

World Science Forum 2024, Budapest
Plenary Session III – Summit of the future

The time of easy water is over

LOOMING WATER CRISES

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BEFORE WE GO ANY FURTHER...

DANA VALENCIA, SPAIN, OCTOBER 29, 2024

Cold drop DANA

Depresión Aislada en Niveles Altos



DANA VALENCIA, SPAIN, OCTOBER 29, 2024



DANA VALENCIA, SPAIN, OCTOBER 29, 2024



WATER AS THE (MISSED) CENTER PIECE OF THE SDGs

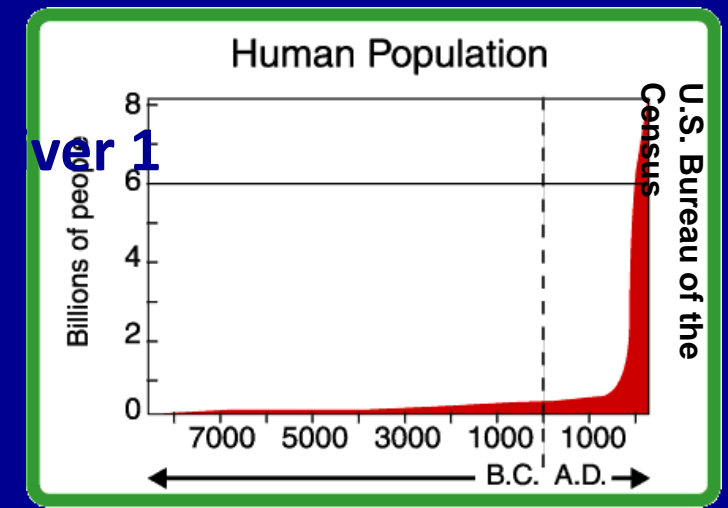


**THINGS HAVE CHANGED DRAMATICALLY
OVER THE PAST HUNDRED YEARS**

THE DRIVERS

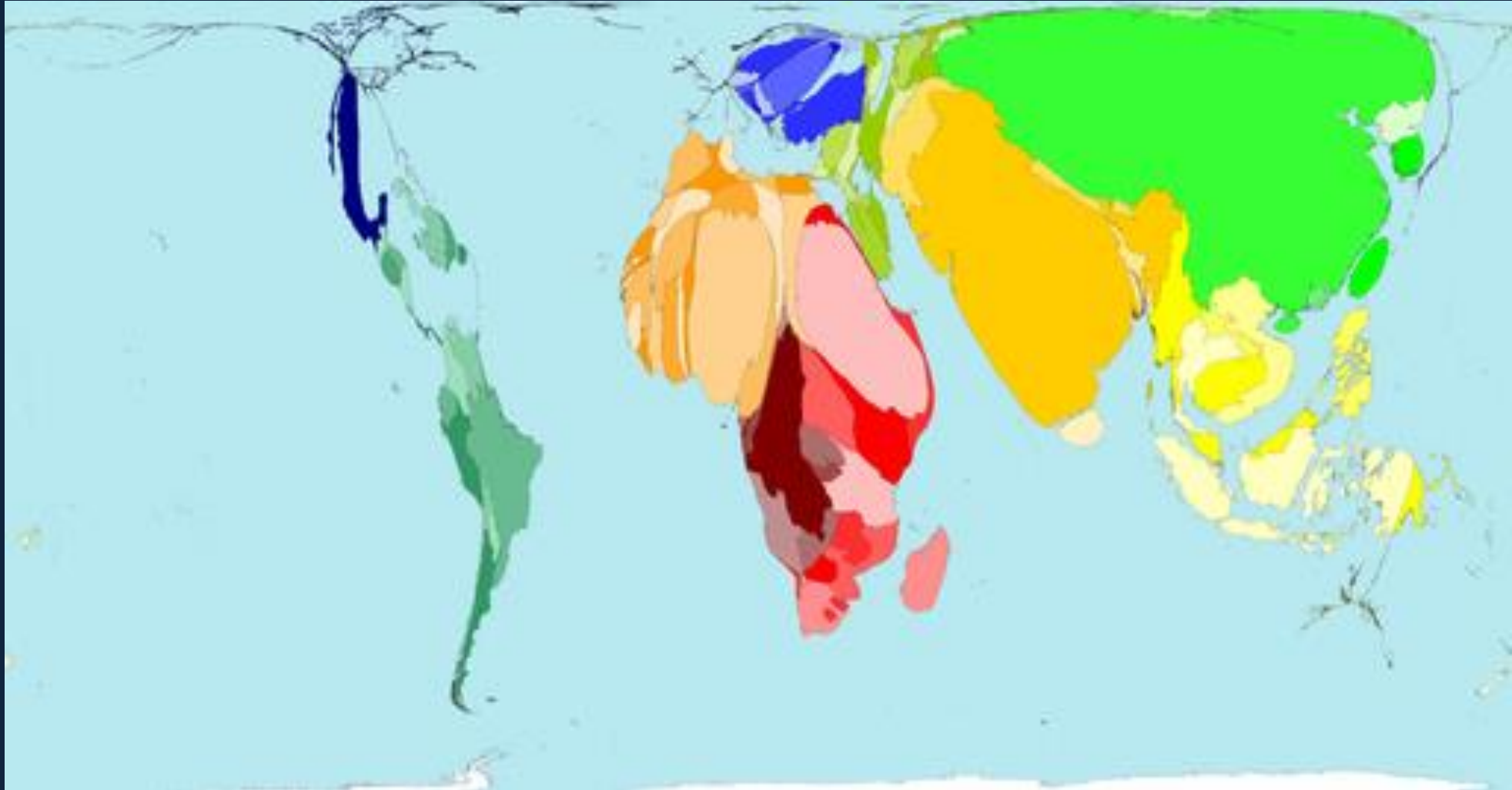
Global /regional change drivers in the last few centuries:

- **Population growth,**
movement and age structures
- **Land use change /ecosystems changed**
- **Urbanization**
- **Geo-political changes and realignments**
- **Trade and subsidies**
- **Technological changes**
- **Climate change**

