GLOBAL WATER RESOURCES BETWEEN RISK AND PROSPERITY

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We are guests on the Earth!

Our function is to protect it for the next generation.

HOW???

COMMENT

ILLUSTRATION BY PETE ELLIS/DRAWOOD.COM

Time to leave GDP behind

Gross domestic product is a misleading measure of national success. Countries should act now to embrace new metrics, urge **Robert Costanza** and colleagues.

Robert F. Kennedy once said that a country's gross domestic product (GDP) measures "everything except that which makes life worthwhile". The metric was developed in the 1930s and 1940s amid the upheaval of the Great Depression and global war. Even before the United Nations began requiring countries to collect data to report national GDP, Simon Kuznets, the metric's chief architect, had warned against equating its growth with well-being.

GDP measures mainly market transactions. It ignores social costs, environmental impacts and income inequality. If a business used GDP-style accounting, it would aim to maximize gross revenue — even at the expense of profitability, efficiency, sustainability or flexibility. That is hardly smart or sustainable (think Enron). Yet since the end of the Second World War, promoting GDP growth has remained the primary national policy goal in almost every country[1].

Meanwhile, researchers have become much better at measuring what actually does make life worthwhile. The environmental and social effects of GDP growth can be estimated, as can the effects of income inequality[2]. The psychology of human well-being can now be surveyed comprehensively and quantitatively[3,4]. A plethora of experiments has produced alternative measures of progress (see Supplementary Information; go.nature.com/bnquxn).

The chance to dethrone GDP is now in sight. By 2015, the UN is scheduled to announce the Sustainable Development Goals, a set of international objectives to improve global well-being. Developing integrated measures of progress attached to these goals offers the global community the opportunity to define what ▶

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For more on sustainable development goals:
go.nature.com/ttayln

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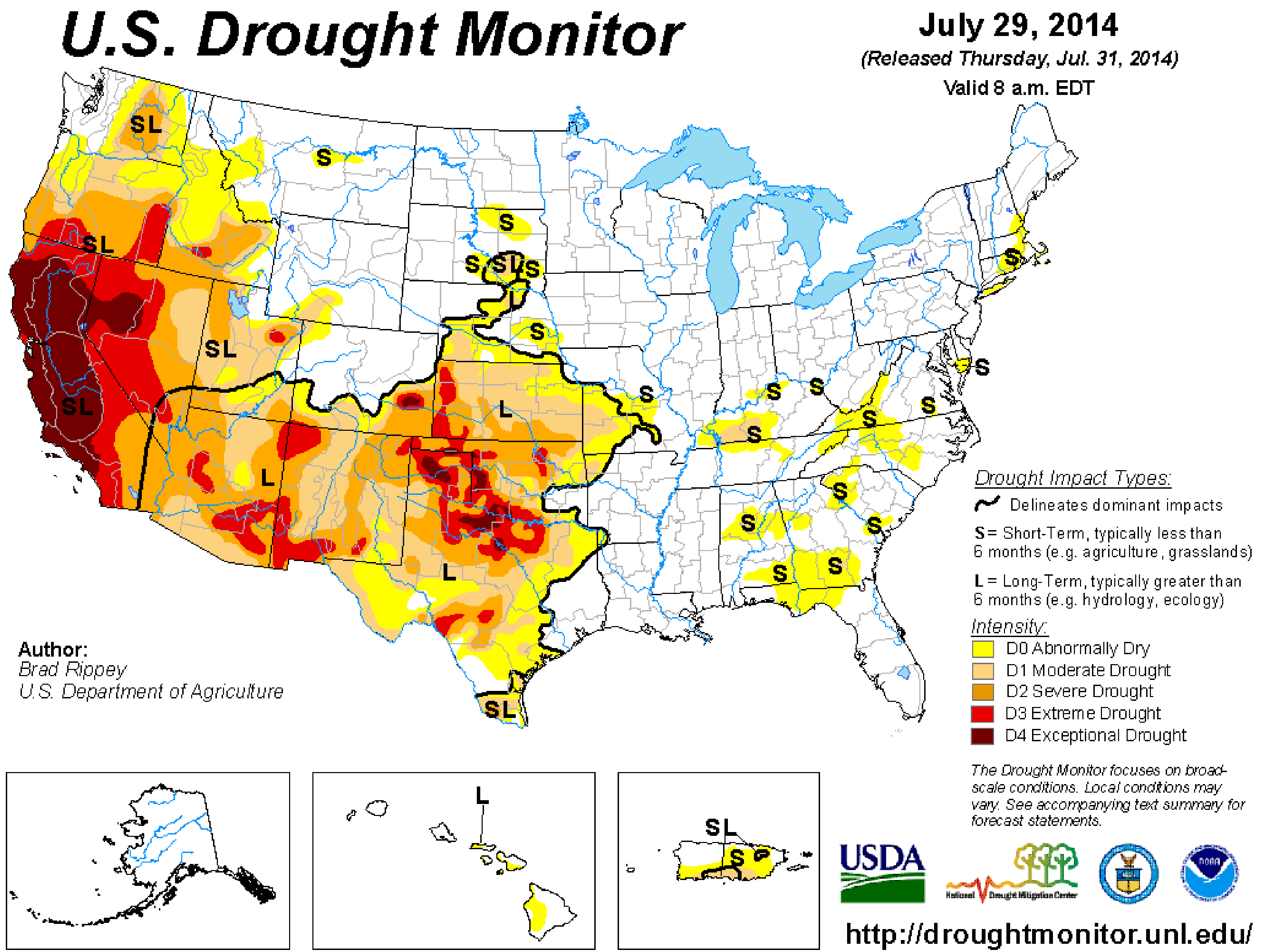
WATER

Water definitely makes life worthwhile. At the same time it is crucial prerequisite for supporting life on the Earth.

Water is the topic of the day on the international scene, because of a critical situation in numerous countries and regions. Fresh water is perhaps the single most important resource on the Earth. World is faced with growing vulnerability of society to natural and anthropogenic water disasters.

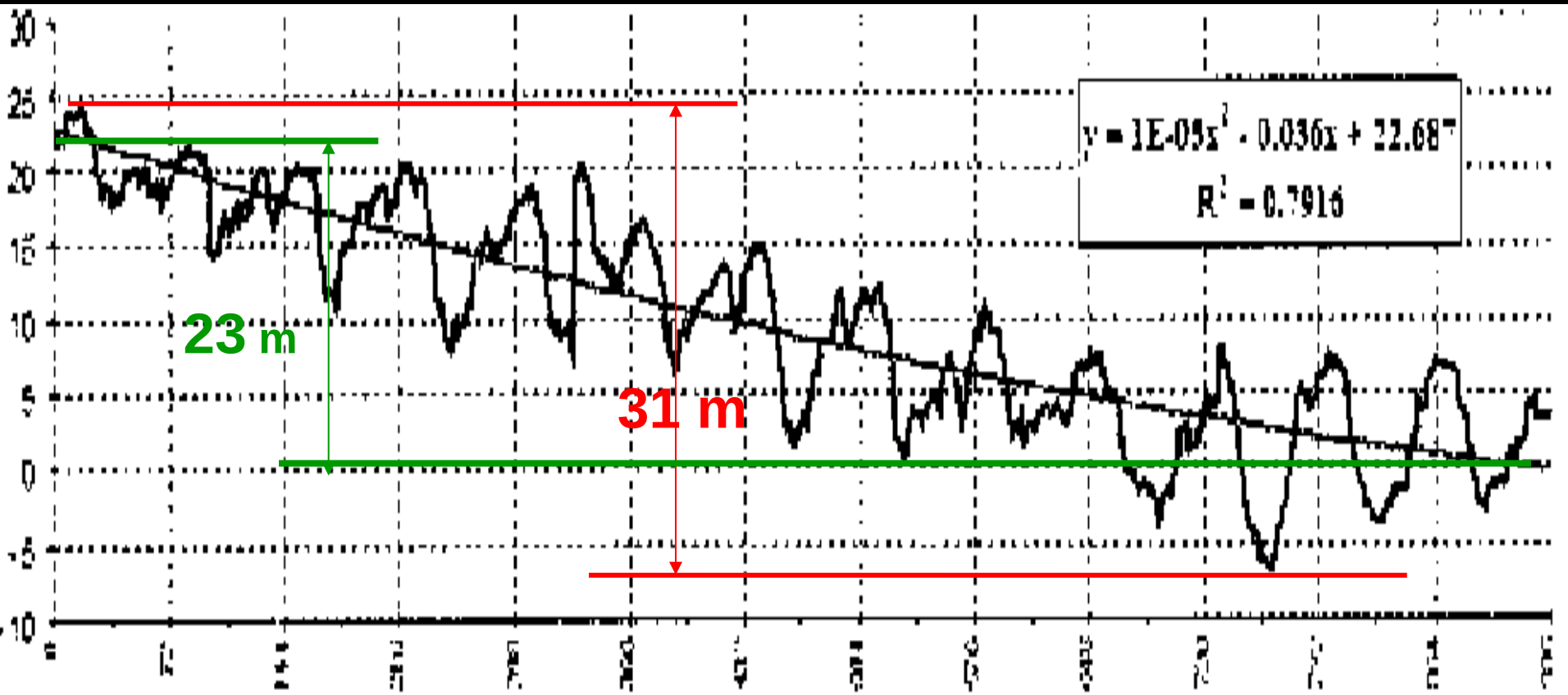
At present international scientific community is faced with an environment ecologically, climatically, geologically, and due to these socially and politically, so fragile and vulnerable to risks of floods, droughts, landslides and water and soil pollution. Now it is hence the decisive moment to start a process of co-ordinated international multi- and inter-disciplinary research and other activities covering knowledge and information exchange.


