

Use of GRACE Satellites to Assess Impacts of Agriculture on Water Storage²

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Basic Issues

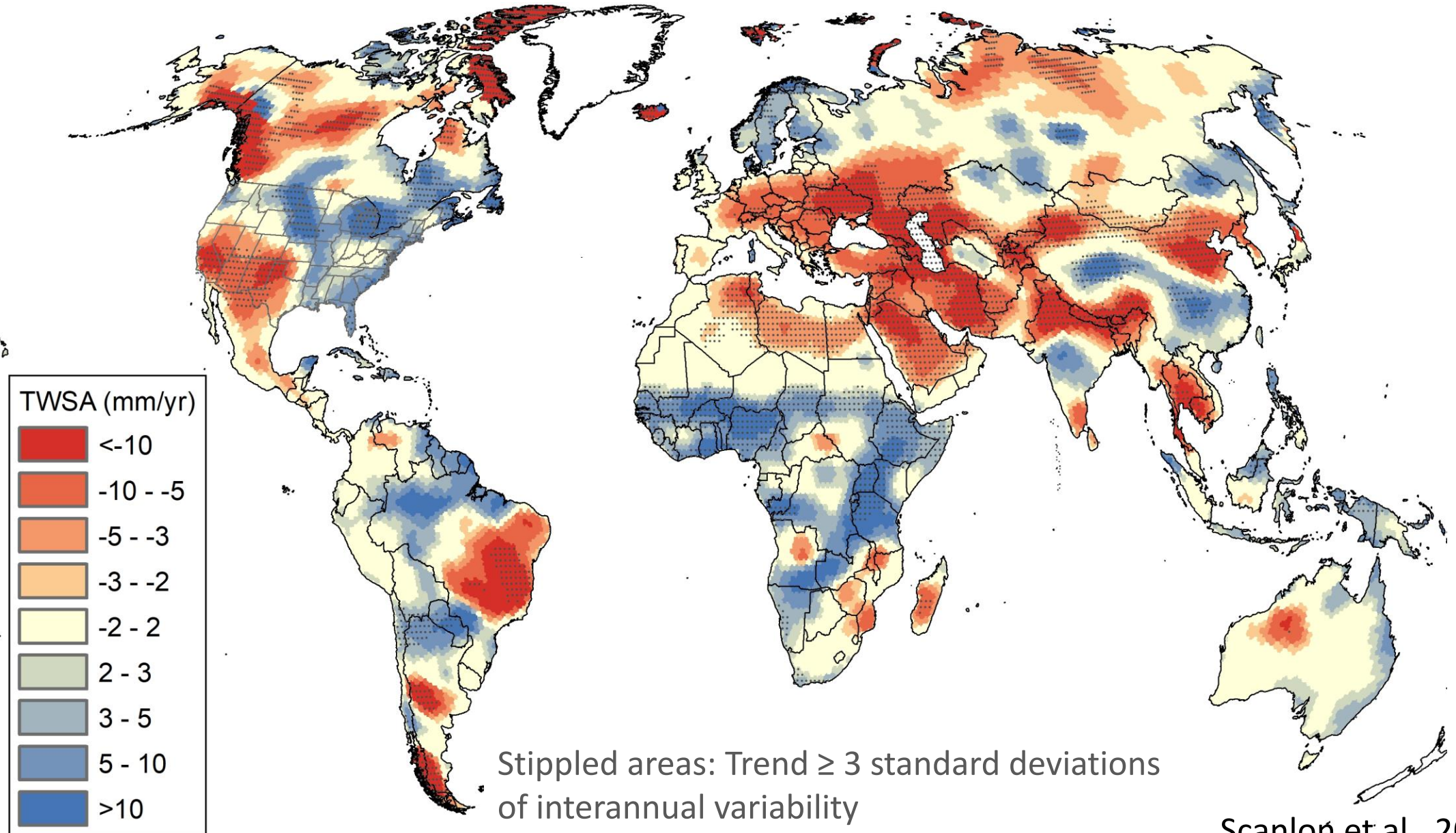
- How can we monitor changes in water storage globally?
- What is controlling changes in water storage?
- How can we manage water resources more sustainably?

