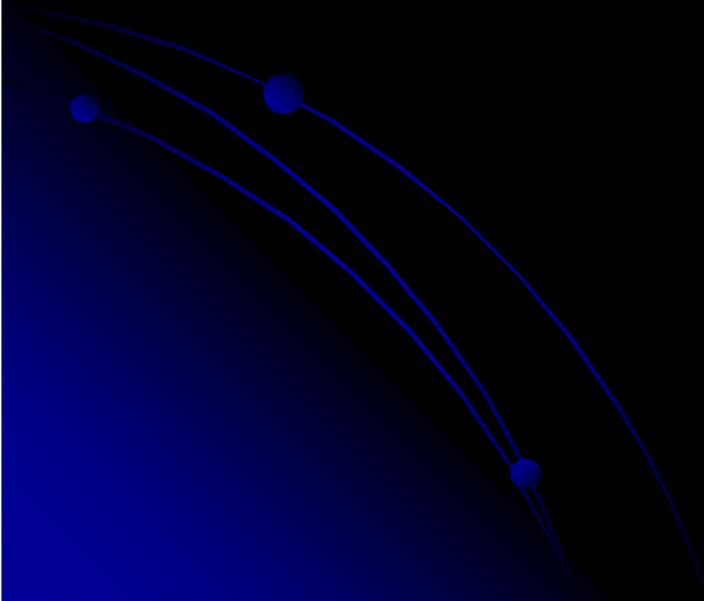
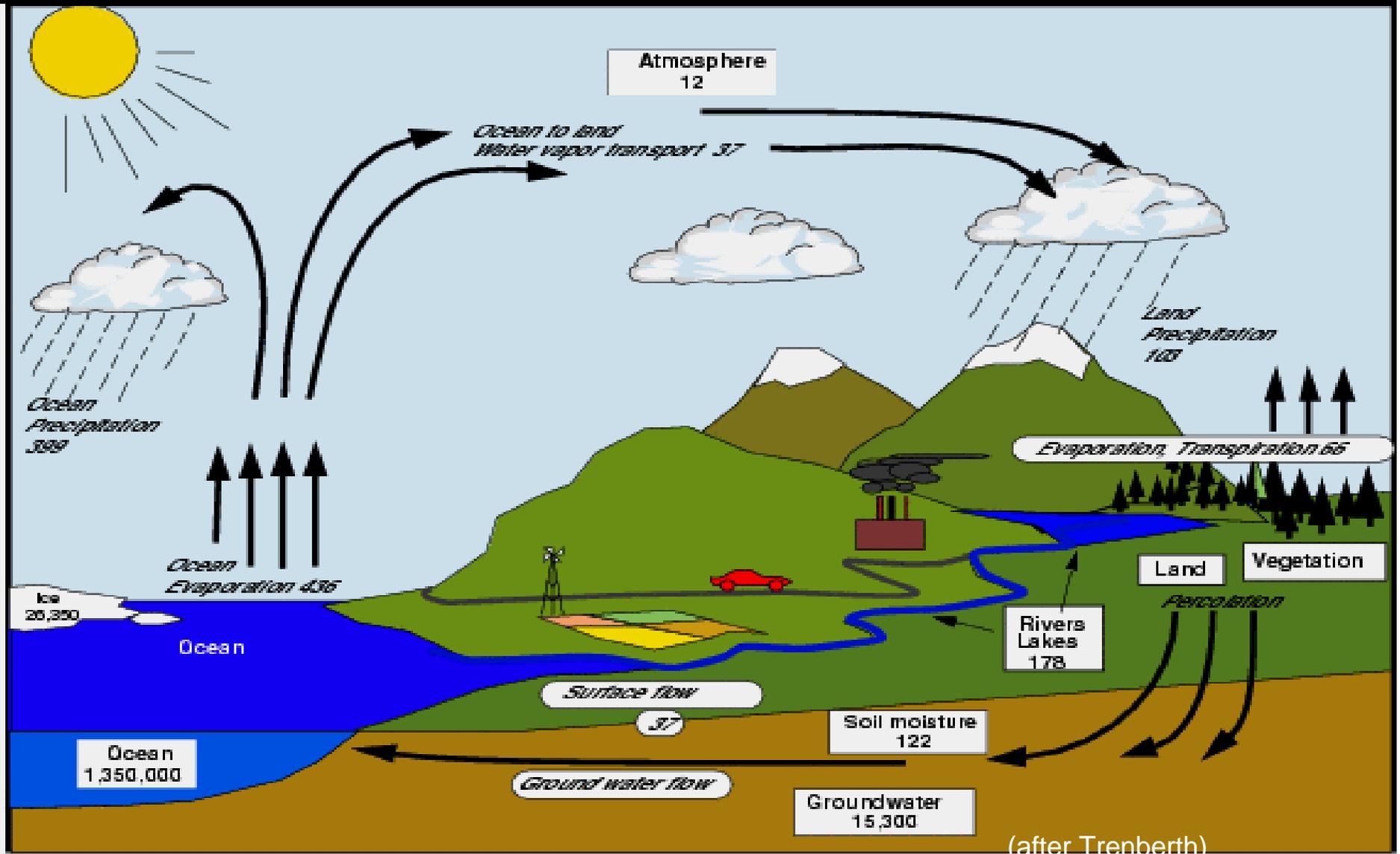


