

**COURSE: GEO-INFORMATICS IN EARTH SCIENCE,
TECTONIC HAZARD AND INFRASTRUCTURE
MANAGEMENT**

LECTURE 9 – Science of Flood

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What is Flooding

Flood has been defined variously as:

- ❖ Water that has overflowed to a place where it normally is dry.
- ❖ An overflowing of water beyond its normal confines.
- ❖ Water where it is not wanted

What is Flooding



What is Flooding



What is Flooding

The muddy deserted streets of flood-ravaged Princeville, North Carolina stand in silent testimony to the destruction wrought by the Tar River. Princeville, NC 9/28/99.

Source: Dave Saville/FEMA News Photo.



Types of Flooding

Key Highlights:

- ❖ Flooding can involve the overflow of rivers due to heavy rainfall or dam failures.
- ❖ Some flooding is rapid and intense, causing significant damage in short periods of time, often triggered by heavy rainfall.
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Types of Flooding

Most floods fall into one of four major categories:

- ❖ Riverine flooding
- ❖ Coastal flooding
- ❖ Flash flooding
- ❖ Pluvial flood/Surface flood/Urban Flooding
- ❖ DAM or Levee failure

Riverine Flooding

Riverine flooding happens when rivers or streams overflow due to heavy rainfall, snowmelt, or dam failures.

The onset of this type of flooding is often slow and can affect extensive areas along the river's course

Riverine Flooding

There are two main types of riverine flooding:

1. Overbank flooding- occurs when water rises overflows over the edges of a river or stream.

This is the most common and can occur in any size channel — from small streams to huge rivers.

2. Flash flooding - characterized by an intense, high velocity torrent of water that occurs in an existing river channel with little to no notice.

Flash floods are very dangerous and destructive



Costal Flooding

Coastal flooding is the inundation of land areas along the coast by seawater.

Common causes of coastal flooding are;

- high tide,
- tsunamis and
- storm surge



Source: RealClimate.org, Online: <https://www.intermap.com/risks-of-hazard-blog/three-common-types-of-flood-explained>

❖ Pluvial flood/Surface flood/Urban Flooding

- ❖ Flood caused when heavy rainfall creates a flood event independent of an overflowing water body.
- ❖ One of the most common misconceptions about flood risk is that one must be located near a body of water to be at risk.
- ❖ Pluvial flooding debunks that myth, as it can happen in any urban area — even higher elevation areas that lie above coastal and river floodplains.



Pluvial flood/Surface flood/Urban Flooding

- ❖ Urban areas with extensive pavement and limited natural drainage are susceptible to urban flooding. Heavy rainfall overwhelms stormwater drainage systems, accumulating water on streets, basements and low-lying areas



Dam or Levee Failure

- ❖ Flooding can result from the failure or breach of dams or levees designed to hold back water. Excessive rainfall, inadequate maintenance, or structural defects can cause such failures, leading to widespread flooding downstream



An aerial view of houses in Laos submerged by floodwaters after the Xe Pian Xe Nam Noy dam collapsed. Villages in neighbouring Cambodia have been flooded. Photograph: Abc Laos News Handout/EPA

Floodplain and Flooding

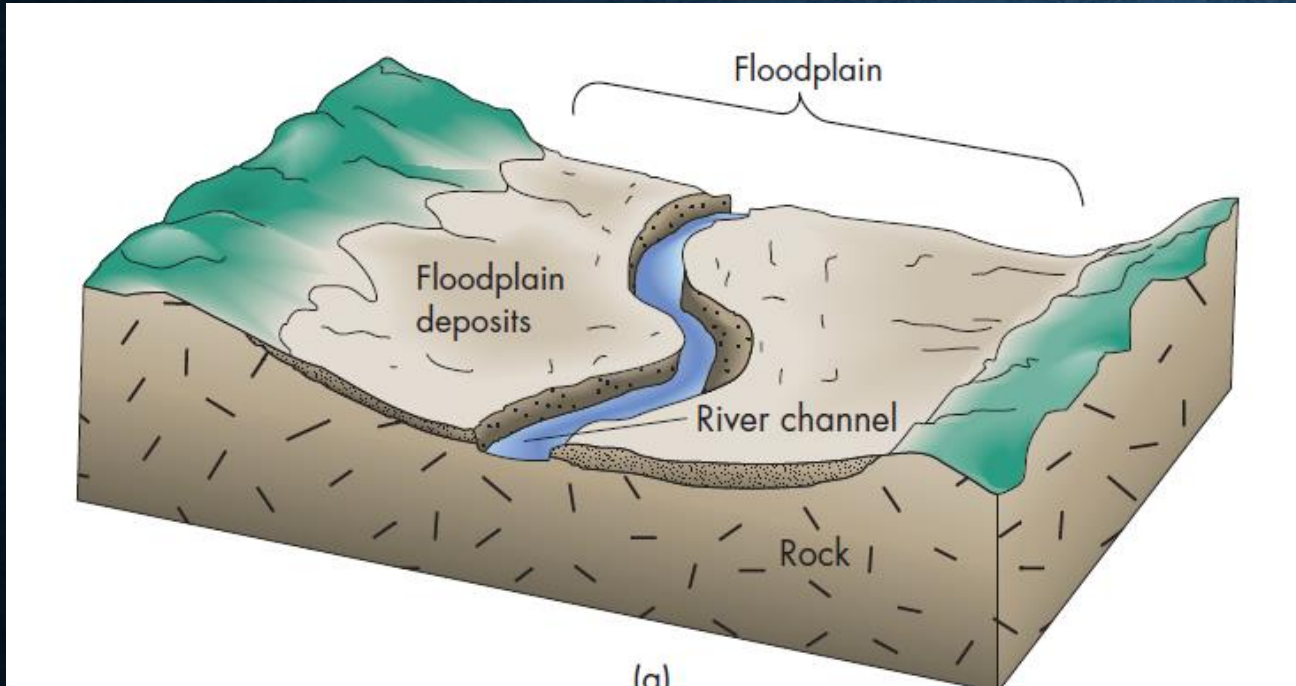
- ❖ Throughout time, floods have altered the floodplain landscape.
- ❖ These areas are continuously shaped by the forces of water—either eroded or built up through deposits of sediment.
- ❖ More recently, the landscape has been altered by human development, affecting both the immediate floodplain and events downstream.



Aerial photograph of inland flooding caused by Hurricane Floyd.

Source: J. Jordan of the US Army Corps of Engineers.