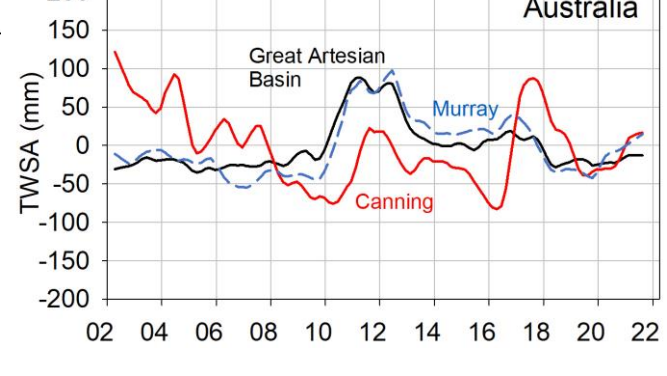
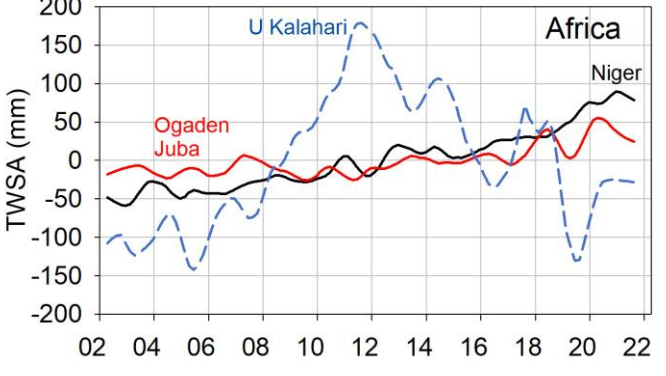
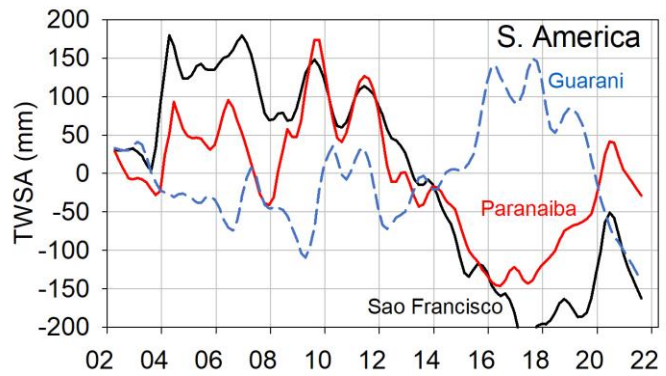
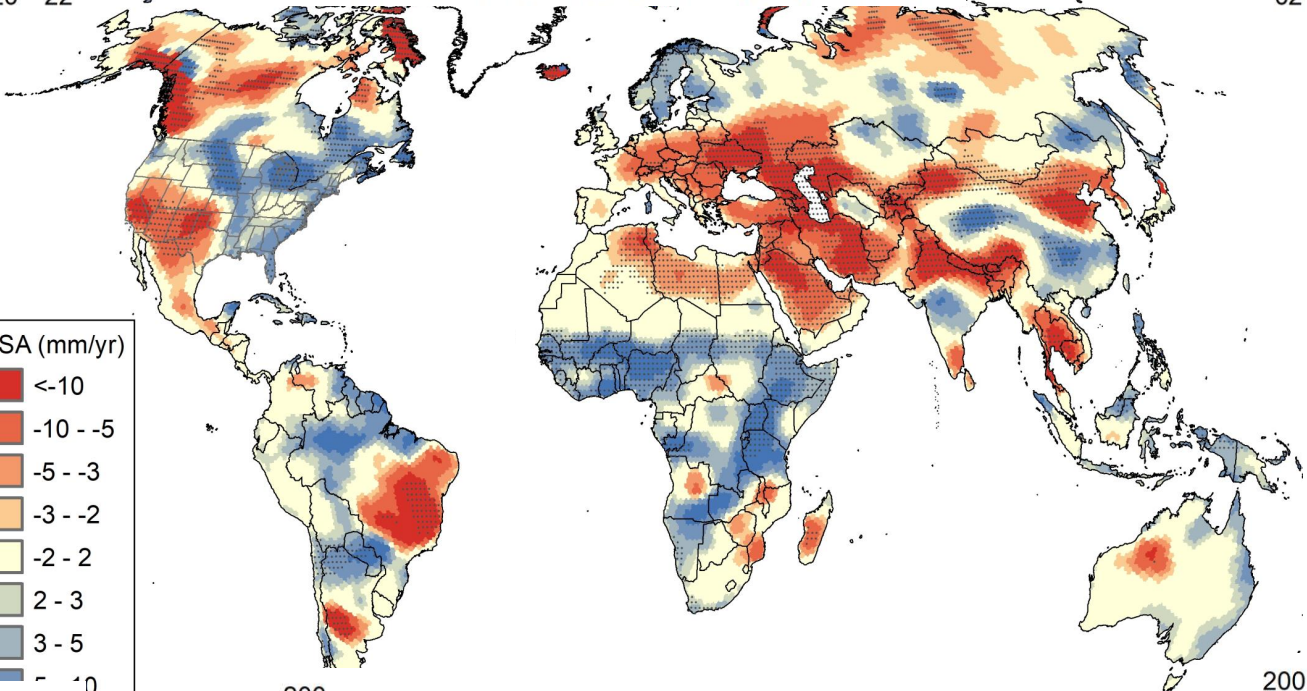
