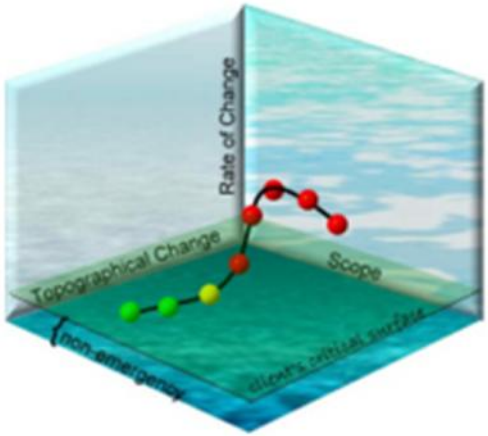
ABSTRACT

Suppose you are responsible for the allocation of resources preparing for several concurrent events. How do you determine which event amounts to an emergency or crisis? How do you compare several dissimilar crisis events to determine which one constitutes a larger disturbance? How do you distinguish between events that are real emergencies and non-emergency events hyped by interested parties such as politicians, lobbyist and the media?



The Unified Localizable Emergency Scale is a means to measure any type of crisis, at the metropolitan level and up. The scale makes it possible to define exactly what event amounts to a disaster, and provides a preliminary theoretical framework along with a proof-of-concept implementation. The theoretical framework is expressed as a mathematical model. In addition to the common measures of monetary loss and number of death, several fundamental economic and social factors (e.g., vulnerability, resilience and the collapse of society) are embedded in the model, a feature that makes the model unique and apparently more accurate. These parameters give the model the necessary flexibility to be localized to specific clientele.

Decision Makers

Homeland Wellbeing

FAMINE

משרד האוצר

Ministry of Finance

FEMA Regions

Unified Localizable Emergency Scale

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Presentation Components

Information Processing Under threat

Crisis Quantification Attempts

Unified Localizable Emergency Scale

Mathematical Modeling

Information Systems

What is an Emergency

FEMA lists events rather than define what it is.

- Chemical Emergencies
- Dam Failure
- Earthquake
- Fire or Wildfire
- Flood
- Hazardous Material
- Heat
- Hurricane
- Landslide
- Nuclear Power Plant Emergency
- Terrorism
- Thunderstorm
- Tornado
- Tsunami
- Volcano
- Wildfire
- Winter Storm

Source: http://www.fema.gov/hazard/types.shtm

But what about…

- **Financial markets meltdown**
- **Epidemic / pandemic**
- **Massive thefts**
- **Cyber attack, historic relics destruction, etc…**

Organizational emergencies

- Strike
- Court Case
- Cost overrun
- Delivery delay
- New regulation
- Supply shortage
- Production delay
- Product malfunction
- Contract Negotiation
- Loss of a key customer
- Responding to an RFP
- Loss of key employee(s)
- New Competitive product

What is an Emergency

- A prevalent definition is Hermann's (1963) classification in which a crisis is said to occur when three conditions are present:

  (1) there is a major threat to system survival;

  (2) there is little time to react;

  (3) the threat (timing) is unanticipated.

Hermann, Charles F.(1963)
Some consequences of crisis which limit the viability of organizations.
Administrative Science Quarterly, 8: 343-358.

Information Processing under Threat

- A threat results in a restriction of the number of alternatives considered by policy makers
  - Snyder and Paige, 1958
  - North et al., 1963
  - Holsti, 1964.
- Fewer sources of information are consulted in a crisis
  - Smart and Vertinsky 1977
- Organizations facing adversity were more likely to limit information processing
  - D'Aveni & MacMillan, 1990

Information Processing under Threat

- Threat Rigidity Effects in Organizational Behavior (Staw 1981)

Information Processing under Threat

- External threat results in the simplification of cognition and language used.
  - (Lasswell et al 1949)
  - (Suedfeld and Tetlock 1977)

Ambiguity Avoidance and Uncertainty

- People are averse to ambiguity and prefer to bet on known probabilities over unknown probabilities.
- Ambiguity aversion is stronger in comparative contexts rather than in non-comparative contexts
  - Rubaltelli et. al 2010

