Puerto Rico after category 5 hurricane Maria, 2017

From Wall Street Journal

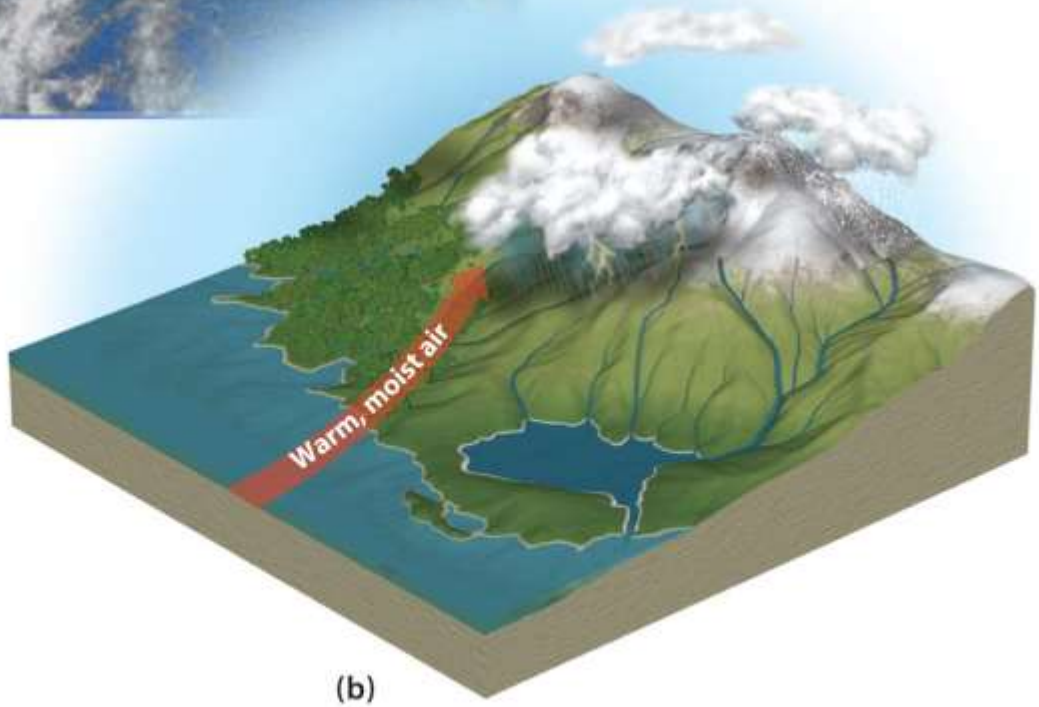
Flooding in China from Purposefully Destroyed Dam Near Zhengzhou

Flooding in China from Purposefully Destroyed Dam…

- July 2021
  - China blew up a dam to immediately release water during major flooding near Luoyang, to prevent flooding and overwhelming of Zhengzhou, the capital of the Henan province...
  - https://twitter.com/i/status/1417499112182849538
  - https://www.npr.org/2021/07/21/1018764692/china-blasts-dam-to-divert-massive-flooding-that-has-killed-at-least-25

Timing of Precipitation and Effect on Flooding

(a)



(b)

Figure 7-20 The "Pineapple Express"

Warm, moist air from the Pacific is carried by high-altitude winds to the U.S. Pacific Coast

(a) When it reaches the snow-covered western slopes of the Cascades and Sierra Nevada mountains, it releases its moisture as rain. **(b)** Combination of rain and melting snow can cause severe flooding. Omaha experienced this type of fast melting caused by rain in the spring of 2019.

When a storm lingers over a drainage network, flash flooding can occur downstream. Ex. Saddle Creek in Omaha, NE

Snoqualmie National Forest, WA
a Temperate Rainforest

Pineapple Express – Atmospheric Rivers

- https://www.npr.org/2023/01/05/1147102968/california-storm-weather-pineapple-express-atmospheric-river