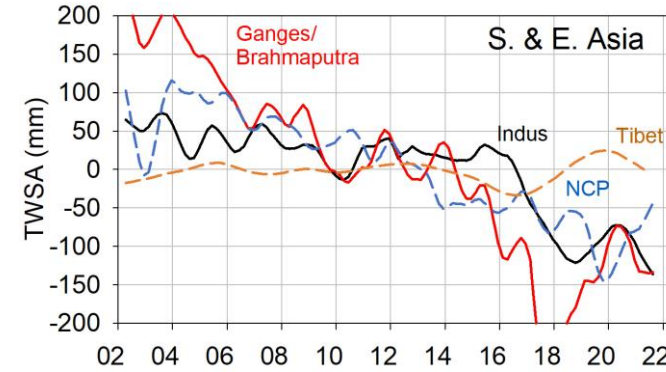
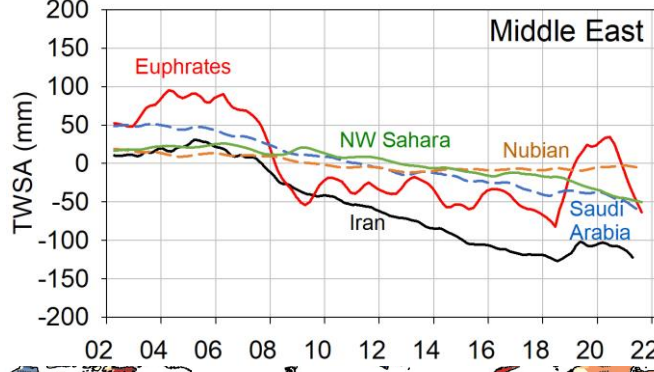
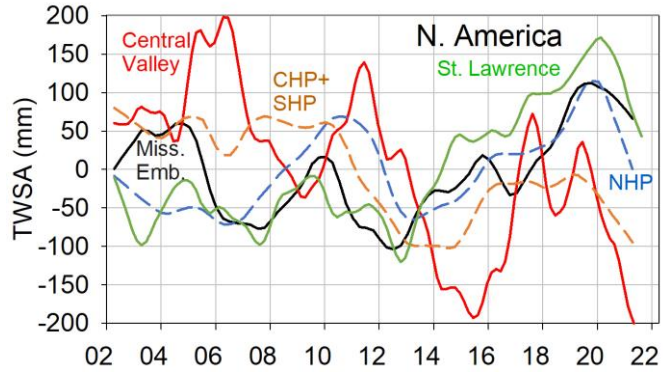