Information Systems for Crisis Management

- *The priority problem of the moment is the magnet that gathers the data, information, people, and resources to deal with it*
- ***The integration of qualitative and quantitative information with measures of timeliness, confidence and priority is critical***
- Having pre-established existing communities of people and resources to draw upon
- Knowing who and what is available in real time
- Learning from each experience and modifying lore for the future
  - **Turoff 2006**

Information Systems for Crisis Management

- Reduce information overload
  - Provide targeted concise information
  - Provide support for decisions
  - Provide expert information
- Reduce ambiguity
- Improve communications
- Help create trust among newly introduced responders

Unified Localizable Emergency Scale

Eli Rohn and Denis Blackmore (2009)
A Unified Localizable Emergency Events Scale
The Int'l Journal of Information Systems for Crisis Response Management (IJISCRAM)
Volume 1, Issue 4, October 2009

Assertion

- A standard objective emergency scale is vital to quantify and unambiguously communicate the nature of any emergency.

The Problem

- **No objectively measurable emergency scale existed to date**
  - 1805: The Beaufort Wind Scale
  - 1931: Modified Mercalli Intensity Scale
  - 1935: Richter Scales
  - 1969: Saffir-Simpson Hurricane Scale
  - 1971: The Fujita Tornado Scale
  - 1999: Air-Quality Index
  - 2001: US Security Terror Alert Scale

Key Findings from Prior Research

- Any emergency can be defined using three orthogonal dimensions:
  - **S**cope
  - **T**opographical change (or lack thereof)
  - **D**elta, the rate of change.
- The intersection of the three dimensions provides a detailed scale for defining emergencies.

Scope

- A continuous variable with a lower limit of zero and a theoretical calculable upper limit.
- We use two parameters that form the scope:
  - percent of affected humans out of the entire population
  - damages, or loss, as a percentile of a given Gross National Product (GNP)

Scope, formalized

$$RawScope = \left(\frac{Victims}{Population} + \frac{¢ * Monetary\ Losses}{GNP} \right)^{\left[\frac{\ln(victims)}{\ln(losses)} \right]}$$

Topographical Change

- A measurable and noticeable change in land characteristics, in terms of elevation, slope, orientation and land coverage.

- Pseudo-Topo
  - Volume or area affected by the emergency (e.g., SARS or SWINE flu)

