

**THE GLOBAL WATER CYCLE THEME
WITHIN THE INTEGRATED GLOBAL
OBSERVING STRATEGY FRAMEWORK**

RICK LAWFORD & JOSEF ASCHBACHER

“WATER FOR THE WORLD: SPACE SOLUTIONS
FOR WATER MANAGEMENT”

SEPTEMBER 13, 2004

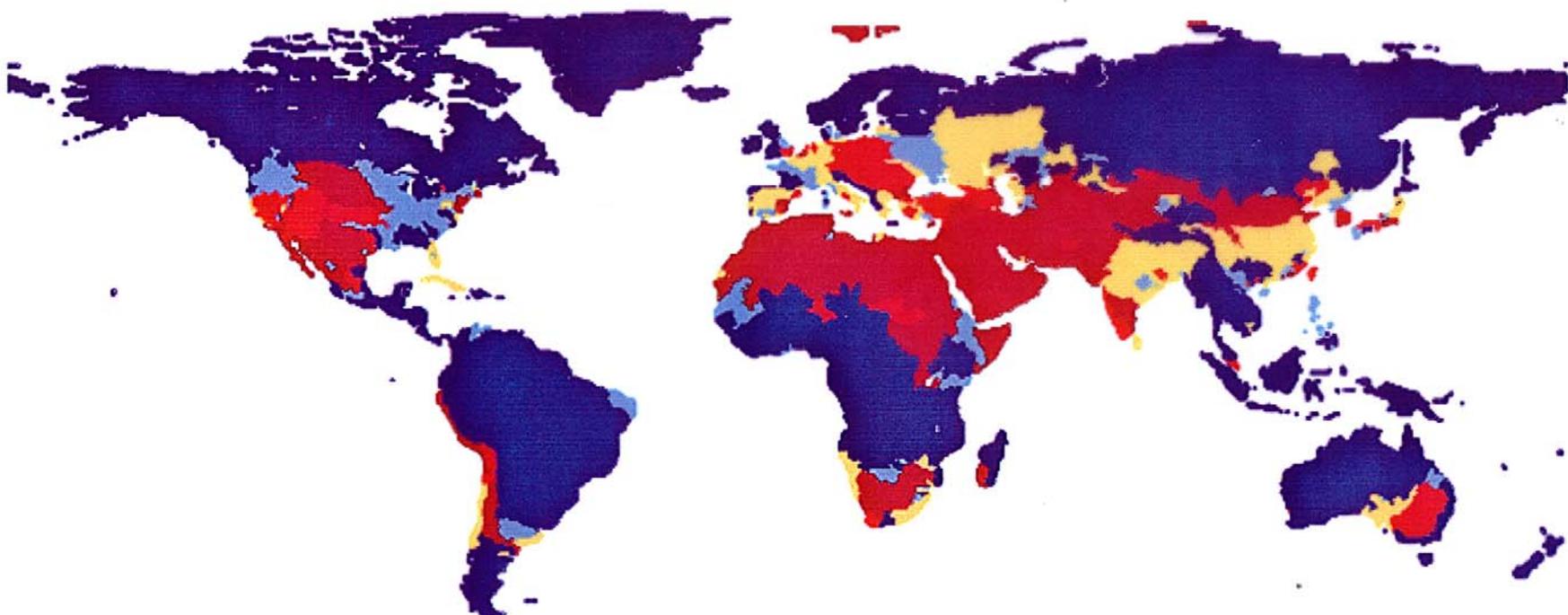
GRAZ, AUSTRIA

WATER IS AN EMERGING GLOBAL ISSUE BECAUSE:

DEMAND IS EXPECTED TO INCREASE DUE TO **POPULATION GROWTH** (INCREASE OF 2-4 BILLION BY 2050)

- PROSPERITY AND CHANGING DIETARY PATTERNS LIKELY TO INCREASE **DEMANDS FOR IRRIGATED AGRICULTURE.**
- **INDUSTRIAL WATER USE** WILL INCREASE (ESTIMATED TO DOUBLE BY 2050).
- **RAPID URBANIZATION** WILL CONTINUE - MORE THAN 50% OF THE WORLD'S POPULATION IS EXPECTED TO LIVE IN URBAN CENTERS BY 2050.
- **LAND USE CHANGE** (FORESTS CONVERTED TO FARMLAND AND FARMLAND TO URBAN AREAS, ETC).
- **CLIMATE VARIABILITY AND CHANGE.**

'Business-as-usual' Scenario for 2025



Stress Indicator: Withdrawal-to-Availability Ratio - under 1961 to 1990 average climate -

