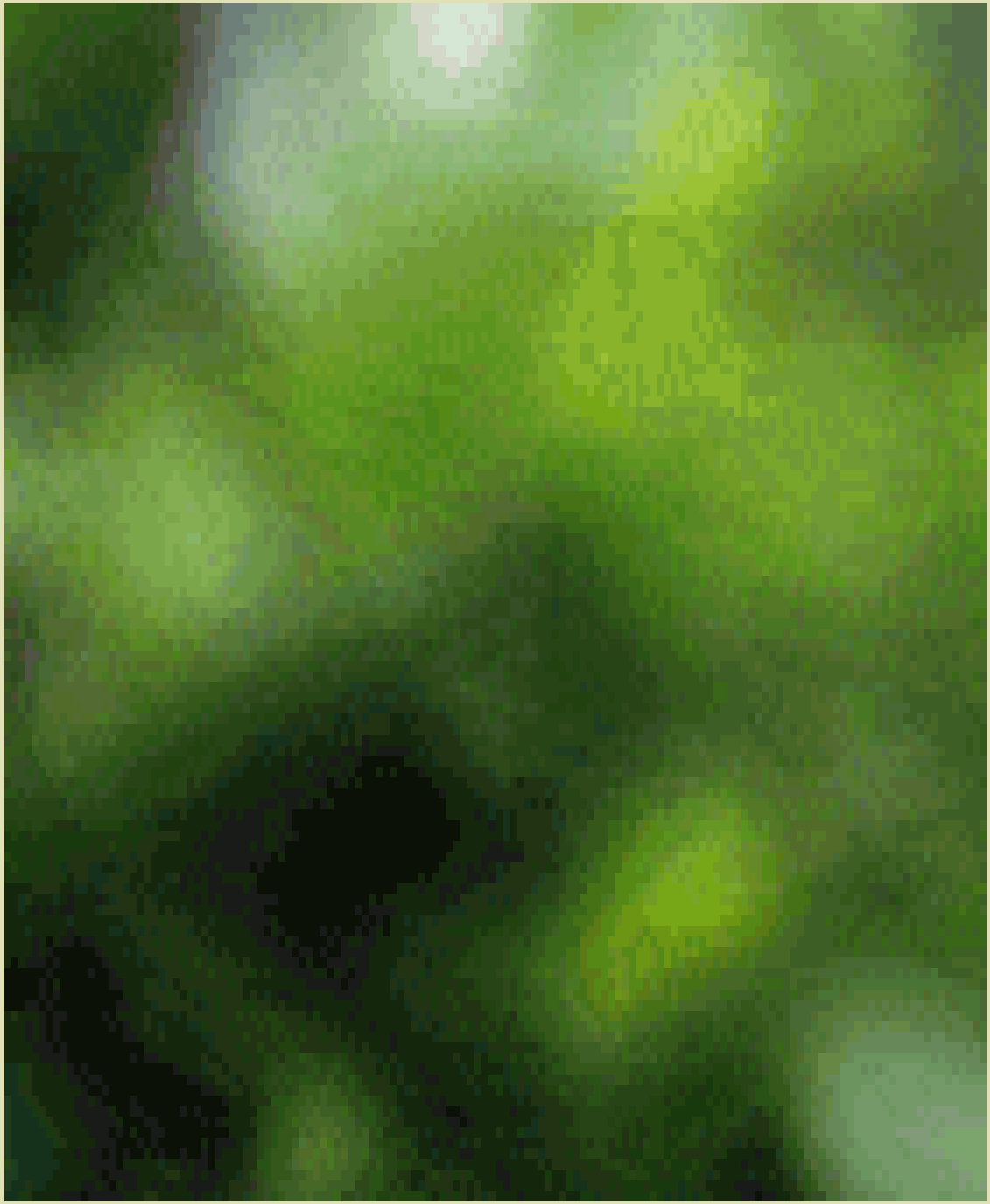


NATURAL HAZARDS AND CLIMATE CHANGE

RISK MANAGEMENT TO FACE THEM

Sergio Mora

DISASTERS, HAZARDS, VULNERABILITY AND RISK

- Disasters are the effect of mismanaged risk
- Risk is not only associated with the occurrence of intense natural processes -hazards- but also with the vulnerability generated by human activity and ways of life:

Hazard * Vulnerability = Risk

$$\int_a p(H)\,da * \int_d p(V)\,da = \int_{a,d} p(R)\,da$$

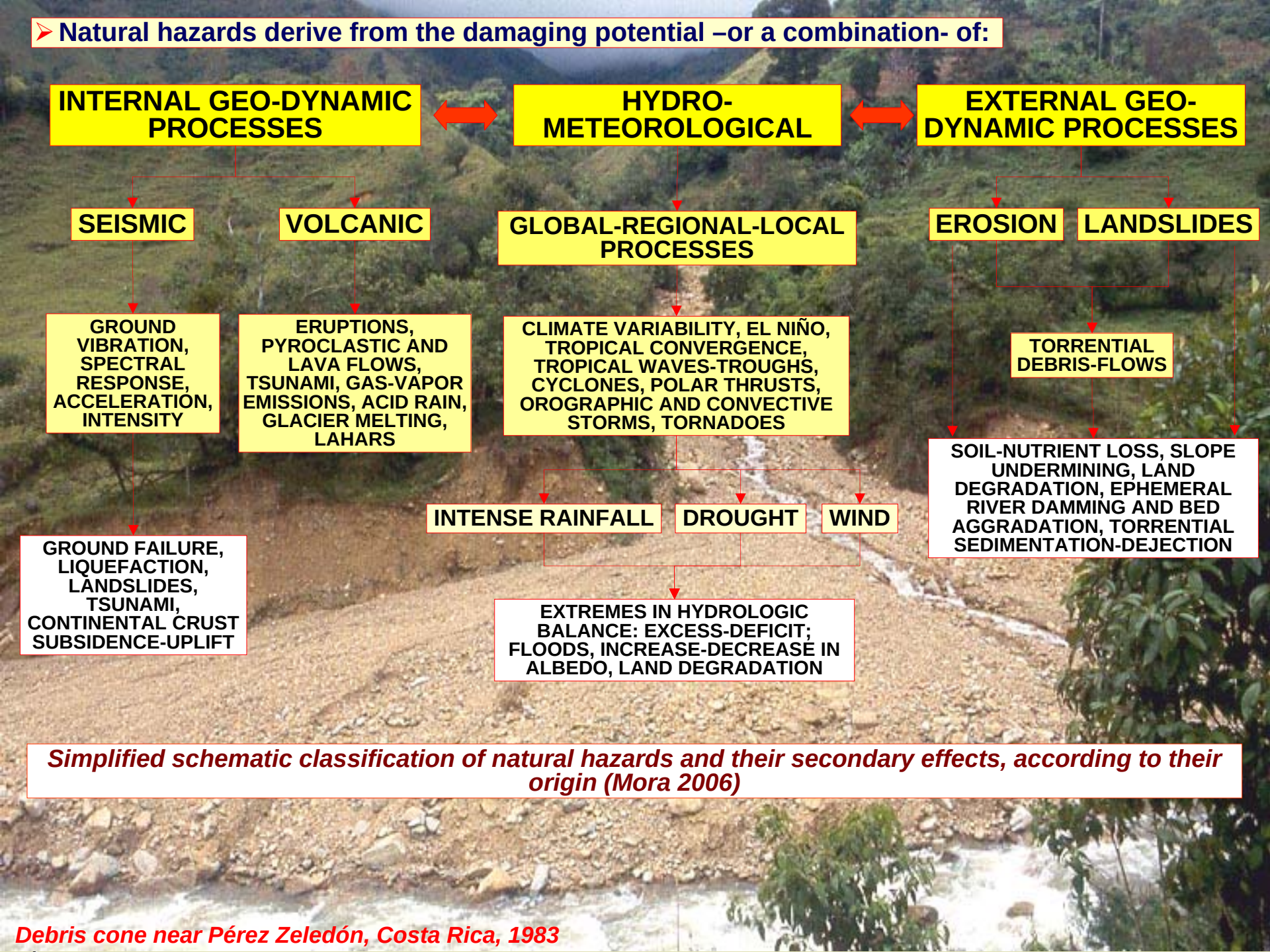
H= hazard; V= vulnerability; R= risk; * = Convolutive function

Intensity of hazard (a) and its damaging potential (d): Functions of accumulated distribution

- Natural hazards (H): Probability that an event becomes so intense (a) within time and space, to produce significant damage
- Vulnerability (V): Probability that, according to the intensity of the event, damage (d) might occur, as a function of the degrees of exposure + fragility of the elements involved
- Risk (R): Combined probability (convolution, *) that an intense (a) hazard (H) might cause severe damage (d), according to the vulnerability involved (V).