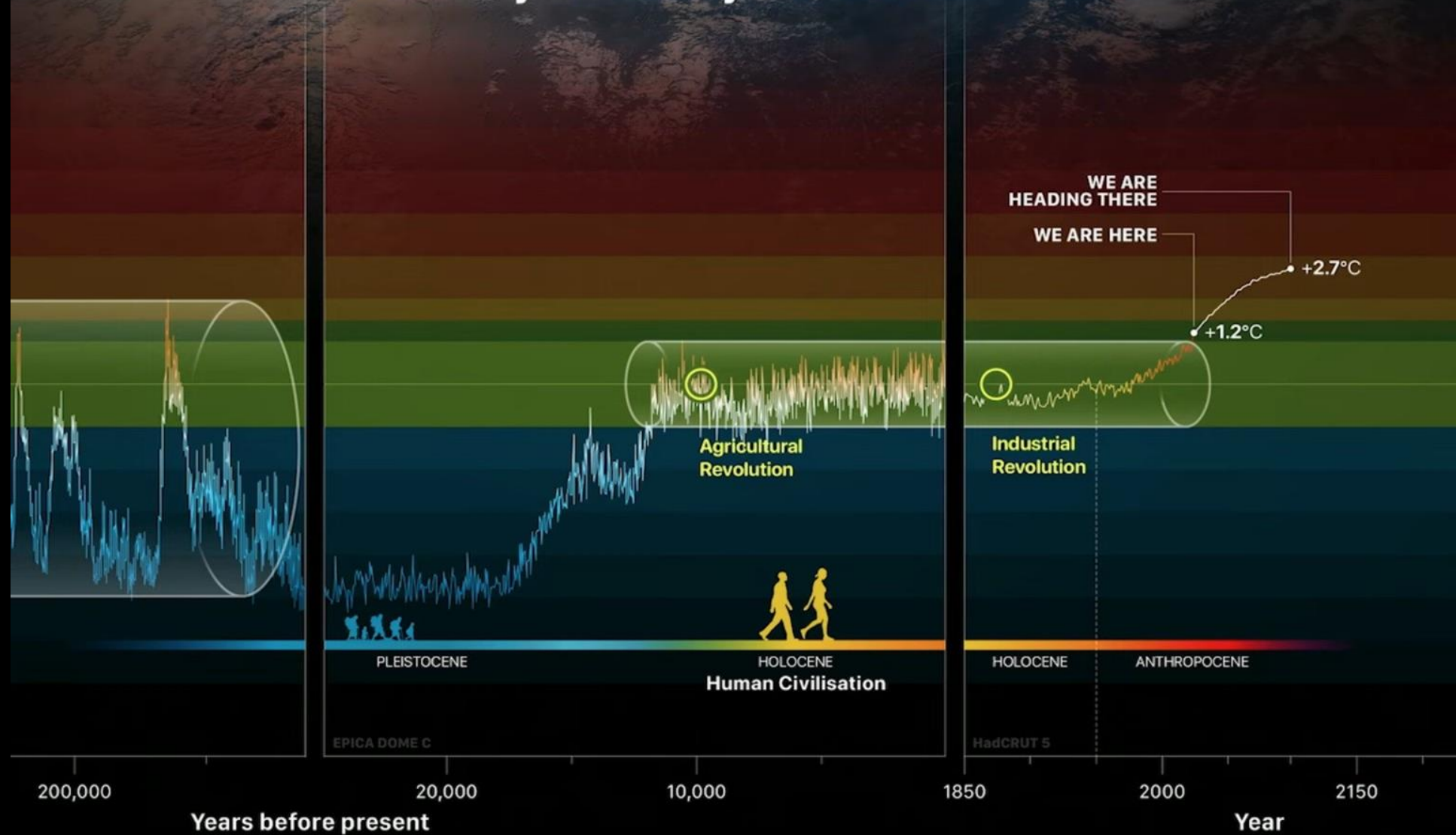


GLOBAL WATER SUPPLY RESILIENCE

Area proportional with non-access to drinking water 2011



Humanity's Journey on Earth

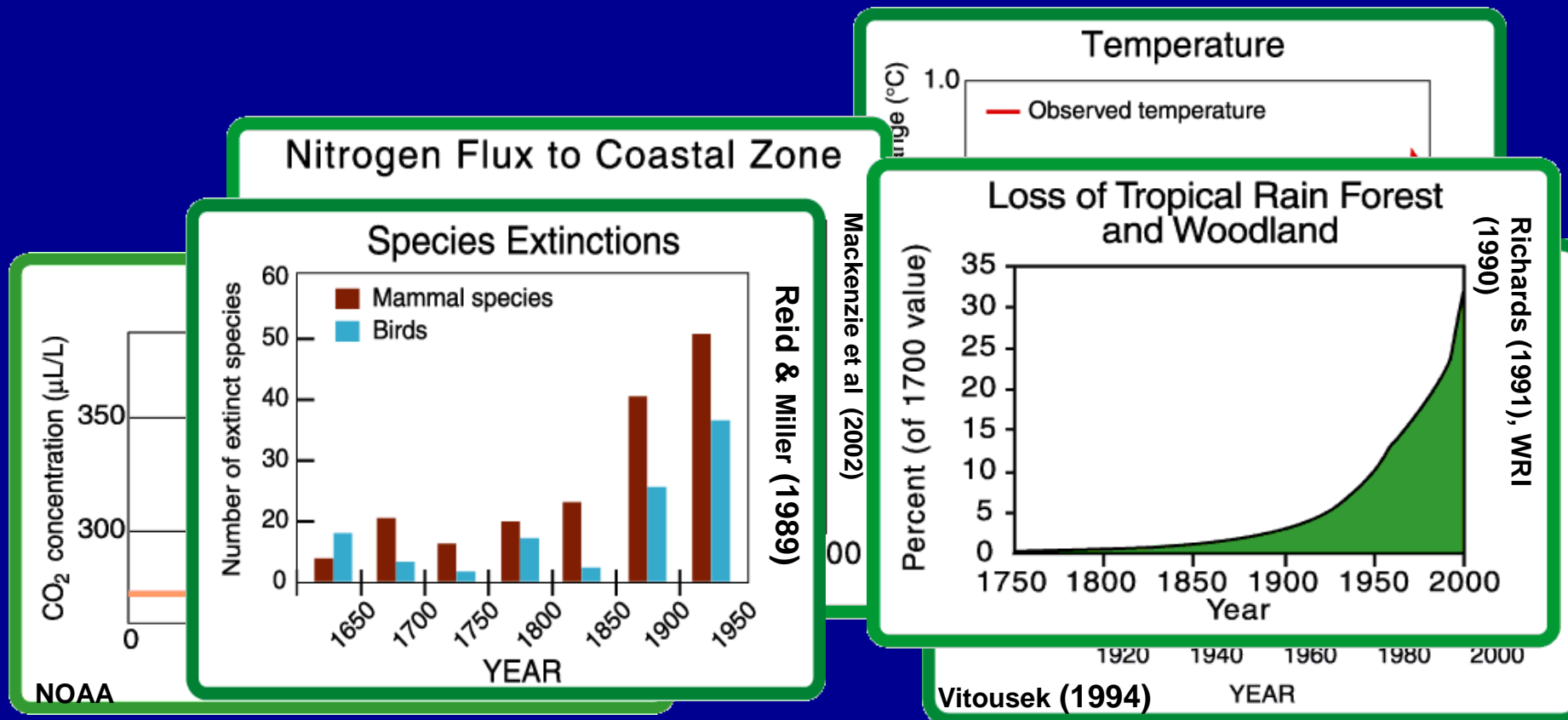


THE IMPACTS

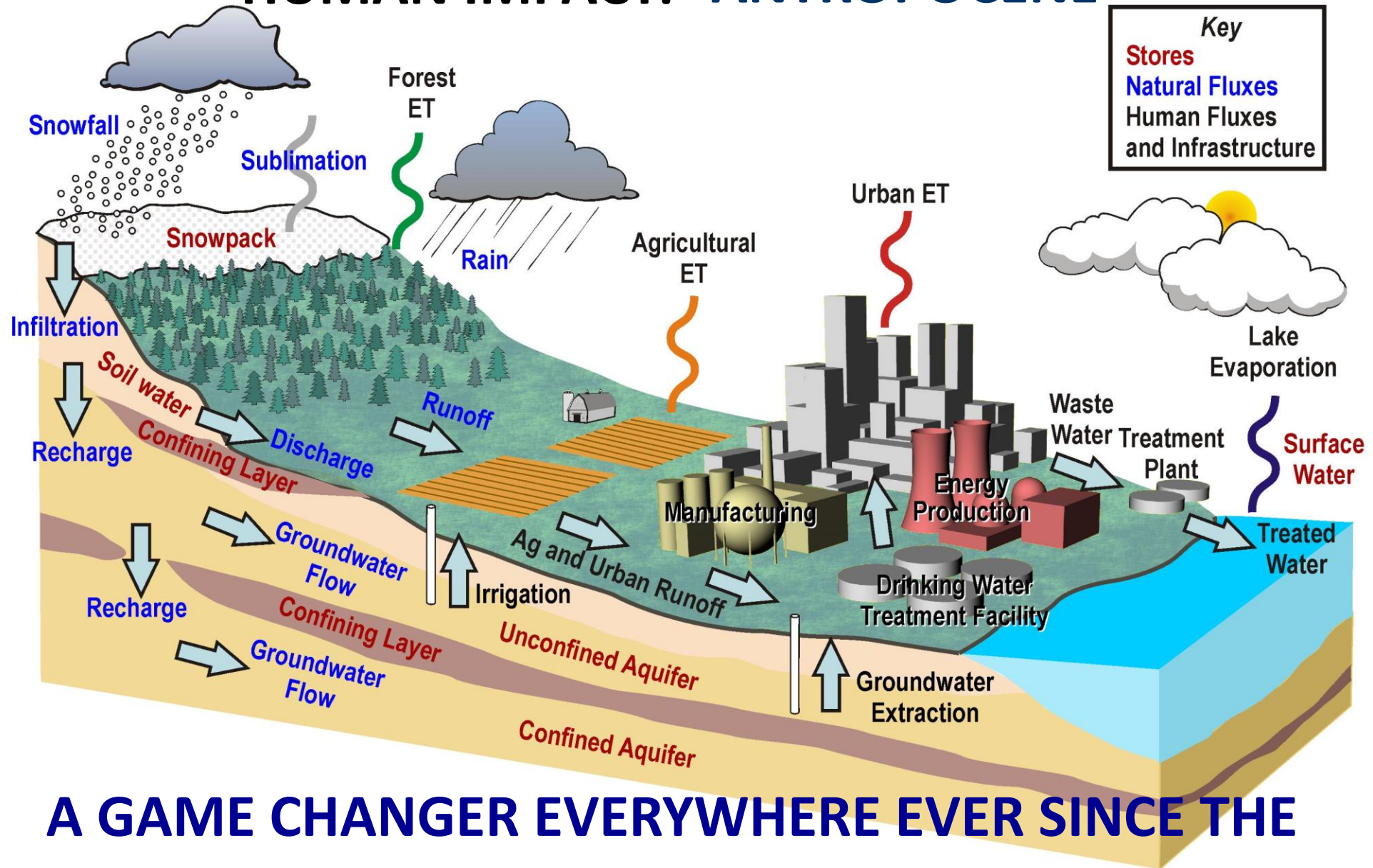
Global change impacts

- Global change is more than global climate variability/change
- It has natural PLUS human/social dimensions
- A constellation of changes, many global in domain

For example, we see large changes in:



HUMAN IMPACT: ANTROPOCENE



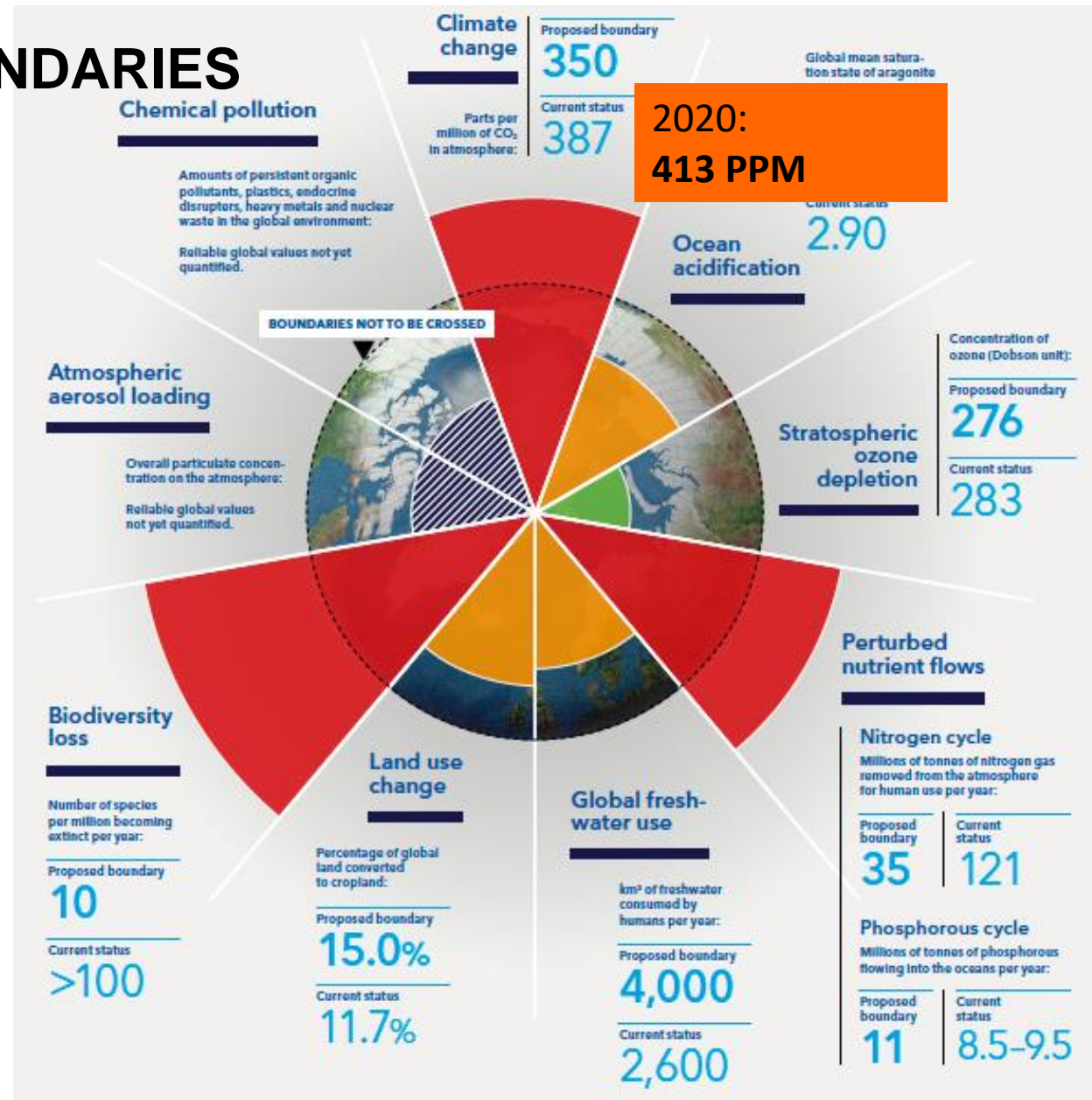
A GAME CHANGER EVERYWHERE EVER SINCE THE INDUSTRIAL REVOLUTION

PLANETARY BOUNDARIES

TIPPING POINTS

- Areas where we have exceeded the boundaries and are continuing to move further beyond them.
- Areas where we are still below the boundary values, but are moving towards them.
- Area where international political agreements have allowed us to start moving away from a boundary – in the correct direction.
- Areas where no boundary values were established.

(Rockström, et al., Nature, 2009)
DNV GL Report 2014



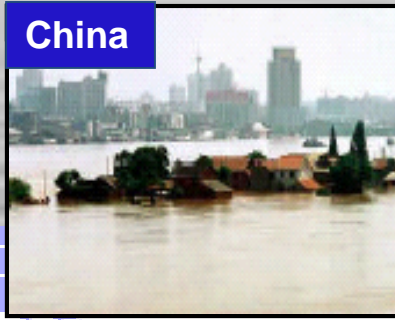
WE ARE ALMOST THERE

Major floods and droughts worldwide

Germany



China



Korea



Flood



Drought



Kenya



USA



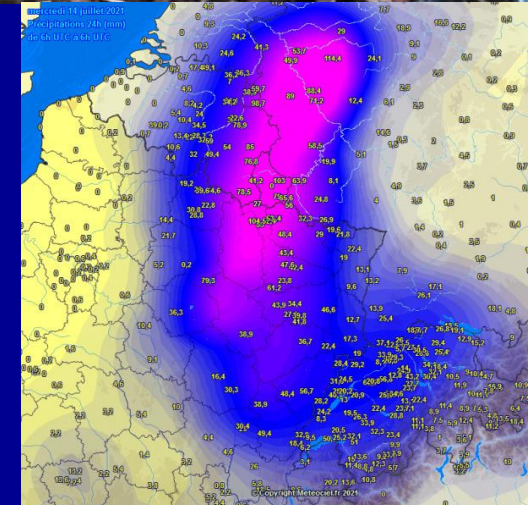
There is pressing need to develop advanced risk management on water hazard in order to secure human life and ensure sustainable socio-economic development and poverty alleviation.

**AS IF THE FRQUENCY OF
HYDROLOGICAL EXTREMES
HAS GONE UP ALL OVER ...**

18 October, 2018: SOUTHERN FRANCE,
Aude department
FLASH URBAN FLOOD
IN 126 SETTLEMENTS
14 DEAD, 75 SERIOUSLY INJURED



SEVEN MONTHS PRECIPITATION IN ONE DAY...



Alten Ahr, Germany, July 13-15, 2021
Rheinland Pfalz, Cyclon "Bernd",
CATASTROPHIC URBAN FLOODING
(My former UN colleague, Dr. Wolfgang Grabs' help is greatly appreciated.)

Belgium, July 2021

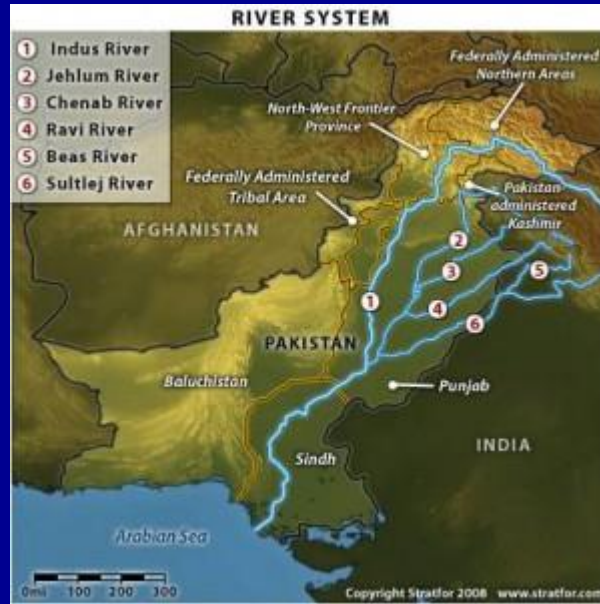




CATANIA, ITALY, FLASH FLOOD (2021 OCTOBER 27)

(Photo SALVATORE ALLEGRA/Anadolu Agency)

Flood Disaster in Pakistan (August, 2010)



FLASH FLOODS IN ASIA



(Uttarakhand, Northern India,
2013 June flood)



