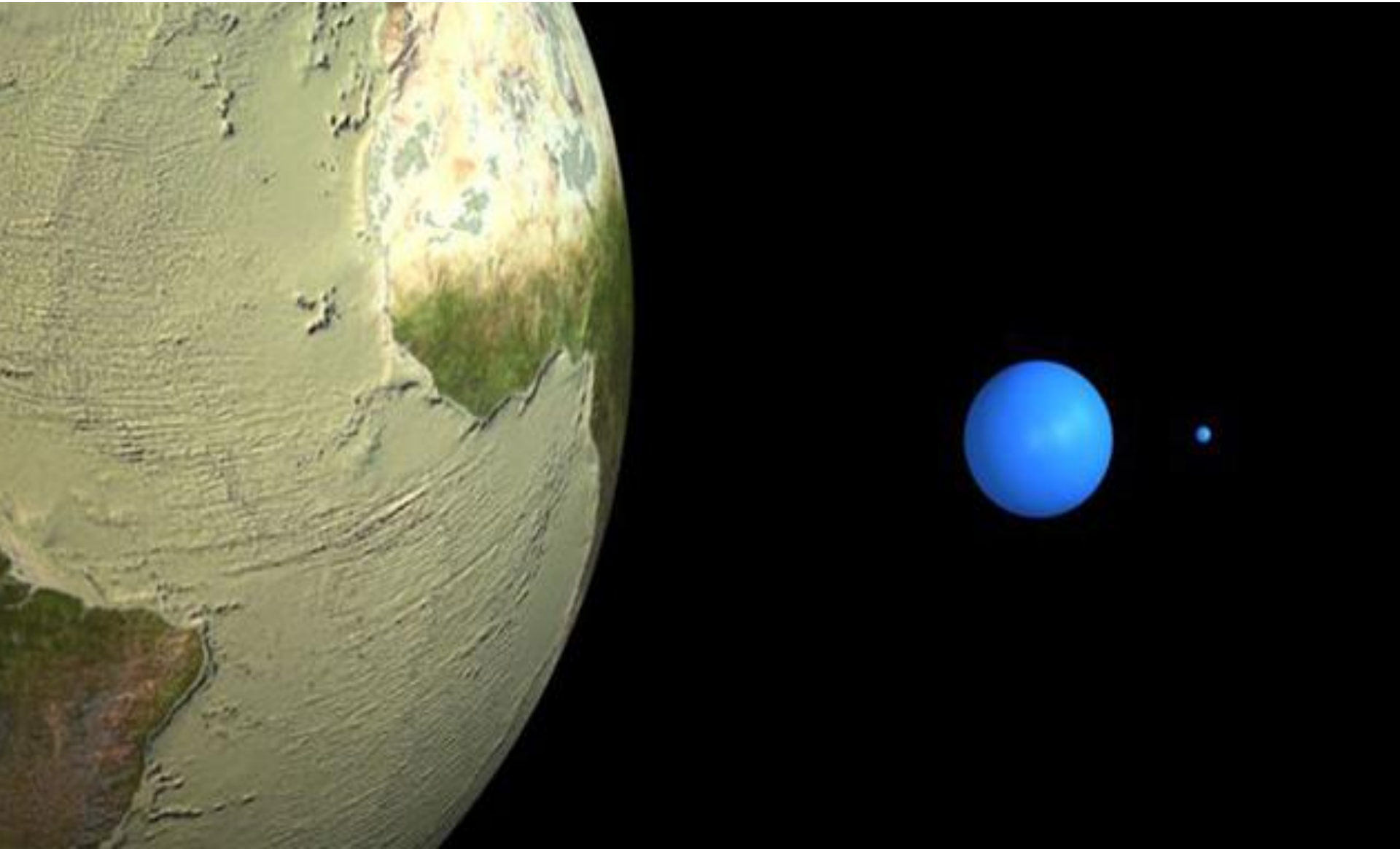
WORLD RESOURCES INSTITUTE

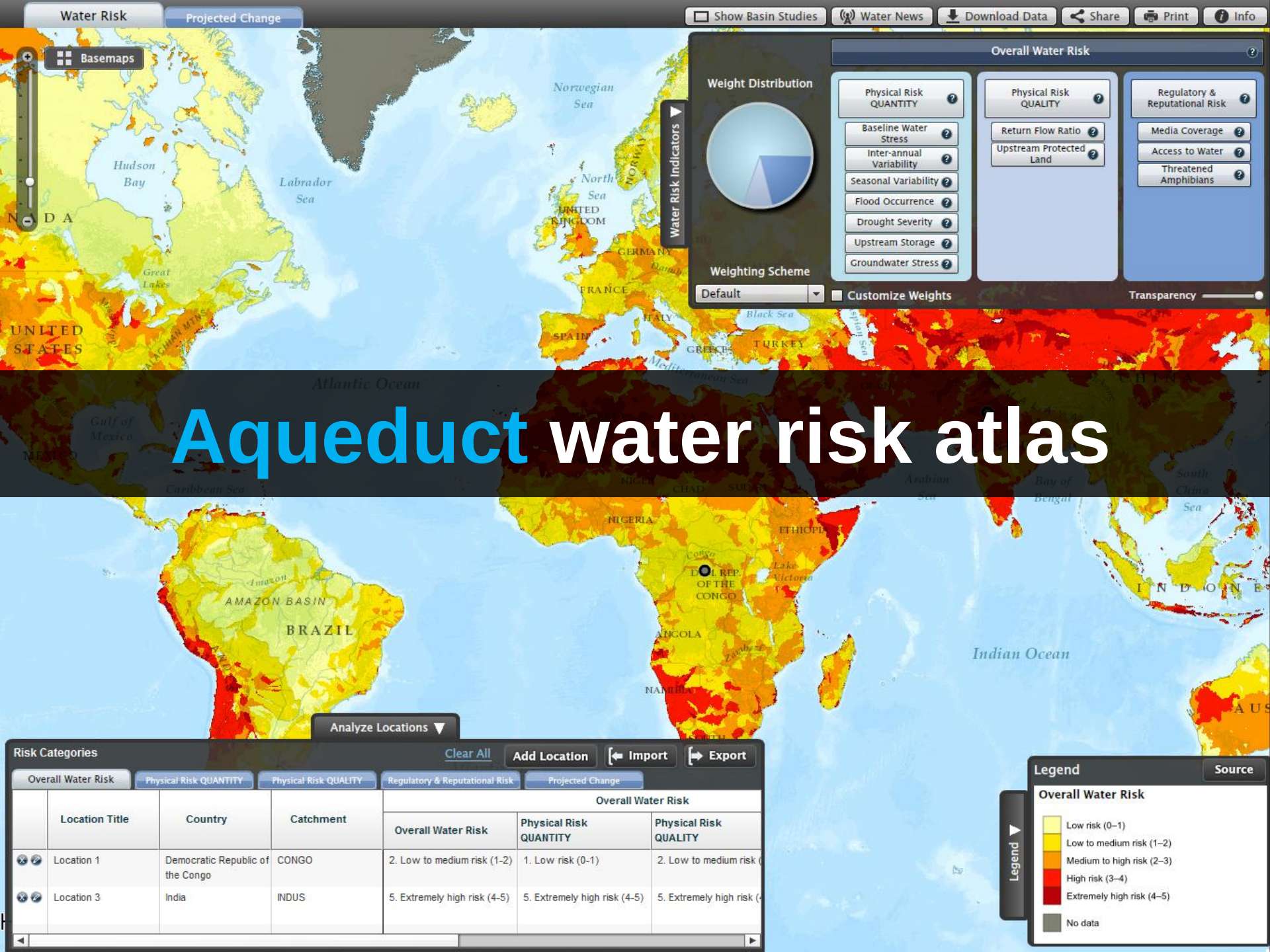
4TH FORUM ON THE CLIMATE-ENERGY SECURITY NEXUS: **WATER & ENERGY**

Modeling Challenges in Understanding the Climate Change Water-Energy Nexus

BETSY OTTO, GLOBAL DIRECTOR, WATER PROGRAM

FRESHWATER SCARCITY




Water Risk
Projected Change
Show Basin Studies
Water News
Download Data
Share
Print
Info
Basemaps
Overall Water Risk
Weight Distribution
Physical Risk QUANTITY
Baseline Water Stress
Inter-annual Variability
Seasonal Variability
Flood Occurrence
Drought Severity
Upstream Storage
Groundwater Stress
Physical Risk QUALITY
Return Flow Ratio
Upstream Protected Land
Regulatory & Reputational Risk
Media Coverage
Access to Water
Threatened Amphibians
Water Risk Indicators
Weighting Scheme
Default
Customize Weights
Transparency
Aqueduct water risk atlas
Analyze Locations
Risk Categories
Clear All
Add Location
Import
Export
Overall Water Risk
Physical Risk QUANTITY
Physical Risk QUALITY
Regulatory & Reputational Risk
Projected Change
Location Title
Country
Catchment
Overall Water Risk
Physical Risk QUANTITY
Physical Risk QUALITY
Location 1
Democratic Republic of the Congo
CONGO
2. Low to medium risk (1-2)
1. Low risk (0-1)
2. Low to medium risk
Location 3
India
INDUS
5. Extremely high risk (4-5)
5. Extremely high risk (4-5)
5. Extremely high risk
Legend
Source
Overall Water Risk
Low risk (0–1)
Low to medium risk (1–2)
Medium to high risk (2–3)
High risk (3–4)
Extremely high risk (4–5)
No data

AQUEDUCT

MEASURING AND MAPPING WATER RISKS

MAPS AND DATA:

- Surface water supply and demand by sector: industry, agriculture, municipalities
- Groundwater (where it is being overdrafted relative to supply)
- Water supply variability
- Historic flood and drought occurrences
- Upstream water storage capacity
- Total of 12 indicators on water related risk

