New Mexico Bureau of Geology and Mineral Resources

A Research Division of New Mexico Institute of Mining and Technology

Presentation by

Kevin Hobbs

New Mexico Tech

About Us

A non-regulatory governmental agency (the state's geological survey) that conducts scientific investigations leading to responsible economic development of the state's mineral, water, and energy resources.

Founded in 1927 through state legislation.

Currently has **approximately 58 FTE staff** consisting of research scientists, professionals and permanent support staff, and emeritus staff. We also mentor and employ graduate students and part-time undergrads.

Two office locations
Socorro (55 staff)
Albuquerque (3)

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The water cycle

1. Introduction to water cycle as a whole
2. New Mexico's water cycle
3. Human impacts on the water cycle

First, a law:

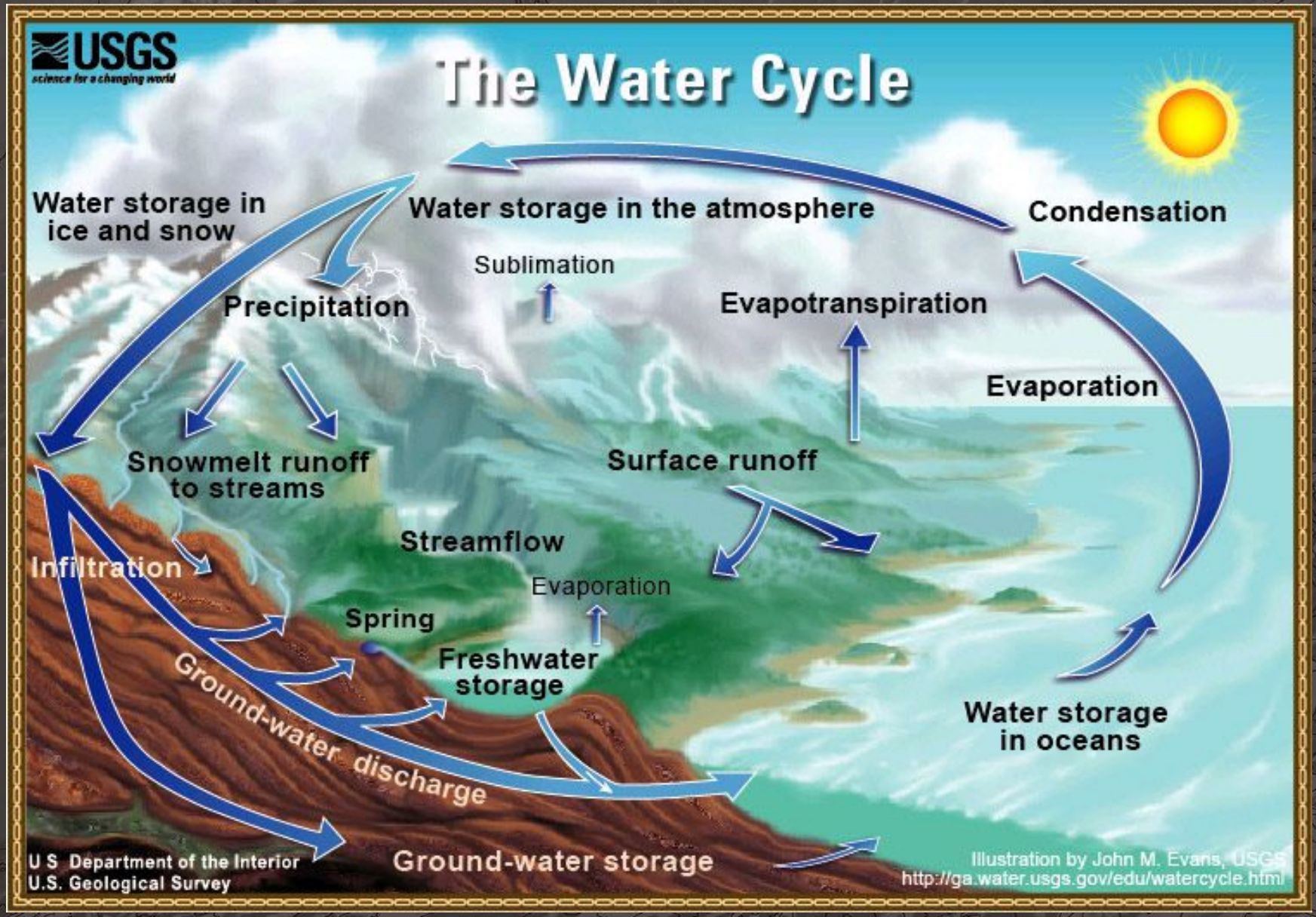
The law of conservation of mass states that in a closed system, the quantity of mass is constant.

Earth is a closed system.

Water has mass.

The amount of water on Earth is constant.

