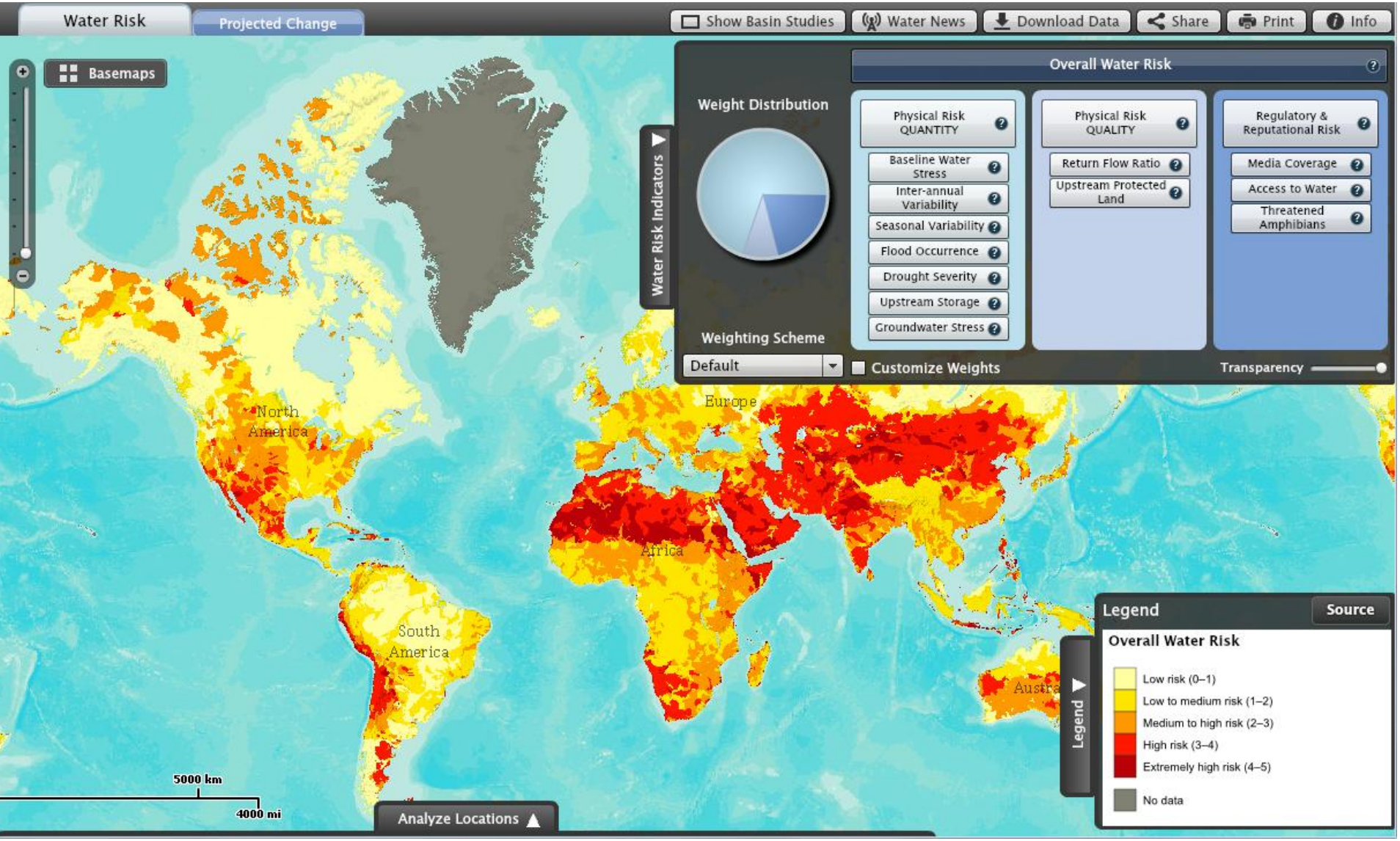

WORLD
RESOURCES
INSTITUTE
AQUEDUCT
WRI's GLOBAL WATER RISK MAPS

AGENDA

- What is Aqueduct
- Water Stress and Water Risk
- Aqueduct's Water Risk Indicators
- Ongoing Work in 2013

GLOBAL WATER RISK DATABASE AND MAPPING TOOL



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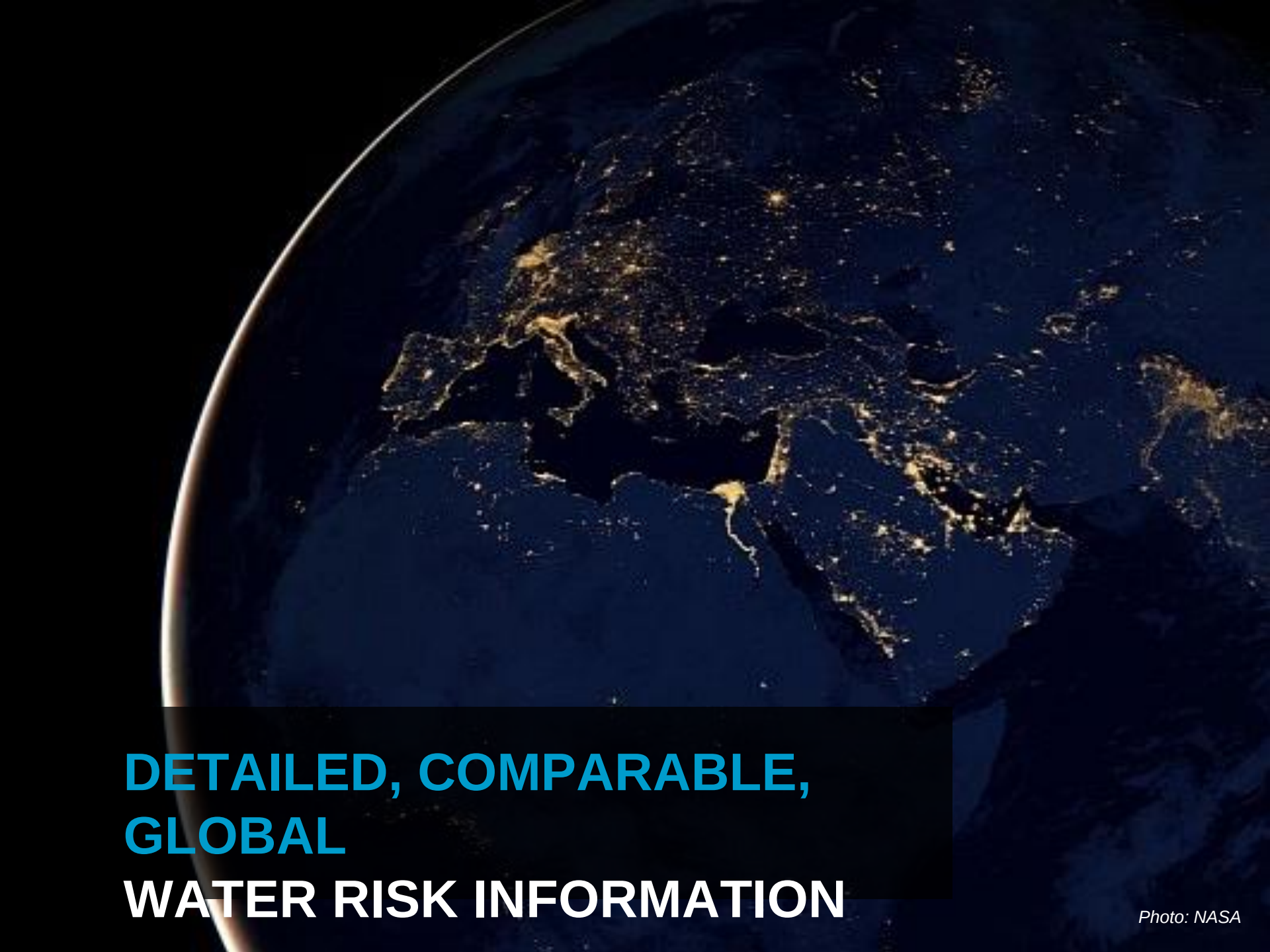
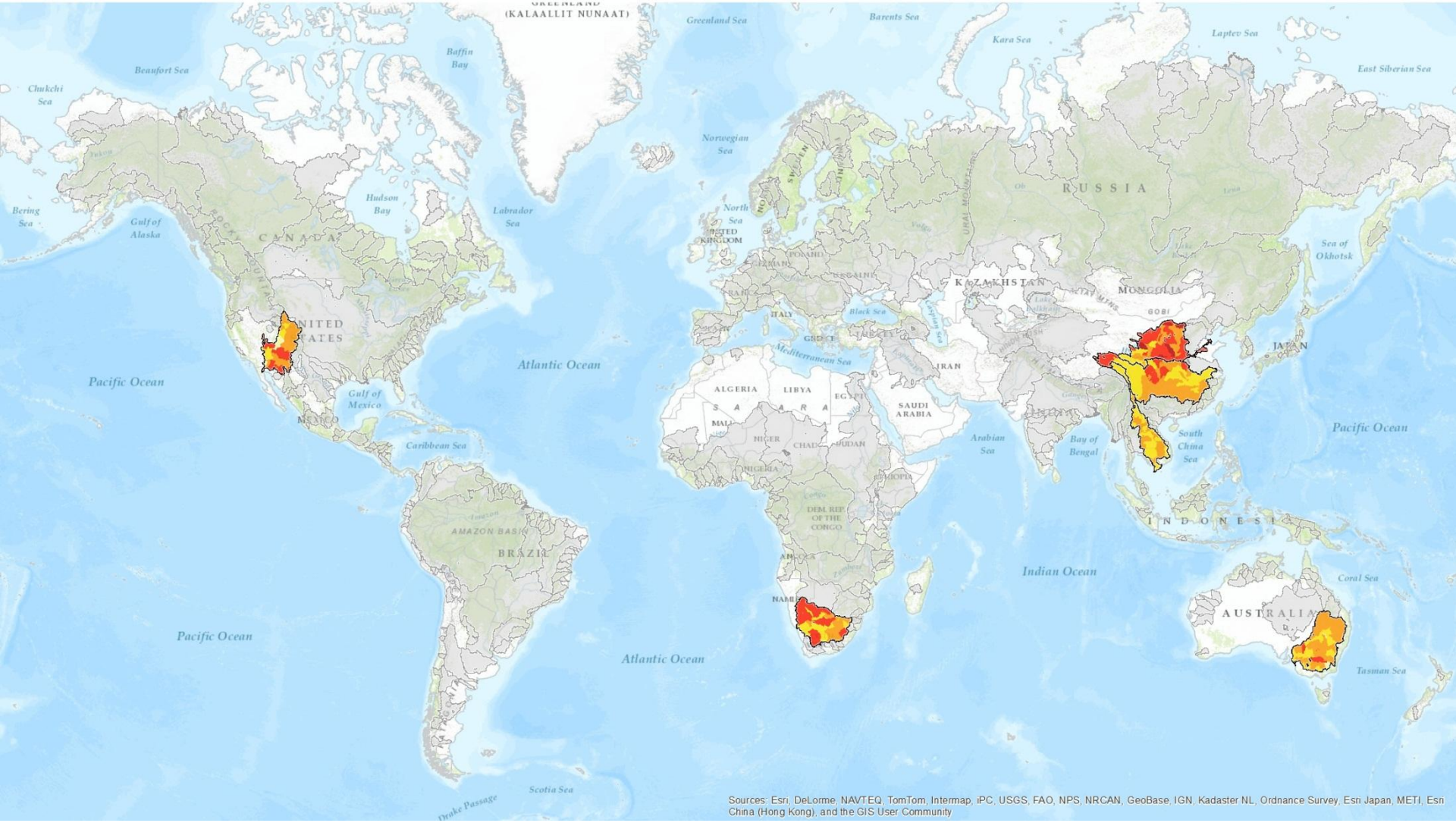
RISKS TO:
GOVERNMENT
SCOMPANIES
INVESTORS
Photo: NOAA