Projections of water stress and flood risk for 2020, 2030, 2040

All data for 15,000 catchments globally

WATER PROGRAM PARTNERS

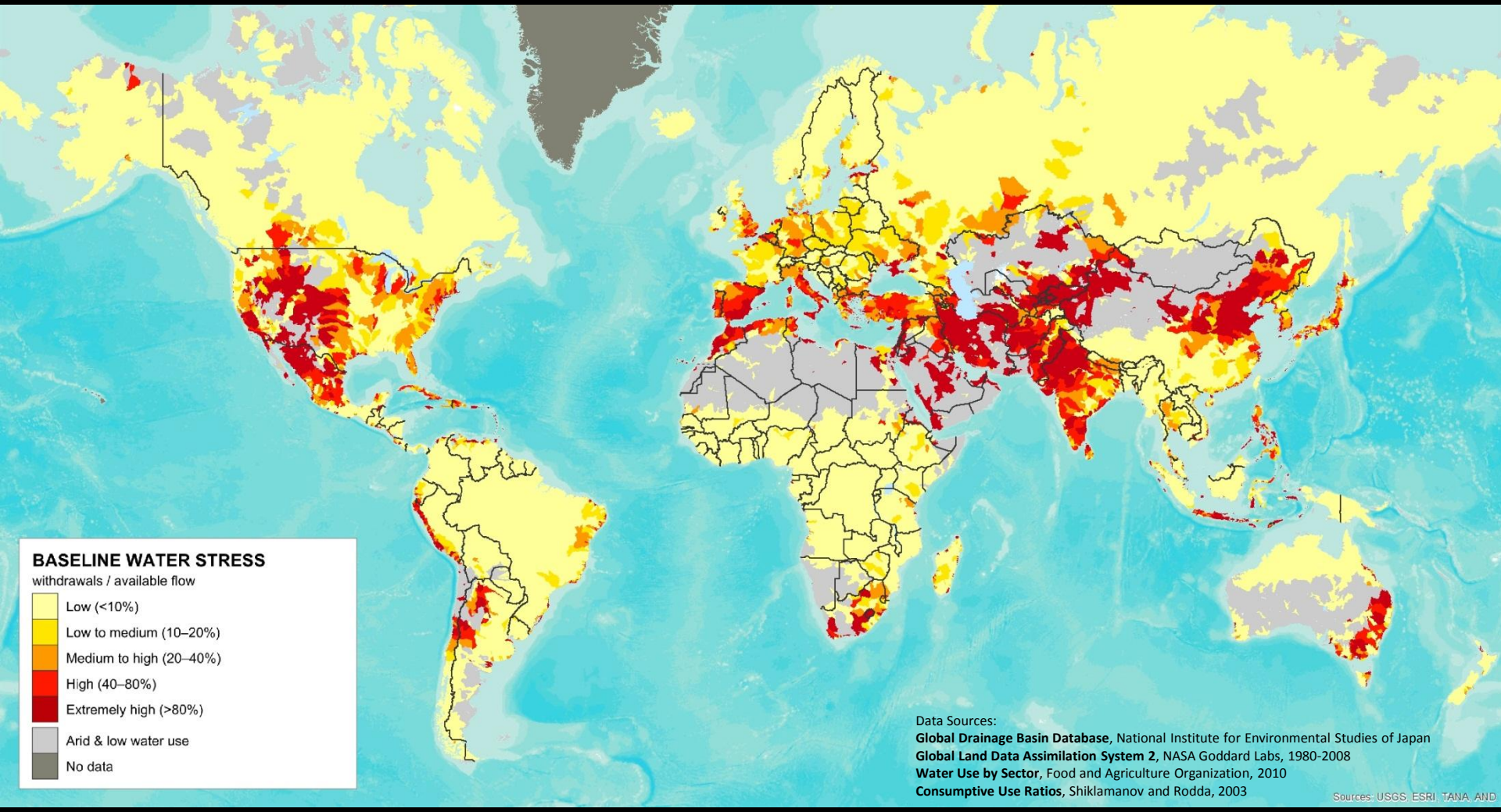
Kingdom of the Netherlands

The Government of Denmark

AQUEDUCT CORPORATE USERS

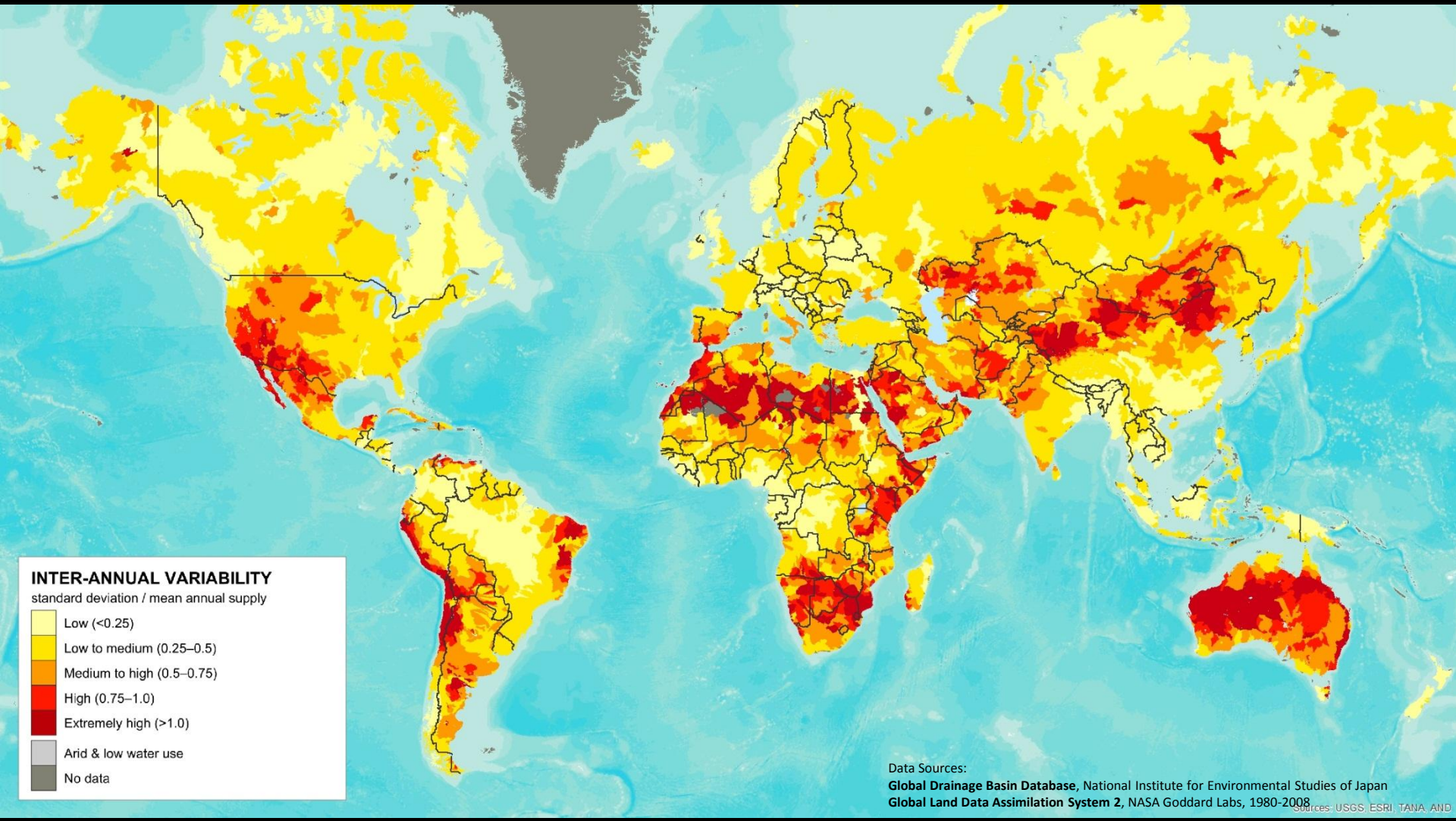
BASELINE WATER STRESS

total annual water withdrawals (municipal, industrial, and agricultural) expressed as a percent of the total annual available flow; higher values indicate more competition among users