The water cycle



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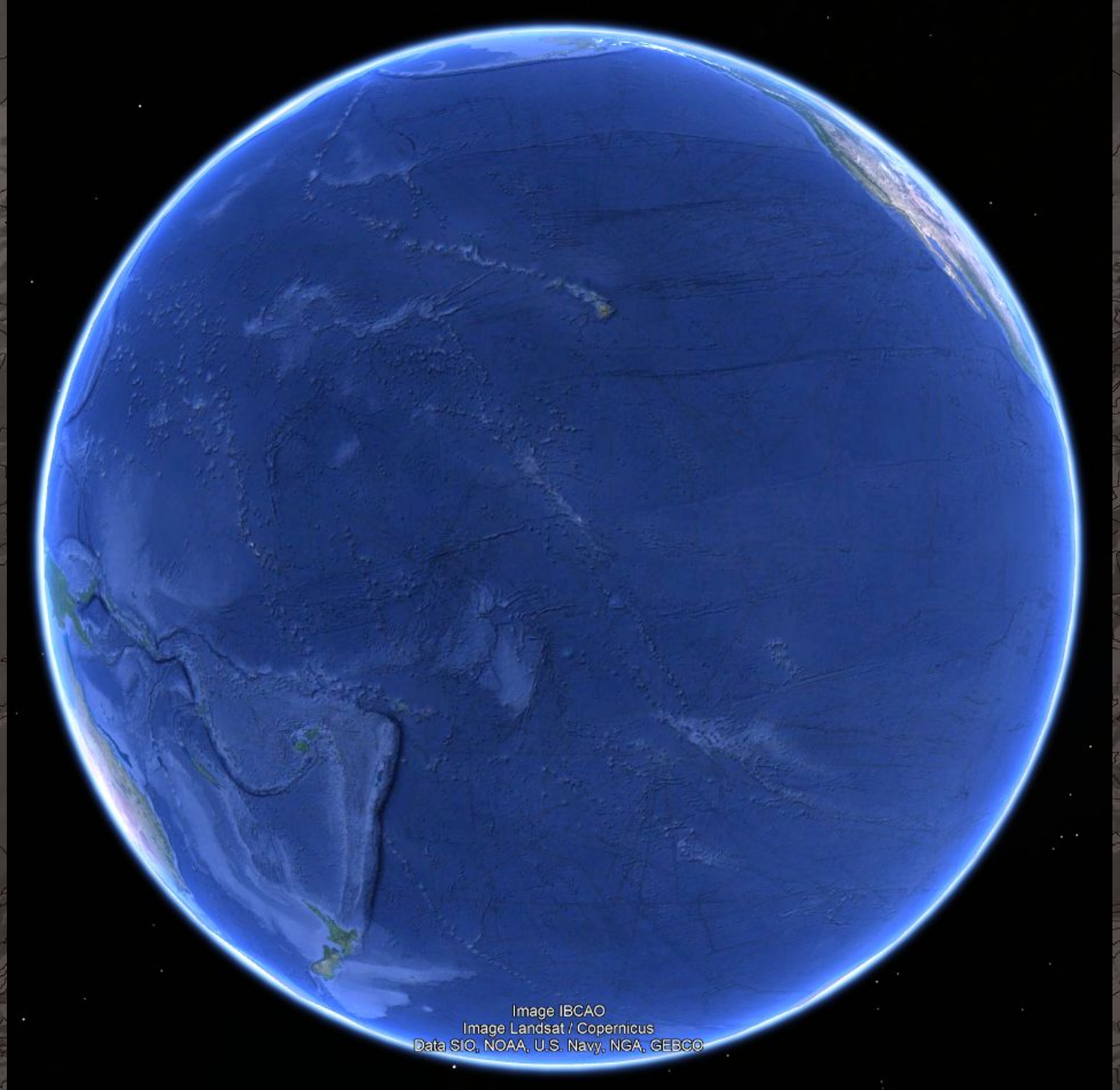
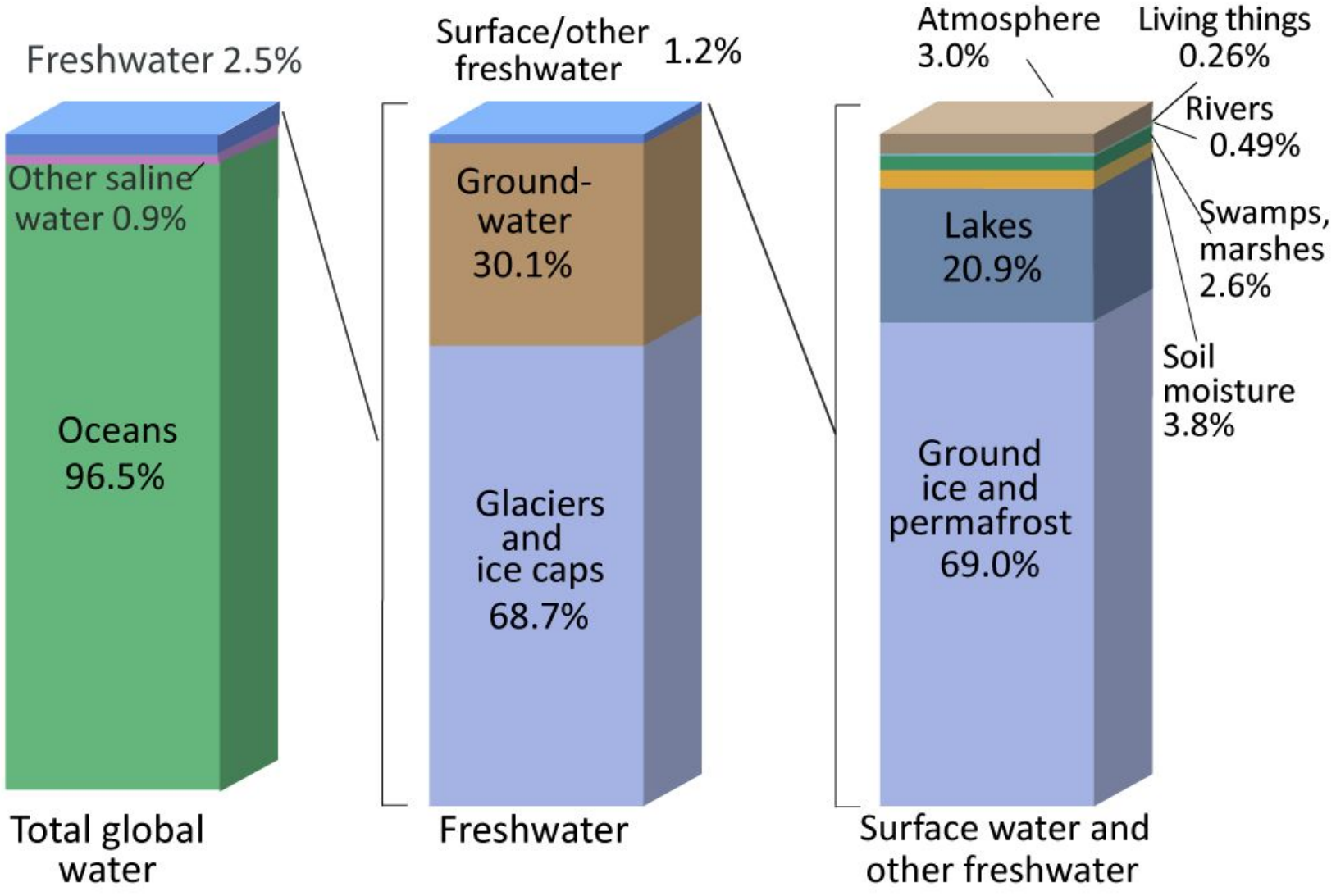


Where is most of the water on Earth?

Where is Earth's Water?



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources. (Numbers are rounded).

