

Lifetime Learning Institute, October 18, 2022



22FA24 RIVERS OF DISTRESS: THE WORLD WATER CRISIS

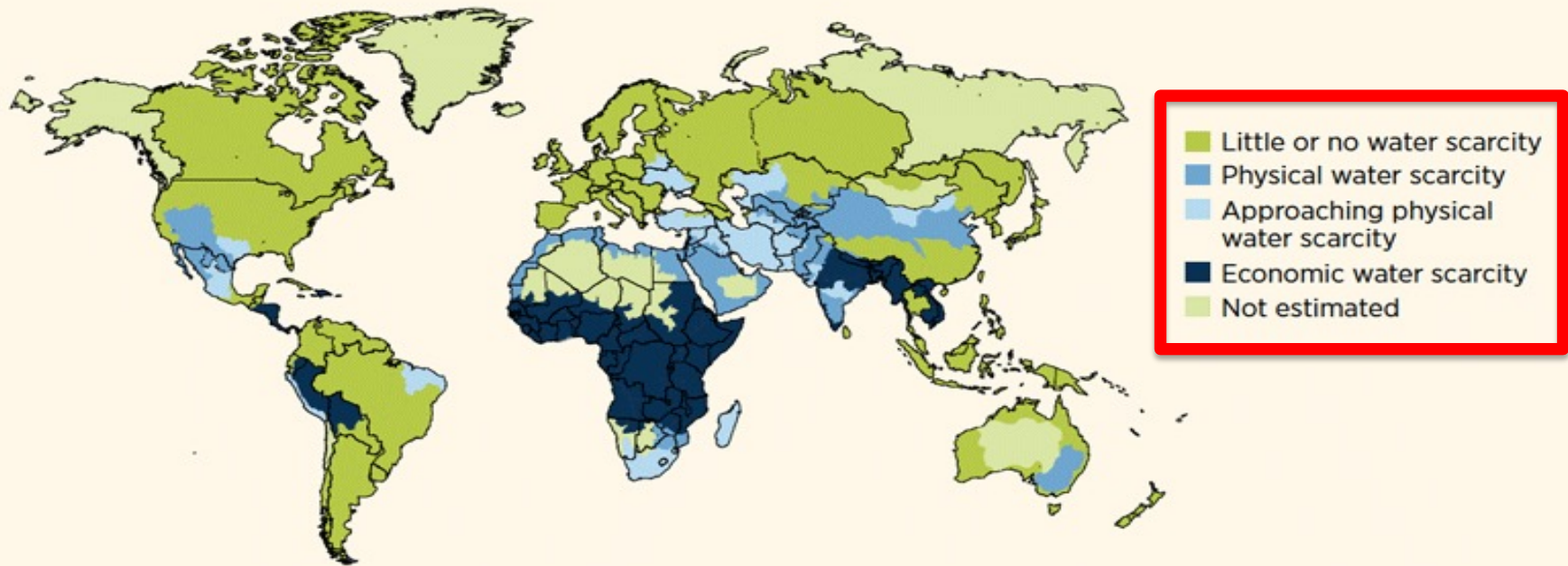
***Barry Centini*, Ph.D.**

barry.centini@verizon.net

RIVERS OF DISTRESS: THE WORLD WATER CRISIS

- ❑ The intersections of hydrology, water management, and climate change are putting the world's water systems at risk.
- ❑ There is frequent news about water issues affecting both water supply and electric generation connected with the world's largest rivers.
- ❑ We will look at the consequences of poor water management, significant droughts connected to climate change, and what is being, and should be done, about it.

Global physical and economic water scarcity



RIVERS ARE THE CANARY IN THE COAL MINE FOR CLIMATE CHANGE



UH
OH

DISTRESS

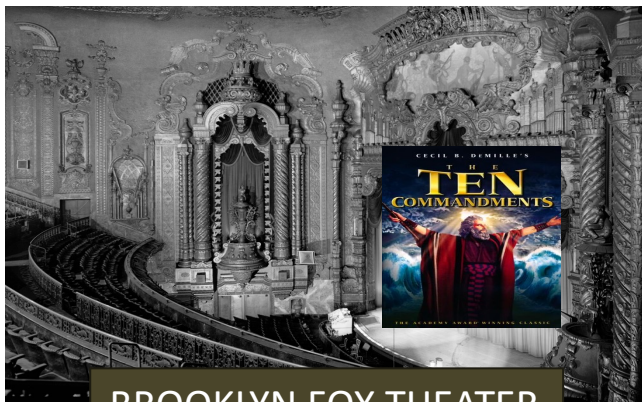
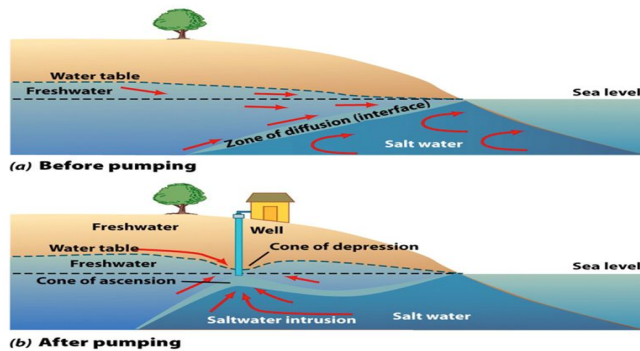
ERIC ALLIE
ILLINOIS POLICY

USGS HYDROLOGIC FIELD ASSISTANT

Ground Water Branch 1958

Ground H₂O Branch, Mineola, NY
Monitor salt-water intrusion

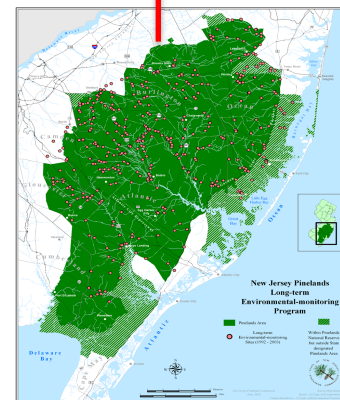
Groundwater on Long Island: saltwater intrusion



BROOKLYN FOX THEATER

Surface Water Branch 1959

Surface H₂O Branch Mullica River,
in the Pinelands of southern NJ





rivers in distress



[All](#) [Images](#) [Maps](#) [Videos](#) [News](#) [More](#) Tools

About 51,200,000 results (0.62 seconds)

Threatened Rivers Span the United States

- Colorado River (Colorado, Utah, Arizona, Nevada, California)
- Snake River (Wyoming, Idaho, Oregon, Washington)
- Mobile River (Alabama)
- Atlantic salmon rivers (Maine)
- Coosa River (Georgia, Alabama)

Google Scholar

rivers in distress



Articles

About 179,000 results (0.08 sec)

My profile

Any time

Since 2022

Since 2021

Since 2018

Custom range...

