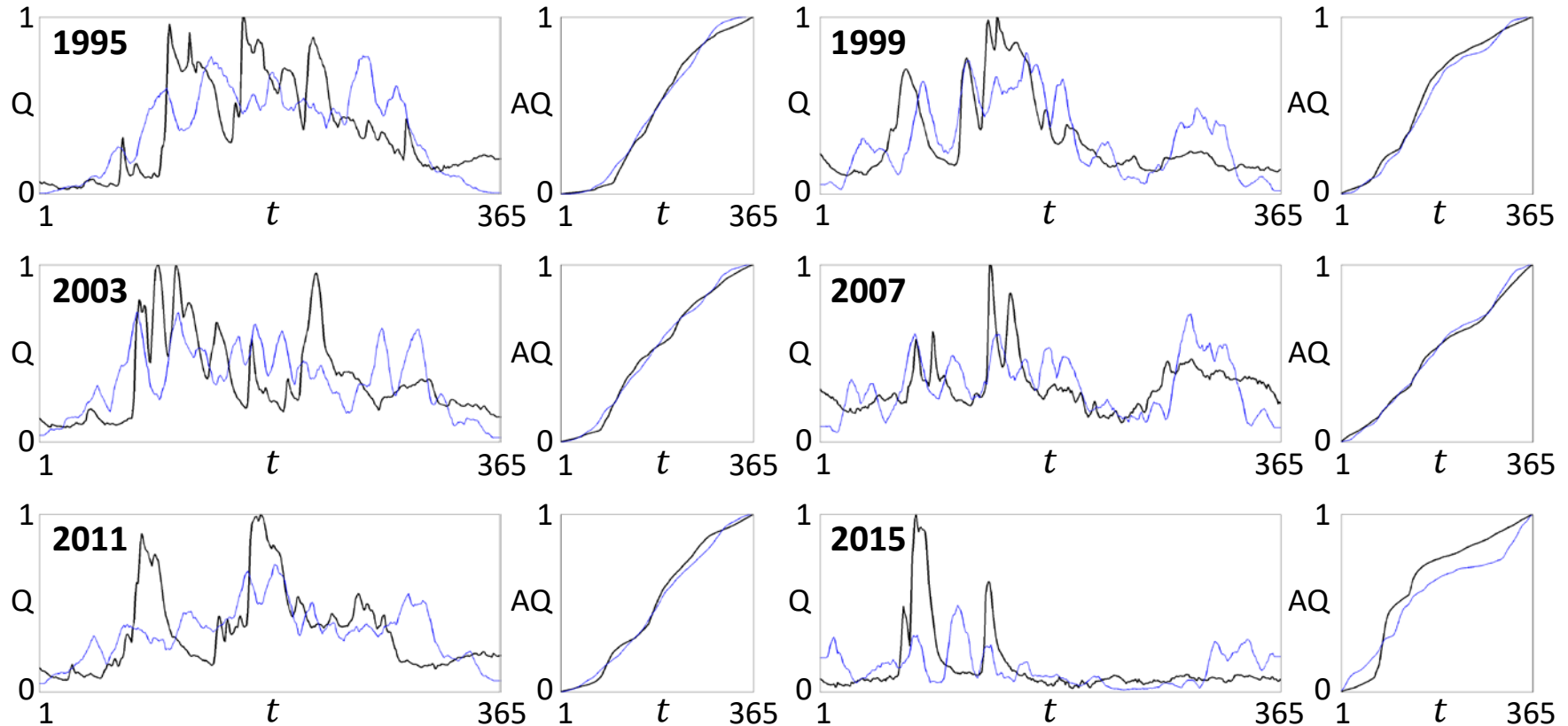
$(2.7 \pm 1.4\%, 5.5 \pm 2.7\%)$ in 22 cases

$(1.4 \pm 0.5\%, 3.4 \pm 1.1\%)$ in 22 cases

decent predictions one year ahead

Daily Streamflow

Sacramento, CA, predictions NN

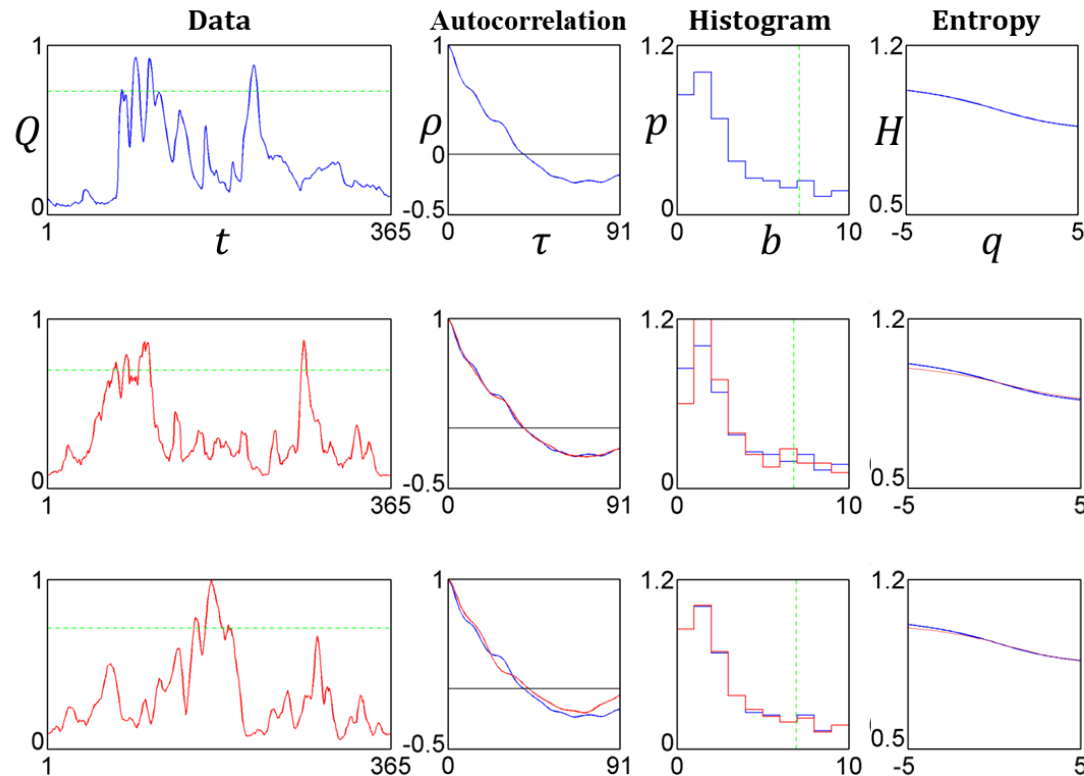


$(3.6 \pm 1.8\%, 7.6 \pm 2.7\%)$ in 26 cases

predictions one year ahead could be quite bad

Daily Streamflow

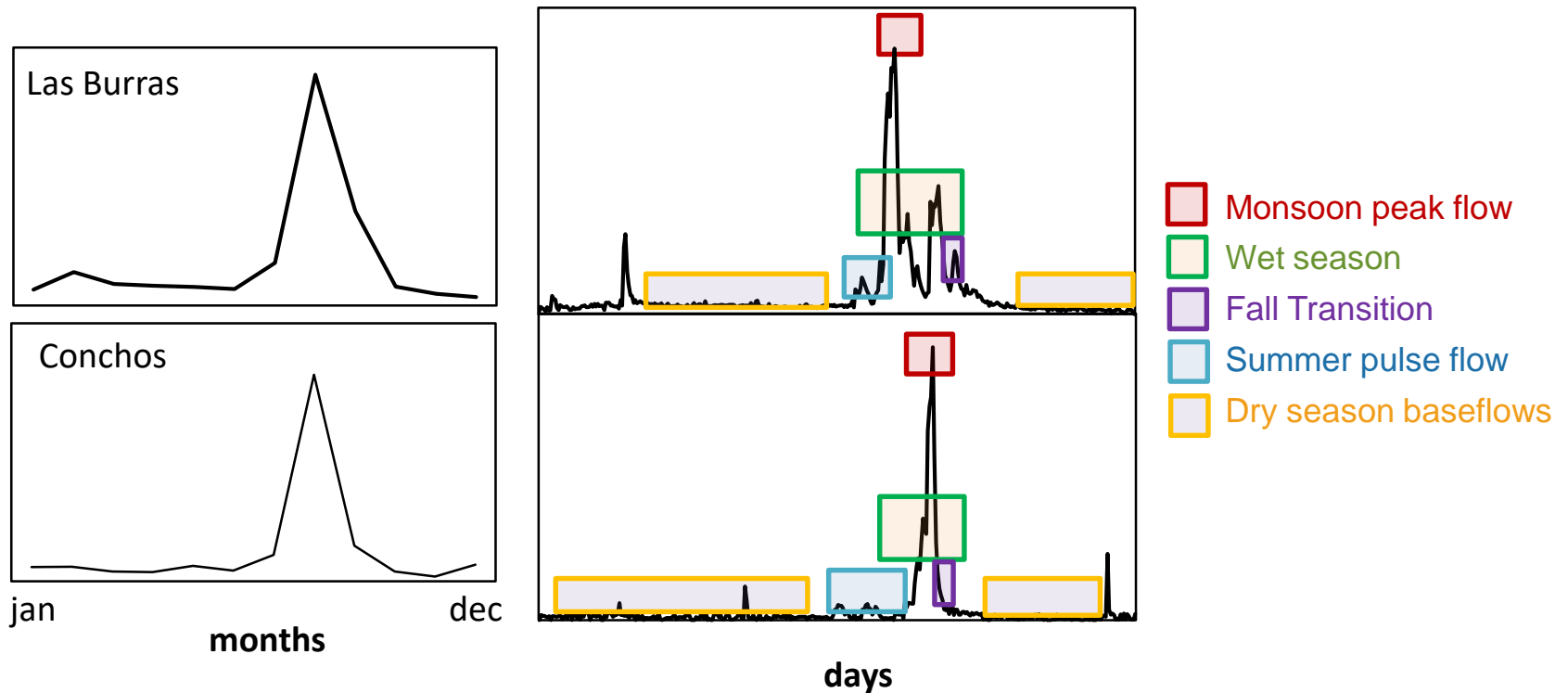
Sacramento, simulations based on autocorrelation and histogram



preservation of whole functions

Daily Streamflow

Rio Grande-Bravo, disaggregations for environmental flows



proper geometries for ecological predictions



FM in Higher Dimensions

more variables, x uncoupled:

$$w_n \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a_n & 0 & 0 \\ c_n & d_n & h_n \\ k_n & l_n & m_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ z \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \\ g_n \end{pmatrix}$$

FM in Higher Dimensions

more variables, x uncoupled:

$$w_n \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a_n & 0 & 0 \\ c_n & d_n & h_n \\ k_n & l_n & m_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ z \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \\ g_n \end{pmatrix}$$

polar coordinates, **radial** and **angular** parameters:

$$D_n = \begin{pmatrix} d_n & h_n \\ l_n & m_n \end{pmatrix} = \begin{pmatrix} r_n^{(1)} \cdot \cos\theta_n^{(1)} & -r_n^{(2)} \cdot \sin\theta_n^{(2)} \\ r_n^{(1)} \cdot \sin\theta_n^{(1)} & r_n^{(2)} \cdot \cos\theta_n^{(2)} \end{pmatrix}$$

FM in Higher Dimensions

more variables, x uncoupled:

$$w_n \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} a_n & 0 & 0 \\ c_n & d_n & h_n \\ k_n & l_n & m_n \end{pmatrix} \cdot \begin{pmatrix} x \\ y \\ z \end{pmatrix} + \begin{pmatrix} e_n \\ f_n \\ g_n \end{pmatrix}$$