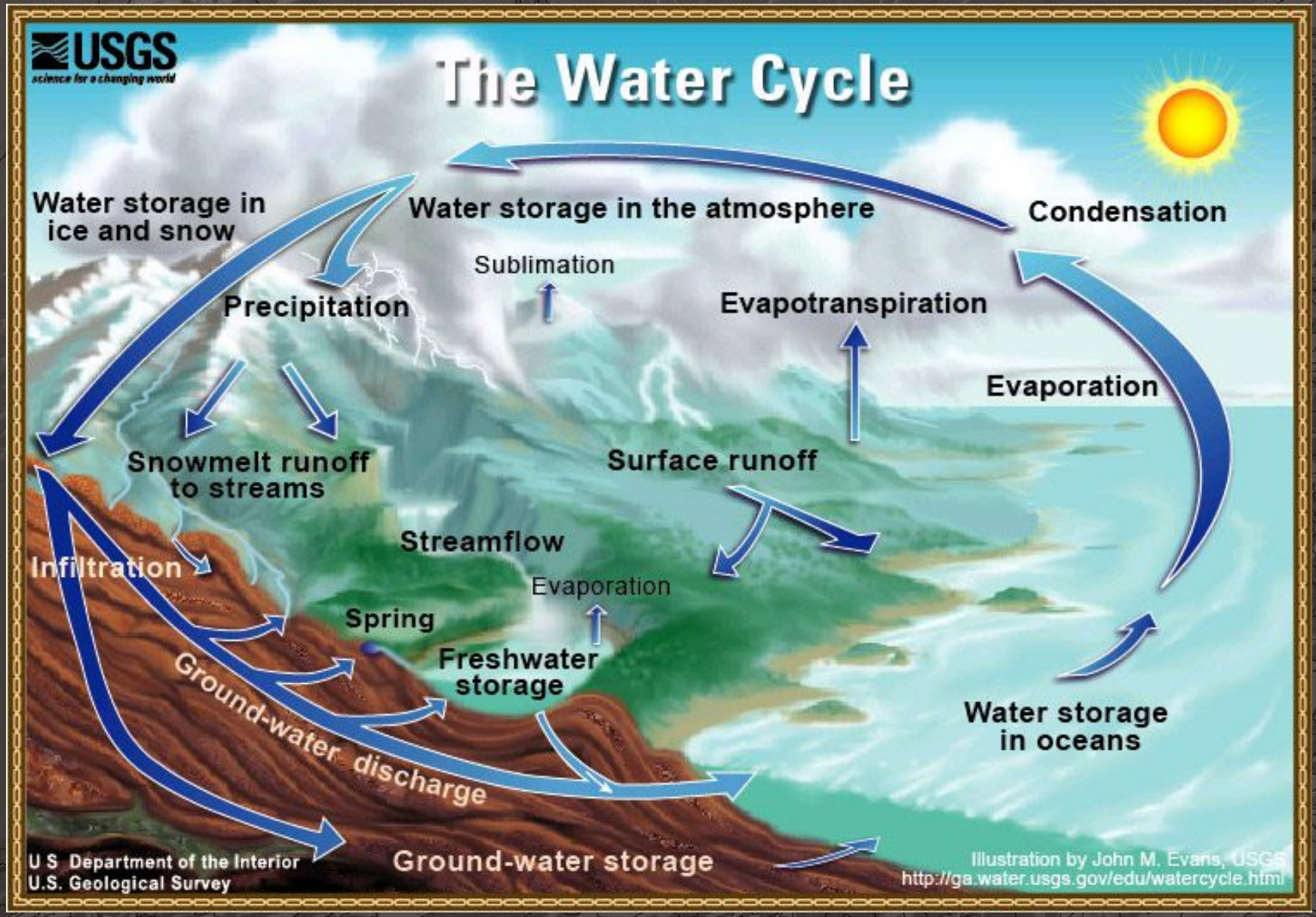
Inventory of Water

Total amount of water: 1,385,990.5 x 10^{15} kg

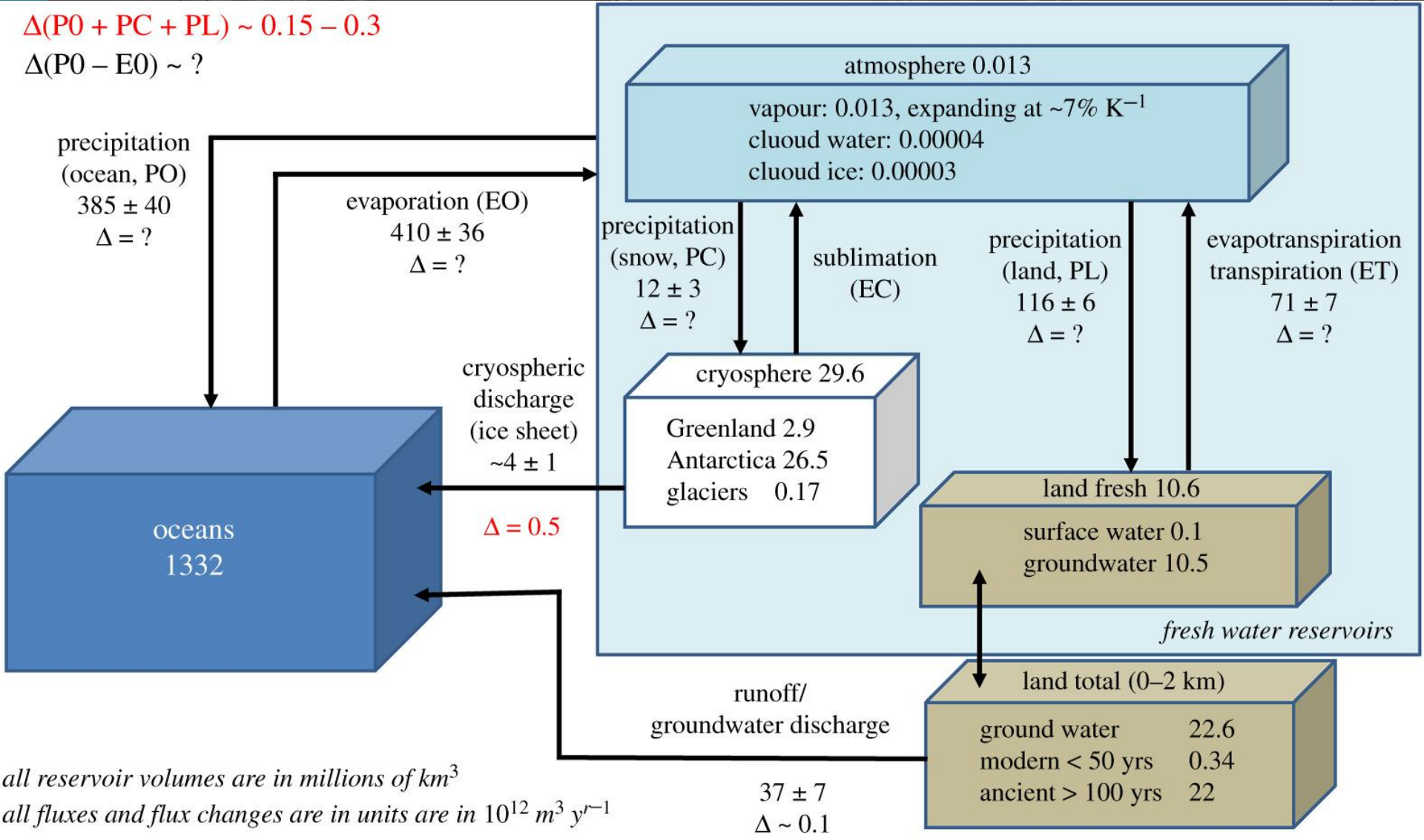
Reservoirs	Mass of Water in 10^{15} kg	Approximate %
Oceans	1,350,000	97.4
Marine atmosphere	11	0.0008
Land atmosphere	4.5	0.0003
Surface Water	275	0.02
Ground Water	8,200	0.59
Snow & Ice	27,500	1.98

Data from Chahine, 1992, The hydrological cycle and its influence on climate, Nature, v. 359, p. 373-380;

The water cycle (a simplified version)



The water cycle, with more detail



From Stephens et al., 2020, Earth's water reservoirs in a changing climate (Proceedings of the Royal Society A)

The previous slides introduce us to reservoirs and fluxes in the water cycle.