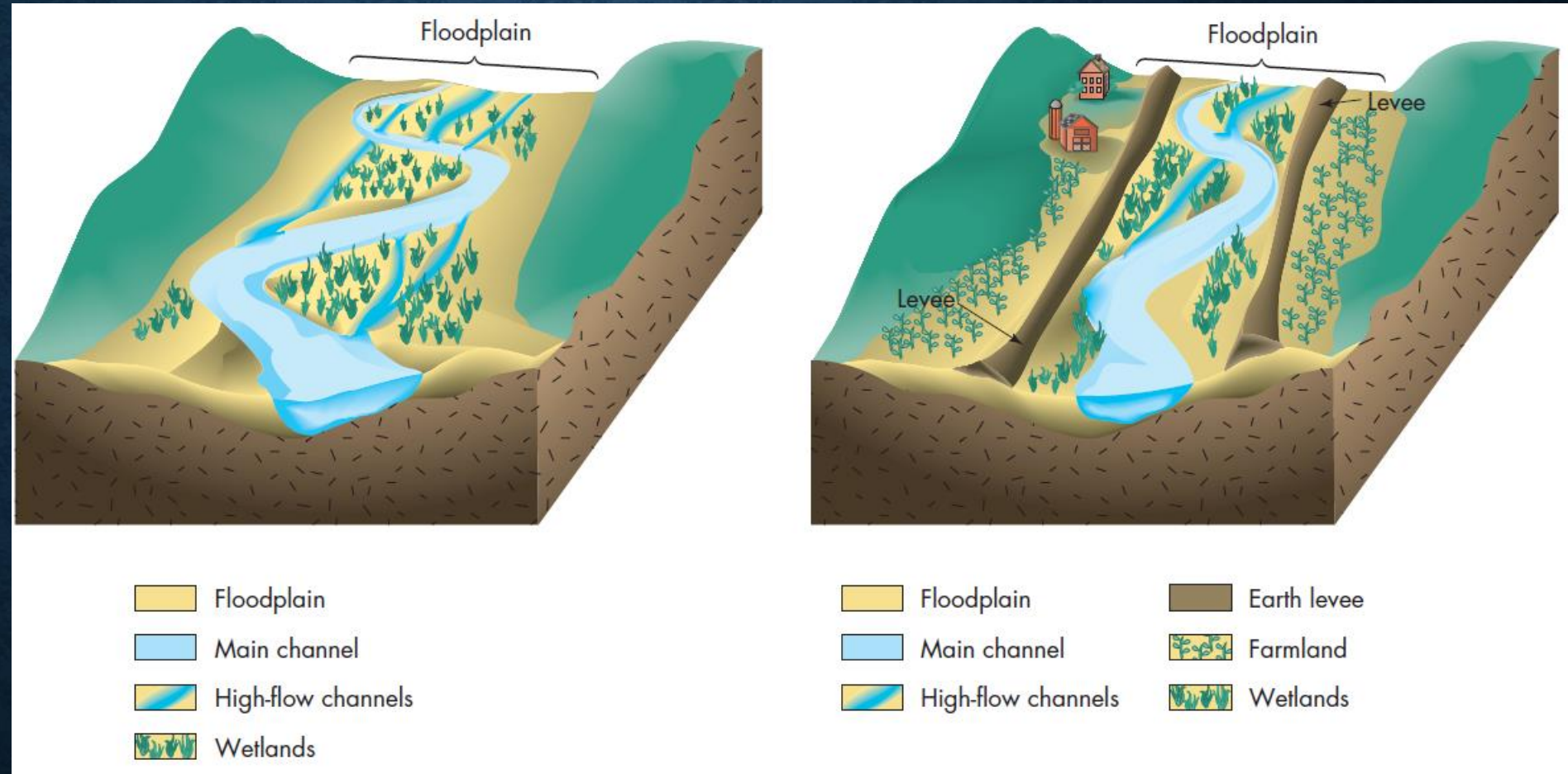
Floodplain



Floodplain of the Rio Grande
near its headwaters in Colorado

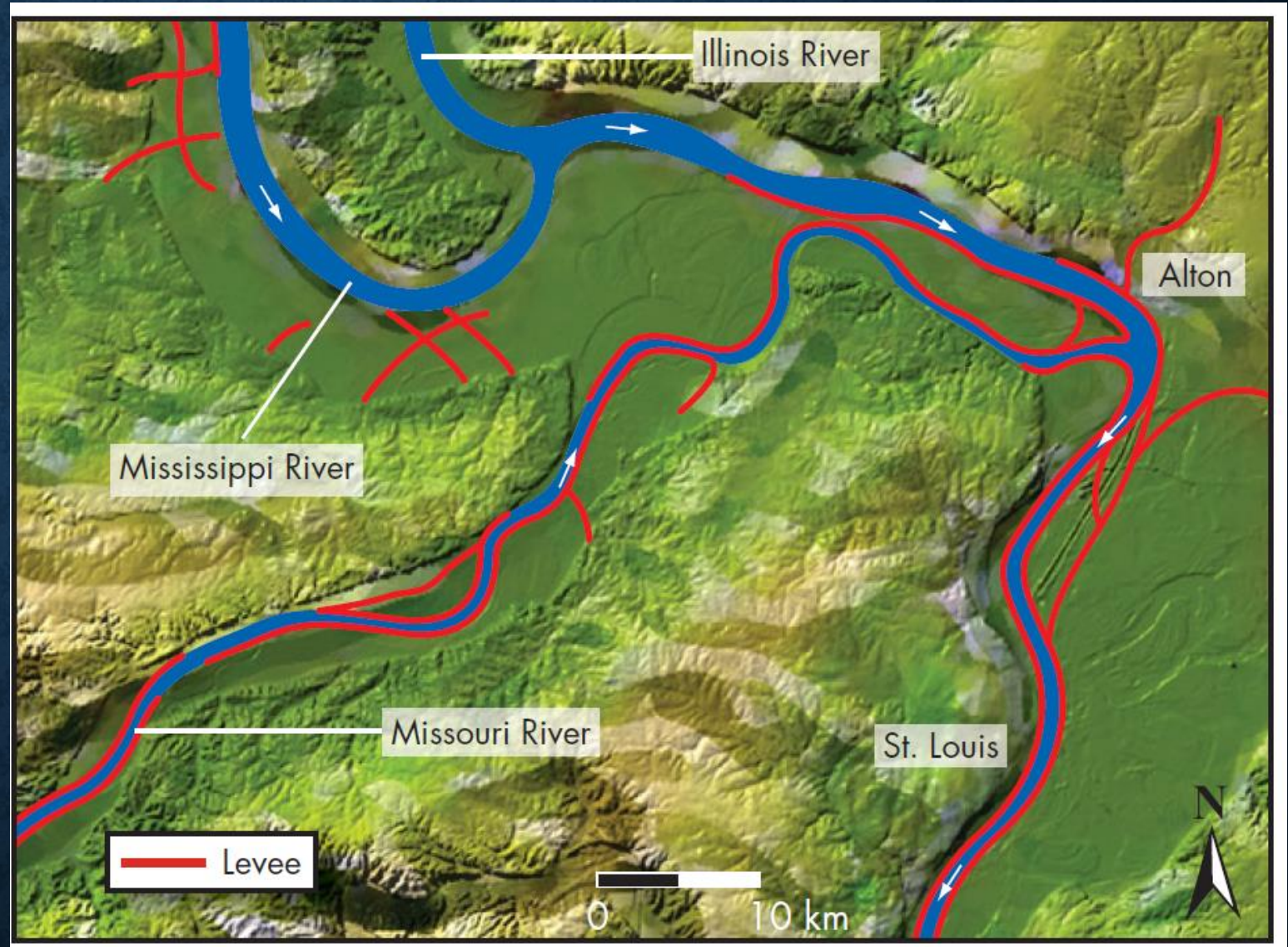
Floodplain and Levees

- ❖ Natural floodplain with wetlands.
- ❖ Floodplain after the channel is shortened and levees are constructed.
- ❖ Land behind levees is farmed, and wetlands are generally confined between the levees.