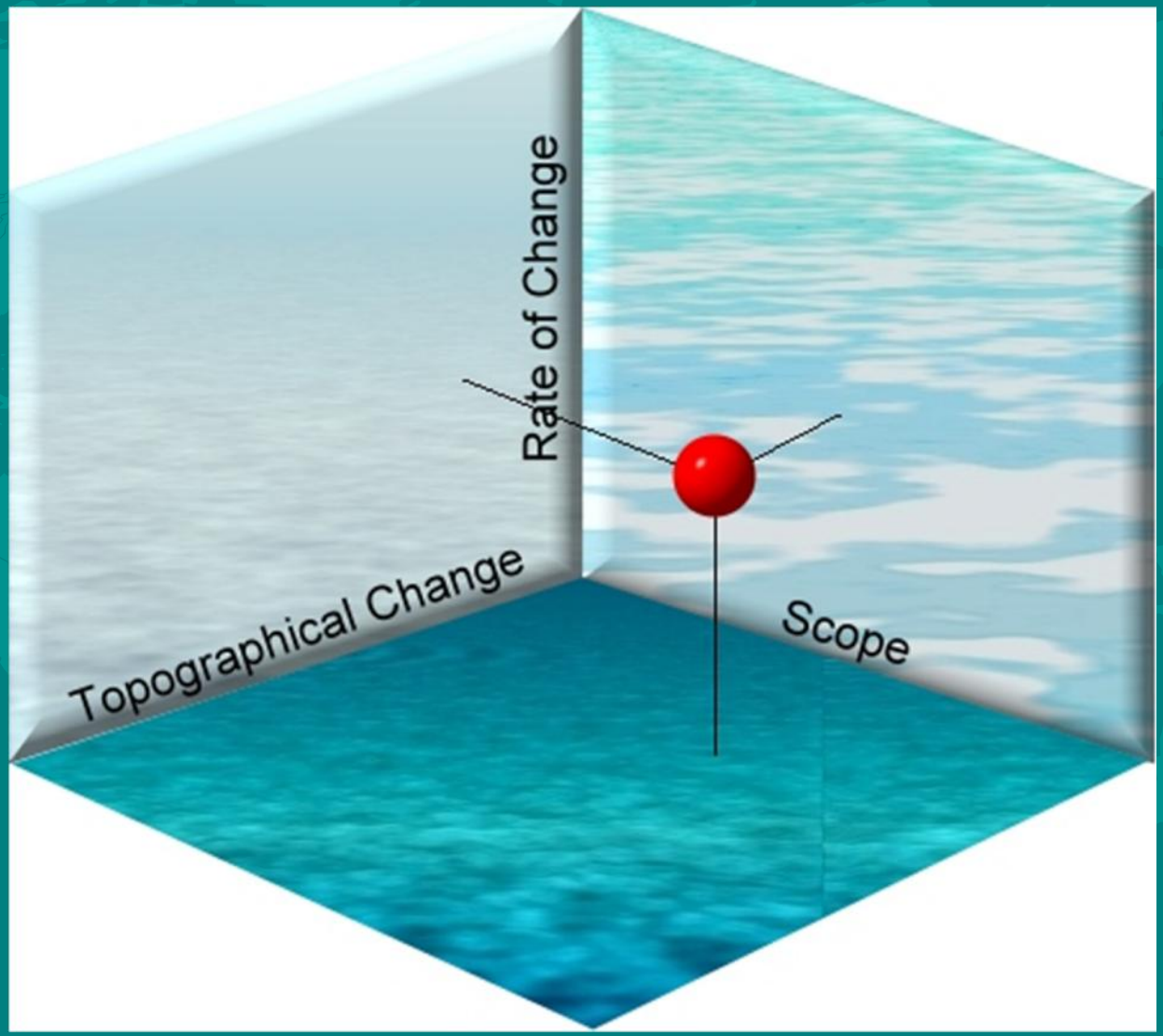
Topographical Change

- Continuum ranging between 0 and 1
- Estimated visual fractional change in the environment.
  - The ratio between the geographical volume occupied before the disaster and the volume occupied after the disaster, in relation to sea level.