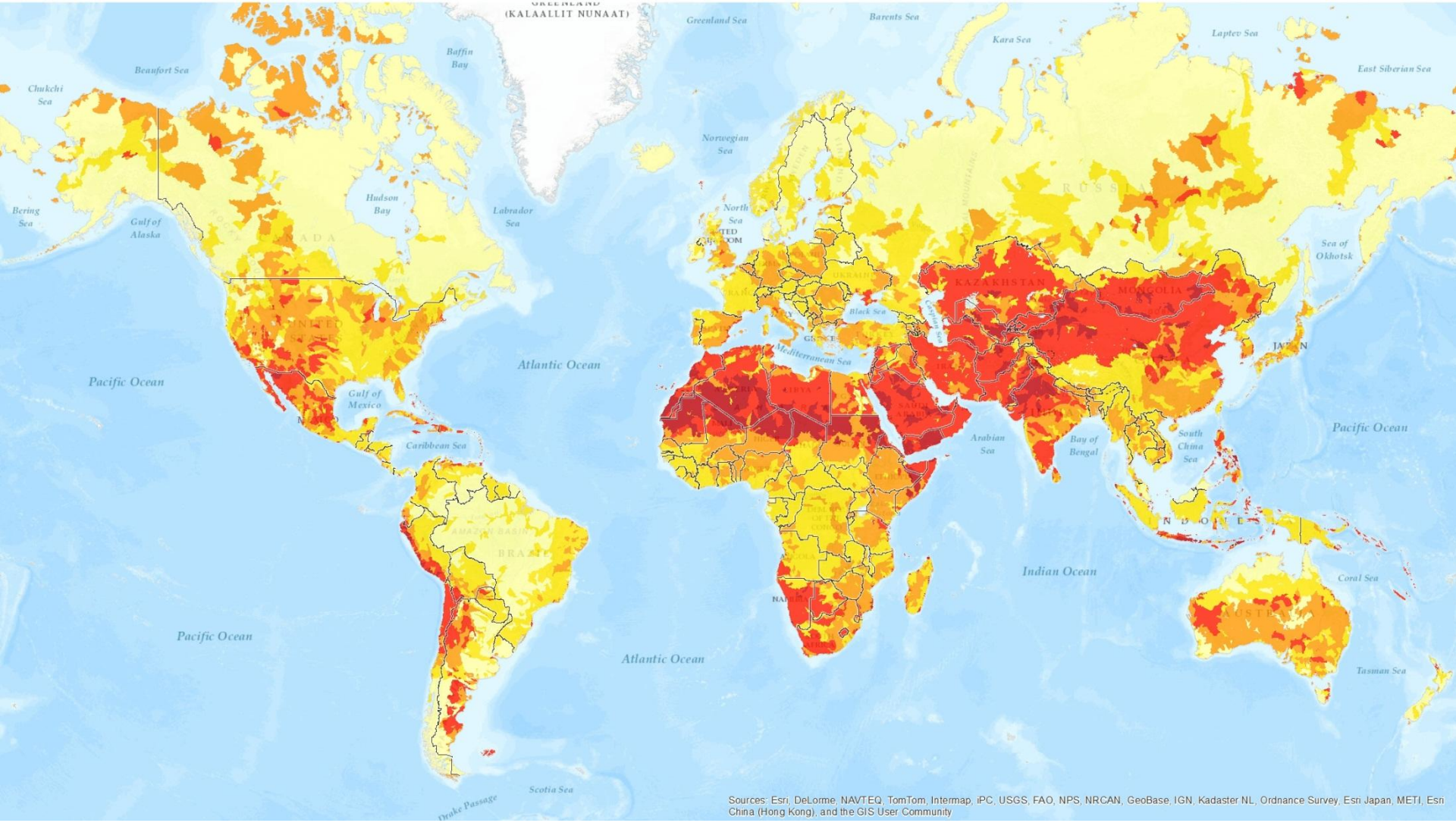
DETAILED, COMPARABLE, GLOBAL
WATER RISK INFORMATION

