Water Resources in the Anthropocene: An Engineering Perspective

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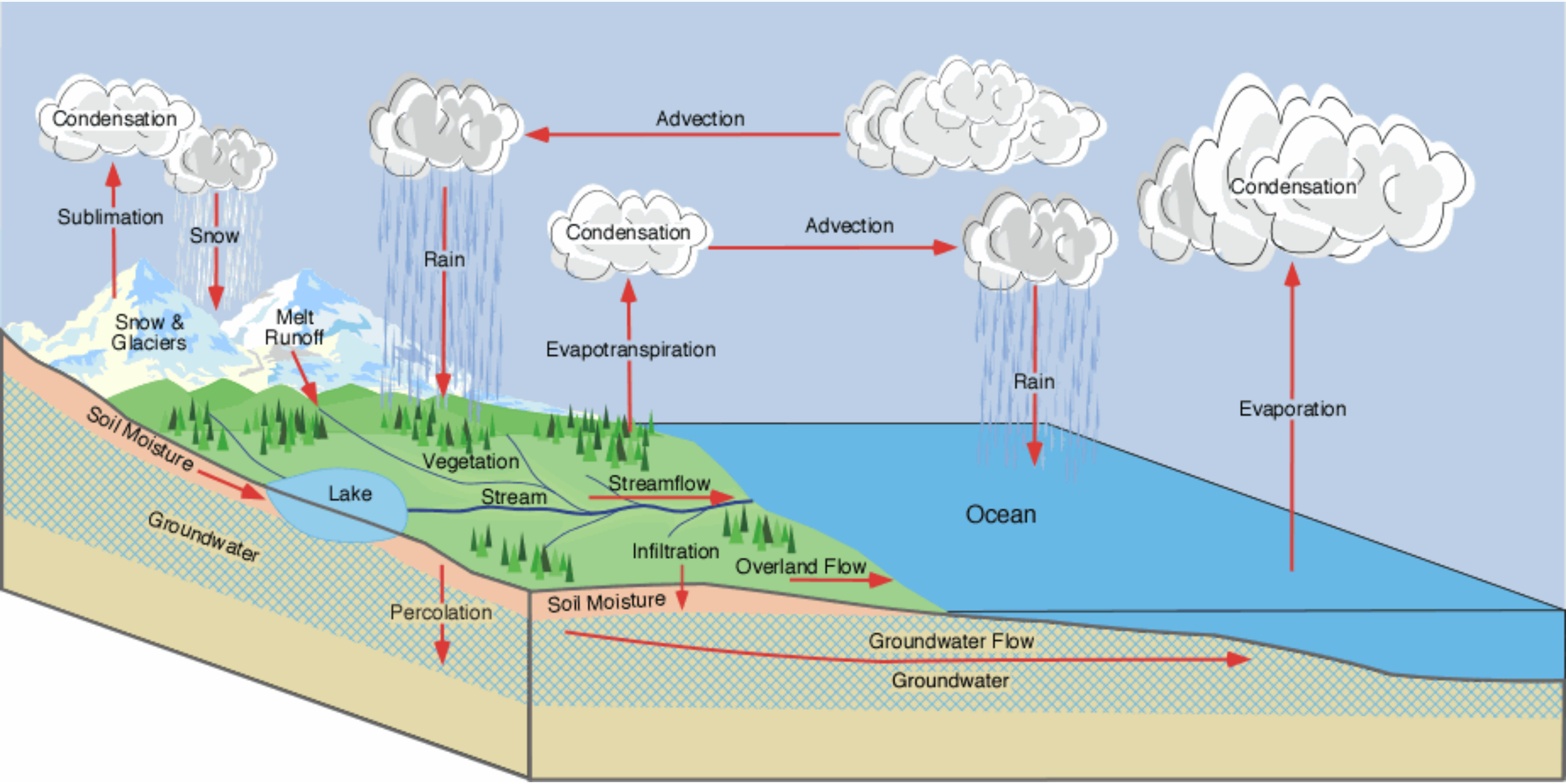
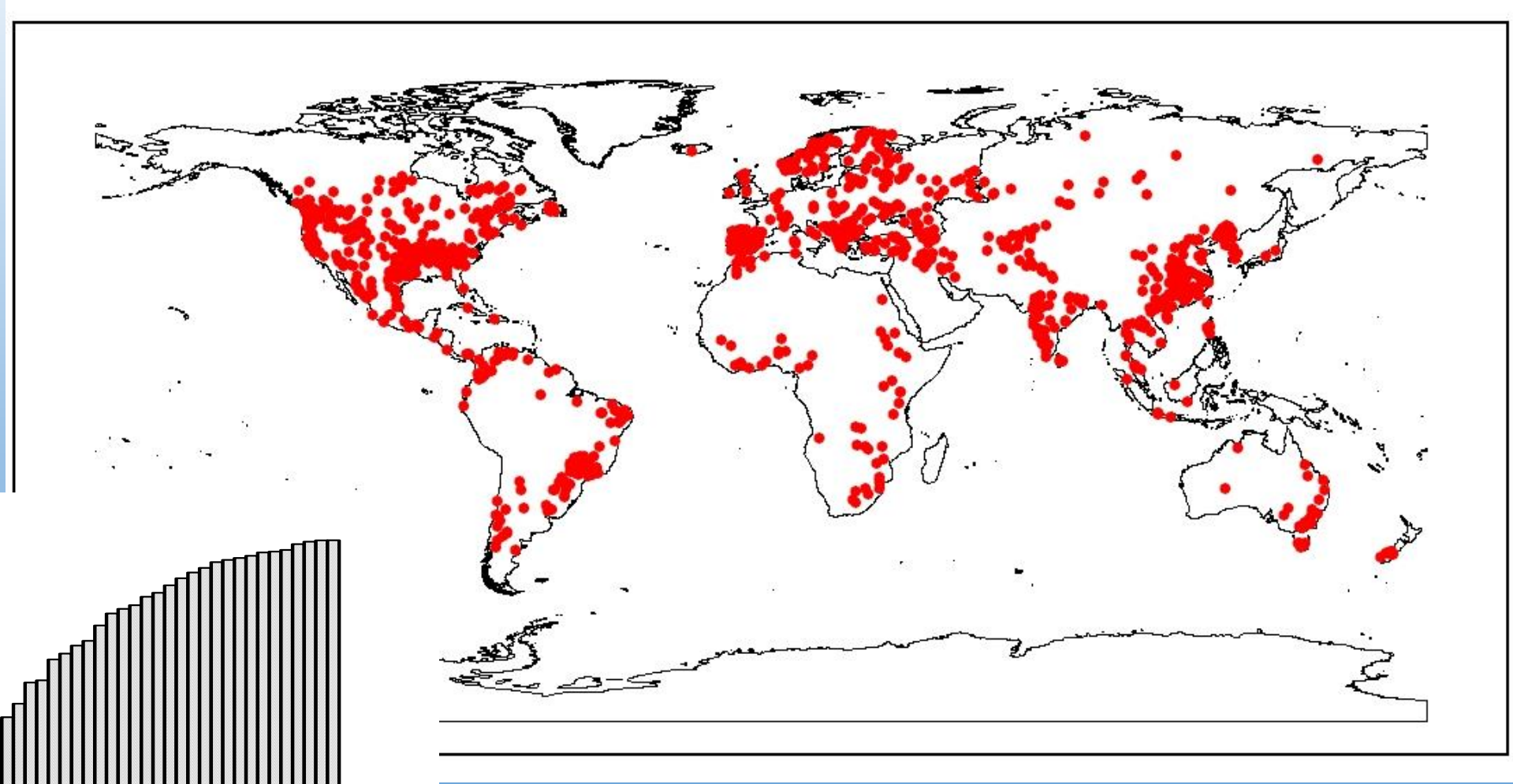