Floodplain and Levees

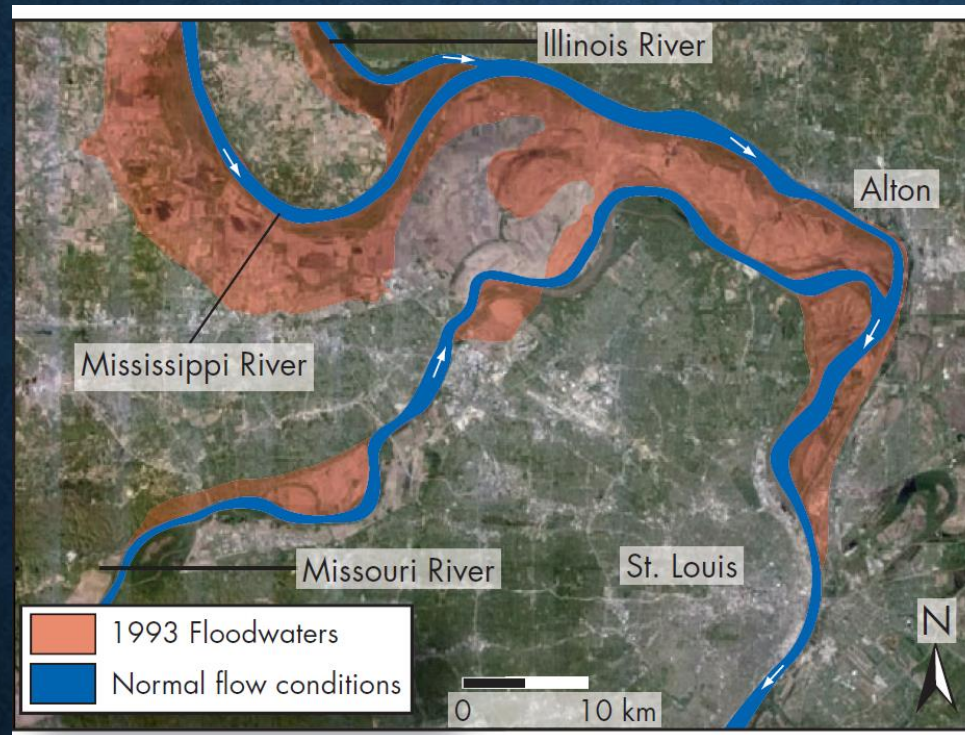
- ❖ Levees almost completely enclose the Mississippi River near the cities of Alton and St. Louis, Missouri



Floodplain and Levees

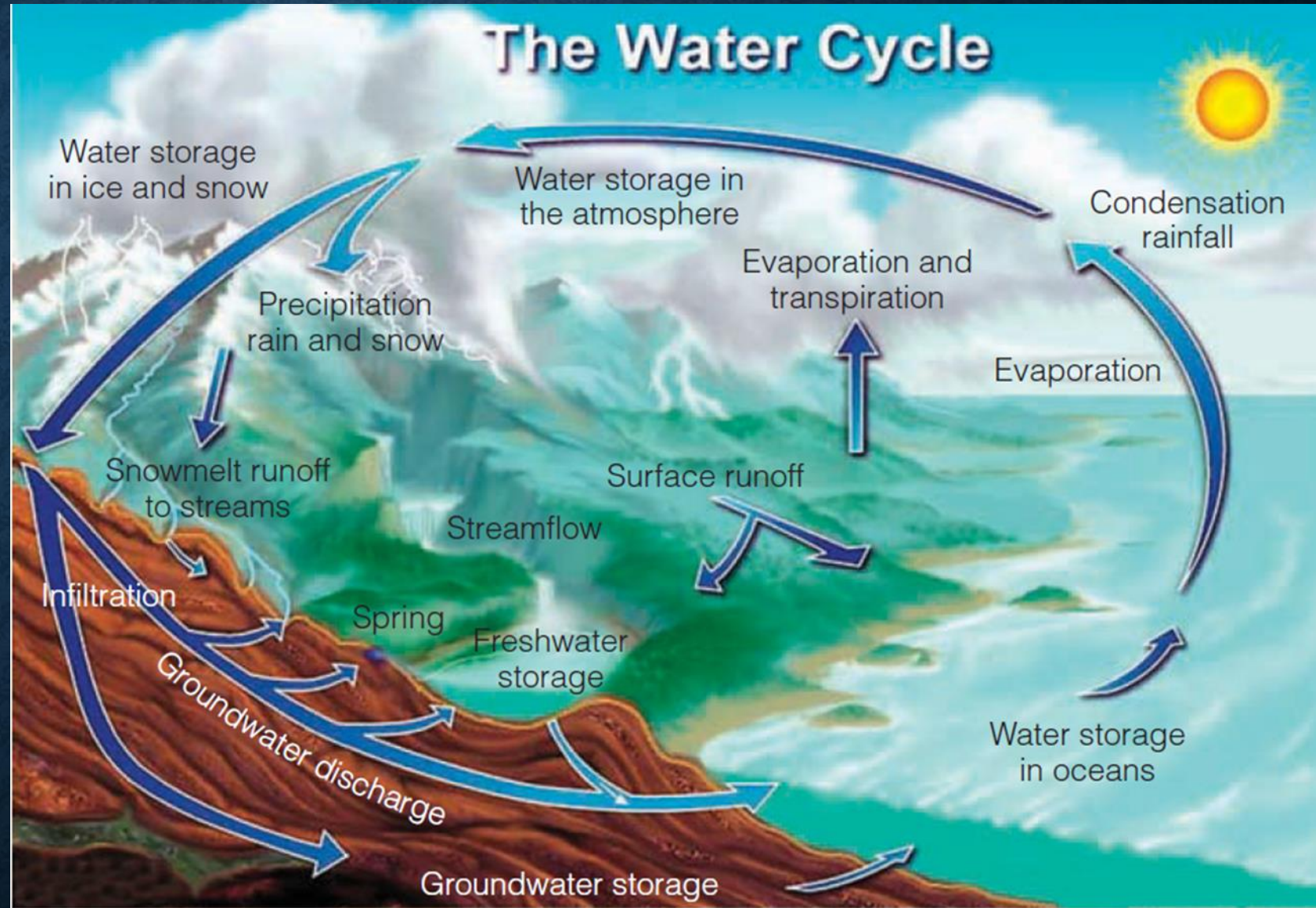
**MISSISSIPPI RIVER
FLOOD OF 1993** Satellite
view of the extent of
flooding in 1993 where
the Illinois and Missouri
Rivers join the
Mississippi.