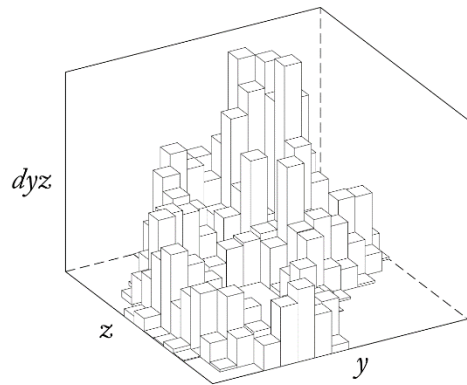
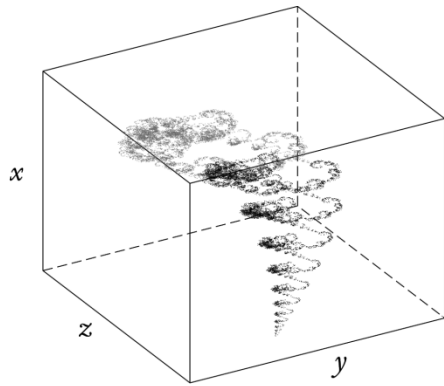
polar coordinates, **radial** and **angular** parameters:

$$D_n = \begin{pmatrix} d_n & h_n \\ l_n & m_n \end{pmatrix} = \begin{pmatrix} r_n^{(1)} \cdot \cos\theta_n^{(1)} & -r_n^{(2)} \cdot \sin\theta_n^{(2)} \\ r_n^{(1)} \cdot \sin\theta_n^{(1)} & r_n^{(2)} \cdot \cos\theta_n^{(2)} \end{pmatrix}$$

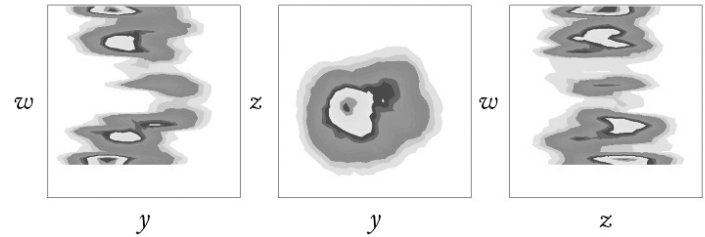
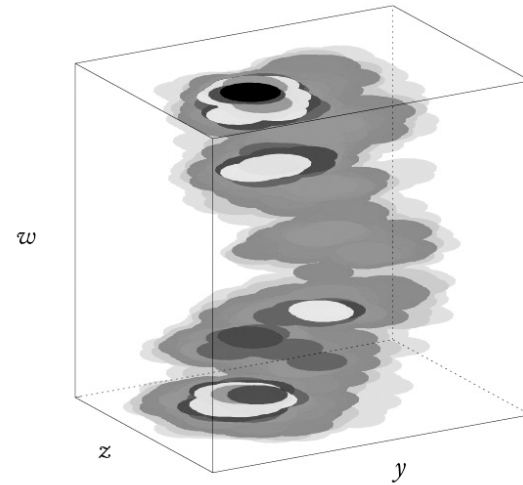
iterations generate **wires** from x to (y, z)

with fractal **dimensions** between 1 and 3

FM in Higher Dimensions

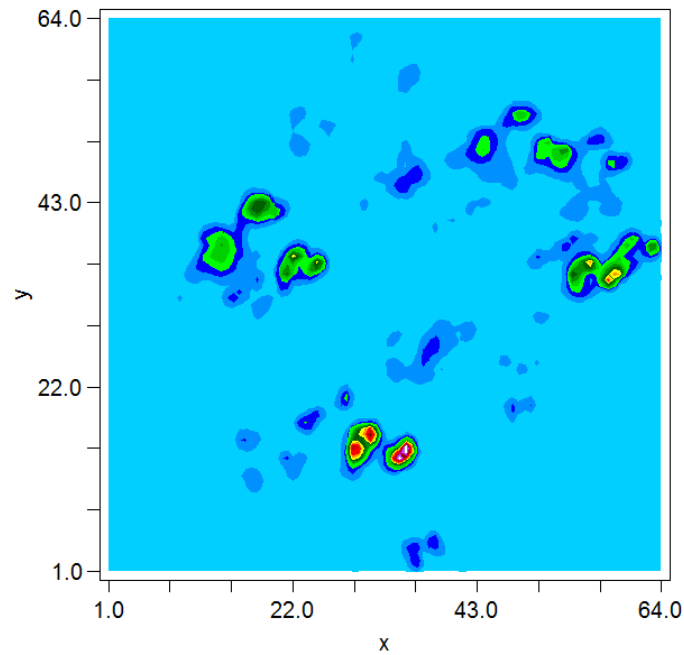
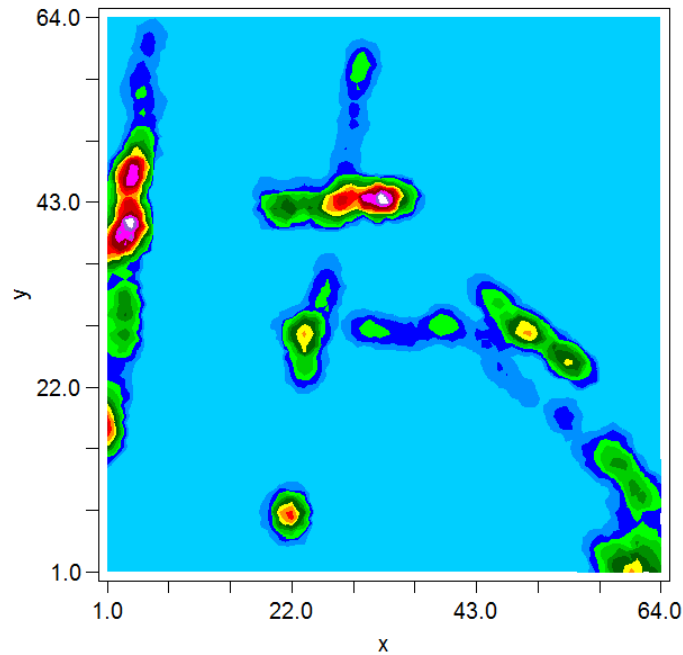


shadow over (y, z)



based on a wire in 4D
pollution, rainfall...

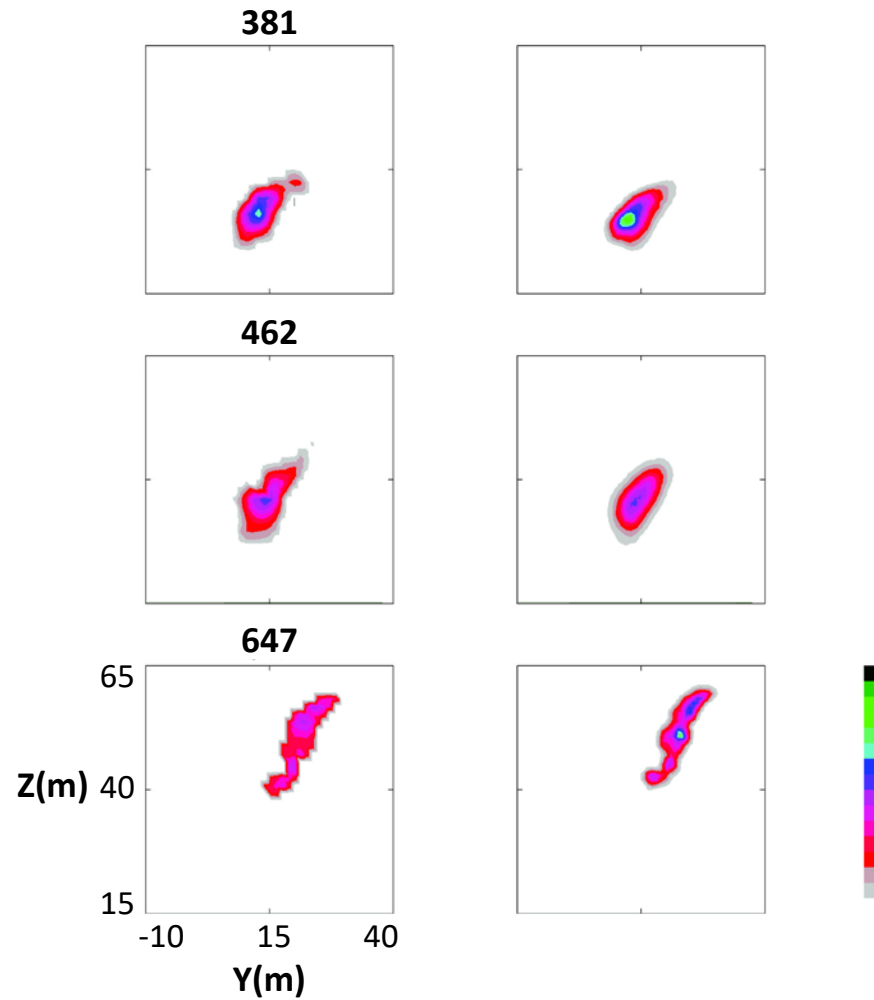
Deterministic Landscapes



geostatistics for the next decades!
complex sets to further explore

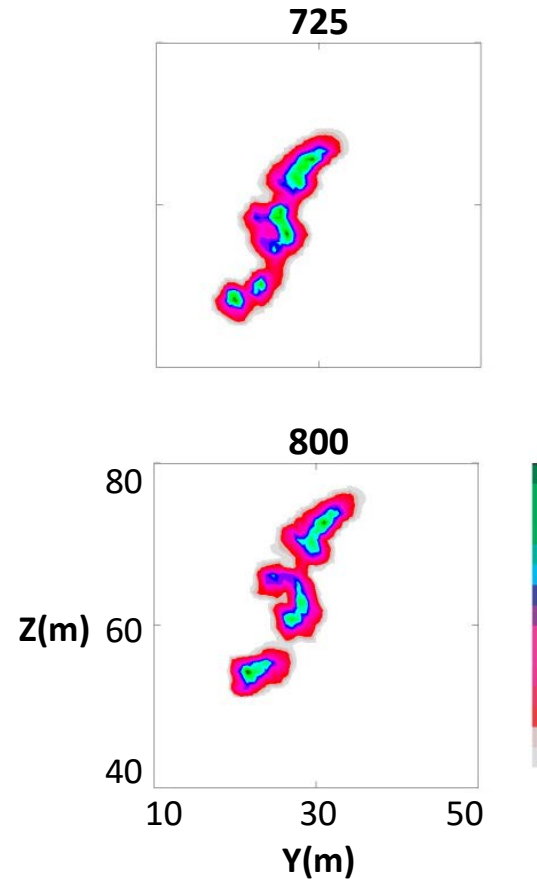
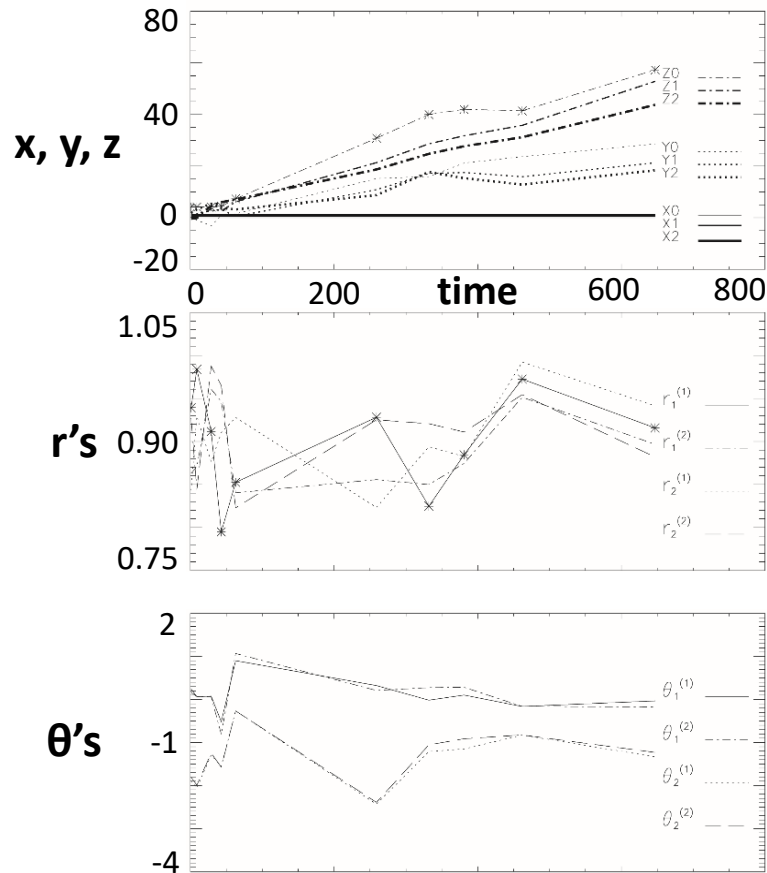