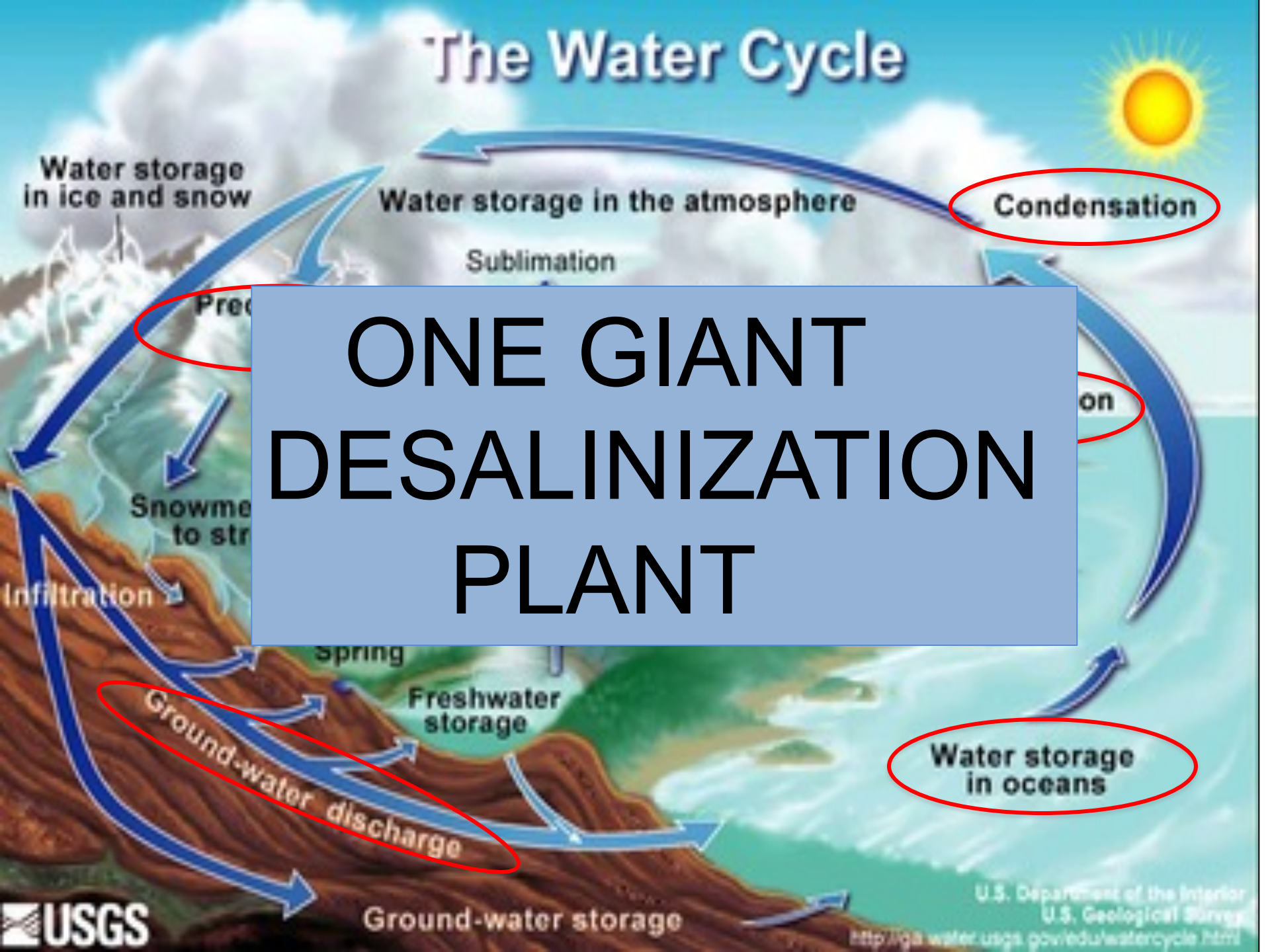
Sort by relevance

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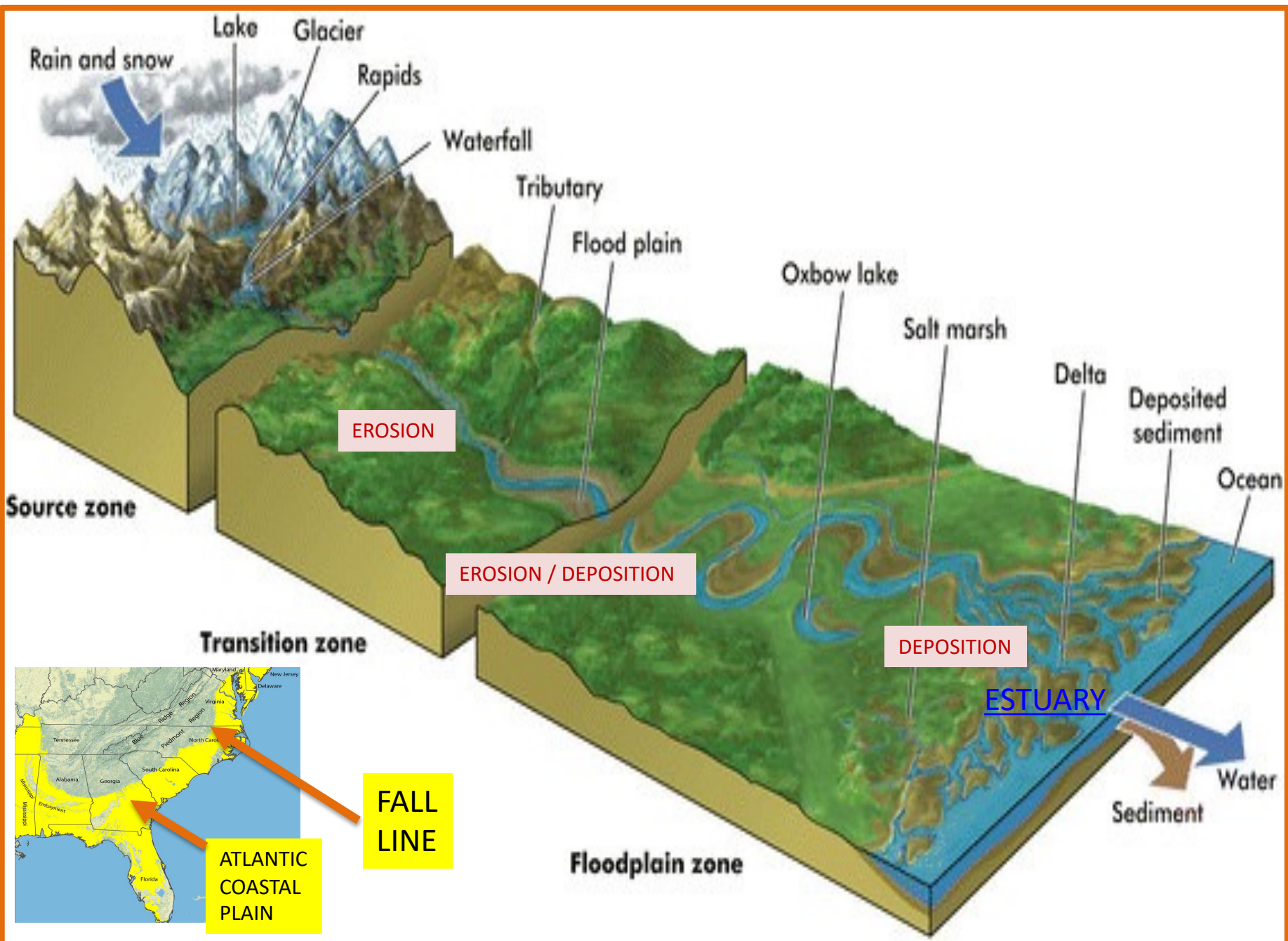
Any type

