

The World Water Scene: *Facing Unprecedented Challenges at Home and Abroad*

***Presentation to NACWA
St Peterberg, Florida
January 31, 2007***

**Paul Reiter
IWA Executive Director**





Scarcity – Mother of Invention

“When the well is dry, we know the worth of water.”

Benjamin Franklin – 1746

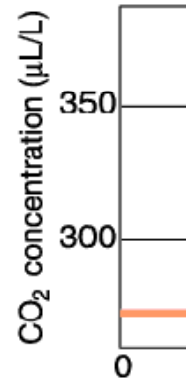


Trend #1

The Advancing Malthusian Puzzle – Population and Its Immediate Implications

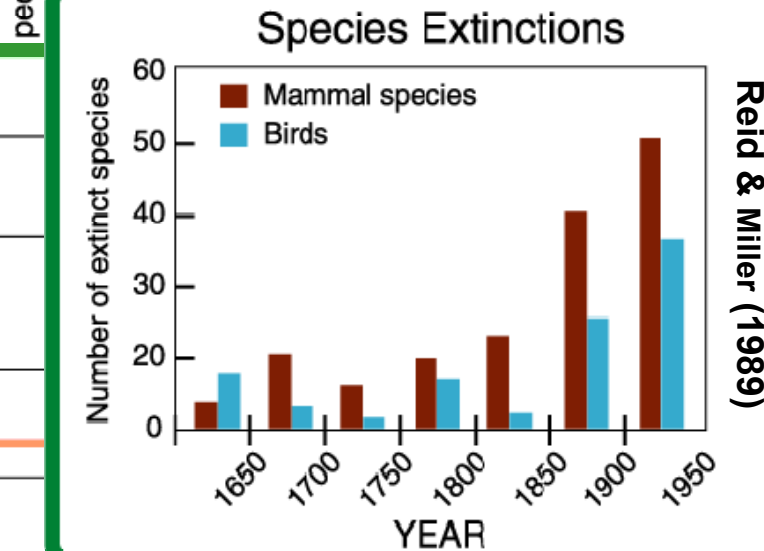


In the Very Big Picture... What's Happening?

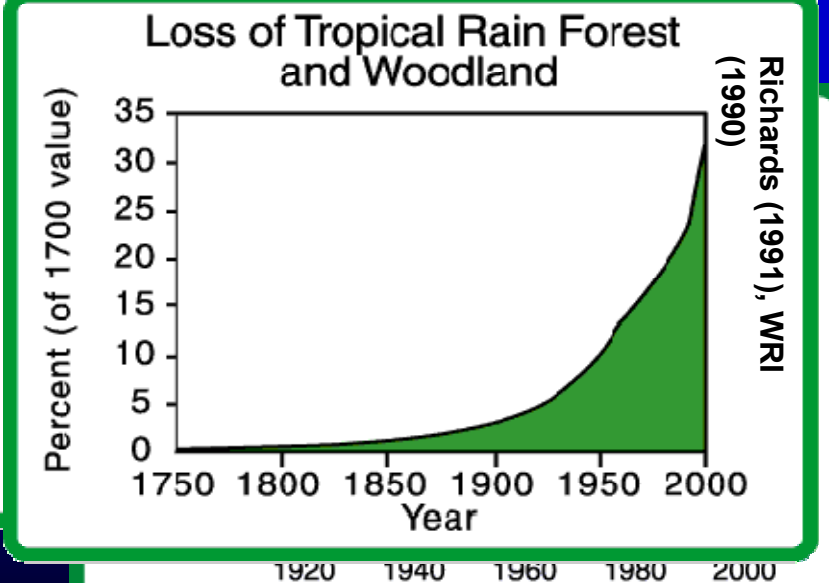
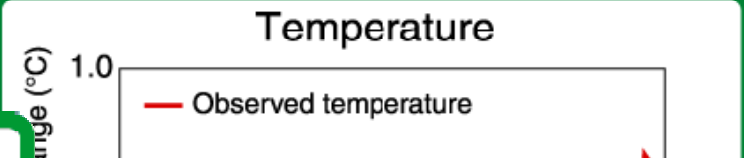


NOAA

Human Population
Nitrogen Flux to Coastal Zone



Mackenzie et al (2002)

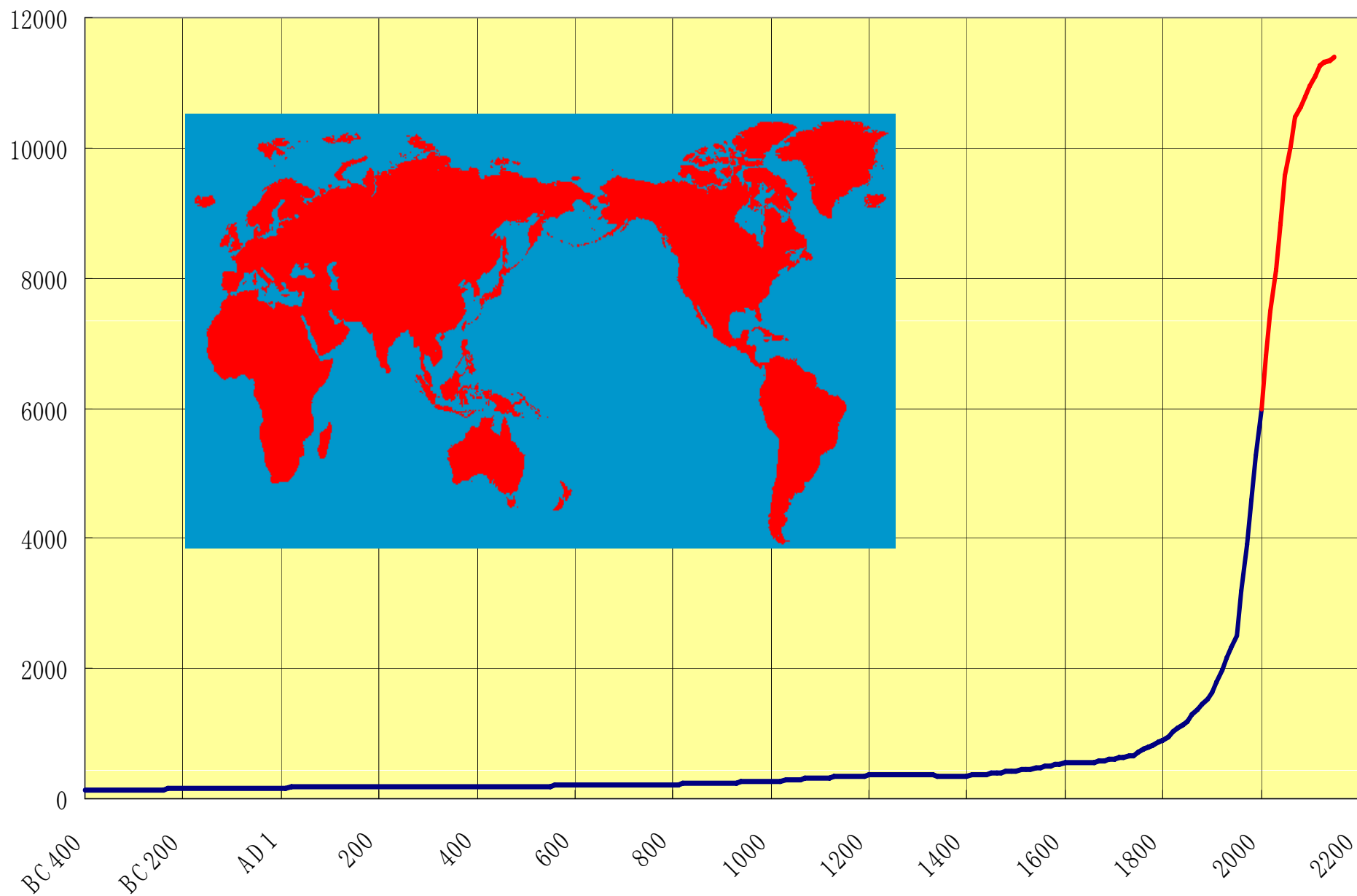


Vitousek (1994)

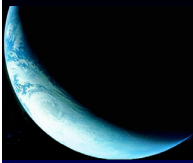
YEAR

Population of The World

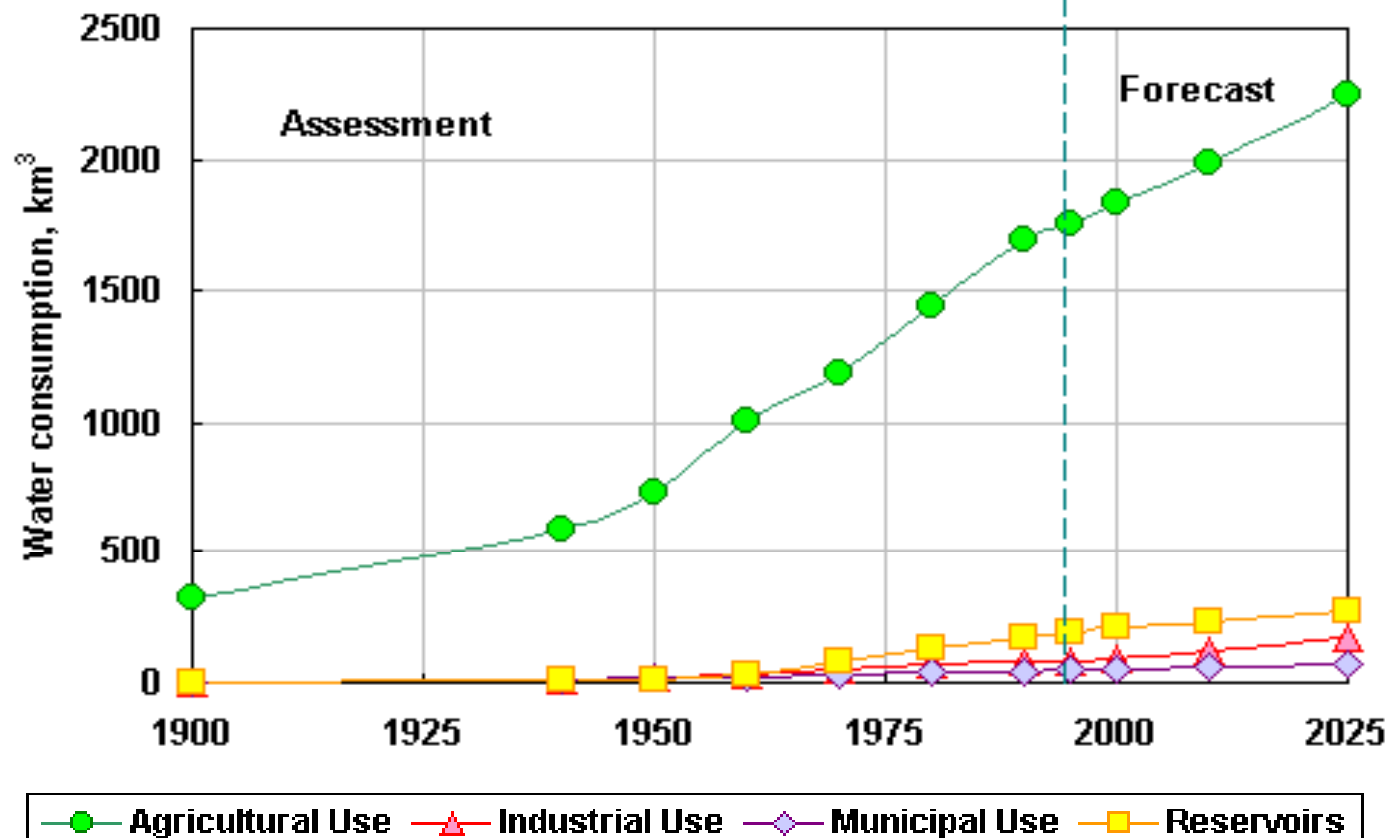
(m illion)







Worldwide Water Use by Sector



a global **network** for water professionals

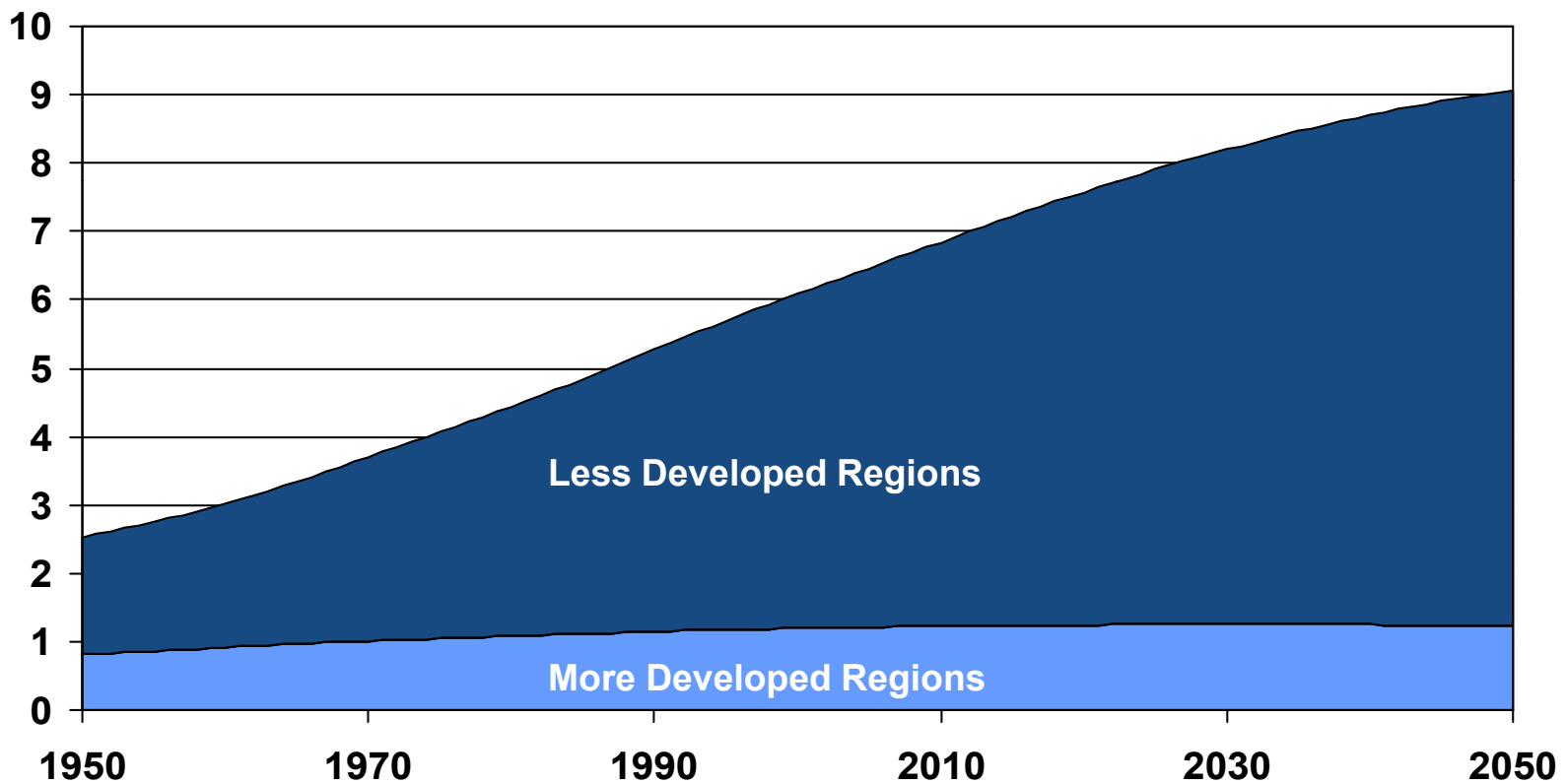


Irrigated Land Worldwide

- 1900 – 1950 – doubled
- 1950 – 1980 – doubled again
- 1980 – present – growing proportionally

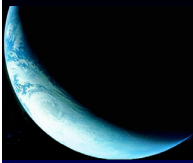
Growth in More, Less Developed Countries

Billions

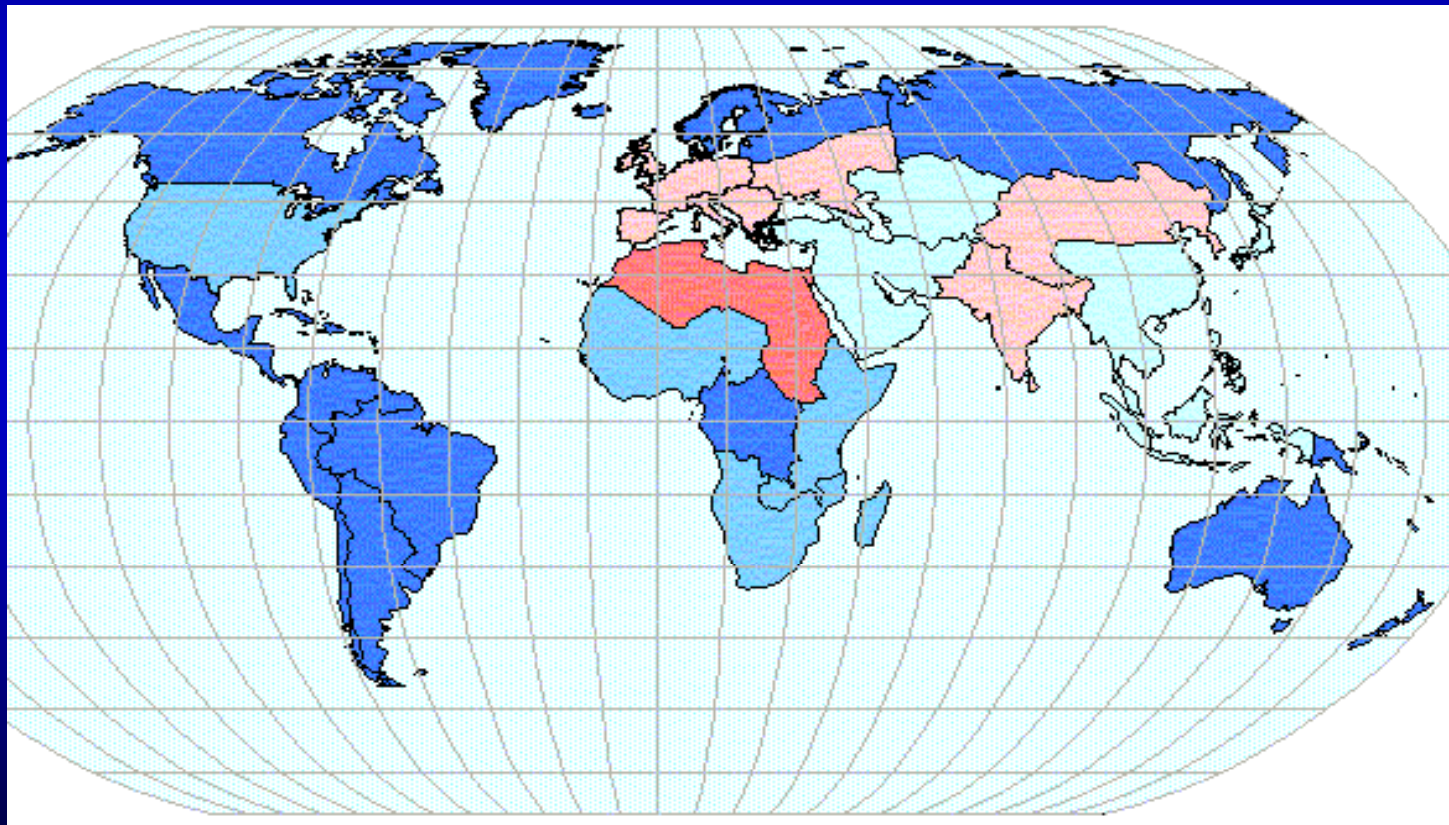


Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.