Groundwater Pollution



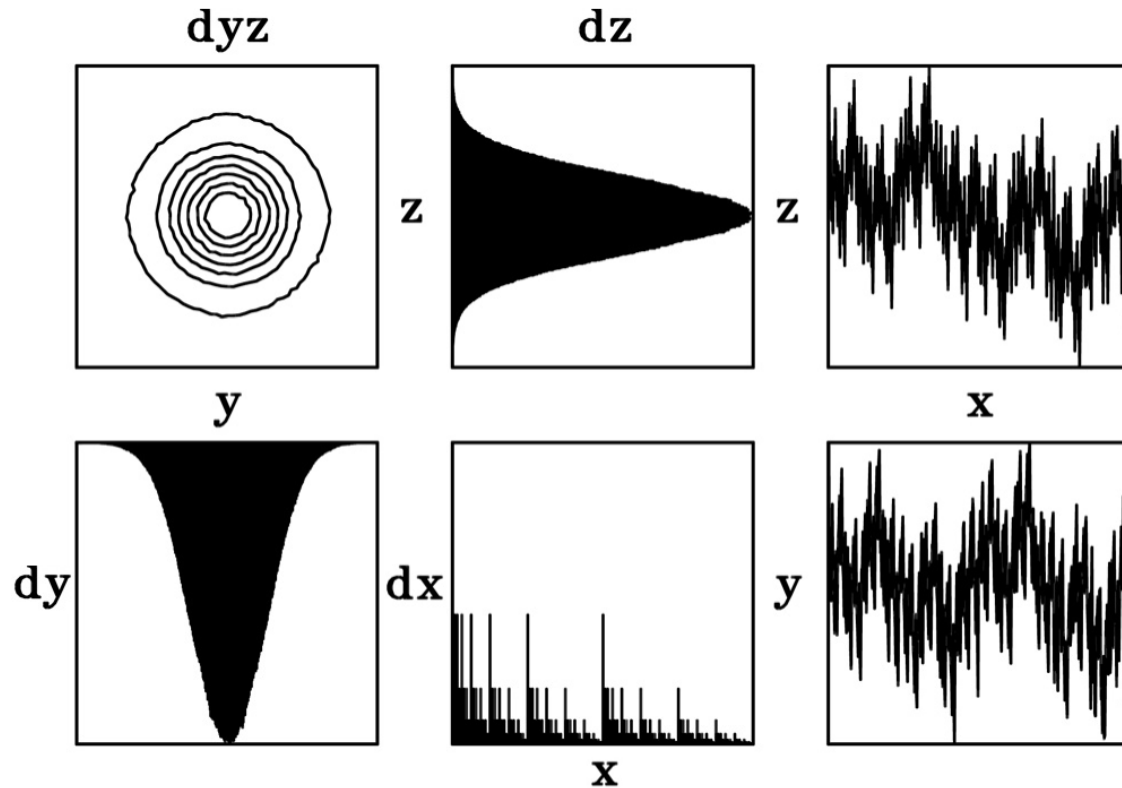
observed and FM sets

Groundwater Pollution

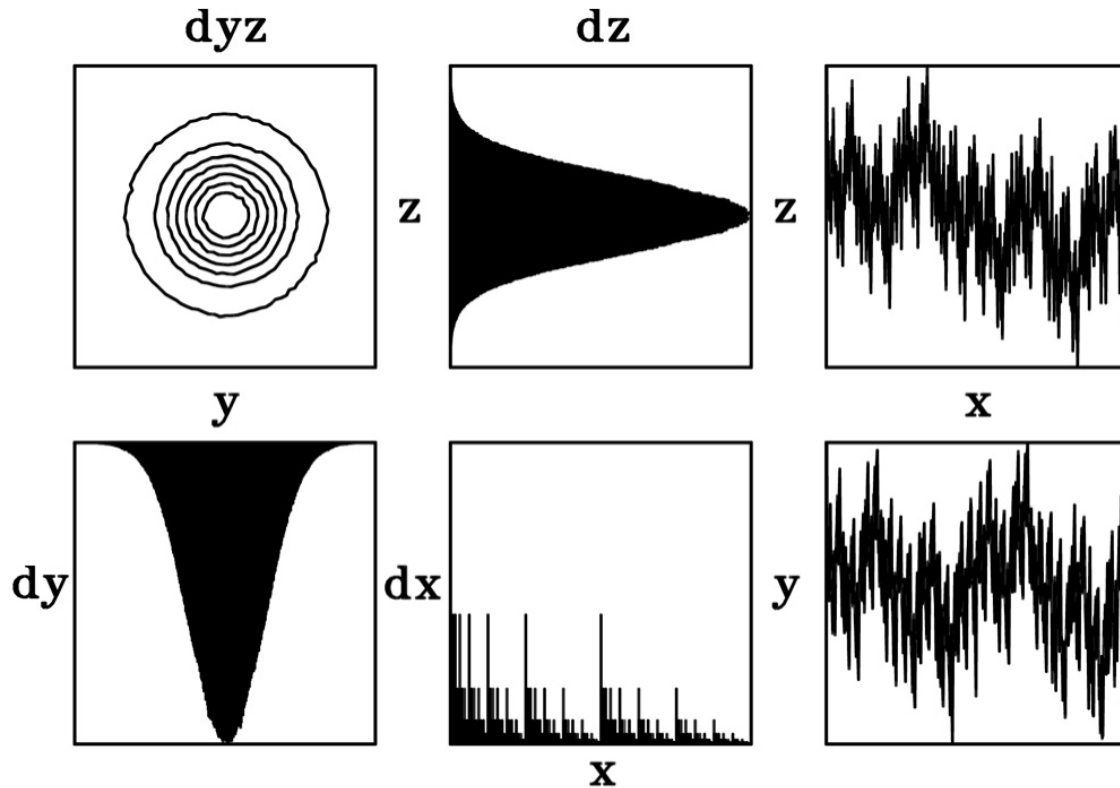


predictions based on geometry!