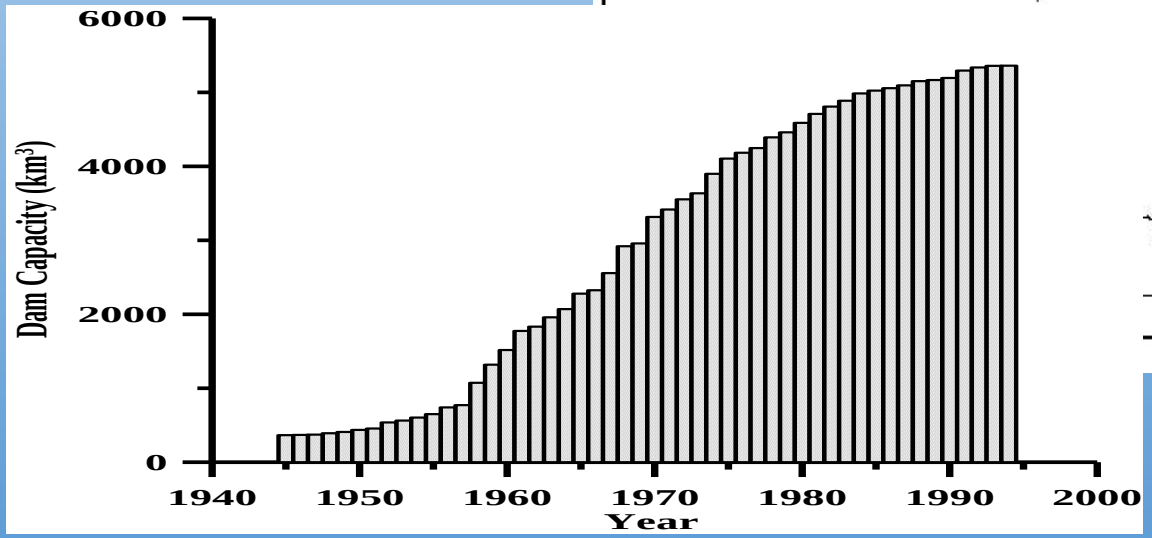
http://www.physicalgeography.net

Source: Natural Resources Conservation Service, USDA

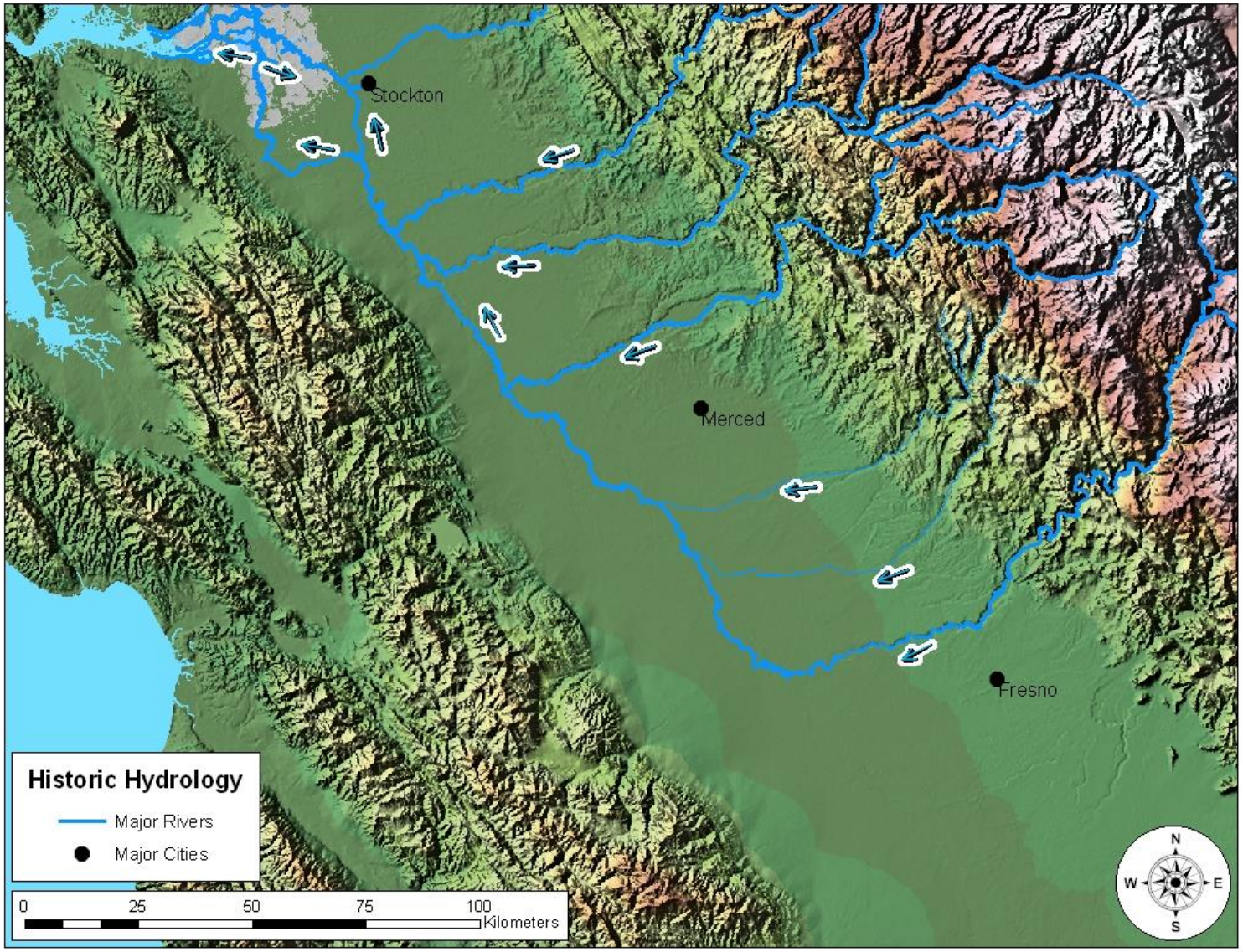
Global Hydrologic Modification

United Nations Environmental Programs, 2010

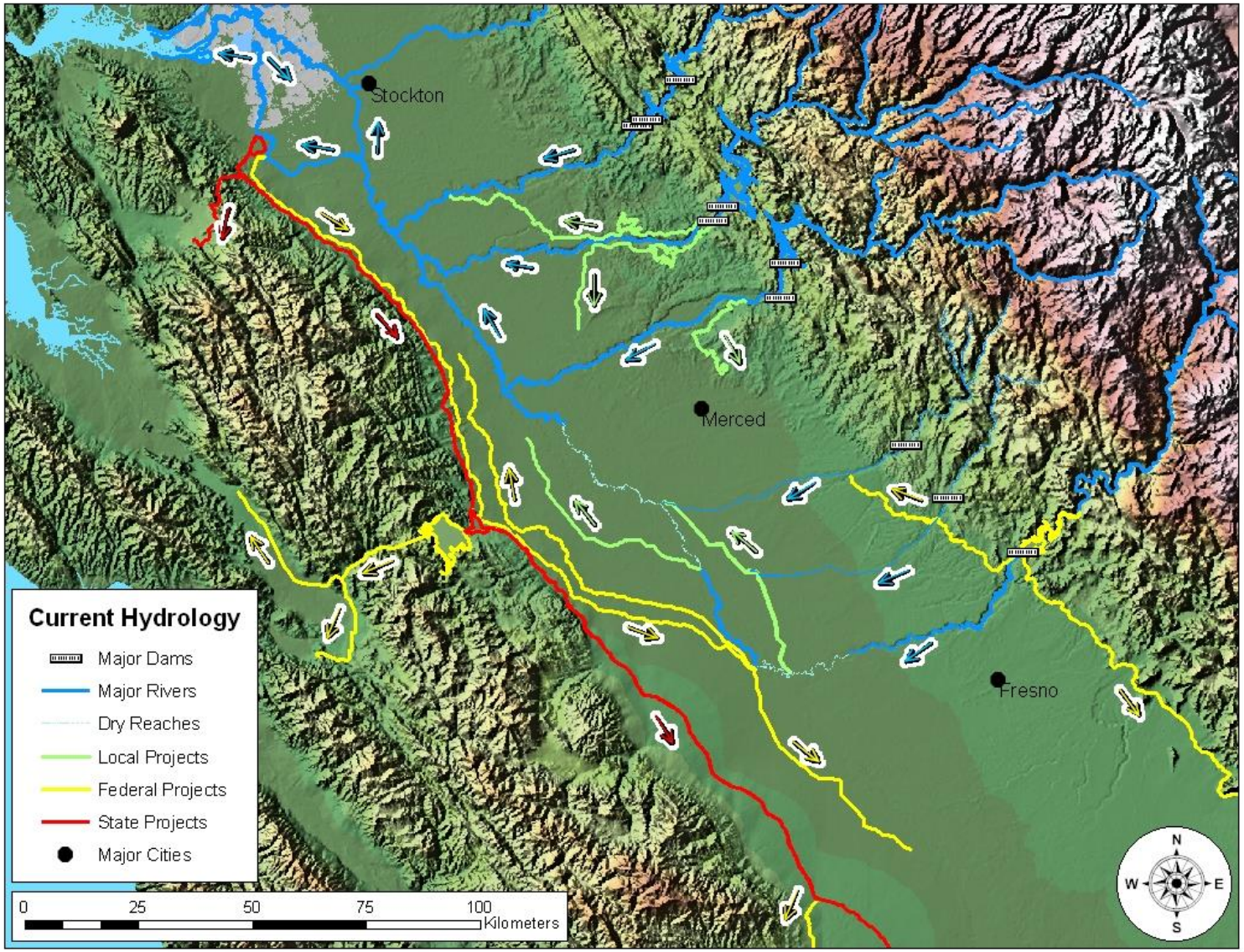




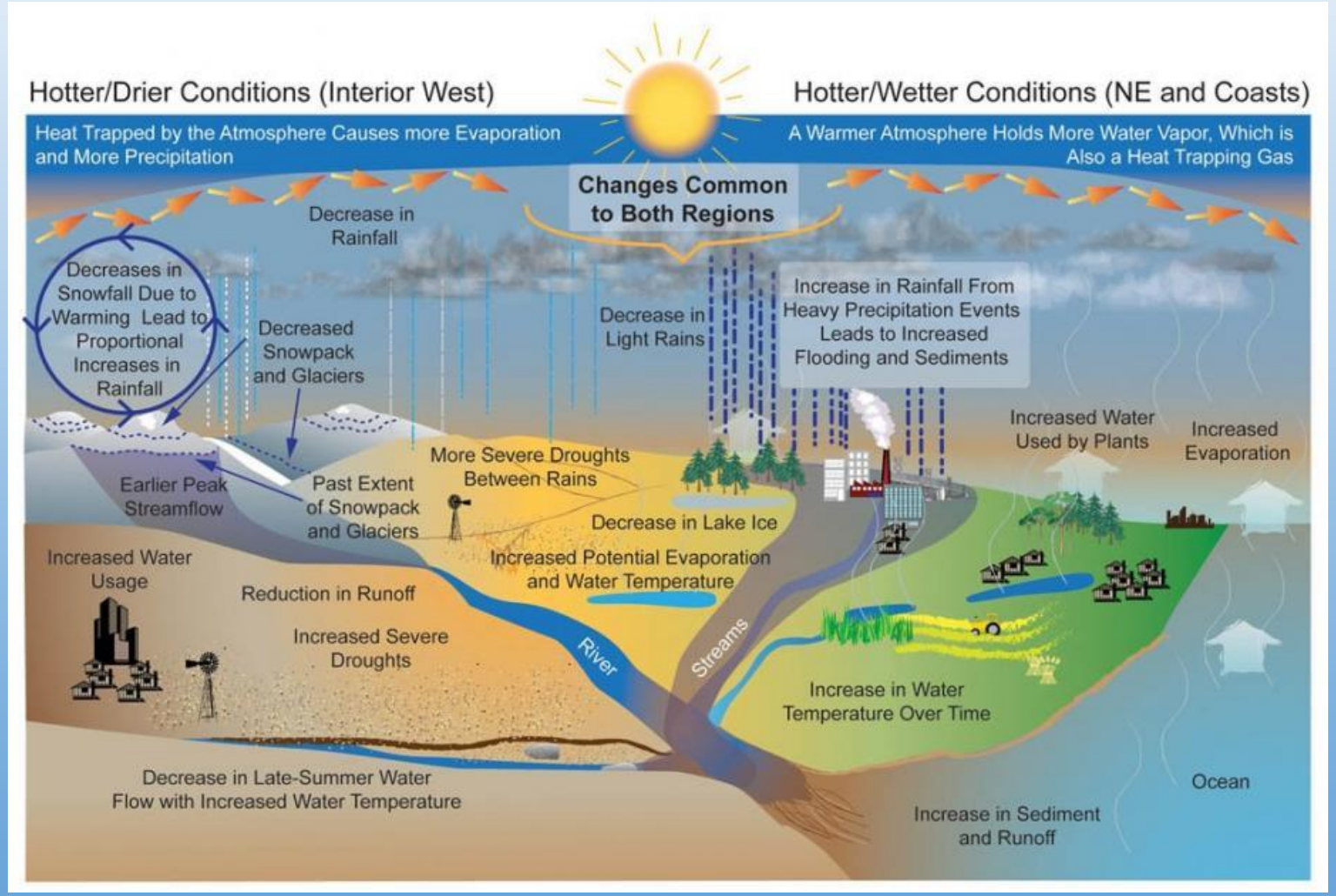
Natural hydrology of San Joaquin River

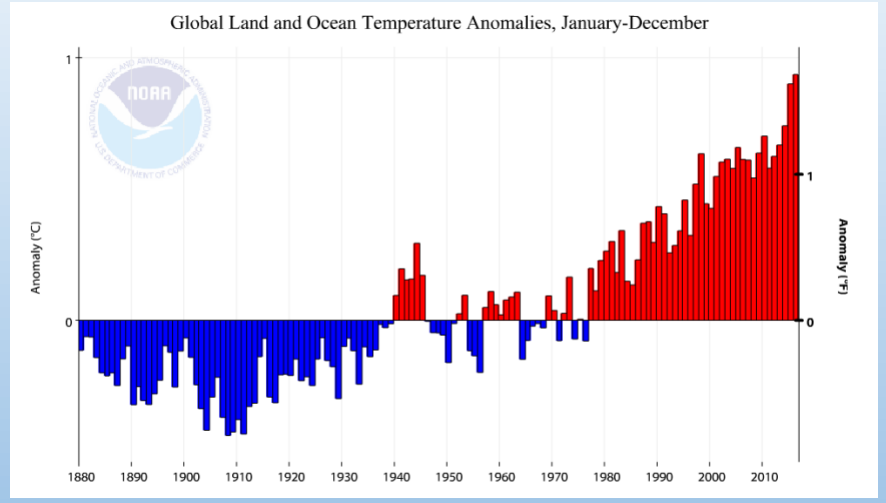


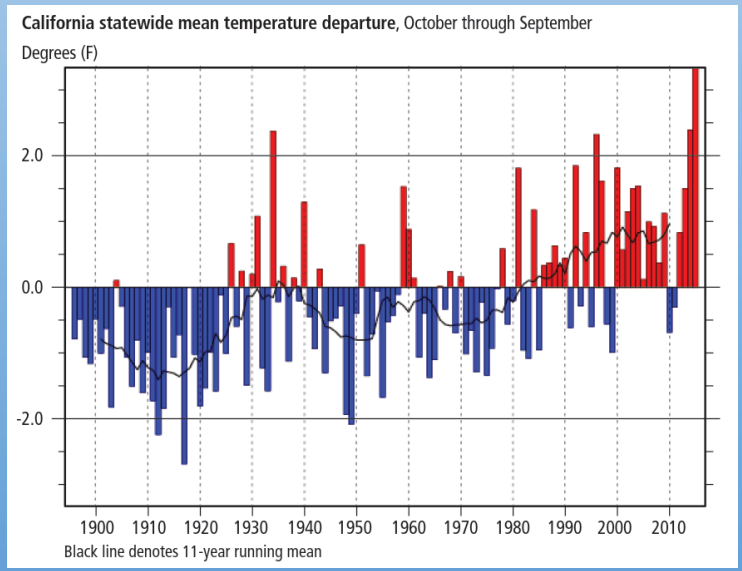
Current hydrology of San Joaquin River