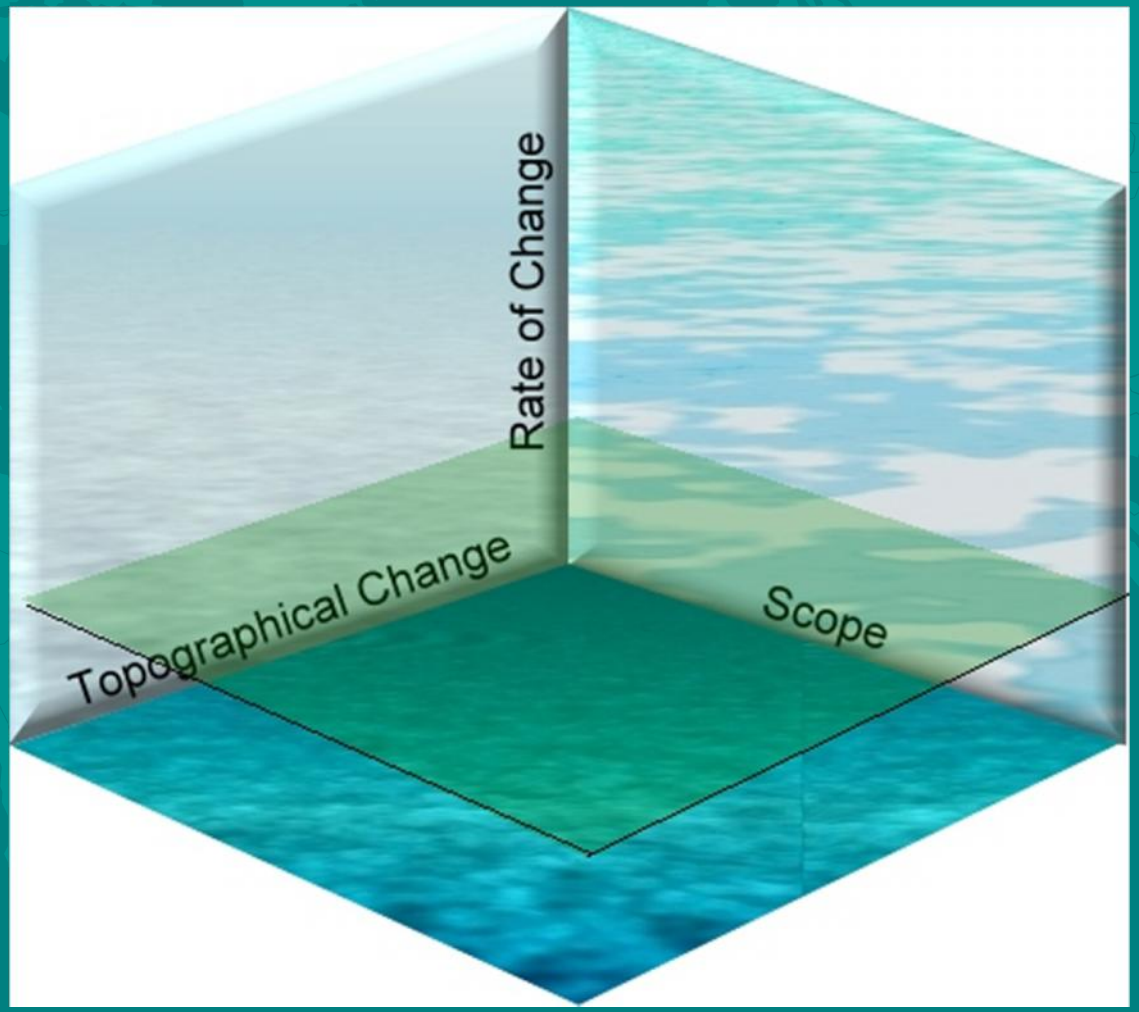
Rate of Change

- Measures the rate of departure from a given environment in a given time.
- We are interested in calculating:
  - Δ victims / Δ time and
  - Δ losses / Δ time
- Possible to calculate critical points and singular points using derivates to identify trend changes and their magnitude or speed.

