

# Endogenous versus Exogenous Origins of Crises

(book sales, volatility shocks, YouTube, cyber-risks, conflicts, epilepsy, earthquakes, social crises, climate,...)



Didier Sornette

Chair of Entrepreneurial Risks

ETH Zurich

(Swiss Federal Institute of Technology, Zurich)

Department of Management, Technology and Economics

<http://www.er.ethz.ch/>

Collaborators:

Y. Ageon (Research scientist, Nice)

J. Andersen (Research fellow, CNRS)

R. Crane (Post-doc, ETH Zurich)

F. Deschatres (ENS student, Paris)

T. Gilbert (graduate student now at Berkeley)

A. Helmstetter (post-doc, now at CNRS Grenoble)

A. Johansen (Niels Bohr, Copenhagen, Denmark)

Y. Malevergne (Professor Univ, of Lyon, France)

T. Maillart (PhD, ETH Zurich)

J.F. Muzy (Research Fellow CNRS)

S. Pillai (ETH Zurich)

B. Roehner (Professor, Univ. Paris)

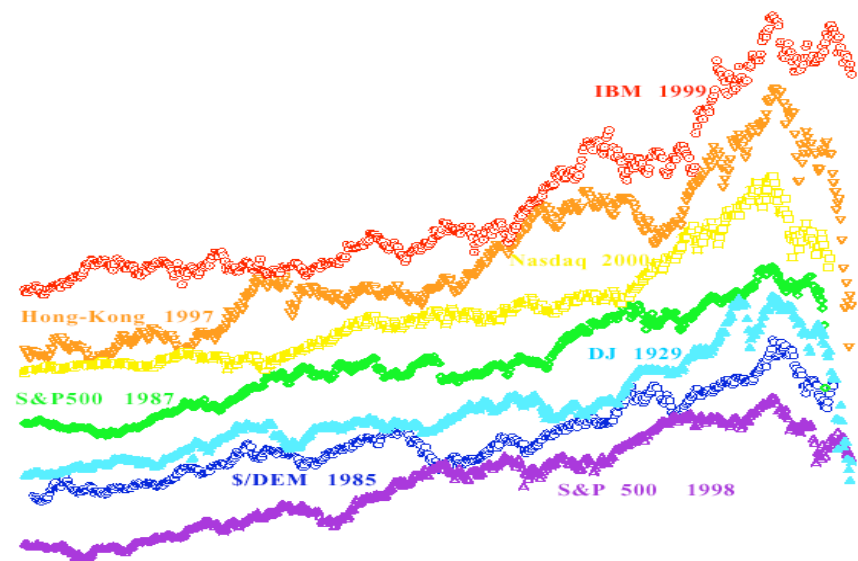
## **CRISES and EXTREME EVENTS**

- dramatic and rapid change of a system which is the culmination of a complex preparatory stage.
- fundamental societal impacts
- large natural catastrophes
  1. earthquakes,
  2. volcanic eruptions,
  3. hurricanes and tornadoes,
  4. landslides, avalanches,
  5. lightning strikes,
  6. meteorite/asteroid impacts,
  7. catastrophic events of environmental degradation,

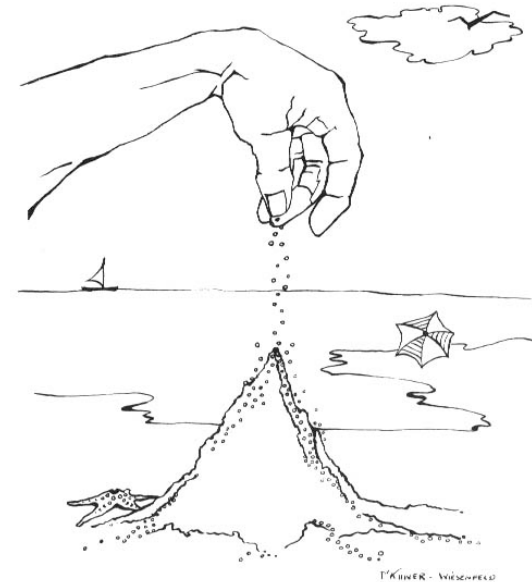


## EXTREME EVENTS in SOCIO-ECONOMIC SYSTEMS

- failure of engineering structures,
- crashes in the stock market,
- social unrest leading to large-scale strikes and upheaval,
- economic drawdowns on national and global scales,
- regional power blackouts,
- traffic gridlock,
- diseases and epidemics, etc.



- **Self-organization?**  
**Extreme events are just part of the tail of power law distribution due to “self-organized criticality”?**  
**(endogenous)**



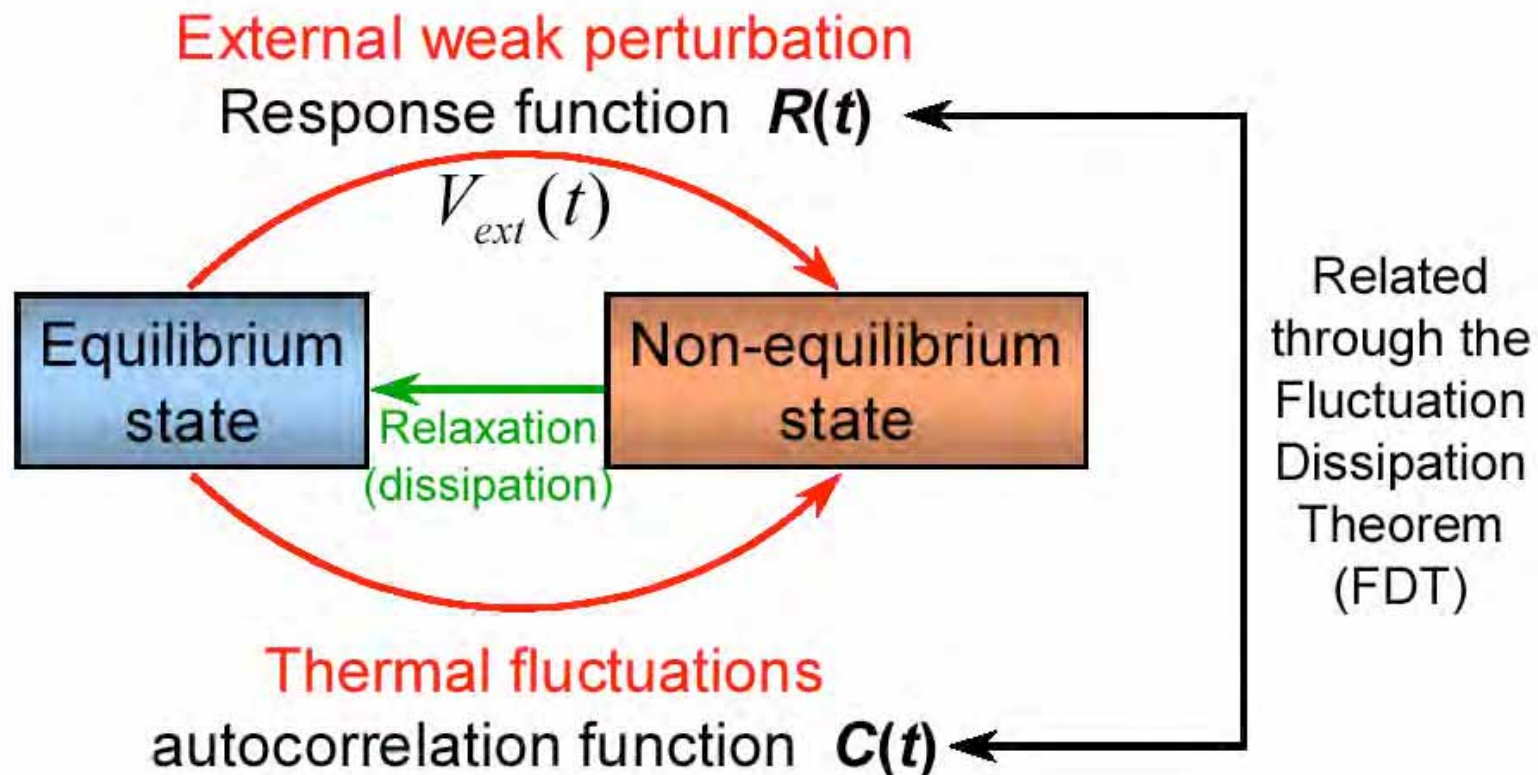
Artwork by Elaine Wiesenfeld  
(from Bak, How Nature Works)

- **“Catastrophism”**: extreme events require extreme causes that lie outside the system  
**(exogenous)**

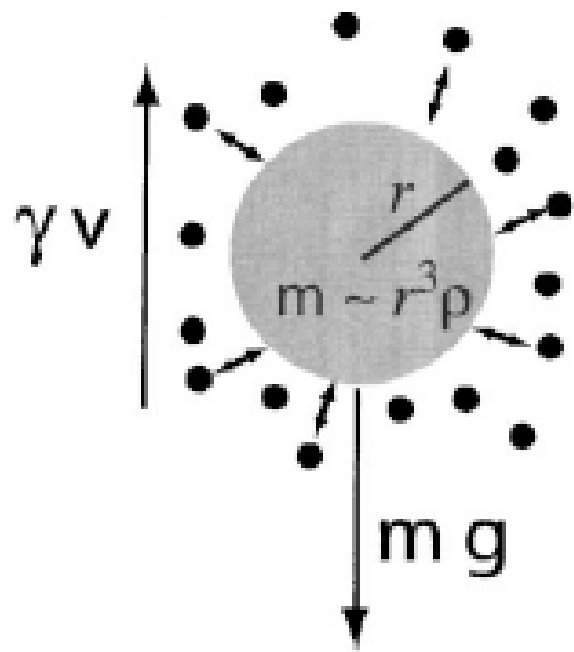
- **A mixture? How would it work?**

# Guidelines from Physics: perturb and study the response

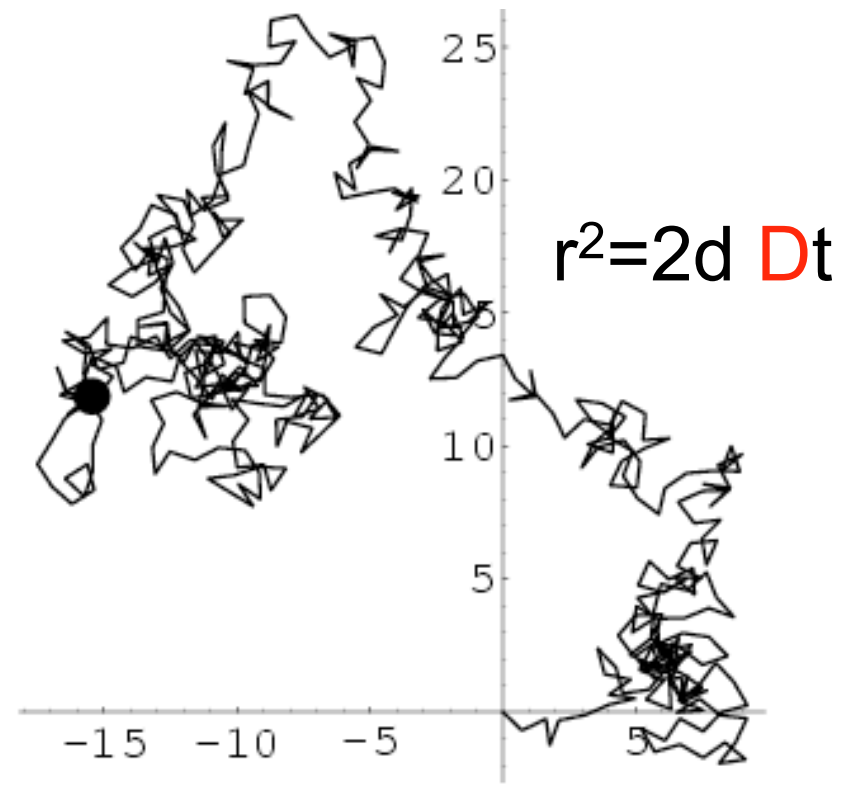
## Linear Response Theory



**EXO:** Drag resistance  
under an external force



**ENDO:** Random walk



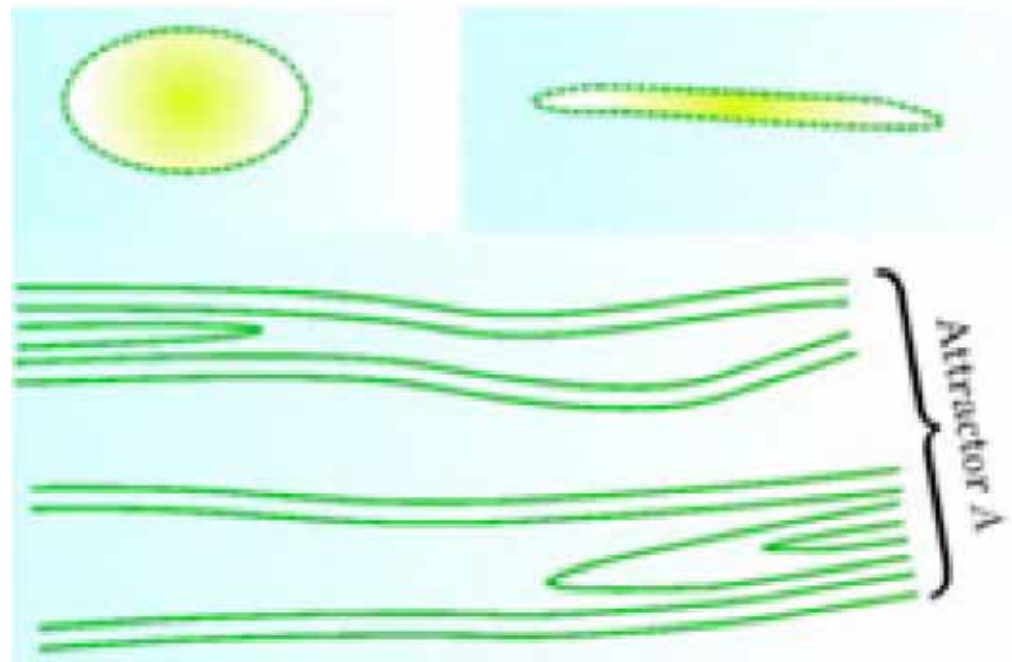
$$D = k_B T / \gamma$$

(Einstein, 1905)



## Fluctuation-dissipation theorem far from equilibrium is not expected to hold

- Externally imposed perturbations may be different from spontaneous fluctuations (external fluctuations lie outside the complex attractor)
- Attractor of dynamics may exhibit bifurcations



# Endogenous versus Exogenous

## Extinctions

- meteorite at the Cretaceous/Tertiary KT boundary
- volcanic eruptions (Deccan traps)
- self-organized critical events

## Financial crashes

- external shock
- self-organized instability

## Immune system

- external viral or bacterial attack
- “ internal” (dis-)organization

## Brain (learning)

- external inputs
- internal self-organization and reinforcements (role of sleep)

## Aviation industry recession

- September 11, 2001
- structural endogenous problems

## Recovery after wars?

- internally generated (civil wars)
- externally generated

## Discoveries

- serendipity
- maturation

## Volatility bursts in financial time series

- external shock
- cumulative effect of “small” news

## Earthquakes

- tectonic driving
- triggering

## Parturition

- mother/foetus triggered?
- mother-foetus complex?

## Commercial success and sales

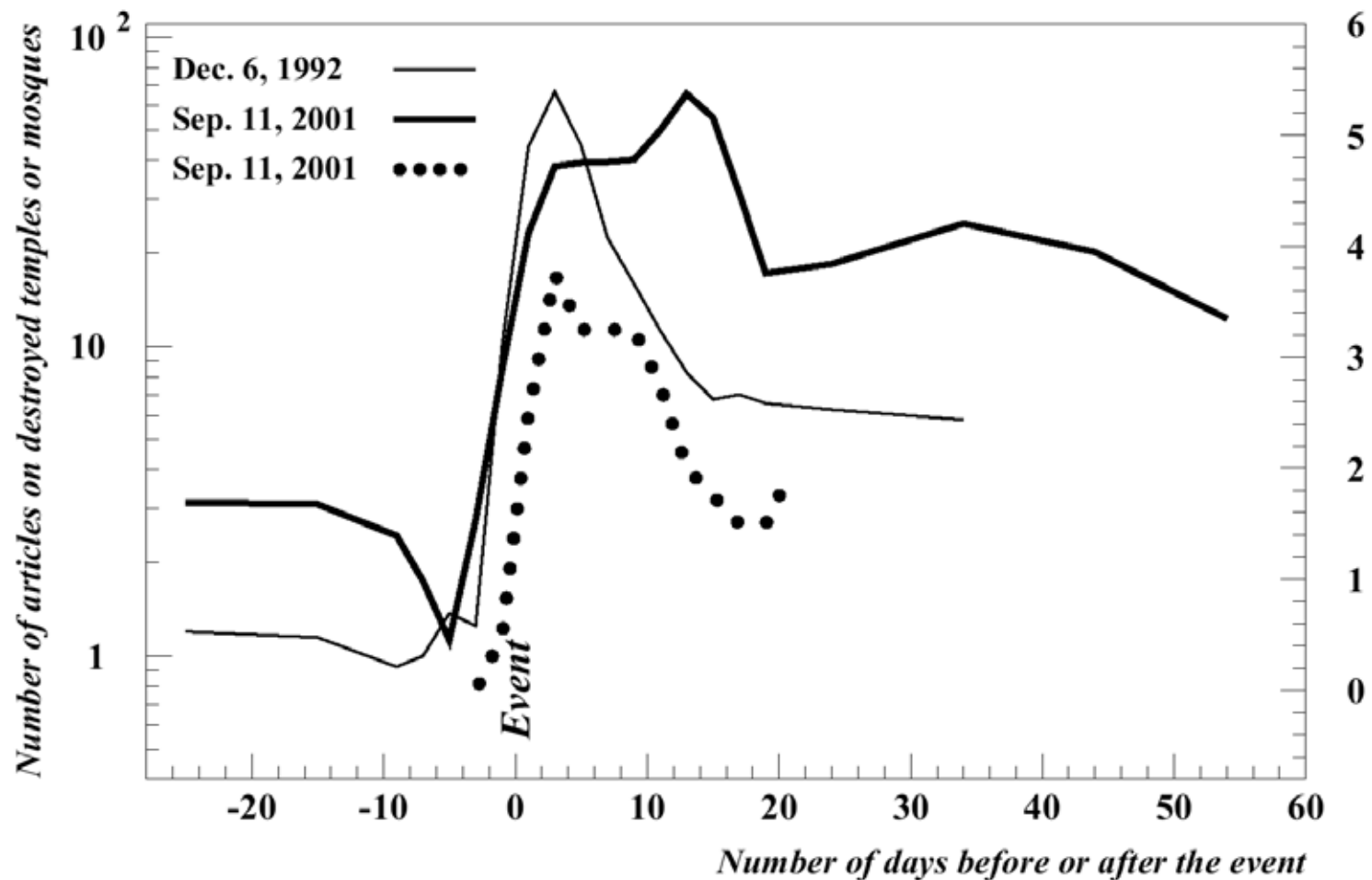
- Ads
- epidemic network

## Social unrests

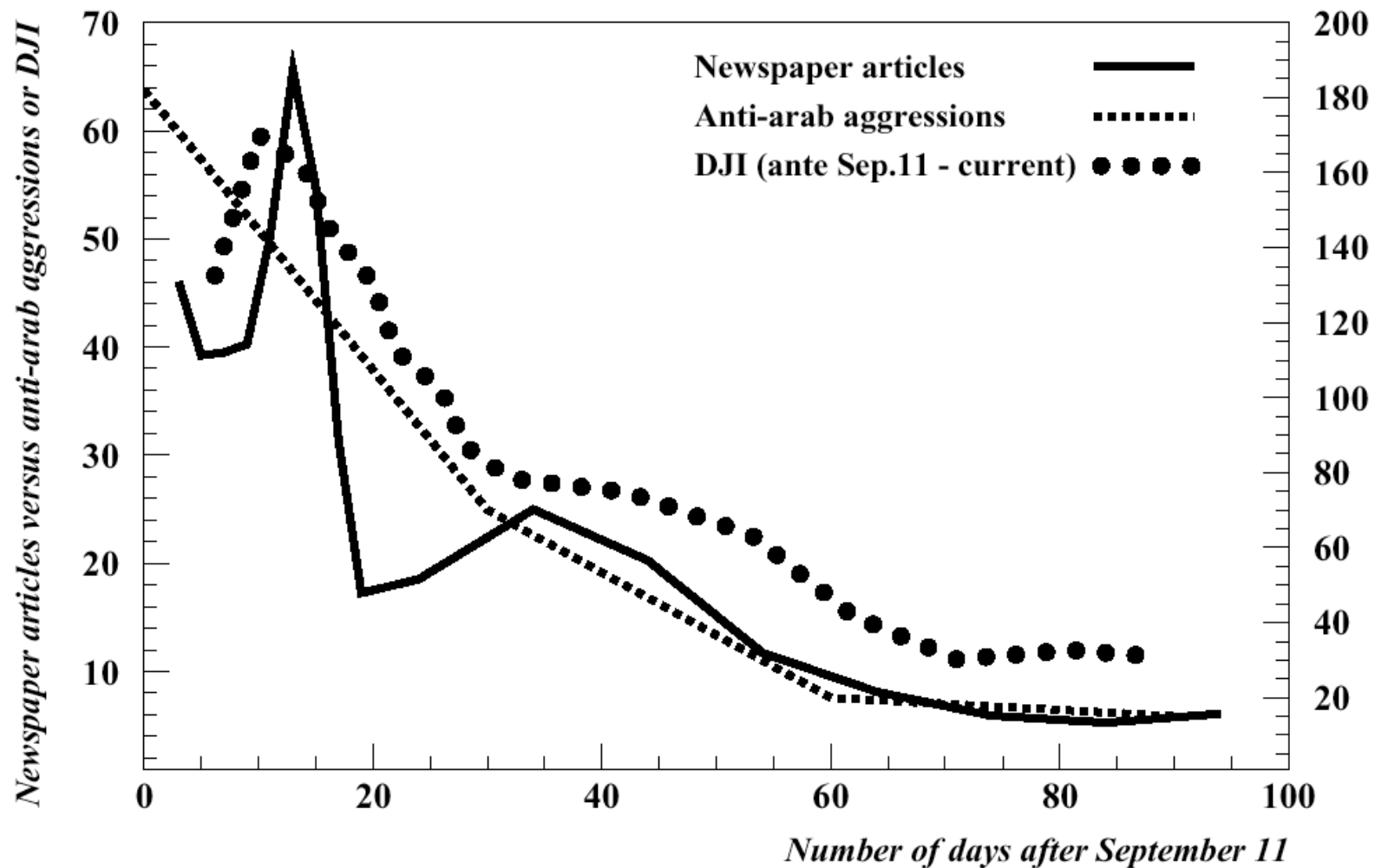
- triggering factors
- rotting of social tissue



## The method of critical events in economics and social sciences



**Fig.1: Aftershocks of two critical events.** December 6, 1992 was marked by the destruction of the Ayodhya mosque in India which sparked a wave of anti-Hindu reactions; September 11, 2001 was marked by the destruction of the World Trade Center in New York which sparked a wave of anti-Islamic reactions. The origin of the horizontal scale corresponds to the day when the critical event occurred. The two solid lines show the number of articles writing on the destruction of Hindu temples or mosques respectively (scale on the left-hand side); the dotted line shows the number of mosques actually destroyed or damaged (scale on the right-hand side). (Roehner and Sornette, 2004)



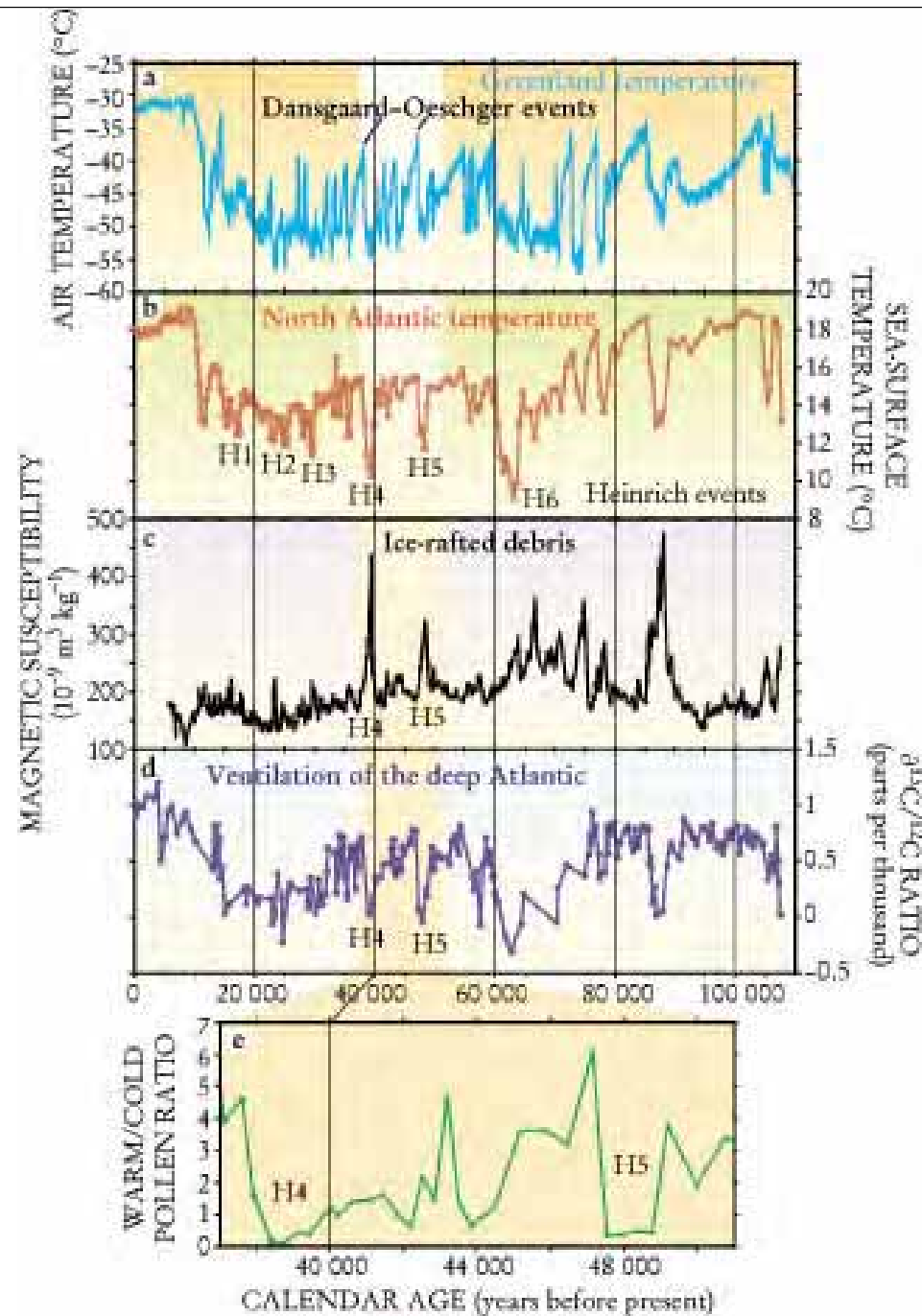
**Fig.2: Relaxation curves after the shock of September 11.** The solid line curve is the same as in Fig.1 but over a larger time interval; the broken line (scale on the right-hand side) shows the number of anti-arab aggressions in California in the three months after September 11; the dotted line shows the changes in the level of the Dow Jones Index with respect to its pre-Sep.11 level as given by the difference  $DJI(\text{pre-9/11}) - DJI(\text{current})$ . The tails of all three curves are well-approximated by power laws  $\sim 1/t^\alpha$ , with exponents  $\alpha$  comprised between -1.4 and -2.2:  $\alpha_1 = -1.8 \pm 0.7$  (newspaper articles),  $\alpha_2 = -1.4 \pm 0.5$  (anti-arab aggressions) and  $\alpha_3 = -2.2 \pm 1.6$  (DJI).  
**(Roehner and Sornette, 2004)**