A reservoir is a place where water resides (*e.g.* ocean, ice, groundwater).

A flux is a process by which water moves between reservoirs.

If water resides (*i.e.*, stops) in reservoirs and moves (*i.e.*, goes) in fluxes, then we might start thinking about time and rates in the water cycle.

An important aspect of this consideration is called residence time: the average duration that a water molecule resides in a given reservoir.

Residence times of water

Reservoir	Residence in years
Ice	27500
Groundwater	4100
Ocean	3110
Land surface water	2.57
Atmosphere over land	0.042 year = 15 days
Atmosphere over ocean	0.025 year = 9 days

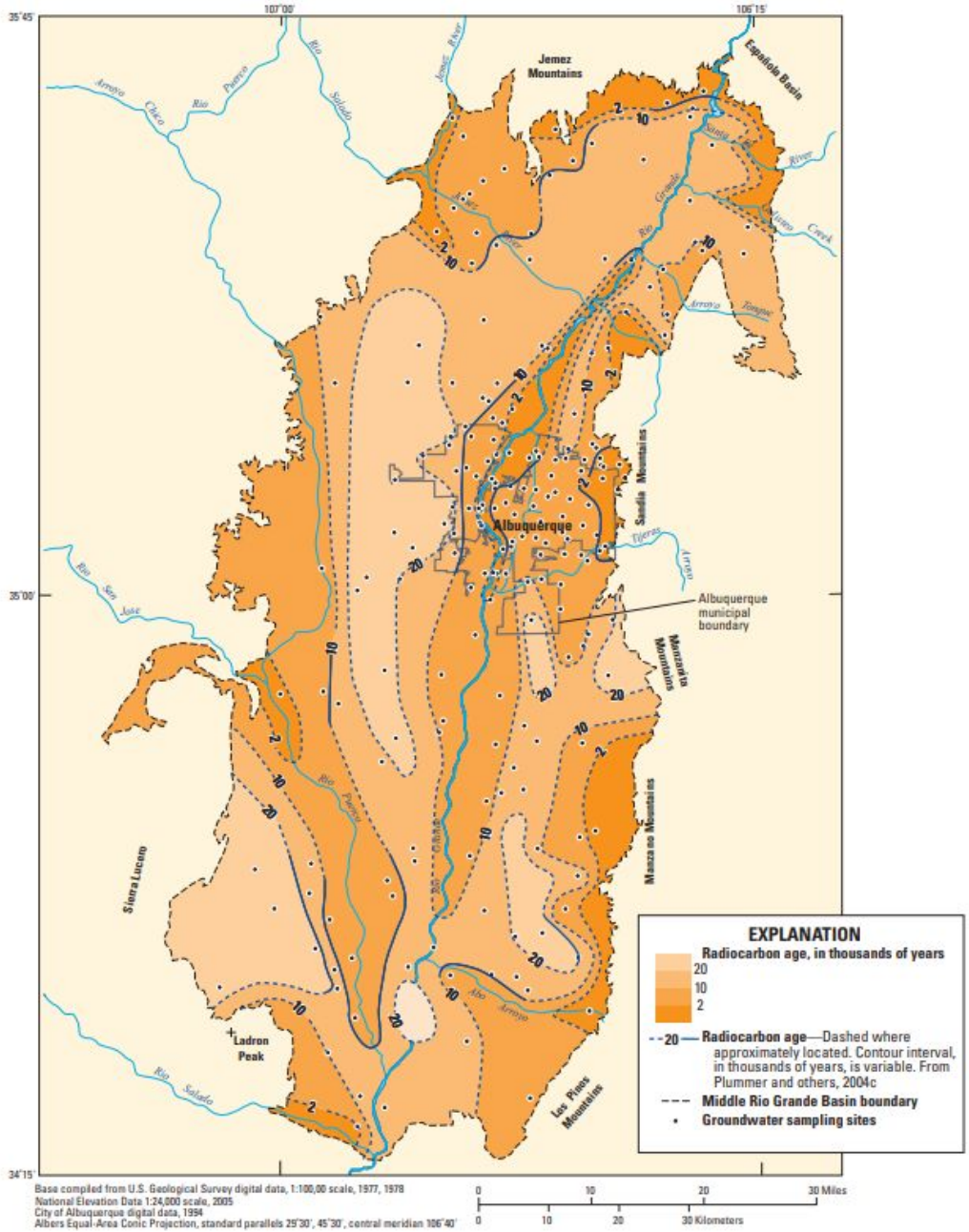


Figure 7. Estimated ages of groundwater in the Santa Fe Group aquifer system of the Middle Rio Grande Basin, New Mexico.