No Stress

Low Stress

Mid Stress

High Stress

Very High Stress

0

0.1

0.2

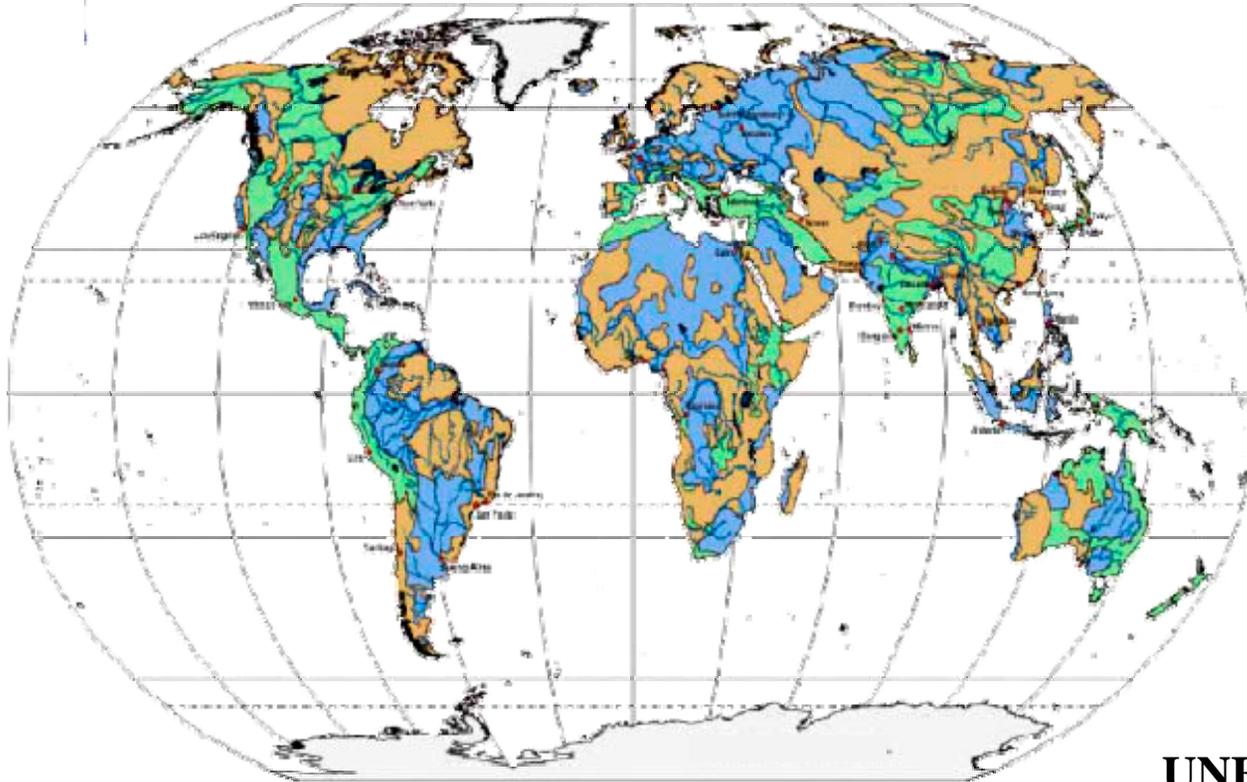
0.4

0.8

WaterGAP 1.1 - CESR Kassel - 10. August 1999

OVERUSE OF GROUND WATER RESERVES IS LEADING TO SERIOUS PROBLEMS IN SOME AREAS OF THE WORLD.

Groundwater Resources of the World



Major groundwater basin with highly-productive aquifer.



Area with complex structure including some important aquifers



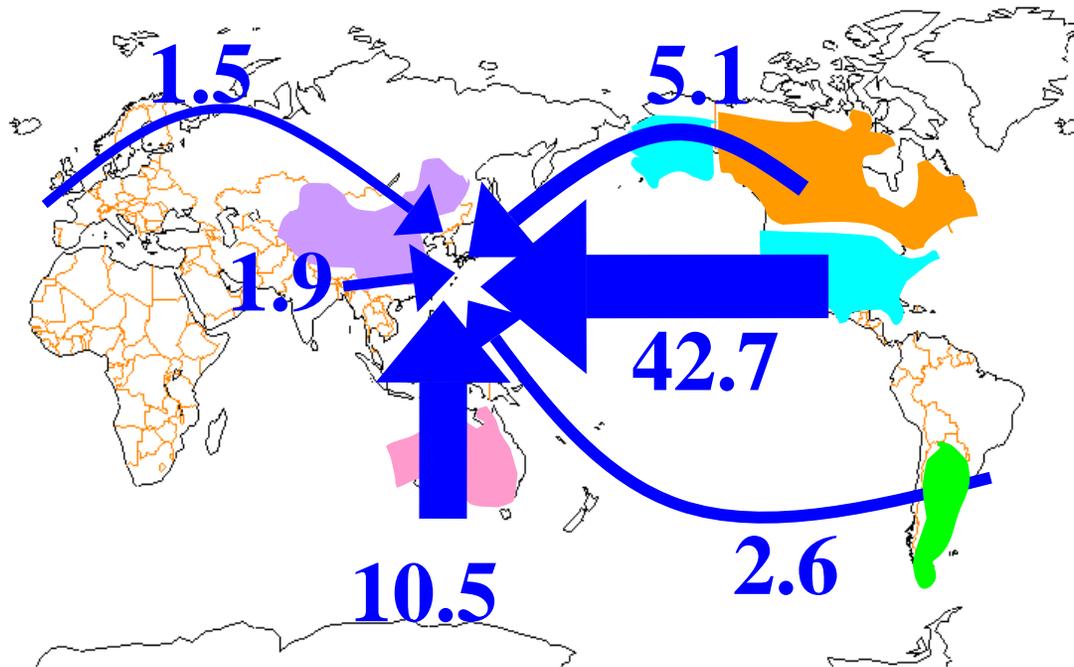
Area with generally poor aquifers, locally overlain by river-bed aquifers.

UNESCO

IAH

Nov. 2002

(the World
Hydrogeological Mapping
and Assessment Programme ,
WHYMAP)



Virtual water in food (in km³ per year) imported into Japan based on analysis by Oki (2002). How will/ could such analyses of implicit water trade be used in developing a global sustainability policy?

DEMANDS FOR WATER MAY LEAD TO NEW APPROACHES IN WATER MANAGEMENT AND NEW ISSUES FOR INTERNATIONAL DIPLOMACY (E.G. STRATEGIES FOR SOME COUNTRIES NOT TO GROW IRRIGATED CROPS).