Methods:

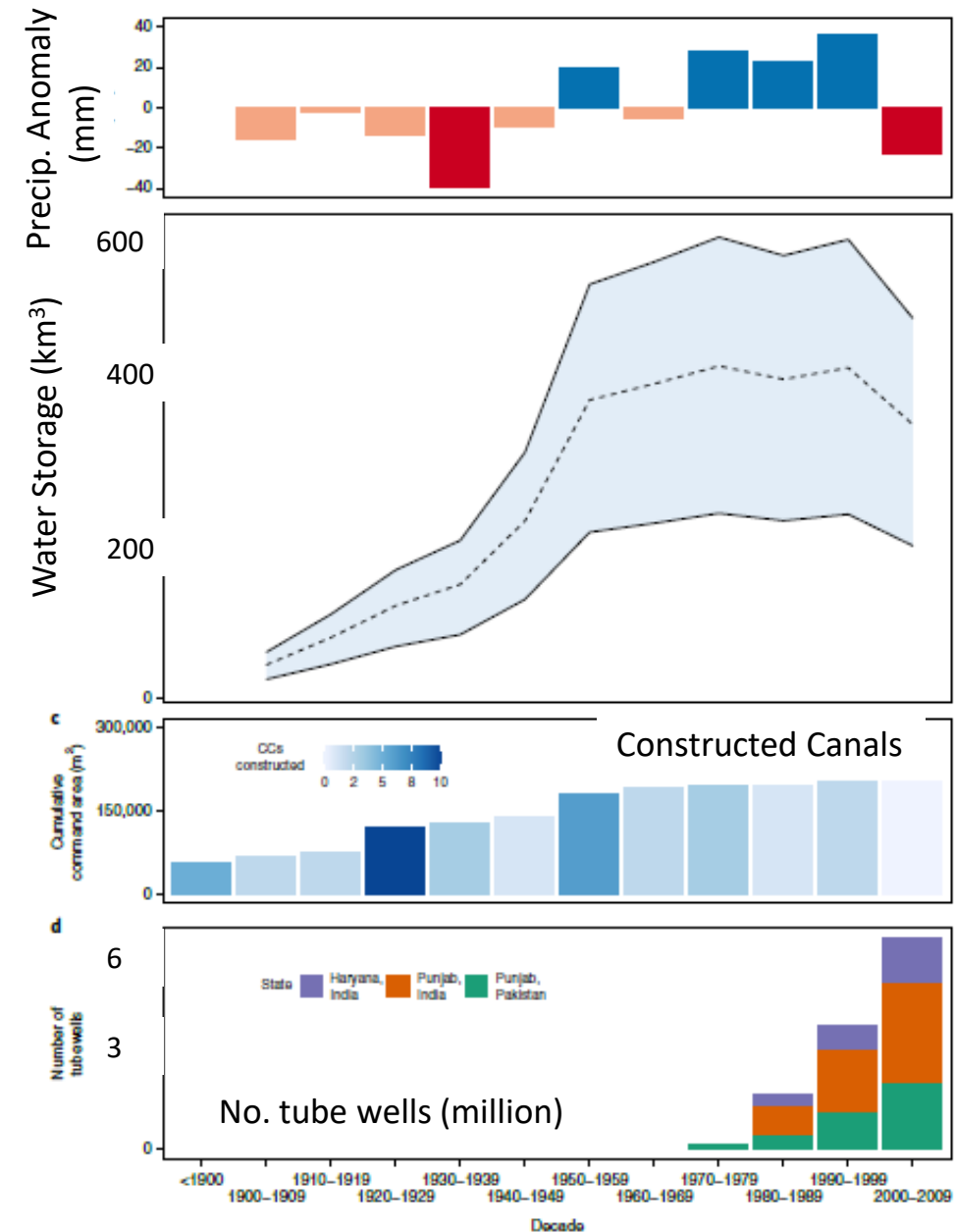
- Satellites (GRACE satellites, total water storage)
- Global and regional models
- Ground-based monitoring
- Water use, land use change

GRACE Trends in Total Water Storage (2002 – 2022)

