# SHARED WATER RESOURCES: CONFLICT, COOPERATION & CLIMATE

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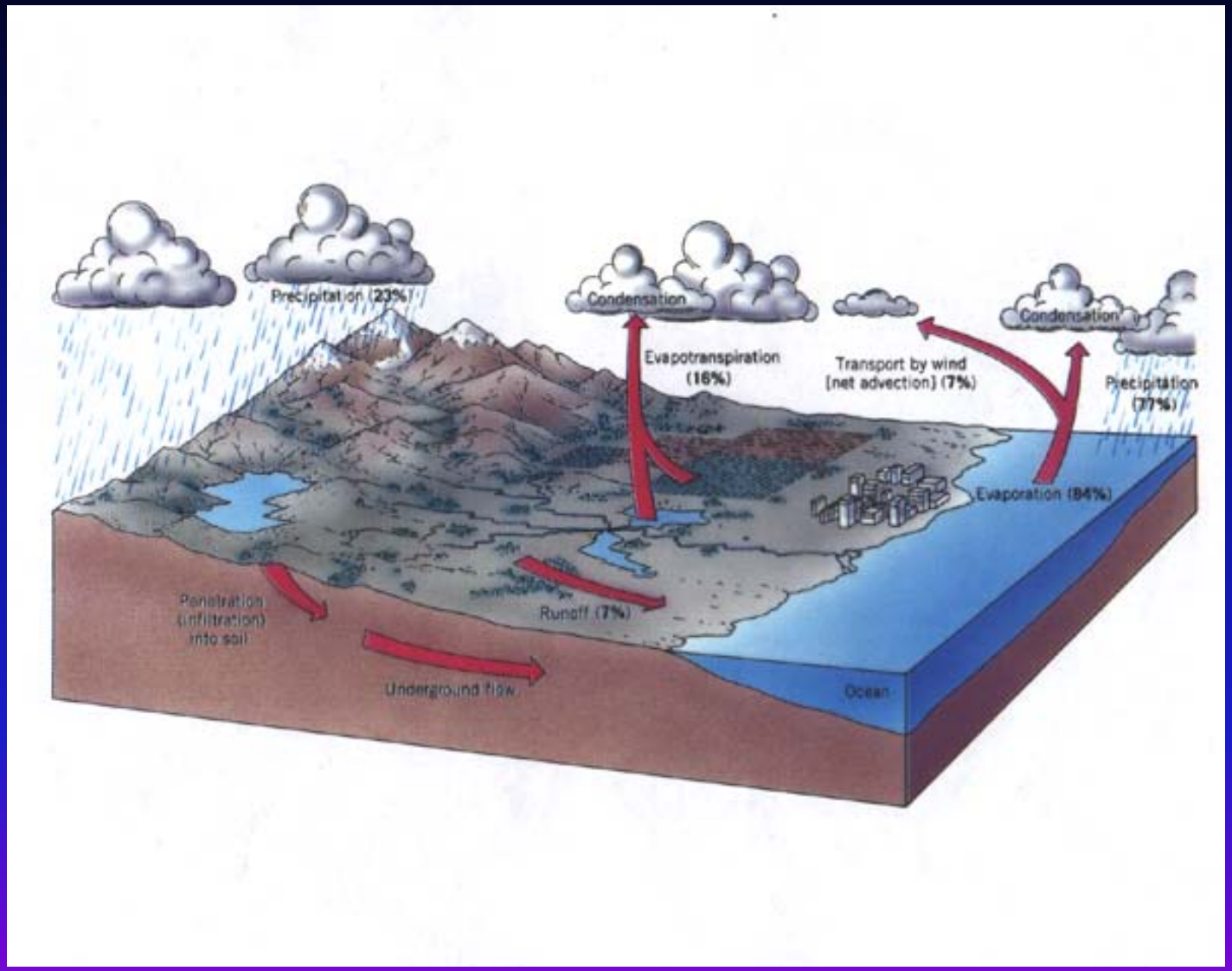
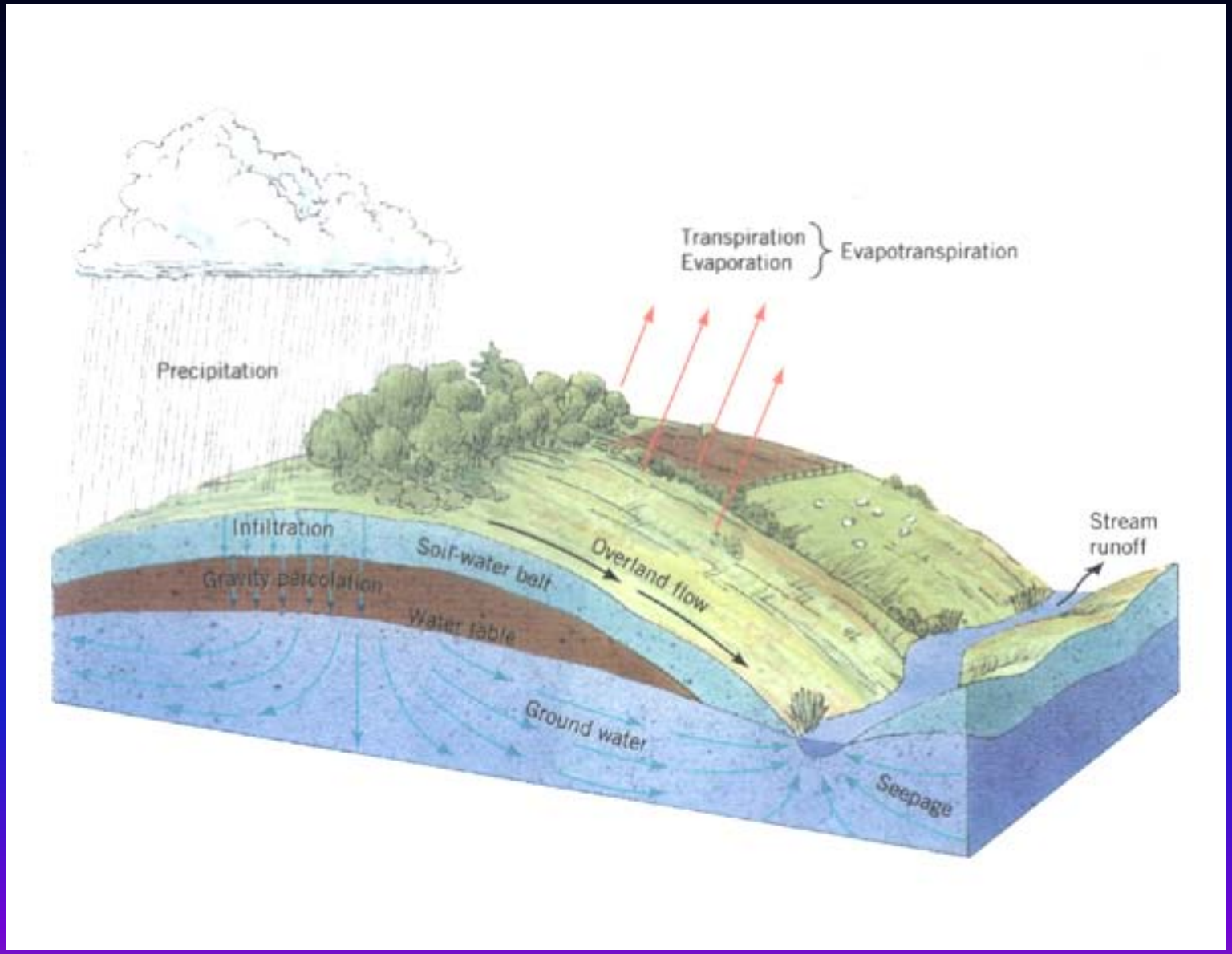
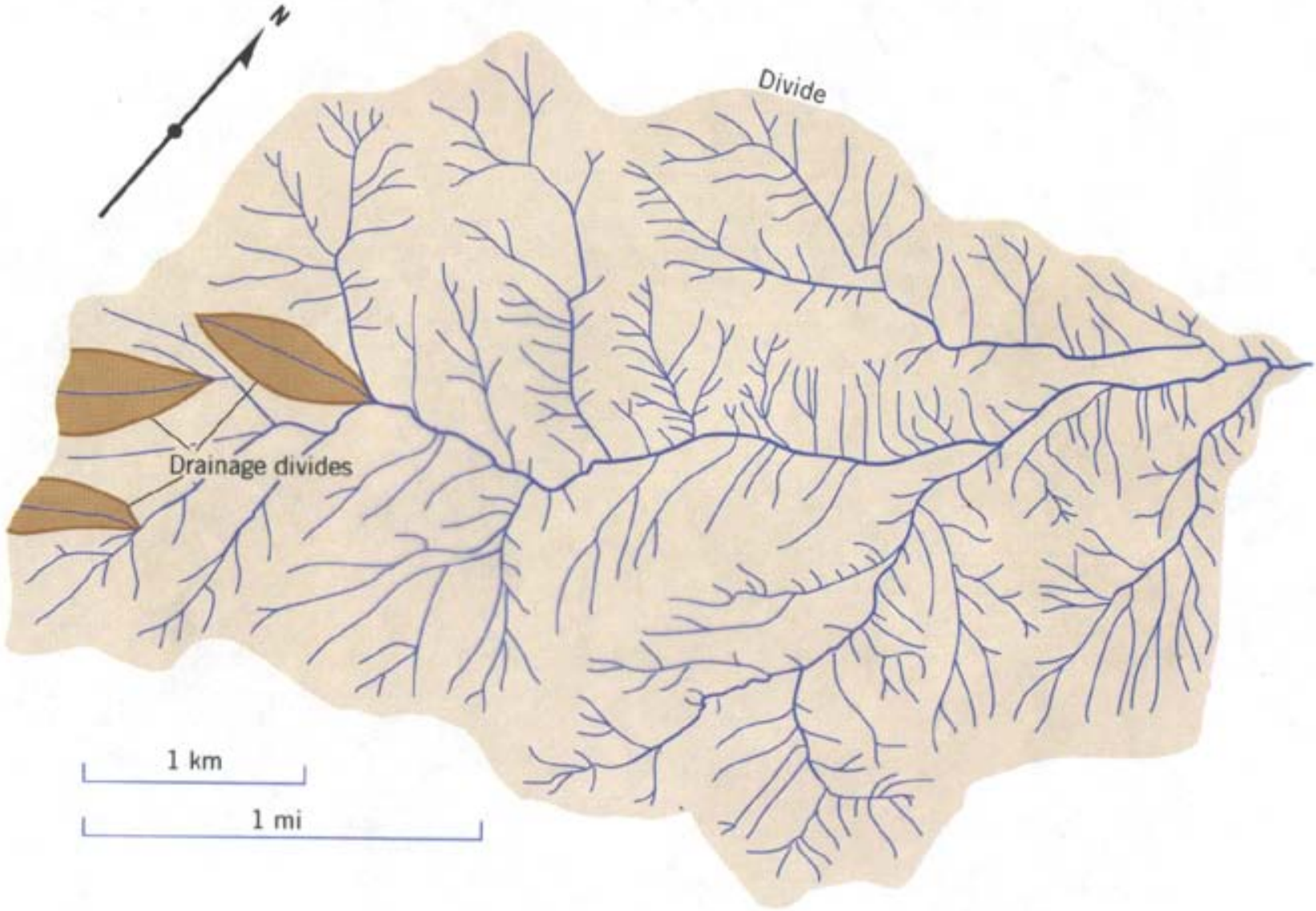
## Global Water Crisis

- 2.4 billion people lack access to adequate sanitation
- >1 billion people lack access to safe drinking water
- At least 250 million illnesses result
- 2.2 to 5 million deaths
- 20% of irrigated lands are salt-laden

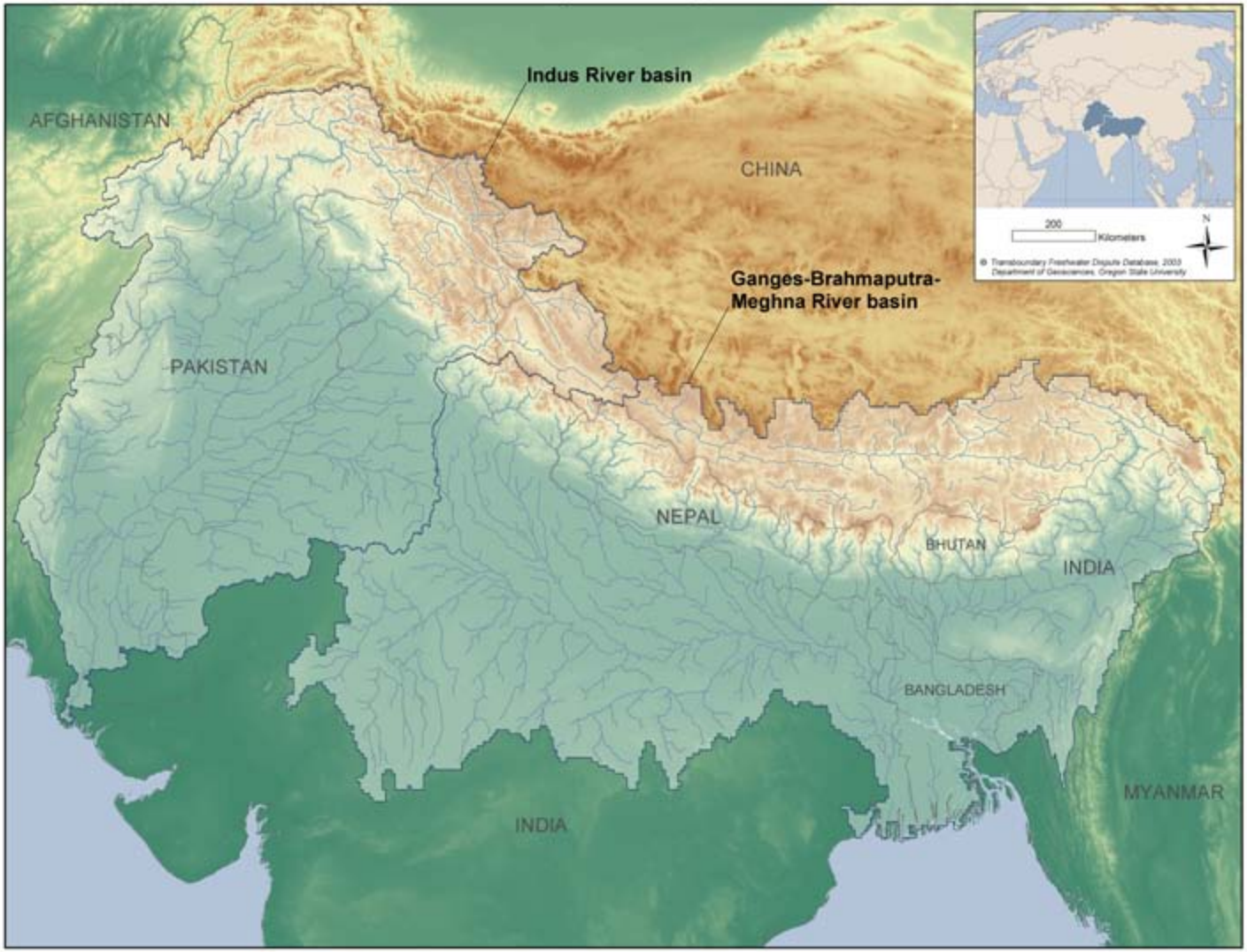
- Water-related disease costs US$125 billion/yr.
- Would “only” cost US$7-50 billion/yr. to resolve


Precipitation (23%)
Condensation
Evapotranspiration (16%)
Transport by wind (net advection) (7%)
Condensation
Precipitation (77%)
Evaporation (84%)
Penetration (infiltration) into soil
Runoff (7%)
Underground flow
Ocean