Hydrologic cycle impacted by climate change

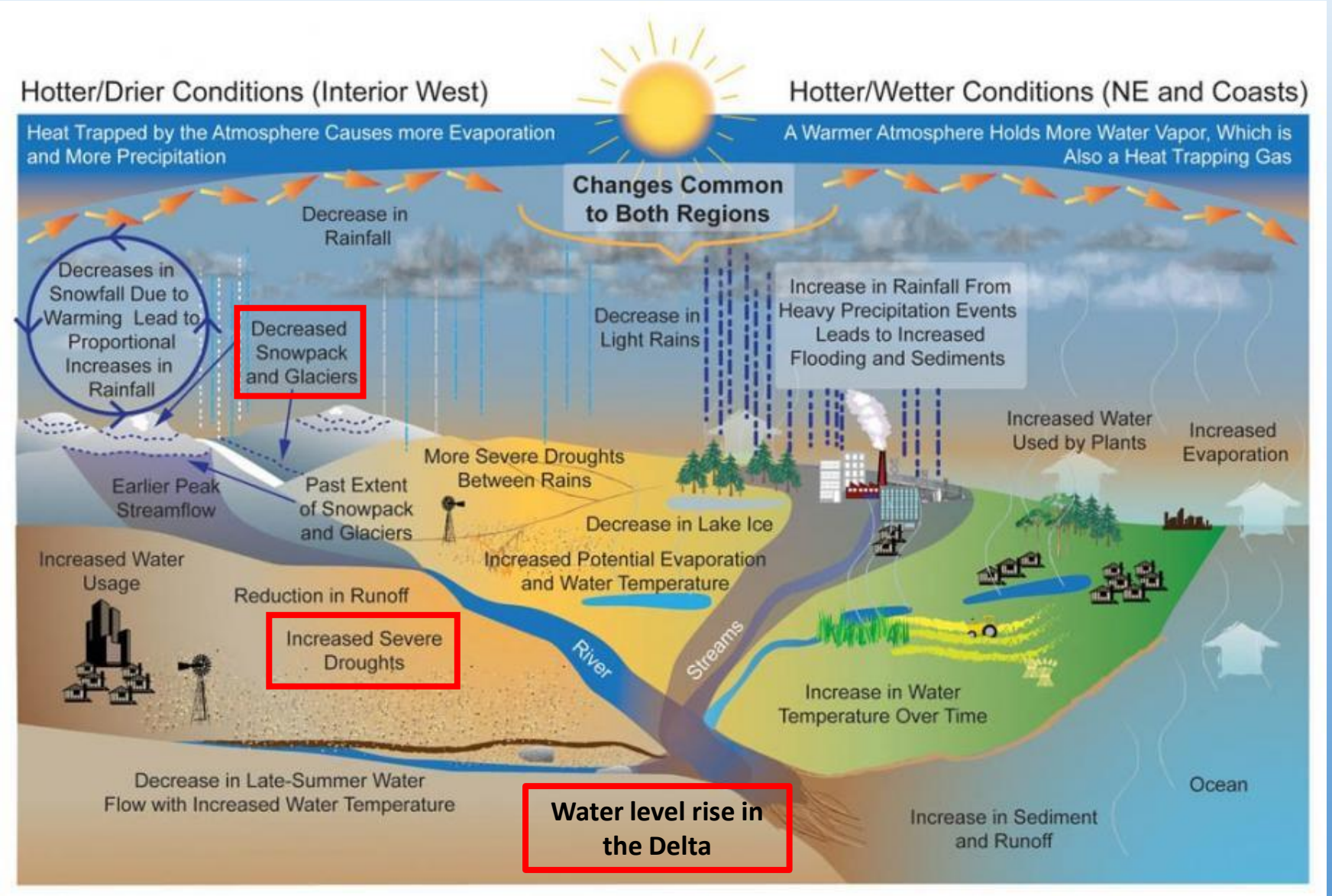






https://downloads.globalchange.gov/usimpacts/allimages/3-Water/3-Hi%20res/3-Water-pg-42_top.jpg

Predicted impact in CA



Impacts stated in:
http://climatechange.ca.gov/climate_action_team/water.html

Take home #1: Water and sanitation are difficult—climate change makes it worse

- Affects hydrologic cycle, water availability, water demand, water allocation
- Leads to water scarcity, floods, water quality problems