# Climate Shock: Abrupt Changes over Millennial Time Scales

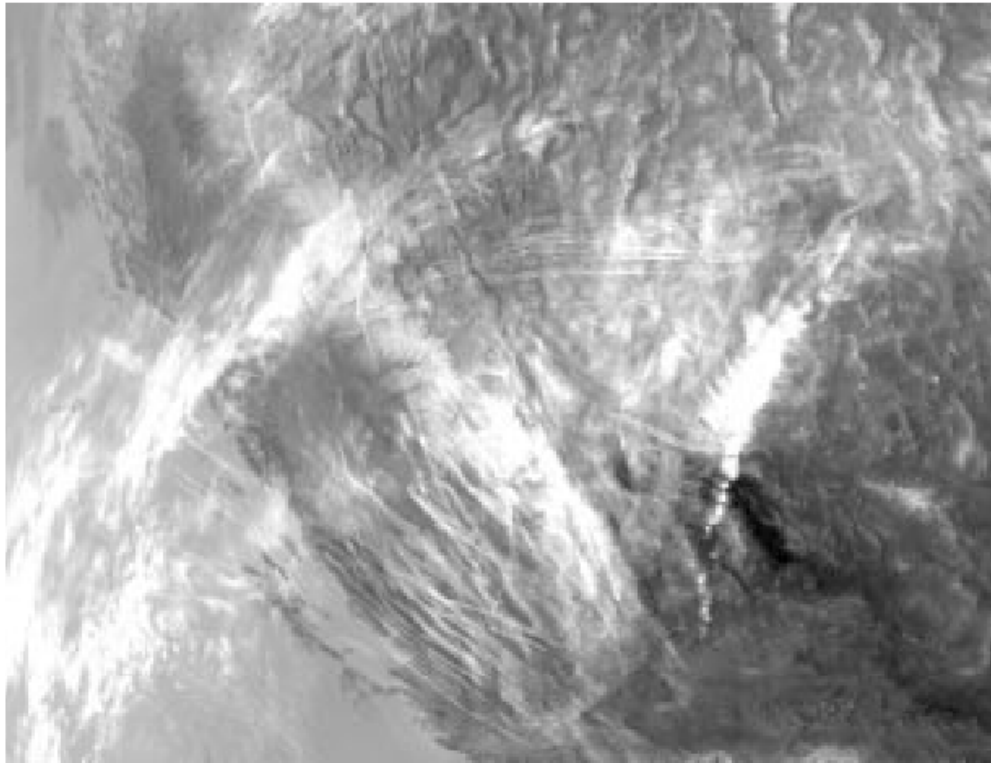
Edouard Bard

Physics Today  
Dec, 2002

Climatic and oceanographic variations in and around the North Atlantic Ocean



Climatic and oceanographic variations in and around the North Atlantic Ocean during the past 110 000 years, as revealed in Greenland ice cores and North Atlantic sediment cores obtained off the Iberian Margin. Time progresses from right to left. (a) The Greenland air temperature based on isotope thermometry shows abrupt warm periods called Dansgaard-Oeschger events. The records were obtained from ice cores by Willie Dansgaard, Sigfus Johnsen, and their collaborators in Copenhagen, Denmark. (b) The sea-surface temperature in the North Atlantic shows episodes of drastic cooling called Heinrich events. This record compiles our results on biomolecular thermometry with long-chain (37-carbon) organic molecules called alkenones measured on two sediment cores at CEREGE (Aix-en-Provence, France). (c) The presence of ice-rafted debris, which was revealed in the sediment magnetic property measurements by Nicolas Thouveny and colleagues at CEREGE, is correlated with the drastic cooling in Heinrich events. (d) The ventilation of the deep Atlantic has been reconstructed by Nicholas Shackleton and his colleagues in Cambridge, UK, from variations in the carbon-isotope ratio contained in bottom-dwelling benthic foraminifera found in the sediment cores. (e) A qualitative measure of the continental climate is the ratio of pollen from temperate plants to that from cold-climate plants, as measured in marine sediments by Maria-Fernanda Sanchez-Goni and her collaborators in Bordeaux, France. The methods used to generate these records are described in the box on page 34. (Ice-core data from ref. 2; sediment-core data from ref. 3.)

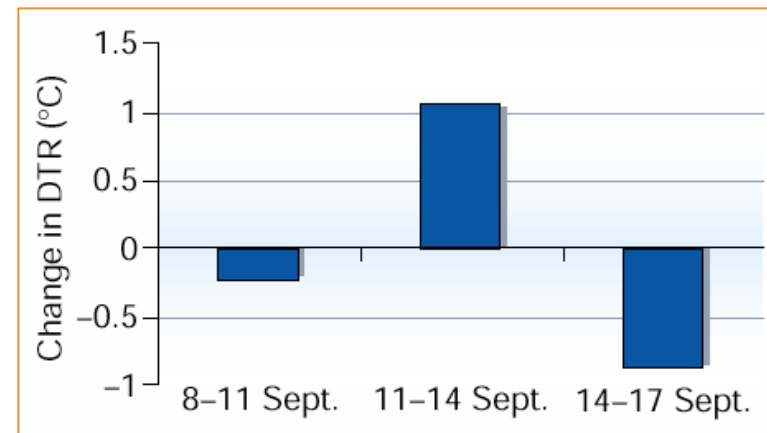


**Figure 2** Flight lines: jet contrails can clearly be seen as thin streaks in this satellite image of the southwestern United States.

"Three days after suicide airplane hijackers toppled the World Trade Center in New York and slammed into the Pentagon in Washington, D.C., the station crew noted an obvious absence of airborne jetliners from their perch 240 miles (384 kilometers) above Earth. 'I'll tell you one thing that's really strange: Normally when we go over the U.S., the sky is like a spider web of contrails,' U.S. astronaut and outpost commander Frank Culbertson told flight controllers at NASA's Mission Control Center in Houston. 'And now the sky is just about completely empty. There are no contrails in the sky,' he added. 'It's very, very weird.' 'I hadn't thought of that perspective,' fellow astronaut Cady Coleman replied.'" [http://www.space.com/missionlaunches/missions/airtraffic\\_absence\\_010914.html](http://www.space.com/missionlaunches/missions/airtraffic_absence_010914.html)

# Travis, D. J., Carleton, A. M & Lauritsen, R. G. Contrails reduce daily temperature range. Nature 418, 601, (2002).

## CONTRAILS



**Figure 1** Departure of average diurnal temperature ranges (DTRs) from the normal values derived from 1971–2000 climatology data for the indicated three-day periods in September 2001. These periods included the three days before the terrorist attacks of 11 September; the three days immediately afterwards, when aircraft were grounded and there were therefore no contrails; and the subsequent three days.

## AMAZON BOOK SALES

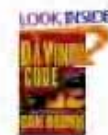
- Amazon.com posts a “live” ranking of all its products
- Book ranks in the top 10,000 are updated **every hour** according to a secret weighting of recent sales and entire history

### Top 100 Bestsellers Updated Hourly



1. [The South Beach Diet](#)  
by Arthur Agatston  
(Author)

**Price: \$14.97 You Save:**  
\$9.98 (40%) [Used & new](#)  
from \$13.24



2. [The Da Vinci Code](#)  
by Dan Brown (Author)

**Price: \$14.97 You Save:**  
\$9.98 (40%) [Used & new](#)  
from \$10.80



3. [The Last Juror](#)  
by John Grisham (Author)

**Price: \$19.57 You Save:**  
\$8.38 (30%)



4. [South Beach Diet Good Fats/Good Carbs Guide](#)  
by Arthur Agatston  
(Author)

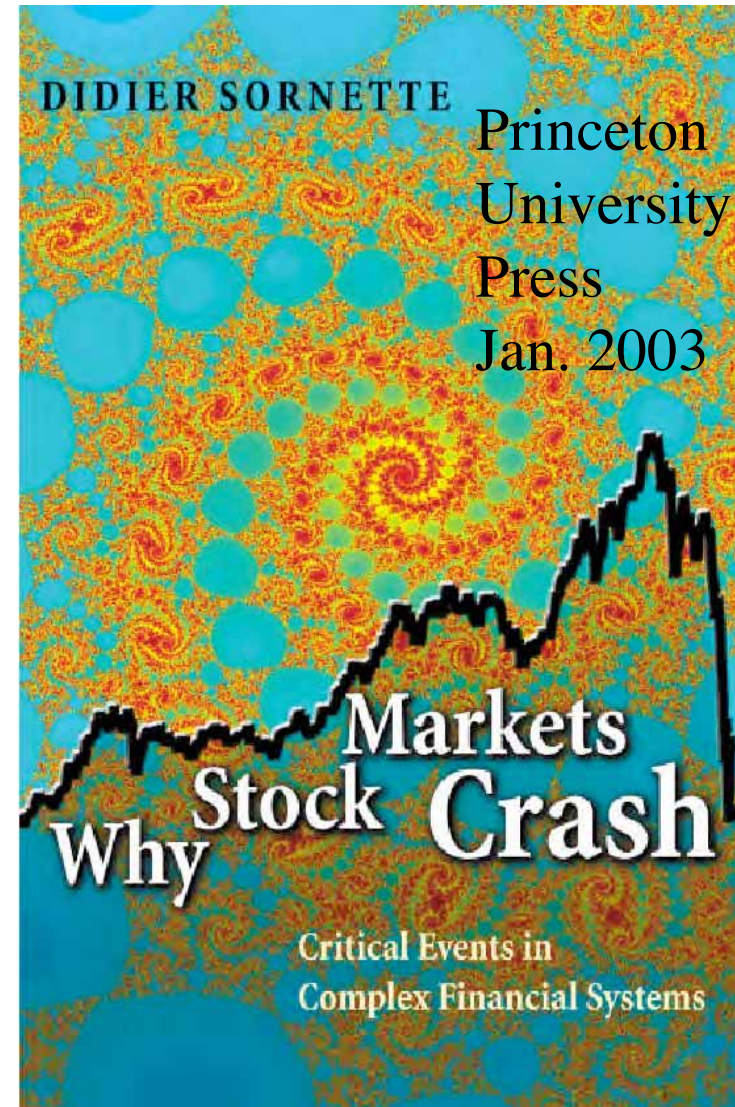
**Price: \$7.99** [Used & new](#)  
from \$7.80



# The Original “Crisis”

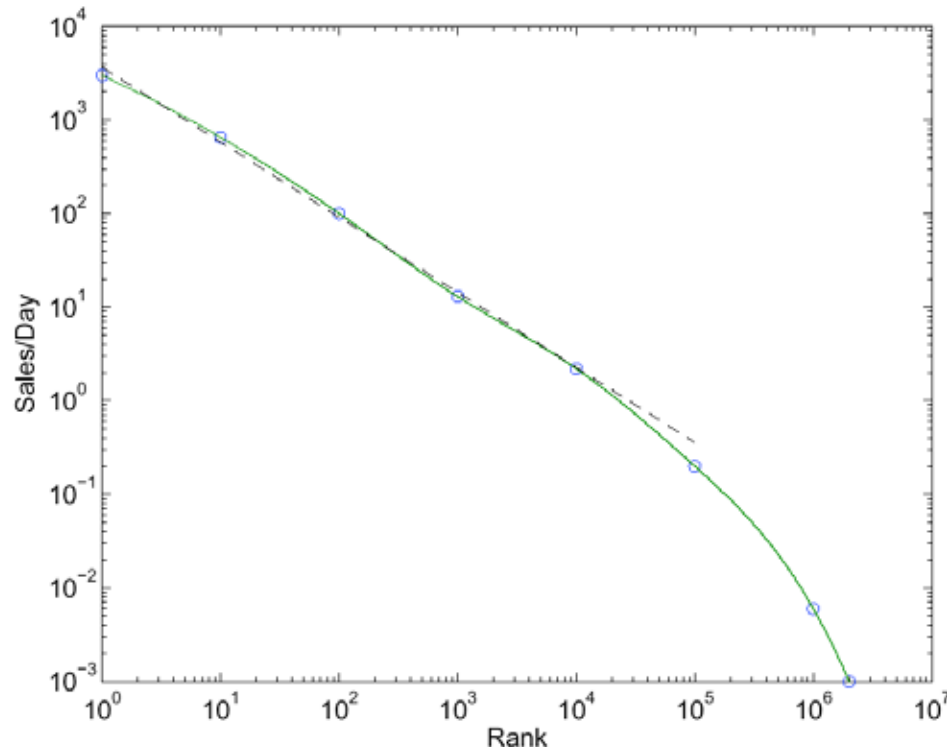
---

- On Friday January 17, 2003, Sornette’s recent book jumped to rank # 5 on Amazon.com’s sales ranking (with Harry Potter as #1!!!)
- Two days before: release of an interview on MSNBC’s MoneyCentral website





# From Ranks to Sales

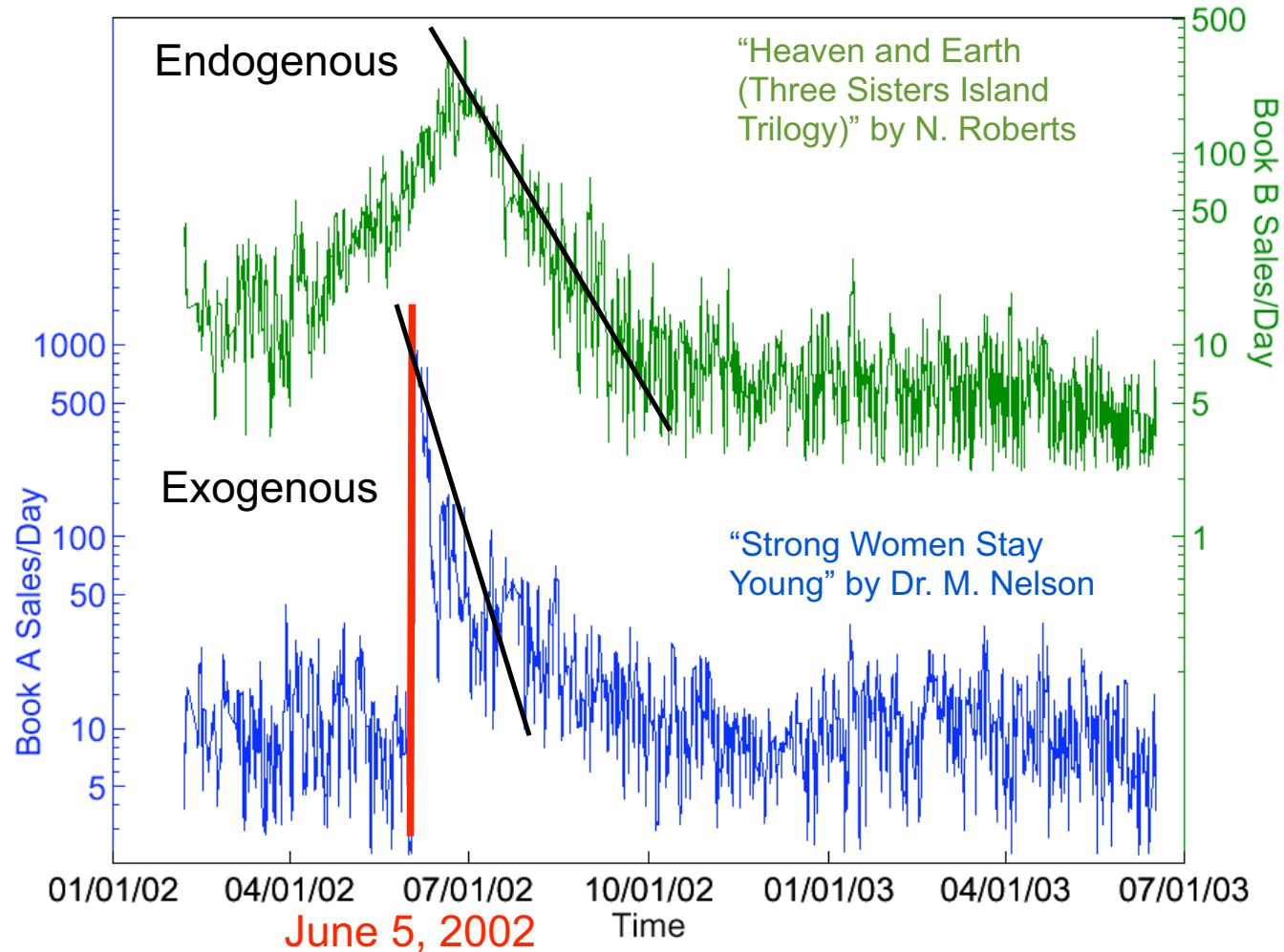


- Need a stationary and relatively smooth time-series
- This curve was reconstructed via careful data and news analysis, interviews... by M. Rosenthal
- Our results are robust to the exact shape of this transformation

FIG. 1: Rank ordering plot of the sales per day,  $S$ , as a function of rank,  $r$ , for books that have sold at least one volume through Amazon.com. The dashed line shows the power law approximation  $S(r) \sim 1/r^\nu$  with exponent  $\nu = 0.8 \pm 0.1$ .

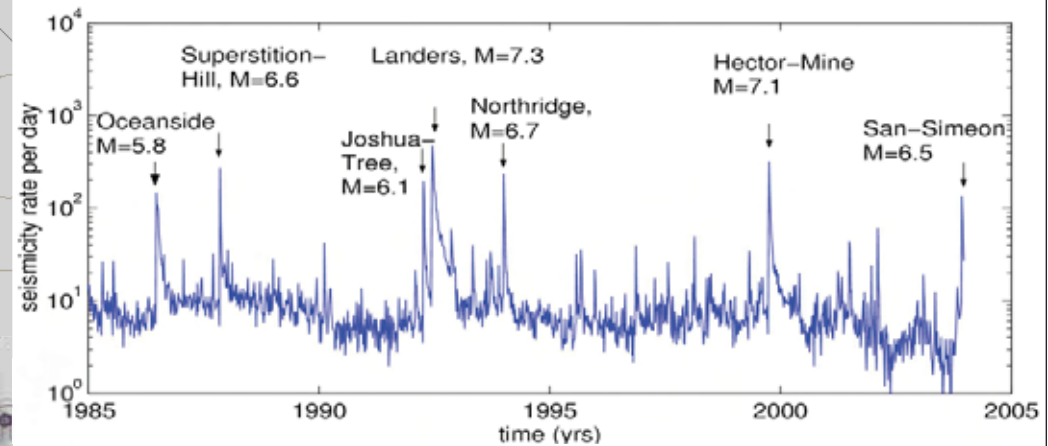
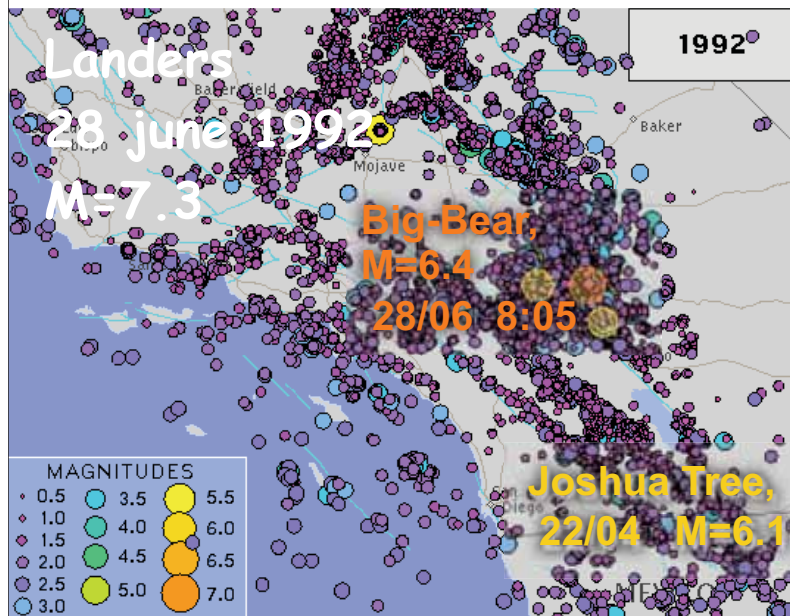
$$S(R) \sim 1/R^{1/\mu} \text{ with exponent } \mu = 2.0 \pm 0.1$$

# Book sales dynamics



June 4, 2002:  
New York Times  
article crediting  
the  
"groundbreaking  
research" of Dr.  
Nelson

# Analogy: Temporal decay of aftershocks



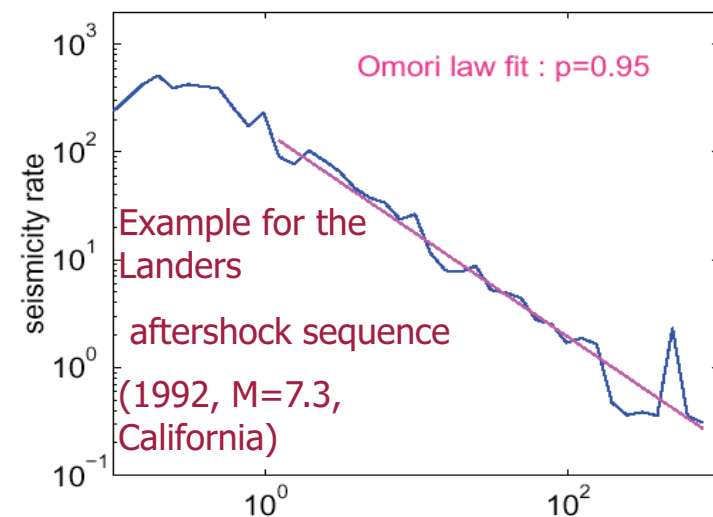
the seismicity rate after a mainshock at time  $t=0$  follows the **modified Omori law**

Temporal decay of the rate  $N(t)$  of aftershocks after a mainshock at  $t=0$

$$N(t) = K/(t+c)^p$$

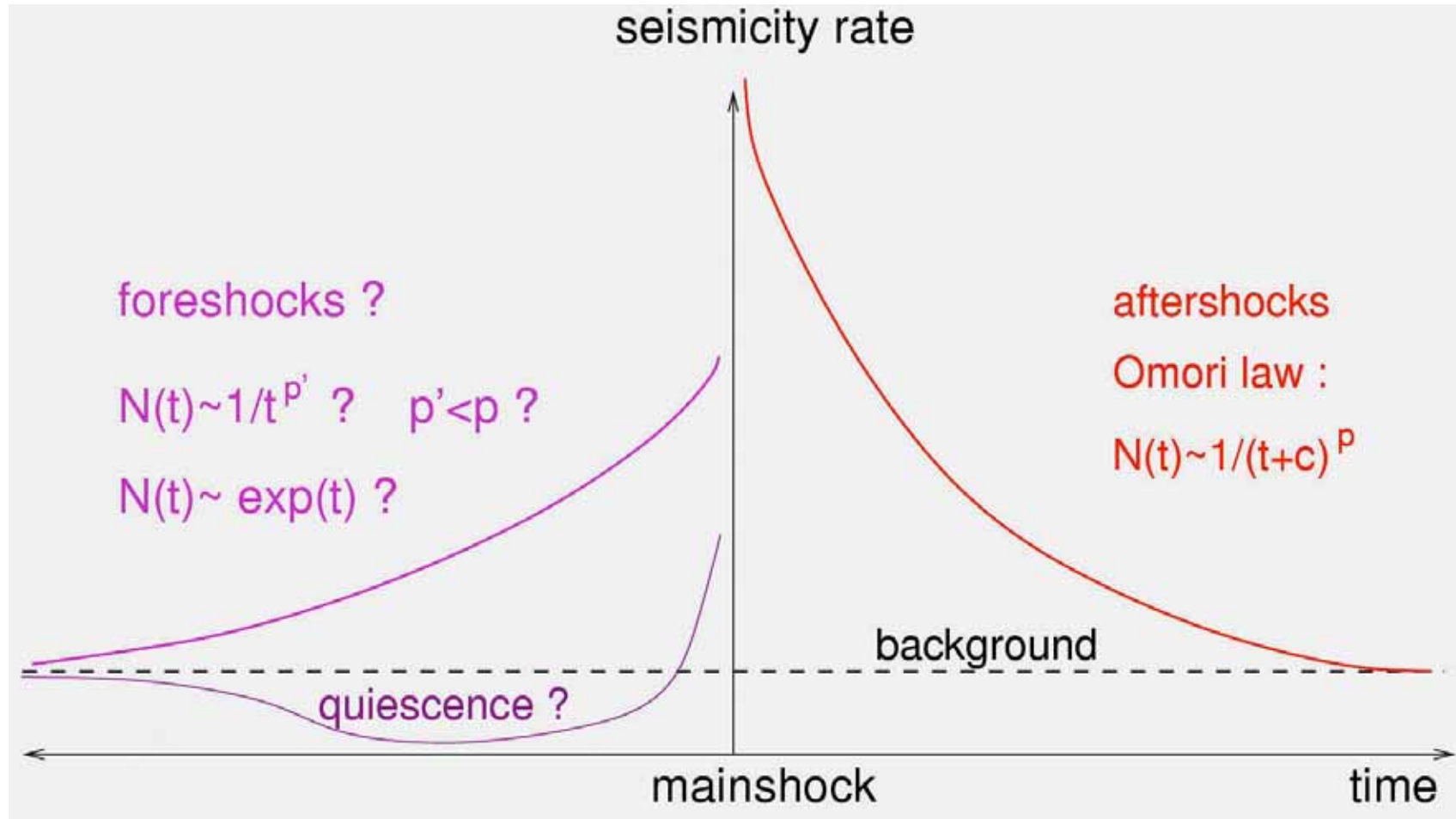
$p$  is in the range  $[0.3, 2]$ , often close to 1