CYCLONE BORIS

AND THE 2024 SEPTEMBER (SECOND LARGEST) FLOOD IN BUDAPEST IN 18 YEARS





**YES, THINGS HAVE CHANGED DRAMATICALLY
OVER THE PAST HUNDRED YEARS**

**BUT IT WILL BE
EVEN WORSE IN 100 YEARS TIME ...**

THE ASSUMPTION OF

STATIONARITY IS DEAD

THE FUTURE WILL NOT BE THE SAME AS THE PAST

The story of the 200-year flood

New technologies are needed

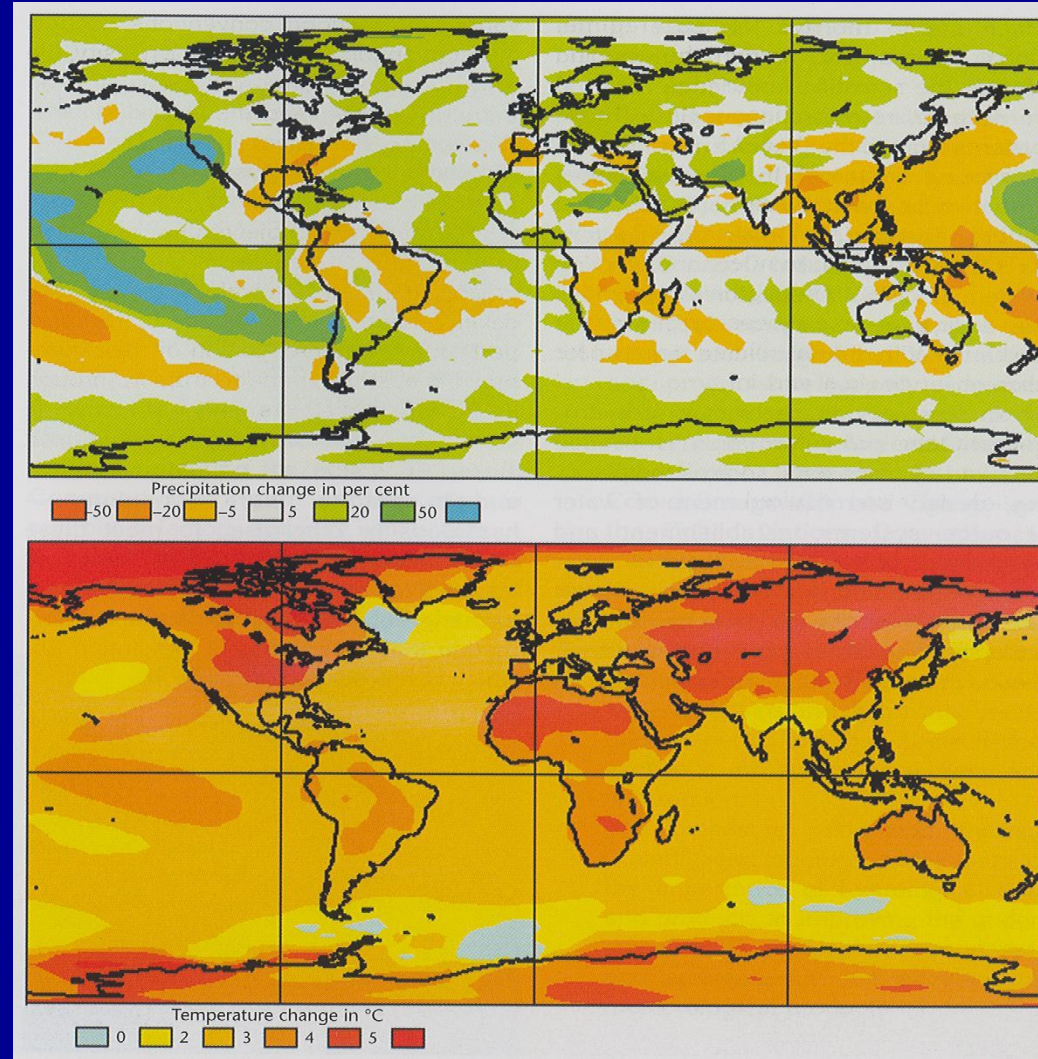
- Machine learning
- Pattern recognition
- AI

WILL WE HAVE MORE FLOODS AND DROUGHTS IMPACTING OUR WATER SYSTEMS ?

Expected Impacts of Global Changes on Water Resources

NOT TOO MUCH HOPE ...

UNLESS POLITICAL LEADERS STICK TO THE PARIS AGREEMENT
(AND DO NOT JUMP OUT AGAIN FROM THE DEAL ...)

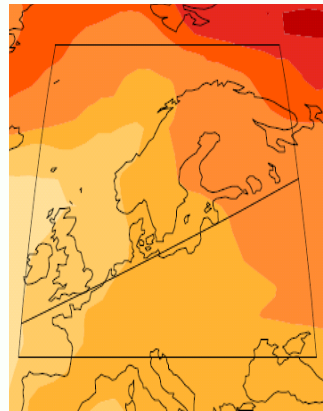
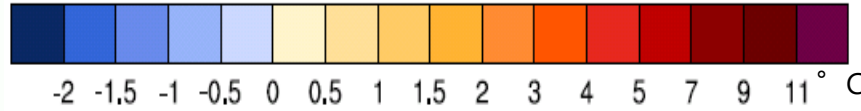
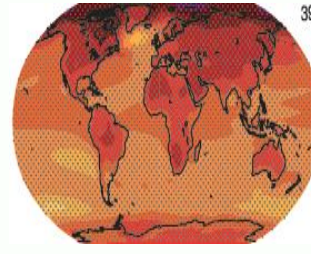


Optimistic scenario

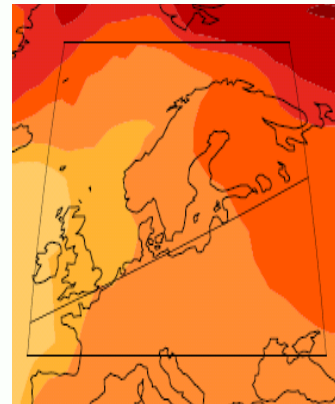


2081-2100

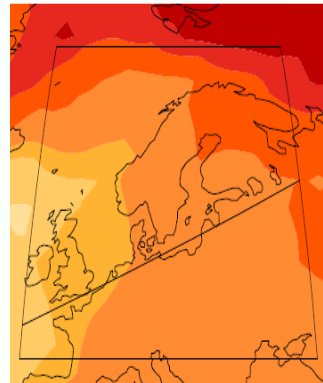
Pessimistic scenario



2046-2065

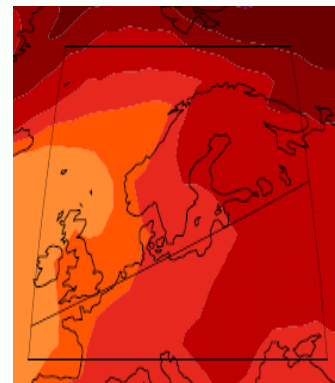


Optimistic scenario



2081-2100

Pessimistic scenario



Expected global and European warming trends (annual averages)