U.S. Drought Monitor
July 29, 2014
(Released Thursday, Jul. 31, 2014)
Valid 8 a.m. EDT
Drought Impact Types:
Delineates dominant impacts
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)
Intensity:
D0 Abnormally Dry
D1 Moderate Drought
D2 Severe Drought
D3 Extreme Drought
D4 Exceptional Drought
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.
Author:
Brad Rippey
U.S. Department of Agriculture
USDA
National Drought Mitigation Center
http://droughtmonitor.unl.edu/

Los Angeles Pipe Burst a Reminder of Aging Water Infrastructure in Central Valley (30 July 2014)

The rupture of the 90-year-old main sent a geyser shooting 10 m in the air and flooded Sunset Boulevard (Los Angeles) with about 35×10^6 L of water before it was shut off more than three hours after the pipe burst.

Many aquifers are currently being over-exploited and polluted. This is especially case in cites and megacities.



Depletion of groundwater level in the vicinity of the capital of China, Beijing in 14 years period (1987-2000)

Sustainable development!?

Sustainable development of water resources requires respecting of hydrological cycle by using renewable water resources which will not be reduced by a prolonged exploitation. Sustainability should not be limited to physical and ecological dimensions but must encompass the socio-economic elements in the process of achieving society's overall objectives without sacrificing those of future generations. Sustainable water resource management can therefore be regarded as the transformation of factor inputs, land, labour, capital and entrepreneurship, into co-ordination activities aimed at achieving society's objectives without putting at risk the legitimate aspirations of future generations.

How humans manage with water?

Ecocide: Plastic Sea, Almeria, Spain
Tendoni, Apulia, Italy

Surrounding the town of El Ejido, Almeria (Spain) is a plastic sea of greenhouses covering about 30,000 hectares of originally dry land. In the coastal zones of the Apulia Region (Italy), the coverage of the grape fields with plastic sheets (tendoni), proposes different scenery of the soil alteration. The consequences are very negative, which became manifest with high intensity rainfalls, accompanies the modified hydrological behavior of the surface. Flood once rare, are becoming normal in the Apulia Region.

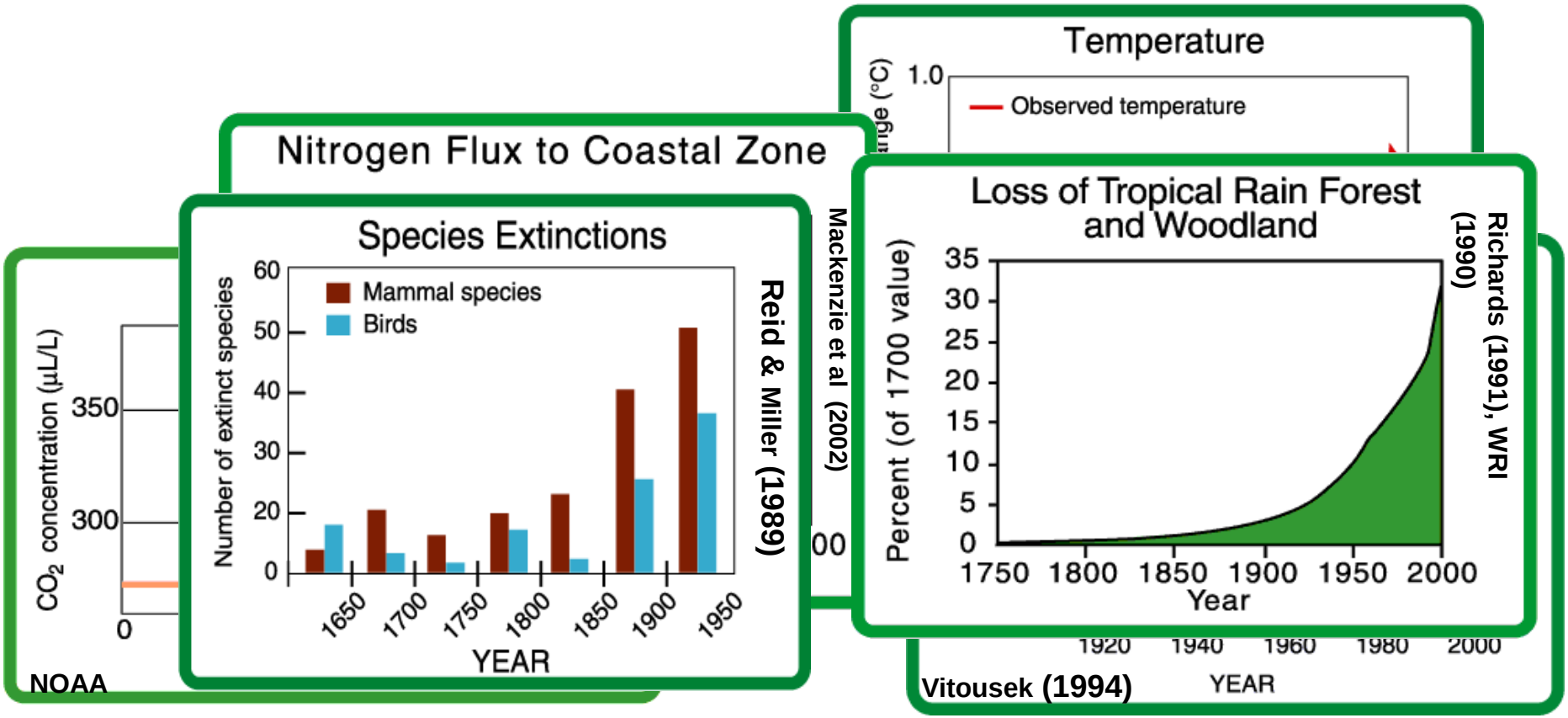
GLOBAL CHANGE

Planetary water resources are under severe stress. They are significantly affected by global change, which involves more than climate change. The major drivers of global change are: population growth, climate change and/or variability, uncontrolled and unsustainable urbanization and industrialization, expansion of infrastructure, land use change, massive pollution, unsustainable water resources management (especially ground- and surface- water overexploitation), massive deforestation, wetland drying up and many other reasons.

Global change impacts

has natural PLUS human (social) dimensions

See large changes in:



NO!!

Crucial question is!

Are humans changing the global water system in a globally-significant way

without

adequate knowledge of the system and thus its response to change?

The global change is the main reason for necessity of interdisciplinary scientific co-operation in their management and protection.

Protection and sustainable management of the water resources is of crucial importance. It is necessary to take the complex, interactive, technical, social, economic, environmental and cultural aspects of global water resources management into account in decision-making.

