

Session 2:
Future Directions of
Global Hydrological Models &
Water Resource Assessment Incorporating
Human Activities



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University of Arizona
The United States

Hydrology delivering Earth System Science to Society (HESSS)
Feb 28 ~ March 2, 2007
Tsukuba, Japan

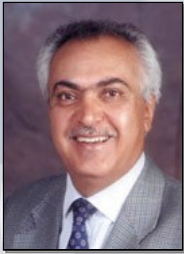
1. Numerical Modeling (Support for Decision Making)
2. Conceptual Models (Bridging Science & Policy)
3. Scenario Models (Evaluating Risk)

As related to ...

- Stochastic Uncertainty
- Communication & Conceptual Uncertainty
- Future Uncertainty



Sustainability of semi-Arid Hydrology and Riparian Areas



~300 Researchers from Universities and Laboratories!

CALIFORNIA

UCIrvine



UNIVERSITY OF CALIFORNIA
RIVERSIDE



University of California
San Diego

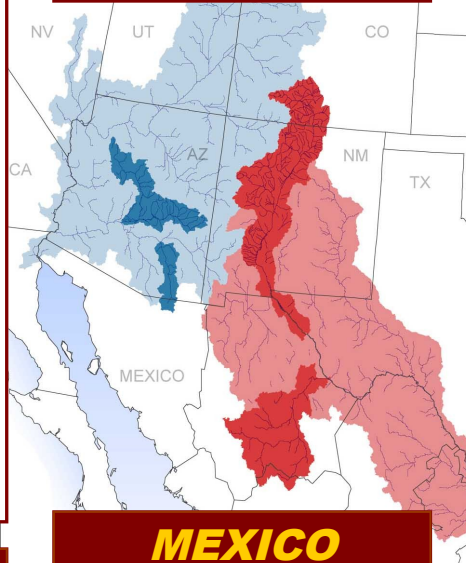
UCLA

SCRIPPS
INSTITUTION OF
OCEANOGRAPHY

CEA-CREST

NEVADA

Desert
Research
Institute



ARIZONA



THE UNIVERSITY OF ARIZONA,
TUCSON ARIZONA



ARIZONA STATE UNIVERSITY



COLUMBIA UNIVERSITY'S
BIOSPHERE 2
CENTER

United States Department of Agriculture
USDA
Agricultural
Research
Service
Southwest
Watershed
Research
Center

USGS
science for a changing world

The Nature
Conservancy®

USPP

NEW MEXICO

New Mexico Tech
SCIENCE-ENGINEERING-RESEARCH-UNIVERSITY



The University of New Mexico

Los Alamos
NATIONAL LABORATORY



Sandia
National
Laboratories



UTAH



Utah State
UNIVERSITY

MEXICO

IMADES



IMTA
Instituto Mexicano
de Tecnología del Agua

COLORADO

USGS
science for a changing world

Colorado
University of Colorado at Boulder

Other



SAHRA's Mission

WHAT: To facilitate decision making leading to sustainable management of water resources in semi-arid regions

HOW: Develop integrated models to simulate complex basin-scale processes and feedbacks by linking physical, environmental, engineering and socio-economic components of the system.

WHY: To enable stakeholders to explore various decision options by running scenarios

Science

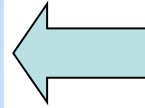
Education

Knowledge Transfer



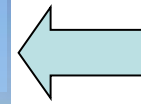
Q1: *What are the impacts of vegetation change on basin scale water balance ?*

1 Extensive vegetation change



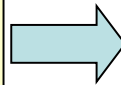
Q2: *What are the costs and benefits of riparian restoration and preservation?*