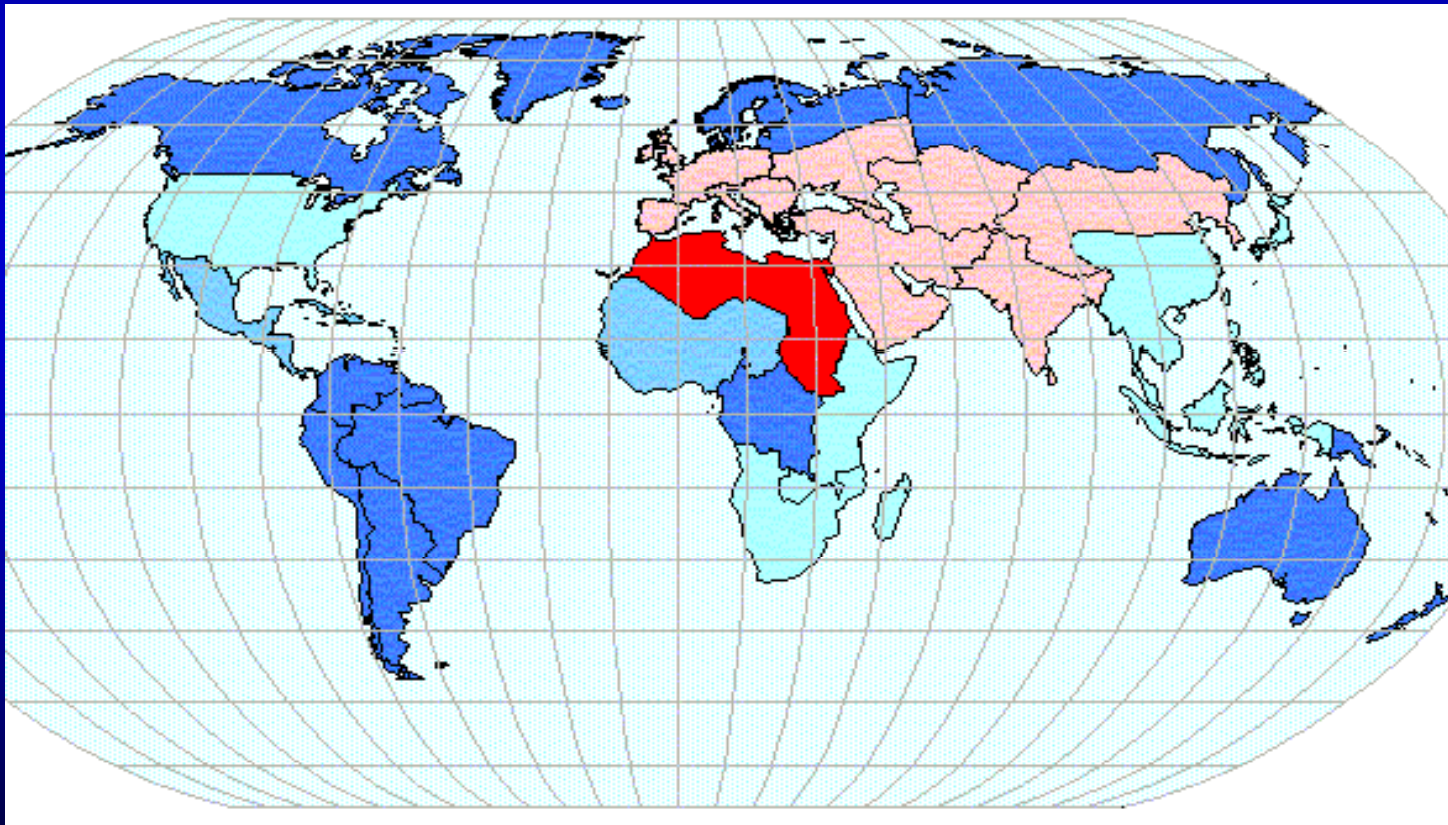
Water Availability Per Capita 1950



a global **network** for water professionals

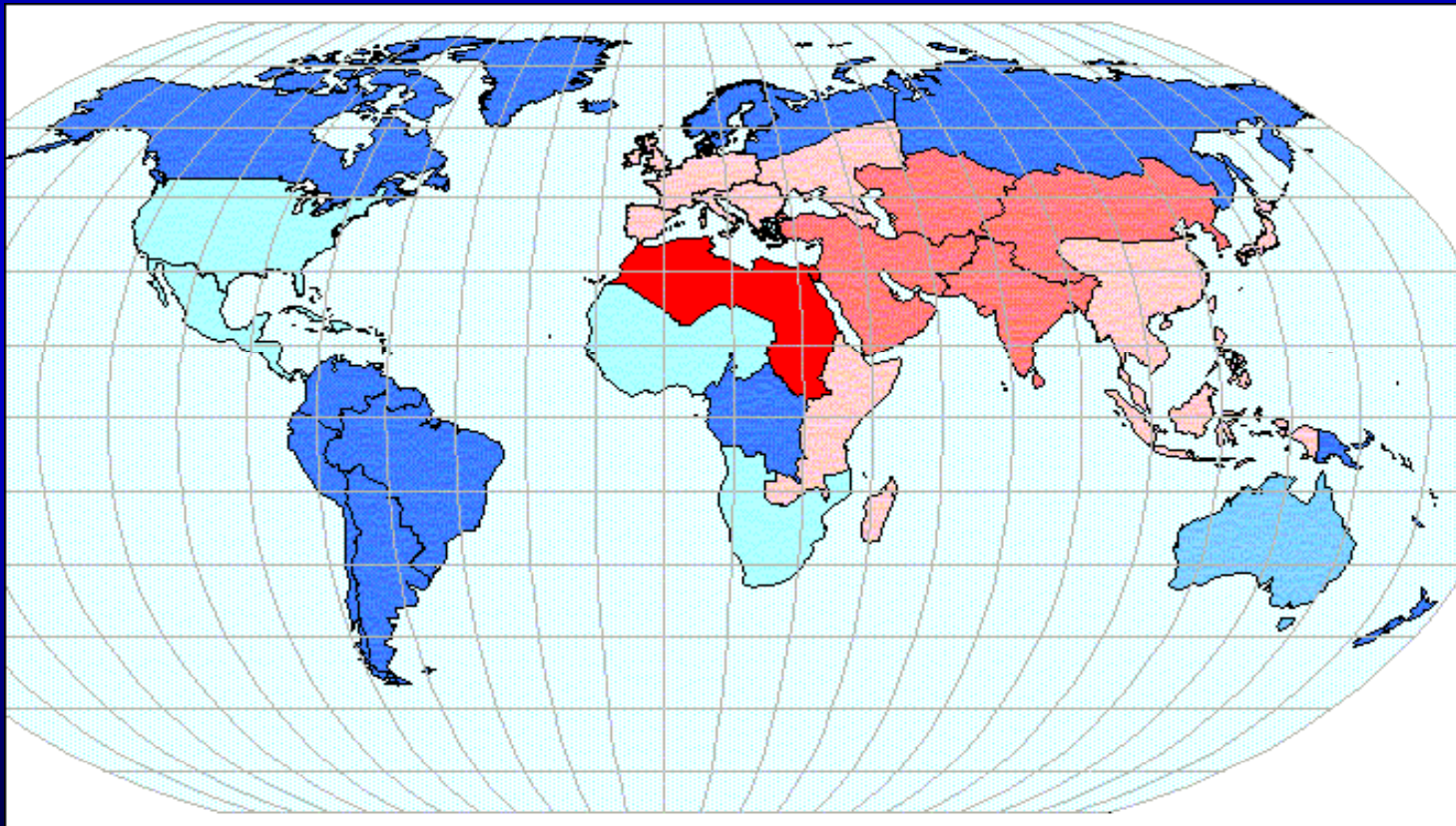


Water Availability Per Capita 1970

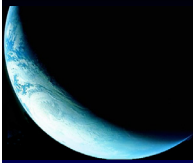




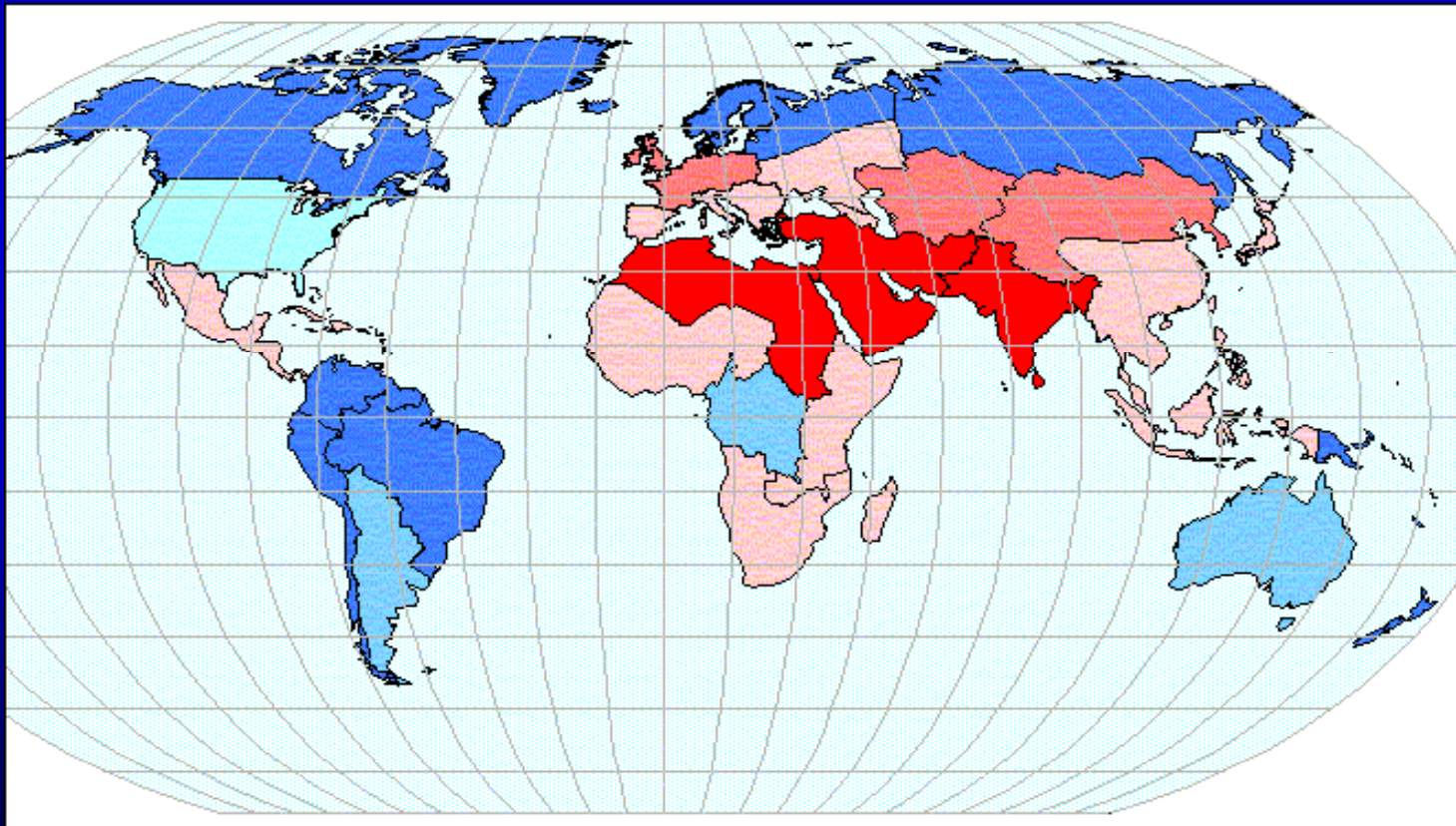
Water Availability Per Capita 1990



a global **network** for water professionals



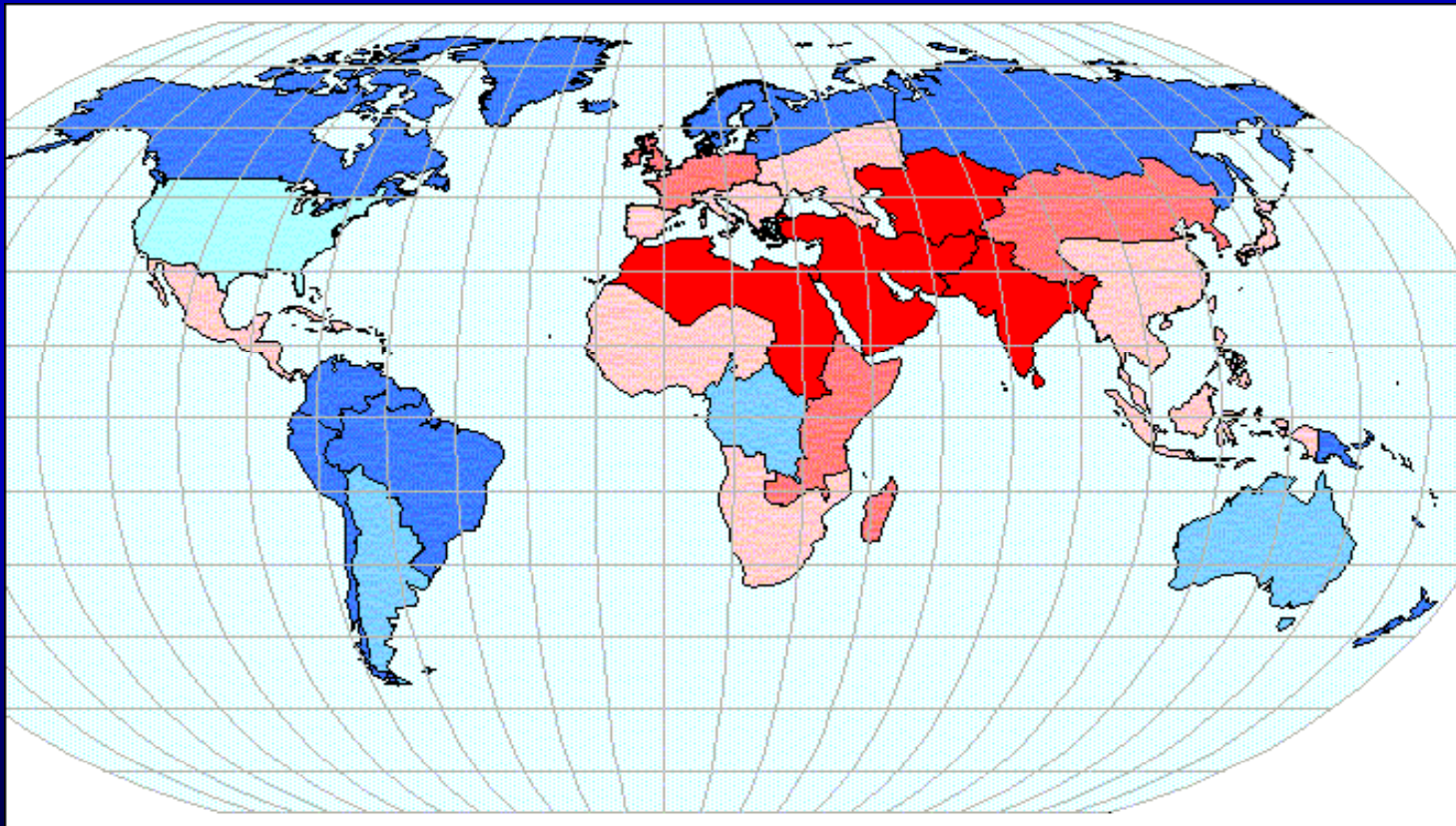
Water Availability Per Capita 2010



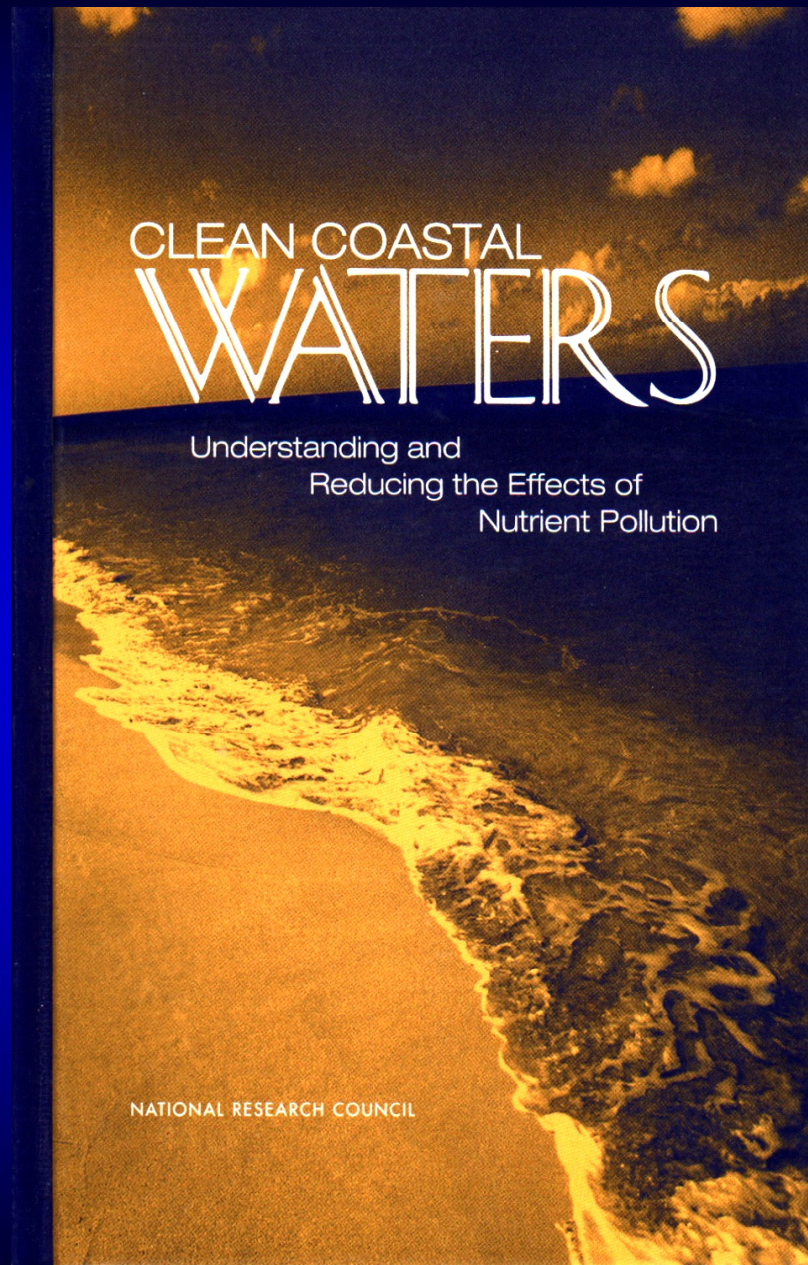
a global **network** for water professionals



Water Availability Per Capita 2025



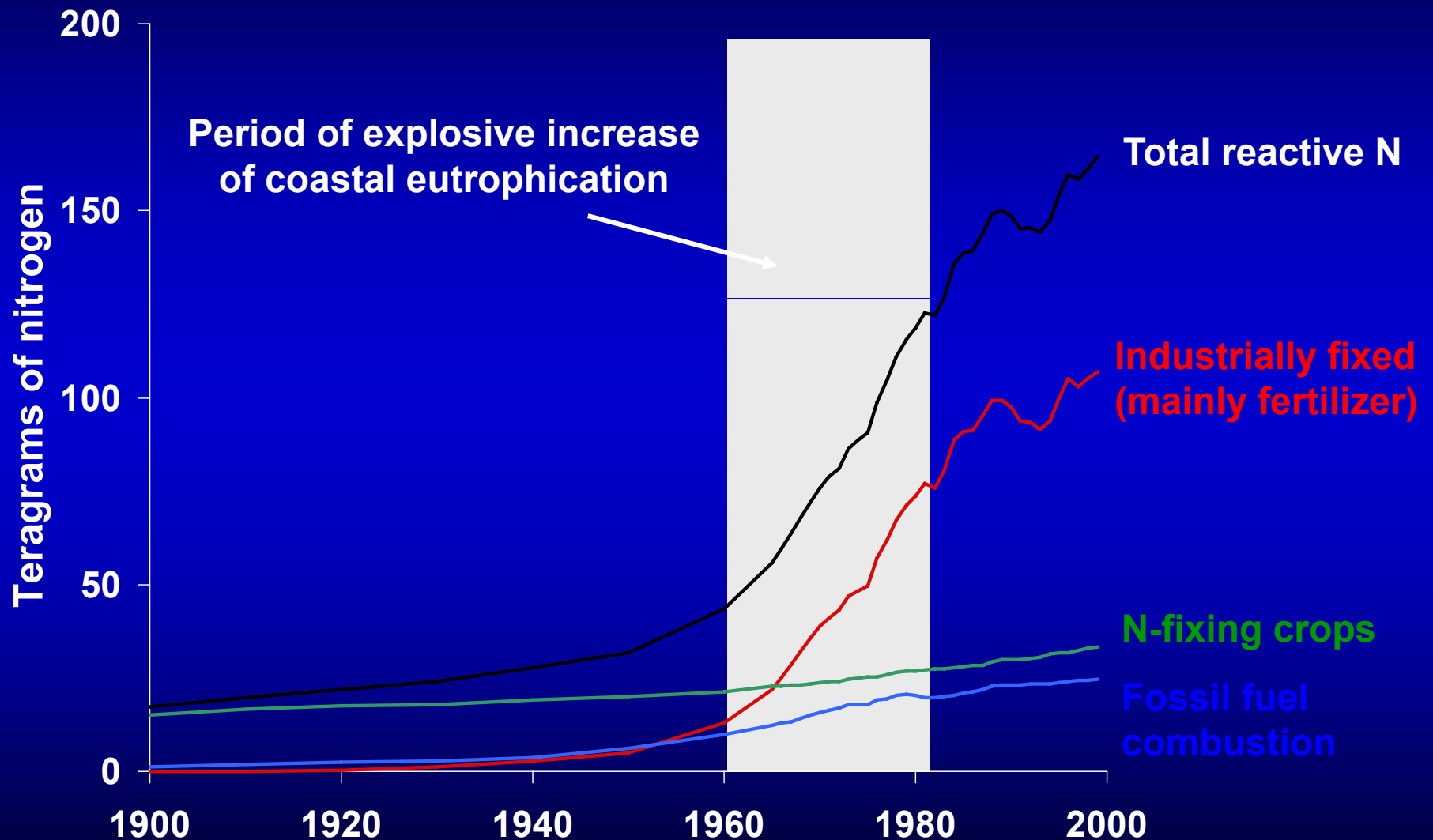
a global **network** for water professionals



NRC 2000:

Nitrogen is now the largest pollution problem in the coastal waters of the United States.

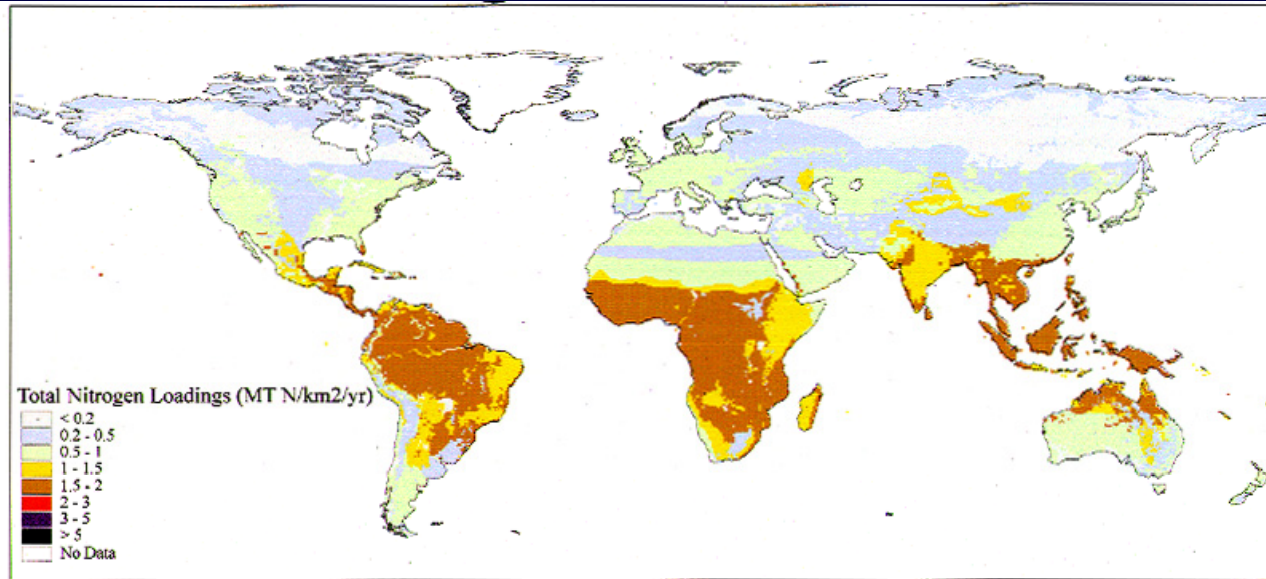
Two thirds of coastal rivers and bays are moderately to severely degraded from nitrogen pollution.



