LINKING HYDROLOGY TO SOCIETY WITH *Panta Rhei*

Hafzullah Aksoy

Leader – Target 2 (Estimation and Prediction)

Istanbul Technical University

Department of Civil engineering

Turkey

Outline

- Changes in Hydrology
- Modelling changes
- Society
- Panta Rhei

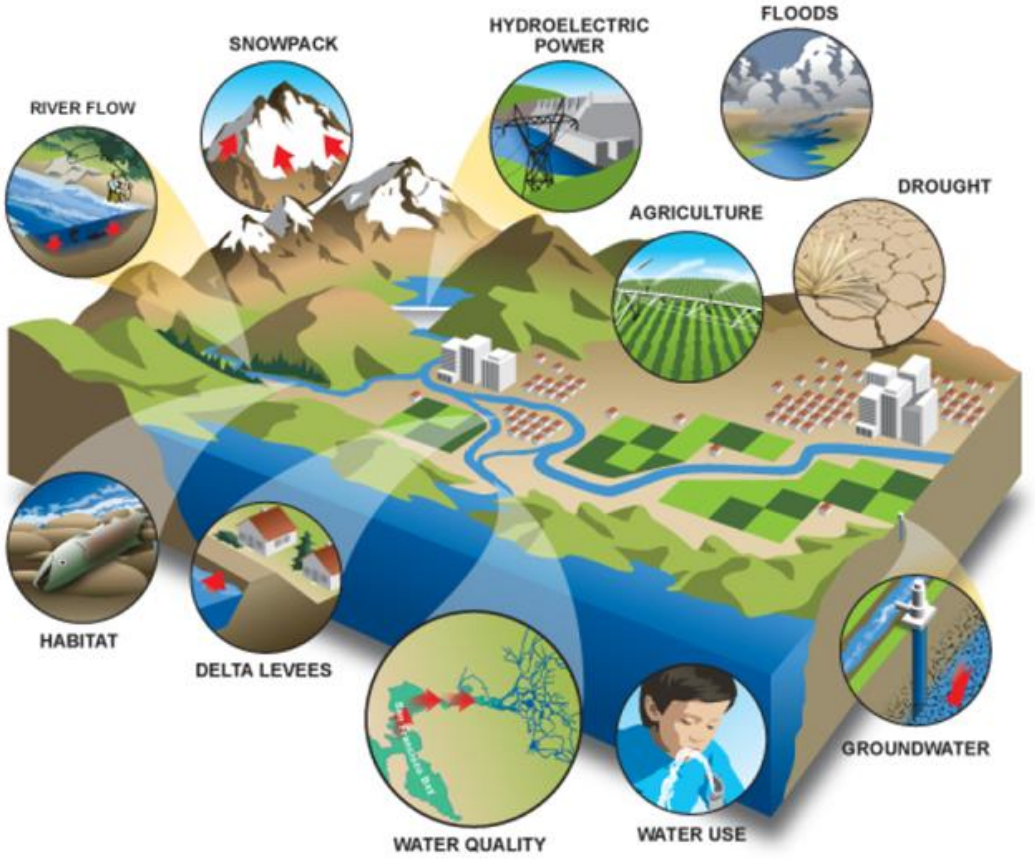
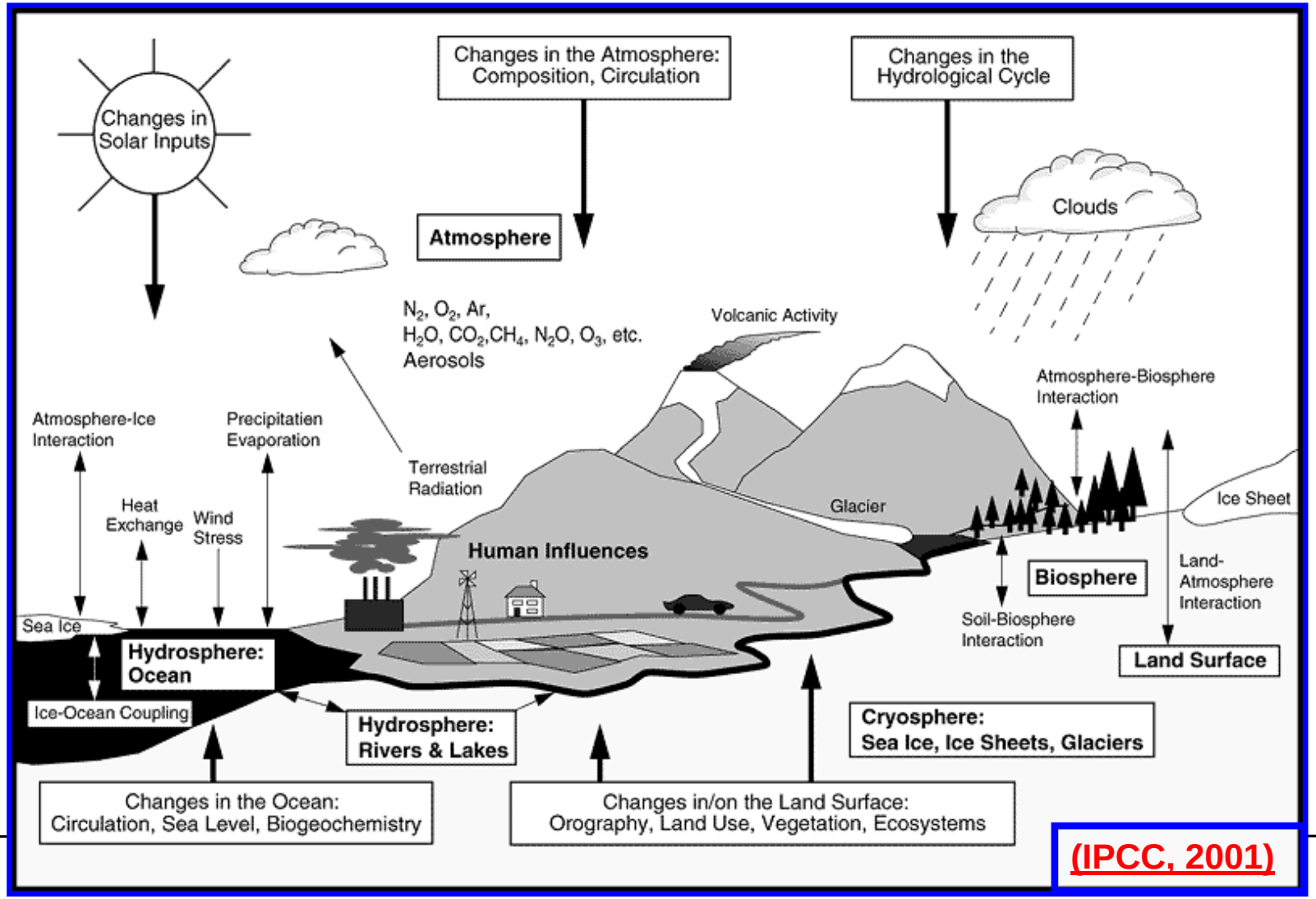
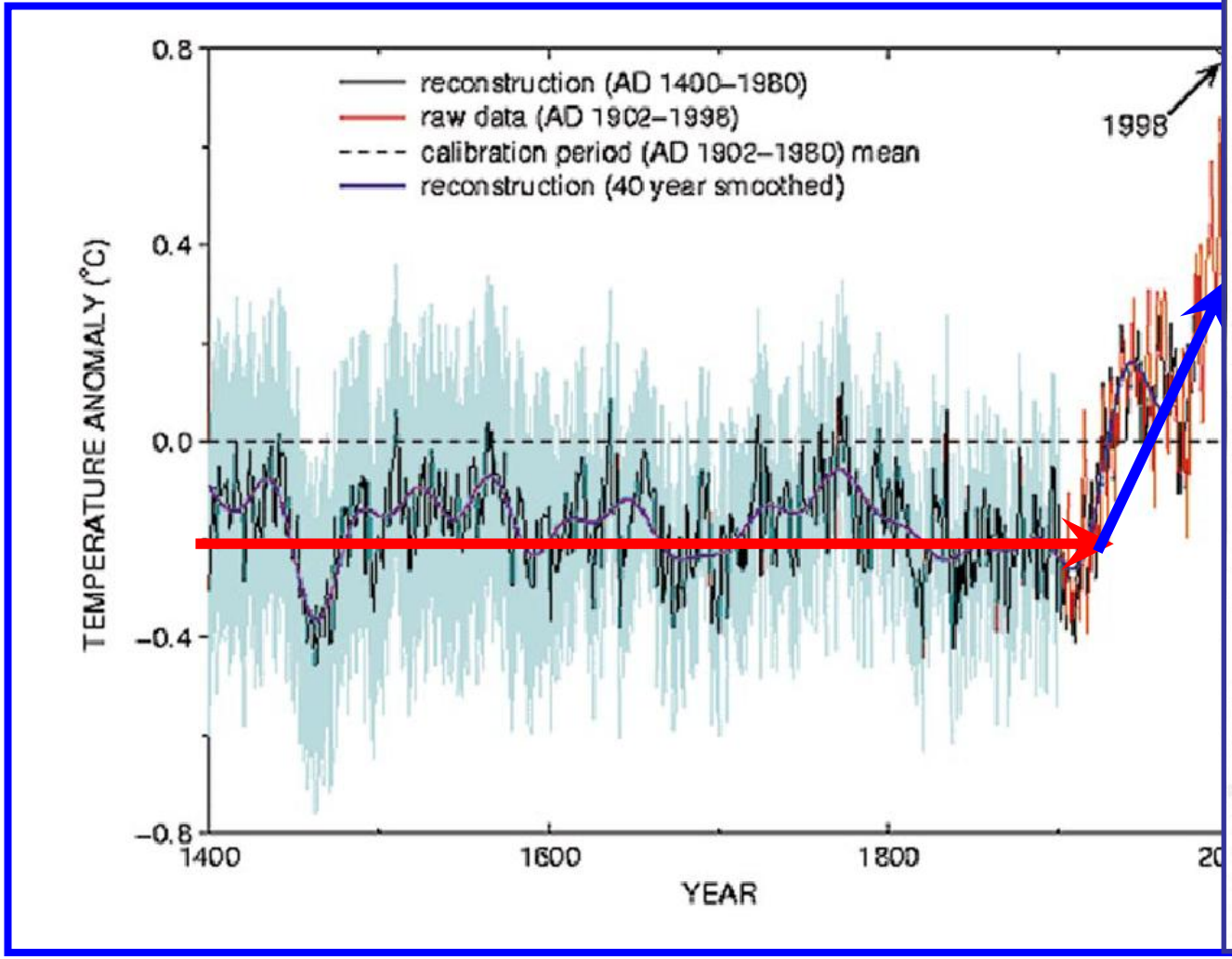