[Omori, 1894; Utsu, 1960]



# Temporal variation

Observations :



# Epidemic processes by word-of-mouth



## Theory: The Model

---

- Epidemic branching process
- The sales flux is made of:
  - **External forces** (news...): exogenous  $\eta(t)$
  - **Social influences** (friends...): impact with delay described with a memory kernel  $\Phi(t-t_j)$
- So the sum of all buys is modeled as a “self-excited” Hawkes conditional Poisson branching process with intensity:

$$\lambda(t) = \eta(t) + \sum_{i|t_i \leq t} \mu_i \phi(t - t_i)$$

## Theory: Aggregate and Exogenous Response

---

- Mean field treatment: **ensemble averages**, rather than individual behavior (where  **$n$  is the branching ratio** of the network):

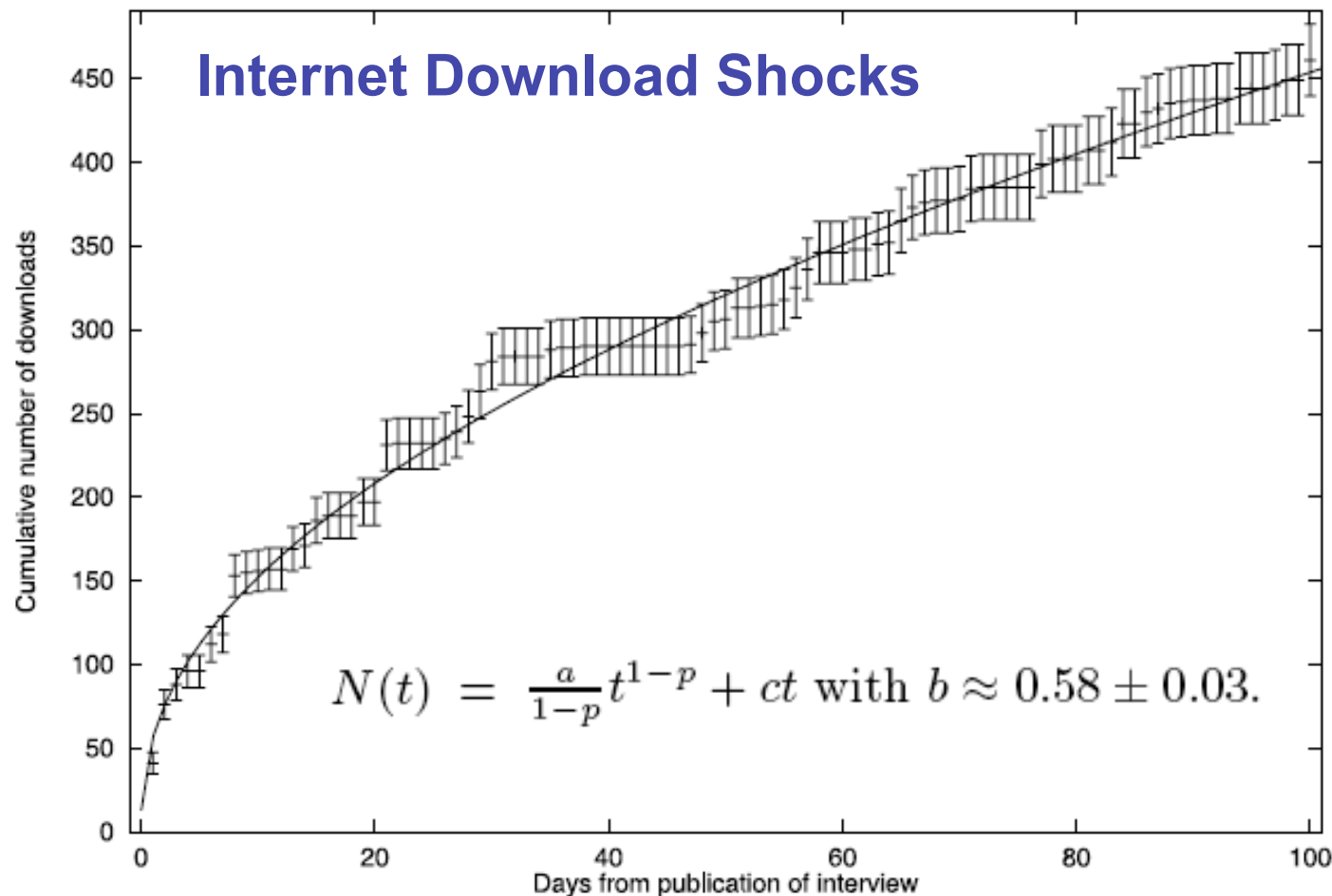
$$S(t) \equiv \langle \lambda(t) \rangle = \eta(t) + n \int_{-\infty}^t \phi(t - \tau) S(\tau) d\tau$$

- One can then solve this equation for an **exogenous shock**  $\eta(t) = \delta(t)$ :
- For  $\phi \sim 1/t^{1+\theta}$

$$S_{exo}(t) \equiv K(t) : \frac{1}{(t - t_c)^{1-\theta}} \quad \text{with} \quad 0 < \theta < 1$$



# Distribution of response times is power law for humans in a large variety of situations



Johansen, A. and D. Sornette, Download relaxation dynamics on the WWW following newspaper publication of URL, *Physica A*, 276 (1-2), 338–345 (2000)

Cumulative number of downloads  $N$  as a function of time  $t$  from the appearance of the interview on Wednesday 14th April 1999.

# Dialog in e-Mail Traffic

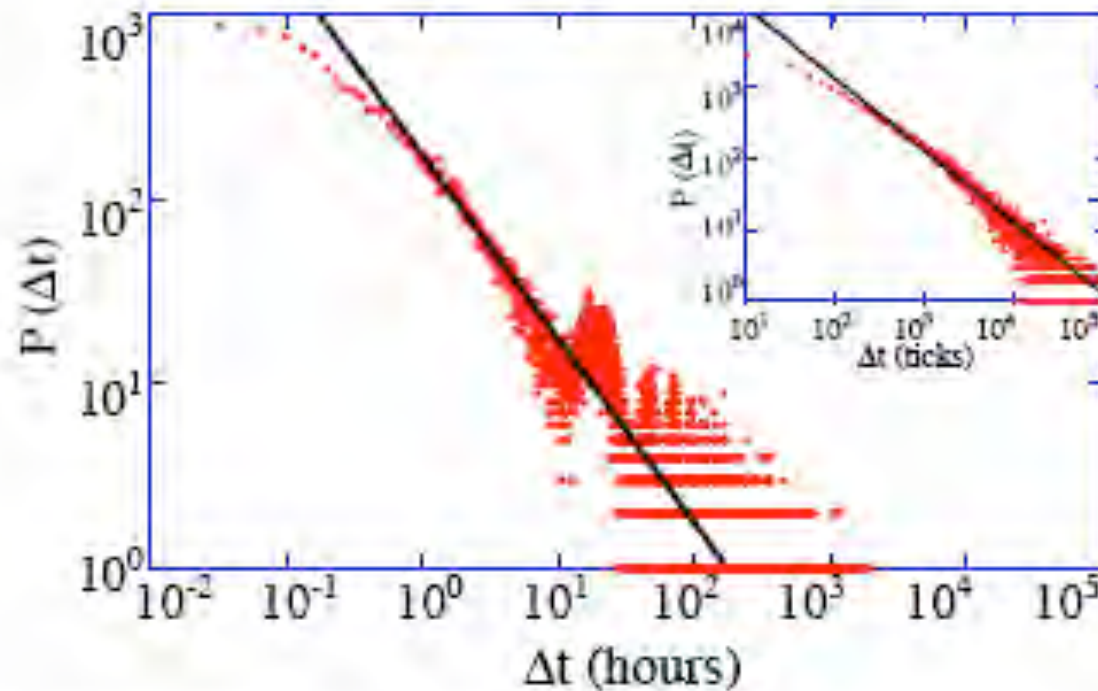


FIG. 1: The probability distribution of the response time till a message is 'answered' (see text for definitions). Inset: same but measured in 'ticks', i.e. units of messages sent in the system. Solid lines follow  $\sim \Delta t^{-1}$  and are meant as a guide to the eye.

Eckmann et al. (2004)

# Mechanisms for “bare” power laws of waiting times

- **Priori-queuing** (Abate & Whitt, 1997)
- **Time-varying activity rate with feedback**  
(Vasquez, 2007)
- **Random walk crossing condition**

## Mean field theory of Hawkes self-exciting conditional Poisson Process

$$A(t) = \int_{-\infty}^t d\tau \eta(\tau) K(t - \tau)$$

### Exogeneous shock

$$E_{\text{exo}}[A(t)] = A_0 K(t) + n \langle \eta \rangle$$

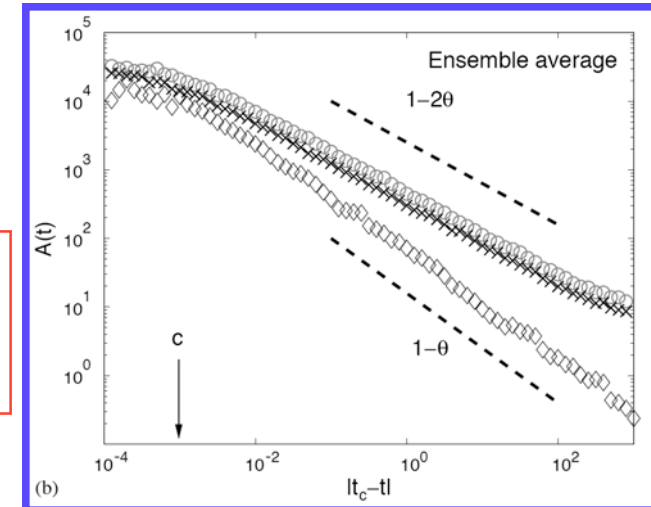
$$n = \int_0^{+\infty} \tau K(\tau)$$

### Endogeneous shock

$$E[X(t)|Y = A_0] - E[X(t)] = (A_0 - E[Y]) \frac{\text{Cov}(X(t), Y)}{E[Y^2]}$$

$$\text{Cov}(A(t), A(0)) = \int_{-\infty}^0 d\tau K(t - \tau) K(-\tau)$$

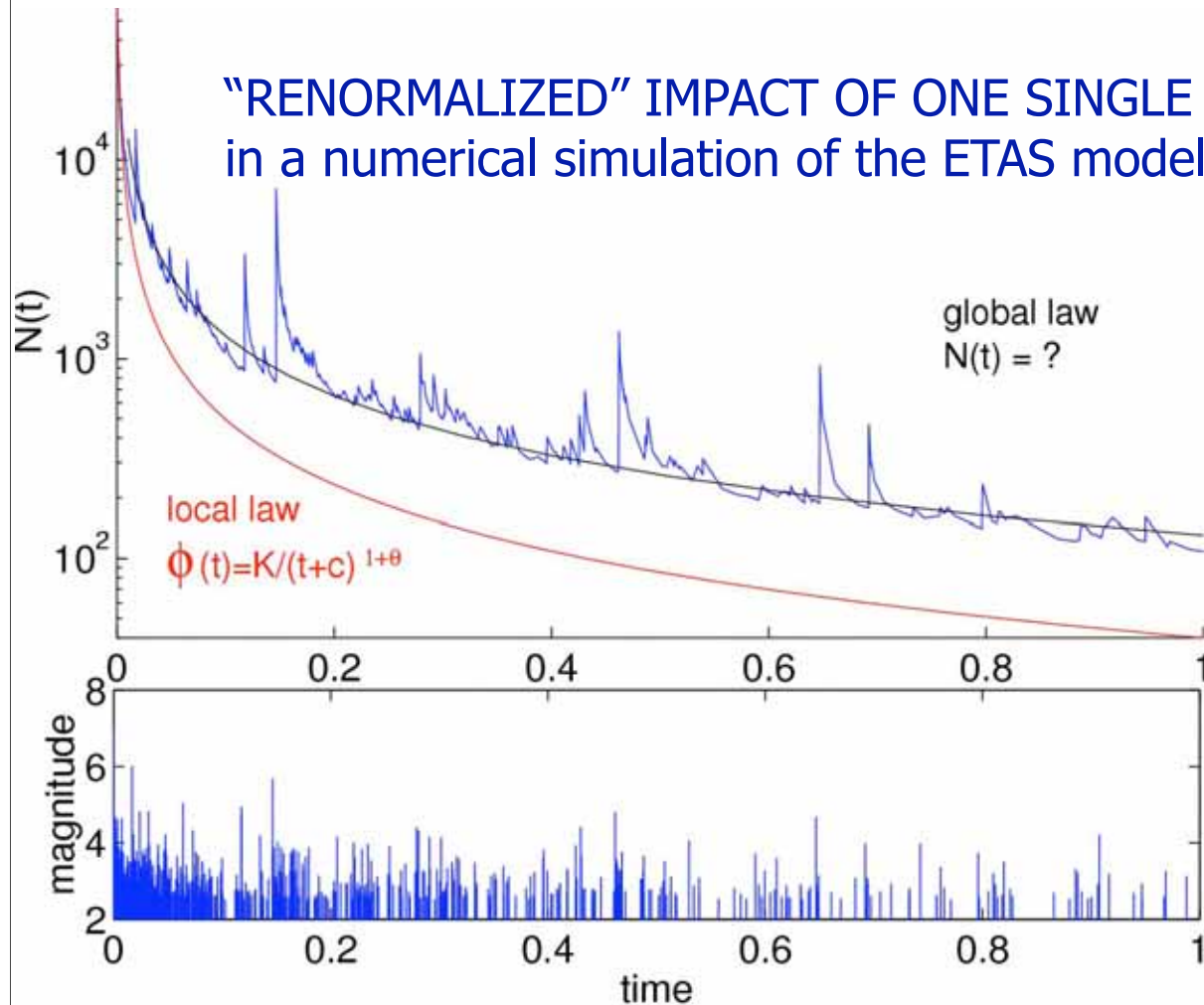
$$E_{\text{endo}}[A(t)|A(0) = A_0] \propto A_0 \int_0^{+\infty} du K(t + u) K(u)$$



# Hawkes ETAS model and numerical simulations

## The impact of cascades of generations

“RENORMALIZED” IMPACT OF ONE SINGLE PIECE OF INFORMATION  
in a numerical simulation of the ETAS model



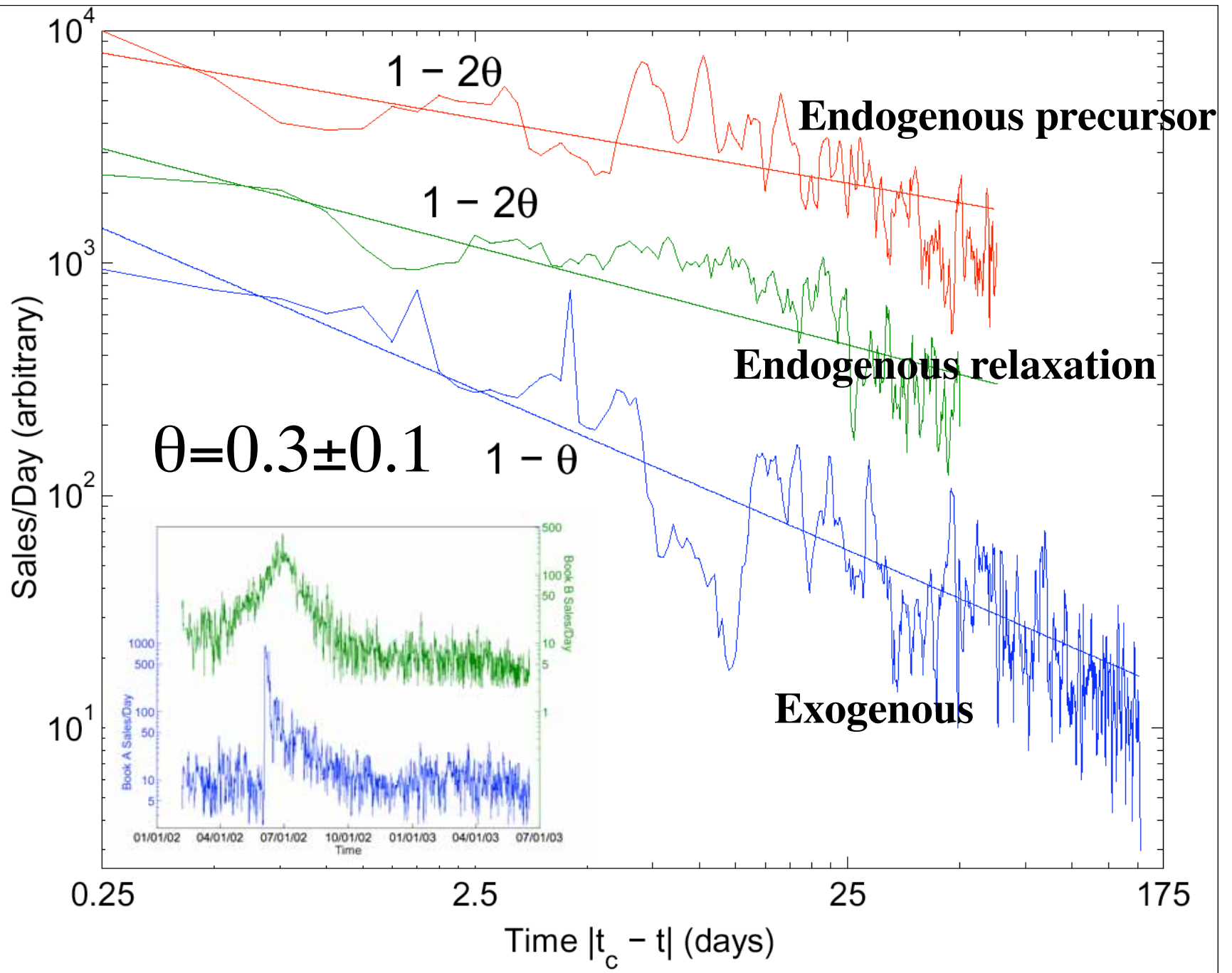
For  $\phi \sim 1/t^{1+\theta}$   $S_{exo}(t) \equiv K(t) : \frac{1}{(t-t_c)^{1-\theta}}$  with  $0 < \theta < 1$

# Theoretical predictions

- The tests are about the slopes of the response functions, conditional on the class of peak determined by the slope of the growth **AT CRITICALITY  $n=1$**

	Endogenous	Exogenous
Foreshock (or growth)	$S(t) \propto \frac{1}{ t ^{1-2\theta}}$	Abrupt peak
Aftershock (or decay)	$S(t) \propto \frac{1}{t^{1-2\theta}}$	$S(t) \propto \frac{1}{t^{1-\theta}}$

**Non-critical:**  $S(t) \propto \frac{1}{t^{1+\theta}}$





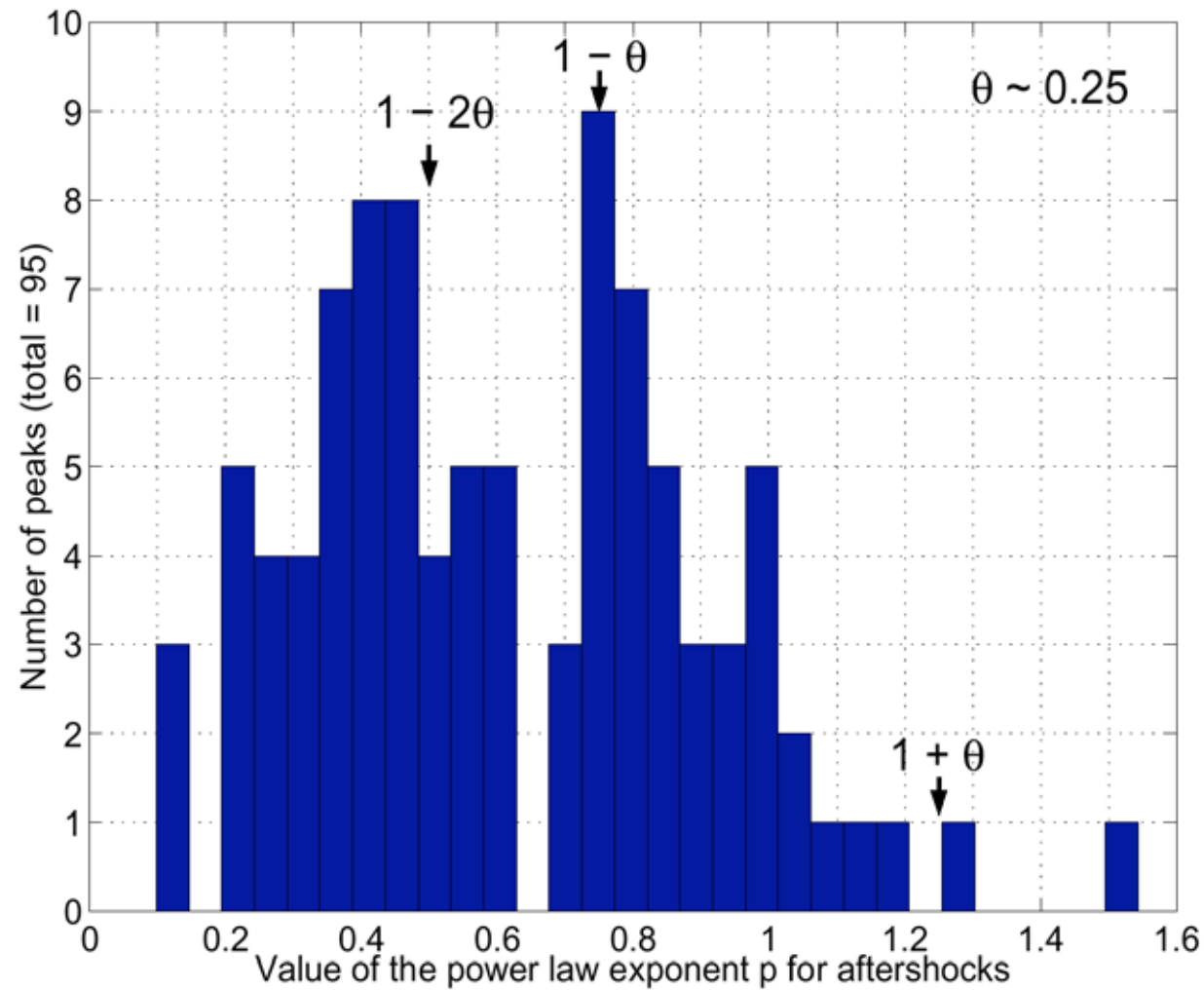
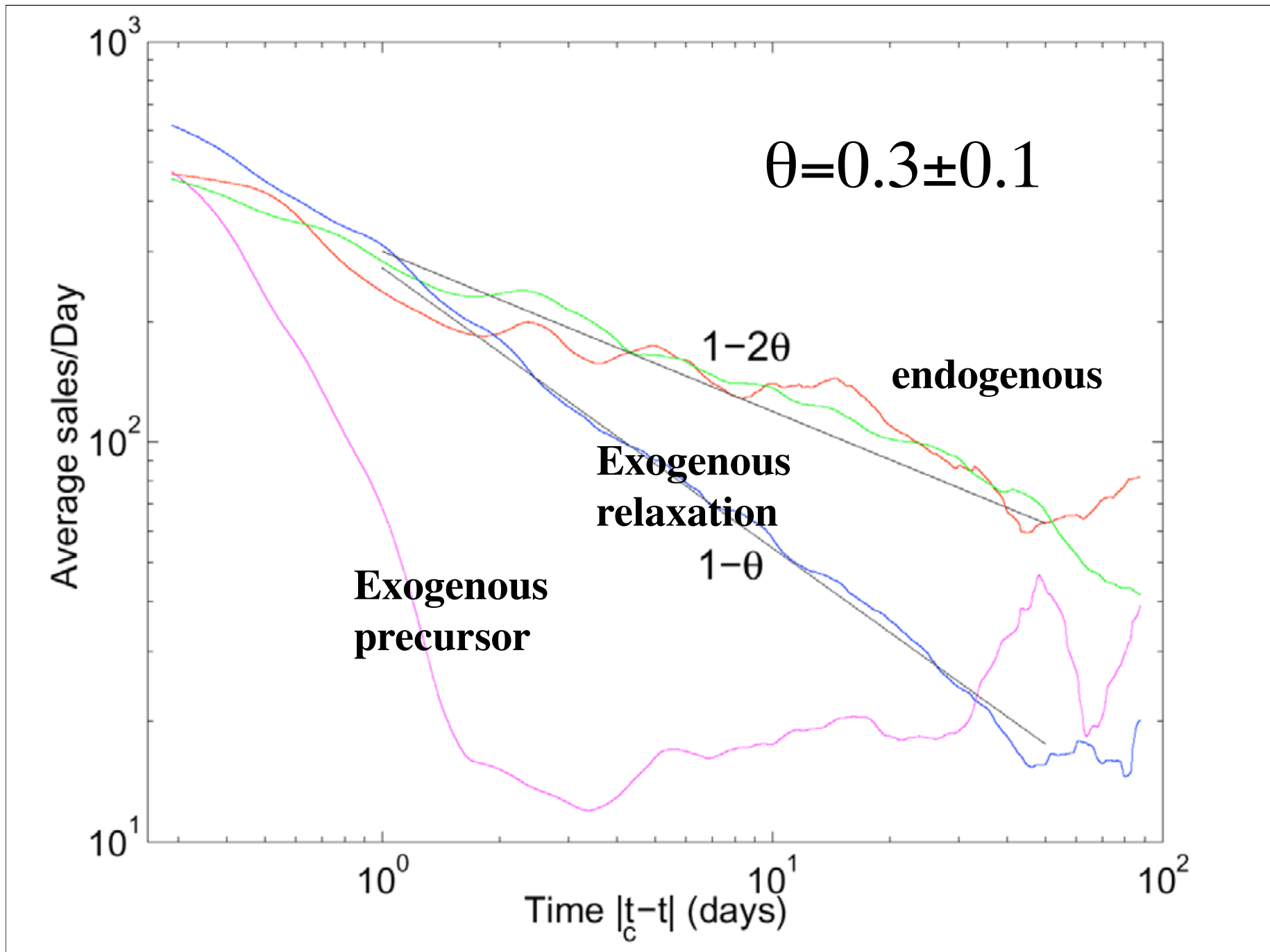


Figure 4: Histogram of the estimates of the power law exponents  $p$  of the relaxations of the sales of books following the largest peaks. The sample is obtained from 77 books, which yield 95 major peaks. One can clearly identify two classes of exponents: endogenous cluster for  $1 - 2\theta$  close to 0.45 and exogenous cluster for  $1 - \theta$  close to 0.75, compatible with the estimation  $\theta = 0.3 \pm 0.1$ . The tail of the distribution of exponents extending up to at  $1 + \theta$  represents an exogenous crossover due to deviations from criticality (see text).