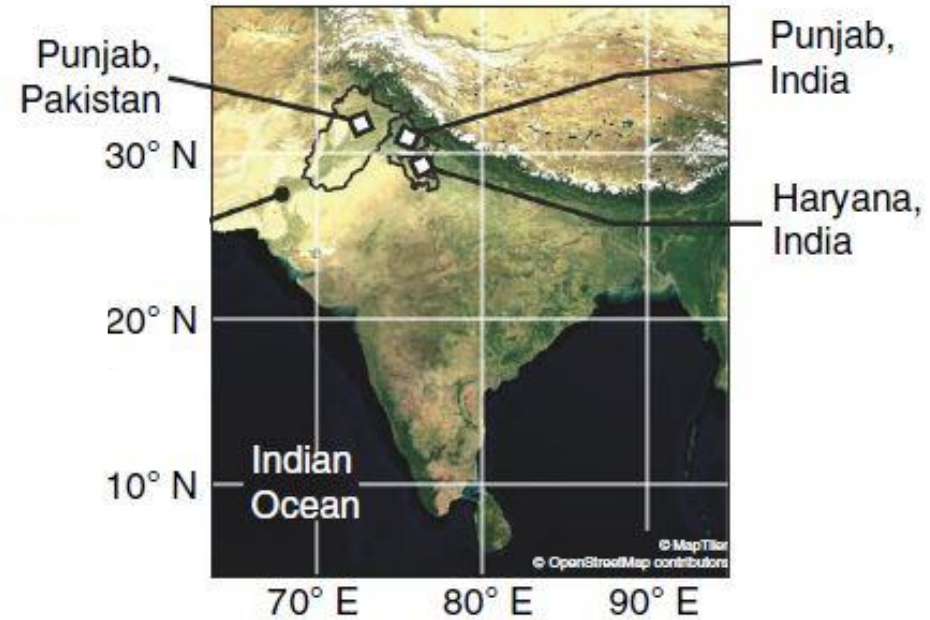




Long-term Changes in Water Storage in NW India

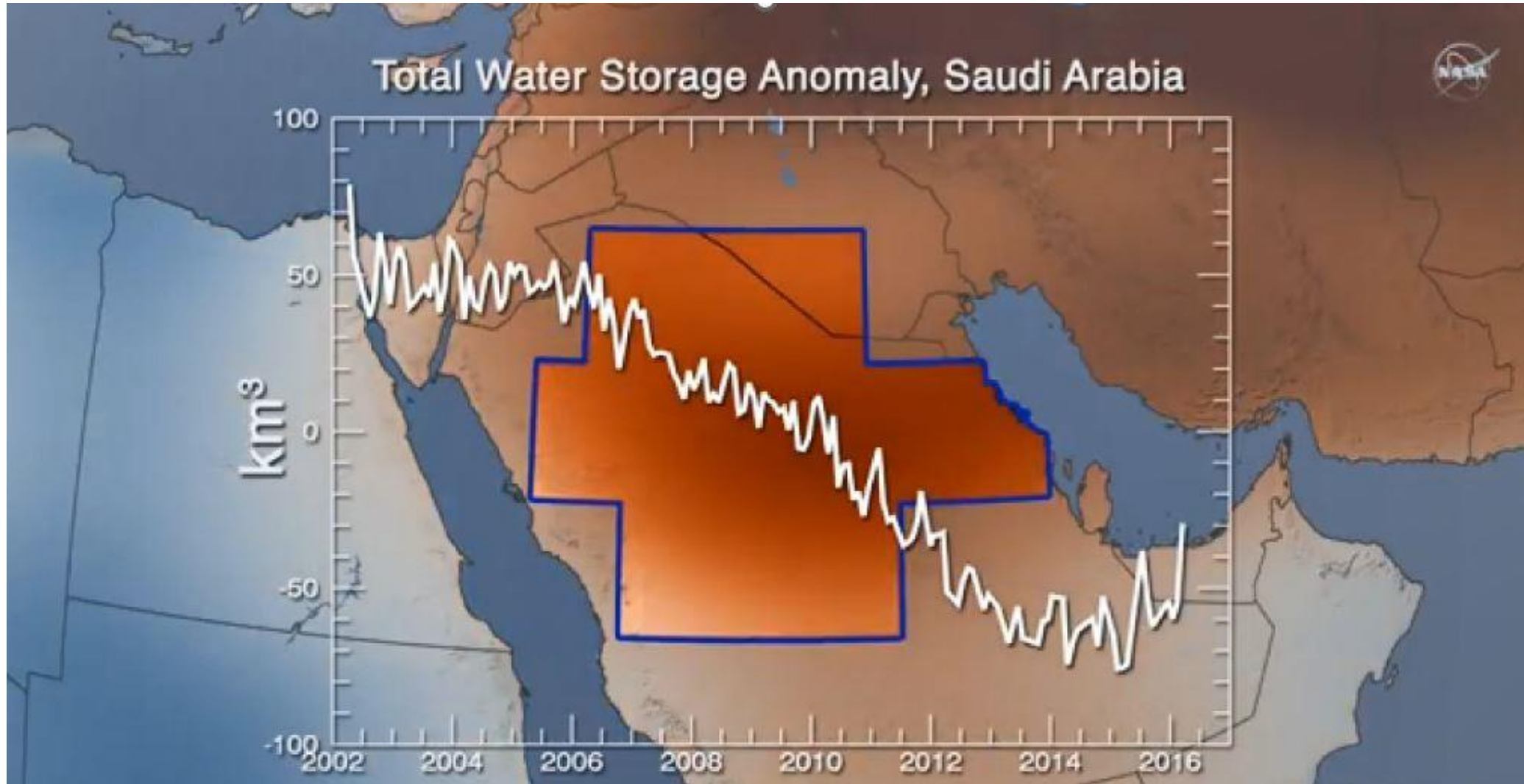


Punjab Pakistan and India and Haryana,



Net increase in water storage of 350 km³ (1900 – 2010)
 Decline of ~ 100 km³ (2000 – 2010)
 Surface water irrigation recharging groundwater