Figure 3. Links between hydrology and society (credit: California Department of Water Resources, http://www.water.ca.gov/climatechange/factsheet.cfm


Changes in Solar Inputs
Changes in the Atmosphere: Composition, Circulation
Changes in the Hydrological Cycle
Atmosphere
Clouds
N_2, O_2, Ar,
H_2O, CO_2,CH_4, N_2O, O_3, etc.
Aerosols
Volcanic Activity
Atmosphere-Biosphere Interaction
Atmosphere-Ice Interaction
Precipitation Evaporation
Terrestrial Radiation
Heat Exchange
Wind Stress
Glacier
Ice Sheet
Human Influences
Biosphere
Land-Atmosphere Interaction
Soil-Biosphere Interaction
Sea Ice
Hydrosphere: Ocean
Land Surface
Ice-Ocean Coupling
Hydrosphere: Rivers & Lakes
Cryosphere: Sea Ice, Ice Sheets, Glaciers
Changes in the Ocean: Circulation, Sea Level, Biogeochemistry
Changes in/on the Land Surface: Orography, Land Use, Vegetation, Ecosystems

(IPCC, 2001)

Climate Change



AGU - EOS

News

cont. from page 350

Congress Assesses Climate Change Paleodata

The 'hockey stick' graph of surface temperature change over the past millennium and implications for climate change assessments was the subject of two hearings held by the U.S. House of Representatives Energy and Commerce Subcommittee on Oversight and Investigations, on 19 and 27 July. These hearings marked only the second time that the committee has discussed climate issues since George W. Bush became president.

The hearings were called to investigate papers published in 1998 and 1999 by Michael Mann (Pennsylvania State University) et al. that showed that surface temperatures for most of the past millennium were flat and then rose significantly in the late twentieth century like the blade of a hockey stick. Their graph of temperature in the Northern Hemisphere during the past 1000 years was reconstructed from proxy data, such as tree rings, ice cores, and other indirect data sources.

Subcommittee Chair Ed Whitfield (R-Ky.) expressed concern that many people could interpret the graph—which also was published in the 2001 report by the Intergovernmental Panel on Climate Change (IPCC)—as definitive evidence of anthropogenic cause of climate change.

The Subcommittee commissioned an assessment of the papers as part of an investigation of the hockey stick and its origins. The report, prepared by a panel of statisticians chaired by Edward Wegman of George Mason University, Va., noted that the papers by Mann et al. were somewhat obscure and incomplete; that criticisms raised by Stephen McIntyre and Ross McKitrick in 2003 and 2005 [*McIntyre and McKitrick*, 2005] were valid and their arguments were compelling; and that the assessment that the 1990s was the hottest decade in a millennium and that 1998 was the hottest year in that decade could not be supported by the panel's analysis.

A second report evaluating the hockey stick, which the House Science Committee had requested from the U.S. National Research Council (NRC), was released on 22 June. Gerald North of Texas A&M University, chair of the NRC panel that authored the report, said the report emphasized there are other lines of evidence supporting the conclusion from Mann et al. that the climate is warming in response to human activities. In addition, he noted that the report supports the conclusion that the global mean surface temperature was higher during the past few decades of the twentieth century than at any comparable time during the preceding four centuries.

Republicans and Democrats on the subcommitee approached the hearing with different perspectives. Republicans thought it important to find how the hockey stick came about. They contended that although there might be some increase in global temperatures, these increases are not significant. They said additional research still is needed to understand whether global warming is taking place.

Democrats instead questioned the rationale for the hearings. They asserted that scientific consensus had been reached that anthropogenic global warming is taking place. They contended that it is more important to examine the potential impacts of global warming rather than continue to debate its existence.

McIntyre told the committee that little reliance should be placed on the original reconstructions or on any attempts to salvage them or similar multiproxy studies, no matter what methodology is used. He also questioned the lack of independence as practiced by the IPCC and the NRC panel.

The first hearing focused on the Wegman and NRC reports, while the second centered on Mann himself. At that hearing, Mann summarized what had transpired in his and other research since the original papers were published. He emphasized that other climate scientists had confirmed and independently reproduced the precise details of his earlier work. The evidence for human-induced climate change does not rest solely or primarily on paleoclimate evidence or on his research, Mann said, noting that results from numerical modeling also have supported his findings.

John Christy, of the University of Alabama, Huntsville, who helped craft the IPCC 2001 statement regarding the hockey stick graph, explained that the original sentence in the IPCC report contained the qualifying term 'likely,' which indicated a low level of confidence in the decadal data related to the 1990s. However, the graph unfortunately became a prominent result of the chapter and attained some notoriety, Christy said.

Summarizing the state of scientific understanding of climate change, U.S. National Academy of Science President Ralph Cicerone, who also is an AGU past president, noted that there are many additional lines of evidence that demonstrate that the climate in changing, and that there is no doubt that the Earth is warming.

Reference

McIntyre, S., and R. McKitrick (2005), Hockey sticks, principal components, and spurious significance, *Geophys. Res. Lett.*, *32*, L03710, doi:10.1029/2004GL021750.

—EUGENE W. BIERLY, AGU Senior Scientist

Figure 4. The Bund in Shangai. A tremendous change occurred between 1990 (upper picture) and 2010 (lower picture).