LANDSLIDE HAZARD → VULNERABILITY → UNMANAGED RISK → DISASTER

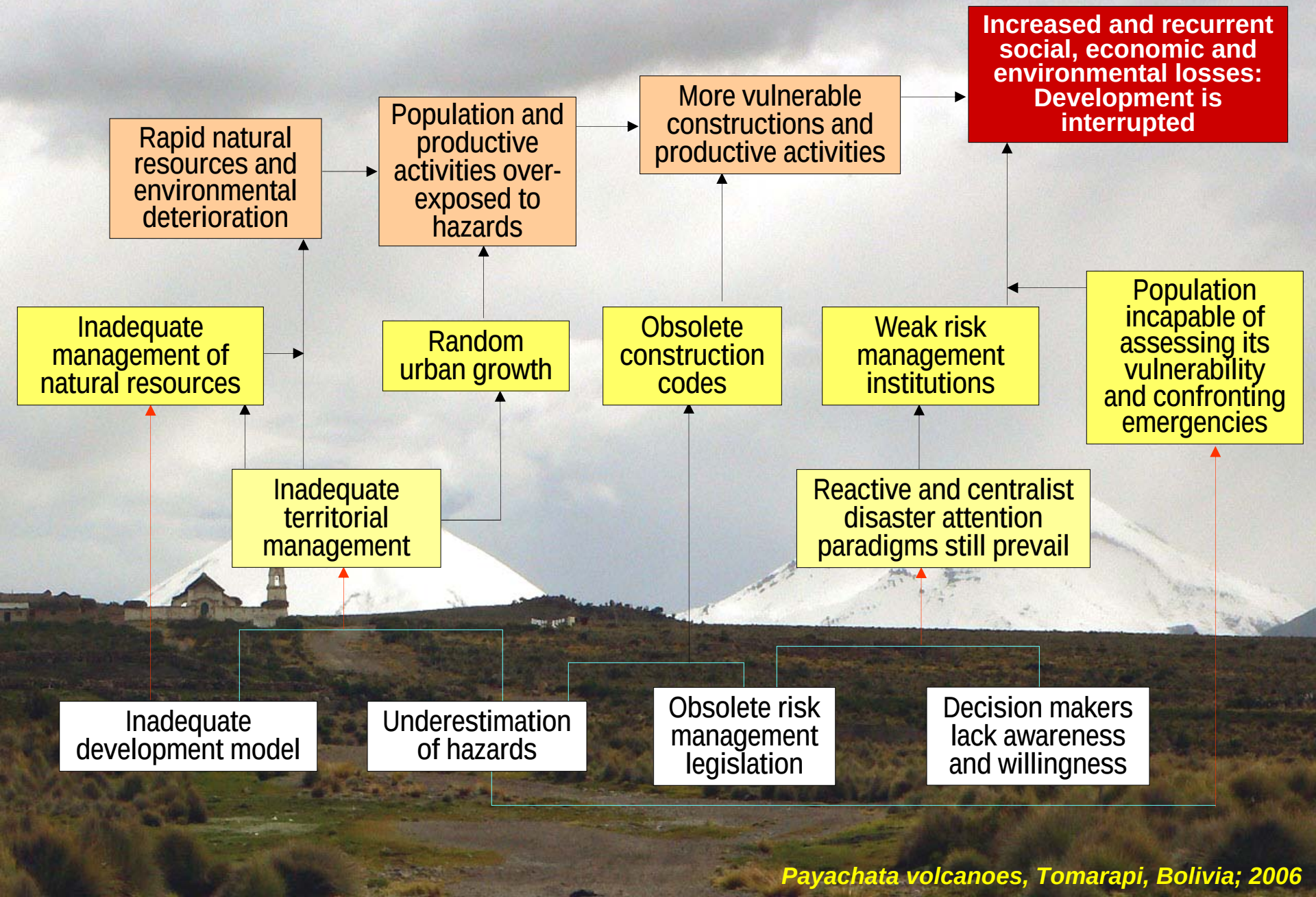
S.Mora



Simplified schematic classification of natural hazards and their secondary effects, according to their origin (Mora 2006)

Debris cone near Pérez Zeledón, Costa Rica, 1983

A problem tree illustrating the most common aggravating factors of vulnerability, leading natural hazards towards becoming disasters by inadequate risk management, in LAC (Mora & Keipi, 2006)



Payachata volcanoes, Tomarapi, Bolivia; 2006

Conclusions from the IV Evaluation Report IPCC's WG II: Impact, Adaptation and Vulnerability

Hazard	Probability	Foreseeable impact
Higher frequency of heat waves	Very probable	Increment of hyperthermia mortality rate
Higher frequency of high intensity rainfall	Very probable	Increment of human life and asset losses caused by flooding and landslides, and spreading of infectious vectorial diseases
Areas affected by drought will spread and increase in size	Probable	Shortage of water and crop yields; food insecurity
Increase in number and intensity of tropical cyclones	Probable	Increase in loss of human life and assets dues to flooding, landslides, storm surges and winds
Rise in sea level	Probable	Loss of life and assets caused by flooding; displacement of populations and infrastructure

Increase in hazard intensity caused by climate change…?

Wind

Storm surges

Tropical cyclones

Rainfall → Floods

Heat waves

Intensity

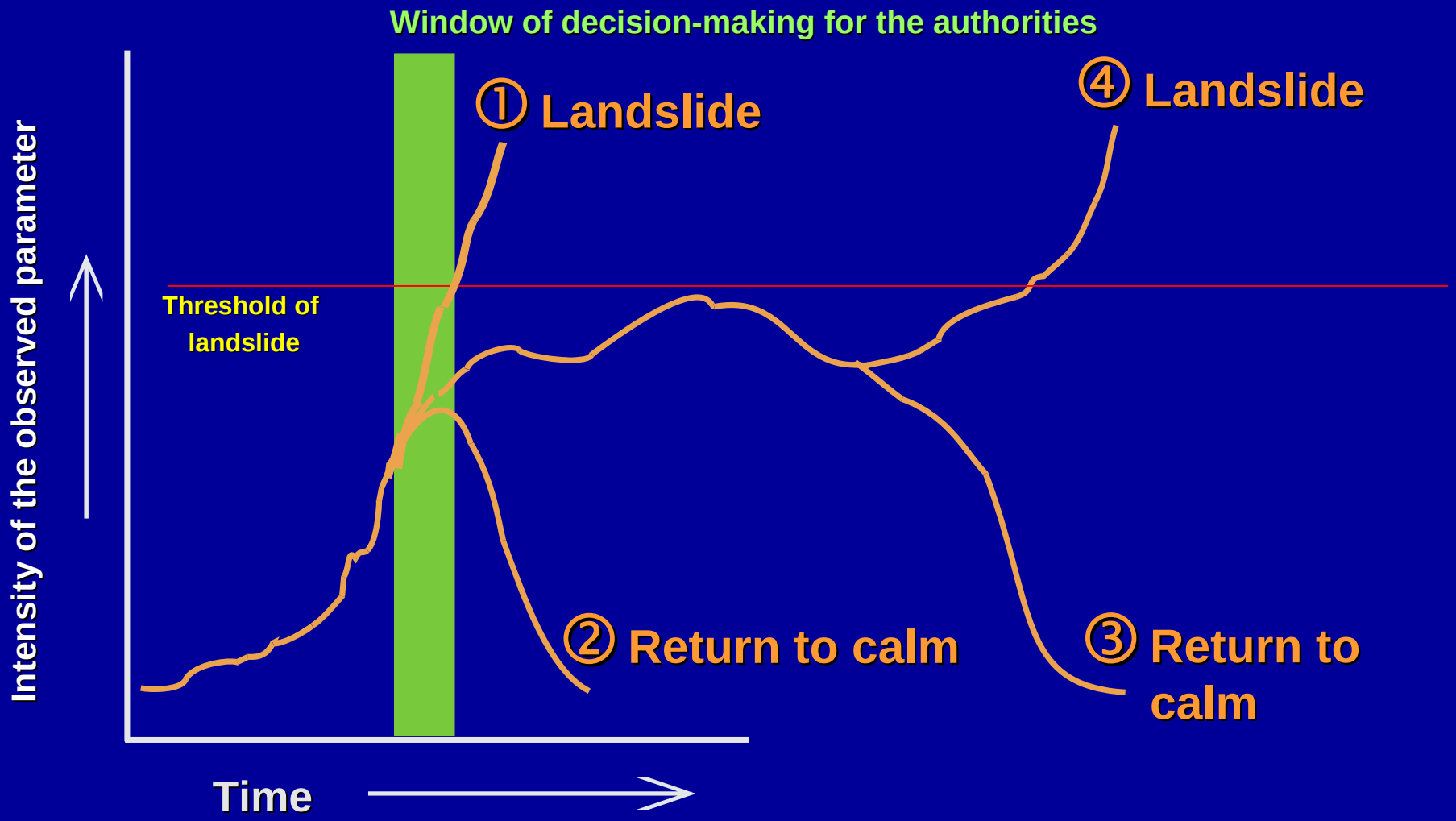
Frequency

HAZARD

Exposure + Vulnerability increase

Higher risk

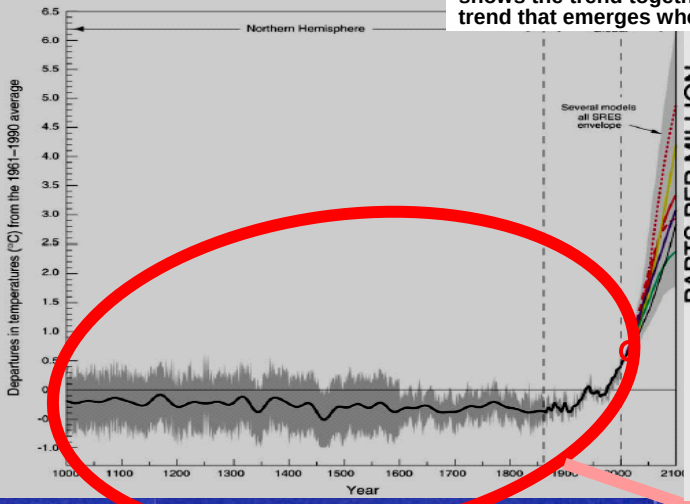
DECISIONS FACING THE EVOLUTION OF A MONITORING PARAMETER



- The growth of the rate of the curve suggests an anomaly and the possibility of ensuing events
- The outcome is impossible to predict: Will the event really occur or not ?