- Impacts economy, poverty, public health, ecosystems

Alavian, V., H.M. Qaddumi, E. Dickson, S.M. Diez, A.V. Danilenko, R.F. Hirji, G. Puz, C. Pizarro, M. Jacobsen, B. Blankespoor. 2009. Water and Climate Change: Understanding the Risks and Making Climate-Smart Investment Decisions, Report No. 52911, The World Bank.

Take home #2: Policy and infrastructure investment make a difference

- Clean Water Act (1972), Southern California Bight
  - Population growth increase 56%
  - Effluent volume increase 31%
  - Mass emissions decrease >65%
- National water use decreased since 1970, all sectors

Lyon, G.S. and E.D. Stein. 2009. How effective has the Clean Water Act been at reducing pollutant mass emissions to the Southern California Bight over the past 35 years? Environ Monit Assess 154 (1-4):413-26.

Donnelly, K. and H. Cooley. 2015. Water Use Trends in the United States. Pacific Institute, Oakland, CA.

Take home #3: Water infrastructure could be a lot better

- Use less water
- Plan for climate change
- Design resilient water systems
- Prioritize multi-beneficial approaches
- Consider water-energy-food nexus
- Integrate flood management
- Use low impact development
- Protect ecosystems, public health and safety

Natural Resources Defense Council. 2010. Climate Change and Water Resource Management: Adaptation Strategies for Protecting People and the Environment. www.nrdc.org/policy

Example: Chemical use limits water reuse

Data availability for chemicals used in routine oil and gas development, South Coast Air Quality Management District.

Chemicals	CASRN	Mass data	Toxicity data
151 (30%)	Available	Available	Available
1 (0%)	Available	Unavailable	Available
97 (18%)	Available	Available	Unavailable
43 (8%)	Unavailable	Available	Unavailable
233 (44%)	Unavailable	Unavailable	Unavailable

Stringfellow W.T., M.K. Camarillo, J.K. Domen, and S.B.C. Shonkoff. 2017. Comparison of chemical-use between hydraulic fracturing, acidizing, and routine oil and gas development. PLoS ONE 12(4): e0175344.