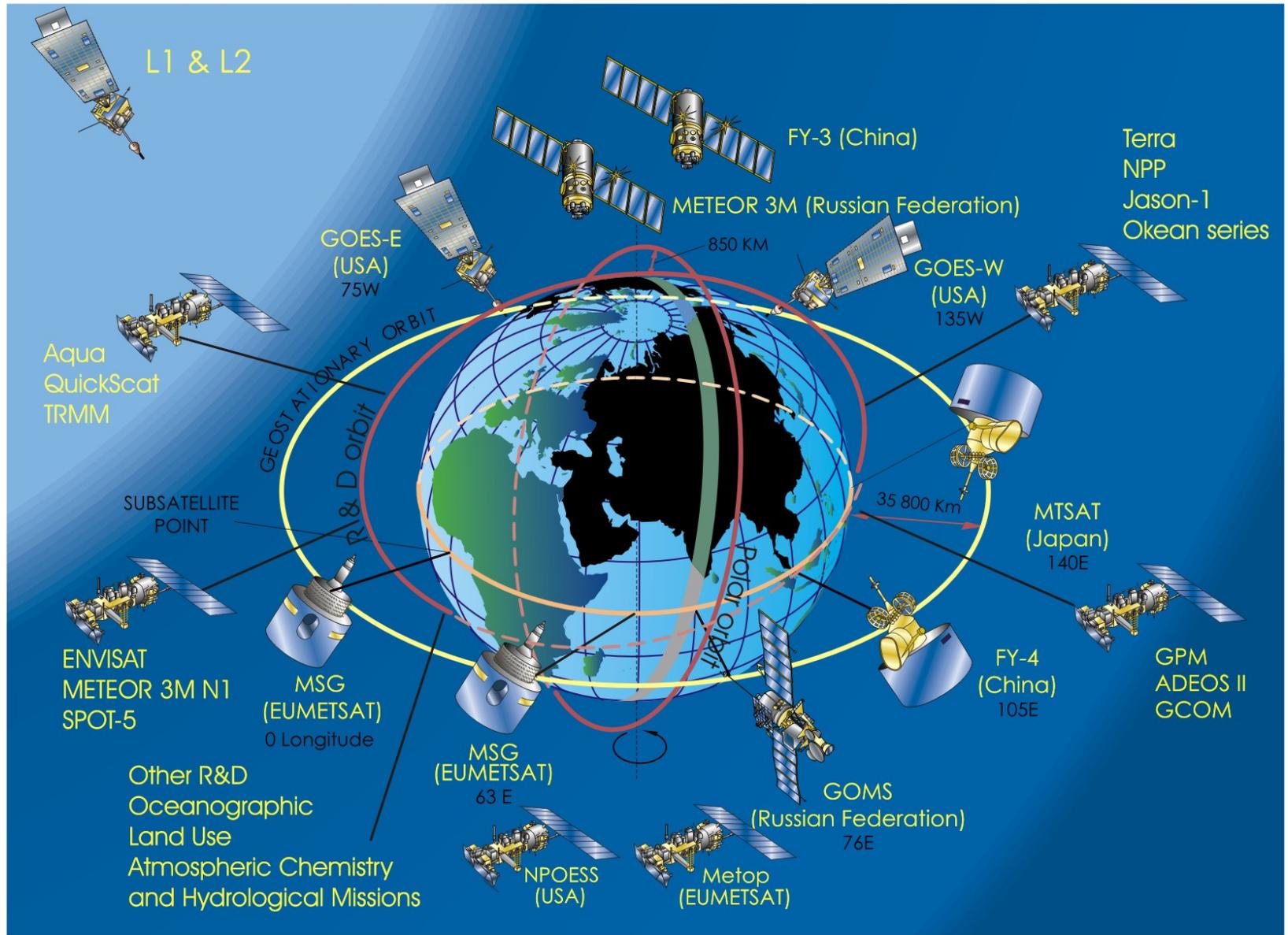
Sustainable Development The Space Contribution

From Rio to Johannesburg -
Progress over the last 10 years

THESE FACTORS LED TO THE WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT (JOHANNESBURG – AUGUST, 2002) RESOLVING TO:

27. (*Decided*) Improve water resource management and scientific understanding of the water cycle through cooperation in joint observation and research, and encourage and promote knowledge sharing, and provide capacity-building and the transfer of technology, as mutually agreed, including remote-sensing and satellite technologies, particularly to developing countries as well as countries with economies in transition, for this purpose.

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.



MORE EO DATA, FASTER ACCESS

Number of satellite sensors

- Today 75 EO SAT 200 sensors
- 2015 150 EO SAT 400 sensors



Factor 2

Data Rate increases

- SAR instruments
- More channels
- Higher resolutions , wider swaths



Factor 5-10

Data access

- Today most applications deliver data within ~7 days
- 2015 50% within 3 hrs, 50% within 7 days
(estimate)



Factor 10+

Towards a Global Observing System Architecture



IGOS IS DEVELOPING THE STRATEGY FOR INTEGRATING OBSERVATIONAL SYSTEMS

EOSs AND GEO ARE DEVELOPING A PLAN FOR AN INTEGRATED OBSERVATIONAL SYSTEM OF SYSTEMS (GEOSS)

INTL. PGMS AND SCIENCE MISSIONS CARRY OUT RESEARCH NEEDED TO DEVELOP A PREDICTION SYSTEM TO SUPPORT WATER MANAGEMENT

A QUICK REVIEW OF THE HISTORY OF MEASUREMENT – SOCIETY INTERACTIONS IN THE FIELD OF WATER

EPOCH #1: WATER NATURE'S GIFT TO MANKIND (DAWN OF CIVILIZATION TO LAST CENTURY)

WATER IS ESSENTIAL FOR LIFE

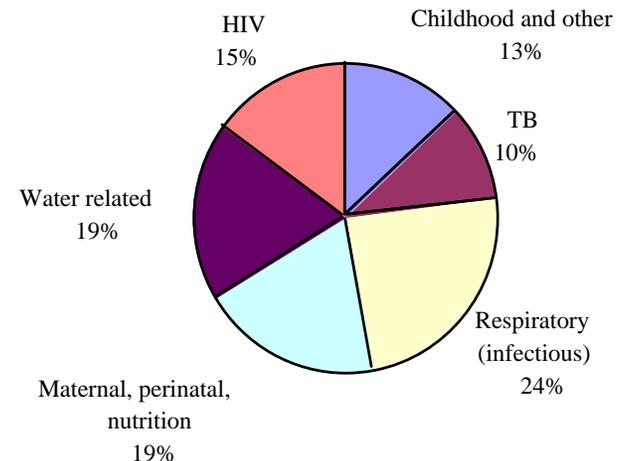


EPOCH #2: WATER AND DEVELOPMENT (LATE 1800'S TO PRESENT)

WATER IS ESSENTIAL FOR PROSPERITY

EPOCH #3: WATER AND THE ENVIRONMENT (APPROX. MID-1960'S TO THE PRESENT)

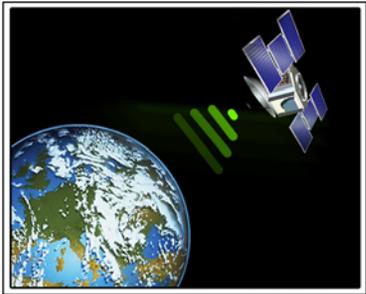
WATER IS ESSENTIAL FOR HEALTH (FOR HUMANS AND ECOSYSTEMS)



LEADING TO THE QUESTION:

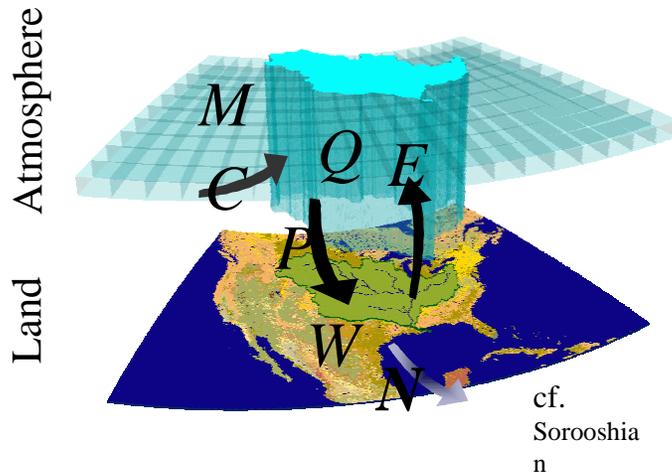
WILL A NEW EPOCH OCCUR IN OUR LIFETIMES AND, IF SO, WHAT WILL BE ITS ATTRIBUTES?