Photo: NASA

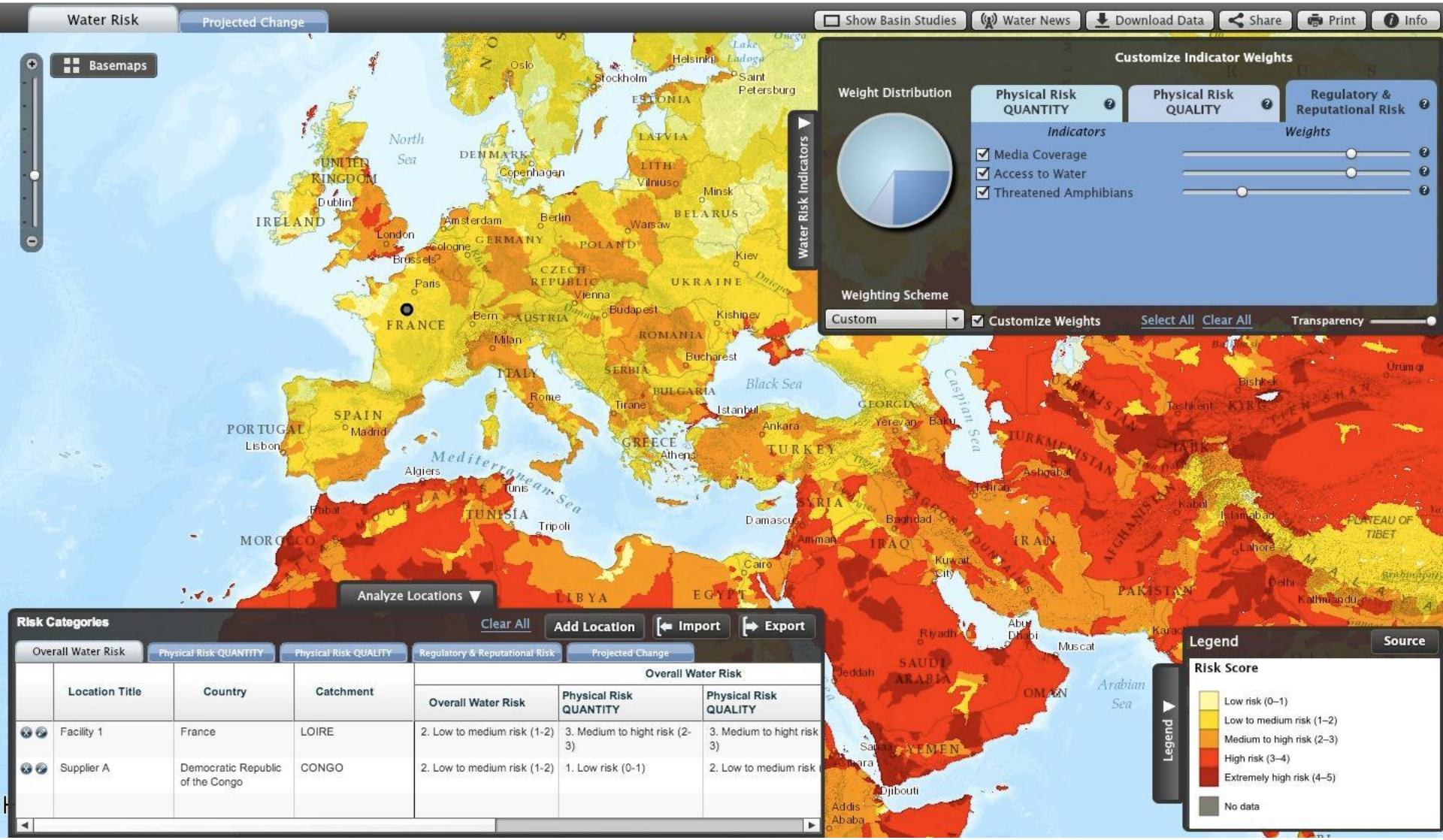
WHERE WE PILOT TESTED: KEY BASINS



HOW WE EVOLVED: GLOBAL MAPPING



USER FRIENDLY USER INTERFACE



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UNDERSTANDING WATER STRESS

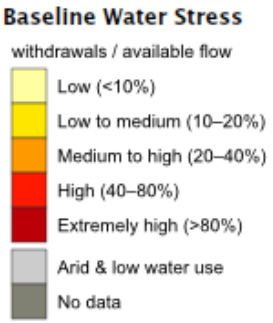
- **Water stress**
  - Definition: Total water withdrawal (2010)/mean available blue water (1950-2008)
  - Total water withdrawal : water withdrawal from domestic water use, industrial water use, and agricultural water use
  - Available blue water : total freshwater water supply subtracting consumptive use. Roughly equivalent to available surface water

- **Water scarcity**
  - Definitions vary: measures the extent to which sufficient water resources physically exist in a specific location
    - Volume of freshwater supply/total population
    - Total withdrawal/freshwater supply
    - Consumptive use/freshwater supply

Vorosmarty et. al. 2000, Science, "Global Water Resources: Vulnerability from Climate Change and Population Growth"

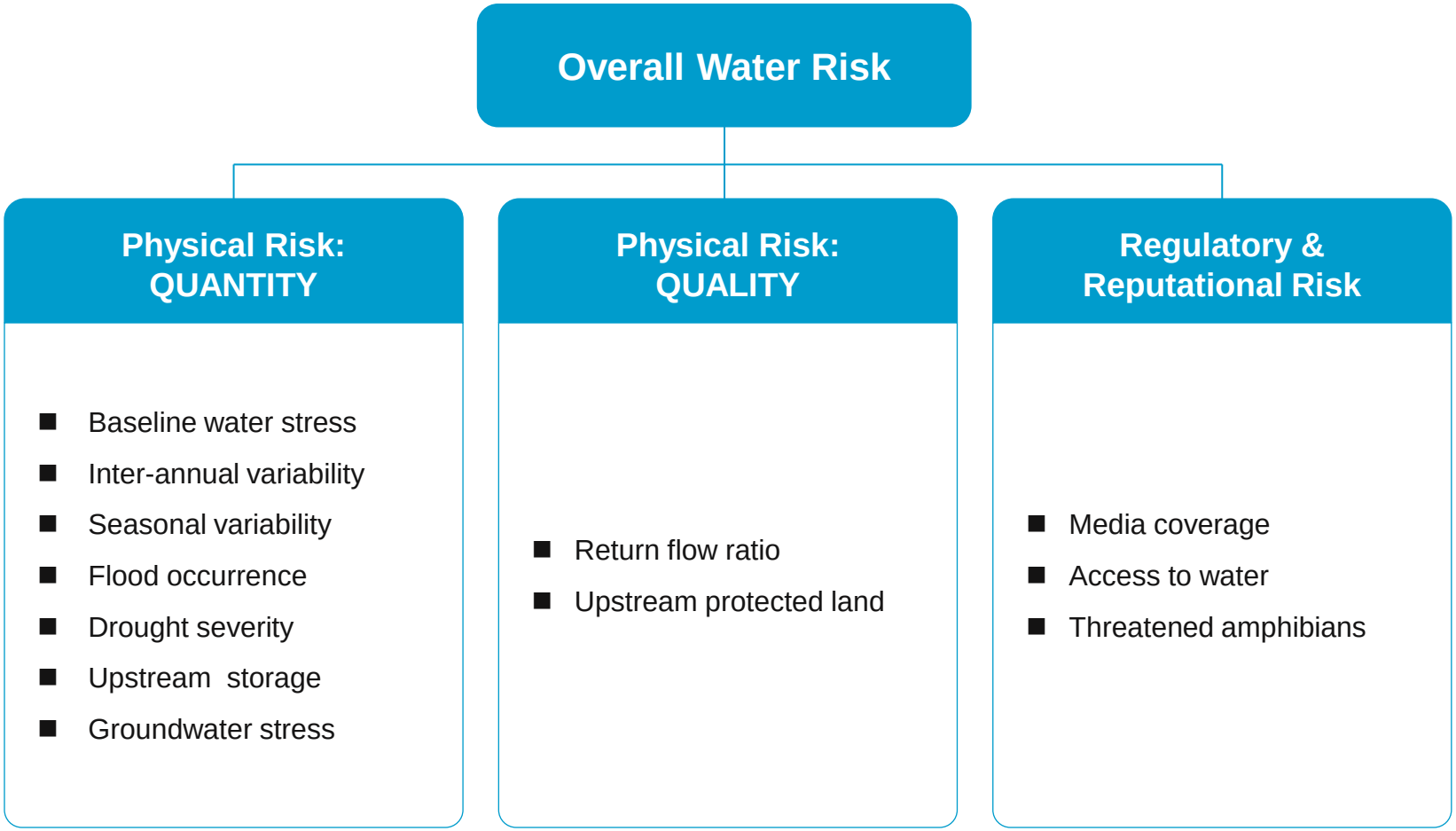
INTERPRETING BASELINE WATER STRESS

- **Baseline Water Stress (BWS)**
  - Total annual water withdrawals expressed as a percentage of mean available blue water
  - Higher values indicate where water stress is high and where there's competition between major water users
- **Thresholds**
  - BWS >20 % may begin to experience risks from stress to the environment, competing water uses, and natural variations in supply
  - BWS > 40% may signify severely water stressed conditions



United Nations , 1997, "Comprehensive Assessment of the Freshwater Resources of the World"
Vorosmarty et. al. 2000, Science, "Global Water Resources: Vulnerability from Climate Change and Population Growth"