Review articles

The Water Cycle

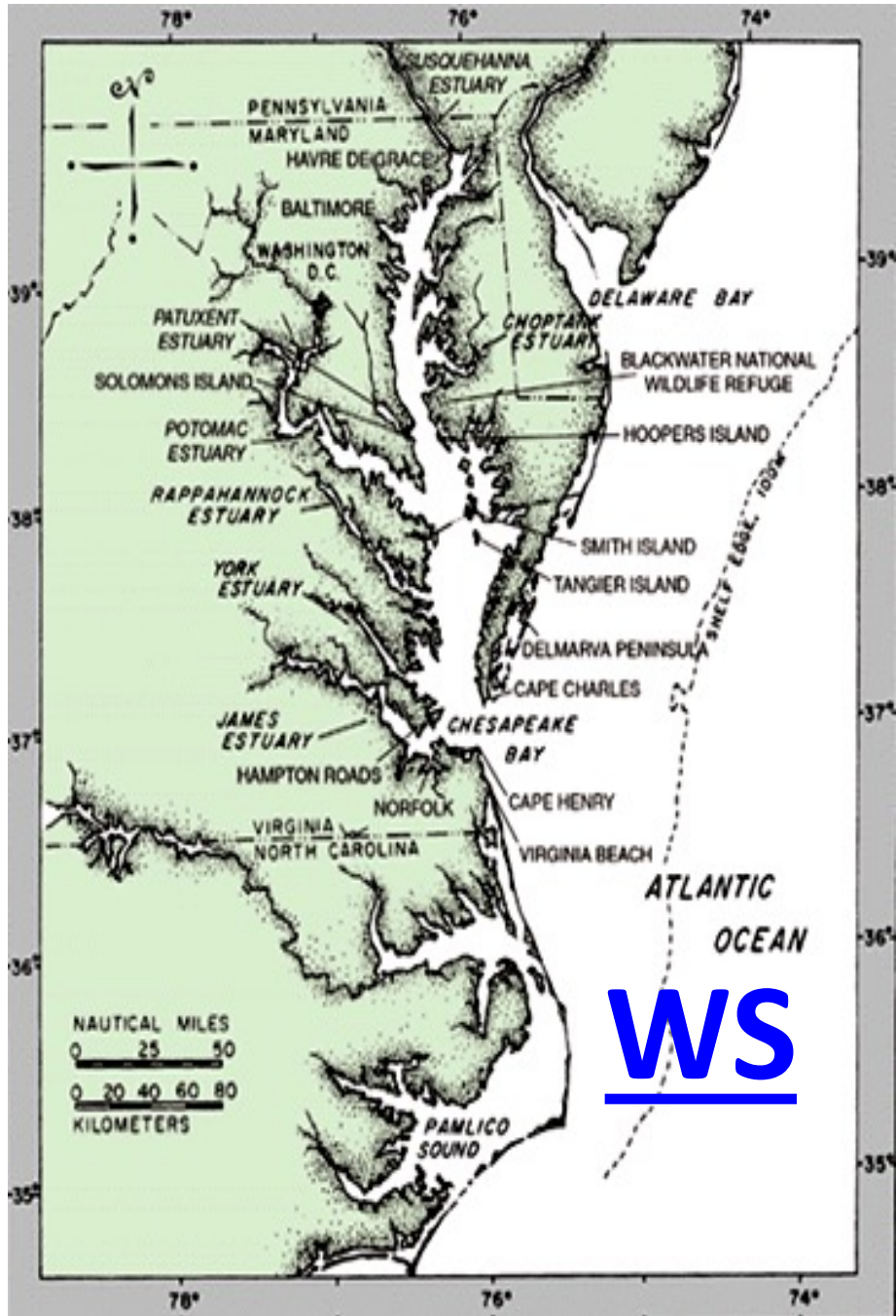


ONE GIANT
DESALINIZATION
PLANT



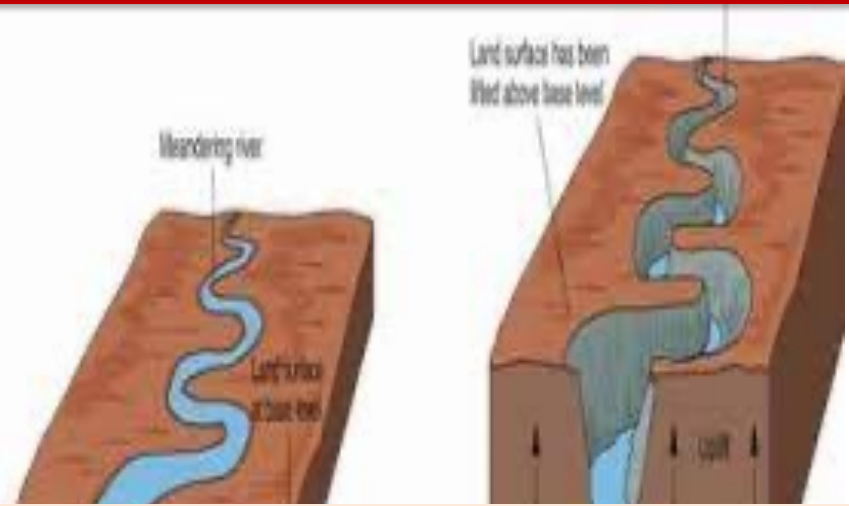
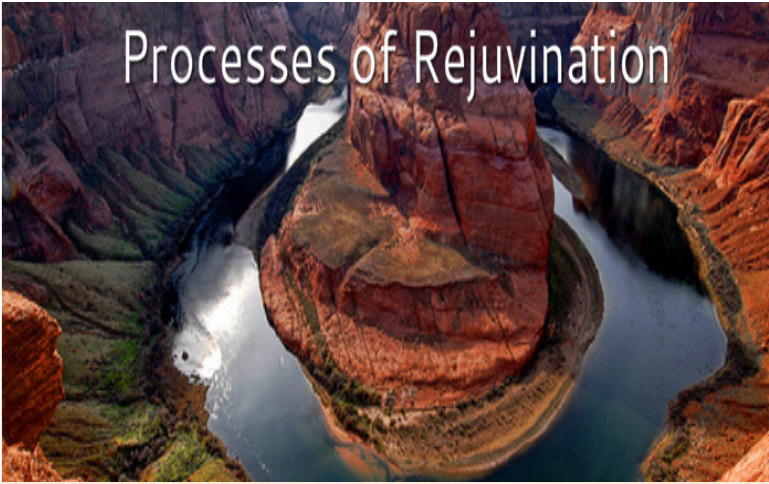
- ❑ The rivers of the Chesapeake region converged at a location directly over the 35 my buried crater.
- ❑ While most rivers, like the Rappahannock, flow southeastward to the Atlantic, the York and James Rivers make sharp turns northeast near the outer rim of the crater.
- ❑ Over the past century, Chesapeake Bay waters have risen about 1 foot, and are predicted to rise another 1.3 to 5.2 feet over the next 100 years.



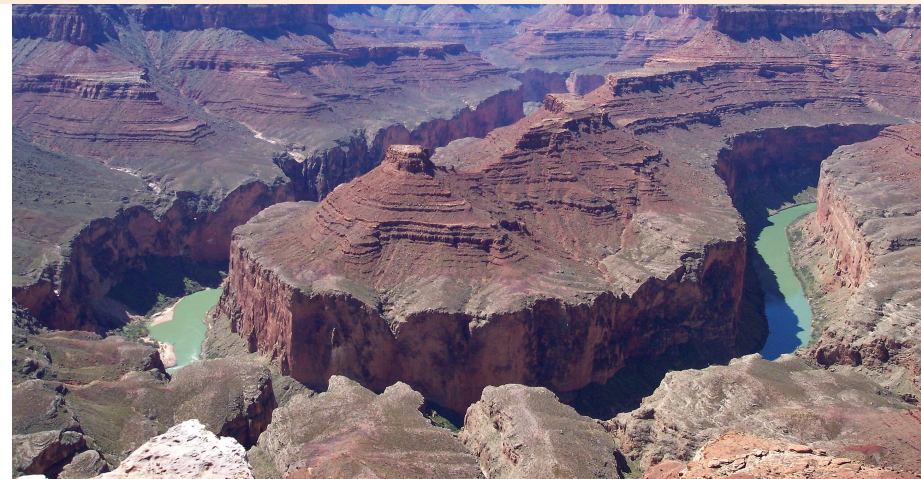


- ✓ The Chesapeake Bay is the drowned, ancestral valley of the Susquehanna River.
- ✓ 18,000 years ago, the Susquehanna riverbed extended to the edge of the continental shelf.
- ✓ During the last glaciation, sea level was approximately 100 meters lower than at present.
- ✓ At the end of the last glacial epoch, sea level rose as continental glaciers melted.
- ✓ Between 6,000 and 7,000 years ago, submergence began to slow, and the Bay took on its characteristic drowned river valley pattern.
- ✓ Sea level at that time stood 9 meters lower than the present level.