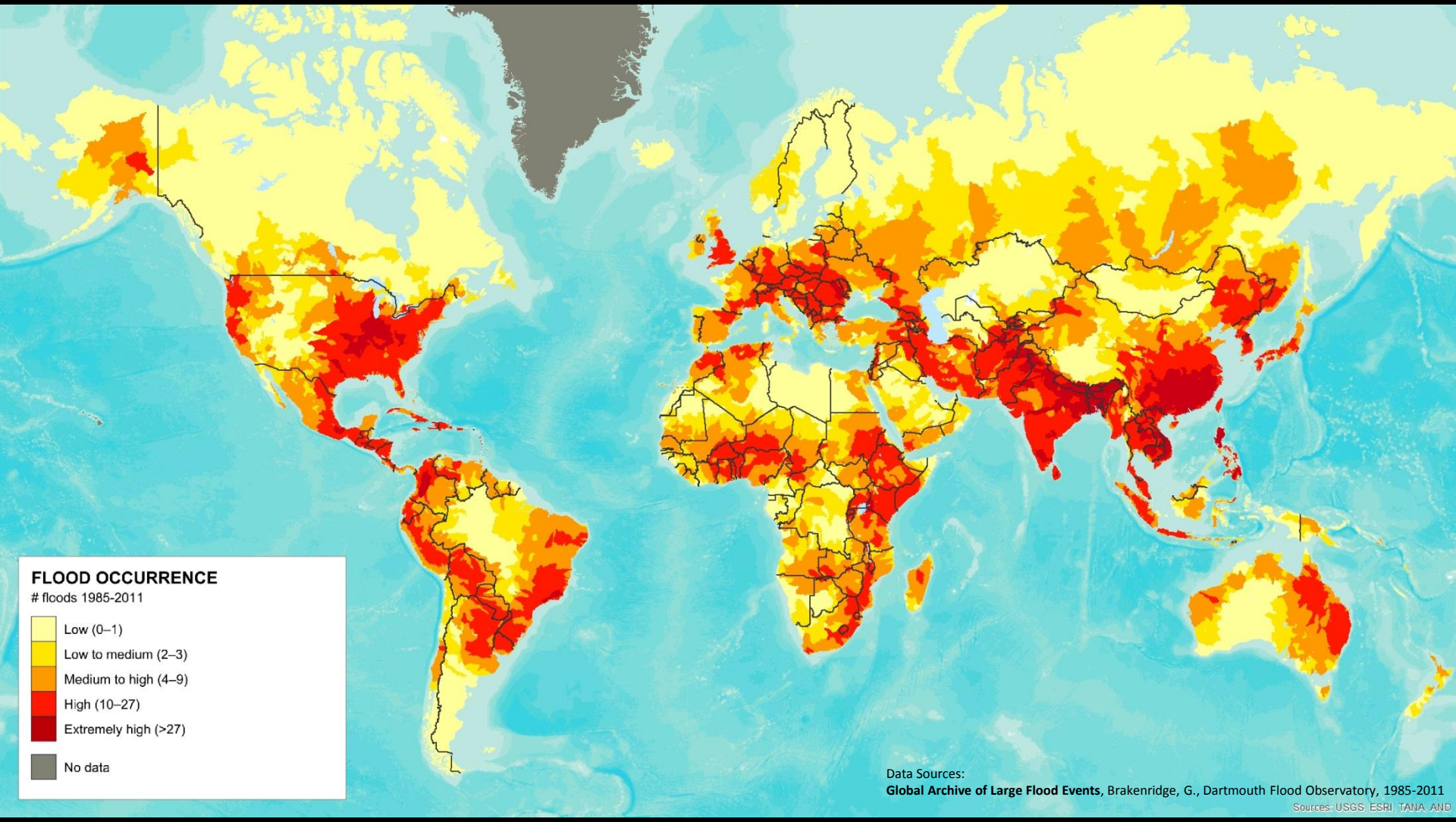
INTER-ANNUAL VARIABILITY

variation in water supply from year-to-year



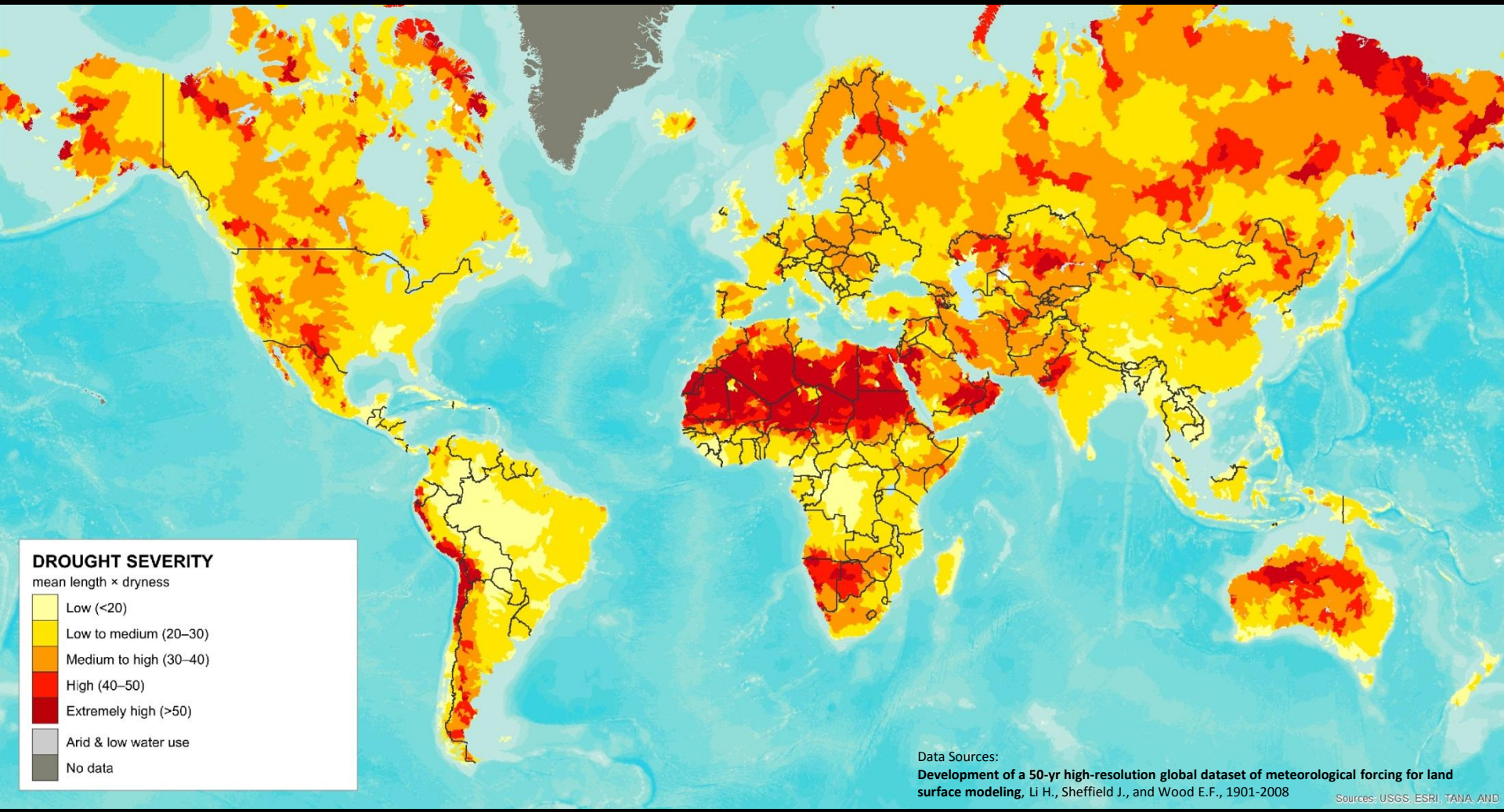
FLOOD OCCURRENCE

count of the number of floods recorded from 1985 to the present date



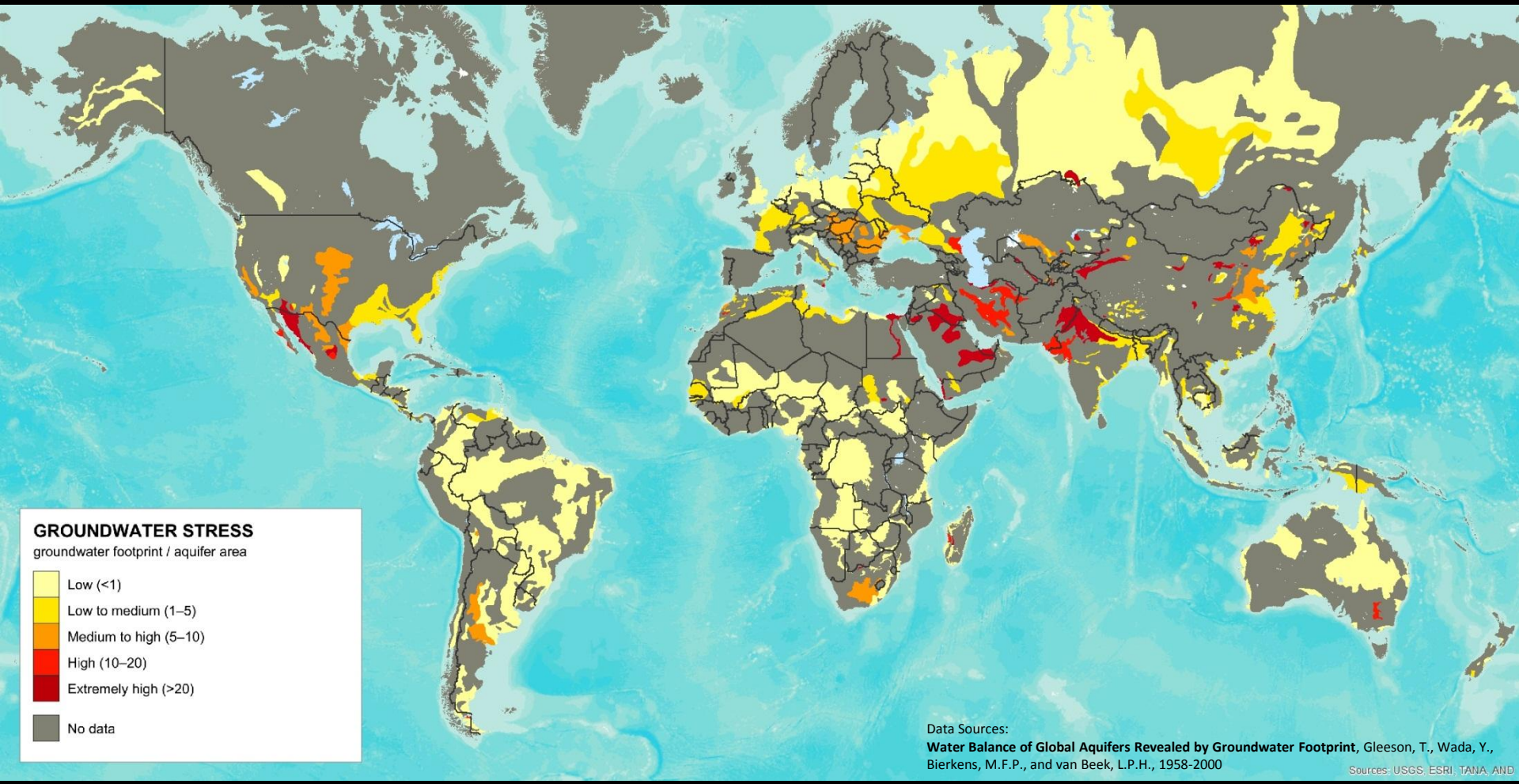
DROUGHT SEVERITY

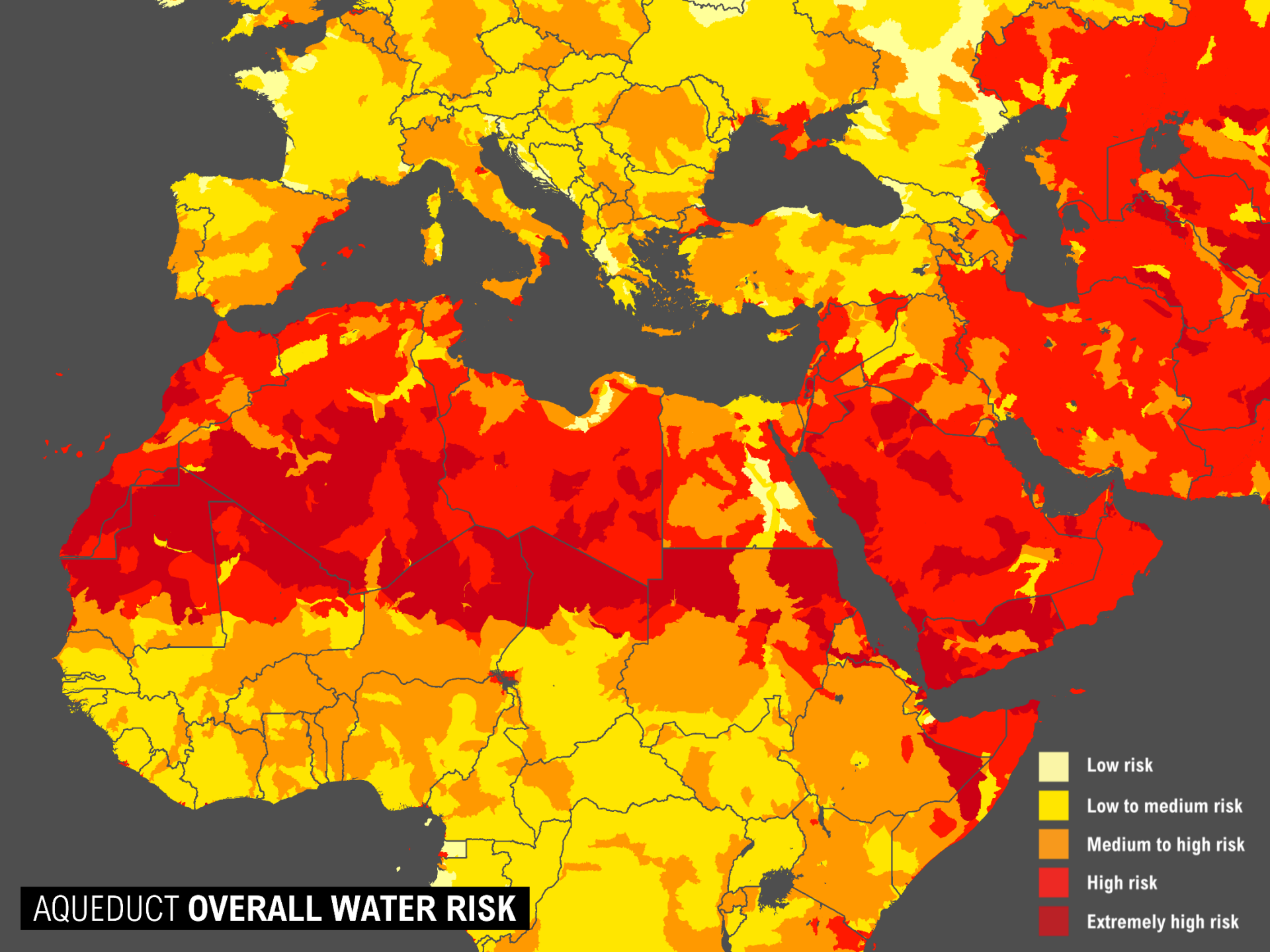
average length times dryness of droughts from 1901 to 2008 (drought is defined as a contiguous period where soil moisture remains below the 20th percentile)