Changing World

Changing World

Gola Urmiyey

Perugia, Italy July 2-13, 2007

50+IGY

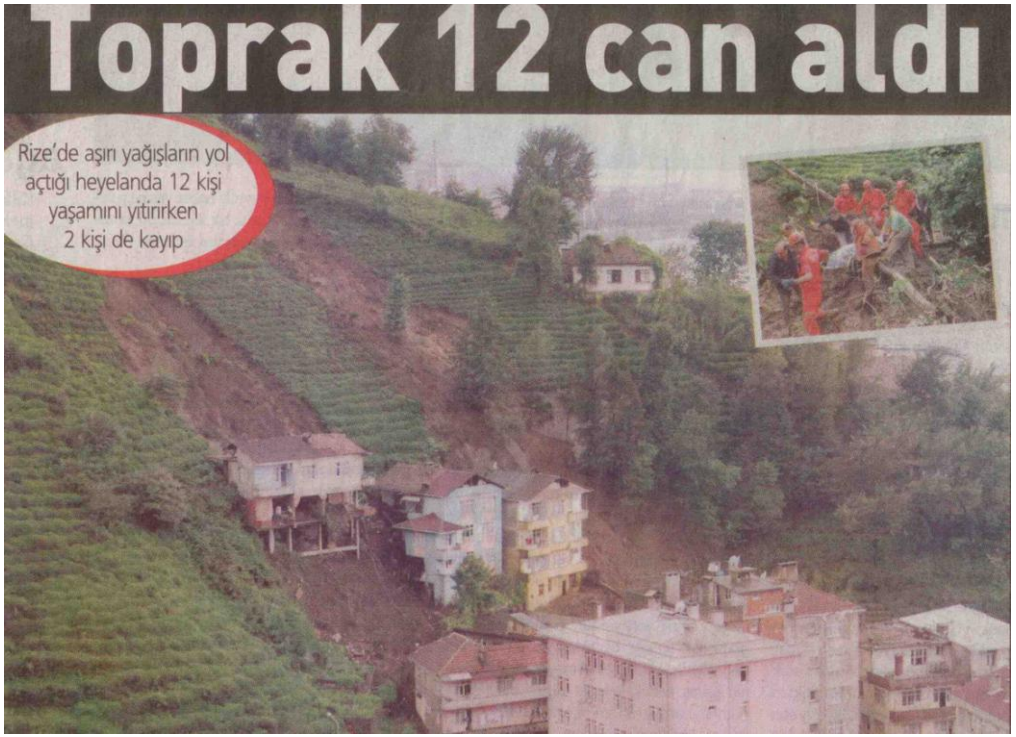
IUGG
XXIV 2007
PERUGIA
ITALY

EARTH: OUR CHANGING PLANET

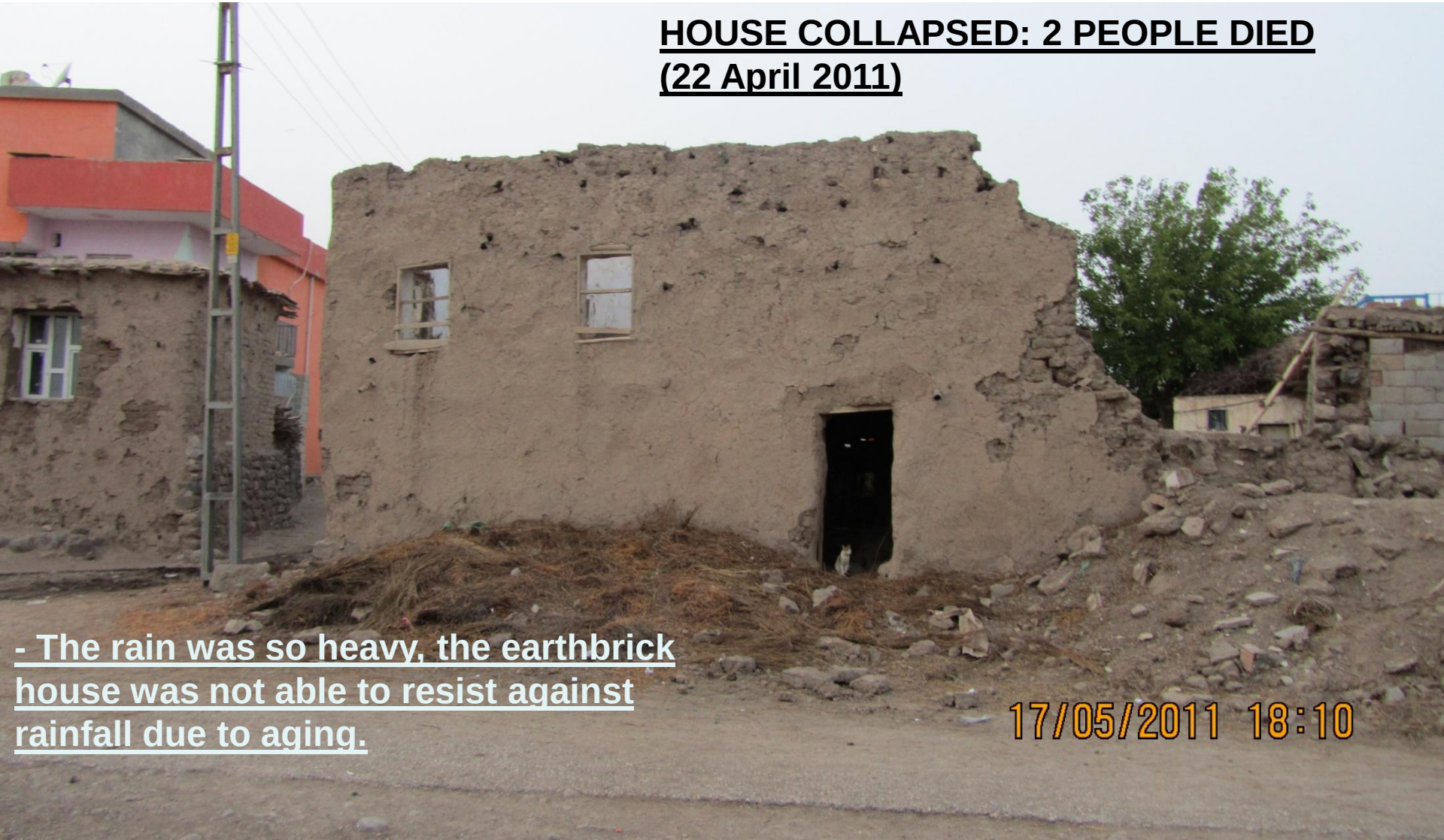
i web site: www.iahs.info/pantarhei

Resistance / No-Resistance of Nature to Change in Nature

Resistance / No-Resistance of Nature to Change in Nature



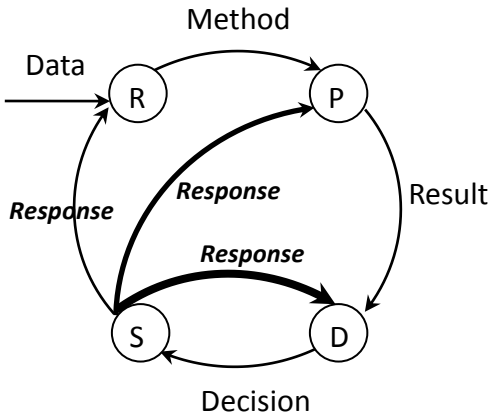
Resistance / No-Resistance of Nature to Change in Nature



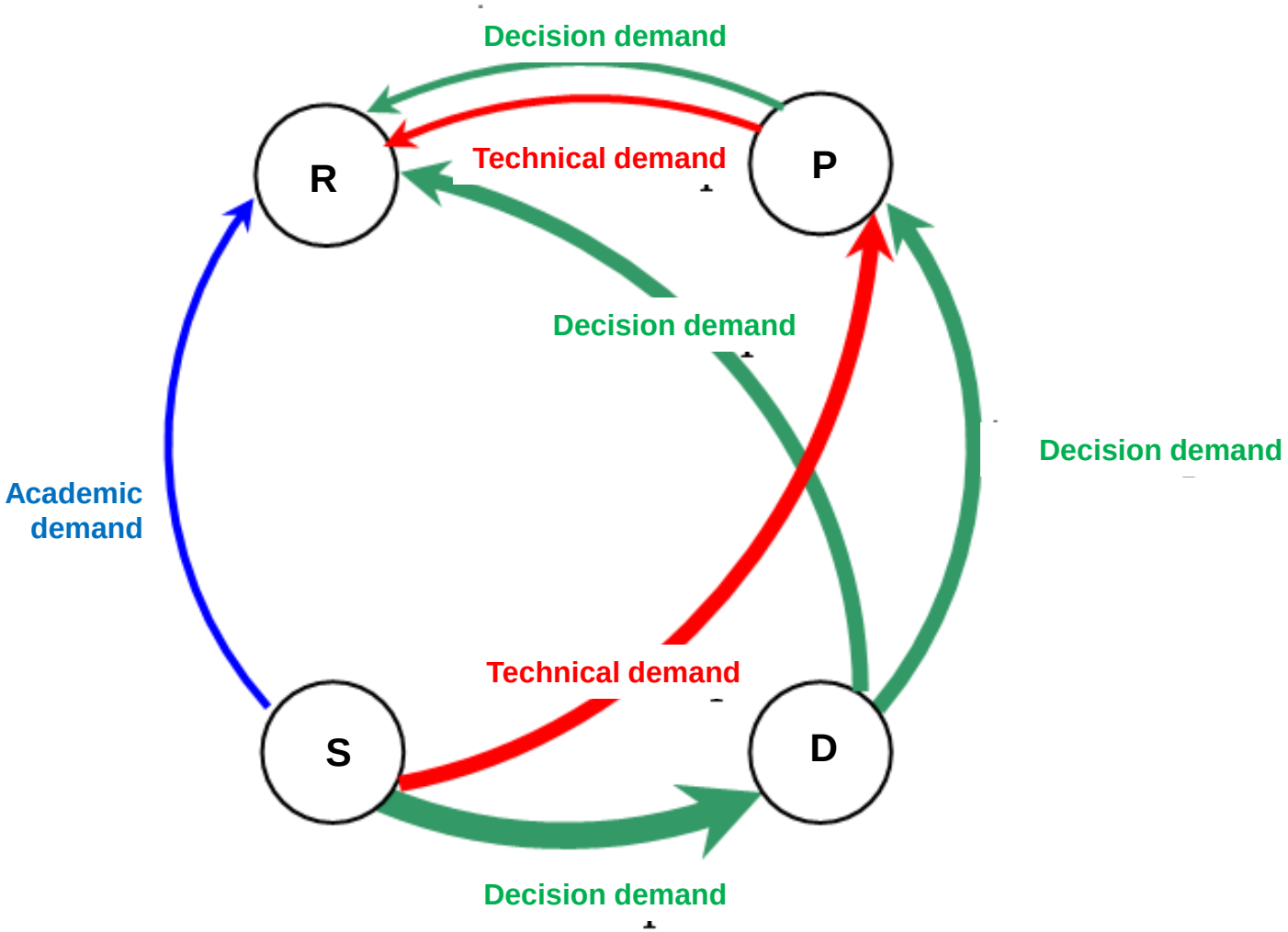
Changes in Hydrology

- Fast / slow
- Temporary / permanent
- Gradual / sudden
- Natural / man-made
- …etc.