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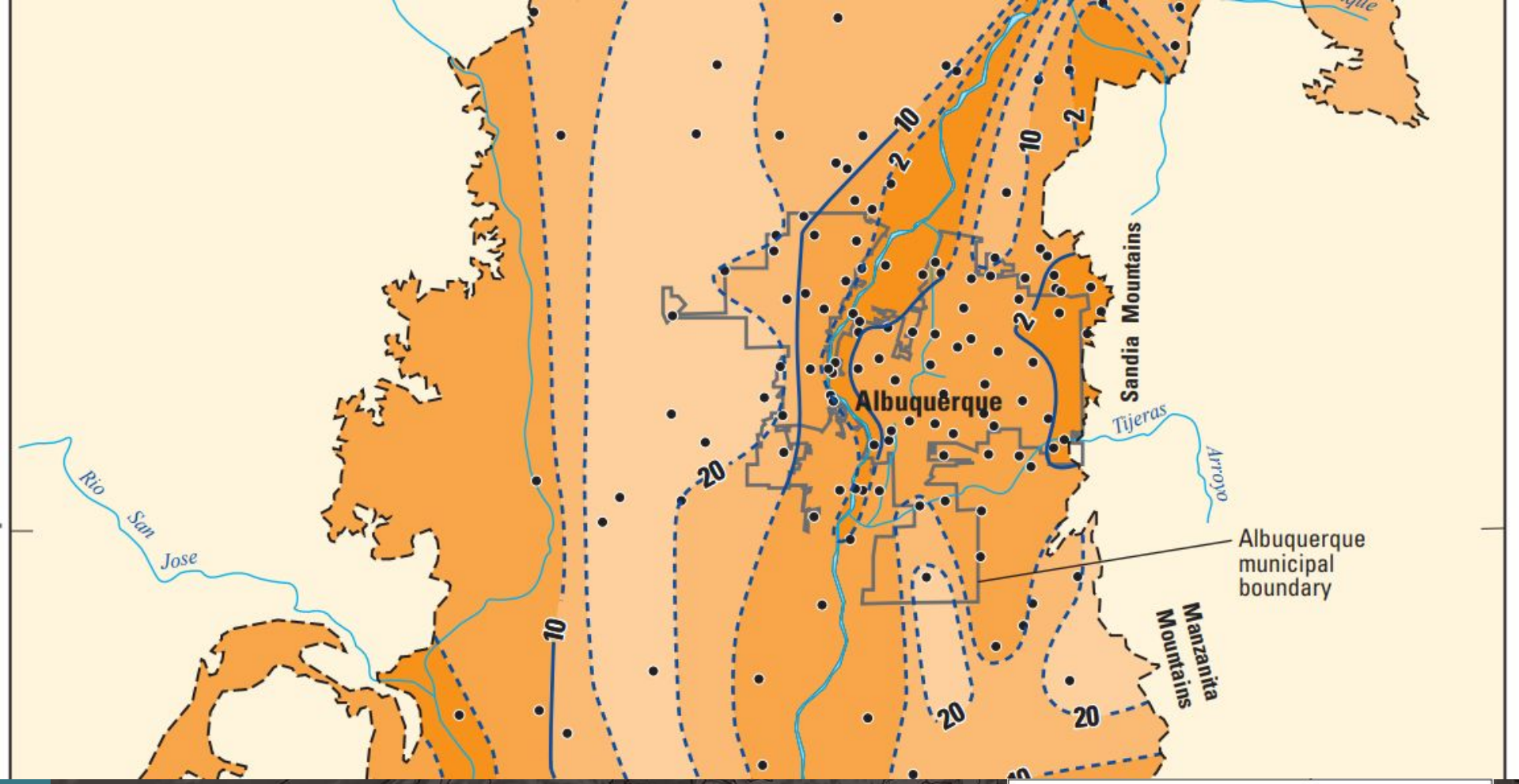
Age of groundwater in the Albuquerque Basin

from
Conceptual Understanding and Groundwater Quality of Selected Basin Fill Aquifers in the Southwestern United States, USGS Professional Paper 1781

https://pubs.usgs.gov/pp/1781/pdf/pp1781_section11.pdf



Zoomed in to previous image

New Mexico's water cycle

Unlike Earth, New Mexico is not a closed system. Mass can be transferred into and out of the New Mexico 'system'.

New Mexico's water cycle

Unlike Earth, New Mexico is not a closed system. Mass can be transferred into and out of the New Mexico 'system'.

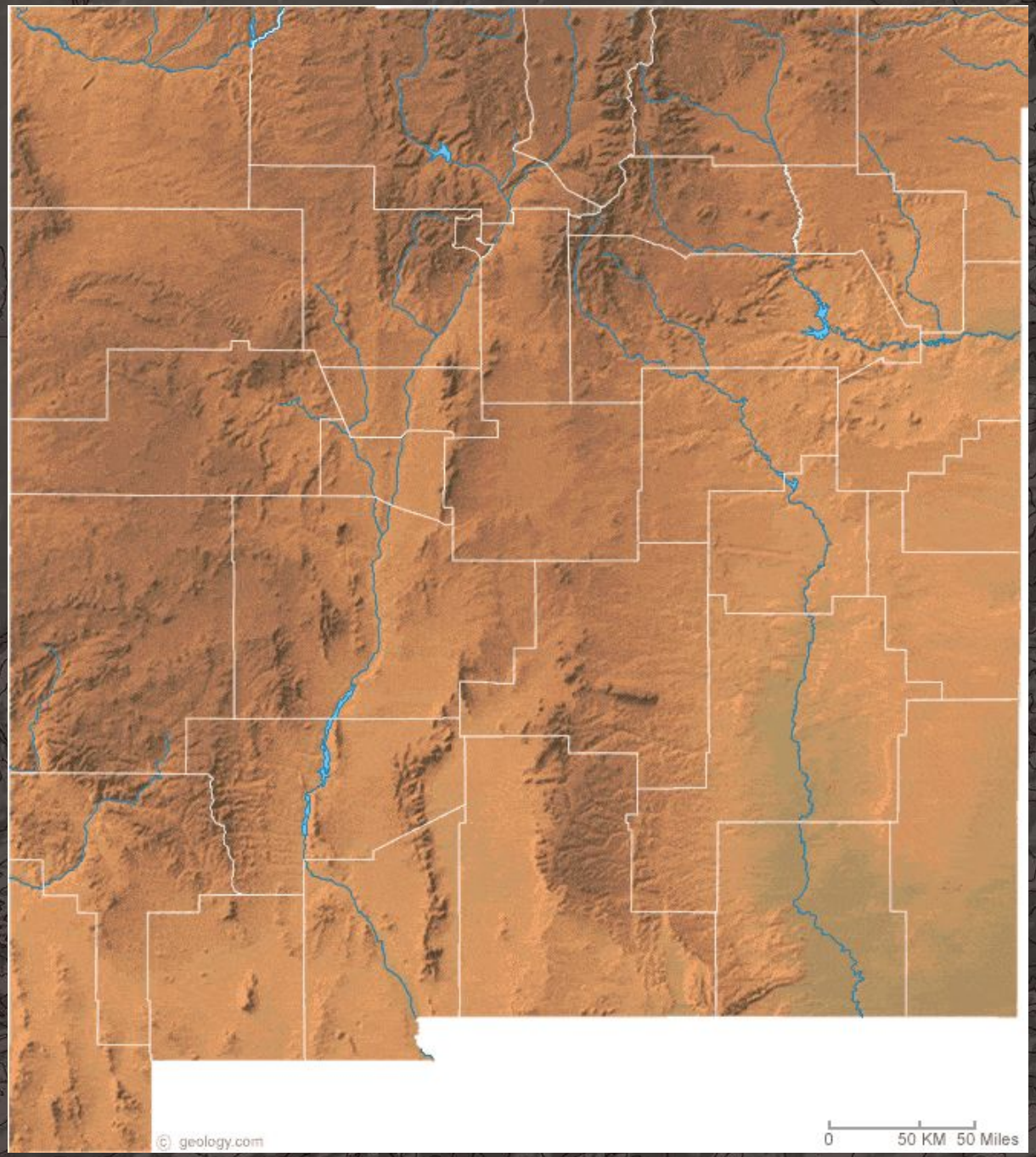
It is still useful to think of reservoirs and fluxes in the NM water cycle.