2 Settlements, agriculture, and biodiversity along riparian corridor

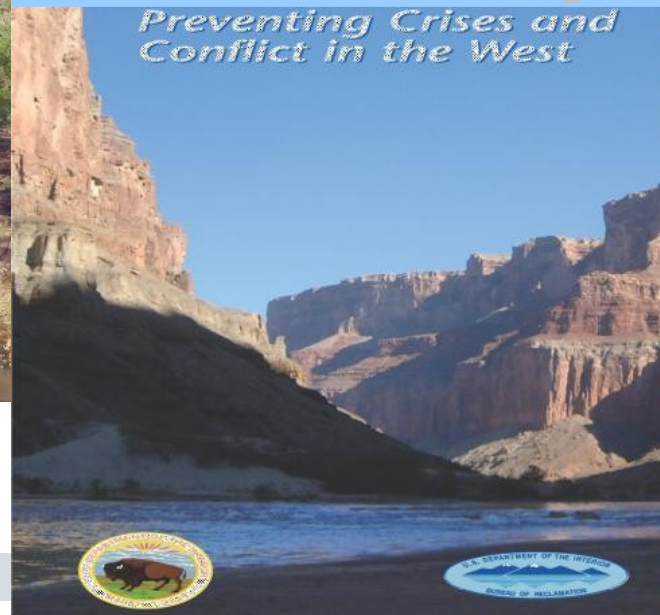


Q3: *Under what conditions are water markets & banking feasible ?*

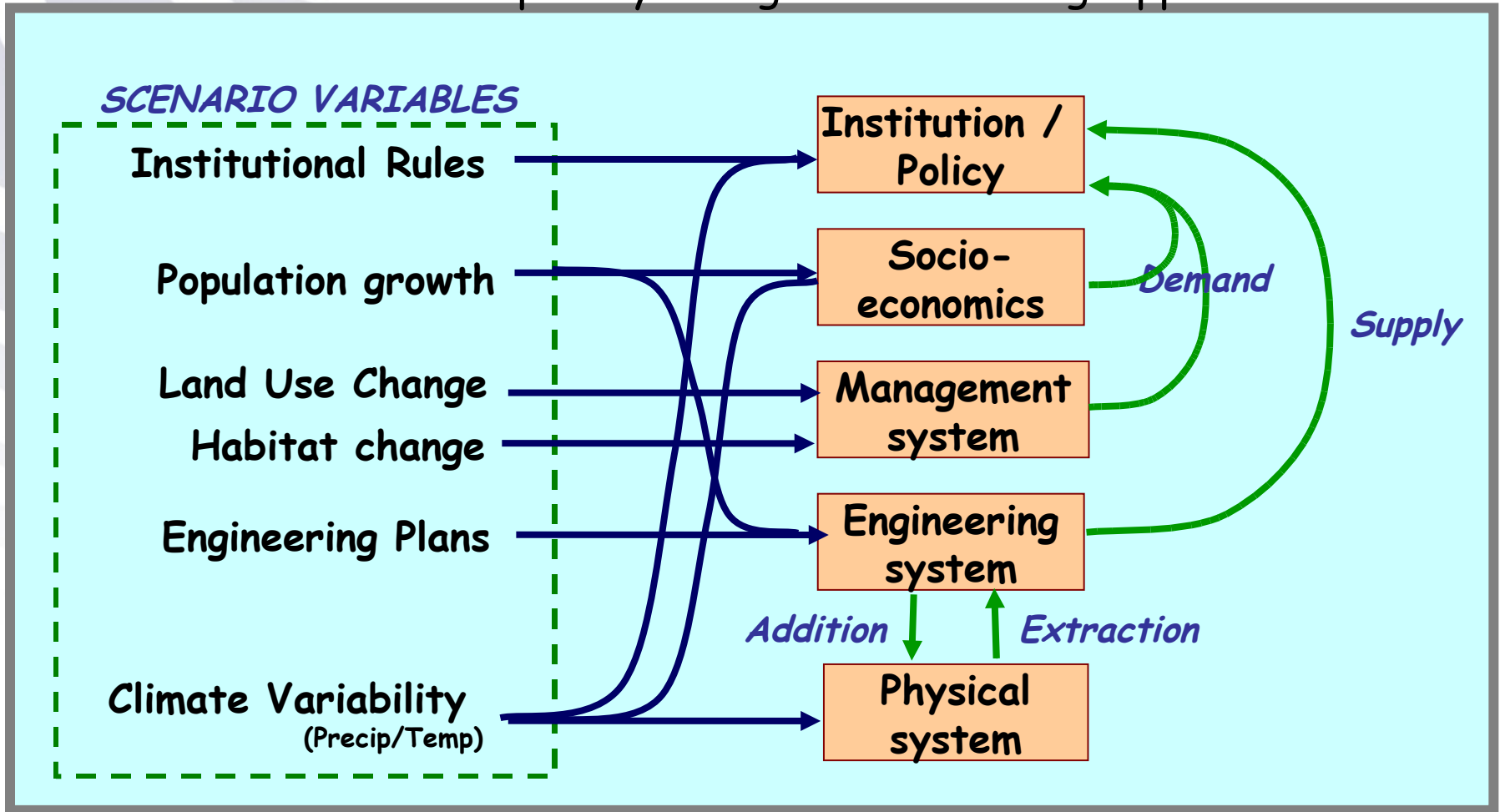
3 Multiple conflicting water uses with limited supply