OBSERVATIONS



IMPROVED CAPABILITY
TO ASSIMILATE AND
PREDICT

INTEGRATED DECISION
SUPPORT SYSTEMS



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

IGWCO OBJECTIVES

“HELPING TO SOLVE THE WORLD’S WATER PROBLEMS WITH INTEGRATED WATER CYCLE OBSERVATIONS AND INFORMATION”

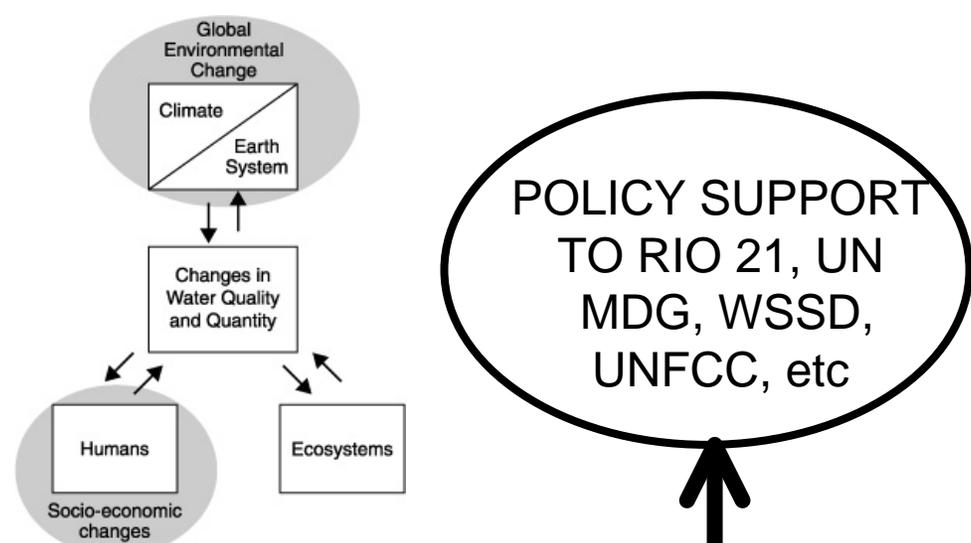


1. Provide a **framework** for guiding **decisions** on priorities and strategies regarding water cycle observations for:
 - Monitoring **climate variability** and change,
 - Effective **water management** and sustainable development of the world’s water resources,
 - Societal applications for **resource 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**

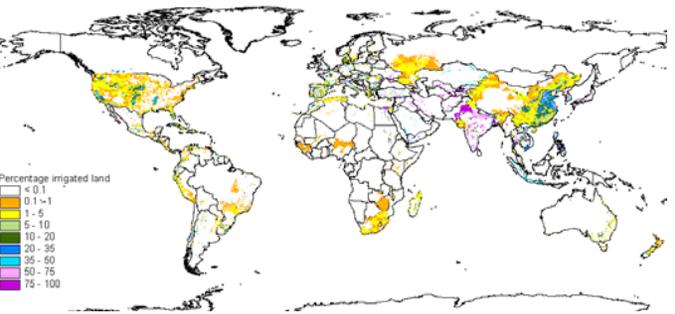
April 2004

An international partnership for cooperation in Earth observations

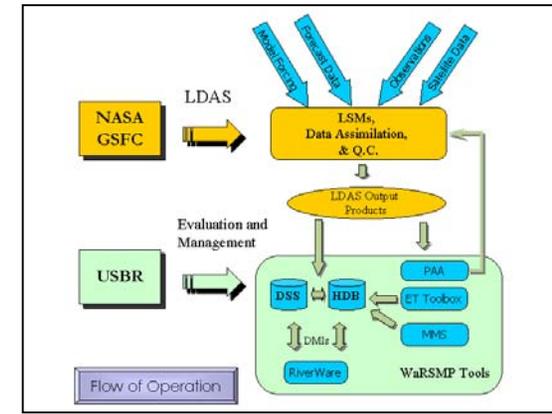
USERS DEFINE NEEDS AND INFLUENCE PRIORITIES



WATER QUALITY DEGRADATION FROM LAND CLEARING



Siebert et al 2001



PRECIPITATION: MOISTURE SUPPLIED BY THE ATMOSPHERE FOR LIFE ON EARTH (FROM IGWCO REPORT)

ISSUE:

PRECIPITATION DETERMINES THE ANNUAL AMOUNT OF **RENEWABLE WATER**, RIVER **RUNOFF** AND THE **LATENT HEAT** RELEASED IN THE ATMOSPHERE. IT IS **POORLY PREDICTED** ON LONGER TIME SCALES AND LONG-TERM RECORDS DO NOT EXIST FOR MUCH OF THE EARTH'S SURFACE (E.G.OCEANS).