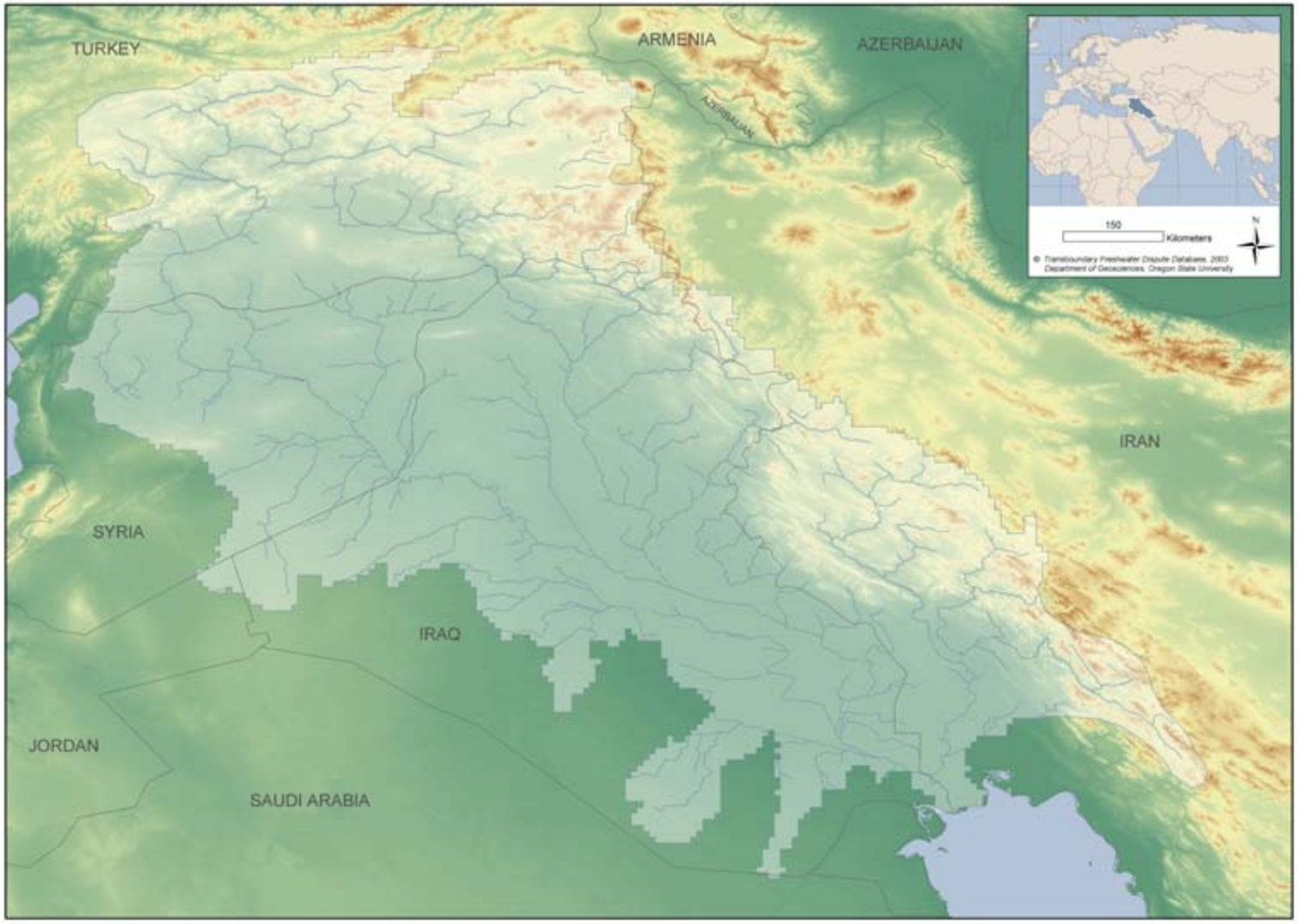

Transpiration
Evaporation
Evapotranspiration
Precipitation
Infiltration
Gravity percolation
Soil-water belt
Water table
Overland flow
Stream runoff
Ground water
Seepage


N
Divide
Drainage divides
1 km
1 mi

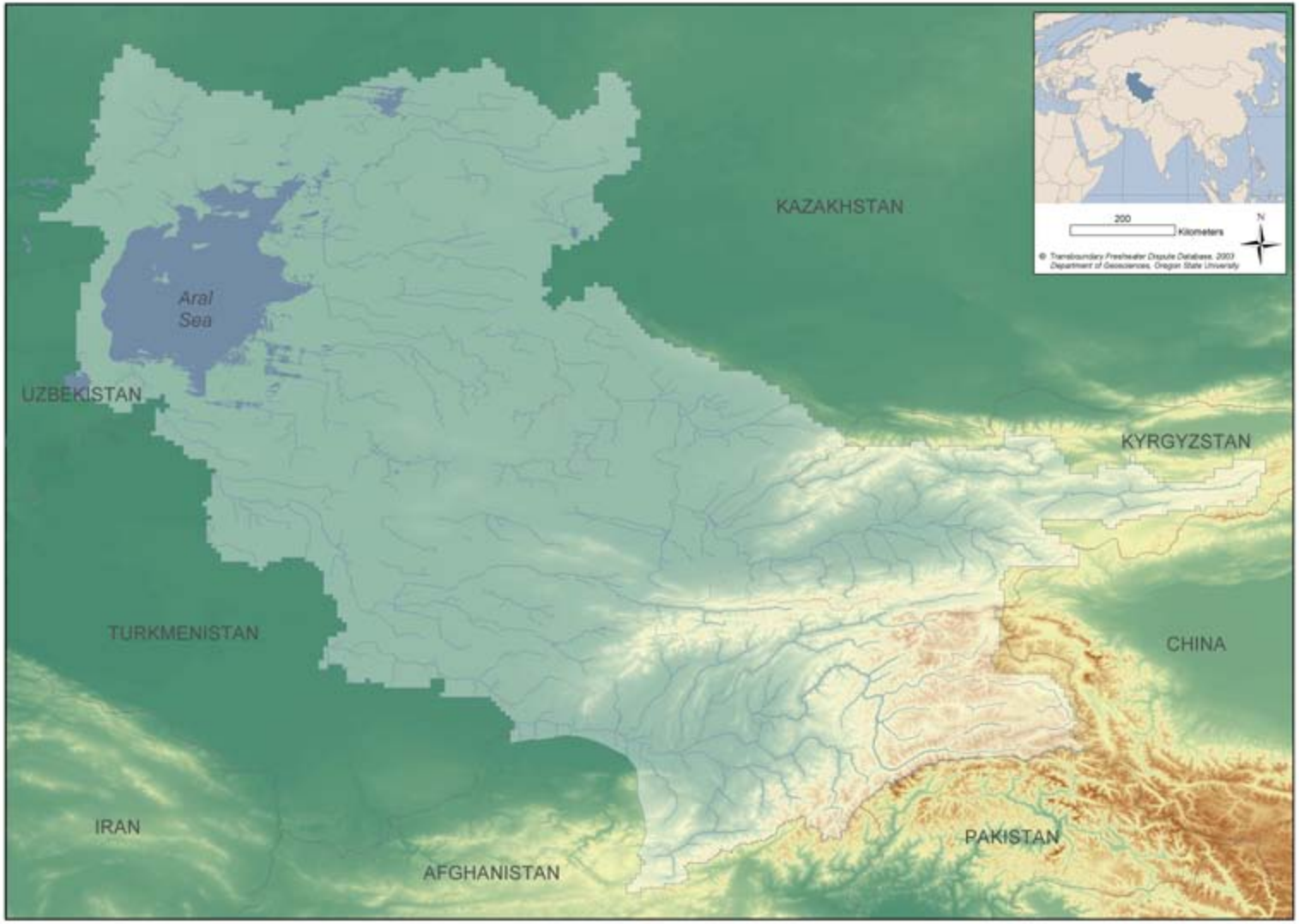
## The Indus River and Ganges-Brahmaputra-Meghna River basins



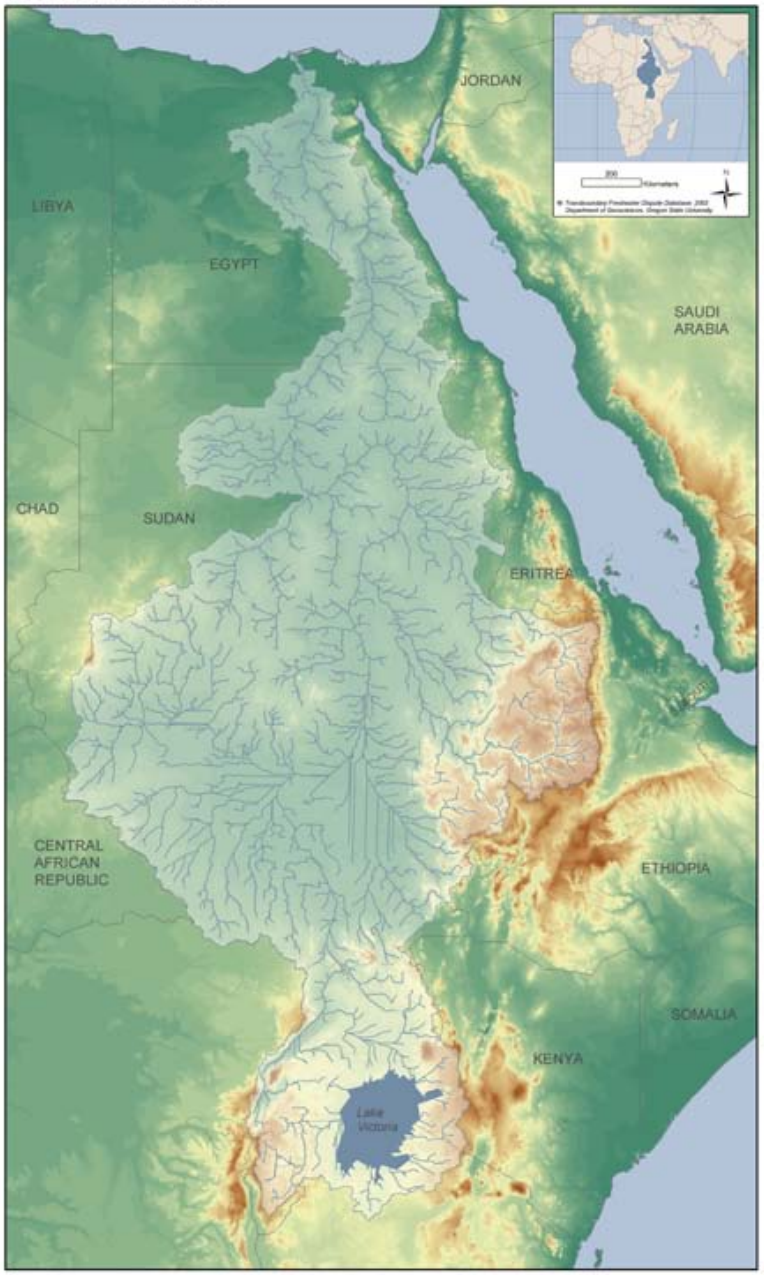
## The Tigris-Euphrates River basin



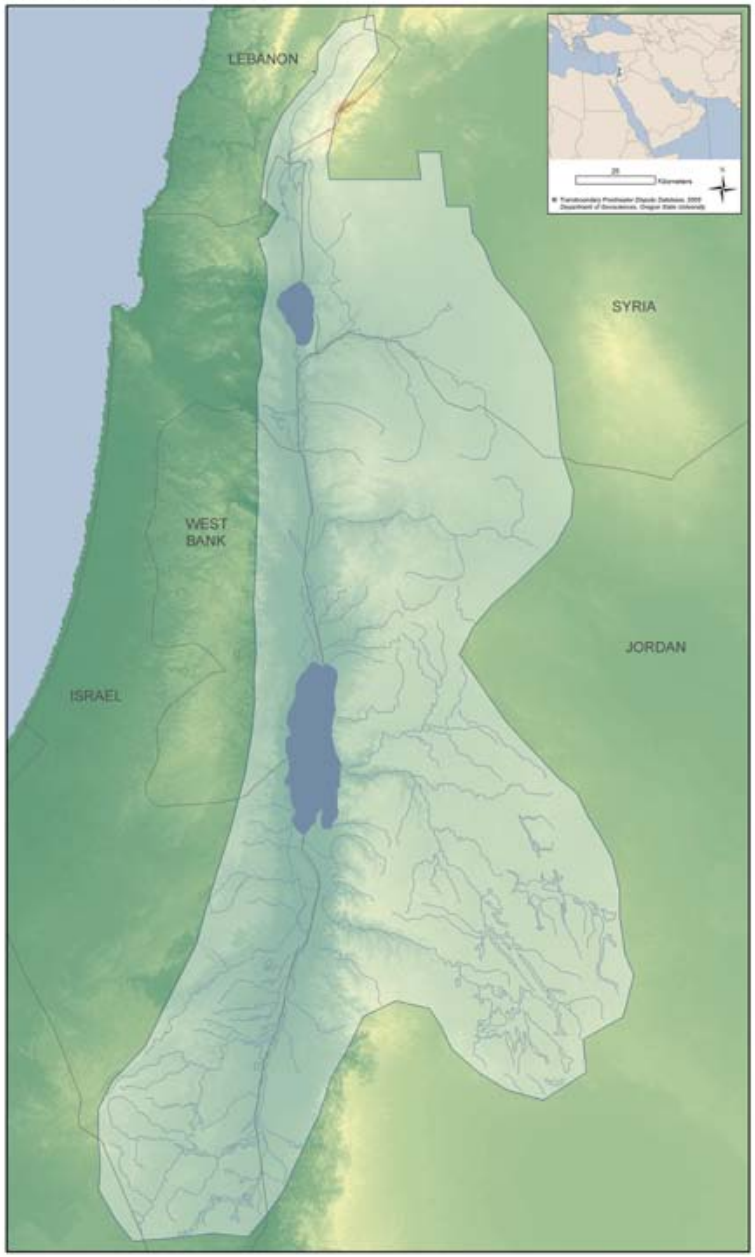
## The Aral Sea basin



**The Nile River basin**




**The Jordan River basin**



# Water and Conflict

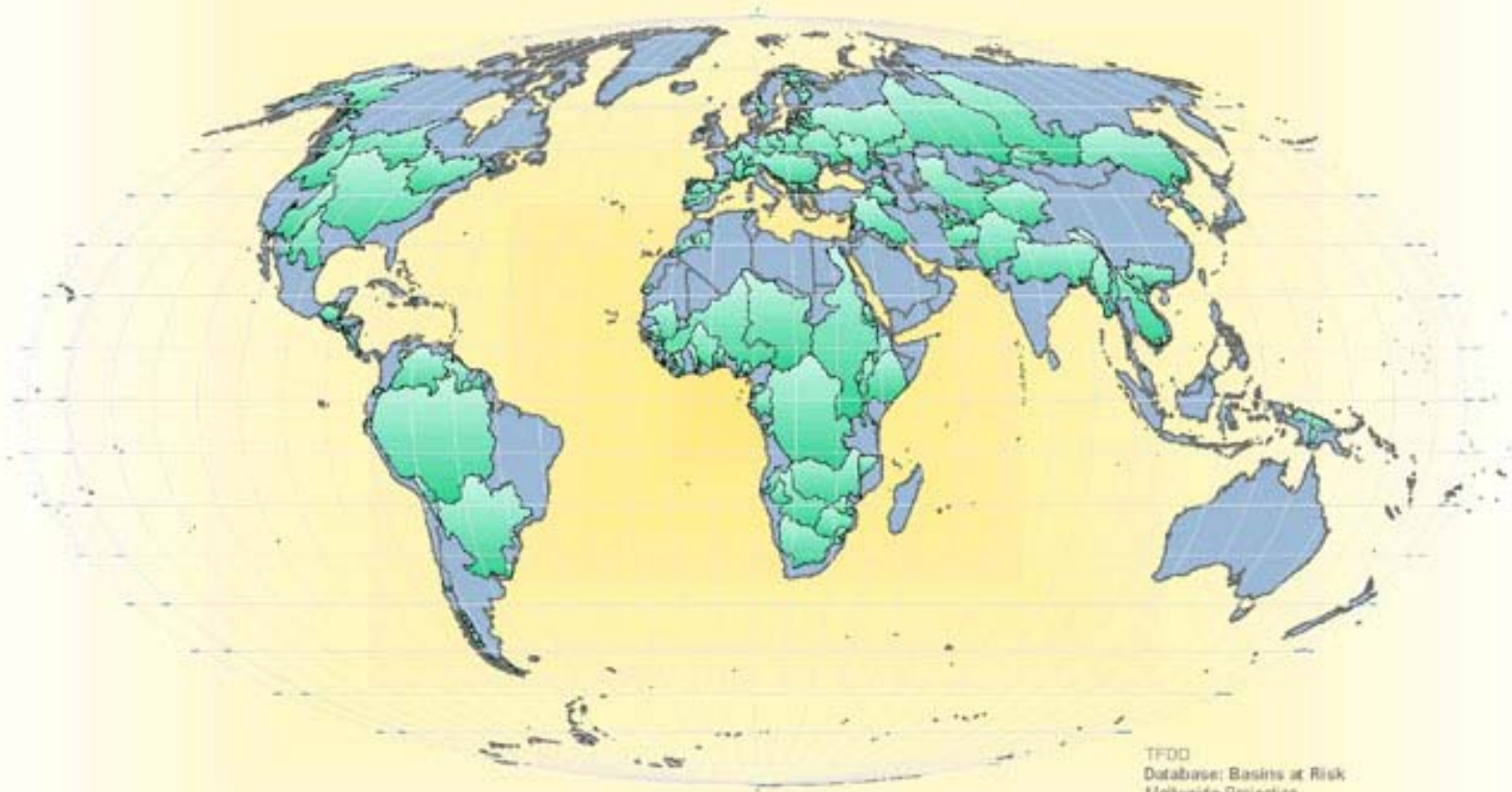
“Fierce competition for fresh water may well become a source of conflict and wars in the future.”