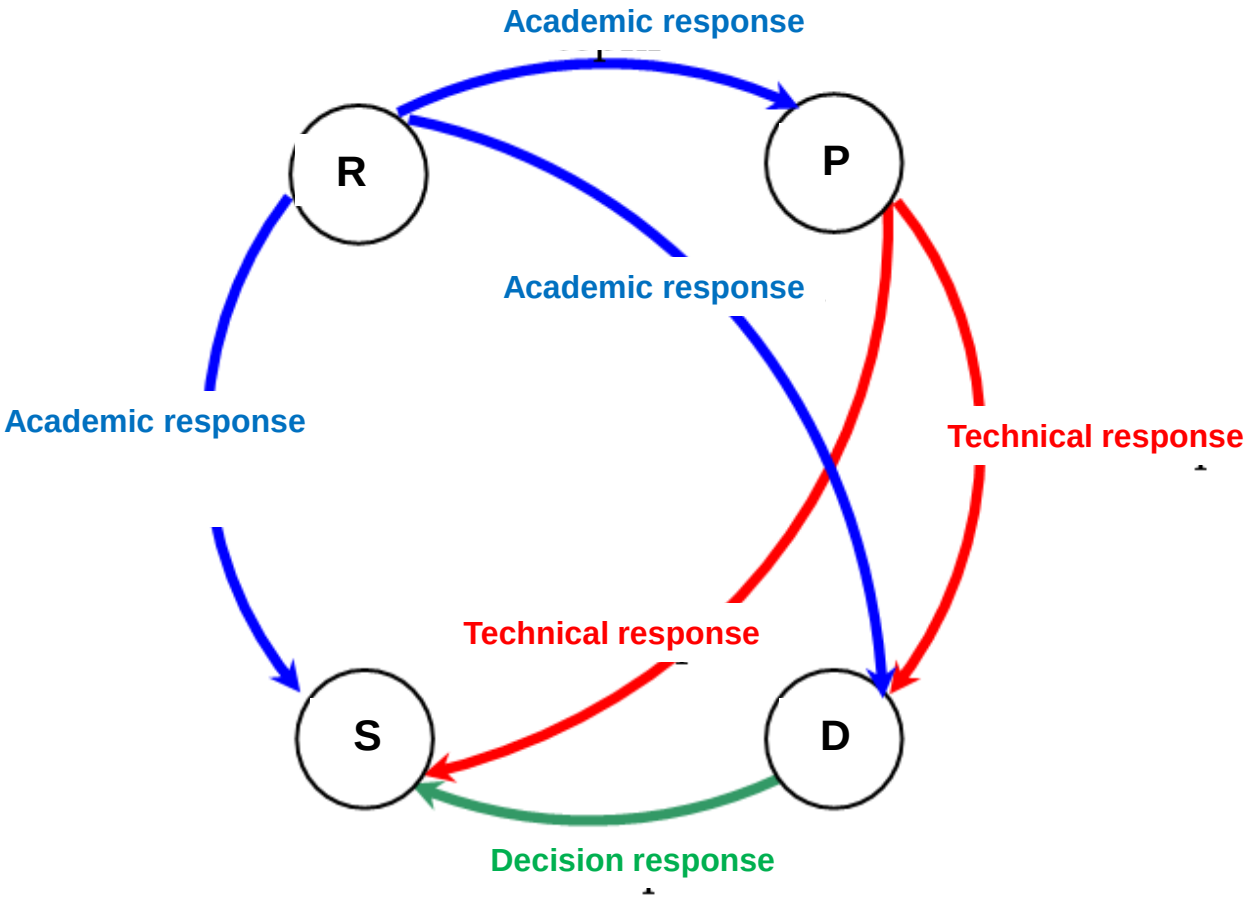
Research, Practice, Decision and Society



Society-based demands



Research-based responses

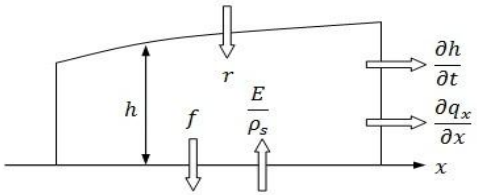


How can we model?

Academical / Theoretical Model

Erosion equation over interrill area

$$\frac{\partial hC_s}{\partial t}+\frac{\partial q_x C_s}{\partial x}+\frac{\partial q_y C_s}{\partial y}=\frac{E}{\rho_s}$$



where

$q_x = k_x h^{3/2},\quad q_y = k_y h^{3/2}$

and

$$k_x = \frac{C_z S_x}{S^{1/2}},\quad k_y = \frac{C_z S_y}{S^{1/2}}$$

After manipulation

$$\left(\frac{\partial h}{\partial t}+\frac{\partial q_x}{\partial x}+\frac{\partial q_y}{\partial y}\right)C_s + h\frac{\partial C_s}{\partial t}+q_x\frac{\partial C_s}{\partial x}+q_y\frac{\partial C_s}{\partial y}=\frac{E}{\rho_s}$$

$$(r-f)C_s + h\frac{\partial C_s}{\partial t}+q_x\frac{\partial C_s}{\partial x}+q_y\frac{\partial C_s}{\partial y}=\frac{E}{\rho_s}$$

Erosion terms

$E = E_r + E_f$

$E_r = \alpha r^\beta$

$$E_f = \begin{cases}\sigma(T_c - q_s) & T_c > q_s \\ 0 & T_c \le q_s\end{cases}$$

$$E = \begin{cases}\alpha r^\beta + \sigma(T_c - q_s) & T_c > q_s \\ \alpha r^\beta & T_c \le q_s\end{cases}$$

$q_s = \rho_s C_s q$

$q = C_z S^{1/2} h^{3/2}$

$T_c = \eta(\tau - \tau_c)^\varepsilon = \eta\tau^\varepsilon$

$\tau = \rho g h S$

$h(x, l_y, t) = h(x,t)$

$C_s(x, l_y, t) = C_s(x,t)$

$$(r-f)YC_s + Y^2 h\frac{\partial C_s}{\partial t}+k_x Y^{5/2}h^{3/2}\frac{\partial C_s}{\partial x}+k_y Y^{3/2}h^{3/2}\frac{\partial Y}{\partial y}C_s = \frac{1}{\rho_s}\left(\alpha r^\beta + \sigma\left(\eta(\rho g S)^\varepsilon Y^\varepsilon h^\varepsilon - \rho_s C_z S^{1/2} Y^{5/2} h^{3/2} C_s\right)\right)$$

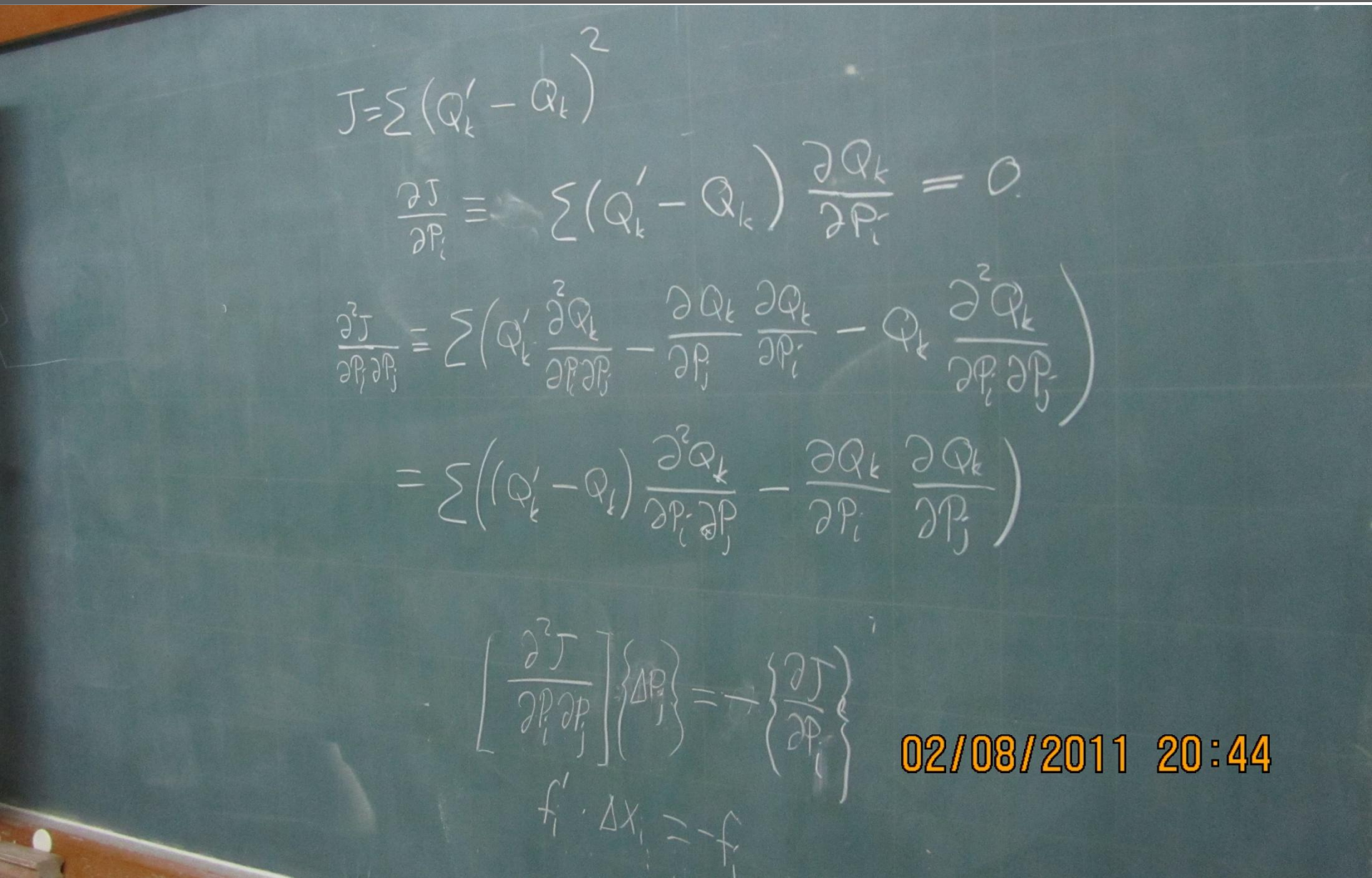
$$Y^2 h\frac{\partial C_s}{\partial t}+k_x Y^{5/2}h^{3/2}\frac{\partial C_s}{\partial x}+\left((r-f)Y + k_y Y^{3/2}\frac{\partial Y}{\partial y}h^{3/2}+\sigma C_z S^{1/2}Y^{5/2}h^{3/2}\right)C_s = \frac{\alpha r^\beta}{\rho_s}+\frac{\sigma}{\rho_s}\eta(\rho g S)^\varepsilon Y^\varepsilon h^\varepsilon$$