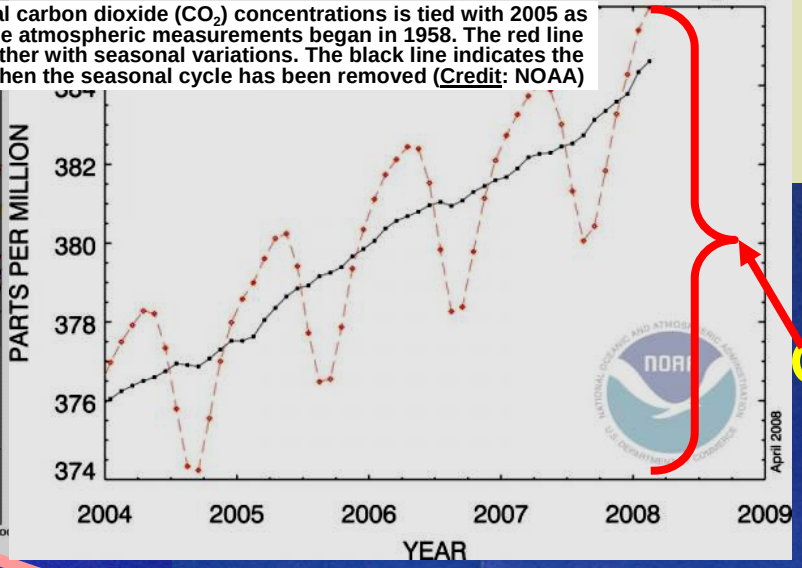
Variations in the surface temperature of the years 1000 a 210

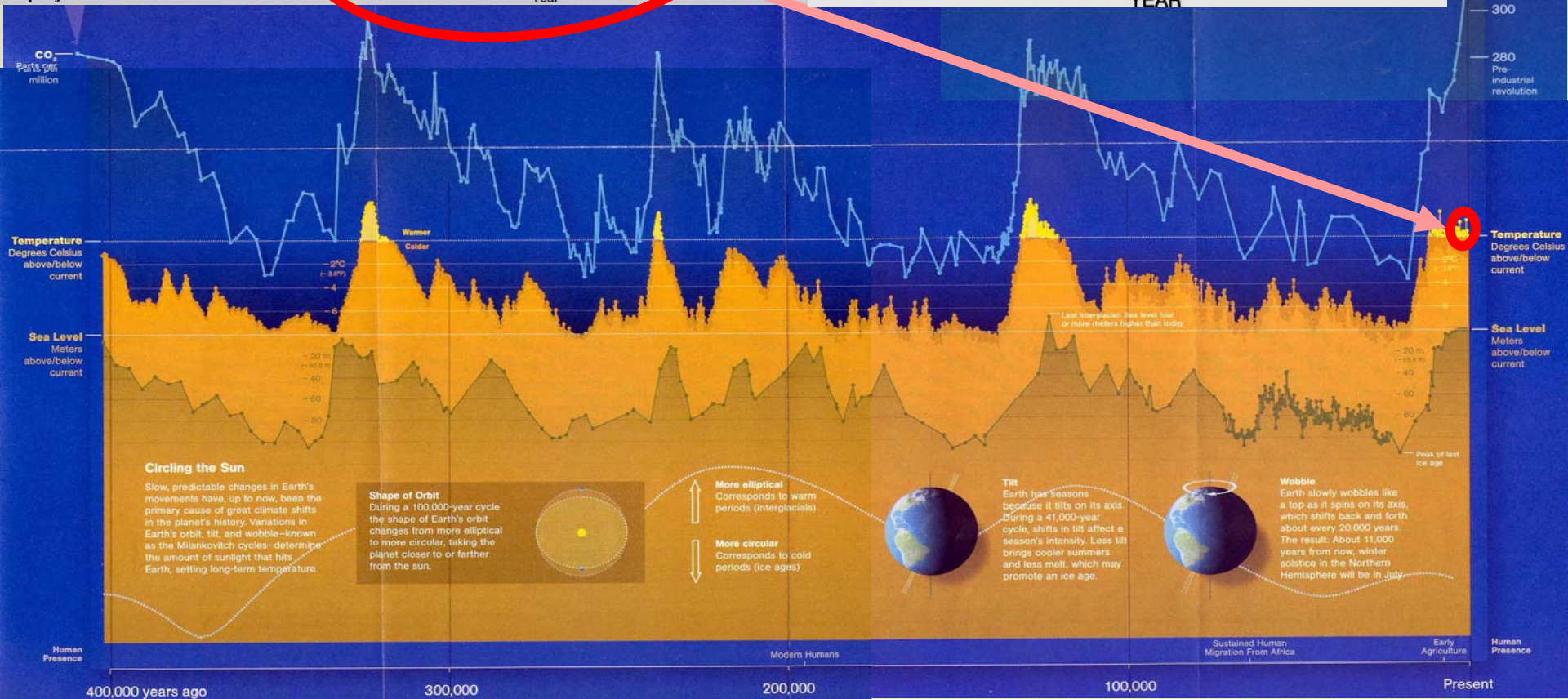
- 1000 to 1861, N. Hemisphere, proxy data;
- 1861 to 2000 Global, Instrumental;
- 2000 to 2100, SRES projections



RECENT GLOBAL MONTHLY MEAN CO_2

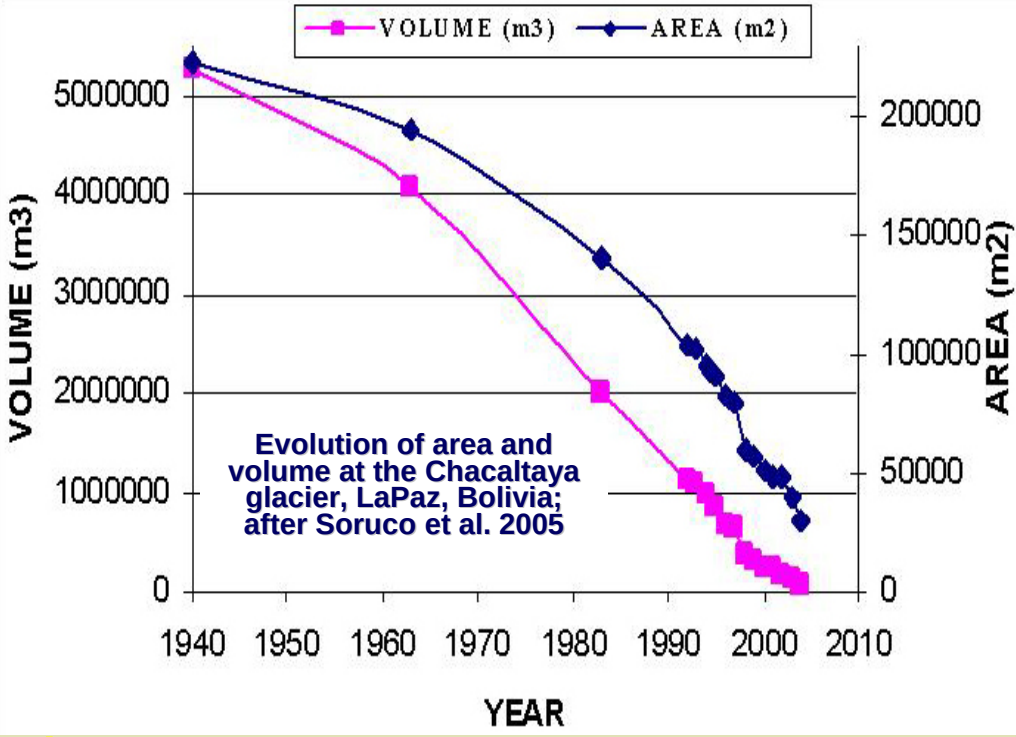
The 2007 rise in global carbon dioxide (CO_2) concentrations is tied with 2005 as the third highest since atmospheric measurements began in 1958. The red line shows the trend together with seasonal variations. The black line indicates the trend that emerges when the seasonal cycle has been removed (Credit: NOAA)





Impacts on Andean glaciers

- Minimum temperatures increase, snowfall decreases
- Reduction of up to 40% of Andean glaciers in Bolivia, Chile, Argentina, Ecuador, Perú and Colombia



Andean glaciers, 2007

Zongo hydroelectric facility, Hwaina-Potosí, La Paz, Bolivia, April 2005

Chacaltaya, LaPaz, Bolivia, November 2005

COTOPAXI VOLCANO, ECUADOR

Hwaina-Potosí, Bolivia, 2007

Illimani, Bolivia; September, 2006

Glaciar El Morado, Maipú National Park Chile; February 2007

Quimsa Cruz, Monte Blanco, Luribay; August, 2005


Seco Glacier, Argentina, May/07


Image © 2007 TerraMetrics
Pointer 50°09'50.16" S 73°17'59.90" W elev 3569 ft
Streaming 100%
Eye alt 11.47 mi