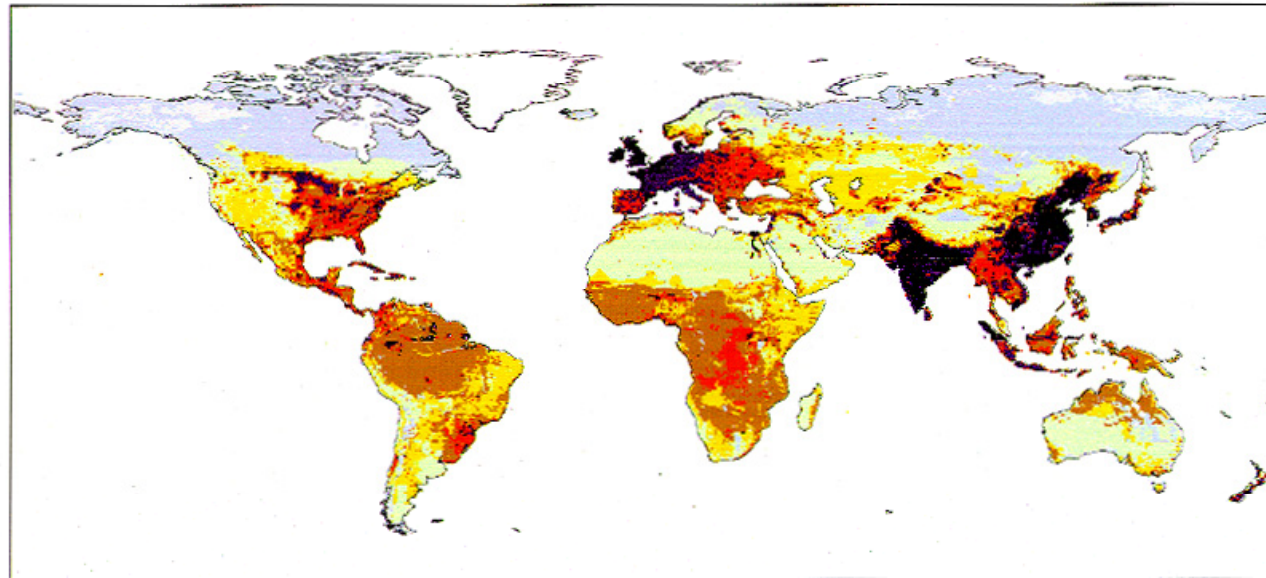
(Boesch 2002)

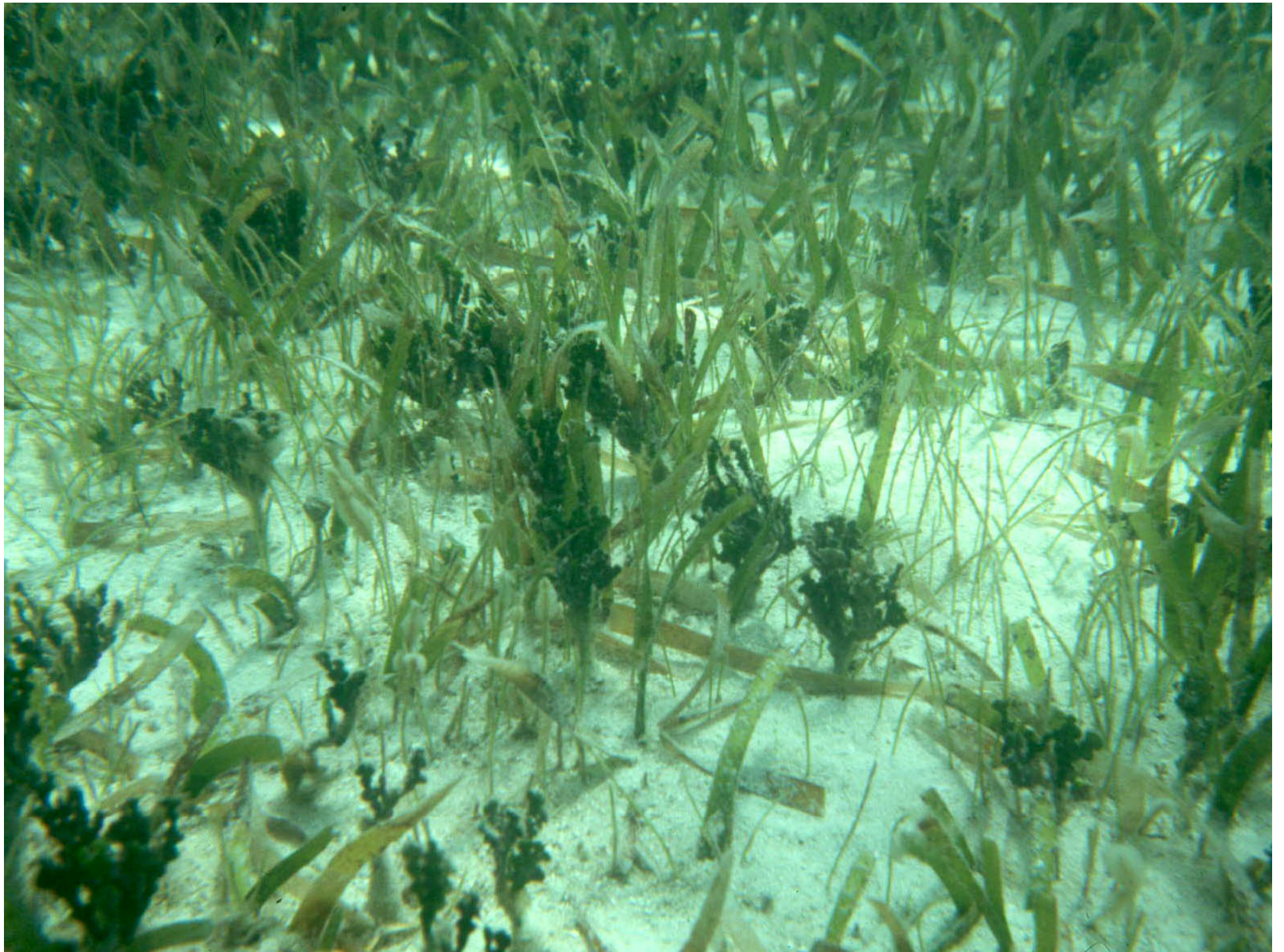
Water Supply-- Doubling of Global Nitrogen Pollution

Pre-Industrial

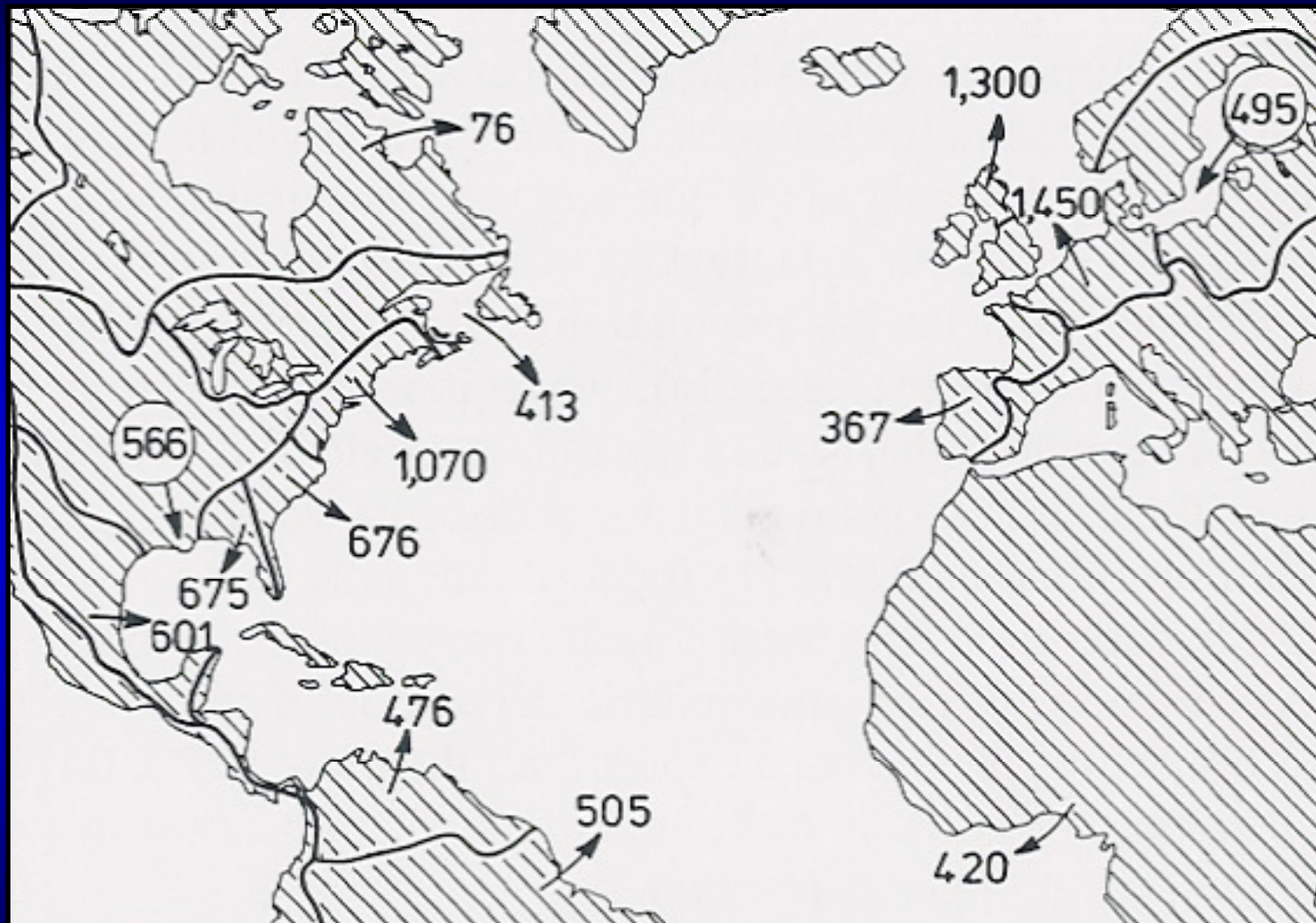


Contemporary









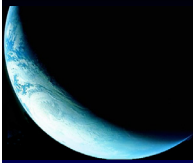
$\text{Kg N km}^{-2} \text{ year}^{-1}$ (Howarth et al. 1996)

a global **network** for water professionals

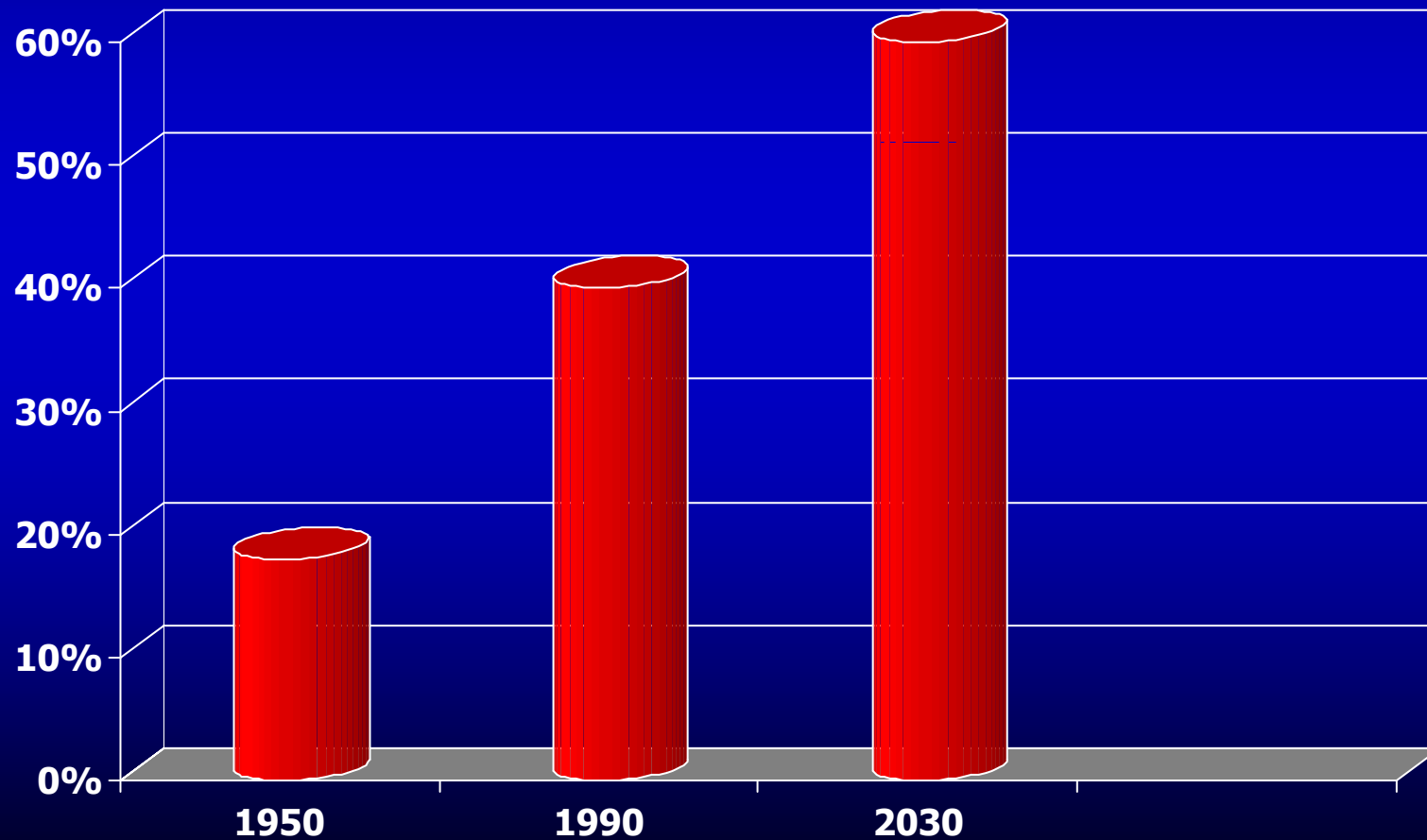


Trend #2

A “Rearranged” Population



Urban Portion of World's Population

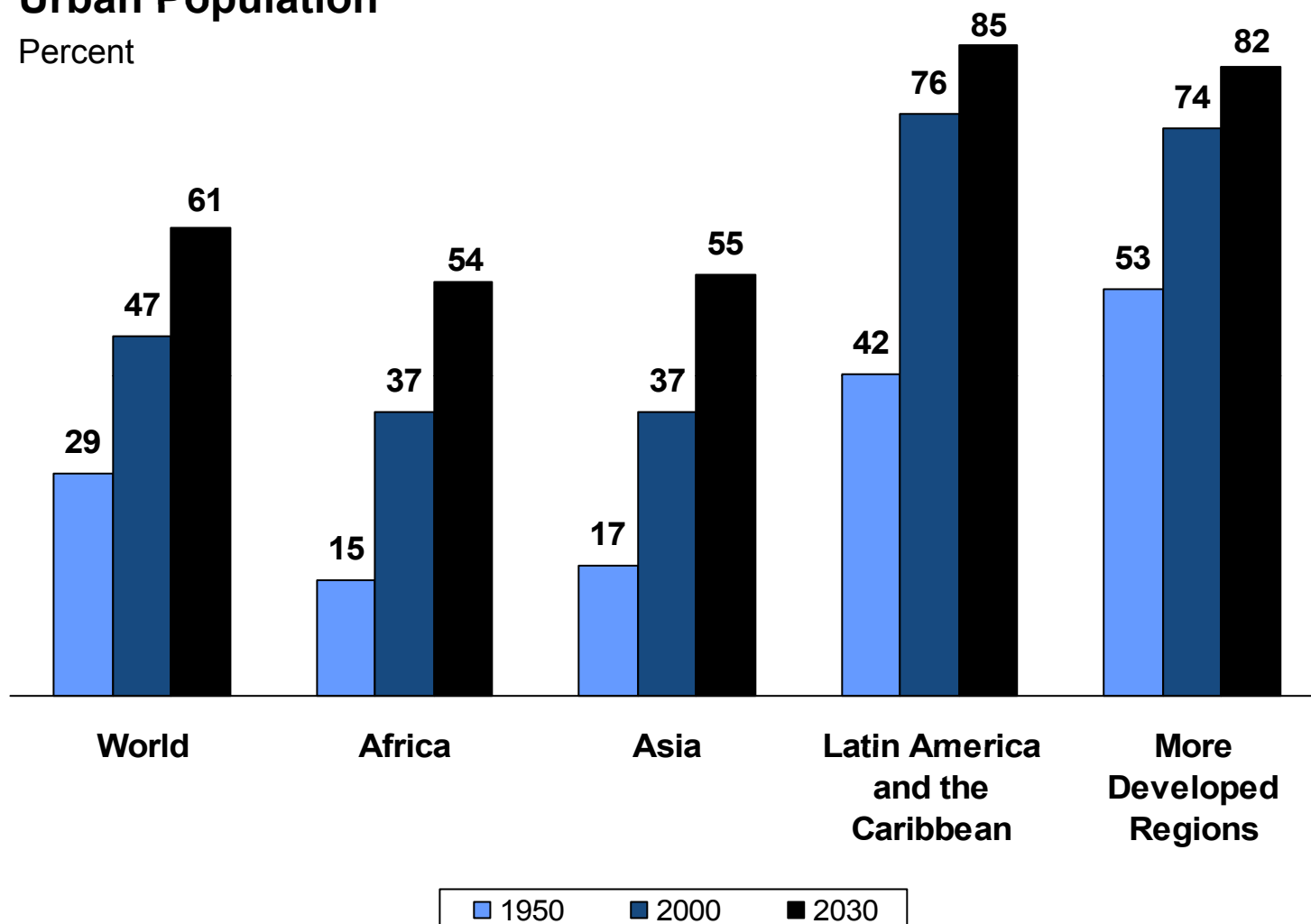


a global **network** for water professionals

Trends in Urbanization, by Region

Urban Population

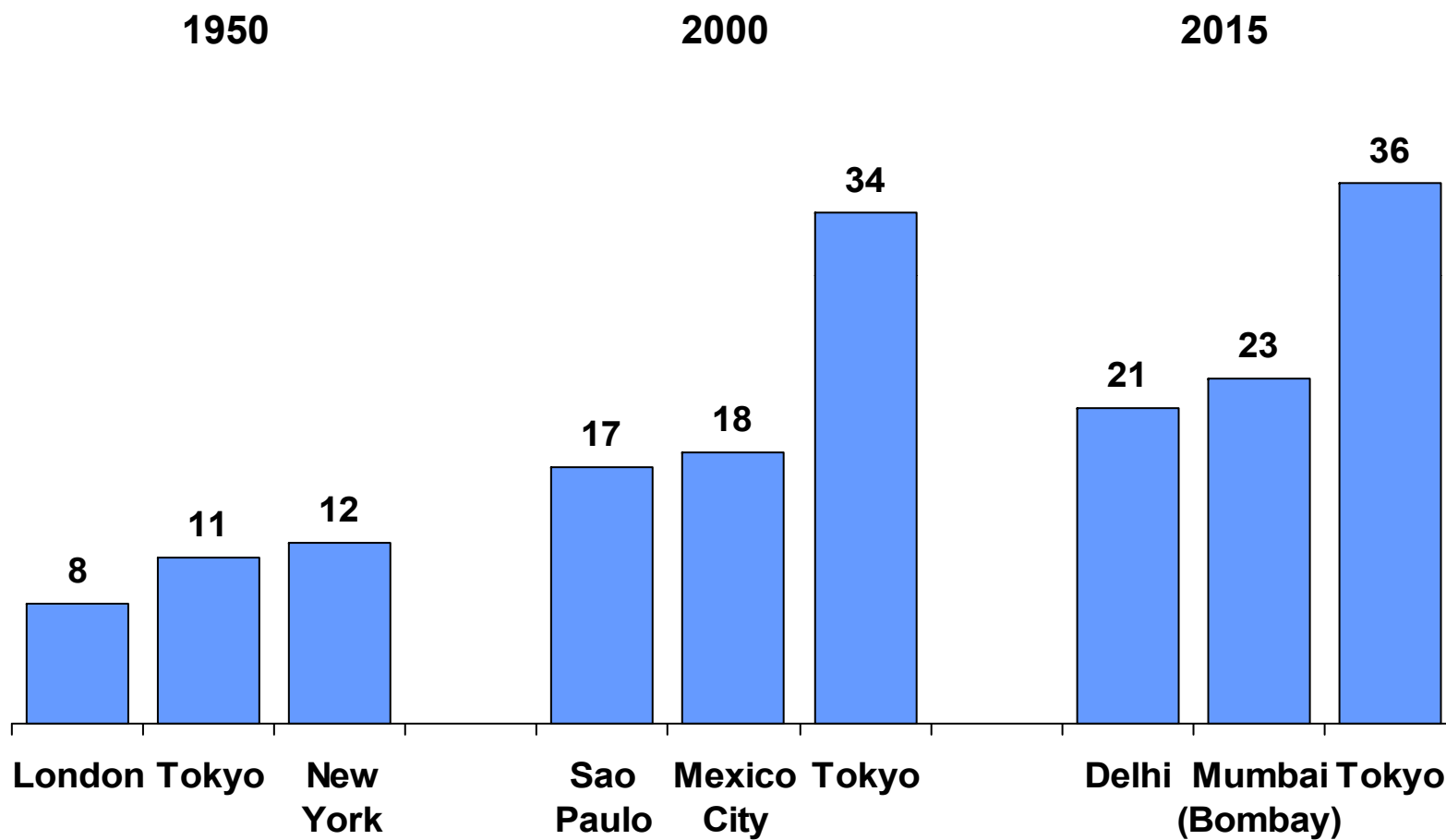
Percent



Source: United Nations, *World Urbanization Prospects: The 2003 Revision* (medium scenario), 2004.

Largest Cities, Worldwide

Millions



Source: United Nations, *World Urbanization Prospects: The 2003 Revision* (medium scenario), 2004.