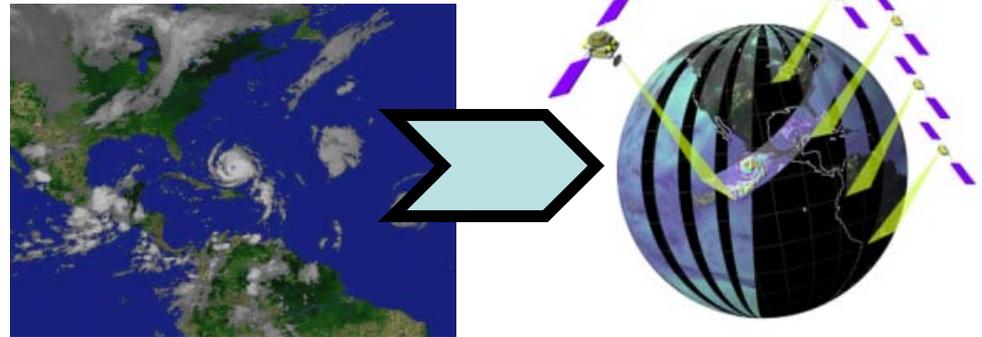
SPECIFIC SHORTCOMINGS:

- LACK OF ABSOLUTE MEASUREMENT **STANDARDS** FOR DIFFERENT SPATIAL SCALES.
- INCOMPLETE **RADAR** COVERAGE (GROUND RADAR, SATELLITE).
- SNOWFALL** MEASUREMENT.
- MEASUREMENT IN COMPLEX **TERRAIN**.
- VERTICAL DISTRIBUTIONS** OF PRECIPITATION FOR LATENT HEATING ESTIMATES.

RECOMMENDATIONS:

- IMPROVE COVERAGE OF **SATELLITE** OBSERVATIONS.
- ENHANCE COVERAGE OF SPACE BORNE **RADAR**.
- IMPROVE **ALGORITHMS** TO BLEND OBSERVATIONS FROM ALL SOURCES.
- FIELD CAMPAIGNS FOR **VALIDATION**.

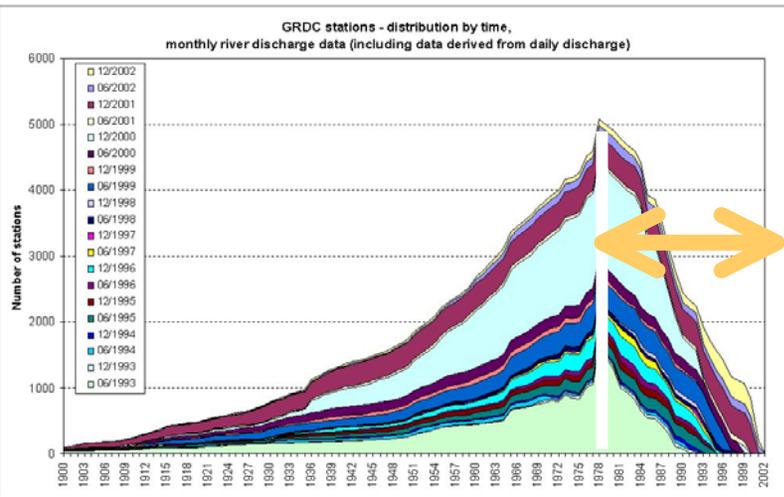
TRMM



(ISSUE: WHAT WILL SCIENCE (AND USERS) DO FOR DATA CONTINUITY BETWEEN THE END OF TRMM DATA AND THE LAUNCH OF GPM?)

GLOBAL DATA CENTERS ARE EXPERIENCING PROBLEMS

Temporal Distribution of all Data at GRDC



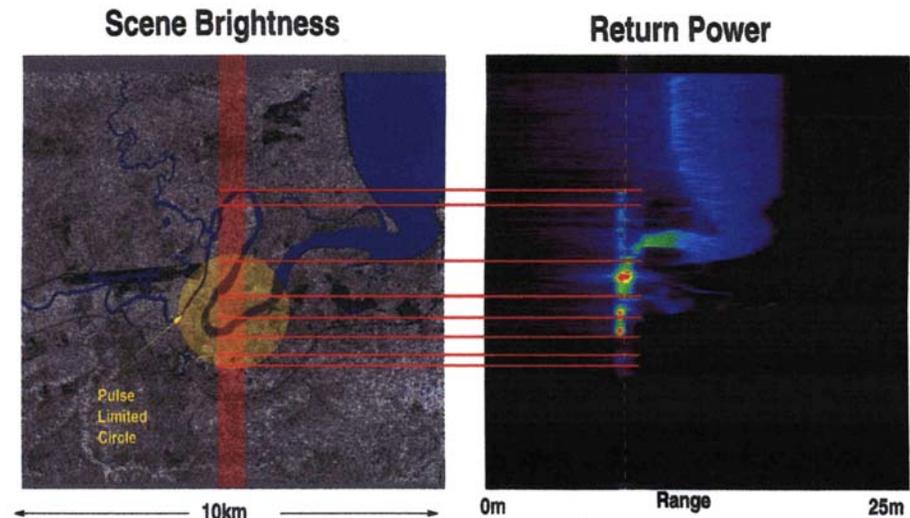
WHAT'S THE PROBLEM?

- Inadequate exchange of available data (political)
- Fragmented data holdings (technological)
- Lag time in data processing and provision (organisational)
- Declining networks (financial)
- Quality of data (scientific)

(From Second Report on the Adequacy of the Global Climate Observing Systems to UNFCCC/SBSTA)

Wide-Beam SAR - Altimeter

**CAN SATELLITE
ALTIMETRY DATA
PROVIDE AN ALTERNATIVE
FOR MEASURING STREAMFLOW?**



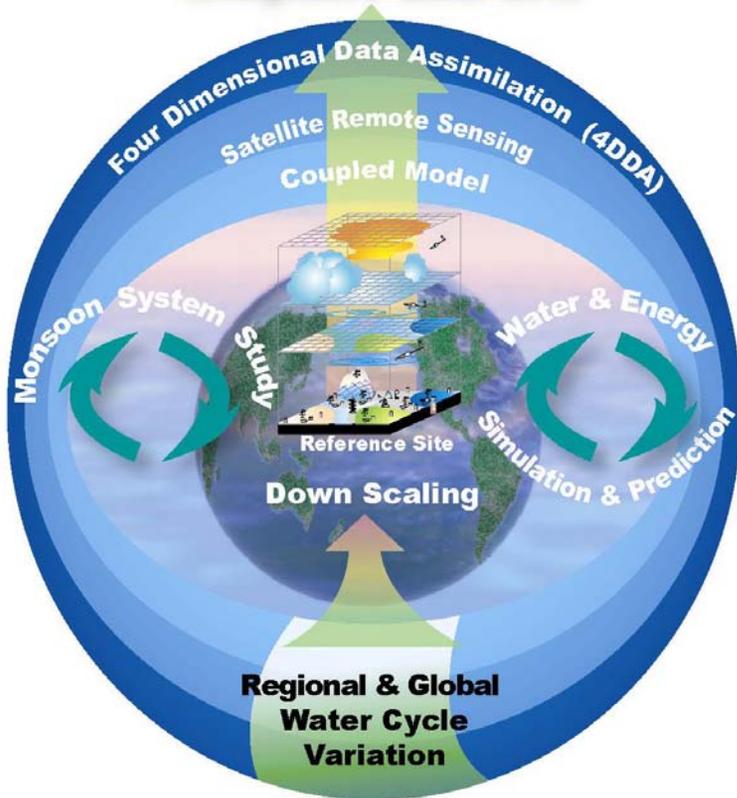
REQUIREMENTS AND OPPORTUNITIES FOR DATA INTEGRATION