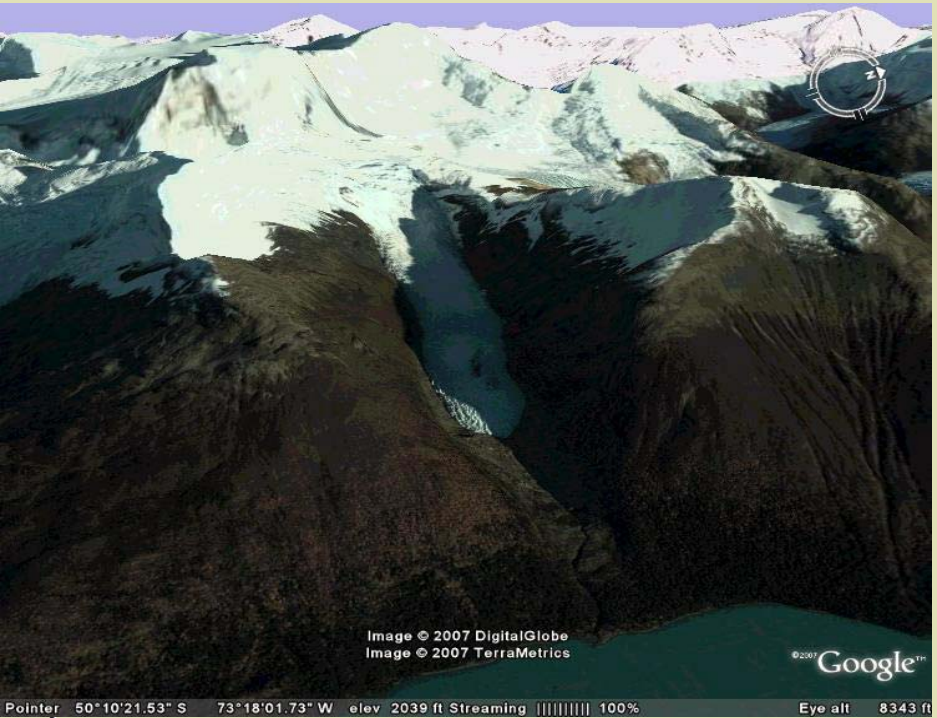
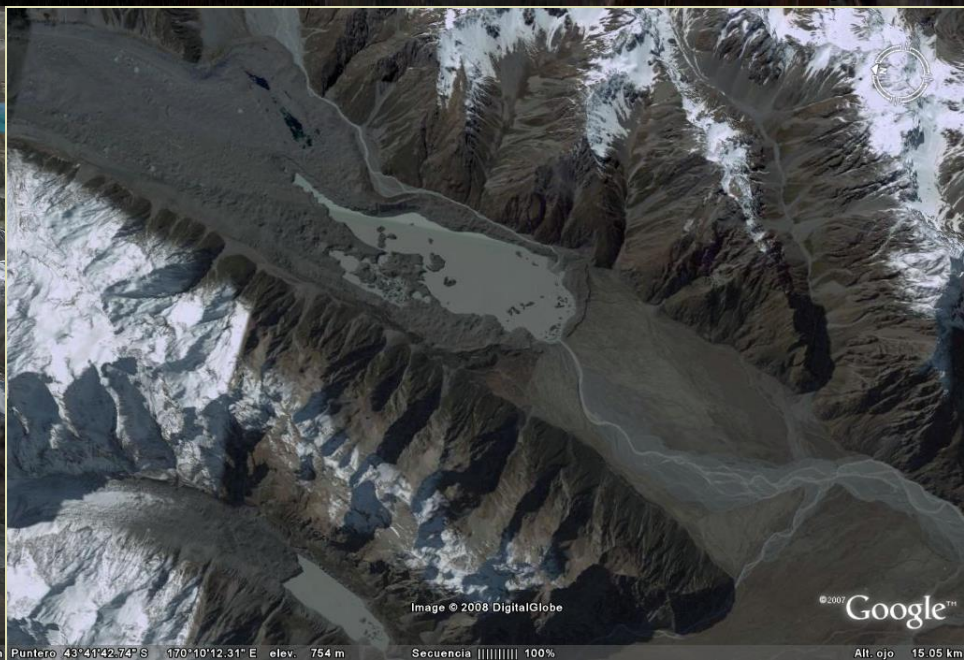


Image © 2007 DigitalGlobe
Image © 2007 TerraMetrics
©2007 Google
Pointer 50°10'21.53" S 73°18'01.73" W elev 2039 ft Streaming 100%
Eye alt 8343 ft

Mt. Cook's Tasman Glacier; new Zealand; May 2008



GREENHOUSE EFFECT INCREMENT AND OZONE LAYER DETERIORATION FACTORS:

- Particles in suspension: smoke, smog, dust, fog, cinder; PM_{25}(25μm); PM_{10} (10 μm)
- Sulphur dioxide (SO_2) and suphide aerosols
- Ozone (O_3)
- Lead (Pb)
- Nitrogen monoxide and dioxide (NO, NO_2; NO_X)
- Carbon monoxide and dioxide (CO, CO_2)
- Volatile organic compounds (VOC)
- CH_4, halocarbons, chlorofluorocarbons CFC and their sub-products; Cl^-, Br^-
- Radon, formaldehydes
- Acid rain generators: SO_2 • OH; NO_X • OH; HCO_3

El Alto-Oruro highway, Bolivia, May/07

Fox glacier, New Zealand, March/08; photo by Jes Michaelsen

Antarctica, March/08

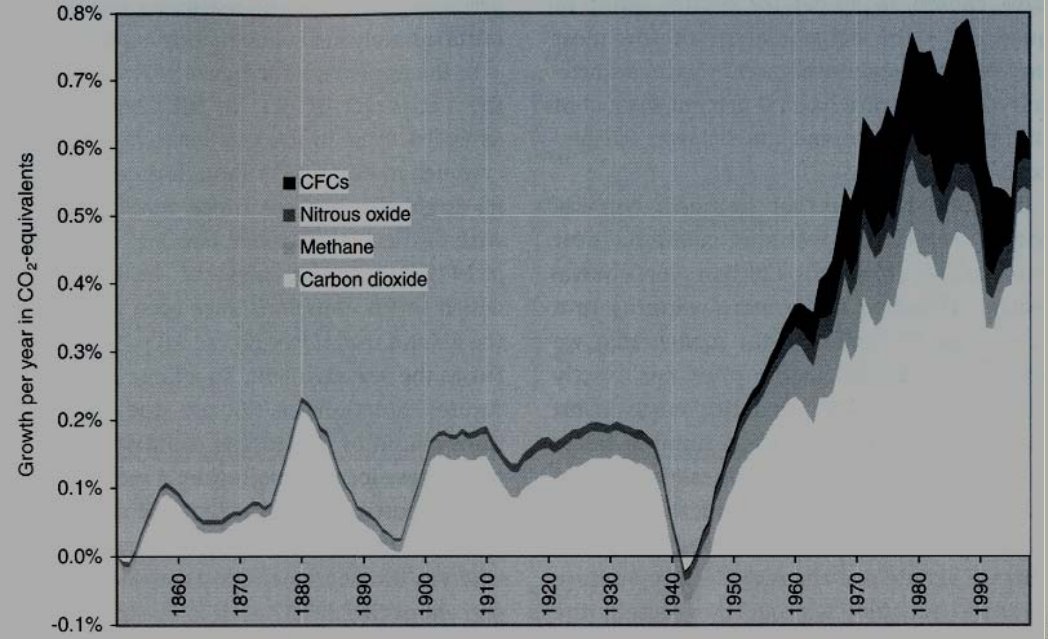


Figure 148 Growth per year in greenhouse gases, 1851–1998, measured in CO_2 equivalent growth rate. 5-year averages. Source: Hansen and Sato 2000, IPCC 1996:92–3.

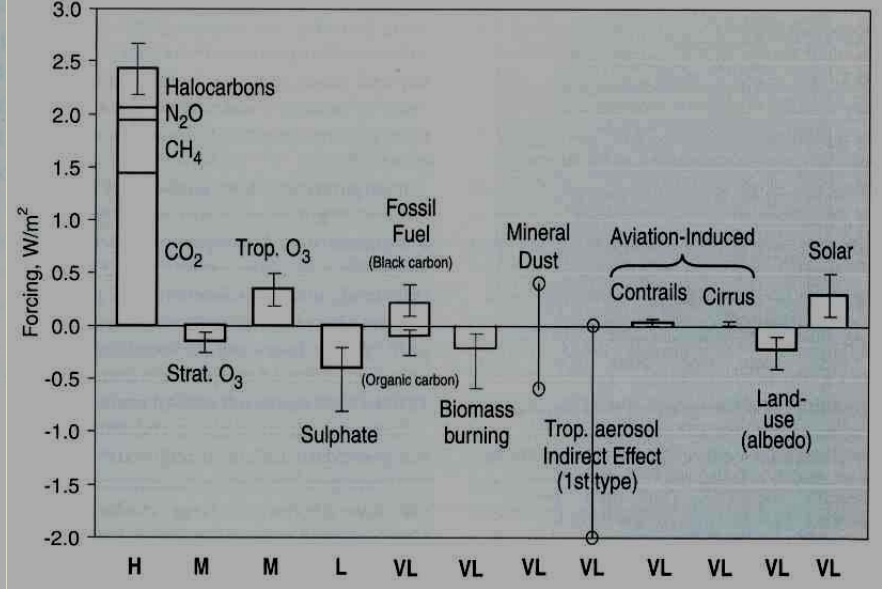
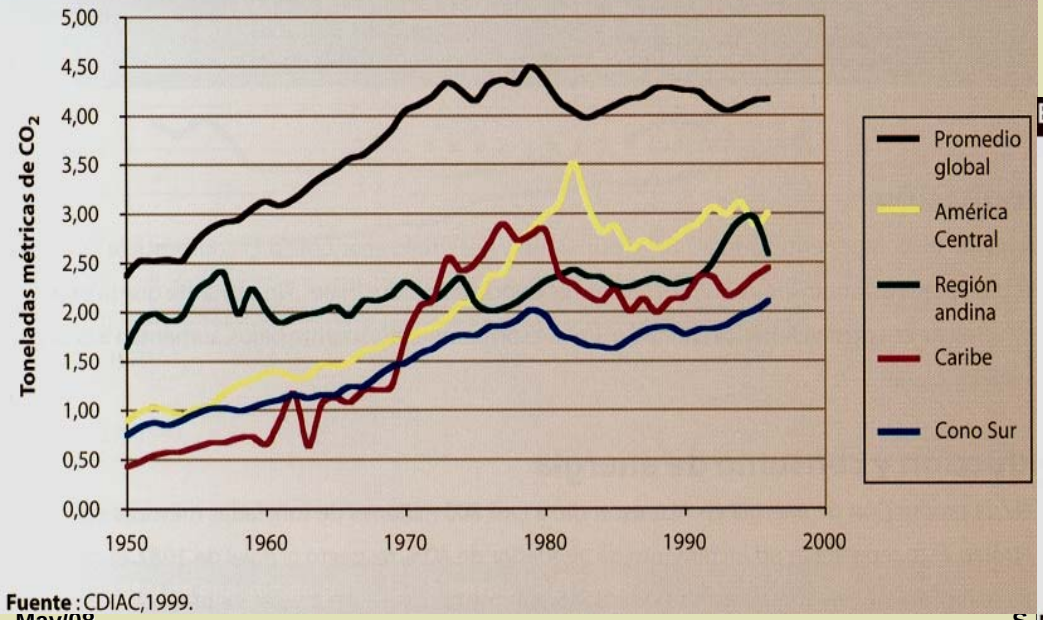