# Empirical Implications

---

- If buys were mainly initiated via news and advertisements, the model predicts an exponent of  $1+\theta$
- So the power-law exponents being smaller than 1 indicates:
  - Sales dynamics is dominated by **cascades** involving high-order generations
  - This implies that  $n \sim 1$ , i.e. **the social network is close to critical**
- Identification of critical niches for optimal marketing strategy

## FINANCIAL SHOCKS

Lucent Technologies Inc  
as of 3-Mar-2000

Splits: ▼

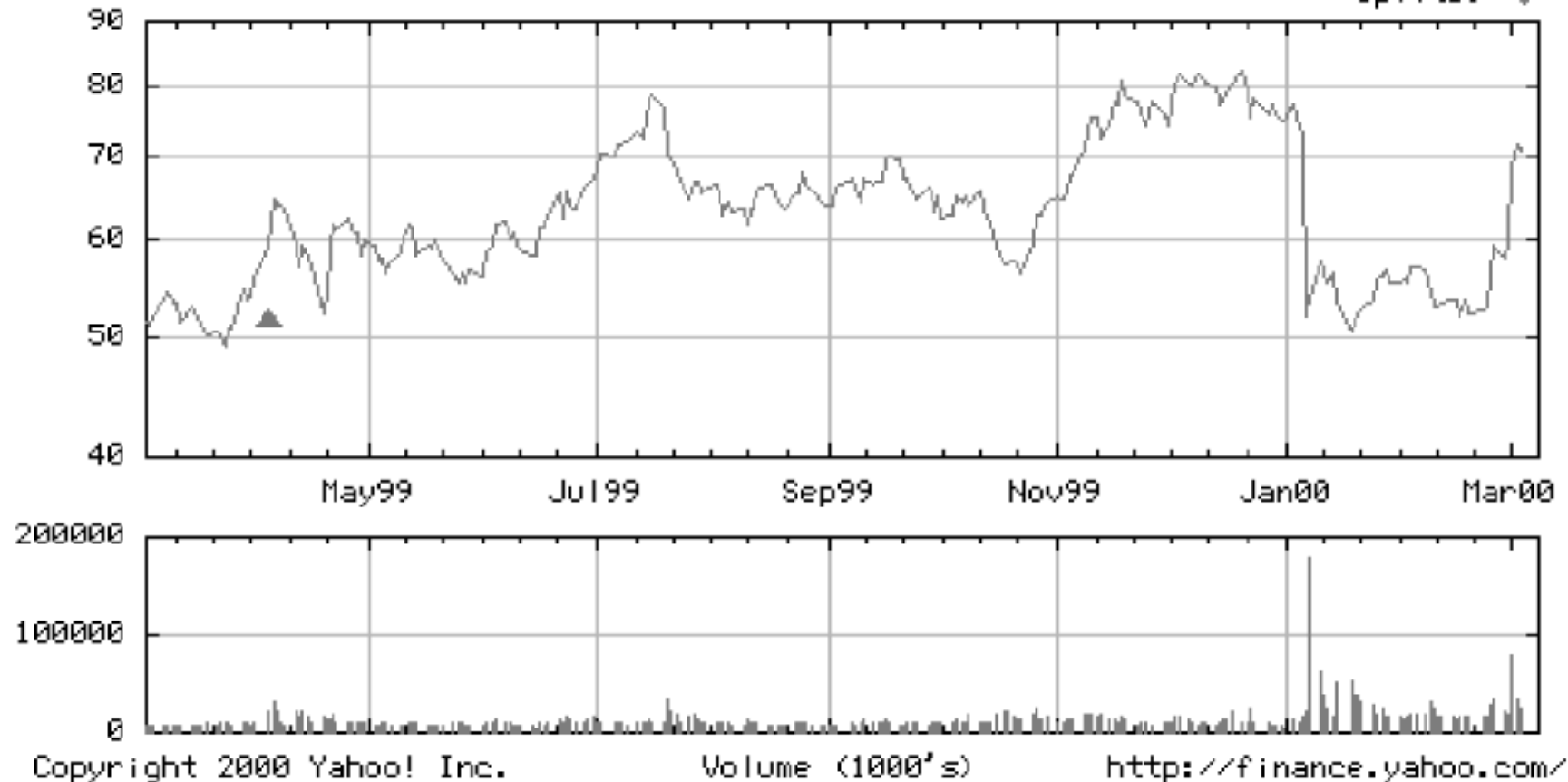
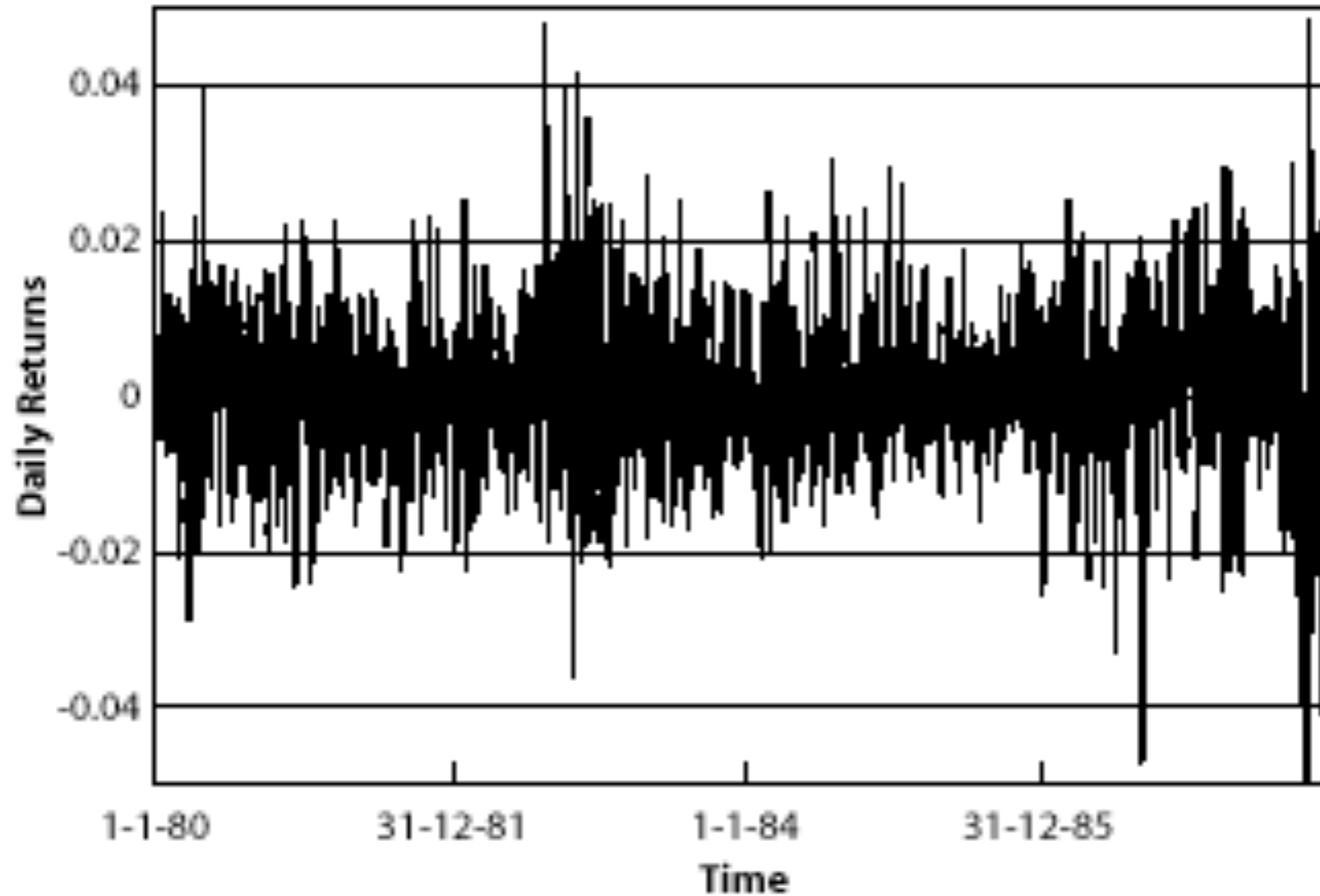


FIG. 1.8. Top panel: Time series of daily closes and volume of the Lucent Technology stock over a one-year period around the large drop of January 6, 2000. The time of the crash can be seen clearly as coinciding with the peak in volume (bottom panel). Taken from <http://finance.yahoo.com/>.

(Sornette, 2003)

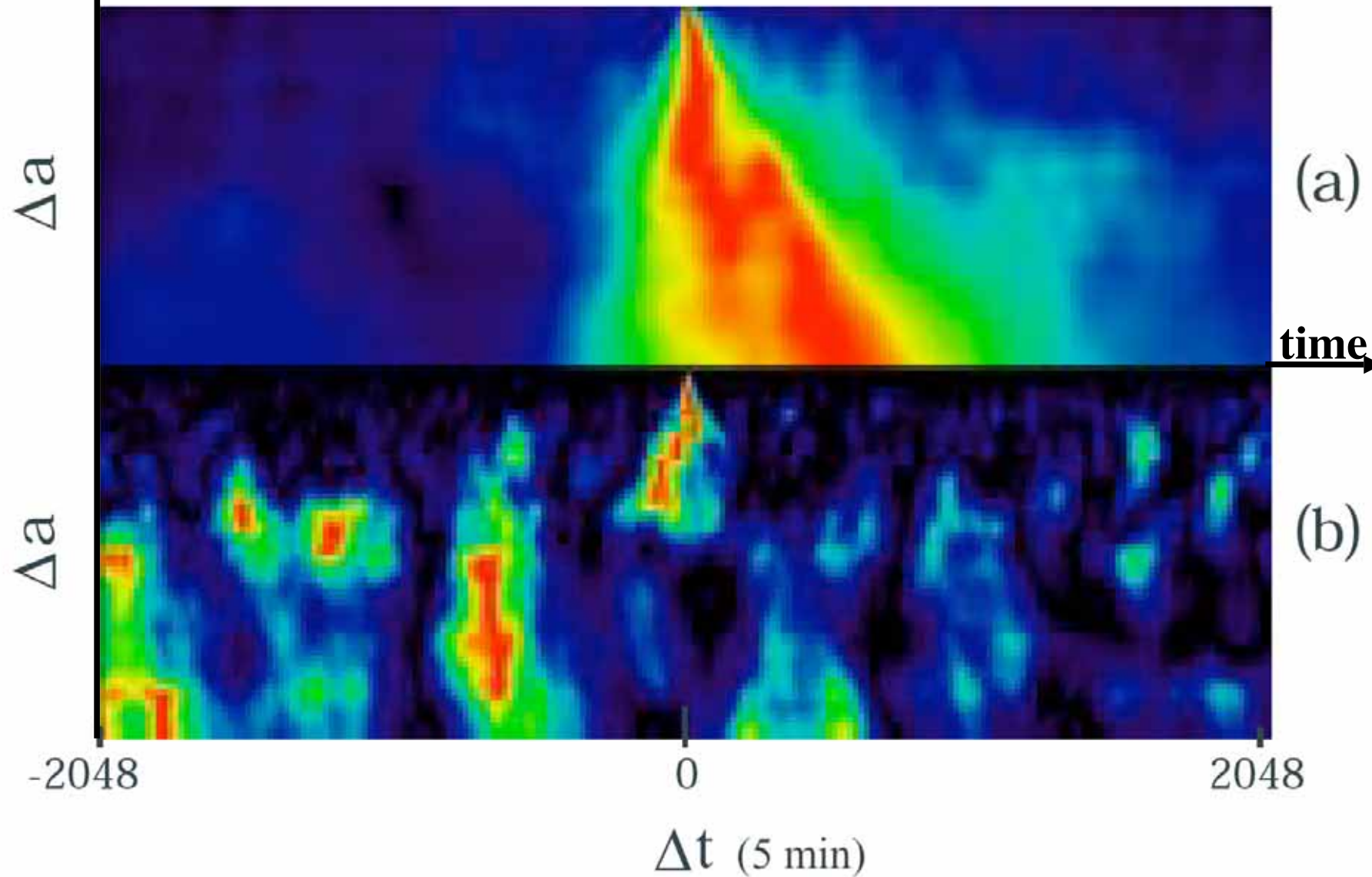
# Volatility

Dow Jones Index Returns Jan. 2nd 1980–Dec.31st 1987



scale

# DIRECT CAUSAL HIERARCHICAL CASCADE

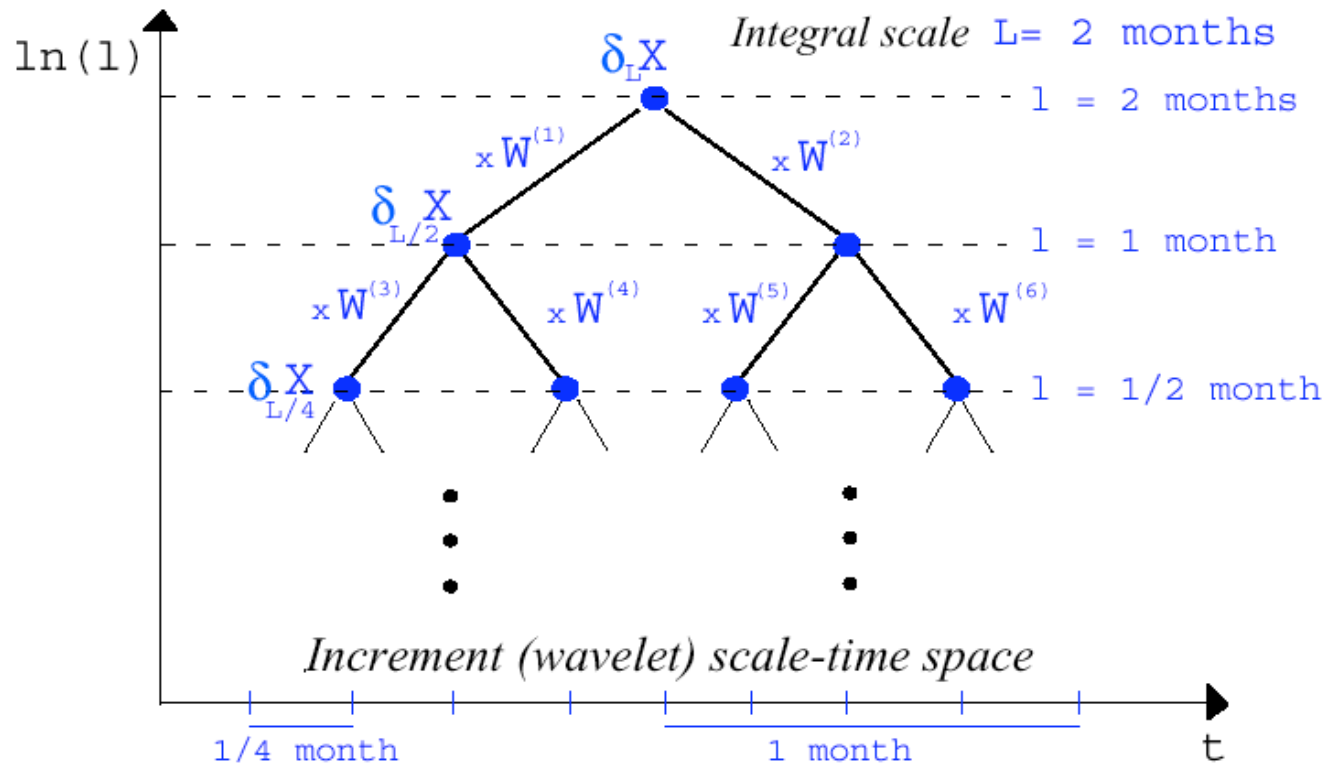


A. Arneodo, J.-F. Muzy and D. Sornette, Direct causal cascade in the stock market, European Physical Journal B 2, 277-282 (1998)

# The multiplicative cascade paradigm

$$\delta_{\lambda l} X(\lambda t) = \lambda^H \delta_l X(t) = W_\lambda \delta_l X(t)$$

- $\mathcal{W}$ -cascades (wavelet cascade)





## The Multifractal Random Walk (MRW) model

$$r_{\Delta t}(t) = \epsilon(t) \cdot \sigma_{\Delta t}(t) = \epsilon(t) \cdot e^{\omega_{\Delta t}(t)}$$

$$\mu_{\Delta t} = \frac{1}{2} \ln(\sigma^2 \Delta t) - C_{\Delta t}(0)$$

$$C_{\Delta t}(\tau) = \text{Cov}[\omega_{\Delta t}(t), \omega_{\Delta t}(t + \tau)] = \lambda^2 \ln \left( \frac{T}{|\tau| + e^{-3/2} \Delta t} \right)$$

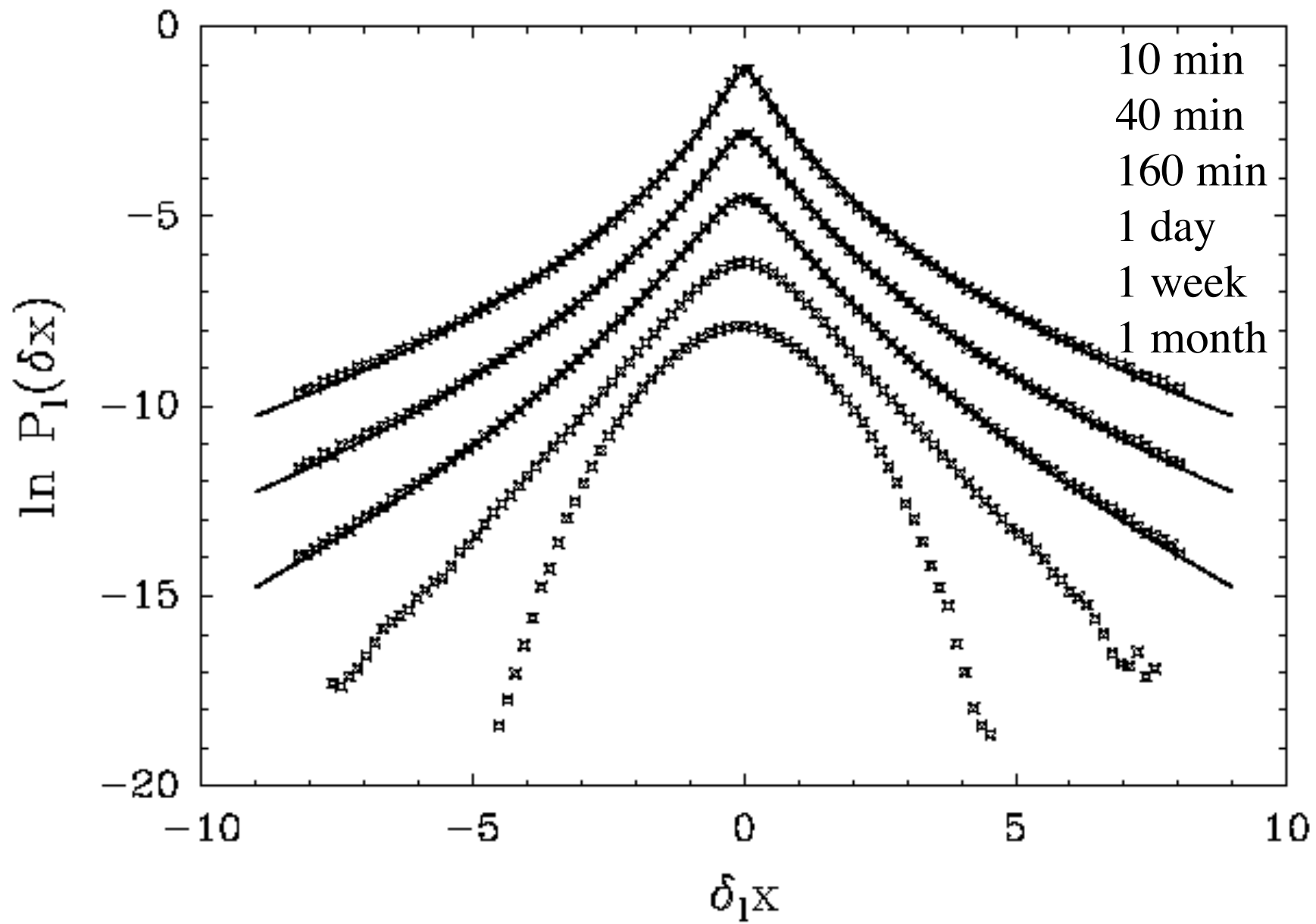
$$\omega_{\Delta t}(t) = \mu_{\Delta t} + \int_{-\infty}^t d\tau \eta(\tau) K_{\Delta t}(t - \tau)$$

$\omega_{\Delta t}(t)$  is Gaussian with mean  $\mu_{\Delta t}$  and variance  $V_{\Delta t} = \int_0^{\infty} d\tau K_{\Delta t}^2(\tau) = \lambda^2 \ln \left( \frac{T e^{3/2}}{\Delta t} \right)$

$$C_{\Delta t}(\tau) = \int_0^{\infty} dt K_{\Delta t}(t) K_{\Delta t}(t + |\tau|)$$

$$\hat{K}_{\Delta t}(f)^2 = \hat{C}_{\Delta t}(f) = 2\lambda^2 f^{-1} \left[ \int_0^{Tf} \frac{\sin(t)}{t} dt + O(f\Delta t \ln(f\Delta t)) \right]$$

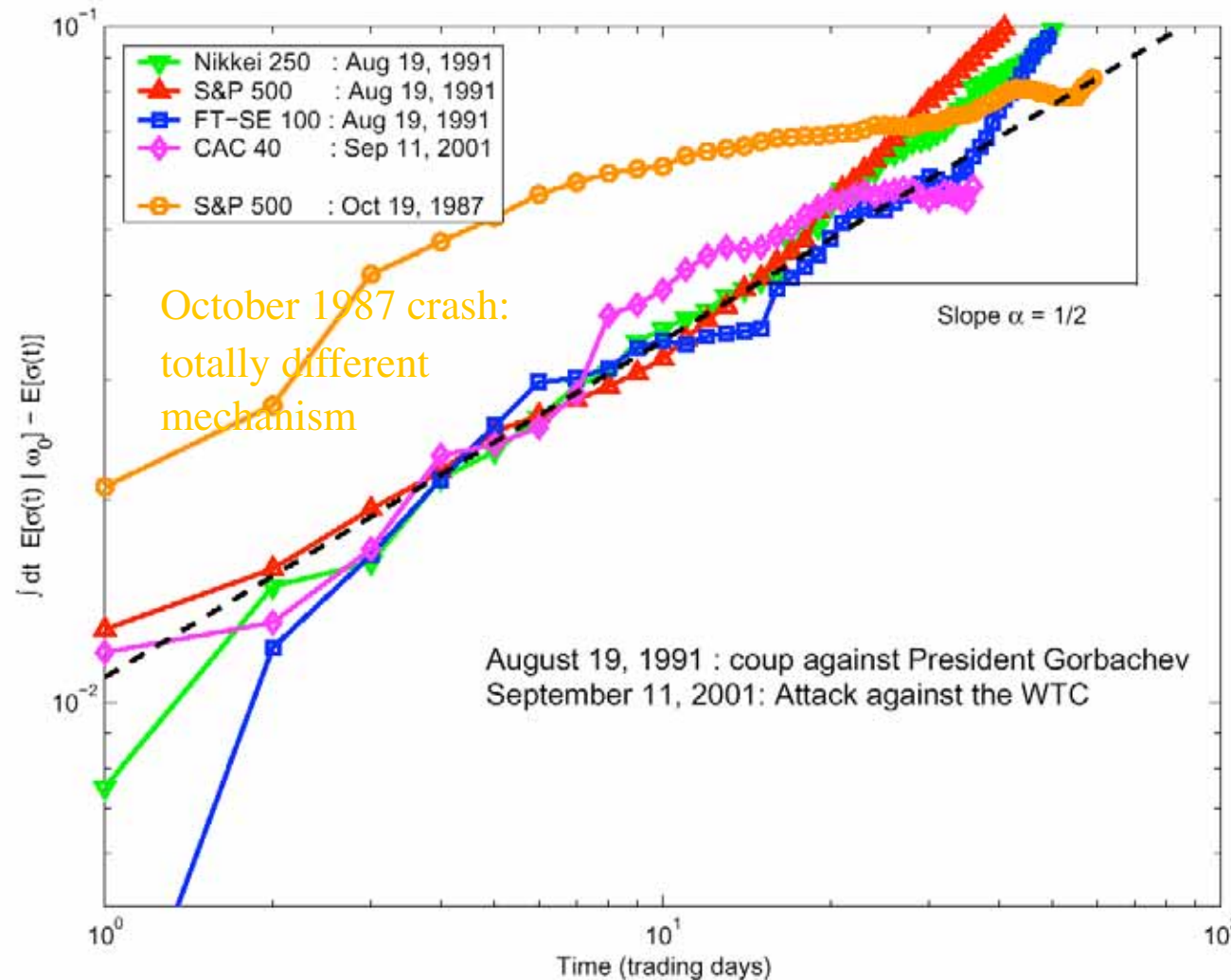
$$K_{\Delta t}(\tau) \sim K_0 \sqrt{\frac{\lambda^2 T}{\tau}} \quad \text{for } \Delta t \ll \tau \ll T$$