Preventing Crises and Conflict in the West



A Multi-disciplinary Integrated Modeling Approach



Issues of **Complexity / Understandability / Credibility**

UNDERSTANDABILITY

Users can understand model only if model complexity is at stakeholders level they can comprehend



Trade-off

CREDIBILITY

Modelled representation must be sufficiently realistic (complex) for users to accept validity of the results

stakeholders

Role of Models in Education and Knowledge Transfer: Understanding Issues



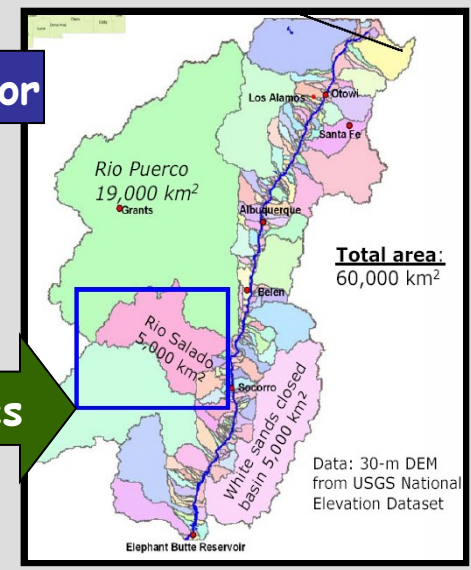
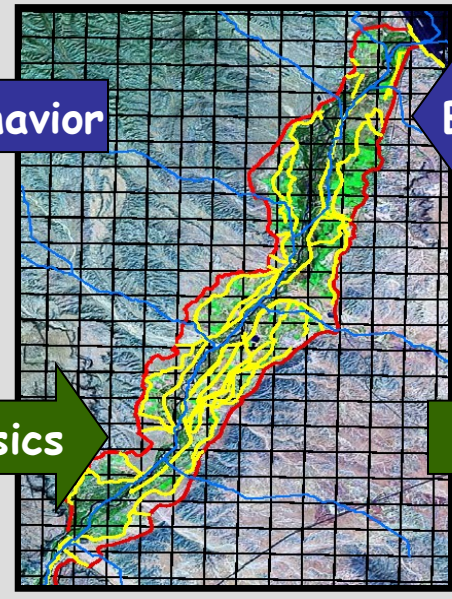
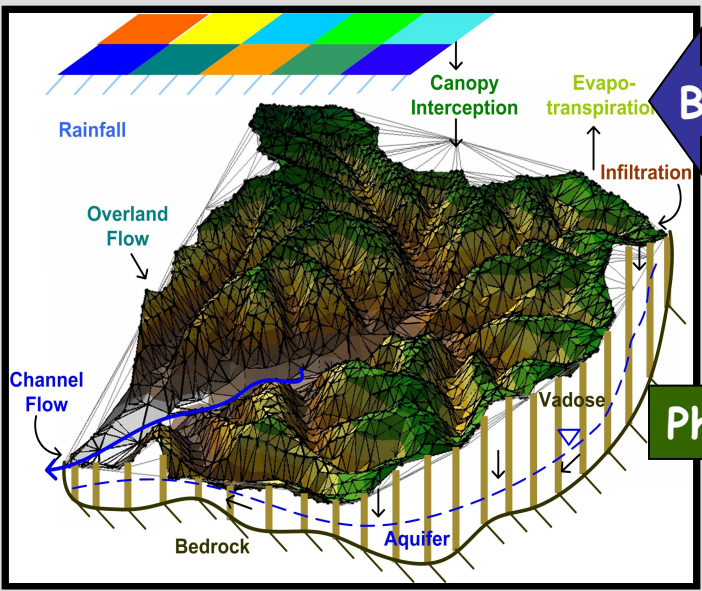
Multi-disciplinary Multi-resolution Integrated Modeling Framework

Scenario Development & Integrated Assessment

Fine Resolution
(100m)

Medium Resolution
(1 to 10km)