GRACE Total Water Storage Changes in NW Saudi Arabia



Irrigation Expansion in Saudi Arabia to Support Agriculture



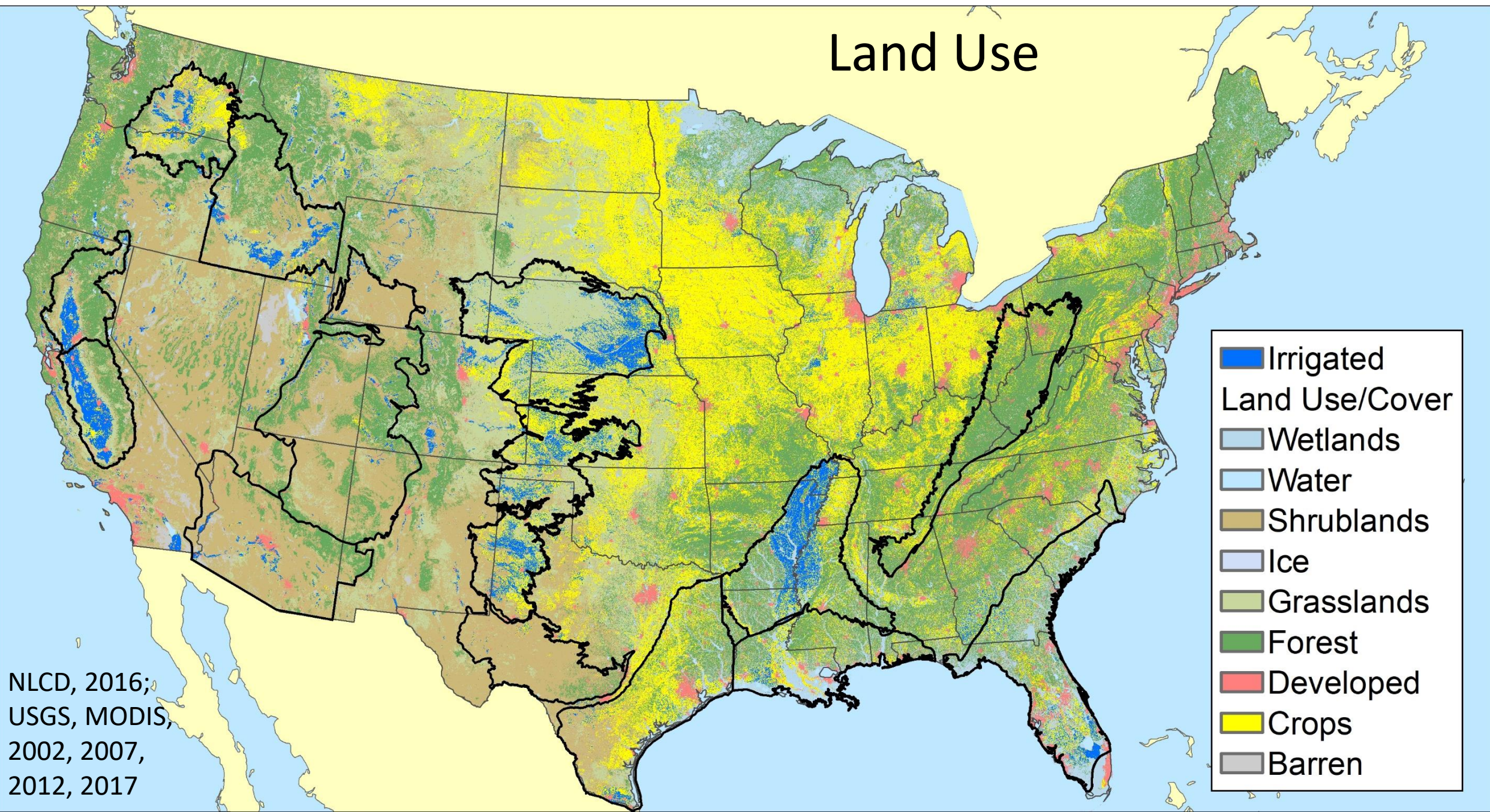
Irrigation Expansion in Saudi Arabia to Support Agriculture