1. MOST USERS WANT ACCESS TO THE BEST POSSIBLE PRODUCT AND WANT TO KNOW THE ERRORS ASSOCIATED WITH THIS PRODUCT (RATHER THAN HAVING 5 PRODUCTS WITH DIFFERENT VALUES FOR THE SAME VARIABLE AT THE SAME POINT IN TIME AND SPACE.)
2. SUPERSITES (HIGH RESOLUTION POINT DATA – CONTINUOUS IN TIME) ARE NEEDED FOR DEVELOPMENT AND VALIDATION PURPOSES. THEY SHOULD BE ESTABLISHED AND THEIR DATA COMBINED WITH SATELLITE DATA (COARSE DATA – CONTINUOUS IN SPACE).
3. TOOLS THAT FACILITATE DATA INTEGRATION:
 - GEOGRAPHICAL INFORMATION SYSTEMS,
 - DATA MINING,
 - REGIONAL AND GLOBAL DATA ASSIMILATION SYSTEMS,
 - MODELS,
 - PERIODIC REANALYSES.

CEOP: EXPERIENCE IGWCO WILL USE IN DEVELOPING A RESEARCH-OPERATIONS PARTNERSHIP AND INTEGRATED DATA SET DEVELOPMENT



Integrated Data Sets



CEOP, THE FIRST ELEMENT OF IGWCO, BRINGS TOGETHER THE EXPERTISE AND CAPABILITIES OF:

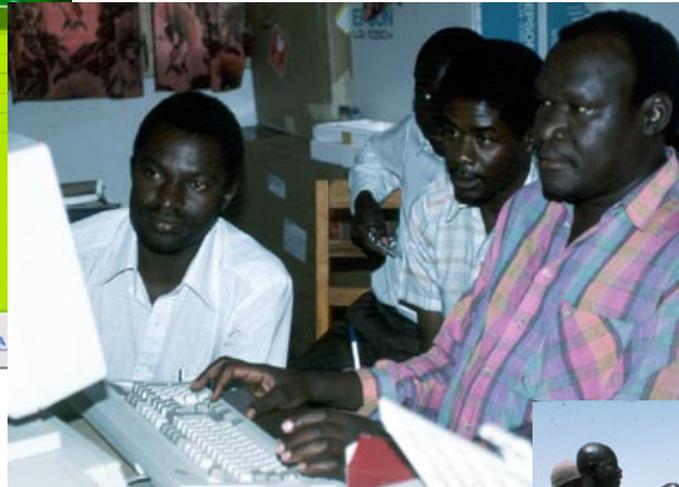
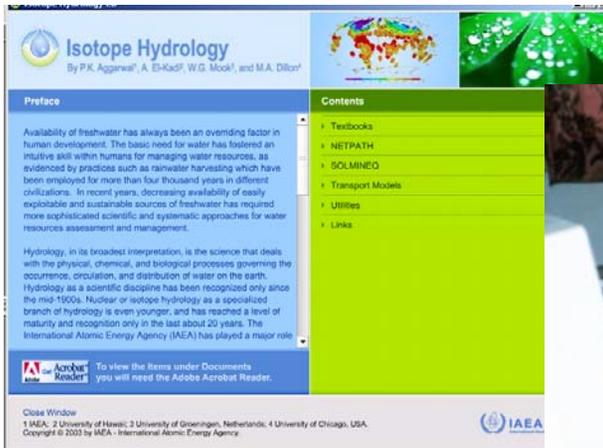
- 5 MAJOR **SPACE AGENCIES** THAT PROVIDE DATA (JAXA, ESA, EUMETSAT, NASA, NOAA)
- 8 MAJOR **NUMERICAL WEATHER PREDICTION** CENTERS IN PROVIDING MODEL OUTPUTS (ECMWF, NCEP, GMAO, JMA, ETC)
- >14 **NATIONS** IN PROVIDING REFERENCE SITE DATA (MANY OF WHICH HAVE RESTRICTIVE DATA POLICIES).
- WCRP/ CEOS CEOP** COMMITTEES BRING ALL THESE GROUPS TOGETHER

CEOP DEMONSTRATES THAT RESEARCH PROGRAMS CAN DEVELOP NEW APPROACHES TO PROBLEMS. A **RESEARCH-OPERATIONS PARTNERSHIP** IS VIEWED AS ESSENTIAL TO ACHIEVE THE GOALS OF IGWCO.

GLOBAL MEASUREMENTS CAN HAVE GLOBAL BENEFITS IF THE ABILITY OF DEVELOPING NATIONS TO USE THESE DATA IS INCREASED

(Capacity Building – Technology, Education/Training and Field Applications)

- Developing nations should be provided with the hardware and software to access all IGWCO data products and forecasts.
- Training materials should be developed and sessions carried out in developing countries.



IGWCO SHOULD WORK ACTIVELY TO SUPPORT THE TRANSFER OF ADVANCED TECHNOLOGIES TO THE DEVELOPING WORLD. IGWCO ENVISIONS WORKING CLOSELY WITH UNESCO AND SPACE AGENCIES TO ACHIEVE THIS GOAL.