# UPDATE ON THE GLOBAL WATER CYCLE COMMUNITY OF PRACTICE



RICK LAWFORD  
GEO UCI MEETING  
WASHINGTON DC  
August 1, 2007

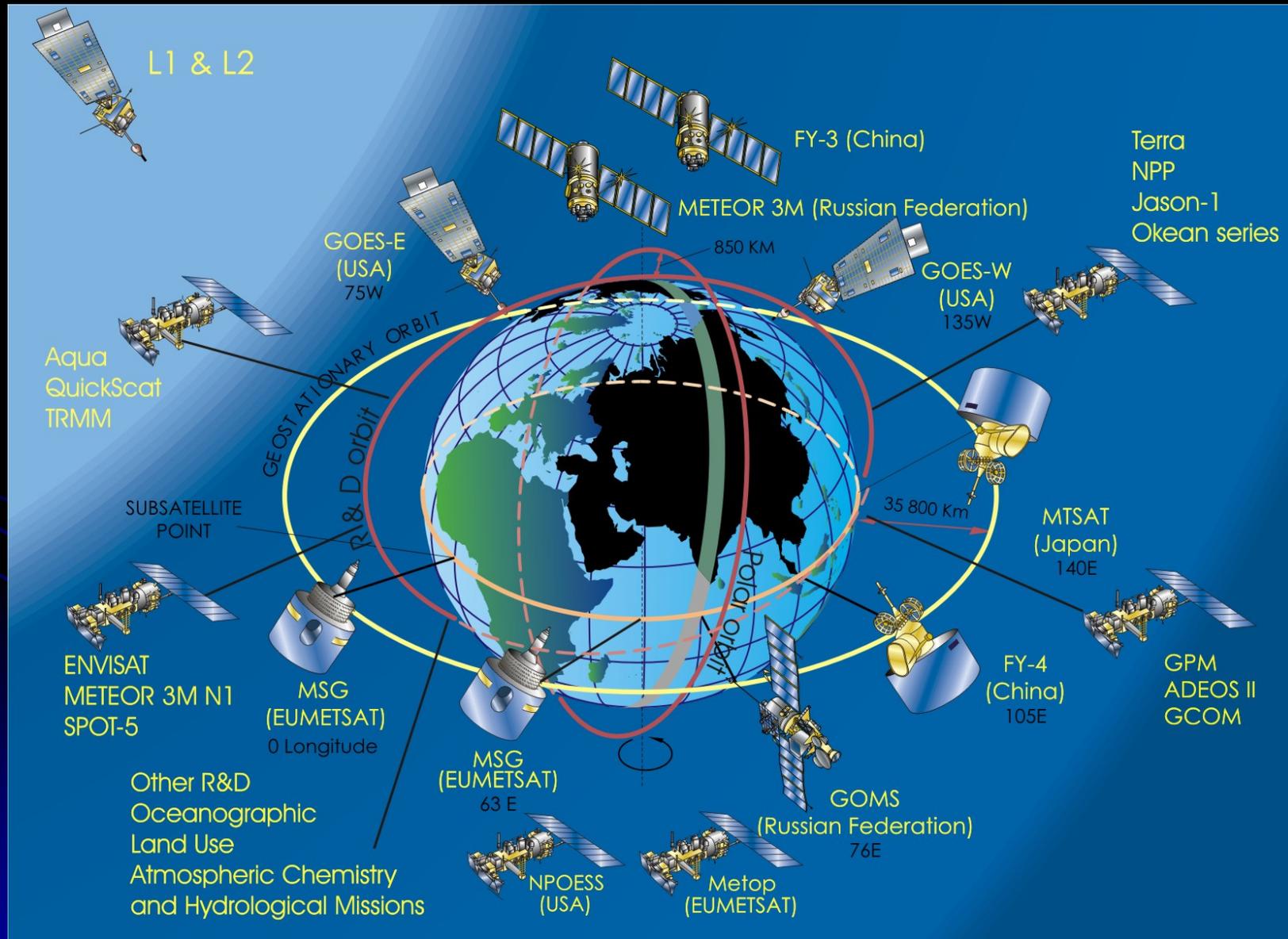
# THE GLOBAL WATER CYCLE



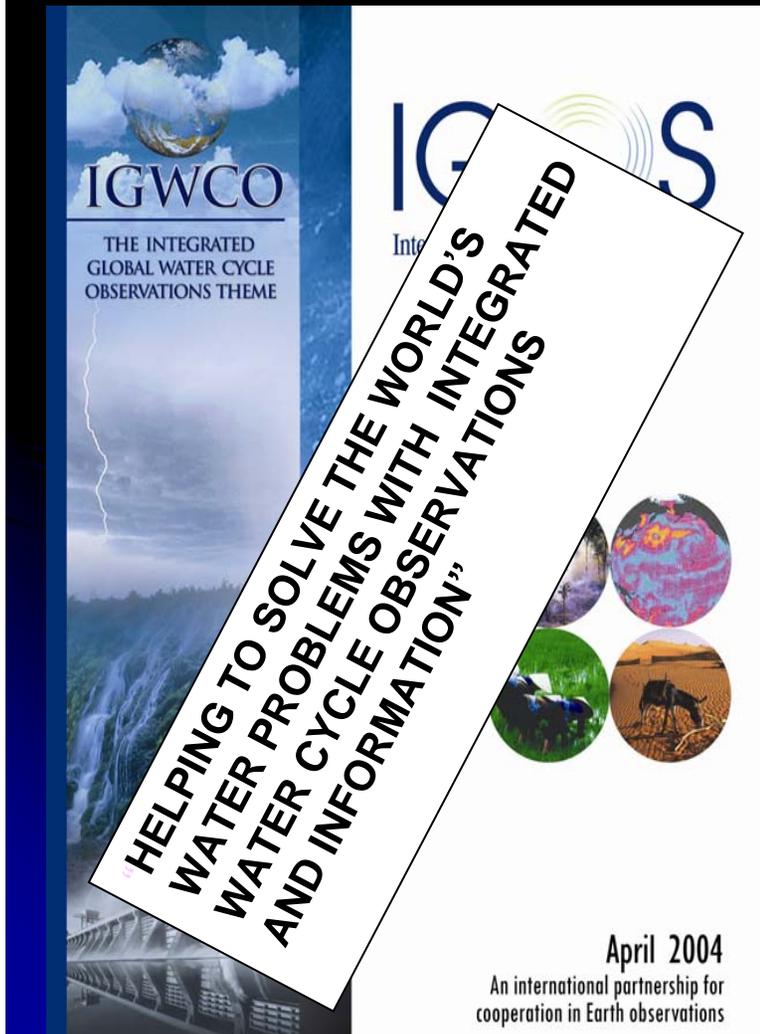
## Hydrological cycle.

*Units are thousand cubic km for storage and thousand cubic km/year for exchanges*

DURING THE NEXT DECADE THERE WILL BE AN UNPRECEDENTED NUMBER OF SATELLITES OBSERVING THE EARTH. HOWEVER, CONSIDERABLE WORK IS NEEDED TO ENSURE THAT THIS CAPABILITY BENEFITS WATER MANAGEMENT.



# THE INTEGRATED GLOBAL WATER CYCLE OBSERVING (IGWCO) THEME HAS THE FOLLOWING OBJECTIVES:



1. Provide a framework for guiding decisions on priorities and strategies regarding water cycle observations for:
  - Monitoring climate variability and change,
  - Effective water management and sustainable development of the world's water resources,
  - Societal applications for resource development and environmental management,
  - Specification of initial conditions for weather and climate forecasts,
  - Research directed at priority water cycle questions
2. Promote strategies that facilitate the processing, archiving and distribution of water cycle data products

**ISSUE: THE USE OF SCIENCE AND  
SATELLITE OBSERVATIONS TO IMPROVE  
THE MANAGEMENT OF WATER RESOURCES  
IS NOT FULLY DEVELOPED**

**ALTHOUGH STATE-OF-THE-  
ART DATA AND PREDICTION  
SYSTEMS ARE BEING  
DEVELOPED, THEIR OVERALL  
CONTRIBUTION TO THE  
MANAGEMENT OF WATER  
RESOURCES IS NOT BEING  
FULLY REALIZED.**



**NEW CAPABILITIES AVAILABLE THROUGH BETTER  
EARTH OBSERVATIONS ARE NOT READILY ADOPTED  
INTO OPERATIONAL MANAGEMENT PROCEDURES.**

# ISSUE: THE WATER CYCLE PLAYS A ROLE IN MAINTAINING A CLIMATE EQUILIBRIUM

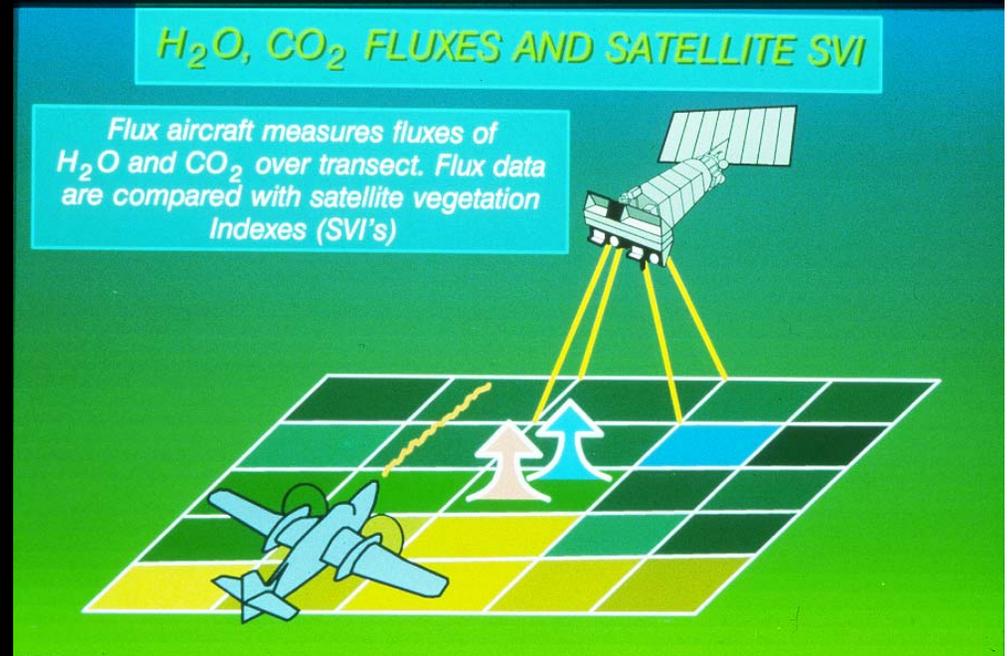
HISTORICALLY, SOME PROCESSES (VEGETATION, WATER CYCLE??) HAVE MAINTAINED THE EARTH'S CLIMATE IN EQUILIBRIUM. THE ROLE OF THE WATER CYCLE IN THE CONTEXT OF FUTURE NATURAL AND ANTHROPOGENIC CLIMATE CHANGE IS NOT WELL UNDERSTOOD.