Coarse / Lumped
Sub-watershed



Behavior

Behavior

Physics

Physics

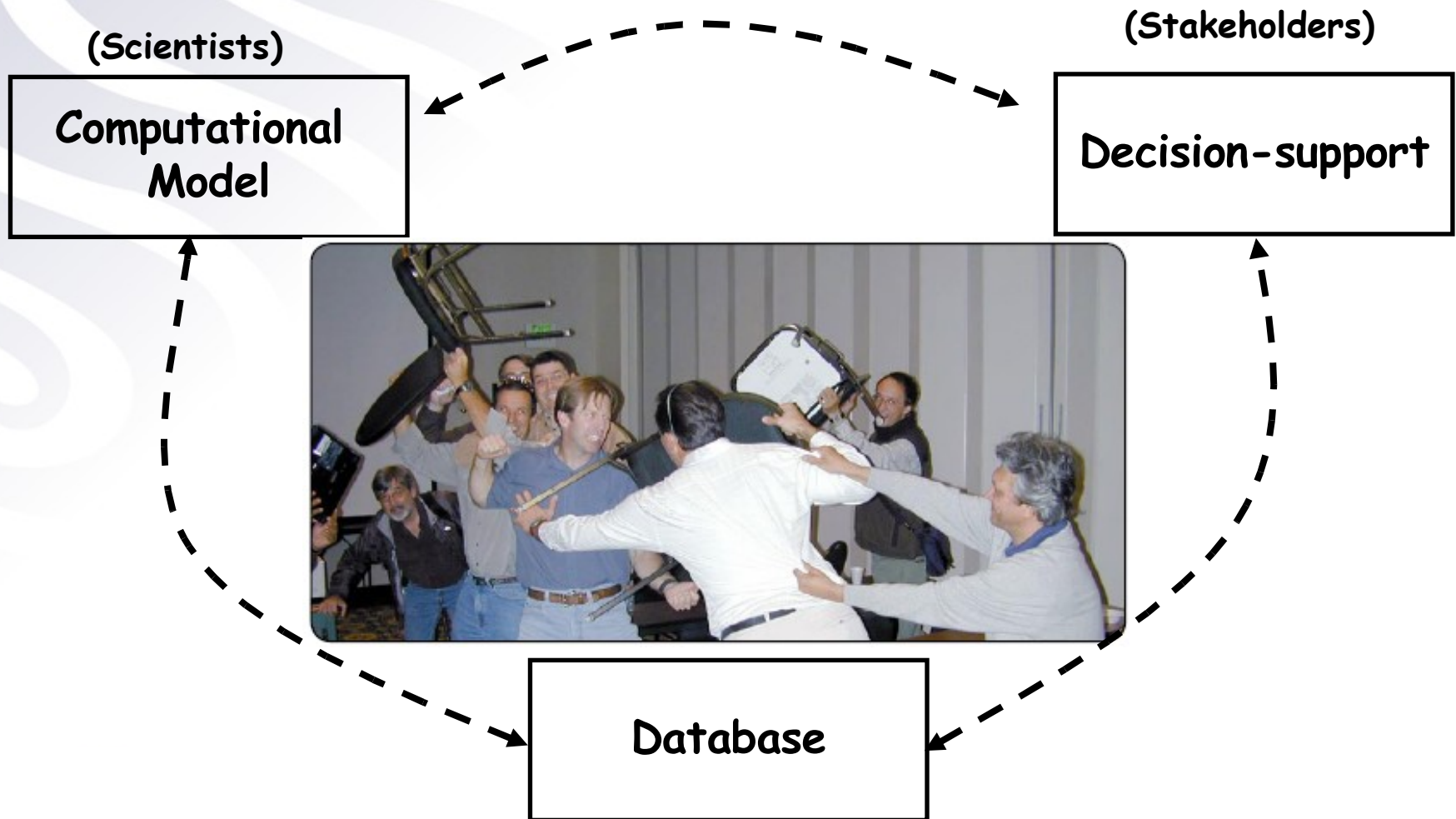
Physical Rigor Communication

Conceptual Model & Geo-database