Irrigation Expansion in Saudi Arabia to Support Agriculture

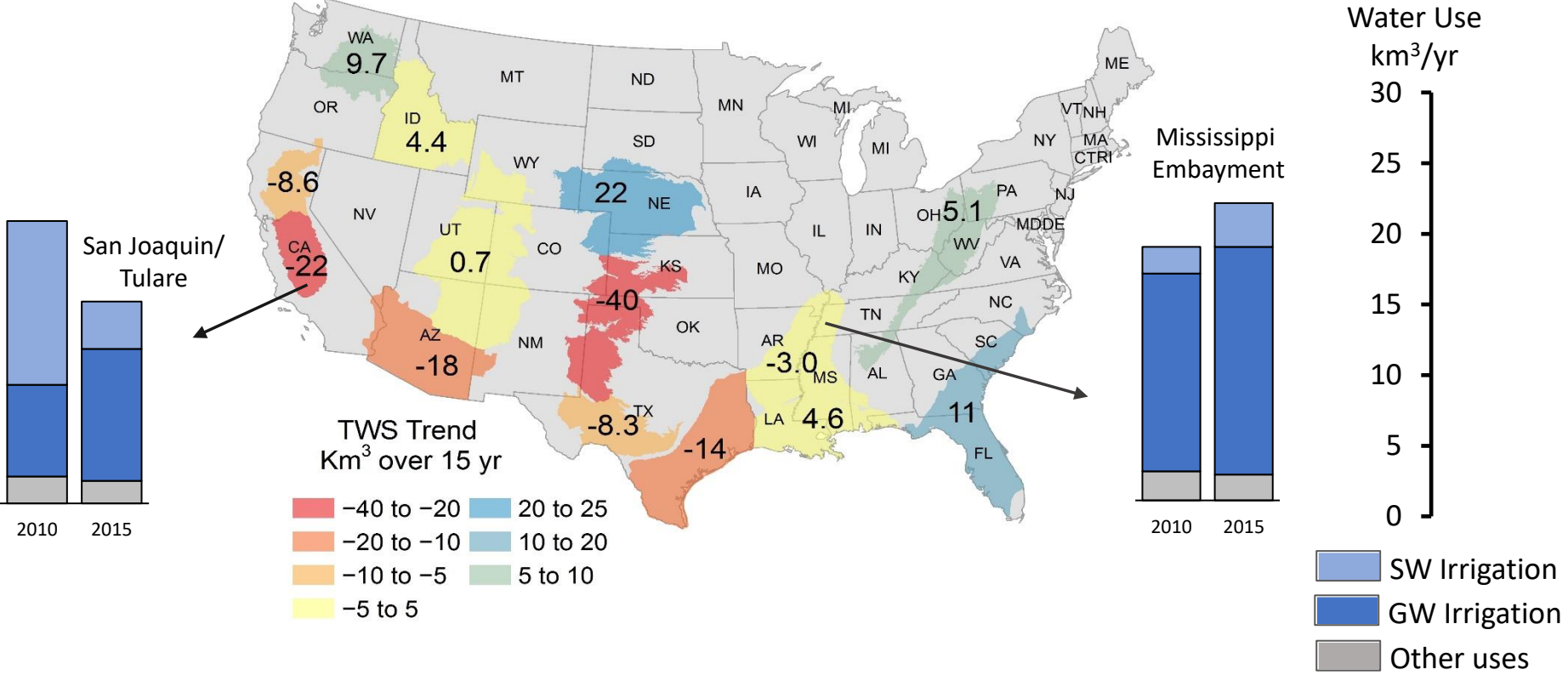


Land Use



NLCD, 2016;
USGS, MODIS,
2002, 2007,
2012, 2017

Human Intervention Irrigation



Move Agriculture from Semi-arid to more Humid Regions

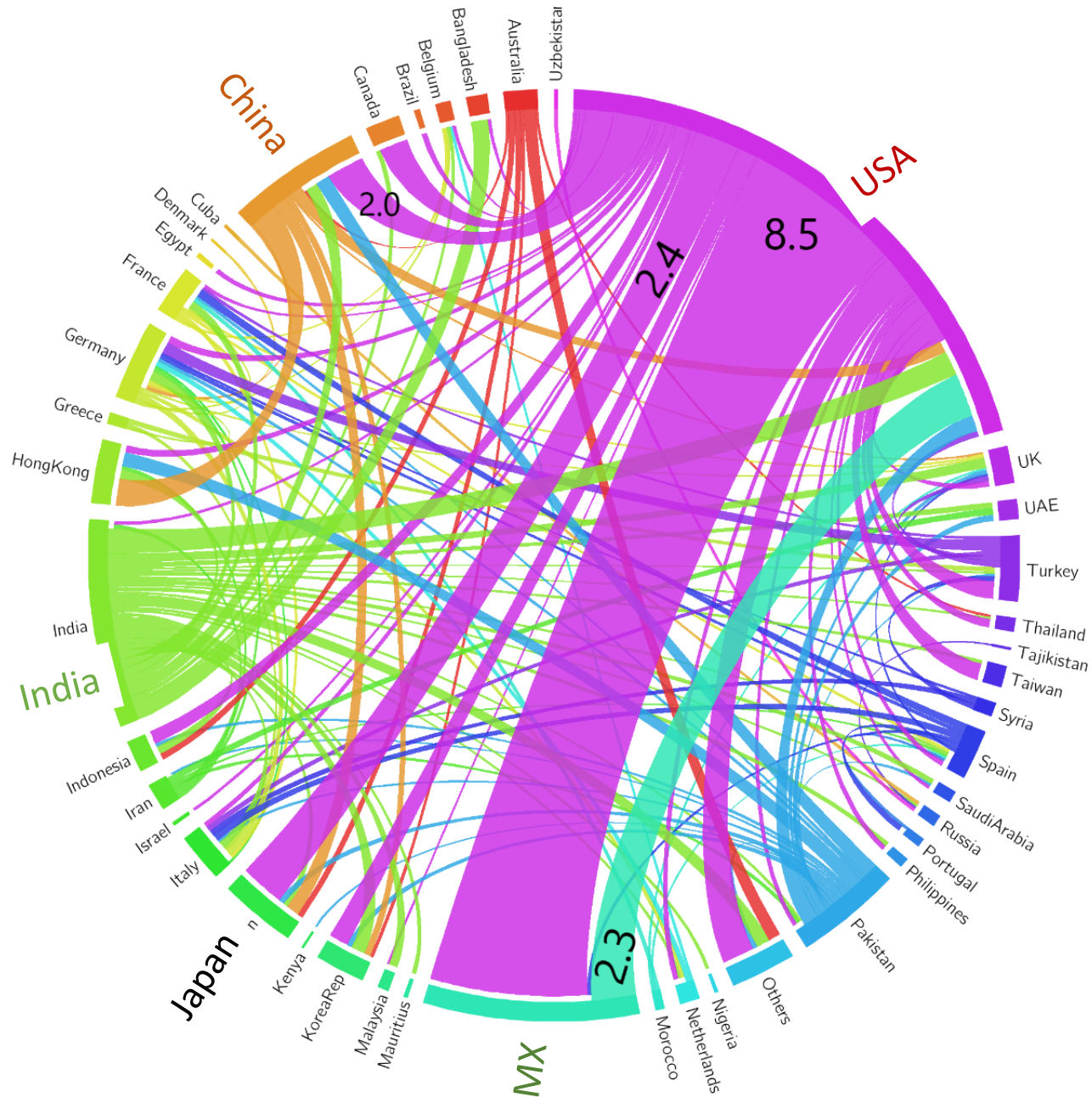


The Next California

Phase 1: Investigating Potential in the mid-Mississippi Delta River region

Julia Kurnik, WWF Director, Innovation Startups - Markets

Virtual Water Transfers



Blue virtual water flows totaled 301 km³/yr from 1996 – 2005

Major virtual groundwater exporters include the USA (31% of global total), India (15%) Pakistan (13%)

Summary

- Satellite data allow us to track water storage variability and irrigated agriculture globally over past two decades
- GRACE data show declines in water storage in semiarid regions globally related to irrigation and climate
- Long-term trends in NW India and Pakistan: rises in storage related to canal irrigation followed by declines linked to groundwater pumpage
- US: Groundwater pumpage impacts on storage in humid region much less than in arid region because capturing surface water in humid region
- Virtual water transfer in food trade



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