CRITICAL EARTH OBSERVATIONS ARE NEEDED ON A LONG-TERM BASIS TO ADDRESS THE ROLE OF THE WATER CYCLE WITHIN THE CLIMATE SYSTEM.

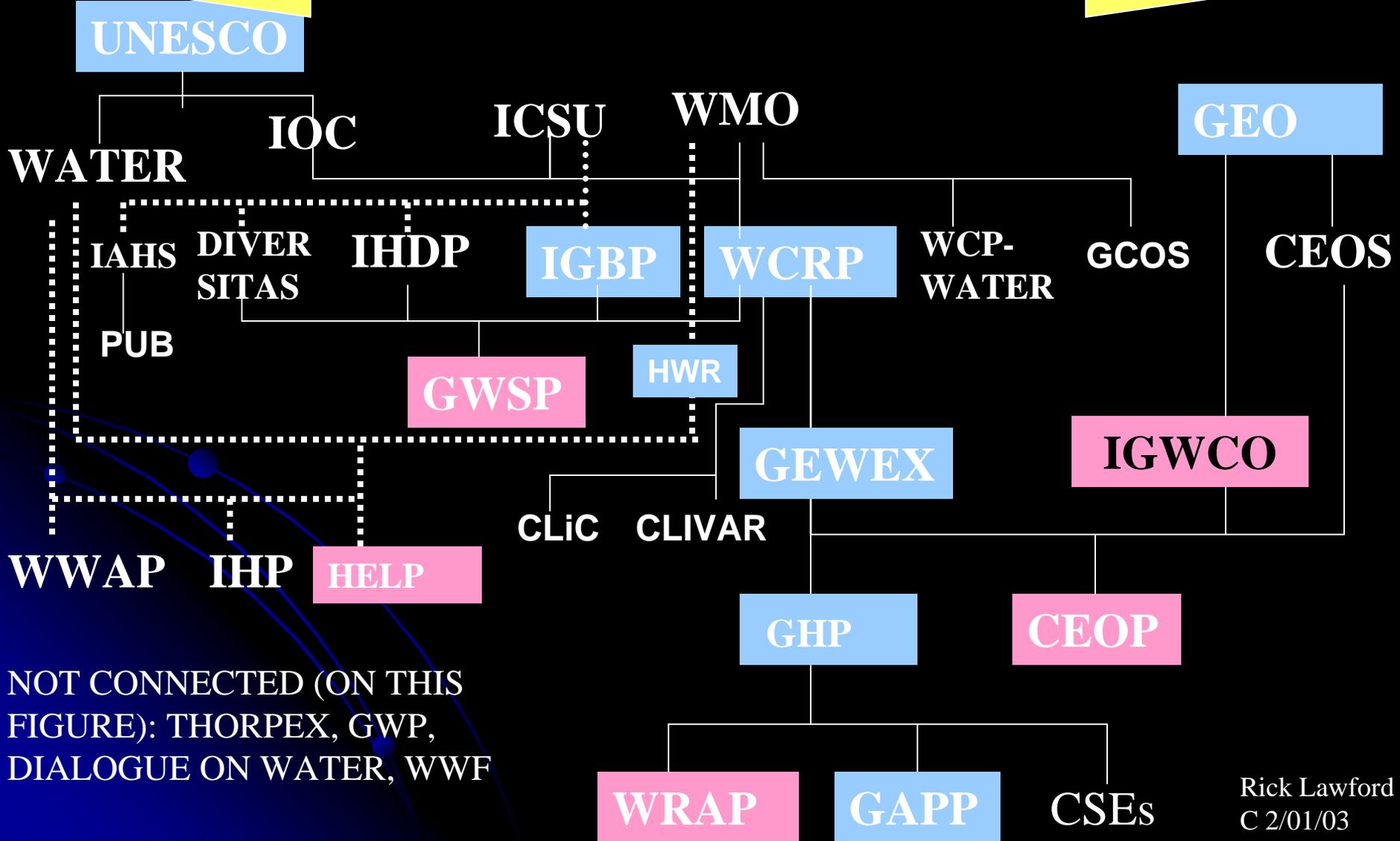
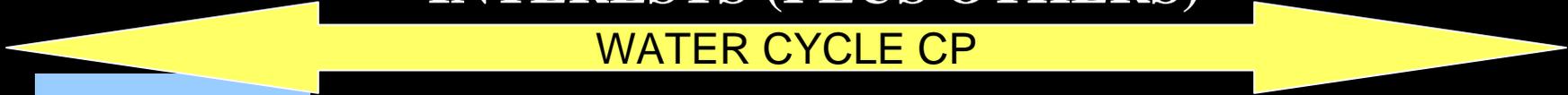
# ISSUE: HYDROLOGIC PREDICTION HAS MANY ERRORS INCLUDING THOSE ARISING FROM INADEQUATE SPECIFICATION OF THE INITIAL CONDITIONS

HYDROLOGIC PROCESSES AND HETEORGENEITY EFFECTS ARE NOT WELL UNDERSTOOD. CONSEQUENTLY, HYDROLOGIC MODELING SYSTEMS TEND TO BE VERY DEPENDANT ON BASIN AND MODEL SPECIFIC CALIBRATIONS.



MORE COMPREHENSIVE EARTH OBSERVATIONS ARE NEEDED TO ACCURATELY DEFINE INITIAL CONDITIONS.

**MANY GROUPS DEAL WITH WATER CYCLE RESEARCH.  
WC CP BRINGS TOGETHER THEIR OBSERVATIONAL  
INTERESTS (PLUS OTHERS)**

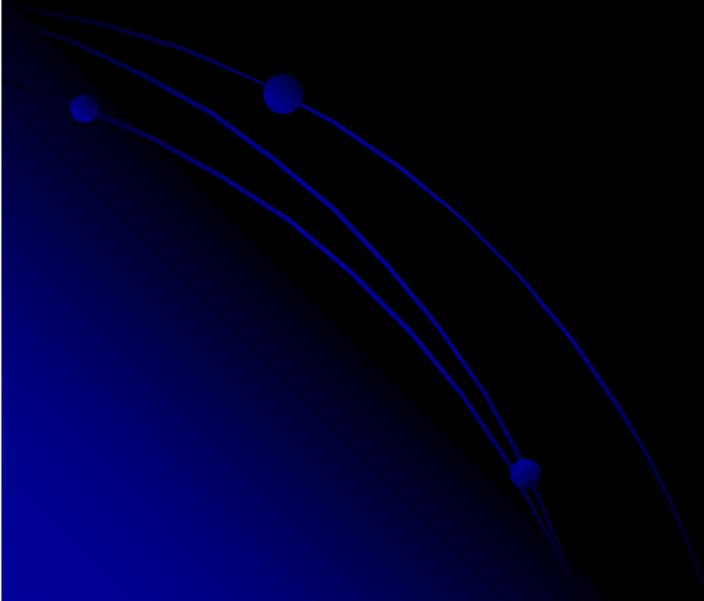


NOT CONNECTED (ON THIS FIGURE): THORPEX, GWP, DIALOGUE ON WATER, WWF

## **OBJECTIVES OF A WC CP (I):**

- 1. TO SUPPORT THE WATER SECTOR BY FACILITATING THE DEVELOPMENT OF APPROPRIATE OBSERVATIONS AND THE USE OF DATA PRODUCTS DERIVED FROM THESE OBSERVATIONS.**
- 2. TO MAXIMIZE THE ECONOMIC BENEFITS OF EARTH OBSERVATIONS IN THE WATER SECTOR.**
- 3. TO MAXIMIZE THE BENEFITS OF EARTH OBSERVATIONS FOR ENVIRONMENTAL ENHANCEMENT AND SUSTAINABLE DEVELOPMENT OF WATER RESOURCES.**
- 4. TO DEVELOP ASSESSMENTS AND STATEMENTS ABOUT THE BENEFITS OF WATER CYCLE OBSERVATIONS.**
- 5. TO PROVIDE A FORUM FOR DISCUSSION ON NEW APPROACHES TO WATER MANAGEMENT THAT ARE NEEDED TO MORE FULLY UTILIZE EARTH OBSERVATIONS AND PRODUCTS.**