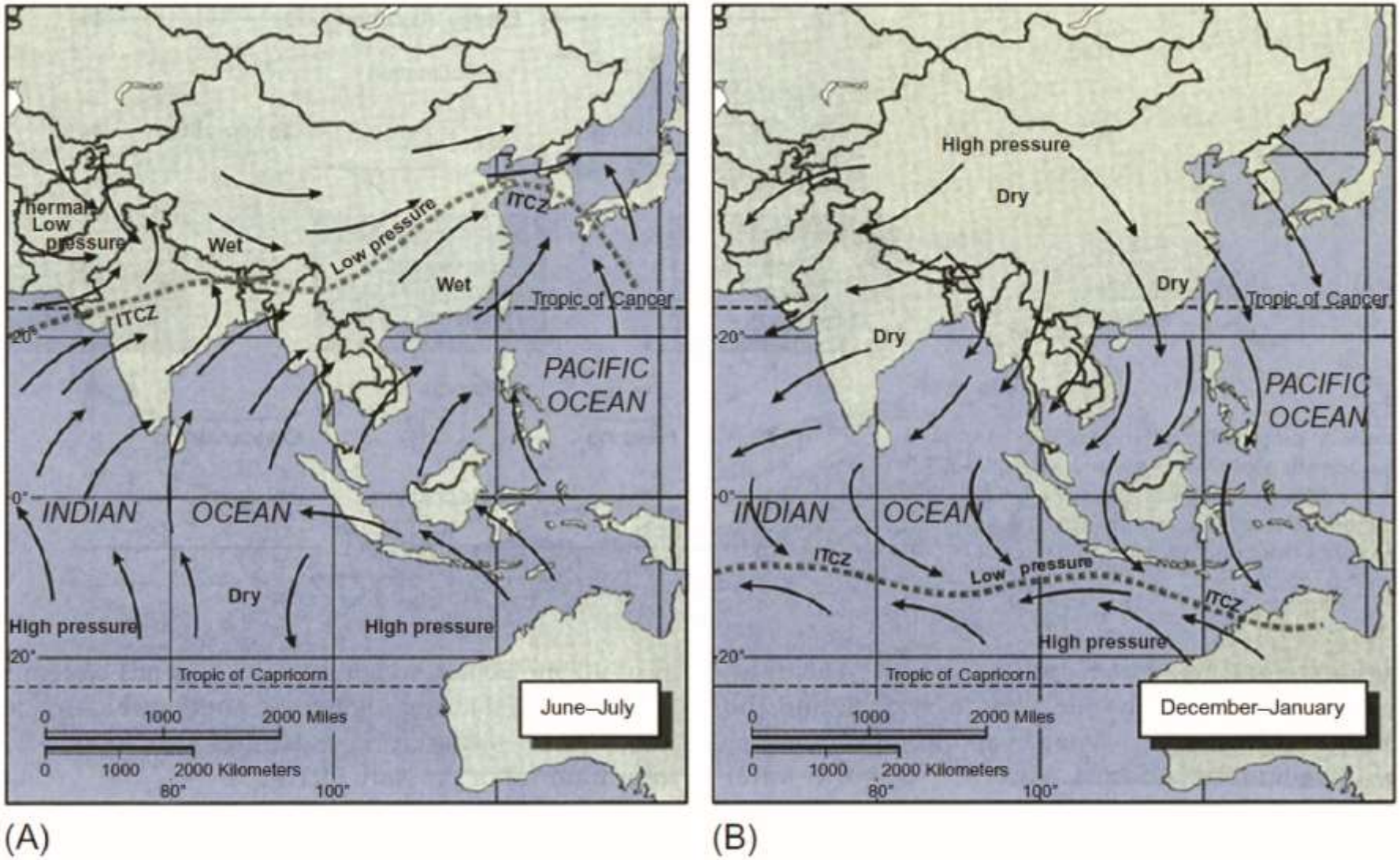
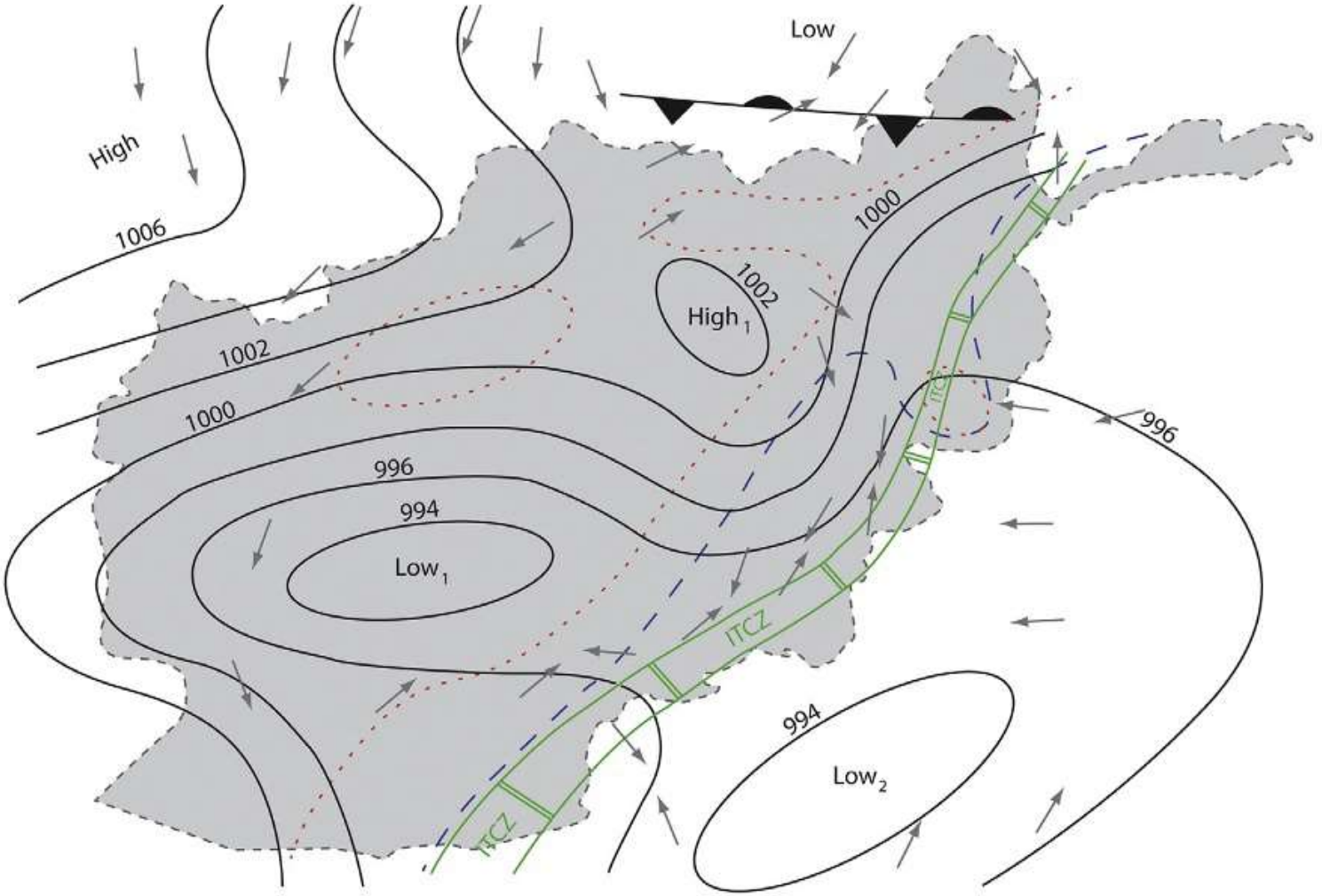