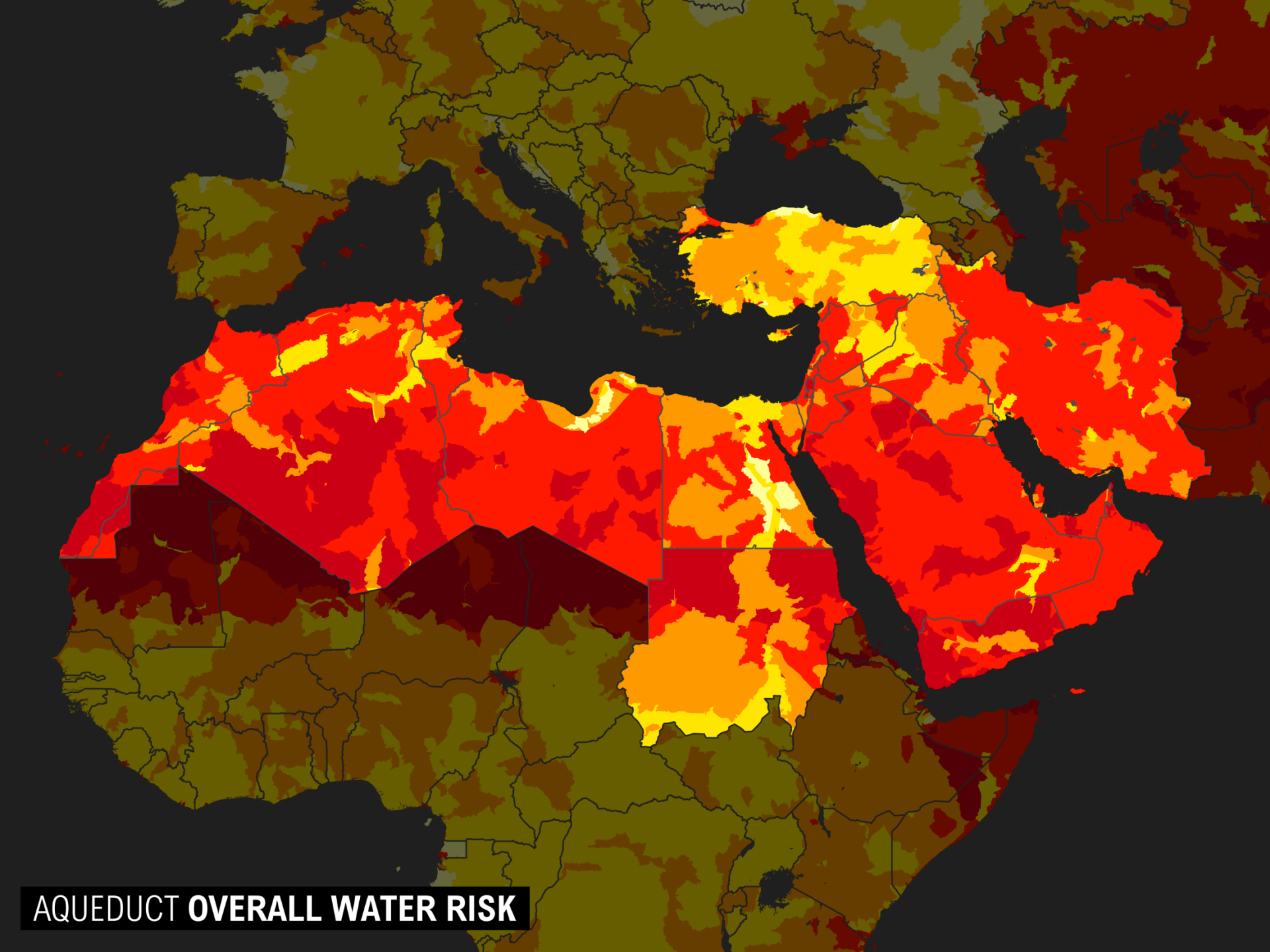


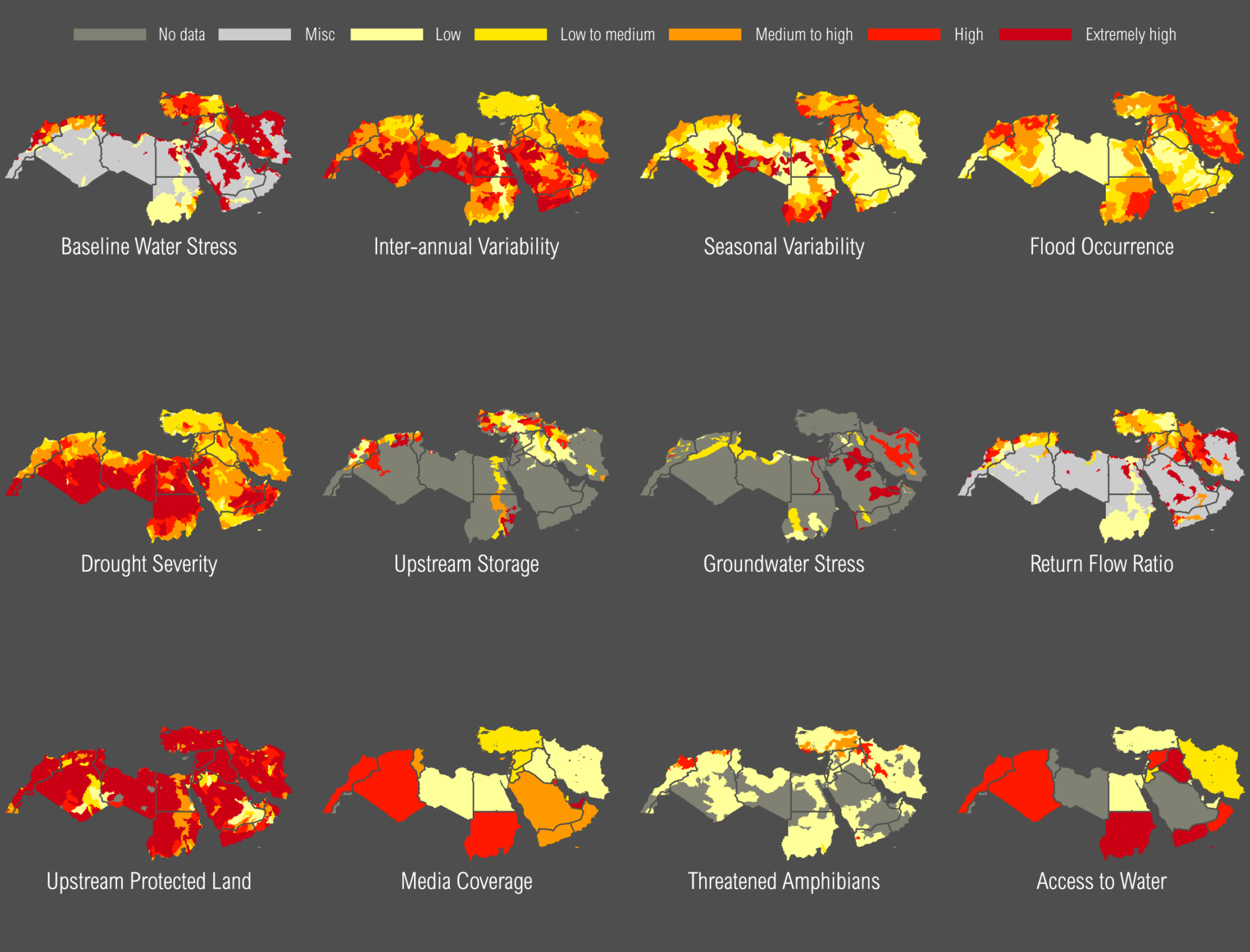
GROUNDWATER STRESS

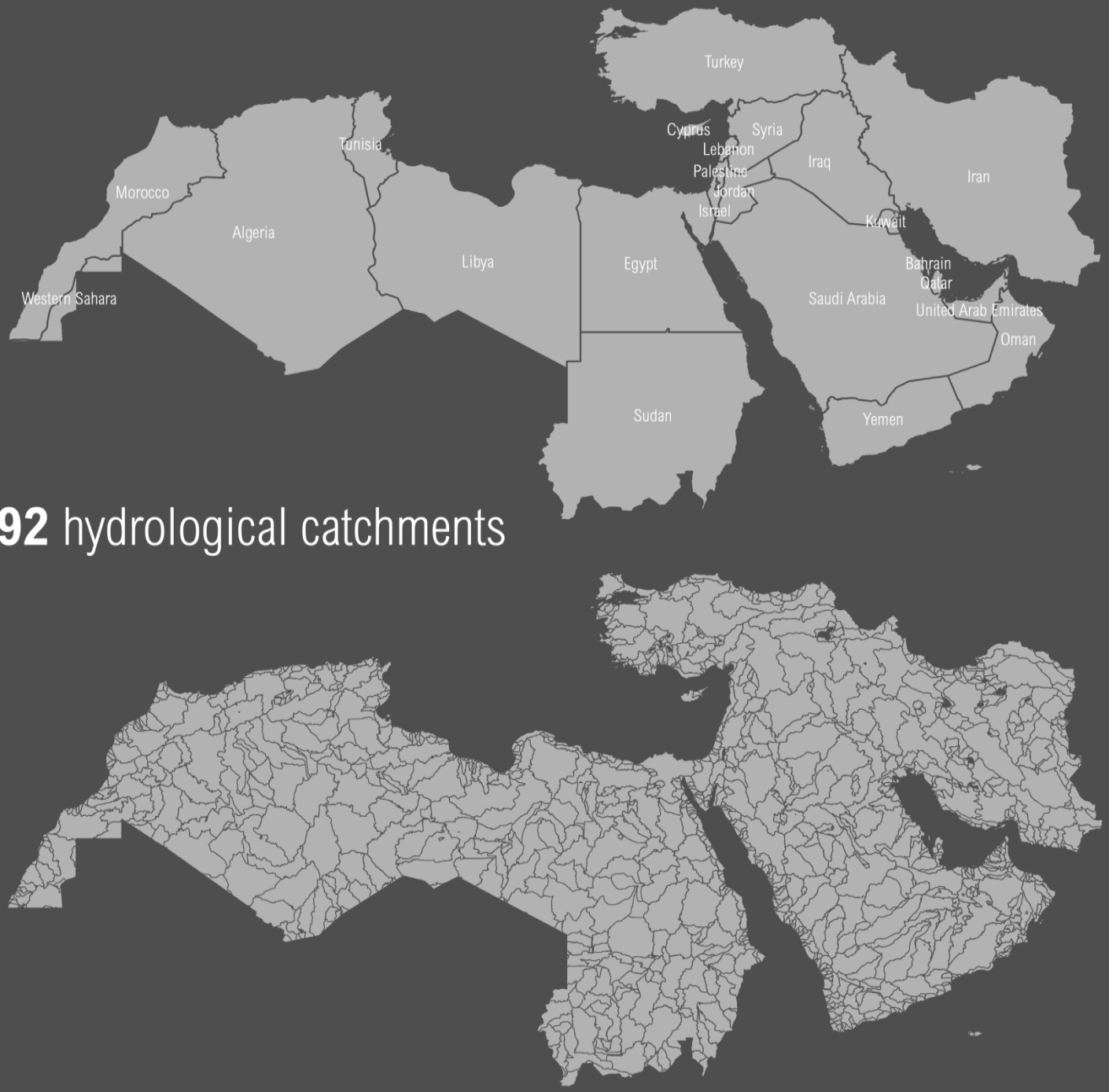
the ratio of groundwater withdrawal relative to the recharge rate to aquifer size; values above one indicate where unsustainable consumption could affect groundwater availability and dependent ecosystems




Low risk
Low to medium risk
Medium to high risk
High risk
Extremely high risk
AQUEDUCT OVERALL WATER RISK


AQUEDUCT **OVERALL WATER RISK**

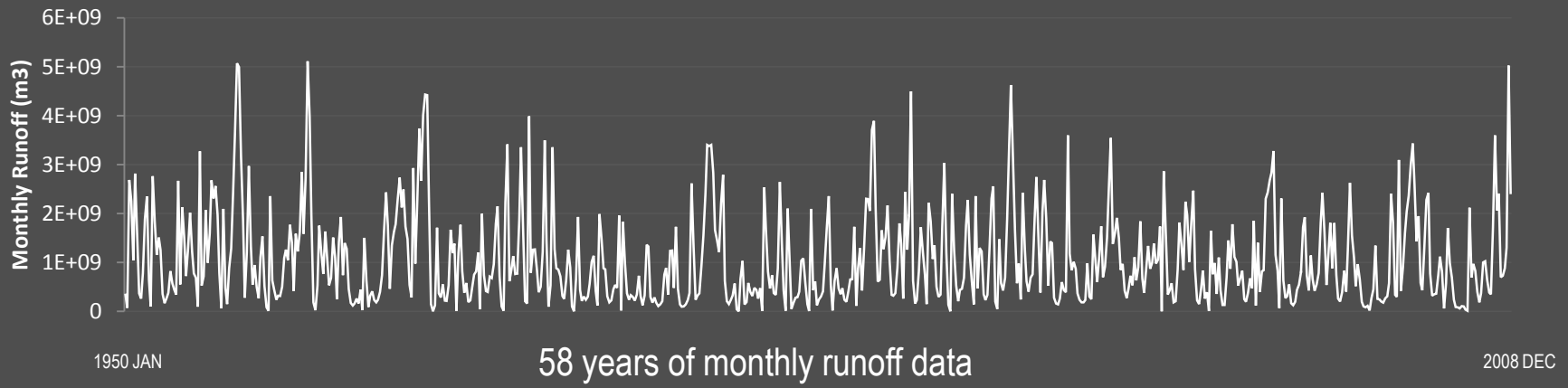

No data
Misc
Low
Low to medium
Medium to high
High
Extremely high
Baseline Water Stress
Inter-annual Variability
Seasonal Variability
Flood Occurrence
Drought Severity
Upstream Storage
Groundwater Stress
Return Flow Ratio
Upstream Protected Land
Media Coverage
Threatened Amphibians
Access to Water