(a)

# Linear response to an external shock (Multifractal Random Walk model)

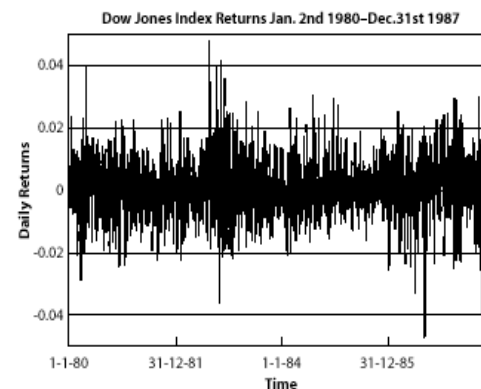
$$E_{\text{exo}}[\sigma^2(t) | \omega_0] - \overline{\sigma^2(t)} \propto e^{2K_0 t^{-1/2}} - 1 \approx \frac{2K_0}{\sqrt{t}}$$



D. Sornette, Y. Malevergne and  
J.F. Muzy  
Volatility fingerprints of large  
shocks: Endogeneous versus  
exogeneous,  
Risk Magazine  
([http://arXiv.org/abs/cond-mat/  
0204626](http://arXiv.org/abs/cond-mat/0204626))

## “Conditional response” to an endogeneous shock

$$\begin{aligned} E_{\text{endo}}[\sigma^2(t) | \omega_0] &= \overline{\sigma^2(t)} \exp \left[ 2(\omega_0 - \mu) \cdot \frac{C(t)}{C(0)} - 2 \frac{C^2(t)}{C(0)} \right] \\ &= \overline{\sigma^2(t)} \left( \frac{T}{t} \right)^{\alpha(s) + \beta(t)} \end{aligned}$$



where

$$\alpha(s) = \frac{2s}{\ln\left(\frac{T e^{3/2}}{\Delta t}\right)},$$

$$\beta(t) = 2\lambda^2 \frac{\ln(t/\Delta t)}{\ln(T e^{3/2}/\Delta t)}$$

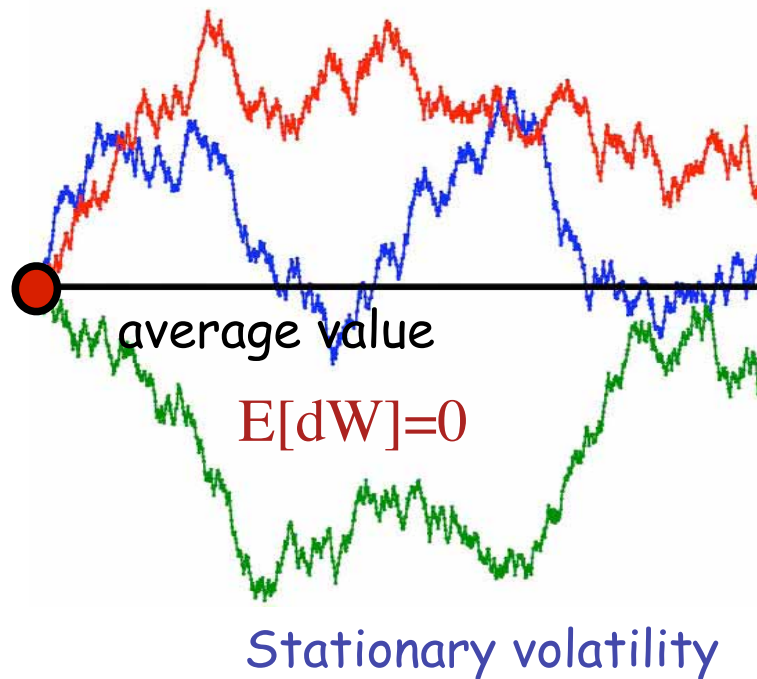
**Interplay between  
-long memory  
-exponential**

Within the range  $\Delta t < t \ll \Delta t e^{\frac{|s|}{\lambda^2}}$ ,  $\beta(t) \ll \alpha(s)$

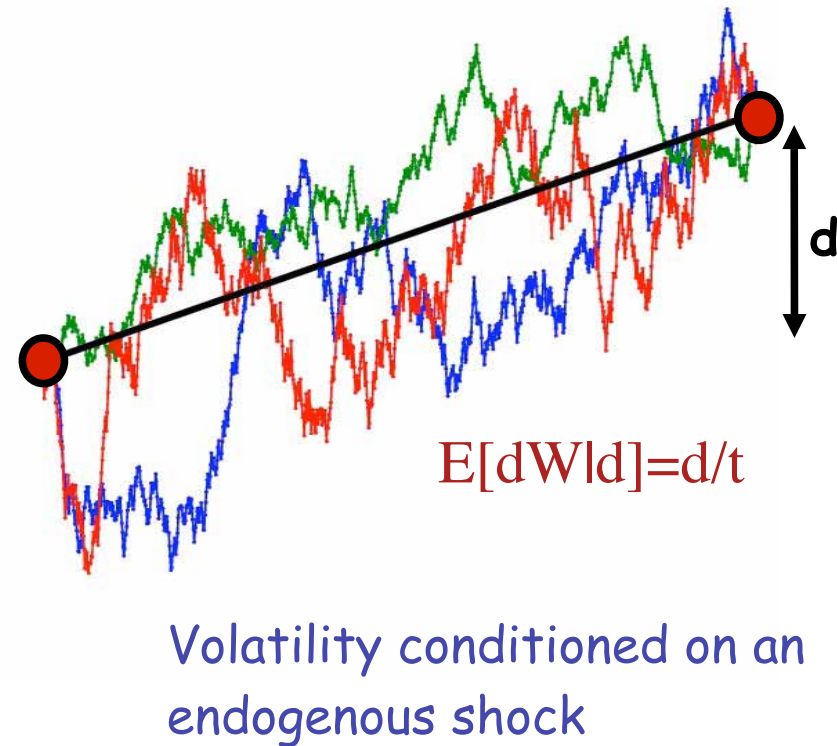
$$E_{\text{endo}}[\sigma^2(t) | \omega_0] \sim t^{-\alpha(s)}$$

# Analogy with Brownian motion

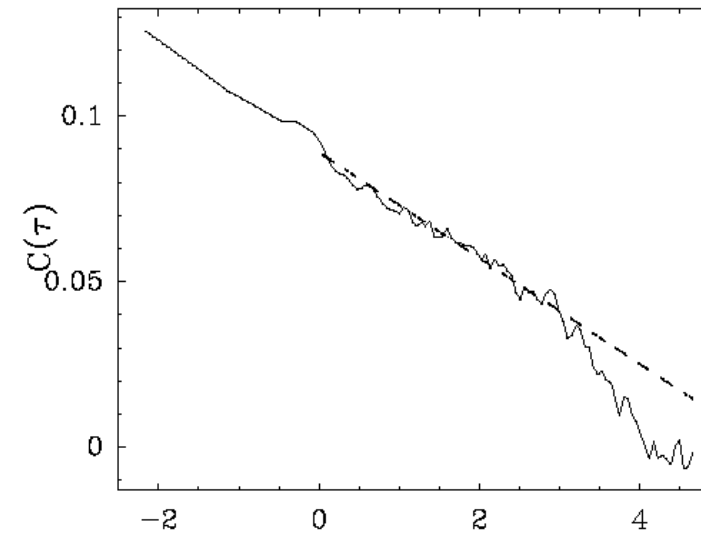
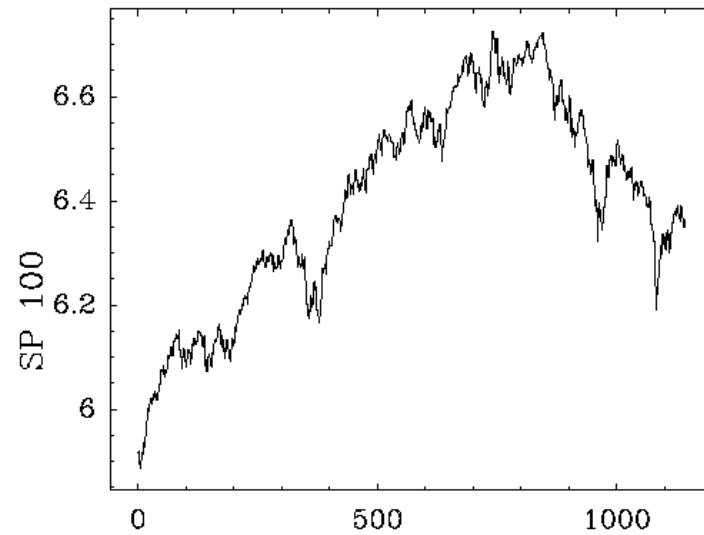
without conditioning:  
stationary process, average=0



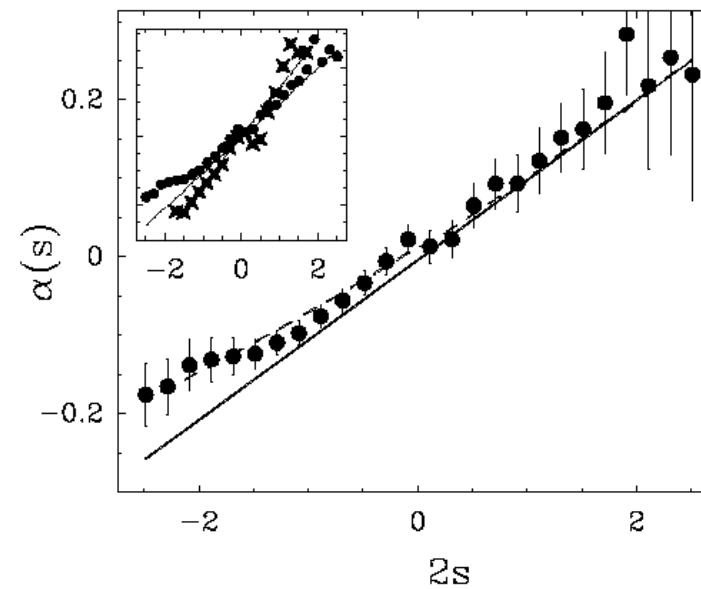
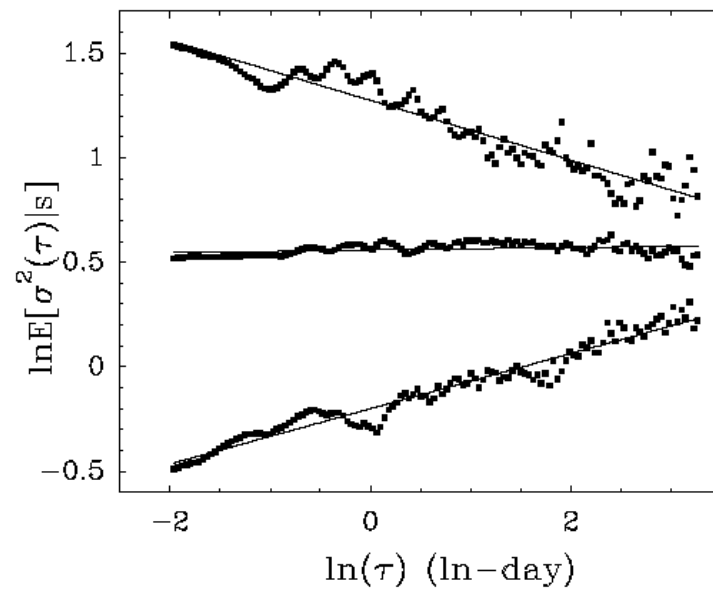
conditioning to a large value  $W(t)=d$  :  
non-stationary process, average  $\neq 0$



# Real Data and Multifractal Random Walk model



$E_{\text{endo}}[\sigma^2(t) | \omega_0] \sim t^{-\alpha(s)}$   $\ln(\tau)$  (ln-day)





# A Shocking Look At...

**You Tube**

Broadcast Yourself™

## Videos

### Browse

- [Most Recent](#)
- [● Most Viewed](#)
- [Top Rated](#)
- [Most Discussed](#)
- [Top Favorites](#)
- [Most Linked](#)
- [Recently Featured](#)



TM



**Riley Crane, Didier Sornette**

ETH Zurich, D-MTEC  
Chair of Entrepreneurial Risks



http://youtube.com/

Sign Up | My Account | History | Help | Log In | Site

Broadcast Yourself™

Videos Categories Channels Community Upload

Search

Videos being watched right now

Promoted Videos

Featured Videos

Final Words...Thank you YouTube!  
Views: 22,069  
Time: 03:36  
More in People & Blogs

The Cacaman - Ain't Got Much of ...  
Views: 143,521  
Time: 03:42  
More in Music

Rescue children living in povert...  
Views: 51,614  
Time: 01:21  
More in News & Politics

Ezekiel's Story  
Views: 36,002  
Time: 06:31  
More in People & Blogs

Share Your Story at the 92nd Str...  
Views: 16,122  
Time: 03:08  
More in People & Blogs

MOTORAZR2 ESSENCE OF SHARPER TRAILER  
Views: 102,062  
Comments: 0  
Time: 01:39  
Login to rate video

Login

Broadcast Your Cause  
The YouTube Nonprofit Program  
Apply now!

What's New

YouTube Nonprofit Program  
Broadcast your cause! Apply for the Nonprofit program and use video to get your organization's message out.

YouTube Mobile  
Watch and upload YouTube videos on your mobile device.

Create Custom Players  
Now you can choose the design and color of your player, and fill it with any of your playlists!

Broadcast Your Cause: The YouTube Nonprofit Program  
Does your nonprofit organization have a great story to tell? Do you want to connect with supporters online but don't have the money for expensive outreach campaigns? Or are you just looking for way...

Read more in our Blog

# The Front Page

Compare candidates on the issues!

Popular Videos for Mobile Devices

Open Your Eyes - Sean Delaney  
Views: 52,531  
Time: 02:48  
More in Music

WOMEN OF DARFUR  
Views: 84,466  
Time: 01:22  
More in News & Politics

Polar Bears  
Views: 236,760  
Time: 01:59  
More in Film & Animation

E-Waste: Dumping on the Poor ??  
Views: 102,846  
Time: 04:35  
More in News & Politics

24 Hours for Darfur -- Numbers &...  
Views: 21,139  
Time: 04:05  
More in News & Politics

Kanye West: Education needs to b...  
Views: 241,220  
Time: 04:25  
More in News & Politics

Contest to End Youth Homelessness  
Views: 52,506  
Time: 01:38  
More in News & Politics

See More Featured Videos

Face The Candidates

Your Account: Videos, Channels, Favorites, Subscribers, Inbox, More...

Help & Info: Help Center, Video Toolbox, Developer APIs, Contact Us, Copyright Notices, Code of Conduct

YouTube: Community Info, Terms of Use, Privacy Policy, Press, About, Contact, Ads

© 2007 YouTube, LLC - Site Feedback

## Overview

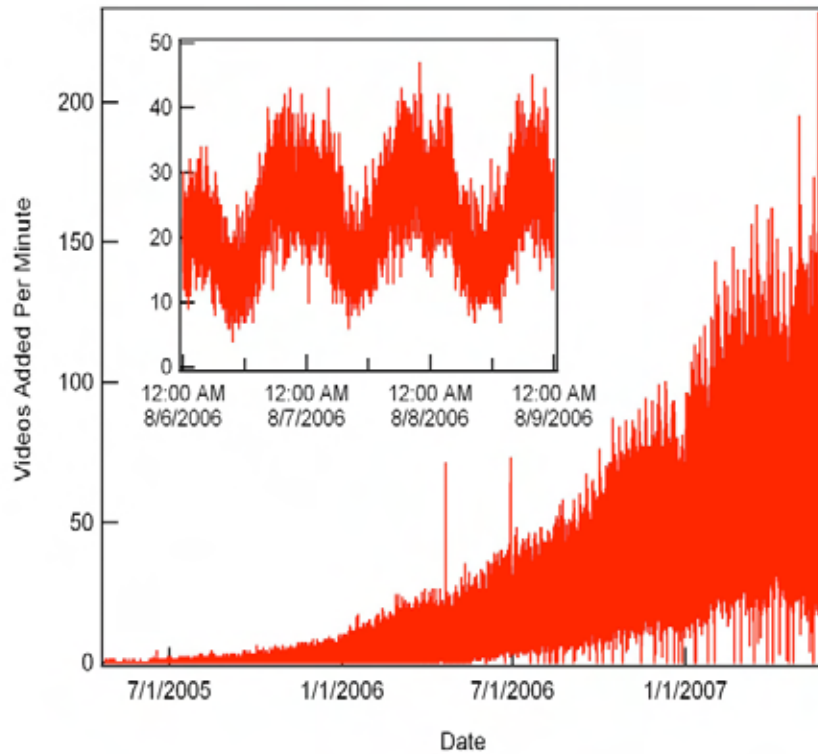
- Video Arrival and Site Growth
- Featuring – Endogenous/Exogenous Shocks
- Dynamical Relaxation Following Shocks

Perl script, via application programming interface (API) for the automated request of data. Stored in MySQL database

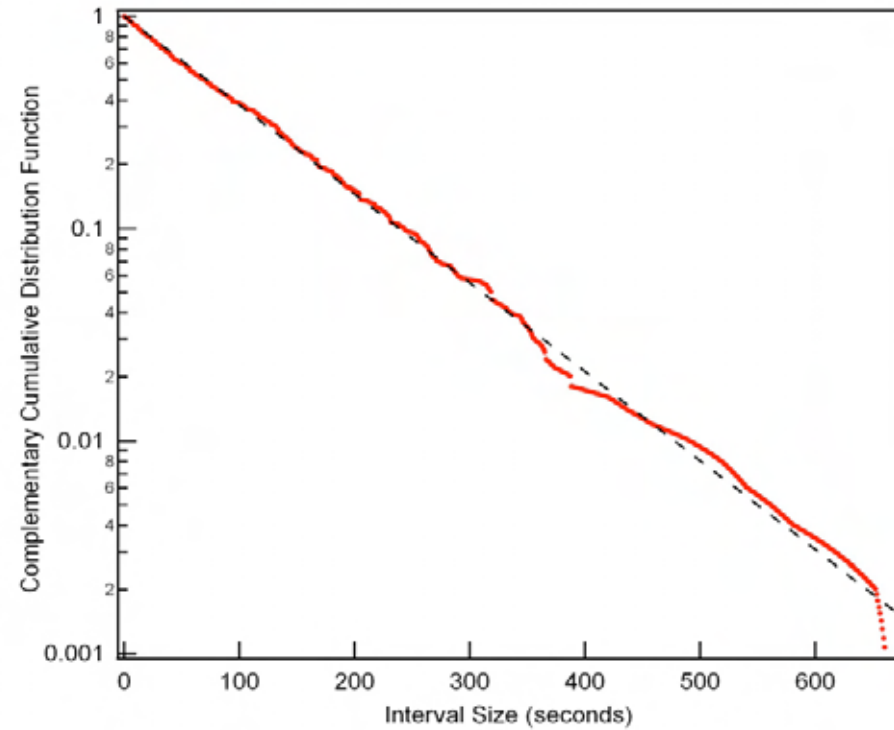
YouTube responds with a structured (XML) document containing information such as the cumulative number of times a video has been viewed (dynamic), along with descriptive information (static) concerning the user who posted the video, the title, tags, length, category, rating, comments, etc

# Birth of a Video

Videos Added per Minute



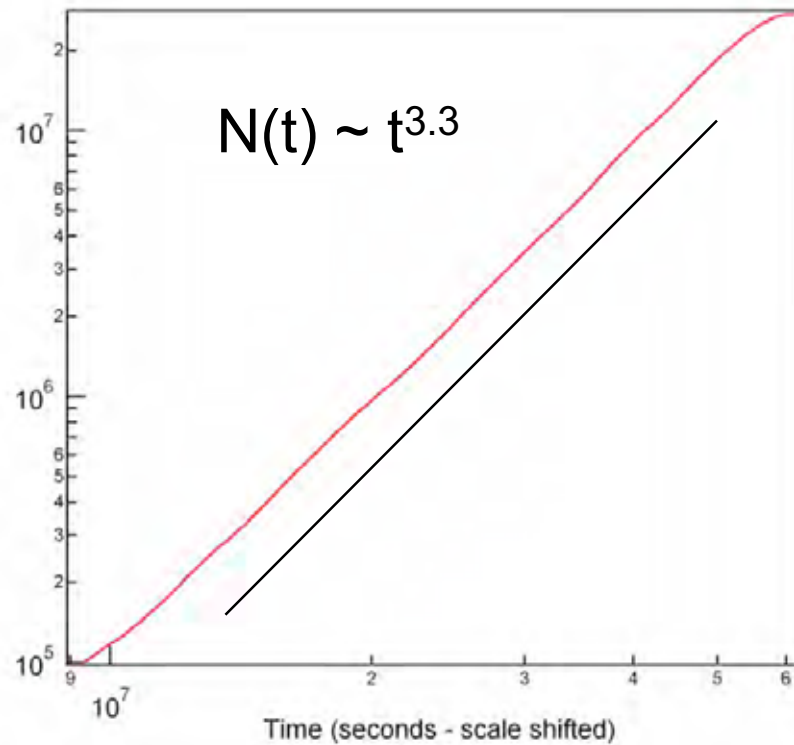
Locally - distribution of Waiting times is Exponential



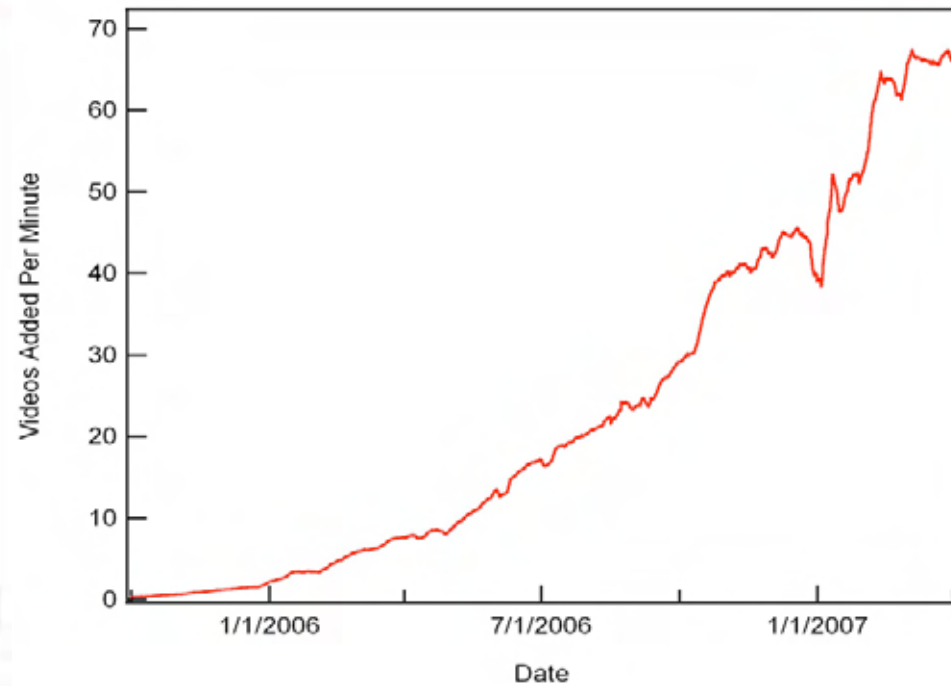
# Non-Stationary Poisson Process

Exponent 3.3 reveals the average nb of “friends”

Cumulative Number of Videos



Non-Stationary Poisson Rate





# Most Viewed Page

http://youtube.com/browse?s=mp

**You Tube** Broadcast Yourself™

[Sign Up](#) | [My Account](#) | [History](#) | [Help](#) | [Log In](#) | [Site](#)

Videos Categories Channels Community

Search powered by Google

## Videos

**Most Viewed : (Today) : All**

**Browse**

- Most Viewed**
- Most Recent
- Top Rated
- Most Discussed
- Top Favorites
- Most Linked
- Recently Featured
- Most Responed
- Watch on Mobile

**Time**

- Today**
- This Week
- This Month
- All Time

**Category**

- All**
- Autos & Vehicles
- Comedy
- Entertainment
- Film & Animation
- Gadgets & Games
- Howto & DIY
- Music
- News & Politics
- People & Blogs
- Pets & Animals
- Sports
- Travel & Places

**Ads by Google**

















**Paris Luxury Rentals**  
Serviced apartments on ile st louis Notre-Dame Great view, Video online  
[www.guestapartment.com](#)

**Spectacular Ocean Views**  
Every suite at The Cove Atlantis enjoys the Bahamas' azure waters.  
[TheCoveAtlantis.com](#)

**Campo Regio Relais**  
A luxury hotel in the heart of Siena with amazing views.  
[www.camporegio.com](#)

**Copy your Music**  
Transfer songs and playlists from your MP3 player to your computer.  
[www.findleydesigns.com](#)

**Rio de Janeiro Apartments**  
Magical Views and Internet Service 2, 3, 4 Bedrooms - Many Penthouses  
[www.rentinrio.com](#)