Reference period: 1986-2005

2046-2065:

- Larger warming: Northern polar regions and in the central regions

2081-2100:

- Significant differences between the various options
- Greater warming in the continental areas of Europe: NE - WS gradient

CONCLUSION

CLIMATE CHANGE IS ALL ABOUT WATER

**80% OF THE CLIMATE CHANGE IMPACTS IS MANIFESTED
THROUGH, WITH AND BY**

**WATER AND
RELATED ECOSYSTEMS**

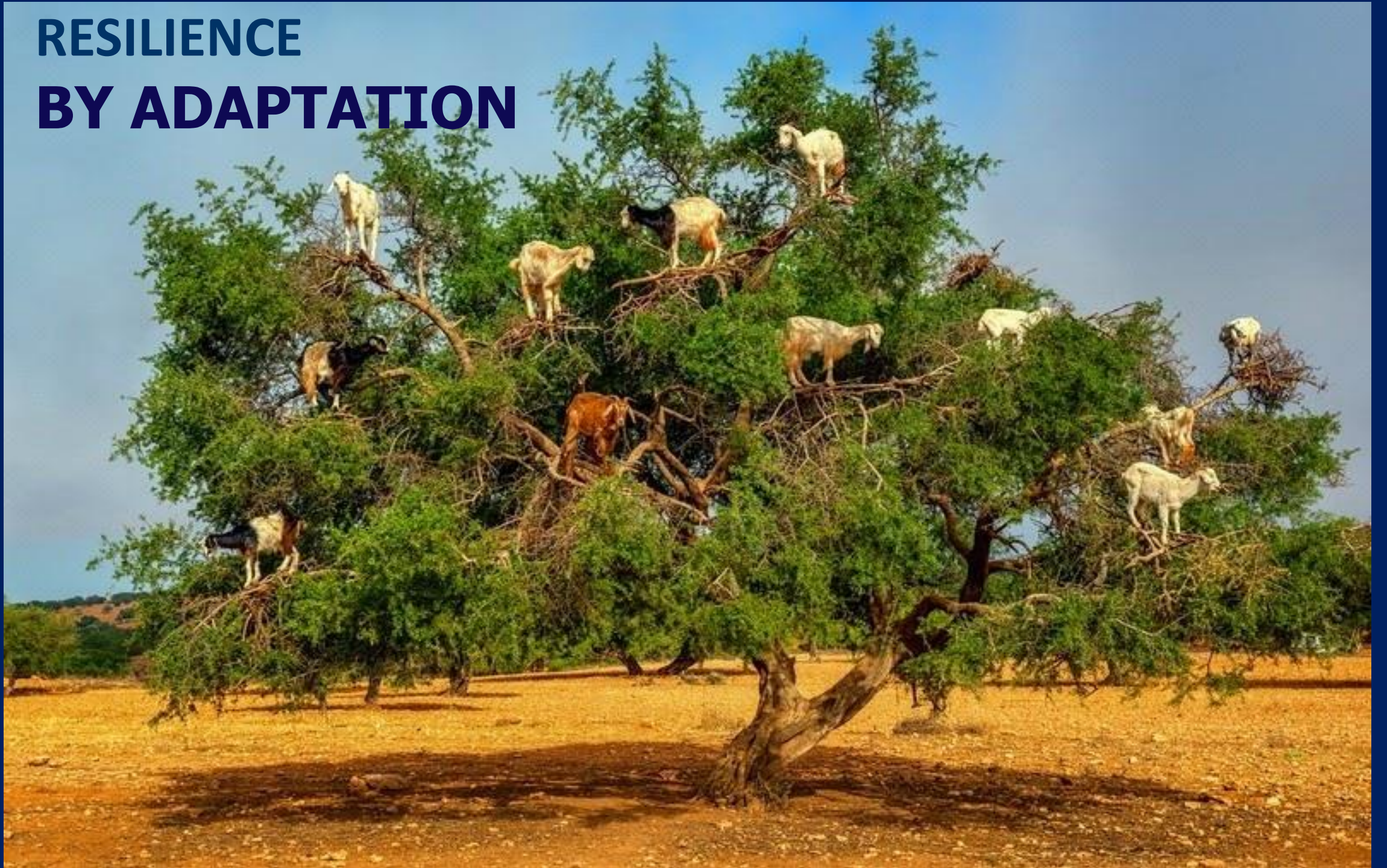


DO WE HAVE A CHOICE AT ALL?

NOPE

**WE NEED TO INCREASE THE
RESILIENCE
OF OUR SYSTEMS**

RESILIENCE BY ADAPTATION



**AGAINST ALL THESE BAD NEWS
THERE IS SOME GOOD NEWS**

**SCIENCE:
HUGE DATA AND
MODELLING
DEVELOPMENTS**

DATA SECURITY:
WILL IT BE FINALLY GONE?

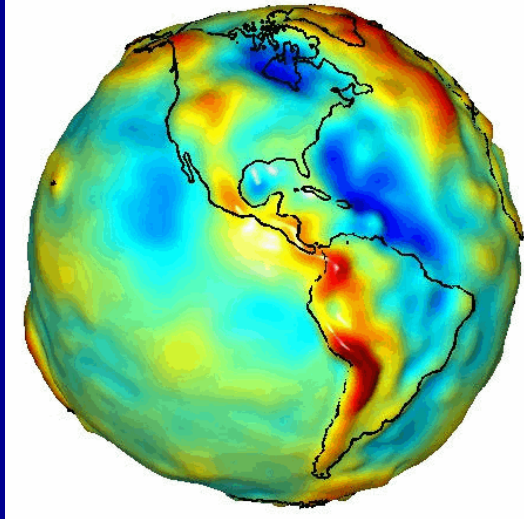
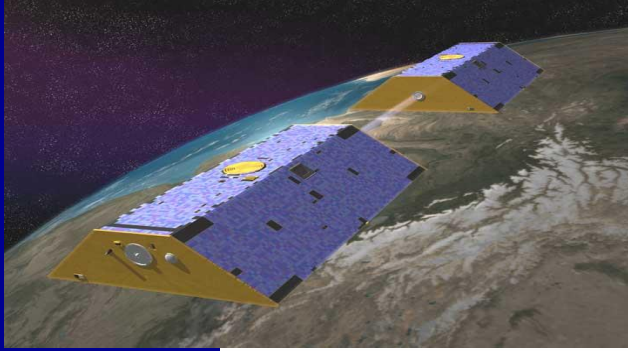
**NEW TECHNOLOGIES OFFER
NEW OPPORTUNITIES**