A breach of this levee in
Illinois during the 1993
floods of the Mississippi
River caused flooding of
the town of Valmeyer.



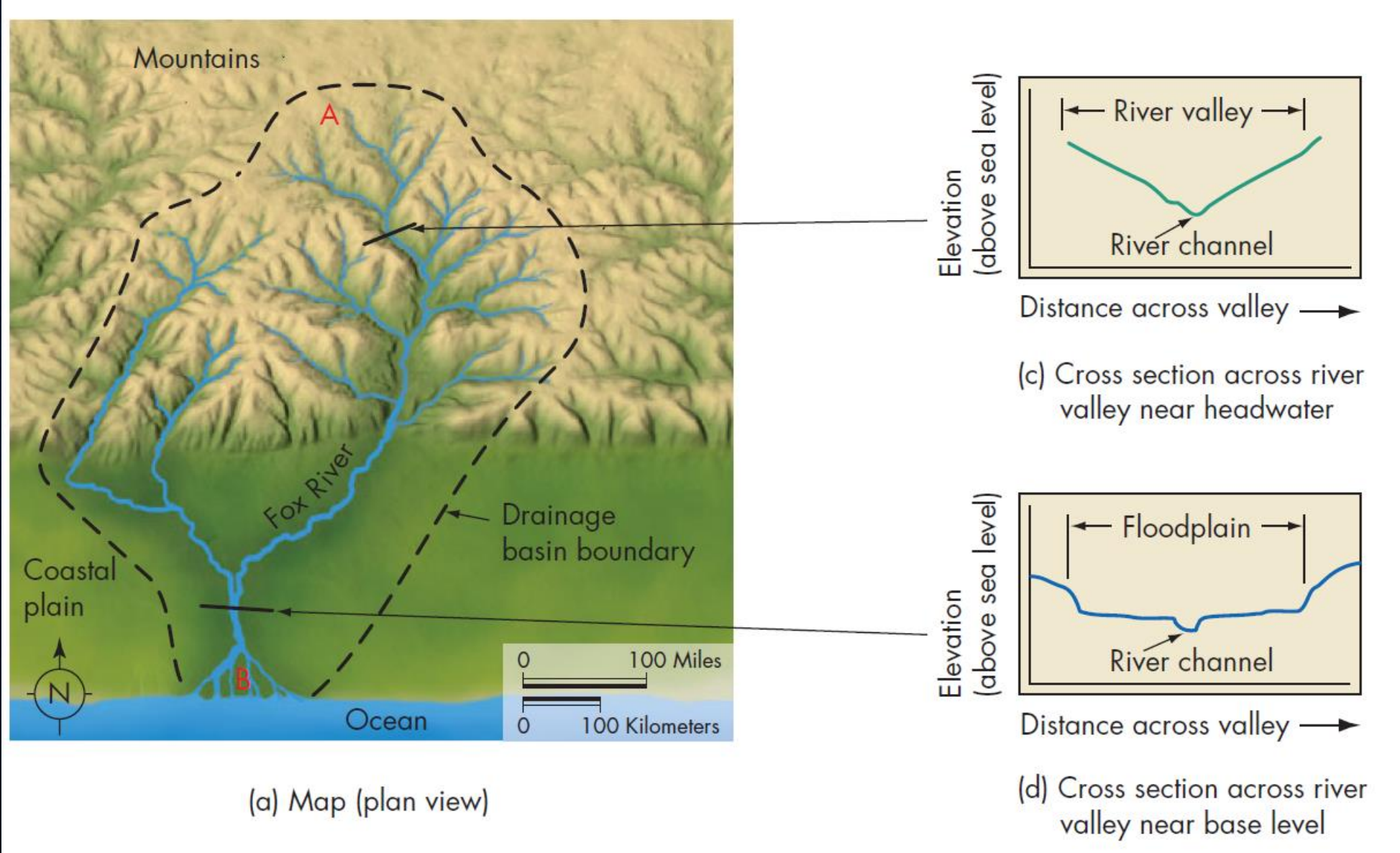
What is Flooding

- ❖ Floods are part of the Earth's natural hydrologic cycle.
- ❖ The cycle circulates water throughout the environment.
- ❖ This process maintains an overall balance between water in the air, on the surface, and in the ground.