UNDERSTANDING RISK: AQUEDUCT FRAMEWORK

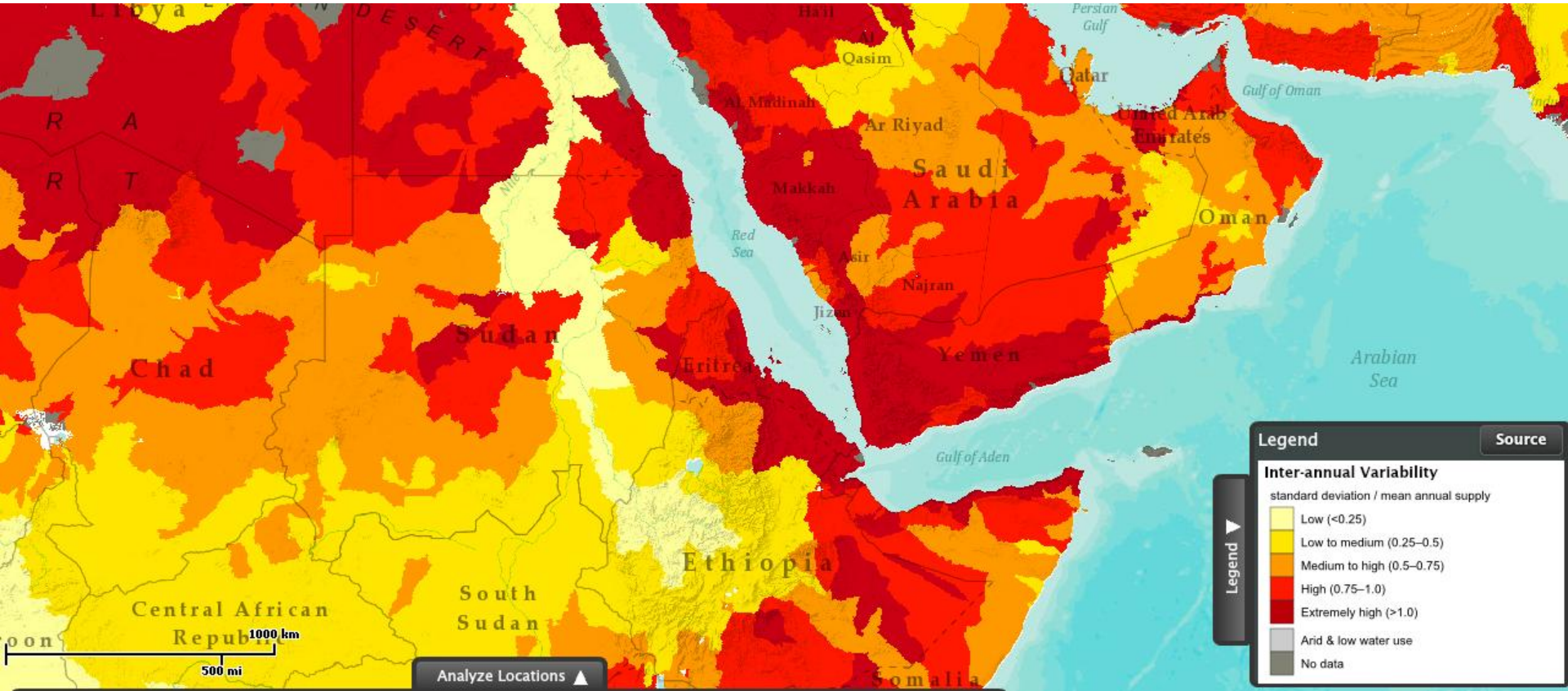


BUILDING ON SCIENCE: EXPERT REVIEWERS

- *CDP Water Disclosure Project*
- *Ceres*
- *Columbia University*
- *Deloitte Consulting LLP*
- *Global Adaptation Institute*
- *Global Water Strategies*
- *Nanjing University*
- *National Geographic*
- *Pacific Institute*
- *The Nature Conservancy*
- *The World Bank*
- *US Environmental Protection Agency*
- *University of Michigan at Ann Arbor*
- *University of North Carolina Chapel Hill*
- *University of Virginia*
- *Water Footprint Network*
- *World Business Council for Sustainable Development*
- *Yale University*

SUPPLY AND DEMAND INDICATORS

$$\textbf{Interannual variability} = \frac{Standard\ deviation\ of\ total\ blue\ water\ (1950-2008)}{Mean\ total\ blue\ water\ (1950-2008)}$$



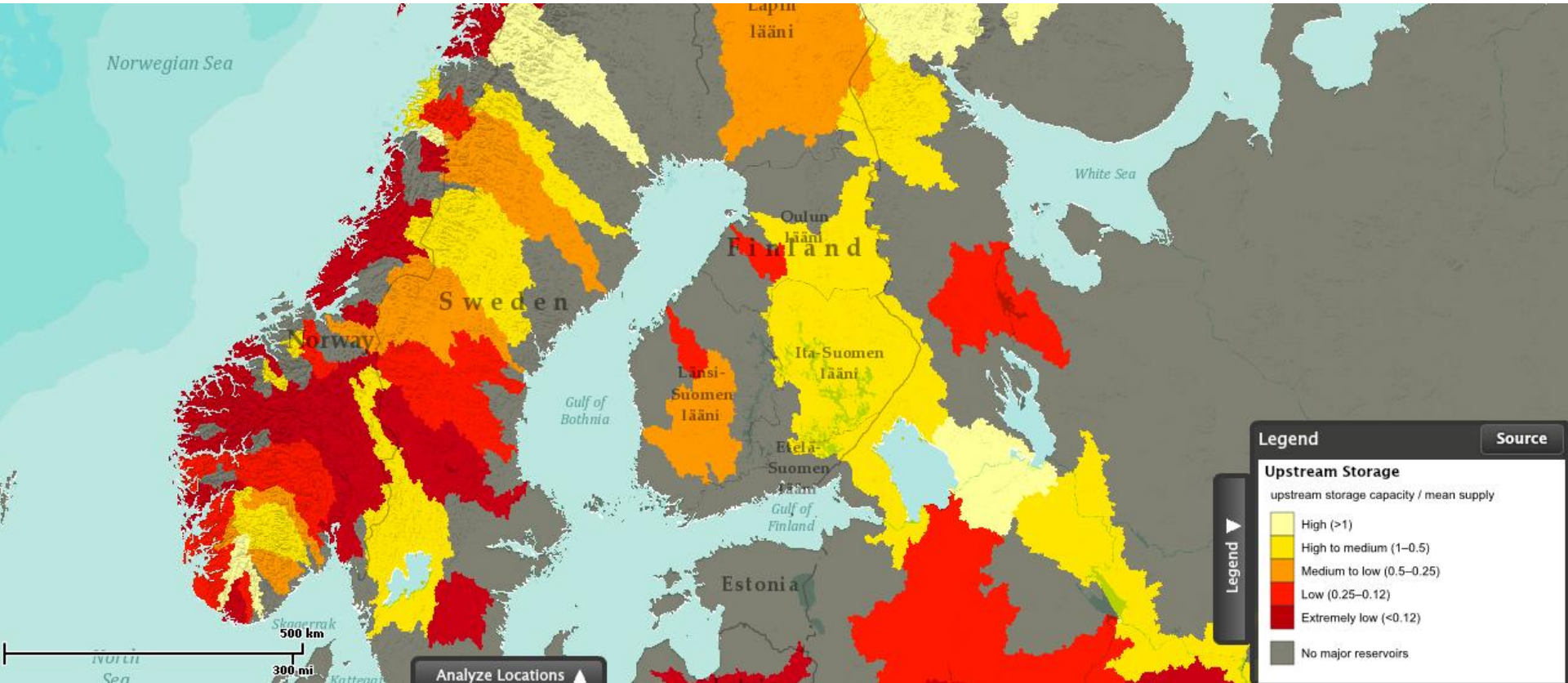
SUPPLY AND DEMAND INDICATORS

$$\textbf{Seasonal variability} = \frac{Standard\ deviation\ of monthly\ total\ blue\ water\ (1950-2008)}{Mean\ monthly\ total\ blue\ water\ (1950-2008)}$$