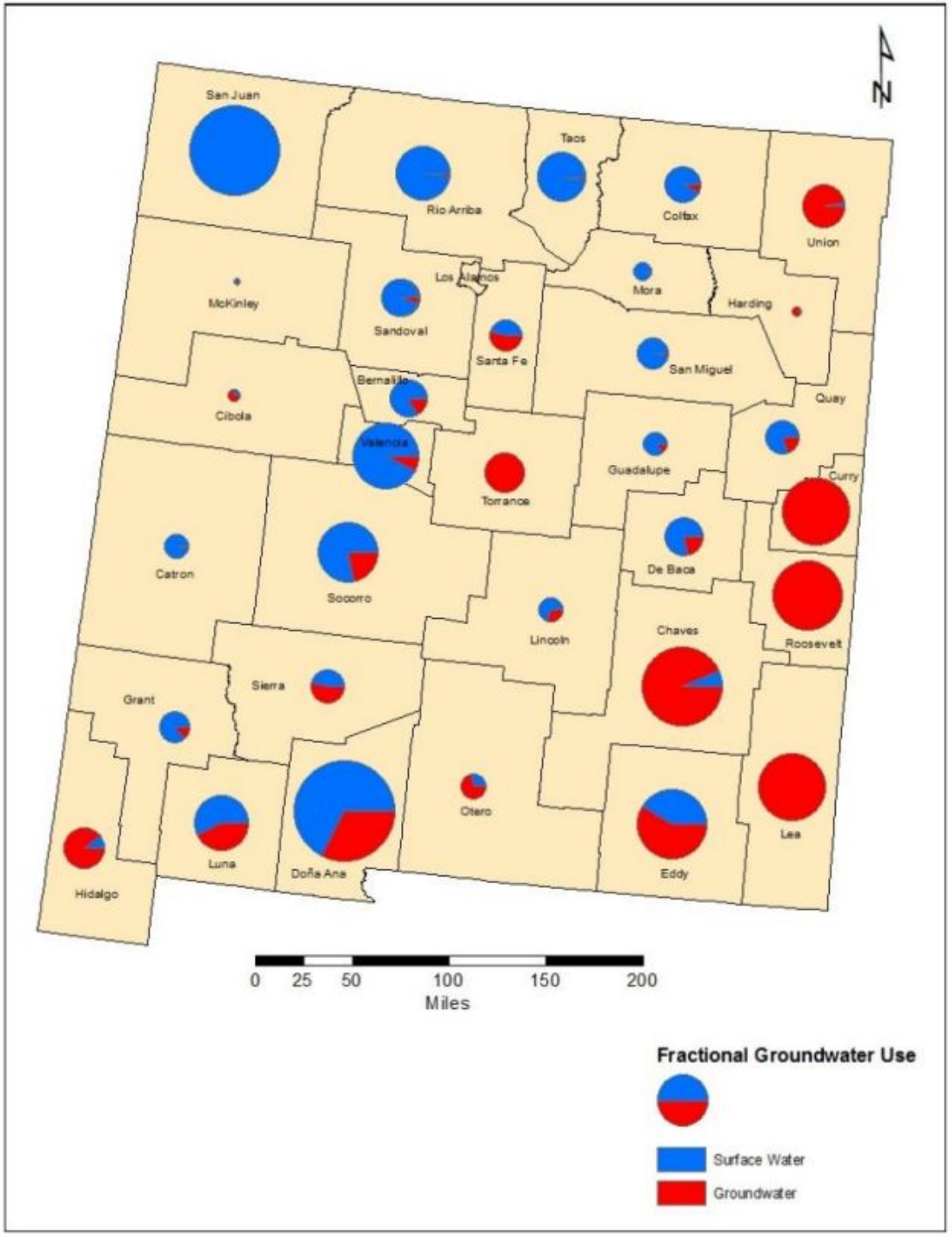
Reservoirs:

atmosphere, rivers, lakes, snowpack, groundwater

Fluxes:

evaporation, river flow





Source: National Water Information System, USGS 2010 Water Use Data

Human impacts on the water cycle (NM-specific)

Santa Fe plans significant water release as state tries to pay down Texas debt

By Scott Wyland swyland@sfnewmexican.com Jan 14, 2021 Updated Jan 15, 2021 9

Will New Mexicans Get Their Green Chile Fix This Year?

Green Chile Farmers Brace For Another Rough Crop

Fallowing land to conserve groundwater not enough, New Mexico lawmakers say

By Scott Wyland swyland@sfnewmexican.com May 19, 2021 Updated May 20, 2021 5

Human impacts on the water cycle (NM-specific)