Limiting Bells over 2D

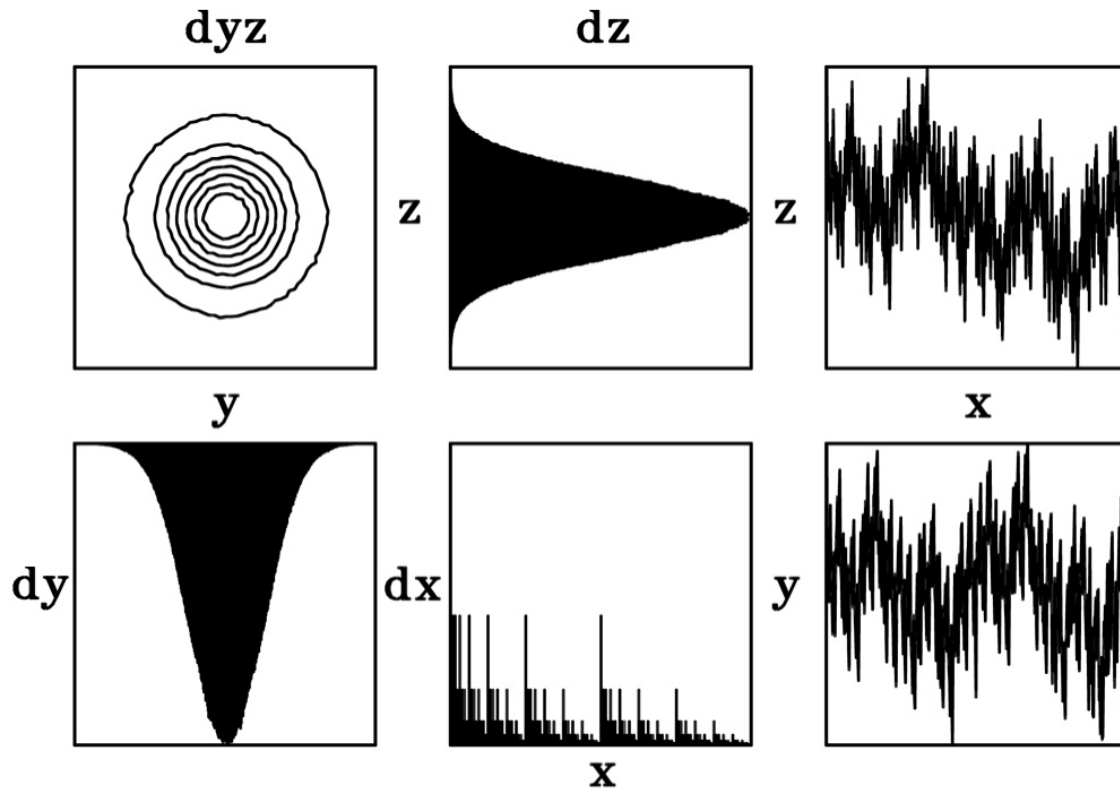


Limiting Bells over 2D



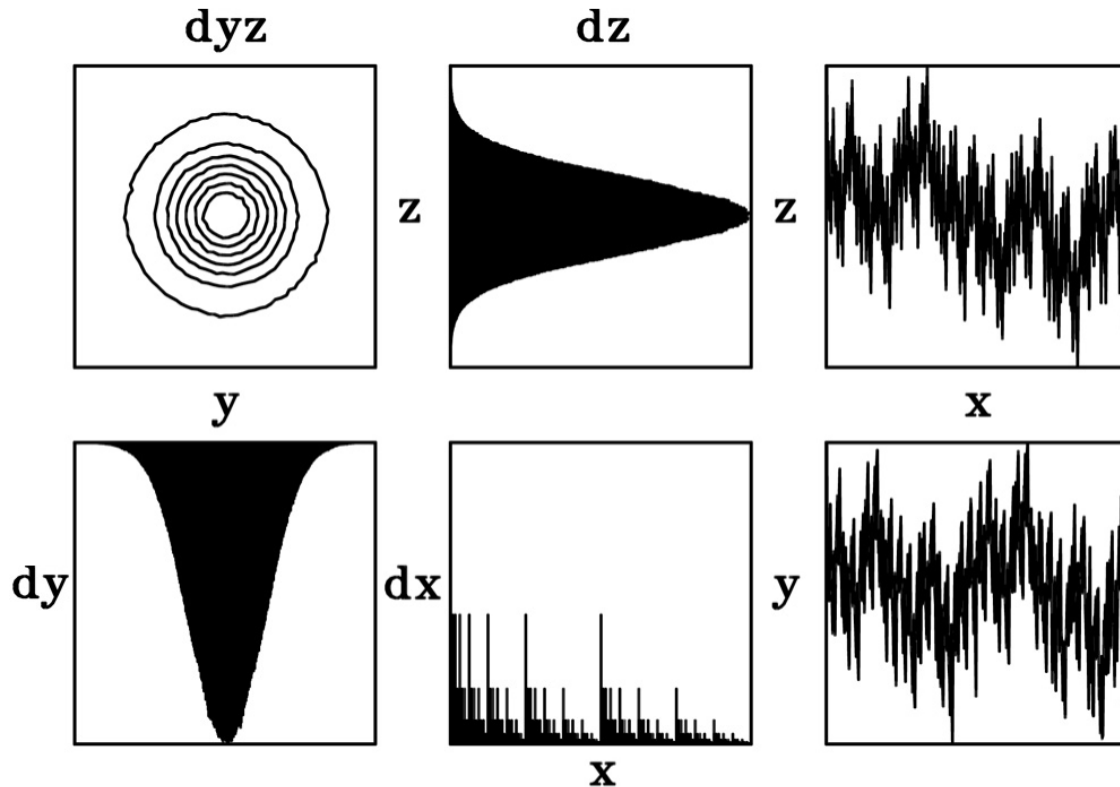
$|D_n| \rightarrow 1, D \rightarrow 3$, **circular** bells, but also **elliptical** and **oscillations**

Limiting Bells over 2D



$|D_n| \rightarrow 1, D \rightarrow 3$, **circular** bells, but also **elliptical** and **oscillations**
portions of wires define bells, *ad infinitum*

Limiting Bells over 2D



$|D_n| \rightarrow 1, D \rightarrow 3$, **circular** bells, but also **elliptical** and **oscillations**
portions of wires define bells, *ad infinitum*
proof of higher-dimensional case is unknown...

Towards Unity, $1 = 0.999\dots$



Carl Friedrich Gauss

- 0.995 already gave bells by eye, from 1M dots

Towards Unity, $1 = 0.999\dots$



Carl Friedrich Gauss

- 0.995 already gave bells by eye, from 1M dots
- we plotted 2,000 dots at a time to study circle formation

Towards Unity, $1 = 0.999\dots$



Carl Friedrich Gauss

- 0.995 already gave bells by eye, from 1M dots
- we plotted 2,000 dots at a time to study circle formation
- we expected superposition of circles and donuts

Towards Unity, $1 = 0.999\dots$



Carl Friedrich Gauss

- 0.995 already gave bells by eye, from 1M dots
- we plotted 2,000 dots at a time to study circle formation
- we expected superposition of circles and donuts
- I was up for tenure and stopped fuzzy experiments

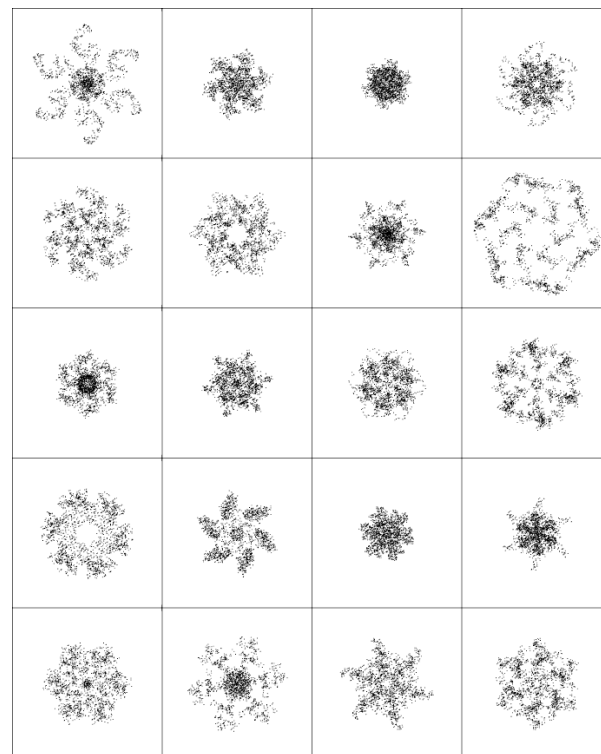
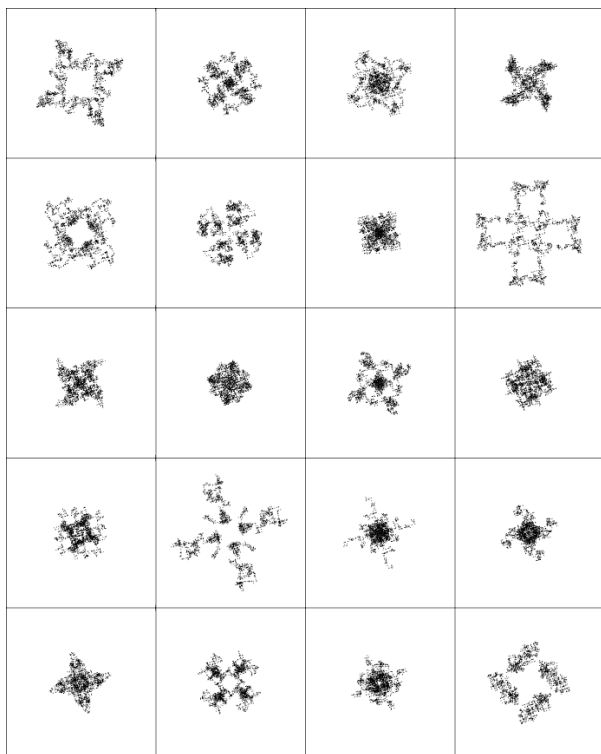
Towards Unity, $1 = 0.999\dots$



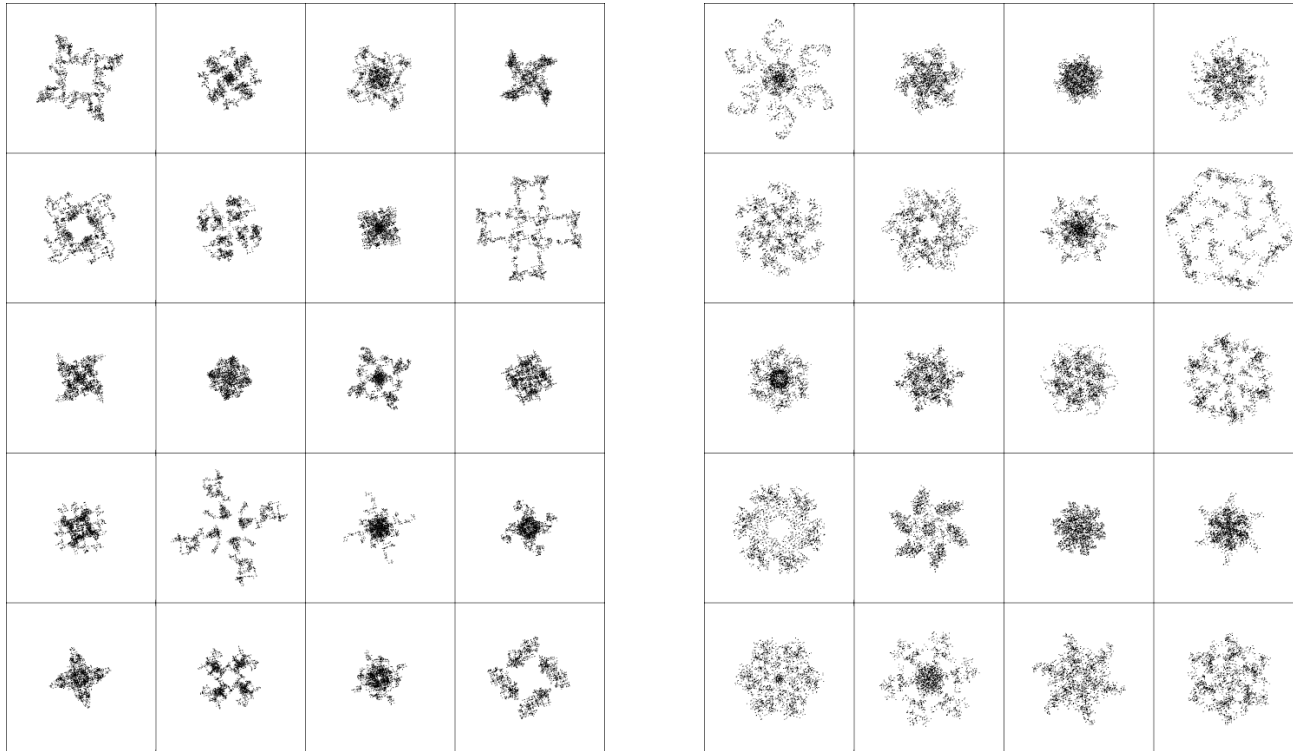
Carl Friedrich Gauss

- 0.995 already gave bells by eye, from 1M dots
- we plotted 2,000 dots at a time to study circle formation
- we expected superposition of circles and donuts
- I was up for tenure and stopped fuzzy experiments
- I got tenure and increased from 0.995 to 0.9999, and...