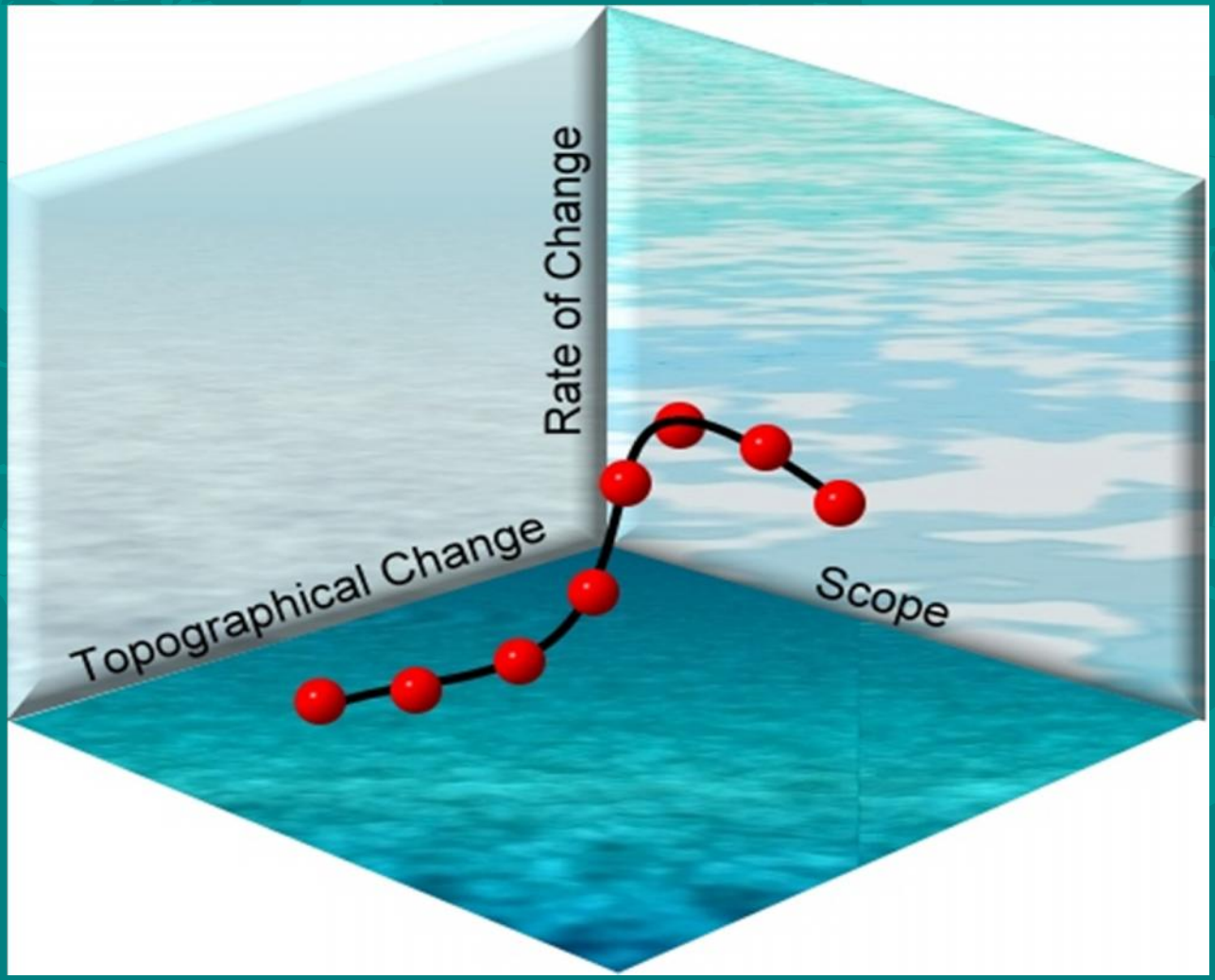
E = f(s,t,d)