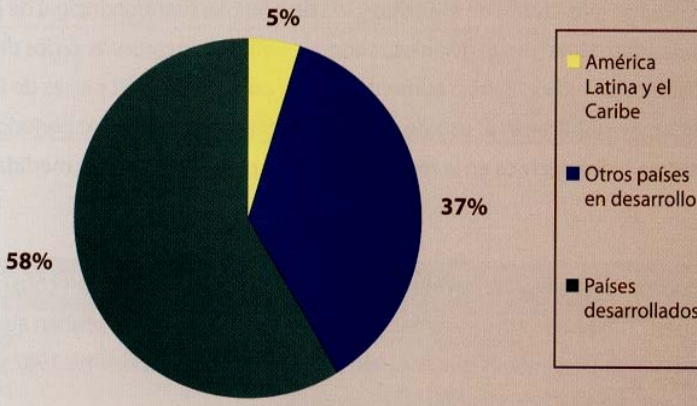
Figure 139 Global mean radiative forcing and uncertainties due to a number of agents, net changes from pre-industrial (1750) till today (late 1990s–2000). Basically, the figure shows the incoming extra energy to Earth due to changes over the past 250 years of a total of about 235W/m². As a rough approximation, one extra W/m² means a temperature increase of about 0.5–1°C.[2175] The total effect of the well-mixed greenhouse gases (CO_2, CH_4, N_2O and halocarbons) is a warming of about 2.43W/m² (as shown in Figure 132), with an uncertainty of 10 percent. Changes in stratospheric ozone cools (the "hole in the ozone layer") whereas ozone in the troposphere warms (ozone pollution). Sulfate, biomass and organic carbon aerosols from fossil fuels cool, whereas black carbon from fossil fuels warms. Mineral dust has no central estimate, only an uncertainty between +.4 and -.6W/m². Tropospheric aerosol, first indirect effect making more water drops, is poorly understood and with no central estimate and an uncertainty between 0 and -2W/m². Second indirect effect is not even estimated. Aviation effects from contrails and extra cirrus clouds indicated. Changes in land use have cooled the Earth slightly, whereas the solar irradiance has increased. Below is indicated the IPCC index of "Level of Scientific Understanding" ranging from High, over Medium to Low and Very Low. Source: IPCC 2001: table 6.11, figure 6.6.[2176]

Emisiones de dióxido de carbono per cápita, 1950-1996



Fuente : CDIAC,1999.

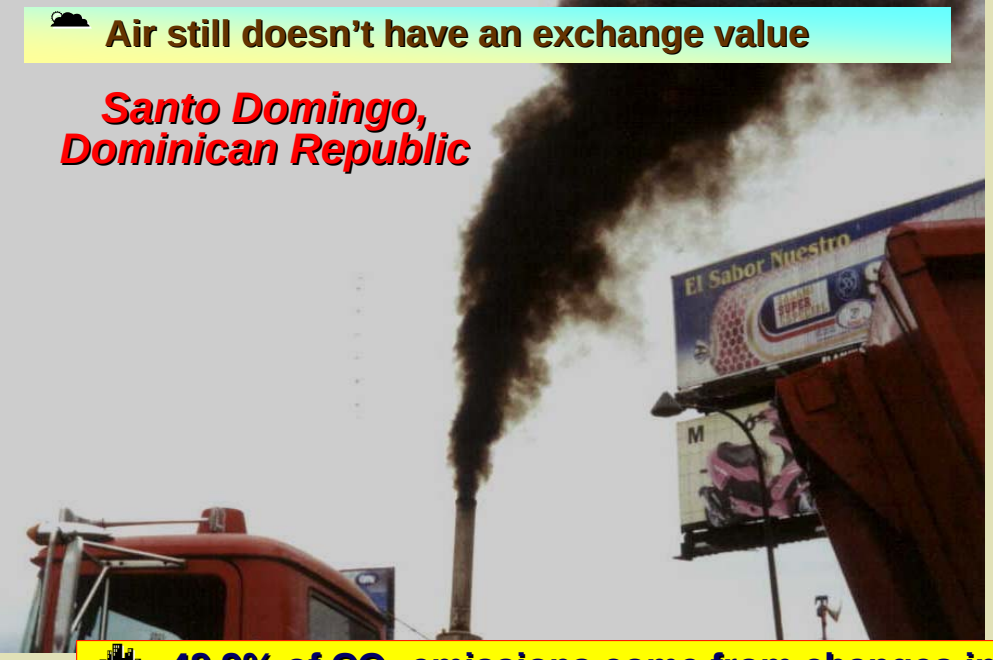
Emisiones a nivel global de CO_2, 1996



Fuente: CDIAC, 1999.

Air still doesn't have an exchange value

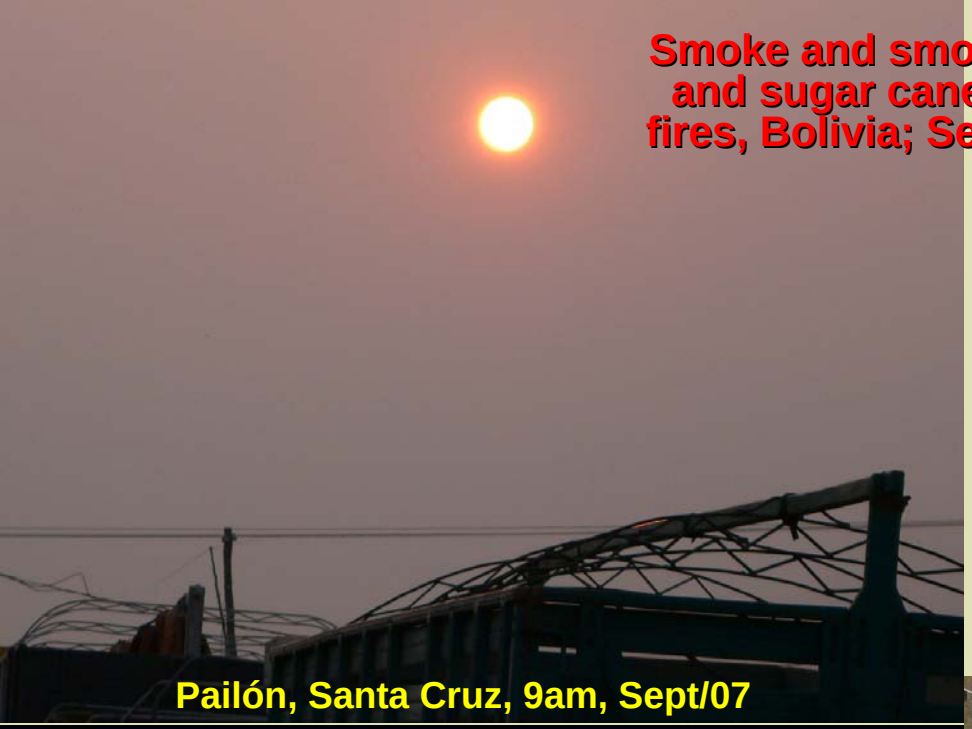
Santo Domingo, Dominican Republic



48,3% of CO_2 emissions come from changes in land use; 43% from industrial processes