SATELITE HYDROLOGY

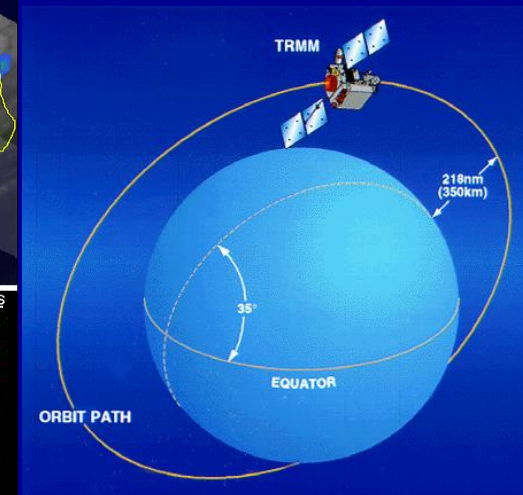
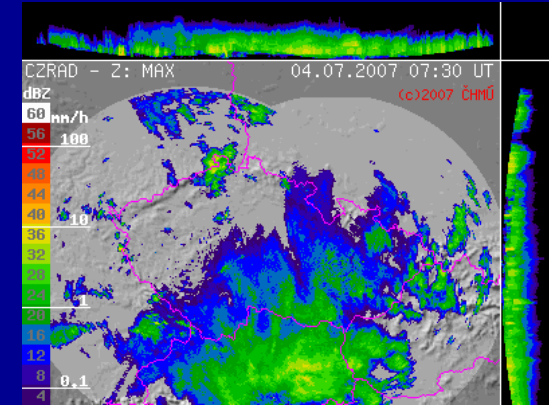
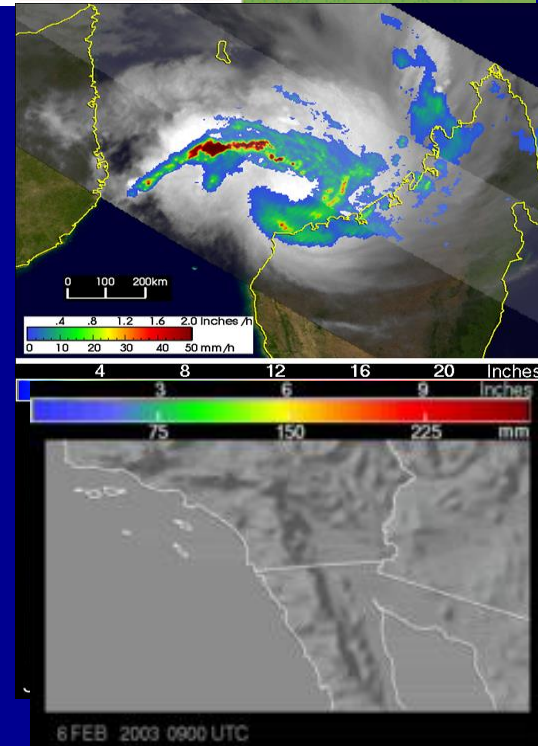
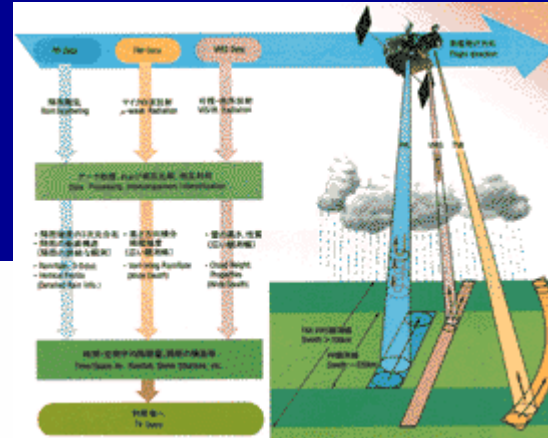
- Formulation
- Implementation
- Primary Ops
- Extended Ops



Remotely sensed data



GRACE



(Source: D. Solomatine)

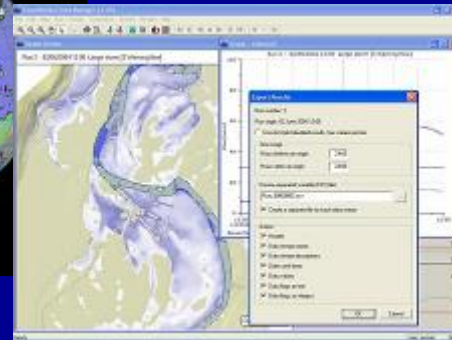
Flow of information in real-time hydrological systems

Data → Models → Knowledge → Decisions

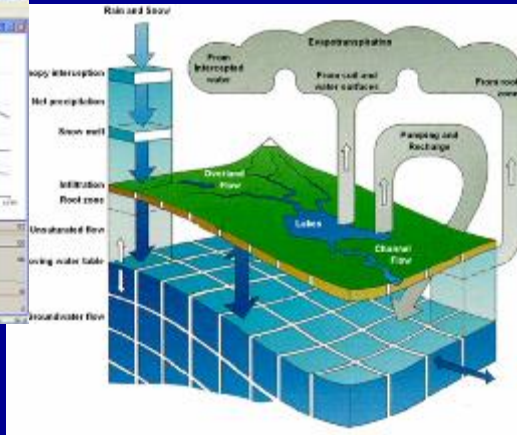
Earth observation,
monitoring



Numerical Weather
Prediction Models



Data modelling,
integration with
hydrologic and hydraulic
models

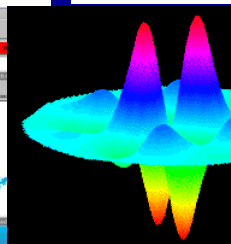
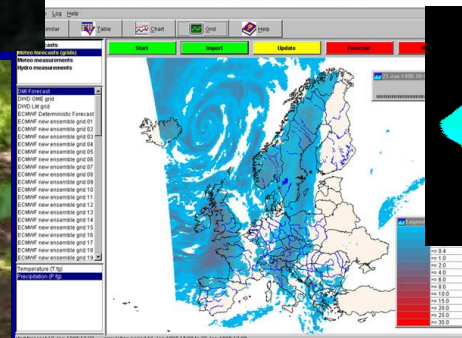