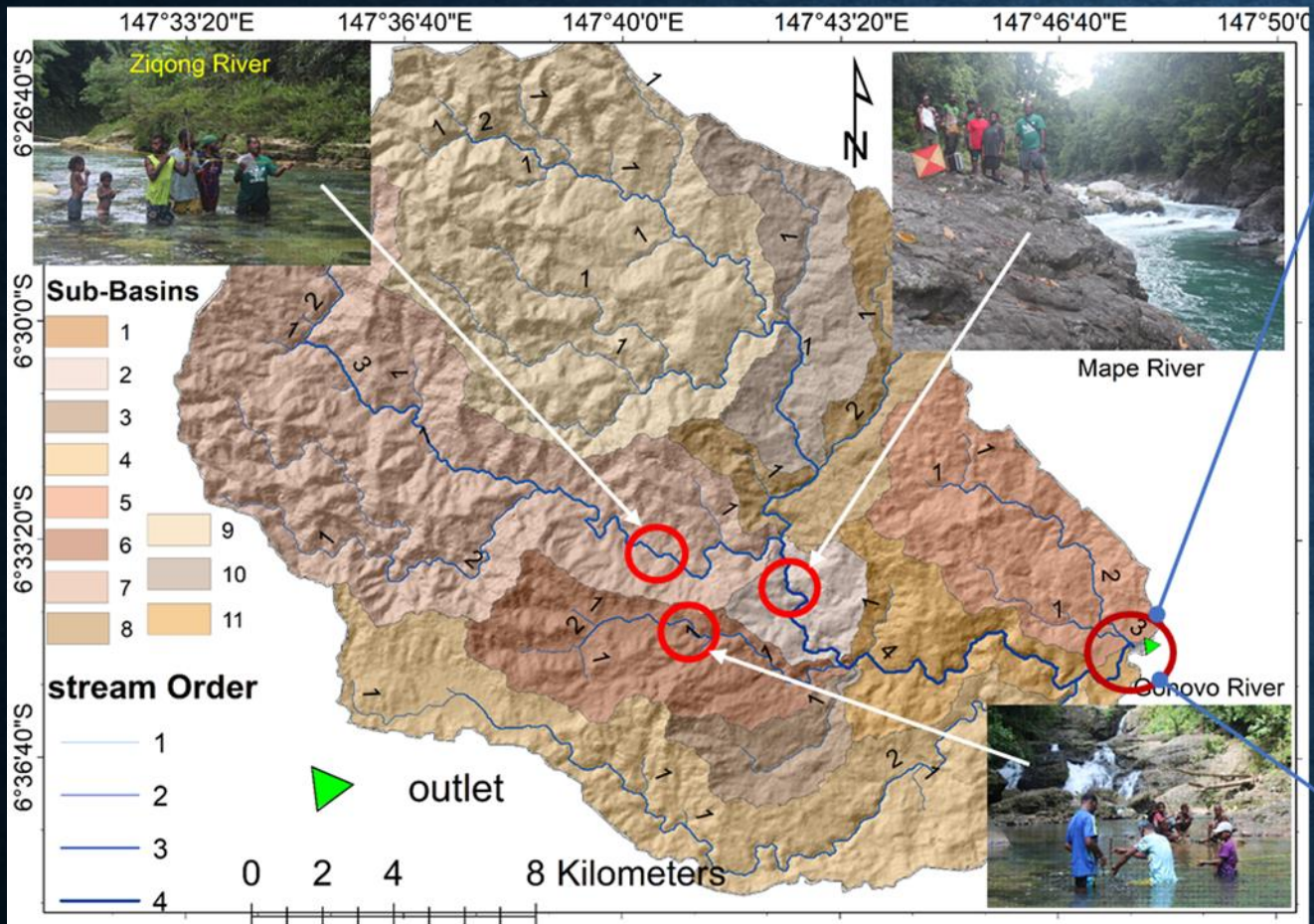


Source: Hyndman, D., and Hyndman, D., (2007).

Drainage Basins and Flooding



Drainage Basins and Flooding



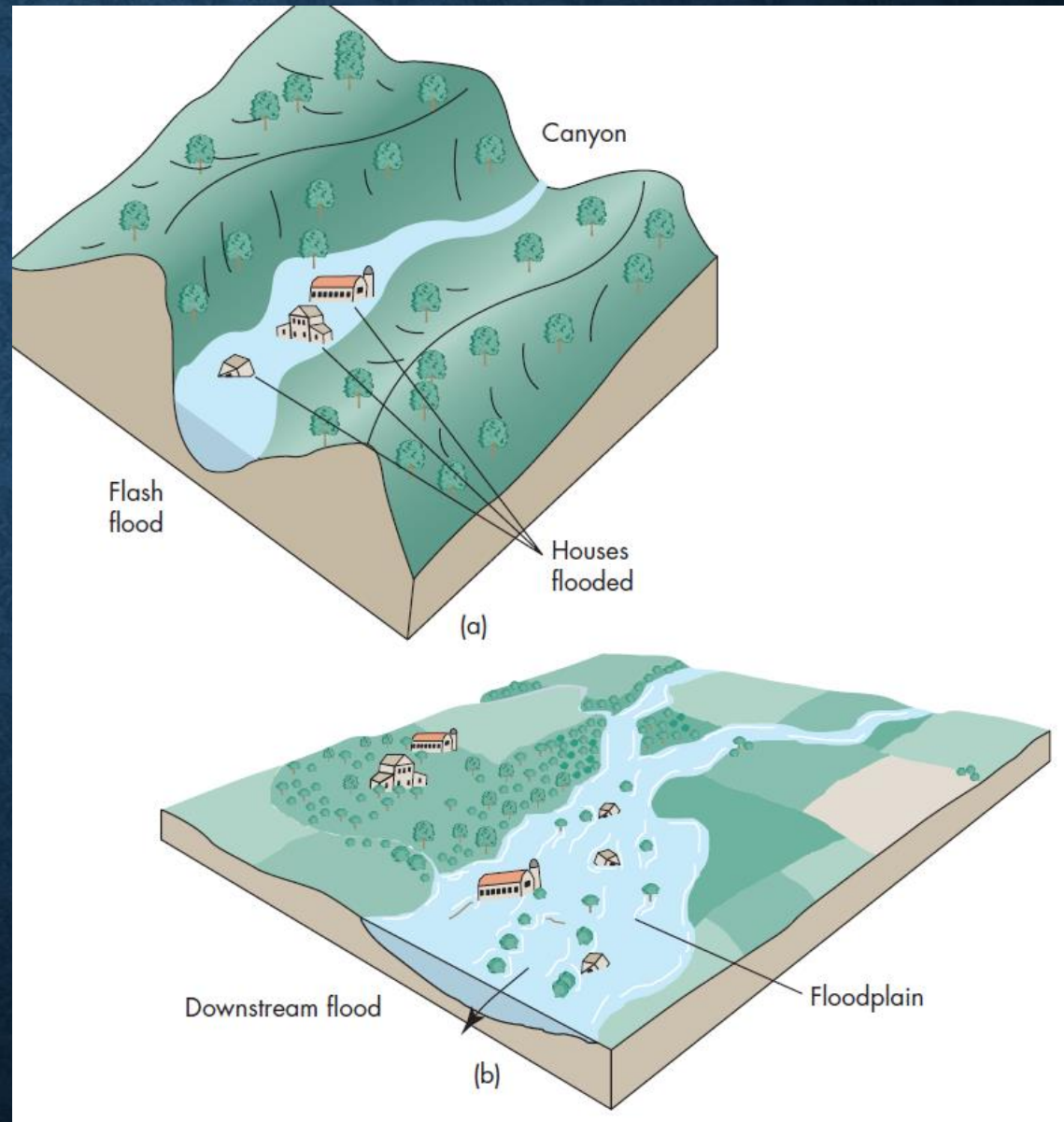
Drainage Basins and Flooding

- ❖ Floods can further be characterized by where they occur in a drainage basin.
- ❖ Flash floods typically occur in the upper part of a drainage basin and in some small drainage basins of tributaries to a larger river.
- ❖ They are generally produced by intense rainfall of short duration over a relatively small area.