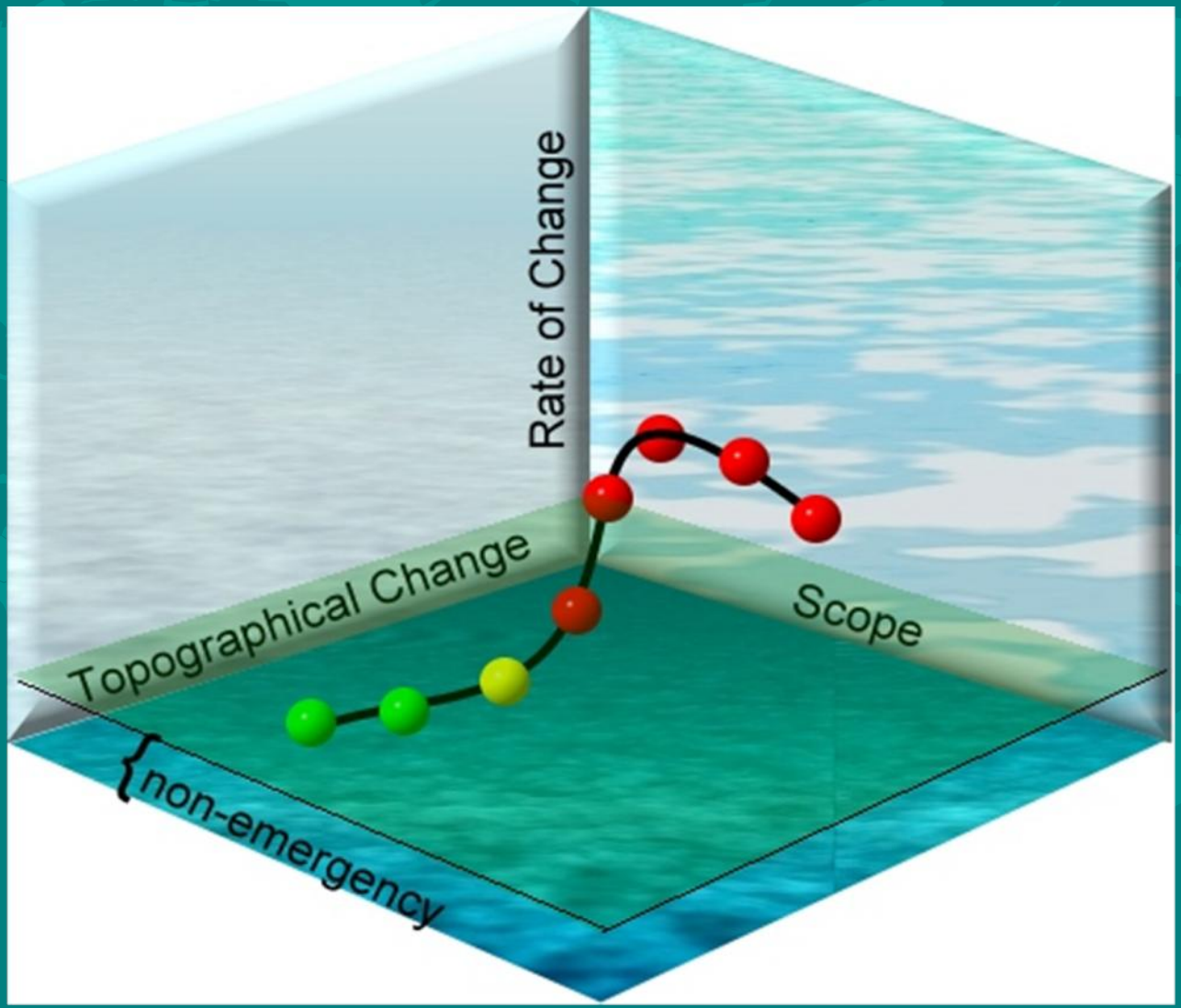
Emergency Critical Surface



Dynamics



Dynamics with Critical Surface



Usage Example

California Automobile Accidents (threshold)

Swine (H1N1) Flu 2009 (emergency)

Swine Flu (H1N1) in California and US

			SICK	
Day	Date	State	Cummulative	New
Tuesday	2009-04-21	California	5	5
Wednesda	2009-04-22	California	5	0
Thursday	2009-04-23	California	5	0
Friday	2009-04-24	California	6	1
Saturday	2009-04-25	California	7	1
Sunday	2009-04-26	California	7	0
Monday	2009-04-27	California	7	0
Tuesday	2009-04-28	California	10	3
Wednesda	2009-04-29	California	14	4
Thursday	2009-04-30	California	14	0
Friday	2009-05-01	California	13	-1
Saturday	2009-05-02	California	13	0
Sunday	2009-05-03	California	26	13

California

H1N1 FLU Data				
Day	Date	New Sick	Hospitalized	New Dead
יום שלישי	2009-04-21	0	0	0
יום רביעי	2009-04-22	21	0	0
יום חמישי	2009-04-23	1	0	0
יום שישי	2009-04-24	1	-1	0
שבת	2009-04-25	2	0	0
יום ראשון	2009-04-26	0	0	0
יום שני	2009-04-27	-1	0	0
יום שלישי	2009-04-28	-1	1	0
יום רביעי	2009-04-29	1	-1	1
יום חמישי	2009-04-30	0	0	0
יום שישי	2009-05-01	43	0	0
Saturday	2009-05-02	NO DATA	0	0
Sunday	2009-05-03	72	0	0