- Kofi Annan, March 2001

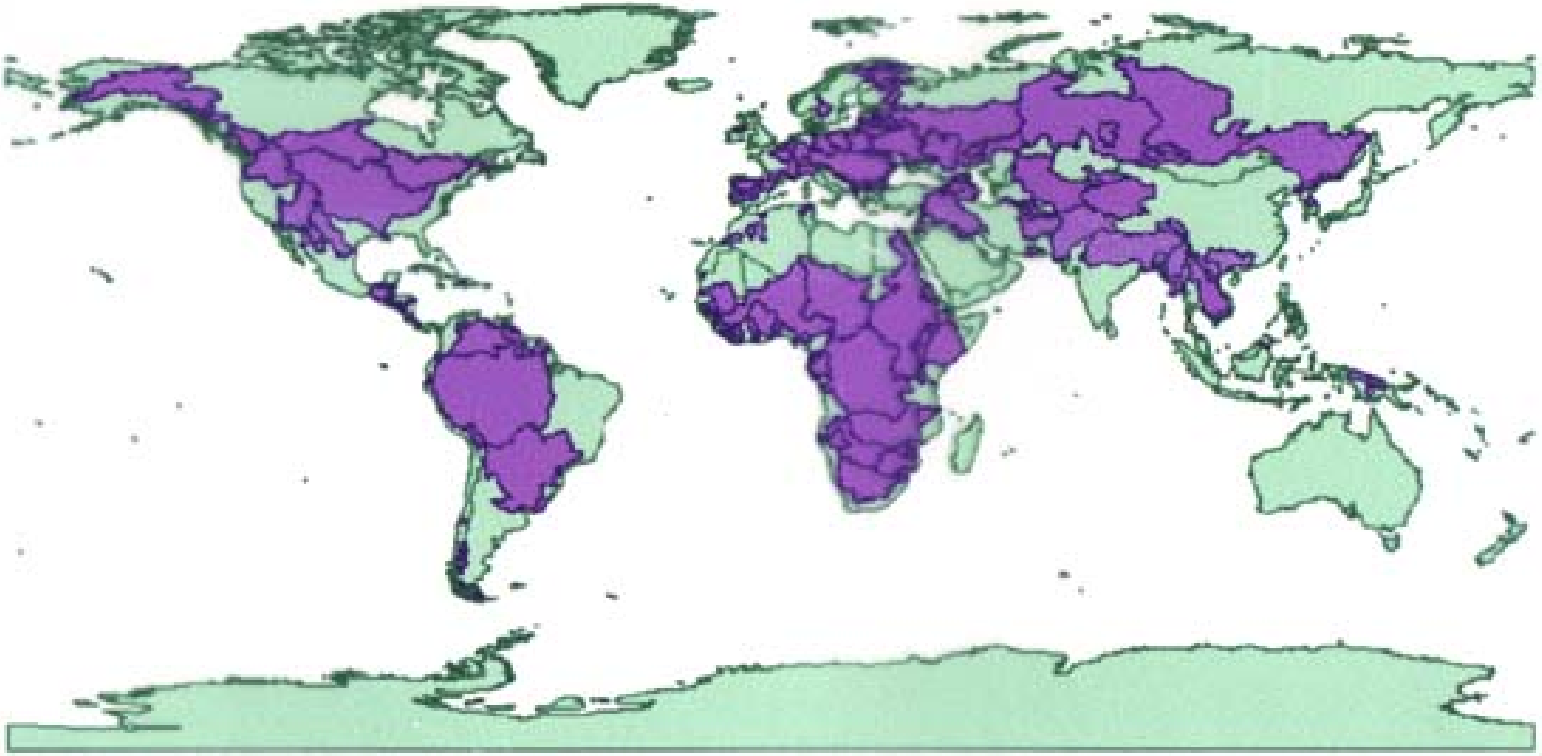
# Water Myths and Water Facts

## Myth 1:
## Water Wars are Prevalent and Inevitable

# International Basins of the World



# Scale of Conflict



# The Transboundary Freshwater Dispute Database

A Project of
Oregon State University
Department of Geosciences
and the Northwest Alliance
for Computational Science

- Reference to 3,600 water-related treaties (805-1997)
- Full-text of 400 treaties and 40 US compacts, entered in computer database
- Detailed negotiating notes (primary or secondary) from fourteen case-studies of water conflict resolution
- Annotated bibliography of “State of the Art” of water dispute resolution literature
- News files on cases of acute water-related disputes

# Interactive Search Interface

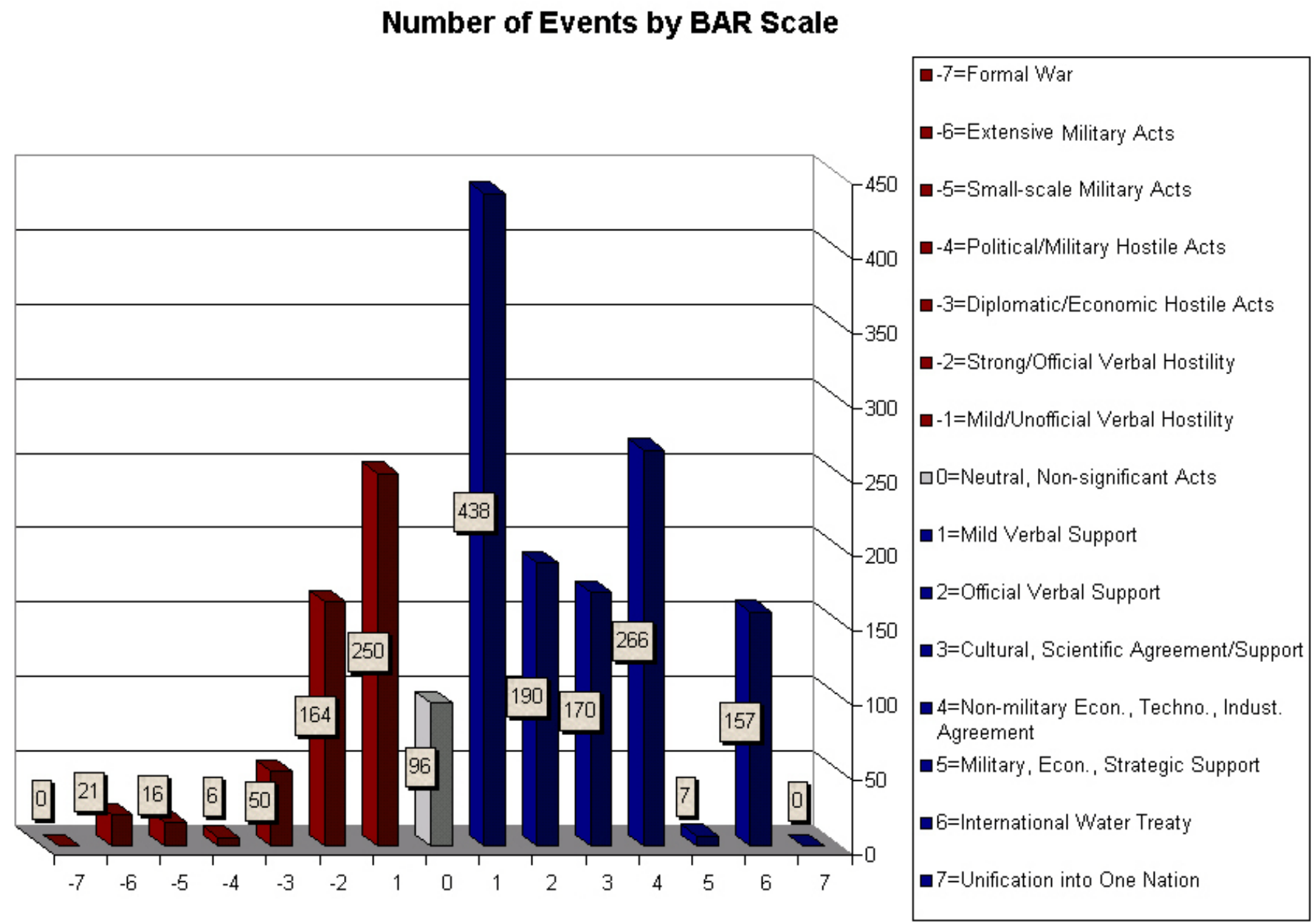

Bibliography

Treaties

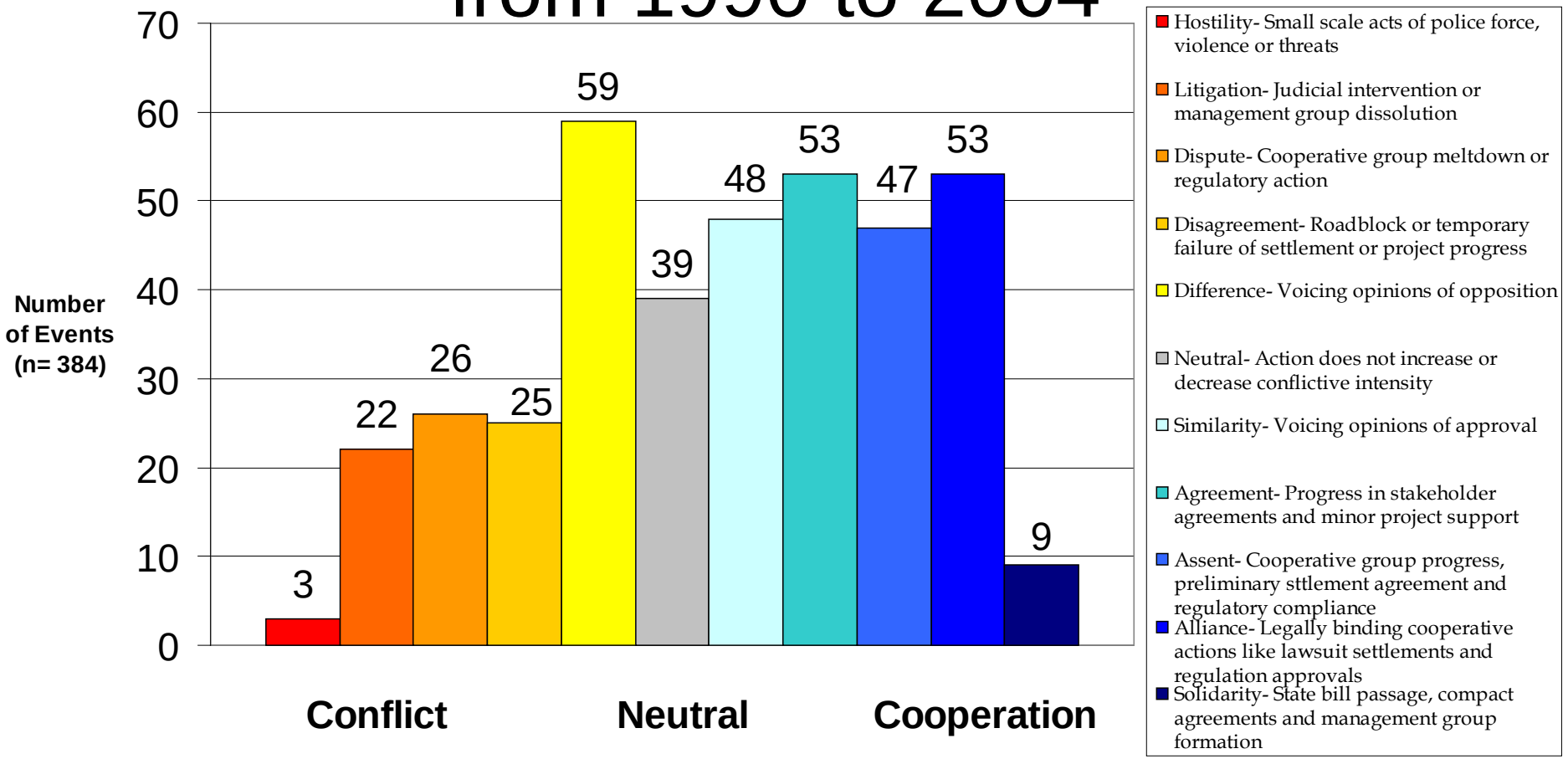
www.transboundarywaters.orst.edu

| DATE | BASIN | COUNTRIES | BAR SCALE | EVENT SUMMARY | ISSUE TYPE |
|---|---|---|---|---|---|
| 12/5/73 | La Plata | Argentina--Paraguay | 4 | PRY AND ARG AGREE TO BUILD 1B DAM, HYDROELECTRIC PROJECT | Infrastructure |
| 1/1/76 | Ganges | Bangladesh--India--United Nations | -2 | Bangladesh lodges a formal protest against India with the United Nations, which adopts a consensus statement encouraging the parties to meet urgently, at the level of minister, to arrive at a settlement. | Quantity |
| 7/3/78 | Amazon | Bolivia--Brazil--Colombia--Ecuador--Guyana--Peru--Suriname--Venezuela | 6 | Treaty for Amazonian Cooperation | Economic Development |
| 4/7/95 | Jordan | Israel--Jordan | 4 | Pipeline from Israel storage at Beit Zera to Abdullah Canal (East Ghor Canal) begins delivering water stipulated in Treaty (20 MCM summer, 10 MCM winter). The 10 mcm replaces the 10 mcm of desalinated water stipulated Annex II, Article 2d until desalinization plant completed | Quantity |
| 6/1/99 | Senegal | Mali--Mauritania | -3 | 13 people died in communal clashes in 6/99 along border between Maur. & Mali; conflict started when herdsmen in Missira-Samoura village in w. Mali, refused to allow Maur. horseman to use watering hole; horseman returned w/ some of his clansmen, attacking village on 6/20/99, causing 2 deaths; in retaliation that followed, 11 more died. | Quantity |

# Events Database, Example

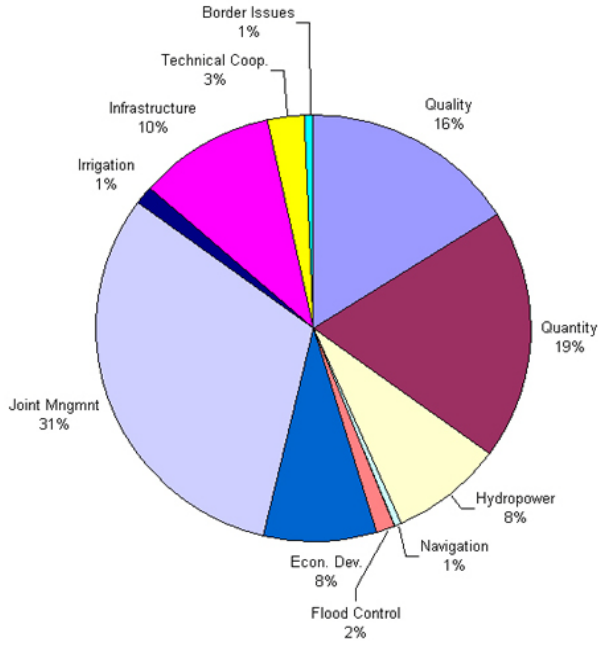

Number of Events by BAR Scale
-7=Formal War
-6=Extensive Military Acts
-5=Small-scale Military Acts
-4=Political/Military Hostile Acts
-3=Diplomatic/Economic Hostile Acts
-2=Strong/Official Verbal Hostility
-1=Mild/Unofficial Verbal Hostility
0=Neutral, Non-significant Acts
1=Mild Verbal Support
2=Official Verbal Support
3=Cultural, Scientific Agreement/Support
4=Non-military Econ., Techno., Indust. Agreement
5=Military, Econ., Strategic Support
6=International Water Treaty
7=Unification into One Nation
0
21
16
6
50
164
250
96
438
190
170
266
7
157
0
450
400
350
300
250
200
150
100
50
0
-7
-6
-5
-4
-3
-2
1
0
1
2
3
4
5
6
7

# Number of Media Reported Events in Oregon along a Cooperation- Conflict Spectrum from 1990 to 2004

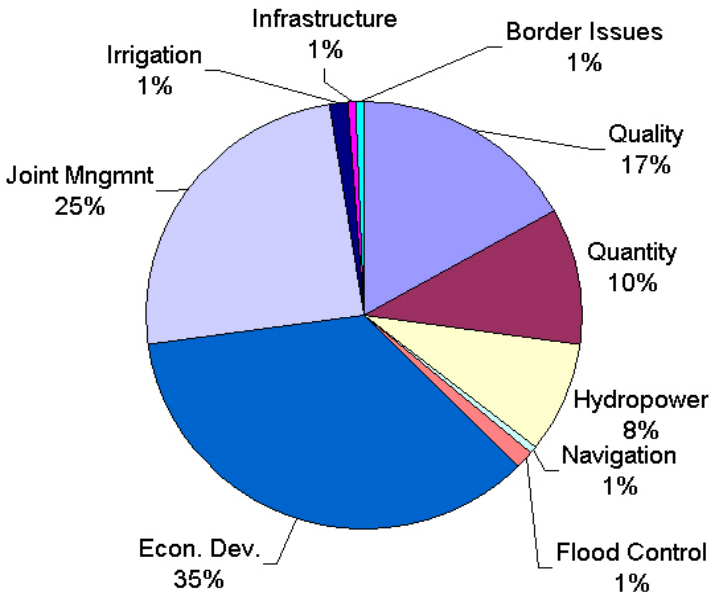



Source: Fesler, K. (2006) [Analysis of social interactions concerning Oregon's water resources between 1990 and 2004.] Unpublished