NEWS

May 11, 2021

Navajo-Gallup water delay spurs problem solving in arid Southwest

By Elizabeth Miller, New Mexico In Depth

NM will pay farmers to stop groundwater use

BY THERESA DAVIS / JOURNAL STAFF WRITER
Friday, January 1st, 2021 at 11:02pm

Boat ramps closed at several New Mexico State Parks due to low water levels

Drought having an effect on outdoor recreation

103 Shares

KOAT ACTION NEWS

Updated: 2:20 PM MDT May 10, 2021

The New Mexico water cycle

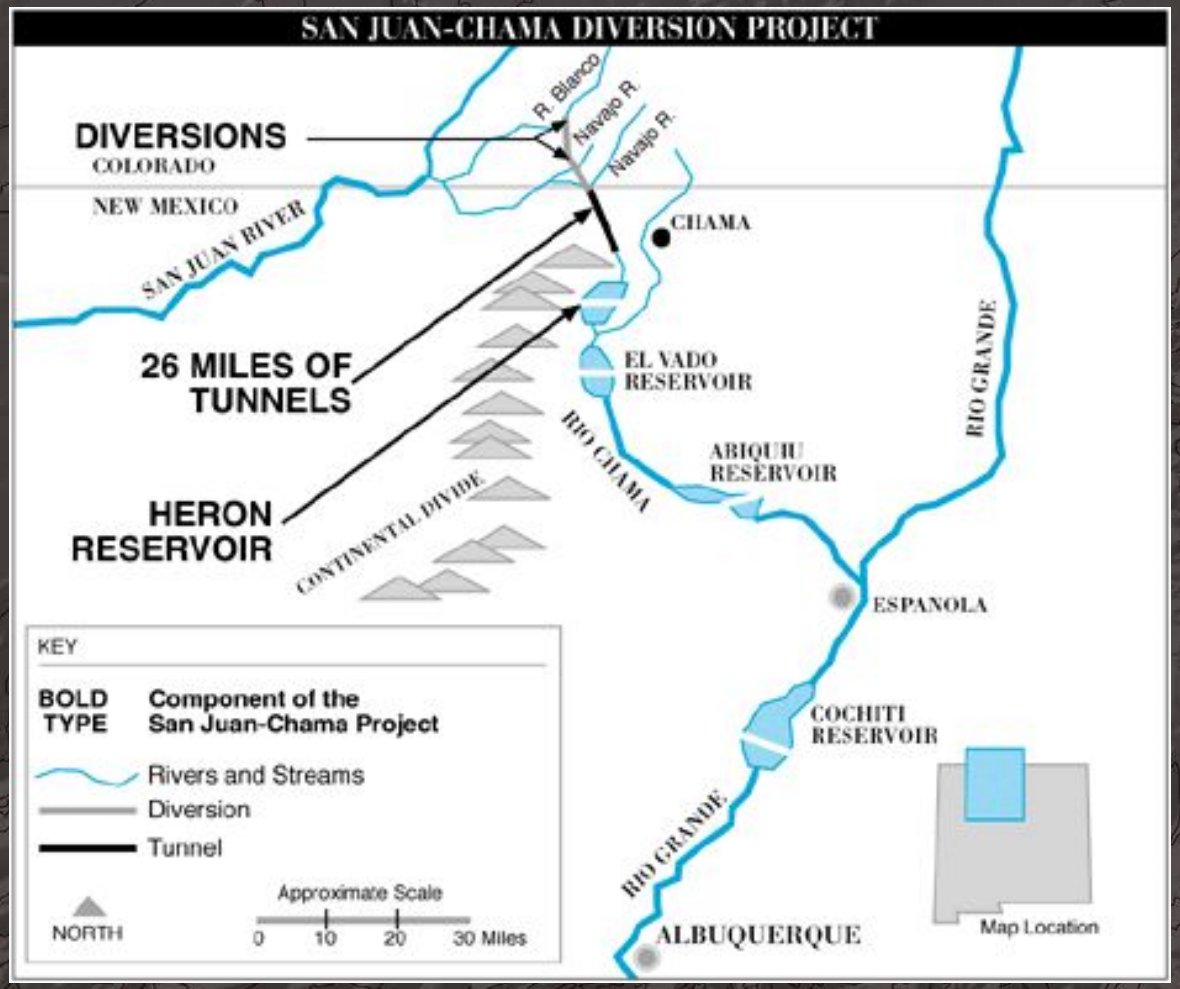
Many users, many uses, many variables.

Can we alter reservoirs and fluxes in the NM water cycle?

Should we alter reservoirs and fluxes in the NM water cycle?

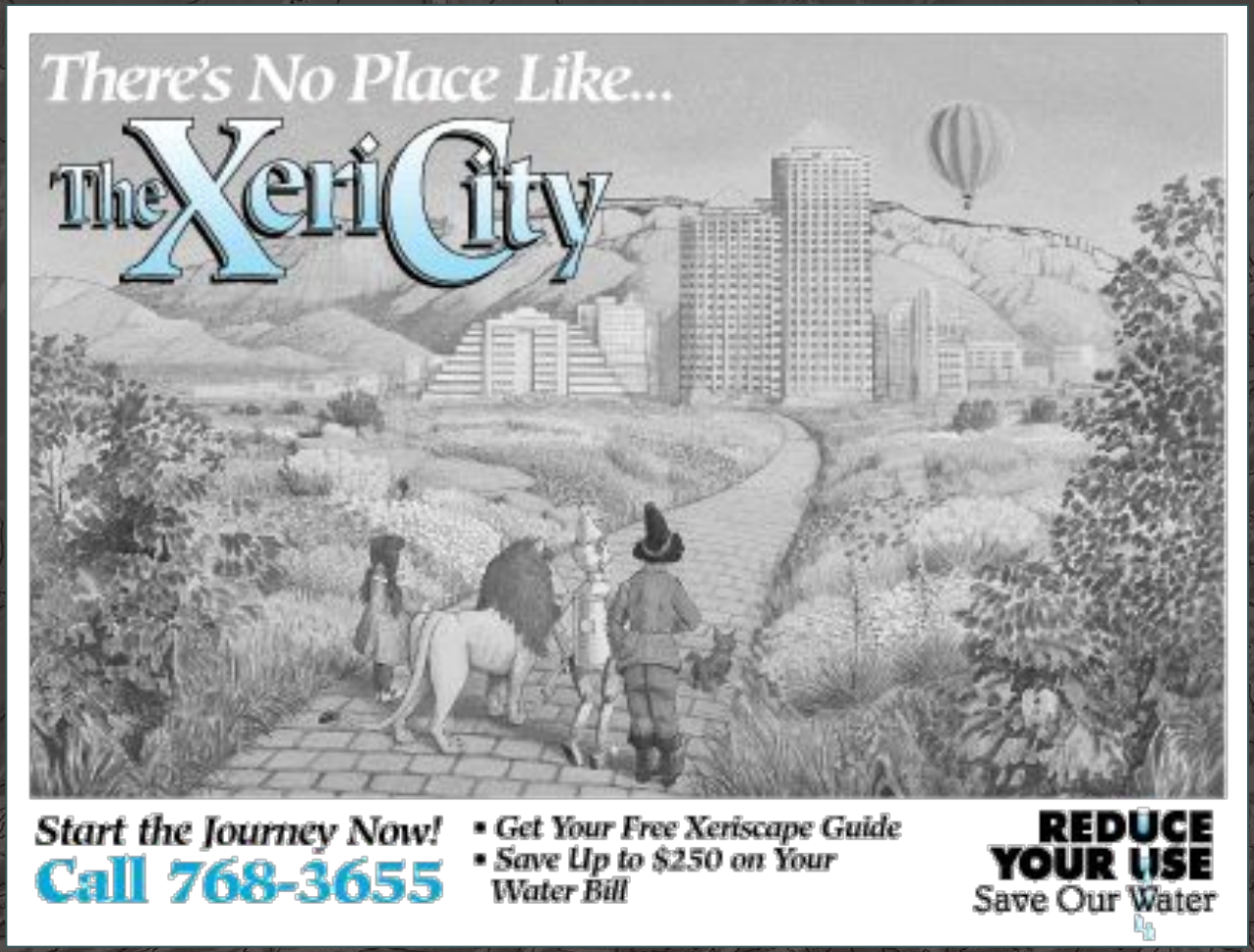
We already are altering the water cycle!