1392 hydrological catchments

1392 hydrological catchments

696 months of runoff data for each catchment



WATER STRESS & CLIMATE

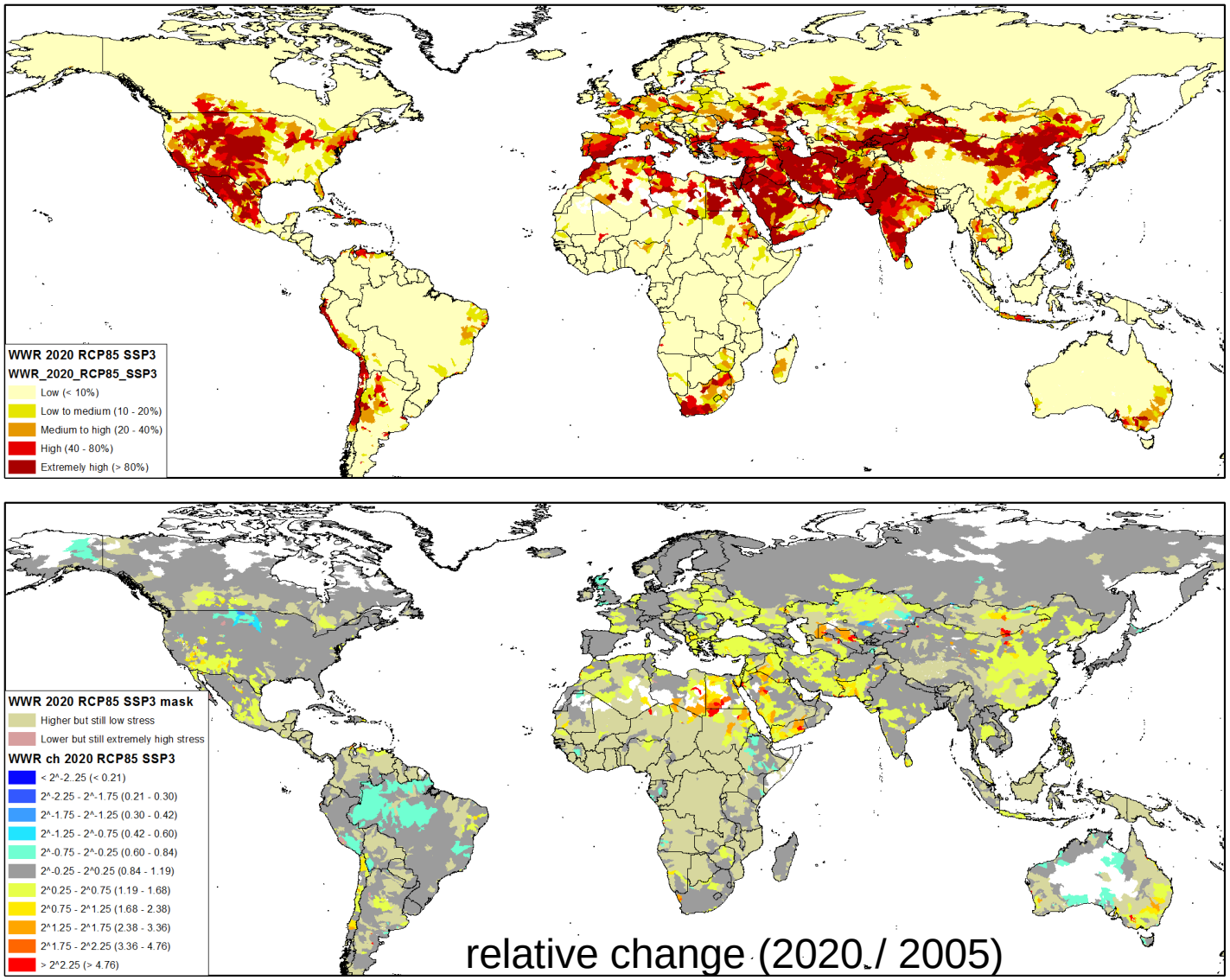
Projected Change in Water Stress Maps

- **Objective:**
  - Plausible scenarios of future water stress
  - Based on expected climatic and socioeconomic changes

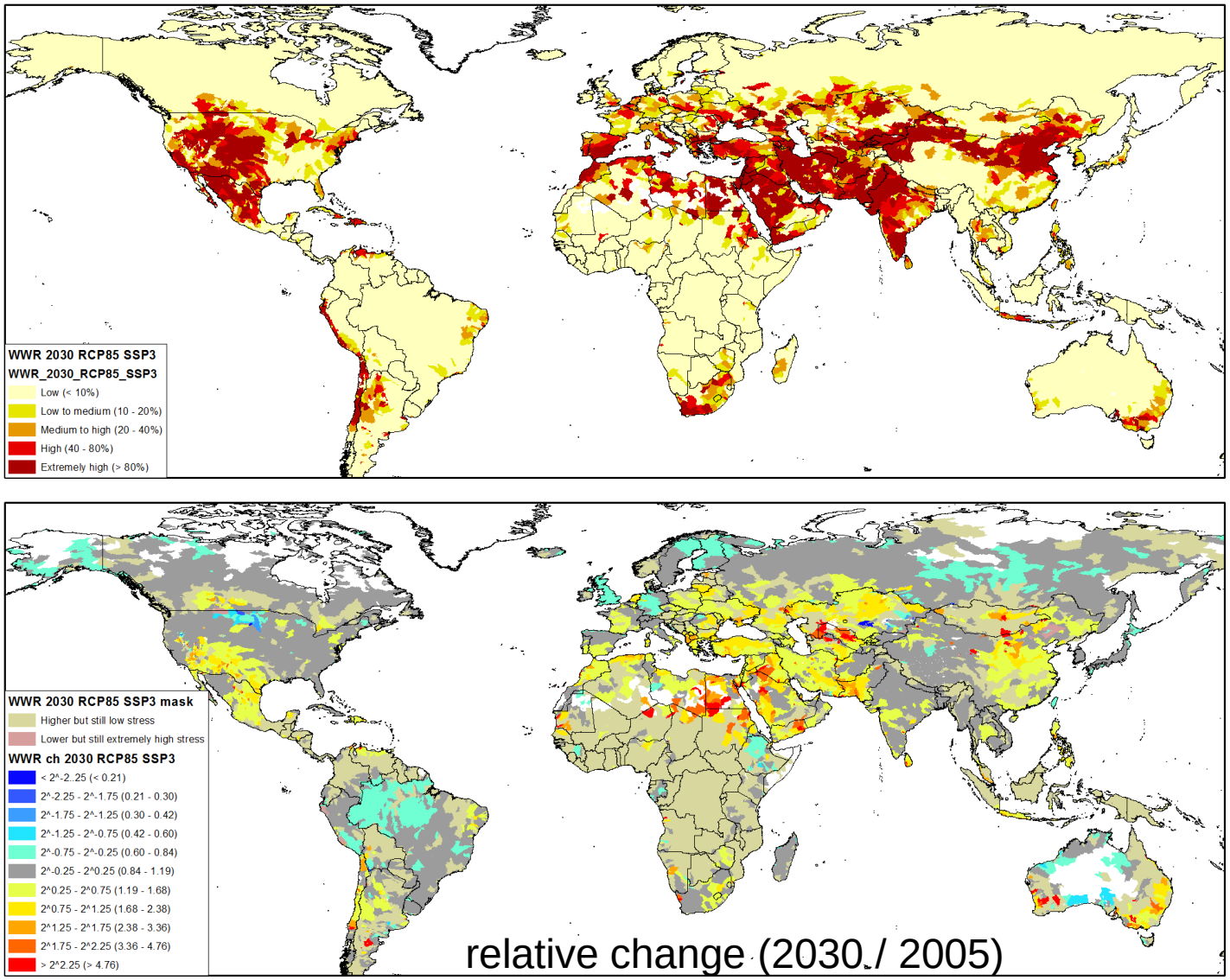
- **Intended audience:**
  - Corporate strategists
  - National and regional policy-makers
  - Multi-lateral development banks

- **Intended use:**
  - Evaluate long-term business risks and opportunities
  - Evaluate regional water-related risks and adaptation strategies
  - Prioritize investments and policy interventions
  - Not intended for site-specific assessment