FIG. 1.4 Seasonal maps of Asia in (A) summer and (B) winter showing dominant wind directions and positions of the intertropical convergence zone (ITCZ) of the stormy, moisture-laden air masses that rise because of their warmth and cause monsoonal precipitation. The thermal low pressure in the summer season over Pakistan and part of Afghanistan shows the patterns of winds in the region at that time. *Map by permission from the Center for Afghanistan Studies.*

Shroder and Ahmadzai, 2016



Stationary front

Isobars (mm)

Wind direction

Areas regularly influenced by monsoon precipitation

Intertropical convergence zone (ITCZ)

Areas occasionally influenced by monsoon precipitation

Political boundary

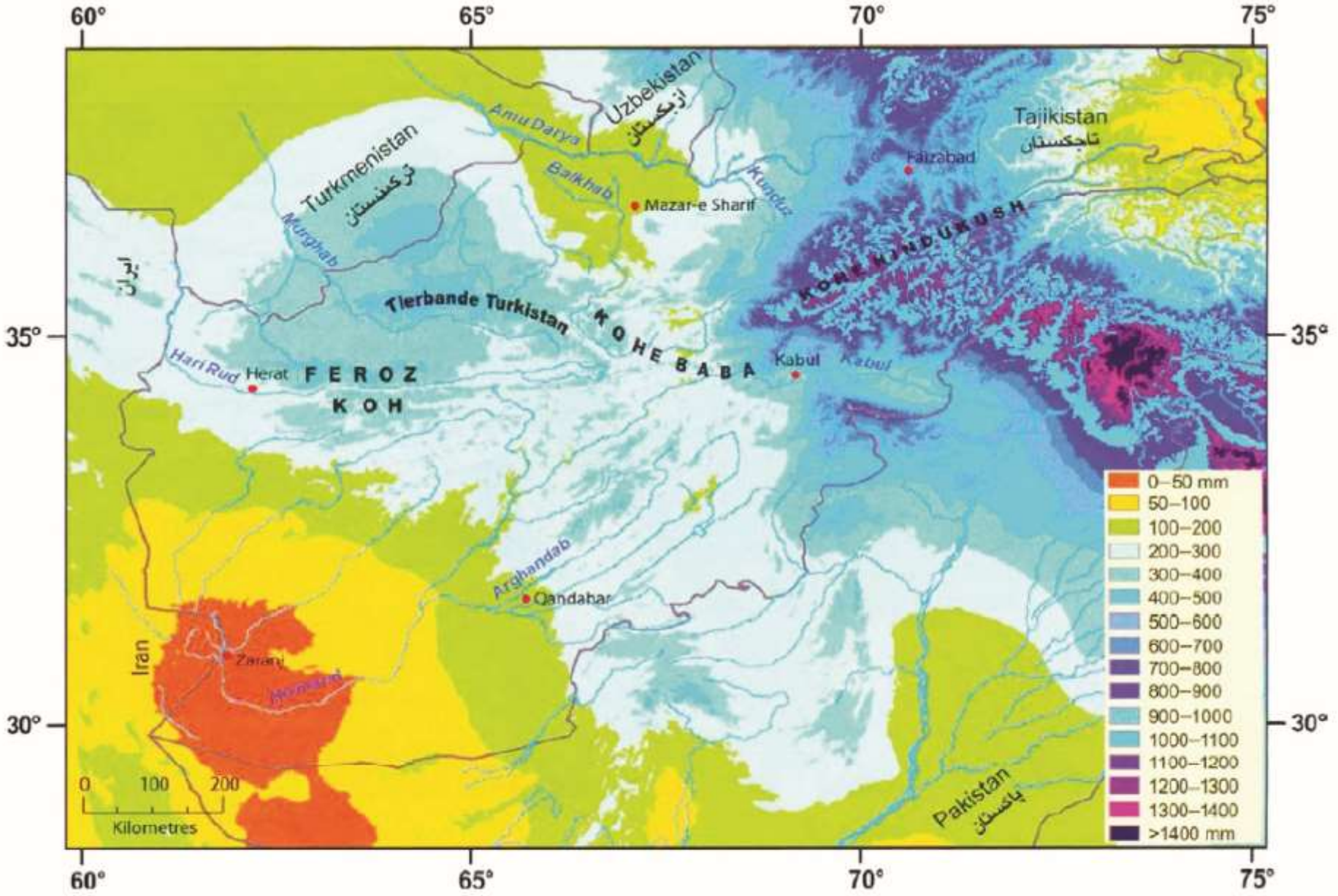
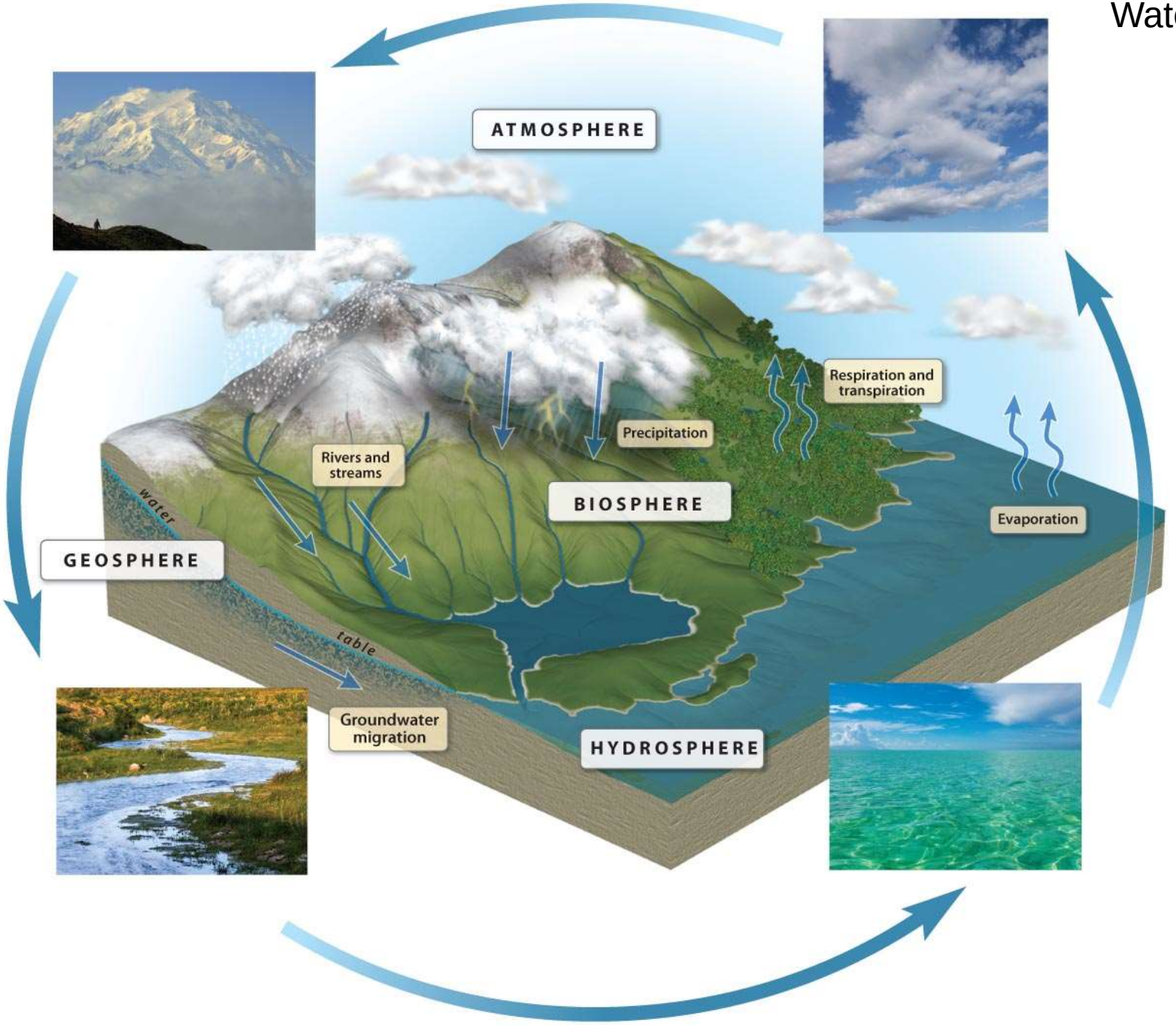
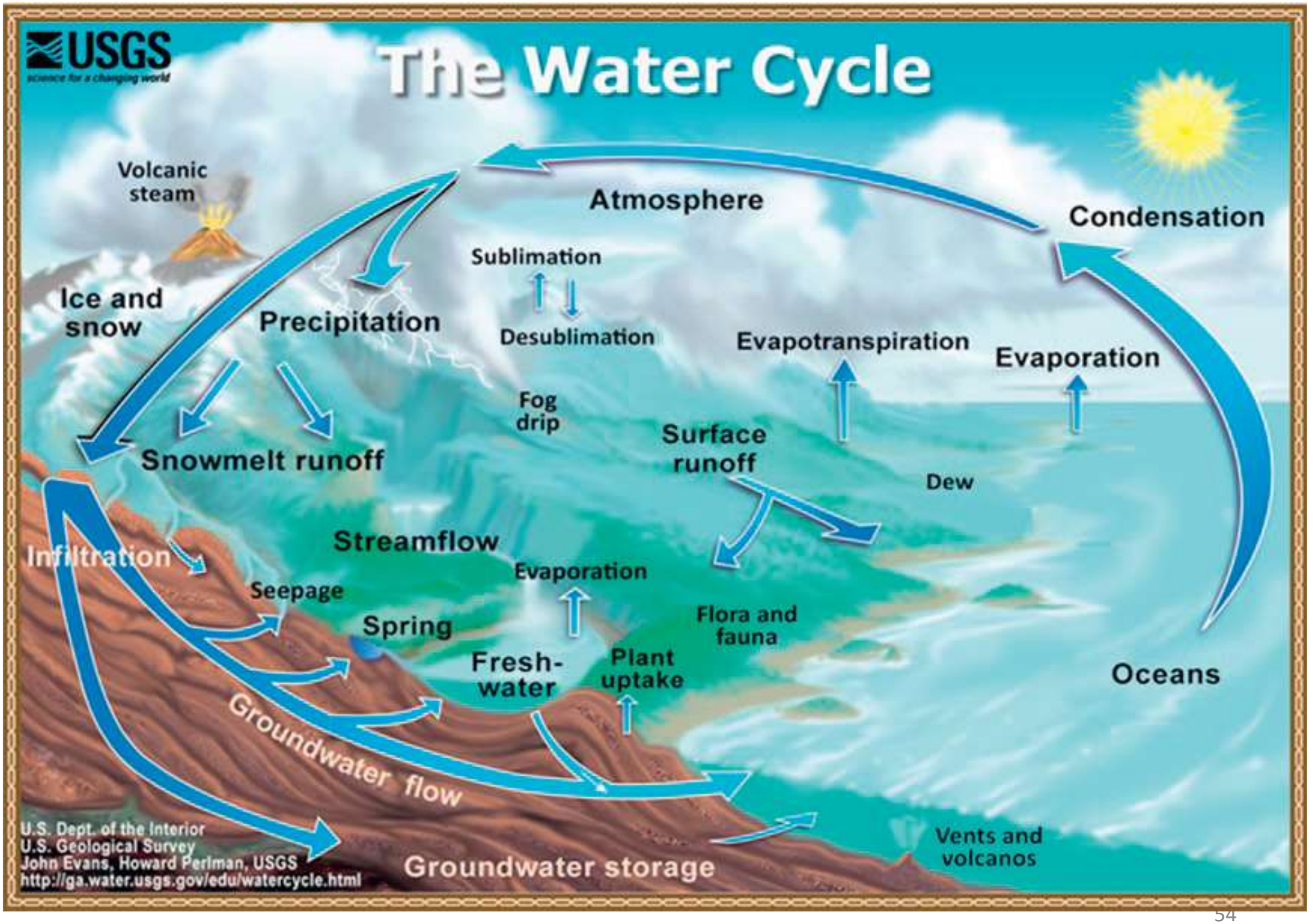