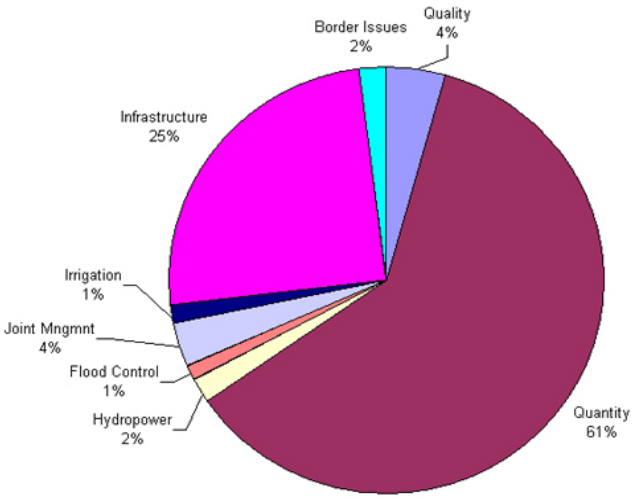
**Distribution of Total Cooperative Events by Issue Area**



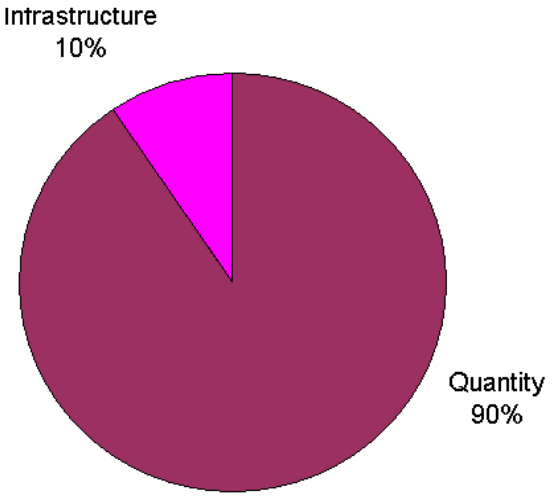

**Country-Pair Interactions By Issue Type Extreme (BAR Scale 6) Cooperation**




**Distribution of Total Conflictive Events by Issue Area**




**Country-Pair Interactions by Issue Type Extreme (BAR Scale -6) Conflict**



# Table 3: Treaty Statistics Summary Sheet

Signatories
- Bilateral 124/145 (86%)
- Multilateral 21/145 (14%)

Principal Focus
- Water Supply 53/145 (37%)
- Hydropower 57/145 (39%)
- Flood Control 13/145 (9%)
- Industrial Uses 9/145 (6%)
- Navigation 6/145 (4%)
- Pollution 6/145 (4%)
- Fishing 1/145 (<1%)

Monitoring
- Provided 78/145 (54%)
- No/N. A. 67/145 (46%)

Conflict Resolution
- Council 43/145 (30%)
- Governmental Unit 9/145 (6%)
- UN/Third Party 14/145 (10%)
- None/N. A. 79/145 (54%)

Enforcement
- Council 26/145 (18%)
- Force 2/145 (1%)
- Economic 1/145 (<1%)
- None/N.A. 116/145 (80%)

Unequal Power Relationship
- Yes 52/145 (36%)
- No/Unclear 93/145 (64%)

Information Sharing
- Yes 93/145 (64%)
- No/N. A. 52/145 (36%)

Water Allocation
- Equal Portions 15/145 (10%)
- Complex/Clear 39/145 (27%)
- Unclear 14/145 (10%)
- None/N. A. 77/145 (53%)

Non-Water Linkages
- Money 44/145 (30%)
- Land 6/145 (4%)
- Political 2/145 (1%)
- Other Linkages 10/145 (7%)
- No Linkages 83/145 (57%)

# Institutional Resiliency Argument

**Transboundary water institutions are resilient over time, even between hostile riparians, even as conflict is waged over other issues:**

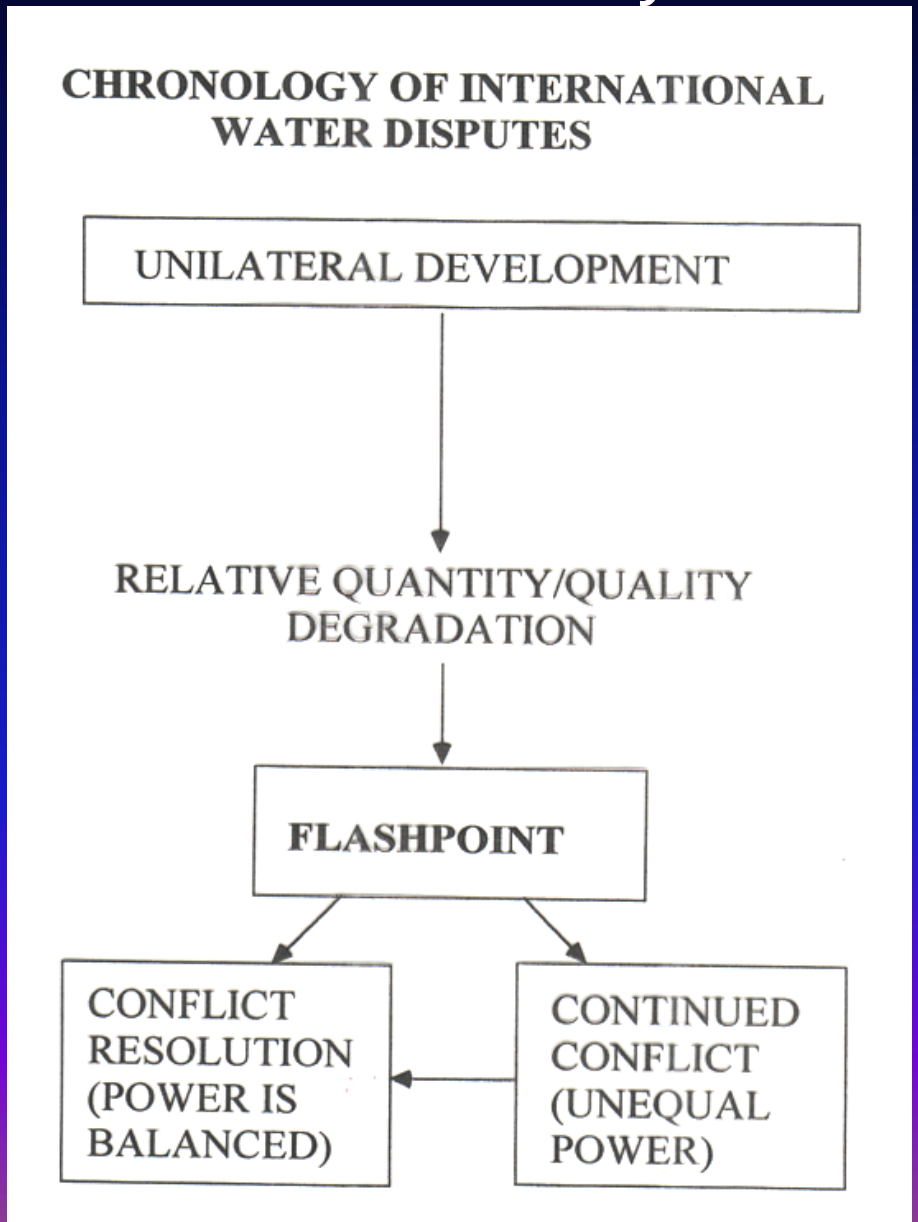
- **Picnic Table Talks**
- **Mekong Committee**
- **Indus River Commission**
- **Caucasus**
- **SADC Region**

# Water Myths and Water Facts

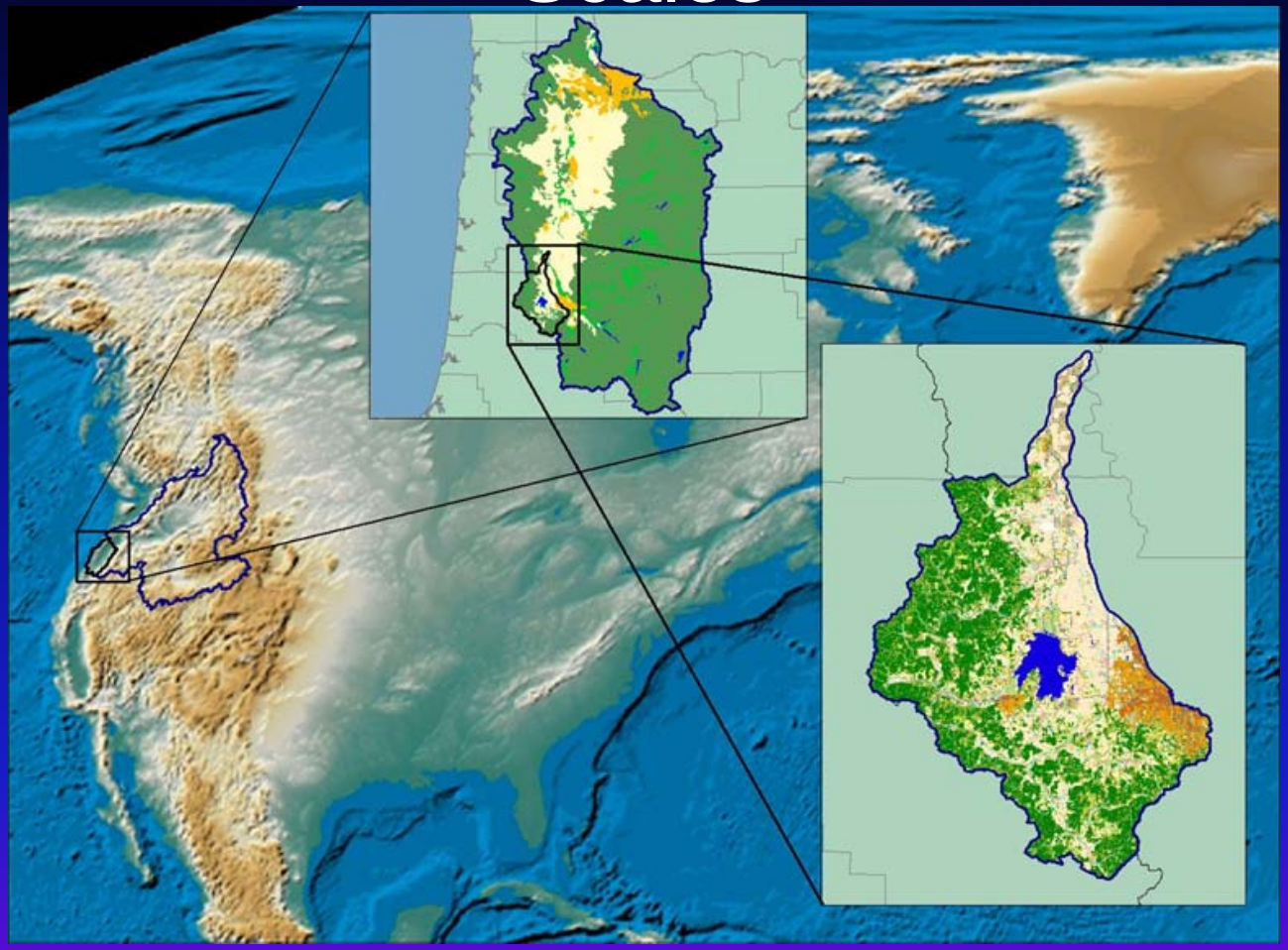
## Myth 2:
## Everything is OK

- Decades of tension, degradation, and inefficiency
- Conflict within and between multiple scales
- Regional instability in areas of security concern
- Climate change and its impacts on water resources

# Decades of Tension, Degradation, and Inefficiency

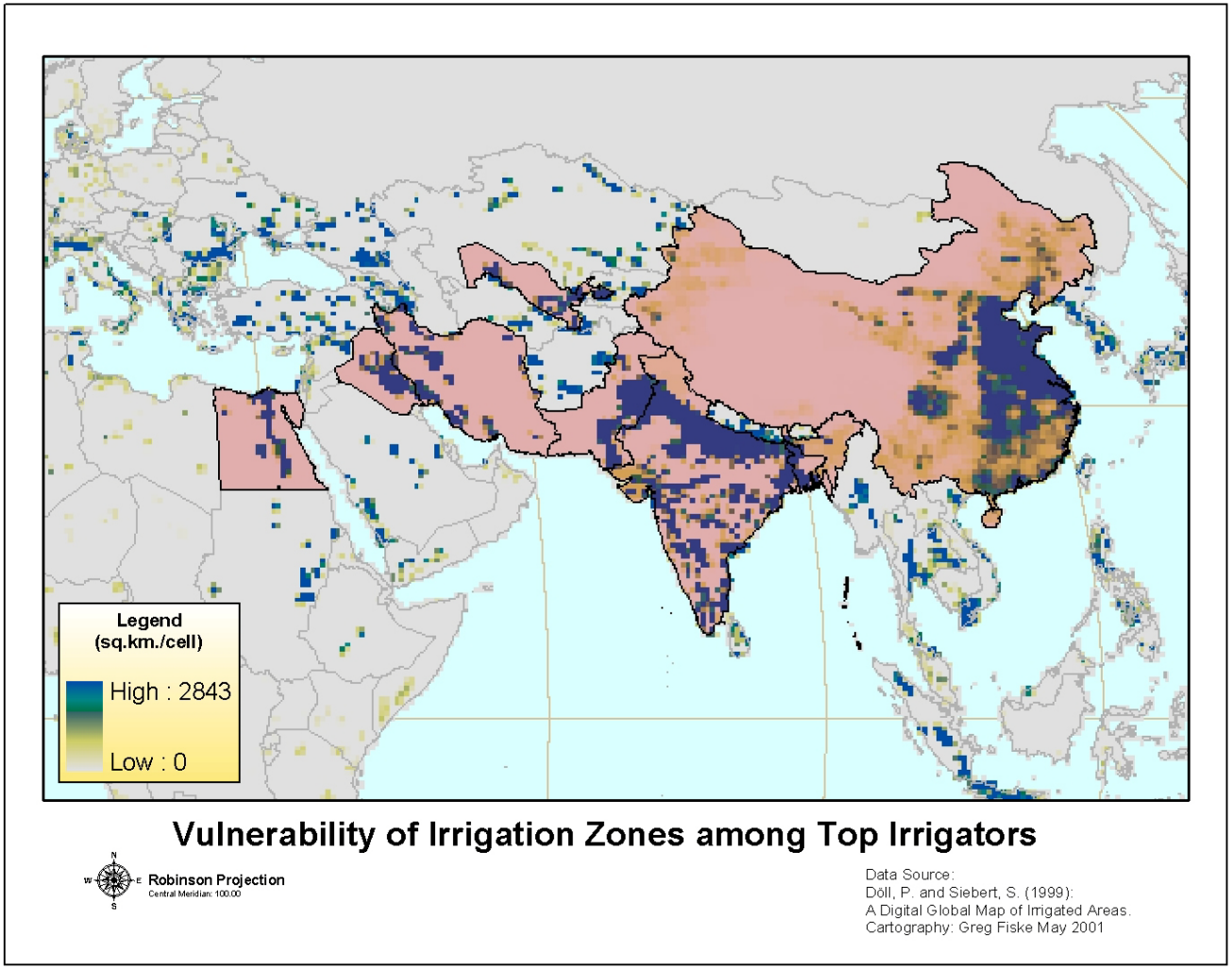


# Conflict Within and Between Multiple Scales



The smaller the scale, the greater the likelihood of dispute.