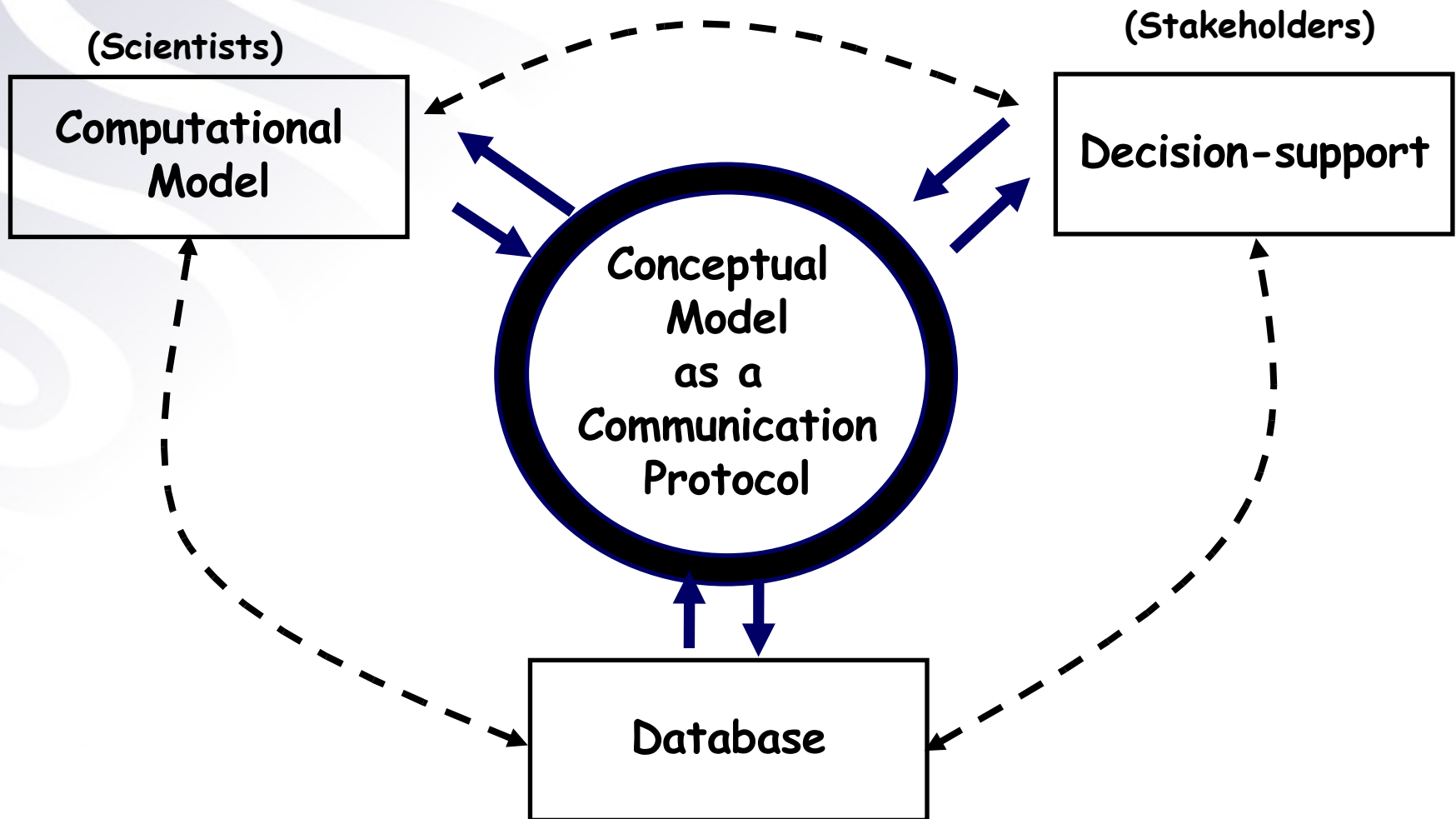
Communication between Scientists & Decision Makers ⁹

How to implement framework to enable communication between science & decision making?