SUPPLY AND DEMAND INDICATORS

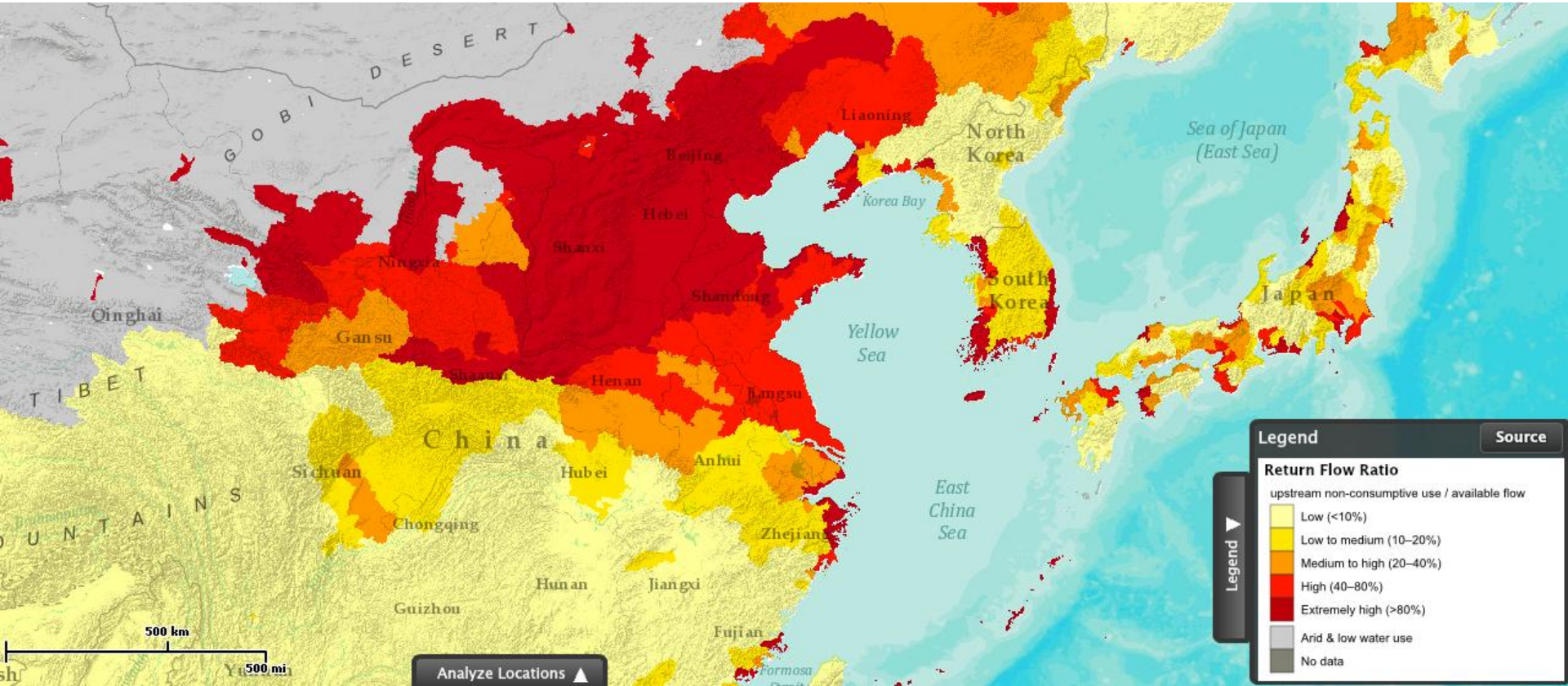
$$\textbf{Upstream storage} = \frac{Upstream\ storage\ capacity}{Mean\ total\ blue\ water\ (1950-2008)}$$

Data: Lehner et al. GRanD



SUPPLY AND DEMAND INDICATORS

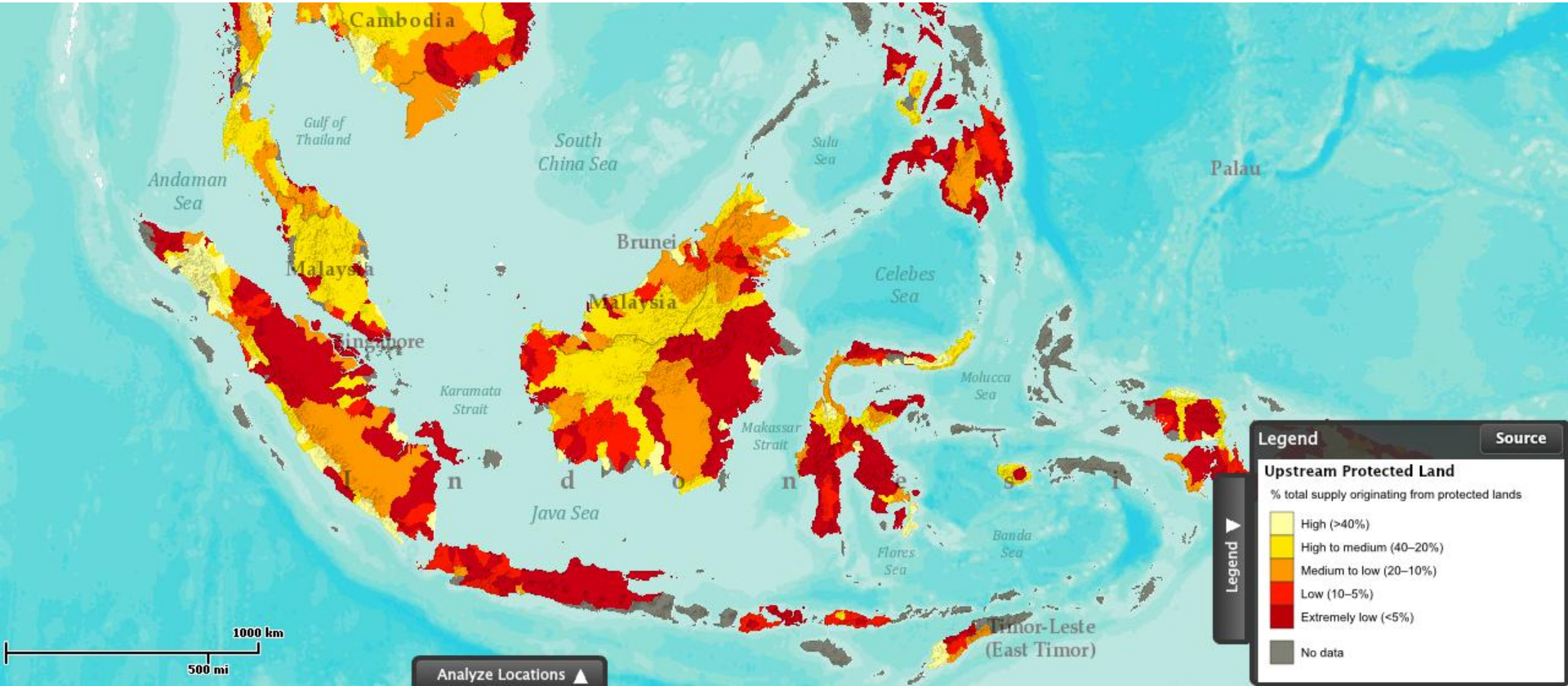
$$\textbf{Return flow ratio} = \frac{Upstream\ nonconsumptive\ use\ (2010)}{Mean\ available\ blue\ water\ (1950-2008)}$$



SUPPLY AND DEMAND INDICATORS

$$\textbf{Upstream protected land} = \frac{Total\ blue\ water\ from\ protected\ lands\ (1950-2008)}{Mean\ total\ blue\ water\ (1950-2008)}$$