# Regional Instability in Areas of Security Concern



# Water Myths and Water Facts

## Myth 3:

## Causes of conflict include:

- **Climate**
- **Water stress**
- **Population**
- **Level of development**
- **Dependence on hydropower**
- **Dams or development *per se***
- **“Creeping” changes:**
  - general degradation of quality
  - climate change induced hydrologic variability

# *Basins at Risk*

## *Conflict and Cooperation Over International Waters*

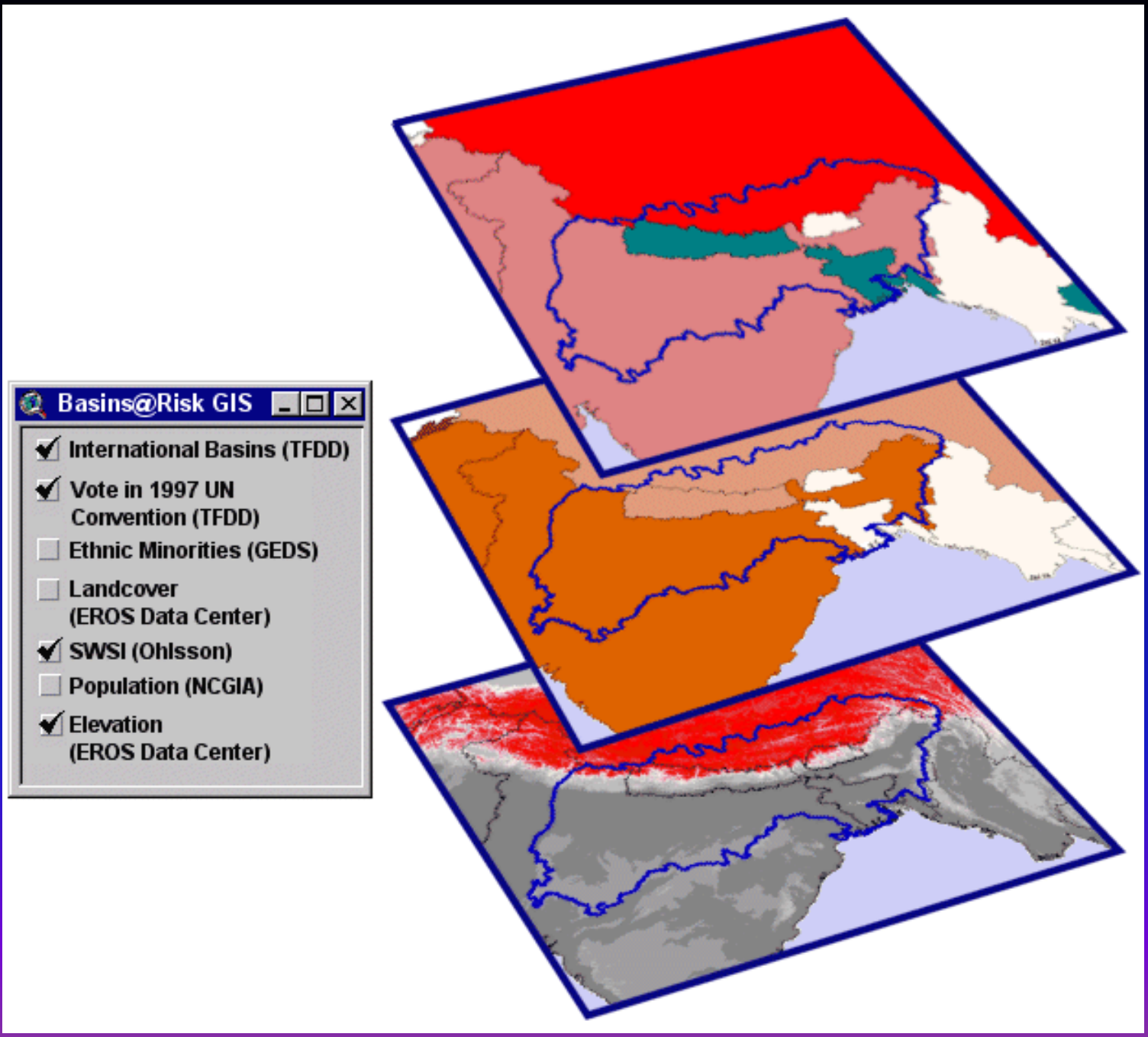

Principal Investigator:
Aaron T. Wolf PhD
Oregon State University

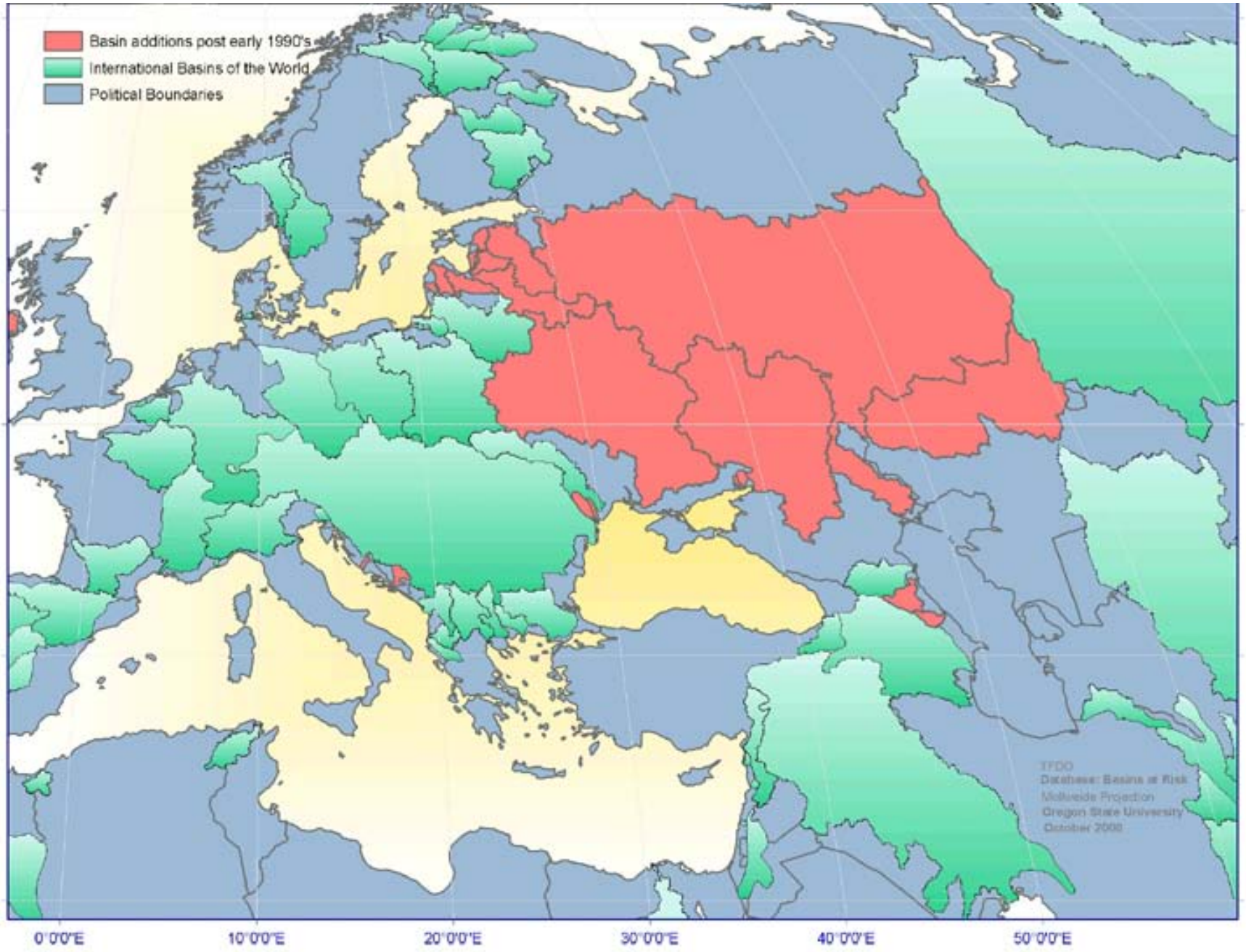
Research Associates:

Shira Yoffe, Project Manager

Case Bowman
Kuuipo Burleigh
Greg Fiske
Mark Giordano
Meredith Giordano
Jeanne Hoadley
Kelli Larson
Kyoko Matsumoto
Marc Rothgery
Daniel Wise

TFDD: Basins at Risk
Department of Geosciences
Oregon State University


Basins@Risk GIS
International Basins (TFDD)
Vote in 1997 UN Convention (TFDD)
Ethnic Minorities (GEDS)
Landcover (EROS Data Center)
SWSI (Ohlsson)
Population (NCGIA)
Elevation (EROS Data Center)


Basin additions post early 1990's
International Basins of the World
Political Boundaries
TFDD
Database: Basins at Risk
Mollweide Projection
Oregon State University
October 2000
0°0'0"E
10°0'0"E
20°0'0"E
30°0'0"E
40°0'0"E
50°0'0"E

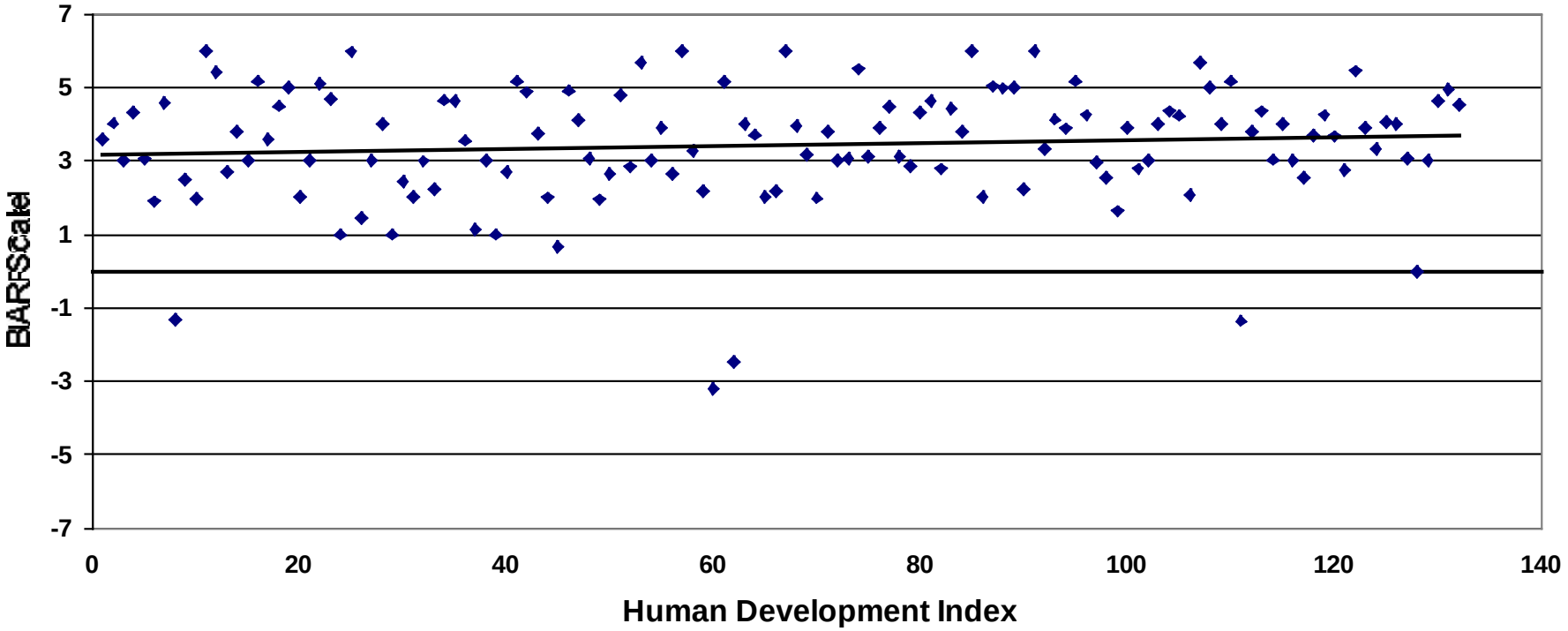
# Excerpt of River Names File
# Amazon River Basin