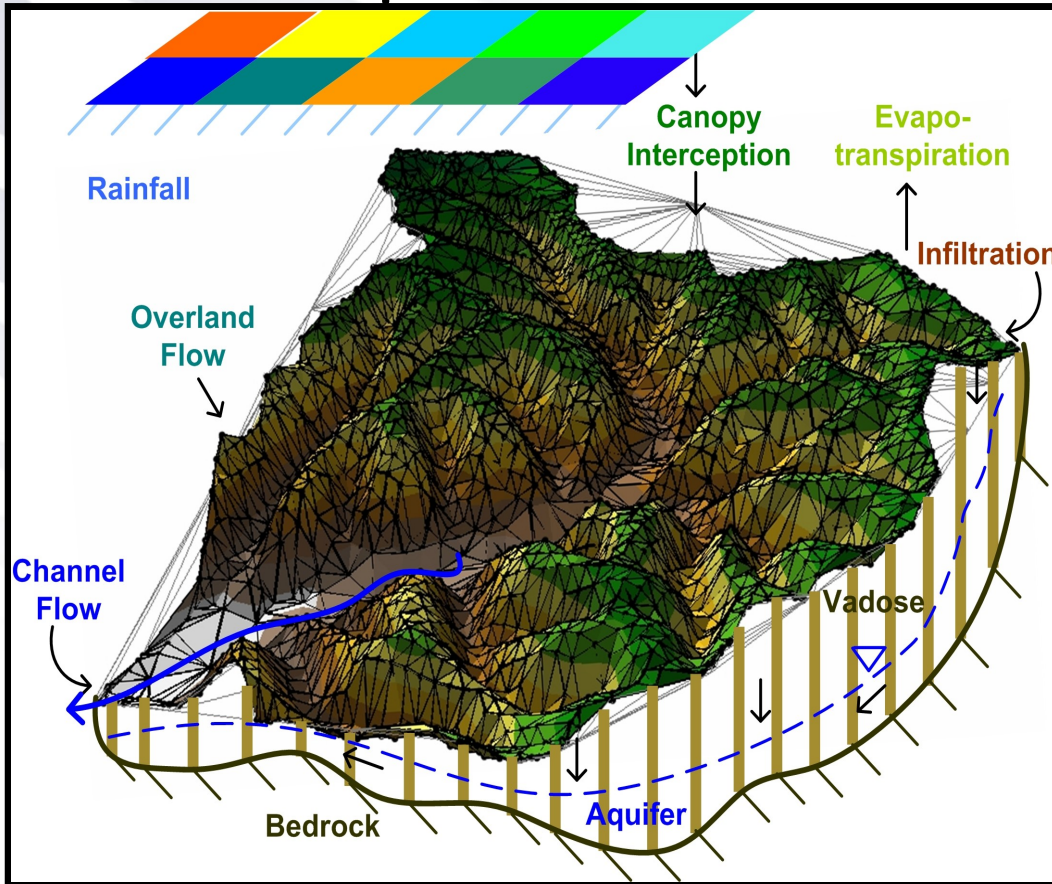


Communication between Scientists & Decision Makers 10

How to implement the framework to enable communication between science and decision making?



Computational Model



How well do most people understand scientific models ?



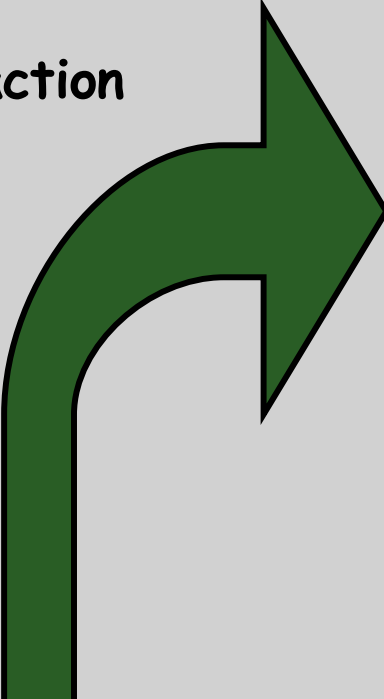
QuickTime and a
H.264 decompressor
are needed to see this picture.