$$h\frac{\partial C_s}{\partial t}Y^2 + k_x h^{3/2}\frac{\partial C_s}{\partial x}Y^{5/2}+\left((r-f)Y+\frac{2}{5}k_y h^{3/2}\frac{\partial Y^{5/2}}{\partial y}+\sigma C_z S^{1/2}h^{3/2}Y^{5/2}\right)C_s = \frac{\alpha r^\beta}{\rho_s}+\frac{\sigma}{\rho_s}\eta(\rho g S)^\varepsilon h^\varepsilon Y^\varepsilon$$

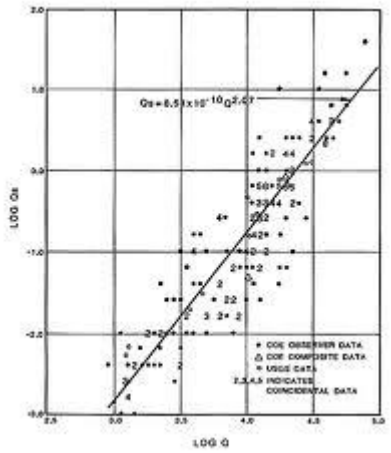
Let's integrate both sides on y from 0 to l_y

$$h\frac{\partial C_s}{\partial t}\int_0^{l_y}Y^2 dy + k_x h^{3/2}\frac{\partial C_s}{\partial x}\int_0^{l_y}Y^{5/2}dy + \left((r-f)\int_0^{l_y}Y dy+\frac{2}{5}k_y h^{3/2}\int_0^{l_y}\frac{dY^{5/2}}{dy}dy+\sigma C_z S^{1/2}h^{3/2}\int_0^{l_y}Y^{5/2}dy\right)C_s = \frac{\alpha r^\beta}{\rho_s}\int_0^{l_y}dy+\frac{\sigma}{\rho_s}\eta(\rho g S)^\varepsilon h^\varepsilon\int_0^{l_y}Y^\varepsilon dy$$

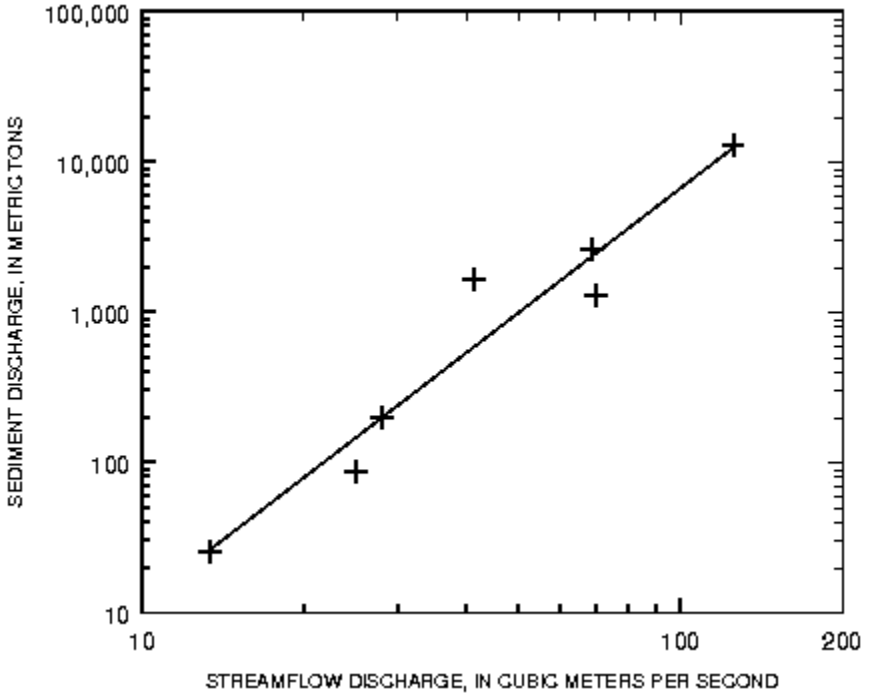
Academical / Theoretical Model



Technical / Practical Model



$$Q_s = aQ^b$$



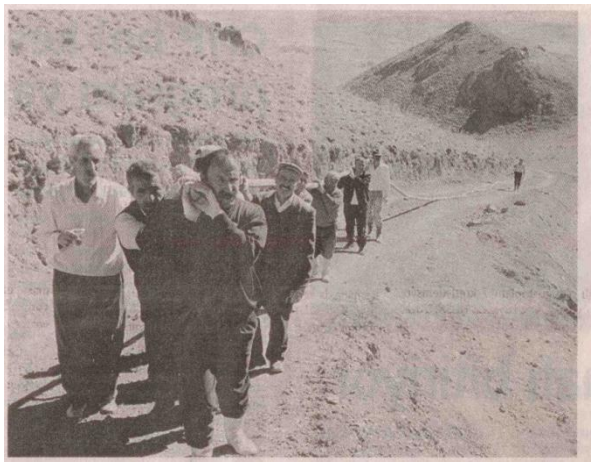
Decision model

max (Benefit – Cost)

max (Benefit / Cost)

* Environment to be affected (?)
* Culture to be destroyed (?)
* History to be submerged (?)

Society model



Project funded by the EUROPEAN UNION

SciNet NatHaz Prevention

Black Sea CROSS BORDER COOPERATION

Common borders. Common solutions.

Current Status of Flood Hazard Analysis in Turkey

İTÜ

Hafzullah Aksoy & Özgür Kırca

Istanbul Technical University, Department of Civil Engineering
Division of Hydraulics, 34469 Maslak, Istanbul, Turkey
(In collaboration with: Bosphorus University, Kandilli Observatory and Earthquake Research Institute, Istanbul, TURKEY)

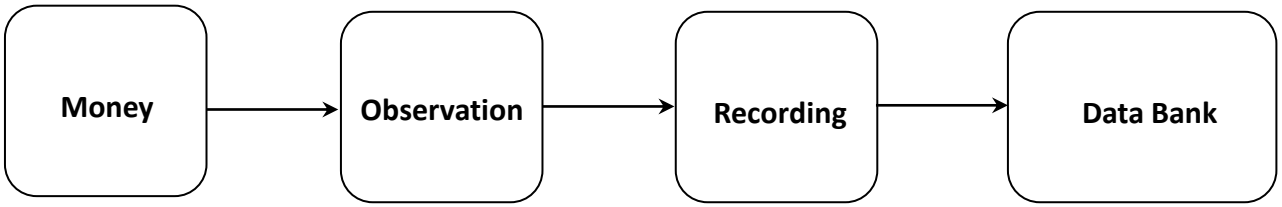
1868

Konstantinos Papatheodorou

Technological Educational Institute of Central Mecedonia, Department of Geomatics and Surveying, Serres, Greece

Data issue

Data Bank



ISTANBUL2009 5th WORLD WATER FORUM
BRIDGING DIVIDES FOR WATER

Session 6.4.1

Data Needs and Data Acquisition

What data should we put in the treasure chest?

Convener : **Arthur Askew (P, IAHS)**
Chair : **Gordon Young (PE, IAHS)**
Rapporteur : **Hafzullah Aksoy (VP, ICSW-IAHS)**

21 March 2009

Linking Hydrology to Society

- Hydrology has significant impacts on society.
- Changes in hydrology have direct impacts on society.
- Impact on individuals in the society and on the society as a whole.
- Hydrology and society are linked.
- Link between society and hydrology is very important.
- Substantial social arrangements are needed due to change in hydrological cycle.