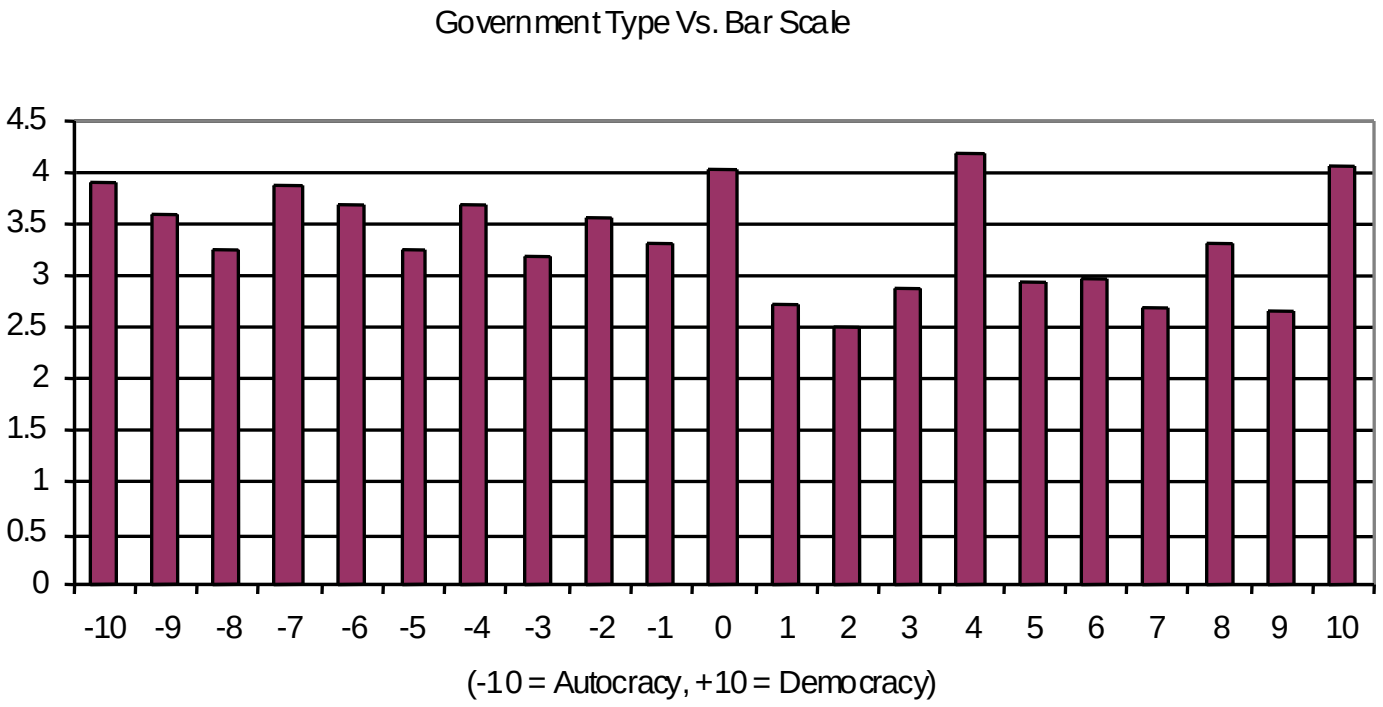
**Basin/Country Polygons**

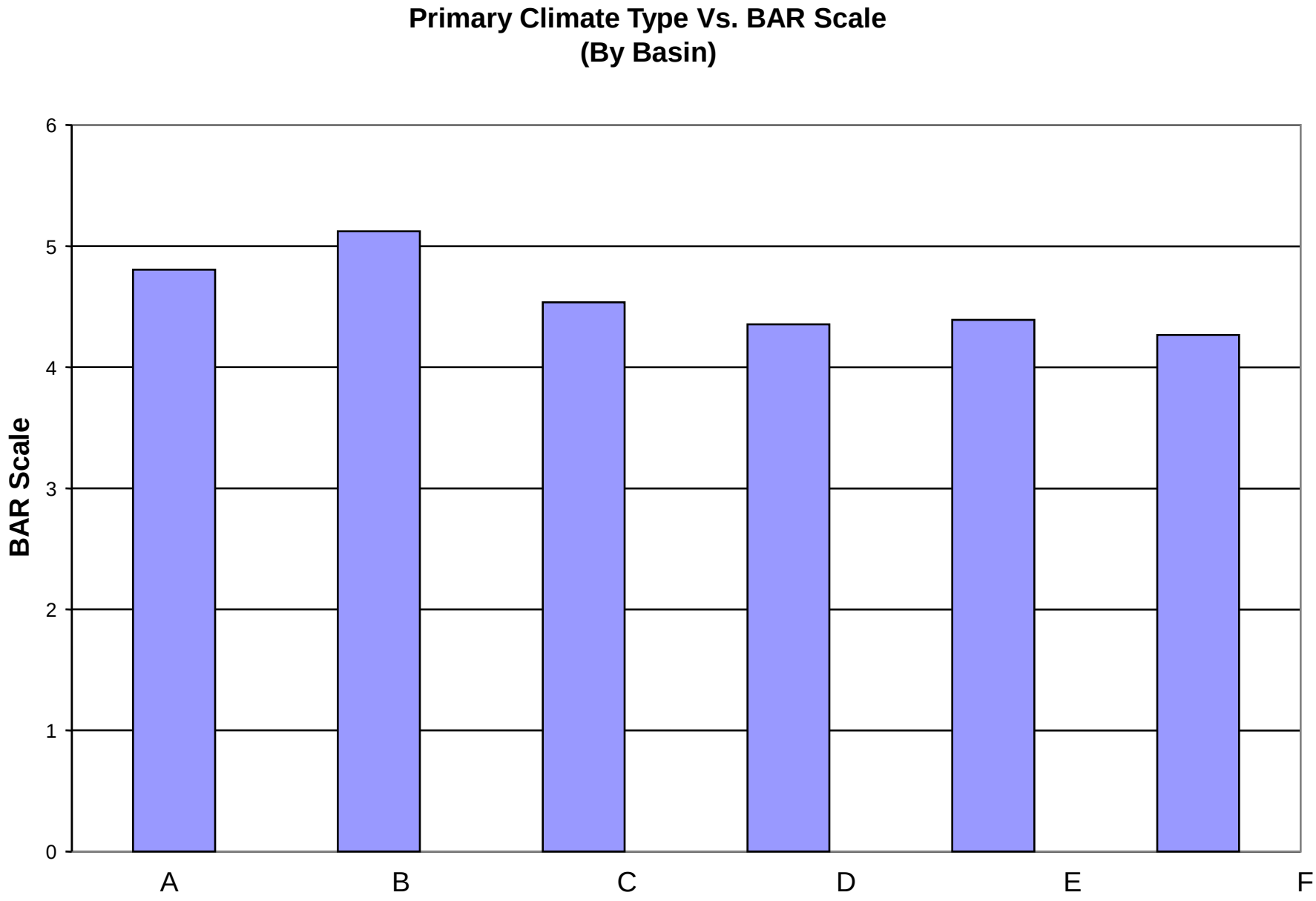
**River Names**

| AMZN_BOL | AMZN_BRA | AMZN_COL | AMZN_ECU | AMZN_GUY | AMZN_PER | AMZN_SUR | AMZN_VEN |
|---|---|---|---|---|---|---|---|
| Abuna | Abacaxis | Ajaju | Acre | Cafuini | Acre | Trombetas | Bina |
| Apere | Abuna | Apaporis | Chandless | Ireng | Alto Purus | | Casiquiare |
| Baures | Acalau | Caqueta | Corrientes | Tacutu | Apurmac | | Concorochite |
| Beni | Acarai | Cuduyari | Curaray | | Blanco | | Grande |
| Blanco | Acre | Icana(Isasha) | Iaco | | Chandless | | Negro |
| Grande | Agua Preta | Papuri | Janua | | Chili | | |
| Guapore | Ajuana | Quaina | Morancon | | Corrientes | | |
| Guapore Ibe | Alalau | Raudal Yupui | Morona | | Heath | | |
| Heath | Anama | Tiquie | Napo | | Huallaga | | |
| Lago de San | Anaua | Traira | Pastaza | | Iaco | | |
| Lago Rogaua | Andma | Uaupes | Tigre | | Inamban | | |
| Madidi | Apaca | Yari | Yavari | | Inuya | | |
| Mamore | Apiau | | | | Janua | | |
| Manu Madre | Apidia | | | | Manu Madre de Dios | | |
| Manuripi | Araca | | | | Manuripi | | |
| Negro | Araua | | | | Maranon | | |
| Orton | Arinos | | | | Moranon | | |
| Paragua | Aripuana | | | | Napo | | |
| Rapulo | Arracias | | | | Orton | | |
| San Martin | Arrainas | | | | Pachitea | | |
| San Miguel | Bacaja | | | | Pampas? | | |
| Secure | Blau | | | | Postaza | | |
| Yata | Bia | | | | Putumayo | | |
| | Brea | | | | San Juan? | | |
| | Bunct | | | | Santa Ana? | | |
| | Cach Do Tareraimbu | | | | Santa Eulalia | | |
| | Cachoer da Bacena | | | | Santuario? | | |
| | Cachoera Caracarai | | | | Sheshea | | |

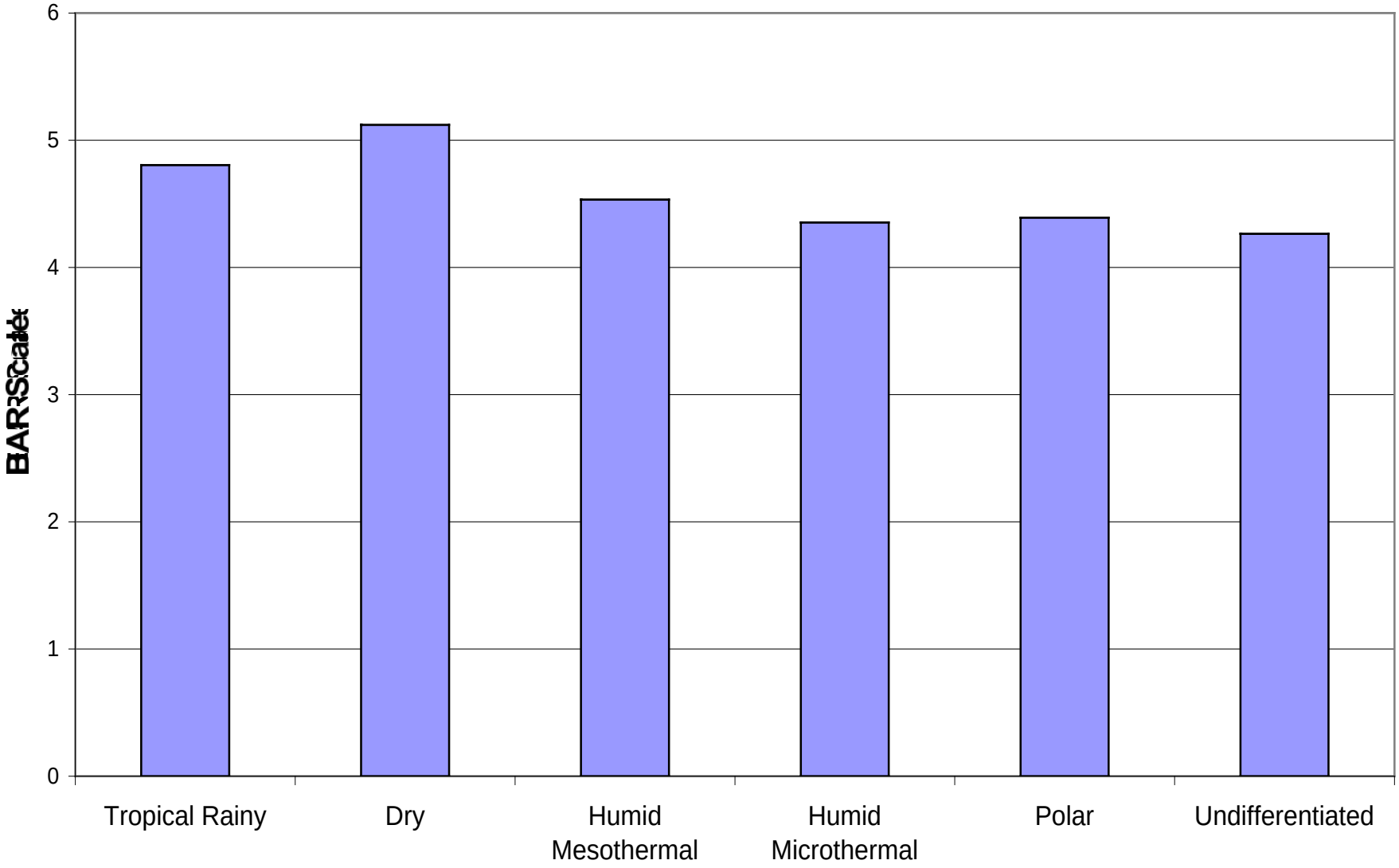
# Human Development Index Vs. BAR Scale (By Country)




Government Type Vs. Bar Scale
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10
(-10 = Autocracy, +10 = Democracy)


Primary Climate Type Vs. BAR Scale
(By Basin)
BAR Scale
6
5
4
3
2
1
0
A
B
C
D
E
F

## Primary Climate Type Vs. BAR Scale
## (By Basin)



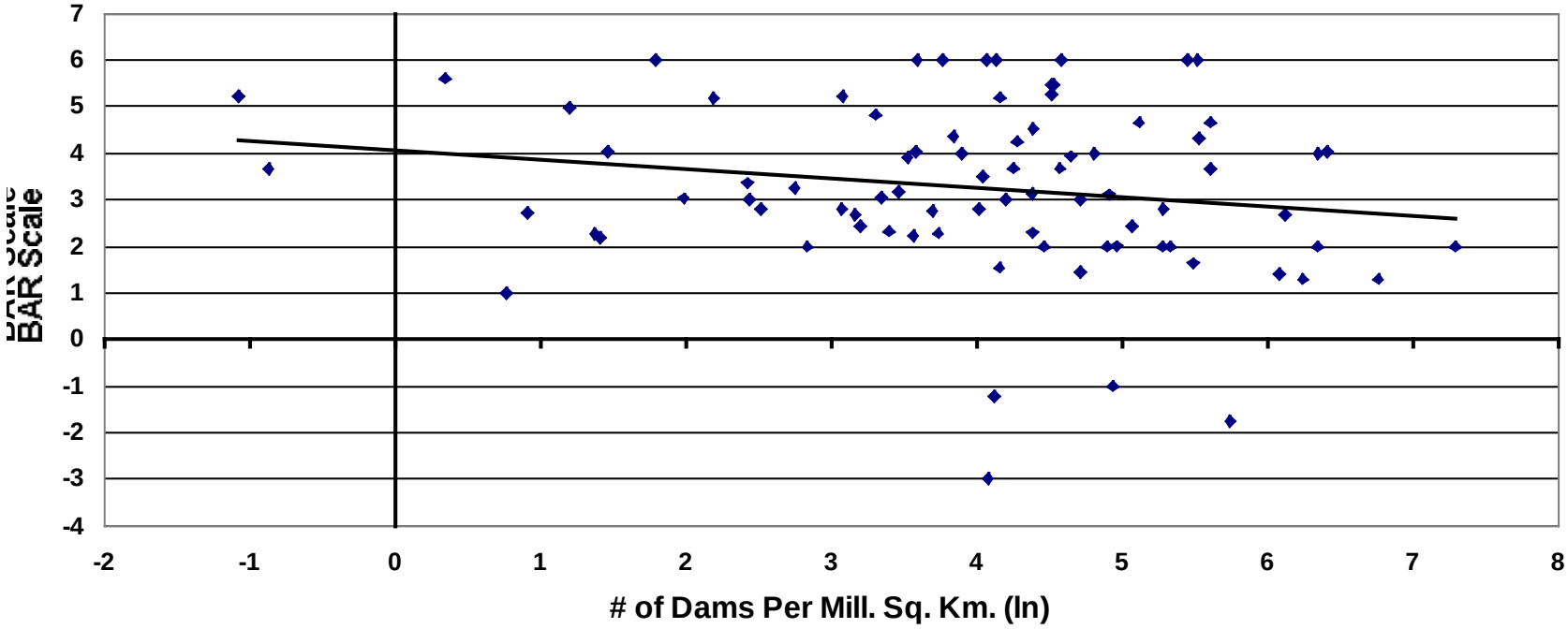
# BASINS AT RISK: Working Hypothesis

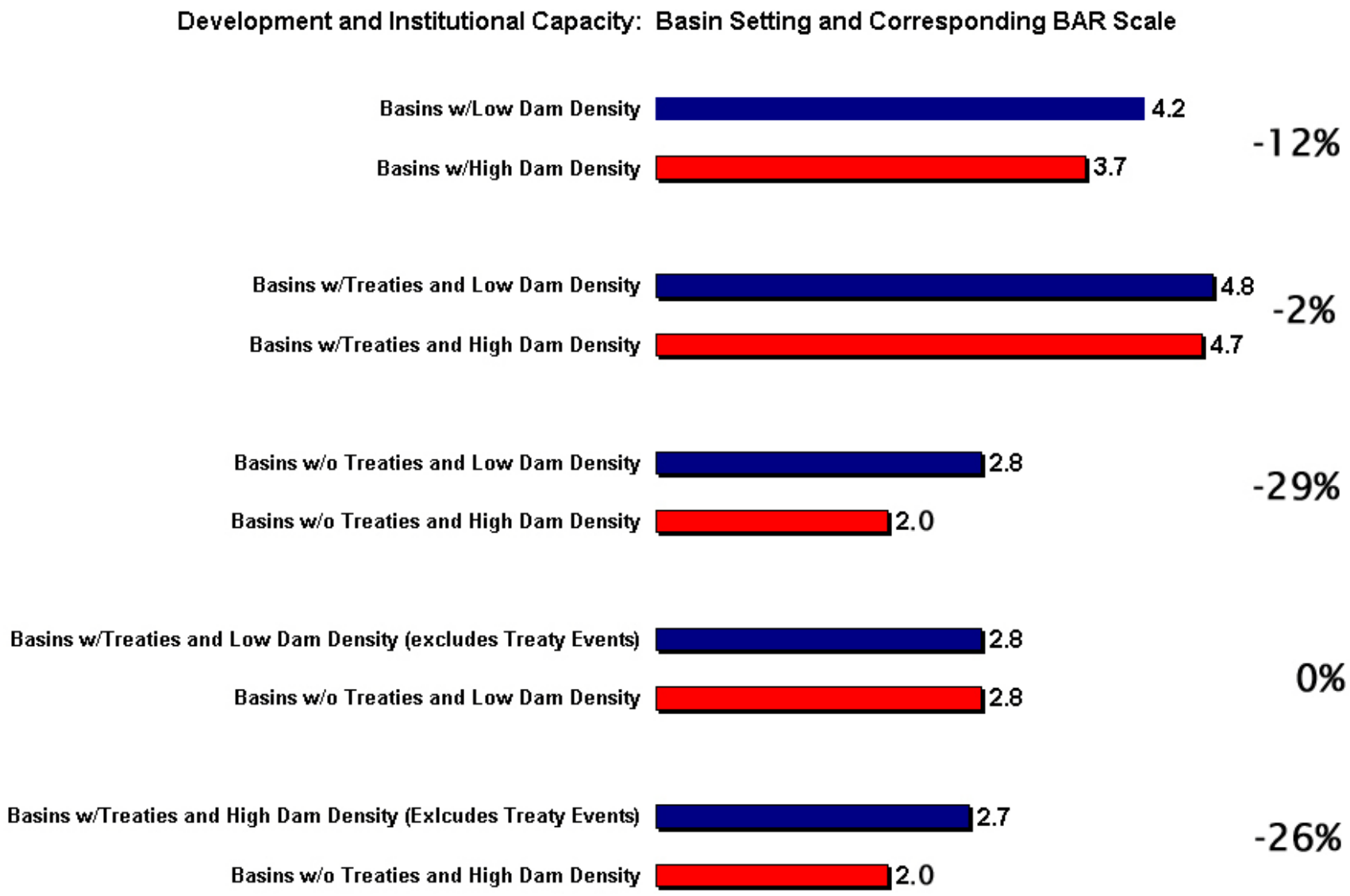
***"The likelihood of conflict rises as the rate of change within the basin exceeds the institutional capacity to absorb that change."***