Alternative
Scenarios



Abstraction



Conceptual
Model

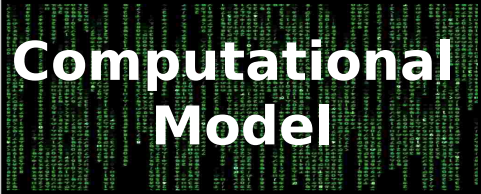
Abstraction



Communication
&
Dialogue

Computational
Model

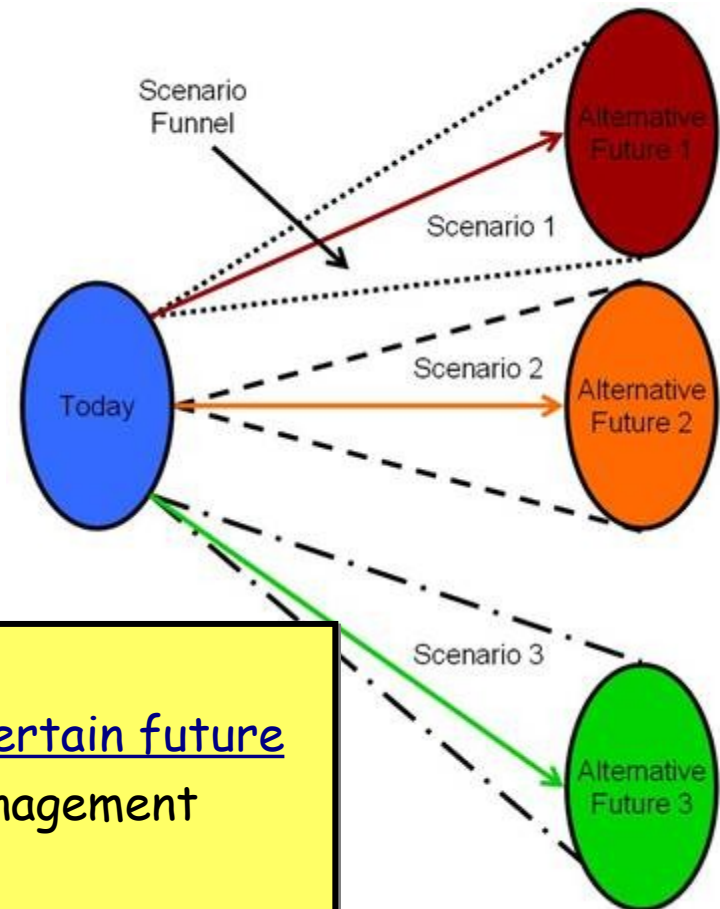
Decision-support



What is a Scenario - How can it Help ?

- IPCC definition:

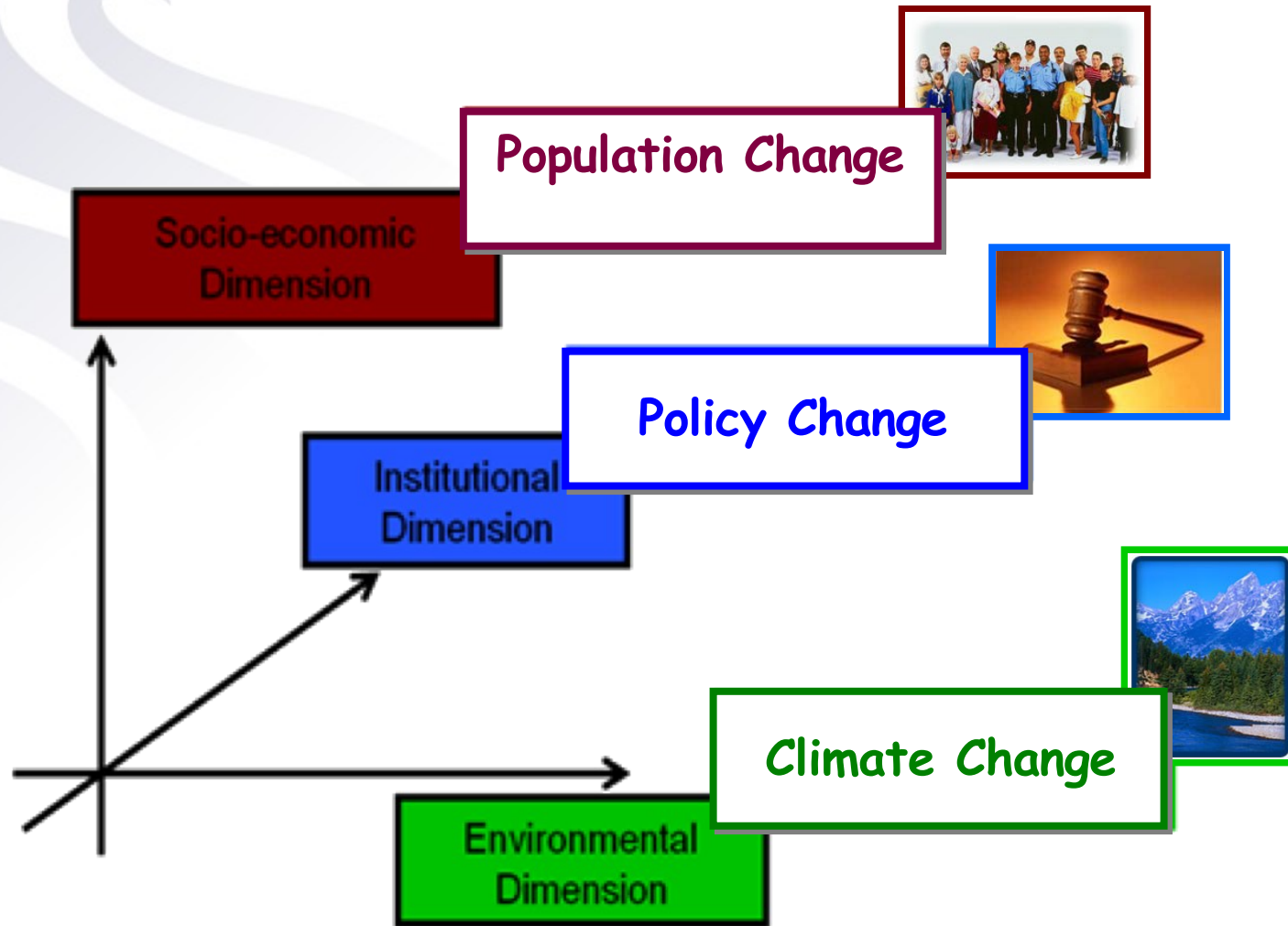
“ A scenario is a coherent, internally consistent and plausible description of a possible future state of the world. **It is not a forecast**; rather, each scenario is one alternative image of how the future can unfold.”