Water hazards and their interdependences

WILDFIRE

WIND EROSION

DROUGHT

WATER AND SOIL POLUTION

FLOOD

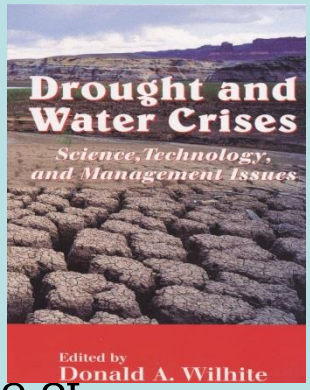
LANDSLIDE

DESERTIFICATION

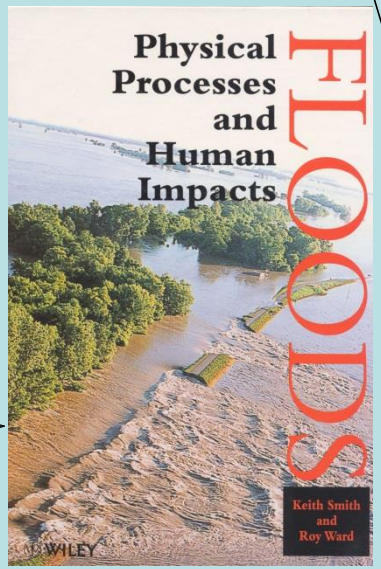
LOW FLOW

WATER SURPLUS

DEBRIS FLOW



WATER DEFICIENCY



MUD FLOW

WATER EROSION

WATER SEDIMENTATION

Legend:

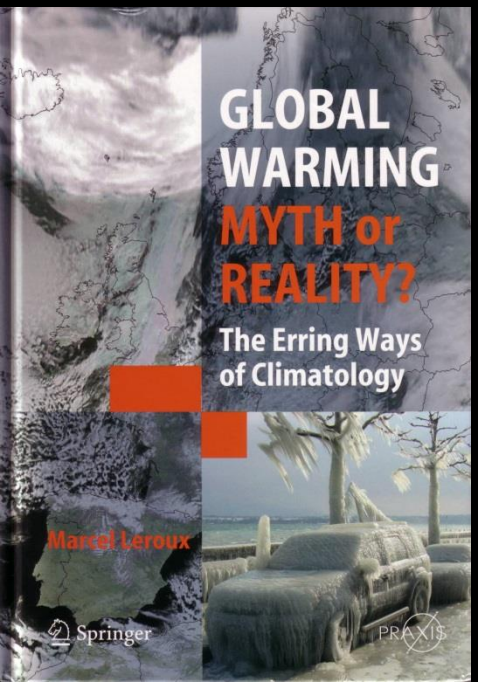
type of water hazard

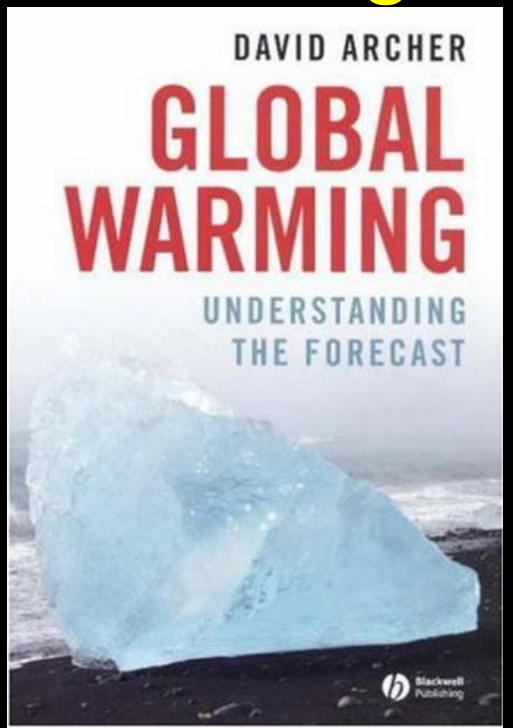
dependence between water hazards

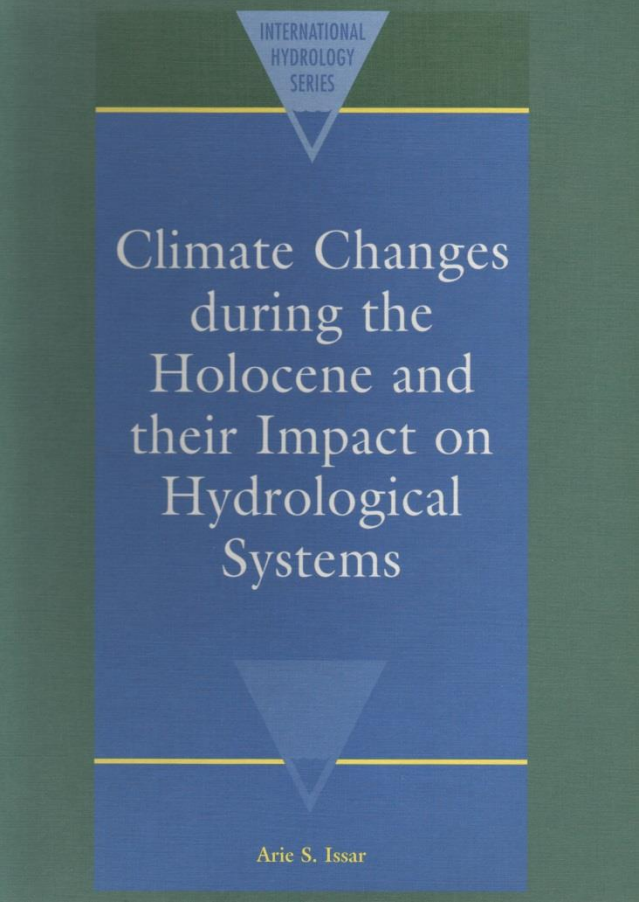
Natural hazards (earthquakes, droughts, floods, landslides, volcanic eruptions, hurricanes, wildfires, water and soil pollution etc.) are risks to inhabited regions due to extreme aberrations in nature. Common among all hazards is the inadequacy of methods to express risk to the public.

Climate change or variability
(global warming)

The effect of climate change, whether caused by human activities or natural variability, on water have not been evaluated well enough. Little is known about how surface water and groundwater might respond to climate change.