**Parameters which seem *not* to be indicators:**

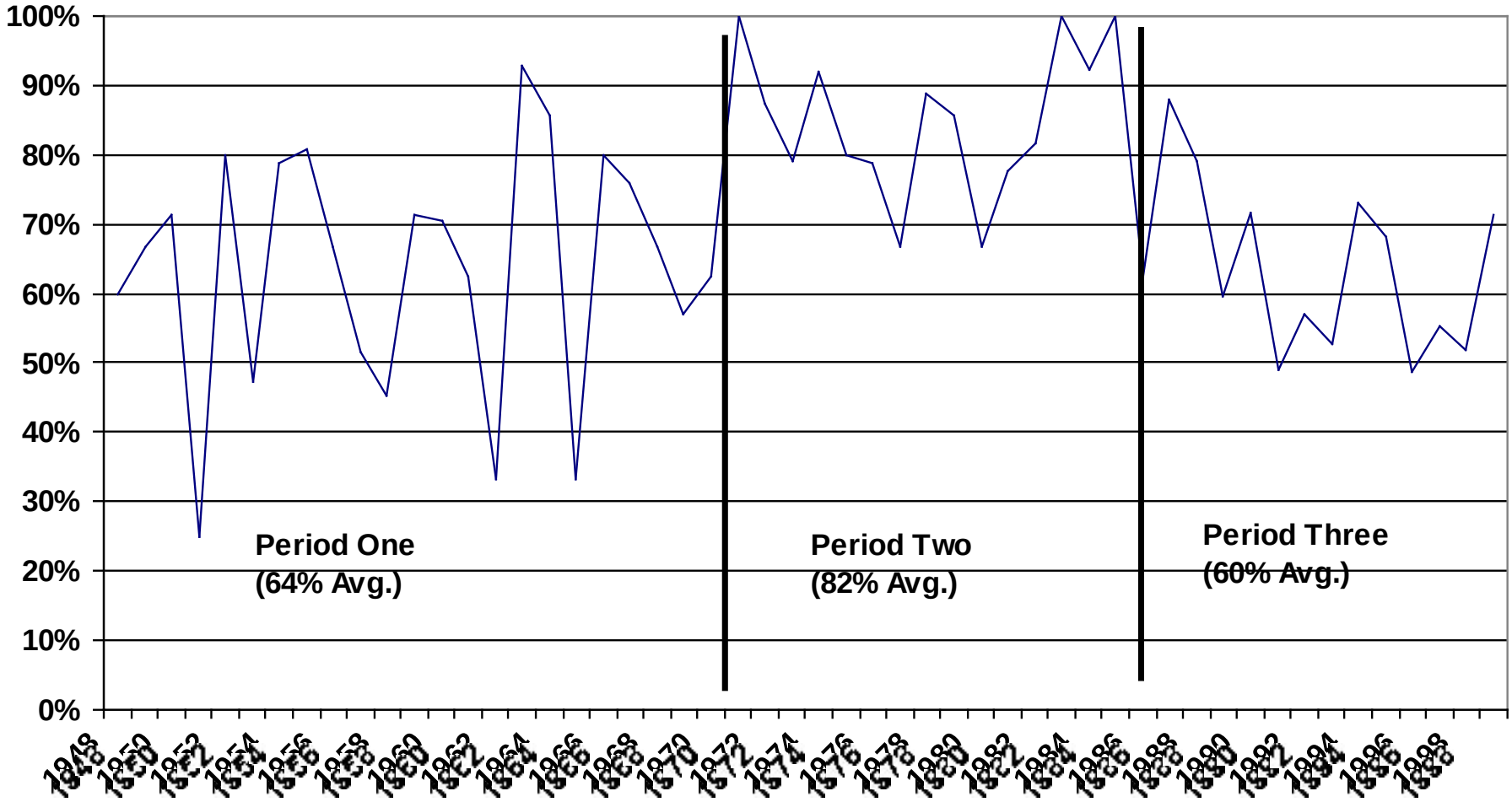
- **Climate**
- **Water stress**
- **Population**
- **Level of development**
- **Dependence on hydropower**
- **Dams or development *per se***
- **"Creeping" changes:**
  - general degradation of quality
  - climate change induced hydrologic variability

# Dams Per Million Sq. Km. (ln) Vs. BAR Scale (By Basin)




Development and Institutional Capacity: Basin Setting and Corresponding BAR Scale
Basins w/Low Dam Density
4.2
Basins w/High Dam Density
3.7
-12%
Basins w/Treaties and Low Dam Density
4.8
Basins w/Treaties and High Dam Density
4.7
-2%
Basins w/o Treaties and Low Dam Density
2.8
Basins w/o Treaties and High Dam Density
2.0
-29%
Basins w/Treaties and Low Dam Density (excludes Treaty Events)
2.8
Basins w/o Treaties and Low Dam Density
2.8
0%
Basins w/Treaties and High Dam Density (Exlcudes Treaty Events)
2.7
Basins w/o Treaties and High Dam Density
2.0
-26%

# Cooperative Events as a Percentage of Total Events



# BASINS AT RISK: Working Hypothesis

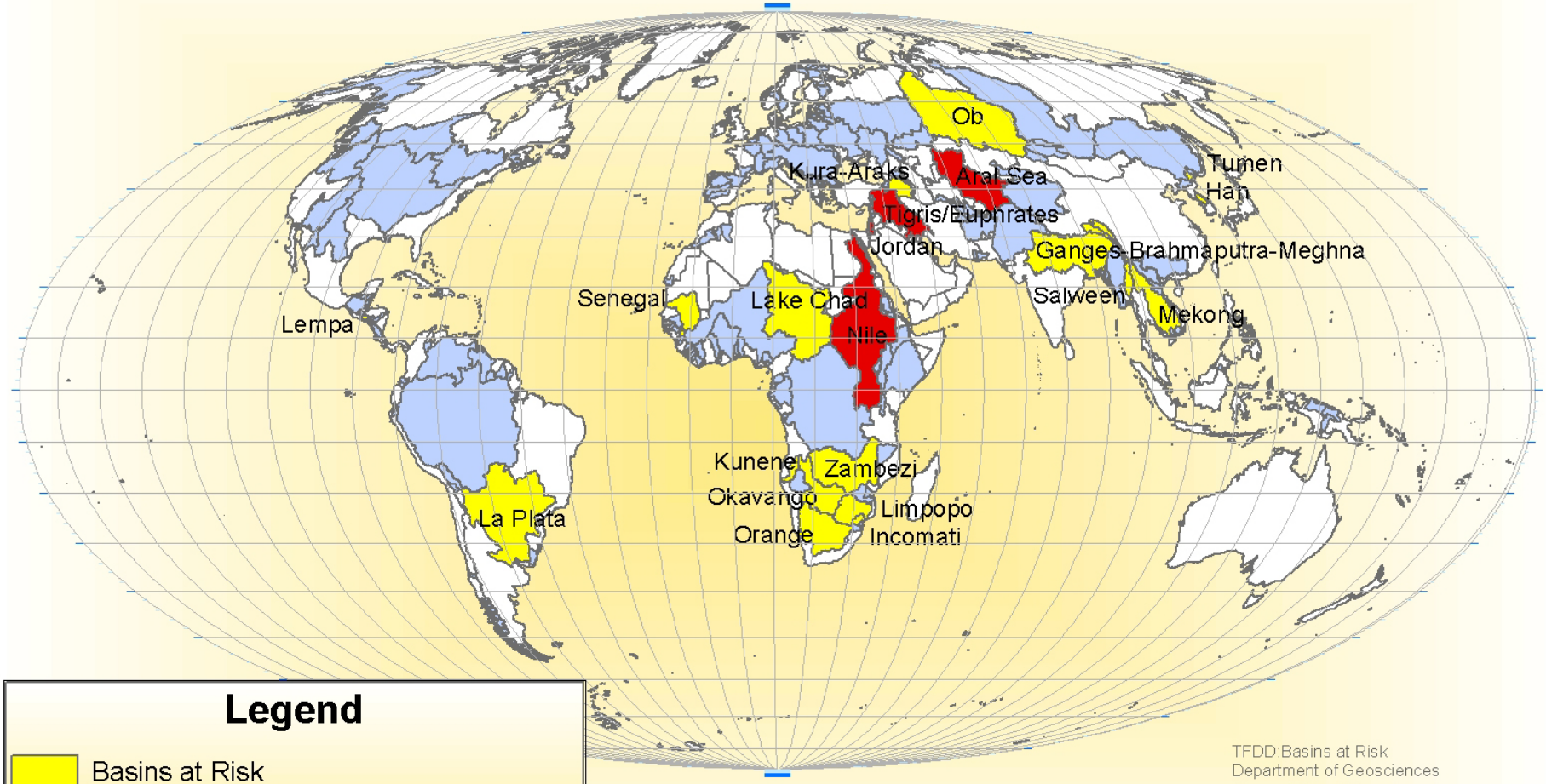
***"The likelihood of conflict rises as the rate of change within the basin exceeds the institutional capacity to absorb that change."***

What *are* indicators*?*

Sudden physical changes or lower institutional capacity are more conducive to disputes:

1) Uncoordinated development: a major project *in the absence* of a treaty or commission
2) "Internationalized basins"
3) General animosity

# Basins at Risk

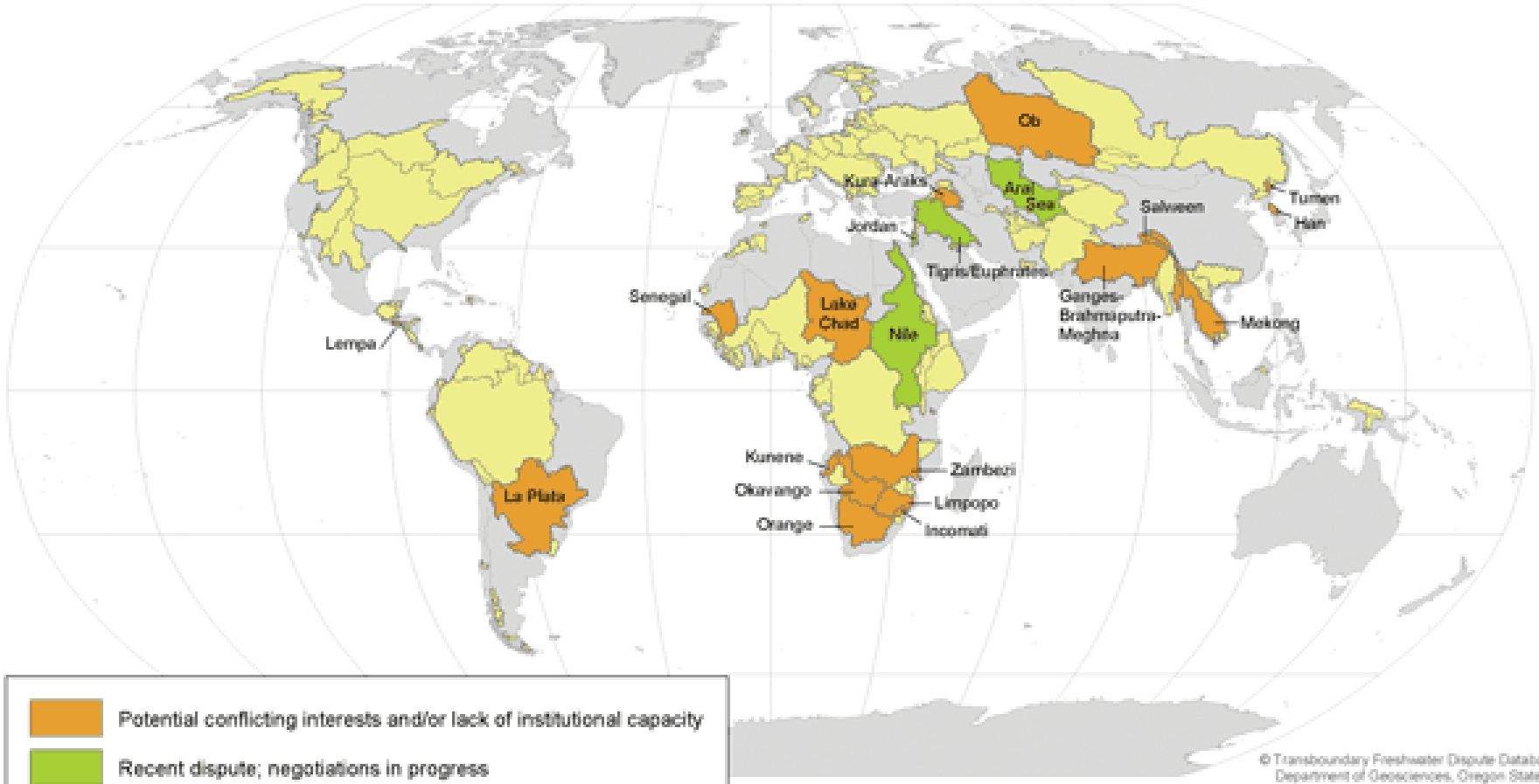



## Legend

- Basins at Risk
- Political Boundaries
- International Basins
- Basins Currently in Dispute/Negotiations

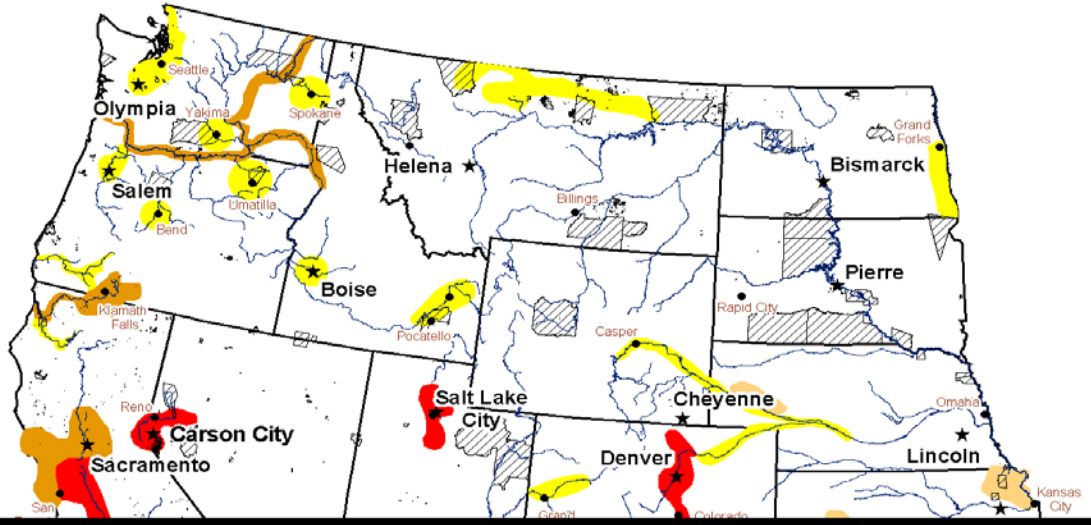
TFDD:Basins at Risk
Department of Geosciences
Oregon State University
Cartography: Greg Fiske
June 2001

# Basins Under Observation

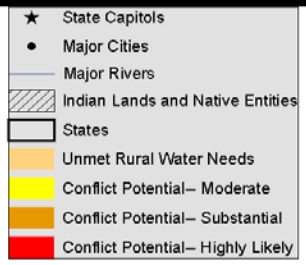


# Potential Water Supply Crises by 2025

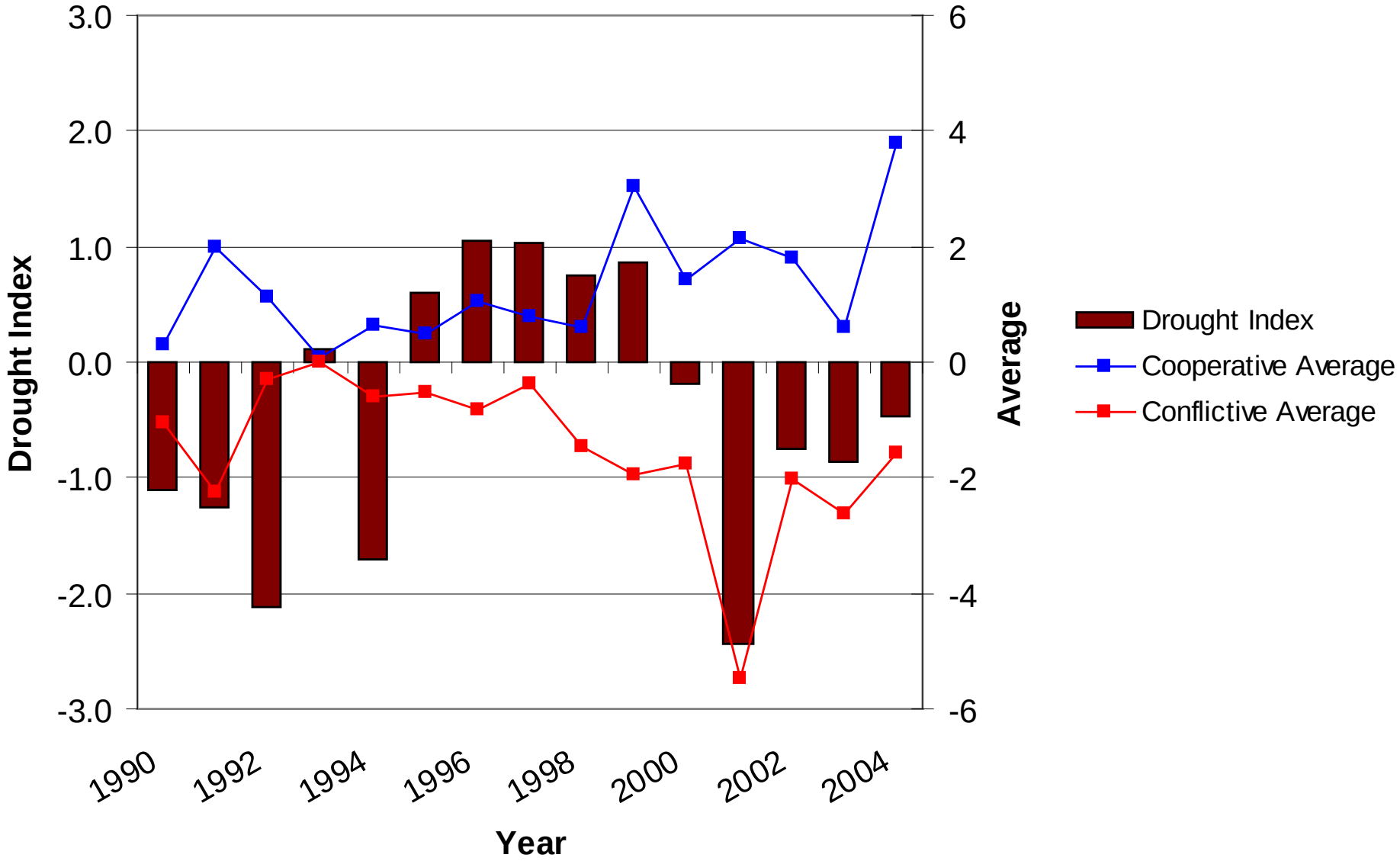
(Areas where existing supplies are not adequate to meet water demands for people, for farms, and for the environment)