Data: IUCN, UNEP

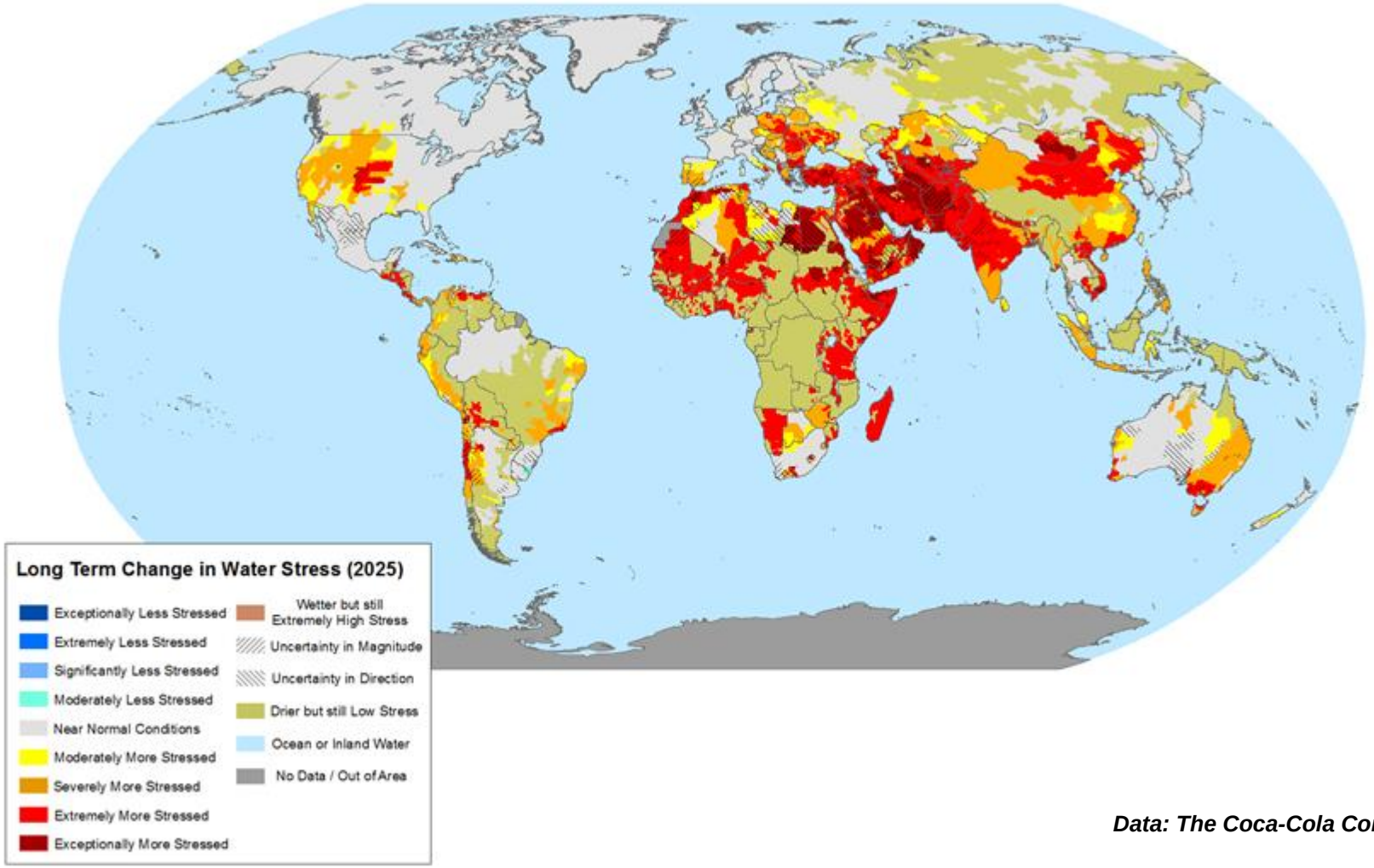


OTHER INDICATORS

Indicator	*Data Source*	*Scale*
Flood occurrence	Brakenridge, Dartmouth Flood Observatory	Polygons
Drought severity	Sheffield and Wood	1 degree raster
Groundwater stress	Gleeson et al.	Major aquifers
Media coverage	Google	Country
Access to water	WHO, UNICEF	Country
Threatened amphibians	IUCN Red List	Polygons

COMING SOON: UPDATED PROJECTIONS

CHANGE IN WATER STRESS: 2020



Data: The Coca-Cola Company

AQUEDUCT™
Measuring and Mapping Water Risk

Thank you!

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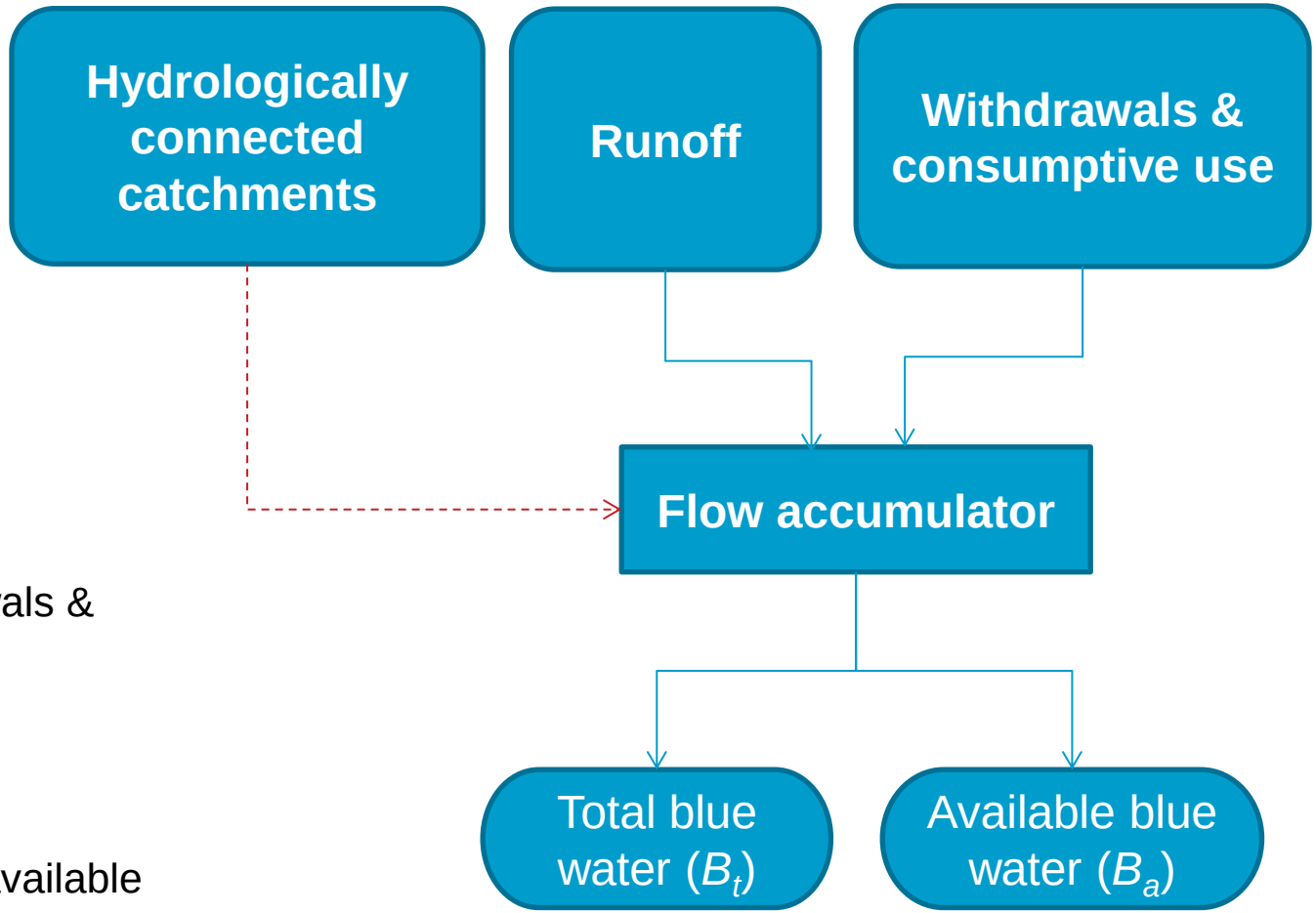
WRI.org/Aqueduct