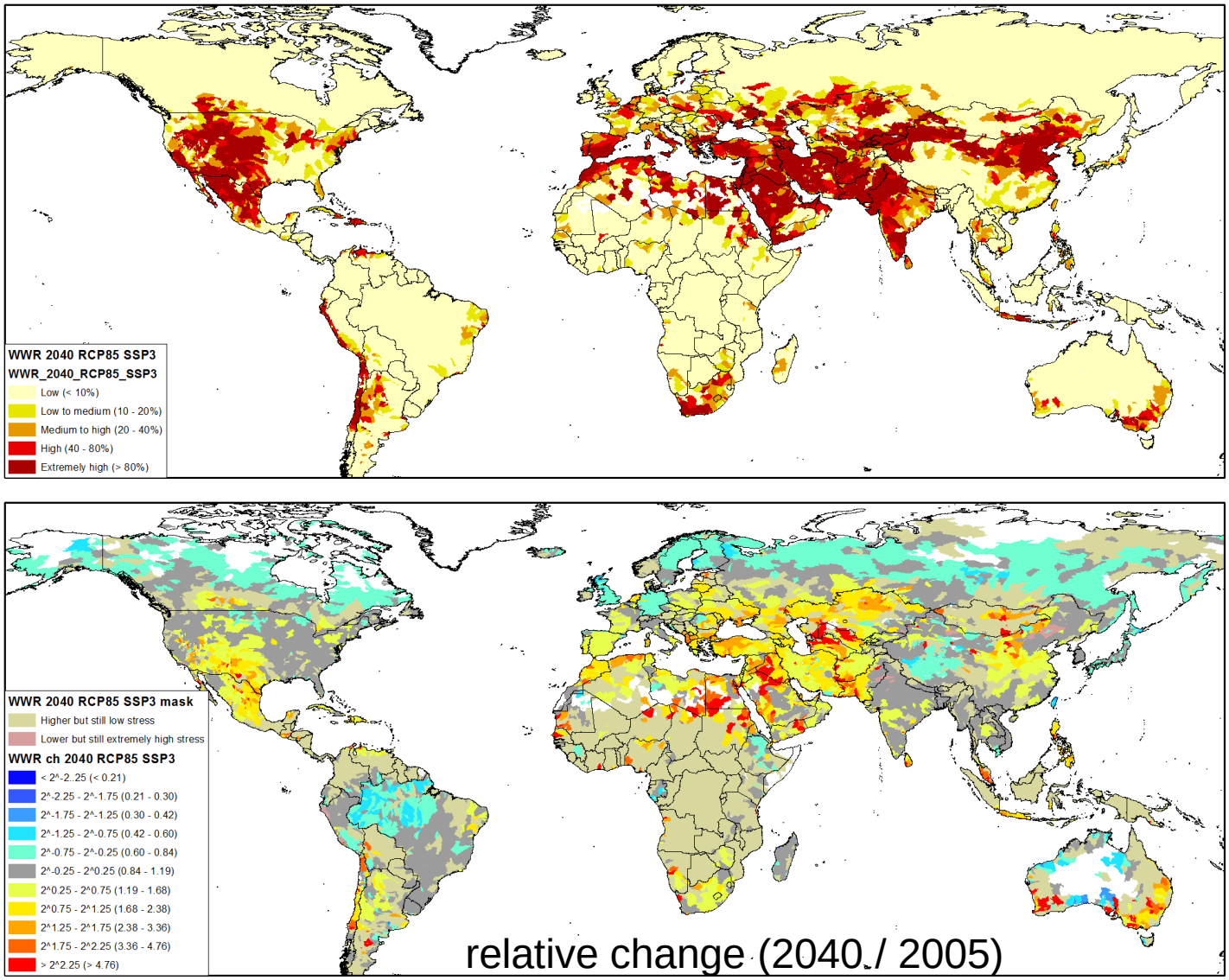
WATER STRESS (RCP85/SSP3) 2020



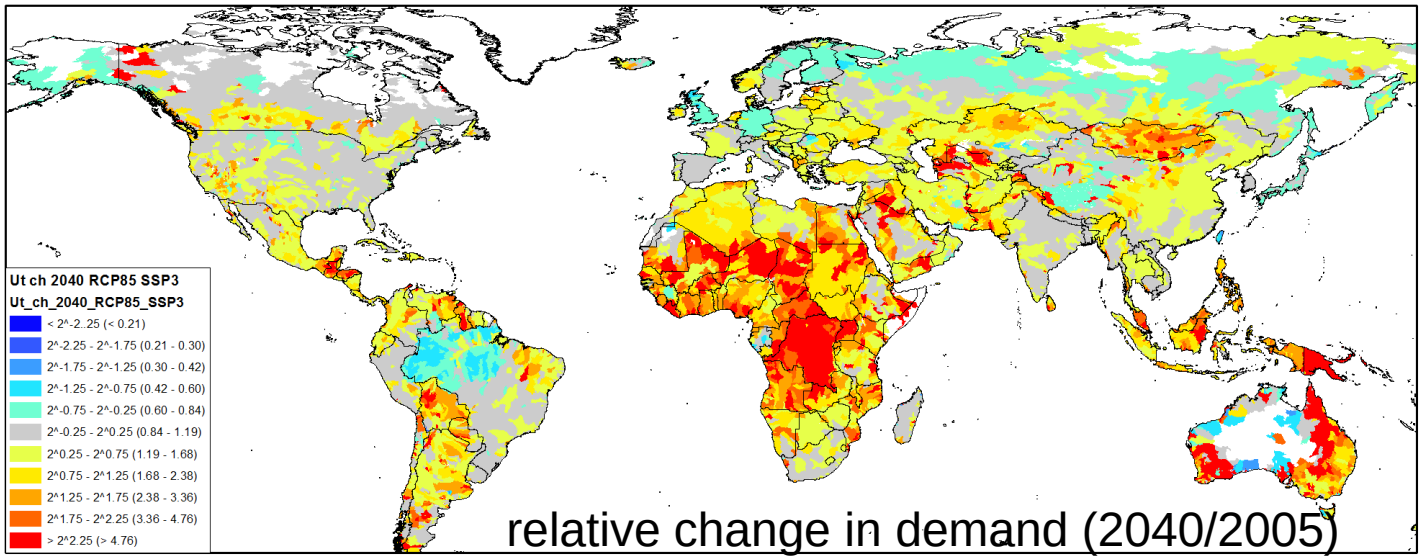
WATER STRESS (RCP85/SSP3) 2030

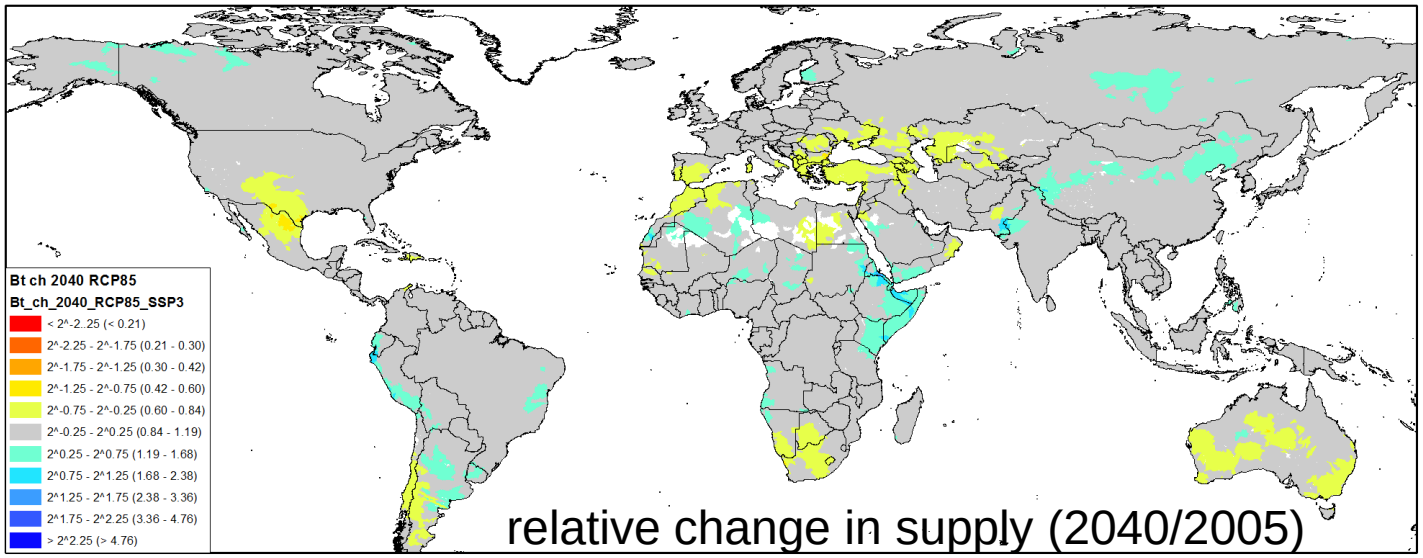


WATER STRESS (RCP85/SSP3) 2040

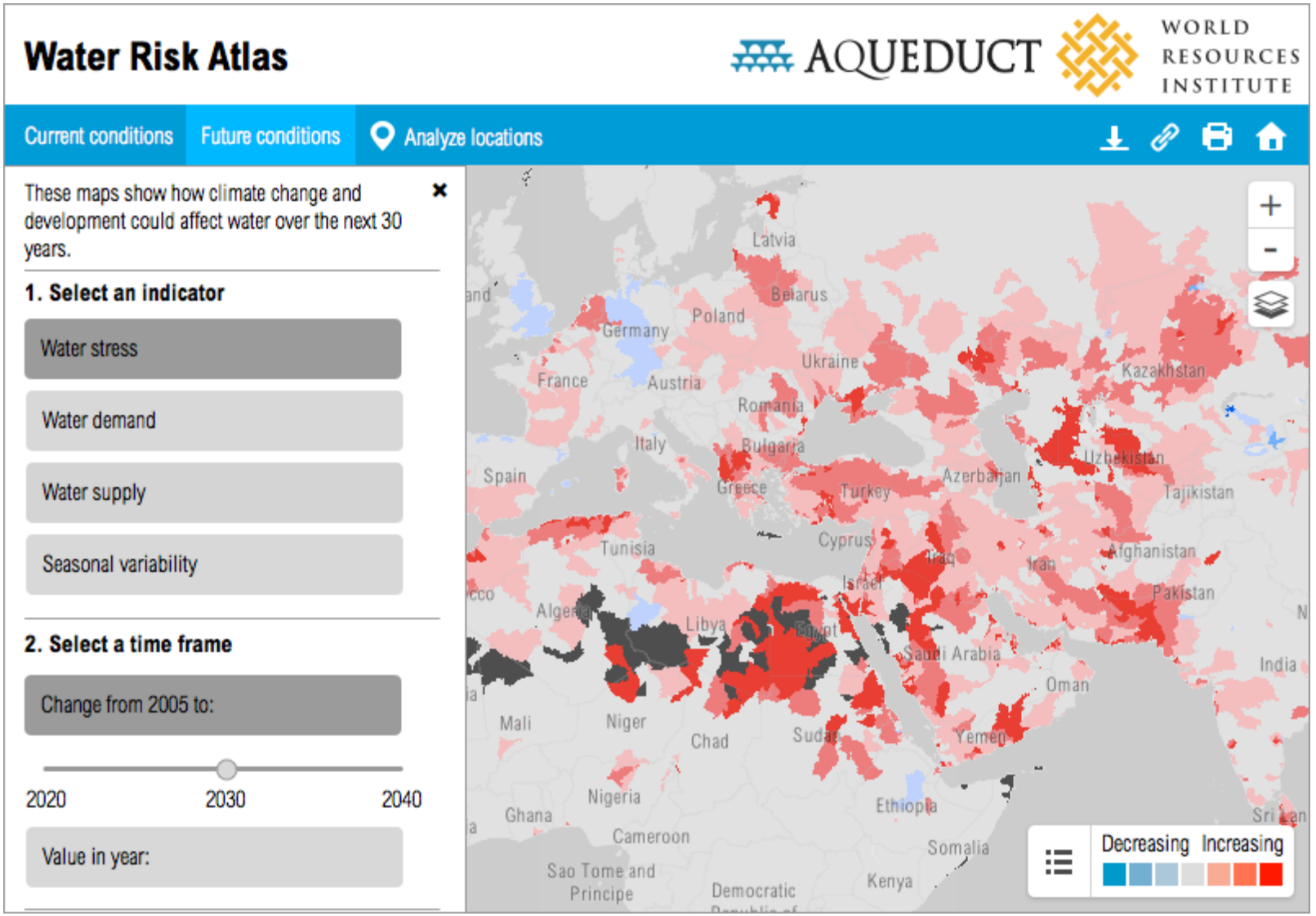


RELATIVE CHANGE IN SUPPLY & DEMAND

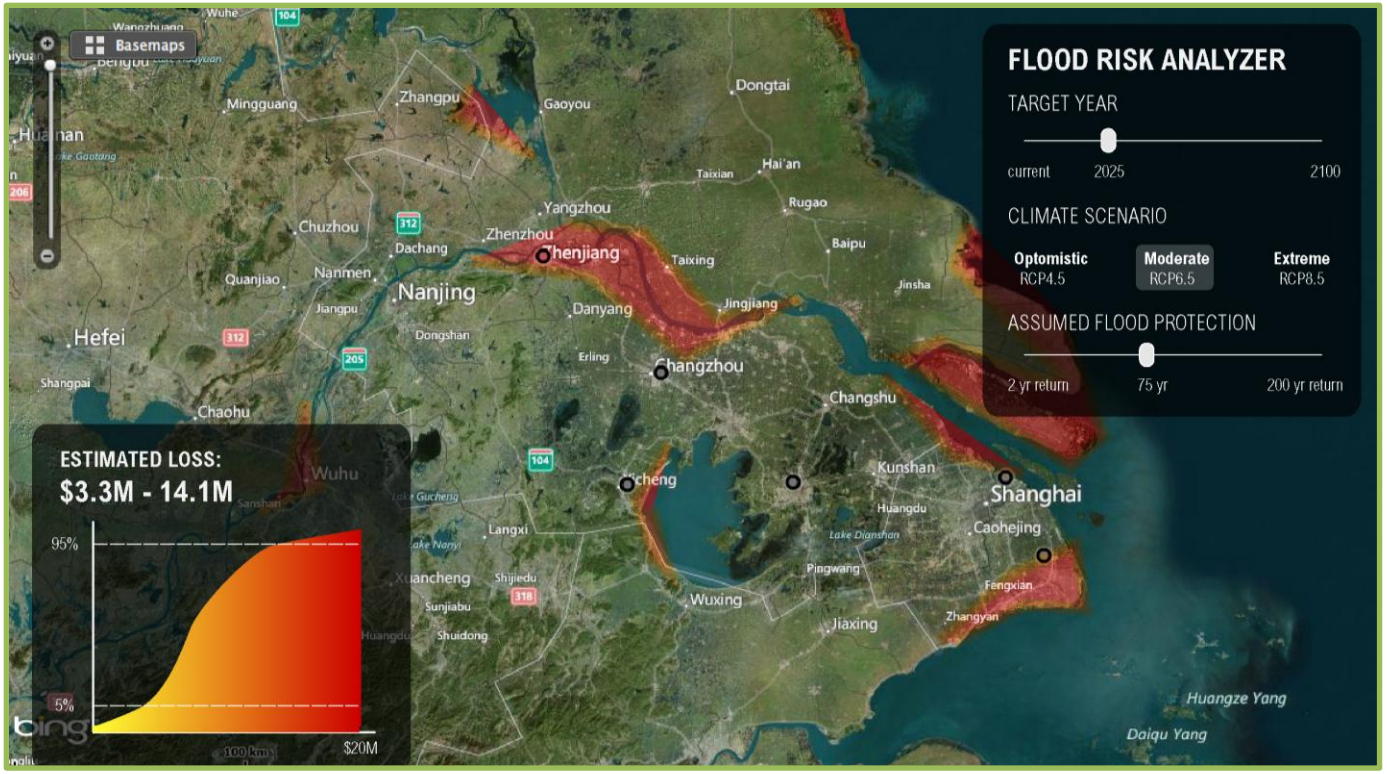




Aqueduct Water Risk Atlas

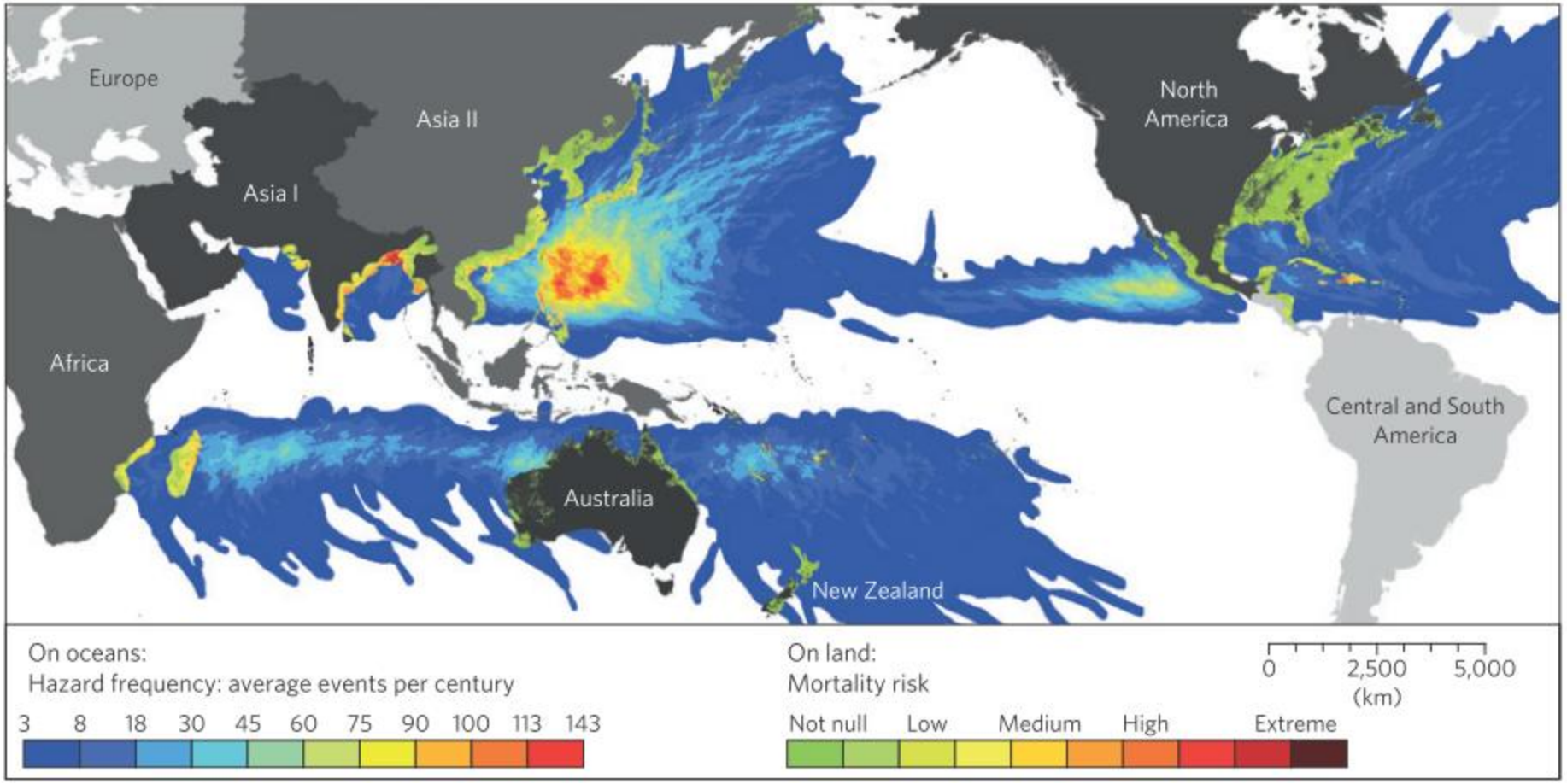


RIVER FLOOD PROJECTIONS (Proposed collaboration with Deltares, VU University Amsterdam, Utrecht University, and PBL)



Global indicators of flood risk under current and future climate and socio-economic conditions.