Access to
modelling
results

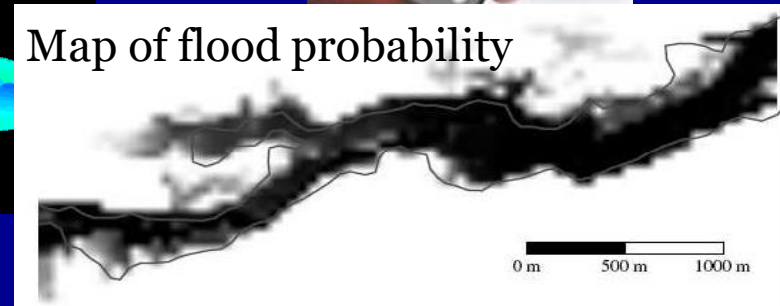
Decision
support



Figure 1. Screenshot of Delt-FEWS for an European Flood Forecasting System (EFFS), showing forecast precipitation over Europe for the 1995 event imported from the Danish Meteorological Institute



Map of flood probability



Source: D. Solomatine

(Source: Solomatine)

BIG DATA ALGORITHMS



Data revolution:

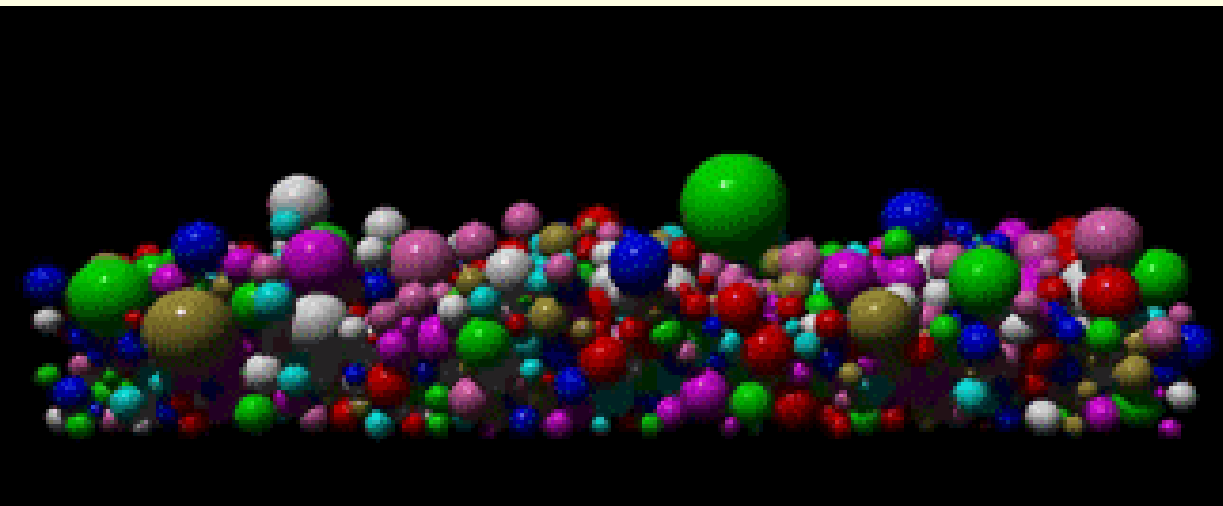
Terra bytes Petabytes Exabytes ... Terra Hertz speed



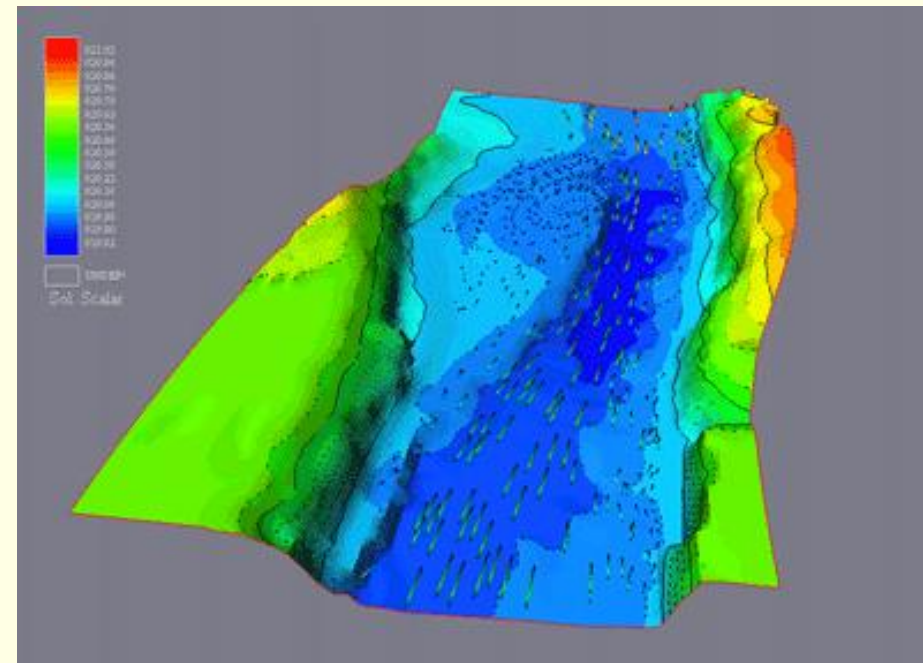
Modeling is the heart of Hydroinformatics

- Technologies ensuring the whole information cycle, and *integrates data, models, and humans*

$$\frac{\partial Q}{\partial t} + \frac{\partial}{\partial x} \left(\frac{Q^2}{A} \right) + gA \frac{\partial h}{\partial x} - gAS_o + gAS_f = 0$$



(Source: Solomatine)



SUMMARY:

WE NEED TO RE-TOOL OUR APPROACHES TO WATER BASED ON SCIENCE(S)

- **EDUCATE POLITICIANS TO UNDERSTAND ISSUES**
- **ECUCATE SCIENTIST TO COMMUNICATE BETTER WITH THE PUBLIC AND THE POLITICIANS**
- MAINSTREAM GOVERNANCE, INCREASE RESILIENCE
- GO BEYOND IWRM
- GO BEYOND STRUCTURES
- GO FOR NATURE BASED SOLUTIONS
- REINFORCE URBAN WATER MANAGEMENT
- REINVIGORATE EXPERIMENTAL CATCHMENTS
- GO DIGITAL
- RE-INFORCE SYSTEM THINKING FROM DATA CAPTURING TO DISSEMINATION
- REDUCE THE GAP BETWEEN SCIENCE AND POLICY STUDIES
- GO TRANSDISCIPLINARY – INCLUDE SOCIAL AND POLITICAL SCIENCE COMPONENTS
- ULTIMATELY SD IS BASED ON CULTURE

SUMMARY

**WE ARE FACING A
LOOMING WATER
CRISES**

WATER IS KEY IN ACHIEVING SDGs

The time of easy water is indeed over

**SCIENCE IS NEEDED MORE THAN ANYTIME
BEFORE**