FIG. 1.7 Precipitation in Afghanistan and the nearest parts of the neighboring countries. *From Breckle, S.-W., Dittman, A., Rafifiqpoor, M.D., (Eds.), 2010. Field Guide Afghanistan: Flora and Vegetation, Scienta Bonnensis, Bonn, Germany; Shroder, J., 2014. Natural Resources in Afghanistan: Geographic and Geologic Perspectives on Centuries of Conflict. Elsevier.*

Shroder and Ahmadzai, 2016

Water cycle





Shroder and Ahmadzai, 2016

The Water Cycle Reservoirs

- One of the shortest paths possible is evaporation from the ocean, then precipitation back into the ocean.
- Surface water is one of the smaller reservoirs and has the shortest residency time for water due to evaporation.
- Ground water can stay underground indefinitely as well (billions of years).
  - It can take 1000's of years for surface water to reach aquifers. Once in the aquifer, it remains relatively unaltered, except by humans.
- Precipitation as snow onto a glacier.
  - Antarctic ice has been dated at ~800,000 years old

View from inside Matanuska Glacier, AK

Glacial Ice Accounts for More Than 2/3 of Earth's Freshwater!

Hydrosphere Reservoirs

- <1% of water on Earth is liquid freshwater, mostly groundwater. Surface freshwater available for human use amounts to only ~ **3/10,000 of Earth's total water**.

- The hydrosphere contains a tremendous amount of water—about 1360 million km^3 (326 million mi^3)—would cover the entire U.S. to depth of 145 km (90 mi) or equivalent to 171 million gallons of water per person on Earth. A problem is that 97.2% is ocean water, which is too salty to drink or grow crops with. Just 2.8% is freshwater (including ice).