- 6. TO FACILITATE THE LINKAGES BETWEEN THE WATER SECTOR AND OTHER SOCIETAL BENEFIT AREAS FOR THE DEVELOPMENT OF DATA PRODUCTS.**
- 7. TO IDENTIFY THE RESEARCH NEEDED TO DEVELOP AND EXPLOIT THE OBSERVATIONAL CAPABILITIES AND DATA PRODUCTS.**



# BENEFITS OF THE WC CP

A WC CP BRINGS BENEFITS TO:

- DATA AND INFORMATION PROVIDERS (BY TELLING THEM WHAT TYPES OF INFORMATION ARE NEEDED AND HOW IT COULD BE MOST EFFECTIVELY PROVIDED).
- DECISION MAKERS (BY GIVING THE ACCESS TO BETTER INFORMATION ON WHICH TO BASE THEIR DECISIONS.)
- THE PUBLIC ( BY PROVIDING THEM WITH BETTER AND MORE COST EFFECTIVE SERVICES THEREBY REDUCING THEIR TAX BURDEN FOR UNNECESSARY COSTS).

SPECIFIC BENEFITS:

1. IMPROVED WATER MANAGEMENT DECISIONS ON ALL TIME SCALES THROUGH BETTER OBSERVATIONAL AND FORECAST INFORMATION.
2. COMPREHENSIVE ADVISORY MECHANISM FOR EARTH OBSERVATIONS IN SUPPORT OF THE "WATER SECTOR."
3. OPTIMIZATION OF WC OBSERVATIONS THROUGH DIALOGUE AND INTEGRATION.

# WC CP WILL WORK CLOSELY WITH GEO WC SBA TARGETS AND GOALS

1. ENHANCEMENTS OF EXISTING IN-SITU WATER CYCLE NETWORKS.
2. DEVELOPMENT OF A NETWORK OF "SUPERSITES."
3. DEVELOPMENT OF A WATER CYCLE DATA INTEGRATION SYSTEM
4. DEVELOPMENT OF INTEGRATED PRECIPITATION AND SOIL MOISTURE PRODUCTS.
5. EVALUATION OF THE INFORMATION NEEDS TO APPLY SATELLITE ALTIMETRY TO STREAMFLOW AND SURFACE STORAGE MEASUREMENTS,
6. COORDINATION OF IN-SITU AND SATELLITE DATA INTEGRATION AND DISSEMINATION.
7. DEVELOPMENT OF ENSEMBLE BASED HYDROLOGIC PREDICTIONS
8. PROMOTION OF THE USE OF EARTH OBSERVATIONS IN SUSTAINABLE DEVELOPMENT.
9. FREE AND OPEN DATA EXCHANGE
10. CAPACITY BUILDING ACTIVITIES AND THE EVALUATION OF BARRIERS TO CAPACITY BUILDING.

# FUNDAMENTAL DATA SETS THAT ARE NEEDED TO ADDRESS CRITICAL WATER SCIENCE ISSUES



DATA SETS ON THE DISTRIBUTION OF DAMS AND RESERVOIRS WILL BE CONSOLIDATED. (WMO HAS RECENTLY LAUNCHED A GLOBAL DATA CENTER FOR LAKES AND RESERVOIRS IN RUSSIA)

DATA BASES ON THE USE OF WATER FOR IRRIGATION AND OTHER DEVELOPMENTAL ACTIVITIES



WATER REQUIREMENTS FOR DIFFERENT ECOSYSTEMS AND BIODIVERSITY REGIMES

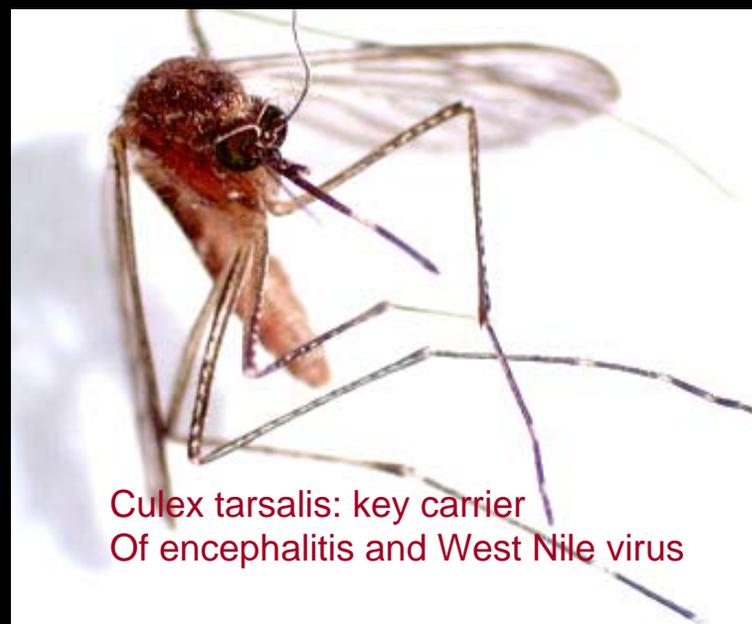
# WC DATA SETS ARE NEEDED TO ASSIST IN THE ANALYSIS OF THE ROLE OF WATER IN HUMAN HEALTH ISSUES ON A PRIORITY BASIS.

Estimates of Global Morbidity and Mortality of Water-Related Diseases  
(early 1990s)

	episodes/year or people infected	deaths/year
Diarrheal Diseases	1,000,000,000	3,300,000
Intestinal Helminths	1,500,000,000 (people infected)	100,000
Schistosomiasis	200,000,000 (people infected)	200,000
Dracunculiasis	150,000 (in 1996)	
Trachoma	150,000,000 (active cases)	
Malaria	400,000,000	1,500,000
Dengue Fever	1,750,000	20,000
Poliomyelitis	114,000	
Trypanosomiasis	275,000	130,000
Bancroftian Filariasis	72,800,000 (people infected)	
Onchocerciasis	17,700,000 (people infected; 270,000 blind)	40,000 (mortality caused by blindness)

Source: Table 2.2 from "The World's Water." Data from World Health Organization, 1995, "Community Water Supply and Sanitation: Needs, Challenges and Health Objectives." 48th World Health Assembly, A48/INF.DOC/2.28 April, Geneva, Switzerland.

Mosquitoes are transmitters of malaria, West Nile, Encephalitis.



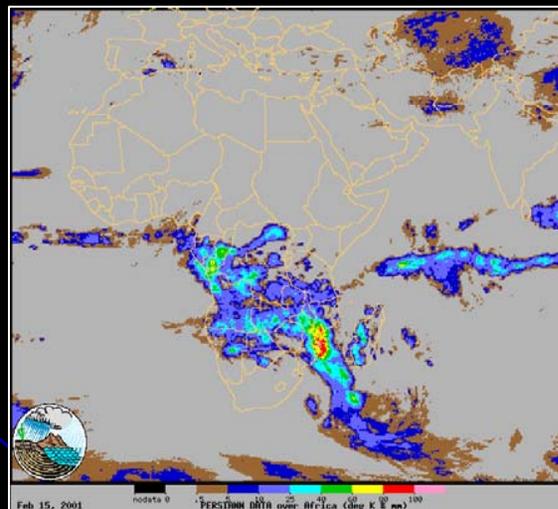
**Culex tarsalis: key carrier  
Of encephalitis and West Nile virus**



REMOTE SENSING CAN BE USED TO  
MONITOR WETLANDS AND PONDS, THE  
BREEDING GROUNDS FOR MOSQUITOS.