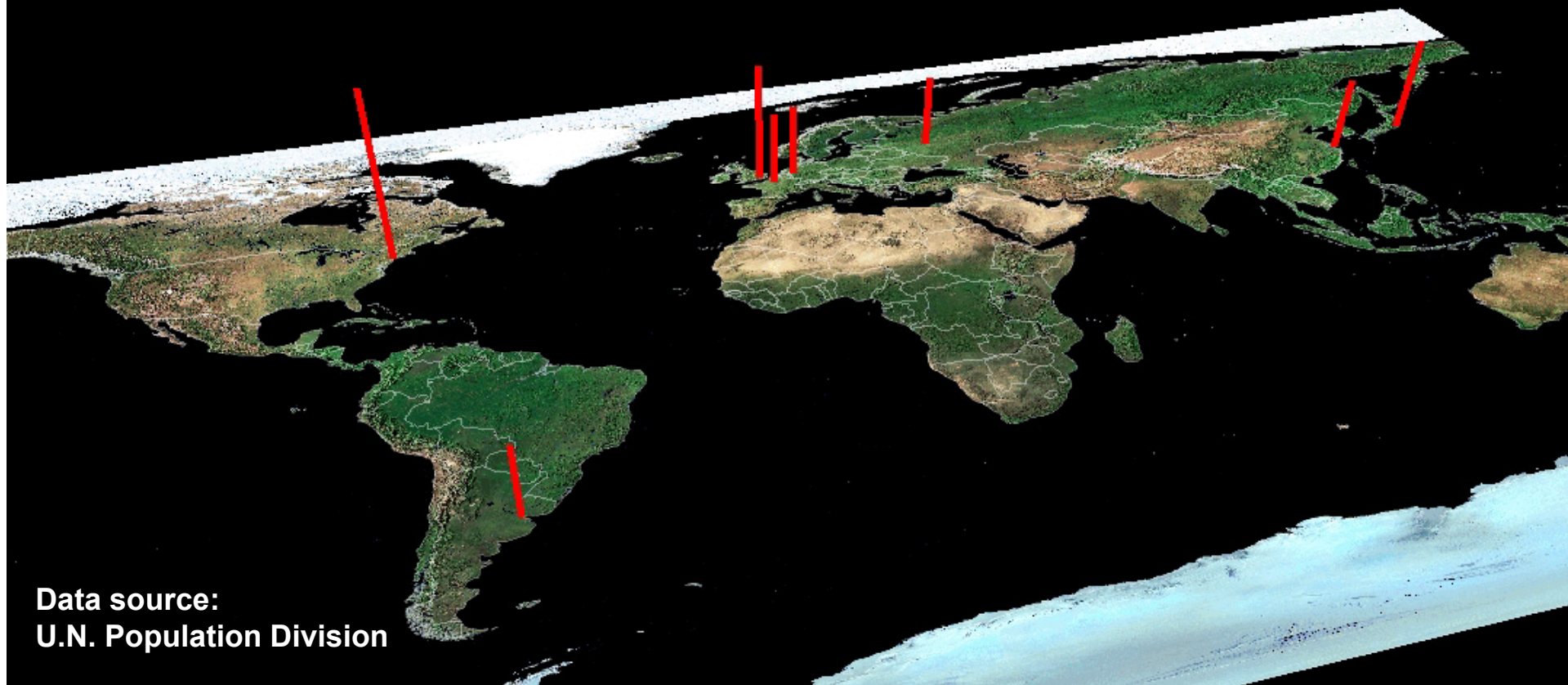
Development of World Cities



Münchener Rück
Munich Re Group

1950

**World Cities exceeding
5 million residents**



Data source:
U.N. Population Division

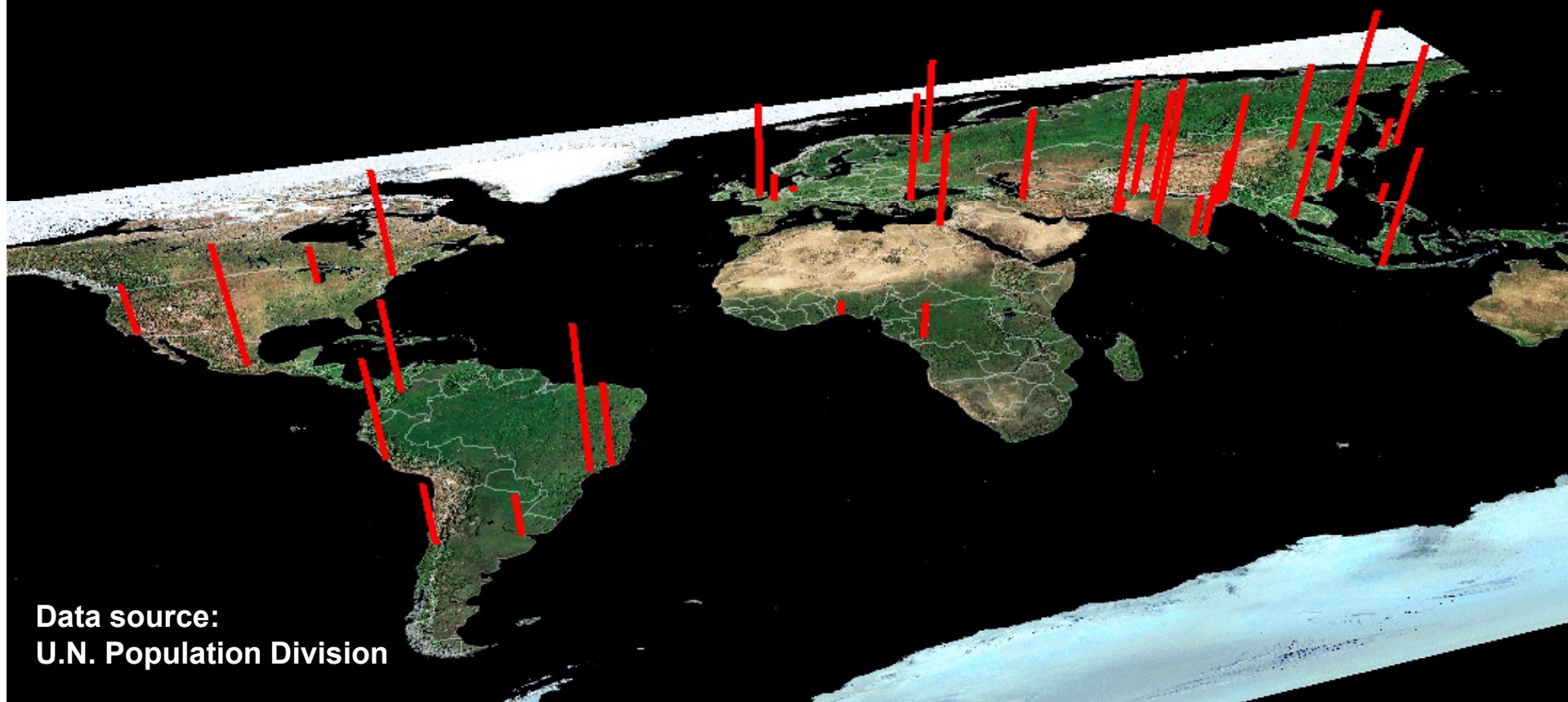
Development of World Cities



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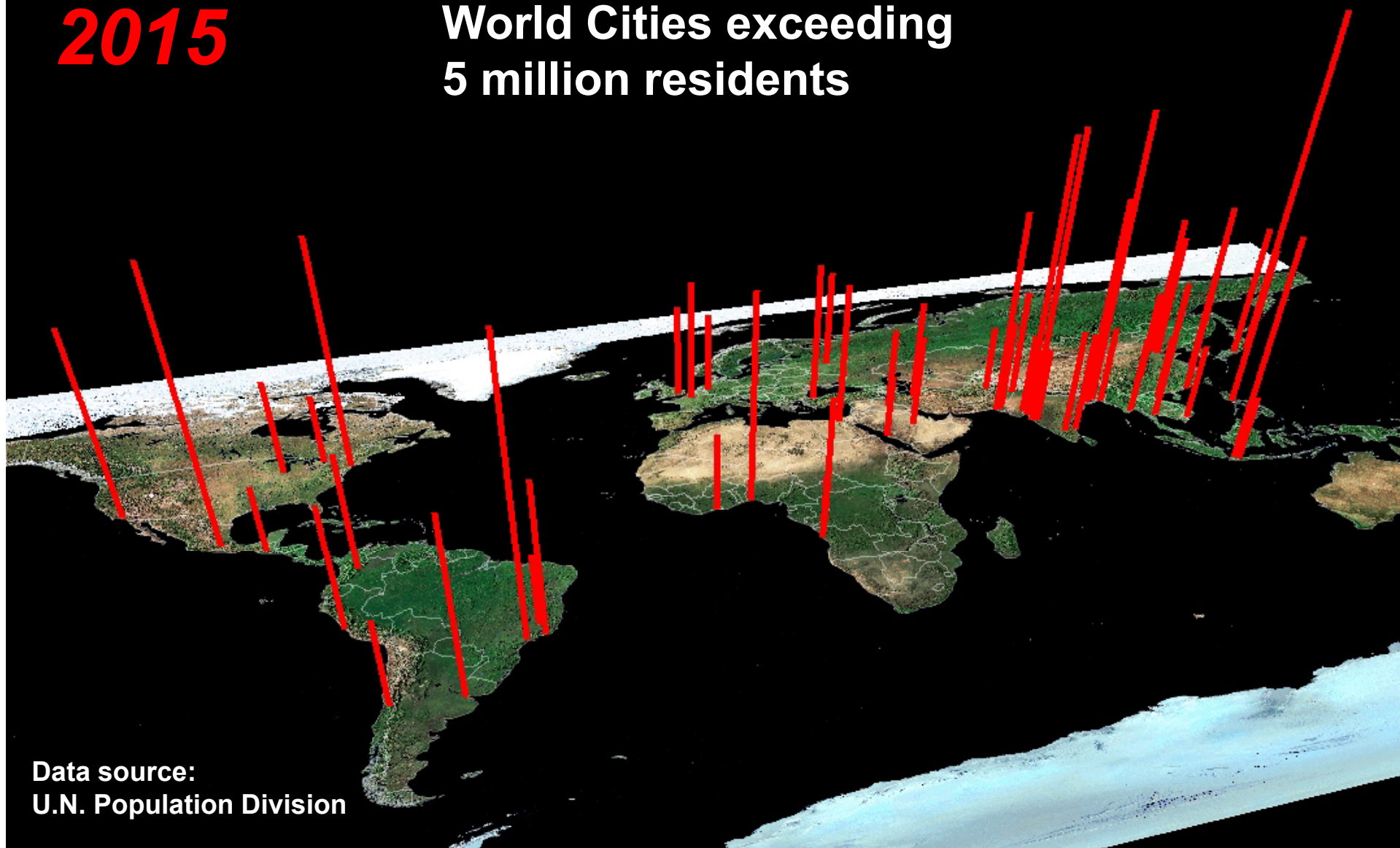
Development of World Cities



Münchener Rück
Munich Re Group

2015

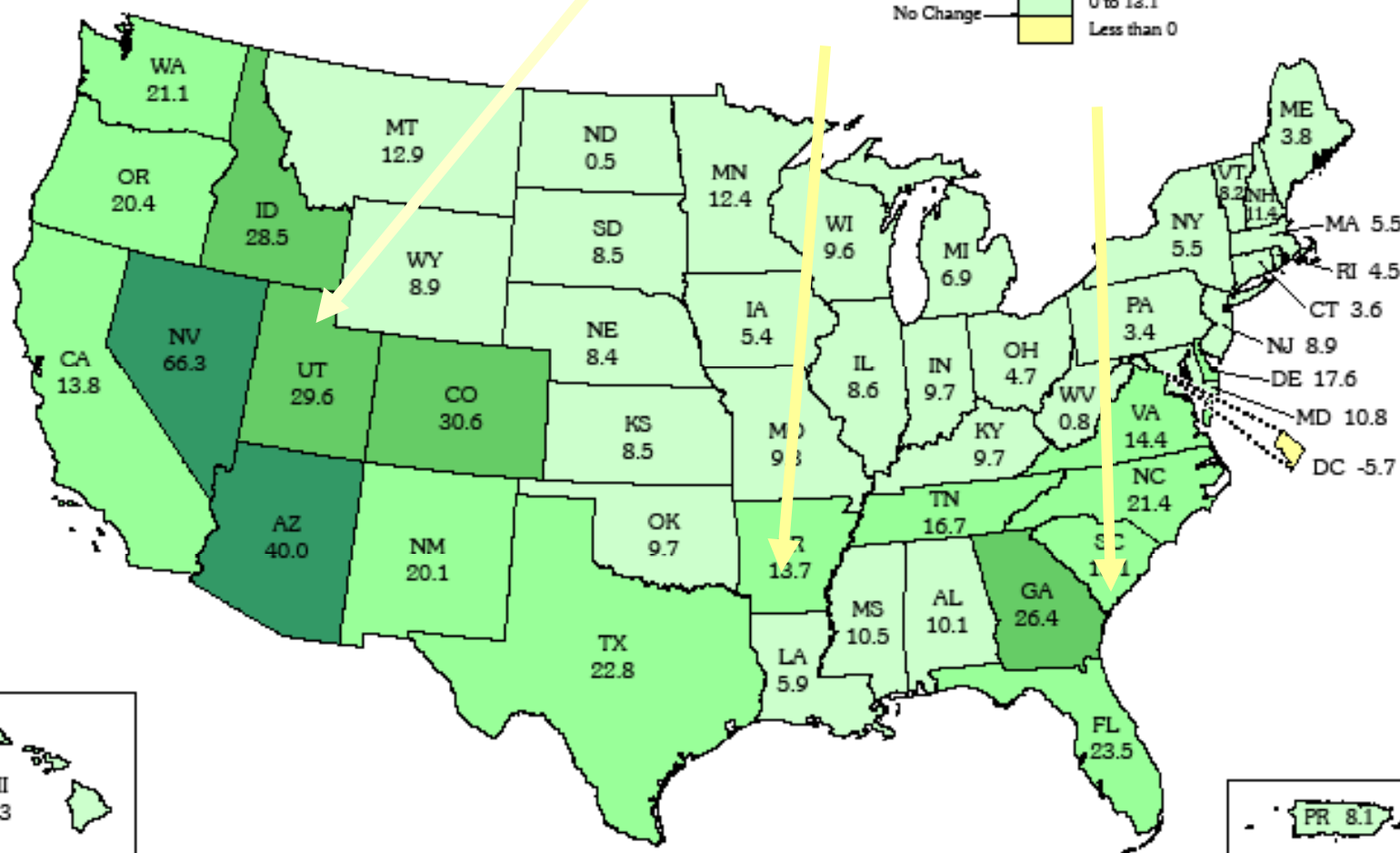
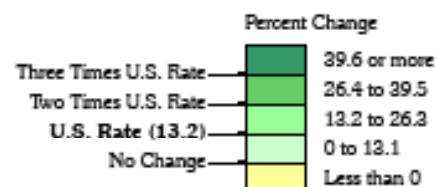
**World Cities exceeding
5 million residents**

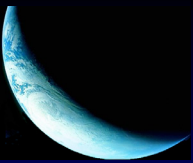


Data source:
U.N. Population Division



Figure 1. Percent Change in Resident Population for the 50 States, the District of Columbia, and Puerto Rico: 1990 to 2000

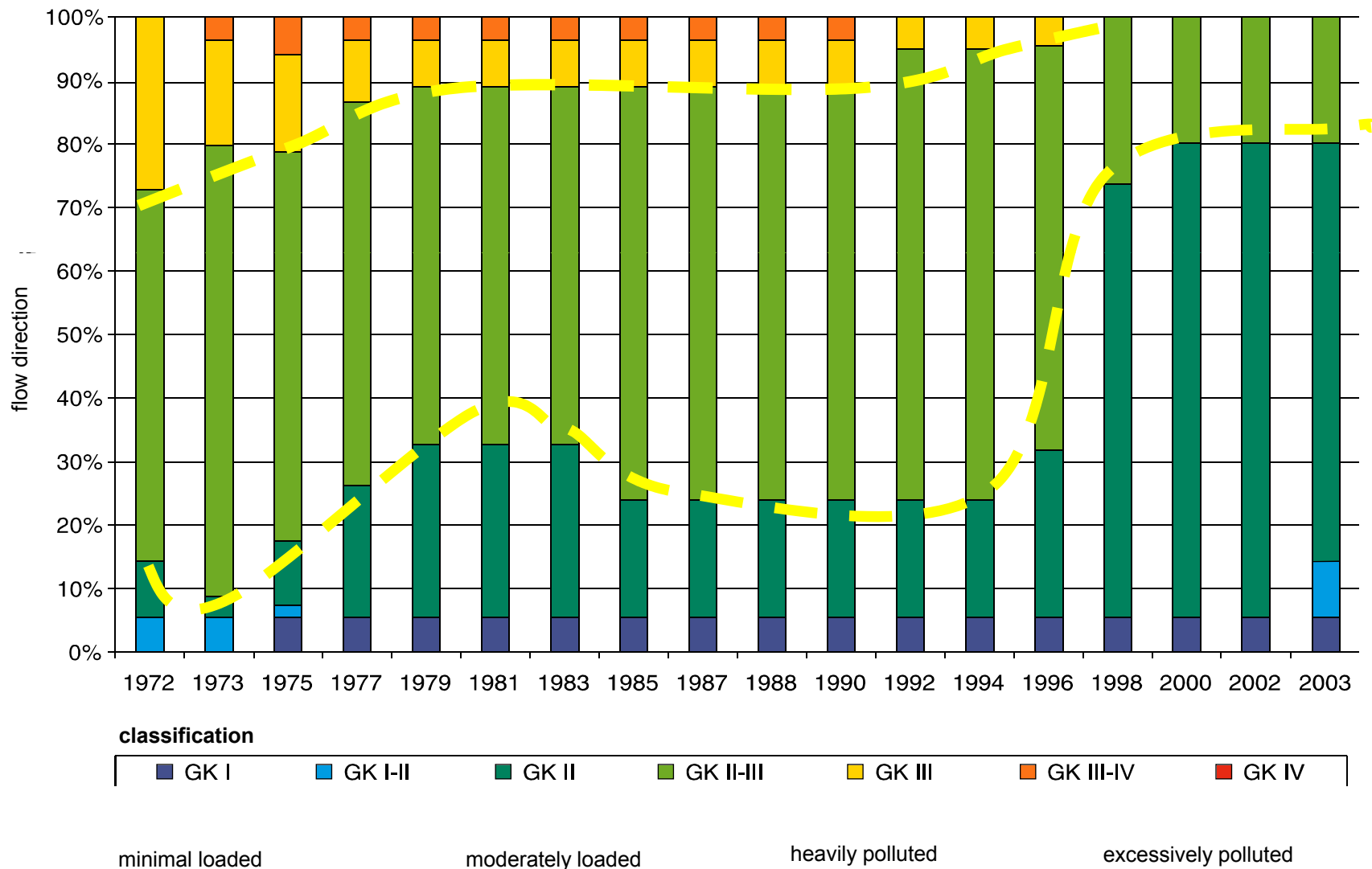




Trend #3

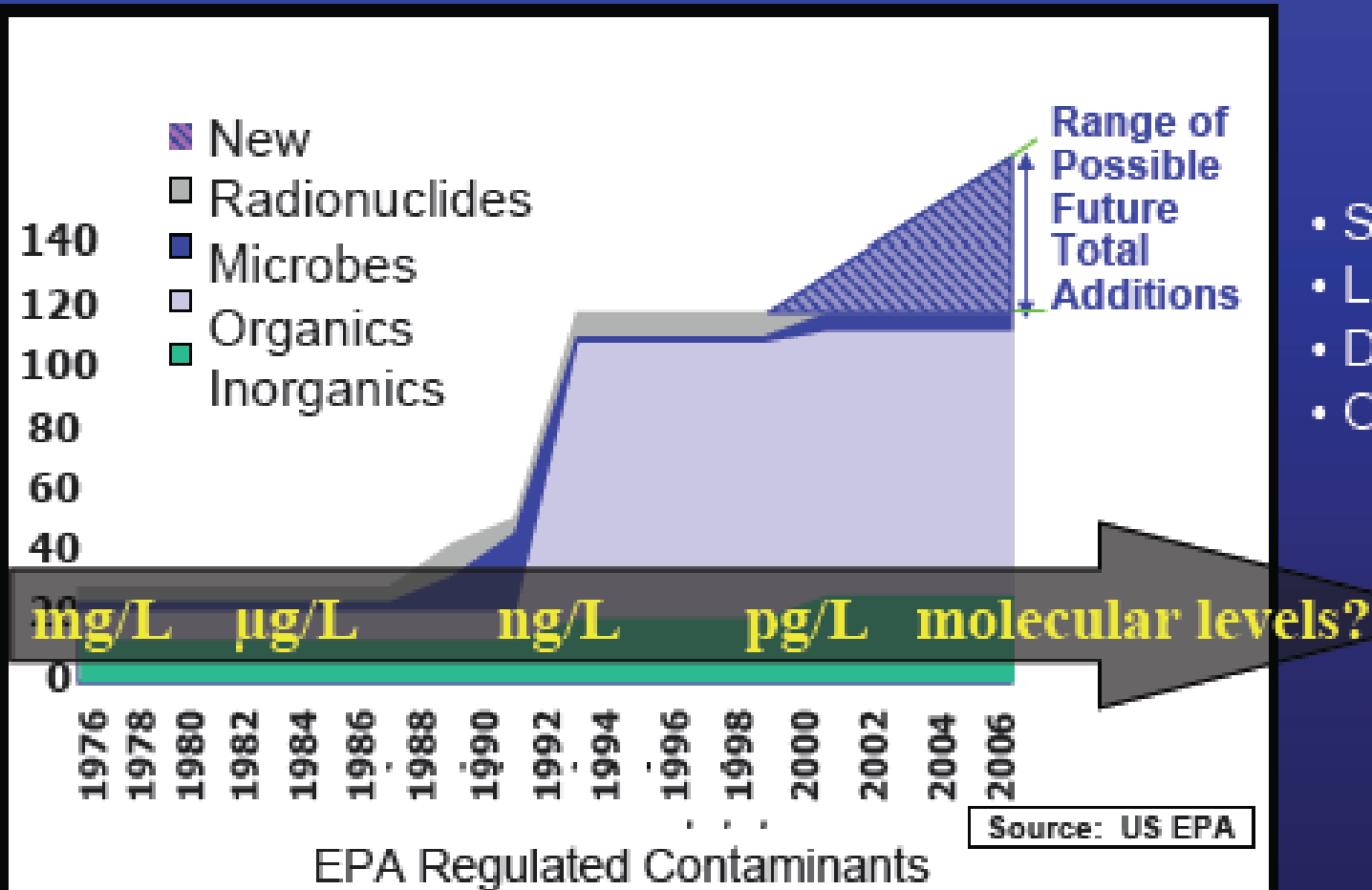
**In Developed Countries,
Trend is Towards Monotonic
Increases in Water Quality
and Environmental Standards**

Development of the Saprobic Quality of the Ruhr River 1972 throughout 2003





Technology: Drinking Water Regs



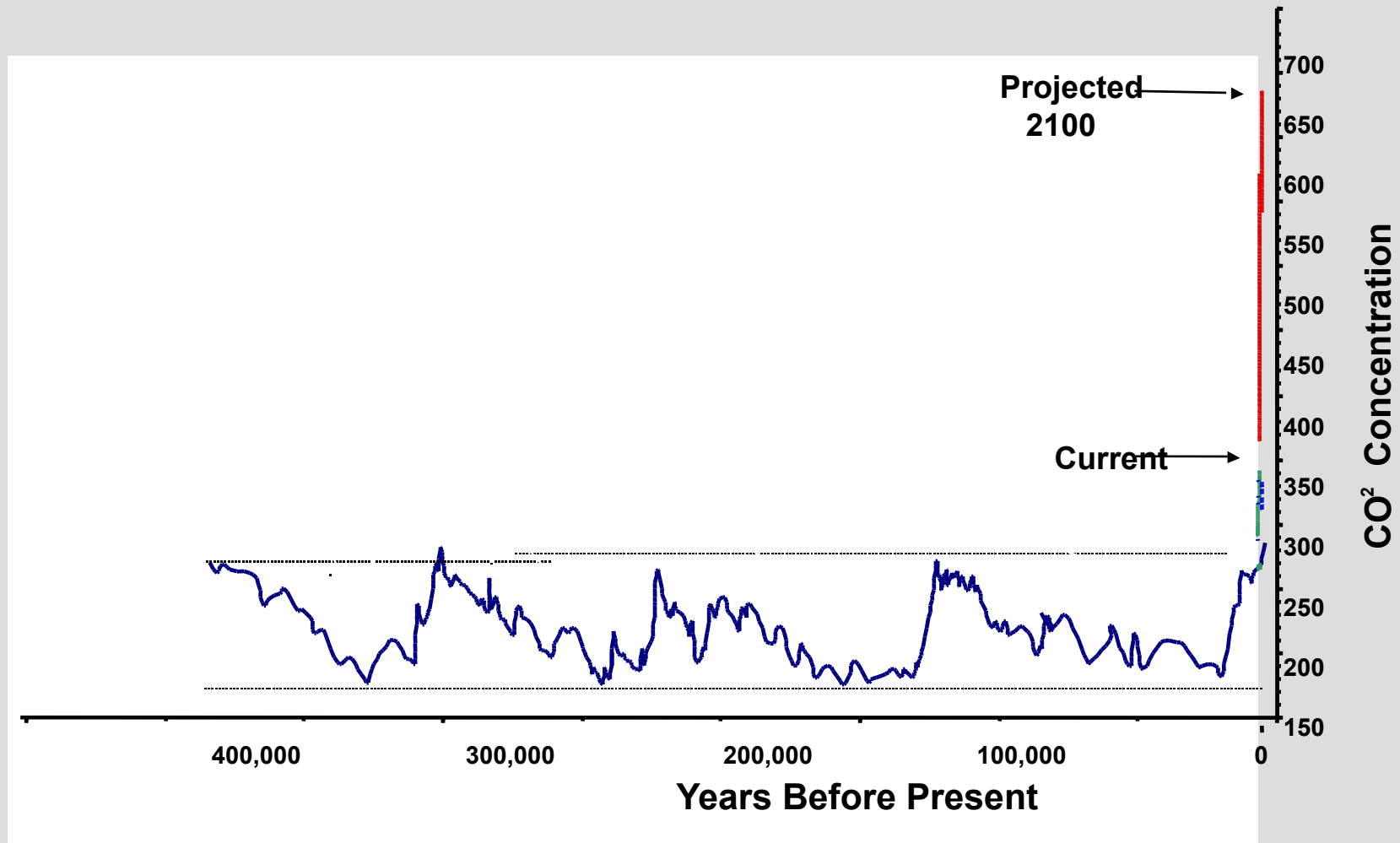
- Stage 2 DBPR
- LT2ESWTR
- Distribution Rule?
- On-line Monitoring