Processes of Rejuvenation



- ❑ In *geomorphology* a river is said to be rejuvenated when it is eroding the landscape in response to a lowering of its base level.
- ❑ The process is often a result of a sudden fall in sea level[?] or the rise of land.
- ❑ The disturbance enables a rise in the river's potential energy, increasing its riverbed erosion rate.



Too Little Water

Barges grounded by low water halt Mississippi River traffic

A low Mississippi River is about to deepen Europe's energy crisis

Lake Mead water crisis is exposing volcanic rock 12 million years old

The American west's drought is its second-worst for 12 centuries

Too Much Water

Death toll from historic eastern Kentucky flooding rises to 40

100's of homes underwater, river is expected to stay flooded through Thanksgiving

Almost 80 people killed as boat capsizes in flood-swollen river in Nigeria

Mississippi River at Memphis expected to approach record low stage

America's Most Endangered Rivers® of 2022

#1 [Colorado River](#)

State: CO, UT, AZ, NV, CA, WY,
NM, Mexico

Threat: Climate change, outdated management

#2 [Snake River](#)

State: ID, WA, OR

Threat: Four federal dams

#3 [Mobile River](#)

State: AL

Threat: Coal ash contamination

#4 [Maine's Atlantic Salmon Rivers](#)

State: ME

Threat: Dams

#5 [Coosa River](#)

State: TN, GA, AL

Threat: Agricultural pollution

#6 [Mississippi River](#)

State: MN, WI, IL, IA, MO, KY, TN,
AR, MS, LA

Threat: Pollution, habitat loss

#7 [Lower Kern River](#)

State: CA

Threat: Excessive water withdrawals

#8 [San Pedro River](#)

State: AZ
protections

Threat: Excessive water pumping; loss of Clean Water Act

#9 [Los Angeles River](#)

State: CA

Threat: Development, pollution

#10 [Tar Creek](#)

State: OK

Threat: Pollution

Recent Floods in USA

USA – Hundreds Rescued From Floods in Florida After Hurricane Ian

1 OCTOBER, 2022.

USA – Hurricane Ian Causes Catastrophic Storm Surge Floods in Florida

29 SEPTEMBER, 2022.

Caribbean – Rain From Hurricane Fiona Triggers Deadly Floods and Mudslides

20 SEPTEMBER, 2022...

USA – Hundreds Evacuate as “Unprecedented Storm” Causes Coastal Flooding in Alaska

19 SEPTEMBER, 2022

USA – Deadly Flash Floods in Texas After 385mm of Rain in 24 Hours

23 AUGUST, 2022

USA – State of Emergency Declared After Floods in West Virginia

16 AUGUST, 2022

USA – 2 Die in Las Vegas Flash Floods

14 AUGUST, 2022

USA – Flash Floods in Death Valley Leave Hundreds Stranded

8 AUGUST, 2022

USA – Emergency Declared After 15 Killed in Kentucky Flash Floods

29 JULY, 2022

USA – Severe Flash Floods in Missouri After Record Rainfall

27 JULY, 2022.

USA – Rain on Burn Scar Areas Triggers Deadly Flooding in Colorado

18 JULY, 2022.



GANGES

- ✓ The river flows through:
 - **100 cities with populations over 100,000**
 - **97 cities with population between 50,000 to 100,000**
- ✓ The **untreated sewage** dumped that contribute to polluting the Ganges.
 - **industrial waste**
 - **agricultural runoff**
 - **animal carcasses**
 - **remnants of partially burned or unburned bodies from funeral pyres**
 - ❖ Because many families cannot afford the high cost of sufficient quantities of cremation wood, **many of the bodies deposited into the Ganges are only half-burnt**
- ✓ During **festival seasons, over 70 million people bathe** in the Ganges to **cleanse** themselves of their past sins.



Jordan River Issues

- **96% of the River's waters claimed by Israel, Syria and Jordan.**
- **Sewage, saline water, agricultural runoff** dumped into the River.
- Pollution caused an **ecological collapse.**
- **> 50 % of the valley's biodiversity has been lost.**
- River Valley is a **border/military area; off-limits to the public.**
- Pollutants removed by **3 Waste-water Treatment Plants.**
- Large scale **desalination** takes place in Israel.

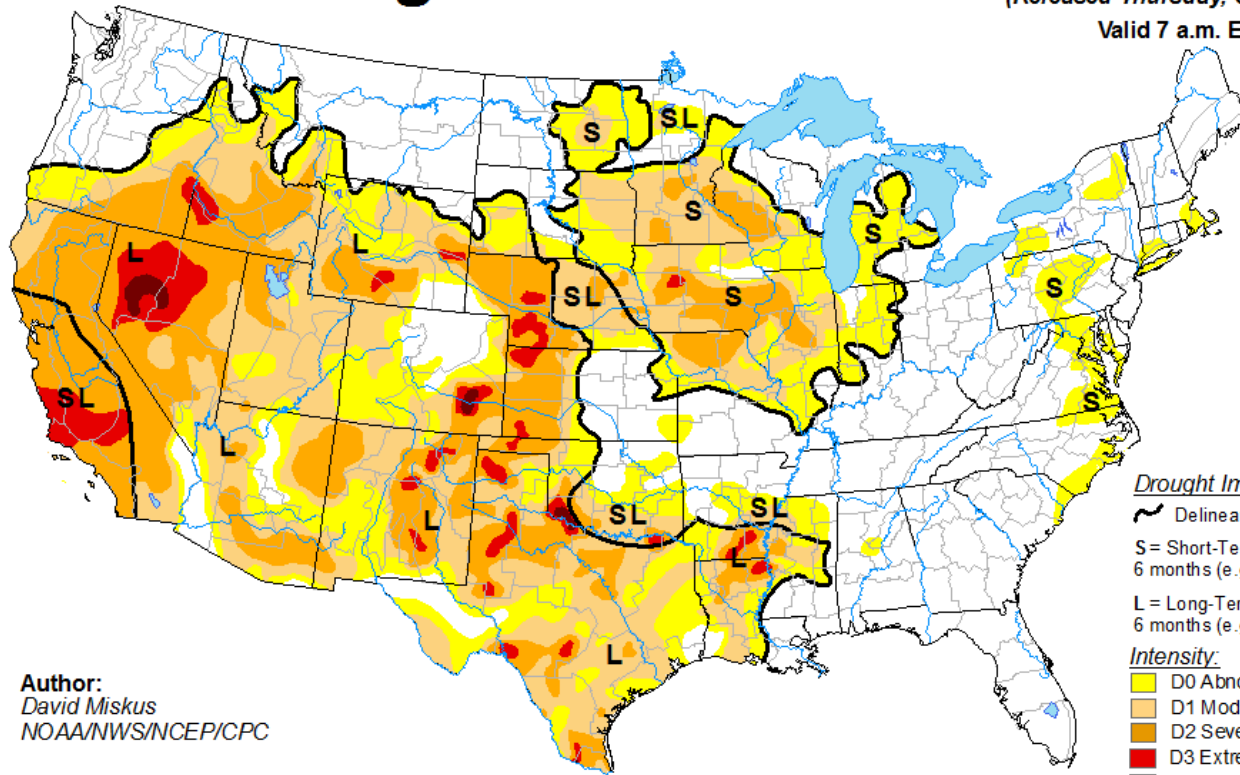
Water's Occurrence, or lack thereof

U.S. Drought Monitor

October 1, 2013

(Released Thursday, Oct. 3, 2013)