STORM SURGE MODELLING (Proposed collaboration with Deltares, VU University Amsterdam, Utrecht University, and PBL)



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iSciences

IVM Institute for Environmental Studies

Universiteit Utrecht

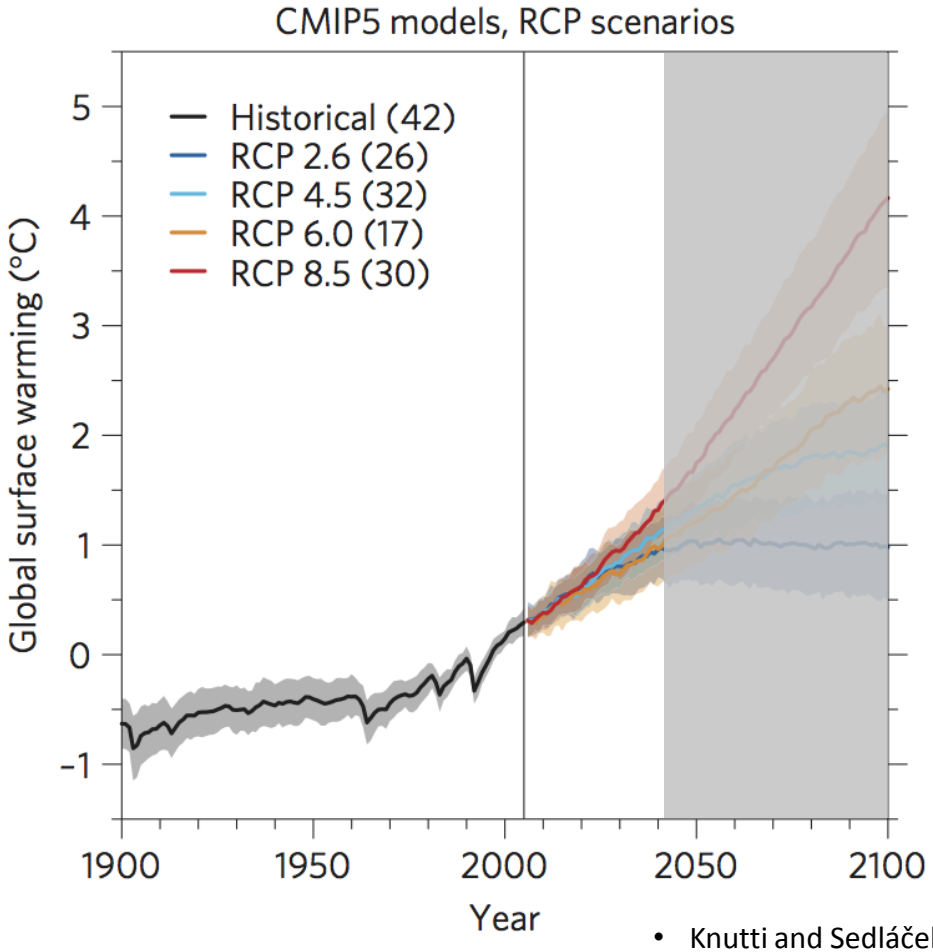
Deltares
Enabling Delta Life

APPENDIX

KEY PARAMETERS (CLIMATE)

- Baseline year: 2005
- Target years: 2020, 2030, 2040

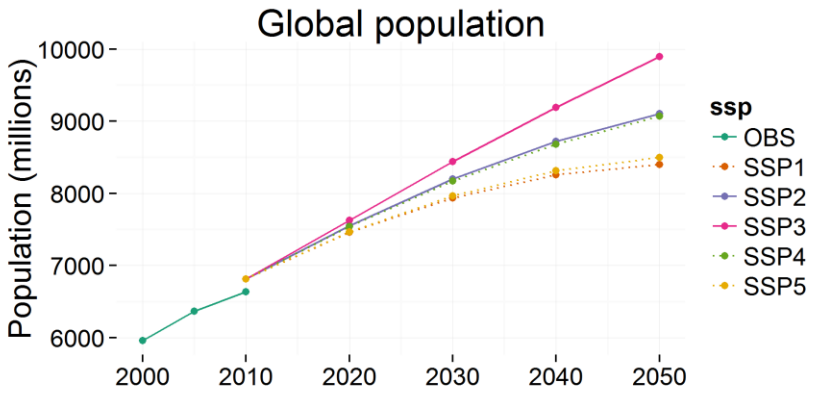
- RCP (Representative Concentration Pathways): climate scenarios
  - **RCP85**: "Business as usual"
    - 8.5 W m^{-2} radiative forcing, 1370 CO_2 ppm, > 4°C by 2100
  - **RCP45**: "Cautiously optimistic"
    - 4.5 W m^{-2}, 650 ppm, 2.5°C.
  - Limited divergence prior to 2040