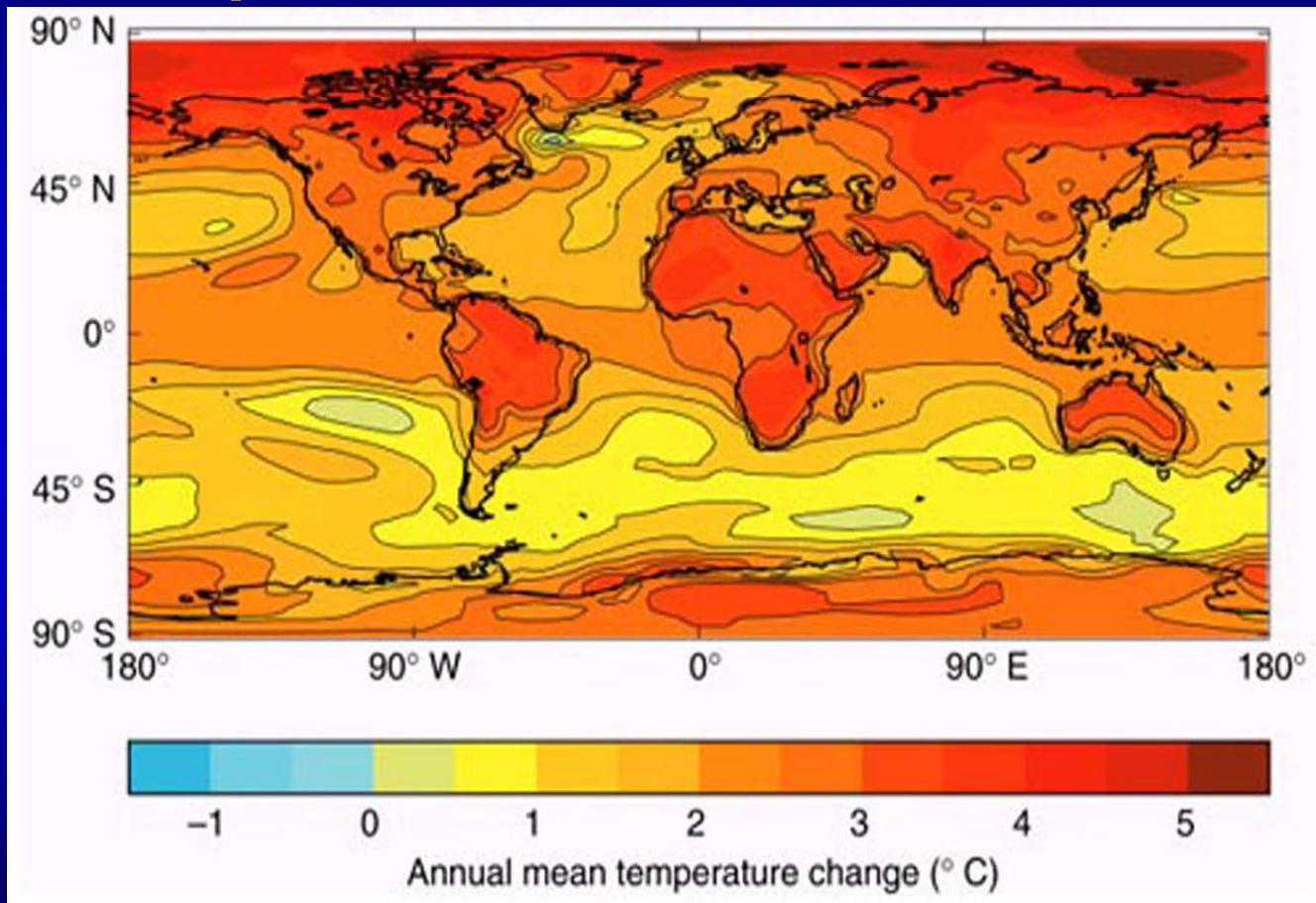
Trend #4

Dawning Recognition of the Impacts of Climate Change

Unprecedented CO₂ Change in History of Our Species



Projected Changes in Annual Temperatures for the 2050s

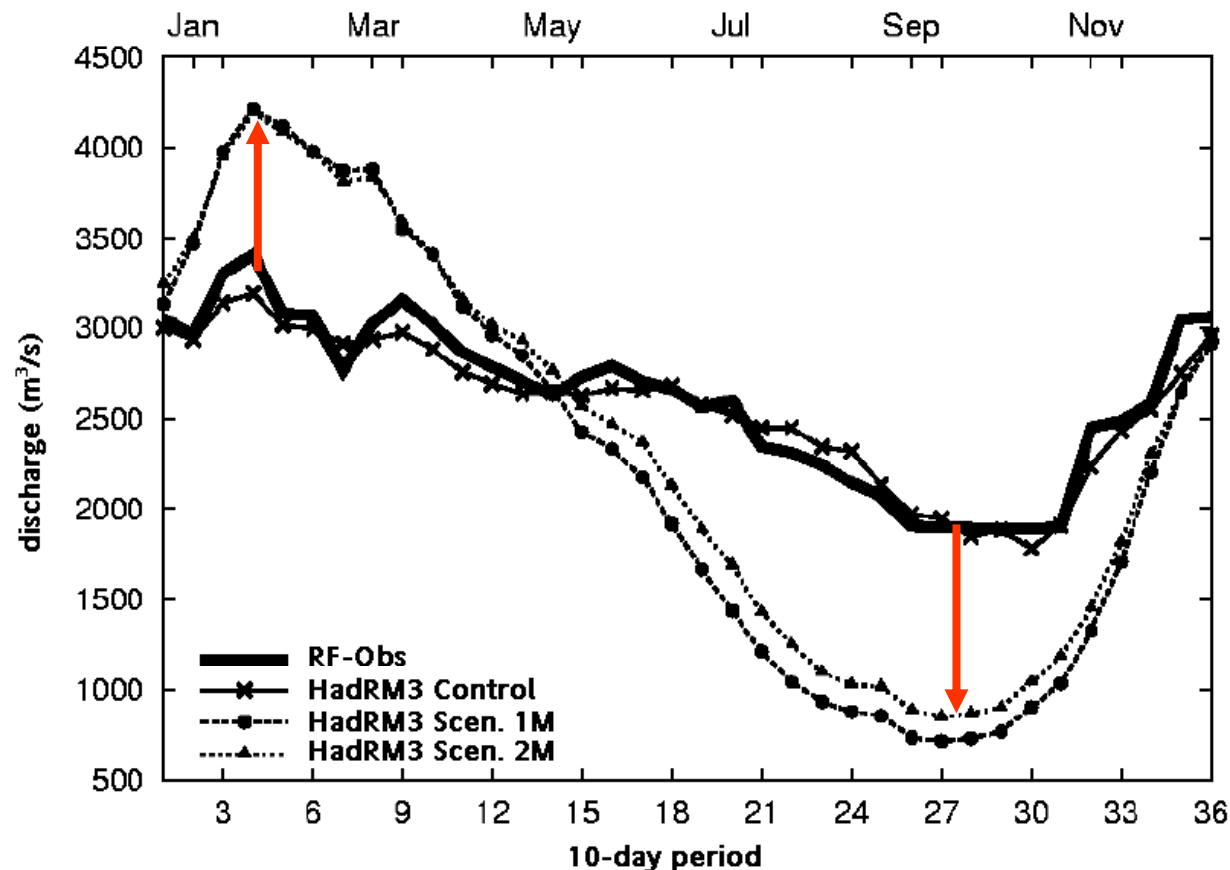


The projected change is compared to the present day with a $\sim 1\%$ increase per year in equivalent CO_2

Source: The Met Office. Hadley Center for Climate Prediction and Research



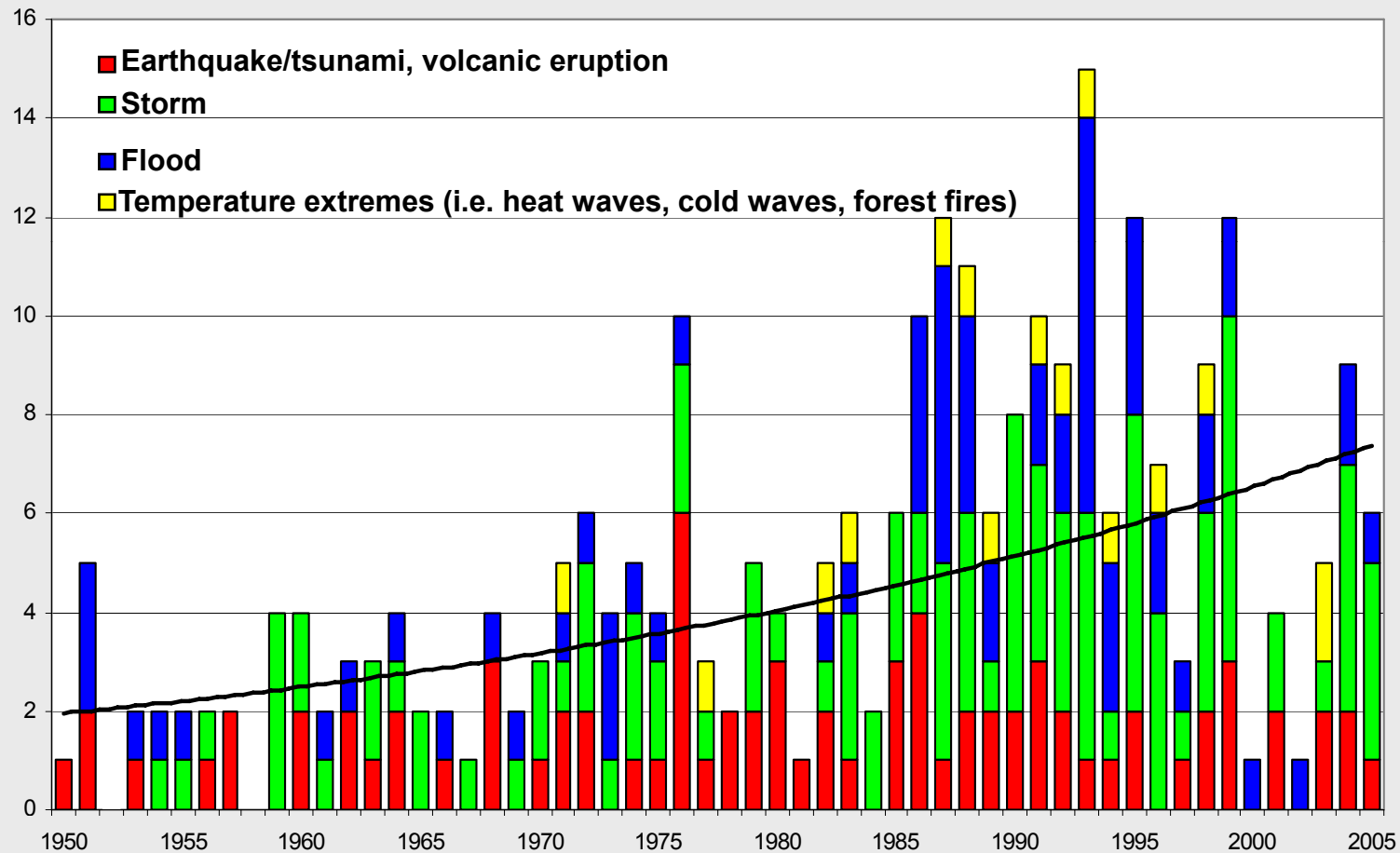
Possible impact of climate change on average discharge of the Rhine River (Lobith)



Buishand, T. A. and G. Lenderink (2004). *Estimation of future discharges of the river Rhine in the SWURVE project*, [KNMI](#), De Bilt, Technical Report TR -273.

Great Natural Disasters 1950–2005

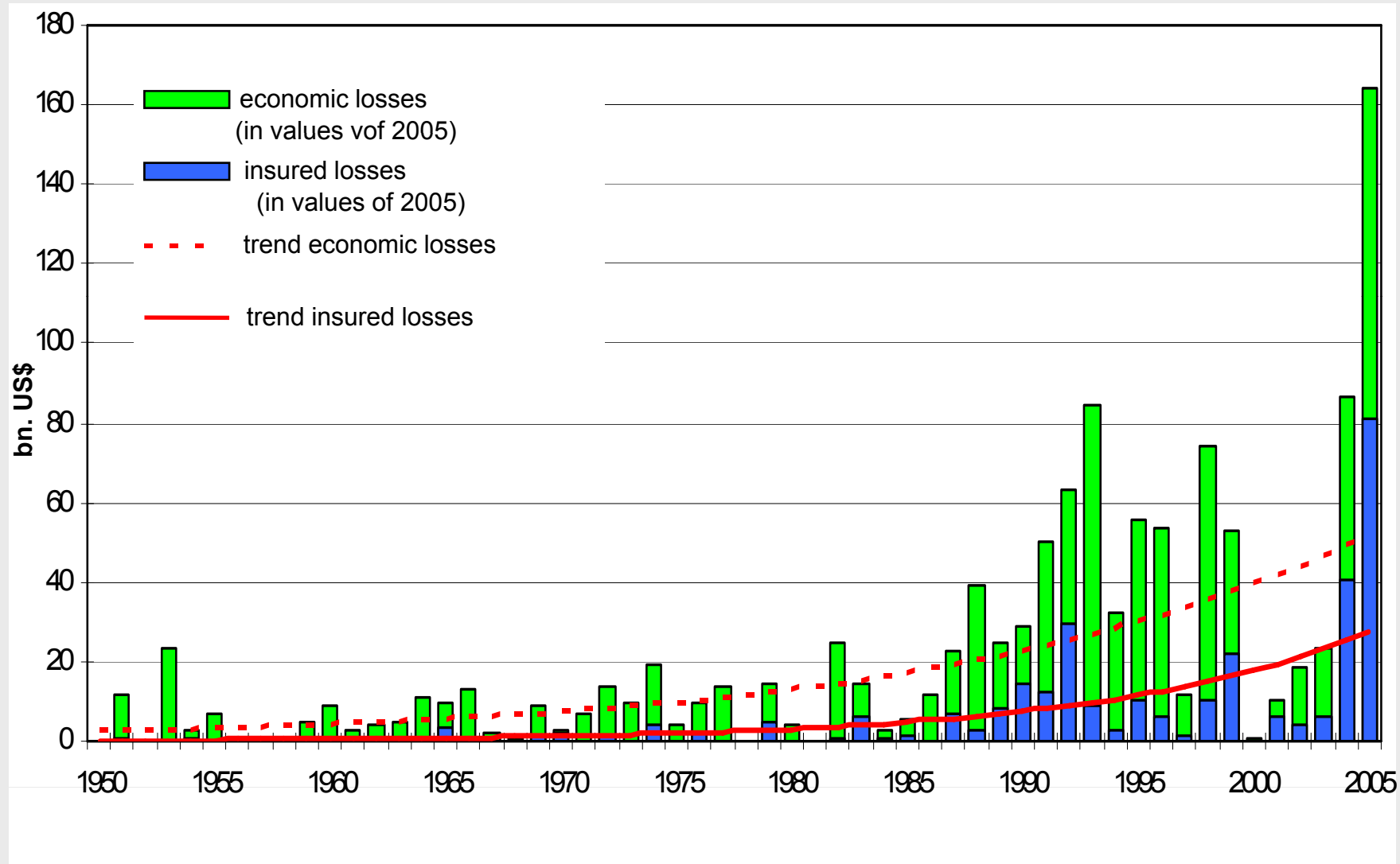
Number



© 2006 NatCatSERVICE, Geo Risks Research, Munich Re

Great Weather Catastrophes 1950 – 2005

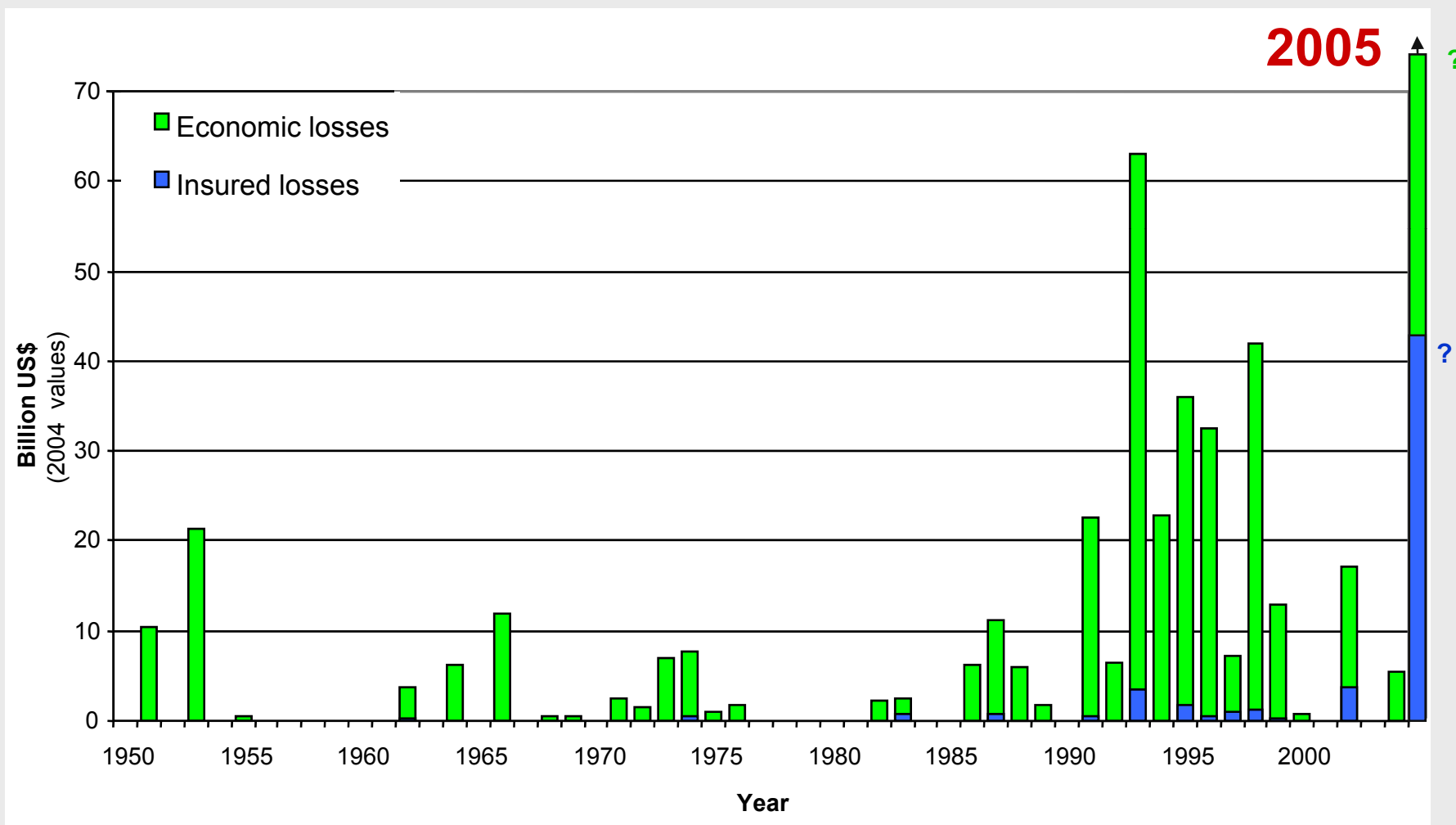
Economic and insured losses



© 2006 NatCatSERVICE, Geo Risks Research, Munich Re

Great Flood Catastrophes 1950 – 2004

Economic and insured losses

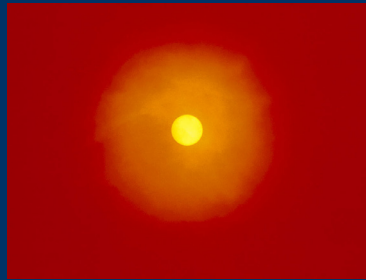




Case Studies

Convergence of Forces:

**Population, Urbanization, Growing
Regulatory Requirements and
Climate Change**



Is sustainable water resource management possible in Australia?