Valid 7 a.m. EDT



MONITOR

Author:
David Miskus
NOAA/NWS/NCEP/CPC

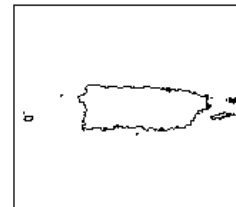
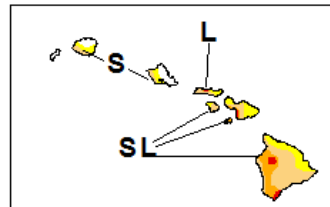
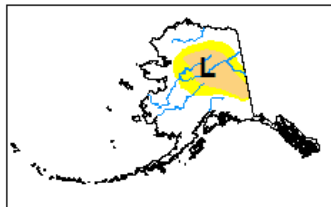
Drought Impact Types:

- ~ Delineates dominant impacts
- S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)
- L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

- Yellow: D0 Abnormally Dry
- Light Orange: D1 Moderate Drought
- Orange: D2 Severe Drought
- Red: D3 Extreme Drought
- Dark Red: D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



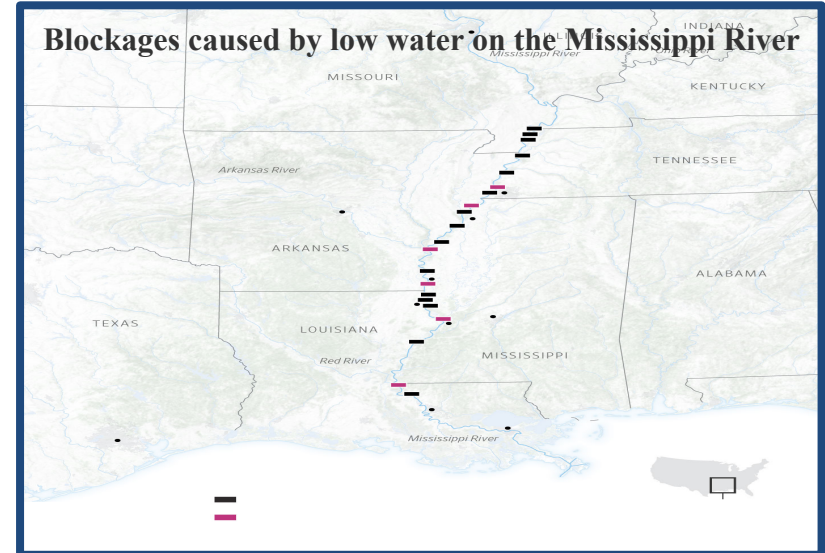
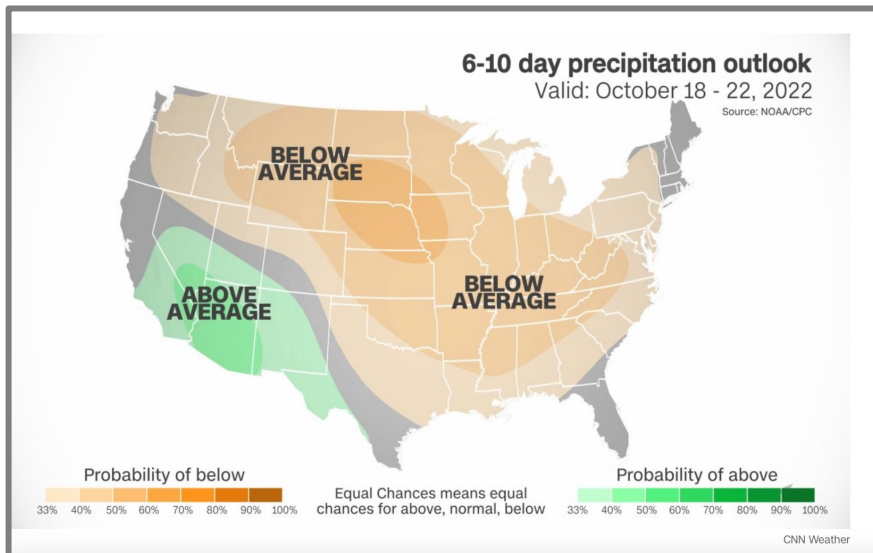
<http://droughtmonitor.unl.edu/>

The mighty Mississippi is so low, people are walking to a unique rock formation rarely accessible by foot



CNN — Tower Rock – a massive island in the middle of the Mississippi is typically surrounded by water, but severe drought pushes river levels to near-record lows, and people can reach it on foot.

- ☐ More than 55% of the United States is in drought, and severe drought covers more than 70% of Arkansas and nearly 40% of Missouri.



40 Million People Rely on the Colorado River. It's Drying Up Fast.

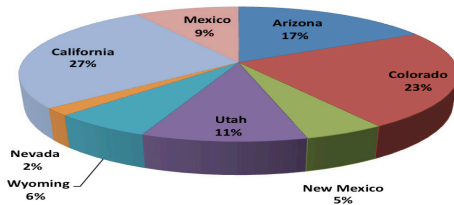
❑ Colorado River aridification caused by climate change is reducing the water flowing in the river.

✓ With each additional 1.8 degrees (F) warming, the river's average flow drops by 9.3%.

❑ Colorado River is severely threatened by:

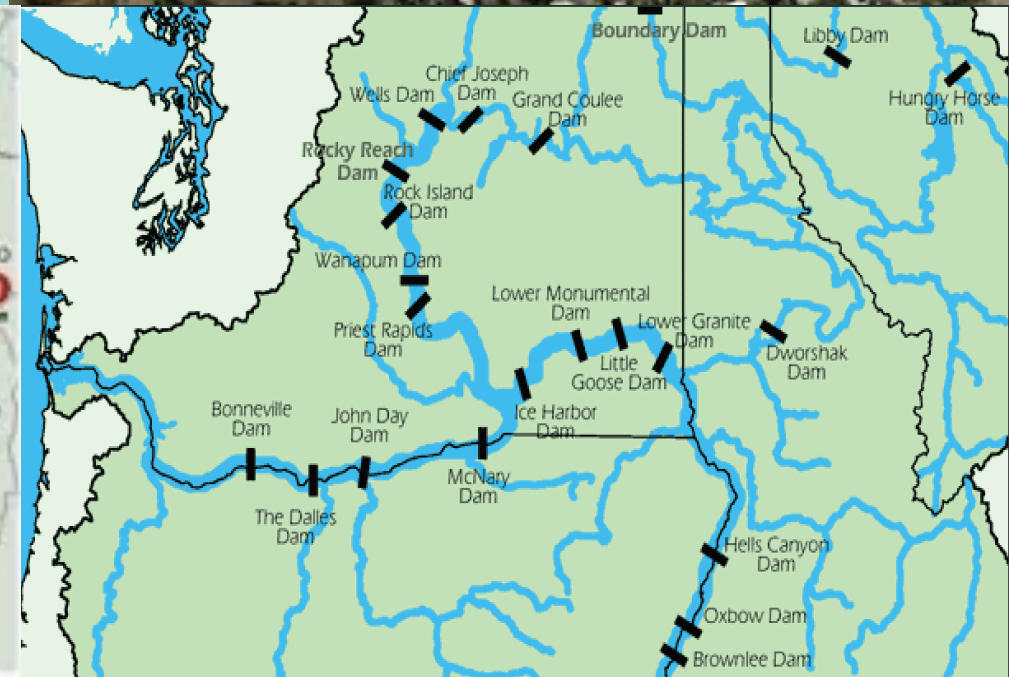
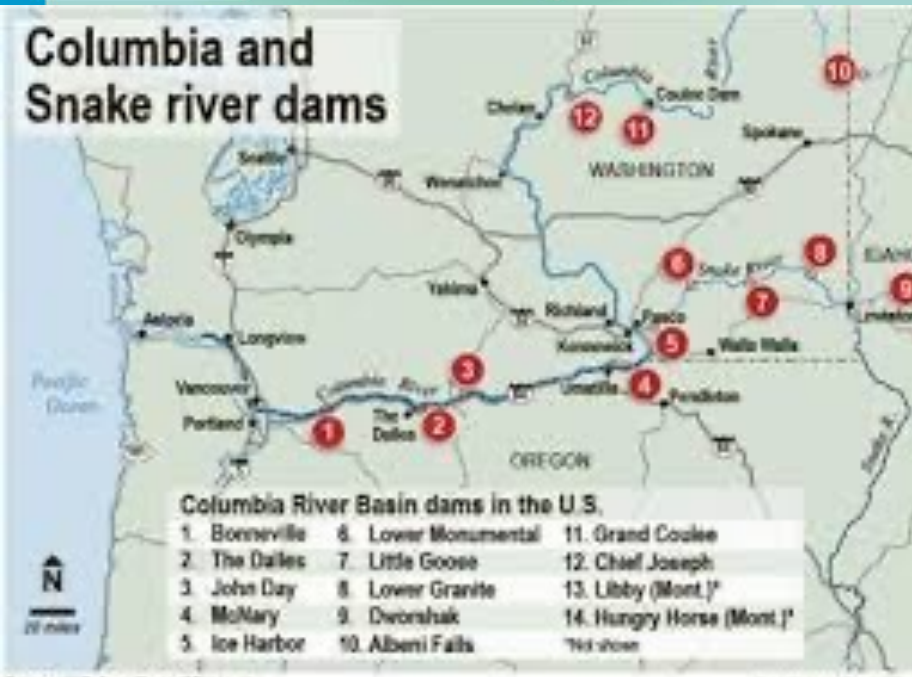
- ✓ human overuse
- ✓ environmental issues
- ✓ poor river management technique
- ✓ agricultural overdraw increasing salinity.

Colorado River Apportionment



The Colorado River has more dams than any other river in the United States. In total, there are 15 dams on the Colorado River, all of which are used to pool water for irrigation and generate electricity..



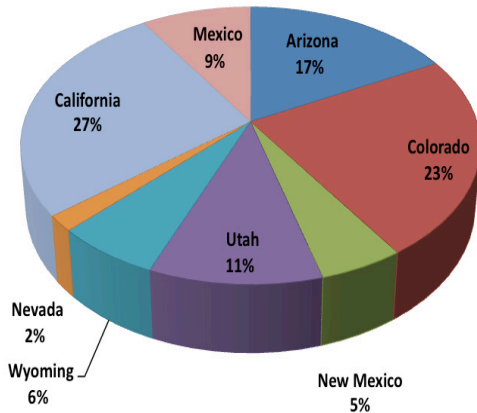


I'll be *damned* or I won't



- ❑ The Colorado River is severely threatened by **human overuse, environmental issues, and poor river management technique.**
- ❑ Water quality is jeopardized by increased salinity caused by agricultural overdraw.

Colorado River Apportionment



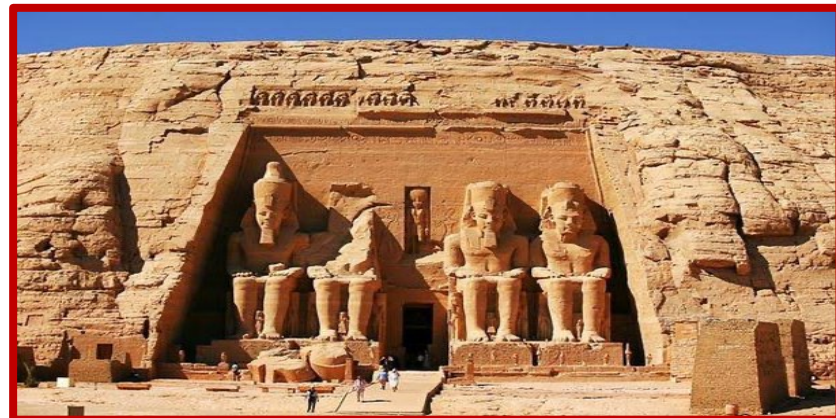
The West's megadrought

- ✓ The West just experienced an aspect of the climate crisis that scientists have warned of for years
- ✓ A massive rockfall crashed into Lake Powell. Record-low water levels could be to blame
- ✓ Lake Mead's water level is running well below predictions
- ✓ This state's two largest reservoirs are already at 'critically low levels' and the dry season is just starting
- ✓ The Colorado River irrigates farms, powers electric grids and provides drinking water for 40 million people. As its supply dwindles, a crisis looms
- ✓ The West's climate-change driven megadrought has plunged the nation's two largest reservoirs, Lake Mead and Lake Powell, to historic lows..



DAMS

- ❑ **The Aswan High Dam (AHD), the world's largest embankment dam, contributed to the Cold War, when Egypt decided to fund the project by nationalizing the Suez Canal.**
- ❑ **What problems has AHD caused?**
 - ✓ **increasing soil salinity**
 - ✓ **changes in the water table**
 - ✓ **excessive downstream water plant growth**
 - ✓ **diseases**
 - ✓ **the social impact on the Nubians, whose homeland was flooded.**



How Is Climate Change Affecting Floods?

- ❑ Like other extreme weather disasters, flooding involves a number of competing factors that may affect its frequency and intensity.
- ❑ It can be tempting to attribute all floods and other extreme events to the forces of warming planet. ***But weather is not climate.***
- ❑ For example, scientists are confident that climate change makes unusually hot days more common. They're not as sure that climate change is **making tornadoes more severe.**
- ❑ Floods fall somewhere along the confidence spectrum between heat waves (“yes, clearly”) and tornadoes (“we don’t know yet”).