SCIENCE PLAN FOR THE DECADE 2013-2022

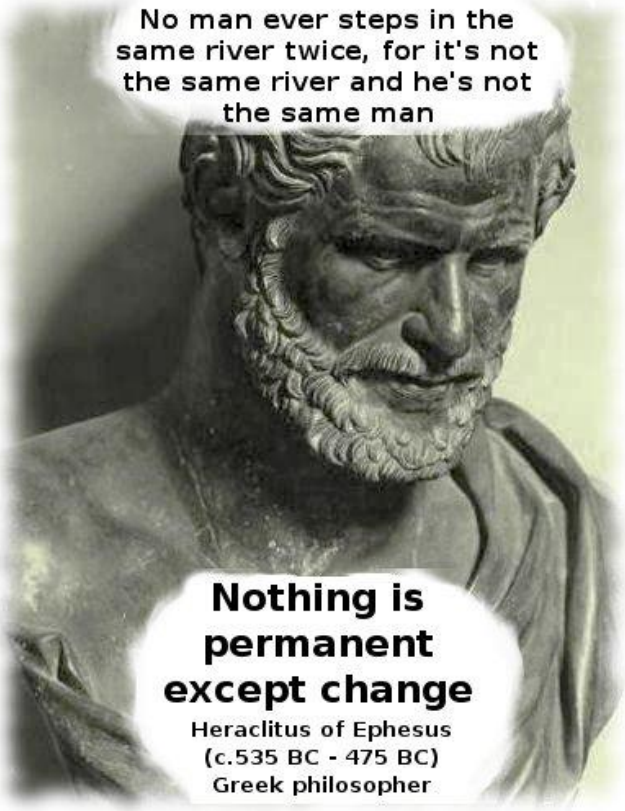
Panta Rhei

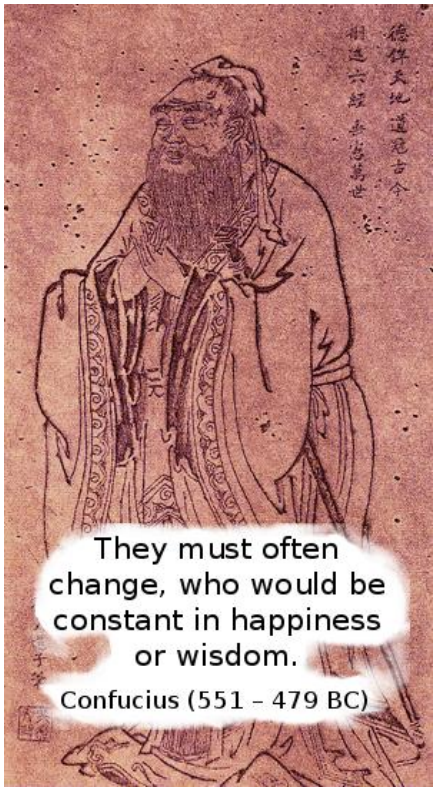
Thanks to:
Alberto Montanari
(University of Bologna)
Chair of Panta Rhei

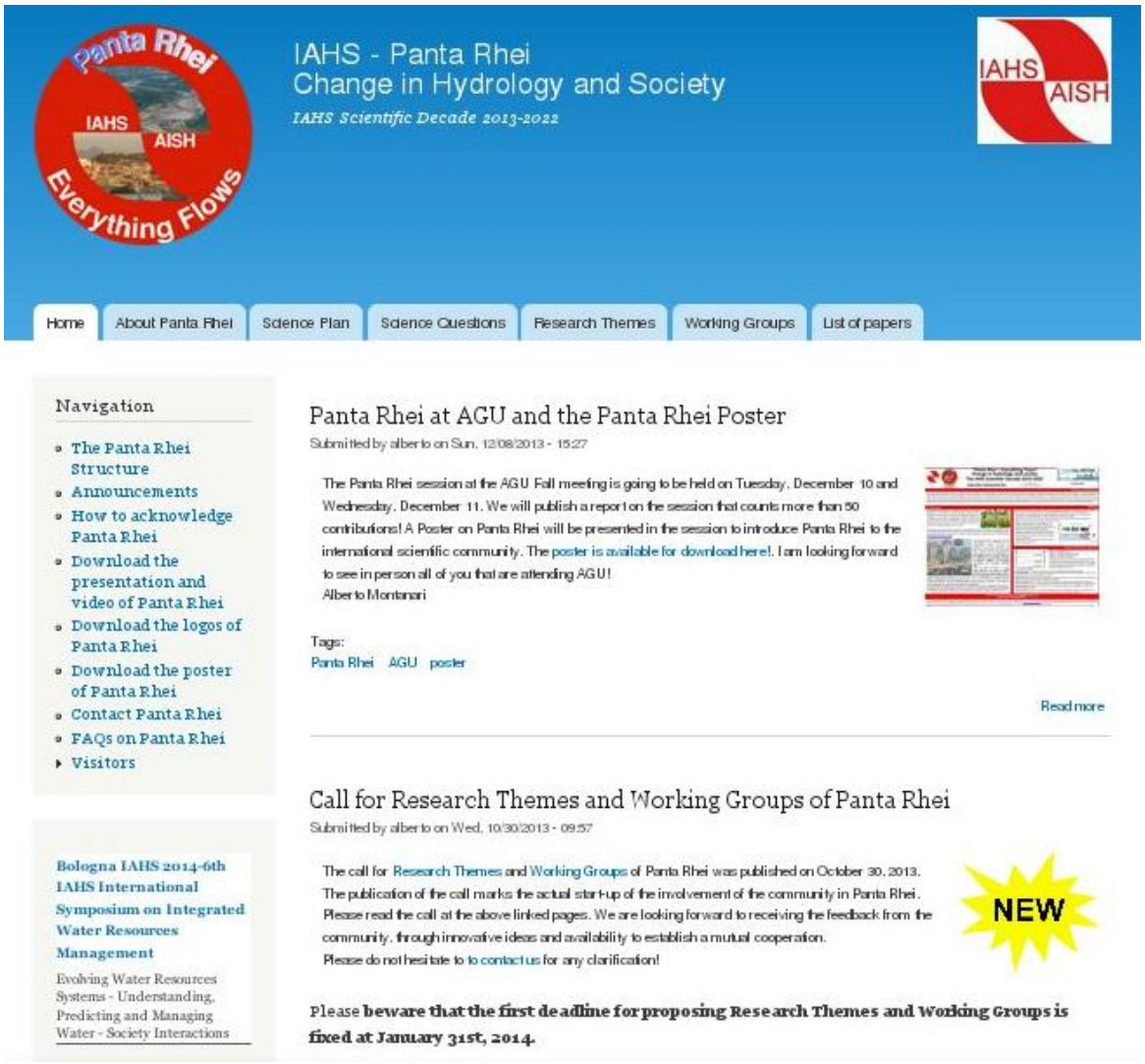
Panta Rhei: the IAHS Science Initiative 2013-2022

2013 change 2022

Launched in July 2013 at the IAHS General Assembly
Montanari et al. (2013)







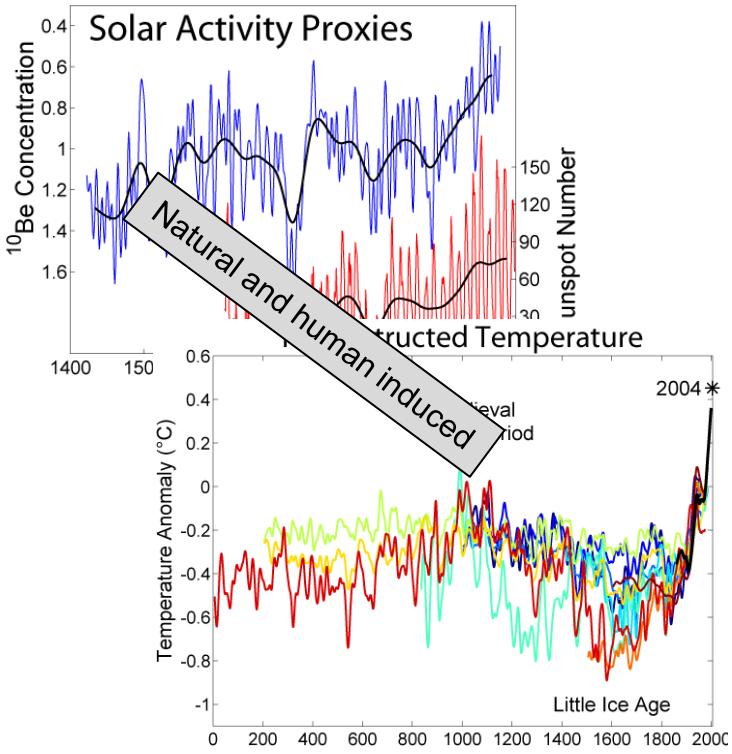
Panta Rhei Everything Flows

The new Science Initiative of the International Association of Hydrological Sciences (IAHS)
www.iahs.info/pantarhei

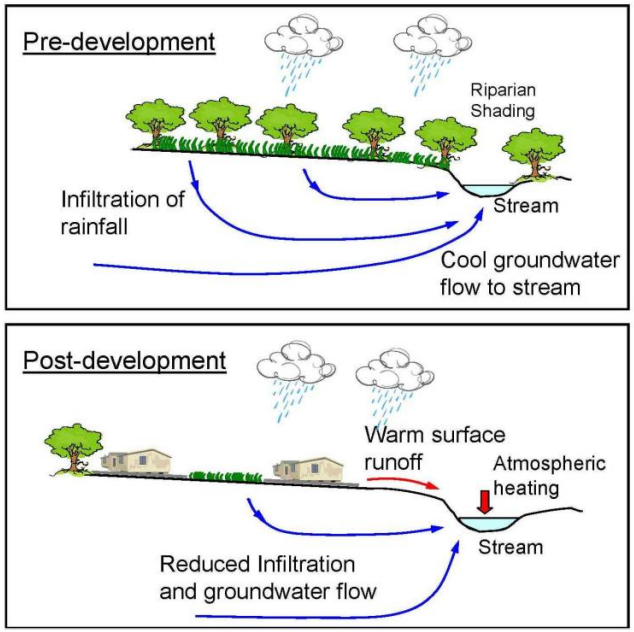
Hydrological Change:

"a well known unknown"

Climate change



Land use change



From University of Minnesota
http://troutstreamresearch.safl.umn.edu/

River training

Genoa – Flood event in 2011

Tunnelling of Seveso River

International scientific associations in Hydrology

EGU – European Geosciences Union
(www.egu.eu)

AGU – American Geophysical Union (www.agu.org)

IAHS – International Association of Hydrological Sciences (www.iahs.info)
(along with National Hydrological Associations)

Why research initiatives?