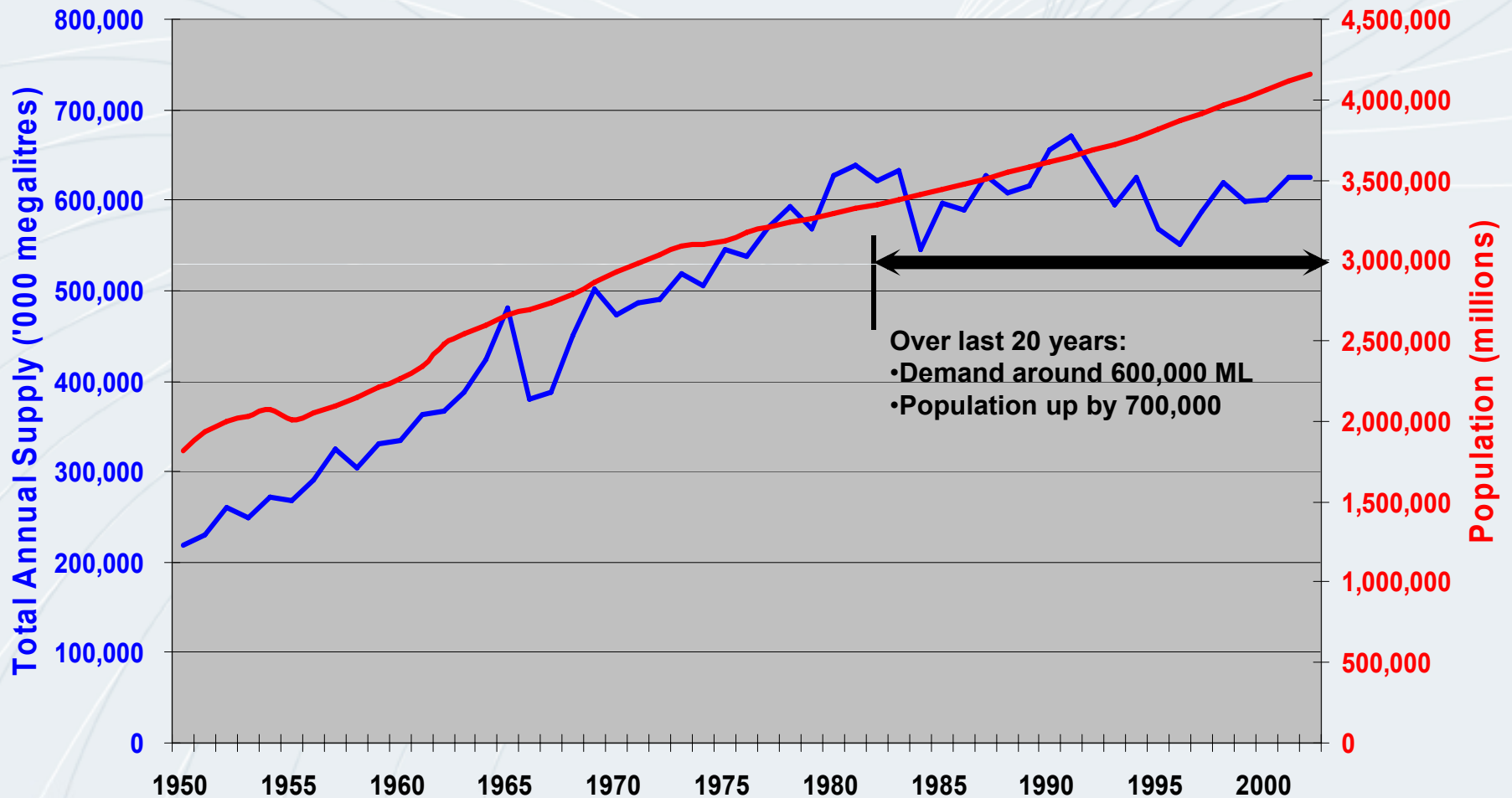
Rob Vertessy, CSIRO Land and Water



Keynote Address
Enviro06 Conference & Exhibition
Melbourne Exhibition Centre
9 May, 2006

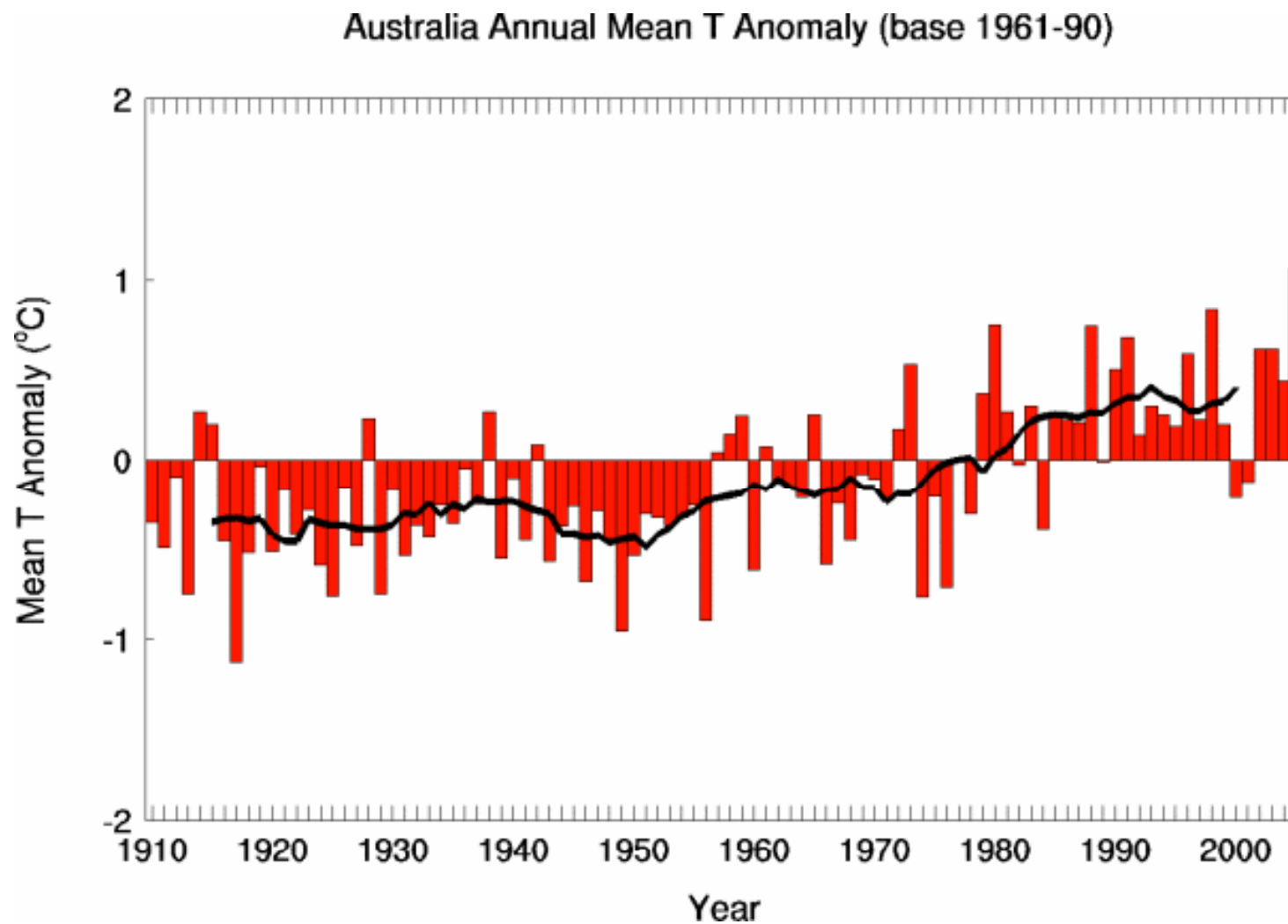
www.csiro.au

Sydney Water Corporation Total Demand - since 1950





Australian mean annual temperature is increasing



Source: BoM, SILO web site..



The Murray - we seek *more* water but are confronted with *less*

The Living Murray Initiative



Climate Change



Groundwater Extraction



Farm Dams



"First Step Decision" - 500 GL/yr



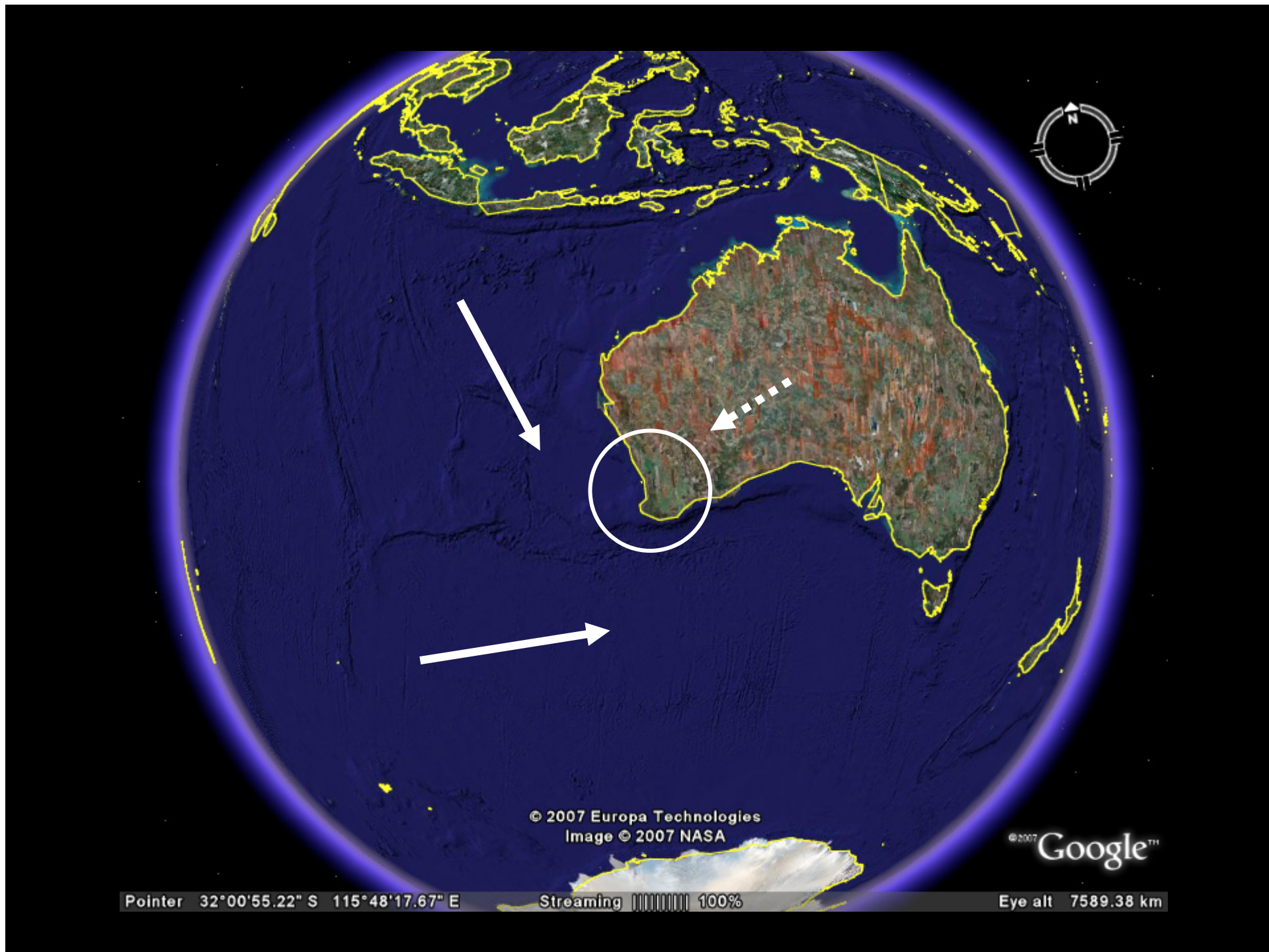
Irrigation Management



Plantations



Bushfire Recovery



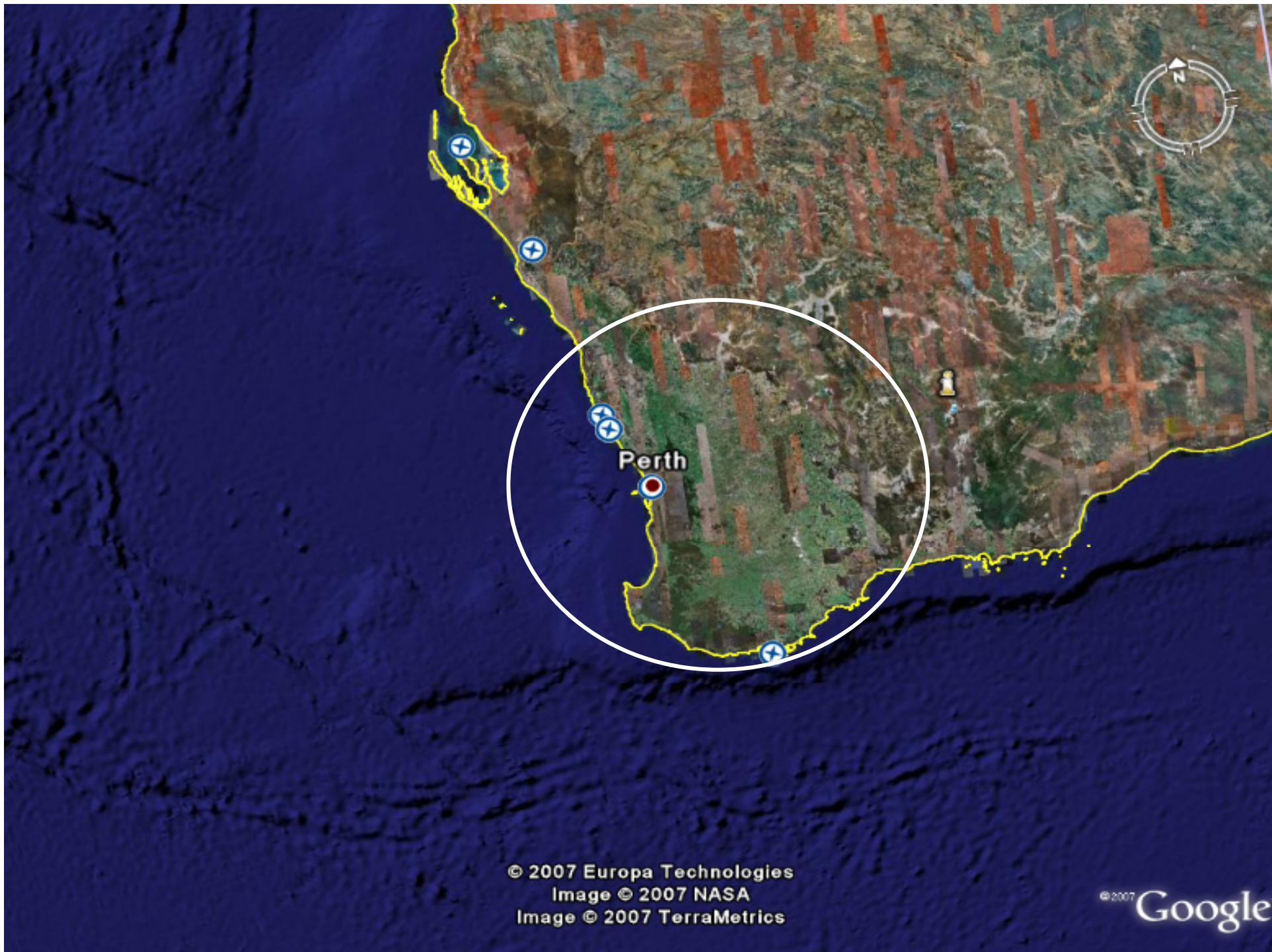
© 2007 Europa Technologies
Image © 2007 NASA

© 2007 Google™

Pointer 32°00'55.22" S 115°48'17.67" E

Streaming 100%

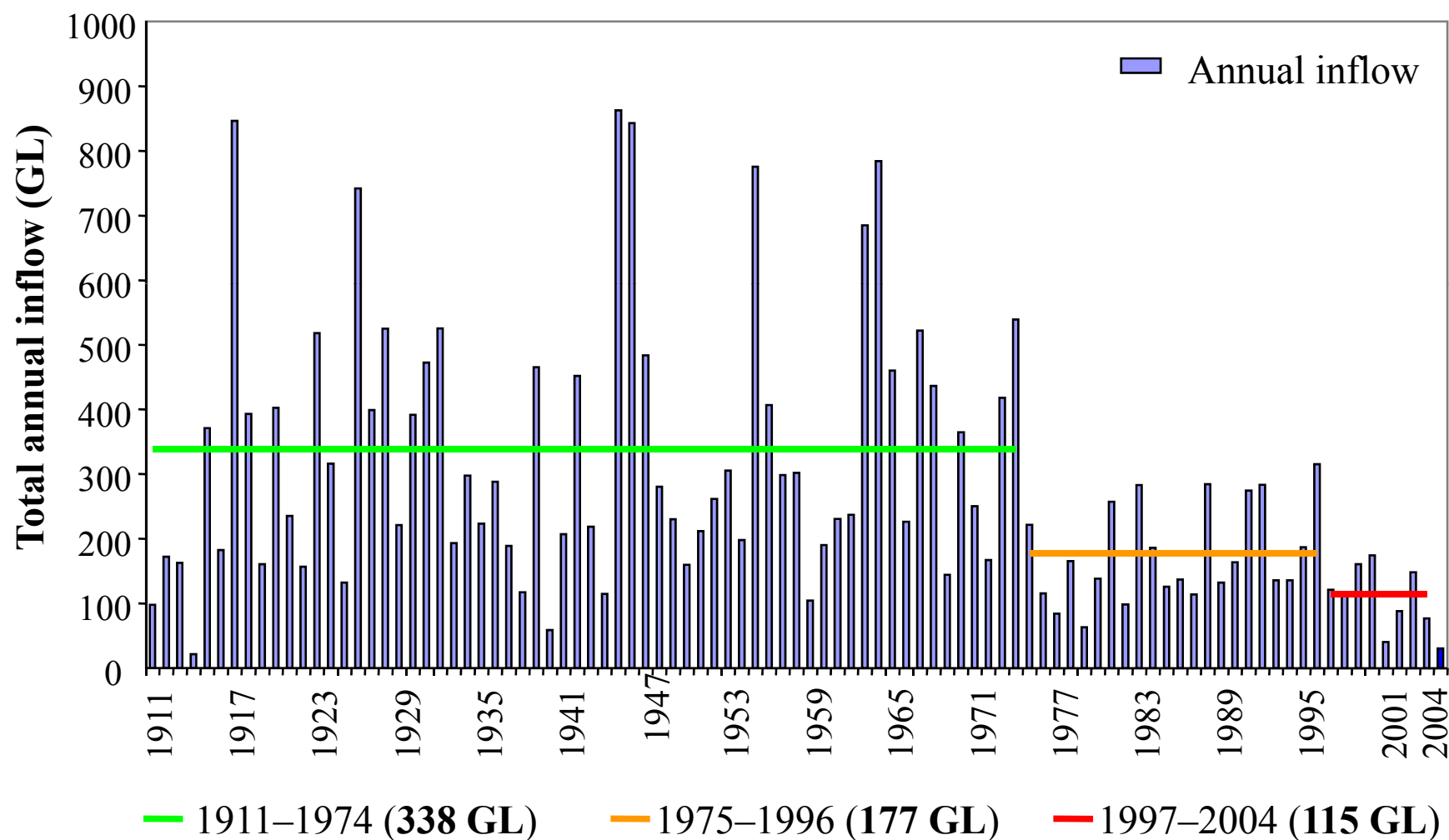
Eye alt 7589.38 km



© 2007 Europa Technologies
Image © 2007 NASA
Image © 2007 TerraMetrics

© 2007 Google

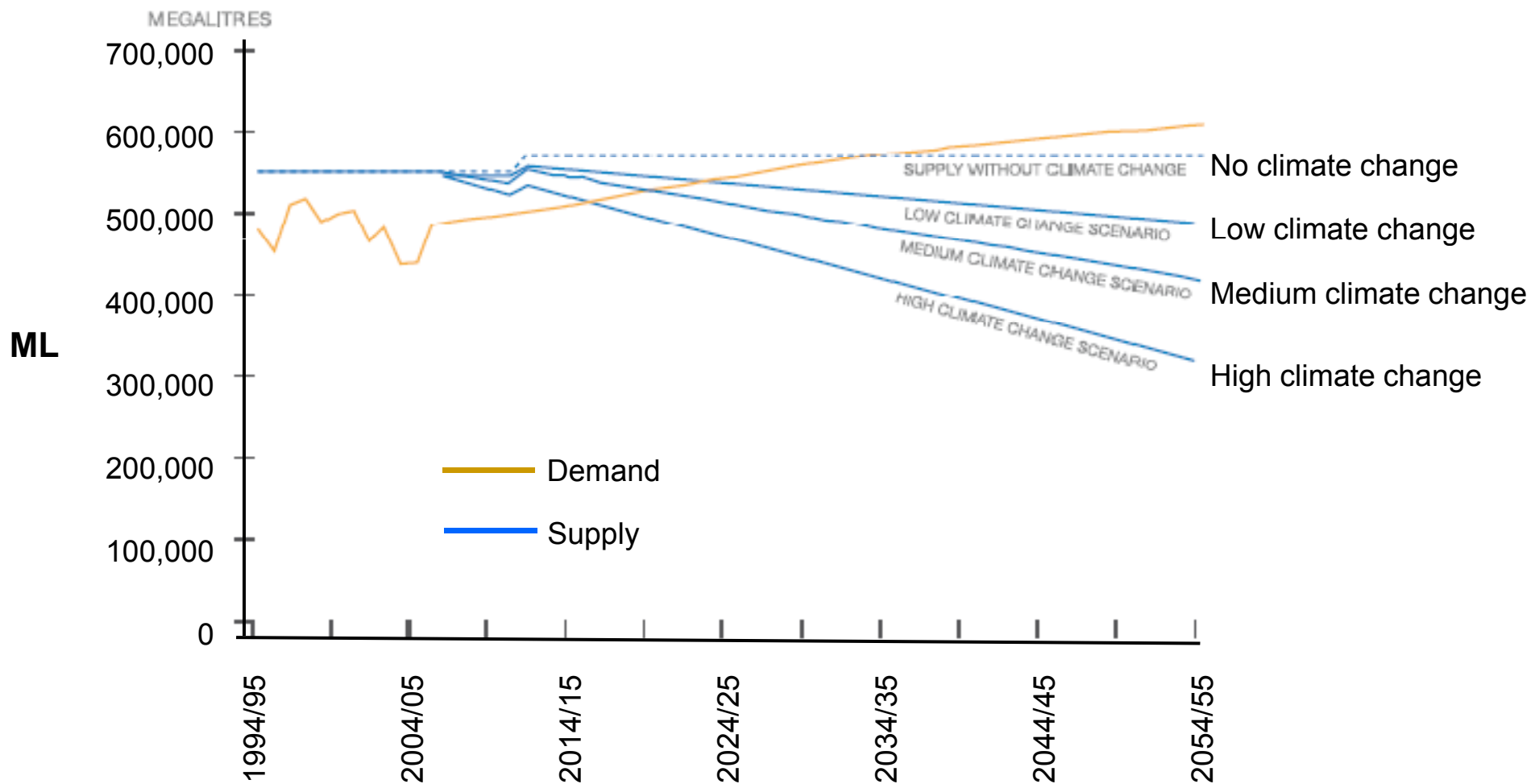
Annual inflows to Perth dams have declined markedly



Source: WA Water Corporation.