The 18 Deadliest U.S. Mainland Hurricanes

WHY TO AVOID USING A WEATHER ANECDOTE WHEN YOU TALK ABOUT CLIMATE ISSUES

14.	Galveston (TX)	1915	4	275
15.	Camille (MS/LA)	1969	5	256
16.	New England	1938	3*	256
17.	Diane (Northeast U.S.)	1955	1	184
18.	GA/SC/NC	1898	4	179

WRITE YOUR
OWN
CAPTION



Shanahan

CREATOR'S REMORSE



PARKINSON'S: MY PERSONAL STORY
SPRING 2023

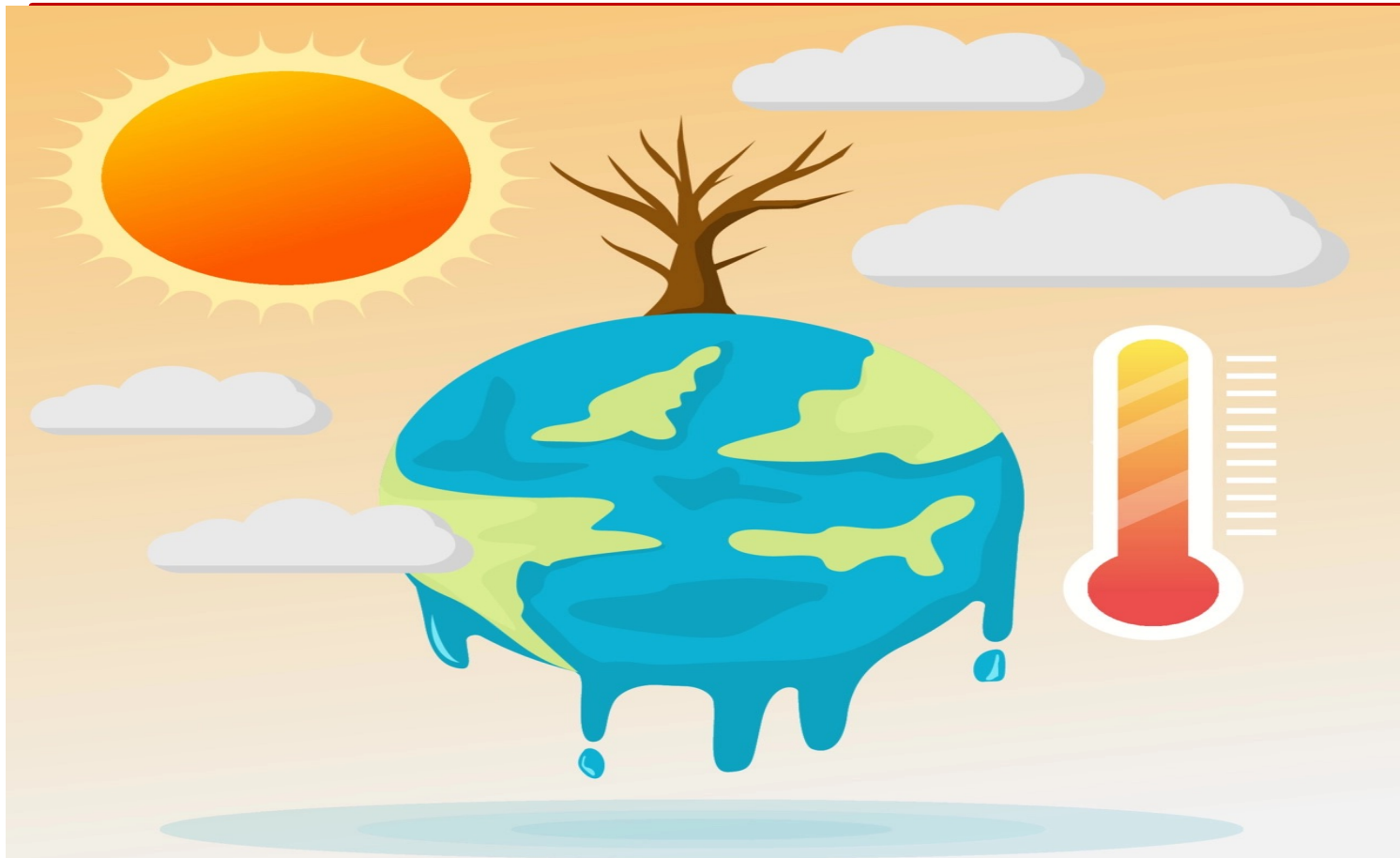
<https://llinova.org>

QUESTIONS

????????????

COMMENTS

REAL PROBLEMS



**CLIMATE CHANGE IS
REAL**

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❑ Ocean water is warming and growing acidic.

- ✓ Warmer waters in the shallow oceans have contributed to the death of about 25% of the world's coral reefs in the last few decades.
- ✓ Many of the coral animals died after weakened by coral bleaching, a process tied directly to warmed waters.
- ✓ Also, corals and other marine life find it more difficult to grow their shells and bones as seawater takes in carbon dioxide from the atmosphere and becomes more acidic
- ✓ $H_2 + CO_2 \ll \gg H_2CO_3$ REVERSIBLE

❑ Sea ice is shrinking, causing more warming..

- ✓ The summer thickness of sea ice is about half of what it was in 1950.
- ✓ Melting sea ice could cause changes in ocean circulation as the temperature and density of water changes.

❑ Less ice means less sunlight reflection and more absorption.

- ✓ Typically, almost all of the sunlight that hits sea ice is reflected back out to space, but as the ice melts, the ocean underneath is exposed, which absorbs more sunlight, causing more climate warming.

CORAL BLEACHING

Have you ever wondered how a coral becomes bleached?

HEALTHY CORAL

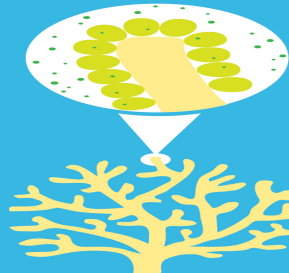
1 Coral and algae depend on each other to survive.



Corals have a symbiotic relationship with microscopic algae called zooxanthellae that live in their tissues. These algae are the coral's primary food source and give them their color.

STRESSED CORAL

2 If stressed, algae leaves the coral.



When the symbiotic relationship becomes stressed due to increased ocean temperature or pollution, the algae leave the coral's tissue.

BLEACHED CORAL

3 Coral is left bleached and vulnerable.



Without the algae, the coral loses its major source of food; turns white or very pale, and is more susceptible to disease.

WHAT CAUSES CORAL BLEACHING?



Change in ocean temperature
Increased ocean temperature caused by climate change is the leading cause of coral bleaching.



Runoff and pollution
Storm generated precipitation can rapidly dilute ocean water and runoff can carry pollutants — these can bleach near-shore corals.



Overexposure to sunlight
When temperatures are high, high solar irradiance contributes to bleaching in shallow-water corals.



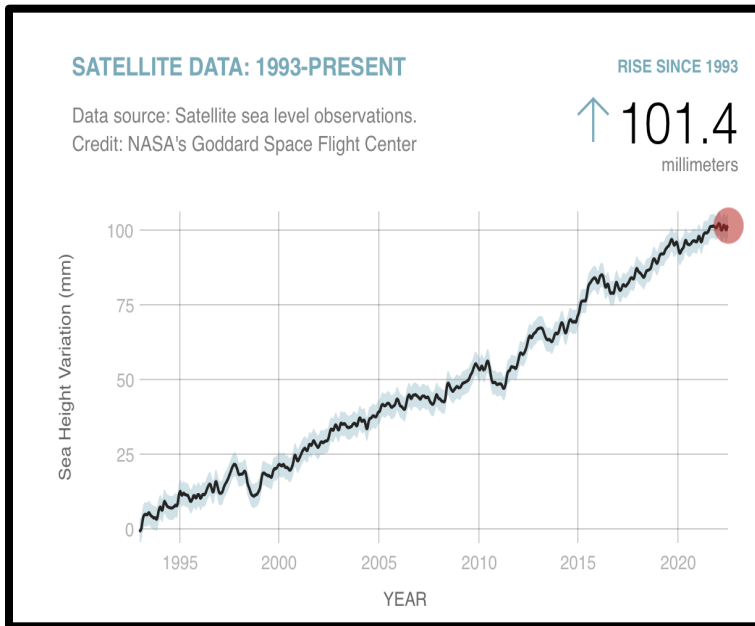
Extreme low tides
Exposure to the air during extreme low tides can cause bleaching in shallow corals.