Drainage Basins and Flooding

- ❖ If flash floods are sudden and of relatively great volume, peak discharge can be reached in less than 10 minutes.
- ❖ Flash flooding is most common in arid and semiarid environments; in areas with steep topography or little vegetation; and following breaks of dams, levees

Idealized diagram comparing a flash flood to a downstream flood



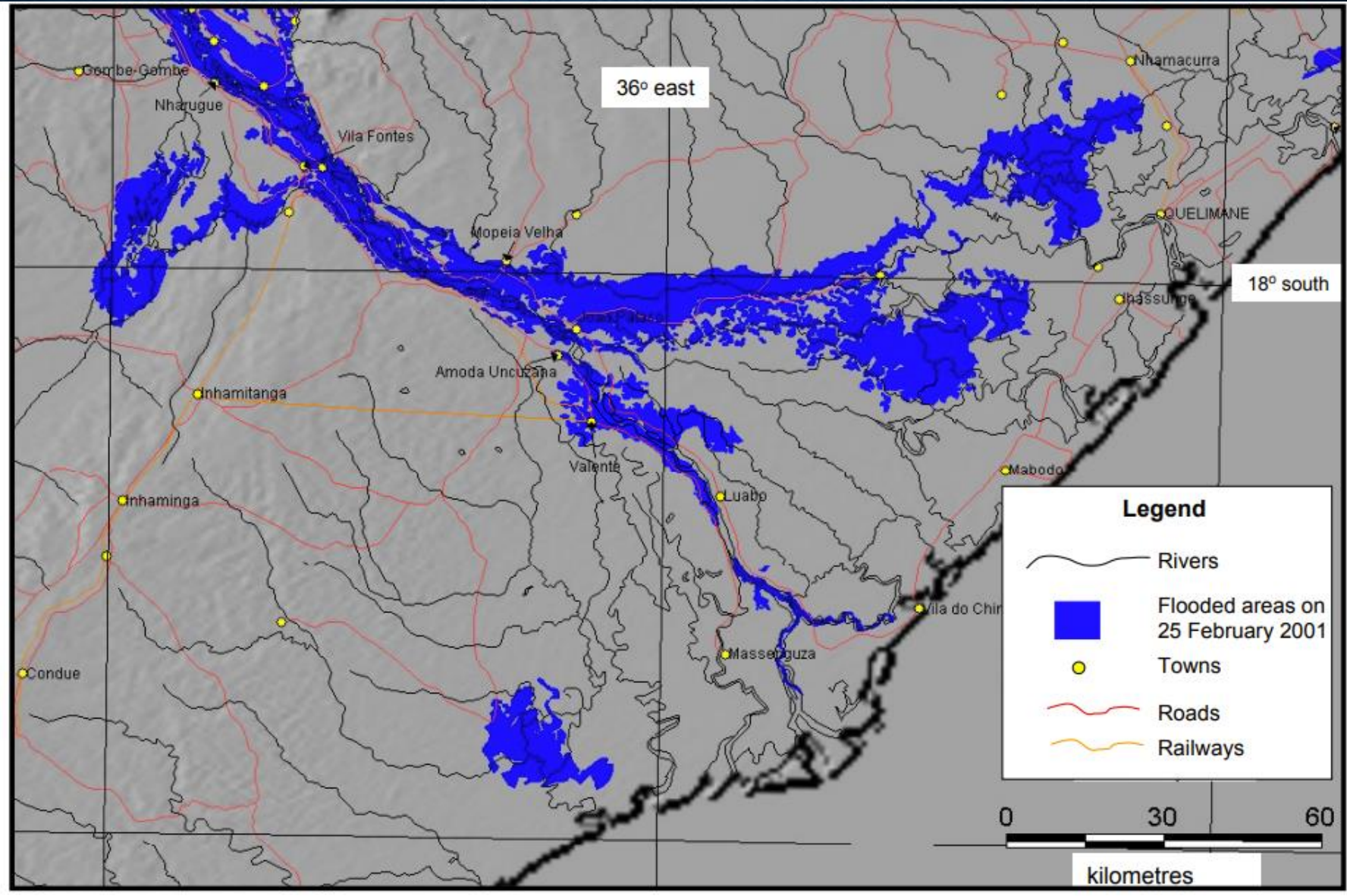
Drainage Basins and Flooding

DOWNSTREAM FLOODING ON THE OHIO RIVER

Downstream, Marietta, Ohio, experienced its worst flooding in 40 years from the Ohio River because of heavy rains.