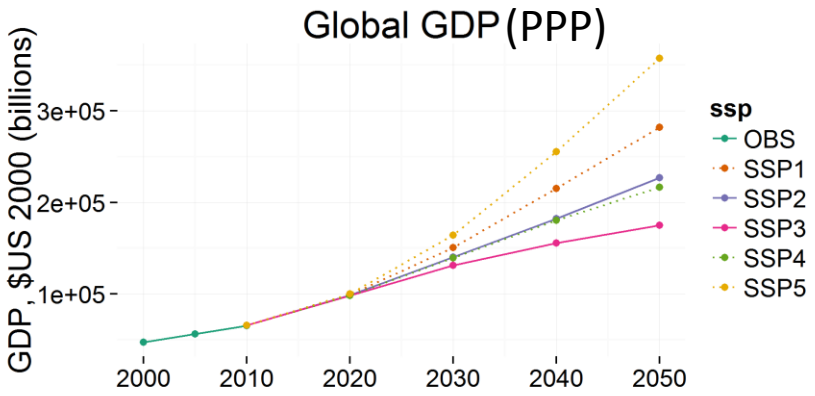


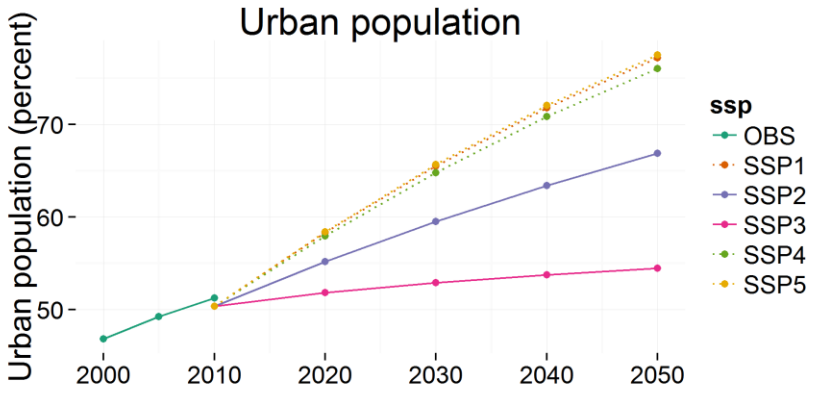
- Knutti and Sedláček 2012

KEY PARAMETERS

- SSP: Shared socioeconomic pathways
  - **SSP2**: “Business as usual”
  - **SSP3**: “Fragmented world”
- Selected scenarios
  - **RCP45/SSP2**: Cautiously optimistic
  - **RCP85/SSP2**: Present trends continue
  - **RCP85/SSP3**: Worst case

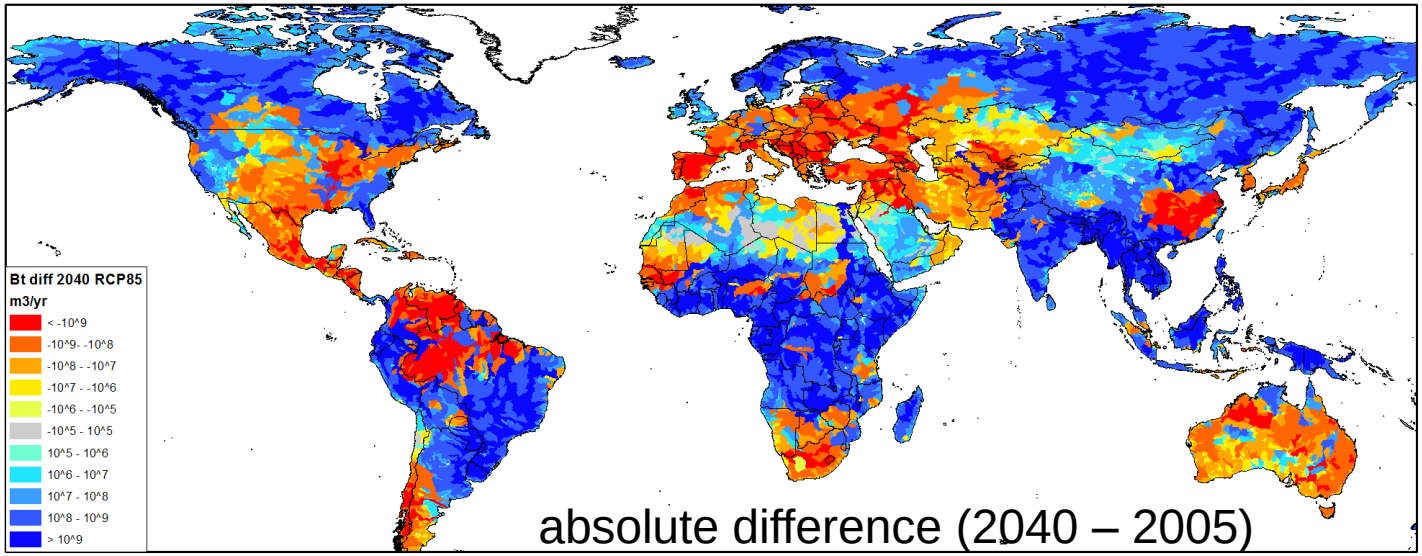




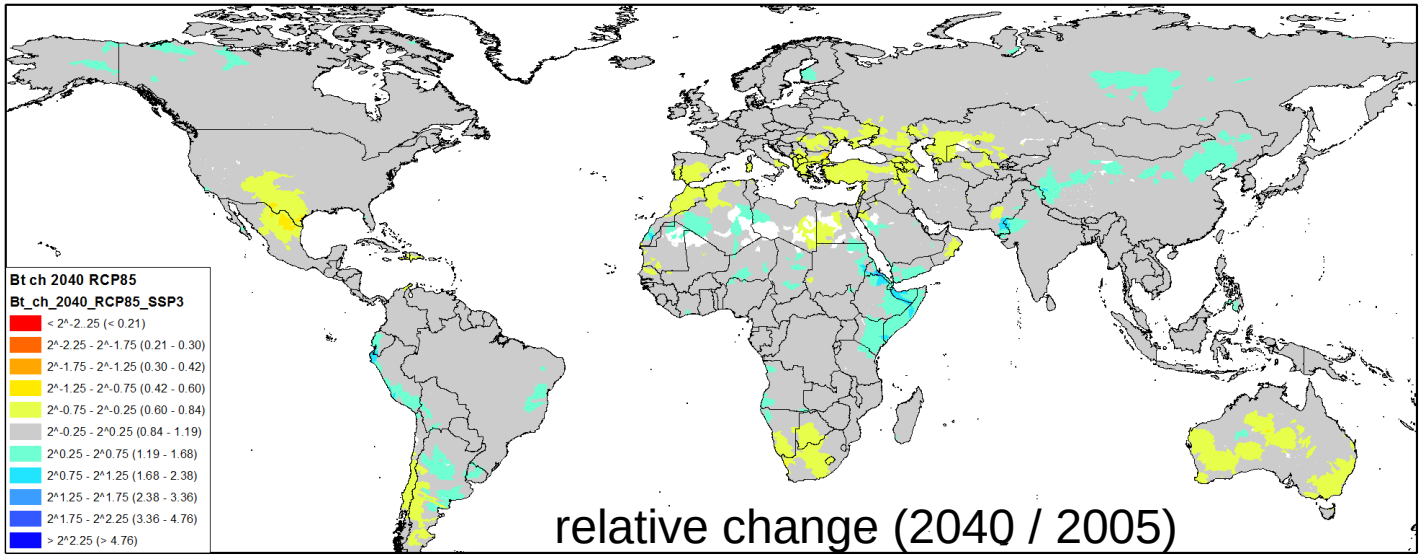


AQUEDUCT

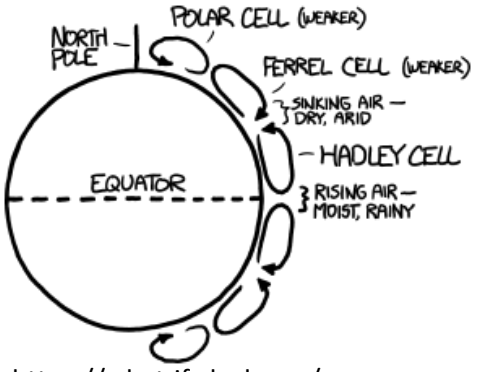
TOTAL BLUE WATER 2040



absolute difference (2040 – 2005)



relative change (2040 / 2005)



https://what-if.xkcd.com/

AQUEDUCT

isciences

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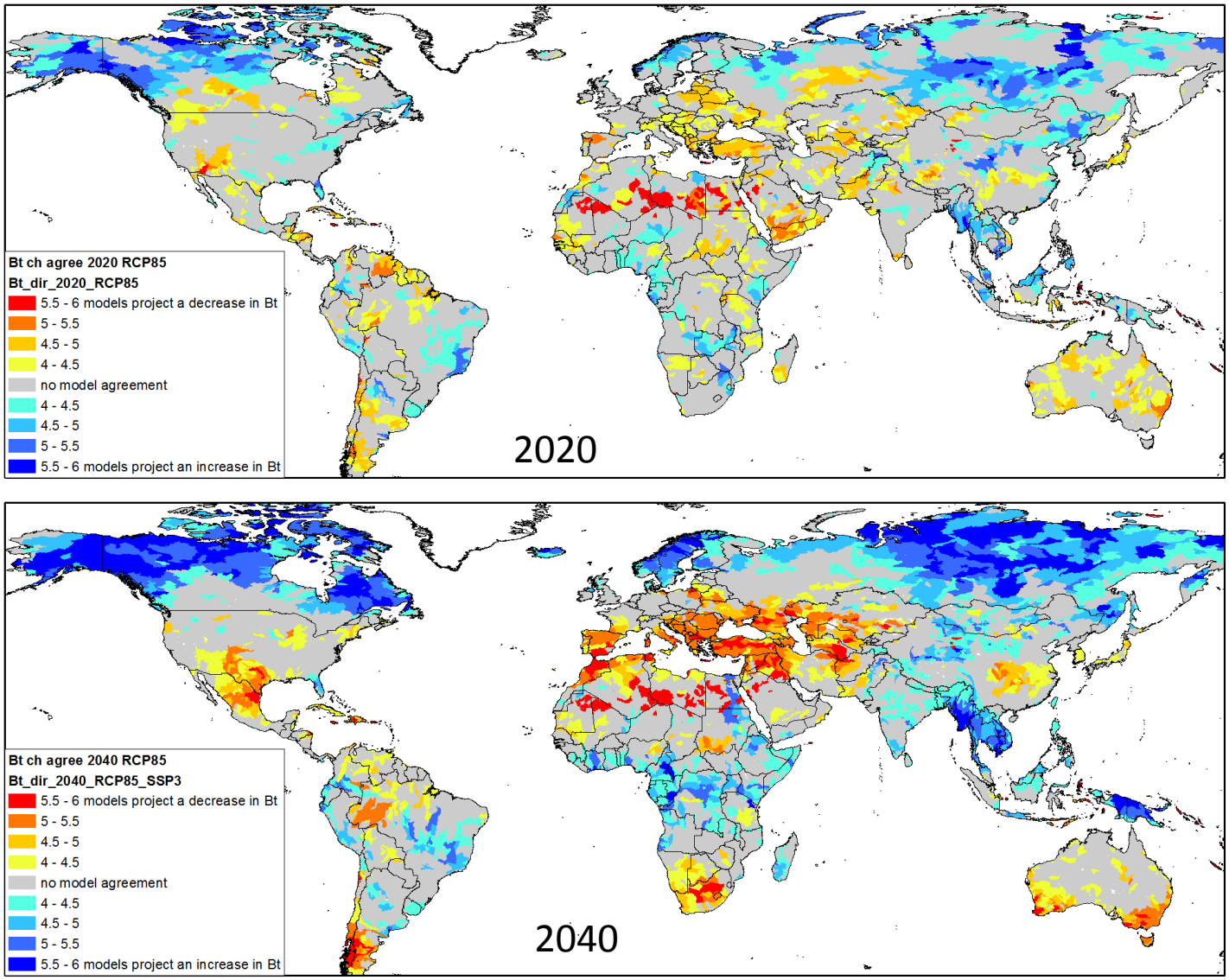
MODEL AGREEMENT

number of models (out of 6) projecting an increase or decrease in Bt (proportional count based on number of ensemble members)



Total Blue Water (Bt)