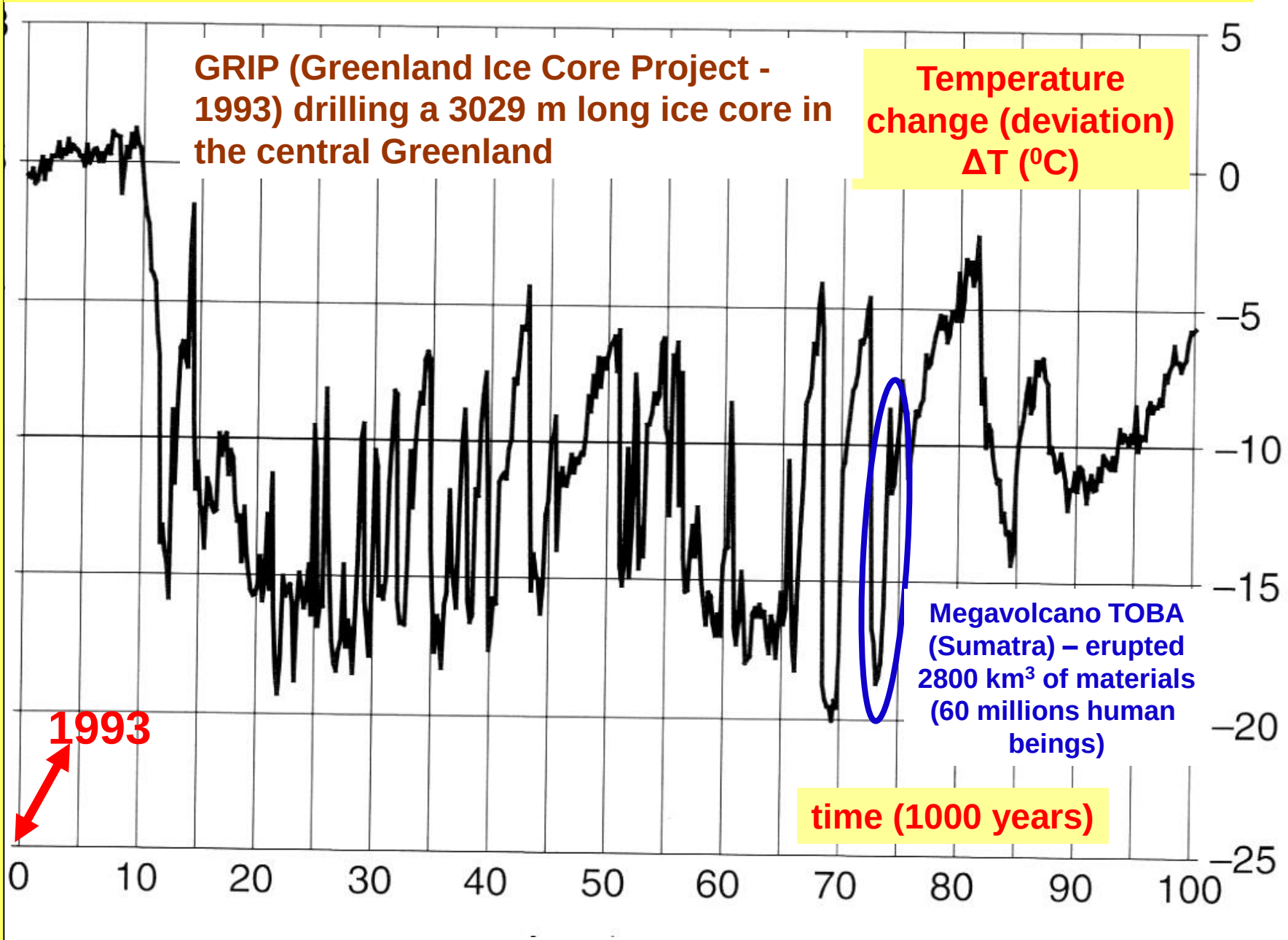




UNESCO & CAMBRIDGE UNIVERSITY PRESS 2003

The volcanic activity should be regarded as an important, if not the major, cause for the periods of cold climates during the Holocen. The problem is that it causes only short-term change. Issar (2003) suggests that a chain of events occurred, starting with strong volcanic activity. This caused short cold periods, which then caused high-pressure systems over the Goby and Sahara deserts, which led to heavy dust storms. It caused "red rains". They are reach in iron oxide and phosphate and act as fertilizers on the bio-environment of the oceans. This causes a bloom of phyto- and zoo-plankton, which are long-term CO_2 sink (more important than rain forest). This process continues until a certain equilibrium is reached. During the period of less volcanic activity, the CO_2 slowly returns to the atmosphere and a worm steady state is reached once again.

Assessment of temperature change on the Earth



Relationship between human beings and climate changes

LASCAUX CAVE, 12 Sep. 1940
ABOUT 17,000 Y. OLD

Picasso: “We have invited nothing!”

CHAUVET CAVE, 1994
OVER 30,000 Y. OLD

SEA LEVEL (m)

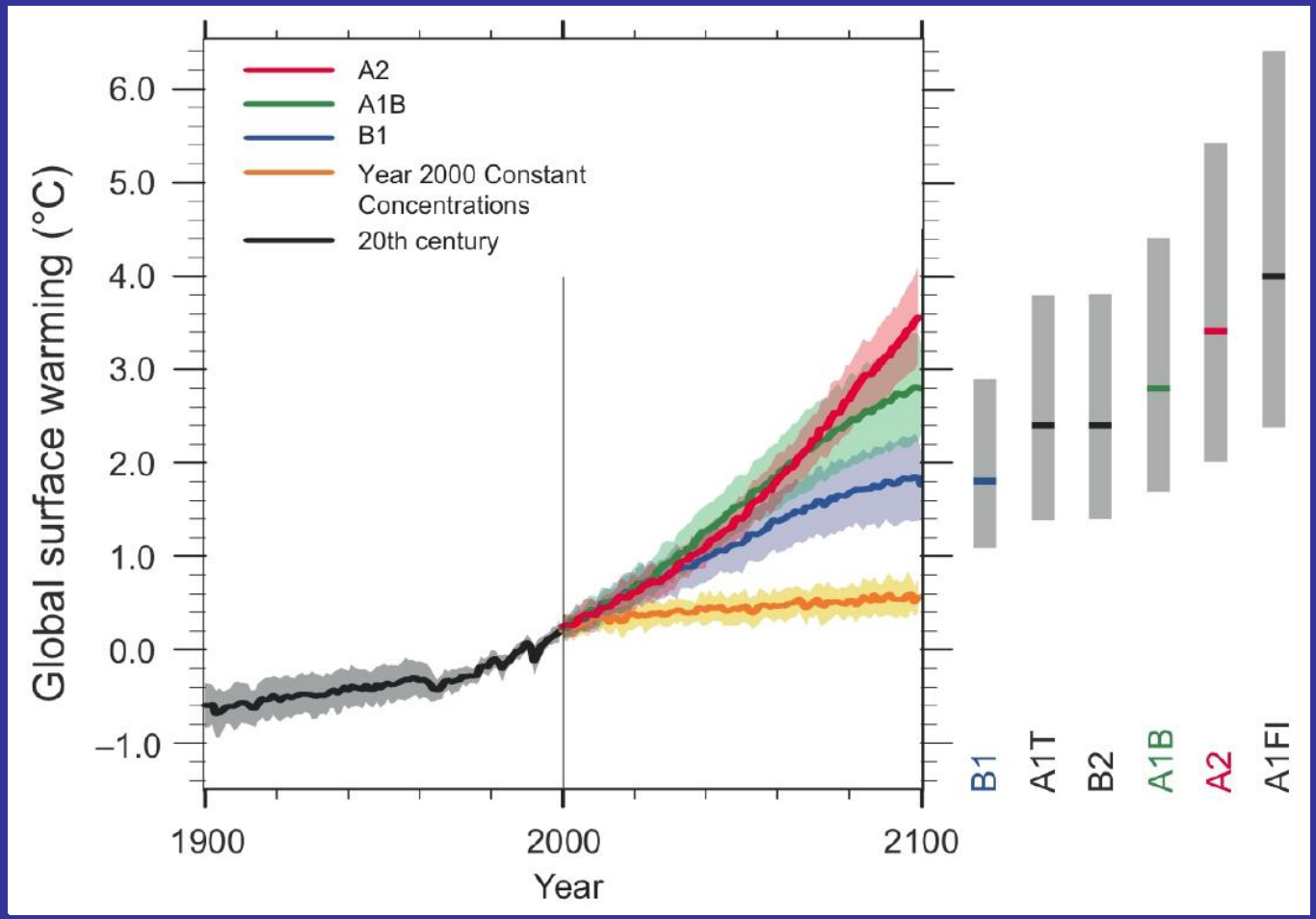
0
−20
−40
−60
−80
−100
−120
−140

0 10 20 30 40 50 60 70 80 90 100 110 120

time (1000 years)

Scenario Issues of Global Circulation Models

- Different GCMs gives very different results
- Which results should be used ??



MODELS AND CLIMATE

The aim of models in meteorology is to solve the equations describing the behaviour of the atmosphere, to determine the future values of its characteristics features from initial values known from meteorological observations.

Problem is that models are seen as absolute references: they pronounce; they predict; they confirm or deny; one might even say that they decide.

The predictions can be reliable only if the modelling has moved on to a deterministic level.

The best existing models have many shortcomings, which make impossible accurate prediction.

Great debate (EGU General Assembly, Vienna 16 April 2008)

IS MODELLING MORE THAN A FASHIONABLE INDOOR SPORT?

Invited speakers: Keith Beven, David Stainforth, Stephan Sobolev

We can't really know the weather will like more than two or three days ahead.

Real question is how reliable are all our predictions about climate changes in the future.

But now, it is unhesitatingly claimed, we can predict weather and climate as far ahead as the year 2100, from our viewpoint a century earlier.

Astrology or science!?

IPCC and Al Gore - Nobel prize for peace (not for science).

There are a lot of contraversy about climate change!