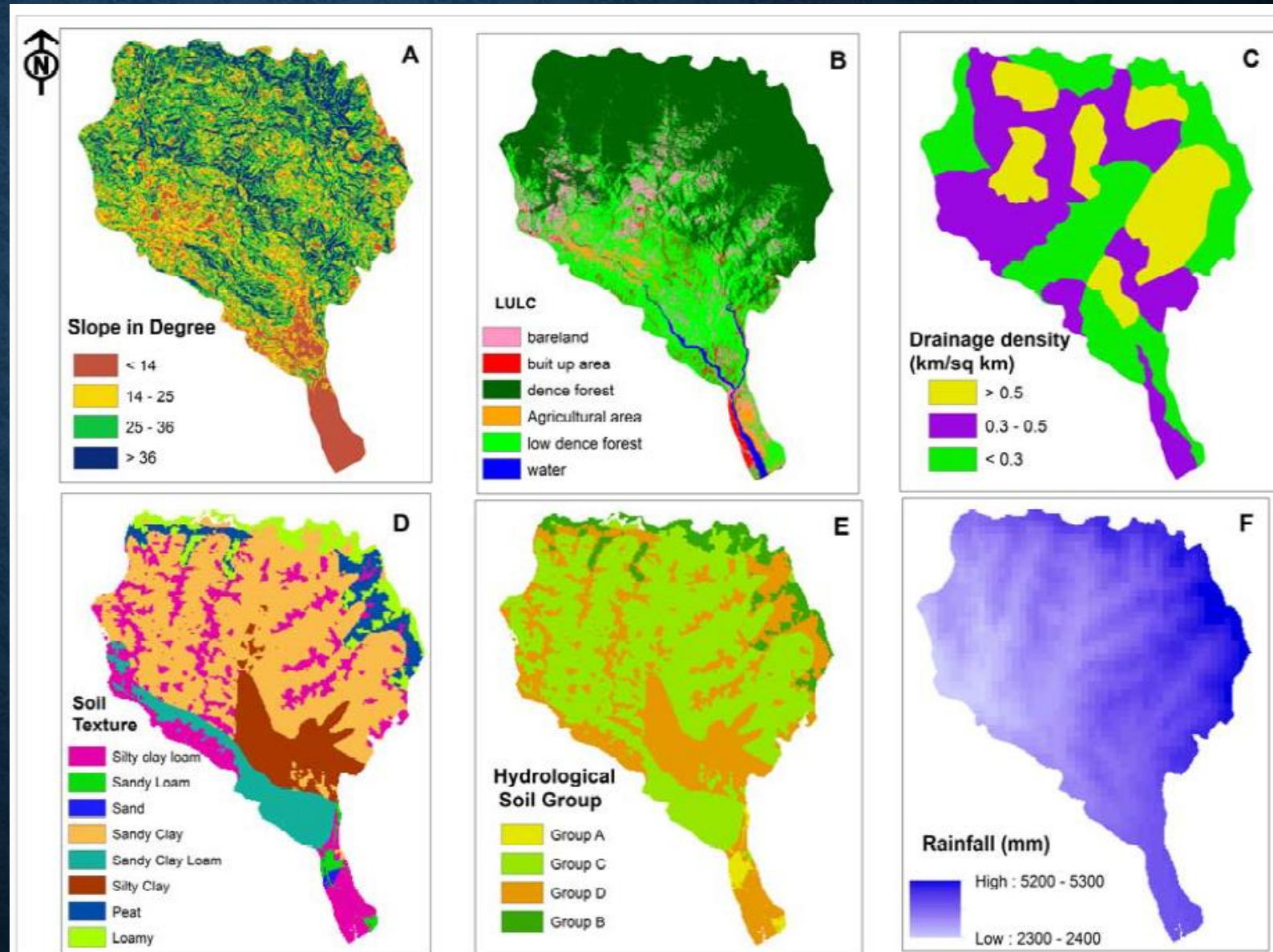
Flood Hazard Assessment and Mapping



Source: Darren Lumbruso, HR Wallingford; Online: https://assets.publishing.service.gov.uk/media/57a08c8540f0b652dd0013a6/R8159-Source_Book.pdf