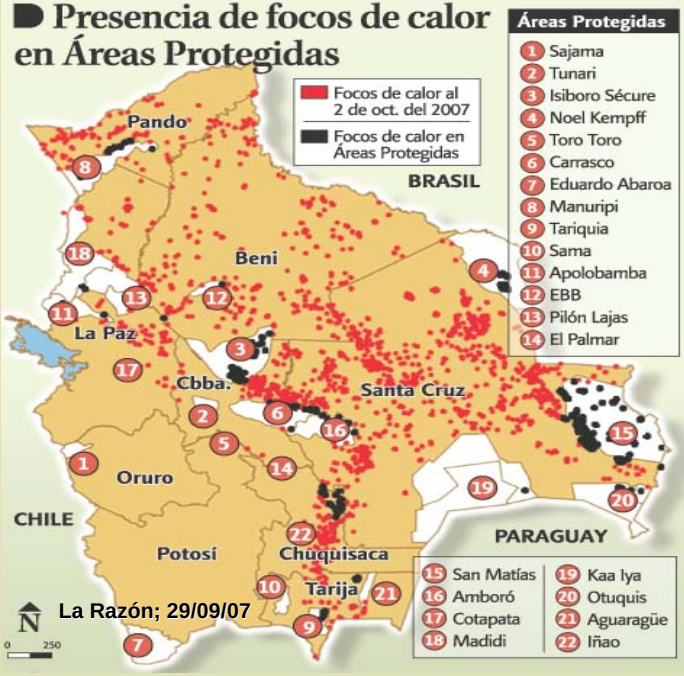
El Alto; Bolivia

Smoke and smog from bush and sugar cane plantation fires, Bolivia; Sept-Oct; 2007

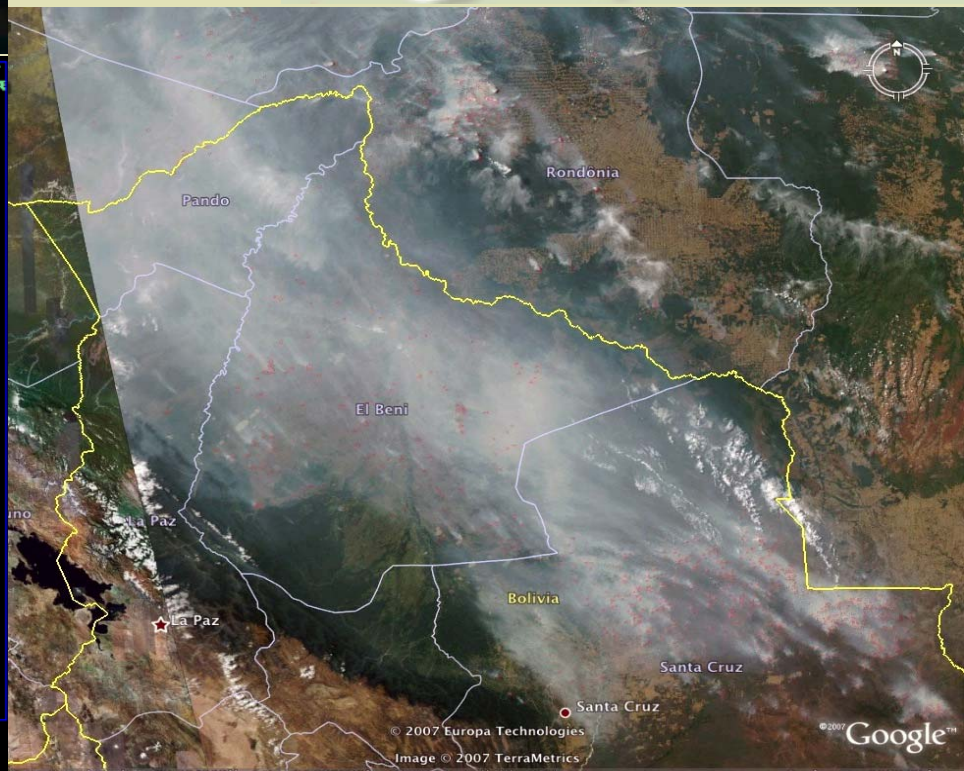


Pailón, Santa Cruz, 9am, Sept/07

WF-ABBA 20072681315 GOES-12

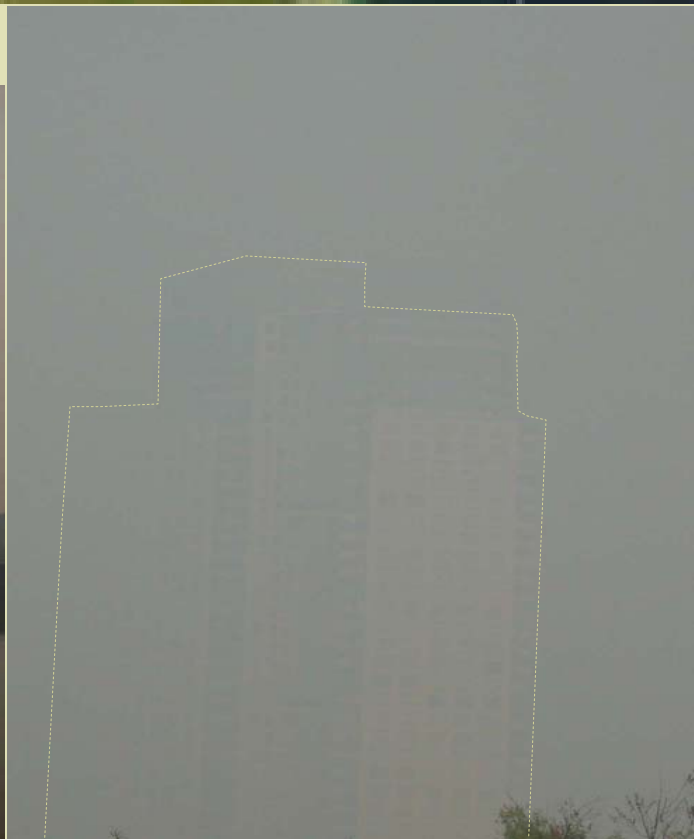


La Razón; 29/09/07



Smoke and smog from nearby bush fires, Buenos Aires, Argentina; 18 April 2008

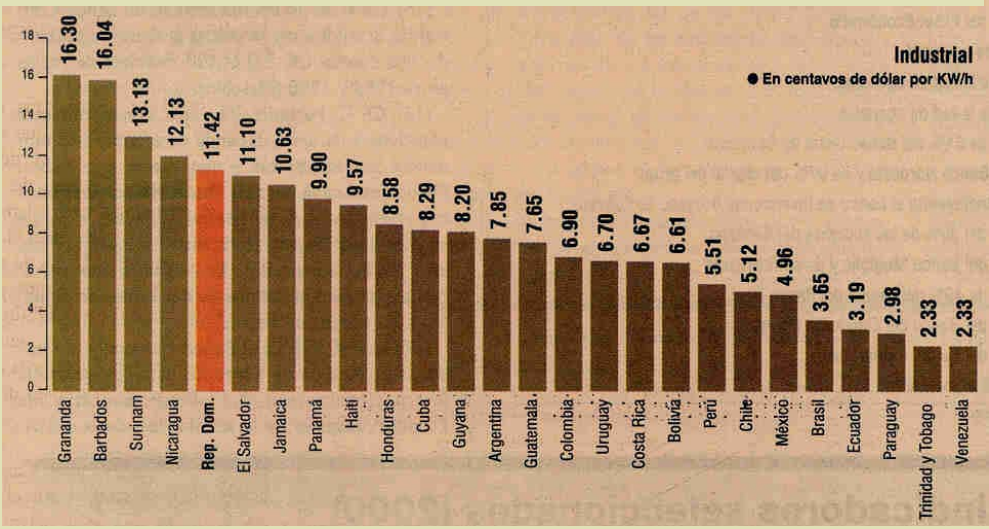
Smoke and smog from nearby bush fires, Buenos Aires, Argentina; 20 April 2008

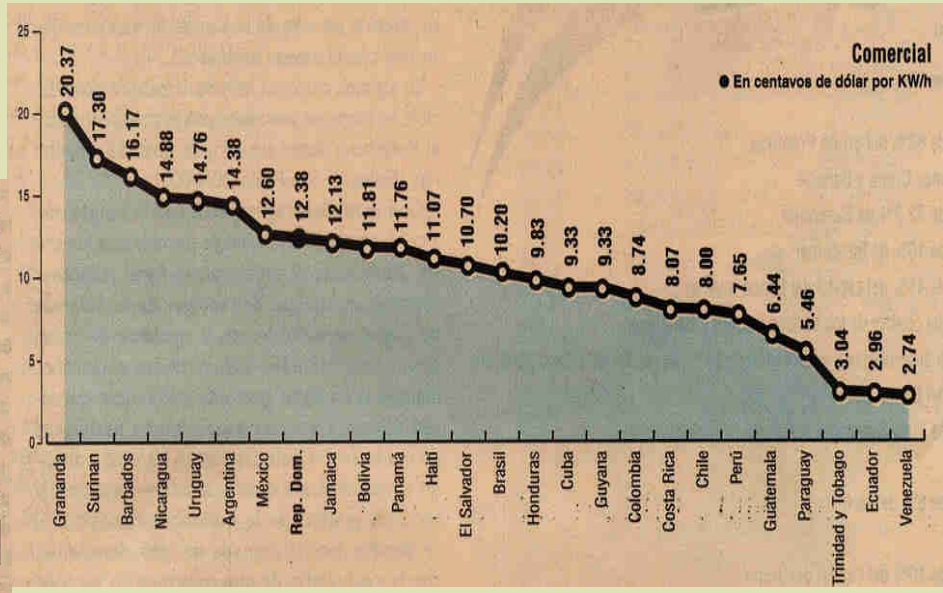



Nearby Christchurch, New Zealand, May 2008

ENERGY AND AIR

Electricity still doesn't have a price that incorporates all environmental costs, ...