# WC OBSERVATIONS AND PREDICTIONS ARE NEEDED IN COPING WITH WATER CYCLE HAZARDS (E.G., FLOODS)

BEFORE THE EVENT, EARTH OBSERVATIONS CAN BE USED TO ASSESS THE VULNERABILITY TO FLOODING (SATURATED SOILS, FULL RESERVOIRS)



DURING THE EVENT, EARTH OBSERVATIONS PROVIDE INFORMATION ON THE PRECIPITATION PATTERNS.



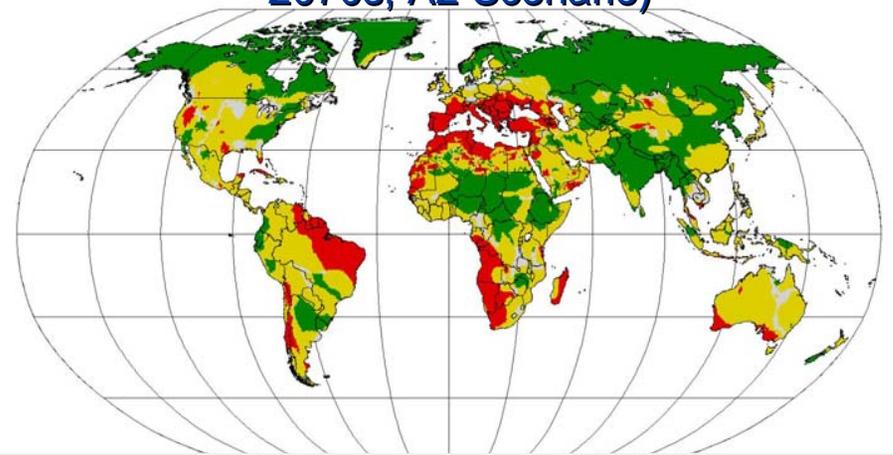
AFTER THE EVENT SATELLITE DATA CAN MAP THE INNUNDATED AREA

# LINKS TO OTHER SOCIETAL BENEFIT AREAS

**CLIMATE: FEEDBACKS FROM WATER VAPOR, CLOUDS AND LAND SURFACE FLUXES ARE THE MAJOR UNCERTAINTIES IN CLIMATE CHANGE PROJECTIONS.**

## Uncertainty of Climate Predictions

Annual Precipitation  
(Hadley and Max Planck Climate Models, 2070s, A2 Scenario)



decrease both    increase both    stable condition    contradiction

**WEATHER: PRECIPITATION AND CLOUD PREDICTION ARE PRIMARY FORECAST VARIABLES THAT NEED THE SUPPORT OF THE OBSERVATIONAL PROGRAMS.**



**AGRICULTURE: WATER IS  
A CRITICAL CONTRIBUTOR TO  
AGRICULTURAL PRODUCTIVITY.**



**ENERGY: THE WATER AND  
ENERGY CYCLE OF THE  
ATMOSPHERE CONTROLS  
MOST OF THE SOURCES OF  
RENEWABLE ENERGY  
(CLOUDS-SOLAR; WIND-WIND;  
WATER-HYDRO)**

# HEALTH: WATER BORNE

DISEASES AND DISEASE

THIS CONNECTION DOES NOT REPLACE THE IMPORTANT WORK OF THE WATER AND HEALTH COMMUNITY OF PRACTICE, BUT IT ONLY PROVIDES THE CONTEXT WITHIN THE WATER SECTOR FOR DEALING WITH REQUESTS FROM THE WATER AND HEALTH CP.

MAJOR CAUSE OF MORTALITY IN THE DEVELOPING WORLD.

Estimates of Global Morbidity and Mortality of Water-Related Diseases (early 1990s)

	episodes/year or people infected	deaths/year
Dengue Fever	1,750,000	20,000
Poliomyelitis	114,000	
Trypanosomiasis	275,000	130,000
Bancroftian Filariasis	72,800,000 (people infected)	
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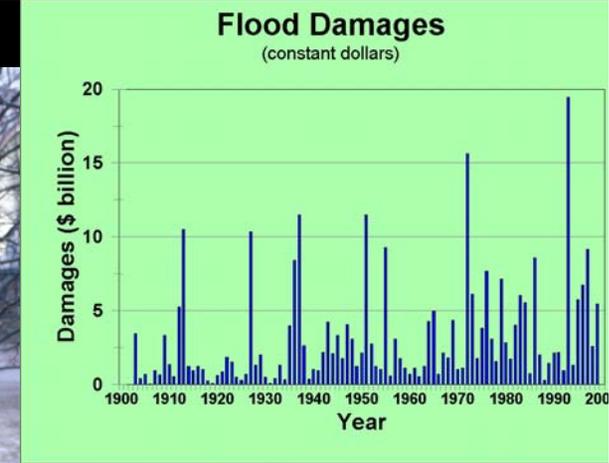
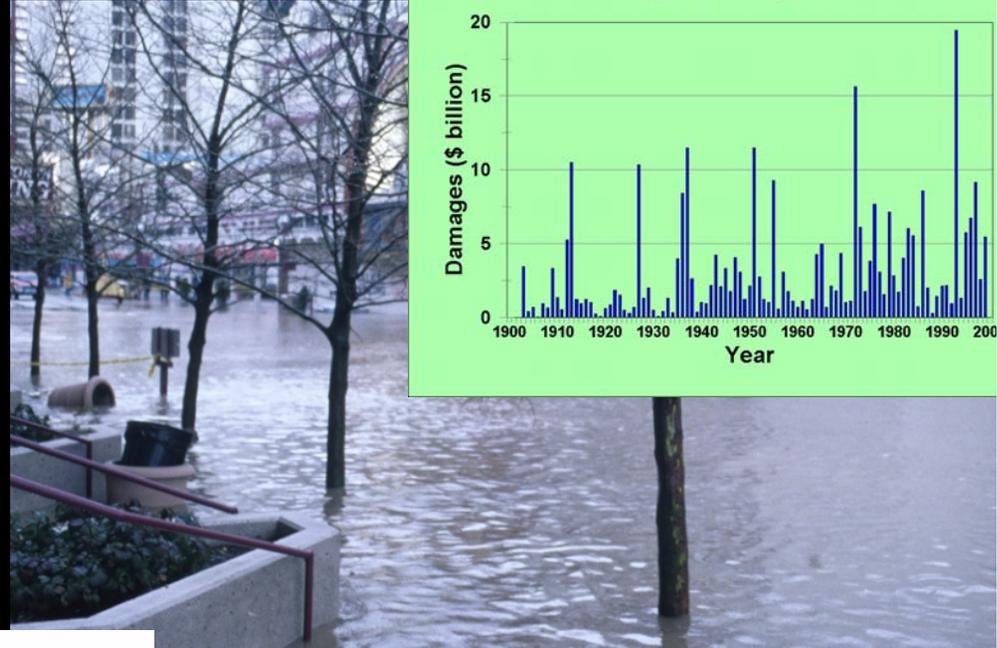
Source: Table 2.2 from "The World's Water." Data from World Health Organization, 1995. "Community Water Supply and Sanitation: Needs, Challenges and Health Objectives." 48th World Health Assembly, A48/INF.DOC/2.28 April, Geneva, Switzerland.