ESA's TIGER Initiative



TIGER

is a concrete action to implement the recommendations of the Johannesburg World Summit on Sustainable Development, focusing on
Space – Water - Africa



Approved at GEO-2:

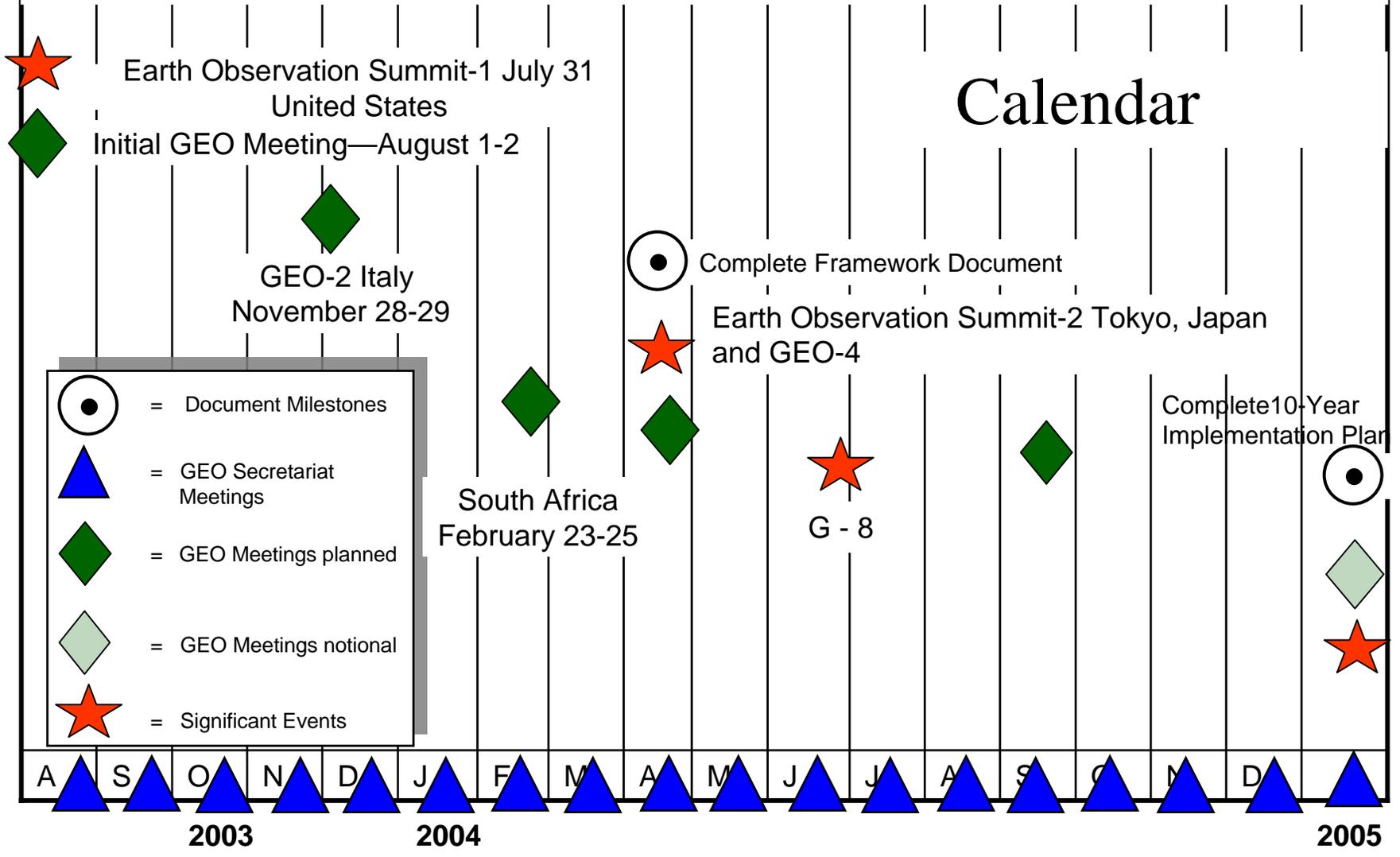
GEOSS: A NEW EARTH OBSERVING INITIATIVE INVOLVING 44 COUNTRIES

Goal: To develop a system of systems supplemented by new observing components as and where required.

- Existing systems maintain their mandates and new observing components are added
- Interfaces are needed among observing components
- Members and participating organizations agree on interoperability specifications and support a common network structure for exchange and dissemination of observational data