(www.friendsofscience.org/index.php?id=113)

"The policy of global climate change is, an emerging science, one that is perhaps the most complex ever tackled. It may be many years yet before we properly understand the Earth's climate system. We need to continue intensive research into the real causes of climate change and help our most vulnerable citizens adopt to whatever nature throws at us next . "

Anthropogenic influences

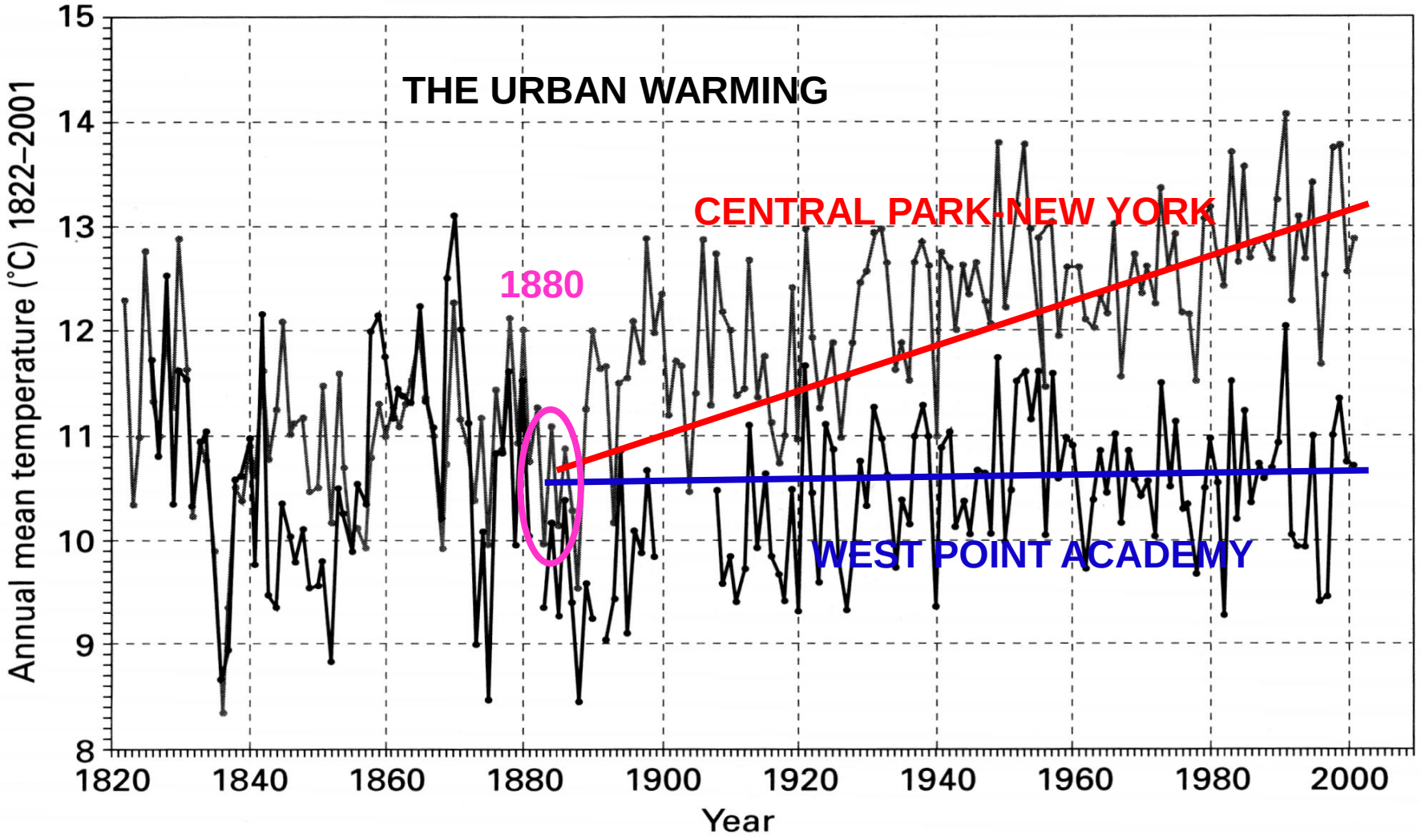


Figure 47. Annual mean temperature (°C), from 1822 to 2001, at: (*top*) Central Park in New York City; and (*bottom*) US Military Academy, West Point, NY.
From Daly (2003).

Solomon M. Hsiang ·Marshall Burke

Climate, conflict, and social stability: what does the evidence say?

Climatic Change (2014) 123:39–55
DOI 10.1007/s10584-013-0868-3

Are violent conflict and socio-political stability associated with changes in climatological variables?

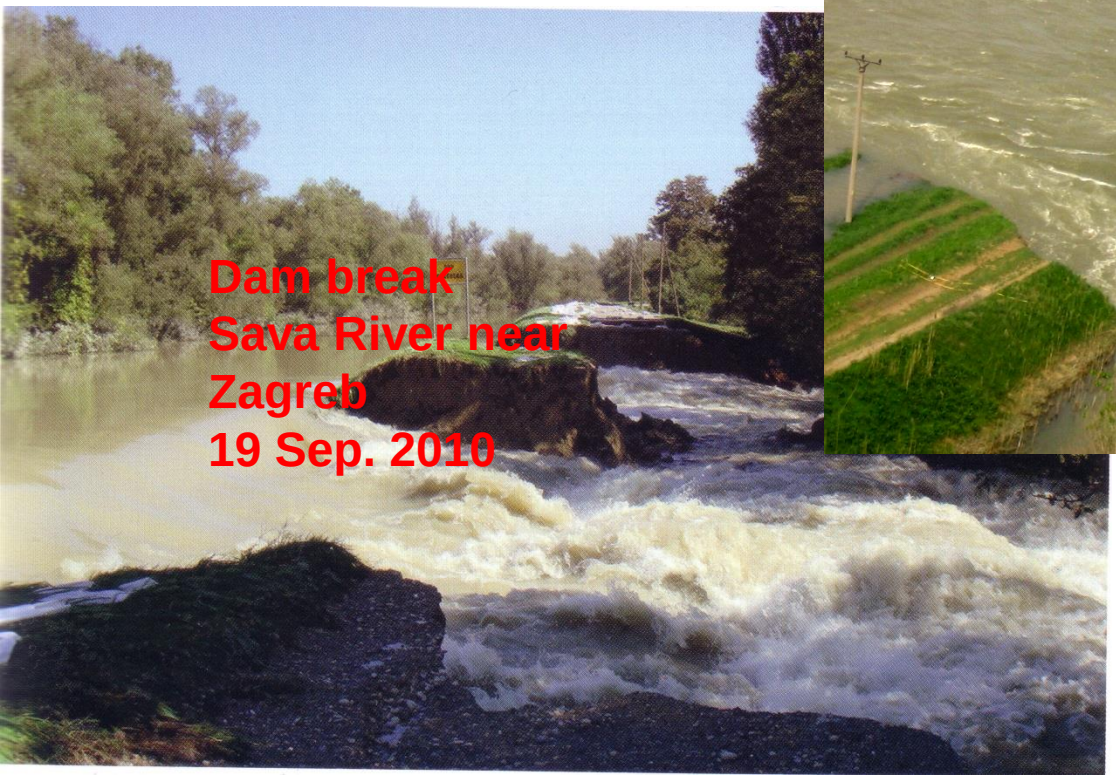
We examine 50 rigorous quantitative studies on this question and find consistent support for a causal association between climatological changes and various conflict outcomes, at spatial scales ranging from individual buildings to the entire globe and at temporal scales ranging from an anomalous hour to an anomalous millennium.

Multiple have been proposed and are sometimes supported by findings, but the literature is currently unable to decisively exclude any proposed pathway.

“Where are geosciences now”?

The time has come to bring the supposed “climate warming”, without its political, economic, and media overtones, **back to the field of climatology and geosciences**!
The whole scientific community; especially meteorologists, climatologists, hydrologists and ecologists, should help gaining this goal.