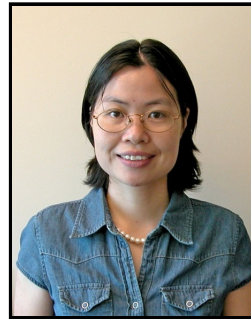
Scenario approach can:

- Help decision-makers plan for an uncertain future
- Explore implications of different management strategies
- Incorporate human & science dimensions into policy making

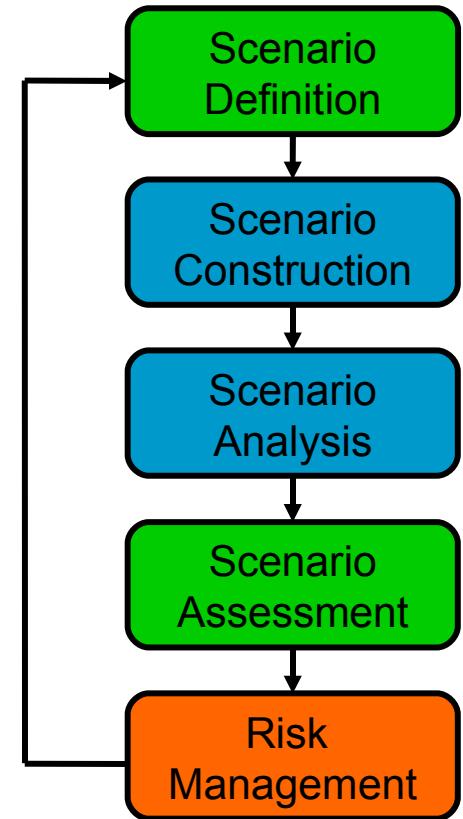







- Formal approach developed by SAHRA Scenario Development Team



Scenario Website:
<http://www.sahra.arizona.edu/scenarios>



	Scientists
	Stakeholders
	Scientists and Stakeholders



Modeling Issues:

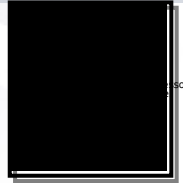
1. Numerical modeling framework (Multi-resolution & Multi-disciplinary)
2. ***Conceptual modeling framework (Understanding & Credibility)***
3. Scenario modeling framework (Alternative plausible futures)

Types of Uncertainty:

1. Numerical Models -- Stochastic Uncertainty
2. ***Conceptual Models -- Communication & Conceptual Uncertainty***
(*Incompleteness of Knowledge*)
1. Scenario Models -- Future Uncertainty



Future Directions of Global Hydrological Models & Water Resource Assessment *Incorporating Human Activities*



- **Petra Doell**

- Institute of Physical Geography, University of Frankfurt, Germany
- **Future directions of global hydrological modelling and water resources assessment incorporating human activities**

- **Naota Hanasaki**

- Institute for Industrial Science, University of Tokyo, Japan
- **An integrated model for global water resources assessments: A perspective on sub-annual variation in renewable freshwater and water use**



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References

- <http://www.sahra.arizona.edu>

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