USA data

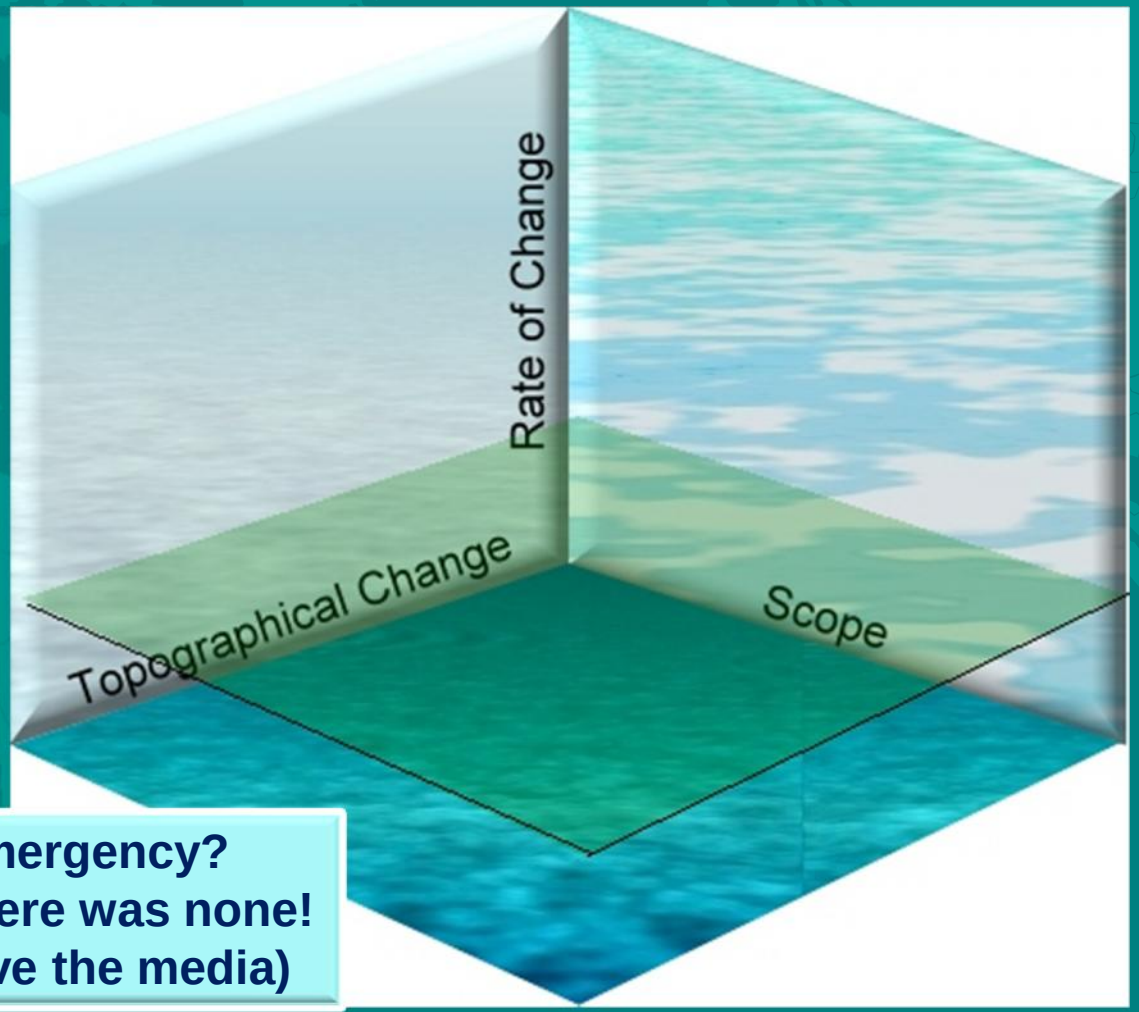
Data collected from official CDC website

Automobile Accidents in California

Day	Date	State	SICK Cummulative	SICK New
Tuesday	2009-04-21	California	5	5
Wednesda	2009-04-22	California	5	0
Thursday	2009-04-23	California	5	0
Friday	2009-04-24	California	6	1
Saturday	2009-04-25	California	7	1
Sunday	2009-04-26	California	7	0
Monday	2009-04-27	California	7	0
Tuesday	2009-04-28	California	10	3
Wednesda	2009-04-29	California	14	4
Thursday	2009-04-30	California	14	0
Friday	2009-05-01	California	13	-1
Saturday	2009-05-02	California	13	0
Sunday	2009-05-03	California	26	13