Towards Unity, $1 = 0.999\dots$

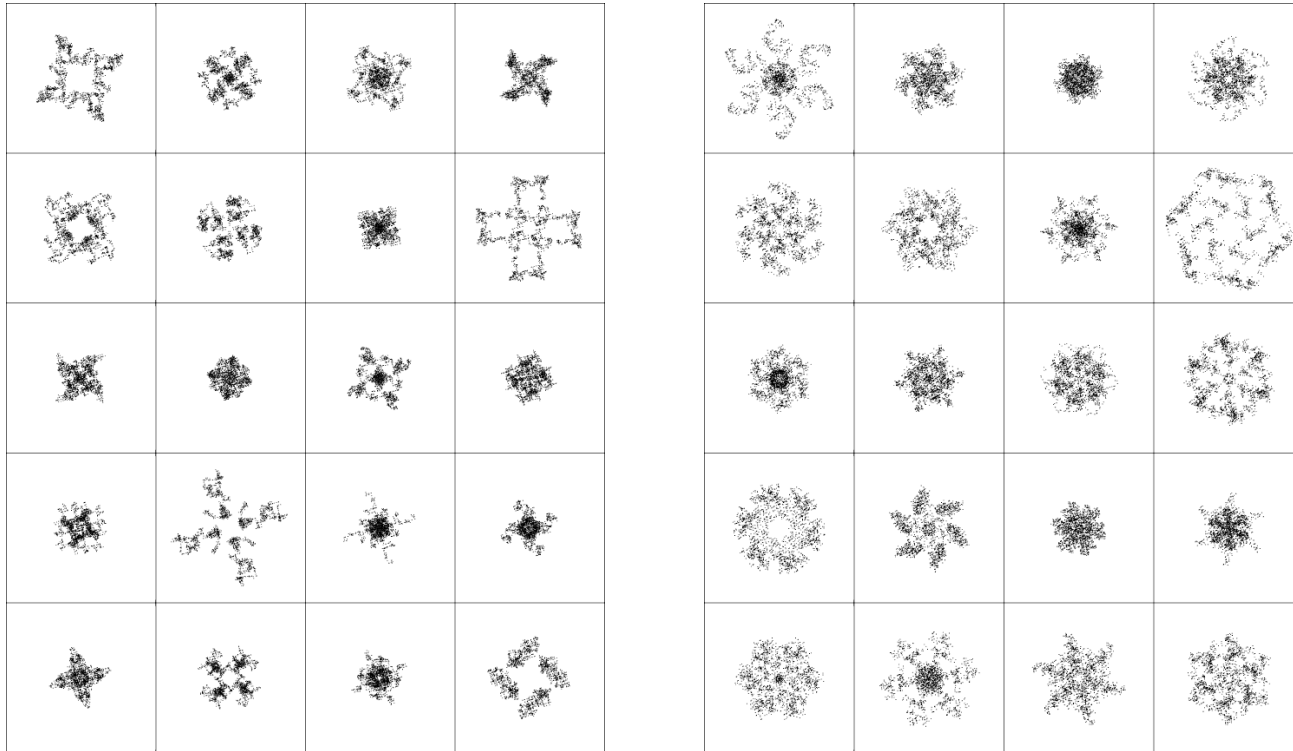


Towards Unity, $1 = 0.999\dots$



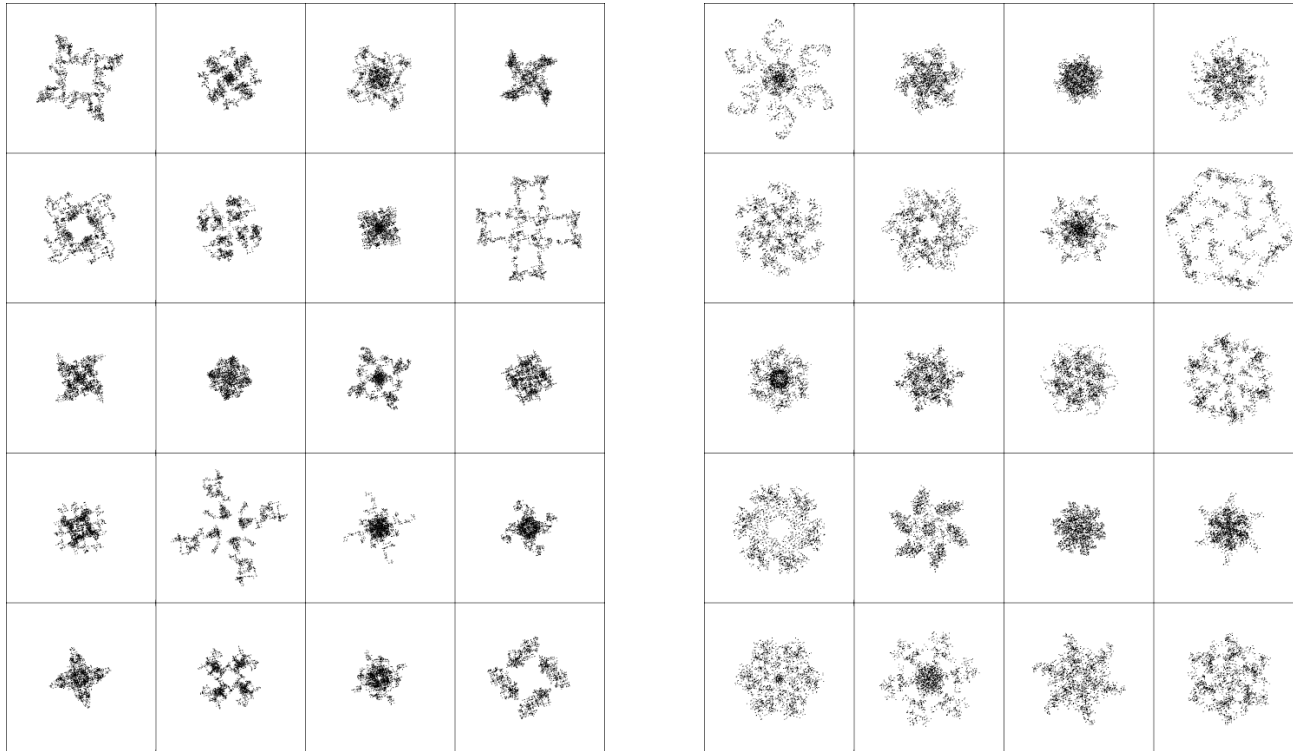
superposition of rosettes give **perfect circles and bells!**

Towards Unity, $1 = 0.999\dots$



superposition of rosettes give **perfect circles and bells!**
only in the **space-filling** limit there is hidden **order in chance**

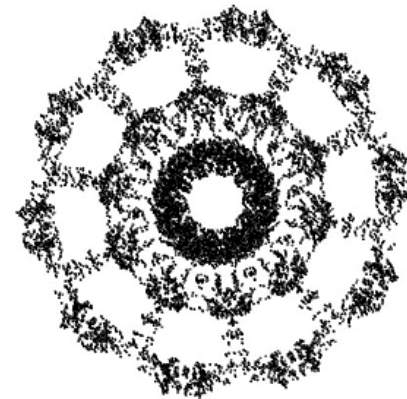
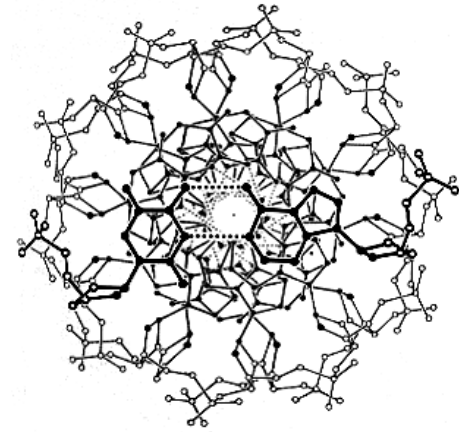
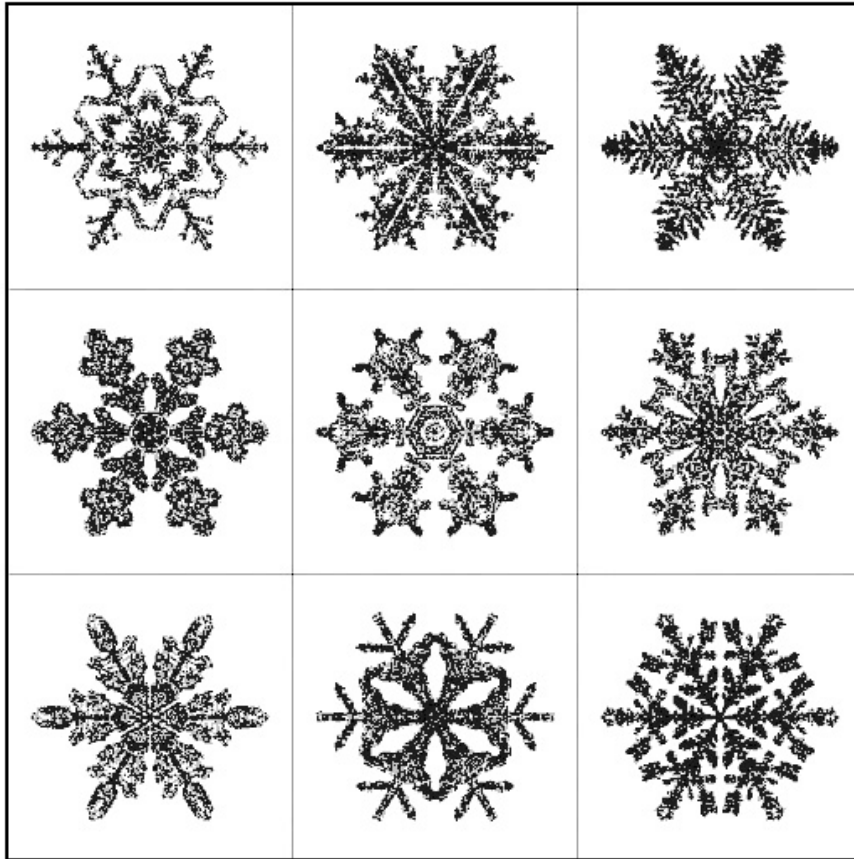
Towards Unity, $1 = 0.999\dots$



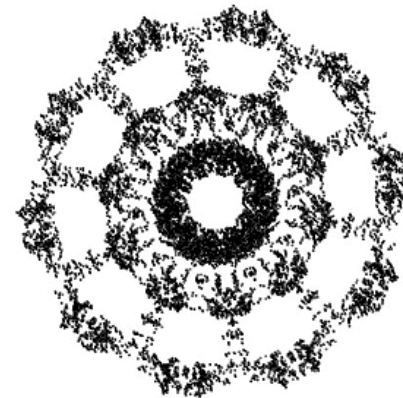
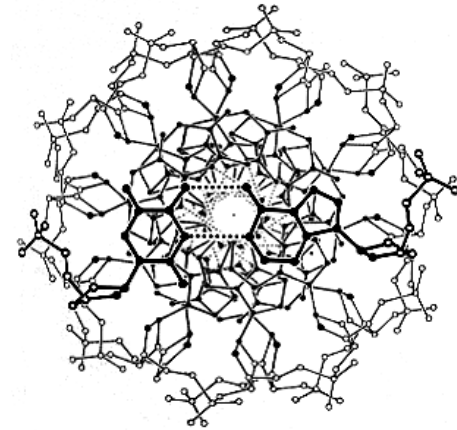
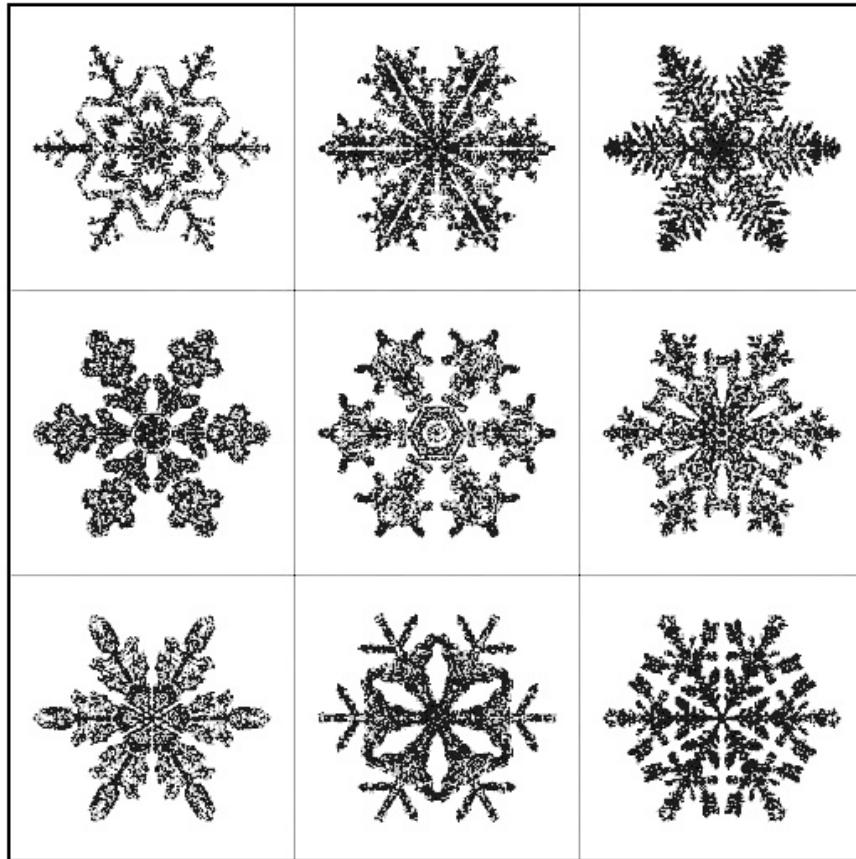
superposition of rosettes give **perfect circles and bells!**
only in the **space-filling** limit there is hidden **order in chance**