**ECOSYSTEMS: MINIMUM REQUIREMENTS FOR WATER EXIST FOR ALL ECOSYSTEMS. INFORMATION IS NEEDED TO ADVISE ON WATER STRESS AND ON THE DEGREE TO WHICH LONG-TERM NEEDS CAN BE MET.**

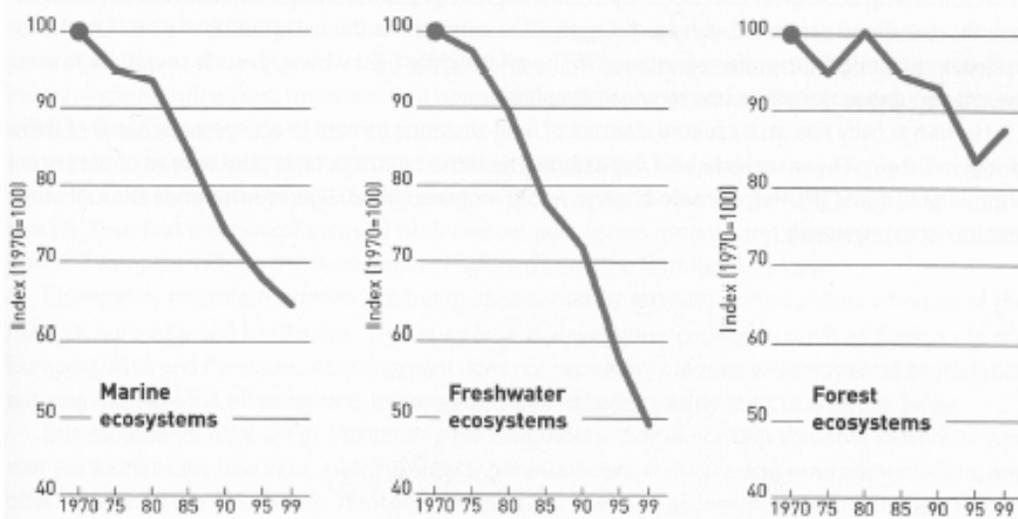


(PFRA?)

**DISASTERS: WATER CYCLE DISASTERS (FLOODS AND DROUGHTS) REQUIRE ACCESS TO IMPROVED FLOOD FORECAST AND MONITORING SERVICES.**



The Living Planet Index, 1970-99

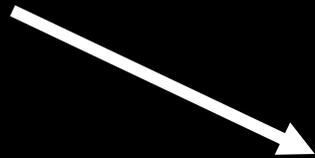
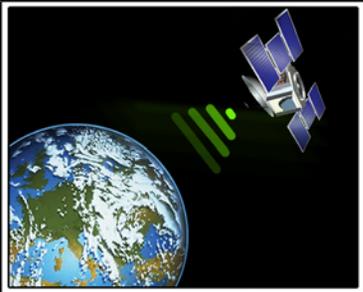


The Living Planet Index, developed by the World Conservation Monitoring Centre (UNEP-wCMC) and WWF, provides an indicator of the health of the three major ecosystems types of the planet. It is based on the population trends of marine, freshwater and forest species.

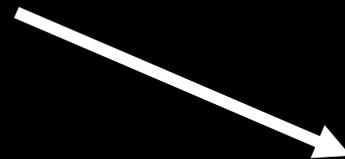
**BIODIVERSITY: TRENDS IN BIODIVERSITY ARE SENSITIVE TO TRENDS IN WATER QUALITY AND CHANGES IN WATER QUANTITY.**

**THE WC CP COULD USE OBSERVATIONAL PROGRAMS AND RESEARCH TO TRANSFORM WATER MANAGEMENT:  
 A VISION: IMPLEMENT A NEW EPOCH OF WATER MANAGEMENT IN OUR LIFETIMES THAT IS FACILITATED BY OBSERVATIONS AND IMPROVED PREDICTION SYSTEMS.**

OBSERVATIONS



IMPROVED CAPABILITY TO ASSIMILATE AND PREDICT



INTEGRATED DECISION SUPPORT SYSTEMS

Atmosphere  
Land



cf. Sorooshian

**A DECISION PROCESS**

INFORMATION INPUTS:  
 - QUALITY AND COVERAGE  
 - SPACE/TIME SCALE MATCHES

EXTERNALITIES:  
 - VULNERABILITIES  
 - TIME FRAME FOR DECISIONS  
 - ECONOMIC/SOCIAL FACTORS

SUBJECTIVE FACTORS:  
 - VALUES  
 - SOCIO-ECONOMIC PRESSURES

DECISION PROCESS

ACTION

# PARTIAL LISTING OF WATER CYCLE DATA REQUIREMENTS



VERT RES	ACCURACY
	0.1 mm/ h
10 cm (30 cm)	5%
1 cm (*)	5% (m <sup>3</sup> /s)
1 cm	5% (cms)
	10%
.1 km	5% cover
.1 km	5%
	5%
	5 W/m <sup>2</sup>

ED IN THE IGWCO REPORT.