FLOOD


Dam break
Sava River near
Zagreb
19 Sep. 2010


Dam break
Mississippi River
May 2011

Desert area

Nevada & Kashmir floods 10 Sep. 2014

Monsoon area

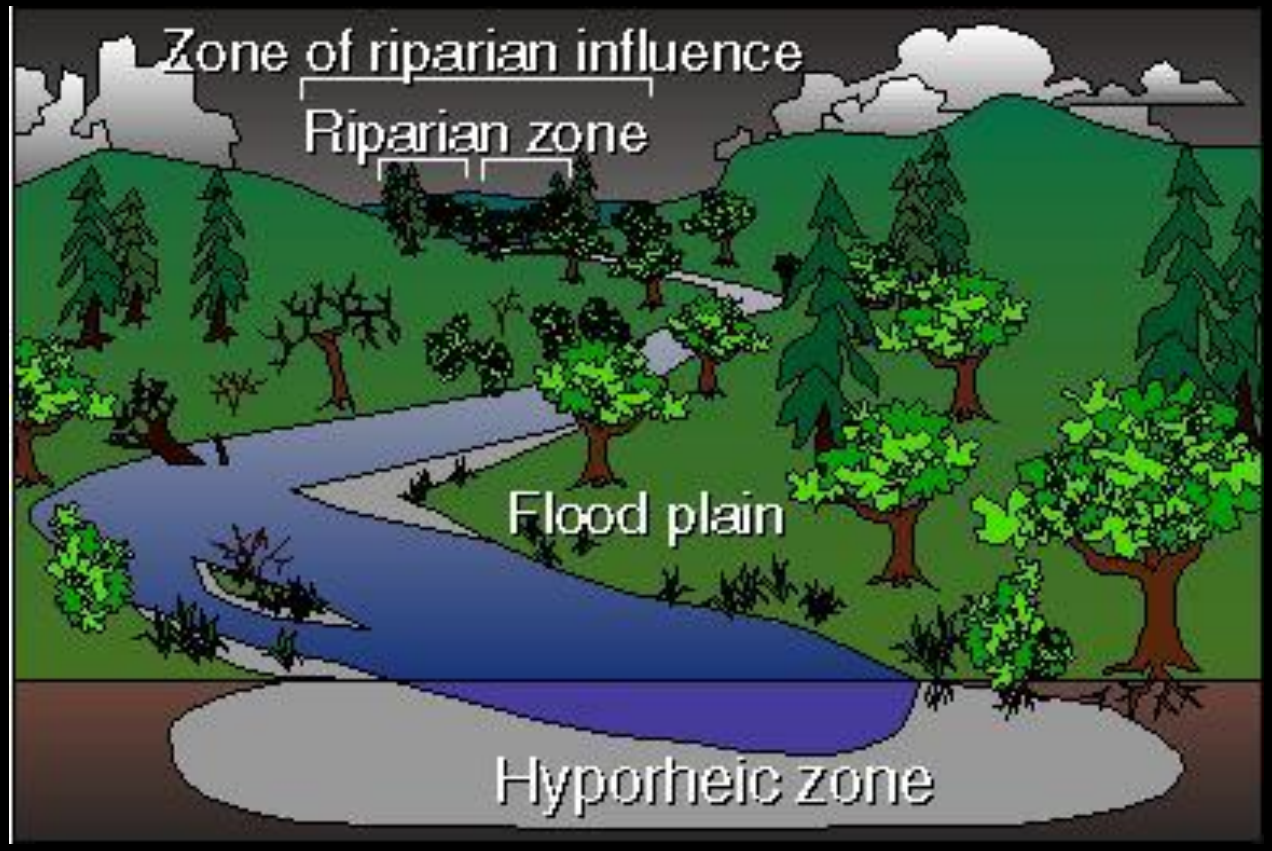
Budapest – Parliament
2006 Mar.-Apr.

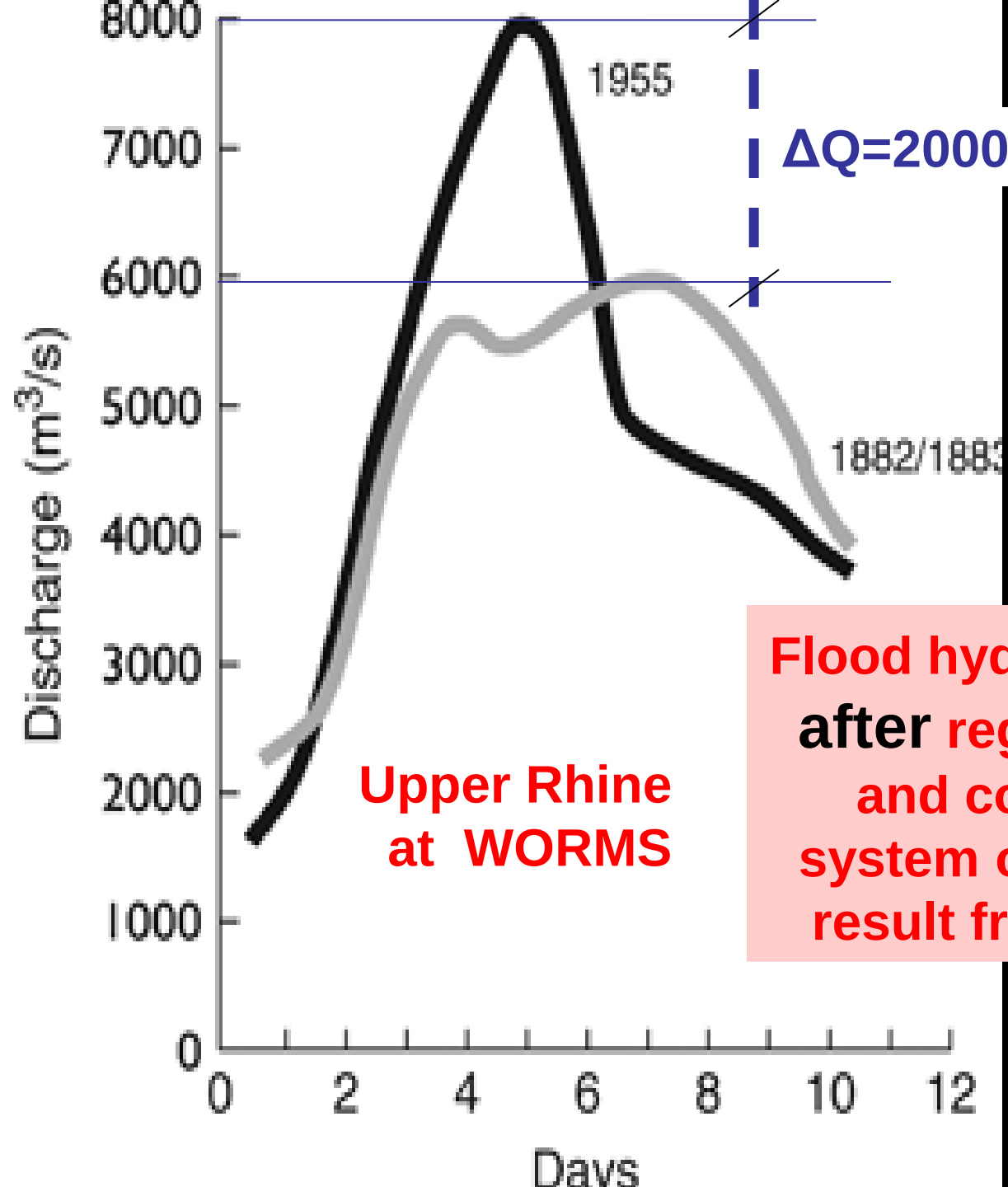
Floods are one of the most dramatic interactions between human beings and environment. They emphasise the sheer force of natural events and man's inadequate efforts to control them. Today it is certain that floods resulting in significant inundation cause larger disasters than in earlier times. Protective measures often are counterproductive. They may result in higher damages than would otherwise have occurred.

At the same time flooding brings many benefits particularly for ecological variability and soil fertility. Flooding promotes exchange of materials and organisms between habitats and plays a key role in determining the level of biological productivity and diversity. The beneficial aspects of flooding are less obvious to many people. Due to those facts in floodplain management it is important to understand all different aspects of flood flow behaviour.

Floodplains are oasis of agricultural development, and they are of major socio-economic and ecological importance.

It is obvious that only long systems of embankments cannot represent a final and safe solution to the problem of protection of floods. At the same time embankments cause many negative ecological consequences and decrease groundwater recharge.