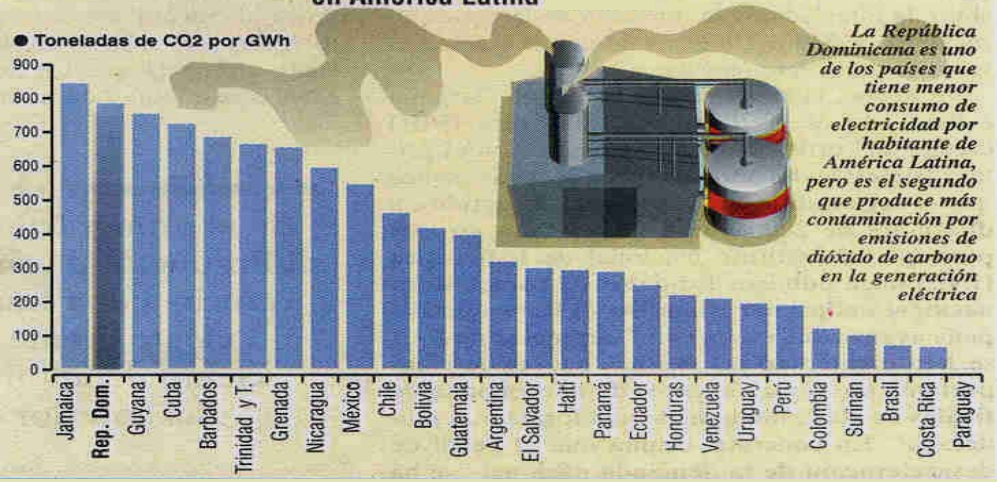


... passives and liabilities...

Consume menos y gasta más

CIFRAS ILUSTRADAS *de los jueves*

Emisiones de dióxido de carbono por generación eléctrica en América Latina



La República Dominicana es uno de los países que tiene menor consumo de electricidad por habitante de América Latina, pero es el segundo que produce más contaminación por emisiones de dióxido de carbono en la generación eléctrica

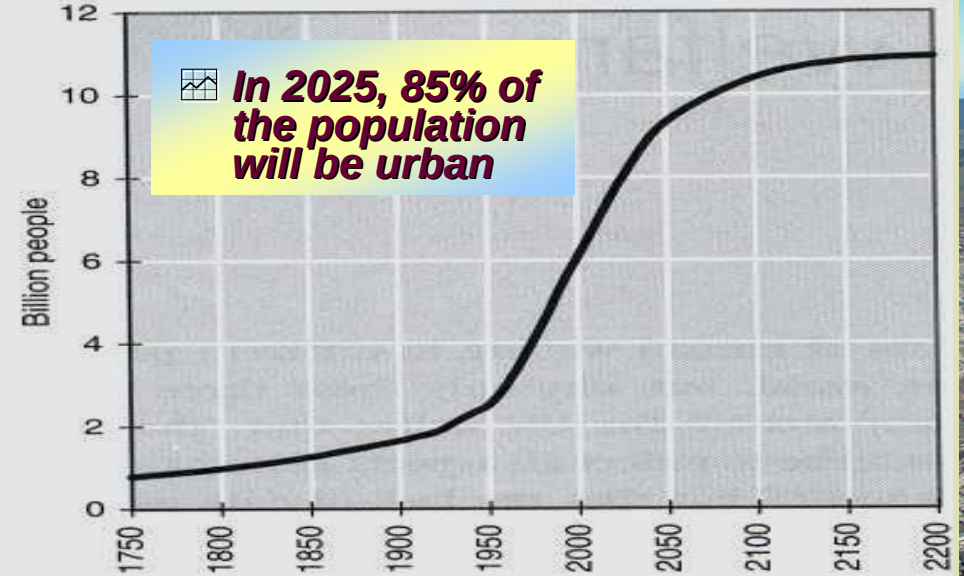
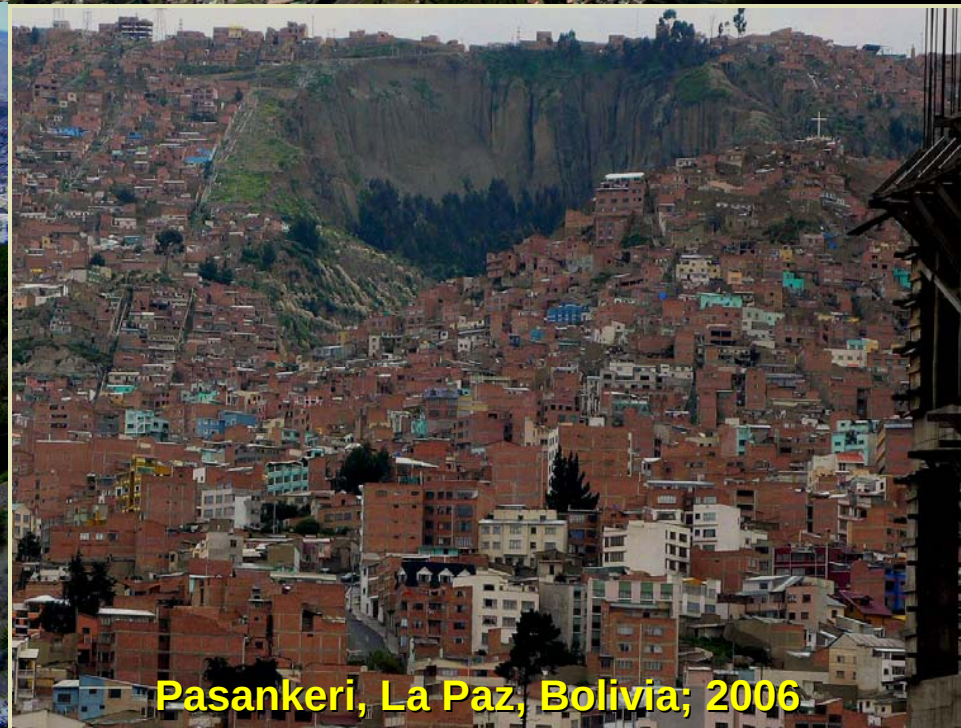
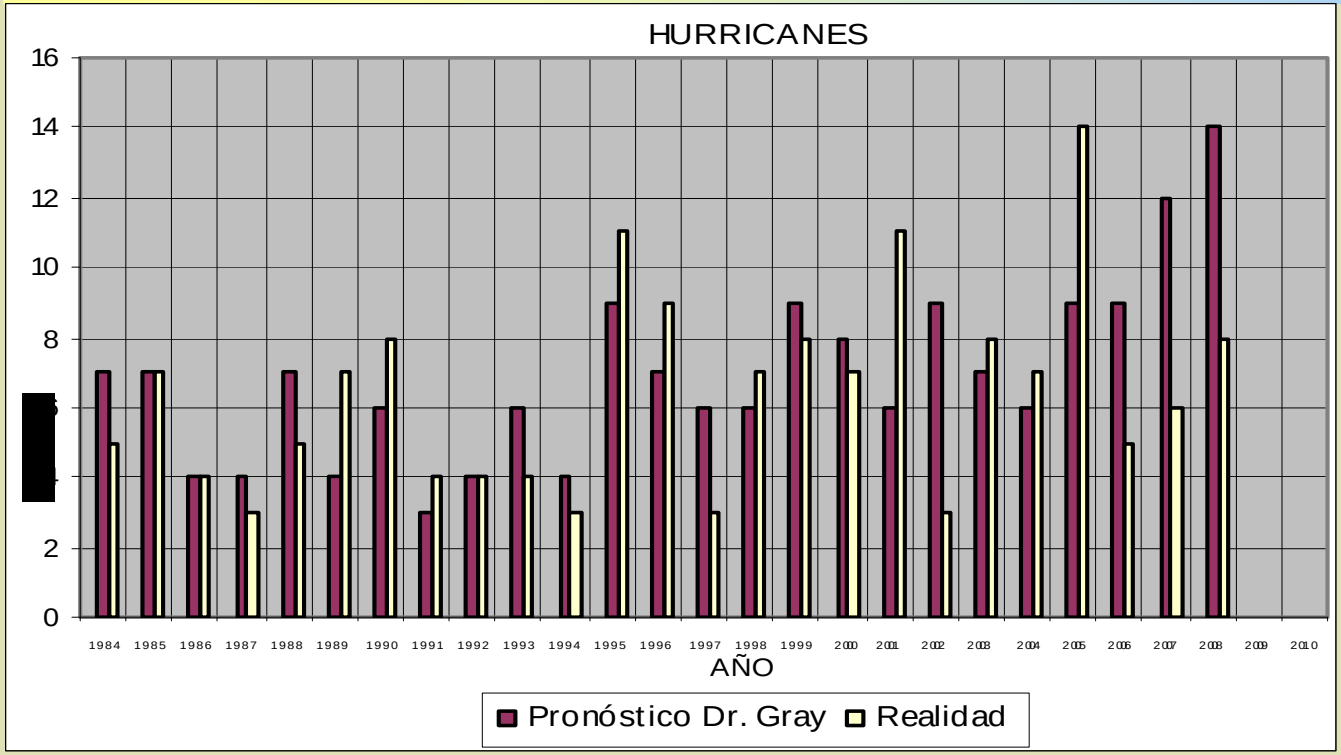


Figure 11 World population 1750–2200, the UN's medium variant forecast from 2000. Source: UNPD 2001b:27; 1998b:37, 1998c.[311]



Will climate change increase the frequency and intensity of naturals hazards?