 <p><b>Justin Timberlake Beyonce- Until The End of Time [ REMIX ]!!</b> 05:29 Added: 1 day ago From: <a href="#">ParadoxModelMinority</a> Views: 532,685 ★★★★☆ 679 ratings</p>	 <p><b>RAF VIDEO 5</b> 00:58 Added: 1 day ago From: <a href="#">RAFFeed</a> Views: 405,876 ★★★☆☆ 122 ratings</p>	 <p><b>[- Ty Tamora -]</b> 00:49 Added: 18 hours ago From: <a href="#">number1position</a> Views: 251,290 ★★★☆☆ 58 ratings</p>	 <p><b>Headshots For Real</b> 01:54 Added: 1 day ago From: <a href="#">actingforreal</a> Views: 215,901 ★★★★☆ 321 ratings</p>
 <p><b>HOLLYWOOD.TV - Britney Spears Becomes Paparazzi in Burbank!</b> 02:12 Added: 1 day ago From: <a href="#">hollywoodtv</a> Views: 202,082 ★★★★☆ 130 ratings</p>	 <p><b>Mac Daddy</b> 02:00 Added: 1 day ago From: <a href="#">HappySlip</a> Views: 177,061 ★★★★☆ 2259 ratings</p>	 <p><b>Santana Lopes versus José Mourinho versus SIC Noticias</b> 01:58 Added: 1 day ago From: <a href="#">FBEmd</a> Views: 138,726 ★★★★☆ 388 ratings</p>	 <p><b>MOTORAZR2 ESSENCE OF SHARPER TRAILER</b> 01:04 Added: 17 hours ago From: <a href="#">MOTORAZR2</a> Views: 102,699</p>
 <p><b>Diet.com Weight Loss Challenger II: Week 6 Tonya Vision</b> 01:32 Added: 1 day ago From: <a href="#">diethealth</a> Views: 95,165 ★★★★☆ 34 ratings</p>	 <p><b>Tutti in consiglio comunale</b> 01:04 Added: 1 day ago From: <a href="#">StaffGrillo</a> Views: 94,991 ★★★★☆ 192 ratings</p>	 <p><b>Barcelona 4 - 1 Real Zaragoza - La Liga Highlights</b> 03:24 Added: 1 day ago From: <a href="#">footyweek</a> Views: 87,708 ★★★★☆ 88 ratings</p>	 <p><b>?????????na kedNEWS???</b> 01:31 Added: 1 day ago From: <a href="#">hohten</a> Views: 85,463 ★★★☆☆ 52 ratings</p>
			

**You choose**  
Compare the candidates!

# Most Recent Page

http://youtube.com/browse?s=mr&t=t&c=0&l= unix time

**You Tube**  
Broadcast Yourself™

[Sign Up](#) | [My Account](#) | [History](#) | [Help](#) | [Log In](#) | [Site](#)

Videos Categories Channels Community [Upload](#)

powered by Google

**Videos** **Most Recent : All**

**Browse**

- Most Recent
- [Most Viewed](#)
- [Top Rated](#)
- [Most Discussed](#)
- [Top Favorites](#)
- [Most Linked](#)
- [Recently Featured](#)
- [Most Responded](#)
- [Watch on Mobile](#)

**Category**

- All
- [Autos & Vehicles](#)
- [Comedy](#)
- [Entertainment](#)
- [Film & Animation](#)
- [Gadgets & Games](#)
- [Howto & DIY](#)
- [Music](#)
- [News & Politics](#)
- [People & Blogs](#)
- [Pets & Animals](#)
- [Sports](#)
- [Travel & Places](#)

**Ads by Google**

**Taproot Music Videos**  
Free Music Videos - Taproot Exclusive In Studio Performance  
[studio.ugo.com](#)

**Free tube Videos**  
Watch & Upload tube Videos for Free Enjoy Funny Videos! No hassle  
[Life.dada.net/Tube/Videos](#)

**Paris Luxury Rentals**  
Serviced apartments on ile st louis Notre-Dame Great view, Video online  
[www.guestapartment.com](#)

**Villa Florentine Lyon**  
panoramic views of Lyon Book online now  
[www.travelintelligence.com](#)

**Watch Music Videos**  
Latest music videos online Free! Also Clips, Free MP3s, Reviews  
[www.ViceLand.com/uk/VBS](#)

**Unwetter Slowenien**  
01:24  
Added: 25 minutes ago  
From: [willem1946](#)  
Views: 1

**Interview du créateur de Heroes**  
08:19  
Added: 25 minutes ago  
From: [Dewey63](#)  
Views: 0

**un tanar battu de politie**  
00:23  
Added: 25 minutes ago  
From: [mcmadrid](#)  
Views: 0

**Joey Bean Walking 3**  
00:35  
Added: 25 minutes ago  
From: [happyheatherly](#)  
Views: 0

**beautiful lady**  
03:01  
Added: 25 minutes ago  
From: [shygal34](#)  
Views: 1

**thyra**  
01:03  
Added: 25 minutes ago  
From: [ruffBITCH](#)  
Views: 2

**Halo 2 Artillery Bombardment**  
00:36  
Added: 25 minutes ago  
From: [bondboy8](#)  
Views: 0

**Se7en on STAR real story! AM [Arirang TV 4-7-2007] Part 5**  
05:00  
Added: 25 minutes ago  
From: [Akakelvin](#)  
Views: 0

**"When you walk by" - Live Song @ wedding (HEBREW)**  
05:15  
Added: 25 minutes ago  
From: [eshedesh](#)  
Views: 0

**Re: Eric and the Army of the Phoenix (1:5)**  
09:59  
Added: 25 minutes ago  
From: [ximubayu](#)  
Views: 0

**Ida Di Benedetto Light up cigarette**  
00:14  
Added: 25 minutes ago  
From: [MDL72](#)  
Views: 0

**hczvole**  
03:11  
Added: 25 minutes ago  
From: [Hodnak](#)  
Views: 0

**jealous guy**  
09:59  
Added: 25 minutes ago  
From: [bigbreadeaterellis](#)  
Views: 0

**im a sucker**  
03:12  
Added: 25 minutes ago  
From: [alexcityhero](#)  
Views: 1

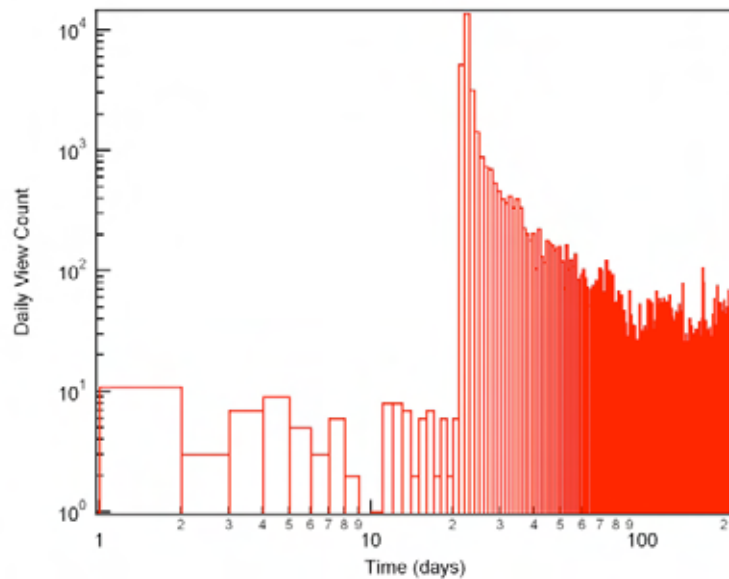
**9-6 Friends Forever 2004-07**  
08:16  
Added: 25 minutes ago  
From: [shbits92](#)  
Views: 0

**CONTINUED, SMOKING:MAGNUM PIPE TOBACCOS.**  
03:13  
Added: 25 minutes ago  
From: [MARIANUSPIPESTOBACCO](#)  
Views: 0

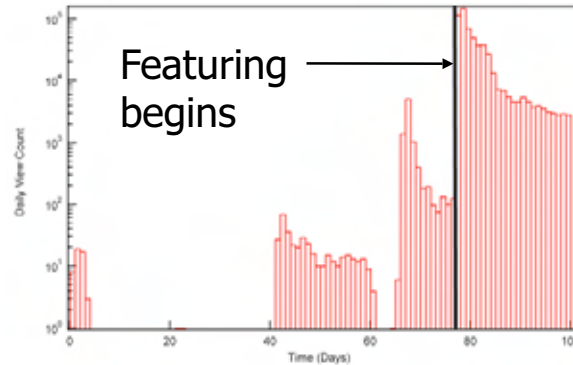
**You Choose**  
Compare the candidates!

# The Effect of Featuring

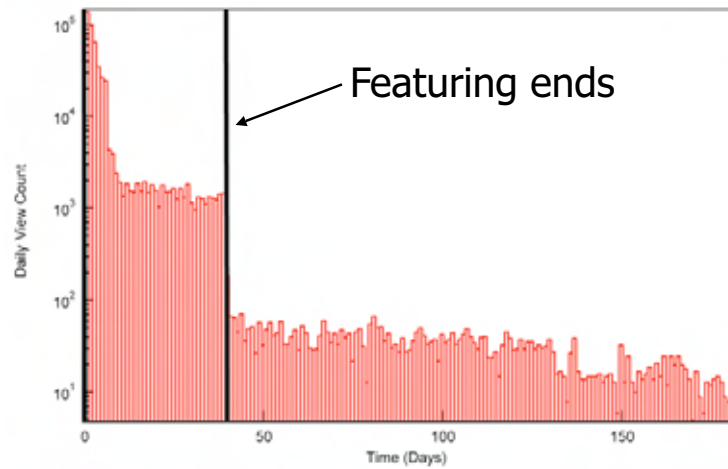
Editorial Featuring  
(arbitrary and random)



Growth of a Video before being featured



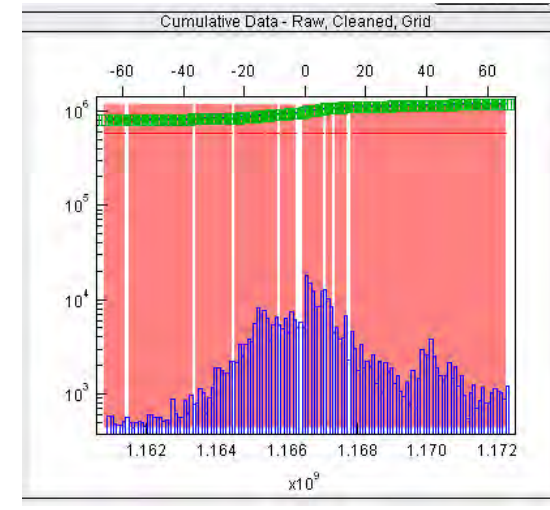
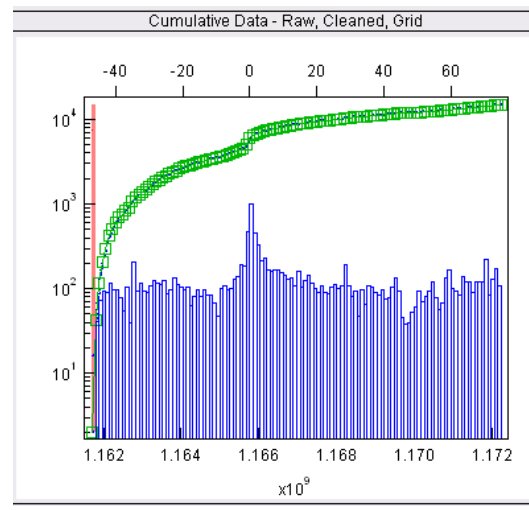
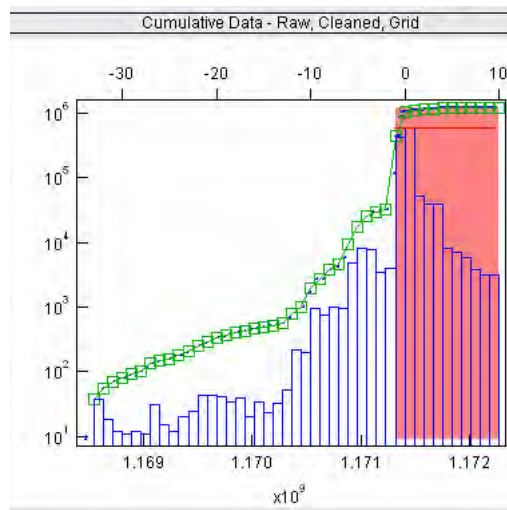
Decline of a video after being featured





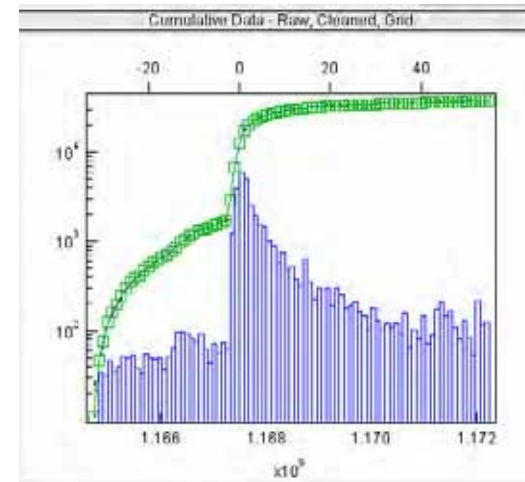
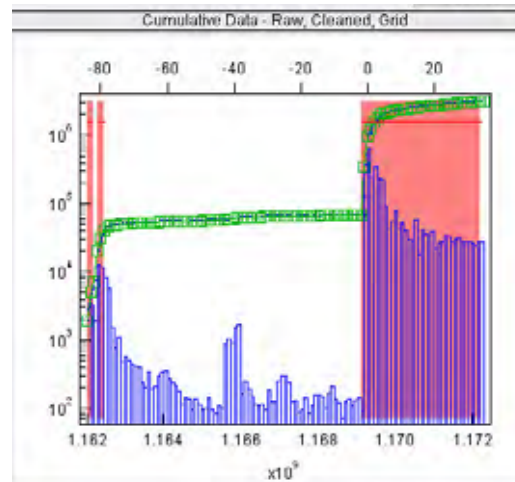
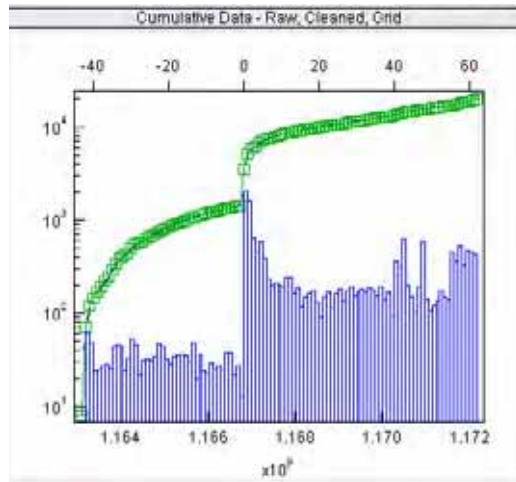
# Shocks in YouTube

“Endogenous”

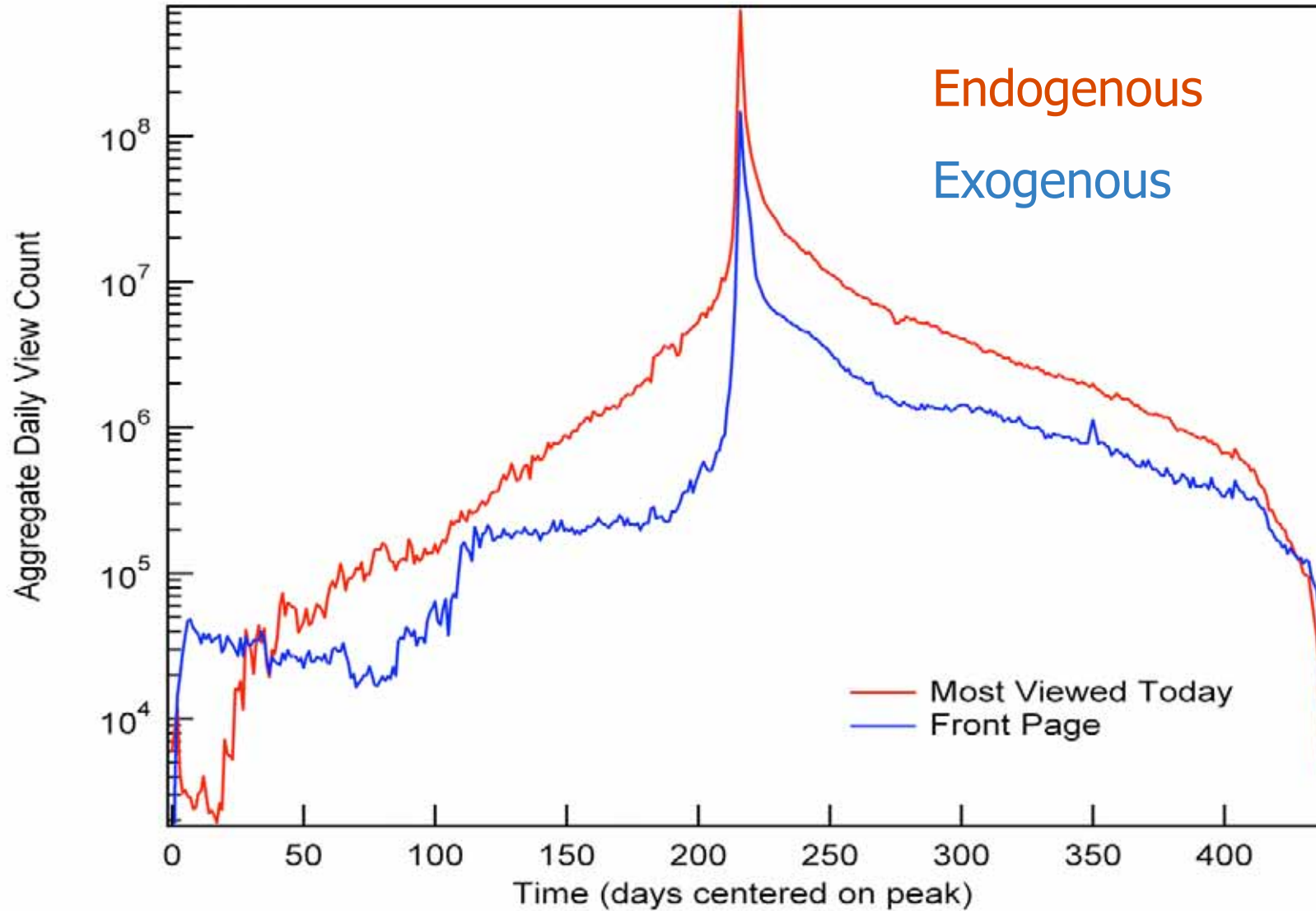


# Shocks in YouTube

“Exogenous”

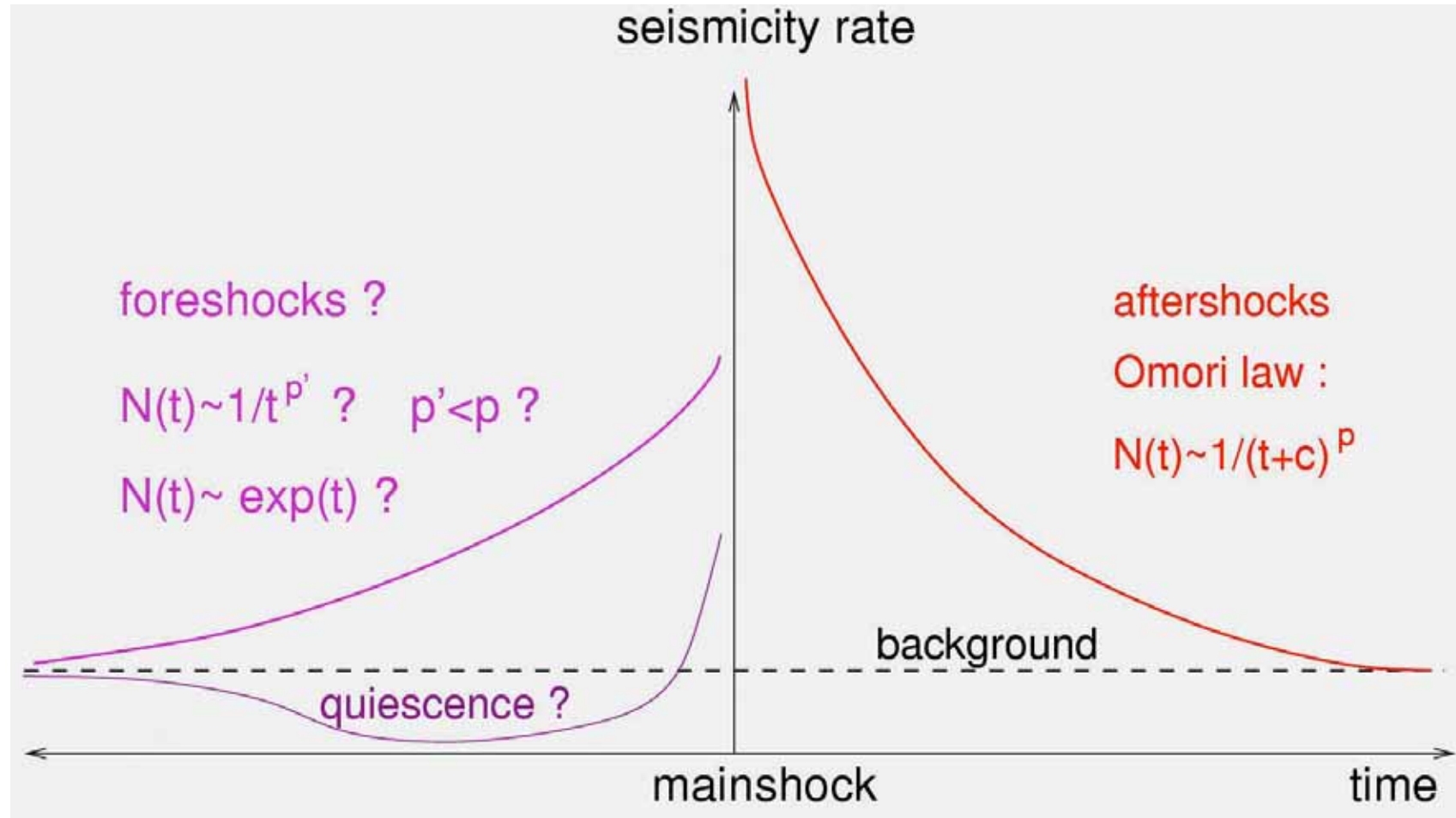


# Non-Parametric Superposition

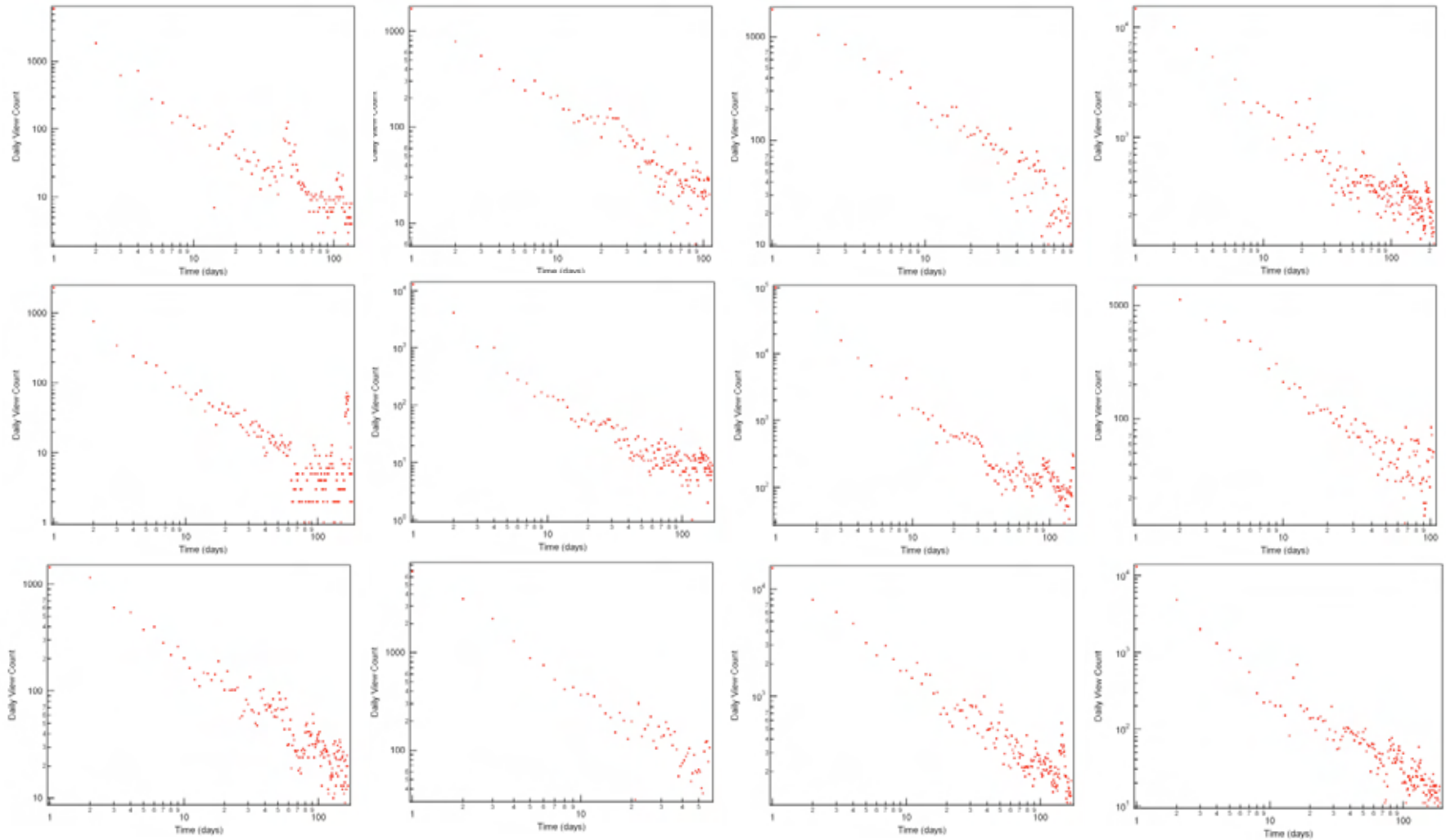


# Temporal variation of seismicity

Observations :

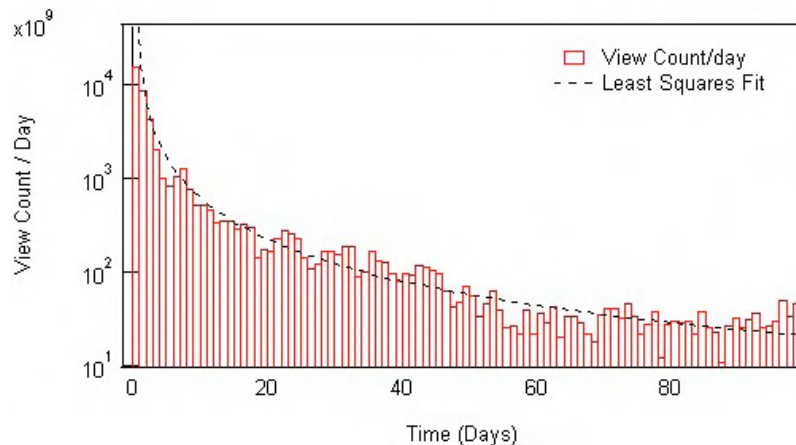


# Typical Relaxation Following Peak



# Typical Response

**Shock:** more than 100 views on a single day, and has at least 10 days following this peak. Of the 5 million videos we are tracking, 76% do not receive 100 views on any given day. Furthermore, 15% either don't have 10 days worth of data, or don't have 10 days following a qualified peak. This leaves us with roughly 9% (=421,487 videos).