GEO: AN AD HOC GROUP THAT IS DEVELOPING PLANS FOR GEOSS

Calendar

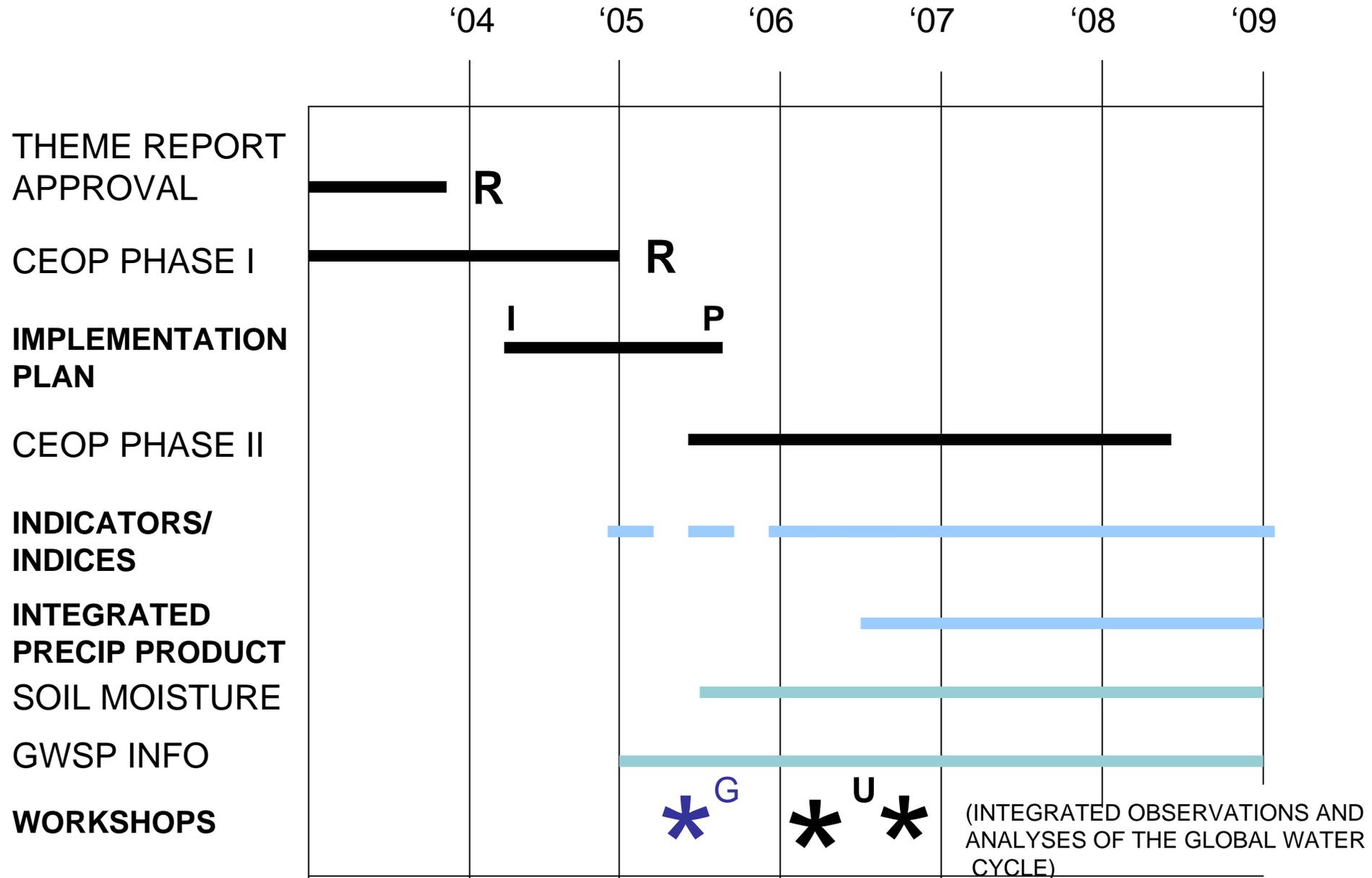


Earth Observation Summit – 2

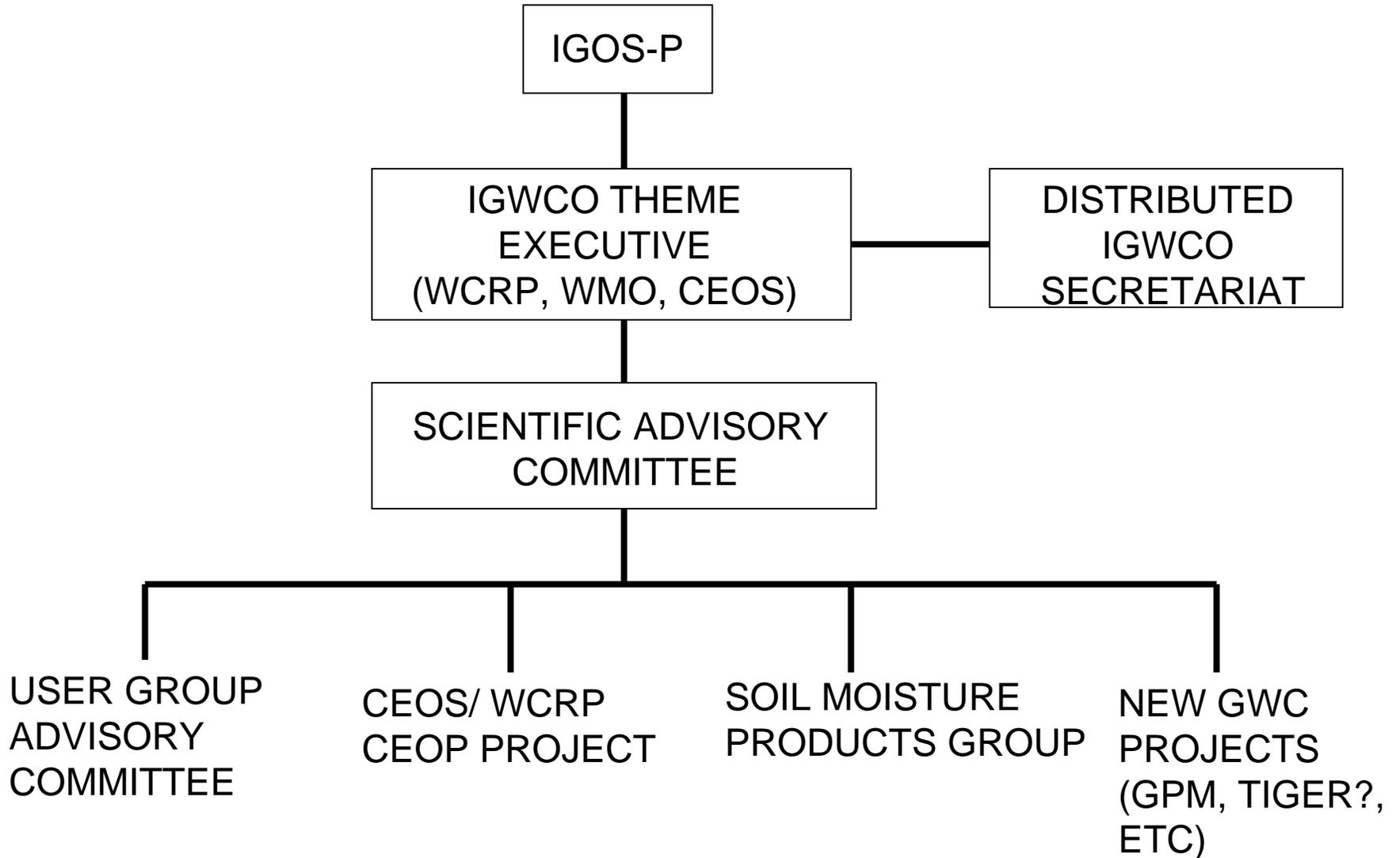
25 April 2004, Tokyo



IGWCO - DRAFT IMPLEMENTATION TIMETABLE



IGWCO IMPLEMENTATION STRUCTURE



SUMMARY

COLLECTIVELY, **SPACE AGENCIES** WILL BE LAUNCHING A LARGE NUMBER OF SATELLITES OVER THE NEXT 5-10 YEARS. THESE INITIATIVES SHOULD **BENEFIT** WATER CYCLE **SCIENCE** AND IMPROVE SERVICES FOR WATER RESOURCE **MANAGEMENT**.

IMMEDIATE **OPPORTUNITIES** TO CONTRIBUTE TO THE **DIALOGUE WITH SPACE AGENCIES** INCLUDE:

- IGWCO PROGRAM IMPLEMENTATION,
- SPECIFIC PROGRAMS LIKE GPM, TIGER, etc.,
- GEO 10-YEAR IMPLEMENTATION PLAN.

SOCIO-ECONOMIC COMPONENT STILL TO BE DEVELOPED.