Projected water demand and availability for Melbourne



Source: http://www.melbournewater.com.au/content/library/news/whats_new/Climate_Change_Study.pdf



Projected urban water supply shortages by 2030

City	Projected Consumption 2030 GL/Y	Current <i>per Capita</i> Consumption (Unrestricted Usage) KL/Y		<i>Per Capita</i> Consumption required in 2030 with no increase in supply KL/Y	Reduction in <i>per capita</i> consumption %
Brisbane	255	210		103	51%
Gold Coast	99	147		78	47%
Melbourne	659	159		93	41%
Perth	313	171		102	41%
Sydney	884	174		80	54%

(1GL = 1billion litres)

- These major cities must reduce *per capita* water consumption by at least 40% in the next 25 years unless they augment their water supply
- Total water supply shortfall by 2030 is ~800 GL/y

J.J.G. Zwolsman, September 25, 2006



Impacts of climate change on the water quality and drinking water function of the Rhine River

Kiwa Water Research, Nieuwegein, NL



Impacts of climate change on the hydrological cycle (1): Retreat of glaciers in the Alps

- Aletsch glacier (Switzerland), 1850 (left) and 2000 (right)





Impacts of climate change on the hydrological cycle (2): Increase of river floods and summer droughts



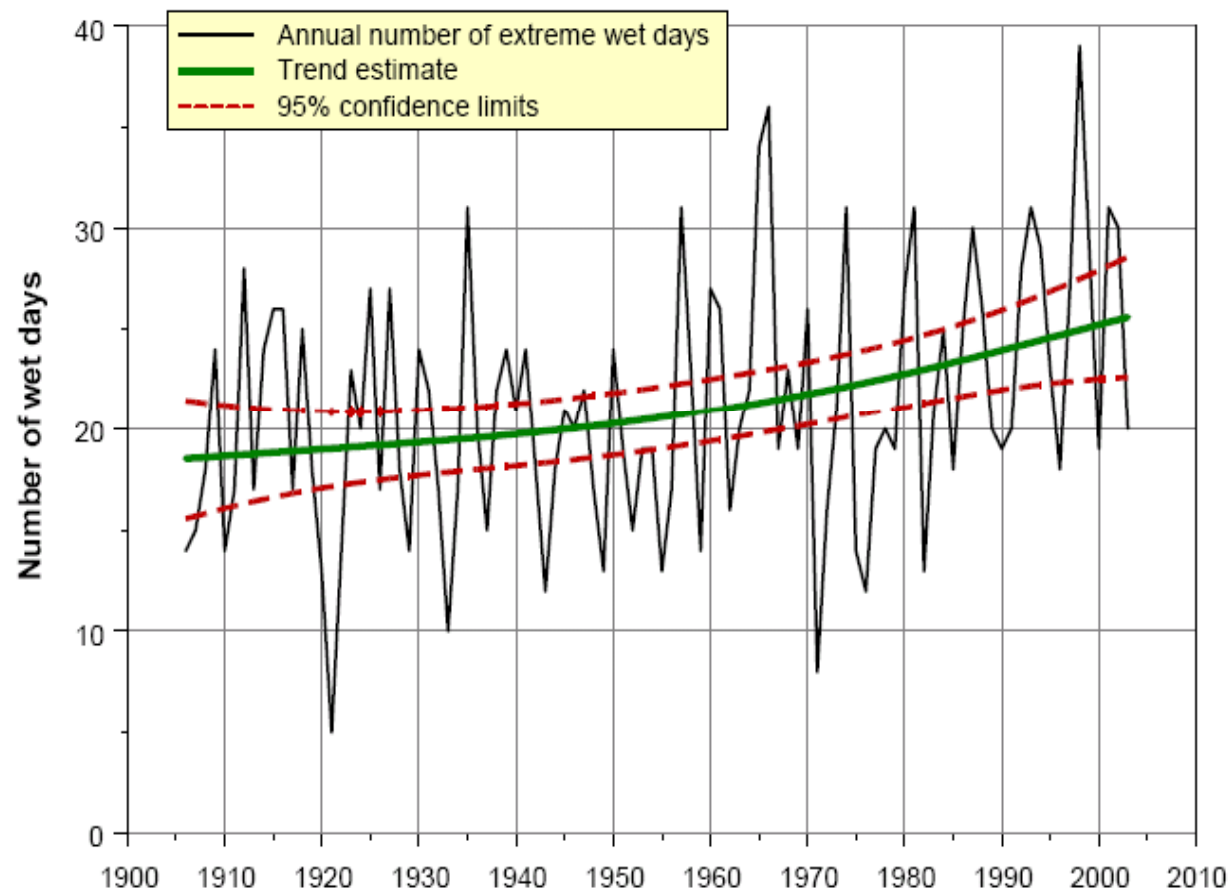
■ Meuse river, December 1993



■ Rhine river (secondary channel in floodplain),
August 2003



Impacts of climate change on the hydrological cycle (3): Increase of extreme precipitation events

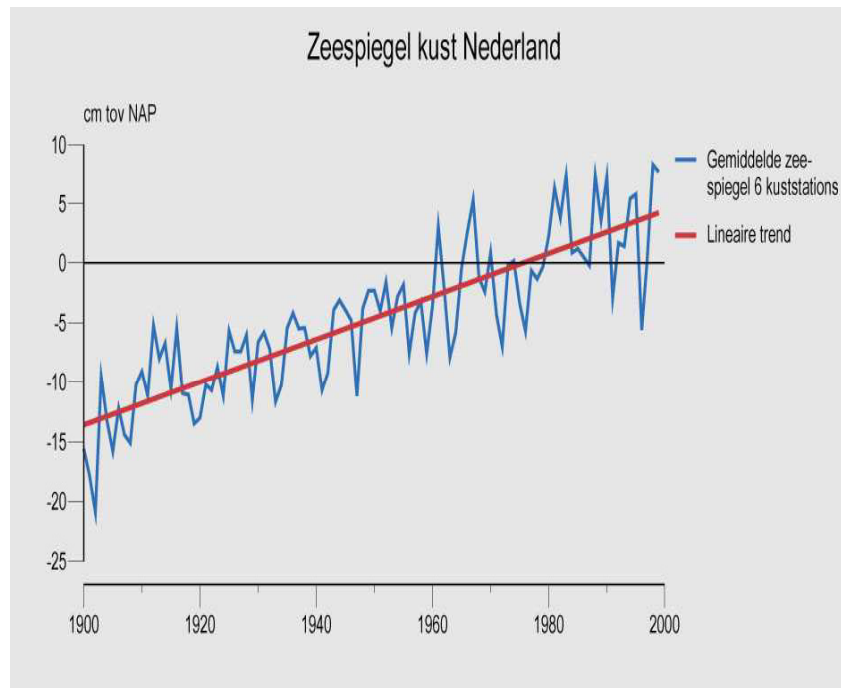




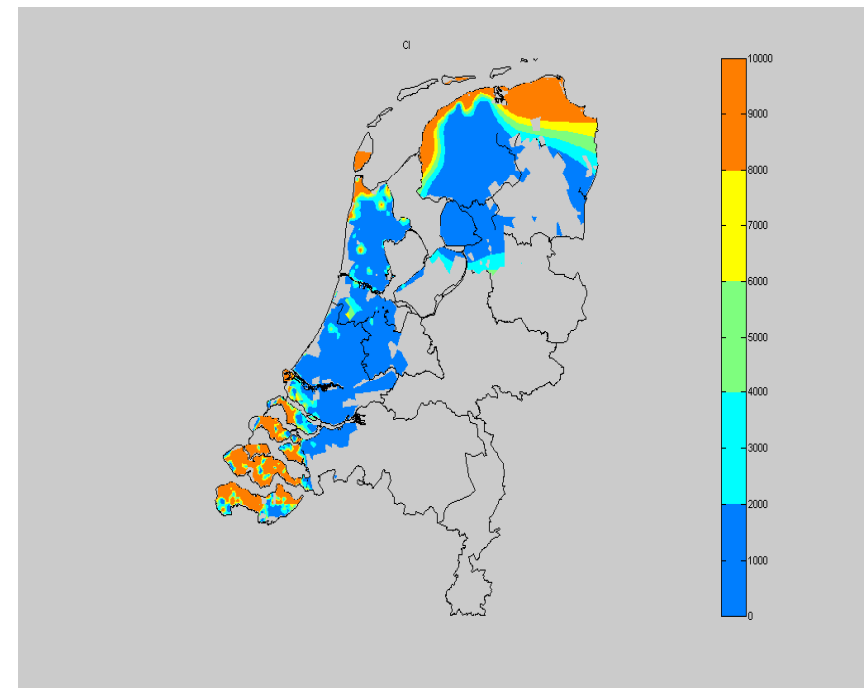
Impacts of climate change on the hydrological cycle

(4): Sea level rise and upconing of brackish groundwater

Sea level rise (1900-2000): 20 cm

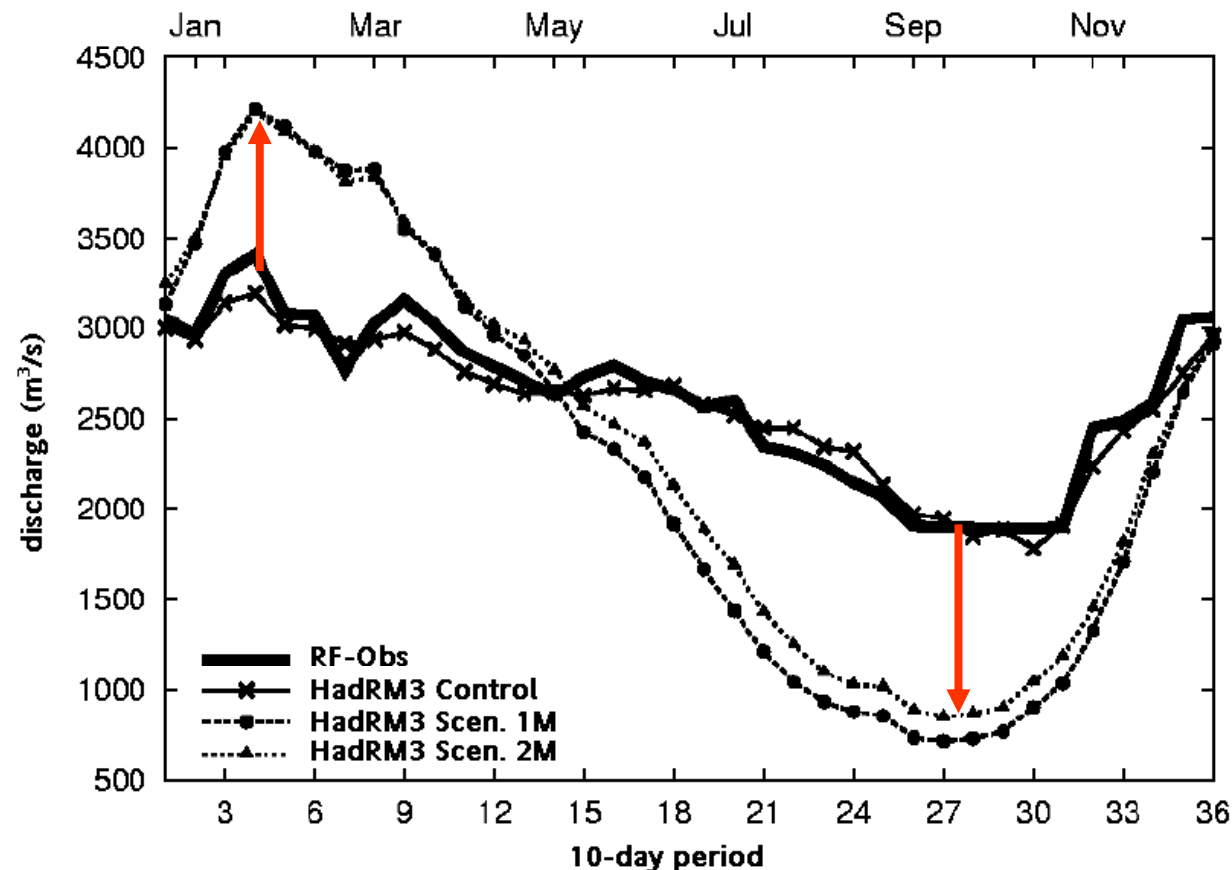


Chloride in groundwater (0-10 m)





Possible impact of climate change on average discharge of the Rhine River (Lobith)



Buishand, T. A. and G. Lenderink (2004). *Estimation of future discharges of the river Rhine in the SWURVE project*, [KNMI](#), De Bilt, Technical Report TR -273.



Summary of climate change impacts on river water quality

■ Droughts

- Temperature close to raw water standard (25 °C)
- Chloride > drinking water standard (150 mg/l)
- Increased concentration of chemicals released by point sources (e.g. heavy metals, pharmaceuticals)
- Enhanced intrusion of sea water in the delta: salinization

■ Floods

- Resuspension of polluted sediments (mud waves)
- Sewer overflows (heavy metals, nutrients, pathogens)
- Industrial calamities (oil spills, release of stored chemicals, etc.)

■ Rainstorms

- Sewer overflows (heavy metals, nutrients, pathogens)
- First-flush events, e.g. pesticides and nutrients (agriculture)



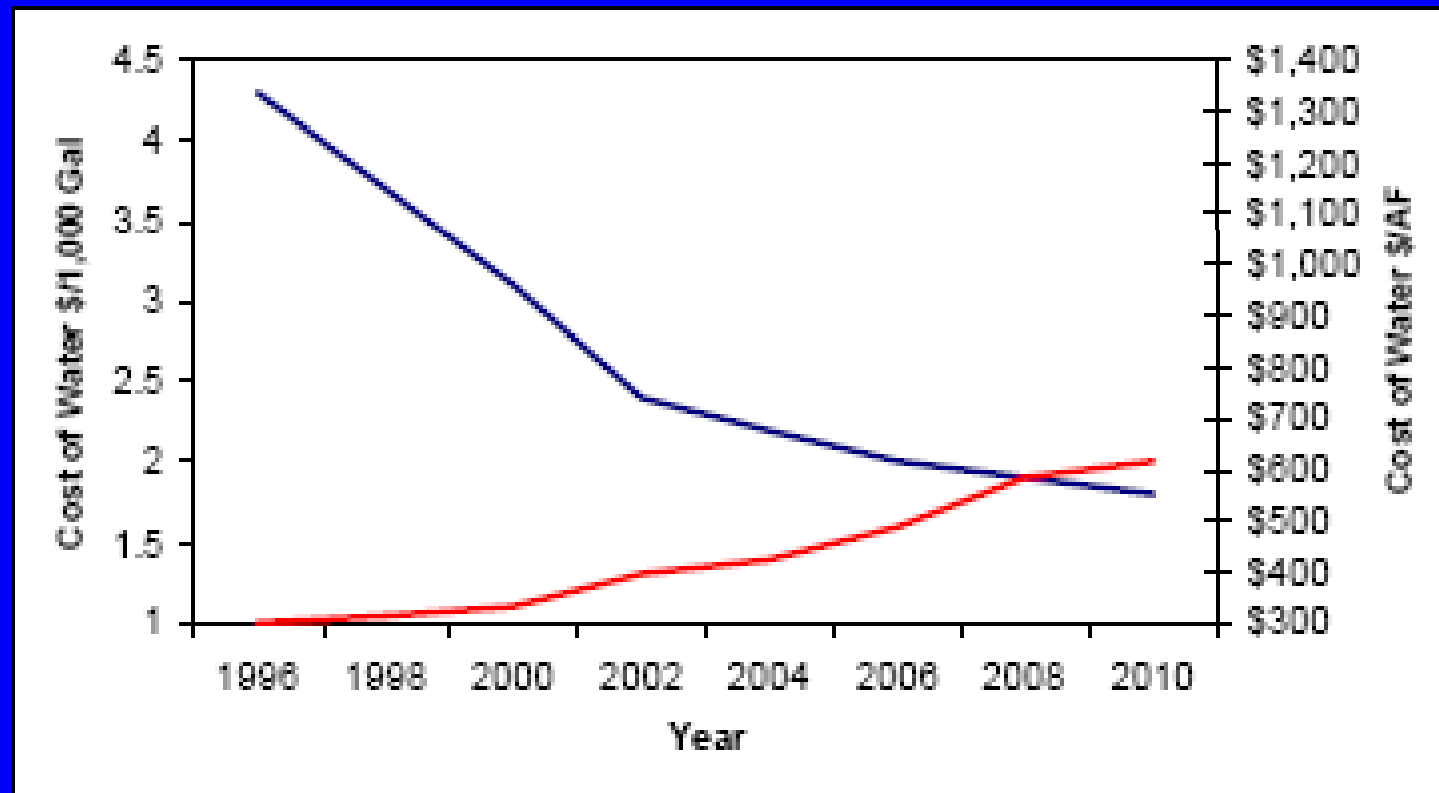
Trend #5

**A Major Rethink in Urban Water
Management is Underway...**

**Driven by both Challenges
and Opportunities**



Membrane Desalination Becoming the Technology of Choice



For more Info see:

<http://www.brazos.org>



Innovation in Water Production and Use: Doing More with Less

Efficiencies in Supply and Demand



More water for people and the environment



Major Changes In The Ways We:

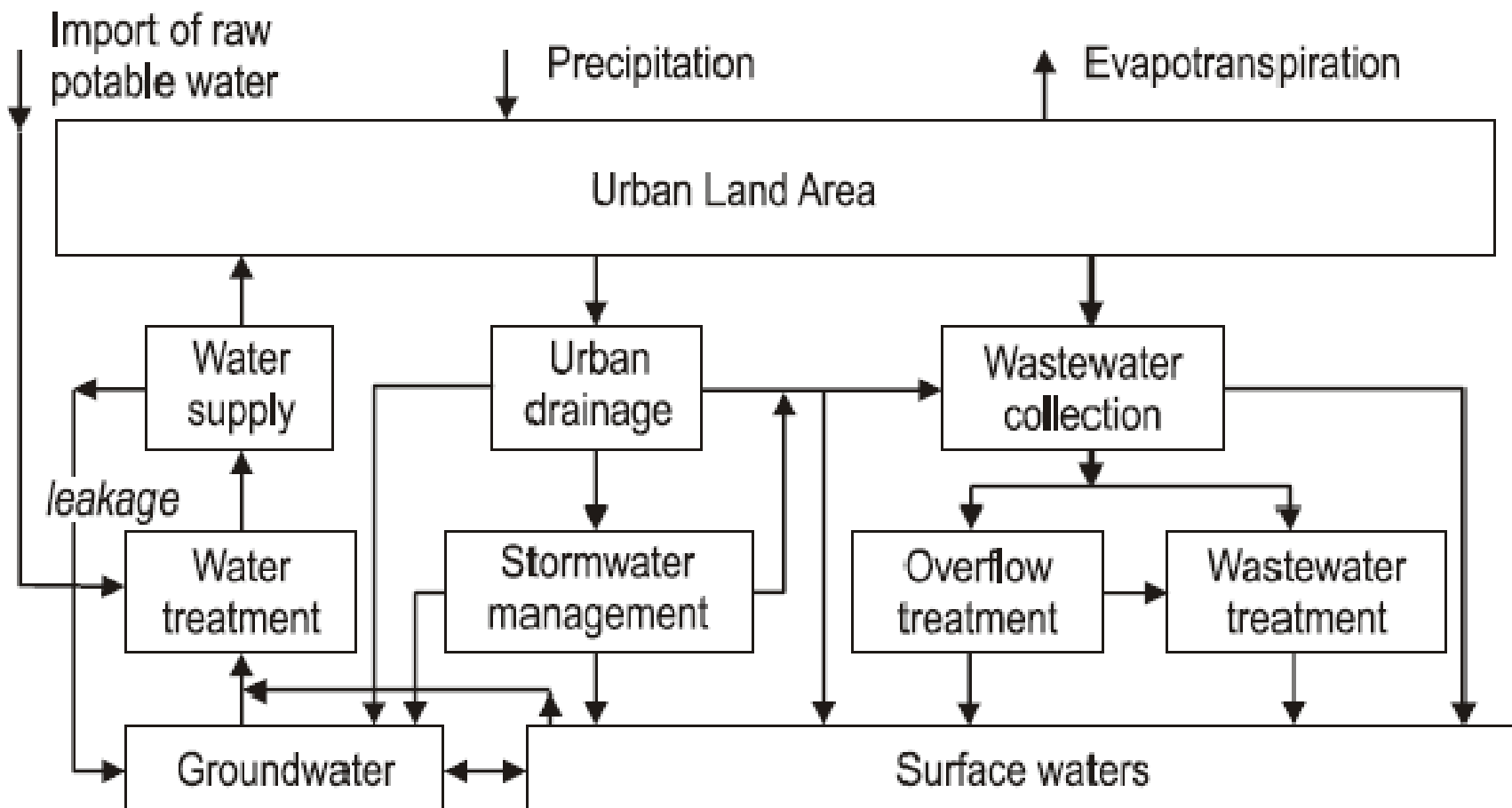
- Think about our mission
- Structure utilities
- Plan and invest
- Relate to the larger urban area, industry and agriculture



Major Changes In The Ways We:

- Think about our mission
- Structure utilities
- Plan and invest
- Relate to the larger urban area, industry and agriculture

Addressing a Disintegrated Approach to Urban Water Mgt



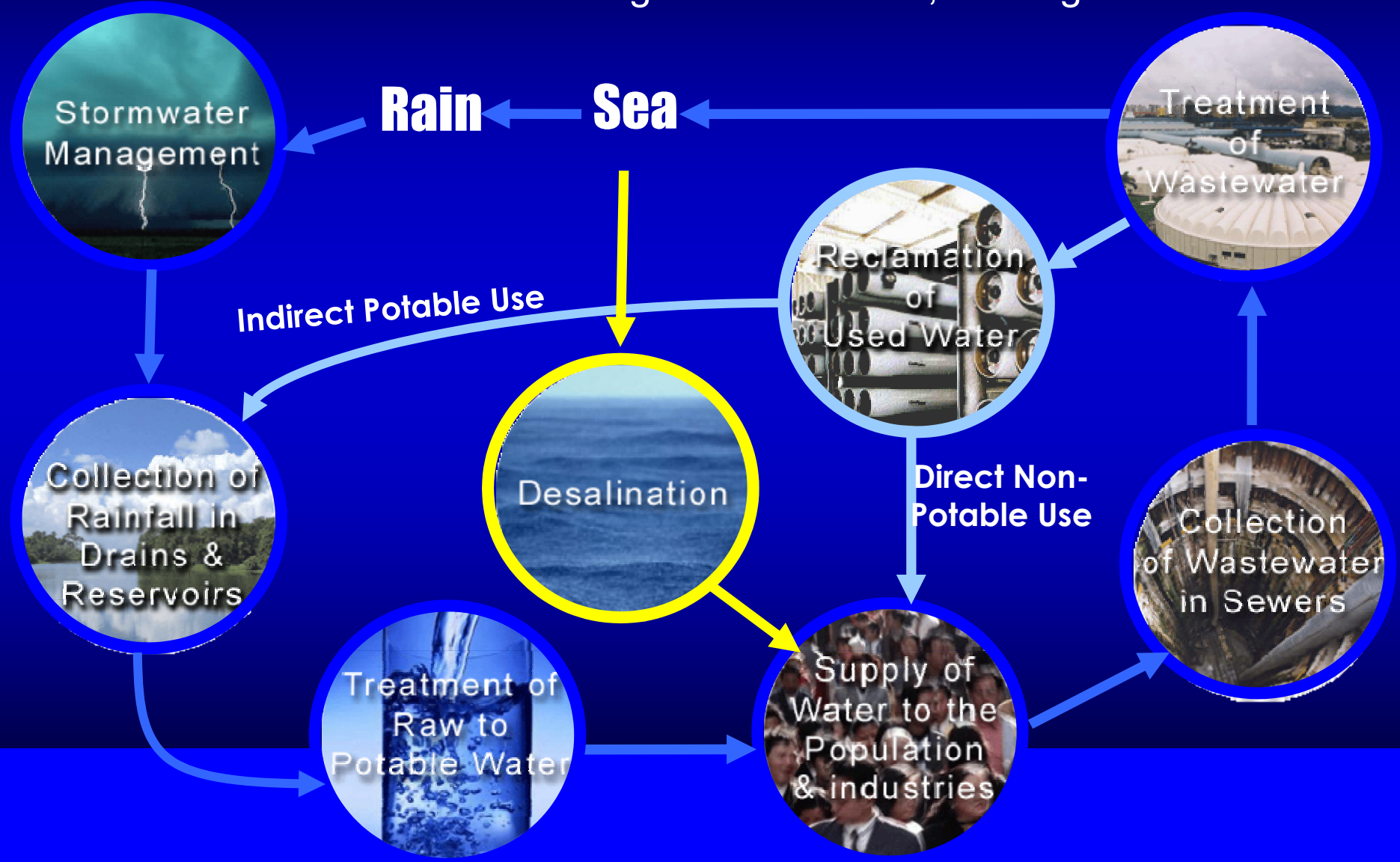
FOUR NATIONAL TAPS



a global **network** for water professionals

PUB manages the complete water cycle

From sourcing, collection, purification and supply of drinking water, to treatment of used water and turning it into NEWater, drainage of storm water