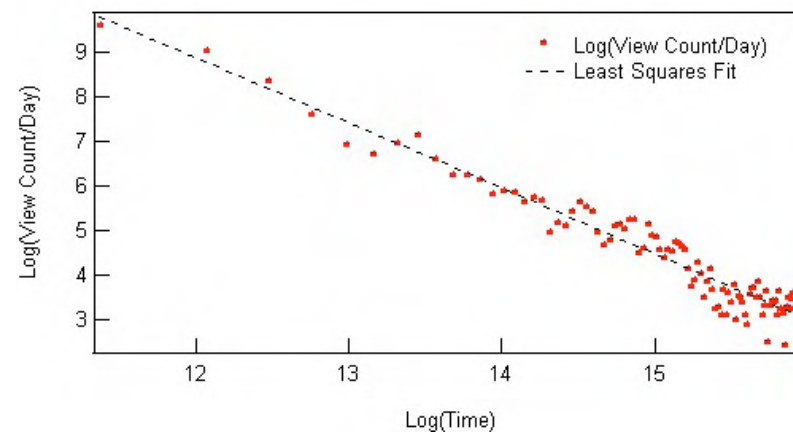


$$\text{View Count per Day} = A(t - t_c)^p$$

A = Amplitude

p = exponent governing decay

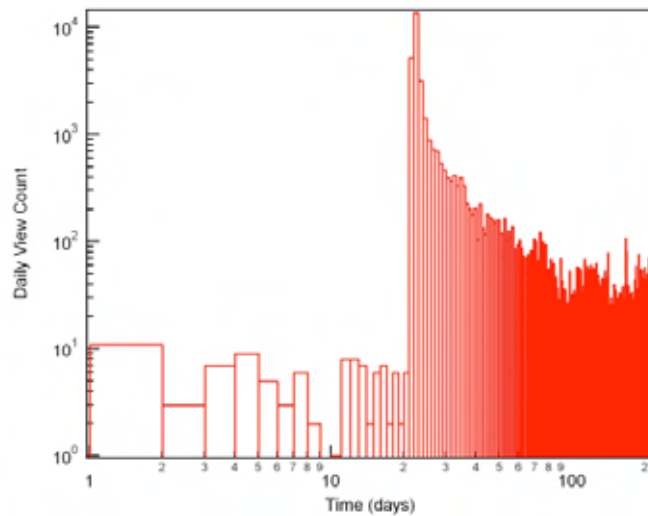
- A Least-Squares Fit is performed on the log-log data over the largest possible range.
- The exponent “p” is extracted



# Sorting out the data: Peak Height Fraction

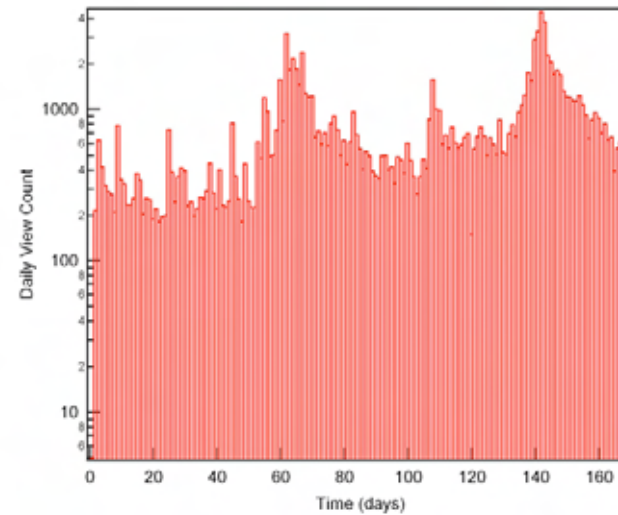
“Not Critical/Exo”

Fraction ~ 40%



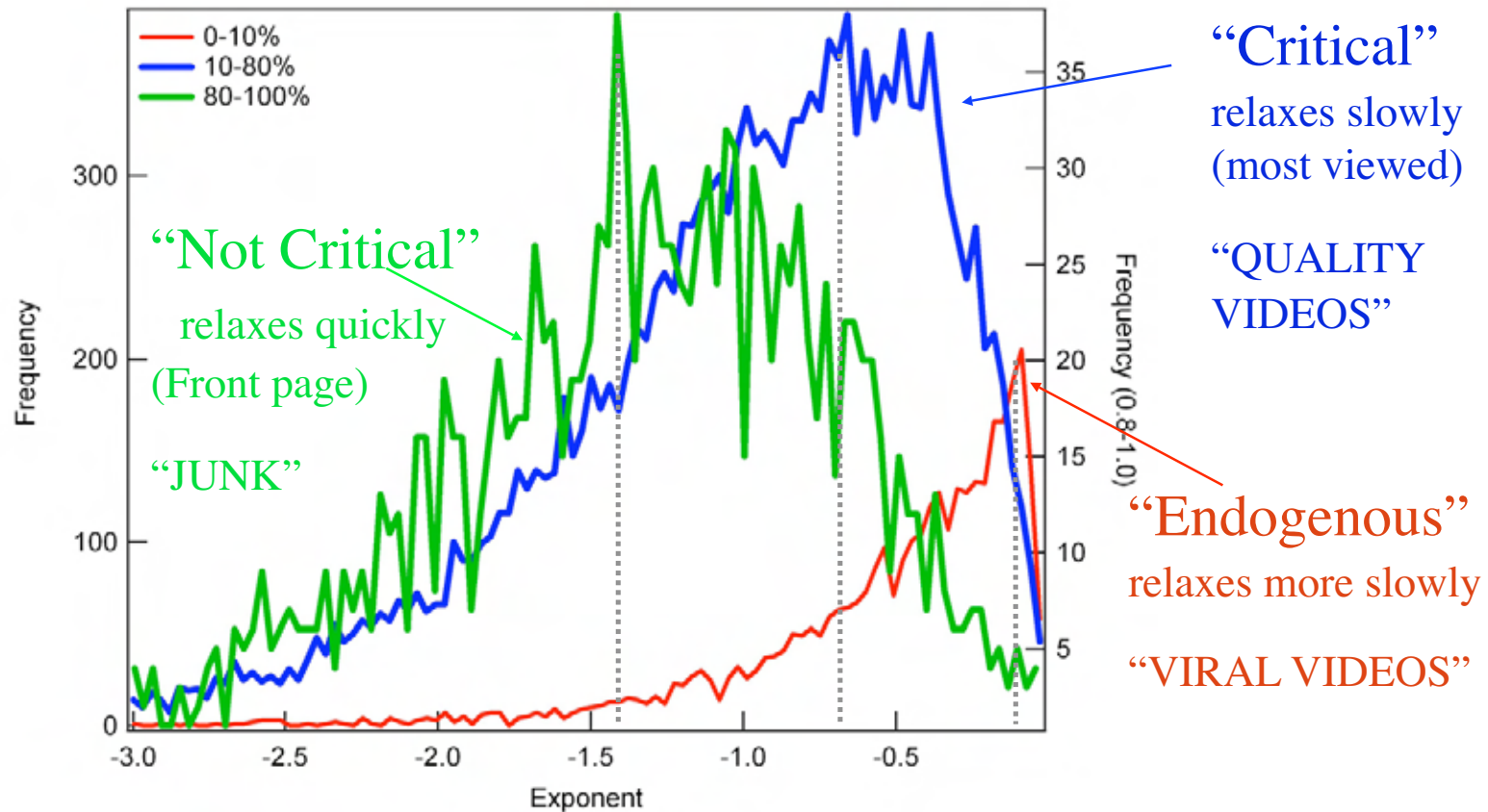
“Critical/Endo”

Fraction ~ 1%





# Exponent – Shock as Fraction of Total Peak Height



	Endogenous	Exogenous
Foreshock (or growth)	$S(t) \propto \frac{1}{ t ^{1-2\theta}}$	Abrupt peak
Aftershock (or decay)	$S(t) \propto \frac{1}{t^{1-2\theta}}$	$S(t) \propto \frac{1}{t^{1-\theta}}$

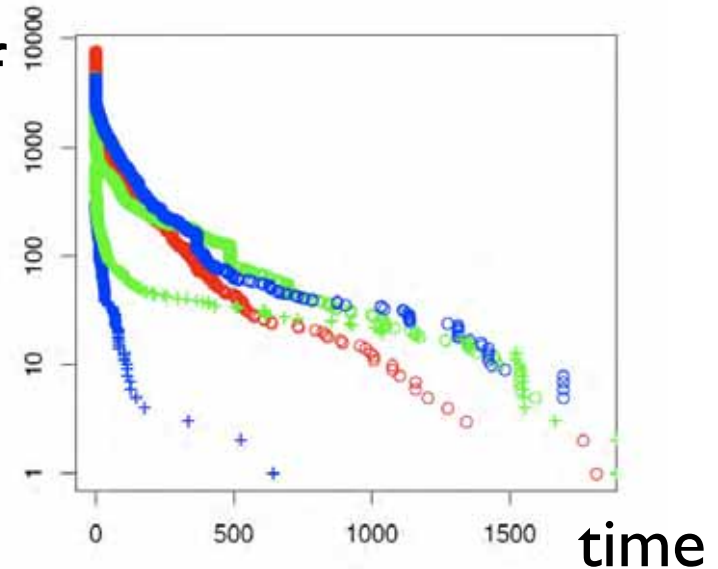
Non-critical:  $S(t) \propto \frac{1}{t^{1+\theta}}$

# Software vulnerability dynamics

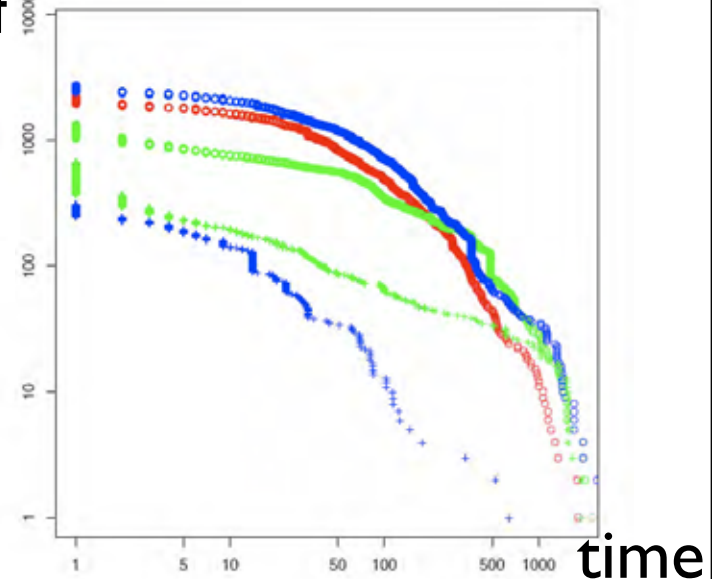
with S. Frei and T. Maillart (ETH Zurich)

- vulnerability process is a good proxy of software resilience to bugs
- we identify 4 steps in vulnerability process:
  1. discovery (red)
  2. exploit (green)
  3. public disclosure (time reference)
  4. patch release (blue)
- exploits and patch can appear before disclosure (crosses) or after (circles)
- once again, response distribution in this process is heavily tailed
- very characteristic is the distribution of exploits (before disclosure, green crosses) which shows some patterns of power-law with phase transition, in lower tail

ccdf

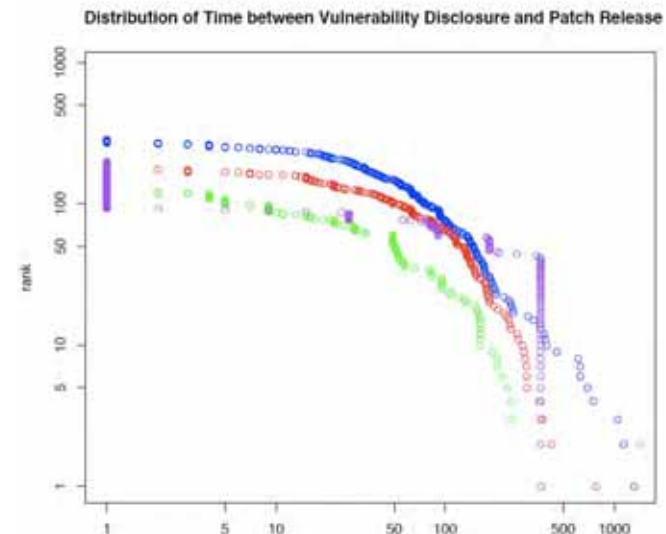
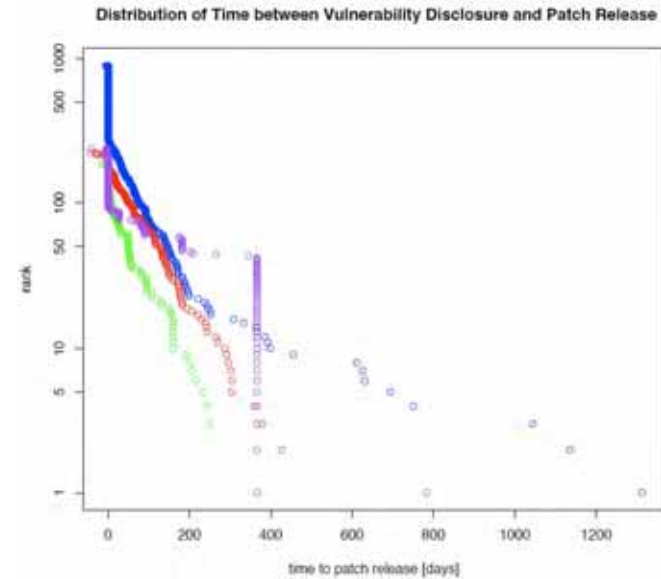


ccdf



# Software vulnerability dynamics

- Here we show comparison between types of softwares:
  - Microsoft (blue)
  - Linux (red)
  - Oracle (purple)
  - Mozilla (green)
- We can see that time to patch distribution is also heavily tailed.
- While it varies differently according to considered software the allure remains somehow the similar, especially when we consider Microsoft (blue) and Linux (red).



# Application to conflict early warning

with P. Meier (Tufts Univ., Boston) and R. Woodard (ETH Zurich)

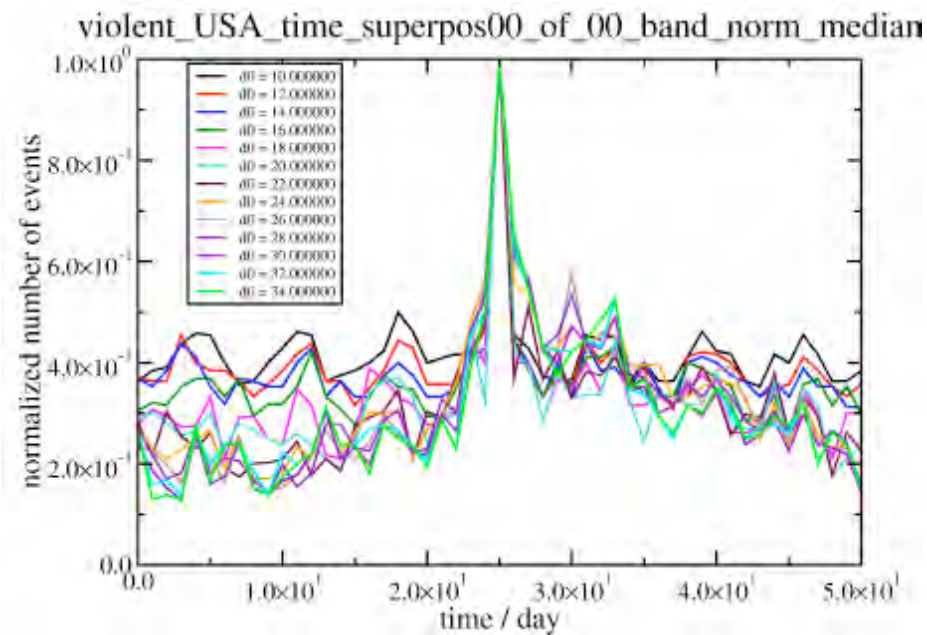
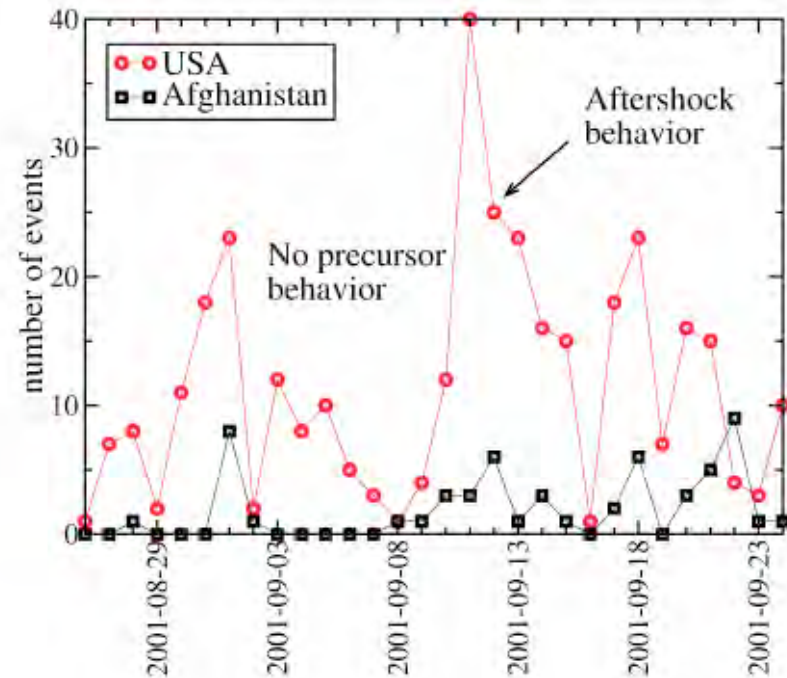
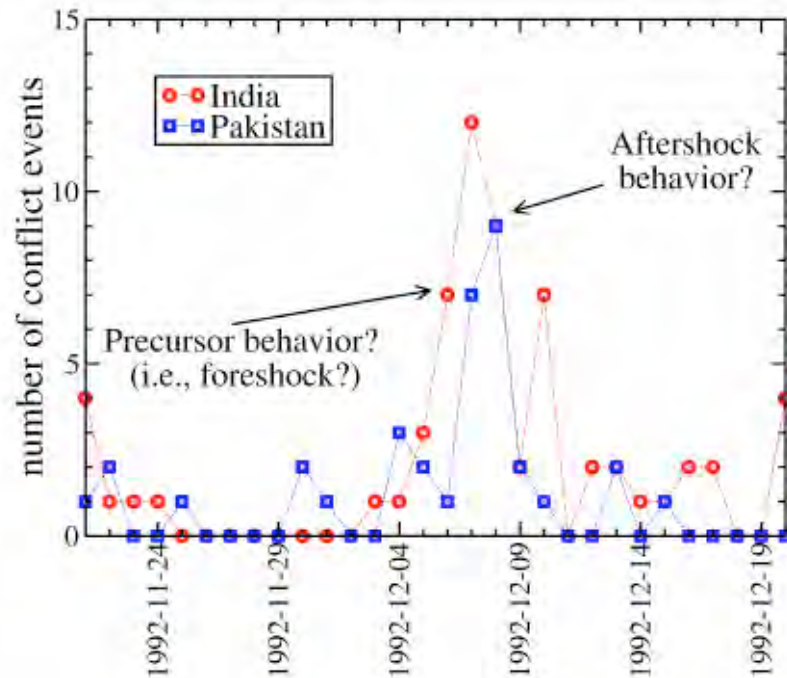
- Data extracted using Virtual Research Associates, Inc. (VRA) Reader <http://www.vranet.com>
- Software parses Reuters Business Briefing newswire
- Database of *source* and *target* actors, *type of event*
- 157 event types, 'all' countries, aggregated into *conflict* and *cooperation* time series, 1990-2005

## 24 conflict event types

Abduction	Armed actions
Armed battle	Arrest and detention
Artillery attack	Assassination
Beatings	Bodily punishment
Coups and mutinies	Criminal arrests
Crowd control	Force use
Hijacking	Hostage and kidnapping
Mine explosion	Missile attack
Physical assault	Political arrests
Riot	Sexual assault
Small arms attack	Suicide bombing
Torture	Vehicle bombing

## 27 cooperation event types.

Acknow. respons.	Agree to mediation
Agree to negotiate	Agree to peacekeeping
Agree to settlement	Apologize
Collaborate	Demobilize armed forces
Ease sanctions	Empathize
Engage in negotiation	Evacuate victims
Forgive	Grant asylum
Host a meeting	Improve relations
Mediate talks	Observe truce
Offer peace proposal	Offer to Negotiate
Offer to mediate	Promise to mediate
Provide shelter	Relax curfew
Request mediation	Request withdrawal or ceasefire
Travel to meet	





## Predicting the rise and fall of social and economic interactions by monitoring and modeling internet activities and commercial sales

- Books, Music, DVD,
- Electronics (audio and video, cameras and photography, software, computers and video games, cell phones. . . )
- Office
- Children and Babies
- Home and Garden (which includes pets)
- Gifts, Registries, Jewellery and Watches
- Apparel and Accessories
- Food
- Health, Personal Care, Beauty
- Sports and Outdoors
- Services (movies, restaurants, travel, cars, . . . )
- Arts and Hobbies
- Friends and Favourites

# Epileptic Seizures – Quakes of the Brain?

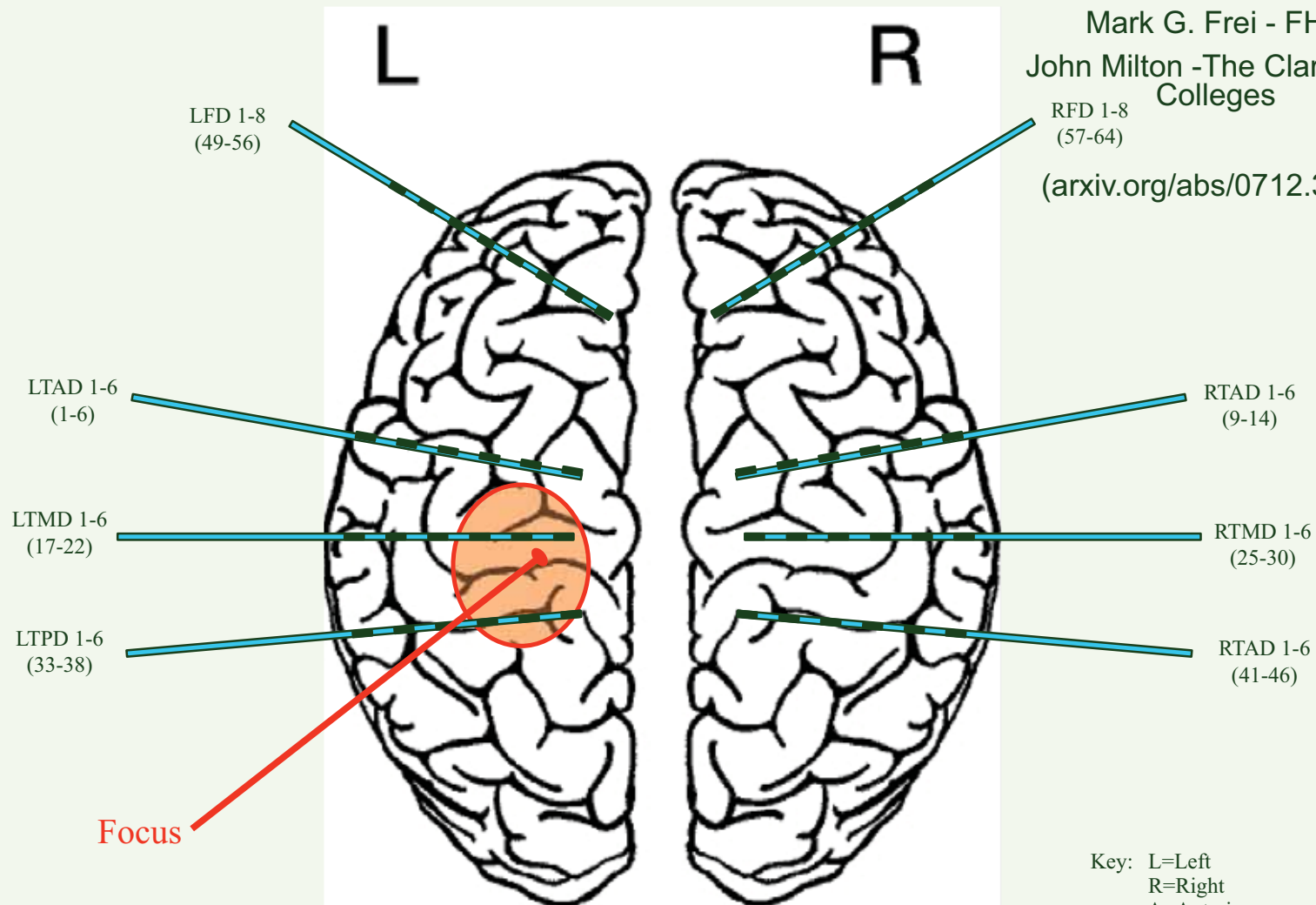
with Ivan Osorio – KUMC & FHS

Mark G. Frei - FHS

John Milton -The Claremont  
Colleges

RFD 1-8  
(57-64)