CA Auto Accidents		
Dead	Injured	Cummu-lative
7	733	7
14	689	21
9	628	30
6	680	36
11	679	47
8	707	55
13	933	68
14	868	82
11	744	93
16	686	109
4	761	113
11	692	124
13	773	137

CA H1N1 on the Emergency Scale



Cannot see the emergency?
That's because there was none!
(Unless you believe the media)

Swine Flu (H1N1) in US Media

U.S. report predicts 30000 to 90000 **H1N1 deaths** - USATODAY.com
24 Aug 2009 ... The global flu pandemic expected to return to the USA this fall is likely to infect as much as half the US population, flooding hospitals ...
www.usatoday.com/.../2009-08-24-swine-flu-vaccine_N.htm - Cached - Similar

H1N1 death toll estimated at 3900 in U.S. - CNN.com
12 Nov 2009 ... Nearly 3900 people, including about 540 children, are believed to have died from the **H1N1** flu in the first six months of the epidemic, ...
www.cnn.com/2009/HEALTH/11/.../**h1n1**...**deaths**/index.html - Cached - Similar

H1N1 Deaths Appear To Triple Overnight - ABC News
12 Nov 2009 ... The Centers for Disease Control and Prevention is revising its estimates for the total number of **deaths** caused by swine flu.

Swine Flu (H1N1) in the US Media

H1N1 death toll estimated at 3900 in U.S. - CNN.com

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U.S. Influenza-associated Pediatric Mortality

Posted May 28, 2010 (Updated Weekly)

Data reported to CDC by May 22, 2010

Date Reported	Laboratory-Confirmed 2009 H1N1 Influenza Pediatric Deaths	Laboratory-Confirmed Influenza A Subtype Unknown Pediatric Deaths	Laboratory-Confirmed Seasonal Influenza	Total
This Week (Week 20, May 16- May 22, 2010)	3	0	0	3
Since August 30, 2009	[illegible]	50	1	276
Cumulative since April 26, 2009	285	53	3	341

This table is based on data reported to CDC through the Influenza-Associated Pediatric Mortality Surveillance System. Influenza-associated deaths in children (persons less than 18 years) was added as nationally notifiable condition in 2004.

For more information about influenza-associated pediatric mortality, see FluView.

http://www.cdc.gov/h1n1flu/updates/us/#totalcases

Swine Flu Numbers: Use and Abuse

- For surveys where people reported having the flu, “we made the assumption that all of those had H1N1 flu”
  - Marc Lipsitch, an epidemiologist at the Harvard School of Public Health
    - Wall Street Journal, 22 Jan 2010

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Swine Flu Numbers: Use and Abuse

H1N1 virus' **death** toll as high as 17000, CDC estimates - CNN.com
12 Feb 2010 **...** The **H1N1** virus, also known as swine flu, may have killed as many as 17000 Americans, according to new estimates by the Centers for Disease **...**
www.cnn.com/2010/HEALTH/02/.../**h1n1**.**deaths**/index.html - Cached - Similar

- The proportion of deaths attributed to pneumonia and influenza (P&I) based on the 122 Cities Report is at about what is normally seen during the summer.
  - CDC 28 May 2010

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Future Research

Near Future

- Engineering
  - Re-written Emergency Scale web based application for public use
  - Validation and fine tuning of the model using data from many more various past disasters.
- Collaborative Research
  - Develop a measurable parameter for economical resilience
  - Develop a measurable upper limit for social breakdown

Future Research: Dynamic Critical Surface

- A flat uniform critical surface is naïve.
- Resilience and ability to cope are dynamic and depend, among other things, on the magnitude of the crisis.

Distant Future Research: Energy Units

- Assertion:
  - The magnitude of an emergency can be translated into units of energy. E.g.,
    - It takes א amount of energy to manufacture a brick
    - It takes ב energy to lay bricks and build a wall
    - It takes ג energy to remove 1 ton of debris
    - etc.
  - The new sought-after systems equilibrium can be expressed in “required energy” terms.

Q & A