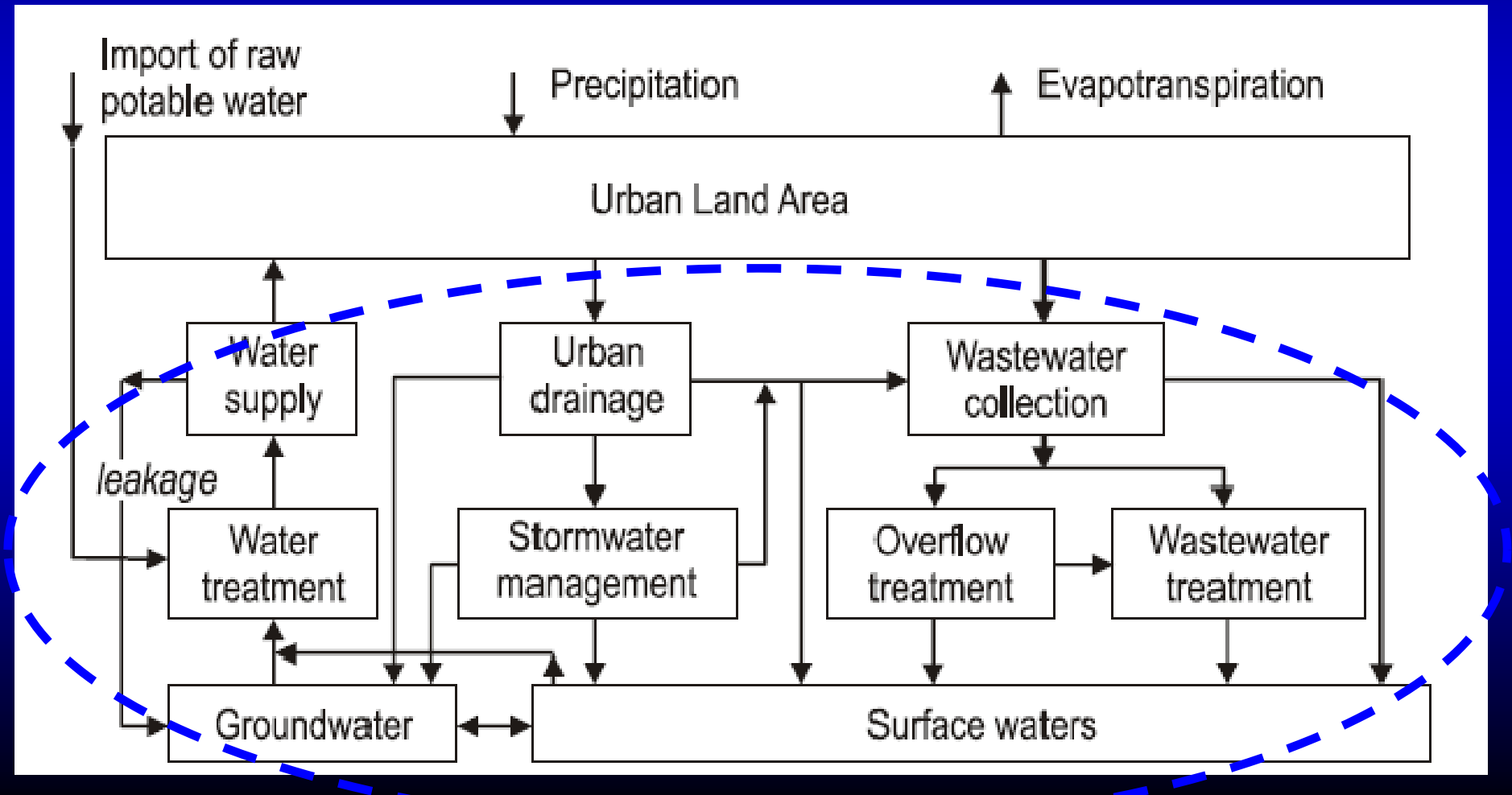




Major Changes In The Ways We:

- Think about our mission
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Addressing a Disintegrated Approach to Urban Water Mgt



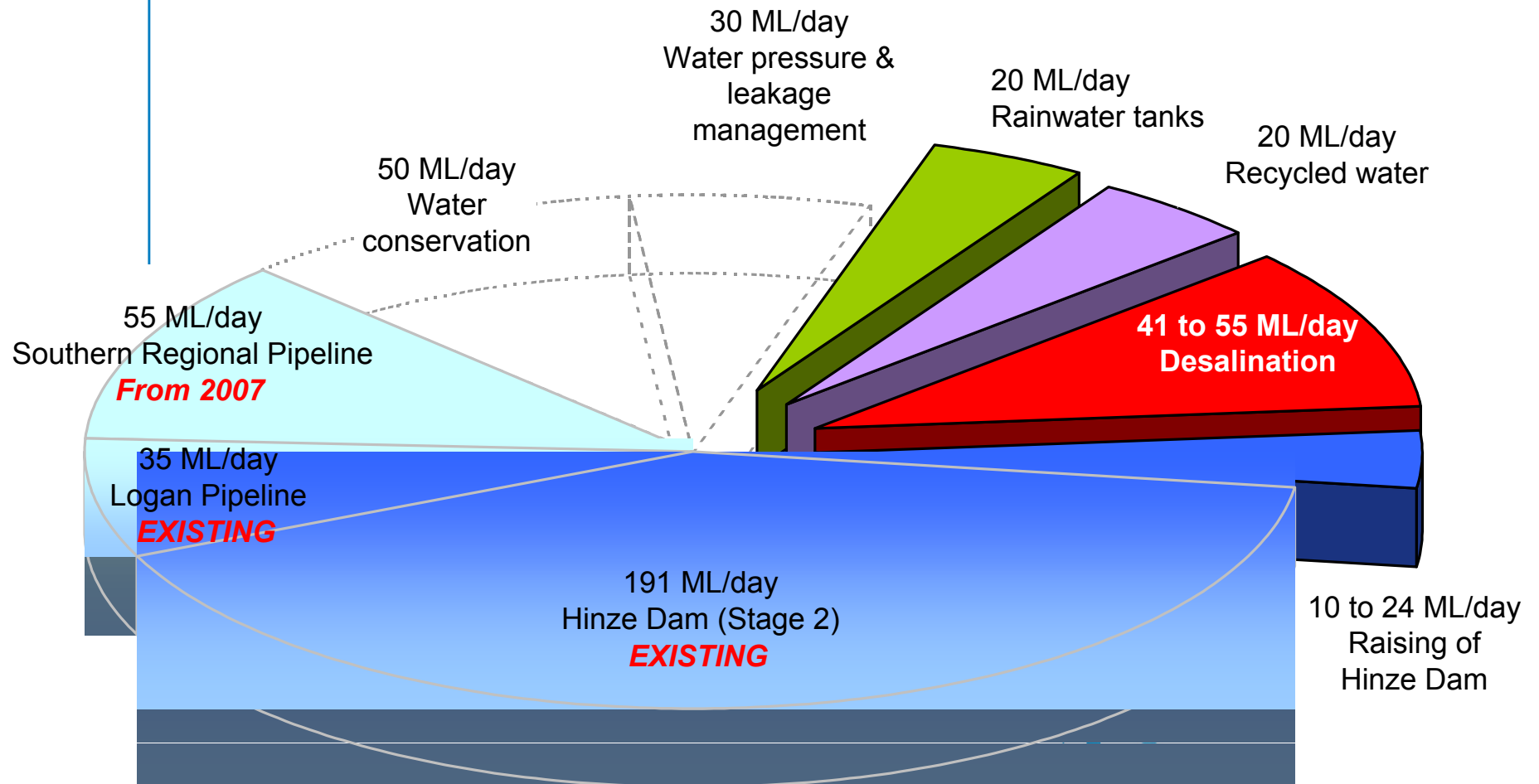


Major Changes In The Ways We:

- Think about our mission
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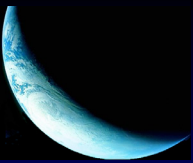
The Preferred GCWF Strategy





"Security Through Diversity"

a global **network** for water professionals

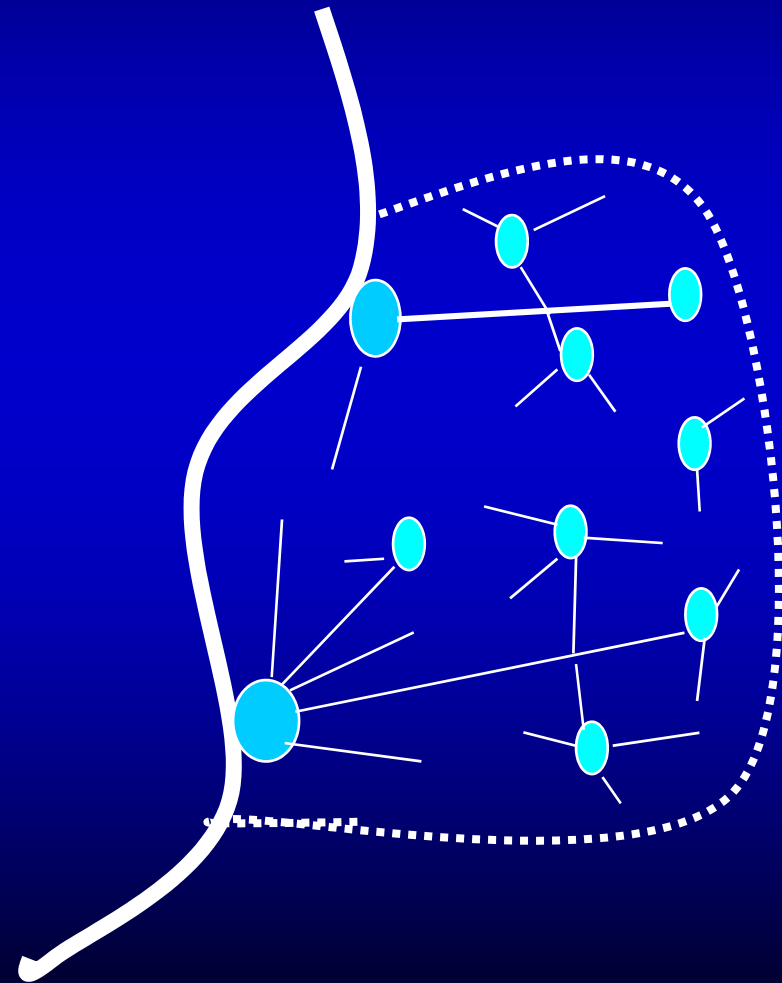
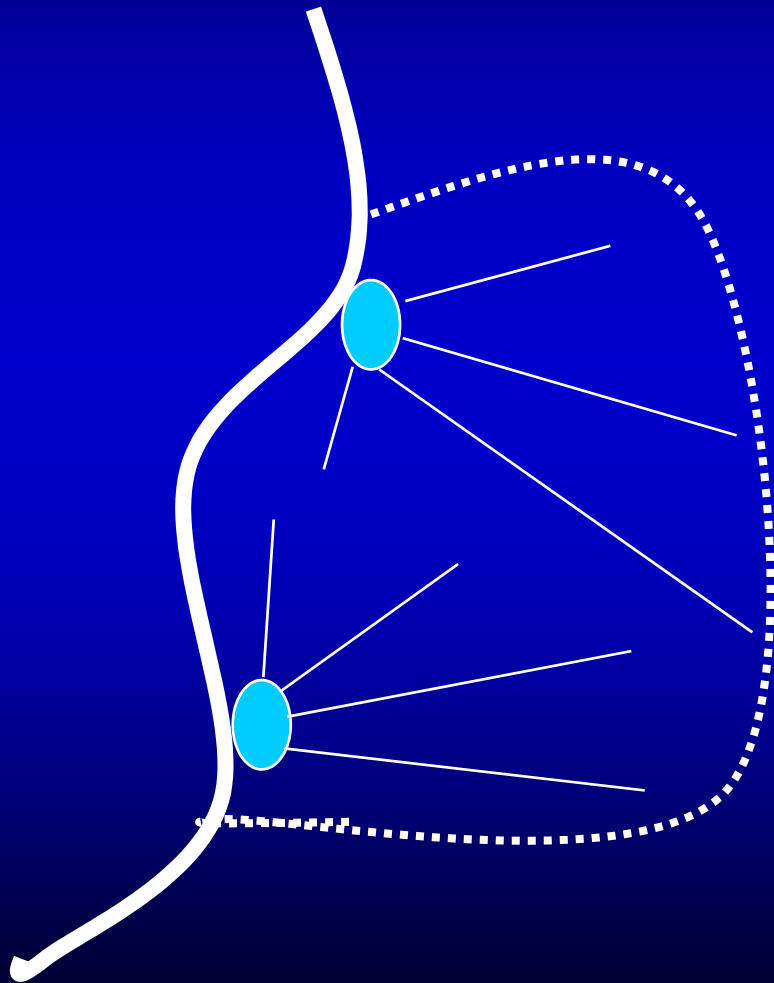


Major Changes In The Ways We:

- Think about our mission
- Structure utilities
- Plan and invest
- Relate to the larger urban area, industry and agriculture



Centralized vs. Nodal System



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Shinjuku Area

Ochiai Sewage Treatment Plant



Administered by UNDOF

Golan Heights

(Tel Aviv)

(Rabbah)

Amman

West Bank

(Jerusalem)

Gaza Strip

Israel

Jordan

© 2007 Europa Technologies
Image © 2007 TerraMetrics

Google™

Pointer 31°50'38.04" N 34°56'15.13" E elev 369 m Streaming 100%

Eye alt 398.70 km

Main Points

- Water needs are significantly outstripping supplies → population & economic growth, climate change, environmental recognition
- Increasingly infeasible to turn to large new transfer projects to resolve the problem
- Consequence – we must do significantly more with significantly less – reuse is key here
- Convergence of technical approaches underway enabled by membrane technologies
- Harmonization of approaches will require a very different approach to planning and development
- Taken together, moving to an era of produced water. This change provides opp's and threats.



Trend #6

Bio and Nanotechnologies – A Revolution on Our Doorstep?

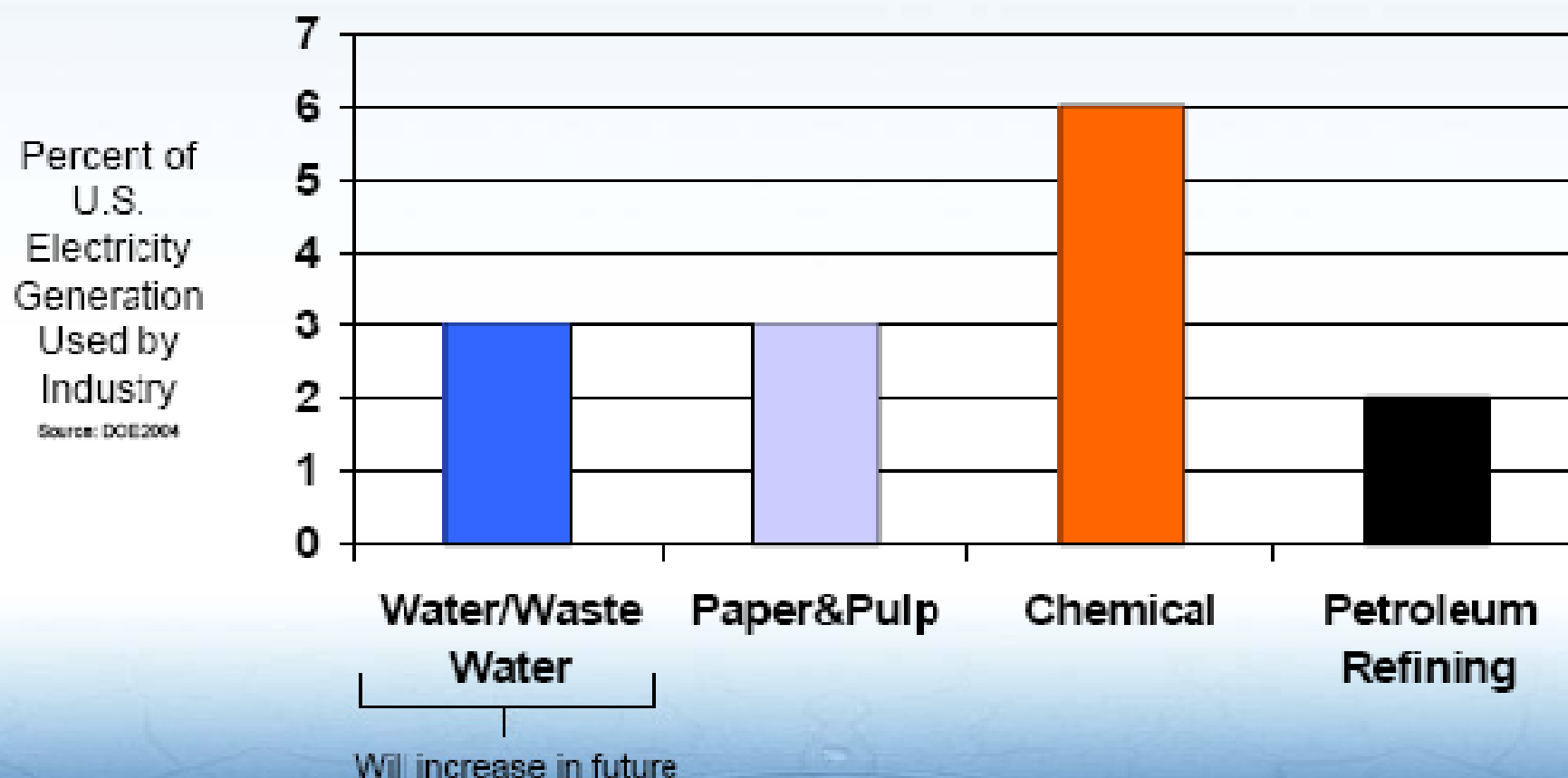


Trend #7

Water and Energy: Joined at the Hip, Walking Down a New Path

Energy for Water

Currently the Water/Wastewater Sector is a Major User of Electricity





Trend #8

In the Meantime...

Continuing Utility Reform: Structure, Governance , PSP and Regulation



Trend #9

Renewed Attention to Asset Management: Planning, Financing and Implementation



Trend #10

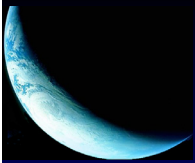
Declining Labor Forces Throughout the Developed World



Trend #11

In Developing Countries

**Big Goals for Water and
Sanitation That Lack A Viable
Paradigm for Scaling Up**



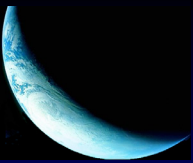
Thoughts for NACWA Members

- Challenge to the world → do more with less
- After conservation, the preferred source of new water is and will be reuse in water limited
- Result -> fundamental change in the “place” of wastewater utilities = opportunity
- Effectiveness in new role greatly aided by new institutional arrangements – difficult
- Hopeful that water quality experts within NACWA can rise to this new challenge

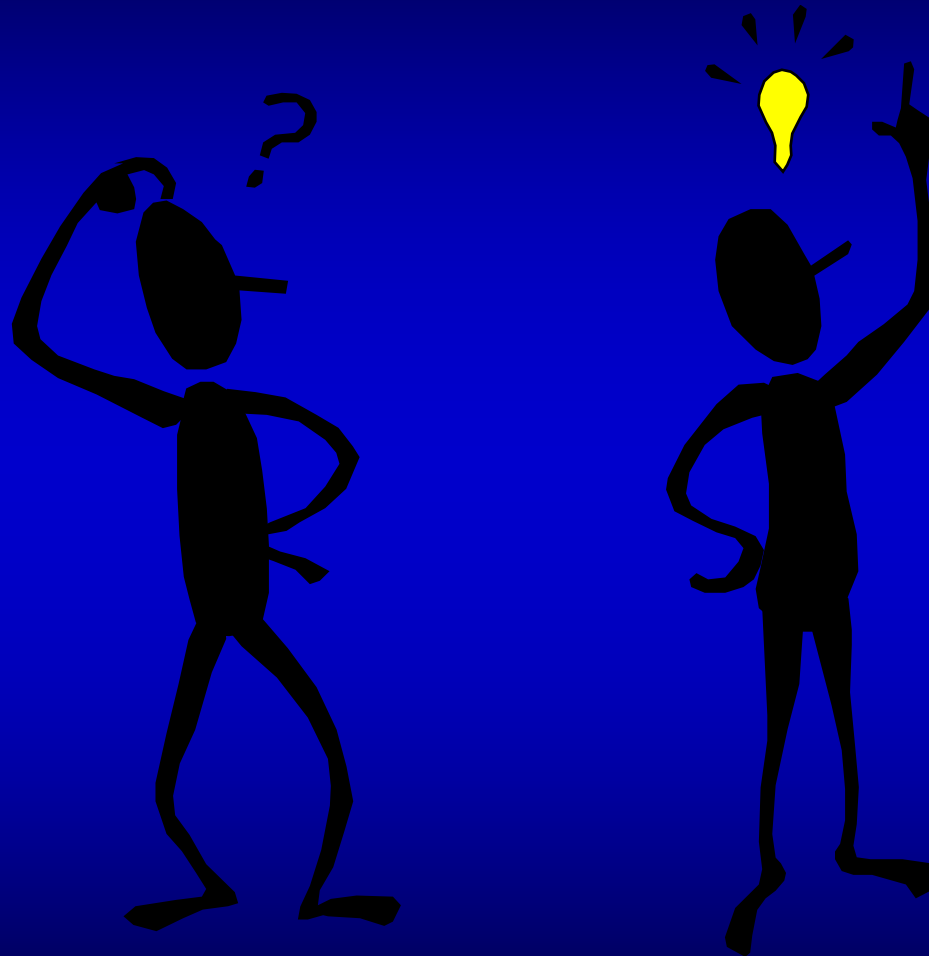


Acknowledgments

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Thank You!



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