- Research initiatives focus the attention of people on emerging scientific challenges
- Favour international cooperation and comparison of research results
- Promote the formation of young researcher
- Promote the visibility of scientific publishing
- Promote the writing of “community papers”

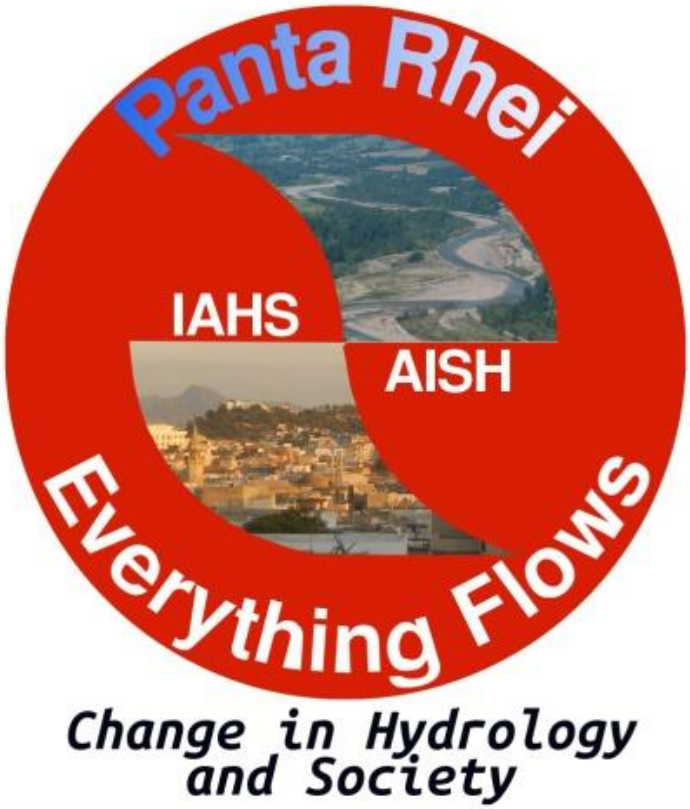
The IAHS Science Initiative 2013-2022
The result of a worldwide consultation

A Task Force was created by I
discussion.
Physical meetings with the cor
in Vienna, Nanjing, Tunis, Delf
The Task Force also created a
web-based discussion.

http://distart119.ing.unibo.it/iah

About 32000 single visits in 20
About 60 comments by 36 diffe
A long series of personal emai

The consultation was a very si
and professional experience.



The IAHS Science Initiative 2013-2022 Change in Hydrology and Society Science Plan

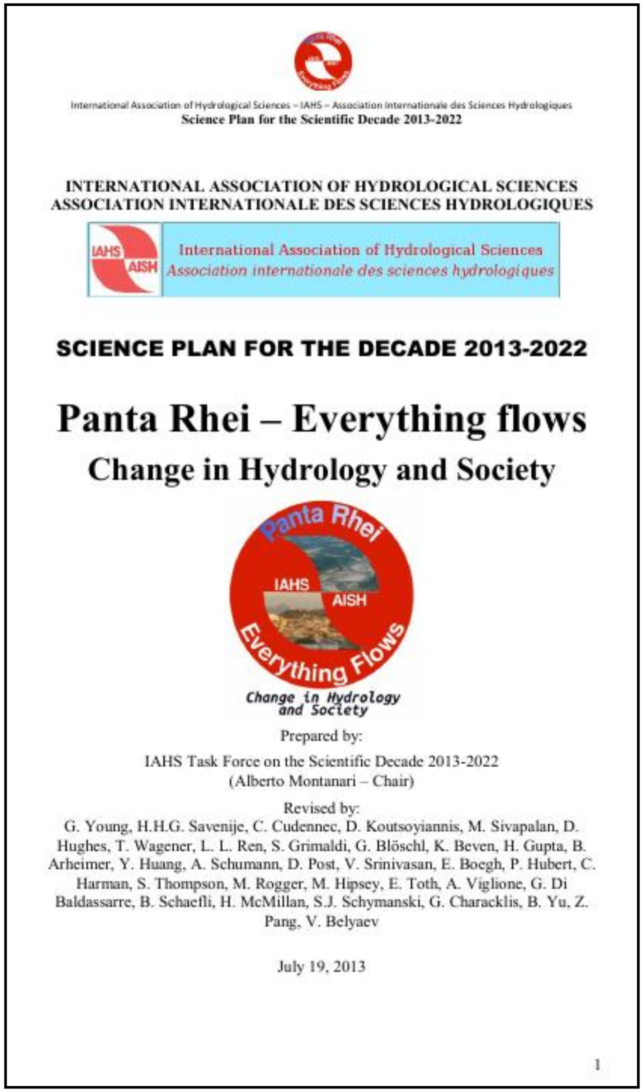
Targets:

- Understanding.
- Estimation and prediction.
- Science in practice.

Science questions:

- What are the key gaps in our understanding of hydrologic change?
- How do changes in hydrological systems interact with and feedback on natural and social systems driven by hydrological processes?
- What are the boundaries of coupled hydrological and societal systems? What are the external drivers and internal system properties of change? How can boundary conditions be defined for the future?

- How can we use improved knowledge of coupled hydrological-social systems to improve model predictions, including estimation of predictive uncertainty and assessment of predictability?
- How can we advance our monitoring and data analysis capabilities to predict and manage hydrological change?
- How can we support societies to adapt to changing conditions by considering the uncertainties and feedbacks between natural and human-induced hydrologic changes?


International Association of Hydrological Sciences – IAHS – Association internationale des Sciences Hydrologiques
Science Plan for the Scientific Decade 2013-2022

INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES
ASSOCIATION INTERNATIONALE DES SCIENCES HYDROLOGIQUES

International Association of Hydrological Sciences
Association internationale des sciences hydrologiques

SCIENCE PLAN FOR THE DECADE 2013-2022

Panta Rhei – Everything flows

Change in Hydrology and Society

Prepared by:
IAHS Task Force on the Scientific Decade 2013-2022
(Alberto Montanari – Chair)

Revised by:
G. Young, H.H.G. Savenije, C. Cudennec, D. Koutsoyiannis, M. Sivapalan, D. Hughes, T. Wagener, L. L. Ren, S. Grimaldi, G. Blöschl, K. Beven, H. Gupta, B. Arheimer, Y. Huang, A. Schumann, D. Post, V. Srinivasan, E. Boegh, P. Hubert, C. Harman, S. Thompson, M. Rogger, M. Hipsey, E. Toth, A. Viglione, G. Di Baldassarre, B. Schaefli, H. McMillan, S.J. Schymanski, G. Characklis, B. Yu, Z. Pang, V. Belyaev

July 19, 2013

1

The IAHS Science Initiative 2013-2022: The Panta Rhei paper (open access)

Hydrological Sciences Journal – Journal des Sciences Hydrologiques, 2013
http://dx.doi.org/10.1080/02626667.2013.809088

"Panta Rhei—Everything Flows": Change in hydrology and society—The IAHS Scientific Decade 2013–2022

A. Montanari[1], G. Young[2], H. H. G. Savenije[3], D. Hughes[4], T. Wagener[5], L. L. Ren[6], D. Koutsoyiannis[7], C. Cudennec[8], E. Toth[1], S. Grimaldi[9], G. Blöschl[10], M. Sivapalan[11], K. Beven[12], H. Gupta[13], M. Hipsey[14], B. Schaefli[15], B. Arheimer[16], E. Boegh[17], S. J. Schymanski[18], G. Di Baldassarre[19], B. Yu[20], P. Hubert[21], Y. Huang[22], A. Schumann[23], D. A. Post[24], V. Srinivasan[25], C. Harman[26], S. Thompson[27], M. Rogger[10], A. Viglione[10], H. McMillan[28], G. Characklis[29], Z. Pang[30] and V. Belyaev[31]

- 30 co-authors that significantly contributed to the preliminary discussion, paper preparation and revision.
- Presenting a comprehensive summary of the problem and the Science Plan
- Another successful community experience.