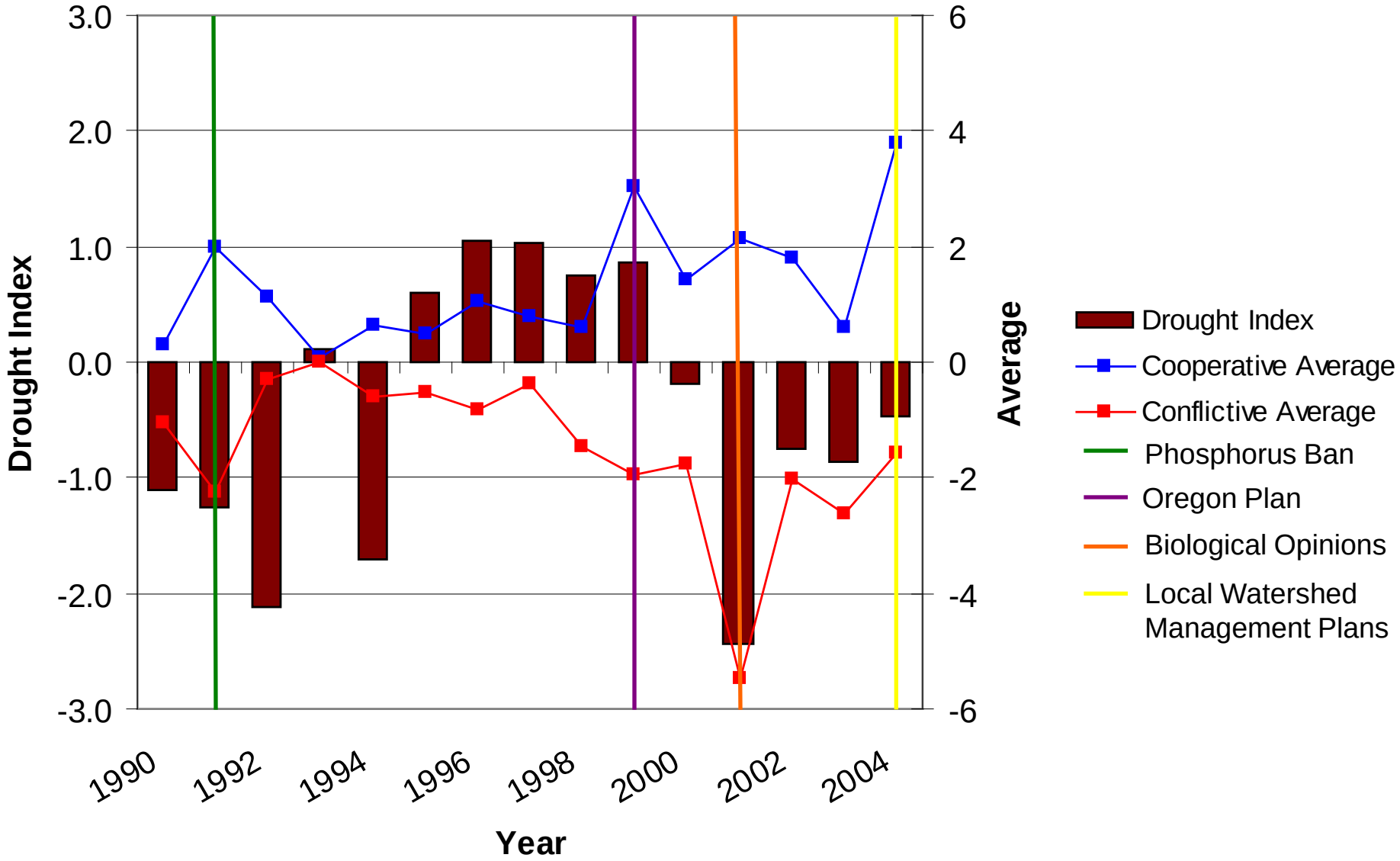



# Oregon Timeline

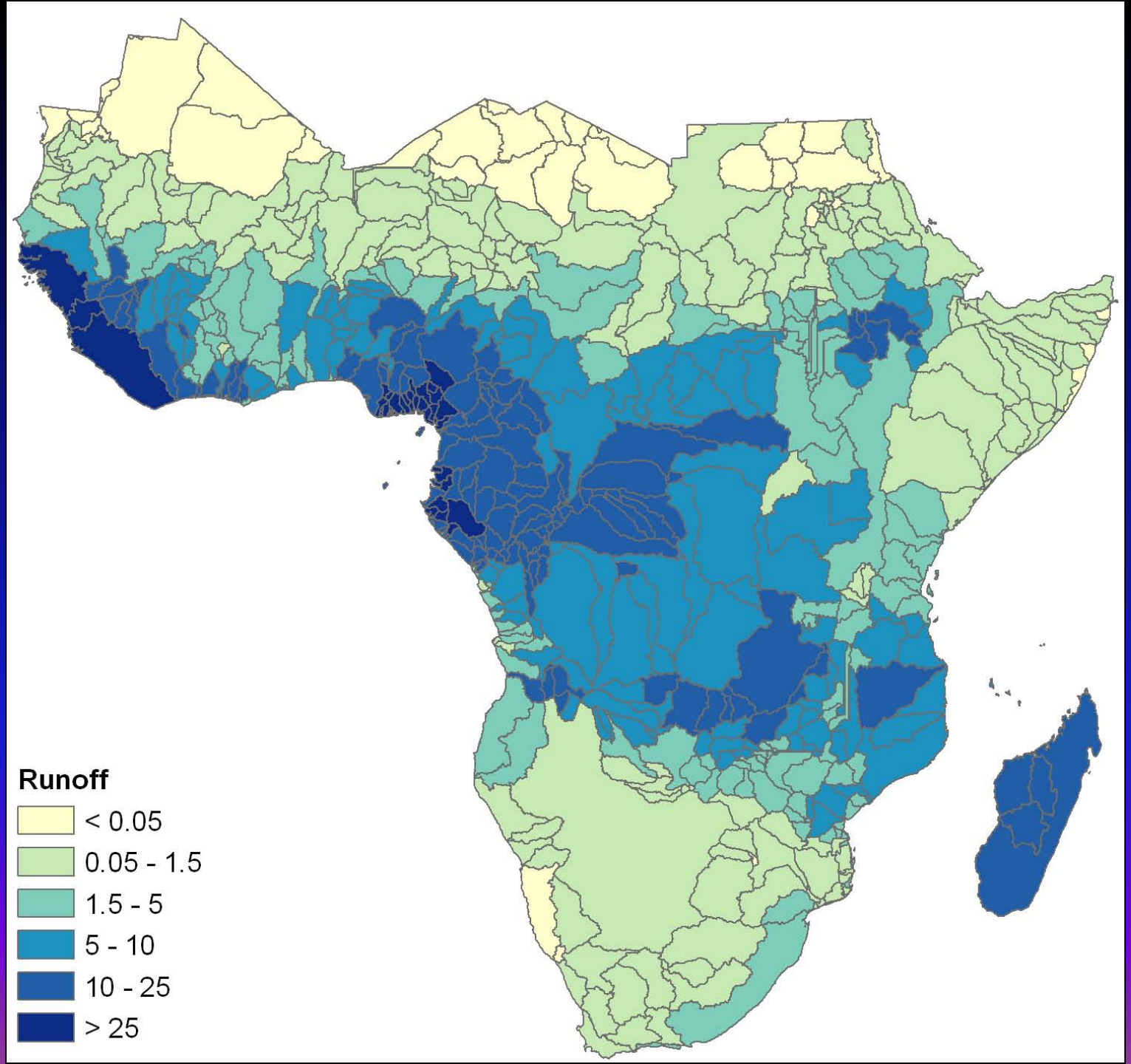


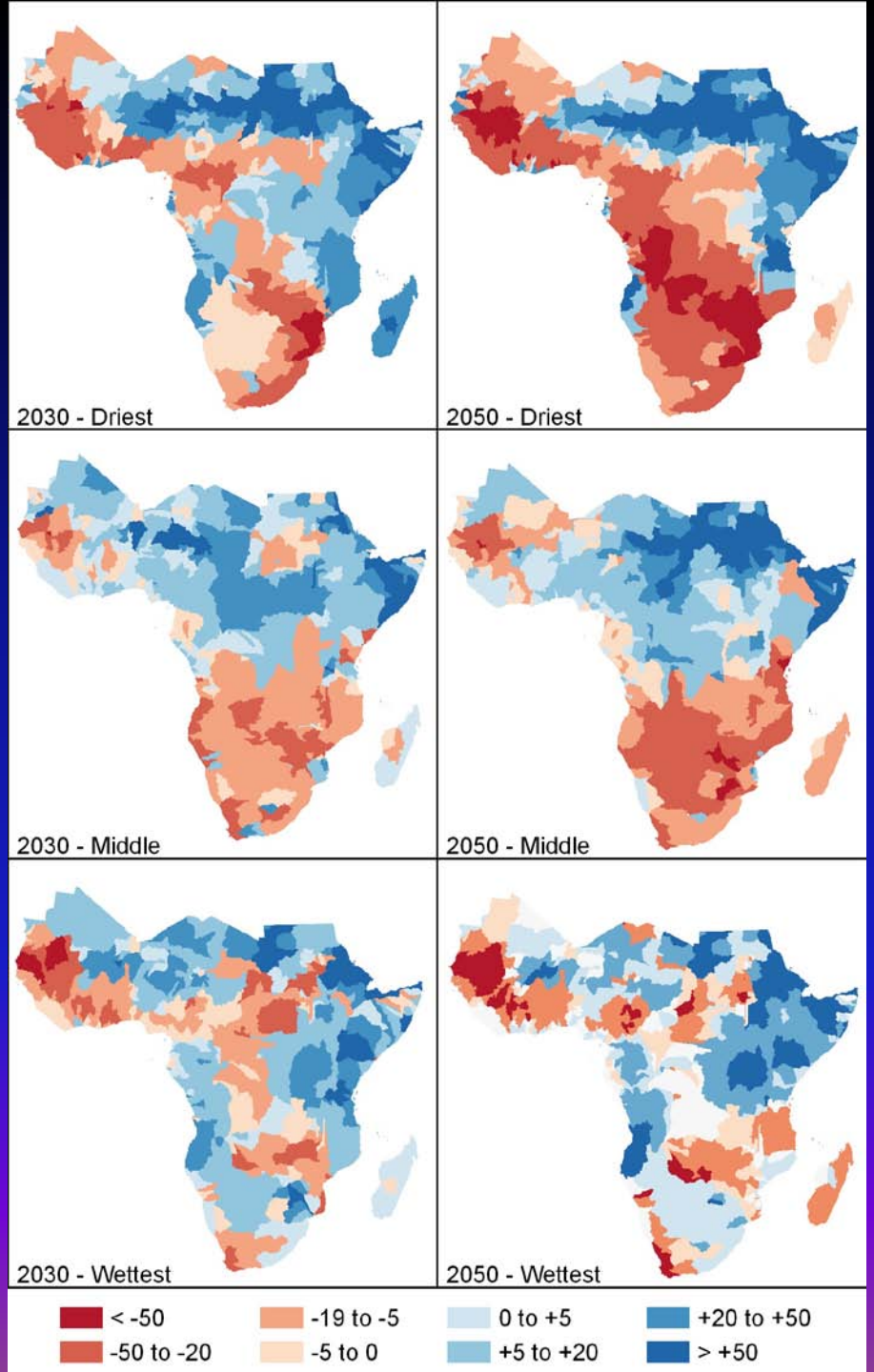

Source: Fesler, K. (2006) [Analysis of social interactions concerning Oregon's water resources between 1990 and 2004.] Unpublished

# Oregon Timeline

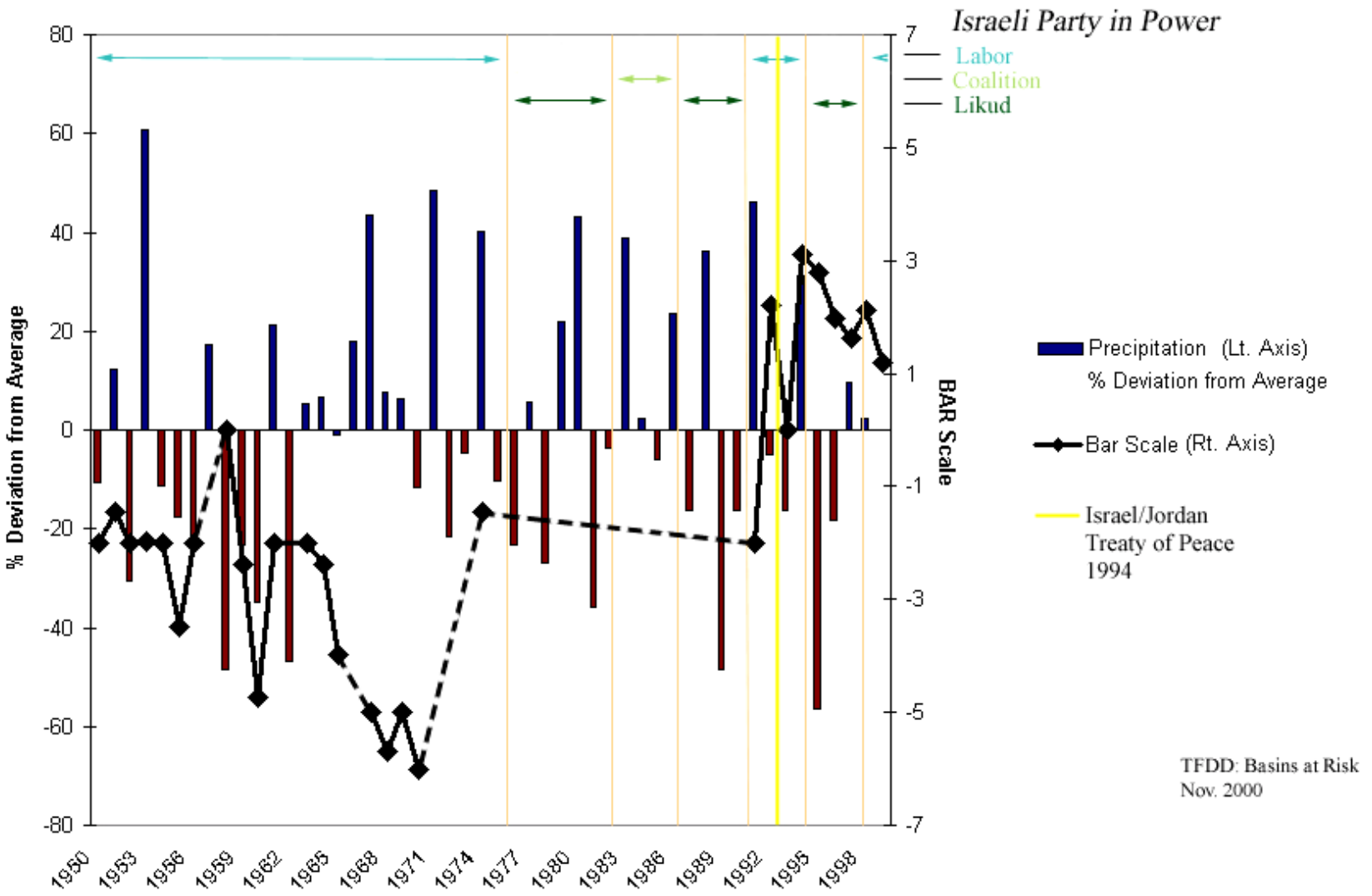



Source: Fesler, K. (2006) [Analysis of social interactions concerning Oregon's water resources between 1990 and 2004.] Unpublished


Runoff
< 0.05
0.05 - 1.5
1.5 - 5
5 - 10
10 - 25
> 25


2030 - Driest
2050 - Driest
2030 - Middle
2050 - Middle
2030 - Wettest
2050 - Wettest
< -50
-50 to -20
-19 to -5
-5 to 0
0 to +5
+5 to +20
+20 to +50
> +50

# *Jordan River Timeline*




TFDD: Basins at Risk
Nov. 2000