- **2005: 25 tropical cyclones; 14 reached hurricane category and 6 categories III, IV; 3 Cat. V: Katrina, Rita, Wilma (Saffir-Simpson)**
- **Wilma was the quickest in intensifying in history: From tropical storm to category V in 24 hours; the lowest barometric pressure ever recorded**

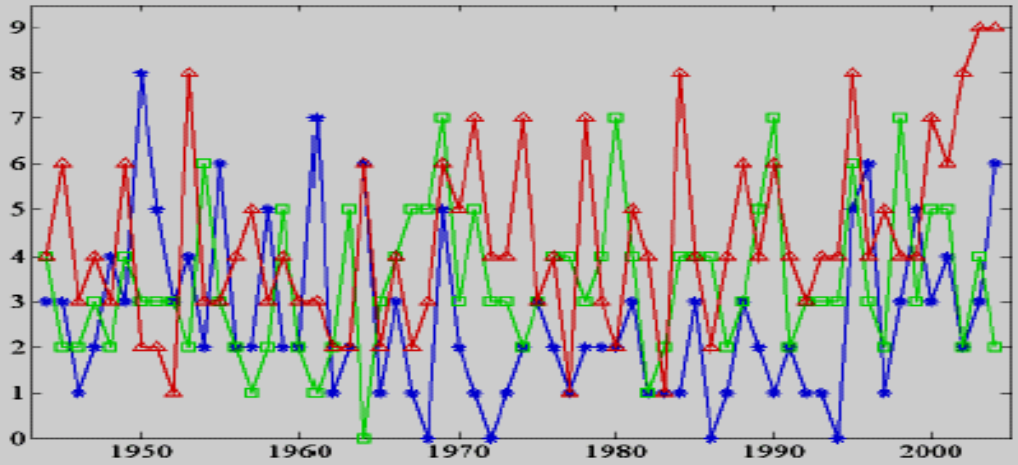


Fig. 1: Series de tiempo para la actividad anual de las Tormentas Tropicales, línea roja con triángulos, los Huracanes Menores, línea verde con cuadros, y los Mayores, línea azul con asteriscos. Cuenca del Atlántico, periodo 1944-2004.

SOLUTIONS ?

ANYBODY GOT ANY GOOD IDEAS?

ONE WEDGE AT A TIME

Each strategy listed below would, by 2057, reduce annual carbon emissions by a billion metric tons.

EFFICIENCY AND CONSERVATION

- Improve fuel economy of the two billion cars expected on the road by 2057 to 60 mpg from 30 mpg.
- Reduce miles traveled annually per car from 10,000 to 5,000.
- Increase efficiency in heating, cooling, lighting, and appliances by 25 percent.
- Improve coal-fired power plant efficiency to 60 percent from 40 percent.

CARBON CAPTURE AND STORAGE

- Introduce systems to capture CO_2 and store it underground at 800 large coal-fired plants or 1,600 natural-gas-fired plants.
- Use capture systems at coal-derived hydrogen plants producing fuel for a billion cars.
- Use capture systems in coal-derived synthetic fuel plants producing 30 million barrels a day.

LOW-CARBON FUELS

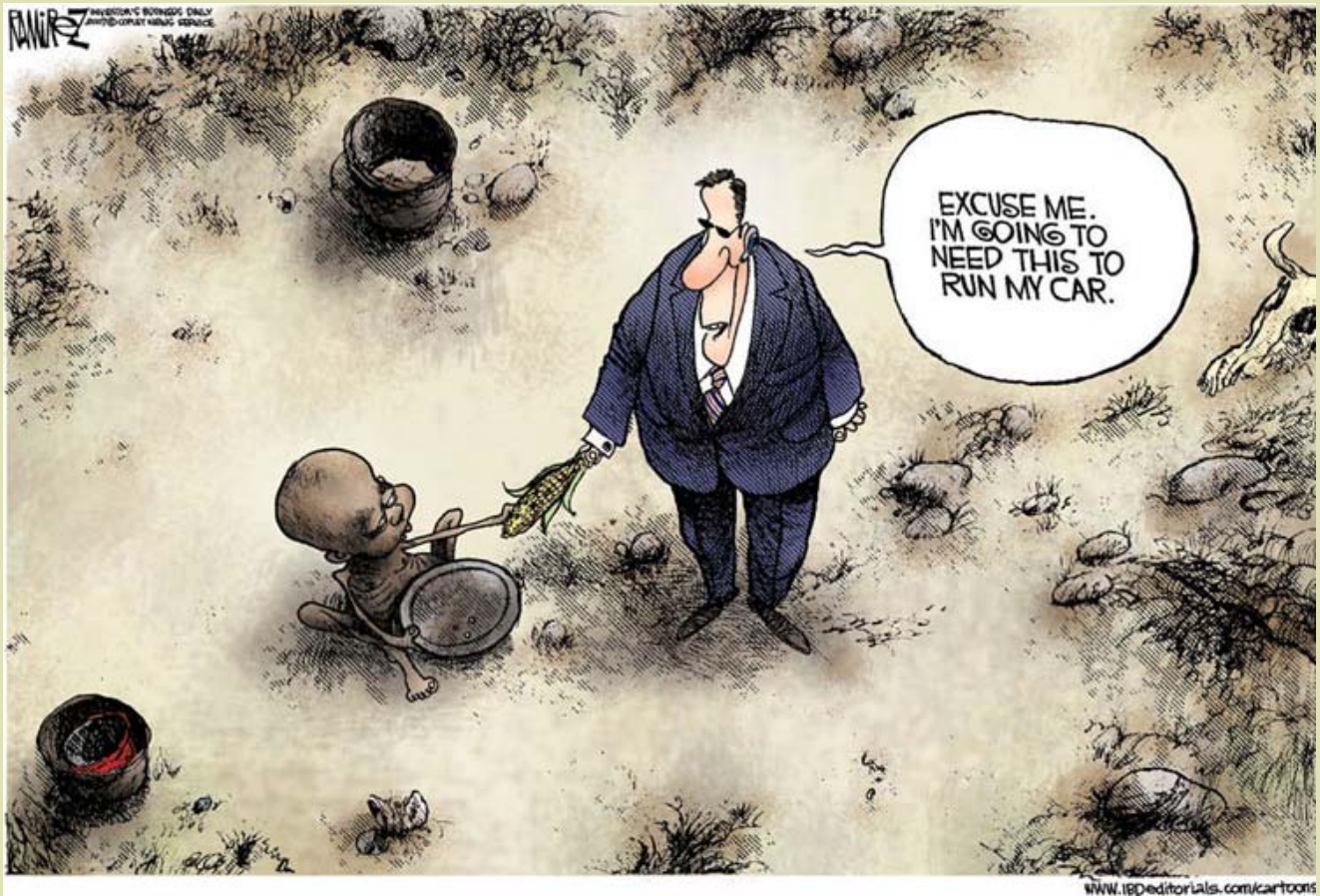
- Replace 1,400 large coal-fired power plants with natural-gas-fired plants.
- Displace coal by increasing production of nuclear power to three times today s capacity.

RENEWABLES AND BIOSTORAGE

- Increase wind-generated power to 25 times current capacity.
- Increase solar power to 700 times current capacity.
- Increase wind power to 50 times current capacity to make hydrogen for fuel-cell cars.
- Increase ethanol biofuel production to 50 times current capacity. About one-sixth of the world's cropland would be needed.
- Stop all deforestation.
- Expand conservation tillage to all cropland (normal plowing releases carbon by speeding decomposition

Bio-fuels: ¿A solution?

Type of fuel	Energy applied during production (Equivalent to fossil fuels)	Equivalent energy produced	Cost of production of respective classic fossil fuel/litre	Cost of production of biofuel (US$/litre)	Cost of sale at retail (US$/litre) in relation to the same amount of usefull energy	Greenhouse-effect gas emission (g/litre)	Difference in emissions in relation to classic gassoline
Classic gassoline	1	1	Gassoline in USA US$ 0,81		In USA US$0,81; in Brasil US$1,41	11,9	1
Corn ethanol	1	0,89	Gassoline in USA US$ 0,81	In USA US$0,78	En Estados Unidos US$0,98	9,47	88%
Sugar cane ethanol	1	8	Gasosline in Brazil US$ 1,30	En Brasil US$0,78	In Brazil US$1,03	5,3	44%
Cellulose Ethanol	1	2 a 36	Experimental			1,11	9%
Soy biodiesel	1	2,5	Diesel in Germany US$1,64	In Germany US$1,78	In Germany US$1,80	4,45	68%



CLIMATE CHANGE ADAPTATION IS A PART OF RISK MANAGEMENT, NOT THE OTHER WAY AROUND !!!

- There is no single panacea, but a summation of partial solutions
- DRM should be aimed at the reduction of vulnerability

But…

Who said it was going to be easy to reverse the damage already made by the industrial nations ? …

… considering that the "emerging" ones would like to have their own share of development … no matter the cost !

The important question is not whether or not there will be more or less rain, but instead how much from what it falls will drip through my roof…

Gustavo Wilchez-Chaux

About the river that takes everything along its path, we refer to as violent…

But about the human margins, enclosing it and oppressing it, nobody talks about violence

Berthold Brecht

Cartoon by Chris Britt/SJ-R

Agua traicionera

Comunidades anegadas en la vertiente caribeña y una tragedia en el cerro Zurquí —con un saldo de tres desaparecidos— son el resultado del temporal que desató una onda tropical desde las últimas horas del domingo.

Onda tropical, la responsable

A farmer riding his kart through a road in very bad condition was stuck in the mud. With his eyes towards heaven, he implored Hercules to come to his aid.

After a while he heard a voice saying:

"…Search the stone which stops you, pull it aside, break it with your sledge hammer, take away the mud that blocks the kart, fill the furrows with the fragments of the broken stone, drive the horses and push the wheels…

¡...and you will see how Hercules helps you…!"

(Aesop's fable; Lafontaine)

¡¡¡ MUCHAS GRACIAS !!!