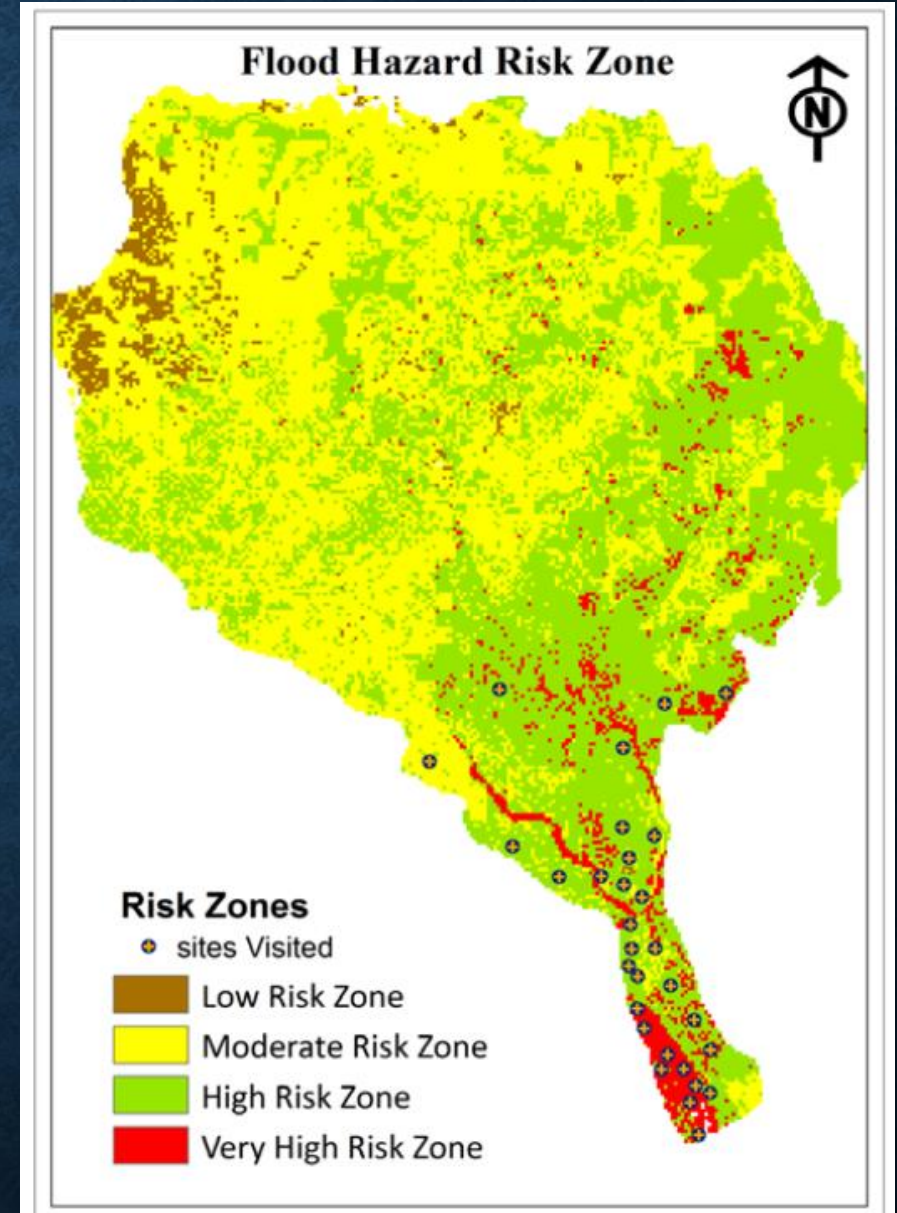
Flood Hazard Assessment and Mapping

Environmental Factors assess for Flood Risk Mapping

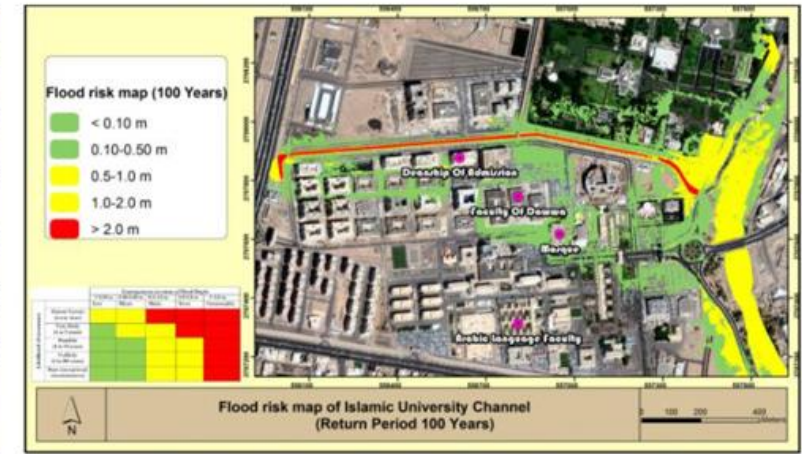
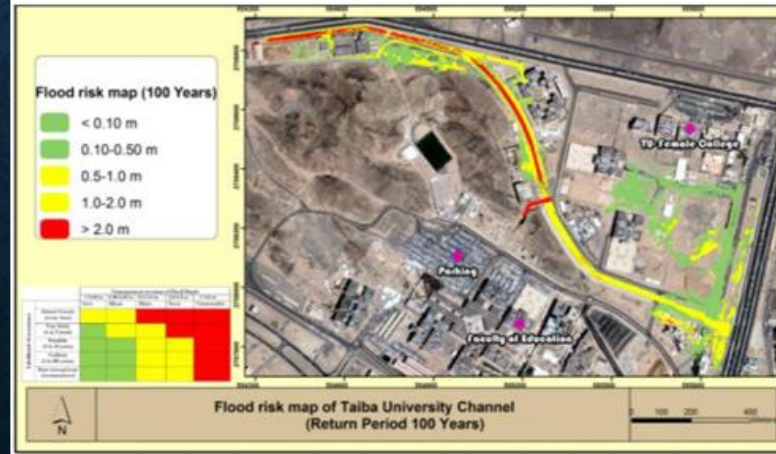
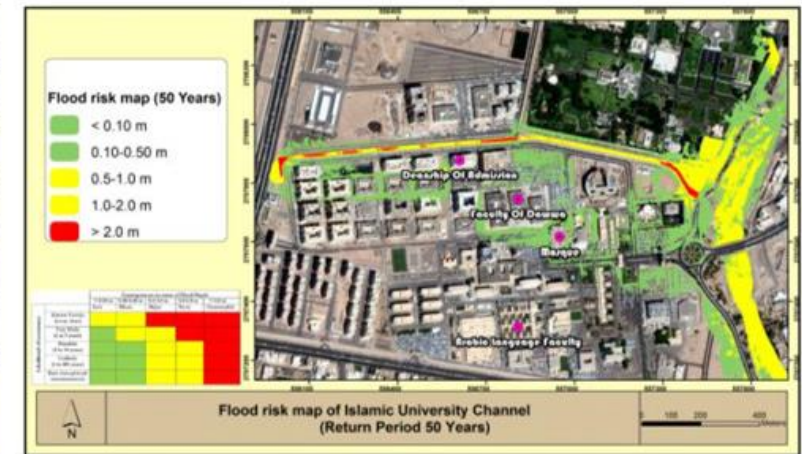
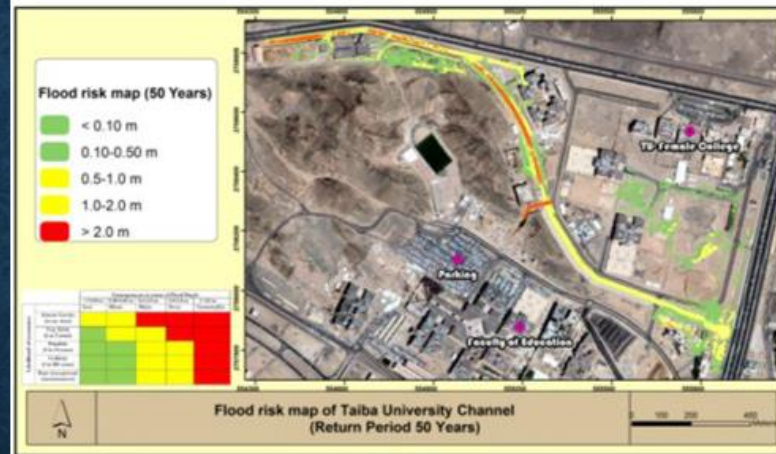
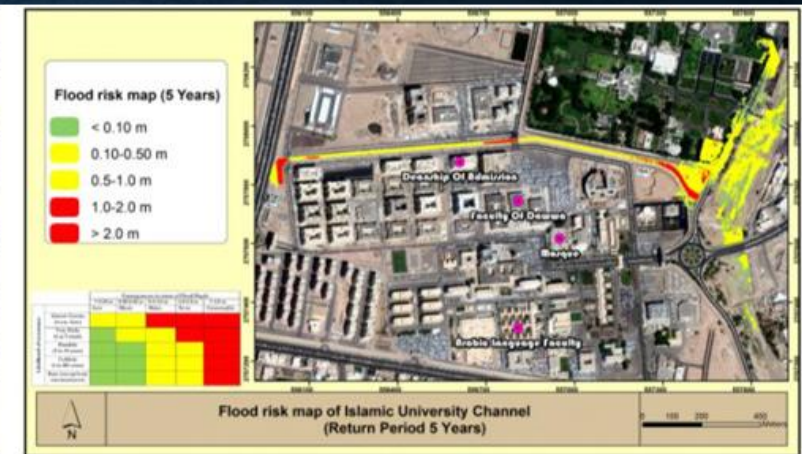
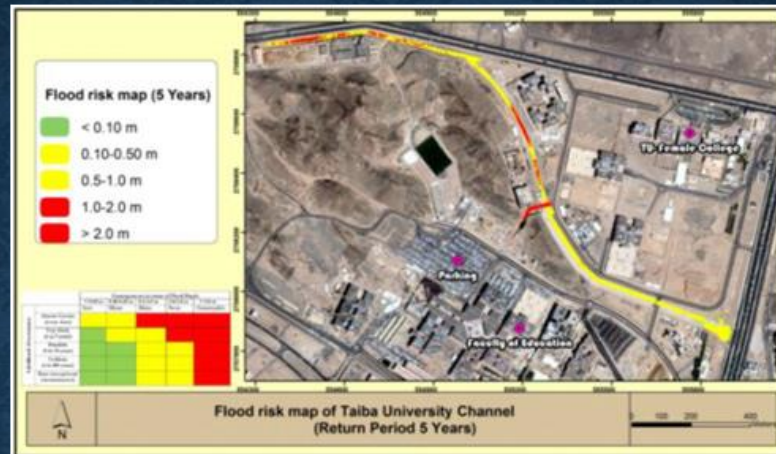


Flood Hazard Assessment and Mapping

Flood Risk Mapping and validation



Flood Hazard Assessment and Mapping



References:

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