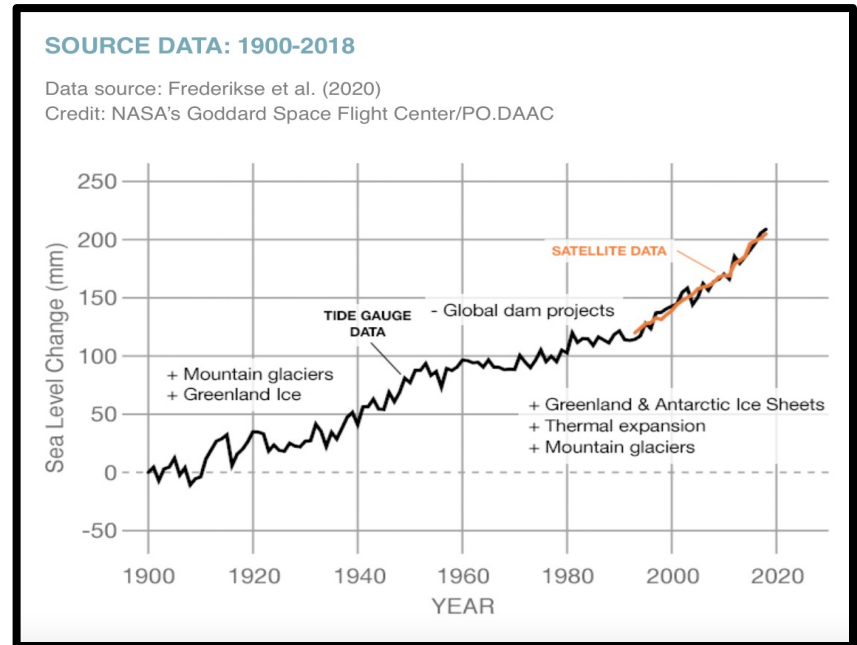


Increased drought and fire danger

- The climate crisis has already led to more extreme drought.
- More than 95 percent of the Western US is in [some level of drought this summer](#), which has triggered water shortages there.
- A major California hydroelectric power plant was forced to shut down last week when the water level in Lake Oroville dropped to a level not seen since the reservoir was filled in the 1960s.
- At 1.5 degrees, droughts will become more intense and more frequent in parts of the world.
- Reports from the ground near the Dixie Fire, California's second-largest fire in state history, suggest we are already experiencing increasingly dangerous conditions.



**SEA
LEVEL IS
ARISING**



There are two ways that our warming climate is causing sea level rise.

❑ First, water from melting glaciers and ice sheets flows down rivers and is added to the ocean.

✓ Melting ice that is already in the ocean, like sea ice, has a minor impact on sea level rise.

❑ Second, water expands as it warms, so warmer water in the ocean takes up more space >>sea level is higher

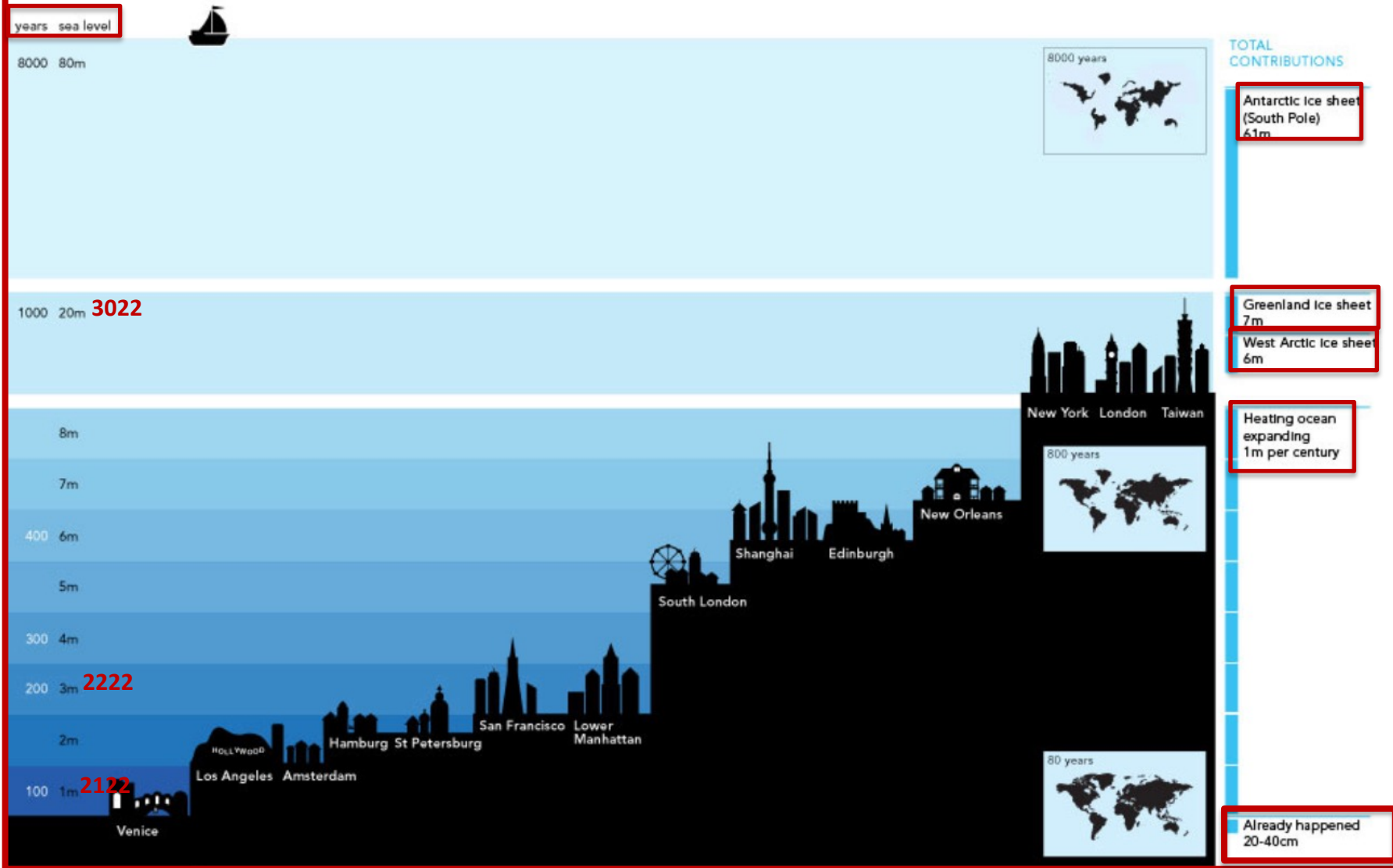
✓ Since 1955, > 90% excess heat in the atmosphere caused by heat-trapping gases enters the ocean.

✓ Thermal expansion of seawater is predicted to account for about 75% of future sea level rise.

When Sea Levels Attack!

WHICH SEA LEVELS ATTACK?

Which cities will flood when?





water distribution on the planet enough to make the planet's axis shift.

HTTP{S} URLs FOR 22FA24 SLIIDES

<https://news.stanford.edu/2021/03/29/jordans-worsening-water-crisis-warning-world/>

<https://waterdata.usgs.gov/nwis>

<https://www.census.gov/popclock/>

<https://endangereddrivers.americanrivers.org>

<https://www.usgs.gov/media/images/chesapeake-bay-watershed-boundary-usa>

https://en.wikipedia.org/wiki/Mississippi_River_Delta#/media/File:Mississippi_Delta_IR.jpg

<http://droughtmonitor.unl.edu/>