“how precious to me are your designs, O God”

Some Designs inside the bell

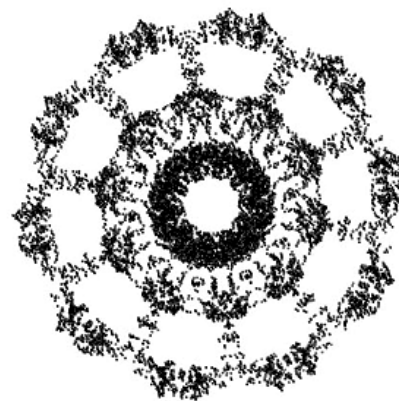
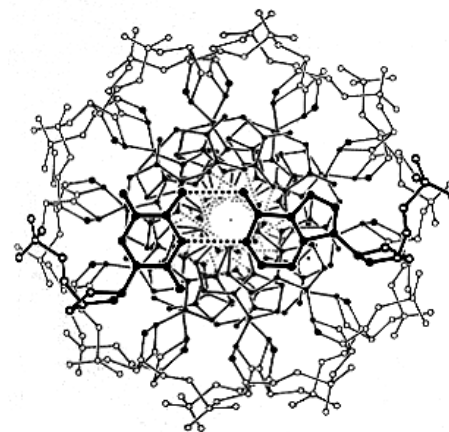
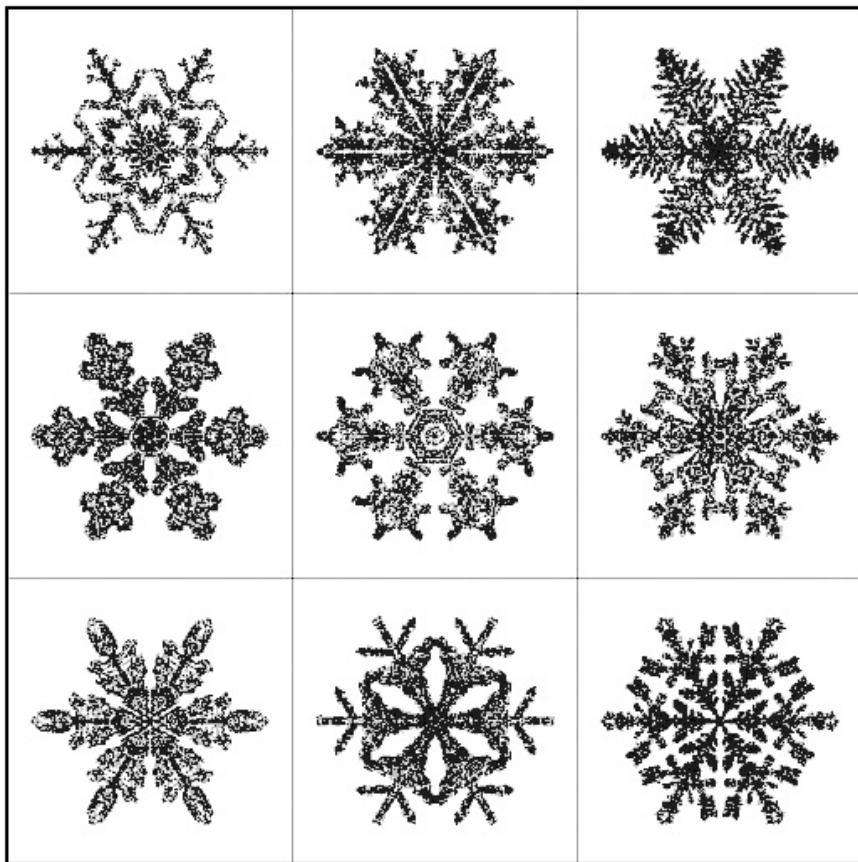


Some Designs inside the bell



with **my wife**: *ice crystals* in a Borgesian aleph, **hydrology!**

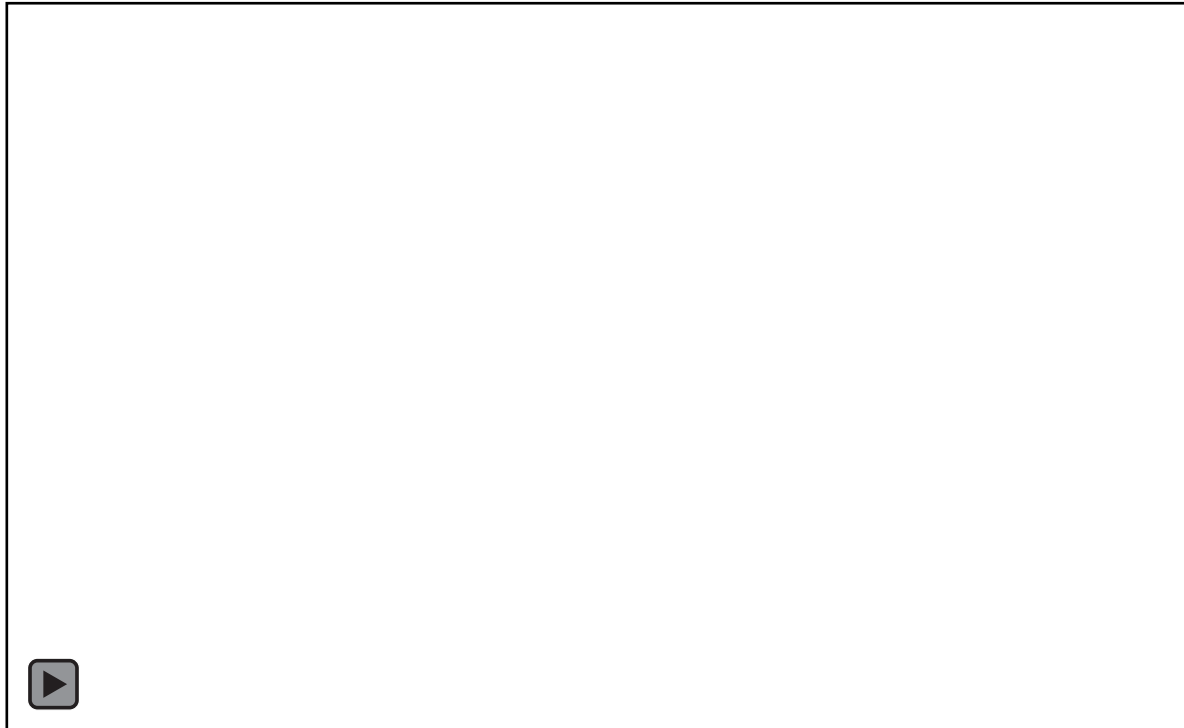
Some Designs inside the bell



with **my wife**: *ice crystals* in a Borgesian aleph, **hydrology!**
the rosette of **DNA** coded via the binary expansion of π !



An evolution with UC Davis colors!

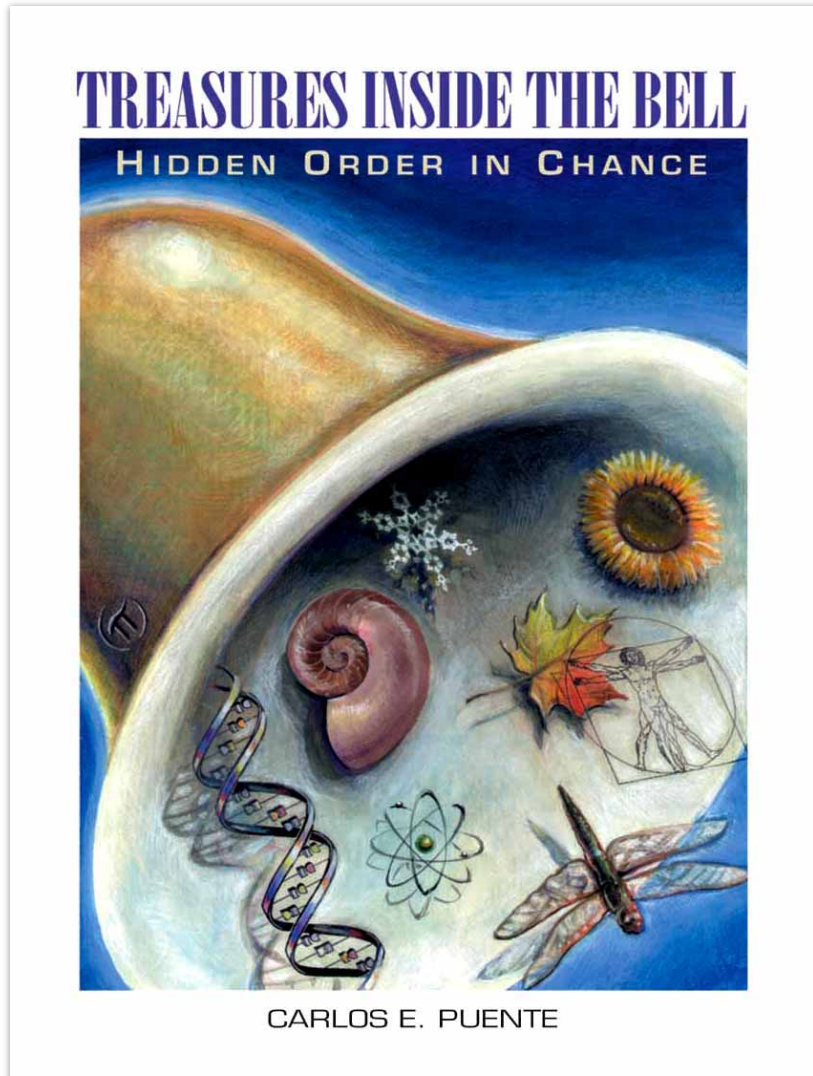


geometry: (0,0,0) (0.5,1,1) (1,3,0)