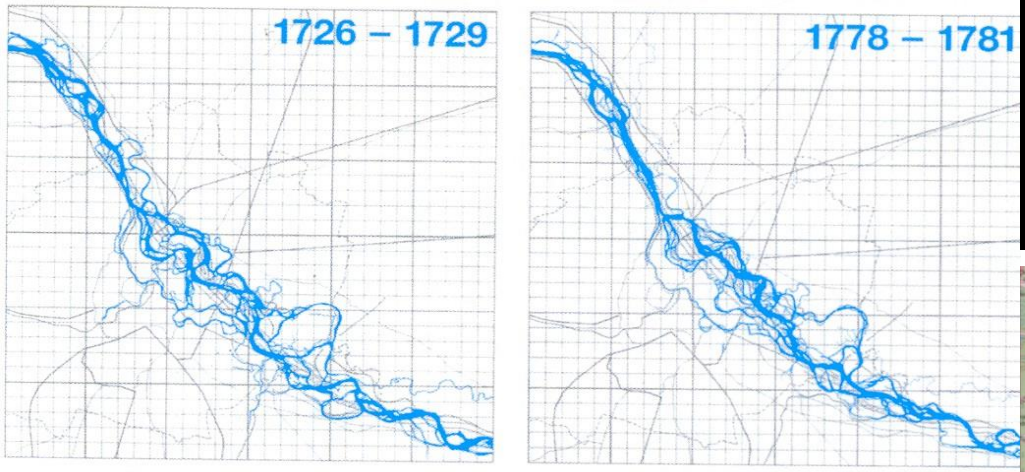


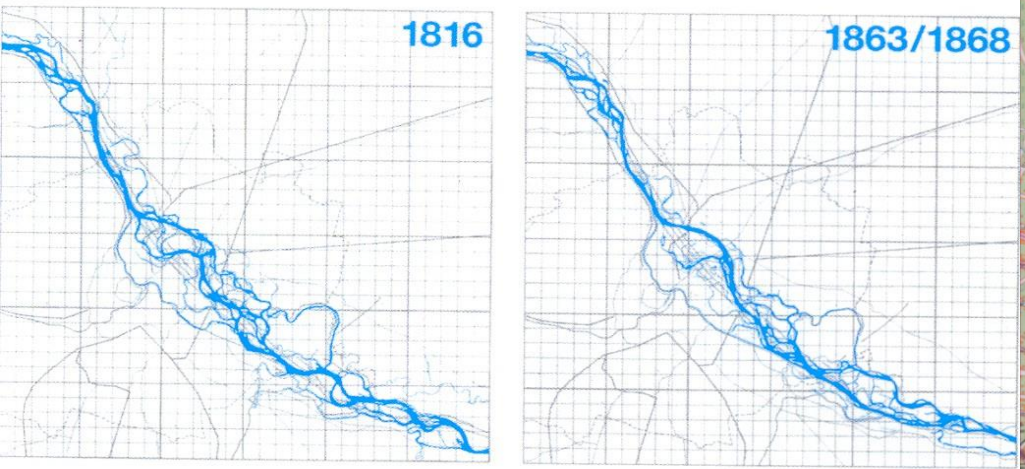


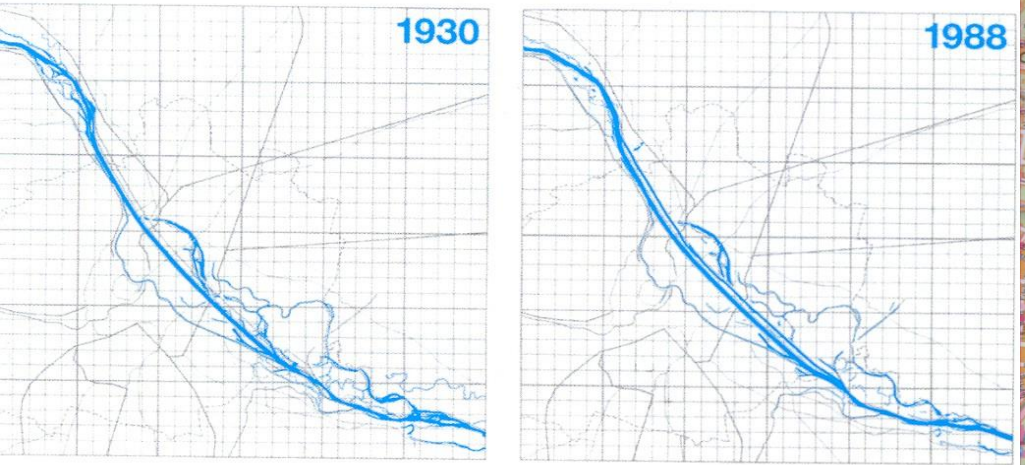
Flood hydrographs before and after regulation, canalization and construction of long system of embankments as a result from the same rainfall

Floodplain restoration is one of the crucial goals of the new integrated flood management approach. The most important prerequisite in improving the management is understanding the floodplain ecology.

River bed of the Danube River near Vienna (Austria) (1726-1988)

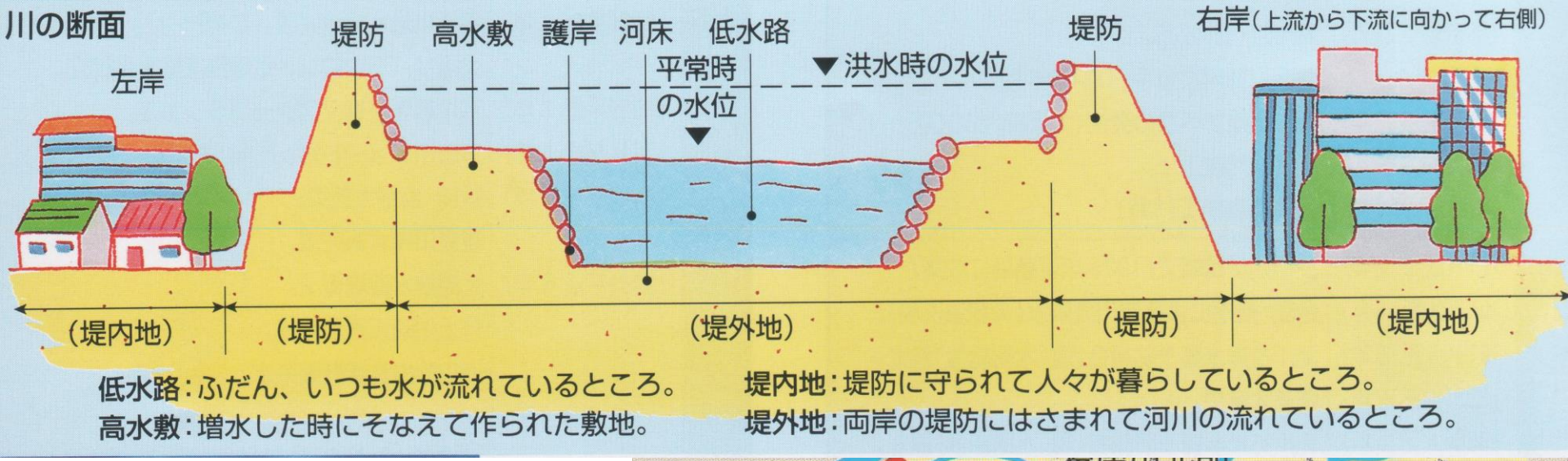






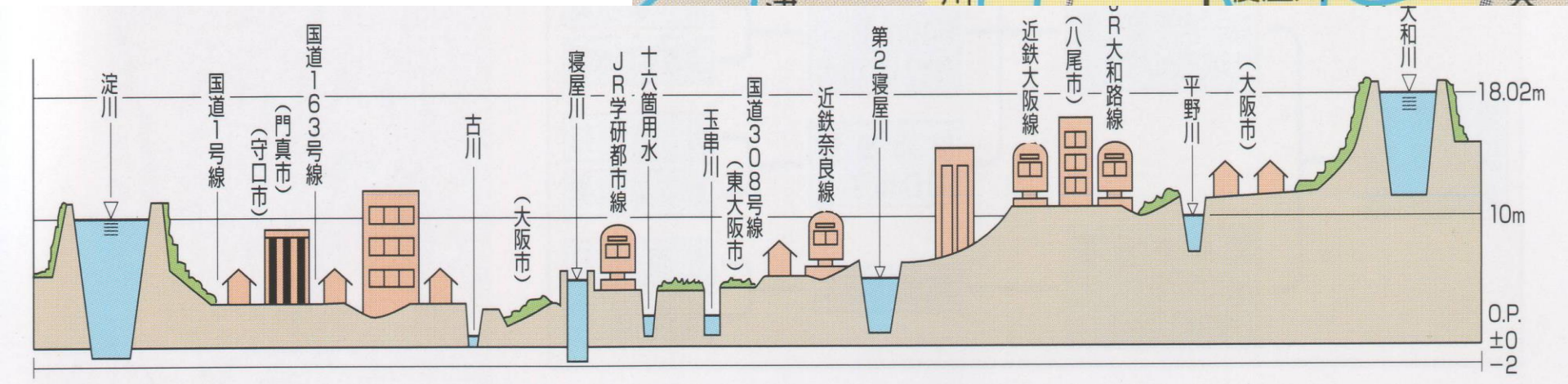
Vienna River in the centre of Vienna.
Is this cannal too large?

PARIS
RIVER SEINE
COASTLINE
Is it an example of sustainable development?



Japanise urban water management

OSAKA (Japan)



Living with flood !!

A flood-protection system guaranteeing complete safety is an illusion. Due to this reason it is necessary to live with awareness of the possibility of floods. Now the emphasis is on living with floods rather them fighting them. Living with floods recognises that while it is not possible to completely eliminate floods, their negative impacts can be reduced through an understanding of flood risks and by working towards modifying this risk-generation process in a holistic manner.