Example: the San Juan-Chama Project



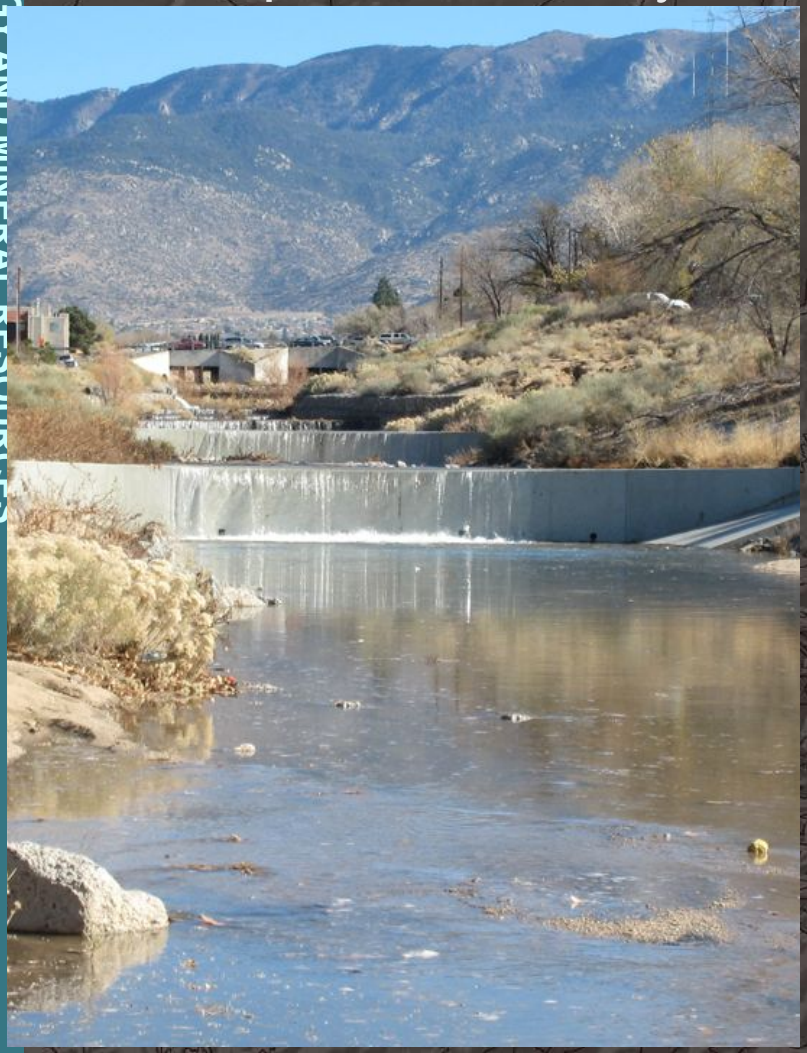
We already are altering the water cycle!

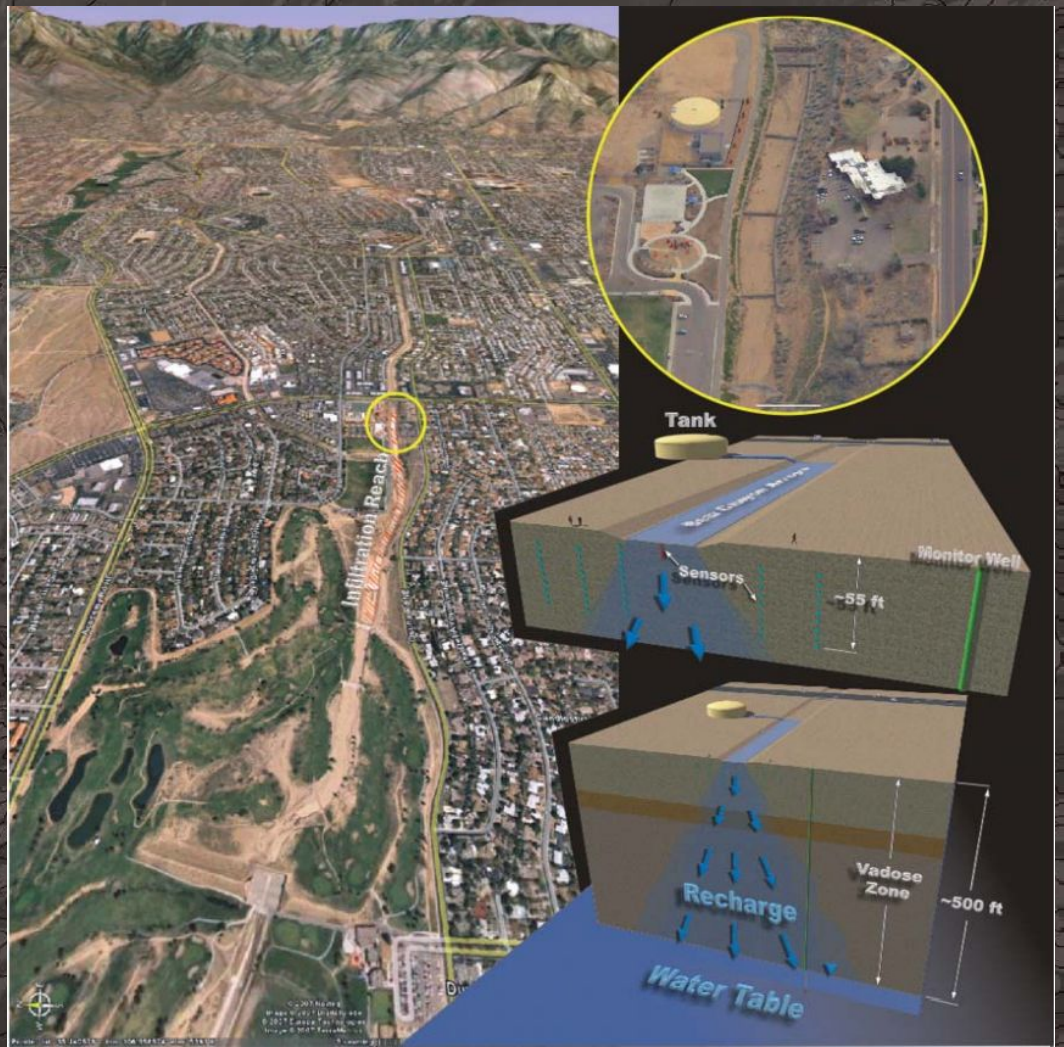
Example: government-sponsored conservation programs



We already are altering the water cycle!

Example: Bear Canyon Recharge Experiment





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Thank you

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Resources

https://www.abcwua.org/your-drinking-water-diversion-and-recharge-data/

https://www.windows2universe.org/earth/Water/water_cycle_climate_change.html

https://geoinfo.nmt.edu/faq/water/#:~:text=Drinking%20water%20comes%20from%20two,linked%20through%20the%20hydrol ogic%20cycle.&text=Precipitation%20in%20New%20Mexico%20ranges,inches%20of%20water%20per%20year.

https://aces.nmsu.edu/programs/sare/documents/irrigationwaterresourcesandclimatechange-in-nm.pdf