parameters: radial (- + + +) 0.999999999, angular 180 60 180 60

every 1,000 points until 100,000 bits of π

The Silent Bell



Fernando Duarte

- covers of other books
- also lovely figurines

The Silent Bell

TREASURES INSIDE THE BELL

HIDDEN ORDER IN CHANCE



CARLOS E. PUENTE

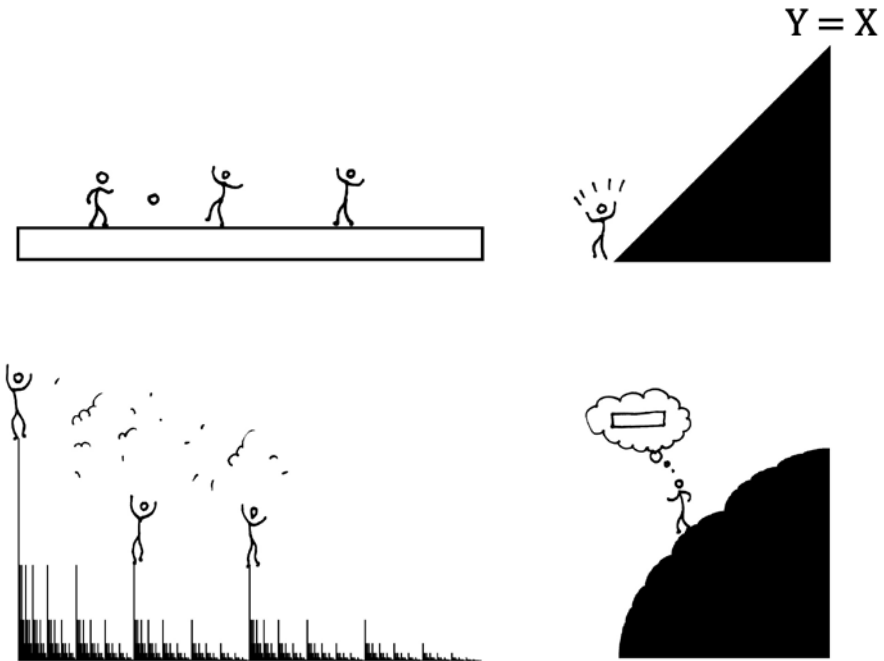
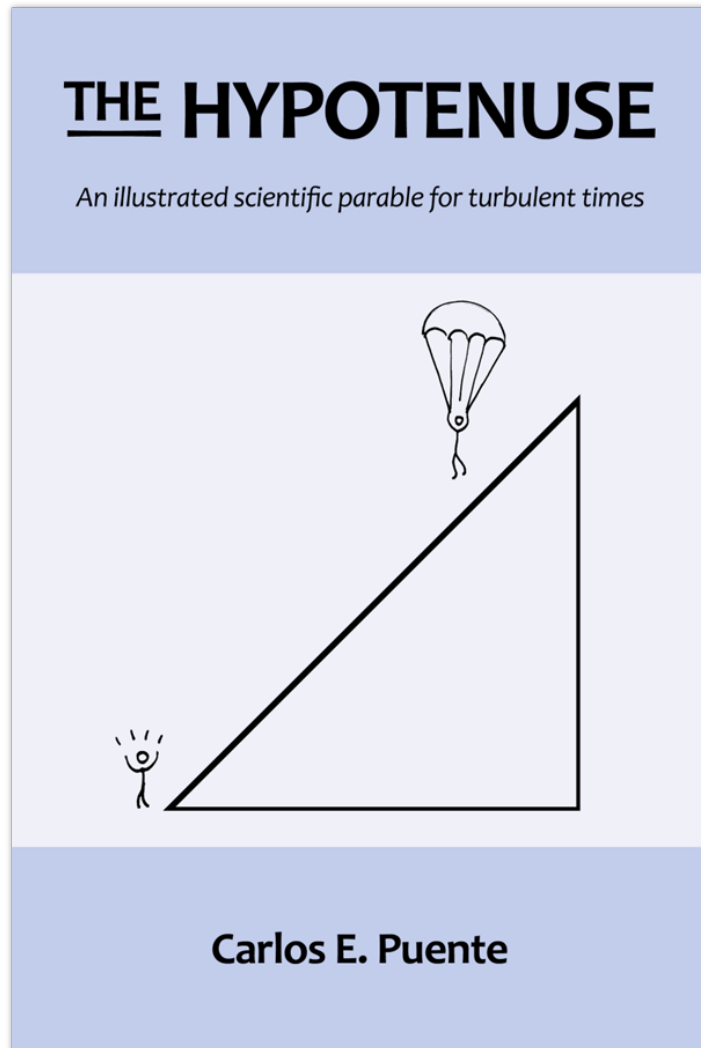
The bell peals intensely
revealing mighty deed,
in shadows, as by magic,
designs of life crossbreed.

Its central theme exalts
independence as a feast,
reparation of the broken
in enduring code within.

O patterns of pure beauty,
giving harmony to chance,
O quintessential simplicity
ascribing a meaning to π .

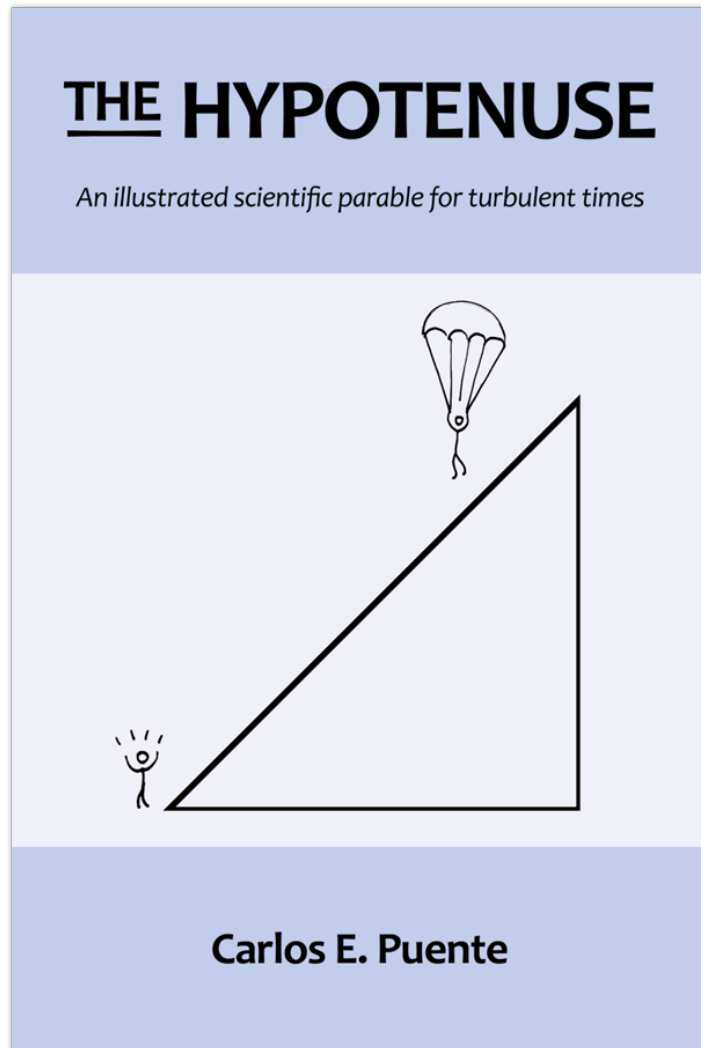
In fullness of dimension,
while defeating all strife,
dwells by ardent iteration
a reflection of God's art.

A Hypotenuse Parable



- equilibrium or multifractal
- hypotenuse or devil's staircase

A Hypotenuse Parable



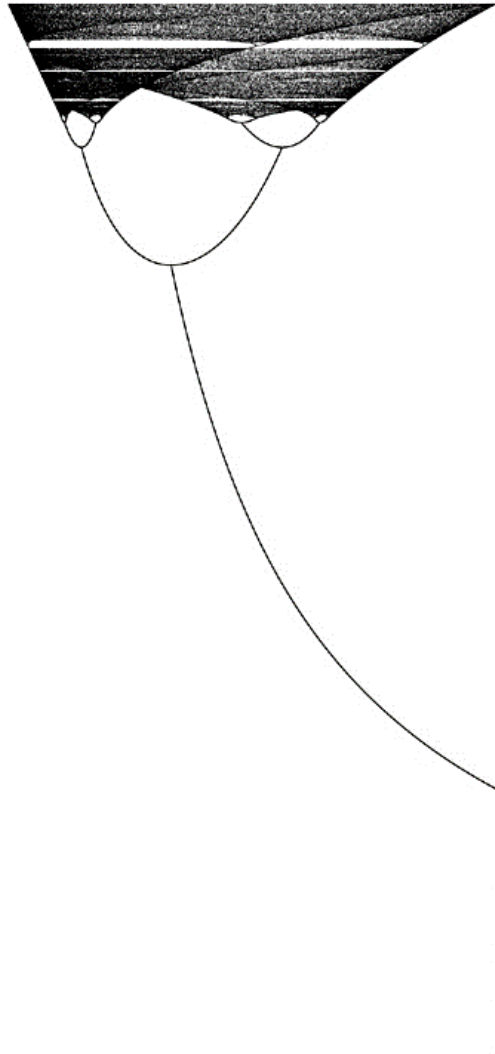
José Saramago



John Polkinghorne

- a Nobel prize winner
- a Templeton prize winner

Feigenbaum's Parable



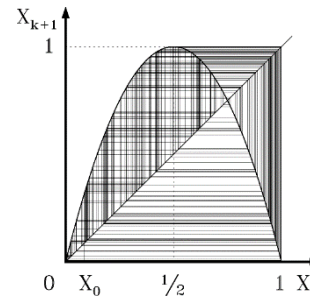
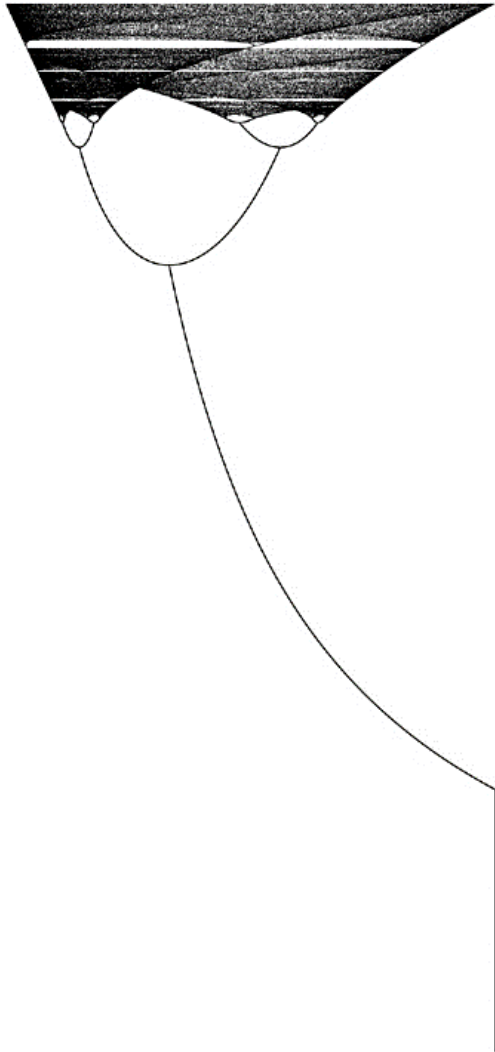
Mitch Feigenbaum



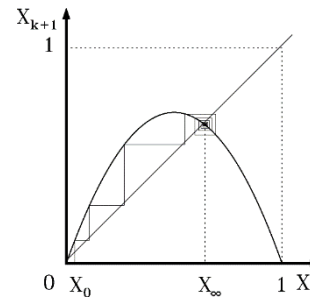
Albert Libchaber

- **order** in the path to chaos
- a tree containing all numbers
- bifurcations in convection