Drought

Drought is harsh climatic event and natural disaster. Their impact on the environment, their socio-economic and political effects lead to disturbance of th ms, to cial up sive dis ally would be available in a region and to which nature and mankind have adapted over centuries. Droughts build up gradually and passively as the cumulative effect of below-average precipitation in a given area during a certain period.

Drought is worse water hazard than flood but less attractive for media!

Aral Sea

Using of water for irrigation for cotton plant

Sustinable solutions?!

Limited quantity of non-renewable groundwater reserves in desert.

Jordan
use of groundwater for irrigation in desert

Integrated water resources management (IWRM) and sustainable development

For a long time, mankind has seen the world as an inexhaustible resource to be used for its own profit. Humans especially learned to bring water where and when they needed it. Today, under the combined pressures of increased demand, water-related disasters and the deterioration of water quality, traditional management approaches have failed.

It is responsibility of the international scientific community to develop new approaches that will allow for satisfaction of human needs while maintaining the quality of environment.

The main objective of scientific community is to discuss and propose possible solutions for more effective measures for water hazards mitigation using IWRM based on principles of sustainable development.

World Water Council gives next actions required to achieve objectives of IWRM: 1) Involve all stakeholders in integrated management; 2) Move to full-cost pricing of water services for all human uses; 3) Increase public funding for research and innovation in the public interest; 4) Recognise the need for co-operation on integral water resource management in international river basin; 5) Significantly increase investments in water.

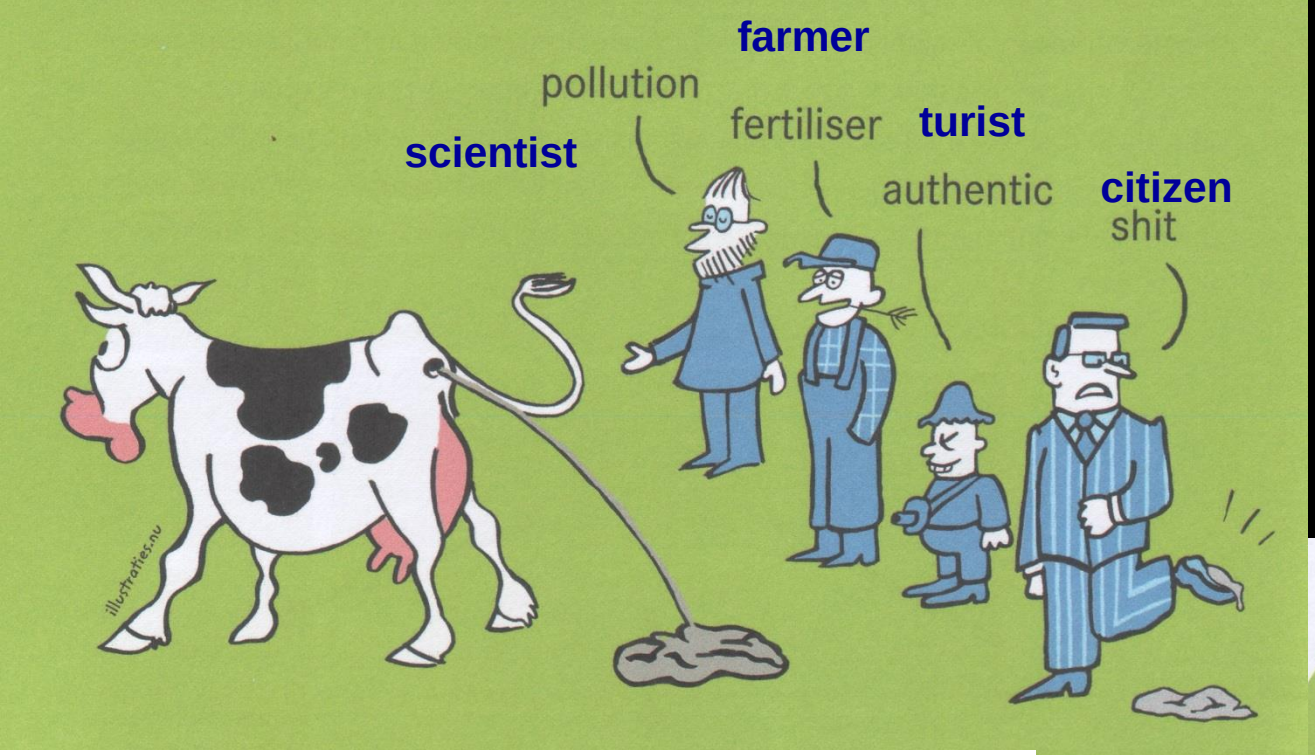
CONCLUSIONS

Humanity has not only learned a great deal from its successful achievements, but also from its errors.

Of special importance is the establishment of firm network of contacts with leading independent scientists, who promote new ideas and concepts independently of mainstream directions. Transfer of information across spatial and temporal scales is one of the most fundamental issues in the water hazard and risk management investigation. In order to better solve or mitigate future water problems, there is an urgent need to improve strategies, approaches and solutions that will lead towards holistic, more effective and sustainable management.

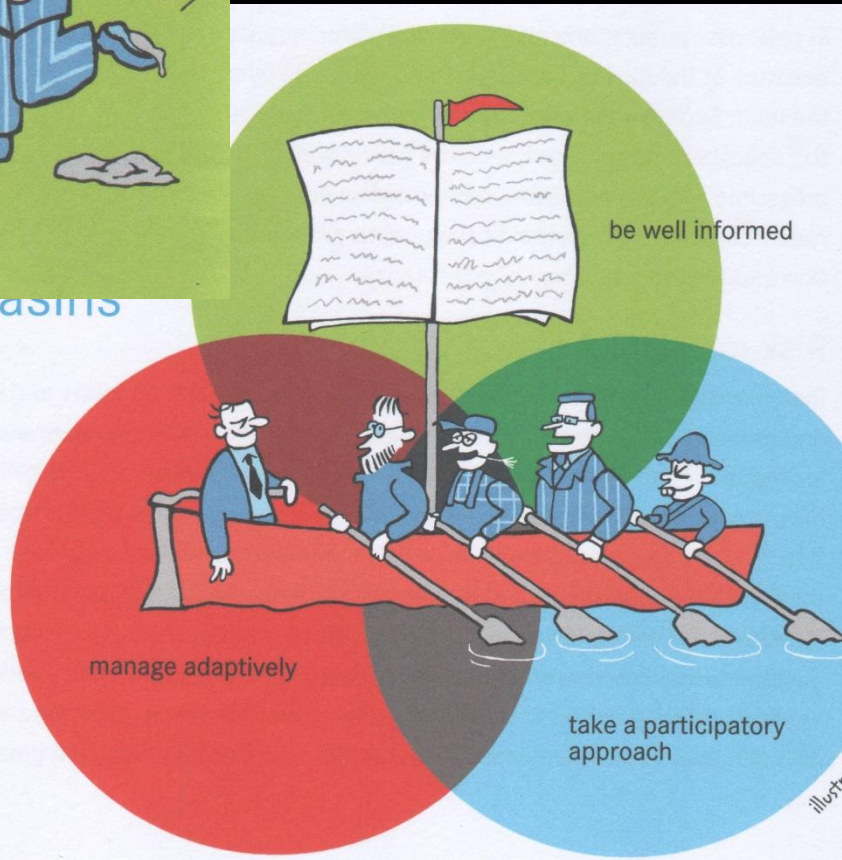
The challenge we all have

How to put the water importance in the minds of people?



How to realize these principles?

Guiding principles to risk-based water and all other resources management



Brills J & Harris B (Eds.) 2009, Towards Risk-Based Management on European River Basins. Key-findings and recommendations of the RISKBASE project, EC FP6 reference GOCE 036938, December 2009, Utrecht, The Netherlands

We are living in a fast changing world. Many of the existing, as well as expecting changes force us to develop adaptation strategies, especially for the water resources management.

We can only develop adaptation strategies if we completely understand their cause and effects, and if we can anticipate the expected changes.

Cooperation around water, for water and through water, must happen everywhere and continuously. In the water sector, the approach is still too often based only on hydrological and climatological data, on modelling and engineering, all relying on the application on scientific and mathematical principles to practical ends.

A synthesis of the Newtonian and Darwinian approaches to science, development of interdisciplinary science (for example ecohydrology), will offer opportunities for progress at the intersection of physics and ecology where many critical issues in earth system science reside.

“Anybody who can solve the problems of water will be worthy of two Nobel Prizes, one for peace and one for science”

(President J. F. Kennedy)


Thank you!
Nature is stronger than we can imagene!