([arxiv.org/abs/0712.3929](https://arxiv.org/abs/0712.3929))

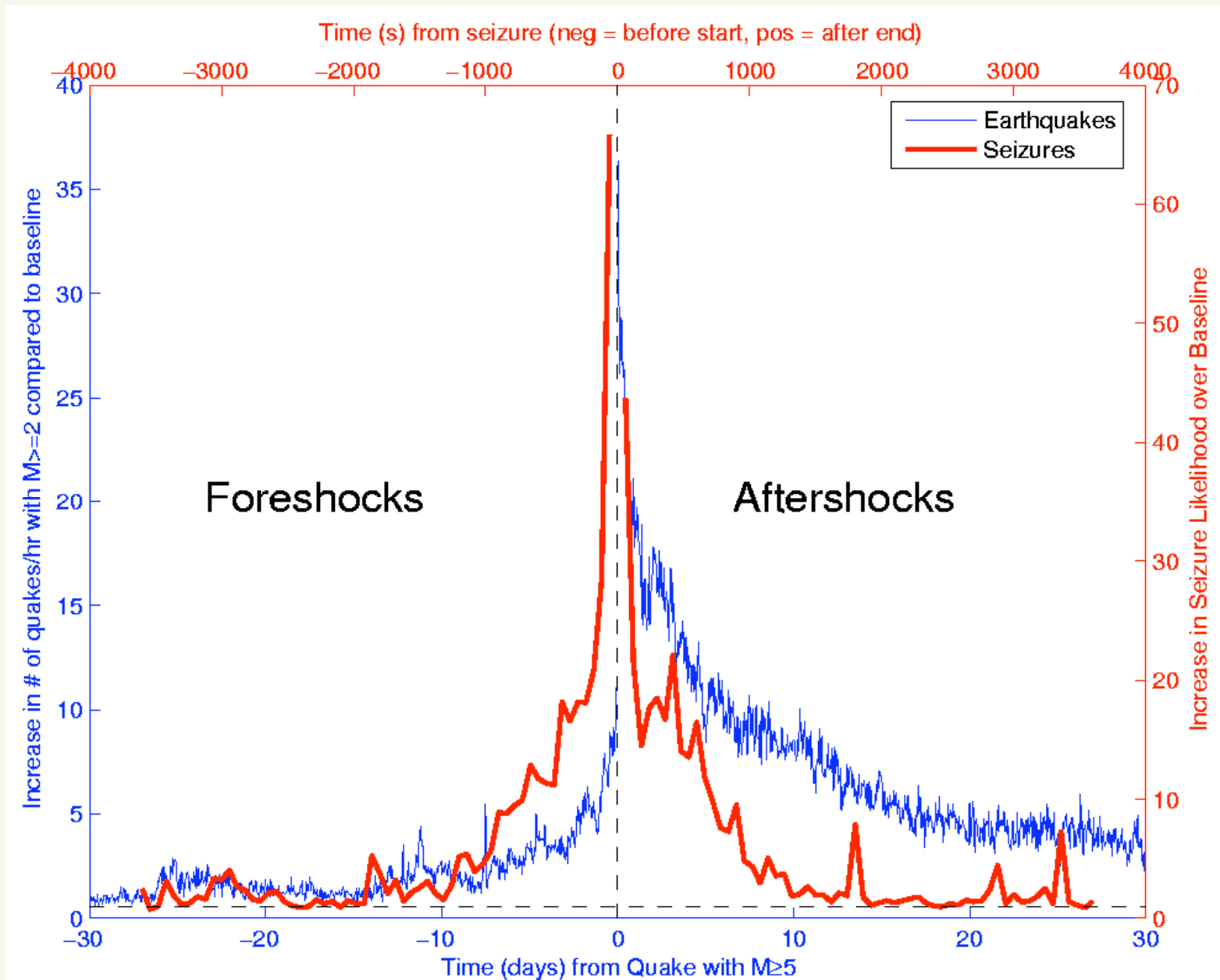


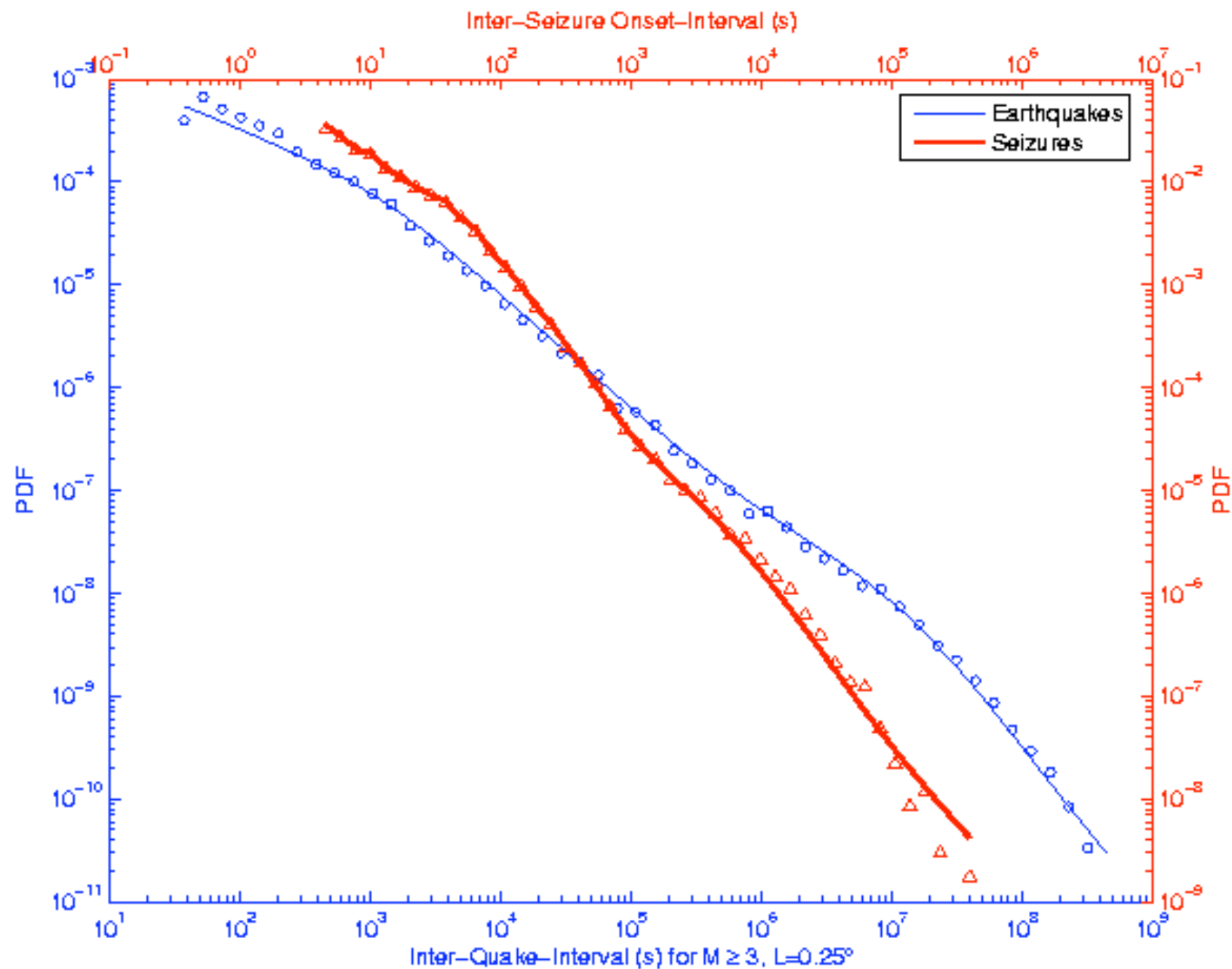
Depth Needle Electrodes Contact Numbering: N ... 3 2 1

Key: L=Left  
R=Right  
A=Anterior  
M=Mesial  
P=Posterior  
D=Depth  
T=Temporal  
F=Frontal

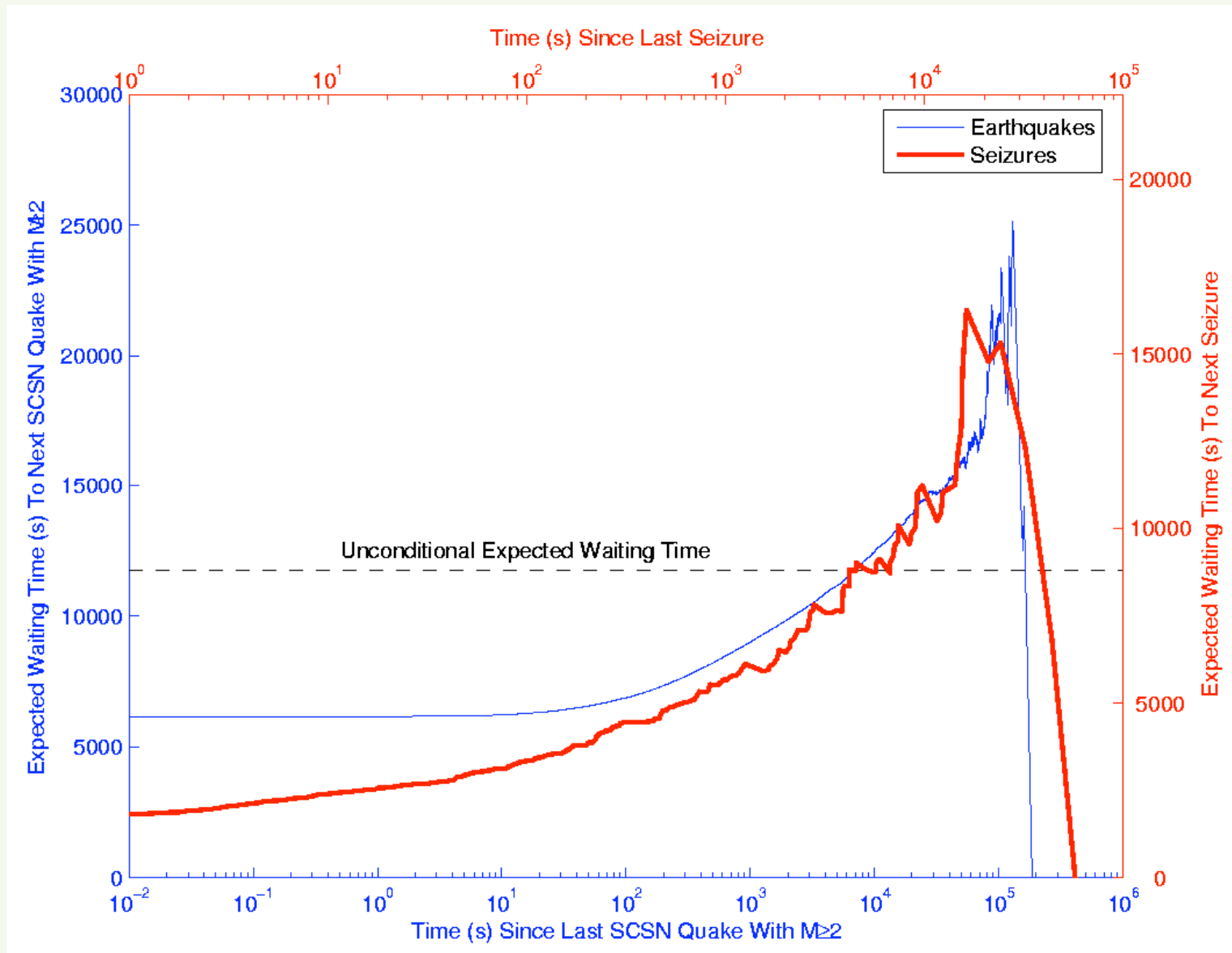


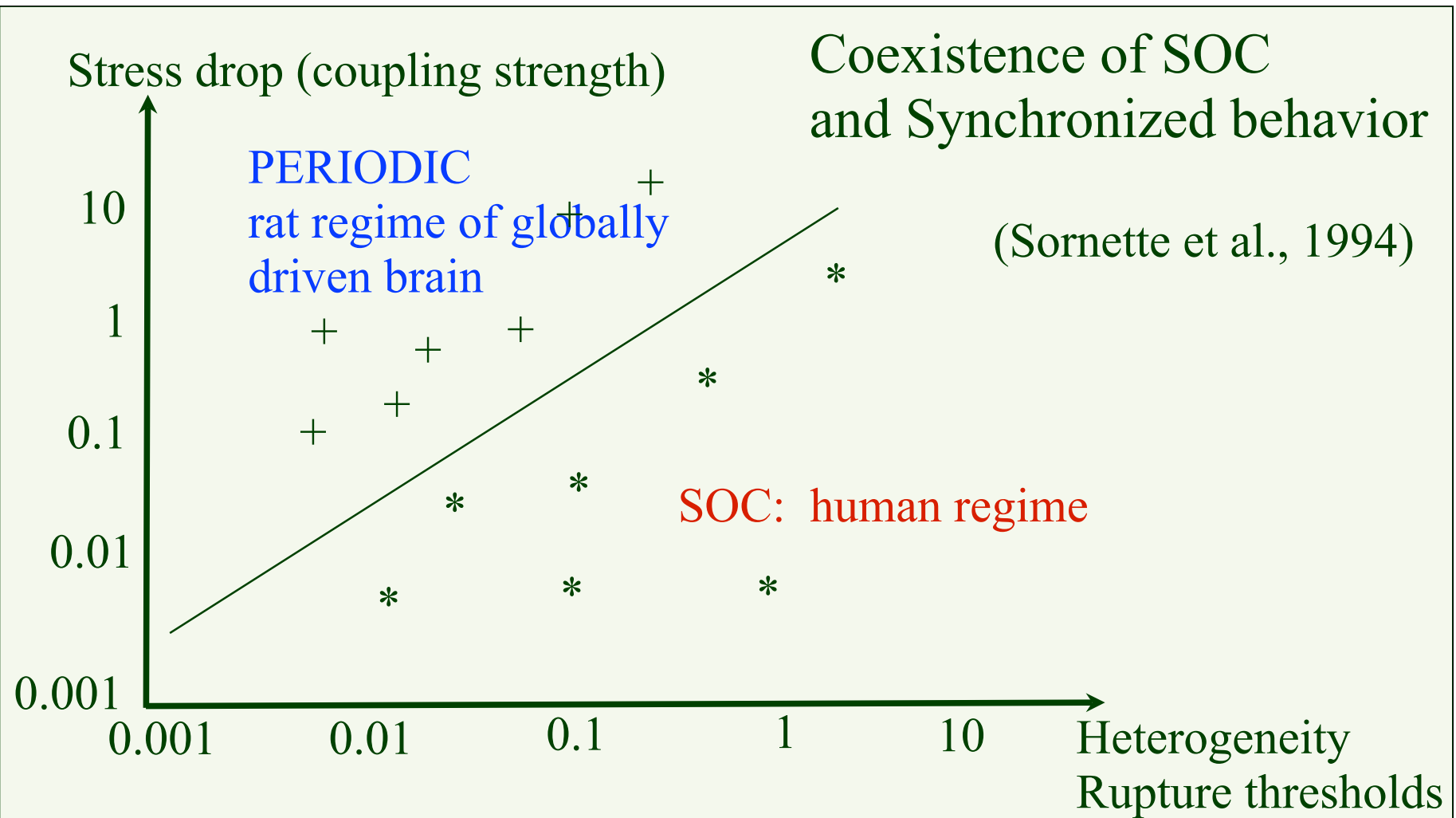
# Omori law: Direct and Inverse





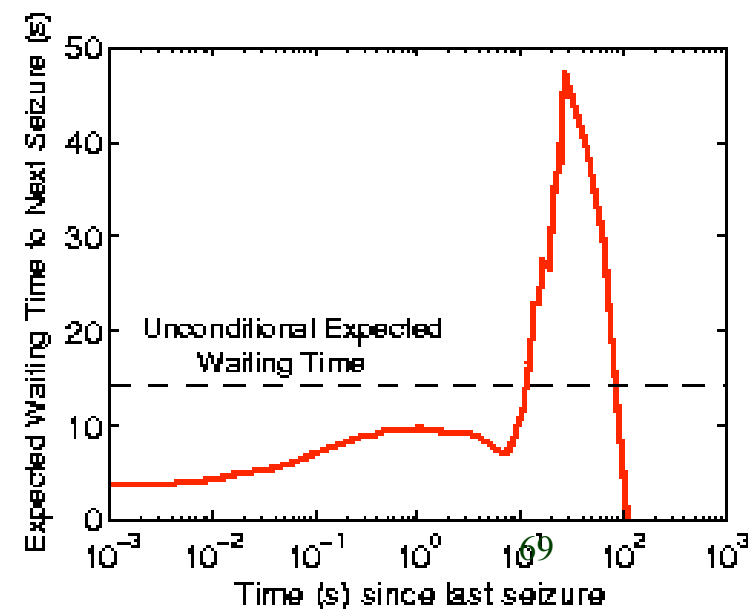
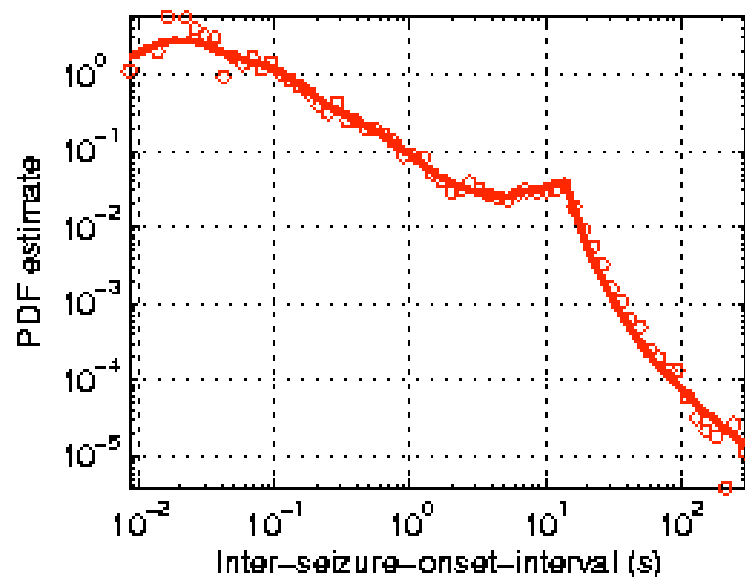
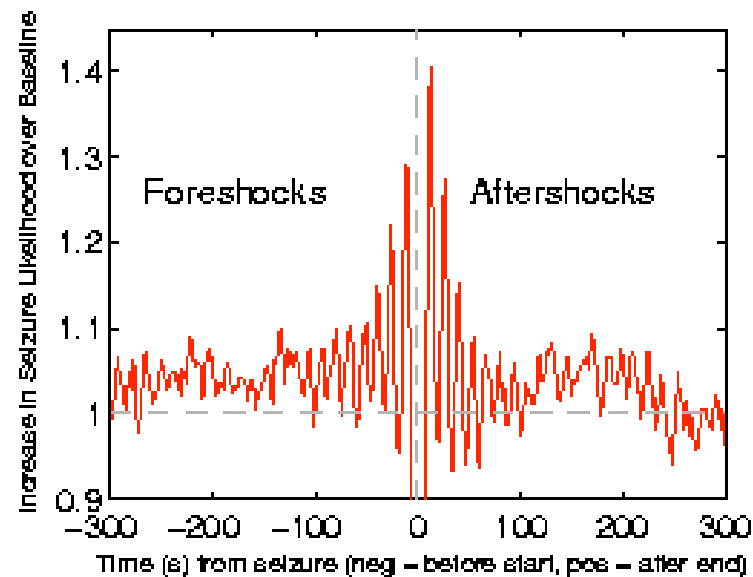
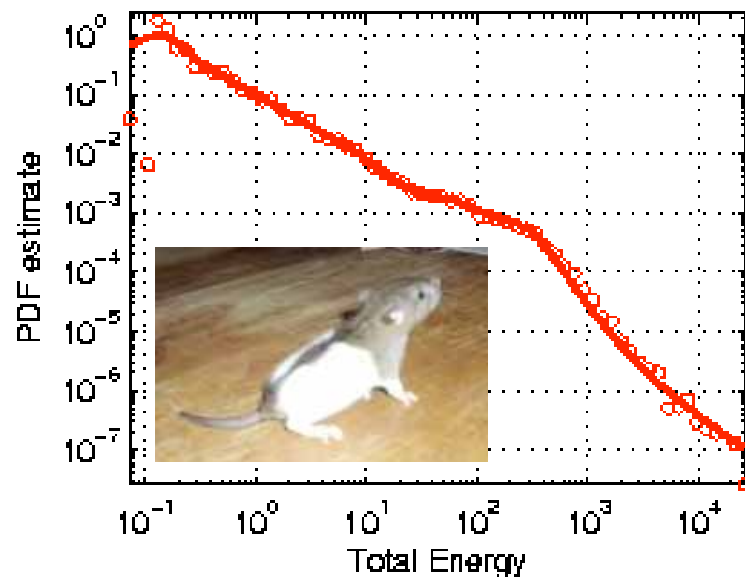
The longer it has been since the last event,  
the longer it will be since the next one! (Sornette&Knopoff, 1997)





“Phase diagram” for the model in the space (heterogeneity, stress drop).  
 Crosses (+) correspond to systems which exhibit a periodic time evolution.  
 Stars \* corresponds to systems that are self-organized critical, with a  
 Gutenberg-Richter earthquake size distribution and fault localization whose  
 geometry is well-described by the geometry of random directed polymers.

19 rats treated intravenously (2) with the convulsant 3-mercapto-proprionic acid (3-MPA)



- Ozone holes (volcanic eruptions, endo dynamics, anthropogenic forcing)
- Climate (Gaia versus shocks and various sources of forcing)

# Endogenous versus Exogenous

## Extinctions

- meteorite at the Cretaceous/Tertiary KT boundary
- volcanic eruptions (Deccan traps)
- self-organized critical events

## Financial crashes

- external shock
- self-organized instability

## Immune system

- external viral or bacterial attack
- “ internal” (dis-)organization

## Brain (learning)

- external inputs
- internal self-organization and reinforcements (role of sleep)

## Aviation industry recession

- September 11, 2001
- structural endogenous problems

## Recovery after wars?

- internally generated (civil wars)
- externally generated

## Discoveries

- serendipity
- maturation

## Volatility bursts in financial time series

- external shock
- cumulative effect of “small” news

## Earthquakes

- tectonic driving
- triggering

## Parturition

- mother/foetus triggered?
- mother-foetus complex?

## Commercial success and sales

- Ads
- epidemic network

## Social unrests

- triggering factors
- rotting of social tissue



D. Sornette

## Critical Phenomena in Natural Sciences

Chaos, Fractals,  
Selforganization and Disorder:  
Concepts and Tools

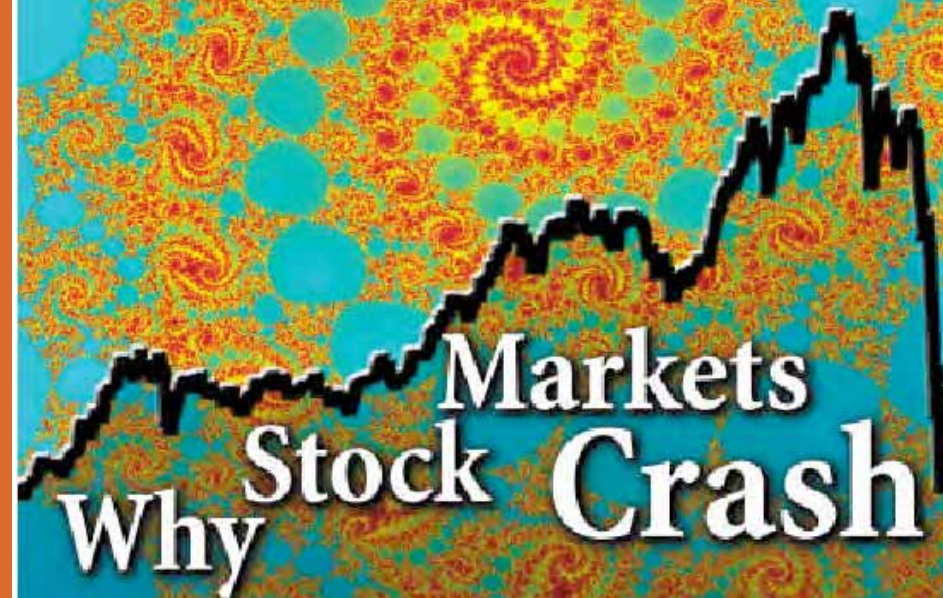
**First edition  
2000**

**Second  
enlarged edition  
2004**



**DIDIER SORNETTE**

Princeton  
University  
Press  
Jan. 2003



## Why Stock Markets Crash

Critical Events in  
Complex Financial Systems

Malevergne · Sornette



Extreme Financial Risks

Y. Malevergne  
D. Sornette

# Extreme Financial Risks

From Dependence  
to Risk Management

(November 2005)

 Springer