**BUT WHAT DO THE USERS THINK? THE WC CP WILL LEAD IN PROVIDING FEEDBACK TO PROVIDERS**

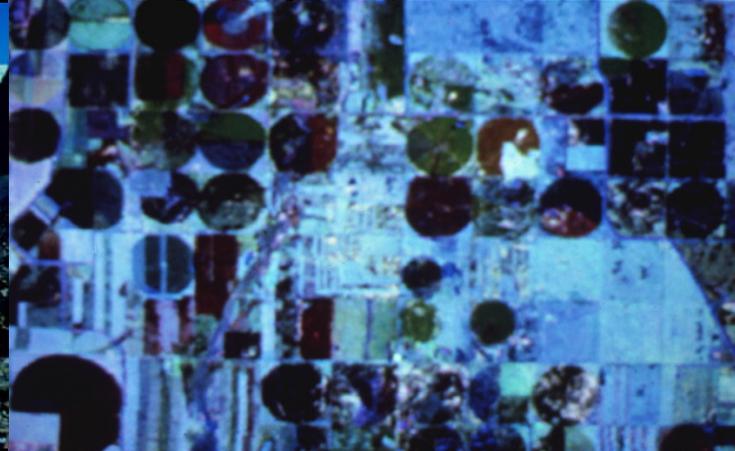
April 2004

An international partnership to  
cooperation in Earth observations

# DATA PRODUCTS



A WATER  
CYCLE GEO  
COMMUNITY  
PAC



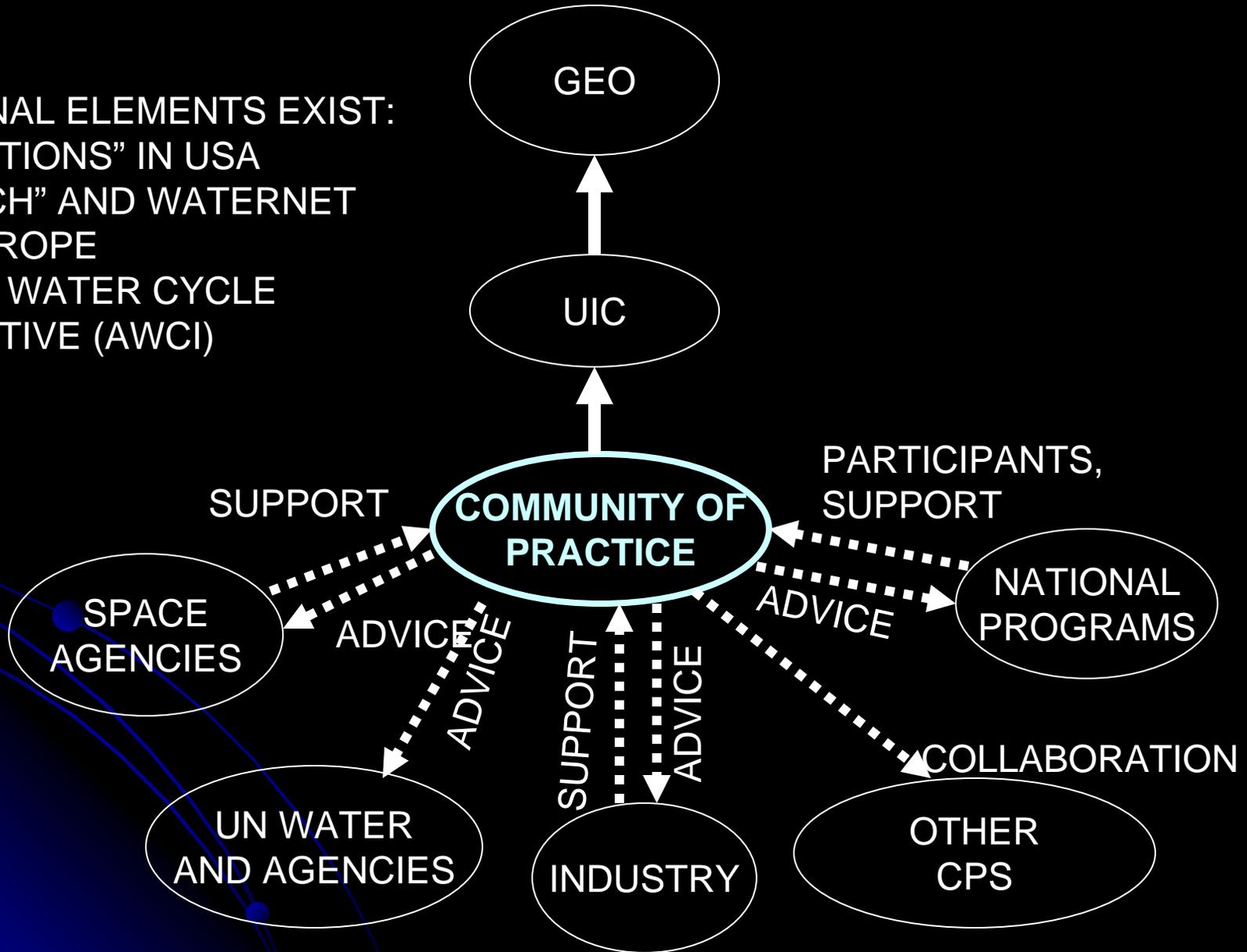
DATA

# SCOPE OF THE WATER CYCLE COMMUNITY OF PRACTICE

# WATER CYCLE COMMUNITY OF PRACTICE LINKAGES

REGIONAL ELEMENTS EXIST:

- "SOLUTIONS" IN USA
- "WATCH" AND WATERNET IN EUROPE
- ASIAN WATER CYCLE INITIATIVE (AWCI)



# GROUPS THAT HAVE EXPRESSED A COMMITMENT TO PARTICIPATING IN THE WC CP

BRITISH SPACE AGENCY

CANADIAN AGRICULTURE AND AGRIFOOD DEPARTMENT

CANADIAN DROUGHT RESEARCH INITIATIVE

CANADIAN CENTER FOR REMOTE SENSING

CATHALAC

CHINESE METEOROLOGICAL ADMINISTRATION

CPTEC (BRAZIL)

EUROPEAN SPACE AGENCY

FINNISH METEOROLOGICAL INTITUTE

GEODETIC COMMUNITY

GLOBAL ENERGY AND WATER CYCLE PROJECT (GEWEX)

GLOBAL WATER SYSTEM PROJECT (GWSP)

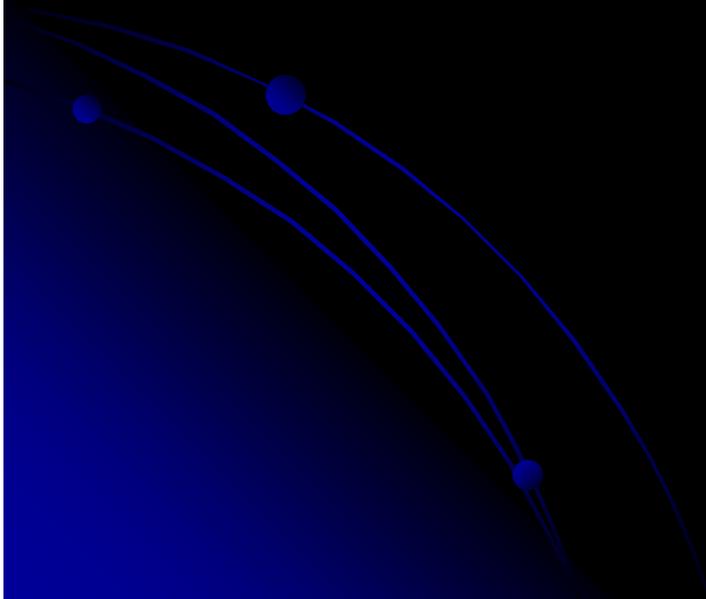
INTEGRATED GLOBAL WATER CYCLE OBSERVATIONS THEME

INTERNATIONAL ASSOCIATION OF HYDROLOGICAL SCIENCES

INTERNATIONAL INSTITUTE FOR SUSTAINABEL DEVELOPMENT (IISD)

ISRO (INDIA)

JAPAN AEROSPACE EXPLORATION AGENCY  
NATIONAL AERONAUTIC AND SPACE AGENCY (NASA)  
NATIONAL OCEANIC AND ATMOPHERIC ADMINISTRATION (NOAA)  
UNIVERSITY OF WASHINGTON  
UNIVERSITY OF BERKLEY  
UNITED NATIONS EDUCATIONAL, SCIENTIFIC AND CULTURAL  
ORGANIZATION (UNESCO)  
WORLD AQUARIUM (ST LOUIS)  
WORLD METEOROLOGICAL ORGANIZATION (HWR)  
WMO COMMISSION ON HYDROLOGY



# TIMELINE FOR DEVELOPMENT

MARCH 2007: COMPLETE THE FIRST DRAFT OF THE CP PLAN

SEPTEMBER 2007: ESTABLISH A CP EXECUTIVE AND A PLANNING COMMITTEE

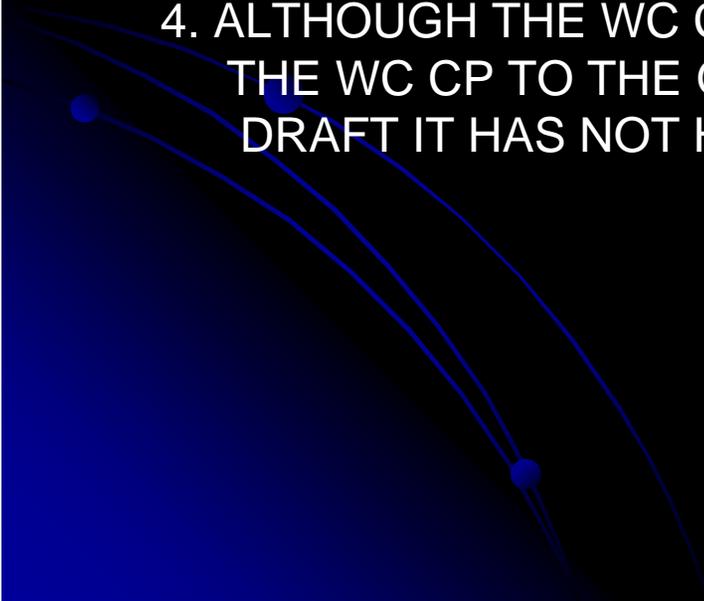
OCTOBER 2007: FINALIZE THE CP REPORT.

NOVEMBER 2007: ESTABLISH A WATER CYCLE CP WEB PAGE

WINTER/ SPRING 2007: HOLD A WC CP WORKSHOP/MEETING

SPRING 2008: INITIATE SEVERAL WC CP PROJECTS, WITH ONE OR TWO IN DEVELOPING COUNTRIES IN COLLABORATION WITH CAPACITY BUILDING EFFORTS.