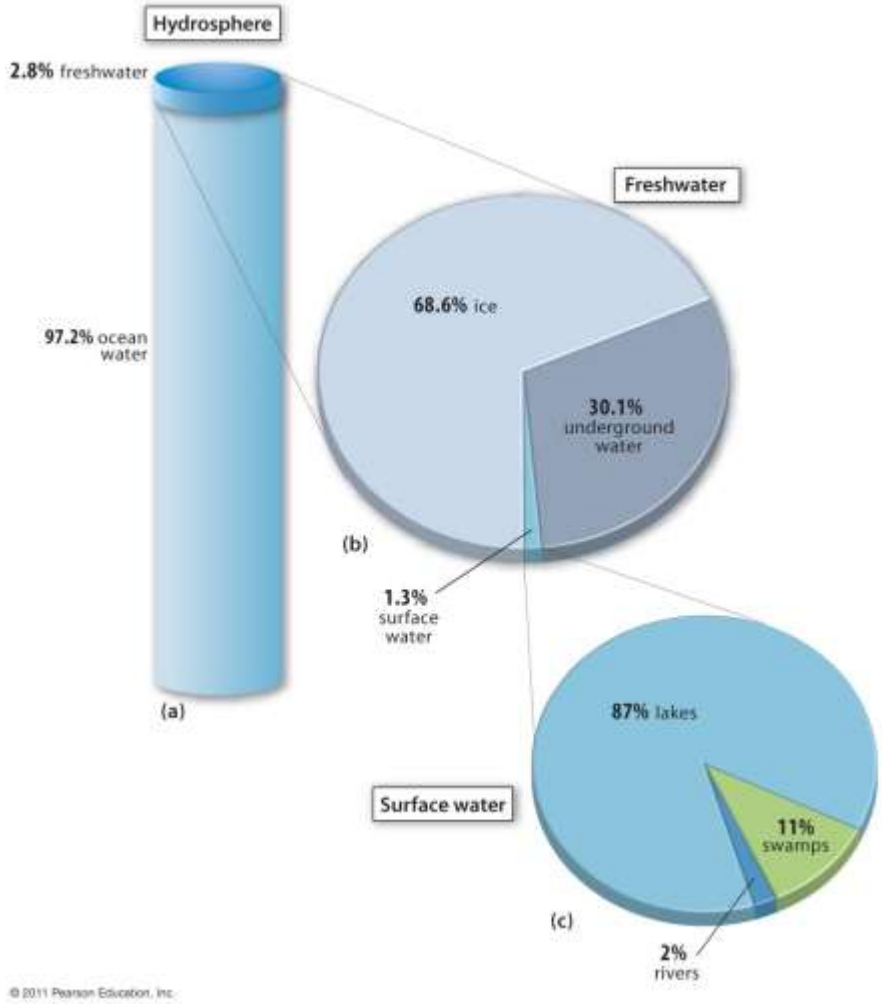


Figure 10-3 Major Hydrosphere Reservoirs

Water quality and pollution

- **Pollution** – degradation of water quality with something:
  - Biological, chemical, physical, thermal,etc.
    - Excess of something harmful
      - Examples:
        - » Soil
        - » Geosphere materials
        - » Chemicals
        - » Plastics
        - » Manure/sewage
        - » Hot materials or hot wastewater

In the 1960s and 70s this phrase was used to “solve” pollution problems:
“The solution to pollution is dilution.”

Meaning if you pour enough water on pollution, it will go away. Today, we know that just pollutes water and doesn’t “remove” pollutants.

Surface Water Resources

Figure 10-4 The Great Salt Lake
Because of a high evaporative rate this lake is 3x to 5x saltier than ocean water and is more dense, making floating easier.

- Surface waters are bodies of water—the oceans, springs, creeks, rivers, ponds, and lakes across the landscape—that you can encounter firsthand.
- Excluding the oceans and seas, most surface waters contain freshwater, but in some places, like the enclosed surface basins of the arid west evaporation has turned lakes salty or salty groundwater discharges at the surface. Example: the Great Salt Lake in Utah and saline lakes in Texas.
- Modern societies similar to the Romans, have altered the landscape to exploit surface-water resources—canals, aqueducts, and artificial reservoirs have all been constructed over many years.