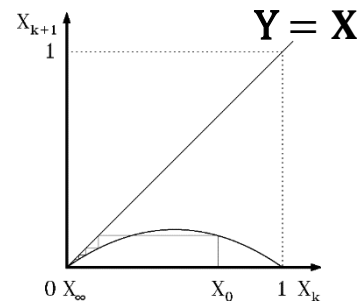
Feigenbaum's Parable



trapped
in chaos

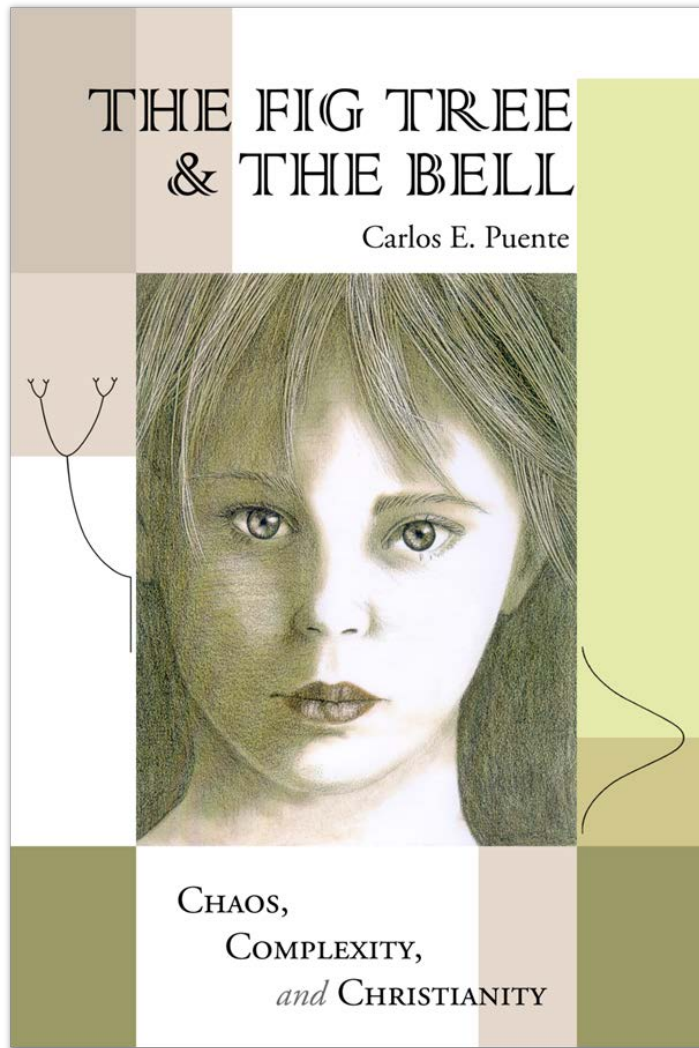


at a
fixed-point



to the
origin

Feigenbaum's Parable



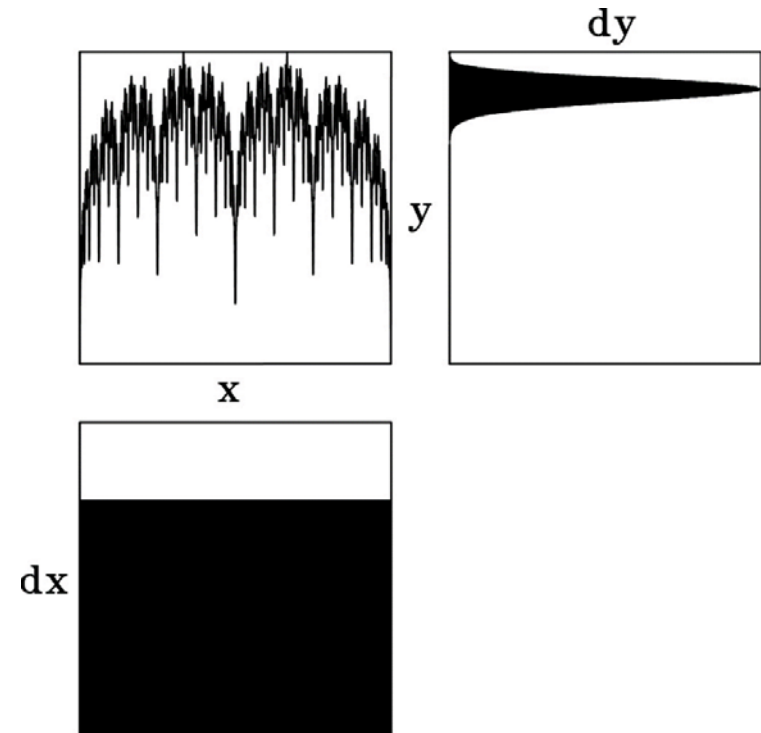
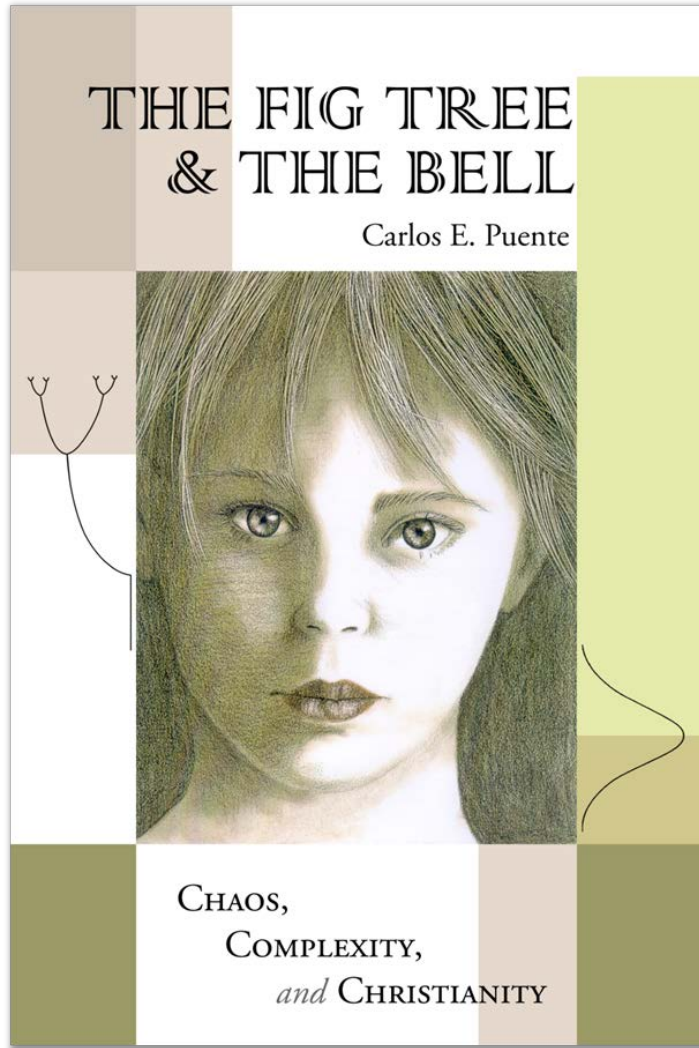
Foliage of disorder
trapped in empty dust,
jumps astir forever
enduring subtle thrust.

Crossing of the outset
leaving faithful root,
looming tender offset
failing to yield fruit.

Cascade of bifurcations,
increasing heat within,
inescapable succession
of branches bent by wind.

Sprouting of dynamics,
attracted to the strange,
o infinity reminding
at the origin the flame.

A Triune Parable

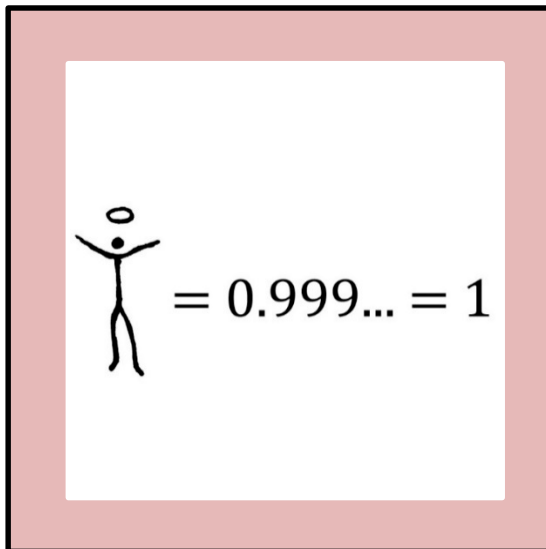


O my God!

A Clandestine Seminar



ינע



- follow $Y = X$
- no chaos, no complexity
- become a **saint**
- **Love** one another
- 44 times, a record



Dreaming Ahead

A Time to Awake



Stephen Bennett



- my support at UC Davis
- Jacob under the fig tree
- lectures and music

Talks to Share



Fr. Rafael Pascual



Fray Nelson Medina

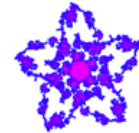


Fr. Wilson Mejía



Juan Sebastián de Plaza

- a priest who summons me to teach in Rome
- the godfather of my blog ***Campanitas de Fe***
- a friend that invites me to share and sing
- an engineer that organizes lectures for me



A Plausible Dream



Lázaro Alemán



Fabiola Jaramillo



- a “resurrected” musician
- to sing at “las mañanitas”
- bridge to peace in Sanskrit

My Finest Composition



Marta, Cristina and Mariana



Pathways

Two options before us
two pathways ahead,
the one is the longest
the other straight.

We journey directly
or go by the legs,
we follow intently
or end up in pain.

By walking the flatness
or hiking the spikes,
we travel in lightness
or take serious frights.

The incentive is unity
and the call proportion,
the key is forgiveness
and the goal true notion.

In wandering wickedness
there is never fruit,
but in ample humbleness
one encounters the root.

Pathways

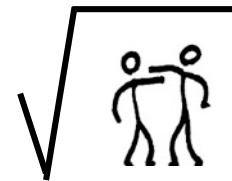
Two options before us
two pathways ahead,
the one is the longest
the other straight.

We journey directly
or go by the legs,
we follow intently
or end up in pain.

By walking the flatness
or hiking the spikes,
we travel in lightness
or take serious frights.

The incentive is unity
and the call proportion,
the key is forgiveness
and the goal true notion.

In wandering wickedness
there is never fruit,
but in ample humbleness
one encounters the root.





Pathways

There is no excuse,
o listen my friend:
it's by the hypotenuse
or else by the legs.

There is no solution
but walking straight:
the spikes of disorder
insinuate the way.

There is a best pathway,
the palpably smooth.
**It's by the hypotenuse
and walking in truth.**

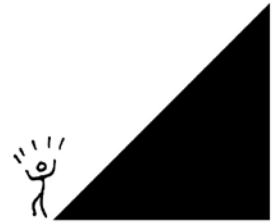
There is one solution,
I tell you the truth.

**It's by the hypotenuse
and walking in truth.**

For any other pathway
will lead us astray.

**It's by the hypotenuse,
there is no other way.**

O listen, you brother,
let's brighten the day.
**It's by the hypotenuse,
there is no other way.**





Pathways

Otherwise, the devil
shall pull by the legs.
**It's by the hypotenuse
or else by the legs.**

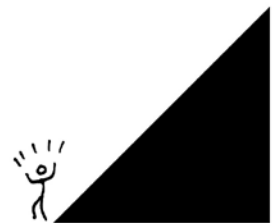
For such road is fractal:
as long as it gets.
**It's by the hypotenuse
or else by the legs.**

O let's mend the broken,
growing to the root.
**It's by the hypotenuse,
the one that yields fruit.**

Let's keep equilibrium,
avoiding dark soot.
**It's by the hypotenuse,
the one that yields fruit.**

O listen, you sister,
a counsel from science.
**It's by the hypotenuse:
the simplest design.**

I tell you integrating,
don't leave it to chance.
**It's by the hypotenuse
the simplest design.**





Pathways

Otherwise, the devil shall pull by the legs.
It's by the hypotenuse or else by the legs.

For such road is fractal: as long as it gets.
It's by the hypotenuse or else by the legs.

O let's mend the broken, growing to the root.
It's by the hypotenuse, the one that yields fruit.

Let's keep equilibrium, avoiding dark soot.
It's by the hypotenuse, the one that yields fruit.

O listen, you sister, a counsel from science.
It's by the hypotenuse: the simplest design.

I tell you integrating, don't leave it to chance.
It's by the hypotenuse the simplest design.

$$Y = X$$



Dancing anyone?



Puente de paz

Conga

infinity



to



It has been an honor!