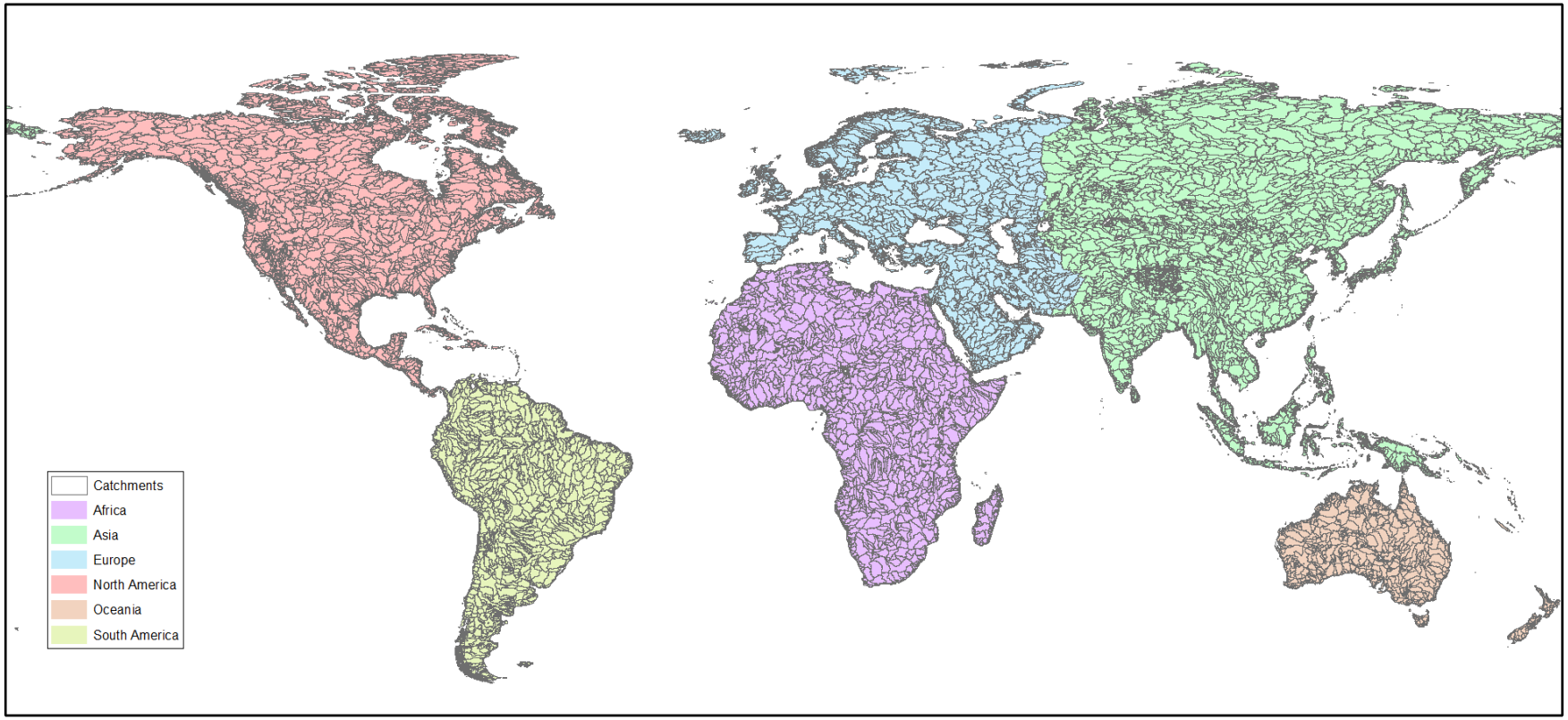
MODELING: WATER SUPPLY AND DEMAND

- Catchments
- Supply: Runoff
- Demand: Withdrawals & consumptive use
- Flow accumulation
- Supply: Total and available blue water



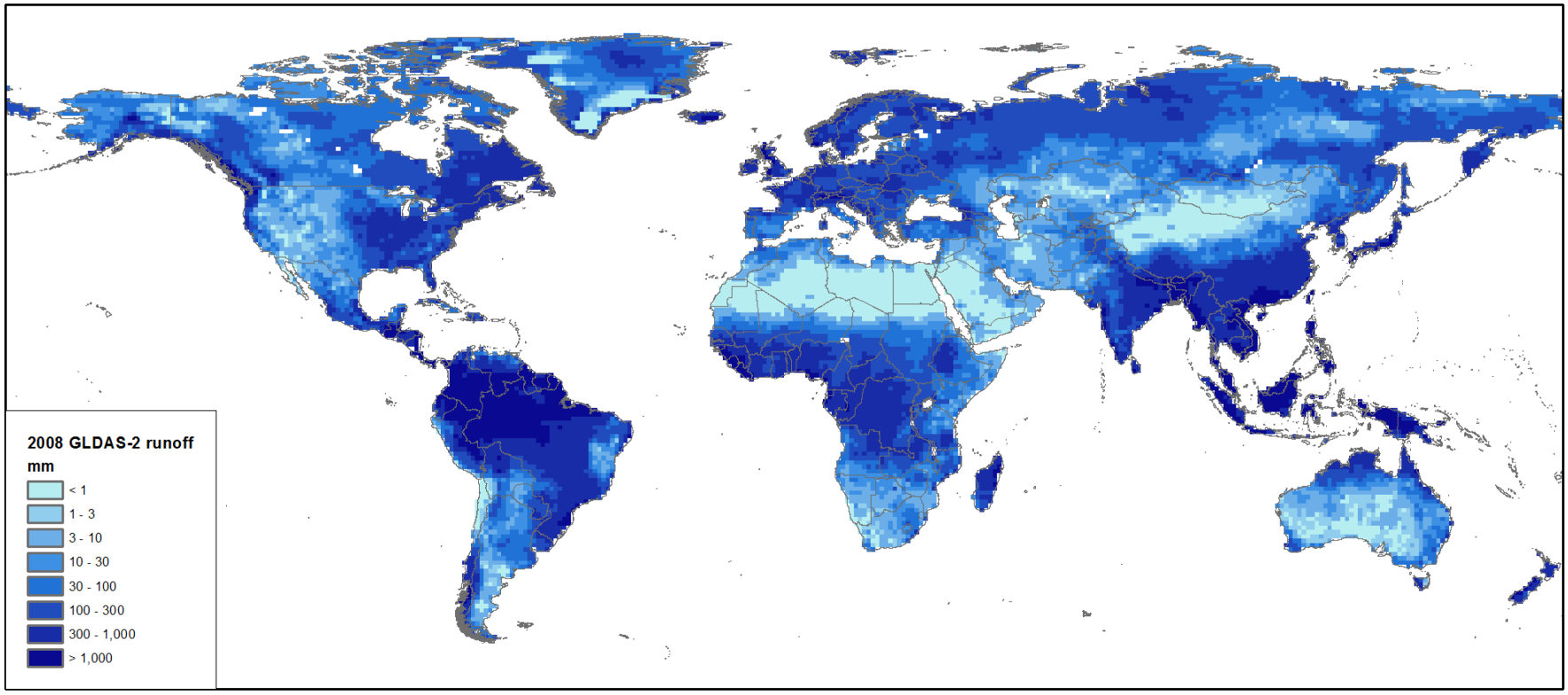
CATCHMENTS

- Global Drainage Basin Database by National Institute for Environmental Studies (2009)
- Approximately 15,000 hydrologically correct catchments
- Mean area is 8,804 km^2

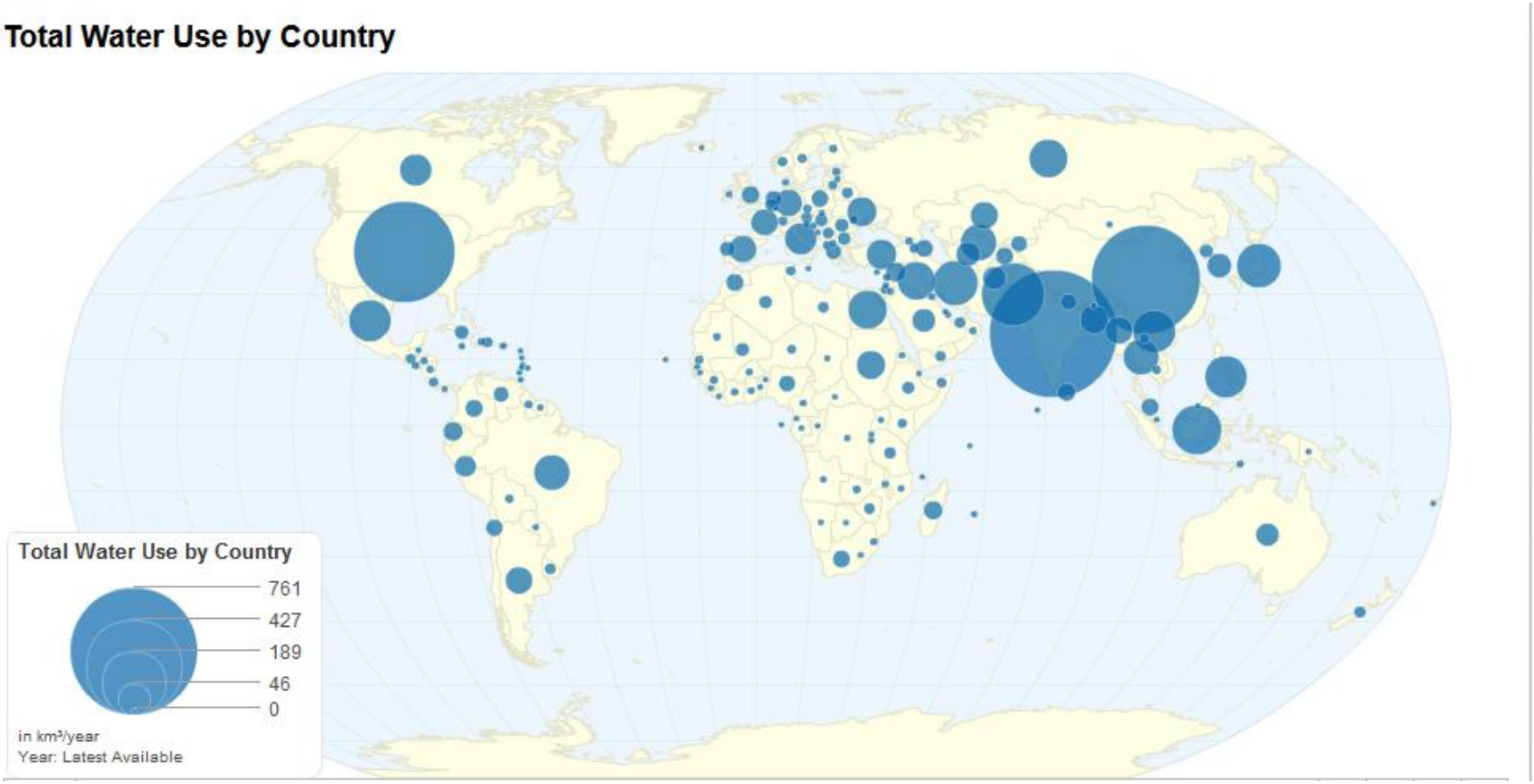


WATER SOURCE: RUNOFF

- NASA's Global Land Data Assimilation System Version 2 Selected GLDAS-2
- 1948-2008 (used 1950-2008)
- Monthly runoff summed to annual
- Resampled to 1km x 1 km