Some first results

Hydrol. Earth Syst. Sci. Discuss., 10, 4515–4536, 2013
www.hydrol-earth-syst-sci-discuss.net/10/4515/2013/
doi:10.5194/hessd-10-4515-2013

Hydrology and Earth System Sciences
Discussions

Socio-hydrology: conceptualising human-flood interactions

G. Di Baldassarre[1], A. Viglione[2], G. Carr[3], L. Kuil[3], J. L. Salinas[2], and G. Blöschl[2,3]

[1]Department of Integrated Water Systems and Governance, UNESCO-IHE, Delft, the Netherlands
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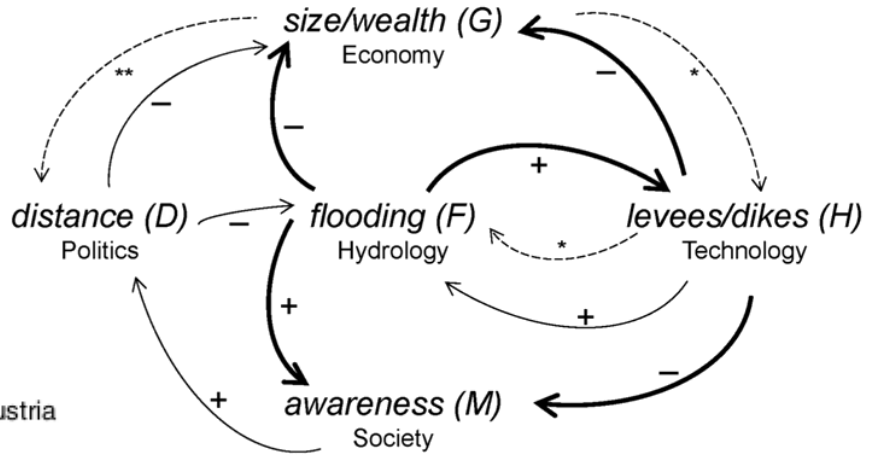
Received: 22 March 2013 – Accepted: 31 March 2013 – Published: 9 April 2013



Research themes and working groups

- A call for research themes and working groups has been issued with deadline Jan 31st, 2014.

- 27 Working Groups have been proposed and approved including about 250 researchers! Call for WG is permanently open.
- 11 Research themes have been adopted so far.

Flood in Florence in November 1966

Panta Rhei Research Themes

1. Transdisciplinarity - Proposer: Tobias Krueger
2. Mountain hydrology - Proposer: Shreedhar Maskey
3. Large scale water projects and society - Proposer: Bellie Sivakumar
4. Physics of changes - Proposer: Alexander Gelfan
5. Water fooprint assessment - Proposer: Saket Pande
6. Water and energy fluxes in a changing environment - Proposer: Maria J. Polo
7. Epistemic uncertainties - Proposer: Paul Smith
8. Hydro-meteorological extremes: Decision making in an uncertain environment - Proposer: Adrián Pedrozo Acuña
9. Global Change in Hydrology and Society - Proposer: Jos Timmermans
10. Reservoirs impact - Proposer: Aleksandr Tskhai
11. Water scarcity assessment - Proposer: Junguo Liu

Panta Rhei Working Groups

1. Hydro-meteorological extremes: Decision making in an uncertain environment - Chair: Adrián Pedrozo-Acuña
2. Large dams, society, and environment - Chair: Bellie Sivakumar
3. Thirsty future: energy and food impacts on water - Chair: Ana Mijic
4. Changing biogeochemistry of aquatic systems in the Anthropocene – Chair: Hong-Yi Li
5. Transdisciplinarity - Chair: Tobias Krueger
6. Natural and man-made control systems in water resources - Chair: Ronald van Nooijen
7. Water and energy fluxes in a changing environment - Chair: Maria J. Polo
8. Epistemic uncertainties - Chair: Paul Smith
9. Comparative water footprint studies - Chair: Arjen Y. Hoekstra
10. Hydrologic services and hazards in multiple ungauged basins - Chair: Hilary McMillan
11. Understanding flood changes - Chair: Alberto Viglione
12. Physics of hydrological predictability - Chair: Alexander Gelfan
13. Mountain hydrology - Chair: Shreedhar Maskey
14. Large sample hydrology - Chair: Vazkén Andreassian
15. Socio-hydrologic modeling and synthesis - Chair: Veena Srinivasan
16. Sustainable water supply in a urban change - Chair: Tatiana Bibikova
17. Water footprint of cities - Chair: Alfonso Mejia
18. Evolving urban water systems - Chair: Alfonso Mejia
19. Changes in flood risk - Chair: Heidi Kreibich
20. Anthropogenic and climatic controls on water availability (ACCuRAcY) - Chair: Attilio Castellarin
21. Floods in historical cities - Chair: Alberto Montanari
22. **Prediction under Change (PUC) - Chair: Hafzullah Aksoy**
23. Data-driven Hydrology - Chair: Elena Toth
24. **Modeling Hydrological Processes and Changes - Chair: Yangbo Chen**
25. Resilience-based management of natural resources: the fundamental role of water and soil in functional ecosystems - Chair: David Finger
26. Integrating history, social conflicts and hydrology: From semi pristine to highly modified hydrological systems - Chair: Victor Rosales Sierra
27. Drought in the Anthropocene - Chair: Anne Van Loon

Let us attend *Panta Rhei*

to disseminate flood outputs of SciNetNatHaz project

- Attending Panta Rhei means:
  - To be informed on initiatives (conferences, workshops, summer schools, etc.)
  - To have opportunities of being involved in research initiatives and project proposals (to be funded by the EU within FP7)
  - To participate to writing community papers
  - To get visibility for papers by getting attention and citations from the community

www.iahs.info/pantarhei

MY IMPRESSION

SciNetNatHaz **meets all requirements in**

- Understanding
- Estimation and prediction
- Science in practice

to be a good link between us and the society

Project funded by the EUROPEAN UNION

MY EXPERIENCE

SciNet NatHaz Prevention

Black Sea CROSS BORDER COOPERATION

Common borders. Common solutions.

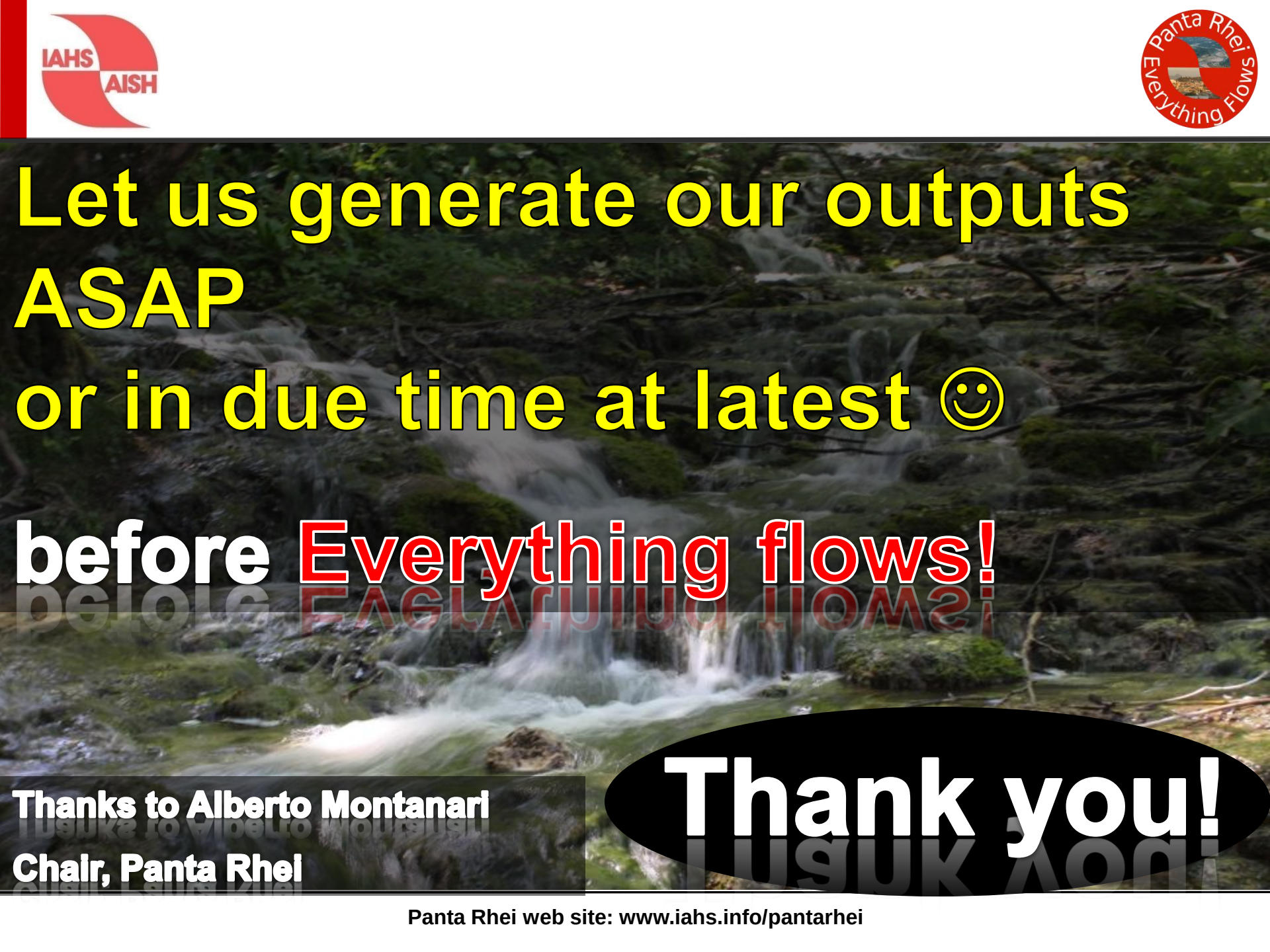
SciNetNatHaz Project Progress Meeting - 23-26 Oct 2014, Burgas, Bulgaria

Using Morphometric models and Open Source Software to locate Flood prone areas

A pilot Implementation

Konstantinos Papatheodorou
Helena Tzanou

TEI of Kentriki Makedonia, LP/ENPI Beneficiary



Panta Rhei web site: www.iahs.info/pantarhei