# STATUS OF THE WC CP

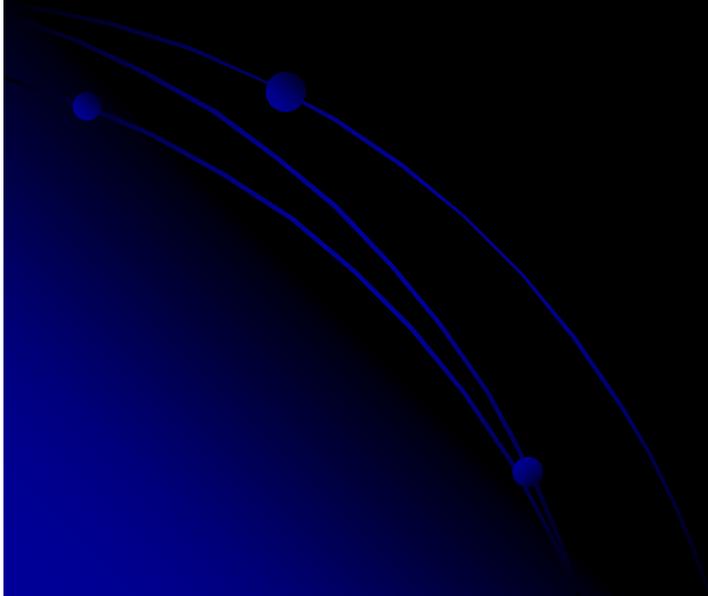
1. A DOCUMENT HAS BEEN DRAFTED AND REVIEWED.
  2. MORE THAN 25 GROUPS HAVE INDICATED AND INTERST IN PARTICIPATING IN THE WC CP.
  3. THE WC CP HAS ACCEPTED THE INVITATION TO LEAD THE WATER SECTOR SURVEY OF USER NEEDS AND HAS DEVELOPED A PLAN AND IDENTIFIED INDIVIDUALS WHO CAN TAKE THIS FORWARD.
  4. ALTHOUGH THE WC CP HAS MADE TWO REPRESENTATIONS ABOUT THE WC CP TO THE GEO UIC AND HAS SUBMITTED A PRELIMINARY DRAFT IT HAS NOT HAD AFFIRMATION FROM THE COMMITTEE.
- 

# WC CP AND A USER NEEDS SURVEY

1. The WC CP has agreed to undertake a User Needs Survey
2. An expert from NASA (Dr. Sushel Unninayar) has committed to doing the bulk of the analysis and document the results of the study.
3. Regional experts from Europe, Asia and South America have been invited to serve on a small oversight team to oversee the survey. (Several reps from international organizations may also be invited).
4. The WC CP has begun to inventory and review previous reports that specify user needs. These reports include a recent European survey, the National Academies of Science Decadal Survey, etc. (Members of the GEO UIC are invited to provide us with references to past user surveys).
5. Discussions about coordination have been held with groups who are planning to undertake surveys including:
  - the Global Precipitation Mission (GPM) user needs survey
  - the Canadian Soil Moisture user needs survey.



ASSESSMENT OF THE REQUIREMENTS FOR EARTH  
SCIENCE INFORMATION FOR DECISION MAKING  
THROUGH SIMULATIONS  
(EXAMPLE: DROUGHT)



BARNEY'S BEEF FARM

CECILE'S CONVENTIONAL  
CERIAL CROP FARM

VERN'S VEGETABLE FARM

BILL'S BIOFUELS FARM

IZZY IRRIGATOR AND  
WATER SUPPLIES

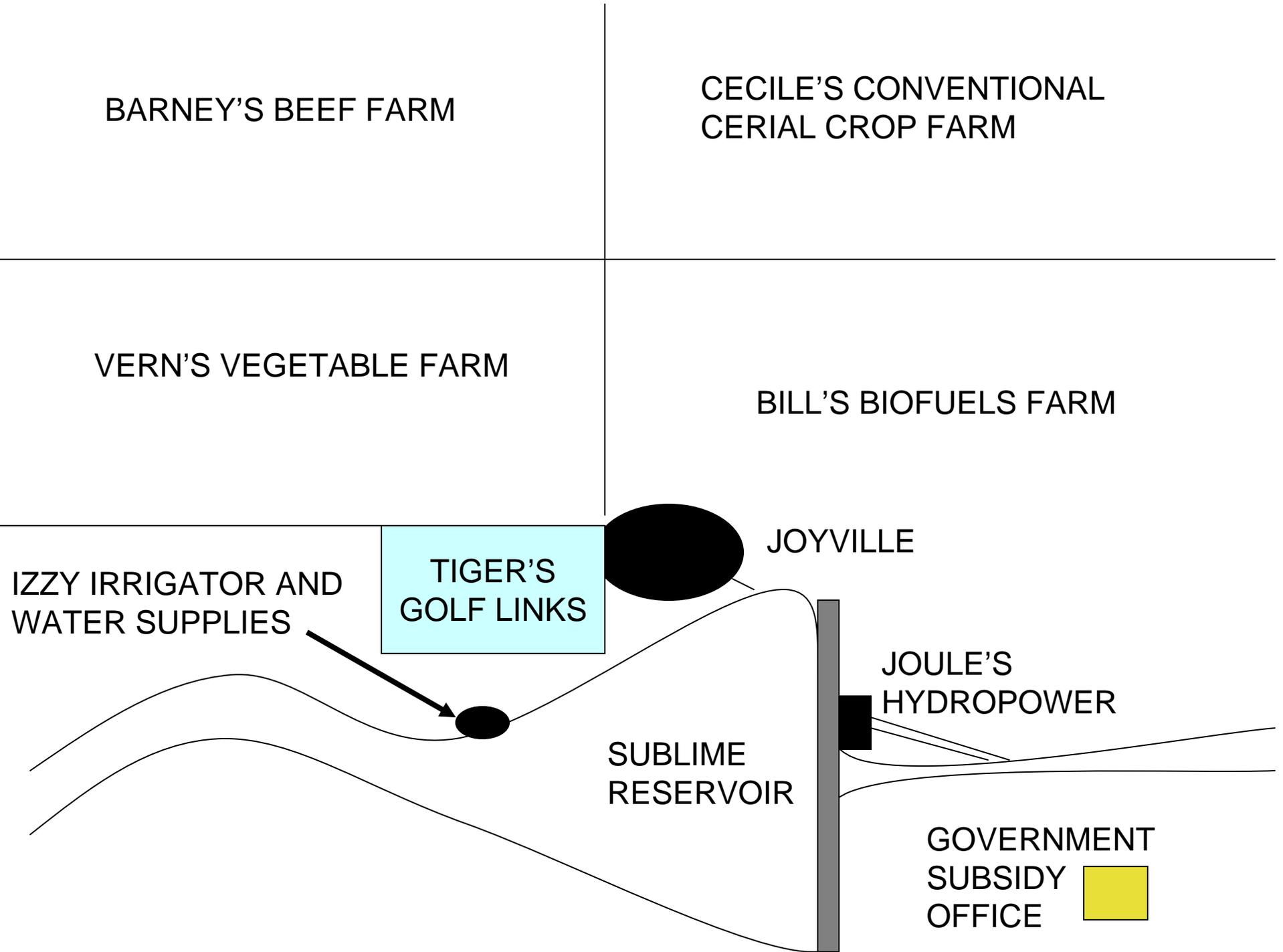
TIGER'S  
GOLF LINKS

JOYVILLE

JOULE'S  
HYDROPOWER

SUBLIME  
RESERVOIR

GOVERNMENT  
SUBSIDY  
OFFICE



**JOYVILLE:**

WATER

FOOD

HYDROELECTRICITY

TIGERS GOLF LINKS

TOURISM REVENUE:

**BARNEY'S BEEF FARM**

WATER

HEAD OF CATTLE:

FEED:

MONEY OF HAND:

**VERN'S VEGETABLE FARM**

CROP TYPE:

STORAGE ON HAND:

WATER

MONEY ON HAND

BILL'S BIOFUEL FARM

WATER

HEAD OF CATTLE:

FEED:

MONEY OF HAND:

CECILE'S CONVENTIONAL CROP

WATER

HEAD OF CATTLE:

FEED:

MONEY OF HAND:

JOULE'S HYDROMPOWERE

GOVERNMENT SUBSIDY OFFICE

SCENARIO 1:

30-YEAR MEAN CLIMATE FOR JOYVILLE:

CURRENT RESERVOIR LEVEL:

INFLOWS::

SCENARIO 2:

WEATHER IN CONTEXT:

TEMPORAL:

SPATIAL:

# SCEANRIO 3: FORECAST FOR THE COMING WEEK/MONTH/SEASON