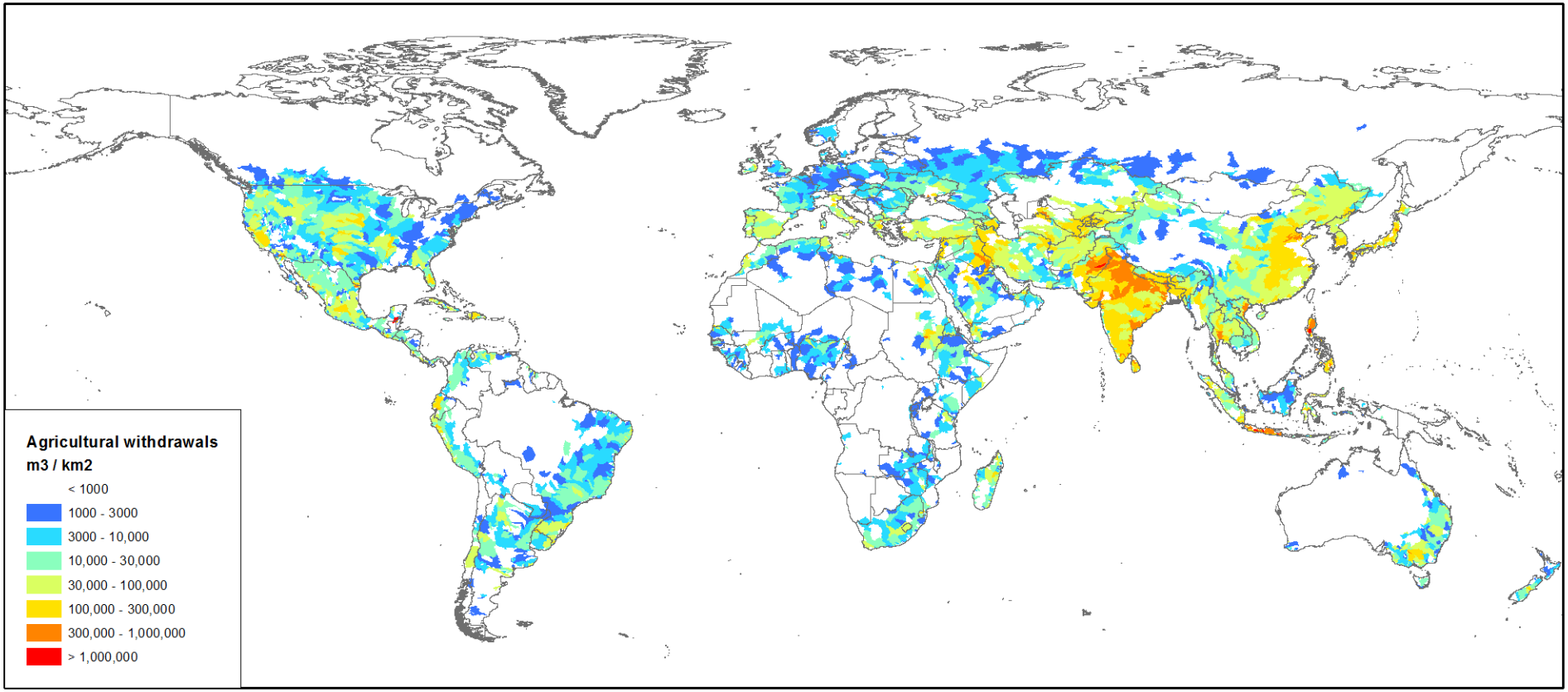
WATER DEMAND: TOTAL WATER WITHDRAWAL BY COUNTRY AND SECTOR



FAO of the UN, AQUAST database 2010

WATER DEMAND: DISAGGREGATION

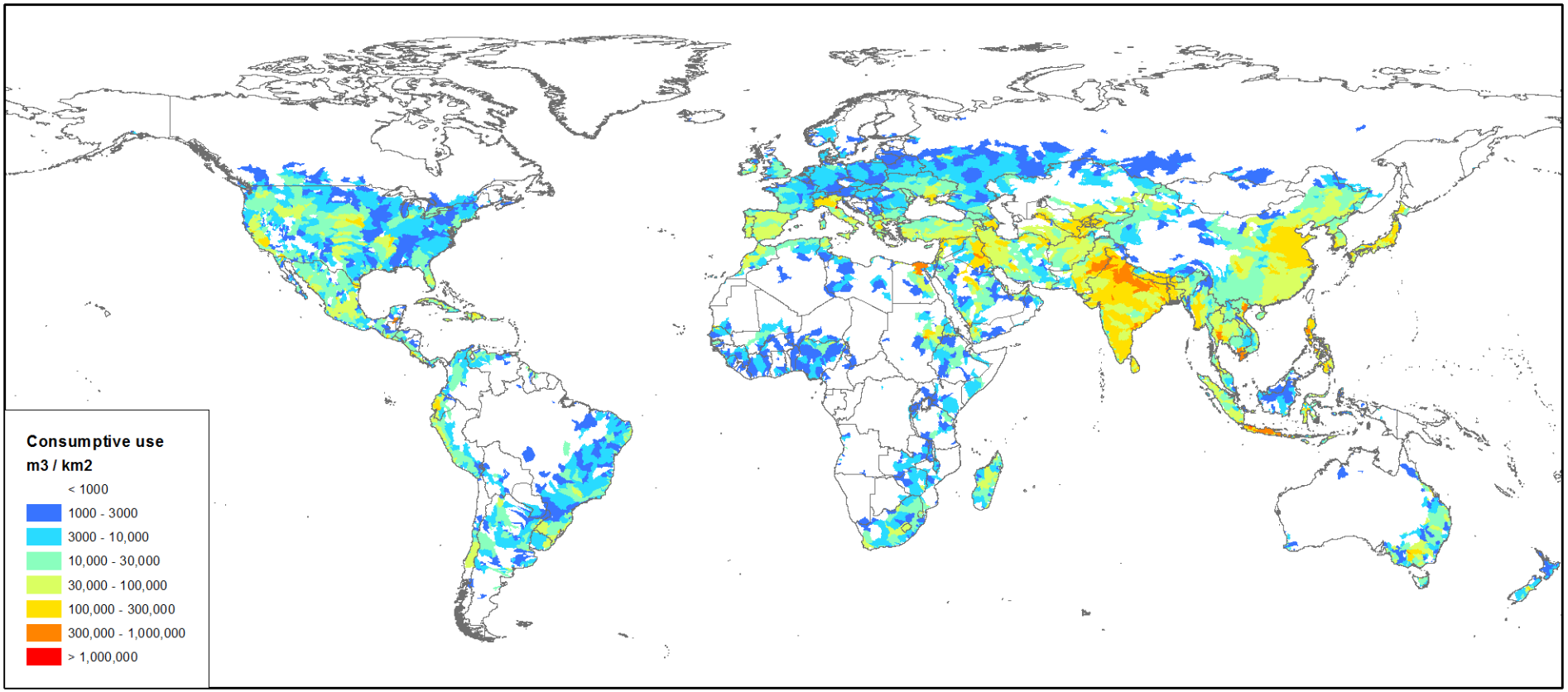
- Agricultural withdrawals disaggregated by Global Map of Irrigated Areas I2000)
- Industrial withdrawals disaggregated by Nighttime Lights (2010)
- Domestic withdrawals disaggregated by Gridded Population of the World (2010)



WATER DEMAND: CONSUMPTIVE USE

Consumptive use (C_t) is the sum of sectoral use times the sectoral consumptive use ratio (cr) (Shiklomanov and Rodda 2003)

$$C_t = (U_{agr} \times cr_{agr}) + (U_{dom} \times cr_{dom}) + (U_{ind} \times cr_{ind})$$



MODELING: FLOW ACCUMULATION

- **Runoff**
  - Precipitation minus evaporation, transpiration, and change in soil moisture
- **Total Blue Water**
  - Accumulated runoff
  - Equivalent to naturalized flow
- **Available Blue Water**
  - Upstream runoff minus consumptive use, plus runoff
  - Loosely equivalent to surface water and shallow groundwater